Final Design Report

Camelback Road Storm Drain Project

59th Avenue to 75th Avenue

Project No. 2008C024, PCN No. 620.03.33

Prepared for:
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1.0 INTRODUCTION

The Flood Control District of Maricopa County (FCDMC), in cooperation with the cities of Phoenix and Glendale, began the Bethany Home/Grand Canal Flood Control Project (BH/GC FCP) in June 1999 to mitigate flooding problems along the Grand Canal, Bethany Home Road, and Camelback Road between the Loop 101 Freeway at Bethany Home Road and the Sunset Detention Basin south of Indian School Road. The entire project spans approximately 5¼ miles and was divided into 9 segments to better analyze, design, manage, and construct the project. Figure 1 below shows the limits of the BH/GC FCP and the project segments.

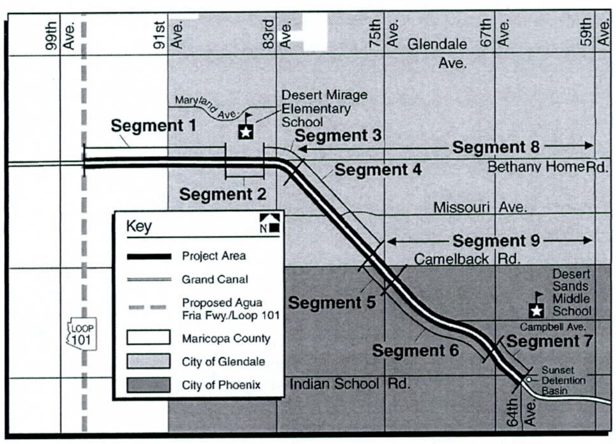


Figure 1: BH/GC Project Area and Segments

Design and construction of Segments 1 through 6 have been completed, and at the time when this report was prepared construction of Segment 7 was ongoing. The next segment to be designed is Segment 9, also called the Camelback Road Strom Drain (59th to 75th Avenues). This segment is along Camelback Road between the BH/GC FCP channel at 75th Avenue to 59th Avenue, at the boundary of the City of Phoenix and City of Glendale.

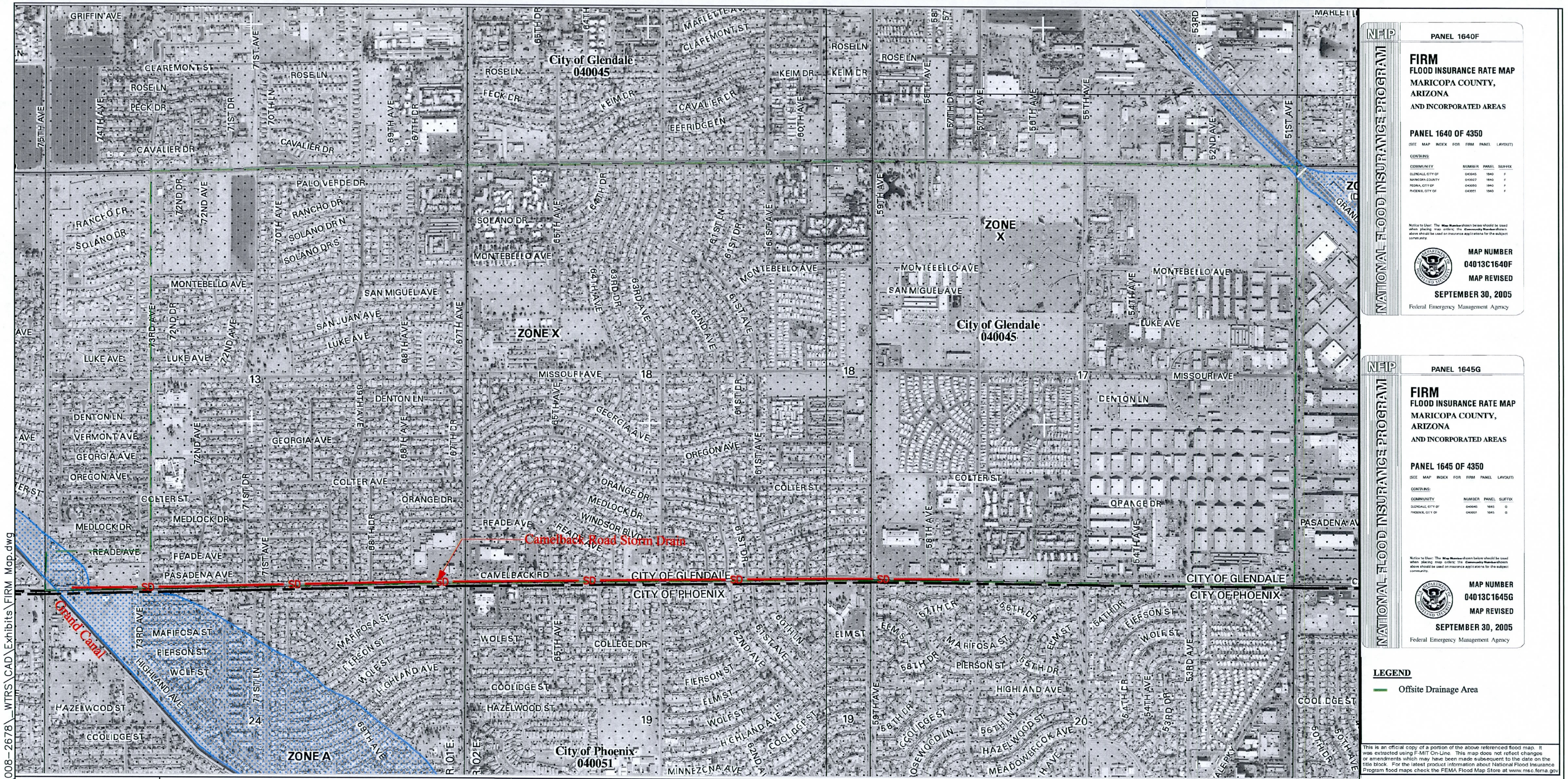
1.1 Purpose of Project

The purpose of the BH/GC FCP is to minimize flooding adjacent to and north of the Grand Canal, Bethany Home Road and Camelback Road between the Loop 101 Freeway at Bethany Home Road and the Sunset Detention Basin south of Indian School Road. The Grand Canal is a large man-made irrigation channel with elevated banks at various locations along its 22.5-mile reach. During large storm events, water ponds along the north and east banks of the canal and floods adjacent homes and businesses. The Federal Emergency Management Agency (FEMA) has designated a floodplain containing approximately 598 structures along the north side of the Grand Canal between Camelback Road and 67th Avenue (See Figure 2 for the FEMA Flood Insurance Rate Map (FIRM). The BH/GC FCP proposes a drainage system consisting of channels, retention basins, and box culverts along the north and east side of the Grand Canal to capture stormwater along the project limit and convey it to the ultimate outfall at New River. This will mitigate flooding and eliminate the floodplain, allowing owners of affected structures to stop paying flood insurance. Once the BH/GC project is completed and a Letter of Map Revision (LOMR) is submitted and approved by FEMA, the 598 structures along the north side of the Grand Canal between Camelback Road and 67th Avenue will be removed from the floodplain.

The Camelback Strom Drain project is a part of BH/GC project and will construct approximately 2 mile long storm drain system in Camelback Road from 59th Ave to 75th Ave. This will mitigate local flooding along Camelback Road and provide flood protection for up to a 10-year event.

1.2 Location of Project

The Camelback Strom Drain Project is located at the border of the City of Glendale and the City of Phoenix within Sections 17 and 18 of Township 2 North, Range 2 East, and the portion of Section 13 of Township 2 North, Range 1 East, of the Gila and Salt River Meridian, Maricopa County, Arizona. More specifically, the proposed storm drain pipe runs along Camelback Road from 1130 ft east of 59th Avenue to approximately 300 ft east of 75th Ave and outfall into BH/GC. Figure 3 provides a Project Vicinity Map, while Figure 4 shows a more detailed location of the site.



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FLOOD INSURANCE RATE MAP

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

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NTS

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Figure 2

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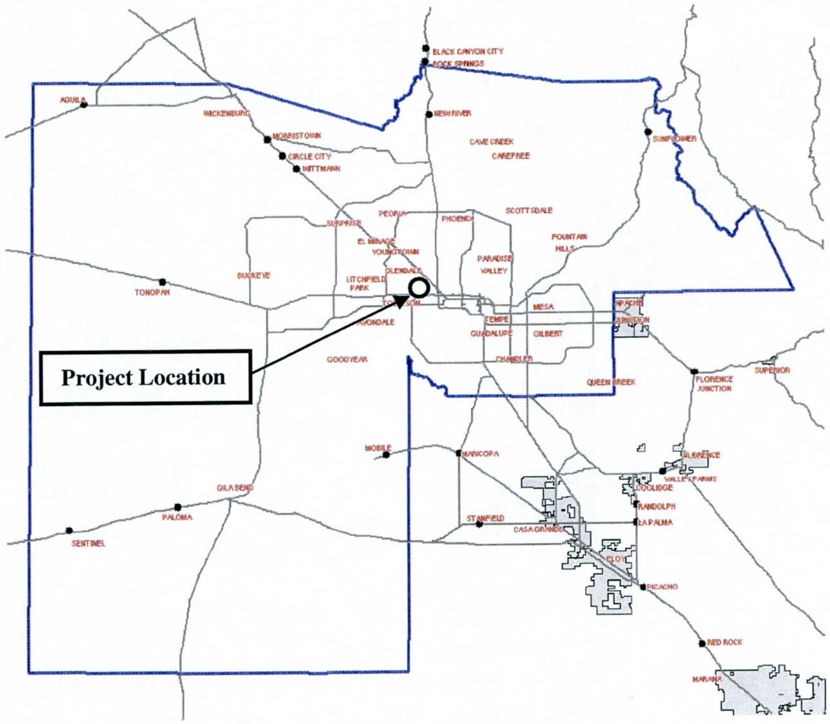


Figure 3: Project Vicinity Map

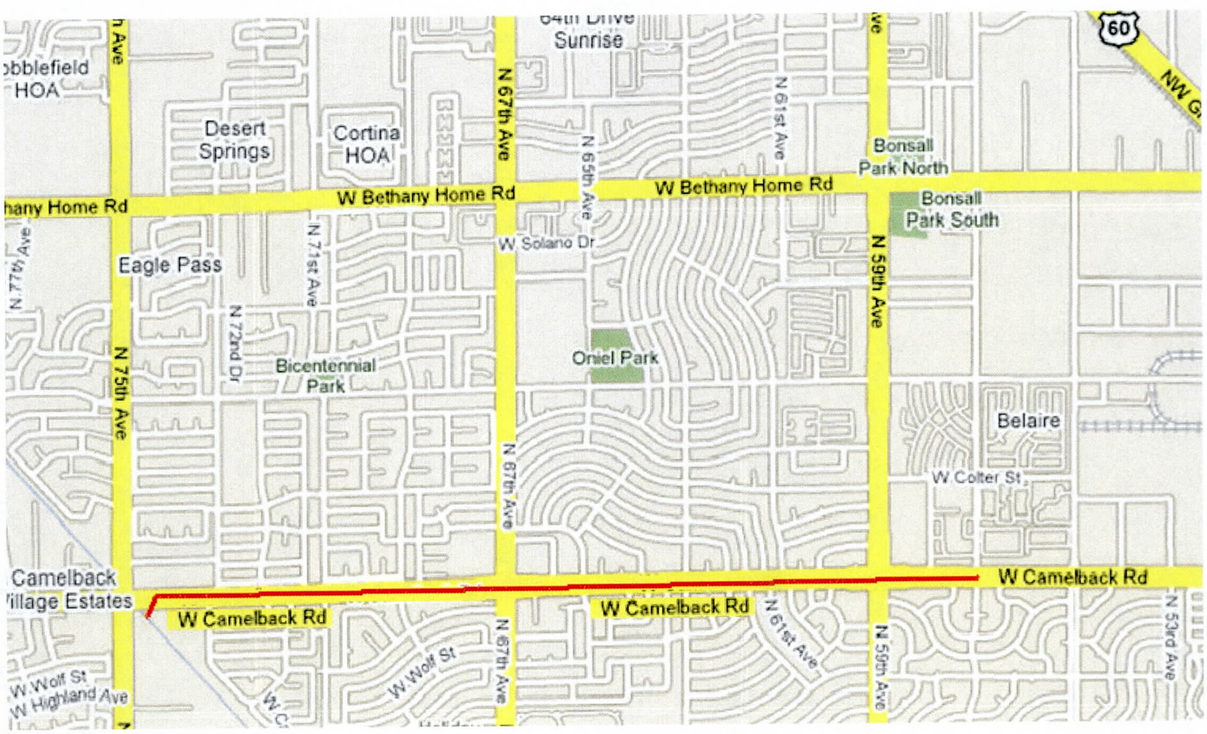


Figure 4: Site Location Map

1.3 Basis of Design

The basis of design for this project will be the *Bethany Home/Grand Canal Flood Control Project Pre-Design Study* (DMJM, September 2000), along with refinements made during design and construction of Segments 1 through 7 from the Loop 101 Freeway to 67th Avenue. Additionally, the design of this project will comply with the intent set forth in the Conditional Letter of Map Revision (CLOMR) that was completed in October 2003.

1.3.1 Basis of Hydrology

The basis for the hydrology for this project is the HEC-1 model that was received from the FCDMC. This model, named BHGC00C.dat, is the most current that was updated for Conditional Letter of Map Revision (CLOMR) and segments 1-7 for Bethany Home Outfall Channel.

1.4 Design Criteria

The Camelback Road Storm Drain Project is located at the boundary of the City of Phoenix and the City of Glendale. However, the design of the proposed storm drain will meet the standards and criteria set forth in the City of Glendale's *Design Guidelines for Site Development and Infrastructure Construction*, unless otherwise noted. These criteria are supplemented with design standards and procedures established in the FCDMC's *Drainage Design Manual*, Volume 1 (Hydrology), and Volume 2 (Hydraulics). The following summarizes the design criteria for the project:

- The storm drain will be designed for the 10-year flow.
- The design discharge for the inlets (catch basins) will be based on the Rational Method for those sub-basins that are 160 acres or less.
- The Hydraulic Grade Line (HGL) will be at least 1 foot below the rim elevation for any catch basins and manholes for the 10-yr event.
- The 10-year discharge through the storm drain will not increase the 100-year water surface elevation in the Bethany Home Grand Canal, meeting the intent of the CLOMR.

- The minimum velocity in the storm drain pipe will be 5 ft/sec and the maximum velocity will be based on the ADOT's pipe selection criteria.

2.0 SURVEY

2.1 Scope

The base aerial mapping for the BH/GC FCP was originally flown by Kenney Aerial Mapping in 1999. This project will use this mapping as the base for offsite areas adjacent to the project, and will use supplemental survey to update the project corridor along Camelback Road from 75th Ave to approximately 1130 ft east of 59th Ave. Additional ground survey for storm drain laterals was performed as a part of this project at several major and minor arterial streets north of Camelback Road. Names of all the arterial streets and length of survey performed for storm drain laterals are summarized in Table 1 below. The survey scope of work also includes verification of the right-of-way limits with finished floor elevations for the first row of building north of Camelback Road within the project corridor.

Table 1: Storm Drain Lateral Survey along Major and Minor Arterial Streets.

Street Name	Length of Survey (ft)
73rd Avenue	650
71st Drive	100
71st Avenue	500
69th Avenue	100
68th Drive	100
Commercial Property W. of 67th Avenue	90
67th Avenue	1,900
Colter Street East of 67th Ave	250
66th Avenue	100
65th Avenue	200
63rd Avenue	600
62nd Avenue	100
61st Drive	100
61st Avenue	300
Pasadena Avenue	100
59th Avenue	1,400
Colter Street- West of 59th Ave	200
Camelback Rd-East of 59th Avenue	950
Total	**7,740 ft**

2.2 Datum

The survey for this project is tied into the Maricopa County Department of Transportation Geodetic Densification and Cadastral Survey (GDACS) network control. This system is based on the North American Vertical Datum of 1988 (NAVD 88), whereas the Pre-Design Study and CLOMR survey data were based on the National Geodetic Vertical Datum of 1929 (NGVD 29).

To be consistent with the designs from the previous segments, the design for the Camelback Storm Drain project use NGVD 1929 vertical datum and the NAD 1983 horizontal datum. The horizontal data is provided in the Arizona State Plane Coordinates (Central Zone) and converted to ground using a factor of 1.00016. The conversion from NGVD 29 datum to NAVD 88 datum, using the following conversion factor:

NAVD 88 datum = NGVD 1929 + 1.92'

Survey data is provided in Appendix E.

3.0 HYDROLOGY

The Maryvale Area Drainage Master Study (ADMS) was prepared by Wood Patel and CH2M Hill in 1997 for the Flood Control District of Maricopa County (FCDMC). A regional HEC-1 hydrology model was included in the ADMS that covered the current project.

In 2000, DMJM was contracted by FCDMC to prepare a Pre-Design Study for Bethany Home/Grand Canal Flood Control Project. DMJM updated the ADMS HEC-1 model to reflect the land use conditions and incorporated the Bethany Home Road storm drain and the Agua Fria Freeway. DMJM also developed a 10-year 6-hour HEC-1 model to reflect the proposed Camelback Road storm drain.

In 2003, DMJM+Harris (formerly DMJM) finalized a CLOMR package for the Bethany Home Outfall Channel. The updated 100-year 24-hour HEC-1 hydrology model was included in the Technical Data Notebook (TDN).

There are three hydrology analyses presented in this report. The Offsite Inlet Hydrology addresses the drainage from the local watershed north of Camelback Road. Inlets and lateral pipes north of Camelback Road will be sized based on this hydrology. The Onsite Inlet Hydrology estimates the street runoff generated from the right-of-way of Camelback Road. The spacing and the size of catch basins and lateral pipes along Camelback Road will be designed based on the Onsite Inlet Hydrology. The trunk line under Camelback Road will be designed based on the Trunk Line Hydrology that follows the CLOMR for the 100-year event and the Pre-Design Study for the 10-year event. This is to ensure that the current project is consistent with the approved CLOMR by FEMA.

3.1 Offsite Inlet Hydrology

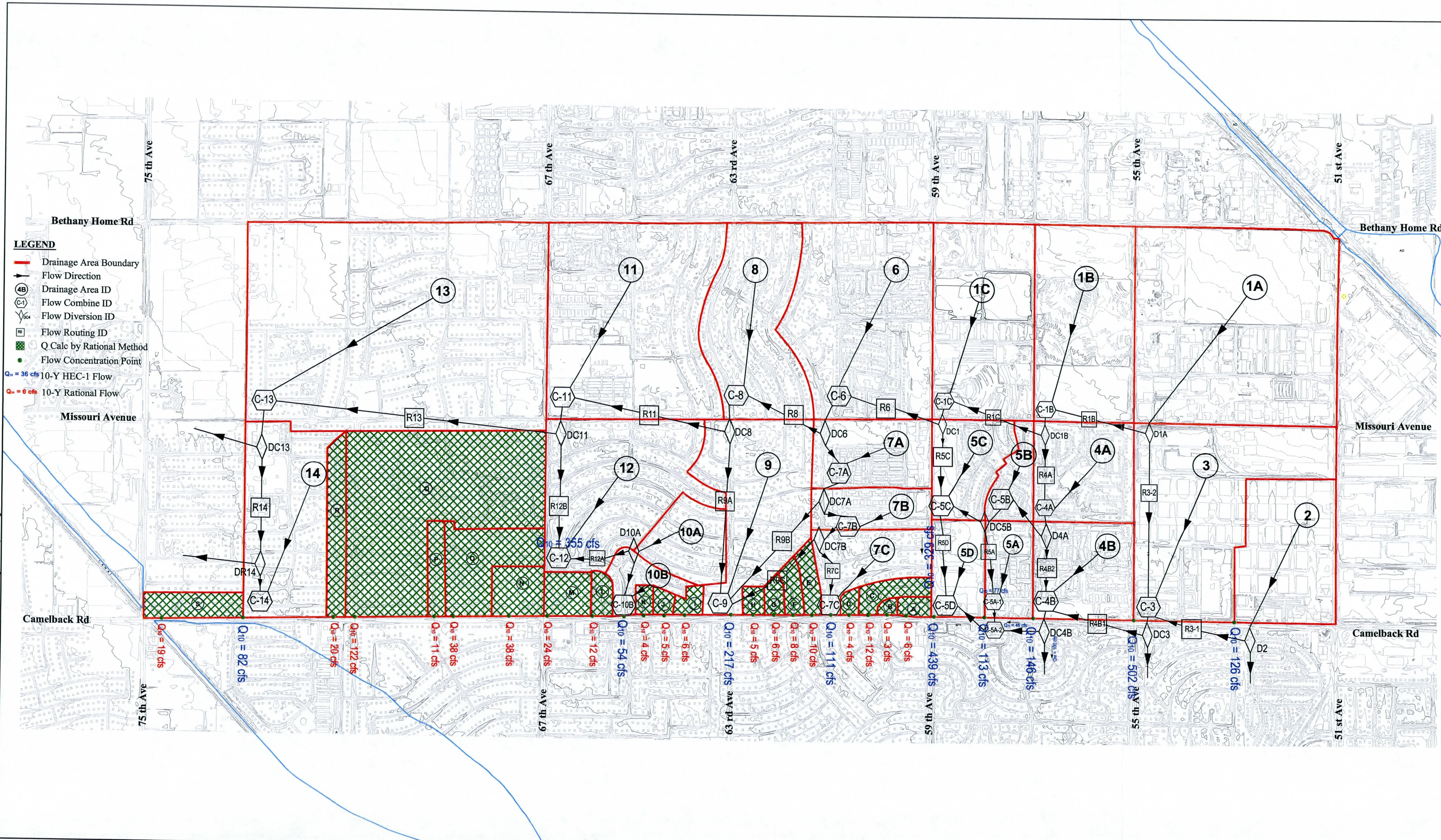
3.1.1 Offsite Watershed

The local offsite watershed lies north of Camelback Road between 51st Avenue and 75th Avenue, south of Bethany Home Road. The future Bethany Home Road storm drain will intercept 10-year flows from the north. The three square mile off-site area was divided into 23 HEC-1 sub-basins labeled 1A through 14, and 19 Rational sub-basins labeled 'A' through 'S'. The land surface gradient is generally from northeast to southwest and it was assumed that storm runoff will mainly flow through open areas, parking lots and, along the roads. The existing topography from FCDMC's Maryvale ADMS was used as a basis for watershed delineation. The survey was conducted in 1994 to support the study. One-foot contours were mapped for Sections 17 and 18, and two-foot contours were mapped for Section 13. Supplementary field survey was performed in critical locations such as street intersections and grade break points. Please refer to Figure 5 and on the foldout Plate I for the Offsite Area Drainage Map.

3.1.2 Methodology

The Rational Method was used for concentration points with single drainage areas less than 160 acres. Procedures and parameters for the Rational Method followed the FCDMC's *Drainage Design Manual for Hydrology Volume I.* Please find Figure 5 and Plate I for the Rational Method drainage area and Appendix C for input and output data. The U.S. Army Corps of Engineers HEC-1 rainfall-runoff model was used to estimate peak discharges for sub-basins and concentration points with a total contributing area of 160 acres or larger. FCDMC's Drainage Design Management System for Windows (DDMSW) version 3.5.4 was used to prepare input parameters for HEC-1. The rainfall losses were estimated using Green and Ampt methodology and the unit hydrographs using Clark's Unit hydrograph methodology. The normal depth routing method was used for the street routing which uses modified plus routing methodology.

The hydrologic parameters were based on research, field reconnaissance, and supplementary topographic survey. The FCDMC's *Drainage Design Manual for Hydrology Volume I* was followed in developing the actual input parameters. The following data sets were obtained for the current study:



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OFFSITE DRAINAGE MAP

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

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SCALE: 1"=1200'

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Figure

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3.1.3 Rainfall

The 10-year, 6-hour storm event was used as the design storm for the approximately 3 square mile of watershed. The point rainfall depths used in the HEC-1 models were obtained from the isopluvials in FCDMC's Drainage Manual. They were obtained from the National Oceanic Atmospheric Administration (NOAA) 2.

The rainfall distribution used was the Maricopa County's 6-hour local storm distributions consisting five dimensionless storm patterns. Each pattern of rainfall distribution is determined by the watershed size. The 6-hour local rainfall distribution and precipitation estimate are automatically calculated by the DDMSW software. The average 10-year, 6-hour rainfall depths and distribution pattern used in the analysis are shown on Table 2.

Table 2: 10-year, 6 hour Rainfall Depths and Distribution Pattern Summary

10-year rainfall Depth (inches)	Drainage Area (mi^2)	FCDMC's Local 6-hour Rainfall Pattern #
1.97	0.0001	Pattern 1
1.958	0.5	Pattern 1
1.921	2.8	Pattern 2

3.1.4 Rainfall Losses

Rainfall losses were estimated using Green and Ampt infiltration equation as outlined in the FCDMC's *Drainage Design Manual for Hydrology Volume I.* . The following parameters are estimated by the DDMSW.

a) Surface retention loss (IA-inches)
b) Effective impervious area (RTIMP-%)
c) Hydraulic conductivity at natural saturation (XKSAT-inches per hour)
d) Volumetric soil moisture deficit (DETHETA)
e) Wetting front capillary suction (PSIF-inches)

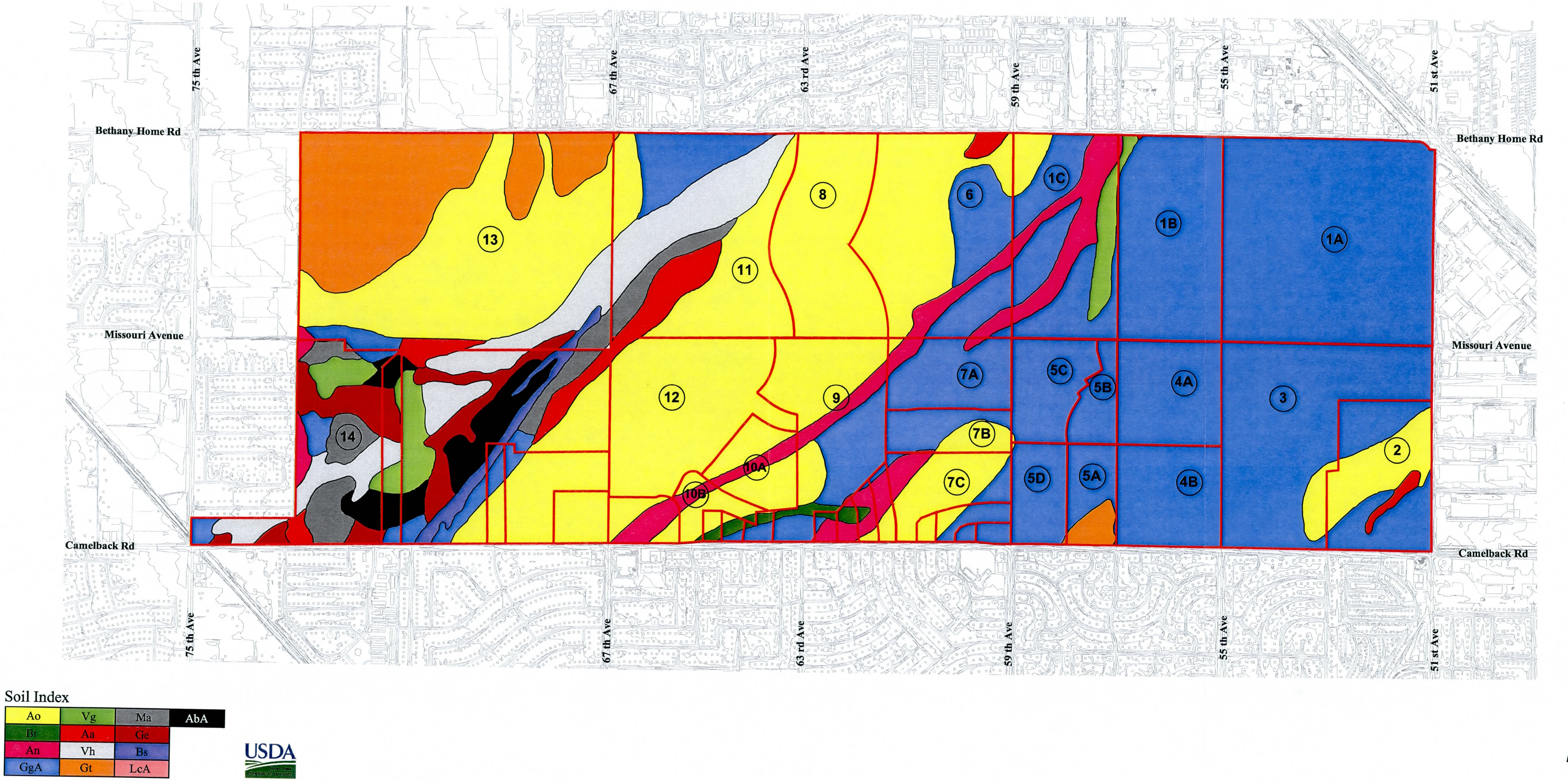
3.1.5 Soils

The soil data were derived from the publications for the region by the USDA Soil conservation Services (Soil Survey of Maricopa County, Arizona, Central Part). These maps provide the underlying soil properties contained within the watershed, including map symbol, soil name, and hydrologic group. The soil types for the study area are shown in Figure 6 and the soil data for each watershed are tabulated in Section A.1.1 of Appendix A.

3.1.6 Land Use

Most of the land in the watershed is fully developed and the land use conditions are determined from the zoning maps and aerial photos from Maricopa County's Assessor's website. For vacant parcels, the current zoning designations were used to project the future land use. The hydrologic parameters such as vegetation cover, percent impervious and initial loss for each land use type are derived from the FCDMC's Drainage Manual. Figure 7 provides the land use type for each sub-basin and the hydrologic parameters are tabulated in section A.1.2 of Appendix A. Representative values used for each land use classification are shown on Table 3.

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE



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SOIL MAP

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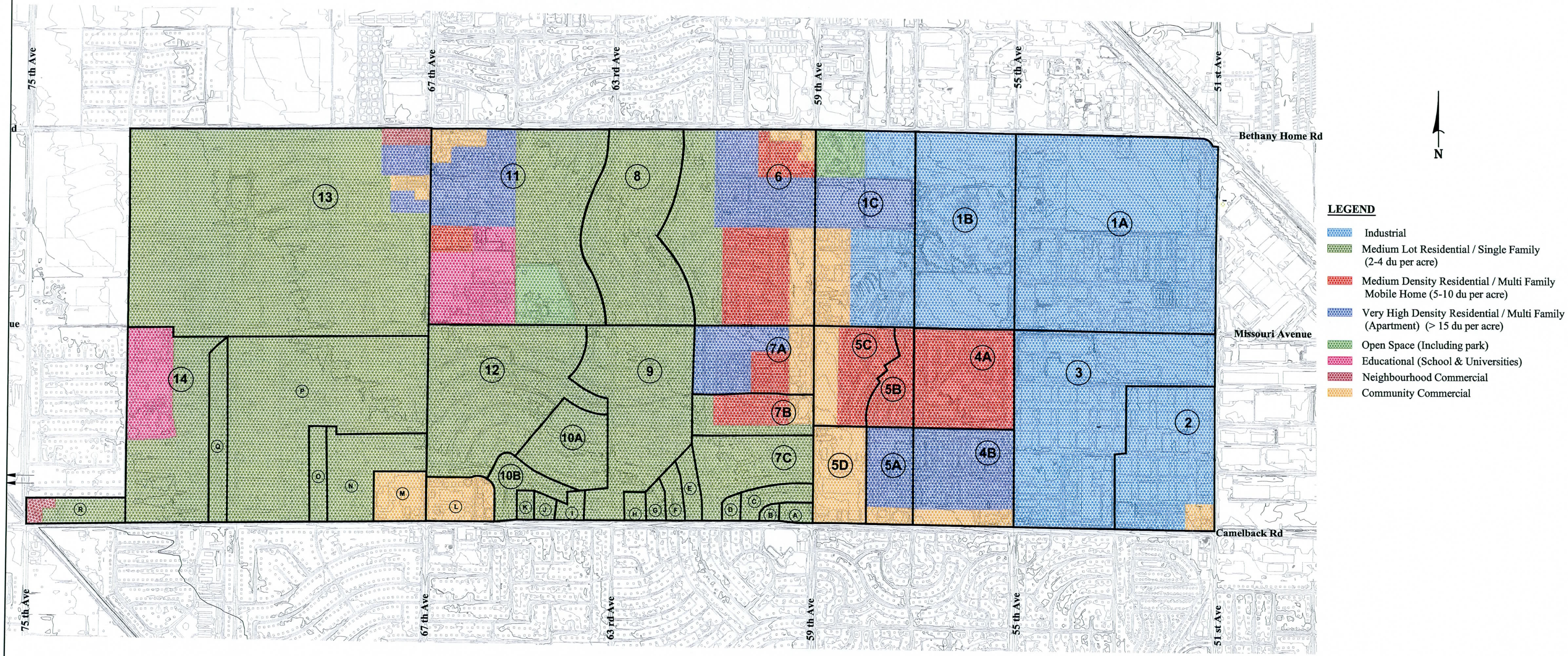
Figure
6

Table 3: Land Use Parameter Default Values

Land Use Code	Description	IA	RTIMP	Veg Cover	DTHETA	ResisCoeff. Kb
220	**Commercial:** Neighborhood Commercial (50,000 to 100,000 sq. ft)	0.1	80	65	Normal	Min
230	**Commercial:** Community Commercial (100,000 to 500,000 sq. ft)	0.1	80	75	Normal	Min
320	**Industrial**	0.15	80	75	Normal	Min
520	**Institutional** : Educational (Schools & Universities)	0.29	45	80	Normal	Min
710	**Open Space :** Active Open Space (Includes parks)	0.1	5	90	Normal	Min
140	**Residential:** Medium Lot Residential-Single Family (2-4 du per acre)	0.25	30	50	Normal	Min
170	**Residential:** Medium Density Residential – Multi Family (5-10 du per acre)	0.25	45	50	Normal	Min
190	**Residential:** Very High Density Residential-Multi Family (>15 du per ac)	0.25	45	50	Normal	Min

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE



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LAND USE MAP

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Figure 7

3.1.7 Unit Hydrograph

The Clark Unit Hydrograph method was used to generate the unit hydrographs for the HEC-1 program. The Clark Unit Hydrograph is a hydrologic routing method used to produce the storm discharge hydrograph at a concentration point. The method requires three input parameters: time of concentration (T_c) in hours, the Clark storage coefficient (R) in hours, and the time-area relation.

The time of concentration is defined as the time for a flood wave to travel from the hydraulically most distant point in the watershed to the desired concentration point. The recommended equation used to estimate the time of concentration is:

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

Where

T_c = Time of concentration, in hours

L = Length of the flow path for T_c in miles

Kb = Representative watershed resistance coefficient

S = Watercourse slope, in ft/mi

i = Average rainfall excess intensity, during the time T_c, in inches/hour

The above equation is an iterative process, where an initial T_c is estimated, and then refined based on the resulting rainfall intensity until the desired accuracy is achieved.

The storage coefficient R, with a dimension of time, accounts for the effect that temporary storage in the watershed has on the hydrograph. The FCDMC equation to estimate the storage coefficient is:

$$R = 0.37 T_c^{1.11} A^{-0.57} L^{0.80}$$

Where

R = Storage coefficient, in hours

T_c = Time of concentration, in hours

A = Drainage area, in square miles

L = Length of flow path, in miles

The drainage area, flow length, slope, and resistance classification data for each basin were entered into the program DDMSW, which iteratively computes the time of concentration and storage coefficient for input into the HEC-1 program.

The time-area relation is a graphical parameter that is required to compute the translation hydrograph. It specifies that portion of the watershed that is contributing runoff to the outlet of the watershed at any point in time. The FCDMC defines three synthetic time-area relations: HEC-1 Default, Natural Watersheds, and Urban Watersheds. For the existing conditions model, the Urban Watersheds time-area relation was used.

3.1.8 Flow Routing

The reach routing of flow between the basins was performed through the local streets using normal depth 8-points routing procedure. For each basin, a typical routing reach section was surveyed. The reach slope and length were then determined by using topographic sources, aerial topography, existing regional study, and field verification. A Manning's "n" values were used based on the previous study and on field observation.

A parameter required for the normal depth routing is the variable NSTPS, the number of routing steps. This is a calibration parameter and is computed as follows:

$$NSTPS = \frac{Length / Velocity}{NMIN}$$

Where,

Length = Reach length

Velocity = Flow Velocity

NMIN = Time Interval

The program DDMSW automates this procedure by running HEC-1 times to calibrate the model to determine the NSTPS value. Please refer Section A.1.3 of Appendix A for street cross section data.

3.1.9 Flow Splits

Flow splits occur at the numerous intersections. The flow splits are reflected in the flow diversion cards in HEC-1. Field survey was performed at all intersections where flow splits occur.

At most of the intersections where split flows are governed by elevated centerline profiles where the flows need to weir over. Therefore, the broad-crested weir equation was used to model the percentage of flows downstream of the intersection. Please refer to Section A.1.4 of Appendix A for flow split survey data and calculations.

3.1.10 Offsite Flows

Based on the 10-year hydrology from Pre-Design Study, there are no offsite flows from north of Bethany Home Road between 51st Avenue and 59th Avenue. However, there are flows from east of 51st Avenue between Bethany Home Road and Camelback Road. These flows come in from two locations, one at Missouri Avenue and one at Camelback Road and divert south before they get into the proposed Camelback Road storm drain, therefore these offsite flows are not included in HEC-1 model as a part of offsite hydrologic study.

3.1.11 Final Results

The HEC-1 model developed for offsite hydrology determines peak discharge for 10-year return interval. The flow values from offsite hydrology are larger than the 10-year CLOMR Q's. This is to be expected, as the collection hydrology for this project has many more basins and hydrologic operations than the CLOMR HEC-1 model. Table 4 summarizes the results for specific concentration points along the Camelback Storm Drain Project.

Table 4: Summary of 10-Year Peak Discharges to Camelback Storm Drain Project.

Location	Concentration Point	HEC-1 Output for 10-year Peak discharge Rate (cfs)
Camelback Rd & 58th Ave	C-5A-2	113 cfs
Camelback Rd & 59th Ave	C-5D	439 cfs
Camelback Rd & 61st Ave	C-7C	111 cfs
Camelback Rd & 63rd Ave	C-9	217 cfs
Camelback Rd & 65th Ave	C-10B	54 cfs
Pasadena Ave & 67th Ave	C-12	355 cfs
Camelback Rd & 73rd Ave	C-14	82 cfs

The HEC-1 supporting documents are provided in Appendix A, and HEC-1 output data for the offsite hydrology are provided in Appendix B and in a CD at the back of this report.

3.2 Onsite Inlet Hydrology

The Onsite Inlet Hydrology estimates the 10-year runoff on Camelback Road from 57th Ave to 75th Ave. It is performed to size the inlets and lateral pipes along Camelback Road. The 10-year runoff will be intercepted so that a minimum of 12-foot dry lane will be maintained in each direction and the flow depth will be maintained below the top of the curb.

Onsite drainage facilities were designed based on requirement and guideline provided in the City of Glendale's Design Guidelines for Site Development and Infrastructure Construction and supplemented by the FCDMC's *Drainage Design Manual for Hydrology Volume 1* and *Drainage Design Manual for Hydraulics Volume 2*. Onsite peak flows were estimated by the Rational Method as follows,

$Q = C\,i\,A$

Where,

Q = Peak discharge (cfs)

C = Weighted runoff coefficient

i = average rainfall intensity, in/hr (i = 5.72 in/hr for Tc of 5 minutes & i = 4.36 in/hr for Tc of 10 minutes)

A = onsite Drainage Area (acres)

The drainage sub-basins were based on the as-built street improvement plans and field survey. The areas include Camelback Road right-of-way and adjacent developments that have a small contributing area. The existing median strip and the crown along Camelback Road delineate the onsite area into north and south drainage areas identified as NCB and SCB respectively in the report. A weighted runoff coefficient was computed using values provided in Table 3.2 of *Drainage Design Manual for Hydrology Volume 1*. The rainfall intensity was based on a minimum time of concentration of 5 minutes for the onsite areas and 10 minutes when combined with adjacent development area, and determined from IDF curves computed using rainfall data shown in Section C.1 of Appendix C. Plate II shows the Onsite Drainage Map. This map shows delineation of the drainage areas and area ID. Rational calculation and supporting documents are provided in Appendix C.

3.3 Trunk Line Hydrology

The 10-year hydrology model from the Pre-Design Study was used as the basis for the design of the proposed trunk line. The following is a summary of the concentrated flows in the trunk line from the Pre-Design Study (concentration point ID in parenthesis):

1. 67th Avenue – 498 cfs (CCB4)
2. 63rd Avenue – 375 cfs (CCB67)
3. 59th Avenue – 313 cfs (CCB3)

The Offsite Inlet Hydrology showed a concentrated flow of 329 cfs at 59th Avenue. This is slightly higher than the one shown in the Pre-Design Study. For conservative reasons, 329 cfs will be used at this point. Please refer to Section D.3.1 of Appendix D for the CLOMR flow and excerpt from the Pre Design Study.

4.0 HYDRAULICS

The hydraulic analysis follows procedures described in Section 3.3 of Flood Control District's *Drainage Design Manual for Hydraulics Volume 2*. These are the same procedures described in Federal Highway Administration (FHWA)'s HEC-22 publication.

4.1 Inlet Hydraulics

Curb opening catch basins will be installed as inlets to intercept street runoff. The catch basins will follow City of Phoenix Standard Details P-1569, P-1573, and P-1581. A clogging factor of 20% will be applied for inlet designed on-grade and clogging factor of 50% in sump conditions. Spacing of the catch basin will be determined by the spread, flow depth, and in some condition median opening. The following parameters were used in the computations for street pavement sections.

Gutter Width = 1.42 ft

Local Depression = 2 inches for 6 inch curb

4 inches for 4 inch curb

Local Depression width = 1.42 ft

Gutter cross slope = 0.06 ft/ft

Road Cross Slope = 0.02-0.03 ft/ft (based on as-builts or survey)

Manning's Roughness Coefficient = 0.015

Bentley's computer program FlowMaster was used to facilitate the inlet calculations. Flow spreads, flow depths, and flow interceptions are calculated for each location and the results are shown in Section D.1 and D.2 of Appendix D.

4.2 Storm Drain Hydraulics

Hydraulic analyses for the proposed trunk line and laterals were performed using the program Storm CAD, developed by Bentley. The software uses backwater analysis and calculates the hydraulic grade line profiles based on the energy equation.

The trunk line model was set up in StormCAD using the Pre-Design flows at 67th Ave (CCB4) and 63rd Ave (CCB67), and offsite inlet hydrology flow at 59th Ave (CCB3). The tailwater elevation for the trunk line system was set at 1108 ft, obtained from the HEC-RAS model from BHOC Reach D Project. Headlosses at the junction/manhole, sudden contraction and expansion, bend, and outlet were also included. The headloss calculation follows procedures described in Section- 4.3.3 of the Flood Control District's *Drainage Design Manual for Hydraulics Volume 2*. A detailed discussion of the procedure to calculate the headloss at junction, transition structure, and bends are provided in Section D 3.2 of Appendix D. The StormCAD model provided the hydraulic grade of the Camelback Storm Drain System.

Similarly, lateral pipes that convey offsite flow into the trunk line system were also designed using StormCAD software. Laterals were modeled using 10-year hydraulic grade line (HGL) of the trunk line as the tail water depth.

The results of the storm drain hydraulics show that the storm drain flows full during the 10-year event with the hydraulic grade line (HGL) at least 1 foot below the rim elevation for any catch basin and manhole. Please refer to Section D 3.3 of Appendix D for output from StormCAD.

4.3 Street Hydraulics

The onsite and offsite street hydraulics was analyzed as part of the inlet hydraulics using the FlowMaster program. It was based on the Manning's Equation to estimate flow depths and flow spreads.

4.3.1 Onsite Street Hydraulics

The results from onsite street hydraulic analysis are shown in the Tables provided in Section D.2 of Appendix D. It must be noted that the frontage roads on the north side of Camelback Road have 4" roll curbs. They receive drainage from adjacent developments to the north. The calculations may show the computed flow depths slightly exceed the curb height of 4". However, catch basins are proposed downstream to incept all the flow.

4.3.2 Offsite Street Hydraulics

Offsite Street Hydraulics uses unique methods to design curb opening inlets to capture the 10-year storm from the local watershed north of Camelback Rd. Offsite collection systems were laid out in the roadways using normal catch basin design procedure to capture the 10-yr offsite flow before it enters into Camelback Road. However, there are some locations that require some special engineering judgment and design. These locations are 58th Ave, 59th Ave, 67th Ave, and 73rd Ave, detail about catch basin design procedure in these locations are discussed below.

58th Ave Collection System:

The 58th Ave collection system was to design to capture the 10-yr, 6hr storm of 77 cfs. However, during the drainage analysis of 58th Ave it was observed that the street Right of Way (ROW) has capacity for only 29 cfs breaking out the excess flow of 48 cfs into adjacent parking lot, west of 58th Ave just north of Camelback Road. Therefore, 2 double-wing P-1569 catch basin of standard sizes 30 ft long curb opening inlet were designed in 58th Ave to capture 29 cfs. Please refer Section D.2 in Appendix D for 58th Ave cross-section capacity and flow break out location, and Figure X-3 for the location of proposed 2-30 ft catch basin in 58th Ave and 2-37 ft catch basin in Camelback Rd.

59^{th} Ave Collection System:

One of the intents of the offsite hydraulic analysis is to capture all the offsite flow before it gets into Camelback Road, the design of 59^{th} Ave Collection System captures the maximum offsite flow at a location near the intersection of 59^{th} Ave and Colter St. The 10-yr, 6hr HEC-1 flow at the intersection of 59^{th} Ave and Camelback Road is 341 cfs (C-5C), which include 188 cfs (R5C) along 59^{th} Ave from the north, 73 cfs (5C) from area northeast of 59^{th} Ave and Colter St, and 123 cfs (DC5B) along Colter St from the east.

Two 37 ft long curb opening inlets were designed in sump in Colter St, just east of 59^{th} Ave. The StormCAD analysis shows that these two curb opening inlets in sump have the capacity to capture 133 cfs with flow depth of 1 foot. The existing basin area on the west side of 59^{th} Ave and north of West Colter St provides an opportunity to design and regrade the available basin area to capture the majority of the flow coming from the north. The analysis shows that flow bypassing this area will flow towards the west side of 59^{th} Ave (West Colter Rd) and along the frontage road, which is much lower than the east side of 59^{th} Ave. Therefore, additional curb opening inlets were provided in Colter St west of 59^{th} Ave and in the frontage road south of Colter St. The standard details, and design and analysis of the proposed hydraulic structure in basin area are provided in Section D.1 of Appendix D

Drainage analysis determined that some areas east of 59^{th} Ave and south of Colter St. drain into Camelback Rd. The drainage area east of 59^{th} Ave were delineated and curb opening inlets were designed along Camelback Rd to capture 10-yr flow from this drainage area. Please refer Figure X-3 for drainage area delineation map for area east of 59^{th} Ave and the 10-yr discharge calc output from DDMSW provided in Section D.1 of Appendix D.

The west half street area of 59th Ave, south of W Colter St, was also delineated based on the as-built street improvement plans and field survey, and the 10-year street discharge was calculated based on the rational method explained in Section 3.1 Onsite Inlet Hydrology. Curb opening inlets were designed to capture the 10-yr flow and were spaced based on the median opening. Please find 59th Ave street delineation in Figure X-3 and discharge calculations in *59th Ave and 67th Ave Street Flow Calc and inlet Design* excel sheet provided in Section D.1 of Appendix D.

67th Ave Collection System:

Based on our field observation and available survey information it was evident that the frontage road east of 67th Ave is much lower than the west side of 67th Ave. The drainage analysis shows that the offsite flow along 67th Ave concentrates on the east Frontage Rd; therefore, most of the catch basins were designed along the frontage road, east of 67th Ave, and capture the 10-year offsite flow by Pasadena Ave. Six catch basins were provided on the west side of 67th Ave to capture the offsite flow and flow from west half of 67th Ave.

Onsite areas in some locations on 67th Ave were also delineated and catch basins were designed to capture the 10-year street flow. The 10-year design discharge from the street was calculated based on the rational method described in Section 3.1 Onsite Inlet Hydrology. Please find Figure X-1 for 67th Ave onsite delineation and discharge calculation in *59th Ave and 67th Ave Street Flow Calc*

73rd Ave Collection System

73rd Ave collection system was extended up to West Reade Ave to capture offsite flow along 73rd Ave before 39 cfs (DIDR14) divert west. 2- 37 ft long curb opening inlet is provided in 73rd Ave just north of West Reade Ave to capture 59cfs coming from the north. The 2-37ft long curb opening inlet has capacity to capture 46 cfs and convey remaining 13 cfs south along 67th Ave. Please refer Figure X-1 for the catch basin location and *Offsite Curb Inlet Design* Excel Sheet for the design summary.

5.0 GEOTECHNICAL INVESTIGATION

Eighteen soil borings were performed along camelback Road by Ninyo & Moore to investigate subsurface soil conditions and characteristics. The soil boring locations and soil boring logs are provided in a separate Geotechnical Report provided along with the final design report.

Preliminary results indicate that that the soil within the project area is mostly silty sand to 15 feet with pockets of sand lenses in some of the borings. No bedrock was encountered. Based on the boring data, an excavation slope of 1 ½ horizontal to 1 vertical is recommended. However, soil is denser below 15 feet, so a 1:1 slope could potentially be used below 15 feet in the more clayey and gravelly soil locations, but it has to be evaluated individually at each location.

6.0 UTILITIES

This section identifies the existing utilities within the project area and the design constraints that impact the design of the proposed storm drain.

Initial identification of utilities within the project area was provided by Bluestake through a design request. The name and contact for each utilities are provided in Table 5 below and a discussion of the major utilities follows. The utilities identified within the project area include: water, sewer, storm drain, traffic signals, irrigation, cable TV, telephone ducts, fiber optics, gas, and underground and overhead power. For the most part, the existing utilities run east-west parallel to the proposed trunk line. The utilities cross the major intersections at 59th and 67th Avenues.

Table 5 – Utility Contact Information

UTILITY	CONTACT	NUMBER
CBS Outdoor	Amy Zetah	(602) 246-9569
Cox Cable	Walt Coombs	(623) 328-3520
Qwest	Matt Phillips	(602) 630-1393
Southwest Gas	Valerie Gallardo-Weller	(602) 484-5431
Salt River Project (SRP) Irrigation	Steve Tanis	(602) 236-4887
Salt River Project (SRP) - Electric	Mariann Ward	(602) 236-6389
City of Phoenix		
- Water	Darlene Helm	(602) 534-9138
- Sewer	Gary Griffith	(602) 261-8363
- Storm Drain	Ralph Gooddall	(602) 495-2039
- Traffic Signals	Dan Shields	(602) 262-6204
City of Glendale		
- Water	Kevin Schell	(623) 930-2711
- Sewer	Kevin Schell	(623) 930-2711
- Reclaimed Water	Kevin Schell	(623) 930-2711
- Fiber Optics	Casey Husky	(623) 692-4892
- Traffic Signals	Larry Green	(623) 640-4025

An initial utility base map was created using as-built maps, quarter section maps, and facility maps obtained from the utility companies. An initial round of pothole was performed along the trunk line to identify potential conflicts. The results of the potholes are shown on the storm drain profile. A second round of pothole was then performed along the storm drain laterals and the results will be included in the lateral profiles.

6.1 Water and Sewer Lines

The Cities of Phoenix and Glendale operate and maintain water and sewer lines along the project limits. Phoenix has a 16"/20" water distribution line and an 8" waterline along the south side of Camelback Road, while Glendale has a 6"/8" waterline along the north side of Camelback. Pothole results show the 16" waterline to be approximately 7 feet deep while the 6" and 8" lines are typically 4 to 5 feet deep. While these lines are not in conflict with the trunk line, the design of the catch basin connector pipes will need to avoid conflict with these waterlines.

The City of Glendale has two sewer lines along the north side of Camelback Road that parallels the trunk line. One is a 15"/18" line located approximately 20' north of centerline and ranges from 7 to 10 feet deep. The lateral storm drains will be crossing this line and will be designed to avoid conflict with this sewer line. Sewer service lines are also present along 71st and 73rd Avenues that will need to be considered as connector pipes are designed.

There is also a 48" diameter sewer line that runs south from 73rd Avenue, then turns west at Camelback Road and runs approximately 37 feet south of centerline. The pre-design of the storm drain had avoided this sewer by jogging south at 73rd Avenue. However, an evaluation was performed early in the design process which indicated that it was more cost effective to cross the 48" sewer with two conflict structures than to run the storm drain south of the sewer, which would require relocation of the 8" and 16" waterlines as well as shoring of 4 structures. The project team met with City of Glendale utility officials and they did not have a problem with the proposed conflict structures.

6.2 SRP Irrigation Lines

SRP has irrigation delivery and drain lines within the project area. There is a well site at the northwest corner of 59th Avenue and Camelback Road with two irrigation pipes (a 30" and a 36") crossing Camelback Road at this location. The 36" pipe continues south along 59th Avenue while the 30" sweeps west at the southwest corner and runs along the south side of Camelback Road to 63rd Avenue. There is also a 30"/18" drain line that begins at 61st Avenue and runs west along the north side of Camelback Road to 67th Avenue. Several catch basins at 61st and 66th Avenues and west of 65th Ave drain into this irrigation line. These will be replaced with new catch basins that outlet into the new storm drain. At the 67th Avenue intersection, a 48" irrigation line crosses the new storm drain on the west side of 67th Avenue and a 24" irrigation pipe crosses the storm drain on the east side of the intersection. Pothole data indicate the irrigation pipes to be relatively shallow and will not be vertically in conflict with the new storm drain. However, the irrigation lines will need to be protected in place during construction.

6.3 SRP Power Lines

SRP also has power facilities within the project limits, including the Grasmoen power station at the northeast corner of 75th Avenue and Camelback Road. The power facilities include both overhead power lines as well as underground electrical conduits. The overhead power lines generally run along the north side of Camelback Road with a few overhead crossings. Caution should be exercised during construction to avoid contact with the overhead power lines. The underground conduits are located along the north side of Camelback Road, and cross the roadway at several locations. Pothole results indicate that the conduits are relatively shallow and are usually encased at the crossings. While not in conflict with the new storm drain, the SRP underground conduits should be protected in place during construction.

6.4 Qwest Conduits

Qwest has underground telephone and telecommunications conduits throughout the project limits. The main line starts at 67th Avenue, where a duct bank from the south splits at telephone manhole located at the southeast corner. There is a conduit that sweeps at the southwest corner and then runs north along the west side of 67th Avenue. A 5-3 ½" transite duct bank runs east from the manhole, paralleling the new storm drain approximately 21 feet south of centerline. Pothole data show that the duct bank is between 5 and 6 feet deep. The line continues east to 59th Avenue, then turns south. If exposed during construction, the Qwest conduits should be protected in place.

6.5 Southwest Gas

There are numerous Southwest Gas lines within the project limits, ranging in size from ¾" to 6". The main gas line is a 4" steel line that runs parallel to the storm drain. Between 75th Avenue and 71st Avenue, the line is approximately 23 feet south of centerline, and from 67th Avenue to 59th Avenue, the 4" line runs approximately 29 feet north of centerline. A 6" plastic gas line running north-south crosses the storm drain at 67th Avenue. Pothole results show the gas lines to be between 4 and 7 feet deep and will not be in conflict with the new storm drain. Caution should be exercised when working near the gas lines. These should be protected in place during construction.

7.0 SUMMARY

- This project will construct a storm drain system along Camelback Road from 1130 ft east of 59th Avenue to approximately 300 ft east of 75th Ave to mitigate flooding along Camelback Road. This storm drain will be designed for the 10-year flow.
- The design basis for this project is the Bethany Home/Grand Canal Flood Control Project Pre-Design Study (DMJM, September 2000), along with refinement made during design and construction of Segment 1 thorough 6 from the Loop 101 Freeway to 67th Avenue.
- Three hydrologic analyses are performed for the Camelback Storm Drain Project. The **Offsite Inlet Hydrology** addresses the drainage from the local watershed north of Camelback Road. Inlets and lateral pipes north of Camelback Road are sized based on this hydrology. The **Onsite Inlet Hydrology** estimates the street runoff generated from the right-of-way of Camelback Road. The spacing and the size of catch basins and lateral pipes along Camelback Road are designed based on the Onsite Inlet Hydrology. The trunk line under Camelback Road is designed based on the **Trunk Line Hydrology** that follows the CLOMR for the 100-year event and the Pre-Design Study for the 10-year event. This is to ensure that the current project is consistent with the approved CLOMR by FEMA.
- The Storm drain hydraulics was analyzed using StormCAD to determine the hydraulic grade line through the storm drain.

8.0 REFERENCES

1. *Drainage Design Manual for Maricopa County, Arizona, Volume 1 – Hydrology*, Flood Control District of Maricopa County, November 2003 (Draft).

2. *Drainage Design Manual for Maricopa County, Arizona, Volume 2 – Hydraulics*, Flood Control District of Maricopa County, September 2003 (Draft).

3. *Design Guidelines for Site Development and Infrastructure Construction*, City of Glendale, 2002.

4. *Bethany Home/Grand Canal Flood Control Project, Pre-Design Study, Vol. I*, DMJM for Flood Control District of Maricopa County, FCD No. 98-46, 2000.

5. *Bethany Home Outfall Channel, Technical Data Notebook Conditional Letter of Map Revision (CLOMR) Vol. I (TDN)*, DMJM+HARRIS for Flood Control District of Maricopa County, FCD No. 98-46, 2003.

PLATE

Plate I

Offsite Drainage Map

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FCD PROJ. NO. 2008C024
PCN 620.03.32

PLATE-1 OFFSITE DRAINAGE MAP

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

N
250' 0' 500'
SCALE IN FEET

OLSSON ASSOCIATES
7250 North 16th Street
Suite 210
Phoenix, AZ 85020
TEL 602.748.1000
FAX 602.748.1001

Plate II

Onsite Drainage Map

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FCD PROJ. NO. 2008C024
PCN 620.03.32

PLATE-2 ONSITE DRAINAGE MAP

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

N

0' 100' 200'
SCALE IN FEET

OLSSON ASSOCIATES
7250 North 16th Street
Suite 210
Phoenix, AZ 85020
TEL 602.748.1000
FAX 602.748.1001

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FCD PROJ. NO. 2008C024

PCN 620.03.32

PLATE-2 ONSITE DRAINAGE MAP

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

N

0' 100' 200'

SCALE IN FEET

OLSSON ASSOCIATES

7250 North 16th Street
Suite 210
Phoenix, AZ 85020
TEL 602.748.1000
FAX 602.748.1001

APPENDIX A

Appendix A

Offsite Inlet Hydrology Supporting Documentation

A.1 HEC-1 Input Data
(10-yr, 6hr)

Project

Reference	008-2678 (HEC-1)
Title	Camelback Road Storm Drain
Location	Maricopa County, Arizona
Agency	Flood Control District of Maricopa County

Project Defaults

Model	HEC1
Land Use Agency	FCDMC
Rainfall	NOAA
Soils Agency	FCDMC

HEC-1 Defaults

Unit Hydrograph	Clark
Loss Method	Green-Ampt
Duration	6 Hour
Tabulation Interval	5
No. Ordinates	300
Output	5

Comments

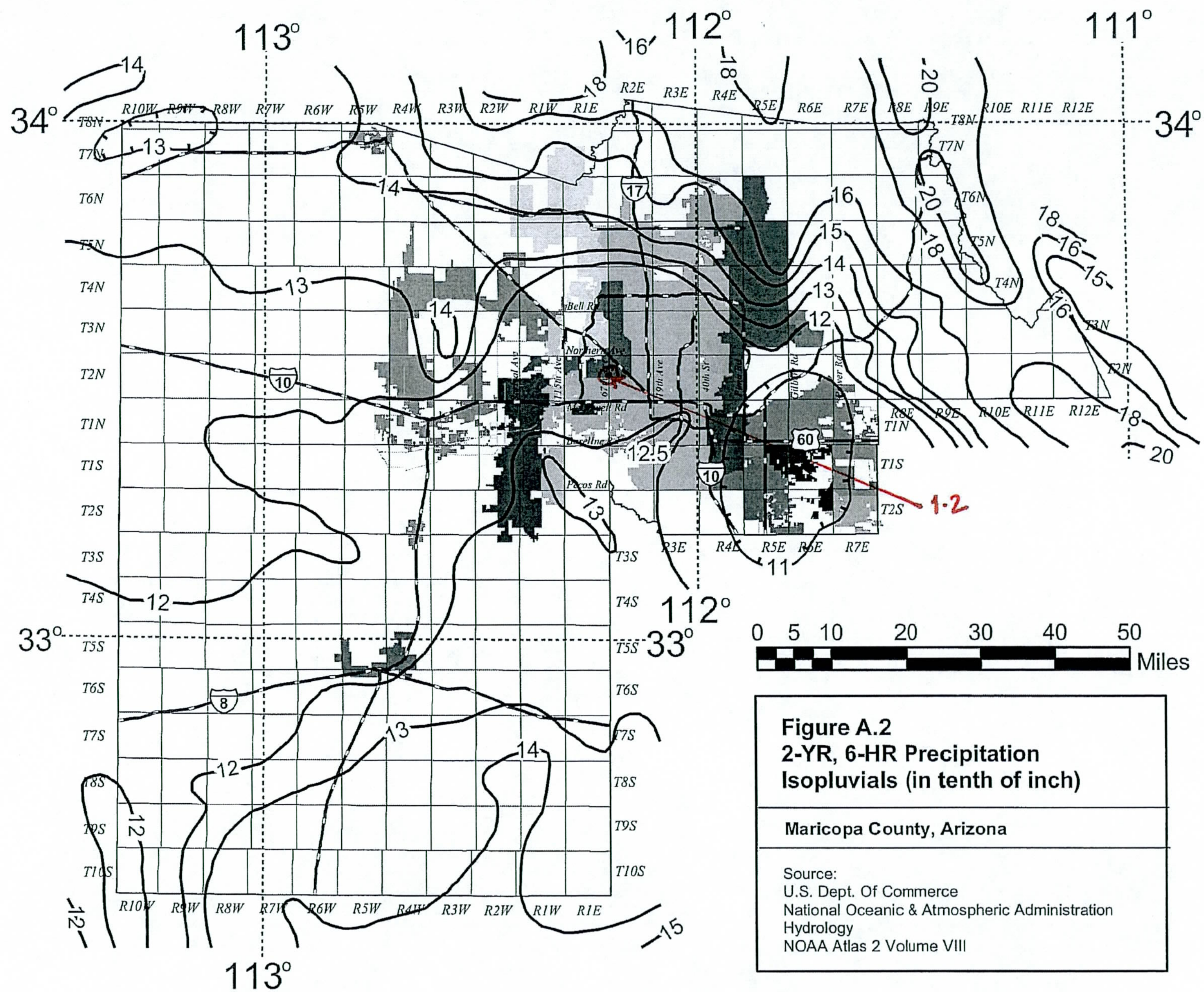


Figure A.2
2-YR, 6-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

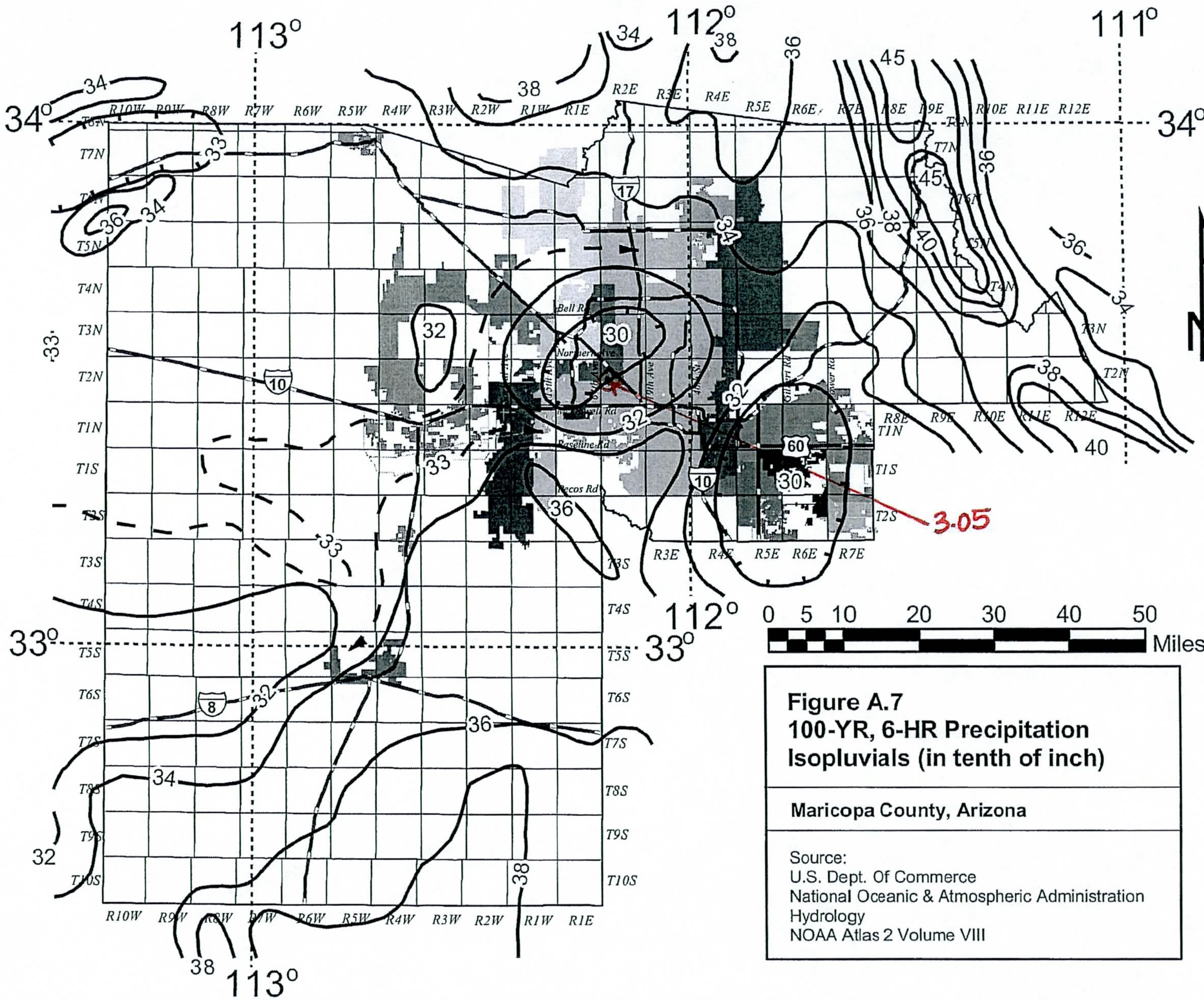


Figure A.7
100-YR, 6-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

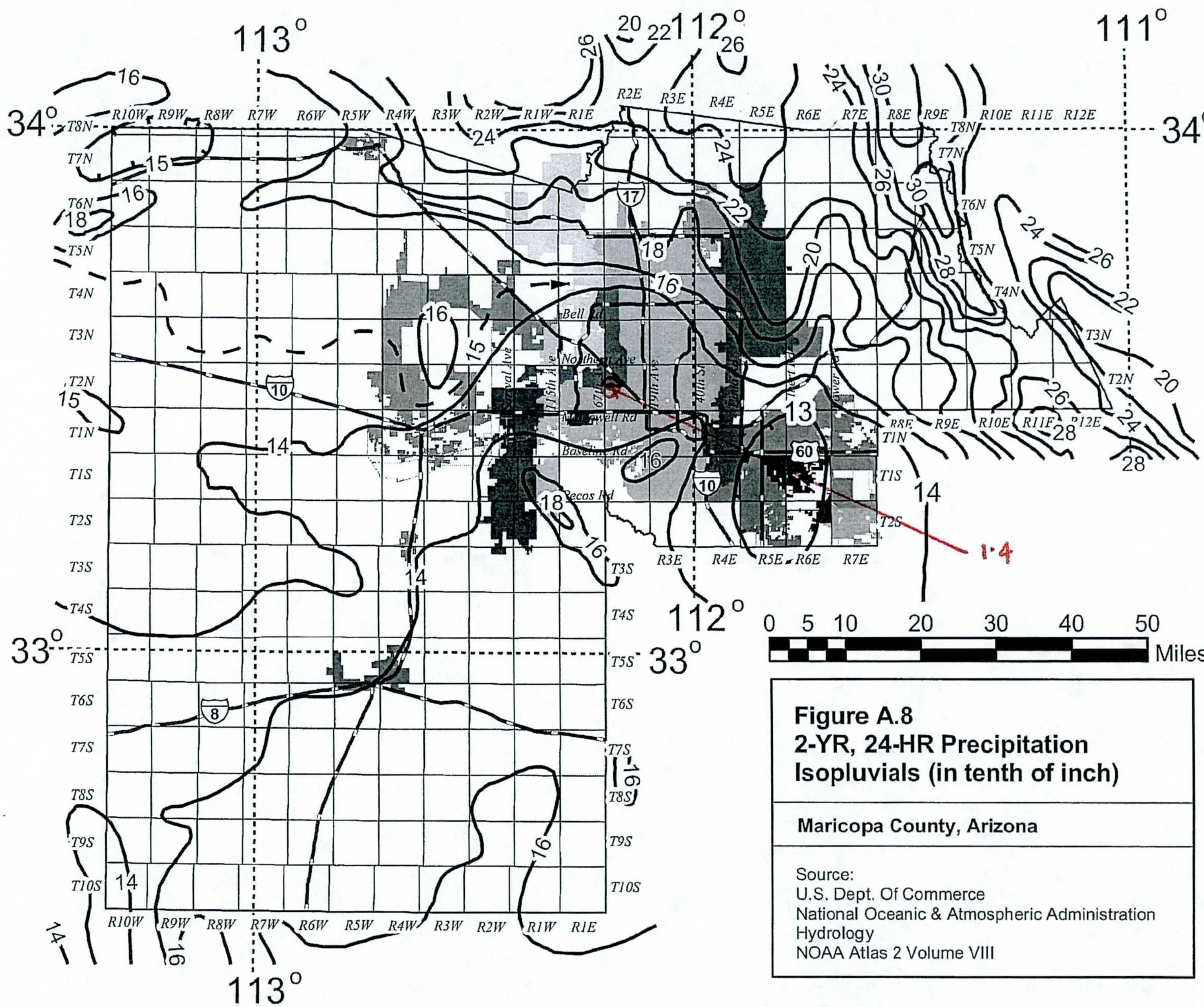


Figure A.8
2-YR, 24-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

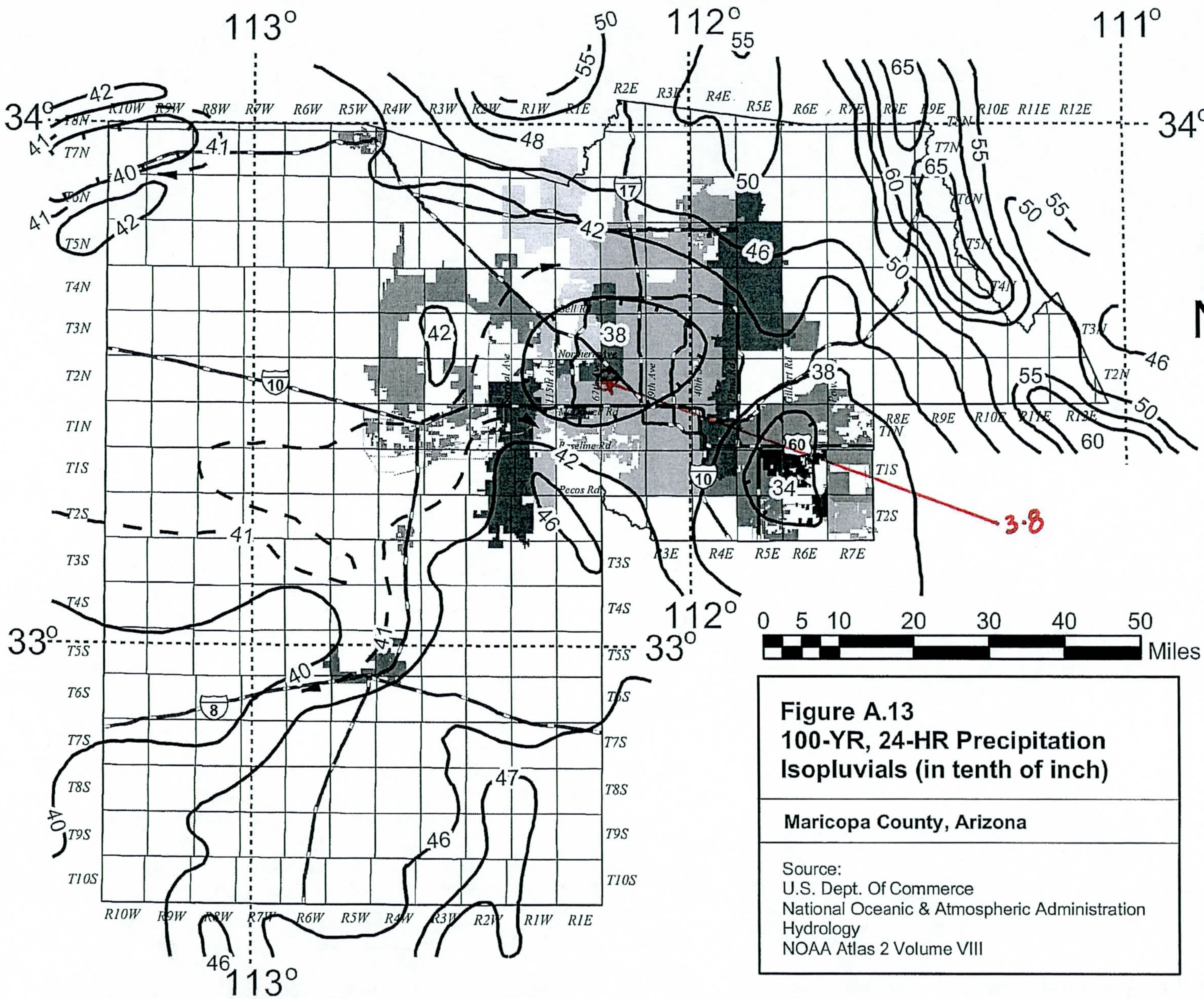


Figure A.13
100-YR, 24-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

RAINFALL DATA

Project Reference: 008-2678 (HEC-1)

Duration	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Rainfall Method: NOAA						
5 MIN	0.330	0.420	0.480	0.570	0.630	0.700
10 MIN	0.490	0.630	0.730	0.860	0.970	1.080
15 MIN	0.590	0.790	0.920	1.100	1.240	1.380
30 MIN	0.790	1.050	1.230	1.480	1.680	1.870
1 HOUR	0.960	1.300	1.530	1.850	2.100	2.340
2 HOUR	1.040	1.420	1.680	2.030	2.310	2.580
3 HOUR	1.100	1.500	1.780	2.160	2.450	2.740
6 HOUR	1.200	1.660	1.970	2.390	2.720	3.050
12 HOUR	1.300	1.830	2.180	2.670	3.050	3.420
24 HOUR	1.400	2.000	2.400	2.950	3.380	3.800

A.1.1 Soil Data

Map Scale: 1:27,900 if printed on A size (8.5" x 11") sheet.

N

Meters: 0, 350, 700, 1,400, 2,100

Feet: 0, 1,500, 3,000, 6,000, 9,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:27,900 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Maricopa County, Arizona, Central Part
Survey Area Data: Version 6, Aug 29, 2008

Date(s) aerial images were photographed: 6/4/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Maricopa County, Arizona, Central Part (AZ651)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Aa	Agualt loam	49.1	2.0%
AbA	Antho sandy loam, 0 to 1 percent slopes	27.9	1.2%
An	Avonda clay loam	95.7	4.0%
Ao	Avondale clay loam	705.3	29.2%
Bs	Brios sandy loam	14.0	0.6%
Bt	Brios loam	11.4	0.5%
Cb	Carrizo gravelly sandy loam	1.1	0.0%
Ge	Gilman fine sandy loam	57.1	2.4%
GgA	Gilman loam, 0 to 1 percent slopes	1,052.7	43.5%
Gt	Glenbar clay loam	197.2	8.2%
LcA	Laveen loam, 0 to 1 percent slopes	10.9	0.5%
Le	Laveen clay loam	0.3	0.0%
Ma	Maripo sandy loam	39.5	1.6%
Mr	Mohall clay loam	3.4	0.1%
Ms	Mohall clay	7.0	0.3%
Tt	Trix clay loam	22.9	0.9%
Vg	Vint loamy fine sand	31.5	1.3%
Vh	Vint fine sandy loam	88.8	3.7%
Vk	Vint loam	1.5	0.1%
Totals for Area of Interest		**2,417.5**	**100.0%**

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)

Major Basin ID: A

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
10A	651	Ao	6512049	0.029	81.30	0.04	-	100
	651	An	6512047	0.007	18.70	0.05	-	100
10B	651	Ao	6512049	0.013	77.80	0.04	-	100
	651	An	6512047	0.003	18.00	0.05	-	100
	651	Bt	6512259	0.001	4.20	0.25	-	100
11	651	GgA	651323320	0.034	16.60	0.25	-	100
	651	Ao	6512049	0.081	39.70	0.04	-	100
	651	Aa	6512021	0.021	10.40	0.26	-	100
	651	Gt	6513259	0.000	0.10	0.04	-	100
	651	Vh	6516235	0.053	25.70	0.27	-	100
	651	Ma	6514421	0.015	7.50	0.40	-	100
12	651	Ao	6512049	0.122	98.50	0.04	-	100
	651	Aa	6512021	0.002	1.40	0.26	-	100
	651	Ma	6514421	0.000	0.10	0.40	-	100
13	651	GgA	651323320	0.008	2.10	0.25	-	100
	651	Aa	6512021	0.005	1.30	0.26	-	100
	651	An	6512047	0.001	0.20	0.05	-	100
	651	Gt	6513259	0.142	36.40	0.04	-	100
	651	Vh	6516235	0.023	5.80	0.27	-	100
	651	Ma	6514421	0.005	1.30	0.40	-	100
	651	Ge	6513229	0.002	0.50	0.26	-	100
	655	LaA	655422120	0.015	3.70	0.25	-	100
	651	Bs	6512257	0.003	0.70	0.39	-	100
	651	Ao	6512049	0.187	48.00	0.04	-	100
14	651	GgA	651323320	0.008	7.50	0.25	-	100
	651	Aa	6512021	0.003	2.50	0.26	-	100
	651	An	6512047	0.006	5.70	0.05	-	100
	651	Vh	6516235	0.015	15.10	0.27	-	100
	651	Ma	6514421	0.029	29.40	0.40	-	100
	651	Ge	6513229	0.020	20.30	0.26	-	100
	651	AbA	651202320	0.008	8.20	0.38	-	100
	651	Vg	6516233	0.011	11.20	0.91	-	100
1A	651	GgA	651323320	0.250	100.00	0.25	-	100
1B	651	An	6512047	0.001	0.40	0.05	-	100
	651	Vg	6516233	0.002	1.70	0.91	-	100
	651	Aa	6512021	0.000	0.10	0.26	-	100
	651	GgA	651323320	0.122	97.80	0.25	-	100
1C	651	Ao	6512049	0.010	7.80	0.04	-	100
	651	GgA	651323320	0.068	54.50	0.25	-	100
	651	An	6512047	0.032	25.80	0.05	-	100
	651	Vg	6516233	0.015	11.90	0.91	-	100
2	651	GgA	651323320	0.049	55.80	0.25	-	100
	651	Ao	6512049	0.034	39.20	0.04	-	100
	651	Aa	6512021	0.004	5.10	0.26	-	100
3	651	GgA	651323320	0.155	94.60	0.25	-	100
	651	Ao	6512049	0.009	5.40	0.04	-	100
4A	651	GgA	651323320	0.064	100.00	0.25	-	100
4B	651	GgA	651323320	0.062	100.00	0.25	-	100
5A	651	GgA	651323320	0.020	69.70	0.25	-	100
	651	Gt	6513259	0.009	30.30	0.04	-	100
5B	651	GgA	651323320	0.021	100.00	0.25	-	100
5C	651	GgA	651323320	0.043	99.50	0.25	-	100
	651	Ao	6512049	0.000	0.50	0.04	-	100
5D	651	GgA	651323320	0.032	98.80	0.25	-	100
	651	Ao	6512049	0.000	0.60	0.04	-	100
	651	Gt	6513259	0.000	0.60	0.04	-	100
6	651	GgA	651323320	0.051	30.20	0.25	-	100
	651	Ao	6512049	0.098	58.30	0.04	-	100
	651	Aa	6512021	0.004	2.50	0.26	-	100

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
Major Basin ID: A								
6	651	An	6512047	0.015	9.00	0.05	-	100
7A	651	GgA	651323320	0.046	88.40	0.25	-	100
	651	Ao	6512049	0.001	1.90	0.04	-	100
	651	An	6512047	0.005	9.70	0.05	-	100
7B	651	GgA	651323320	0.021	65.10	0.25	-	100
	651	Ao	6512049	0.011	34.30	0.04	-	100
	651	An	6512047	0.000	0.60	0.05	-	100
7C	651	GgA	651323320	0.006	14.20	0.25	-	100
	651	Ao	6512049	0.031	71.70	0.04	-	100
	651	An	6512047	0.006	14.20	0.05	-	100
8	651	Ao	6512049	0.105	100.00	0.04	-	100
9	651	GgA	651323320	0.036	35.60	0.25	-	100
	651	Ao	6512049	0.053	52.00	0.04	-	100
	651	An	6512047	0.010	9.40	0.05	-	100
	651	Bt	6512259	0.003	3.00	0.25	-	100

CAMELBACK STORM DRAIN: 59th Ave to 75th Ave

Soil Table

Basin ID	Soli			Soil ID	Map Unit Name
	Symbol	Area (ac.)	Sq. mile		
1A	GgA	**160.28**	**0.250**	651323320	Gilman loam, 0 to 1 percent slopes
1B	GgA	78.213	0.1222	651323320	Gilman loam, 0 to 1 percent slopes
	An	0.339	0.0005	6512047	Avonda clay loam
	Aa	0.075	0.0001	6512021	Agualt loam
	Vg	1.368	0.0021	6516233	Vint loamy fine sand
		79.99	**0.125**		
1C	Ao	6.228	0.0097	6512049	Avondale clay loam
	GgA	43.671	0.0682	651323320	Gilman loam, 0 to 1 percent slopes
	An	20.669	0.0323	6512047	Avonda clay loam
	Vg	9.510	0.0149	6516233	Vint loamy fine sand
		80.08	**0.125**		
2	GgA	31.072	0.0486	651323320	Gilman loam, 0 to 1 percent slopes
	Ao	21.855	0.0341	6512049	Avondale clay loam
	Aa	2.824	0.0044	6512021	Agualt loam
		55.75	**0.087**		
3	GgA	98.898	0.1545	651323320	Gilman loam, 0 to 1 percent slopes
	Ao	5.623	0.0088	6512049	Avondale clay loam
		104.52	**0.163**		
4A	GgA	**40.65**	**0.064**	651323320	Gilman loam, 0 to 1 percent slopes
4B	GgA	**39.66**	**0.062**	651323320	Gilman loam, 0 to 1 percent slopes
5A	GgA	12.905	0.0202	651323320	Gilman loam, 0 to 1 percent slopes
	Gt	5.657	0.0088	6513259	Glenbar clay loam
		18.56	**0.029**		
5B	GgA	**13.11**	**0.020**	651323320	Gilman loam, 0 to 1 percent slopes
5C	GgA	27.563	0.0431	651323320	Gilman loam, 0 to 1 percent slopes
	Ao	0.115	0.0002	6512049	Avondale clay loam
		27.68	**0.043**		
5D	Gt	0.10	0.0002	6513259	Glenbar clay loam
	GgA	20.68	0.0323	651323320	Gilman loam, 0 to 1 percent slopes
	Ao	0.098	0.0002	6512049	Avondale clay loam
		20.87	**0.033**		
6	Ao	62.858	0.0982	6512049	Avondale clay loam
	Aa	2.712	0.0042	6512021	Agualt loam
	GgA	32.531	0.0508	651323320	Gilman loam, 0 to 1 percent slopes
	An	9.671	0.0151	6512047	Avonda clay loam
		107.77	**0.168**		
7A	Ao	0.625	0.0010	6512049	Avondale clay loam
	An	3.186	0.0050	6512047	Avonda clay loam
	GgA	29.331	0.0458	651323320	Gilman loam, 0 to 1 percent slopes
		33.14	**0.052**		

CAMELBACK STORM DRAIN: 59th Ave to 75th Ave

Soil Table

Basin ID	Soli			Soil ID	Map Unit Name
	Symbol	Area (ac.)	Sq. mile		
7B	Ao	6.930	0.0108	6512049	Avondale clay loam
	GgA	13.137	0.0205	651323320	Gilman loam, 0 to 1 percent slopes
	An	0.151	0.0002	6512047	Avonda clay loam
		20.22	**0.032**		
7C	GgA	3.905	0.0061	651323320	Gilman loam, 0 to 1 percent slopes
	An	3.922	0.0061	6512047	Avonda clay loam
	Ao	19.795	0.0309	6512049	Avondale clay loam
		27.62	**0.043**		
8	Ao	**66.96**	**0.105**	6512049	Avondale clay loam
9	Ao	33.793	0.0528	6512049	Avondale clay loam
	An	6.172	0.0096	6512047	Avonda clay loam
	GgA	23.137	0.0362	651323320	Gilman loam, 0 to 1 percent slopes
	Bt	1.921	0.0030	6512259	Brios loam
		65.02	**0.102**		
10A	Ao	18.602	0.0291	6512049	Avondale clay loam
	An	4.303	0.0067	6512047	Avonda clay loam
		22.90	**0.036**		
10B	Ao	8.335	0.0130	6512049	Avondale clay loam
	An	1.905	0.003	6512047	Avonda clay loam
	Bt	0.460	0.001		
		10.70	**0.017**		
11	Gt	0.131	0.000	6513259	Glenbar clay loam
	Ao	51.932	0.081	6512049	Avondale clay loam
11	GgA	21.779	0.034	651323320	Gilman loam, 0 to 1 percent slopes
	Vh	33.660	0.053	6516235	Vint fine sandy loam
	Aa	13.563	0.021	6512021	Agualt loam
	Ma	9.768	0.015	6514421	Maripo sandy loam
		130.83	**0.204**		
12	Ma	0.036	0.000	6514421	Maripo sandy loam
	Aa	1.160	0.002	6512021	Agualt loam
	Ao	78.354	0.122	6512049	Avondale clay loam
		79.55	**0.124**		
13	Gt	91.003	0.1422	6513259	Glenbar clay loam
	Ao	119.896	0.1873	6512049	Avondale clay loam
	An	0.577	0.0009	6512047	Avonda clay loam
	Ma	3.214	0.0050	6514421	Maripo sandy loam
	Aa	3.134	0.0049	6512021	Agualt loam
	Vh	14.615	0.0228	6516235	Vint fine sandy loam
	GgA	5.183	0.0081	651323320	Gilman loam, 0 to 1 percent slopes
	Ge	1.331	0.0021	6513229	Gilman fine sandy loam
	LcA	9.363	0.0146	655422120	Laveen loam
	Bs	1.640	0.0026	6512257	Brios sandy loam
		249.96	**0.3906**		

CAMELBACK STORM DRAIN: 59th Ave to 75th Ave

Soil Table

Basin ID	Soli			Soil ID	Map Unit Name
	Symbol	Area (ac.)	Sq. mile		
14	An	3.669	0.006	6512047	Avonda clay loam
	GgA	4.802	0.008	651323320	Gilman loam, 0 to 1 percent slopes
	Ma	18.753	0.029	6514421	Maripo sandy loam
	Aa	1.596	0.002	6512021	Agualt loam
	Vg	7.131	0.011	6516233	Vint loamy fine sand
	AbA	5.249	0.008	651202320	Antho sandy loam
	Vh	9.590	0.015	6516235	Vint fine sandy loam
	Ge	12.930	0.020	6513229	Gilman fine sandy loam
		63.72	**0.100**		

A.1.2 Land Use Data

Flood Control District of Maricopa County
Drainage Design Management System
LAND USE DEFAULTS
Project Reference: 008-2678 (HEC-1)

Code	Description	Initial Abstraction IA	Percent Impervious RTIMP	Vegetation Cover	Moisture Deficit DTHETA	Resistance Coefficient Kb
Agriculture						
750	Agriculture	0.50	-	85.0	ORMAL	LOW
Commercial						
200	General Commercial (Commercial where no detail available)	0.10	80	60.0	ORMAL	MIN
210	Specialty Commercial (<=50,000 sq. ft.)	0.10	80	65.0	ORMAL	MIN
220	Neighborhood Commercial (50,000 to 100,000 sq. ft.)	0.10	80	65.0	ORMAL	MIN
230	Community Commercial (100,000 to 500,000 sq. ft.)	0.10	80	75.0	ORMAL	MIN
240	Regional Commercial (500,000 to 1,000,000 sq. ft.)	0.10	80	65.0	ORMAL	MIN
250	Super-Regional Commercial (>= 1,000,000 sq. ft.)	0.10	80	70.0	ORMAL	MIN
Industrial						
300	General Industrial (Industrial where no detail available)	0.15	55	60.0	ORMAL	MIN
310	Warehouse/Distribution Centers	0.10	80	75.0	ORMAL	MIN
320	Industrial	0.15	55	60.0	ORMAL	MIN
Institutional						
520	Educational (Schools and universities)	0.29	45	80.0	ORMAL	MIN
530	Institutional (Includes hospitals and churches)	0.10	80	75.0	ORMAL	MIN
550	Public Facilities (comm centers, libraries, sub-stations)	0.10	80	75.0	ORMAL	MIN
Office						
400	Office General (Office where no detail available)	0.10	80	75.0	ORMAL	MIN
410	Office Low Rise (1-4 stories)	0.10	80	75.0	ORMAL	MIN
420	Office Mid Rise (5-12 stories)	0.10	80	75.0	ORMAL	MIN
430	Office High Rise (13 stories or more)	0.10	80	75.0	ORMAL	MIN
810	Business Park (enclosed industrial, office or retail)	0.10	80	75.0	ORMAL	MIN
Open Space						
540	Cemeteries	0.10	5	90.0	ORMAL	LOW
700	General Open Space (Open space where no detail available)	0.10	5	90.0	ORMAL	LOW
710	Active Open Space (Includes parks)	0.10	5	90.0	ORMAL	MIN
720	Golf courses	0.10	5	90.0	ORMAL	MIN
730	Passive Open Space (Includes mountain preserves and washes)	0.10	-	90.0	ORMAL	HI
740	Water	0.00	-	0.0	WET	MIN
900	Vacant (Existing land use database only)	0.35	-	25.0	DRY	LOW
Other						
560	Special Events (stadiums, sports complexes and fairgrounds)	0.10	80	75.0	ORMAL	MIN
Other Employment						
570	Other Employment - low (Proving grounds and land fills)	0.10	80	75.0	ORMAL	MIN
580	Other Employment - medium	0.10	80	75.0	ORMAL	MIN
590	Other Employment - high	0.10	80	75.0	ORMAL	MIN
Residential						
110	Rural Residential (<= 1/5 du per acre)	0.30	5	30.0	ORMAL	MIN
120	Estate Residential (1/5 du per acre to 1 du per acre)	0.30	5	30.0	ORMAL	MIN
130	Large Lot Residential - Single Family (1-2 du per acre)	0.30	15	50.0	ORMAL	MIN
140	Medium Lot Residential - Single Family (2-4 du per acre)	0.25	30	50.0	ORMAL	MIN
150	Small Lot Residential - Single Family (4-6 du per acre)	0.25	30	50.0	ORMAL	MIN
160	Very Small Lot Residential - Single Family (>6 du per acre)	0.25	40	50.0	ORMAL	MIN
170	Medium Density Residential - Muli Family (5-10 du per acre)	0.25	45	50.0	ORMAL	MIN
180	High Density Residential - Multi Family (10-15 du per acre)	0.25	45	50.0	ORMAL	MIN
190	Very High Density Residential - Multi Family (>15 du per ac)	0.25	45	50.0	ORMAL	MIN

Code	Description	Initial Abstraction IA	Percent Impervious RTIMP	Vegetation Cover	Moisture Deficit DTHETA	Resistance Coefficient Kb
Tourist						
510	Tourist and Visitor Accommodations (Hotels, motels, resorts)	0.10	80	75.0	ORMAL	MIN
Transportation						
600	General Transportation (where no detail available)	0.10	80	75.0	ORMAL	MIN
610	Transportation (railways, transit centers, freeways)	0.10	80	75.0	ORMAL	MIN
620	Airports (Includes public use airports)	0.15	55	60.0	ORMAL	MIN

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetable Cover (%)	DTHETA	Kb

Major Basin ID: A

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetable Cover (%)	DTHETA	Kb
10A	140	0.036	100.0	0.25	30	50.0	NORMAL	0.03
		0.036	**100.0**					
10B	140	0.017	100.0	0.25	30	50.0	NORMAL	0.03
		0.017	**100.0**					
11	140	0.078	38.2	0.25	30	50.0	NORMAL	0.03
	170	0.007	3.6	0.25	45	50.0	NORMAL	0.04
	190	0.044	21.5	0.25	45	50.0	NORMAL	0.03
	230	0.008	4.1	0.10	80	75.0	NORMAL	0.04
	520	0.046	22.7	0.29	45	80.0	NORMAL	0.03
	710	0.020	9.9	0.10	5	90.0	NORMAL	0.03
		0.204	**100.0**					
12	140	0.124	100.0	0.25	30	50.0	NORMAL	0.03
		0.124	**100.0**					
13	140	0.366	93.8	0.25	30	50.0	NORMAL	0.03
	190	0.014	3.6	0.25	45	50.0	NORMAL	0.03
	220	0.005	1.3	0.10	80	65.0	NORMAL	0.04
	230	0.005	1.3	0.10	80	75.0	NORMAL	0.04
		0.391	**100.0**					
14	140	0.068	67.8	0.25	30	50.0	NORMAL	0.03
	520	0.032	32.2	0.29	45	80.0	NORMAL	0.03
		0.100	**100.0**					
1A	320	0.250	100.0	0.15	55	60.0	NORMAL	0.03
		0.250	**100.0**					
1B	320	0.125	100.0	0.15	55	60.0	NORMAL	0.03
		0.125	**100.0**					
1C	190	0.033	26.1	0.25	45	50.0	NORMAL	0.03
	230	0.023	18.0	0.10	80	75.0	NORMAL	0.03
	320	0.055	44.0	0.15	55	60.0	NORMAL	0.03
	710	0.015	11.9	0.10	5	90.0	NORMAL	0.03
		0.125	**100.0**					
2	230	0.005	6.0	0.10	80	75.0	NORMAL	0.04
	320	0.082	94.0	0.15	55	60.0	NORMAL	0.03
		0.087	**100.0**					
3	320	0.163	100.0	0.15	55	60.0	NORMAL	0.03
		0.163	**100.0**					
4A	170	0.064	100.0	0.25	45	50.0	NORMAL	0.03
		0.064	**100.0**					
4B	190	0.051	82.9	0.25	45	50.0	NORMAL	0.03
	230	0.011	17.1	0.10	80	75.0	NORMAL	0.03
		0.062	**100.0**					
5A	190	0.024	82.4	0.25	45	50.0	NORMAL	0.03
	230	0.005	17.6	0.10	80	75.0	NORMAL	0.04
		0.029	**100.0**					
5B	170	0.021	100.0	0.25	45	50.0	NORMAL	0.03
		0.021	**100.0**					
5C	170	0.028	64.6	0.25	45	50.0	NORMAL	0.03

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetable Cover (%)	DTHETA	Kb
Major Basin ID: A								
5C	230	0.015	35.4	0.10	80	75.0	NORMAL	0.03
		0.043	**100.0**					
5D	230	0.033	100.0	0.10	80	75.0	NORMAL	0.03
		0.033	**100.0**					
6	140	0.049	29.2	0.25	30	50.0	NORMAL	0.03
	170	0.054	31.9	0.25	45	50.0	NORMAL	0.03
	190	0.045	26.4	0.25	45	50.0	NORMAL	0.03
	230	0.021	12.5	0.10	80	75.0	NORMAL	0.03
		0.168	**100.0**					
7A	170	0.010	19.7	0.25	45	50.0	NORMAL	0.03
	190	0.031	59.4	0.25	45	50.0	NORMAL	0.03
	230	0.011	20.9	0.10	80	75.0	NORMAL	0.03
		0.052	**100.0**					
7B	140	0.012	38.3	0.25	30	50.0	NORMAL	0.03
	170	0.015	46.8	0.25	45	50.0	NORMAL	0.03
	230	0.005	14.9	0.10	80	75.0	NORMAL	0.04
		0.032	**100.0**					
7C	140	0.043	100.0	0.25	30	50.0	NORMAL	0.03
		0.043	**100.0**					
8	140	0.105	100.0	0.25	30	50.0	NORMAL	0.03
		0.105	**100.0**					
9	140	0.102	100.0	0.25	30	50.0	NORMAL	0.03
		0.102	**100.0**					

CAMELBACK STORM DRAIN: 59th Ave to 75th Ave

Land Use Table

Basin ID	Land Use			FCDMC Land Use CODE	FCDMC Land Use Description
	Type	Area (ac.)	Sq. mile		
1A	I	**160.28**	**0.250**	320	Industrial
1B	I	**79.99**	**0.125**	320	Industrial
1C	I	35.252	0.0551	320	Industrial
	VHDR	20.909	0.0327	190	Very High Density Residential/Multi family (Apartment)
	AOP	9.517	0.0149	710	Open Space (Including Park)
	CC	14.402	0.0225	230	Community Commercial
		80.08	**0.125**		
2	I	52.426	0.0819	320	Industrial
	CC	3.326	0.0052	230	Community Commercial
		55.75	**0.087**		
3	I	**104.52**	**0.163**	320	Industrial
4A	MDR	**40.65**	**0.064**	170	Medium Density Residential / Multi Family (Mobile Home)
4B	VHDR	32.876	0.051	190	Very High Density Residential/Multi family (Apartment)
	CC	6.784	0.011	230	Community Commercial
		39.66	**0.062**		
5A	CC	3.2621	0.0051	230	Community Commercial
	VHDR	15.2998	0.0239	190	Very High Density Residential/Multi family (Apartment)
		18.56	**0.029**		
5B	MDR	**13.11**	**0.020**	170	Medium Density Residential / Multi Family (Mobile Home)
5C	MDR	17.859	0.0279	170	Medium Density Residential / Multi Family (Mobile Home)
	CC	9.806	0.0153	230	Community Commercial
		27.67	**0.043**		
5D	CC	**20.87**	**0.033**	230	Community Commercial
6	CC	13.466	0.0210	230	Community Commercial
	VHDR	28.487	0.0445	190	Very High Density Residential/Multi family (Apartment)
	MDR	34.453	0.0538	170	Medium Density Residential / Multi Family (Mobile Home)
	MLR	31.393	0.0491	140	Medium Lot Residential / Single Family
		107.80	**0.168**		
7A	CC	6.923	0.0108	230	Community Commercial
	VHDR	19.676	0.0307	190	Very High Density Residential/Multi family (Apartment)
	MDR	6.543	0.0102	170	Medium Density Residential / Multi Family (Mobile Home)
		33.14	**0.052**		
7B	MLR	7.743	0.0121	140	Medium Lot Residential / Single Family
	CC	2.982	0.0047	230	Community Commercial
	MDR	9.482	0.0148	170	Medium Density Residential / Multi Family (Mobile Home)
		20.21	**0.032**		
7C	MLR	**27.62**	**0.043**	**140**	Medium Lot Residential / Single Family
8	MLR	**66.96**	**0.105**	140	Medium Lot Residential / Single Family
9	MLR	**65.02**	**0.102**	140	Medium Lot Residential / Single Family
10A	MLR	**22.90**	**0.036**	140	Medium Lot Residential / Single Family
10B	MLR	**10.70**	**0.017**	140	Medium Lot Residential / Single Family
11	CC	5.373	0.0084	230	Community Commercial
	VHDR	28.191	0.0440	190	Very High Density Residential/Multi family (Apartment)
	MLR	49.925	0.0780	140	Medium Lot Residential / Single Family
	MDR	4.641	0.0073	170	Medium Density Residential / Multi Family (Mobile Home)
	AOP	13.011	0.0203	710	Open Space (Including Park)
	School	29.703	0.0464	520	Educational (School & University)
		130.84	**0.204**		
12	MLR	**79.55**	**0.124**	140	Medium Lot Residential / Single Family
13	MLR	234.472	0.3664	140	Medium Lot Residential / Single Family
	VHDR	8.994	0.0141	190	Very High Density Residential/Multi family (Apartment)
	NC	3.354	0.0052	220	Neighbourhood Commercial

CAMELBACK STORM DRAIN: 59th Ave to 75th Ave

Land Use Table

Basin ID	Land Use			FCDMC Land Use CODE	FCDMC Land Use Description
	Type	Area (ac.)	Sq. mile		
13	CC	3.136	0.0049	230	Community Commercial
		249.96	**0.391**		
14	School	20.523	0.0321	520	Educational (School & University)
	MLR	43.198	0.0675	140	Medium Lot Residential / Single Family
		63.72	**0.100**		

A.1.3 Flow Routing Data

Number Of Routing Steps (NSTPS) - Normal Depth Routing Paramter Calculation for HEC-1

$$\boxed{NSTPS = ((L)/V_{avg})/NMIN}$$

NSTPS = number of routing steps, a dimensionless integer
L = reach length (ft)
V_{avg} = velocity of flood wave (ft/min)
NMIN = hydrograph computation time interval, in min (5 min)

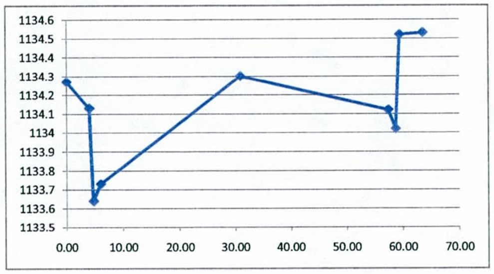
Routing Id	Reach Length 'L' (ft)	Slope (ft/ft)	Velocity (ft/sec)	Velocity (ft/min)	NSTPS
R1B	1335	0.0018	1.39	83.4	3
R1C	1345	0.0028	2.14	128.4	2
R3-1	1340	0.0022	1.64	98.4	3
R3-2	2610	0.0027	4.64	278.4	2
R4A	1325	0.003	3.57	214.2	1
R4B1	1340	0.0022	1.55	93	3
R4B2	1315	0.003	3.05	183	1
R5A	2030	0.0021	2.65	159	3
R5D	1330	0.0026	4.3	258	1
R5C	1330	0.0026	3.45	207	1
R6	1580	0.0025	1.12	67.2	5
R7C	1150	0.0022	2.83	169.8	1
R8	1195	0.0025	4.29	257.4	1
R9A	2580	0.0027	3.58	214.8	2
R9B	2580	0.0027	1.96	117.6	4
R9C	2310	0.0024	2.07	124.2	4
R11	2350	0.0021	3.47	208.2	2
R12A	1550	0.0026	0.66	39.6	3
R12B	2010	0.003	3.93	235.8	2
R13	3975	0.0033	1	60	3
R14	2620	0.0024	2.76	165.6	3

STREET ROUTING X-SECTION

Roadway X-section Data

Missouri Ave- R1B

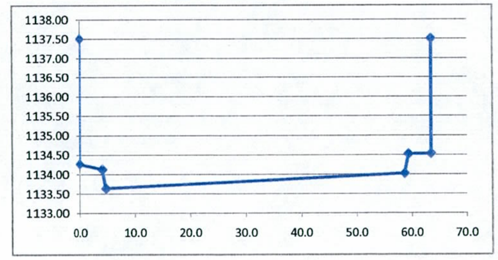
Station		Elevation	Description
0.00	0.00	1134.27	EOS
4.08	4.08	1134.13	BCV
0.69	4.77	1133.64	GUTT
1.24	6.01	1133.73	EOS
24.86	30.86	1134.3	P
26.54	57.41	1134.12	EOA
1.32	58.73	1134.02	GUTT
0.71	59.44	1134.52	BCV
4.08	63.52	1134.53	SOS



Normalized 8 points X-section Data

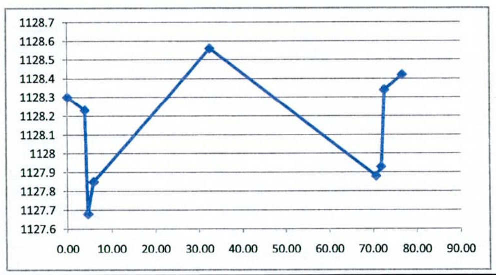
Station	Elev
0.0	1137.50
0.0	1134.27
4.1	1134.13
4.8	1133.64
58.7	1134.02
59.4	1134.52
63.5	1134.53
63.5	1137.50

Missouri Ave Route - R1A and R1B



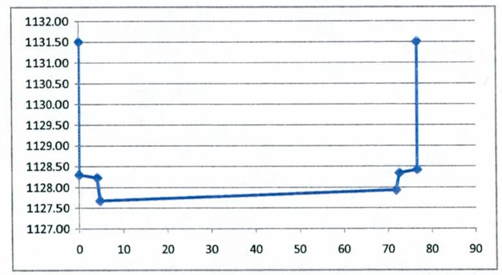
Missouri Ave- R1C

Station		Elevation	Description
0	0.00	1128.3	EOS
4.04	4.04	1128.23	BCV
0.66	4.70	1127.68	GUT
1.28	5.98	1127.85	EOA
26.51	32.49	1128.56	P
38.28	70.77	1127.88	EOA
1.16	71.93	1127.93	GUT
0.76	72.69	1128.34	BCV
4.03	76.72	1128.42	EOS



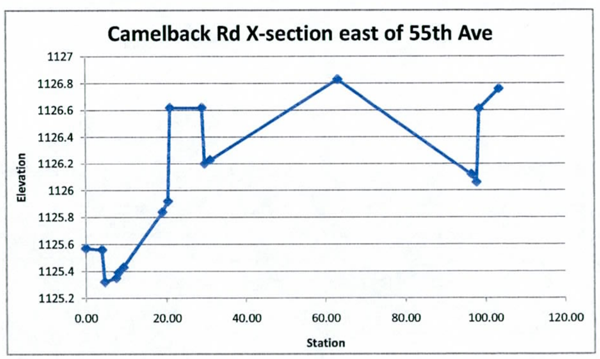
Missouri Ave Route- R1C

Station	Elev
0	1131.50
0	1128.30
4.04	1128.23
4.7	1127.68
71.93	1127.93
72.69	1128.34
76.72	1128.42
76.72	1131.50



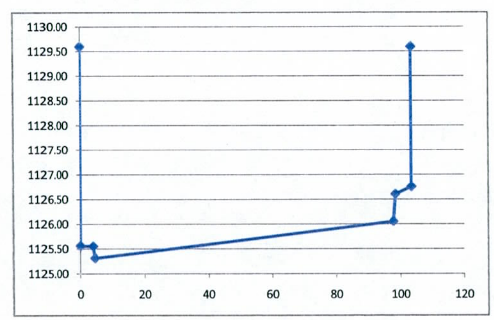
amelback Road -R3-1

Station		Elevation	Description
0	0.00	1125.57	EOS
3.91	3.91	1125.56	BCV
0.65	4.56	1125.32	GUT
2.84	7.40	1125.35	GUT
0.55	7.95	1125.39	BCV
1.27	9.22	1125.43	EOA
9.74	18.96	1125.84	EOA
1.41	20.37	1125.92	GUT
0.6	20.97	1126.62	BCV
8.07	29.04	1126.62	BCV
0.58	29.62	1126.2	GUT
1.41	31.03	1126.23	EOA
32.25	63.28	1126.83	P
33.26	96.54	1126.12	EOA
1.27	97.81	1126.06	GUT
0.67	98.48	1126.61	BCV
5.01	103.49	1126.76	EOS



Camelback Road Route-R3-1

Station	Elev
0	1129.60
0.00	1125.57
3.91	1125.56
4.56	1125.32
97.81	1126.06
98.48	1126.61
103.49	1126.76
103.49	1129.60



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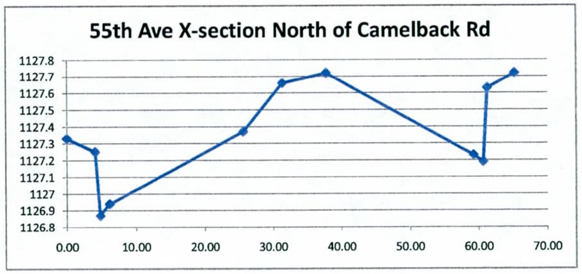
STREET ROUTING X-SECTION

Roadway X-section Data

Normalized 8 points X-section Data

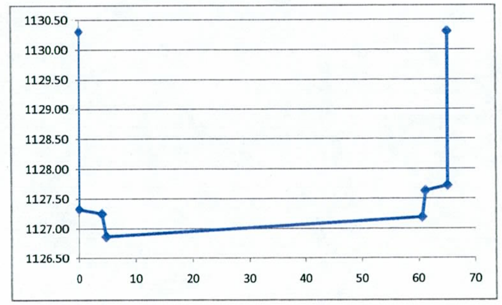
55th Ave -R3-2

Station		Elevation	Description
0	0.00	1127.33	EOS
4.03	4.03	1127.25	BCV
0.75	4.78	1126.87	GUT
1.34	6.12	1126.94	EOA
19.46	25.58	1127.37	DYS
5.77	31.35	1127.66	P
6.4	37.75	1127.72	SWS
21.51	59.26	1127.23	EOA
1.42	60.68	1127.19	GUT
0.59	61.27	1127.63	BCV
3.94	65.21	1127.72	EOS



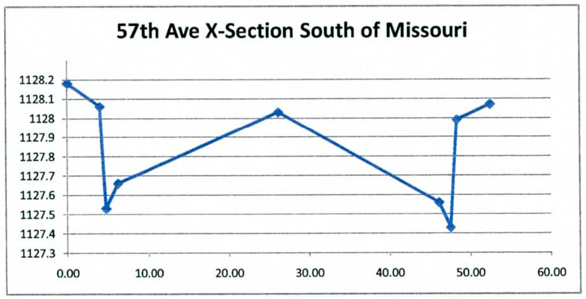
Station	Elev
0	1130.30
0	1127.33
4.03	1127.25
4.78	1126.87
60.68	1127.19
61.27	1127.63
65.21	1127.72
65.21	1130.30

55th Ave Route R3-2



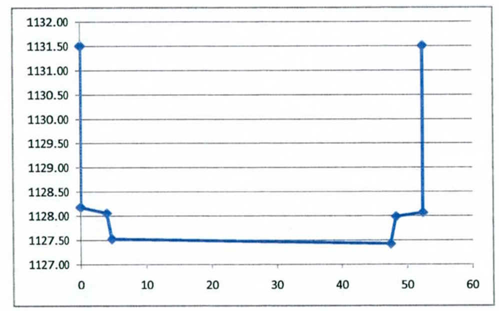
57th Ave -R4A

Station		Elevation	Description
0	0.00	1128.18	EOS
3.98	3.98	1128.06	BCV
0.76	4.74	1127.53	GUT
1.45	6.19	1127.66	EOA
19.95	26.14	1128.03	P
19.95	46.09	1127.56	EOA
1.43	47.52	1127.43	GUT
0.82	48.34	1127.99	BCV
4.08	52.42	1128.07	EOS



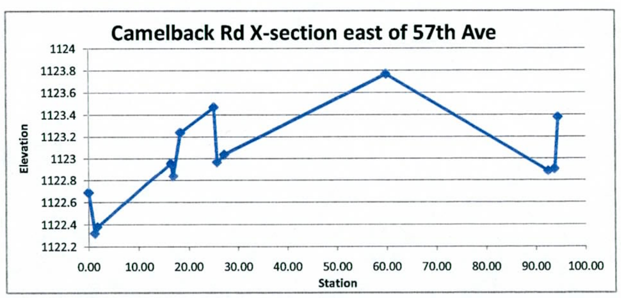
station	elevation
0	1131.50
0	1128.18
3.98	1128.06
4.74	1127.53
47.52	1127.43
48.34	1127.99
52.42	1128.07
52.42	1131.50

57th Ave Route R4A



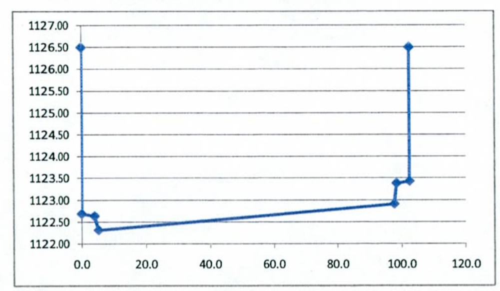
amelback Road -R4B1

Station		Elevation	Description
0	0.00	1122.69	BCR
1.21	1.21	1122.32	GUT
0.5	1.71	1122.38	EOA
14.71	16.42	1122.96	EOA
0.54	16.96	1122.84	GUT
1.42	18.38	1123.24	BCR
6.75	25.13	1123.47	BCV
0.6	25.73	1122.97	GUT
1.45	27.18	1123.04	EOA
32.75	59.93	1123.77	P
32.63	92.56	1122.89	EOA
1.26	93.82	1122.91	GUT
0.7	94.52	1123.38	BCV



Station	Elev
0.0	1126.50
0.0	1122.69
4.0	1122.64
5.2	1122.32
97.8	1122.91
98.5	1123.38
102.5	1123.43
102.5	1126.50

Camelback Road Route-R4B1



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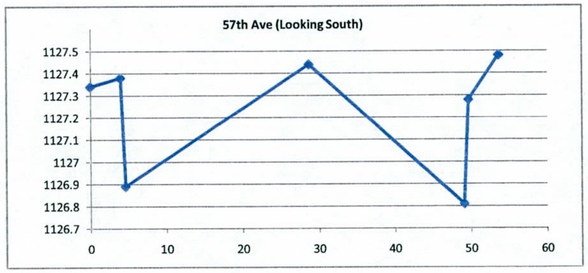
STREET ROUTING X-SECTION

Roadway X-section Data

Normalized 8 points X-section Data

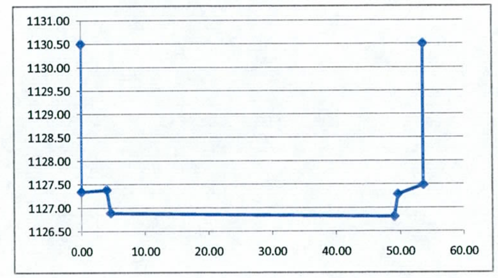
57th Ave -R4B2

Station		Elevation	Description
0	0	1127.34	EOS
3.97	3.97	1127.38	BCV
0.63	4.6	1126.89	GUT
22.77	28.67	1127.44	P
1.24	49.09	1126.81	GUT
0.59	49.68	1127.28	BCV
3.99	53.67	1127.48	EOS



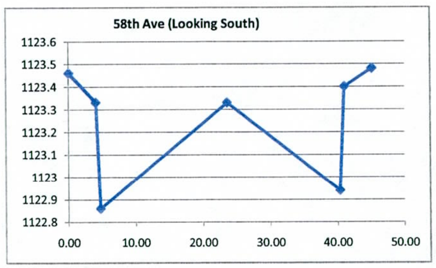
Station	Elev
0.00	1130.50
0.00	1127.34
3.97	1127.38
4.60	1126.89
49.09	1126.81
49.68	1127.28
53.67	1127.48
53.67	1130.50

57th Ave -R4B2



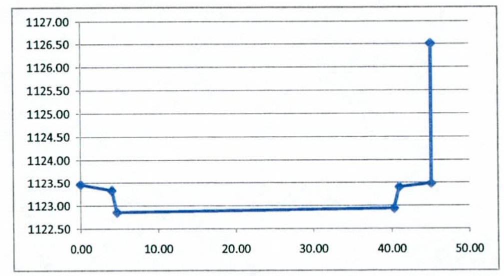
58th Ave -R5A

Station		Elevation	Description
0.00	0.00	1123.46	EOS
4.00	4.00	1123.33	BOC
0.68	4.69	1122.86	GUTT
17.53	23.58	1123.33	P
1.36	40.30	1122.94	GUTT
0.67	40.97	1123.4	BOC
4.08	45.05	1123.48	EOS



Station	Elev
0	1126.50
0.00	1123.46
4.00	1123.33
4.69	1122.86
40.30	1122.94
40.97	1123.40
45.05	1123.48
45.05	1126.50

58th Ave -R5A

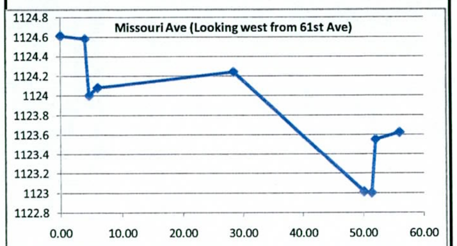


Street Routing X-section

Roadway X-section Data

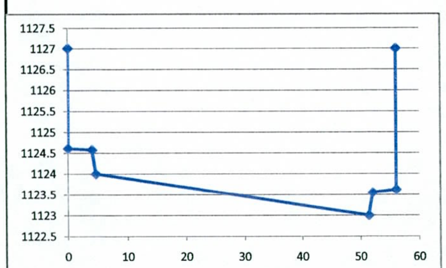
Missouri Ave-R8

Station		Elevation	Description
0	0.00	1124.61	
4.09	4.09	1124.58	
0.65	4.73	1124	
1.38	6.11	1124.08	
22.33	28.44	1124.24	
21.65	50.09	1123.01	
1.33	51.42	1123	
0.66	52.09	1123.55	
3.95	56.03	1123.62	



Normalized 8 points X-section Data
Revised X-sec (R8)

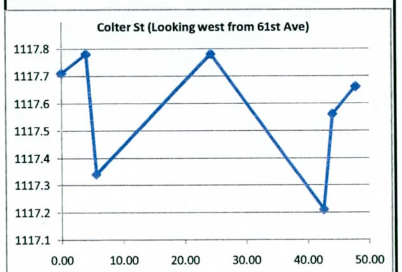
Station	Elev
0	1127
0.00	1124.61
4.09	1124.58
4.73	1124.00
51.42	1123.00
52.09	1123.55
56.03	1123.62
56.03	1127



Roadway X-section Data

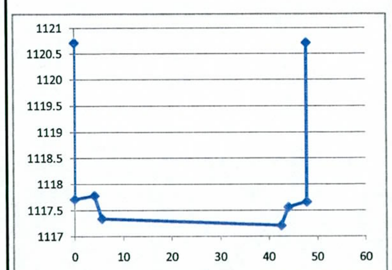
Colter St -R9B

Station		Elevation	Description
0.00	0.00	1117.71	EDGE OF SIDEWALK
4.02	4.02	1117.78	BACK OF CURB - ROLL
1.54	5.56	1117.34	GUTTER
18.15	24.29	1117.78	PAVEMENT SPOT
0.53	42.55	1117.21	GUTTER
1.49	44.04	1117.56	BACK OF CURB - ROLL
3.81	47.84	1117.66	EDGE OF SIDEWALK



Normalized 8 points X-section Data
Revised X-sec (R9B)

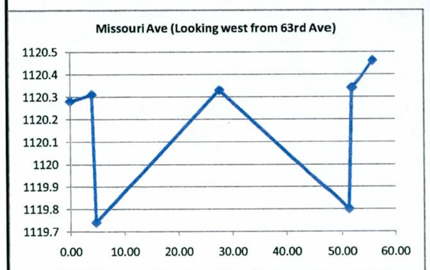
Station	Elev
0	1120.71
0.00	1117.71
4.02	1117.78
5.56	1117.34
42.55	1117.21
44.04	1117.56
47.84	1117.66
47.84	1120.71



Roadway X-section Data

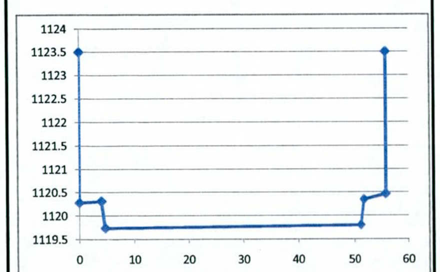
Missouri Ave-R11

Station		Elevation	Description
0.00	0.00	1120.28	
4.01	4.01	1120.31	
0.68	4.69	1119.74	
21.68	27.64	1120.33	
1.57	51.30	1119.8	
0.64	51.94	1120.34	
4.00	55.94	1120.46	



Normalized 8 points X-section Data
Revised X-sec (R11)

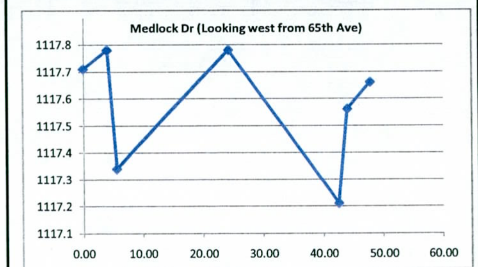
Station	Elev
0	1123.5
0.00	1120.28
4.01	1120.31
4.69	1119.74
51.30	1119.8
51.94	1120.34
55.94	1120.46
55.94	1123.5



Roadway X-section Data

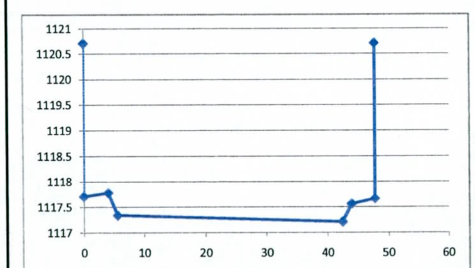
Missouri Ave-R12A

Station		Elevation	Description
0.00	0.00	1117.71	EDGE OF SIDEWALK
4.02	4.02	1117.78	BACK OF CURB - ROLL
1.54	5.56	1117.34	GUTTER
18.15	24.28	1117.78	PAVEMENT SPOT
0.53	42.55	1117.21	GUTTER
1.49	44.04	1117.56	BACK OF CURB - ROLL
3.81	47.85	1117.66	EDGE OF SIDEWALK



Normalized 8 points X-section Data
Revised X-sec (R12A)

Station	Elev
0	1120.71
0.00	1117.71
4.02	1117.78
5.56	1117.34
42.55	1117.21
44.04	1117.56
47.85	1117.66
47.84	1120.71



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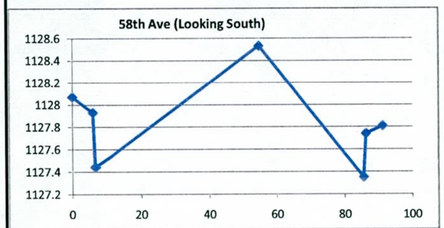
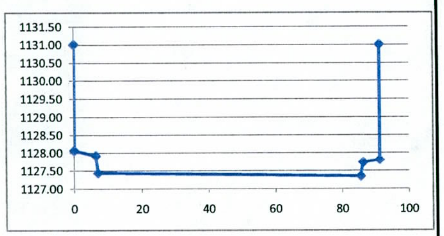
Street Routing X-section

59th Ave -R5C & R5D			
Station		Elevation	Description
0	0	1128.07	EDGE OF SIDEWALK
6	6	1127.93	BACK OF CURB (VERT) STD 2'
0.66	6.66	1127.44	GUTTER
46.79	54.74	1128.53	EDGE OF ASPHALT
1.34	85.55	1127.35	GUTTER
0.71	86.26	1127.74	BACK OF CURB (VERT) STD 2'
4.95	91.21	1127.81	EDGE OF SIDEWALK

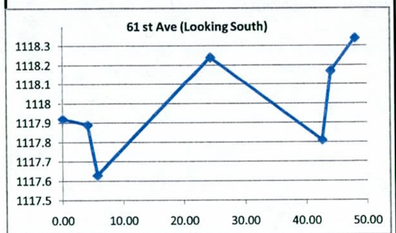


Revised X-sec (R5C & R5A3)

Station	Elev
0	1131.00
0	1128.07
6	1127.93
6.66	1127.44
85.55	1127.35
86.26	1127.74
91.21	1127.81
91.21	1131.00

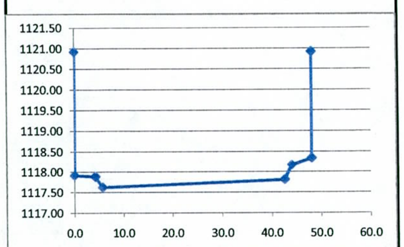


61st Ave -R7C			
Station		Elevation	Description
0.00	0.00	1117.92	EDGE OF SIDEWALK
4.16	4.16	1117.89	BACK OF CURB - ROLL
1.55	5.71	1117.63	GUTTER
18.18	24.38	1118.24	PAVEMENT SPOT
0.60	42.60	1117.81	GUTTER
1.47	44.04	1118.17	BACK OF CURB - ROLL
3.99	48.06	1118.34	EDGE OF SIDEWALK

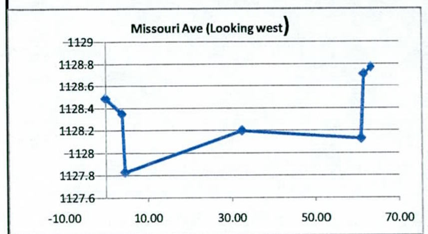


Revised X-sec (R7C)

Station	Elev
0.0	1120.92
0.0	1117.92
4.2	1117.89
5.7	1117.63
42.6	1117.81
44.0	1118.17
48.1	1118.34
48.1	1120.92

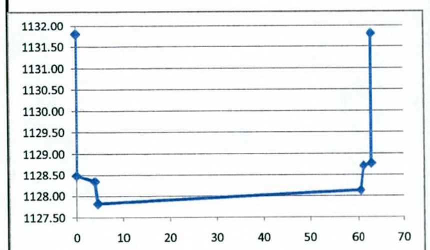


Missouri Ave -R6			
Station		Elevation	Description
0	0.00	1128.49	EDGE OF SIDEWALK
3.92	3.92	1128.35	BACK OF CURB (VERT) STD 2'
0.67	4.59	1127.83	GUTTER
26.28	32.48	1128.2	PAVEMENT SPOT
1.36	60.61	1128.13	GUTTER
0.71	61.32	1128.71	BACK OF CURB (VERT) STD 2'
4.03	63.35	1128.77	EDGE OF SIDEWALK

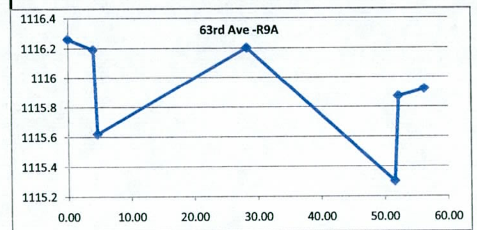


Revised X-sec (R6)

Station	Elev
0	1131.80
0.00	1128.49
3.92	1128.35
4.59	1127.83
60.61	1128.13
61.32	1128.71
63.35	1128.77
63.35	1131.80

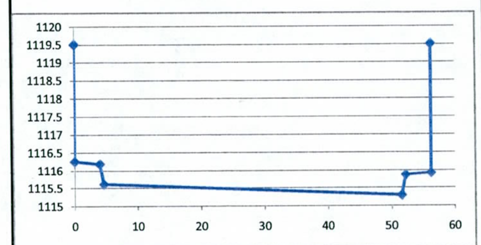


63rd Ave -R9A			
Station		Elevation	Description
0.00	0.00	1116.26	EDGE OF SIDEWALK
3.99	3.99	1116.19	BACK OF CURB (VERT) STD 2'
0.66	4.65	1115.62	GUTTER
22.35	28.31	1116.2	PAVEMENT SPOT
1.38	51.62	1115.3	GUTTER
0.63	52.25	1115.87	BACK OF CURB (VERT) STD 2'
4.02	56.27	1115.92	EDGE OF SIDEWALK



Revised X-sec (R9A)

Station	Elev
0	1119.5
0.00	1116.26
3.99	1116.19
4.65	1115.62
51.62	1115.3
52.25	1115.87
56.27	1115.92
56.27	1119.5



A.1.4 Flow Split Data

Half Street Capacity of Camelback Rd (West of 53rd Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	0.82	ft

Section Definitions

Station (ft)	Elevation (ft)
0+68	1129.67
0+80	1129.50
0+96	1128.91
0+97	1128.85
0+98	1129.40
1+03	1129.48

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+68, 1129.67)	(1+03, 1129.48)	0.016

Results

Discharge	23.15	ft^3/s
Elevation Range	1128.85 to 1129.67 ft	
Flow Area	11.00	ft^2
Wetted Perimeter	34.99	ft
Top Width	34.59	ft
Normal Depth	0.82	ft
Critical Depth	0.71	ft
Critical Slope	0.00577	ft/ft
Velocity	2.10	ft/s
Velocity Head	0.07	ft
Specific Energy	0.89	ft
Froude Number	0.66	

Half Street Capacity of Camelback Rd (West of 53rd Ave)

Results

Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.82	ft
Critical Depth	0.71	ft
Channel Slope	0.00240	ft/ft
Critical Slope	0.00577	ft/ft

Flow Split at 55th Ave & Camelback Rd

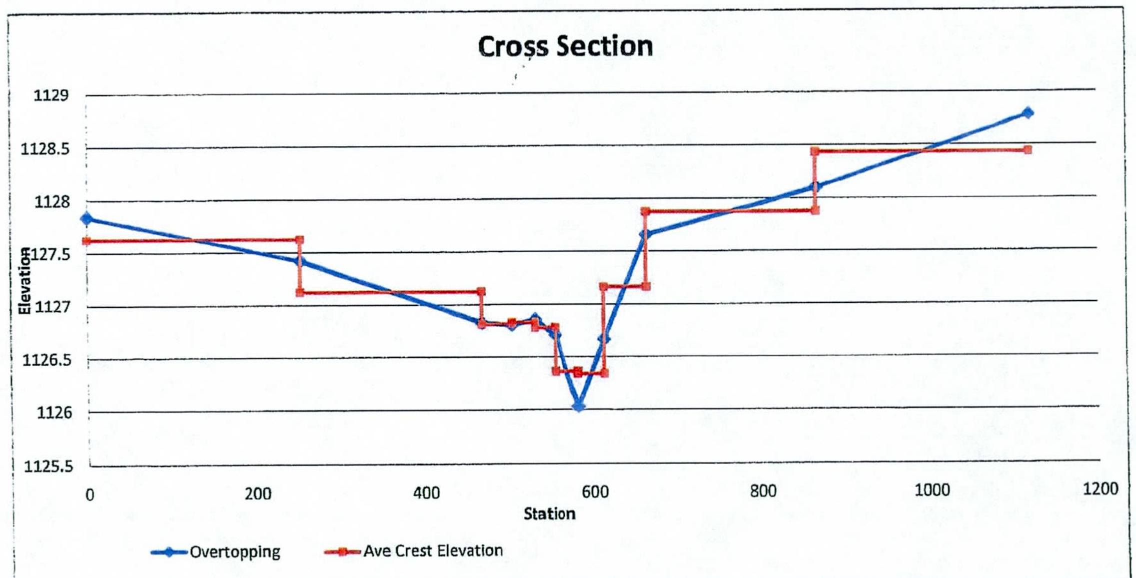
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1127.84	1127.42	254	1127.63	1126.7	0.0	0.00	1127	0.0	0.00	1127.2	0.0	0.00	1127.5	0.0	0.00
South	1127.42	1126.83	215	1127.13	1126.7	0.0	0.00	1127	0.0	0.00	1127.2	0.1	13.26	1127.5	0.4	148.29
South	1126.83	1126.81	36	1126.82	1126.7	0.0	0.00	1127	0.2	8.32	1127.2	0.4	25.51	1127.5	0.7	61.06
South	1126.81	1126.86	27	1126.84	1126.7	0.0	0.00	1127	0.2	5.35	1127.2	0.4	17.60	1127.5	0.7	43.27
South	1126.86	1126.71	23	1126.79	1126.7	0.0	0.00	1127	0.2	7.00	1127.2	0.4	18.78	1127.5	0.7	42.46
West	1126.71	1126.03	27	1126.37	1126.7	0.3	15.57	1127	0.6	41.06	1127.2	0.8	62.09	1127.5	1.1	98.63
West	1126.03	1126.67	31	1126.35	1126.7	0.4	19.42	1127	0.7	49.15	1127.2	0.9	73.49	1127.5	1.2	115.65
West	1126.67	1127.66	51	1127.17	1126.7	0.0	0.00	1127	0.0	0.00	1127.2	0.0	1.00	1127.5	0.3	29.67
West	1127.66	1128.1	203	1127.88	1126.7	0.0	0.00	1127	0.0	0.00	1127.2	0.0	0.00	1127.5	0.0	0.00
West	1128.1	1128.78	252	1128.44	1126.7	0.0	0.00	1127	0.0	0.00	1127.2	0.0	0.00	1127.5	0.0	0.00
						Totals:	34.98			110.87			211.73			539.04

Graph Computations:

Station	Elev
0	1127.84
253.6	1127.42
468.85	1126.83
505.15	1126.81
531.75	1126.86
555.16	1126.71
582.53	1126.03
613.79	1126.67
664.79	1127.66
867.58	1128.1
1119.8	1128.78

Weir Approximation

Station	Elev
0	1127.63
253.6	1127.63
253.6	1127.13
468.85	1127.13
468.85	1126.82
505.15	1126.82
505.15	1126.84
531.75	1126.84
531.75	1126.79
555.16	1126.79
555.16	1126.37
582.53	1126.37
582.53	1126.35
613.79	1126.35
613.79	1127.17
664.79	1127.17
664.79	1127.88
867.58	1127.88
867.58	1128.44
1119.8	1128.44



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	0.00	0%	Q south	20.67	19%	Q south	75.15	35%	Q south	295.09	55%
Q west	34.98	100%	Q west	90.20	81%	Q west	136.58	65%	Q west	243.95	45%

inflow at Intersection	34.98	110.87	211.73	539.04
Outflow (South)	0.00	20.67	75.15	295.09
Outflow (West)	34.98	90.20	136.58	243.95

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1128.78
252'
1128.81
55TH AVENUE
203'
1127.66
51'
1126.67
34'
1126.03
27'
1126.71
23'
1126.81
36'
1126.83
1126.86
27'
CAMELBACK ROAD
215'
1127.42
254'
1127.84

Half Street Capacity Camelback Rd (West of 55th Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	0.90	ft

Section Definitions

Station (ft)	Elevation (ft)
0+63	1126.69
0+74	1126.62
0+85	1126.41
0+97	1125.78
0+98	1125.91
0+99	1126.43
1+03	1126.48

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+63, 1126.69)	(1+03, 1126.48)	0.016

Results

Discharge	22.46	ft^3/s
Elevation Range	1125.78 to 1126.69 ft	
Flow Area	11.28	ft^2
Wetted Perimeter	38.98	ft
Top Width	38.56	ft
Normal Depth	0.90	ft
Critical Depth	0.77	ft
Critical Slope	0.00570	ft/ft
Velocity	1.99	ft/s
Velocity Head	0.06	ft
Specific Energy	0.97	ft

Half Street Capacity Camelback Rd (West of 55th Ave)

Results

Froude Number	0.65	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.90	ft
Critical Depth	0.77	ft
Channel Slope	0.00240	ft/ft
Critical Slope	0.00570	ft/ft

Flow Split at 57th Ave & Camelback Rd

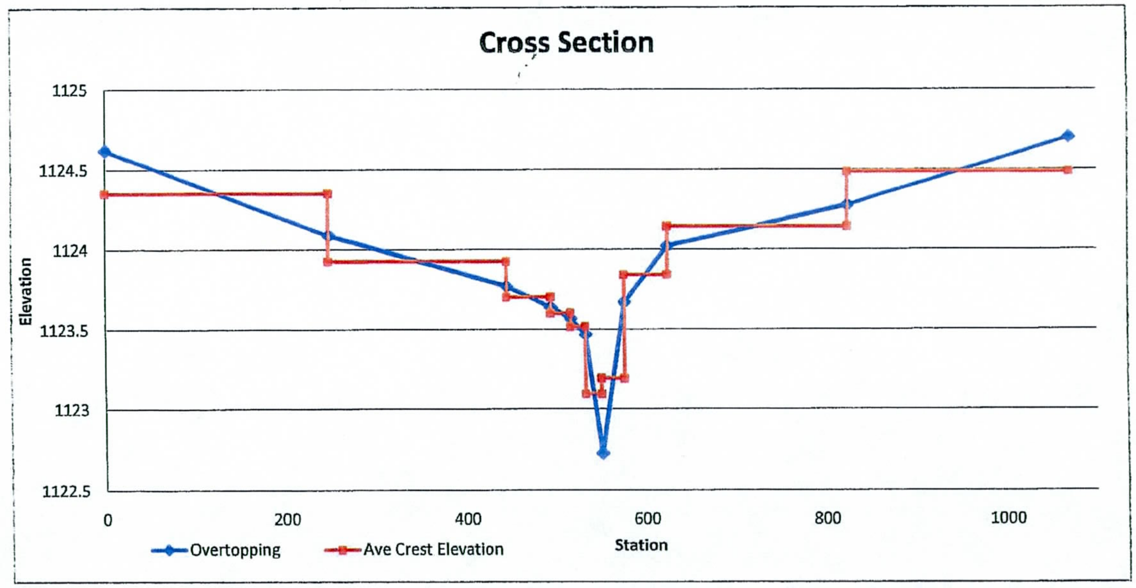
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1124.62	1124.09	249	1124.36	1123.7	0.0	0.00	1124	0.0	0.00	1124.1	0.0	0.00	1124.3	0.0	0.00
South	1124.09	1123.77	197	1123.93	1123.7	0.0	0.00	1124	0.1	10.97	1124.1	0.2	41.52	1124.3	0.4	133.33
South	1123.77	1123.64	48	1123.71	1123.7	0.0	0.00	1124	0.3	23.00	1124.1	0.4	35.63	1124.3	0.6	65.87
South	1123.64	1123.57	23	1123.61	1123.7	0.1	2.03	1124	0.4	17.21	1124.1	0.5	24.15	1124.3	0.7	40.17
West	1123.57	1123.47	17	1123.52	1123.7	0.2	3.86	1124	0.5	16.82	1124.1	0.6	22.34	1124.3	0.8	34.84
West	1123.47	1122.73	18	1123.10	1123.7	0.6	24.87	1124	0.9	45.70	1124.1	1.0	53.52	1124.3	1.2	70.35
West	1122.73	1123.67	26	1123.20	1123.7	0.5	27.12	1124	0.8	54.89	1124.1	0.9	65.50	1124.3	1.1	88.50
West	1123.67	1124.02	48	1123.85	1123.7	0.0	0.00	1124	0.2	8.75	1124.1	0.3	18.47	1124.3	0.5	44.03
West	1124.02	1124.28	200	1124.15	1123.7	0.0	0.00	1124	0.0	0.00	1124.1	0.0	0.00	1124.3	0.1	34.85
West	1124.28	1124.7	245	1124.49	1123.7	0.0	0.00	1124	0.0	0.00	1124.1	0.0	0.00	1124.3	0.0	0.00
						Totals:	57.89			177.34			261.13			511.94

Graph Computations:

Station	Elev
0	1124.62
248.6	1124.09
446.07	1123.77
493.91	1123.64
517.02	1123.57
533.88	1123.47
551.72	1122.73
577.29	1123.67
625.11	1124.02
825.05	1124.28
1070.35	1124.7

Weir Approximation

Station	Elev
0	1124.355
248.6	1124.355
248.6	1123.93
446.07	1123.93
446.07	1123.71
493.91	1123.71
493.91	1123.61
517.02	1123.61
517.02	1123.52
533.88	1123.52
533.88	1123.10
551.72	1123.10
551.72	1123.20
577.29	1123.20
577.29	1123.85
625.11	1123.85
625.11	1124.15
825.05	1124.15
825.05	1124.49
1070.35	1124.49



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	2.03	4%	Q south	51.18	29%	Q south	101.30	39%	Q south	239.37	47%
Q west	55.86	96%	Q west	126.16	71%	Q west	159.83	61%	Q west	272.57	53%

inflow at Intersection	57.89	177.34	261.13	511.94
Outflow (South)	2.03	51.18	101.30	239.37
Outflow (West)	55.86	126.16	159.83	272.57

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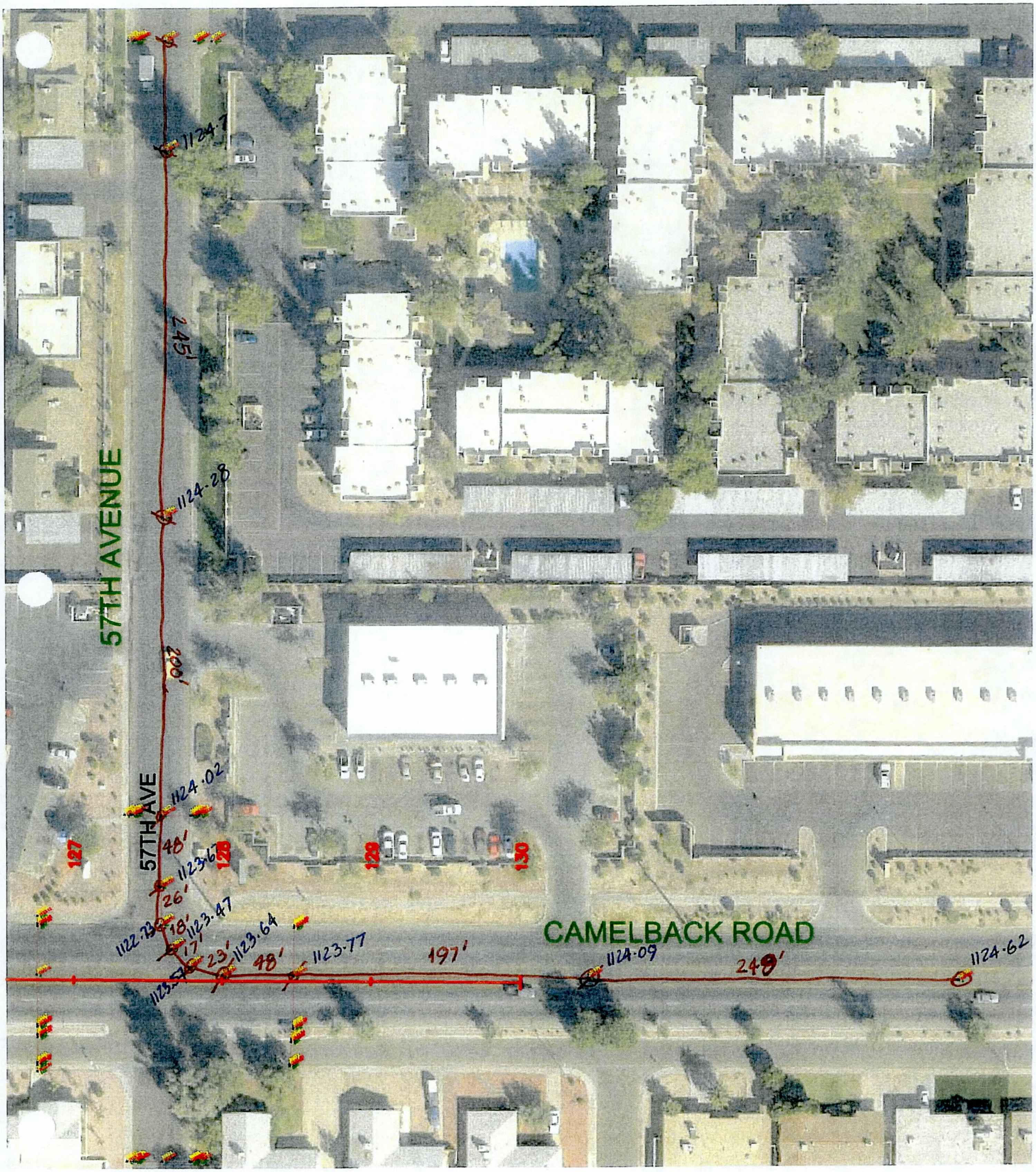


57TH AVENUE
57TH AVE
CAMELBACK ROAD
127
128
129
130
1124.7
245'
1124.28
200'
1124.02
48'
1123.67
26'
18'
1123.47
17'
23'
1123.64
48'
1123.77
197'
1124.09
248'
1124.62

Half Street Capacity Camelback Rd (West of 57th Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	0.93	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+64	1123.46
0+97	1122.62
0+98	1122.54
0+99	1123.10
1+04	1123.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+64, 1123.46)	(1+04, 1123.13)	0.016

Results

Discharge	45.43	ft^3/s
Elevation Range	1122.54 to 1123.46 ft	
Flow Area	17.43	ft^2
Wetted Perimeter	40.18	ft
Top Width	39.60	ft
Normal Depth	0.93	ft
Critical Depth	0.82	ft
Critical Slope	0.00529	ft/ft
Velocity	2.61	ft/s
Velocity Head	0.11	ft
Specific Energy	1.04	ft
Froude Number	0.69	
Flow Type	Subcritical	

Half Street Capacity Camelback Rd (West of 57th Ave)

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.93	ft
Critical Depth	0.82	ft
Channel Slope	0.00240	ft/ft
Critical Slope	0.00529	ft/ft

Flow Split at 57th Ave & Colter Street

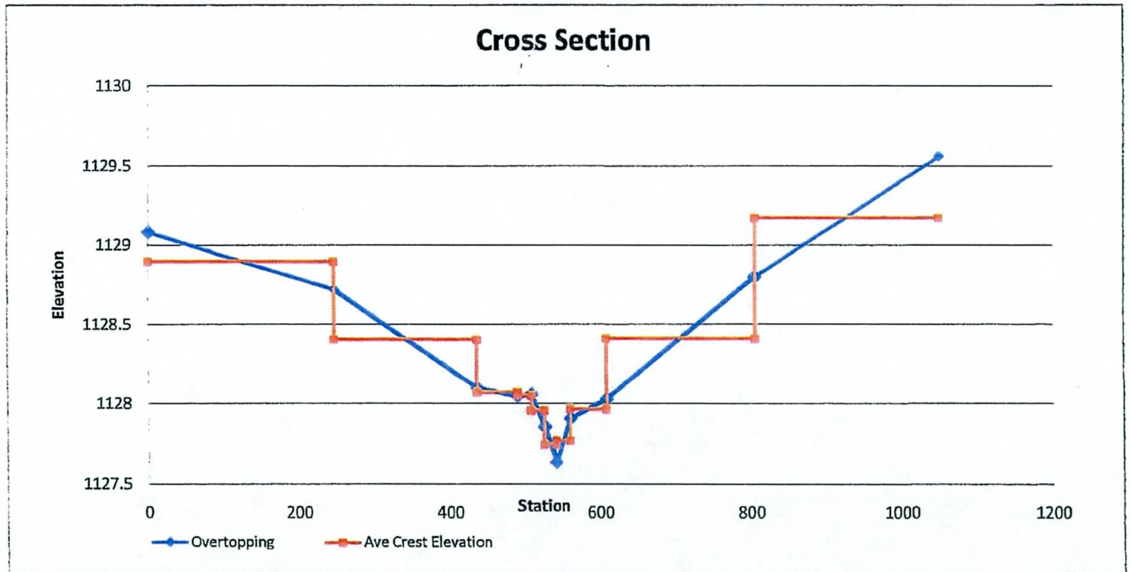
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1129.08	1128.72	247	1128.90	1128.2	0.0	0.00	1128.3	0.0	0.00	1128.4	0.0	0.00	1128.6	0.0	0.00
South	1128.72	1128.1	190	1128.41	1128.2	0.0	0.00	1128.3	0.0	0.00	1128.4	0.0	0.00	1128.6	0.2	47.08
South	1128.1	1128.05	54	1128.08	1128.2	0.1	7.14	1128.3	0.2	17.24	1128.4	0.3	29.94	1128.6	0.5	61.46
South	1128.05	1128.06	17	1128.06	1128.2	0.1	2.83	1128.3	0.2	6.22	1128.4	0.3	10.39	1128.6	0.5	20.63
West	1128.06	1127.86	18	1127.96	1128.2	0.2	6.26	1128.3	0.3	10.55	1128.4	0.4	15.53	1128.6	0.6	27.25
West	1127.86	1127.64	15	1127.75	1128.2	0.5	13.90	1128.3	0.5	18.78	1128.4	0.7	24.13	1128.6	0.8	36.09
West	1127.64	1127.91	20	1127.78	1128.2	0.4	16.83	1128.3	0.5	23.11	1128.4	0.6	30.02	1128.6	0.8	45.52
West	1127.91	1128.03	48	1127.97	1128.2	0.2	15.99	1128.3	0.3	27.47	1128.4	0.4	40.87	1128.6	0.6	72.47
West	1128.03	1128.8	197	1128.42	1128.2	0.0	0.00	1128.3	0.0	0.00	1128.4	0.0	0.00	1128.6	0.2	47.05
West	1128.8	1129.56	244	1129.18	1128.2	0.0	0.00	1128.3	0.0	0.00	1128.4	0.0	0.00	1128.6	0.0	0.00
						Totals:	**62.95**			**103.38**			**150.87**			**357.56**

Graph Computations:

Station	Elev
0	1129.08
246.83	1128.72
436.33	1128.1
490.19	1128.05
507.28	1128.06
525.02	1127.86
540.37	1127.64
560.62	1127.91
608.93	1128.03
806.04	1128.8
1050.22	1129.56

Weir Approximation

Station	Elev
0	1128.9
246.83	1128.9
246.83	1128.41
436.33	1128.41
436.33	1128.08
490.19	1128.08
490.19	1128.06
507.28	1128.06
507.28	1127.96
525.02	1127.96
525.02	1127.75
540.37	1127.75
540.37	1127.78
560.62	1127.78
560.62	1127.97
608.93	1127.97
608.93	1128.42
806.04	1128.42
806.04	1129.18
1050.22	1129.18



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	9.97	16%	Q south	23.46	23%	Q south	40.33	27%	Q south	129.18	36%
Q west	52.98	84%	Q west	79.92	77%	Q west	110.55	73%	Q west	228.38	64%

inflow at Intersection	62.95	103.38	150.87	357.56
Outflow (South)	9.97	23.46	40.33	129.18
Outflow (West)	52.98	79.92	110.55	228.38

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57TH AVENUE
COLTER ST
1129.56
244'
1128.8
197'
1128.03
48'
1127.91
20'
15'
1127.64
18'
1127.86
1128.06
17'
1128.05
54'
1128.1
190'
1128.72
247'
1129.08

Flow Split Table at 58th Ave & Colter Street

WSE	Discharge (cfs)		Total Q
	W Colter St	S 58th Ave	
1125.3	0	0	0
1125.4	0.1	0	0
1125.5	3.76	0.18	4
1125.6	13.12	1.15	14
1125.7	26.55	3.96	31
1125.8	40.82	9.36	50
1125.9	58.23	18.09	76
1126	82.53	29.9	112
1126.1	109.99	48.5	158
1126.2	140.38	70.42	211
1126.3	173.54	95.36	269
1126.4	209.31	123.12	332

Flow Split at 58th Ave & Colter St

Inflow at Intersection	14.27		30.51		76.32		158.49		269.00		332.00	
Outflow (South)	1.2	8%	3.96	13%	18.09	24%	48.50	31%	95.36	35%	123	37%
Outflow (West)	13.1	92%	26.55	87%	58.23	76%	109.99	69%	173.64	65%	209.00	63%

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Flow Split for 58th Ave (South Of Colter St)

Input Data

Water Surface Elevation (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
1125.30					
1125.40	0.00	0.33	0.01	0.63	0.61
1125.50	0.18	0.76	0.23	4.47	4.37
1125.60	1.15	1.05	1.10	13.07	12.90
1125.70	3.96	1.41	2.81	21.67	21.43
1125.80	9.36	1.74	5.38	30.28	29.96
1125.90	18.09	2.06	8.79	37.84	37.47
1126.00	29.90	2.31	12.94	44.46	43.99
1126.10	48.50	2.80	17.34	44.66	43.99
1126.20	70.42	3.24	21.74	44.86	43.99
1126.30	95.36	3.65	26.14	45.06	43.99
1126.40	123.12	4.03	30.54	45.26	43.99

Flow Split for 58th Ave (South Of Colter St)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00360	ft/ft
Normal Depth	3.64	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	1130.00
0+00	1125.97
0+04	1125.92
0+05	1125.36
0+06	1125.50
0+22	1125.87
0+38	1125.46
0+39	1125.39
0+40	1125.87
0+44	1125.95
0+44	1130.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1130.00)	(0+05, 1125.36)	0.020
(0+05, 1125.36)	(0+39, 1125.39)	0.016
(0+39, 1125.39)	(0+44, 1130.00)	0.020

Water Surface Elevation (ft)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
1125.20					

Flow Split for W Colter street (West of 58th Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00280	ft/ft
Normal Depth	3.72	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00	1130.00
0+00	1125.80
0+04	1125.73
0+05	1125.28
0+06	1125.41
0+46	1125.42
0+47	1125.30
0+48	1125.80
0+52	1125.90
0+52	1130.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1130.00)	(0+05, 1125.28)	0.020
(0+05, 1125.28)	(0+47, 1125.30)	0.016
(0+47, 1125.30)	(0+52, 1130.00)	0.020

Water Surface Elevation (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
1125.00					
1125.10					

Flow Split for W Colter street (West of 58th Ave)

Input Data

Water Surface Elevation (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
1125.20					
1125.30	0.00	0.21	0.00	0.23	0.23
1125.40	0.10	0.67	0.15	2.71	2.63
1125.50	3.76	0.97	3.86	43.51	43.36
1125.60	13.12	1.60	8.21	43.85	43.64
1125.70	26.55	2.11	12.59	44.20	43.92
1125.80	40.82	2.38	17.13	48.39	48.07
1125.90	58.23	2.63	22.14	52.49	52.07
1126.00	82.53	3.02	27.35	52.69	52.07
1126.10	109.99	3.38	32.55	52.89	52.07
1126.20	140.38	3.72	37.76	53.09	52.07
1126.30	173.54	4.04	42.97	53.29	52.07
1126.40	209.31	4.34	48.17	53.49	52.07

Flow Split Table at 55th Ave & Missouri Ave

North half street Capacity of Missouri Ave	2.51	cfs
South half Street Capacity of Missouri Ave	12.85	cfs
Total Capacity of Missoure Ave	15.36	cfs

Flow Split at 55th Ave & Missouri Ave

Inflow at Intersection	5.00		16.00		100.00		200.00		300.00		500.00	
Outflow (South)	0.0	0%	0	0%	84.00	84%	184.00	92%	284.00	95%	484.00	97%
Outflow (West)	5.0	100%	16.00	100%	16.00	16%	16.00	8%	16.00	5%	16.00	3%

Worksheet for South Half Missouri Ave (east of 55th Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00220	ft/ft
Normal Depth	0.63	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	1134.27
0+04	1134.13
0+05	1133.64
0+06	1133.73
0+31	1134.30

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1134.27)	(0+05, 1133.64)	0.020
(0+05, 1133.64)	(0+31, 1134.30)	0.016

Results

Discharge	12.85	ft^3/s
Elevation Range	1133.64 to 1134.30 ft	
Flow Area	7.63	ft^2
Wetted Perimeter	29.72	ft
Top Width	29.55	ft
Normal Depth	0.63	ft
Critical Depth	0.52	ft
Critical Slope	0.00679	ft/ft
Velocity	1.68	ft/s
Velocity Head	0.04	ft
Specific Energy	0.67	ft
Froude Number	0.58	

Cross Section for South Half Missouri Ave (east of 55th Ave)

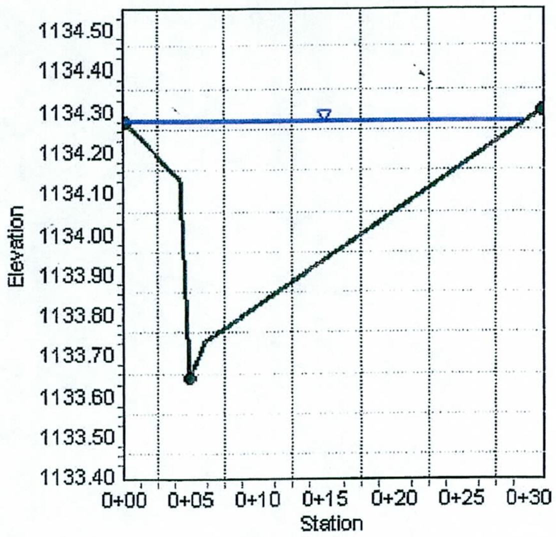
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00220	ft/ft
Normal Depth	0.63	ft
Discharge	12.85	ft³/s

Cross Section Image



Worksheet for North Half Missouri Ave (east of 55th Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00220	ft/ft
Normal Depth	0.28	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+31	1134.30
0+57	1134.12
0+59	1134.02
0+59	1134.52
0+64	1134.53

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+31, 1134.30)	(0+59, 1134.02)	0.016
(0+59, 1134.02)	(0+64, 1134.53)	0.020

Results

Discharge	2.51	ft³/s
Elevation Range	1134.02 to 1134.53 ft	
Flow Area	2.75	ft²
Wetted Perimeter	28.36	ft
Top Width	28.27	ft
Normal Depth	0.28	ft
Critical Depth	0.23	ft
Critical Slope	0.00897	ft/ft
Velocity	0.91	ft/s
Velocity Head	0.01	ft
Specific Energy	0.29	ft
Froude Number	0.52	

Cross Section for North Half Missouri Ave (east of 55th Ave)

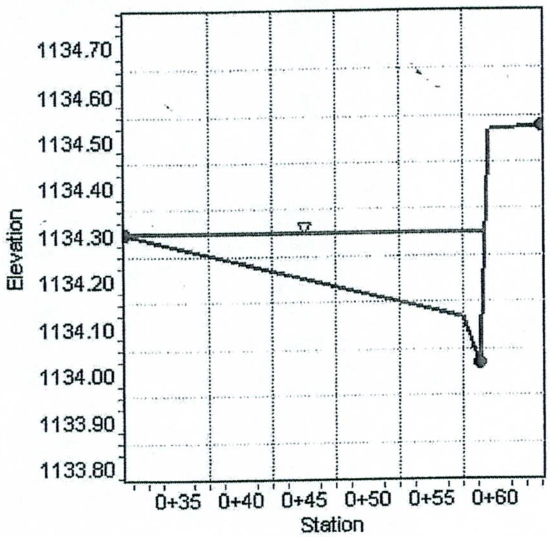
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00220	ft/ft
Normal Depth	0.28	ft
Discharge	2.51	ft^3/s

Cross Section Image



Flow Split Table at 57th Ave & Missouri Ave

North half street Capacity of Missouri Ave	33.95	cfs
South half Street Capacity of Missouri Ave	7.94	cfs
Total Capacity of Missoure Ave	41.89	cfs

Flow Split at 57th Ave & Missouri Ave

Inflow at Intersection	25.00		42.00		50.00		100.00		200.00		350.00	
Outflow (South)	0.0	0%	0.00	0%	8.00	16%	58.00	58%	158.00	79%	308.00	88%
Outflow (West)	25.0	100%	42.00	100%	42.00	84%	42.00	42%	42.00	21%	42.00	12%

Worksheet for South Half Missouri Ave (east of 57th Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00280	ft/ft
Normal Depth	0.62	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00	1128.30
0+04	1128.23
0+05	1127.68
0+06	1127.85
0+32	1128.56

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1128.30)	(0+05, 1127.68)	0.020
(0+05, 1127.68)	(0+32, 1128.56)	0.016

Results

Discharge	7.94	ft³/s
Elevation Range	1127.68 to 1128.56 ft	
Flow Area	4.83	ft²
Wetted Perimeter	23.00	ft
Top Width	22.78	ft
Normal Depth	0.62	ft
Critical Depth	0.53	ft
Critical Slope	0.00723	ft/ft
Velocity	1.64	ft/s
Velocity Head	0.04	ft
Specific Energy	0.66	ft
Froude Number	0.63	

Cross Section for South Half Missouri Ave (east of 57th Ave)

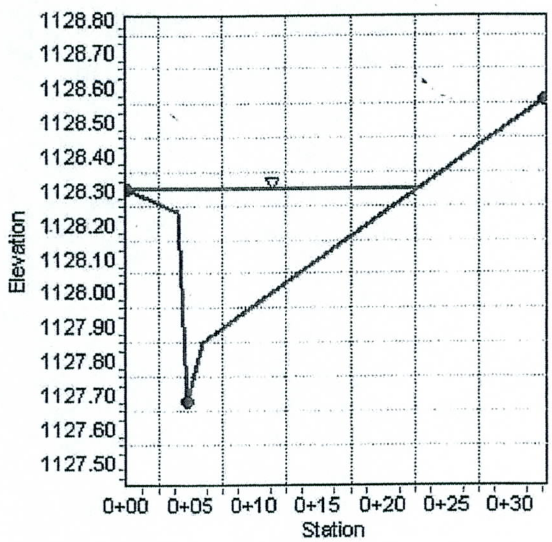
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00280	ft/ft
Normal Depth	0.62	ft
Discharge	7.94	ft^3/s

Cross Section Image



Worksheet for North Half Missouri Ave (east of 57th Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00280	ft/ft
Normal Depth	0.68	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+32	1128.56
0+71	1127.88
0+72	1127.93
0+73	1128.34
0+77	1128.42

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+32, 1128.56)	(0+72, 1127.93)	0.016
(0+72, 1127.93)	(0+77, 1128.42)	0.020

Results

Discharge	33.95	ft^3/s
Elevation Range	1127.88 to 1128.56 ft	
Flow Area	14.82	ft^2
Wetted Perimeter	44.48	ft
Top Width	44.23	ft
Normal Depth	0.68	ft
Critical Depth	0.59	ft
Critical Slope	0.00606	ft/ft
Velocity	2.29	ft/s
Velocity Head	0.08	ft
Specific Energy	0.76	ft
Froude Number	0.70	

Cross Section for North Half Missouri Ave (east of 57th Ave)

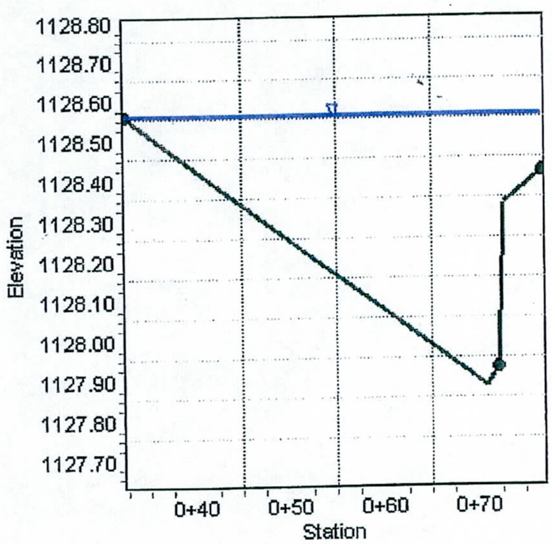
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00280	ft/ft
Normal Depth	0.68	ft
Discharge	33.95	ft³/s

Cross Section Image



Flow Split at 59th Ave & Missouri Ave

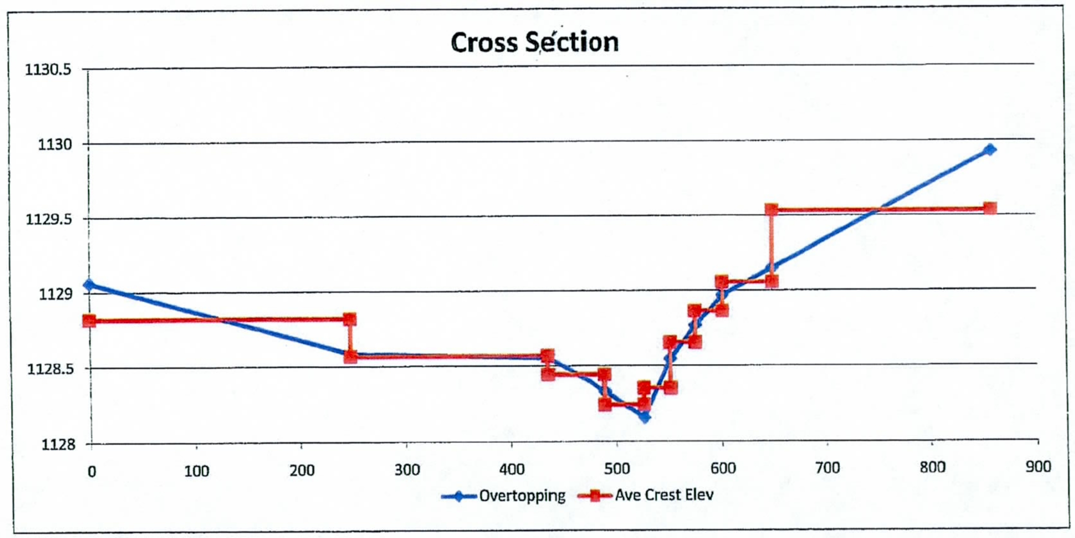
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1129.06	1128.59	248	1128.83	1128.5	0.0	0.00	1128.8	0.0	0.00	1129.1	0.3	107.29	1129.4	0.6	324.40
South	1128.59	1128.56	188	1128.58	1128.5	0.0	0.00	1128.8	0.2	60.19	1129.1	0.5	214.54	1129.4	0.8	422.63
South	1128.56	1128.33	54	1128.45	1128.5	0.1	2.09	1128.8	0.4	34.27	1129.1	0.7	85.88	1129.4	1.0	151.19
South	1128.33	1128.16	37	1128.25	1128.5	0.3	14.29	1128.8	0.6	45.89	1129.1	0.9	87.76	1129.4	1.2	137.78
South	1128.16	1128.55	25	1128.36	1128.5	0.1	4.14	1128.8	0.4	22.26	1129.1	0.7	48.23	1129.4	1.0	80.12
West	1128.55	1128.77	24	1128.66	1128.5	0.0	0.00	1128.8	0.1	3.77	1129.1	0.4	21.01	1129.4	0.7	45.83
West	1128.77	1128.97	26	1128.87	1128.5	0.0	0.00	1128.8	0.0	0.00	1129.1	0.2	8.60	1129.4	0.5	30.10
West	1128.97	1129.15	48	1129.06	1128.5	0.0	0.00	1128.8	0.0	0.00	1129.1	0.0	1.15	1129.4	0.3	28.55
West	1129.15	1129.93	208	1129.54	1128.5	0.0	0.00	1128.8	0.0	0.00	1129.1	0.0	0.00	1129.4	0.0	0.00
West	1129.93	1130.88	258	1130.41	1128.5	0.0	0.00	1128.8	0.0	0.00	1129.1	0.0	0.00	1129.4	0.0	0.00
						Totals:	20.52			166.39			574.47			1220.59

Graph Computations:

Station	Elev
0	1129.06
248	1128.59
436	1128.56
490	1128.33
527	1128.16
552	1128.55
576	1128.77
602	1128.97
650	1129.15
858	1129.93
1116	1130.88

Weir Approximation

Station	Elev
0	1128.825
248	1128.825
248	1128.58
436	1128.58
436	1128.45
490	1128.45
490	1128.25
527	1128.25
527	1128.36
552	1128.36
552	1128.66
576	1128.66
576	1128.87
602	1128.87
602	1129.06
650	1129.06
650	1129.54
858	1129.54
858	1130.41
1116	1130.41



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	20.52	100%	Q south	162.62	98%	Q south	543.70	95%	Q south	1116.12	91%
Q west	0.00	0%	Q west	3.77	2%	Q west	30.77	5%	Q west	104.48	9%

inflow at Intersection	20.52	166.39	574.47	1220.59
Outflow (South)	20.52	162.62	543.70	1116.12
Outflow (West)	0.00	3.77	30.77	104.48

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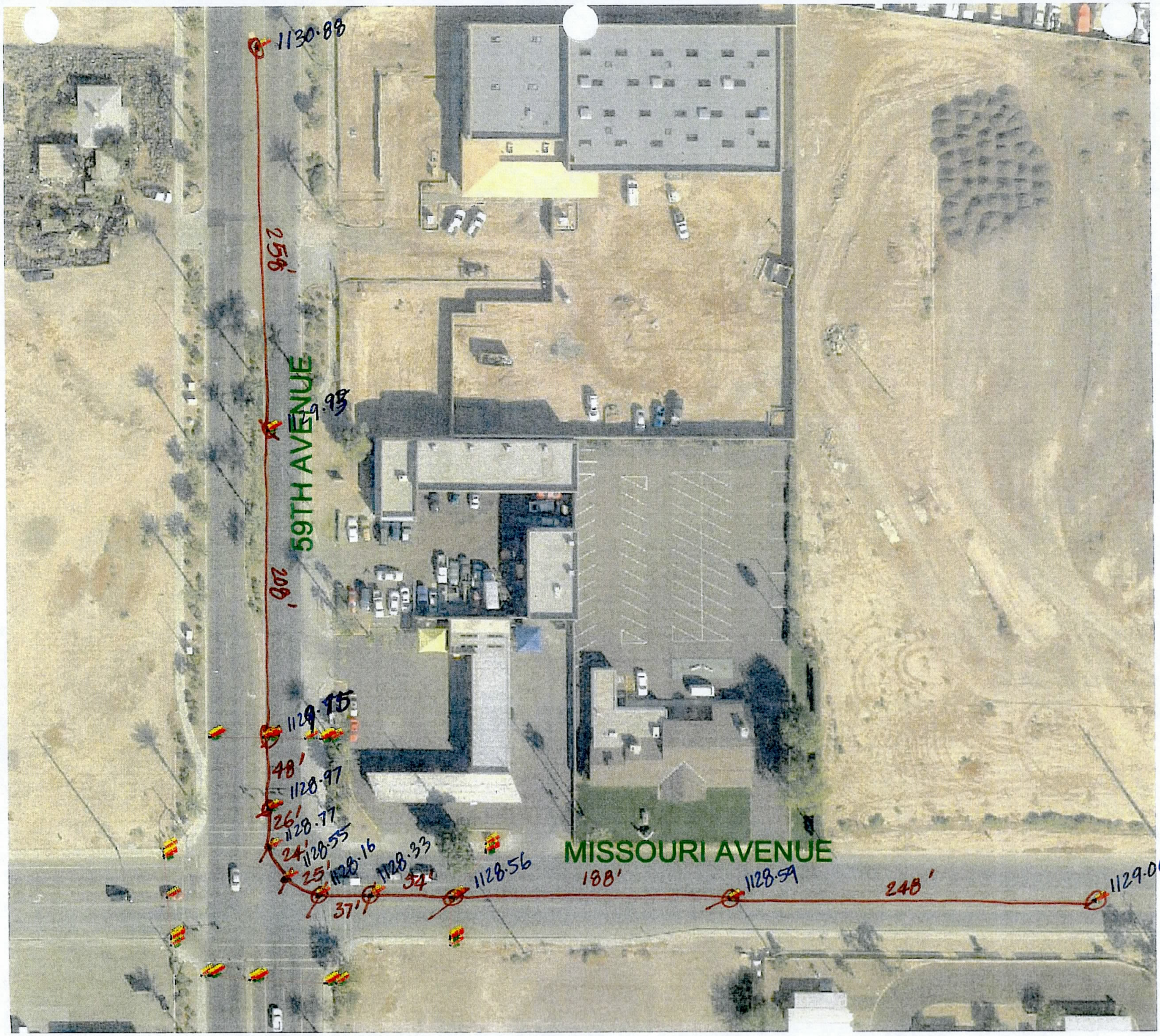


59TH AVENUE
MISSOURI AVENUE
1130.88
1128.97
48'
26'
1128.77
24'
1128.55
25'
1128.16
37'
1128.33
34'
1128.56
188'
1128.59
248'
1129.06

Flow Split at 61st Ave & Missouri Ave

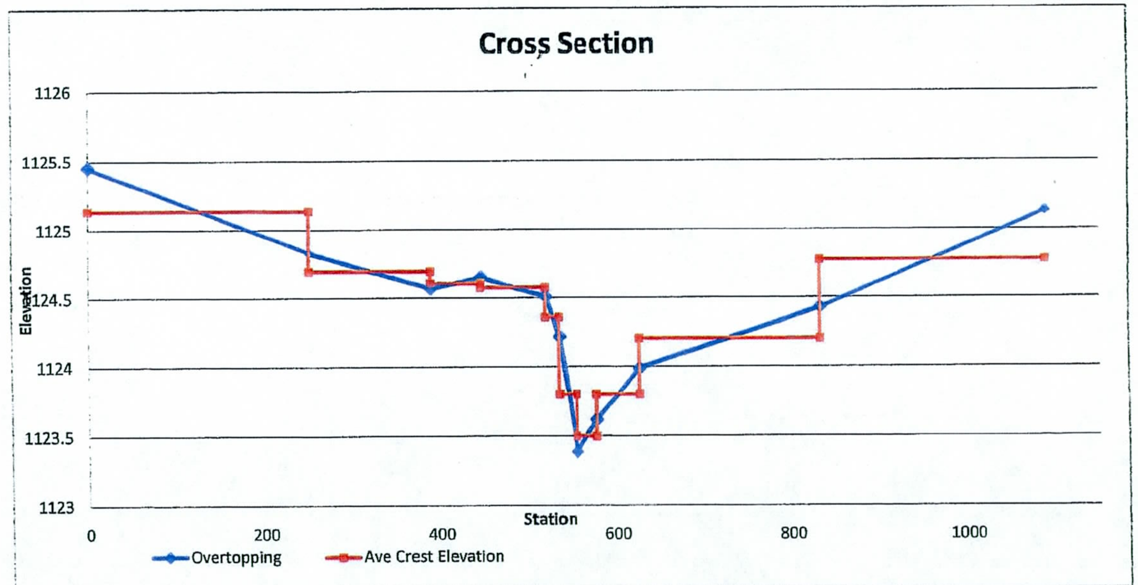
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1125.45	1124.83	252	1125.14	1123.9	0.0	0.00	1124.2	0.0	0.00	1124.5	0.0	0.00	1124.8	0.0	0.00
South	1124.83	1124.57	138	1124.70	1123.9	0.0	0.00	1124.2	0.0	0.00	1124.5	0.0	0.00	1124.8	0.1	13.11
South	1124.57	1124.65	57	1124.61	1123.9	0.0	0.00	1124.2	0.0	0.00	1124.5	0.0	0.00	1124.8	0.2	14.09
South	1124.65	1124.51	72	1124.58	1123.9	0.0	0.00	1124.2	0.0	0.00	1124.5	0.0	0.00	1124.8	0.2	22.41
South	1124.51	1124.22	16	1124.37	1123.9	0.0	0.00	1124.2	0.0	0.00	1124.5	0.1	2.39	1124.8	0.4	13.81
West	1124.22	1123.39	19	1123.81	1123.9	0.1	1.70	1124.2	0.4	14.37	1124.5	0.7	33.55	1124.8	1.0	57.47
West	1123.39	1123.62	24	1123.51	1123.9	0.4	17.55	1124.2	0.7	40.95	1124.5	1.0	70.15	1124.8	1.3	104.16
West	1123.62	1123.99	49	1123.81	1123.9	0.1	4.33	1124.2	0.4	36.72	1124.5	0.7	85.69	1124.8	1.0	146.79
West	1123.99	1124.43	206	1124.21	1123.9	0.0	0.00	1124.2	0.0	0.00	1124.5	0.3	96.66	1124.8	0.6	280.49
West	1124.43	1125.13	256	1124.78	1123.9	0.0	0.00	1124.2	0.0	0.00	1124.5	0.0	0.00	1124.8	0.0	2.17
						Totals:	23.57			92.04			288.44			654.50

Graph Computations:

Station	Elev
0	1125.45
252	1124.83
390.23	1124.57
446.95	1124.65
519.33	1124.51
535.37	1124.22
554.67	1123.39
578.23	1123.62
627.53	1123.99
833.84	1124.43
1089.84	1125.13

Weir Approximation

Station	Elev
0	1125.14
252	1125.14
252	1124.70
390.23	1124.70
390.23	1124.61
446.95	1124.61
446.95	1124.58
519.33	1124.58
519.33	1124.37
535.37	1124.37
535.37	1123.81
554.67	1123.81
554.67	1123.51
578.23	1123.51
578.23	1123.81
627.53	1123.81
627.53	1124.21
833.84	1124.21
833.84	1124.78
1089.84	1124.78



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	0.00	0%	Q south	0.00	0%	Q south	2.39	1%	Q south	63.42	10%
Q west	23.57	100%	Q west	92.04	100%	Q west	286.05	99%	Q west	591.08	90%

inflow at Intersection	23.57	92.04	288.44	654.50
Outflow (South)	0.00	0.00	2.39	63.42
Outflow (West)	23.57	92.04	286.05	591.08

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1125.13
256'
61ST AVENUE
206'
1123.99
1123.62
49'
1124.22
1123.39
16'
72'
1124.65
57'
MISSOURI AVENUE
138'
1124.83
252'
1125.45
1124.51

Flow Split at 61st Ave & Oregon Ave

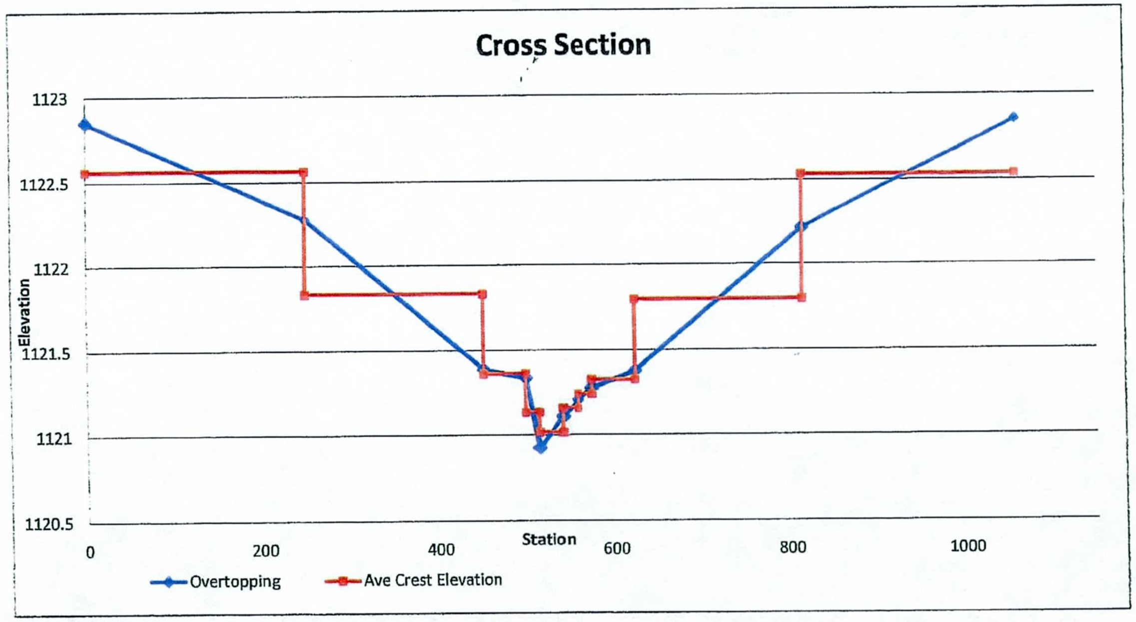
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1122.85	1122.28	249	1122.57	1121.4	0.0	0.00	1121.6	0.0	0.00	1121.8	0.0	0.00	1122	0.0	0.00
South	1122.28	1121.39	203	1121.84	1121.4	0.0	0.00	1121.6	0.0	0.00	1121.8	0.0	0.00	1122	0.2	40.86
South	1121.39	1121.34	48	1121.37	1121.4	0.0	0.95	1121.6	0.2	16.45	1121.8	0.4	41.42	1122	0.6	73.05
South	1121.34	1120.93	14	1121.14	1121.4	0.3	5.71	1121.6	0.5	13.27	1121.8	0.7	22.69	1122	0.9	33.67
South	1120.93	1121.11	27	1121.02	1121.4	0.4	18.94	1121.6	0.6	35.71	1121.8	0.8	55.70	1122	1.0	78.44
South	1121.11	1121.21	18	1121.16	1121.4	0.2	6.22	1121.6	0.4	15.45	1121.8	0.6	27.10	1122	0.8	40.74
West	1121.21	1121.28	17	1121.25	1121.4	0.2	3.03	1121.6	0.4	10.51	1121.8	0.6	20.55	1122	0.8	32.61
West	1121.28	1121.38	49	1121.33	1121.4	0.1	2.72	1121.6	0.3	20.64	1121.8	0.5	47.40	1122	0.7	80.68
West	1121.38	1122.22	191	1121.80	1121.4	0.0	0.00	1121.6	0.0	0.00	1121.8	0.0	0.00	1122	0.2	51.33
West	1122.22	1122.85	243	1122.54	1121.4	0.0	0.00	1121.6	0.0	0.00	1121.8	0.0	0.00	1122	0.0	0.00
						Totals:	37.57			112.03			214.86			431.37

Graph Computations:

Station	Elev
0	1122.85
249.29	1122.28
452.48	1121.39
500.6	1121.34
514.55	1120.93
541.5	1121.11
559.14	1121.21
575.71	1121.28
624.75	1121.38
816.03	1122.22
1058.7	1122.85

Weir Approximation

Station	Elev
0	1122.565
249.29	1122.565
249.29	1121.84
452.48	1121.84
452.48	1121.37
500.6	1121.37
500.6	1121.14
514.55	1121.14
514.55	1121.02
541.5	1121.02
541.5	1121.16
559.14	1121.16
559.14	1121.25
575.71	1121.25
575.71	1121.33
624.75	1121.33
624.75	1121.80
816.03	1121.80
816.03	1122.54
1058.7	1122.54



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	31.82	85%	Q south	80.87	72%	Q south	146.90	68%	Q south	266.75	62%
Q west	5.76	15%	Q west	31.15	28%	Q west	67.96	32%	Q west	164.62	38%

inflow at Intersection	37.57	112.03	214.86	431.37
Outflow (South)	31.82	80.87	146.90	266.75
Outflow (West)	5.76	31.15	67.96	164.62

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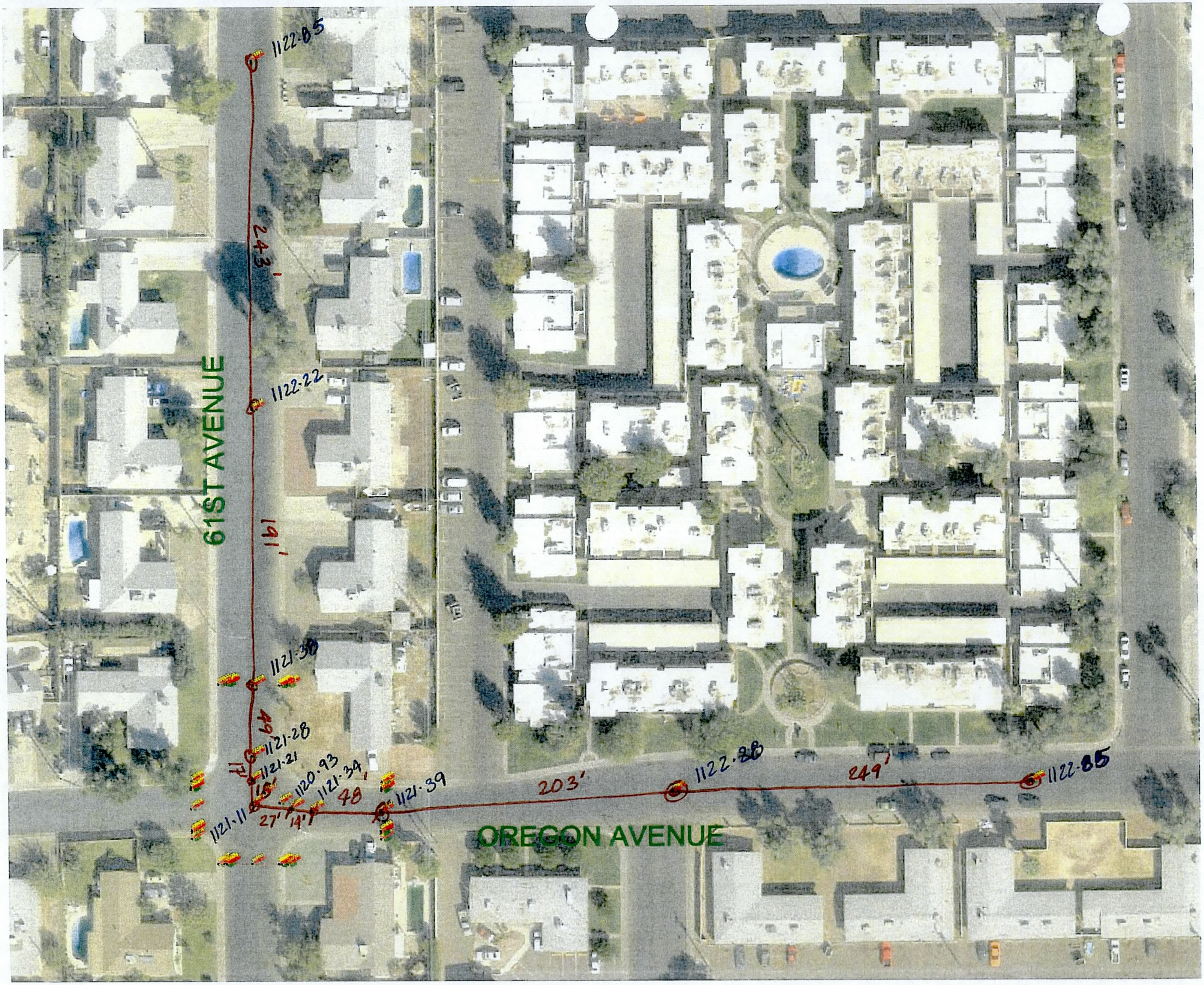


1122.85
243'
1122.22
61ST AVENUE
191'
1121.30
49'
1121.28
1121.21
17'
16'
1121.11
27'
14'
1120.93
1121.34
48'
1121.39
203'
1122.88
249'
1122.85
OREGON AVENUE

Flow Split at 61st Ave & Colter St

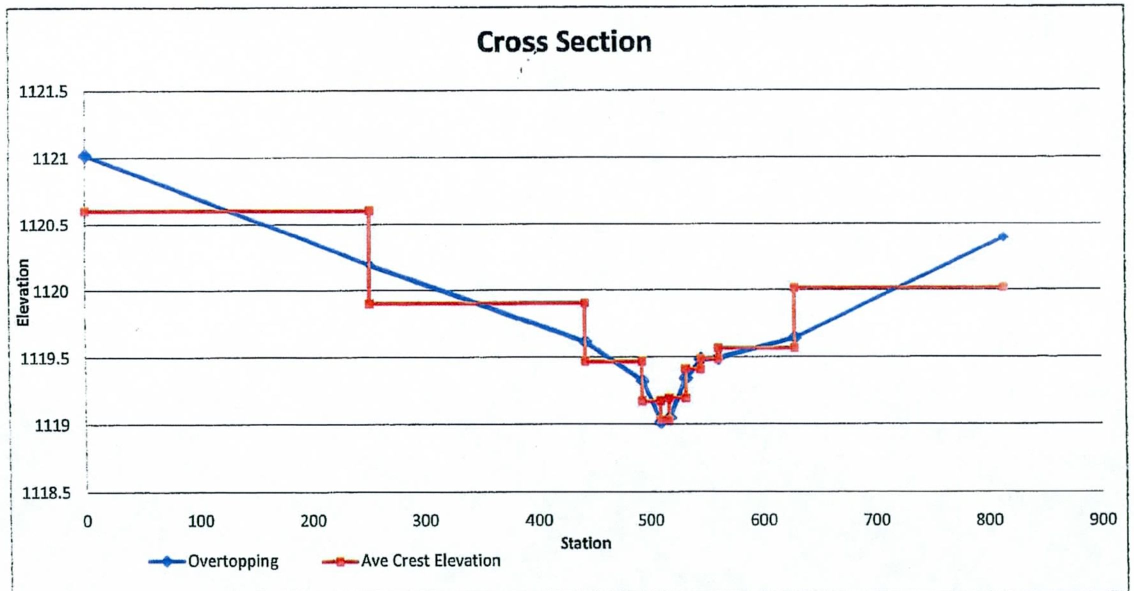
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1121.02	1120.2	253	1120.61	1119.5	0.0	0.00	1119.7	0.0	0.00	1119.9	0.0	0.00	1120	0.0	0.00
South	1120.2	1119.62	191	1119.91	1119.5	0.0	0.00	1119.7	0.0	0.00	1119.9	0.0	0.00	1120	0.1	15.46
South	1119.62	1119.33	50	1119.48	1119.5	0.0	0.60	1119.7	0.2	16.09	1119.9	0.4	41.78	1120	0.5	57.36
South	1119.33	1119.02	16	1119.18	1119.5	0.3	9.08	1119.7	0.5	18.64	1119.9	0.7	30.24	1120	0.8	36.71
South	1119.02	1119.05	8	1119.04	1119.5	0.5	7.51	1119.7	0.7	12.85	1119.9	0.9	19.07	1120	1.0	22.47
South	1119.05	1119.35	15	1119.20	1119.5	0.3	7.25	1119.7	0.5	15.59	1119.9	0.7	25.83	1120	0.8	31.56
West	1119.35	1119.49	13	1119.42	1119.5	0.1	0.90	1119.7	0.3	5.87	1119.9	0.5	13.17	1120	0.6	17.49
West	1119.49	1119.5	16	1119.50	1119.5	0.0	0.02	1119.7	0.2	4.41	1119.9	0.4	12.26	1120	0.5	17.06
West	1119.5	1119.65	68	1119.58	1119.5	0.0	0.00	1119.7	0.1	8.95	1119.9	0.3	37.54	1120	0.4	56.13
West	1119.65	1120.4	185	1120.03	1119.5	0.0	0.00	1119.7	0.0	0.00	1119.9	0.0	0.00	1120	0.0	0.00
						Totals:	25.35			82.41			179.87			254.24

Graph Computations:

Station	Elev
0	1121.02
252.72	1120.2
443.61	1119.62
493.87	1119.33
510.2	1119.02
518.1	1119.05
532.8	1119.35
546	1119.49
561.85	1119.5
629.38	1119.65
814.41	1120.4

Weir Approximation

Station	Elev
0	1120.61
252.72	1120.61
252.72	1119.91
443.61	1119.91
443.61	1119.48
493.87	1119.48
493.87	1119.18
510.2	1119.18
510.2	1119.04
518.1	1119.04
518.1	1119.20
532.8	1119.20
532.8	1119.42
546	1119.42
546	1119.50
561.85	1119.50
561.85	1119.58
629.38	1119.58
629.38	1120.03
814.41	1120.03



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	24.43	96%	Q south	63.17	77%	Q south	116.91	65%	Q south	163.55	64%
Q west	0.91	4%	Q west	19.23	23%	Q west	62.96	35%	Q west	90.69	36%

inflow at Intersection	25.35	82.41	179.87	254.24
Outflow (South)	24.43	63.17	116.91	163.55
Outflow (West)	0.91	19.23	62.96	90.69

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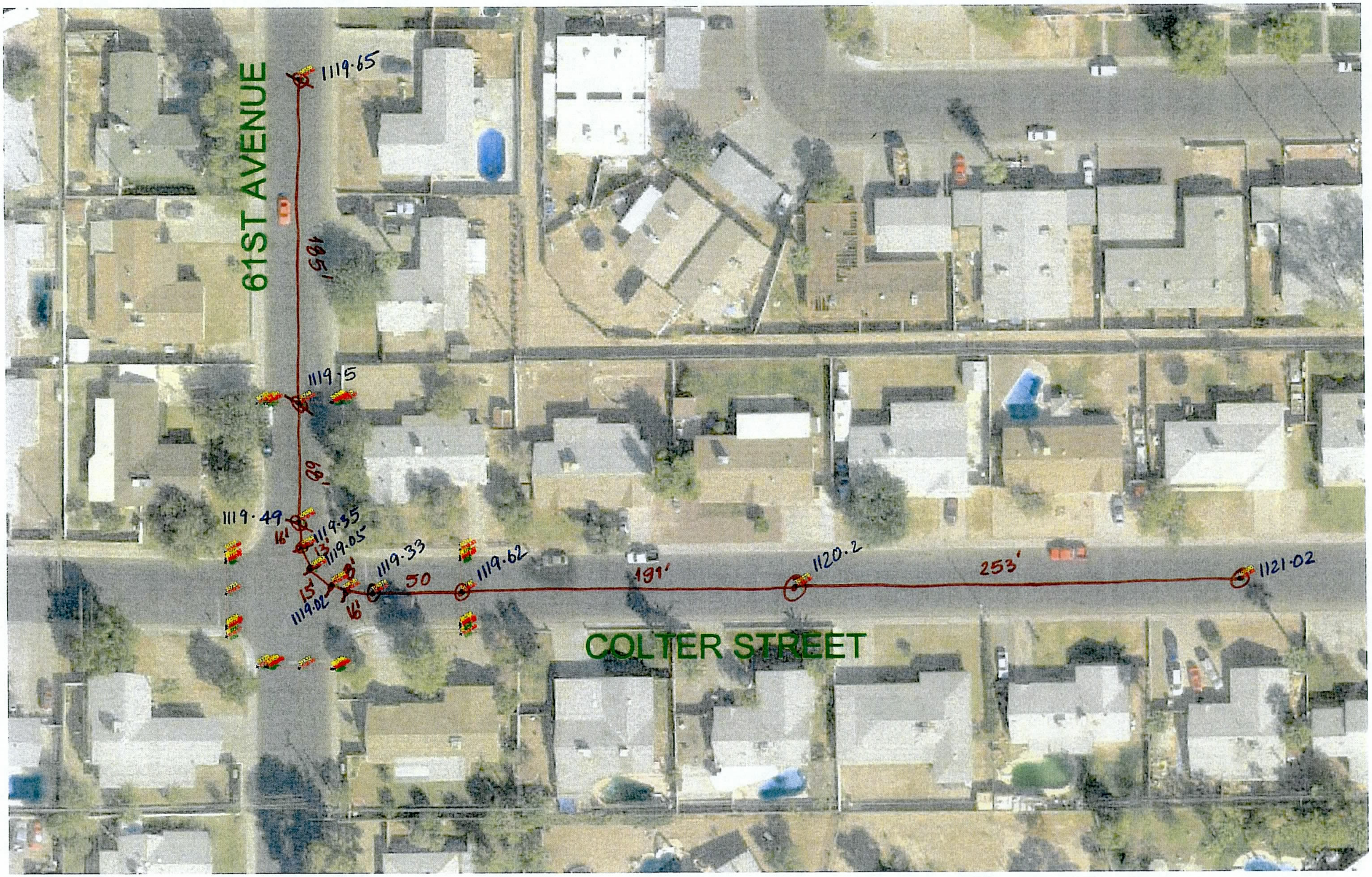

61ST AVENUE
COLTER STREET
1119.65
185'
1119.5
60'
1119.49
1119.35
1119.05
1119.33
1119.02
50
1119.62
191'
1120.2
253'
1121.02

Flow Split at 63rd Ave & Missouri Ave

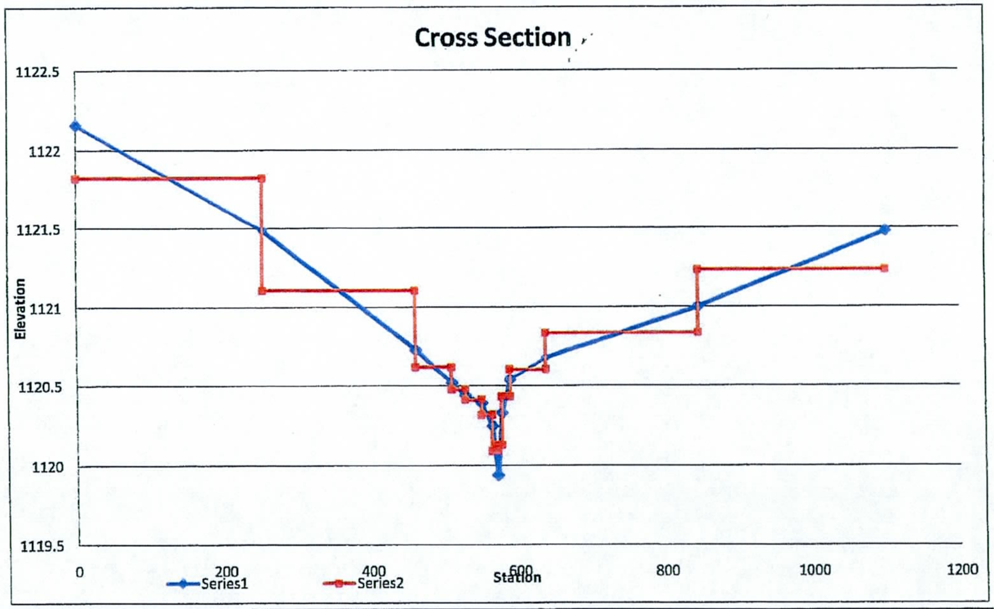
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1122.16	1121.49	253	1121.83	1120.5	0.0	0.00	1120.8	0.0	0.00	1121	0.0	0.00	1121.2	0.0	0.00
South	1121.49	1120.73	208	1121.11	1120.5	0.0	0.00	1120.8	0.0	0.00	1121	0.0	0.00	1121.2	0.1	16.88
South	1120.73	1120.52	49	1120.63	1120.5	0.0	0.00	1120.8	0.2	10.66	1121	0.4	33.43	1121.2	0.6	63.47
South	1120.52	1120.44	18	1120.48	1120.5	0.0	0.15	1120.8	0.3	9.79	1121	0.5	20.27	1121.2	0.7	33.03
South	1120.44	1120.39	22	1120.42	1120.5	0.1	1.66	1120.8	0.4	15.98	1121	0.6	29.93	1121.2	0.8	46.53
South	1120.39	1120.25	14	1120.32	1120.5	0.2	3.28	1120.8	0.5	14.27	1121	0.7	24.06	1121.2	0.9	35.41
West	1120.25	1119.94	7	1120.10	1120.5	0.4	5.36	1120.8	0.7	12.31	1121	0.9	17.90	1121.2	1.1	24.15
West	1119.94	1120.33	6	1120.14	1120.5	0.4	3.86	1120.8	0.7	9.48	1121	0.9	14.07	1121.2	1.1	19.22
West	1120.33	1120.54	11	1120.44	1120.5	0.1	0.56	1120.8	0.4	7.46	1121	0.6	14.37	1121.2	0.8	22.64
West	1120.54	1120.68	49	1120.61	1120.5	0.0	0.00	1120.8	0.2	12.24	1121	0.4	36.00	1121.2	0.6	66.99
West	1120.68	1121	208	1120.84	1120.5	0.0	0.00	1120.8	0.0	0.00	1121	0.2	39.84	1121.2	0.4	134.47
West	1121	1121.48	255	1121.24	1120.5	0.0	0.00	1120.8	0.0	0.00	1121	0.0	0.00	1121.2	0.0	0.00
						Totals:	**14.86**			**92.19**			**229.87**			**462.78**

Graph Computations:

Station	Elev
0	1122.16
253.33	1121.49
461.7	1120.73
510.22	1120.52
528.24	1120.44
550.54	1120.39
564.84	1120.25
571.77	1119.94
577.6	1120.33
588.88	1120.54
638.15	1120.68
845.66	1121
1100.77	1121.48

Weir Approximation

Station	Elev
0	1121.83
253.33	1121.83
253.33	1121.11
461.70	1121.11
461.70	1120.63
510.22	1120.63
510.22	1120.48
528.24	1120.48
528.24	1120.42
551	1120.42
550.54	1120.32
565	1120.32
564.84	1120.10
572	1120.10
571.77	1120.14
578	1120.14
577.6	1120.44
589	1120.44
588.88	1120.61
638	1120.61
638	1120.84
846	1120.84
846	1121.24
1101	1121.24



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	5.09	34%	Q south	50.69	55%	Q south	107.69	47%	Q south	195.32	42%
Q west	9.78	66%	Q west	41.50	45%	Q west	122.18	53%	Q west	267.47	58%

inflow at Intersection	14.86	92.19	229.87	462.78
Outflow (South)	5.09	50.69	107.69	195.32
Outflow (West)	9.78	41.50	122.18	267.47

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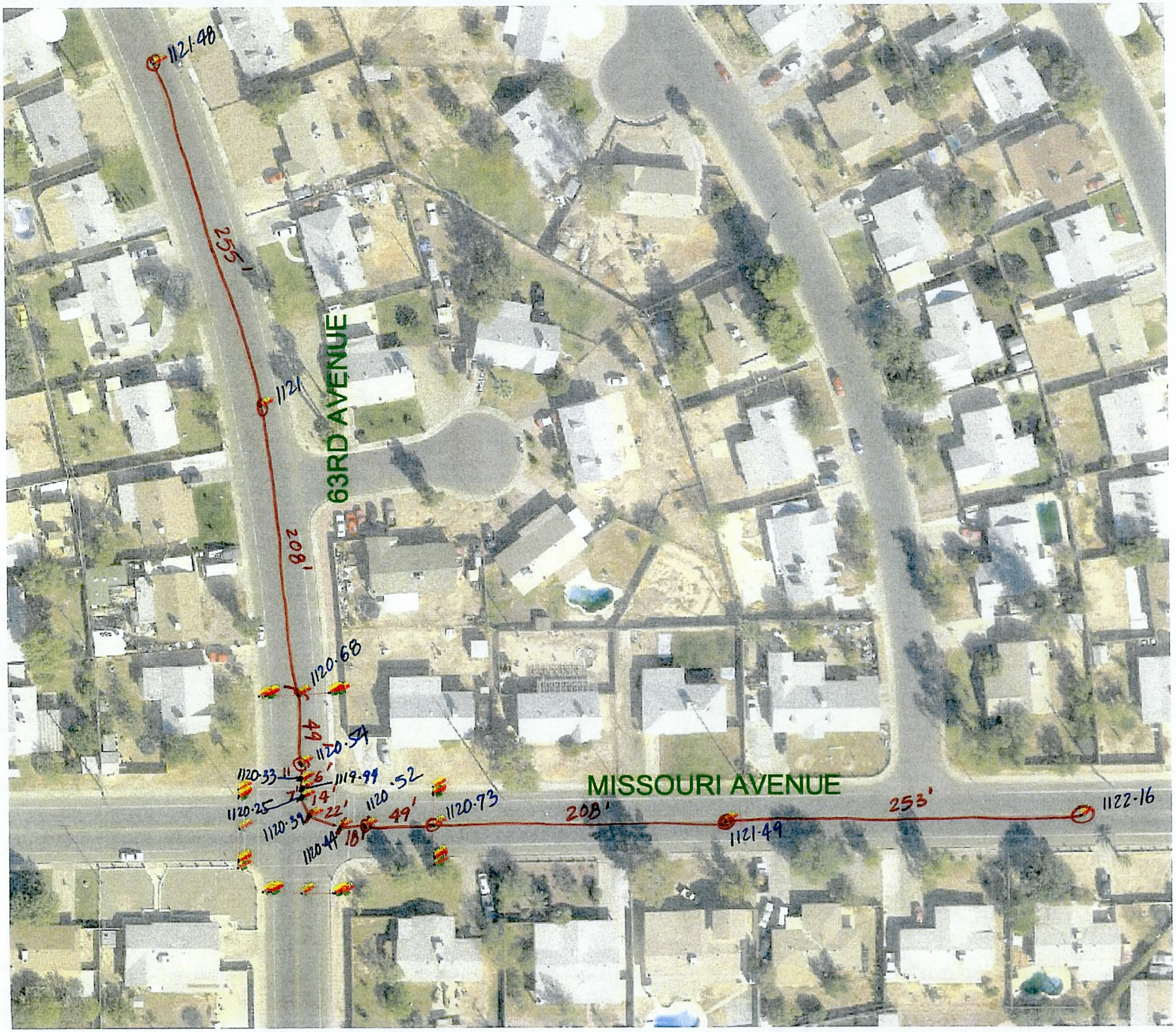


1121.48
255'
1121
63RD AVENUE
208'
1120.68
49
1120.54
6'
1120.33
1119.99
1120 .52
7'
14'
1120.25
22'
1120.39
1120.44
18'
49'
1120.73
MISSOURI AVENUE
208'
1121.49
253'
1122.16

Flow Split at 65th Ave & Windsor Blvd

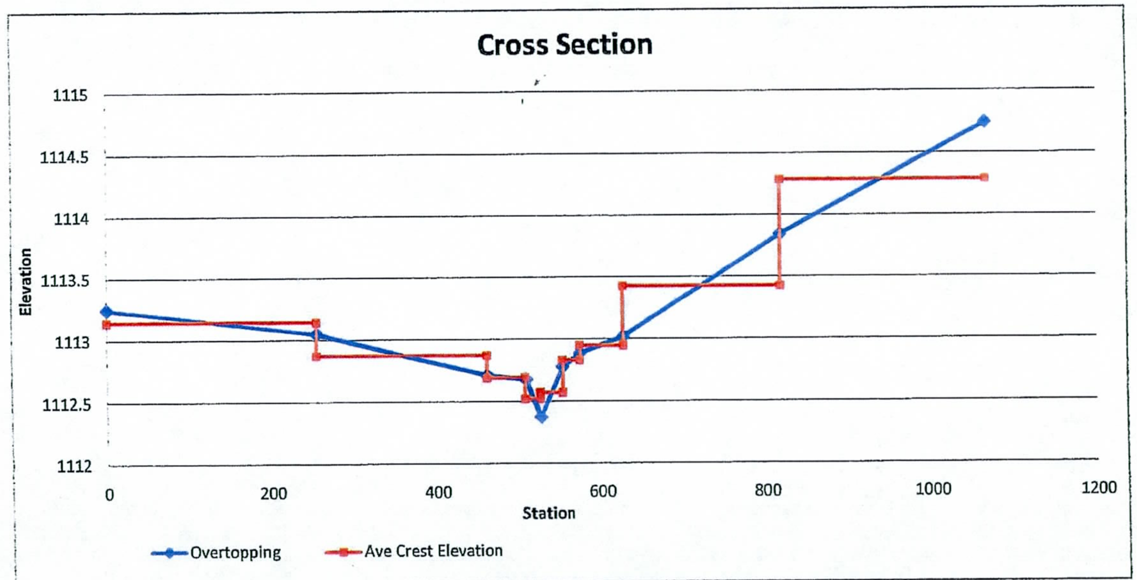
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1113.25	1113.05	254	1113.15	1112.7	0.0	0.00	1112.9	0.0	0.00	1113	0.0	0.00	1113.2	0.0	8.53
South	1113.05	1112.71	207	1112.88	1112.7	0.0	0.00	1112.9	0.0	1.76	1113	0.1	25.85	1113.2	0.3	112.56
South	1112.71	1112.68	47	1112.70	1112.7	0.0	0.05	1112.9	0.2	13.04	1113	0.3	23.67	1113.2	0.5	50.43
South	1112.68	1112.37	17	1112.53	1112.7	0.2	3.79	1112.9	0.4	11.89	1113	0.5	16.95	1113.2	0.7	28.72
South	1112.37	1112.78	26	1112.58	1112.7	0.1	3.51	1112.9	0.3	14.72	1113	0.4	22.01	1113.2	0.6	39.25
West	1112.78	1112.89	23	1112.84	1112.7	0.0	0.00	1112.9	0.1	1.13	1113	0.2	4.58	1113.2	0.4	15.07
West	1112.89	1113.02	52	1112.96	1112.7	0.0	0.00	1112.9	0.0	0.00	1113	0.0	1.49	1113.2	0.2	18.98
West	1113.02	1113.85	191	1113.44	1112.7	0.0	0.00	1112.9	0.0	0.00	1113	0.0	0.00	1113.2	0.0	0.00
West	1113.85	1114.74	248	1114.30	1112.7	0.0	0.00	1112.9	0.0	0.00	1113	0.0	0.00	1113.2	0.0	0.00
						Totals:	7.35			42.54			94.55			273.54

Graph Computations:

Station	Elev
0	1113.25
254	1113.05
462	1112.71
509	1112.68
526	1112.37
552	1112.78
575	1112.89
627	1113.02
818	1113.85
1067	1114.74

Weir Approximation

Station	Elev
0	1113.15
254	1113.15
254	1112.88
462	1112.88
461.67	1112.70
509	1112.70
508.51	1112.53
526	1112.53
525.77	1112.58
552	1112.58
552.25	1112.84
575.03	1112.84
575.03	1112.96
627	1112.96
627.2	1113.44
818	1113.44
818.44	1114.30
1067	1114.30



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	7.35	100%	Q south	41.41	97%	Q south	88.48	94%	Q south	239.49	88%
Q west	0.00	0%	Q west	1.13	3%	Q west	6.07	6%	Q west	34.05	12%

inflow at Intersection	7.35	42.54	94.55	273.54
Outflow (South)	7.35	41.41	88.48	239.49
Outflow (West)	0.00	1.13	6.07	34.05

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65TH AVENUE
248'
161'
52'
23'
28'
17'
47
207
WINDSOR BOULEVARD
254
65TH AVE

Flow Split at 67th Ave & Missouri Ave

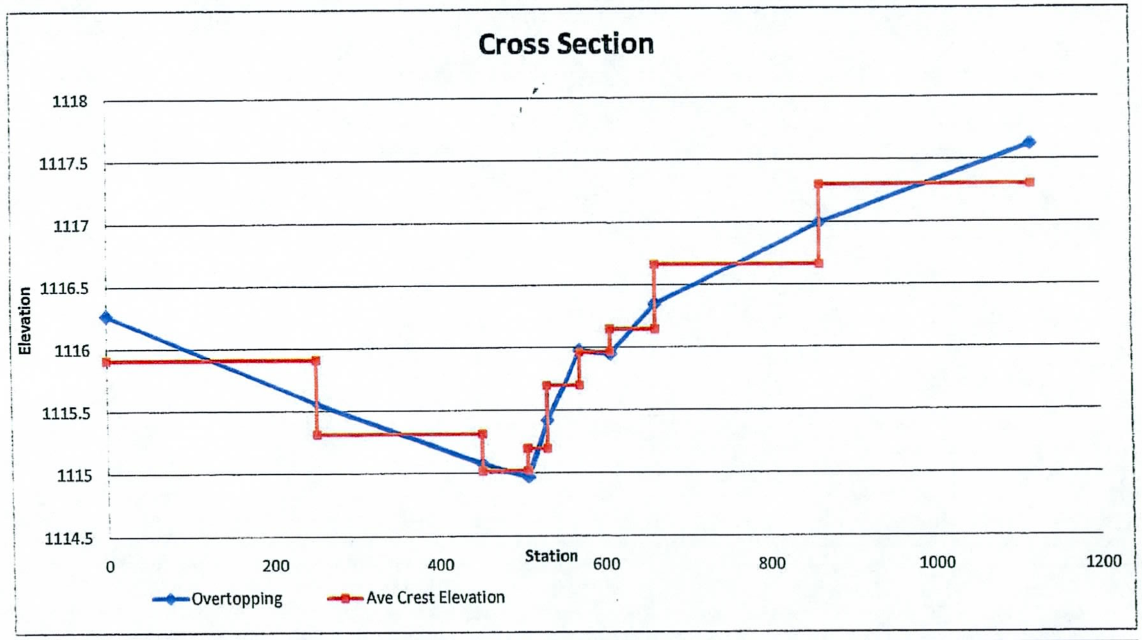
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1116.27	1115.56	253	1115.92	1115.2	0.0	0.00	1115.5	0.0	0.00	1115.7	0.0	0.00	1115.9	0.0	0.00
South	1115.56	1115.07	201	1115.32	1115.2	0.0	0.00	1115.5	0.2	47.94	1115.7	0.4	143.91	1115.9	0.6	269.55
South	1115.07	1114.97	55	1115.02	1115.2	0.2	12.53	1115.5	0.5	54.54	1115.7	0.7	91.97	1115.9	0.9	135.39
South	1114.97	1115.42	23	1115.20	1115.2	0.0	0.02	1115.5	0.3	11.52	1115.7	0.5	24.55	1115.9	0.7	40.49
South	1115.42	1115.98	41	1115.70	1115.2	0.0	0.00	1115.5	0.0	0.00	1115.7	0.0	0.00	1115.9	0.2	10.95
West	1115.98	1115.95	37	1115.97	1115.2	0.0	0.00	1115.5	0.0	0.00	1115.7	0.0	0.00	1115.9	0.0	0.00
West	1115.95	1116.35	55	1116.15	1115.2	0.0	0.00	1115.5	0.0	0.00	1115.7	0.0	0.00	1115.9	0.0	0.00
West	1116.35	1117	200	1116.68	1115.2	0.0	0.00	1115.5	0.0	0.00	1115.7	0.0	0.00	1115.9	0.0	0.00
West	1117	1117.62	255	1117.31	1115.2	0.0	0.00	1115.5	0.0	0.00	1115.7	0.0	0.00	1115.9	0.0	0.00
						Totals:	12.55			114.00			260.43			456.38

Graph Computations:

Station	Elev
0	1116.27
253	1115.56
454	1115.07
508	1114.97
531	1115.42
572	1115.98
609	1115.95
664	1116.35
863	1117
1118	1117.62

Weir Approximation

Station	Elev
0	1115.92
253	1115.92
253	1115.32
454	1115.32
453.61	1115.02
508	1115.02
508.28	1115.20
531	1115.20
531.08	1115.70
572	1115.70
571.89	1115.97
609.14	1115.97
609.14	1116.15
664	1116.15
663.75	1116.68
863	1116.68
863.47	1117.31
1118	1117.31



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	12.55	100%	Q south	114.00	100%	Q south	260.43	100%	Q south	456.38	100%
Q west	0.00	0%	Q west	0.00	0%	Q west	0.00	0%	Q west	0.00	0%

inflow at Intersection	12.55	114.00	260.43	456.38
Outflow (South)	12.55	114.00	260.43	456.38
Outflow (West)	0.00	0.00	0.00	0.00

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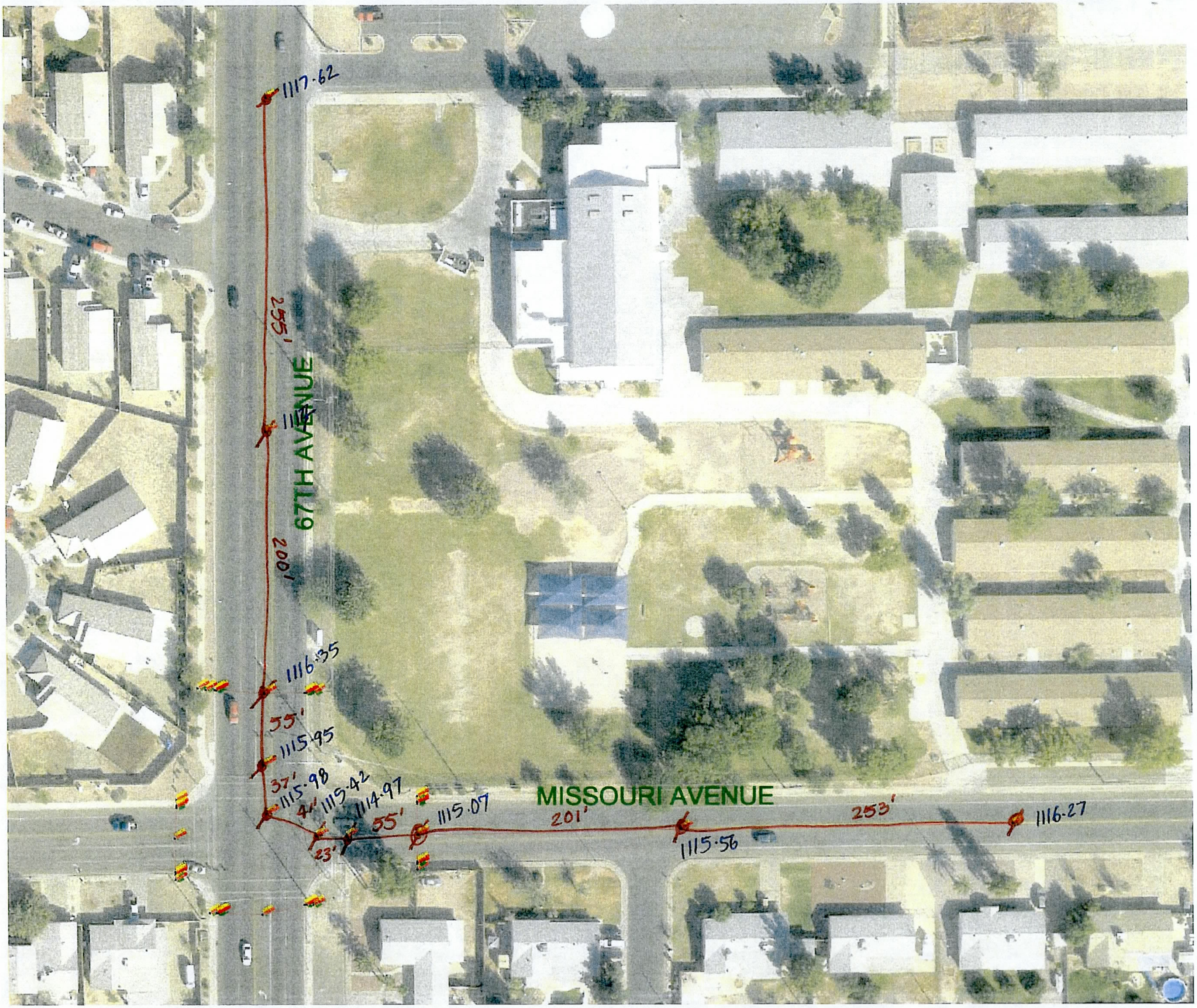

67TH AVENUE
MISSOURI AVENUE
1117·62
255'
200'
1116·35
55'
1115·95
37'
1115·98
41'
1115·42
1114·97
23'
55'
1115·07
201'
1115·56
253'
1116·27

Flow Split at 73rd Ave & Missouri Ave

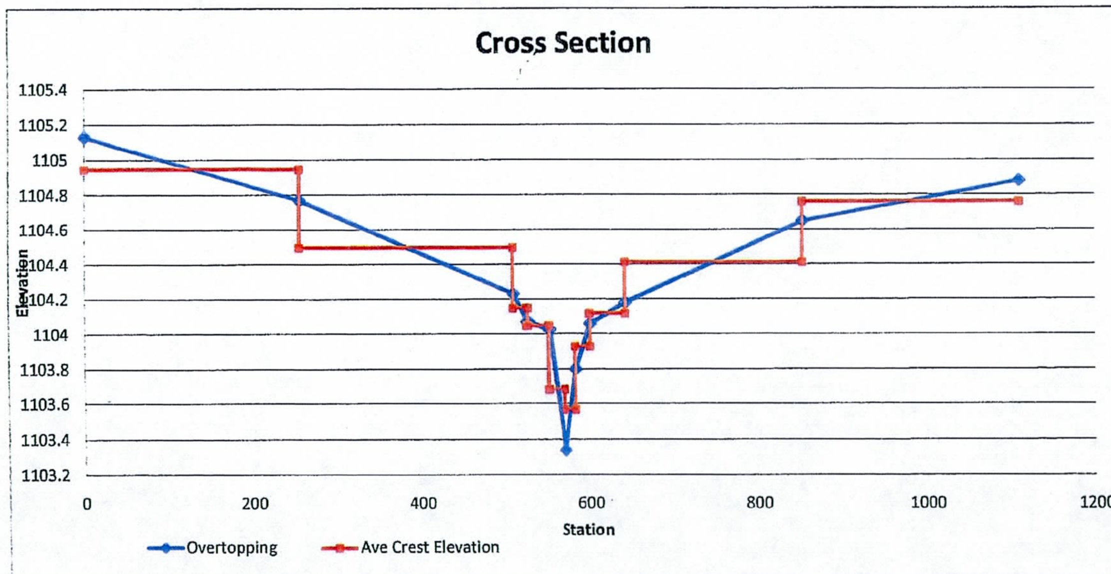
Segment	Start Elevation (ft)	End Elevation (Ft)	Length (ft)	Crest Avg Elevation (ft)	Start Calc Elev Iter 1	iter 1 H (ft)	Q1 (cfs)	Start Calc Elev Iter 2	iter 2 H (ft)	Q2 (cfs)	Start Calc Elev Iter 3	iter 3 H (ft)	Q3 (cfs)	Start Calc Elev iter 4	iter 4 H (ft)	Q4
South	1105.13	1104.77	256	1104.95	1104	0.0	0.00	1104.3	0.0	0.00	1104.6	0.0	0.00	1104.9	0.0	0.00
South	1104.77	1104.23	254	1104.50	1104	0.0	0.00	1104.3	0.0	0.00	1104.6	0.1	24.13	1104.9	0.4	193.06
South	1104.23	1104.07	17	1104.15	1104	0.0	0.00	1104.3	0.1	2.90	1104.6	0.4	15.07	1104.9	0.8	32.42
South	1104.07	1104.03	25	1104.05	1104	0.0	0.00	1104.3	0.3	9.30	1104.6	0.5	30.36	1104.9	0.9	58.33
West	1104.03	1103.34	19	1103.69	1104	0.3	9.89	1104.3	0.6	26.97	1104.6	0.9	48.94	1104.9	1.2	74.89
West	1103.34	1103.8	14	1103.57	1104	0.4	11.61	1104.3	0.7	25.69	1104.6	1.0	43.06	1104.9	1.3	63.18
West	1103.8	1104.06	17	1103.93	1104	0.1	0.97	1104.3	0.4	11.73	1104.6	0.7	28.58	1104.9	1.0	49.78
West	1104.06	1104.18	42	1104.12	1104	0.0	0.00	1104.3	0.2	9.59	1104.6	0.5	41.74	1104.9	0.8	86.47
West	1104.18	1104.65	211	1104.42	1104	0.0	0.00	1104.3	0.0	0.00	1104.6	0.2	50.47	1104.9	0.5	214.25
West	1104.65	1104.88	256	1104.77	1104	0.0	0.00	1104.3	0.0	0.00	1104.6	0.0	0.00	1104.9	0.1	38.09
						Totals:	22.47			86.18			282.36			810.48

Graph Computations:

Station	Elev
0	1105.13
255.5	1104.77
509.88	1104.23
526.52	1104.07
551.33	1104.03
569.97	1103.34
583.7	1103.8
601.07	1104.06
642.91	1104.18
854.35	1104.65
1110.35	1104.88

Weir Approximation

Station	Elev
0	1104.95
255.5	1104.95
255.5	1104.50
509.88	1104.50
509.88	1104.15
526.52	1104.15
526.52	1104.05
551.33	1104.05
551.33	1103.69
569.97	1103.69
569.97	1103.57
583.7	1103.57
583.7	1103.93
601.07	1103.93
601.07	1104.12
642.91	1104.12
642.91	1104.42
854.35	1104.42
854.35	1104.77
1110.35	1104.77



Iteration -1			Iteration -2			Iteration -3			Iteration -4		
Q south	0.00	0%	Q south	12.20	14%	Q south	69.56	25%	Q south	283.81	35%
Q west	22.47	100%	Q west	73.97	86%	Q west	212.80	75%	Q west	526.66	65%

inflow at Intersection	22.47	86.18	282.36	810.48
Outflow (South)	0.00	12.20	69.56	283.81
Outflow (West)	22.47	73.97	212.80	526.66

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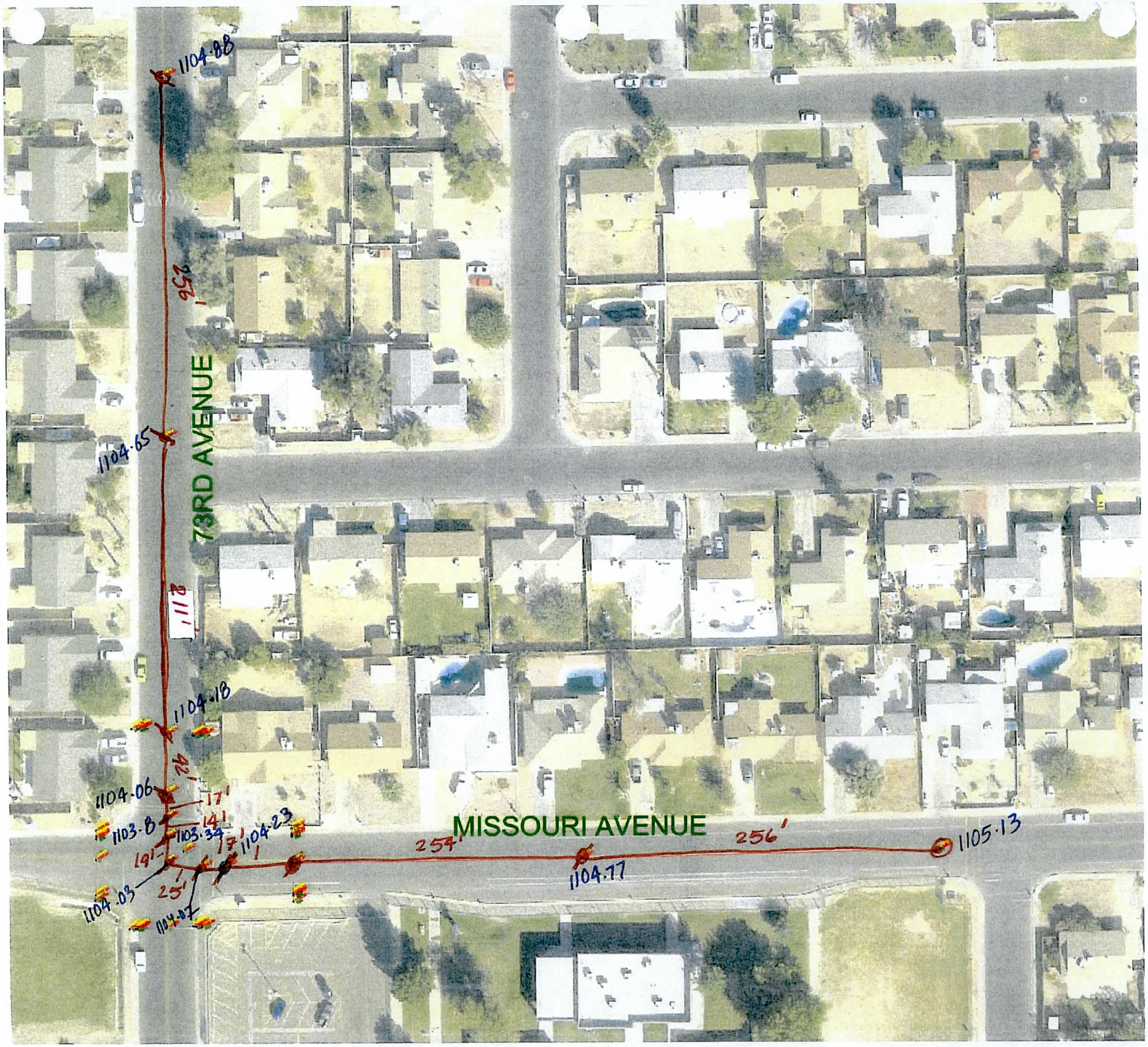
1104.88
258'
73RD AVENUE
1104.65
211'
1104.18
42'
1104.06
17'
14'
1103.8
1103.34
14'
17'
1104.23
25'
1104.03
1104.07
MISSOURI AVENUE
254'
256'
1104.77
1105.13

Flow Split Table for 73rd Ave & Reade Ave

WSE	Discharge (cfs)		Total Q
	W 73rd Ave	S 73rd Ave	
1098.8	0.5	0	1
1098.9	2.92	0.18	3
1099	8.66	1.13	10
1099.1	20.38	3.65	24
1099.2	32.02	8.32	40
1099.3	51.48	14.75	66
1099.4	74.85	25.65	101
1099.5	101.45	42.97	144
1099.6	131.06	63.6	195
1099.7	163.48	87.24	251
1099.8	198.53	113.68	312
1099.9	236.09	142.73	379
1100	276.03	174.24	450

Flow Split at 73rd Ave & Reade Ave

Inflow at Intersection	24.03		66.23		194.66		450.27	
Outflow (South)	3.7	15%	14.75	22%	63.60	33%	174.24	39%
Outflow (West)	20.4	85%	51.48	78%	131.06	67%	276.03	61%

F:\Projects\008-2678_WTRS\CALCS\Hydrology\Flow Splits\Flow Split Excel.xls

73rd Ave (South Of Reade Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	0.60	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00	1099.31
0+04	1099.24
0+05	1098.76
0+06	1098.84
0+25	1099.36
0+46	1098.89
0+47	1098.80
0+48	1099.29
0+52	1099.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1099.31)	(0+52, 1099.40)	0.016

Results

Discharge	21.19	ft^3/s
Elevation Range	1098.76 to 1099.40 ft	
Flow Area	12.09	ft^2
Wetted Perimeter	50.60	ft
Top Width	50.20	ft
Normal Depth	0.60	ft
Critical Depth	0.51	ft
Critical Slope	0.00633	ft/ft
Velocity	1.75	ft/s

73rd Ave (South Of Reade Ave)

Results

Velocity Head	0.05	ft
Specific Energy	0.65	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.51	ft
Channel Slope	0.00240	ft/ft
Critical Slope	0.00633	ft/ft

Flow Split for 73rd Ave (South Of Reade Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	2.24	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	1103.00
0+00	1099.31
0+04	1099.24
0+05	1098.76
0+06	1098.84
0+25	1099.36
0+46	1098.89
0+47	1098.80
0+48	1099.29
0+52	1099.40
0+52	1103.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1103.00)	(0+05, 1098.76)	0.020
(0+05, 1098.76)	(0+47, 1098.80)	0.016
(0+47, 1098.80)	(0+52, 1103.00)	0.020

Water Surface Elevation (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
1098.50					

Flow Split for 73rd Ave (South Of Reade Ave)

Input Data

Water Surface Elevation (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
1098.60					
1098.70					
1098.80	0.00	0.32	0.01	0.74	0.73
1098.90	0.18	0.62	0.29	5.60	5.51
1099.00	1.13	0.90	1.26	14.05	13.89
1099.10	3.65	1.19	3.07	22.50	22.27
1099.20	8.32	1.46	5.71	30.95	30.65
1099.30	14.74	1.59	9.30	42.96	42.61
1099.40	25.65	1.82	14.13	52.10	51.66
1099.50	42.97	2.23	19.30	52.30	51.67
1099.60	63.60	2.60	24.46	52.50	51.68
1099.70	87.25	2.94	29.63	52.70	51.69
1099.80	113.69	3.27	34.80	52.90	51.70
1099.90	142.74	3.57	39.97	53.10	51.71
1100.00	174.25	3.86	45.14	53.30	51.72

Flow Split for Reade Ave (West of 73rd Ave)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00410	ft/ft
Normal Depth	1.35	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	1102.00
0+00	1099.21
0+04	1099.14
0+04	1098.65
0+06	1098.72
0+22	1099.00
0+38	1098.75
0+39	1098.66
0+40	1099.11
0+44	1099.15
0+44	1102.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 1102.00)	(0+04, 1098.65)	0.020
(0+04, 1098.65)	(0+39, 1098.66)	0.016
(0+39, 1098.66)	(0+44, 1102.00)	0.020

Water Surface Elevation (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
1098.60					

Flow Split for Reade Ave (West of 73rd Ave)

Input Data

Water Surface Elevation (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
1098.70	0.02	0.47	0.04	1.83	1.80
1098.80	0.50	0.83	0.60	11.18	11.07
1098.90	2.92	1.26	2.32	23.60	23.42
1099.00	8.66	1.64	5.28	36.03	35.77
1099.10	20.38	2.30	8.87	36.34	36.02
1099.20	32.02	2.49	12.85	43.74	43.35
1099.30	51.48	2.99	17.24	44.48	43.90
1099.40	74.85	3.46	21.63	44.68	43.91
1099.50	101.45	3.90	26.02	44.88	43.91
1099.60	131.06	4.31	30.41	45.08	43.92
1099.70	163.48	4.70	34.81	45.28	43.92
1099.80	198.53	5.06	39.20	45.48	43.92
1099.90	236.09	5.42	43.59	45.68	43.93
1100.00	276.03	5.75	47.98	45.88	43.93

A.1.5 Sub-Basin Physical Parameters

Sub Basin Physical Parameters

Basin ID	Basin Area		
	sq.ft	acres	sq.mile
1A	6981751.57	160.28	0.250
1B	3484547.965	79.99	0.125
1C	3488243.969	80.08	0.125
2	2428556	55.75	0.087
3	4552925.642	104.52	0.163
4A	1770831.886	40.65	0.064
4B	1727616.125	39.66	0.062
5A	808554.6454	18.56	0.029
5B	571280.3367	13.11	0.020
5C	1205093.309	27.67	0.043
5D	909284.1363	20.87	0.033
6	4695711.846	107.80	0.168
7A	1443688.803	33.14	0.052
7B	880237.1155	20.21	0.032
7C	1203237.364	27.62	0.043
8	2916607.747	66.96	0.105
9	2832410.728	65.02	0.102
10A	997721.4847	22.90	0.036
10B	466067.5392	10.70	0.017
11	5699598.246	130.84	0.204
12	3465200.092	79.55	0.124
13	10888048.9	249.96	0.391
14	2775673.517	63.72	0.100

HEC-1 Combined Area Calculation

Basin ID	Area (sq.mi)		Combine-Area
1A	0.250	C-1 A= 1A	**0.250**
1B	0.125	C-1B = C-1A+1B	**0.375**
1C	0.125	C-1C = C-1B+1C	**0.501**
2	0.087	C-2 = 2+0.479	**0.087**
3	0.163	C-3 = 2+ 3 +1A	**0.5004**
4A	0.064	C-4A = C-1B + 4A	**0.439**
4B	0.062	C-4B = C-3 + 4A + 4B+1B	**0.751**
5A	0.029	C-5A-1 = C-5B+5A	**0.488**
		C-5A-2 =C-5A-1+2+3+4B	**0.800**
5B	0.020	C-5B = C-4A + 5B	**0.459**
5C	0.043	C-5C = C-1C + 4A+5B+5C	**0.628**
5D	0.033	C-5D = C-5C+2+3+4B+5A+5D	**1.002**
6	0.168	C-6 = C-1C + 6	**0.669**
7A	0.052	C-7A = C-6 +7A	**0.721**
7B	0.032	C-7B = C-7A + 7B	**0.753**
7C	0.043	C-7C = C-7B + 7C	**0.796**
8	0.105	C-8 = C-6 + 8	**0.774**
9	0.102	C-9 = C-8 + 7A + 7B + 9	**0.960**
10A	0.036		**0.036**
10B	0.017	C-10B = 10A + 10B	**0.053**
11	0.204	C-11 = C-8 + 11	**0.978**
12	0.124	C-12 = C-11 + 12 + 10A	**1.138**
13	0.391	C-13 = C-11 + 13	**1.369**
14	0.100	C-14 = C-13 + 14	**1.469**

Major Basin ID: A

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 (%)
1A	0.250	0.50	25.8	25.8	URBAN	0.026	0.15	0.25	4.80	0.40	55
1B	0.125	0.37	35.4	35.4	URBAN	0.028	0.15	0.25	4.80	0.40	55
1C	0.125	0.41	28.0	28.0	URBAN	0.028	0.16	0.25	5.70	0.27	51
2	0.087	0.34	26.5	26.5	URBAN	0.029	0.15	0.19	6.60	0.19	57
3	0.163	0.44	27.3	27.3	URBAN	0.027	0.15	0.25	5.00	0.37	55
4A	0.064	0.18	44.0	44.0	URBAN	0.030	0.25	0.25	4.80	0.35	45
4B	0.062	0.21	33.3	33.3	URBAN	0.030	0.22	0.25	4.80	0.36	51
5A	0.029	0.15	34.5	34.5	URBAN	0.032	0.22	0.23	6.20	0.20	51
5B	0.021	0.13	47.2	47.2	URBAN	0.033	0.25	0.25	4.80	0.35	45

Area ID	Return Period Parameters	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
1A	**Tc (Hrs)**	0.436	0.435	0.402	0.367	0.346	0.327
	Vel (f/s)	1.68	1.69	1.82	2.00	2.12	2.24
	R (Hrs)	0.187	0.186	0.170	0.154	0.144	0.136
1B	**Tc (Hrs)**	0.353	0.352	0.325	0.297*	0.280*	0.265*
	Vel (f/s)	1.54	1.54	1.67	1.83	1.94	2.05
	R (Hrs)	0.172	0.172	0.157	0.142	0.133	0.125
1C	**Tc (Hrs)**	0.400	0.399	0.367	0.335	0.314	0.298*
	Vel (f/s)	1.50	1.51	1.64	1.80	1.92	2.02
	R (Hrs)	0.214	0.214	0.195	0.176	0.164	0.154
2	**Tc (Hrs)**	0.364	0.363	0.334	0.305	0.288*	0.274*
	Vel (f/s)	1.37	1.37	1.49	1.63	1.73	1.82
	R (Hrs)	0.204	0.204	0.186	0.168	0.158	0.149
3	**Tc (Hrs)**	0.409	0.408	0.377	0.344	0.324	0.307
	Vel (f/s)	1.58	1.58	1.71	1.88	1.99	2.10
	R (Hrs)	0.200	0.199	0.182	0.165	0.154	0.145
4A	**Tc (Hrs)**	0.247*	0.246*	0.226*	0.205*	0.192*	0.181*
	Vel (f/s)	1.07	1.07	1.17	1.29	1.38	1.46
	R (Hrs)	0.095	0.095	0.086	0.078	0.072	0.068
4B	**Tc (Hrs)**	0.285*	0.284*	0.261*	0.238*	0.224*	0.212*
	Vel (f/s)	1.08	1.08	1.18	1.29	1.38	1.45
	R (Hrs)	0.128	0.128	0.117	0.105	0.098	0.092
5A	**Tc (Hrs)**	0.240*	0.240*	0.221*	0.201*	0.189*	0.179*
	Vel (f/s)	0.92	0.92	1.00	1.09	1.16	1.23
	R (Hrs)	0.125	0.125	0.114	0.103	0.096	0.090
5B	**Tc (Hrs)**	0.216*	0.215*	0.197*	0.179*	0.168*	0.159*
	Vel (f/s)	0.88	0.89	0.97	1.07	1.13	1.20
	R (Hrs)	0.119	0.119	0.108	0.097	0.090	0.085

* 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: A																		
5C	0.043	0.17	46.2	46.2	URBAN	0.031	0.20	0.25	4.80	0.38	57	**Tc (Hrs)**	0.231*	0.230*	0.213*	0.195*	0.183*	0.174*
												Vel (f/s)	1.08	1.08	1.17	1.28	1.36	1.43
												R (Hrs)	0.106	0.106	0.097	0.088	0.082	0.077
5D	0.033	0.18	45.7	45.7	URBAN	0.032	0.10	0.25	4.80	0.43	80	**Tc (Hrs)**	0.227*	0.226*	0.211*	0.195*	0.185*	0.176*
												Vel (f/s)	1.16	1.17	1.25	1.35	1.43	1.50
												R (Hrs)	0.126	0.126	0.117	0.107	0.101	0.095
6	0.168	0.53	24.5	24.5	URBAN	0.027	0.23	0.15	7.60	0.12	45	**Tc (Hrs)**	0.450	0.449	0.412	0.376	0.354	0.337
												Vel (f/s)	1.73	1.73	1.89	2.07	2.20	2.31
												R (Hrs)	0.254	0.253	0.230	0.208	0.195	0.184
7A	0.052	0.17	41.7	41.7	URBAN	0.030	0.22	0.25	5.20	0.31	52	**Tc (Hrs)**	0.237*	0.236*	0.218*	0.199*	0.186*	0.176*
												Vel (f/s)	1.05	1.06	1.14	1.25	1.34	1.42
												R (Hrs)	0.098	0.097	0.089	0.080	0.075	0.070
7B	0.032	0.21	29.1	29.1	URBAN	0.032	0.23	0.21	6.40	0.19	44	**Tc (Hrs)**	0.304	0.303	0.278*	0.252*	0.236*	0.224*
												Vel (f/s)	1.01	1.02	1.11	1.22	1.31	1.38
												R (Hrs)	0.202	0.201	0.182	0.163	0.152	0.143
7C	0.043	0.34	17.6	17.6	URBAN	0.031	0.25	0.15	8.80	0.07	30	**Tc (Hrs)**	0.430	0.428	0.392	0.357	0.337	0.321
												Vel (f/s)	1.16	1.17	1.27	1.40	1.48	1.55
												R (Hrs)	0.368	0.366	0.332	0.299	0.281	0.266
8	0.105	0.68	14.7	14.7	URBAN	0.028	0.25	0.15	9.70	0.06	30	**Tc (Hrs)**	0.607	0.605	0.555	0.506	0.478	0.455
												Vel (f/s)	1.64	1.65	1.80	1.97	2.09	2.19
												R (Hrs)	0.565	0.563	0.510	0.461	0.432	0.409
9	0.102	0.57	19.3	19.3	URBAN	0.029	0.25	0.15	7.60	0.11	30	**Tc (Hrs)**	0.535	0.533	0.486	0.441	0.415	0.394
												Vel (f/s)	1.56	1.57	1.72	1.90	2.01	2.12
												R (Hrs)	0.433	0.431	0.389	0.349	0.326	0.308
10A	0.036	0.30	13.5	13.5	URBAN	0.031	0.25	0.15	9.70	0.06	30	**Tc (Hrs)**	0.436	0.435	0.399	0.363	0.343	0.327
												Vel (f/s)	1.01	1.01	1.10	1.21	1.28	1.35
												R (Hrs)	0.374	0.373	0.338	0.305	0.287	0.271

* 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: A																		
10B	0.017	0.26	11.6	11.6	URBAN	0.034	0.25	0.15	8.80	0.07	30	**Tc (Hrs)**	0.449	0.447	0.409	0.373	0.352	0.335
												Vel (f/s)	0.85	0.85	0.93	1.02	1.08	1.14
												R (Hrs)	0.528	0.526	0.477	0.430	0.403	0.382
11	0.204	0.64	18.9	18.9	URBAN	0.027	0.24	0.21	6.40	0.20	37	**Tc (Hrs)**	0.570	0.568	0.519	0.468	0.438	0.414
												Vel (f/s)	1.65	1.65	1.81	2.01	2.14	2.27
												R (Hrs)	0.343	0.342	0.310	0.276	0.256	0.241
12	0.124	0.72	15.4	15.4	URBAN	0.028	0.25	0.15	9.70	0.06	30	**Tc (Hrs)**	0.616	0.614	0.563	0.513	0.484	0.461
												Vel (f/s)	1.71	1.72	1.88	2.06	2.18	2.29
												R (Hrs)	0.546	0.544	0.494	0.446	0.418	0.396
13	0.391	1.29	14.0	14.0	URBAN	0.025	0.25	0.15	8.80	0.07	32	**Tc (Hrs)**	0.803	0.801	0.733	0.669	0.631	0.601
												Vel (f/s)	2.36	2.36	2.58	2.83	3.00	3.15
												R (Hrs)	0.608	0.605	0.549	0.495	0.465	0.440
14	0.100	0.36	22.3	22.3	URBAN	0.029	0.26	0.25	4.40	0.49	35	**Tc (Hrs)**	0.452	0.451	0.409	0.369	0.345	0.325
												Vel (f/s)	1.17	1.17	1.29	1.43	1.53	1.62
												R (Hrs)	0.252	0.251	0.225	0.201	0.186	0.174

APPENDIX B

Appendix B

HEC-1 Output Data
(10-yr, 6 hr)

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1***************************************                    ***************************************
*                                     *                    *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                    *  U.S. ARMY CORPS OF ENGINEERS        *
*             JUN  1998               *                    *  HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.1               *                    *        609 SECOND STREET            *
*                                     *                    *     DAVIS, CALIFORNIA 95616         *
* RUN DATE   20APR09  TIME  11:55:40  *                    *        (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   Olsson Associates
   3          ID   7250 N. 16th Street, Suite 210
   4          ID   Phoenix, AZ 85020
   5          ID
   6          ID   Date: April 8, 2009
   7          ID
   8          ID   File: CSD-10.dat
   9          ID
  10          ID   Inlet Hydrology for local watershed
  11          ID   Study Areas:  51st Ave. to 75th Ave. and Bethany Home Rd. to Camelback Rd.
  12          ID
  13          ID   Design Storm:  10 Year - 6 Hour
  14          ID   Land Use:  Fully Developed Conditions
  15          ID   Precipitation:  NOAA 2
  16          ID   Soil Losses: Green & Ampt
  17          ID   Unit Hydrograph: Clark Unit Hydrograph
  18          ID
  19          ID   ==========================================================================
  20          IT       5                 300
  21          IN      15
  22          IO       5
              *DIAGRAM
              *
  23          JD   1.970  0.0001
  24          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  25          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  26          PC   0.962   0.972   0.983   0.991   1.000
  27          JD   1.958  0.5000
  28          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  29          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  30          PC   0.962   0.972   0.983   0.991   1.000
  31          JD   1.921     2.8
  32          PC   0.000   0.009   0.016   0.025   0.034   0.042   0.051   0.059   0.068   0.077
  33          PC   0.088   0.101   0.121   0.164   0.253   0.451   0.694   0.836   0.900   0.938
  34          PC   0.950   0.963   0.975   0.988   1.000
              *

  35          KK      1A   BASIN
  36          BA   0.250
  37          LG    0.15    0.25    4.80    0.40      55
  38          UC   0.402   0.170
  39          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  40          UA     100
              *

  41          KK     D1A  DIVERT
  42          DT    DI1A
  43          DI     0.0     5.0    16.0    50.0   100.0   200.0   300.0   500.0
  44          DQ     0.0     0.0     0.0    34.0    84.0   184.0   284.0   484.0
              *
1                                        HEC-1 INPUT                                             PAGE  2

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

  45          KK     R1B   ROUTE
  46          RS       3    FLOW      -1
  47          RC   0.020   0.016   0.020    1335  0.0018
  48          RX    0.00    0.00    4.10    4.80   58.70   59.40   63.50   65.50
  49          RY  1137.5 1134.27 1134.13 1133.64 1134.02 1134.52 1134.53 1137.50
              *

  50          KK      1B   BASIN
  51          BA   0.125
  52          LG    0.15    0.25    4.80    0.40      55
  53          UC   0.325   0.157
  54          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  55          UA     100
              *

  56          KK    C-1B COMBINE
  57          HC       2   0.375
              *

  58          KK    DC1B  DIVERT
  59          DT   DIC1B
  60          DI     0.0    25.0    42.0    50.0   100.0   200.0   300.0   350.0
  61          DQ     0.0     0.0     0.0     8.0    58.0   158.0   258.0   308.0
```

```
                  *
  62              KK      R1C   ROUTE
  63              RS        2    FLOW      -1
  64              RC    0.020   0.016   0.020    1345  0.0028
  65              RX     0.00    0.00    4.00    4.70   71.90   72.70   76.70   76.70
  66              RY   1131.5 1128.30 1128.23 1127.68 1127.93 1128.34 1128.42 1131.50
                  *

  67              KK       1C   BASIN
  68              BA    0.125
  69              LG     0.16    0.25    5.70    0.27      51
  70              UC    0.367   0.195
  71              UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  72              UA      100
                  *

  73              KK     C-1C COMBINE
  74              HC        2   0.501
                  *

  75              KK     DC1C  DIVERT
  76              DT    DIC1C
  77              DI      0.0    25.0   167.0   575.0  1121.0
  78              DQ      0.0     0.0     4.0    31.0   105.0
                  *
```



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

  79              KK      R5C   ROUTE
  80              RS        1    FLOW      -1
  81              RC    0.020   0.016   0.020    1330  0.0026
  82              RX     0.00    0.00    6.00    6.60   85.60   86.30   91.20   91.20
  83              RY   1131.0 1128.07 1127.93 1127.44 1127.35 1127.74 1127.81 1131.00
                  *

  84              KK     DR5C  DIVERT
  85              DT    DIR5C
  86              DI      0.0    15.0    25.0    50.0   100.0   300.0   500.0
  87              DQ      0.0    15.0    25.0    50.0   100.0   300.0   500.0
                  *

  88              KK        2   BASIN
  89              BA    0.087
  90              LG     0.15    0.19    6.60    0.19      57
  91              UC    0.334   0.186
  92              UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  93              UA      100
                  *

  94              KK       D2  DIVERT
  95              DT      DI2
  96              DI      0.0    15.0    24.0    50.0   100.0   150.0   300.0   500.0
  97              DQ      0.0     0.0     0.0    26.0    76.0   126.0   276.0   476.0
                  *

  98              KK     R3-1   ROUTE
  99              RS        3    FLOW      -1
 100              RC    0.020   0.016   0.020    1340  0.0022
 101              RX     0.00    0.00    3.90    4.60   97.80   98.50  103.50  103.50
 102              RY   1129.6 1125.57 1125.56 1125.32 1126.06 1126.61 1126.76 1129.60
                  *

 103              KK        3   BASIN
 104              BA    0.163
 105              LG     0.15    0.25    5.00    0.37      55
 106              UC    0.377   0.182
 107              UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 108              UA      100
                  *

 109              KK     D1ARETRIEVE
 110              DR     DI1A
                  *

 111              KK     R3-2   ROUTE
 112              RS        2    FLOW      -1
 113              RC    0.020   0.016   0.020    2610  0.0027
 114              RX     0.00    0.00    4.00    4.80   60.70   61.30   65.20   65.20
 115              RY   1130.3 1127.33 1127.25 1126.87 1127.19 1127.63 1127.72 1130.30
                  *
```



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

 116              KK      C-3 COMBINE
 117              HC        3  0.5004
                  *

 118              KK      DC3  DIVERT
 119              DT     DIC3
 120              DI      0.0    23.0    50.0   100.0   125.0   150.0   300.0   600.0
 121              DQ      0.0     0.0    27.0    77.0   102.0   127.0   277.0   577.0
                  *

 122              KK     R4B1   ROUTE
 123              RS        3    FLOW      -1
 124              RC    0.020   0.016   0.020    1340  0.0022
 125              RX     0.00    0.00    4.00    5.20   97.80   98.50  102.50  102.50
 126              RY   1126.5 1122.69 1122.64 1122.32 1122.91 1123.38 1123.43 1126.50
                  *

 127              KK       4A   BASIN
 128              BA    0.064
 129              LG     0.25    0.25    4.80    0.35      45
 130              UC    0.226   0.086
 131              UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 132              UA      100
                  *

 133              KK     DC1BRETRIEVE
 134              DR    DIC1B
                  *
```

```
 135          KK      R4A   ROUTE
 136          RS        1    FLOW      -1
 137          RC    0.020   0.016   0.020    1325  0.0030
 138          RX     0.00    0.00    4.00    4.70   47.50   48.30   52.40   52.40
 139          RY   1131.5 1128.18 1128.06 1127.53 1127.43 1127.99 1128.07 1131.50
              *

 140          KK     C-4A COMBINE
 141          HC        2   0.439
              *

 142          KK      D4A  DIVERT
 143          DT    DID4A
 144          DI      0.0    63.0   103.0   151.0   358.0
 145          DQ      0.0    53.0    80.0   111.0   228.0
              *

 146          KK     R4B2   ROUTE
 147          RS        1    FLOW      -1
 148          RC    0.020   0.016   0.020    1315  0.0030
 149          RX     0.00    0.00    4.00    4.60   49.10   49.70   53.70   53.70
 150          RY   1130.5 1127.34 1127.38 1126.89 1126.81 1127.28 1127.48 1130.50
              *
1                                      HEC-1 INPUT                                          PAGE  5

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


 151          KK       4B   BASIN
 152          BA    0.062
 153          LG     0.22    0.25    4.80    0.36      51
 154          UC    0.261   0.117
 155          UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 156          UA      100
              *

 157          KK     C-4B COMBINE
 158          HC        3   0.751
              *

 159          KK     DC4B  DIVERT
 160          DT    DIC4B
 161          DI      0.0    25.0    46.0    50.0   100.0   150.0   300.0   600.0
 162          DQ      0.0     0.0     0.0     4.0    54.0   104.0   254.0   554.0
              *

 163          KK       5A   BASIN
 164          BA    0.029
 165          LG     0.22    0.23    6.20    0.20      51
 166          UC    0.221   0.114
 167          UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 168          UA      100
              *

 169          KK       5B   BASIN
 170          BA    0.021
 171          LG     0.25    0.25    4.80    0.35      45
 172          UC    0.197   0.108
 173          UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 174          UA      100
              *

 175          KK     D4ARETRIEVE
 176          DR    DID4A
              *

 177          KK     C-5B COMBINE
 178          HC        2   0.459
              *

 179          KK     DC5B  DIVERT
 180          DT   DIDC5B
 181          DI      0.0    15.0    31.0    77.0   159.0   269.0   332.0
 182          DQ      0.0    13.0    27.0    58.0   110.0   174.0   209.0
              *

 183          KK      R5A   ROUTE
 184          RS        3    FLOW      -1
 185          RC    0.020   0.016   0.020    2030  0.0021
 186          RX     0.00    0.00    4.00    4.70   40.30   41.00   45.10   45.10
 187          RY   1126.5 1123.46 1123.33 1122.86 1122.94 1123.40 1123.48 1126.50
              *
1                                      HEC-1 INPUT                                          PAGE  6

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


 188          KK   C-5A-1 COMBINE
 189          HC        2   0.488
              *

 190          KK   C-5A-2 COMBINE
 191          HC        2     0.8
              *

 192          KK       5C   BASIN
 193          BA    0.043
 194          LG     0.20    0.25    4.80    0.38      57
 195          UC    0.213   0.097
 196          UA        0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 197          UA      100
              *

 198          KK     DC5BRETRIEVE
 199          DR   DIDC5B
              *

 200          KK     DR5CRETRIEVE
 201          DR    DIR5C
              *

 202          KK     C-5C COMBINE
 203          HC        3   0.628
              *

 204          KK      R5D   ROUTE
 205          RS        1    FLOW      -1
```

```
 206            RC   0.020   0.016   0.020    1330  0.0026
 207            RX    0.00    0.00    6.00    6.60   85.60   86.30   91.20   91.20
 208            RY  1131.0 1128.07 1127.93 1127.44 1127.35 1127.74 1127.81 1131.00
                *

 209            KK      5D   BASIN
 210            BA   0.033
 211            LG    0.10    0.25    4.80    0.43      80
 212            UC   0.211   0.117
 213            UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 214            UA     100
                *

 215            KK    C-5D COMBINE
 216            HC       3   1.002
                *

 217            KK     DC1CRETRIEVE
 218            DR   DIC1C
                *
```



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

 219            KK      R6   ROUTE
 220            RS       5    FLOW      -1
 221            RC   0.020   0.016   0.020    1580  0.0025
 222            RX    0.00    0.00    3.90    4.60   60.60   61.30   63.30   63.30
 223            RY  1131.8 1128.49 1128.35 1127.83 1128.13 1128.71 1128.77 1131.80
                *

 224            KK       6   BASIN
 225            BA   0.168
 226            LG    0.23    0.15    7.60    0.12      45
 227            UC   0.412   0.230
 228            UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 229            UA     100
                *

 230            KK     C-6 COMBINE
 231            HC       2   0.669
                *

 232            KK     DC6  DIVERT
 233            DT   DIDC6
 234            DI     0.0    24.0    92.0   289.0   655.0
 235            DQ     0.0    24.0    92.0   286.0   591.0
                *

 236            KK      7A   BASIN
 237            BA   0.052
 238            LG    0.22    0.25    5.20    0.31      52
 239            UC   0.218   0.089
 240            UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 241            UA     100
                *

 242            KK    C-7A COMBINE
 243            HC       2   0.721
                *

 244            KK    DC7A  DIVERT
 245            DT  DIDC7A
 246            DI     0.0    38.0   112.0   215.0   432.0
 247            DQ     0.0     6.0    31.0    68.0   165.0
                *

 248            KK      7B   BASIN
 249            BA   0.032
 250            LG    0.23    0.21    6.40    0.19      44
 251            UC   0.278   0.182
 252            UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 253            UA     100
                *
```



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

 254            KK    C-7B COMBINE
 255            HC       2   0.753
                *

 256            KK    DC7B  DIVERT
 257            DT  DIDC7B
 258            DI     0.0    26.0    83.0   180.0   255.0
 259            DQ     0.0     1.0    19.0    63.0    91.0
                *

 260            KK     R7C   ROUTE
 261            RS       1    FLOW      -1
 262            RC   0.020   0.016   0.020    1150  0.0022
 263            RX    0.00    0.00    4.20    5.70   42.60   44.00   48.10   48.10
 264            RY  1120.9 1177.92 1117.89 1117.63 1117.81 1118.17 1118.34 1120.92
                *

 265            KK      7C   BASIN
 266            BA   0.043
 267            LG    0.25    0.15    8.80    0.07      30
 268            UC   0.392   0.332
 269            UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 270            UA     100
                *

 271            KK    C-7C COMBINE
 272            HC       2   0.796
                *

 273            KK     DC7BRETRIEVE
 274            DR  DIDC7B
                *

 275            KK     R9C   ROUTE
 276            RS       4    FLOW      -1
 277            RC   0.020   0.016   0.020    2310  0.0024
 278            RX    0.00    0.00    4.00    5.60   42.50   44.00   47.80   47.80
```

```
279          RY  1120.7 1117.71 1117.78 1117.34 1117.21 1117.56 1117.66 1120.71
             *

280          KK     DC7ARETRIEVE
281          DR   DIDC7A
             *

282          KK      R9B   ROUTE
283          RS        4    FLOW      -1
284          RC    0.020   0.016   0.020     2580  0.0027
285          RX     0.00    0.00    4.00     5.60   42.50   44.00   47.80   47.80
286          RY  1120.7 1117.71 1117.78 1117.34 1117.21 1117.56 1117.66 1120.71
             *
```



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

287          KK     DC6RETRIEVE
288          DR   DIDC6
             *

289          KK       R8   ROUTE
290          RS        1    FLOW      -1
291          RC    0.020   0.016   0.020     1195  0.0025
292          RX     0.00    0.00    4.10     4.70   51.40   52.10   56.00   56.00
293          RY  1127.0 1124.61 1124.58 1124.00 1123.00 1123.55 1123.62 1127.00
             *

294          KK        8   BASIN
295          BA    0.105
296          LG     0.25    0.15    9.70     0.06      30
297          UC    0.555   0.510
298          UA        0     5.0    16.0     30.0    65.0    77.0    84.0    90.0    94.0    97.0
299          UA      100
             *

300          KK      C-8 COMBINE
301          HC        2   0.774
             *

302          KK      DC8  DIVERT
303          DT    DIDC8
304          DI      0.0    15.0    93.0    230.0   463.0
305          DQ      0.0    10.0    42.0    122.0   268.0
             *

306          KK      R9A   ROUTE
307          RS        2    FLOW      -1
308          RC    0.020   0.016   0.020     2580  0.0027
309          RX     0.00    0.00    4.00     4.60   51.60   52.20   56.30   56.30
310          RY  1119.5 1116.26 1116.19 1115.62 1115.30 1115.87 1115.92 1119.50
             *

311          KK        9   BASIN
312          BA    0.102
313          LG     0.25    0.15    7.60     0.11      30
314          UC    0.486   0.389
315          UA        0     5.0    16.0     30.0    65.0    77.0    84.0    90.0    94.0    97.0
316          UA      100
             *

317          KK      C-9 COMBINE
318          HC        4   0.960
             *

319          KK      10A   BASIN
320          BA    0.036
321          LG     0.25    0.15    9.70     0.06      30
322          UC    0.399   0.338
323          UA        0     5.0    16.0     30.0    65.0    77.0    84.0    90.0    94.0    97.0
324          UA      100
             *
```



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

325          KK     D10A  DIVERT
326          DT    DI10A
327          DI      0.0     8.0    43.0     95.0   274.0
328          DQ      0.0     0.0     1.0      6.0    34.0
             *

329          KK      10B   BASIN
330          BA    0.017
331          LG     0.25    0.15    8.80     0.07      30
332          UC    0.409   0.477
333          UA        0     5.0    16.0     30.0    65.0    77.0    84.0    90.0    94.0    97.0
334          UA      100
             *

335          KK    C-10B COMBINE
336          HC        2   0.053
             *

337          KK     D10ARETRIEVE
338          DR    DI10A
             *

339          KK     R12A   ROUTE
340          RS        3    FLOW      -1
341          RC    0.020   0.016   0.020     1550  0.0026
342          RX     0.00    0.00    4.00     5.60   42.50   44.00   47.80   47.80
343          RY  1120.7 1117.71 1117.78 1117.34 1117.21 1117.56 1117.66 1120.71
             *

344          KK     DC8RETRIEVE
345          DR    DIDC8
             *

346          KK      R11   ROUTE
347          RS        2    FLOW      -1
348          RC    0.020   0.016   0.020     2350  0.0021
349          RX     0.00    0.00    4.00     4.70   51.30   51.90   55.90   55.90
350          RY  1123.5 1120.28 1120.31 1119.74 1119.80 1120.34 1120.46 1123.50
             *
```

```
351          KK      11   BASIN
352          BA   0.204
353          LG    0.24    0.21    6.40    0.20      37
354          UC   0.519   0.310
355          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
356          UA     100
             *

357          KK    C-11 COMBINE
358          HC       2   0.978
             *
```



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

359          KK    DC11  DIVERT
360          DT  DIDC11
361          DI     0.0    13.0   114.0   261.0   457.0
362          DQ     0.0     0.0     0.0     0.0     0.0
             *

363          KK    R12B   ROUTE
364          RS       2    FLOW      -1
365          RC   0.020   0.016   0.020    2010  0.0030
366          RX    0.00    0.00    3.90    5.60  101.90  102.50  107.70  107.70
367          RY  1114.0 1110.36 1110.23 1109.87 1110.39 1110.86 1110.77 1114.00
             *

368          KK      12   BASIN
369          BA   0.124
370          LG    0.25    0.15    9.70    0.06      30
371          UC   0.563   0.494
372          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
373          UA     100
             *

374          KK    C-12 COMBINE
375          HC       3   1.138
             *

376          KK    DC11RETRIEVE
377          DR  DIDC11
             *

378          KK     R13   ROUTE
379          RS       3    FLOW      -1
380          RC   0.020   0.016   0.020    3975  0.0033
381          RX    0.00    0.00    4.00    4.60   47.80   48.40   52.40   52.40
382          RY  1114.2 1111.17 1111.13 1110.65 1110.48 1110.94 1110.98 1114.17
             *

383          KK      13   BASIN
384          BA   0.391
385          LG    0.25    0.15    8.80    0.07      32
386          UC   0.733   0.549
387          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
388          UA     100
             *

389          KK    C-13 COMBINE
390          HC       2   1.369
             *

391          KK    DC13  DIVERT
392          DT  DIDC13
393          DI     0.0    23.0    87.0   283.0   811.0
394          DQ     0.0    23.0    74.0   213.0   527.0
             *
```



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

395          KK     R14   ROUTE
396          RS       3    FLOW      -1
397          RC   0.020   0.016   0.020    2620  0.0024
398          RX    0.00    0.00    3.90    4.50   47.10   47.70   51.70   51.70
399          RY  1102.5 1099.31 1099.24 1098.76 1098.80 1099.29 1099.40 1102.50
             *

400          KK    DR14  DIVERT
401          DT  DIDR14
402          DI     0.0    15.0    22.0    25.0    50.0   100.0   150.0   200.0   300.0   400.0
403          DQ     0.0     0.0     0.0     3.0    28.0    88.0   128.0   188.0   288.0   388.0
             *

404          KK      14   BASIN
405          BA   0.100
406          LG    0.26    0.25    4.40    0.49      35
407          UC   0.409   0.225
408          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
409          UA     100
             *

410          KK    C-14 COMBINE
411          HC       2   1.469
412          ZZ
```

```
1
           SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

   35         1A
              .
              .
   42         .------->     DI1A
   41        D1A
              V
              V
   45        R1B
              .
              .
   50         .           1B
```

```
            .         .
 56      C-1B..........
            .
 59         .------->  DIC1B
 58      DC1B
            V
            V
 62       R1C
            .
 67         .        1C
            .         .
 73      C-1C..........
            .
 76         .------->  DIC1C
 75      DC1C
            V
            V
 79       R5C
            .
 85         .------->  DIR5C
 84      DR5C
            .
 88         .         2
            .         .
 95         .         .------->  DI2
 94         .        D2
            .         V
            .         V
 98         .      R3-1
            .         .
103         .         .         3
            .         .         .
110         .         .         .         .<-------  DI1A
109         .         .         .       D1A
            .         .         .         V
            .         .         .         V
111         .         .         .      R3-2
            .         .         .         .
116         .       C-3....................
            .         .
119         .         .------->  DIC3
118         .       DC3
            .         V
            .         V
122         .      R4B1
            .         .
127         .         .        4A
            .         .         .
134         .         .         .         .<-------  DIC1B
133         .         .         .      DC1B
            .         .         .         V
            .         .         .         V
135         .         .         .       R4A
            .         .         .         .
140         .         .      C-4A..........
            .         .         .
143         .         .         .------->  DID4A
142         .         .       D4A
            .         .         V
            .         .         V
146         .         .      R4B2
            .         .         .
151         .         .         .        4B
            .         .         .         .
157         .      C-4B....................
            .         .
160         .         .------->  DIC4B
159         .      DC4B
            .         .
163         .         .        5A
            .         .         .
169         .         .         .        5B
            .         .         .         .
176         .         .         .         .         .<-------  DID4A
175         .         .         .         .       D4A
            .         .         .         .         .
177         .         .         .      C-5B..........
            .         .         .         .
180         .         .         .         .------->  DIDC5B
179         .         .         .      DC5B
            .         .         .         V
            .         .         .         V
183         .         .         .       R5A
            .         .         .         .
188         .         .    C-5A-1..........
            .         .         .
190         .    C-5A-2..........
            .         .
192         .         .        5C
            .         .         .
```

```
199         .         .         .         .<-------  DIDC5B
198         .         .         .      DC5B
            .         .         .         .
201         .         .         .         .          .<-------  DIR5C
200         .         .         .         .       DR5C
            .         .         .         .          .
202         .         .      C-5C.......................
            .         .          V
            .         .          V
204         .         .       R5D
            .         .         .
209         .         .         .        5D
            .         .         .         .
215         .     C-5D.......................
            .         .         .
218         .         .         .<-------  DIC1C
217         .         .      DC1C
            .         .          V
            .         .          V
219         .         .        R6
            .         .         .
224         .         .         .         6
            .         .         .         .
230         .         .       C-6...........
            .         .         .
233         .         .         .------->  DIDC6
232         .         .       DC6
            .         .         .
236         .         .         .        7A
            .         .         .         .
242         .         .      C-7A...........
            .         .         .
245         .         .         .------->  DIDC7A
244         .         .      DC7A
            .         .         .
248         .         .         .        7B
            .         .         .         .
254         .         .      C-7B...........
            .         .         .
257         .         .         .------->  DIDC7B
256         .         .      DC7B
            .         .          V
            .         .          V
260         .         .       R7C
            .         .         .
265         .         .         .        7C
            .         .         .         .
271         .         .      C-7C...........
            .         .         .
274         .         .         .         .<-------  DIDC7B
273         .         .         .      DC7B
            .         .         .          V
            .         .         .          V
275         .         .         .       R9C
            .         .         .         .
281         .         .         .         .          .<-------  DIDC7A
280         .         .         .         .       DC7A
            .         .         .         .          V
            .         .         .         .          V
282         .         .         .         .       R9B
            .         .         .         .          .
288         .         .         .         .          .          .<-------  DIDC6
287         .         .         .         .          .        DC6
            .         .         .         .          .          V
            .         .         .         .          .          V
289         .         .         .         .          .         R8
            .         .         .         .          .          .
294         .         .         .         .          .          .         8
            .         .         .         .          .          .         .
300         .         .         .         .          .        C-8...........
            .         .         .         .          .          .
303         .         .         .         .          .          .------->  DIDC8
302         .         .         .         .          .        DC8
            .         .         .         .          .          V
            .         .         .         .          .          V
306         .         .         .         .          .        R9A
            .         .         .         .          .          .
311         .         .         .         .          .          .         9
            .         .         .         .          .          .         .
317         .         .         .       C-9.................................
            .         .         .         .
319         .         .         .         .       10A
            .         .         .         .          .
326         .         .         .         .          .------->  DI10A
325         .         .         .         .       D10A
            .         .         .         .          .
329         .         .         .         .          .        10B
            .         .         .         .          .          .
```

```
335        .         .         .         .      C-10B...........
                                                  .
338        .         .         .         .        .    .<-------   DI10A
337        .         .         .         .        .   D10A
           .         .         .         .        .    V
           .         .         .         .        .    V
339        .         .         .         .        .   R12A
           .         .         .         .        .    .
345        .         .         .         .        .    .         .<-------   DIDC8
344        .         .         .         .        .    .        DC8
           .         .         .         .        .    .         V
           .         .         .         .        .    .         V
346        .         .         .         .        .    .        R11
           .         .         .         .        .    .         .
351        .         .         .         .        .    .         .         11
           .         .         .         .        .    .         .          .
357        .         .         .         .        .    .        C-11...........
           .         .         .         .        .    .         .
360        .         .         .         .        .    .         .------->  DIDC11
359        .         .         .         .        .    .        DC11
           .         .         .         .        .    .         V
           .         .         .         .        .    .         V
363        .         .         .         .        .    .        R12B
           .         .         .         .        .    .         .
368        .         .         .         .        .    .         .         12
           .         .         .         .        .    .         .          .
374        .         .         .         .        .   C-12.......................
           .         .         .         .        .    .
377        .         .         .         .        .    .         .<-------  DIDC11
376        .         .         .         .        .    .        DC11
           .         .         .         .        .    .         V
           .         .         .         .        .    .         V
378        .         .         .         .        .    .        R13
           .         .         .         .        .    .         .
383        .         .         .         .        .    .         .         13
           .         .         .         .        .    .         .          .
389        .         .         .         .        .    .        C-13...........
           .         .         .         .        .    .         .
392        .         .         .         .        .    .         .------->  DIDC13
391        .         .         .         .        .    .        DC13
           .         .         .         .        .    .         V
           .         .         .         .        .    .         V
395        .         .         .         .        .    .        R14
           .         .         .         .        .    .         .
401        .         .         .         .        .    .         .------->  DIDR14
400        .         .         .         .        .    .        DR14
           .         .         .         .        .    .         .
404        .         .         .         .        .    .         .         14
           .         .         .         .        .    .         .          .
410        .         .         .         .        .    .        C-14...........

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
1*****************************************                    ***************************************
 *                                         *                  *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)     *                  *   U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998                 *                  *   HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1                  *                  *        609 SECOND STREET            *
 *                                         *                  *     DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   20APR09  TIME  11:55:40     *                  *        (916) 756-1104               *
 *                                         *                  *                                     *
 *****************************************                    ***************************************
```

```
                 Olsson Associates
                 7250 N. 16th Street, Suite 210
                 Phoenix, AZ 85020

                 Date: April 8, 2009

                 File: CSD-10.dat

                 Inlet Hydrology for local watershed
                 Study Areas:  51st Ave. to 75th Ave. and Bethany Home Rd. to Camelback Rd.

                 Design Storm:  10 Year - 6 Hour
                 Land Use:  Fully Developed Conditions
                 Precipitation:  NOAA 2
                 Soil Losses: Green & Ampt
                 Unit Hydrograph: Clark Unit Hydrograph

                 ======================================================================

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

    IT        HYDROGRAPH TIME DATA
                    NMIN          5  MINUTES IN COMPUTATION INTERVAL
                   IDATE     1    0  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE     2    0  ENDING DATE
                  NDTIME       0055  ENDING TIME
                   ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   24.92 HOURS
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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

23 JD          INDEX STORM NO. 1
                      STRM       1.97  PRECIPITATION DEPTH
                      TRDA        .00  TRANSPOSITION DRAINAGE AREA

24 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       .01       .01       .01       .01       .01       .01       .03
                   .03       .03       .05       .05       .05       .15       .15       .15       .03       .03
                   .03       .01       .01       .01       .01       .01       .01       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00

27 JD          INDEX STORM NO. 2
                      STRM       1.96  PRECIPITATION DEPTH
                      TRDA        .50  TRANSPOSITION DRAINAGE AREA

28 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       .01       .01       .01       .01       .01       .01       .03
                   .03       .03       .05       .05       .05       .15       .15       .15       .03       .03
                   .03       .01       .01       .01       .01       .01       .01       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00

31 JD          INDEX STORM NO. 3
                      STRM       1.92  PRECIPITATION DEPTH
                      TRDA       2.80  TRANSPOSITION DRAINAGE AREA

32 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       .01       .01       .01       .01       .01       .01       .03
                   .03       .03       .07       .07       .07       .08       .08       .08       .05       .05
                   .05       .02       .02       .02       .01       .01       .01       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00
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	1A	325.	4.08	36.	9.	9.	.25		
+	DIVERSION TO	DI1A	309.	4.08	27.	7.	6.	.25		
+	HYDROGRAPH AT	D1A	16.	3.42	9.	2.	2.	.25		
+	ROUTED TO	R1B	16.	4.50	9.	2.	2.	.25		
+	HYDROGRAPH AT	1B	178.	4.08	18.	5.	4.	.13		
+	2 COMBINED AT	C-1B	193.	4.08	27.	7.	7.	.38		
+	DIVERSION TO	DIC1B	151.	4.08	10.	2.	2.	.38		
+	HYDROGRAPH AT	DC1B	42.	3.67	18.	4.	4.	.38		
+	ROUTED TO	R1C	42.	4.08	17.	4.	4.	.38		
+	HYDROGRAPH AT	1C	161.	4.08	18.	5.	4.	.13		
+	2 COMBINED AT	C-1C	203.	4.08	35.	9.	9.	.50		
+	DIVERSION TO	DIC1C	6.	4.08	1.	0.	0.	.50		
+	HYDROGRAPH AT	DC1C	197.	4.08	35.	9.	8.	.50		
+	ROUTED TO	R5C	188.	4.17	35.	9.	8.	.50		
+	DIVERSION TO	DIR5C	188.	4.17	35.	9.	8.	.50		
+	HYDROGRAPH AT	DR5C	0.	.00	0.	0.	0.	.50		
+	HYDROGRAPH AT	2	126.	4.08	14.	3.	3.	.09		
+	DIVERSION TO	DI2	102.	4.08	7.	2.	2.	.09		
+	HYDROGRAPH AT	D2	24.	3.75	7.	2.	2.	.09		

ROUTED TO

+		R3-1	24.	4.25	7.	2.	2.	.09
+	HYDROGRAPH AT	3	212.	4.08	24.	6.	6.	.16
+	HYDROGRAPH AT	D1A	309.	4.08	27.	7.	6.	.25
+	ROUTED TO	R3-2	287.	4.25	27.	7.	6.	.25
+	3 COMBINED AT	C-3	502.	4.17	57.	14.	14.	.50
+	DIVERSION TO	DIC3	479.	4.17	45.	11.	11.	.50
+	HYDROGRAPH AT	DC3	23.	3.50	12.	3.	3.	.50
+	ROUTED TO	R4B1	23.	4.33	12.	3.	3.	.50
+	HYDROGRAPH AT	4A	105.	4.00	8.	2.	2.	.06
+	HYDROGRAPH AT	DC1B	151.	4.08	10.	2.	2.	.38
+	ROUTED TO	R4A	139.	4.17	10.	2.	2.	.38
+	2 COMBINED AT	C-4A	221.	4.08	18.	5.	4.	.44
+	DIVERSION TO	DID4A	151.	4.08	14.	3.	3.	.44
+	HYDROGRAPH AT	D4A	70.	4.08	5.	1.	1.	.44
+	ROUTED TO	R4B2	60.	4.17	5.	1.	1.	.44
+	HYDROGRAPH AT	4B	96.	4.08	9.	2.	2.	.06
+	3 COMBINED AT	C-4B	146.	4.08	25.	6.	6.	.75
+	DIVERSION TO	DIC4B	100.	4.08	6.	2.	2.	.75
+	HYDROGRAPH AT	DC4B	46.	3.83	19.	5.	5.	.75
+	HYDROGRAPH AT	5A	48.	4.00	4.	1.	1.	.03
+	HYDROGRAPH AT	5B	34.	4.00	3.	1.	1.	.02
+	HYDROGRAPH AT	D4A	151.	4.08	14.	3.	3.	.44
+	2 COMBINED AT	C-5B	181.	4.08	17.	4.	4.	.46
+	DIVERSION TO	DIDC5B	123.	4.08	12.	3.	3.	.46
+	HYDROGRAPH AT	DC5B	58.	4.08	4.	1.	1.	.46
+	ROUTED TO	R5A	50.	4.25	4.	1.	1.	.46
+	2 COMBINED AT	C-5A-1	77.	4.17	8.	2.	2.	.49
+	2 COMBINED AT	C-5A-2	113.	4.17	27.	7.	7.	.80
+	HYDROGRAPH AT	5C	73.	4.00	6.	2.	2.	.04
+	HYDROGRAPH AT	DC5B	123.	4.08	12.	3.	3.	.46
+	HYDROGRAPH AT	DR5C	188.	4.17	35.	9.	8.	.50
+	3 COMBINED AT	C-5C	341.	4.08	53.	13.	13.	.63
+	ROUTED TO	R5D	329.	4.17	53.	13.	13.	.63
+	HYDROGRAPH AT	5D	58.	4.00	6.	1.	1.	.03
+	3 COMBINED AT	C-5D	439.	4.17	84.	22.	21.	1.00
+	HYDROGRAPH AT	DC1C	6.	4.08	1.	0.	0.	.50
+	ROUTED TO	R6	4.	4.42	1.	0.	0.	.50
+	HYDROGRAPH AT	6	214.	4.17	26.	6.	6.	.17
+	2 COMBINED AT	C-6	203.	4.17	26.	6.	6.	.67
	DIVERSION TO							

+		DIDC6	201.	4.17	26.	6.	6.	.67
+	HYDROGRAPH AT	DC6	2.	4.17	0.	0.	0.	.67
+	HYDROGRAPH AT	7A	89.	4.00	7.	2.	2.	.05
+	2 COMBINED AT	C-7A	81.	4.00	7.	2.	2.	.72
+	DIVERSION TO	DIDC7A	20.	4.00	1.	0.	0.	.72
+	HYDROGRAPH AT	DC7A	60.	4.00	6.	1.	1.	.72
+	HYDROGRAPH AT	7B	45.	4.08	4.	1.	1.	.03
+	2 COMBINED AT	C-7B	97.	4.08	10.	3.	2.	.75
+	DIVERSION TO	DIDC7B	26.	4.08	2.	0.	0.	.75
+	HYDROGRAPH AT	DC7B	71.	4.08	9.	2.	2.	.75
+	ROUTED TO	R7C	71.	4.08	9.	2.	2.	.75
+	HYDROGRAPH AT	7C	47.	4.17	6.	2.	1.	.04
+	2 COMBINED AT	C-7C	111.	4.08	15.	4.	4.	.80
+	HYDROGRAPH AT	DC7B	26.	4.08	2.	0.	0.	.75
+	ROUTED TO	R9C	18.	4.33	2.	0.	0.	.75
+	HYDROGRAPH AT	DC7A	20.	4.00	1.	0.	0.	.72
+	ROUTED TO	R9B	13.	4.33	1.	0.	0.	.72
+	HYDROGRAPH AT	DC6	201.	4.17	26.	6.	6.	.67
+	ROUTED TO	R8	196.	4.17	26.	6.	6.	.67
+	HYDROGRAPH AT	8	88.	4.25	15.	4.	4.	.10
+	2 COMBINED AT	C-8	267.	4.17	40.	10.	10.	.77
+	DIVERSION TO	DIDC8	145.	4.17	21.	5.	5.	.77
+	HYDROGRAPH AT	DC8	121.	4.17	19.	5.	5.	.77
+	ROUTED TO	R9A	115.	4.33	19.	5.	5.	.77
+	HYDROGRAPH AT	9	95.	4.17	14.	4.	3.	.10
+	4 COMBINED AT	C-9	217.	4.33	35.	9.	9.	.96
+	HYDROGRAPH AT	10A	40.	4.17	5.	1.	1.	.04
+	DIVERSION TO	DI10A	1.	4.17	0.	0.	0.	.04
+	HYDROGRAPH AT	D10A	39.	4.17	5.	1.	1.	.04
+	HYDROGRAPH AT	10B	15.	4.17	2.	1.	1.	.02
+	2 COMBINED AT	C-10B	54.	4.17	8.	2.	2.	.05
+	HYDROGRAPH AT	D10A	1.	4.17	0.	0.	0.	.04
+	ROUTED TO	R12A	1.	4.50	0.	0.	0.	.04
+	HYDROGRAPH AT	DC8	145.	4.17	21.	5.	5.	.77
+	ROUTED TO	R11	137.	4.33	21.	5.	5.	.77
+	HYDROGRAPH AT	11	195.	4.17	26.	7.	6.	.20
+	2 COMBINED AT	C-11	285.	4.25	46.	12.	11.	.98
+	DIVERSION TO	DIDC11	0.	.00	0.	0.	0.	.98
+	HYDROGRAPH AT	DC11	285.	4.25	46.	12.	11.	.98
	ROUTED TO							

+		R12B	276.	4.42	46.	12.	11.	.98
+	HYDROGRAPH AT	12	105.	4.25	18.	5.	4.	.12
+	3 COMBINED AT	C-12	355.	4.33	63.	16.	15.	1.14
+	HYDROGRAPH AT	DC11	0.	.00	0.	0.	0.	.98
+	ROUTED TO	R13	0.	.00	0.	0.	0.	.98
+	HYDROGRAPH AT	13	295.	4.33	57.	14.	14.	.39
+	2 COMBINED AT	C-13	251.	4.33	54.	14.	13.	1.37
+	DIVERSION TO	DIDC13	190.	4.33	44.	11.	11.	1.37
+	HYDROGRAPH AT	DC13	61.	4.33	10.	2.	2.	1.37
+	ROUTED TO	R14	59.	4.58	10.	2.	2.	1.37
+	DIVERSION TO	DIDR14	39.	4.58	4.	1.	1.	1.37
+	HYDROGRAPH AT	DR14	22.	4.25	6.	1.	1.	1.37
+	HYDROGRAPH AT	14	99.	4.17	11.	3.	3.	.10
+	2 COMBINED AT	C-14	82.	4.25	15.	4.	4.	1.47

*** NORMAL END OF HEC-1 ***

APPENDIX C

Appendix C

Offsite Rational Calculation Supporting Documentation

C.1 Rational Method Input Data

Project

Reference	008- 2678
Title	Camelback Storm Drain Rational Method Subbasins
Location	Maricopa County, AZ
Agency	Flood Control District of Maricopa County

Project Defaults

Model	Rational
Land Use Agency	FCDMC
Rainfall	NOAA
Roads and Inlets Agency	FCDMC

Comments

	Duration	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Rainfall Method: NOAA							
	5 MIN	0.330	0.420	0.480	0.570	0.630	0.700
	10 MIN	0.490	0.630	0.730	0.860	0.970	1.080
	15 MIN	0.590	0.790	0.920	1.100	1.240	1.380
	30 MIN	0.790	1.050	1.230	1.480	1.680	1.870
	1 HOUR	0.960	1.300	1.530	1.850	2.100	2.340
	2 HOUR	1.040	1.420	1.680	2.030	2.310	2.580
	3 HOUR	1.100	1.500	1.780	2.160	2.450	2.740
	6 HOUR	1.200	1.660	1.970	2.390	2.720	3.050
	12 HOUR	1.300	1.830	2.180	2.670	3.050	3.420
	24 HOUR	1.400	2.000	2.400	2.950	3.380	3.800

PART E

Depth - Duration - Frequency (DDF)

Rainfall Depth, in inches							
	Frequency, in years						
Duration	2	5	10	25	50	100	500
5-min	0.33	0.41	0.48	0.57	0.63	0.70	0.86
10-min	0.49	0.63	0.73	0.86	0.97	1.08	1.32
15-min	0.59	0.78	0.92	1.10	1.24	1.38	1.71
30-min	0.79	1.05	1.23	1.48	1.68	1.87	2.32
1-hour	0.96	1.30	1.53	1.85	2.10	2.34	2.91
2-hour	1.04	1.42	1.68	2.03	2.31	2.58	3.22
3-hour	1.10	1.50	1.78	2.16	2.45	2.74	3.42
6-hour	1.20	1.66	1.96	2.39	2.72	3.05	3.81
12-hour	1.30	1.83	2.18	2.67	3.05	3.43	4.29
24-hour	1.40	2.00	2.40	2.95	3.38	3.80	4.78

Intensity - Duration - Frequency (IDF)

Rainfall Intensity, in inches per hour								
		Frequency, in years						
Duration	minutes	2	5	10	25	50	100	500
5-min	5	3.91	4.98	5.72	6.79	7.61	8.43	10.33
10-min	10	2.93	3.77	4.36	5.18	5.83	6.46	7.94
15-min	15	2.38	3.14	3.66	4.39	4.96	5.53	6.83
30-min	30	1.57	2.10	2.46	2.97	3.36	3.75	4.65
1-hour	60	0.96	1.30	1.53	1.85	2.10	2.34	2.91
2-hour	120	0.52	0.71	0.84	1.02	1.15	1.29	1.61
3-hour	180	0.37	0.50	0.59	0.72	0.82	0.91	1.14
6-hour	360	0.20	0.28	0.33	0.40	0.45	0.51	0.63
12-hour	720	0.11	0.15	0.18	0.22	0.25	0.29	0.36
24-hour	1440	0.06	0.08	0.10	0.12	0.14	0.16	0.20

Land Use Data for Rational Area

Basin ID	Area (sq.ft)	Area (ac.)	Land Use Type	Flow Length [ft]	Upstream Elev [ft]	Dnstream Elev[ft]
A	116580	2.6763	MLR	370	1121	1120
B	52464	1.2044	MLR	265	1120.5	1119
C	283550	6.5094	MLR	1011	1121	1118
D	79206	1.8183	MLR	412	1119	1117
E	219723	5.0442	MLR	1039	1119	1115
F	175655	4.0325	MLR	820	1118	1115
G	122647	2.8156	MLR	571	1116	1114
H	108785	2.4974	MLR	418	1114	1113
I	123747	2.8408	MLR	498	1112.5	1111
J	92143	2.1153	MLR	325	1112	1110
K	90171	2.0700	MLR	424	1112	1110
L	161654	3.7111	CC	710	1110	1109
M	360908	8.2853	CC	1185	1110	1108
N	454820	10.4412	CC	823	1109	1106
O	1078246	24.7531	MLR	2160	1110	1104
P	291265	6.6865	MLR	1258	1106.5	1104
Q	4638538	106.4862	MLR	4680	1112	1100
R	581192	13.3423	MLR	2306	1106	1100
S	347972	7.9883	MLR	1187	1098	1096
	96017	2.2043	NC			
	443990	10.1926				

F:\Projects\008-2678_WTRS\CALCS\Hydrology\HEC-1\Land Use Data.xls

Sub Basin	Land Use Code	Area (acres)	Area (%)	Kb	Runoff Coefficient C 2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin ID: 01										
A	140	2.68	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		2.676	**100.0**							
B	140	1.20	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		1.204	**100.0**							
C	140	6.51	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		6.509	**100.0**							
D	140	1.82	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		1.818	**100.0**							
E	140	5.04	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		5.044	**100.0**							
F	140	4.03	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		4.033	**100.0**							
G	140	2.82	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		2.816	**100.0**							
H	140	2.50	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		2.497	**100.0**							
I	140	2.84	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		2.841	**100.0**							
J	140	2.12	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		2.115	**100.0**							
K	140	2.07	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		2.070	**100.0**							
L	230	3.71	100.0	MIN	0.85	0.85	0.85	0.94	0.95	0.95
		3.711	**100.0**							
M	230	8.28	100.0	MIN	0.85	0.85	0.85	0.94	0.95	0.95
		8.280	**100.0**							
N	230	10.44	100.0	MIN	0.85	0.85	0.85	0.94	0.95	0.95
		10.441	**100.0**							
O	140	24.75	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		24.753	**100.0**							
P	140	6.69	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		6.687	**100.0**							
Q	140	106.49	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		106.486	**100.0**							
R	140	13.34	100.0	MIN	0.48	0.48	0.48	0.53	0.58	0.60
		13.342	**100.0**							

Sub Basin	Land Use Code	Area (acres)	Area (%)	Kb	Runoff Coefficient C					
					2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin ID: 01										
S	140	7.99	78.4	MIN	0.48	0.48	0.48	0.53	0.58	0.60
	220	2.20	21.6	MIN	0.85	0.85	0.85	0.94	0.95	0.95
		10.193	**100.0**							

C.2 DDMSW Output Data

ID	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	Sub Basin Data								Sub Basin Hydrology Summary					
Major Basin ID: 01														
A	2.7	370	1,121.00	1,120.00	14.3	0.04	-	Q (cfs)	4	5	6	7	9	10
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	1.29	1.29	1.29	1.42	1.55	1.61
								Tc (min)	10	10	10	10	10	10
								i (in/hr)	2.94	3.78	4.38	5.16	5.82	6.48
B	1.2	265	1,120.50	1,119.00	29.9	0.04	-	Q (cfs)	2	2	3	3	4	5
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	0.58	0.58	0.58	0.64	0.70	0.72
								Tc (min)	10	10	10	10	10	10
								i (in/hr)	2.94	3.78	4.38	5.16	5.82	6.48
C	6.5	1,011	1,121.00	1,118.00	15.7	0.03	-	Q (cfs)	7	10	12	17	21	25
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	3.12	3.12	3.12	3.45	3.78	3.91
								Tc (min)	16	14	13	12	12	11
								i (in/hr)	2.30	3.28	3.95	4.84	5.46	6.28
D	1.8	412	1,119.00	1,117.00	25.6	0.04	-	Q (cfs)	3	3	4	5	6	7
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	0.87	0.87	0.87	0.96	1.06	1.09
								Tc (min)	10	10	10	10	10	10
								i (in/hr)	2.94	3.78	4.38	5.16	5.82	6.48
E	5.0	1,039	1,119.00	1,115.00	20.3	0.04	-	Q (cfs)	6	8	10	13	17	20
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	2.42	2.42	2.42	2.67	2.92	3.02
								Tc (min)	15	13	12	12	11	10
								i (in/hr)	2.36	3.39	4.09	4.84	5.64	6.48
F	4.0	820	1,118.00	1,115.00	19.3	0.04	-	Q (cfs)	5	7	8	11	14	16
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	1.93	1.93	1.93	2.14	2.34	2.42

ID	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	Sub Basin Data								Sub Basin Hydrology Summary					
Major Basin ID: 01														
								Tc (min)	13	12	11	10	10	10
								i (in/hr)	2.58	3.52	4.23	5.16	5.82	6.48
G	2.8	571	1,116.00	1,114.00	18.5	0.04	-	Q (cfs)	4	5	6	8	10	11
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	1.35	1.35	1.35	1.49	1.64	1.69
								Tc (min)	11	10	10	10	10	10
								i (in/hr)	2.81	3.78	4.38	5.16	5.82	6.48
H	2.5	418	1,114.00	1,113.00	12.6	0.04	-	Q (cfs)	3	5	5	7	8	10
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	1.20	1.20	1.20	1.33	1.45	1.50
								Tc (min)	11	10	10	10	10	10
								i (in/hr)	2.81	3.78	4.38	5.16	5.82	6.48
I	2.8	498	1,112.00	1,111.00	10.6	0.04	-	Q (cfs)	4	5	6	8	10	11
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	1.36	1.36	1.36	1.51	1.65	1.70
								Tc (min)	13	11	10	10	10	10
								i (in/hr)	2.58	3.65	4.38	5.16	5.82	6.48
J	2.1	325	1,112.00	1,110.00	32.5	0.04	-	Q (cfs)	3	4	5	6	7	8
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	1.02	1.02	1.02	1.12	1.23	1.27
								Tc (min)	10	10	10	10	10	10
								i (in/hr)	2.94	3.78	4.38	5.16	5.82	6.48
K	2.1	424	1,112.00	1,110.00	24.9	0.04	-	Q (cfs)	3	4	4	6	7	8
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	0.99	0.99	0.99	1.10	1.20	1.24
								Tc (min)	10	10	10	10	10	10
								i (in/hr)	2.94	3.78	4.38	5.16	5.82	6.48

* Non default value

ID	Sub Basin Data								Sub Basin Hydrology Summary					
	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin ID: 01														
L	3.7	710	1,110.00	1,109.00	7.4	0.04	-	Q (cfs)	7	10	12	16	19	21
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	3.15	3.15	3.15	3.49	3.52	3.52
								Tc (min)	18	16	15	13	13	12
								i (in/hr)	2.18	3.08	3.68	4.69	5.29	6.08
M	8.3	1,185	1,110.00	1,108.00	8.9	0.03	-	Q (cfs)	14	20	24	33	38	43
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	7.04	7.04	7.04	7.78	7.87	7.87
								Tc (min)	22	19	18	16	16	15
								i (in/hr)	1.96	2.83	3.40	4.29	4.83	5.52
N	10.4	823	1,109.00	1,106.00	19.2	0.03	-	Q (cfs)	23	32	38	51	58	64
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	8.87	8.87	8.87	9.81	9.92	9.92
								Tc (min)	13	11	11	10	10	10
								i (in/hr)	2.58	3.65	4.23	5.16	5.82	6.48
O	24.8	2,160	1,110.00	1,104.00	14.7	0.03	-	Q (cfs)	22	31	38	52	66	78
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	11.88	11.88	11.88	13.12	14.36	14.85
								Tc (min)	25	22	20	19	18	17
								i (in/hr)	1.81	2.61	3.22	3.96	4.59	5.24
P	6.7	1,258	1,106.50	1,104.00	10.5	0.03	-	Q (cfs)	6	9	11	15	19	22
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	3.21	3.21	3.21	3.55	3.88	4.01
								Tc (min)	22	19	18	16	15	15
								i (in/hr)	1.96	2.83	3.40	4.29	4.96	5.52
Q	106.5	4,680	1,112.00	1,100.00	13.5	0.03	-	Q (cfs)	70	101	122	172	224	265
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	51.12	51.12	51.12	56.44	61.76	63.89

ID	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	Sub Basin Data								Sub Basin Hydrology Summary					
Major Basin ID: 01														
								Tc (min)	39	34	32	29	27	26
								i (in/hr)	1.36	1.97	2.38	3.04	3.63	4.15
R	13.3	2,306	1,106.00	1,100.00	13.7	0.03	-	Q (cfs)	11	16	20	27	35	41
								C	0.48	0.48	0.48	0.53	0.58	0.60
								CA (ac)	6.40	6.40	6.40	7.07	7.74	8.00
								Tc (min)	28	24	22	20	19	18
								i (in/hr)	1.67	2.47	3.05	3.86	4.47	5.11
S	10.2	1,187	1,098.00	1,096.00	8.9	0.03	-	Q (cfs)	11	16	19	27	33	38
								C	0.56	0.56	0.56	0.62	0.66	0.68
								CA (ac)	5.71	5.71	5.71	6.32	6.73	6.93
								Tc (min)	22	19	18	16	15	15
								i (in/hr)	1.96	2.83	3.40	4.29	4.96	5.52

APPENDIX D

Appendix D

Hydraulics Supporting Documentation

Project:	**Camelback Storm Drain**	By:	**GMS**
Location :	**75th Ave to 59th Ave along Camelback Rd**	Date:	**8/30/2009**
Subject :	**Rainfall intensity determination for street flow calc in 59th & 67th Ave**	Project #:	**008-2678**

RAINFALL DEPTH-DURATION-FREQUENCY (D-D-F) WORKSHEET
AND INTENSITY-DURATION-FREQUENCY (I-D-F)CURVES

Determine rainfall depths from the isopluvial maps (Appendix B):

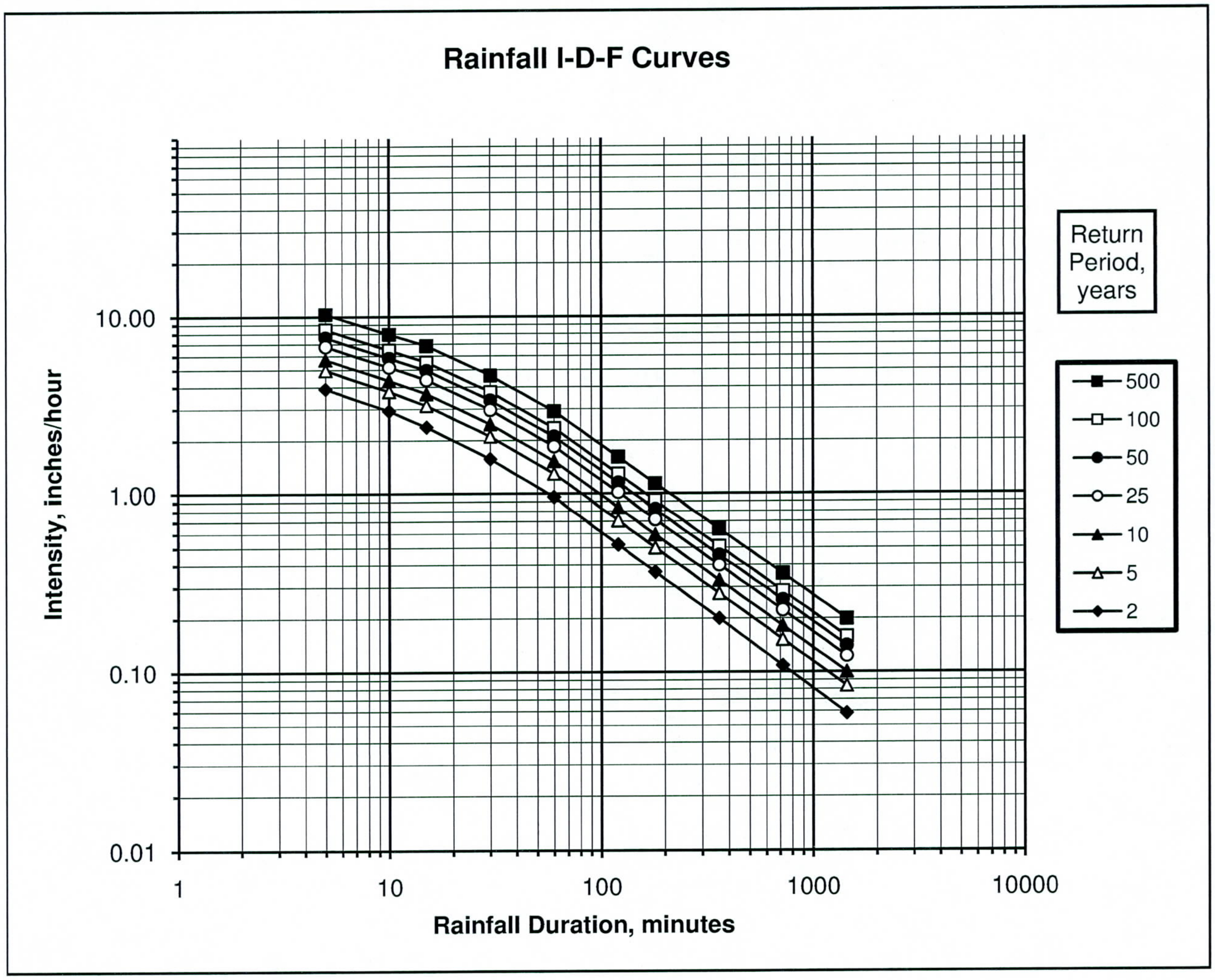
2-year, 6-hour	P2,6' =	1.2
2-year, 24-hour	P2,24' =	1.4
100-year, 6-hour	P100,6' =	3.05
100-year, 24-hour	P100,24' =	3.8
Short Duration Frequency Zone	Zone =	8

Depth - Duration - Frequency (DDF)

Rainfall Depth, in inches								
		Frequency, in years						
Duration	**minutes**	**2**	**5**	**10**	**25**	**50**	**100**	**500**
5-min	5	0.33	0.41	0.48	0.57	0.63	0.70	0.86
10-min	10	0.49	0.63	0.73	0.86	0.97	1.08	1.32
15-min	15	0.59	0.78	0.92	1.10	1.24	1.38	1.71
30-min	30	0.79	1.05	1.23	1.48	1.68	1.87	2.32
1-hour	60	0.96	1.30	1.53	1.85	2.10	2.34	2.91
2-hour	120	1.04	1.42	1.68	2.03	2.31	2.58	3.22
3-hour	180	1.10	1.50	1.78	2.16	2.45	2.74	3.42
6-hour	360	1.20	1.66	1.96	2.39	2.72	3.05	3.81
12-hour	720	1.30	1.83	2.18	2.67	3.05	3.43	4.29
24-hour	1440	1.40	2.00	2.40	2.95	3.38	3.80	4.78

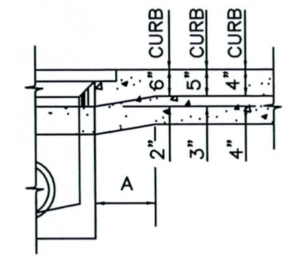
Intensity - Duration - Frequency (IDF)

Rainfall Intensity, in inches per hour								
		Frequency, in years						
Duration	minutes	2	5	10	25	50	100	500
5-min	5	3.91	4.98	5.72	6.79	7.61	8.43	10.33
10-min	10	2.93	3.77	4.36	5.18	5.83	6.46	7.94
15-min	15	2.38	3.14	3.66	4.39	4.96	5.53	6.83
30-min	30	1.57	2.10	2.46	2.97	3.36	3.75	4.65
1-hour	60	0.96	1.30	1.53	1.85	2.10	2.34	2.91
2-hour	120	0.52	0.71	0.84	1.02	1.15	1.29	1.61
3-hour	180	0.37	0.50	0.59	0.72	0.82	0.91	1.14
6-hour	360	0.20	0.28	0.33	0.40	0.45	0.51	0.63
12-hour	720	0.11	0.15	0.18	0.22	0.25	0.29	0.36
24-hour	1440	0.06	0.08	0.10	0.12	0.14	0.16	0.20

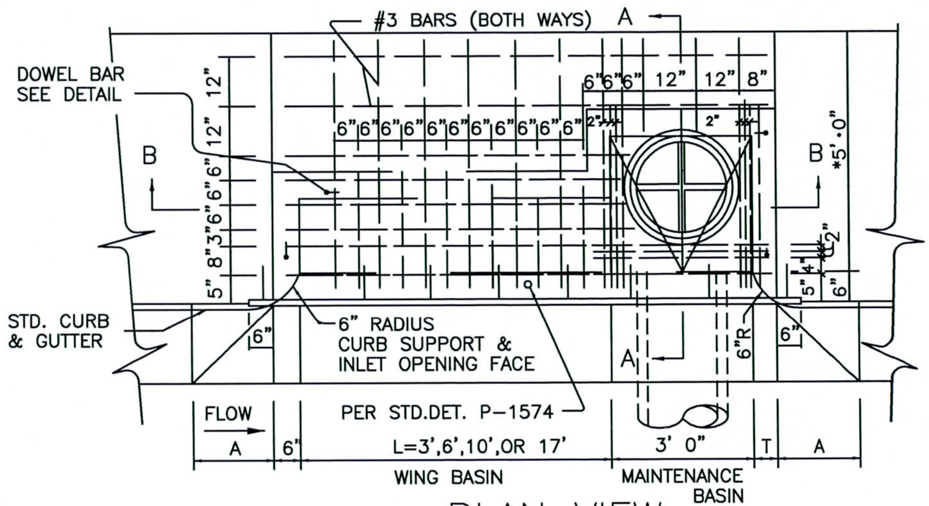


D.1 Offsite Inlet Hydraulics

GUTTER TRANSITION	
CURB HEIGHT	DIM 'A'
4"	3'-3"
5"	2'-6"
6"	1'-9"



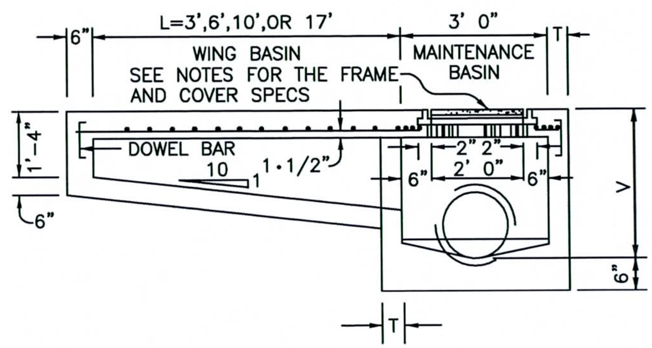
DEPRESSED GUTTER



PLAN VIEW

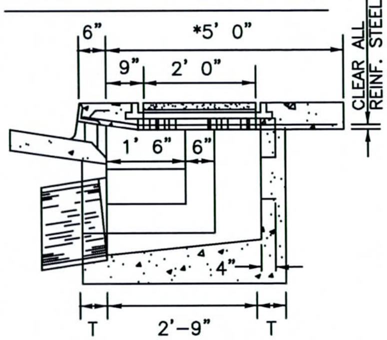
NOTES

1. TYPES ARE DESIGNATED AS FOLLOWS: 'M'.. NO WING, 'M-1'.. ONE WING, 'M-2'.. TWO WINGS.
2. ALL CONCRETE SHALL BE CLASS 'A'.
3. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
4. CONNECTOR PIPES SHALL BE PLACED IN THE APPROPRIATE WALL OF THE MAINTENANCE BASIN.
5. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOPE FROM ALL DIRECTIONS TO OUTLET.
6. CONSTRUCTION DRAINS SHALL BE INSTALLED IN WHEN NOTED. (SEE DET. P-1575.)
7. LOCATE WING BASIN ON UPSTREAM SIDE OF MAINTENANCE BASIN FOR TYPE M-1. WING BASINS FOR TYPE M-2 SHALL BE BOTH SIDES OF MAINTENANCE BASIN.
8. ACCESS FRAME AND COVER PER DET. P-1561

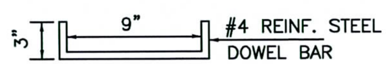


SECTION B - B

TRANSITION (BOTH SIDES)



SECTION A - A



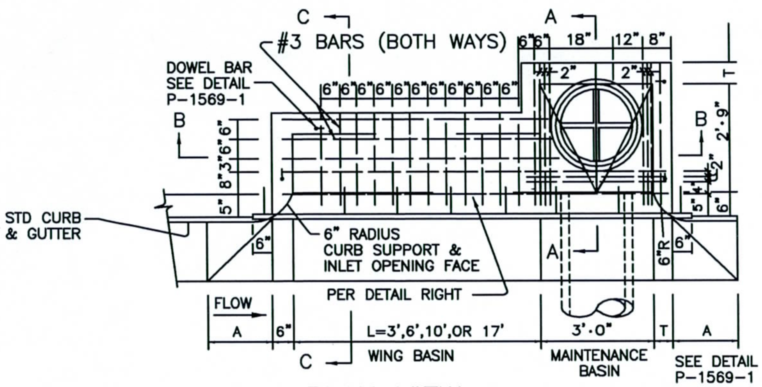
DOWEL BAR DETAIL

CATCH BASIN WALL THICKNESS
T = 6" IF V = 4' OR LESS T = 8" IF V = 4' TO 8' (IF V EXCEEDS 8', SPECIAL DESIGN IS REQUIRED.)
L = 0' UNLESS SPECIFIED ON THE PLANS V = 4'-0" MIN. UNLESS OTHERWISE NOTED

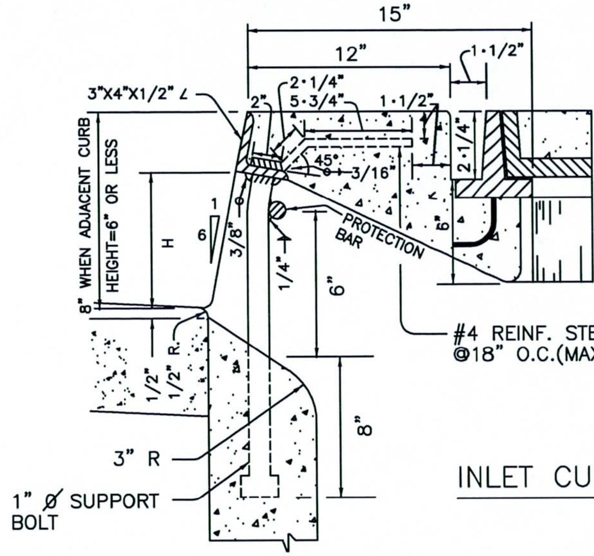
*4'-0" IN LOCATIONS WHERE 4' SIDEWALK IS REQ'D.

REVISED 4/14/08

DETAIL NO.	City of Phoenix STANDARD DETAIL	CATCH BASIN TYPE "M"	APPROVED	DATE	DETAIL NO.
P1569-1			ACTING CITY ENGINEER	7/31/08	P1569-1



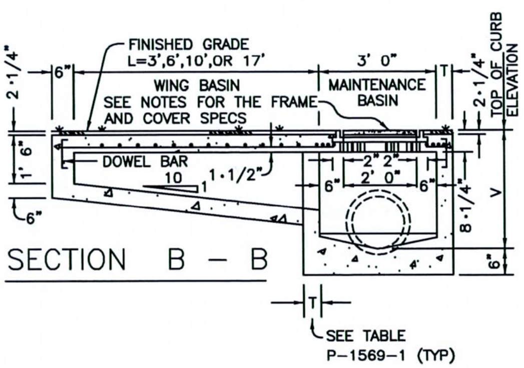
PLAN VIEW



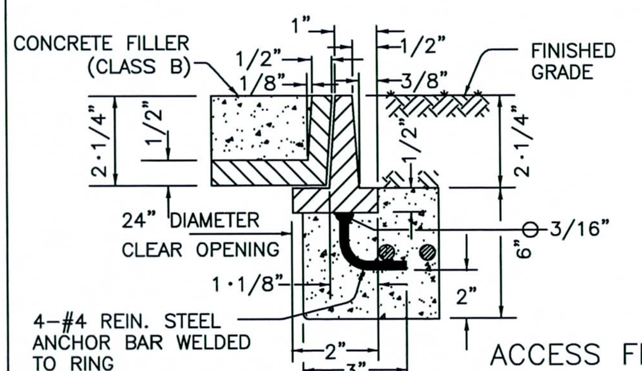
INLET CURB OPENING

NOTES:

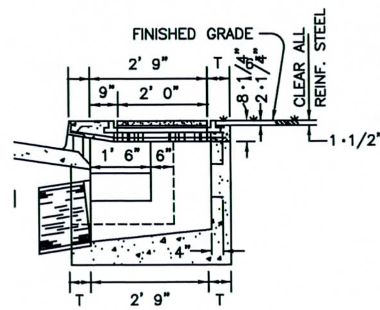
SEE STANDARD DETAILS P–1569–1, P–1561, AND P–1574 FOR CONSTRUCTION NOTES AND ADDITIONAL DETAILS.



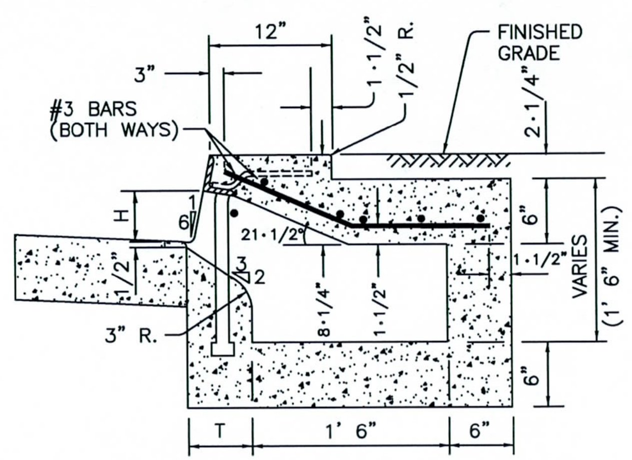
SECTION B – B



ACCESS FRAME & COVER

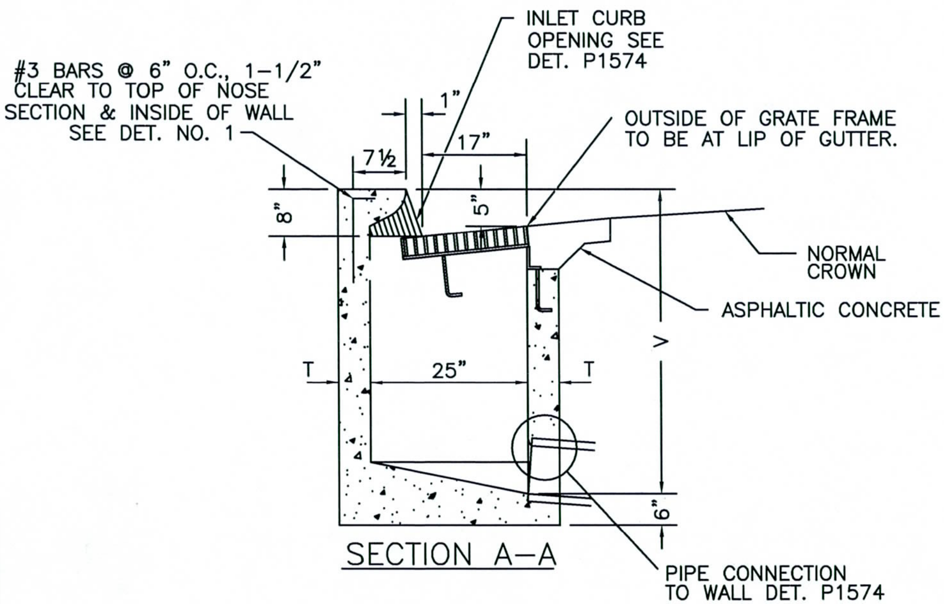


SECTION A – A

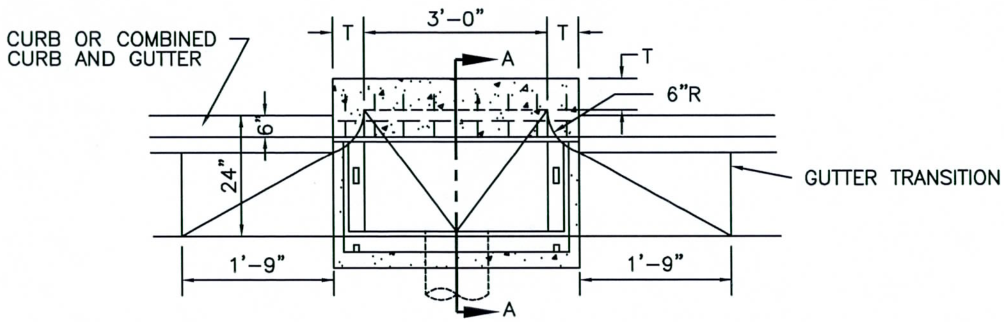


SECTION C – C

DETAIL NO.	City of Phoenix STANDARD DETAIL	CATCH BASIN – TYPE "M" TOP MODIFICATION IN LANDSCAPE PARKWAY	APPROVED [signature] CITY ENGINEER	7/19/04 DATE	DETAIL NO.
P1569–2					P1569–2



SECTION A–A



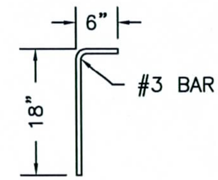
PLAN VIEW

NOTES:

1. ALL CONCRETE SHALL BE CLASS 'A'.
2. CONNECTOR PIPES MAY BE PLACED IN ANY WALL AS PER PLAN.
3. FLOOR OF BASIN SHALL BE TROWELLED TO A HARD, SMOOTH SURFACE AND SHALL SLOP FROM ALL DIRECTIONS TO OUTLET.
4. THE CONSTRUCTION DRAINS SHALL BE INSTALLED IN ALL INLETS BUILT WITH PAVING PROJECTS (SEE DET. P1575).
5. CONNECTOR PIPE SHALL BE TRIMMED TO THE FINAL SHAPE AND LENGTH BEFORE CONCRETE IS POURED.
6. LOCATION OF THE TYPE 'R' CATCH BASIN SHALL BE RESTRICTED TO AREAS WHERE 6" VERTICAL CURB & GUTTER IS EXISTING.
7. ALL REINFORCING STEEL SHALL BE DEFORMED BARS AND SHALL CONFORM TO A.S.T.M. SPECIFICATION 615.
8. THE FRAME SHALL BE DET. P1564, TYPE 2 AND THE GRATE SHALL BE DET. P1565, TYPE 2.

CATCH BASIN WALL THICKNESS

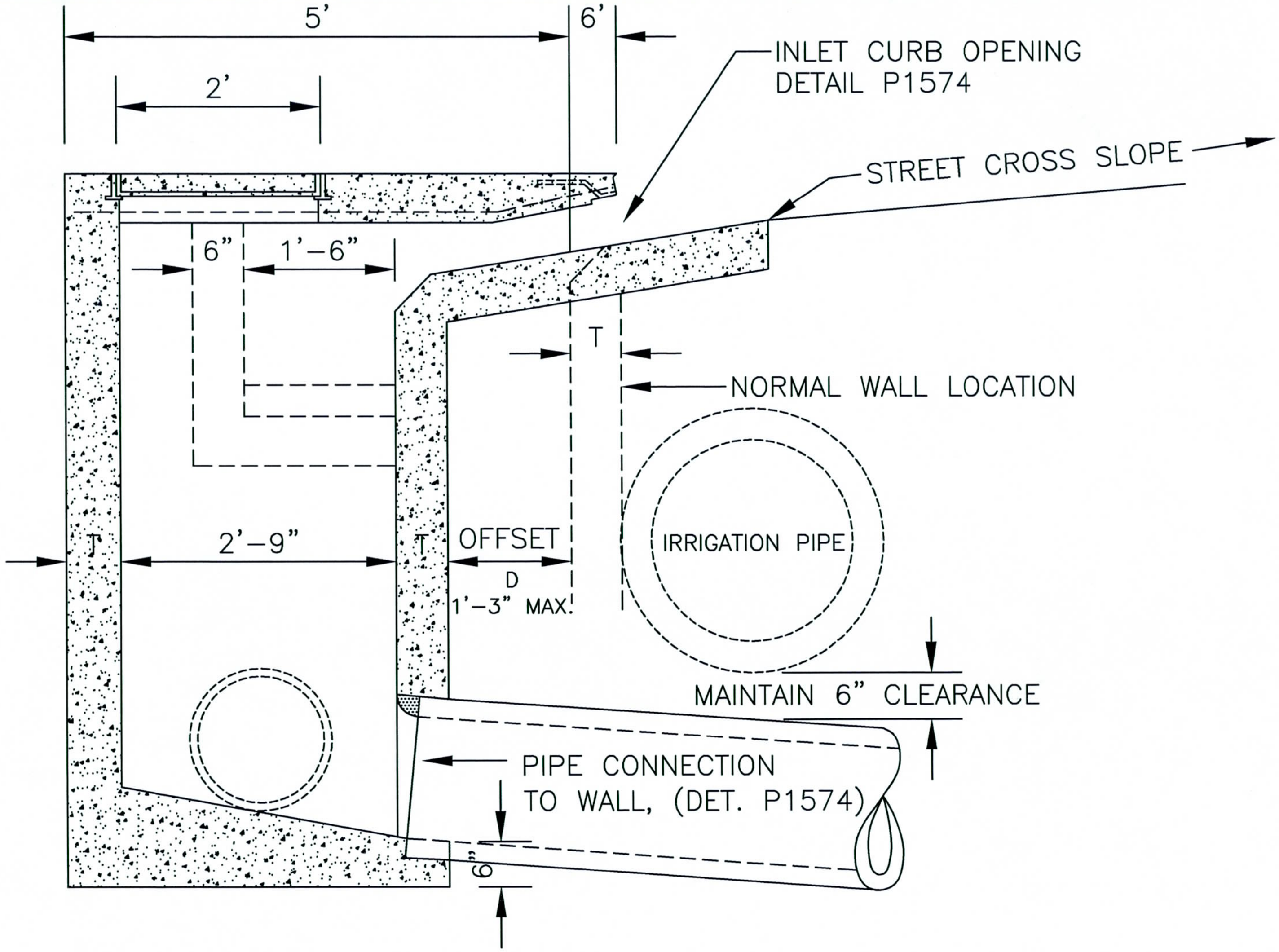
T=6" IF V = 4' OR LESS
T=8" IF V = 4' TO 8'
IF V EXCEEDS 8' SPECIAL DESIGN IS REQUIRED
V=4'–0' UNLESS OTHERWISE NOTED.



DETAIL 1

REVISED 4/14/08

DETAIL NO.	City of Phoenix STANDARD DETAIL	CATCH BASIN TYPE "R"	APPROVED ACTING CITY ENGINEER 7/31/08 DATE	DETAIL NO.
P1573				P1573



SECTION A–A

FOR ADDITIONAL INFORMATION & NOTES
SEE CITY OF PHOENIX DETAIL P1569–1.

DETAIL NO. P1581	**City of Phoenix** **STANDARD DETAIL**	CATCH BASIN – TYPE "M" MODIFIED (OFFSET OPENING)	APPROVED CITY ENGINEER 7/3/00 DATE	DETAIL NO. P1581

58th Ave Street Capacity Calc Doc

Cross Section for 58th Ave Street Capacity at Section X-X

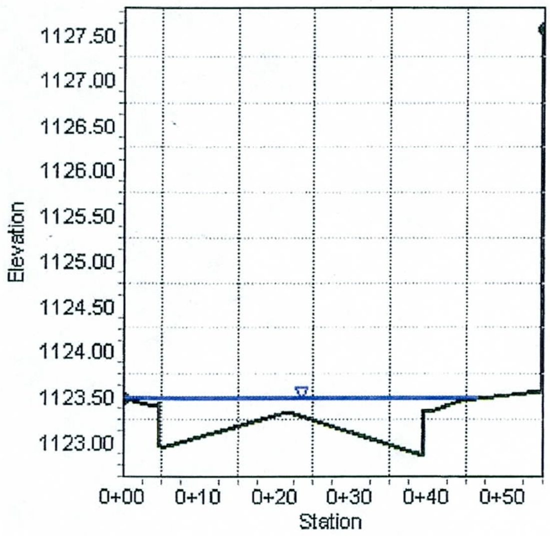
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00250	ft/ft
Normal Depth	0.62	ft
Discharge	29.00	ft³/s

Cross Section Image




118
582
583
121
58TH AVE
29cfs
29cfs
48cfs
77cfs
122
124

Rational Method Discharge Calc at Area East of 59^{th} Ave

Project

Reference	59TH AVE BASIN DELIN
Title	Camelback Storm Drain Project
Location	Northwest Corner of 59th Ave & Camelback Rd
Agency	Flood Control District of Maricopa County

Project Defaults

Model	Rational
Land Use Agency	FCDMC
Rainfall	NOAA
Roads and Inlets Agency	FCDMC

Comments

Please refer Figure X-3 in this Section D.1 for the drainage area delineation.

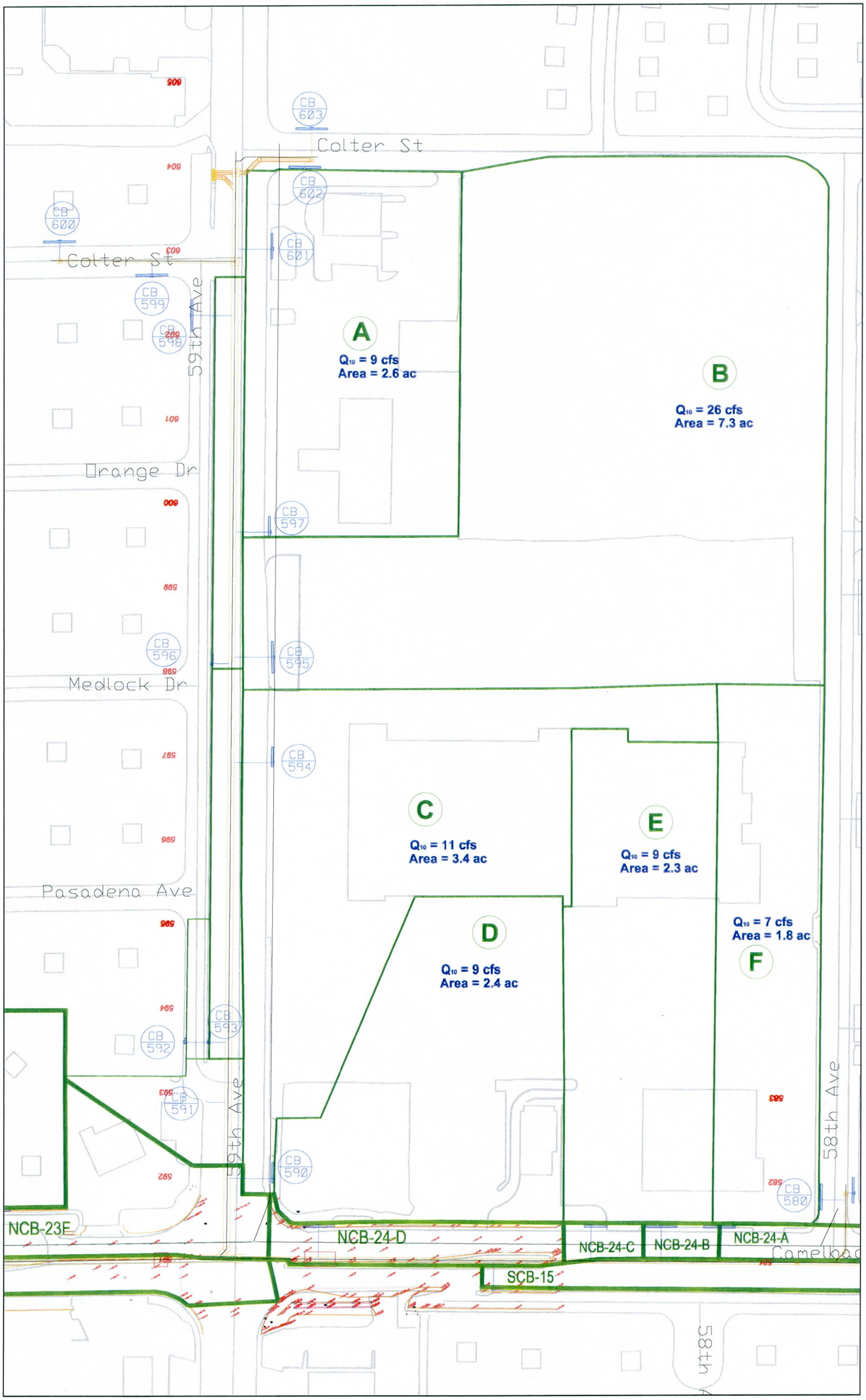
Flood Control District of Maricopa County
Drainage Design Management System
RAINFALL DATA
Project Reference: 59TH AVE BASIN DELIN

 11/6/2009

Duration	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Rainfall Method: NOAA						
5 MIN	0.330	0.420	0.480	0.570	0.630	0.700
10 MIN	0.490	0.630	0.730	0.860	0.970	1.080
15 MIN	0.590	0.790	0.920	1.100	1.240	1.380
30 MIN	0.790	1.050	1.230	1.480	1.680	1.870
1 HOUR	0.960	1.300	1.530	1.850	2.100	2.340
2 HOUR	1.040	1.420	1.680	2.030	2.310	2.580
3 HOUR	1.100	1.500	1.780	2.160	2.450	2.740
6 HOUR	1.200	1.660	1.970	2.390	2.720	3.050
12 HOUR	1.300	1.830	2.180	2.670	3.050	3.420
24 HOUR	1.400	2.000	2.400	2.950	3.380	3.800

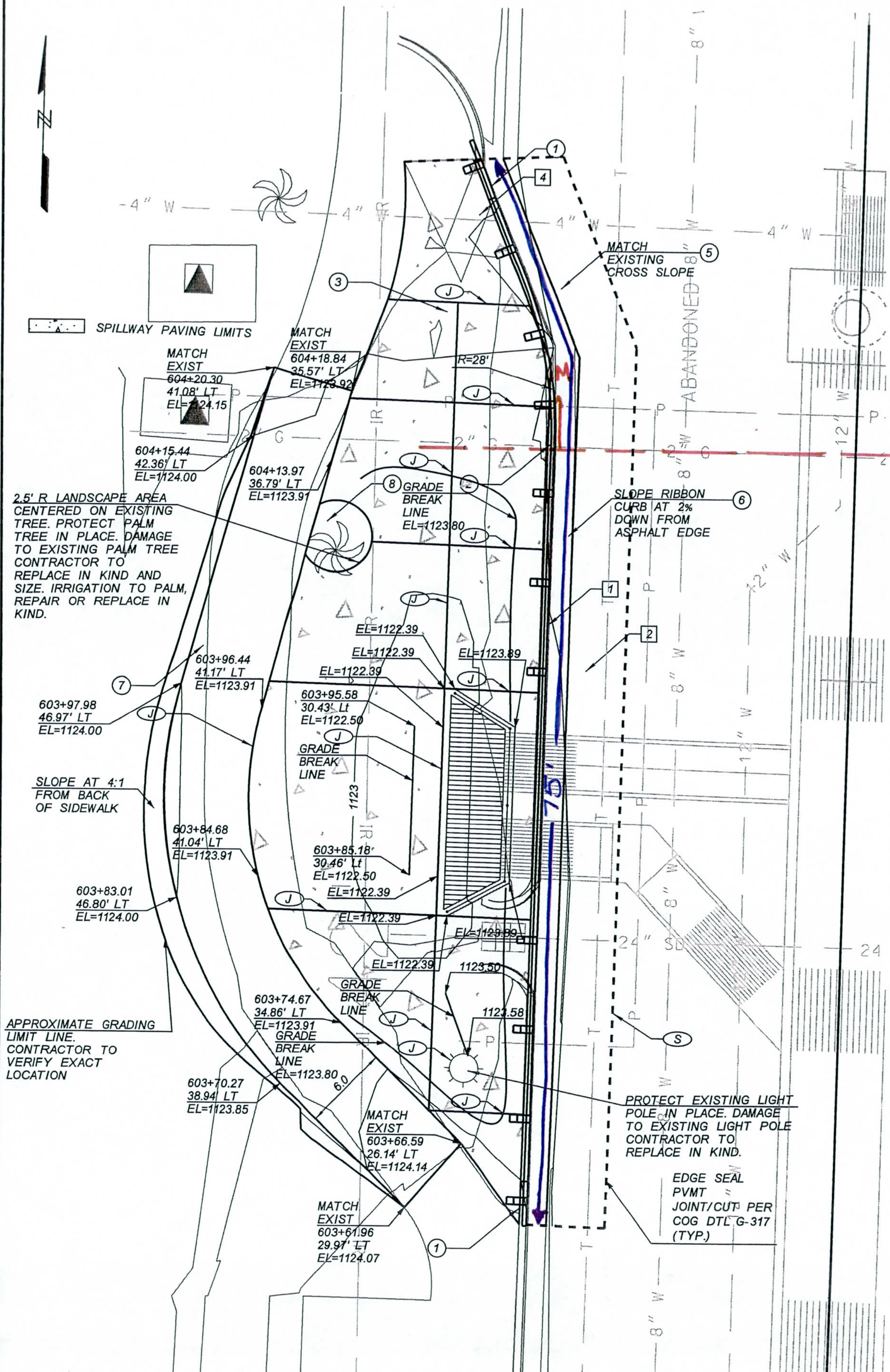
ID	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	Sub Basin Data								Sub Basin Hydrology Summary					
Major Basin ID: 01														
A	2.6	617	1,125.00	1,123.30	14.5	0.04	-	Q (cfs)	6	8	9	12	14	16
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	2.17	2.17	2.17	2.40	2.42	2.42
								Tc (min)	13	11	11	10	10	10
								i (in/hr)	2.58	3.65	4.23	5.16	5.82	6.48
B	7.3	873	1,126.00	1,123.00	18.1	0.03	-	Q (cfs)	15	22	26	34	40	45
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	6.21	6.21	6.21	6.87	6.94	6.94
								Tc (min)	14	12	11	11	10	10
								i (in/hr)	2.47	3.52	4.23	5.00	5.82	6.48
C	3.4	1,005	1,123.00	1,120.70	12.1	0.04	-	Q (cfs)	6	9	11	15	17	19
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	2.91	2.91	2.91	3.21	3.25	3.25
								Tc (min)	18	16	15	14	13	13
								i (in/hr)	2.18	3.08	3.68	4.54	5.29	5.89
D	2.4	506	1,123.50	1,120.30	33.4	0.04	-	Q (cfs)	6	8	9	12	13	15
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	2.01	2.01	2.01	2.23	2.25	2.25
								Tc (min)	10	10	10	10	10	10
								i (in/hr)	2.94	3.78	4.38	5.16	5.82	6.48
E	2.3	410	1,123.50	1,121.20	29.6	0.04	-	Q (cfs)	6	8	9	11	13	14
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	1.98	1.98	1.98	2.19	2.21	2.21
								Tc (min)	10	10	10	10	10	10
								i (in/hr)	2.94	3.78	4.38	5.16	5.82	6.48
F	1.8	653	1,124.00	1,121.60	19.4	0.04	-	Q (cfs)	4	6	7	9	10	11
								C	0.85	0.85	0.85	0.94	0.95	0.95
								CA (ac)	1.56	1.56	1.56	1.72	1.74	1.74

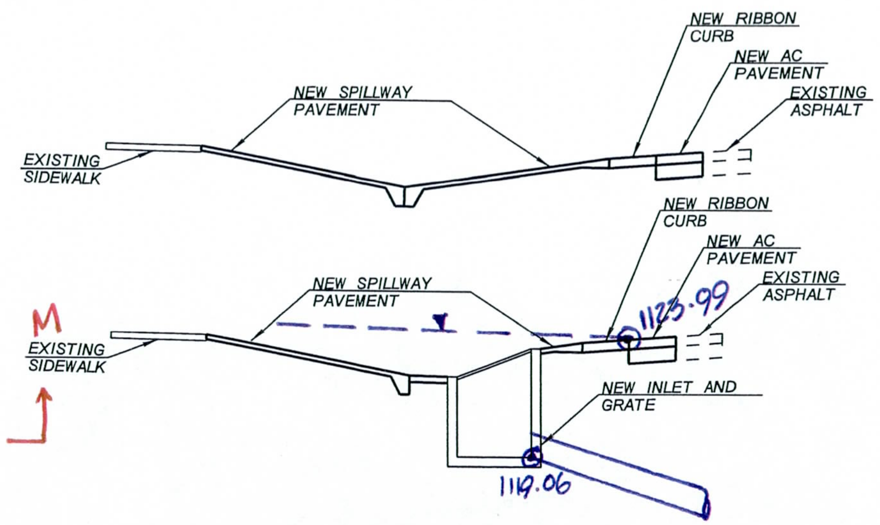
ID	Area (acres)	Length (ft)	USGE	DSGE	Slope (ft/mi)	Kb	CustomTc (min)		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	Sub Basin Data								Sub Basin Hydrology Summary					
Major Basin ID: 01														
								Tc (min)	12	11	10	10	10	10
								i (in/hr)	2.69	3.65	4.38	5.16	5.82	6.48



Colter St
CB 603
CB 602
CB 600
CB 601
Colter St
CB 599
CB 598
59th Ave
A
Q_{10} = 9 cfs
Area = 2.6 ac
B
Q_{10} = 26 cfs
Area = 7.3 ac
Orange Dr
CB 597
CB 596
CB 595
Medlock Dr
CB 594
C
Q_{10} = 11 cfs
Area = 3.4 ac
E
Q_{10} = 9 cfs
Area = 2.3 ac
Pasadena Ave
D
Q_{10} = 9 cfs
Area = 2.4 ac
Q_{10} = 7 cfs
Area = 1.8 ac
F
CB 593
CB 592
CB 591
59th Ave
CB 590
58th Ave
CB 580
NCB-23E
NCB-24-D
NCB-24-C
NCB-24-B
NCB-24-A
SCB-15
58th

Drop Inlet Design Detail and Supporting Documents





SPILLWAY PAVEMENT DETAIL
NTS

No. of Guard rails = 11

width of Guard rails = 0.5 ft

Curb opening length = $(75 - 11 \times 0.5)$ ft = 69.5 ft

Q_{weir} = 157 cfs

Head = ?

$157 = 3.33 \times 69.5 \times H^{3/2}$

$H = 0.77$ ft

REMOVE		
1	EXISTING CURB AND GUTTER	76 LF
2	EXISTING AC PAVEMENT	34 LF
3	EXISTING SIDEWALK	40 LF
4	EXISTING CONCRETE AND STEEL STRUCTURE	1 EA

RELOCATE

RELOCATE BY OTHERS

CONSTRUCT		
1	NEW CURB TERMINATION PER MAG DET 222	6 LF
2	NEW W-BEAM GUARDRAIL G4(1S) PER ADOT DET C-10.04 (SEE SHT 67)	39 LF
3	NEW CONCRETE SPILLWAY PAVING, 6" THICK	104 SY
4	NEW GUARDRAIL END TERMINAL 37'-6" PER ADOT DET C-10.00 (SEE SHT 67)	1 EA
5	NEW AC REPLACEMENT PER STRUCT. SECT. NO. 1 AND MAG SECTION 710	34 SY
6	NEW RIBBON CURB PER MAG DET 220-1 TYPE B	76 LF
7	NEW CONCRETE SIDEWALK PER MAG DET. 230	370 SF
8	3/4" SCREENED DECOMPOSED GRANITE PALOMINO GOLD, PAY ITEM 430-1 LANDSCAPING.	2 SY

NOTES

S	SAW CUT 4' FROM EXISTING EDGE OF ASPHALT
J	JOINTS PER ADOT DET C-07.01 (SEE SHT 67)
SD	SEE STORM DRAIN PLANS FOR HEADWALL CONSTRUCTION, SHT 48

2.5 0 2.5 5
Scale in Feet

TWO WORKING DAYS BEFORE YOU DIG, CALL
263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

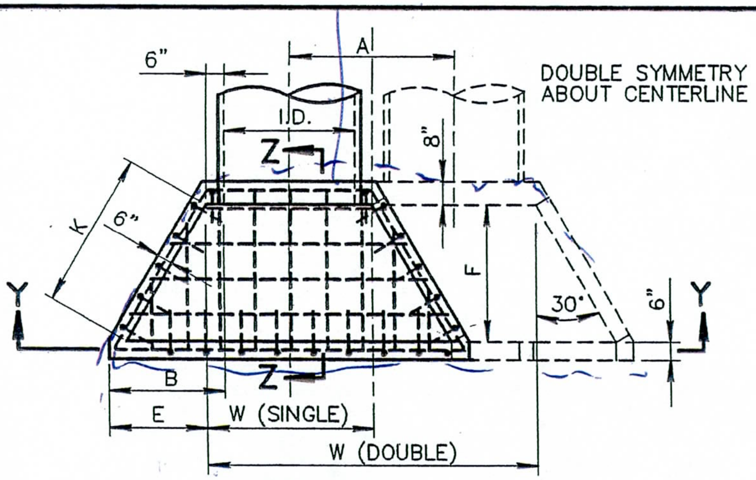
CAMELBACK ROAD STORM DRAIN
59TH AVENUE TO 75TH AVENUE
PCN 620.03.33

	BY	DATE
DESIGNED	WH	12/29/2009
DRAWN	EW	12/29/2009
CHECKED	JCF	12/29/2009

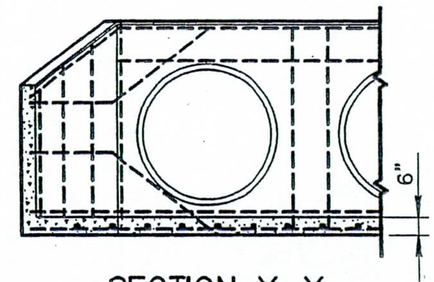
Registered Professional Engineer, Certificate No. 37849, DUC VAN DAO, ARIZONA, U.S.A., EXP 09/30/2011

OLSSON ASSOCIATES
7250 North 16th Street, Suite 210, Phoenix, AZ 85020-5282, TEL 602.748.1000, FAX 602.748.1001

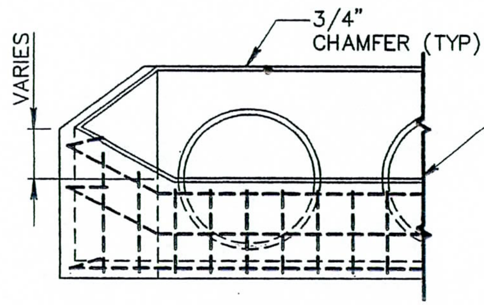
DRAWING NO.		SHEET	OF
DE-1.01	DRAINAGE DETAILS SLOPE PAVING	66	125



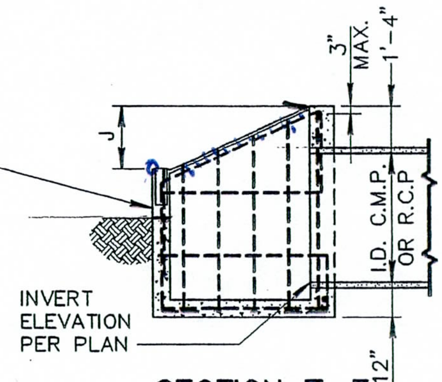
PLAN



SECTION Y–Y



ELEVATION



SECTION Z–Z

PIPE	DIMENSIONS							
I.D.	W		A	B	E	F	J	K
	SINGLE	DOUBLE						
18"	2'–6"	5'–2"	2'–8"	1'–3"	0'–9"	1'–3·5/8"	9"	1'–6"
24"	3'–0"	6'–6"	3'–6"	1'–7·1/2"	1'–1·1/2"	1'–11·3/8"	11"	2'–3"
30"	3'–6"	7'–10"	4'–4"	2'–0"	1'–6"	2'–7·1/4"	1'–1"	3'–0"
36"	4'–0"	9'–2"	5'–2"	2'–4·1/2"	1'–10·1/2"	3'–3"	1'–4"	3'–9"
42"	4'–6"	10–6"	6'–0"	2'–9"	2'–3"	3'–10·3/4"	1'–6"	4'–6"

NOTES:

1. HIGH POINT OF HEADWALL SHALL NOT PROJECT MORE THAN 3" ABOVE SLOPE.

2. ALL CONCRETE SHALL BE CLASS 'A' PER SECT. 725.

3. ALL REINFORCING BARS SHALL BE NO. 4, 12" C TO C AND 3" CLEAR TO INSIDE OF FLOOR AND WALLS.

DETAIL NO.				REVISED	DETAIL NO.
501–5	MARICOPA ASSOCIATION of GOVERNMENTS	STANDARD DETAIL ENGLISH	HEADWALL DROP INLET		501–5

Culvert Calculator Report
2-42" Drop Inlet

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	1,123.99 ft	Headwater Depth/Height	1.41
Computed Headwater Eleva	1,123.99 ft	Discharge	157.27 cfs
Inlet Control HW Elev.	1,123.98 ft	Tailwater Elevation	1,120.16 ft
Outlet Control HW Elev.	1,123.99 ft	Control Type	Entrance Control

Grades

Upstream Invert	1,119.06 ft	Downstream Invert	1,110.05 ft
Length	180.00 ft	Constructed Slope	0.050056 ft/ft

Hydraulic Profile

Profile	CompositePressureProfileS1S2	Depth, Downstream	10.11 ft
Slope Type	N/A	Normal Depth	1.43 ft
Flow Regime	N/A	Critical Depth	2.77 ft
Velocity Downstream	8.17 ft/s	Critical Slope	0.006522 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	2		

Outlet Control Properties

Outlet Control HW Elev.	1,123.99 ft	Upstream Velocity Head	1.44 ft
Ke	0.50	Entrance Loss	0.72 ft

Inlet Control Properties

Inlet Control HW Elev.	1,123.98 ft	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	19.2 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Rating Table Report
2-42" Drop Inlet

Range Data:

	Minimum	Maximum	Increment	
Allowable HW E	1,123.90	1,124.00	0.01	ft

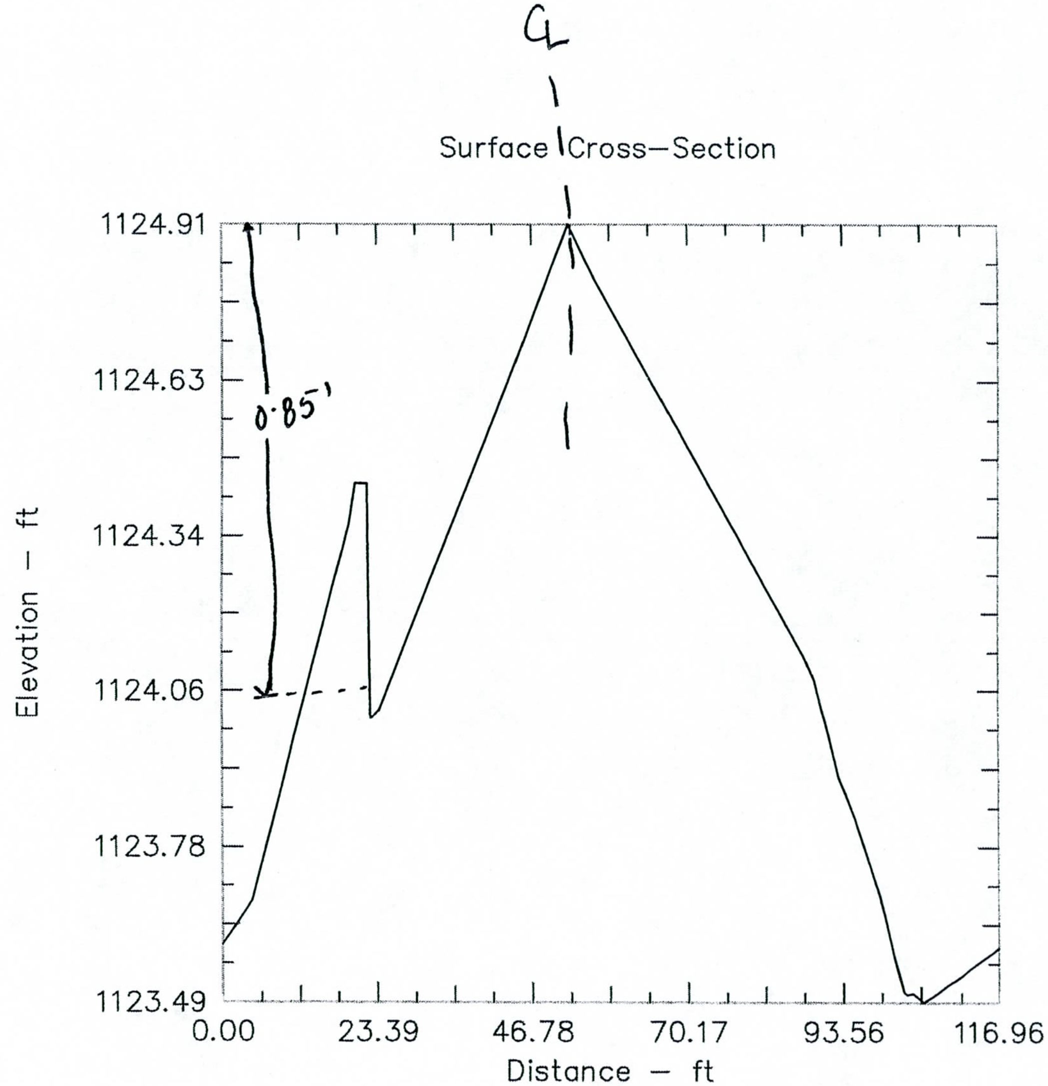
HW Elev. (ft)	Discharge (cfs)	Dn. V (ft/s)	Dn. depth (ft)
1,123.90	153.40	7.97	3.50
1,123.91	153.83	7.99	3.50
1,123.92	154.26	8.02	3.50
1,123.93	154.69	8.04	3.50
1,123.94	155.12	8.06	3.50
1,123.95	155.55	8.08	3.50
1,123.96	155.98	8.11	3.50
1,123.97	156.41	8.13	3.50
1,123.98	156.84	8.15	3.50
1,123.99	157.27	8.17	3.50
1,124.00	157.70	8.20	3.50

CAMELBACK ROAD STORM DRAIN
59TH AVENUE TO 75TH AVENUE
WEIR FLOW CALCULATIONS

Weir: $Q = CLh^{3/2}$ 3.33

Orifice: $Q = C_d A\sqrt{2gh}$ 0.6

h (ft)	Effective Weir Perimeter (ft)	Q_{weir} (cfs)
0.05	69.50	2.59
0.10	69.50	7.32
0.15	69.50	13.45
0.20	69.50	20.70
0.25	69.50	28.93
0.30	69.50	38.03
0.35	69.50	47.92
0.40	69.50	58.55
0.45	69.50	69.86
0.50	69.50	81.82
0.55	69.50	94.40
0.60	69.50	107.56
0.65	69.50	121.28
0.70	69.50	135.54
0.75	69.50	150.32
0.80	69.50	165.60
0.85	69.50	181.37
0.90	69.50	197.60
0.95	69.50	214.30
1.00	69.50	231.44



59th Ave

Section M-M.

Offsite Inlet Location Exhibit and Design Summary Table

CAMELBACK STORM DRAIN PROJECT

Offsite Curb Inlet Design 58th Ave to 73rd Ave

Curb Inlet ID	Inlet Condition	Curb Type	Gutter		Roadway Cross-Slope S_x (ft/ft)	10-yr Design Flow Q_{10} (cfs)	Previous By-pass Flow (cfs)	Flow Depth (ft)	Physical Inlet Length (ft)	Clogging Factor CF %	Inlet Length Reduced by Clogging (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type of Inlet Selected			
			Width (ft)	Long Slope S_L(ft/ft)										Type/Size		L1	L2
58th AVENUE																	
CB-580	On Grade	6 " Vertical	1.42	0.0012	0.017	77	0	0.59	30	20%	24	14	48*	P 1569	M-2	17	10
CB-581	On Grade	6" Vertical	1.42	0.0014	0.019		0	0.68	30	20%	24	15		P 1569	M-2	17	10
											Total Intercepted Flow	29					

Note: * 58th Ave has capacity for 29 cfs;therefore,excess flow (48 cfs) overtops 58th Ave and conveys into adjacent parking lot, located northwest of 58th Ave & camelback Rd, and flow south towards Camelback Rd. The curb opening inlets were design along Camelback Rd just west of 58th Ave to capture 48 cfs, detail calculation is shown in onsite curb inlet design spreadsheet.

Curb Inlet ID	Inlet Condition	Curb Type	Width (ft)	Long Slope S_L(ft/ft)	Roadway Cross-Slope S_x (ft/ft)	10-yr Design Flow Q_{10} (cfs)	Previous By-pass Flow (cfs)	Flow Depth (ft)	Physical Inlet Length (ft)	Clogging Factor CF %	Inlet Length Reduced by Clogging (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type/Size		L1	L2
59Th AVENUE																	
Drop Inlet *		-	-	-	-	341						157	184				
CB-603	In Sag	6" Vertical	1.42	0.0029	0.014		184	1	37	20%	29.6	67	51	P 1569	M-2	17	17
CB-602	In Sag	6" Vertical	1.42	0.0029	0.011			1	37	20%	29.6	66		P 1569	M-2	17	17
CB-601	On Grade	6" Vertical	1.42	0.0019	0.016		51	0.53	30	20%	24	13.5	37.5	P 1569	M-2	17	10
CB-599	On Grade	4" Roll Curb	1.42	0.0015	0.030		37.5	0.63	37	20%	29.6	11	26.5	P 1569	M-2	17	17
CB-600	On Grade	4" Roll Curb	1.42	0.0034	0.020		26.5	0.46	37	20%	29.6	9	17.5	P 1569	M-2	17	17
CB-598	On Grade	4" Roll Curb	1.42	0.0021	0.040		17.5	0.74	37	20%	29.6	17.5	0	P 1569	M-2	17	17
											Total Intercepted Flow	341					
CB-597**	On Grade	6" Vertical	1.42	0.0021	0.019	9	0	0.48	23	20%	18.4	9	0	P 1569	M-2	17	3
CB-596***																	
CB-595**	On Grade	6" Vertical	1.42	0.0025	0.019	26	0	0.6	37	20%	29.6	19	7	P 1569	M-2	17	17
CB-594**	On Grade	6" Vertical	1.42	0.0043	0.021		7	0.4	23	20%	18.4	7	0	P 1569	M-2	17	3
CB-593***	On Grade																
CB-592***	On Grade																
CB-591***	In Sump																
CB-590**	On Grade	6" Vertical	1.42	0.0029	0.038	11	0	0.58	23	20%	18.4	11	0	P 1569	M-2	17	3
											Total Intercepted Flow	46					

Note: * A drop Inlet is proposed on the west side of 59th Ave just north of West Colter St, and designed to capture approximately 157 cfs.
** Catch basin sized for local area east of 59th Ave and south of Colter Rd. Please refer **Figure X-3** in Section D.1 for offsite curb inlet location and drainage area delineation, and DDMSW output for 10-year flow calculation.
***Curb opening inlets design to capture local area/street flow. Please refere separate Excel sheet (59th Ave & 67th Ave Street Flow Calc and Inlet Design) in Section D.1 for street flow calc and catch basin design, and **Figure X-1** and **Figure X-3** for drainage area delineation.

Curb Inlet ID	Inlet Condition	Curb Type	Width (ft)	Long Slope S_L(ft/ft)	Roadway Cross-Slope S_x (ft/ft)	10-yr Design Flow Q_{10} (cfs)	Previous By-pass Flow (cfs)	Flow Depth (ft)	Physical Inlet Length (ft)	Clogging Factor CF %	Inlet Length Reduced by Clogging (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type/Size		L1	L2
61st AVENUE																	
CB-615	On Grade	4" Roll Curb	1.42	0.0032	0.030	111	0	0.83	37	20%	29.6	36.5	74.5	P 1569	M-2	17	17
CB-614	On Grade	4" Roll Curb	1.42	0.0022	0.033		74.5	0.84	30	20%	24	30	44.5	P 1573 Modified		11 Grates	
CB-613	On Grade	4" Roll Curb	1.42	0.0020	0.027		44.5	0.7	26	20%	20.8	20	2	P 1569	M-2	17	6
CB-612	On Grade	4" Roll Curb	1.42	0.0016	0.028			0.77	26	20%	20.8	22.5		P 1573 Modified		8 Grates	
											Total Intercepted Flow	109					

Note: The bypass flow will be captured at the Frontage Rd along Camelback Rd at Onsite Catchbasin ID NCB-17F. Please refer **Plate II** for the onsite catch basin location.

Curb Inlet ID	Inlet Condition	Curb Type	Width (ft)	Long Slope S_L(ft/ft)	Roadway Cross-Slope S_x (ft/ft)	10-yr Design Flow Q_{10} (cfs)	Previous By-pass Flow (cfs)	Flow Depth (ft)	Physical Inlet Length (ft)	Clogging Factor CF %	Inlet Length Reduced by Clogging (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type/Size		L1	L2
61st DRIVE																	
CB-144	On Grade	4" Roll Curb	1.42	0.0014	0.041	10	0	0.63	13	20.0%	10.4	9	0	P 1569	M-1	10	0
CB-145	On Grade	4" Roll Curb	1.42	0.0015	0.035			0.35	6	20.0%	4.8	2		P 1569	M-1	3	0
											Total Intercepted Flow	11					
62nd AVENUE																	
CB-140	On Grade	4" Roll Curb	1.42	0.0013	0.028	8	0	0.44	9	20.0%	7.2	4	4	P 1569	M-1	6	0
CB-141	On Grade	4" Roll Curb	1.42	0.0013	0.031		4	0.45	9	20.0%	7.2	4	0	P 1569	M-1	6	0
											Total Intercepted Flow	8					
63rd AVENUE																	
CB-637	On Grade	6" Vertical	1.42	0.0021	0.032	217	0	0.75	37	20%	29.6	22	195	P 1581 Modified	M-2	17	17
CB-636	On Grade	6" Vertical	1.42	0.0026	0.034		195	0.82	37	20%	29.6	30	165	P 1569	M-2	17	17
CB-635	On Grade	6" Vertical	1.42	0.0019	0.032		165	0.89	37	20%	29.6	34	131	P 1581 Modified	M-2	17	17
CB-634	On Grade	6" Vertical	1.42	0.0020	0.030		131	0.84	37	20%	29.6	31	100	P 1569	M-2	17	17
CB-633	On Grade	6" Vertical	1.42	0.0019	0.029		100	0.84	37	20%	29.6	31	69	P 1581 Modified	M-2	17	17
CB-632	On Grade	6" Vertical	1.42	0.0020	0.028		69	0.8	37	20%	29.6	29	40	P 1569	M-2	17	17
CB-631	On Grade	6" Vertical	1.42	0.0019	0.029		40	0.73	30	20%	24	21	19	P 1581 Modified	M-2	17	10
CB-630	On Grade	6" Vertical	1.42	0.0020	0.034		19	0.73	30	20%	24	19	0	P 1569	M-2	17	10
											Total Intercepted Flow	217					

CAMELBACK STORM DRAIN PROJECT

Offsite Curb Inlet Design 58th Ave to 73rd Ave

Curb Inlet ID	Inlet Condition	Curb Type	Gutter Width (ft)	Gutter Long Slope S_L(ft/ft)	Roadway Cross-Slope S_x (ft/ft)	10-yr Design Flow Q_{10} (cfs)	Previous By-pass Flow (cfs)	Flow Depth (ft)	Physical Inlet Length (ft)	Clogging Factor CF %	Inlet Length Reduced by Clogging (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type of Inlet Selected: Type/Size		L1	L2
65th AVENUE																	
CB-651	On Grade	4" Roll Curb	1.42	0.0024	0.030	55	0	0.77	30	20.0%	24	27	0	P 1569	M-2	17	10
CB-650	On Grade	4" Roll Curb	1.42	0.0026	0.033		0	0.80	30	20.0%	24	28		P 1569	M-2	17	10
											Total Intercepted Flow	55					
67th AVENUE																	
CB-690	On Grade	4" Roll Curb	1.42	0.0031	0.033	285	0	0.75	30	20%	24	26	259	P 1581	M-2	17	10
CB-689	On Grade	6" Vertical	1.42	0.0024	0.027		259	0.74	37	20%	29.6	26	211.5	P 1573 Modified		11 Grates	
CB-688	On Grade	4" Roll Curb	1.42	0.0031	0.038			0.73	26	20%	20.8	21.5		P 1581	M-2	17	6
CB-687	On Grade	4" Roll Curb	1.42	0.0031	0.033		211.5	0.86	37	20%	29.6	38	173.5	P 1581	M-2	17	17
CB-686	On Grade	4" Roll Curb	1.42	0.0031	0.026		173.5	0.76	37	20%	29.6	32	114.5	P 1581	M-2	17	17
CB-685	On Grade	6" Vertical	1.42	0.0029	0.032			0.77	37	20%	29.6	27		P 1573 Modified		11 Grates	
CB-684*																	
CB-683	On Grade	4" vertical	1.42	0.0031	0.023		114.5	0.52	26	20%	20.8	12	102.5	P 1569	M-2	17	6
CB-682	On Grade	4" vertical	1.42	0.0031	0.023		102.5	0.52	26	20%	20.8	12	90.5	P 1569	M-2	17	6
CB-681	On Grade	4" Roll Curb	1.42	0.0035	0.037		90.5	0.89	37	20%	29.6	39.5	51	P 1569	M-2	17	17
CB-680	On Grade	4" Roll Curb	1.42	0.0035	0.033		51	0.83	37	20%	29.6	36	15	P 1569	M-2	17	17
CB-679	On Grade	6" Vertical	1.42	0.0025	0.034		15	0.6	23	20%	18.4	12	3	P 1573 Modified		7 Grates	
											Total Intercepted Flow	282.0					
CB-678	On Grade	4" Roll Curb	1.42	0.0035	0.027	105	3	0.61	30	20%	24	18	90	P 1569	M-2	17	10
CB-677	On Grade	4" Roll Curb	1.42	0.0071	0.029		90	0.54	30	20%	24	17	73	P 1569	M-2	17	10
CB-676	On Grade	4" Roll Curb	1.42	0.0030	0.023		73	0.62	30	20%	24	20	53	P 1569	M-2	17	10
CB-675	On Grade	6" Vertical	1.42	0.0015	0.015		53	0.62	37	20%	29.6	20	33	P 1573 Modified		11 Grates	
CB-674*																	
CB-673	On Grade	4" Roll Curb	1.42	0.0020	0.036		33	0.91	37	20%	29.6	33	0	P 1569	M-2	17	17
CB-672*																	
CB-671*																	
											Total Intercepted Flow	108					

Note: *Curb opening inlets design to capture street flow. Please refere separate Excel sheet (59th Ave & 67th Ave Street Flow Calc and Inlet Design) in Section D.1 for street flow calc and catch basin design.

Curb Inlet ID	Inlet Condition	Curb Type	Gutter Width (ft)	Gutter Long Slope S_L(ft/ft)	Roadway Cross-Slope S_x (ft/ft)	10-yr Design Flow Q_{10} (cfs)	Previous By-pass Flow (cfs)	Flow Depth (ft)	Physical Inlet Length (ft)	Clogging Factor CF %	Inlet Length Reduced by Clogging (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type of Inlet Selected: Type/Size		L1	L2
68th DRIVE																	
CB-115	On Grade	4" Roll Curb	1.42	0.0021	0.019	38	0	0.61	30	20.0%	24	18	0	P 1569	M-2	17	10
CB-114	On Grade	4" Roll Curb	1.42	0.0016	0.023		0	0.69	30	20.0%	24	20		P 1569	M-2	17	10
											Total Intercepted Flow	38					
71st AVENUE																	
CB-715	On Grade	6" Vertical	1.42	0.0015	0.021	122	0	0.76	37	20%	29.6	27	75	P 1569	M-2	17	17
CB-714	On Grade	6" Vertical	1.42	0.0013	0.022			0.71	30	20%	24	20		P 1569	M-2	17	10
CB-713	On Grade	4" Roll Curb	1.42	0.0018	0.026		75	0.6	20	20%	16	13	62	P 1569	M-1	17	0
CB-712	On Grade	4" Roll Curb	1.42	0.0017	0.028		62	0.65	20	20%	16	14.5	47.5	P 1569	M-1	17	0
CB-711	On Grade	6" Vertical	1.42	0.0012	0.019		47.5	0.77	37	20%	29.6	27.5	20	P 1569	M-2	17	17
CB-710	On Grade	6" Vertical	1.42	0.0026	0.019		20	0.6	37	20%	29.6	19.5	0.5	P 1569	M-2	17	17
											Total Intercepted Flow	121.5					
71st DRIVE																	
CB-106	On Grade	4" Roll Curb	1.42	0.0015	0.030	20	0	0.59	20	20%	16	10	20	P 1569	M-1	17	0
CB-107	On Grade	4" Roll Curb	1.42	0.0016	0.028		0	0.58	20	20%	16	10		P 1569	M-1	17	0
											Total Intercepted Flow	20					
73rd AVENUE																	
CB-735	On Grade	6" Vertical	1.42	0.0021	0.015	121	0	0.62	37	20%	29.6	20	75	P 1569	M-2	17	17
CB-734	On Grade	6" Vertical	1.42	0.0018	0.015			0.74	37	20%	29.6	26		P 1569	M-2	17	17
CB-733	On Grade	6" Vertical	1.42	0.0018	0.023		75	0.74	37	20%	29.6	26	27	P 1569	M-2	17	17
CB-732	On Grade	6" Vertical	1.42	0.0018	0.019			0.66	37	20%	29.6	22		P 1569	M-2	17	17
CB-731	On Grade	6" Vertical	1.42	0.0019	0.019		27	0.55	30	20%	24	13	0	P 1569	M-2	17	10
CB-730	On Grade	6" Vertical	1.42	0.0035	0.025			0.55	30	20%	24	14		P 1569	M-2	17	10
											Total Intercepted Flow	121					

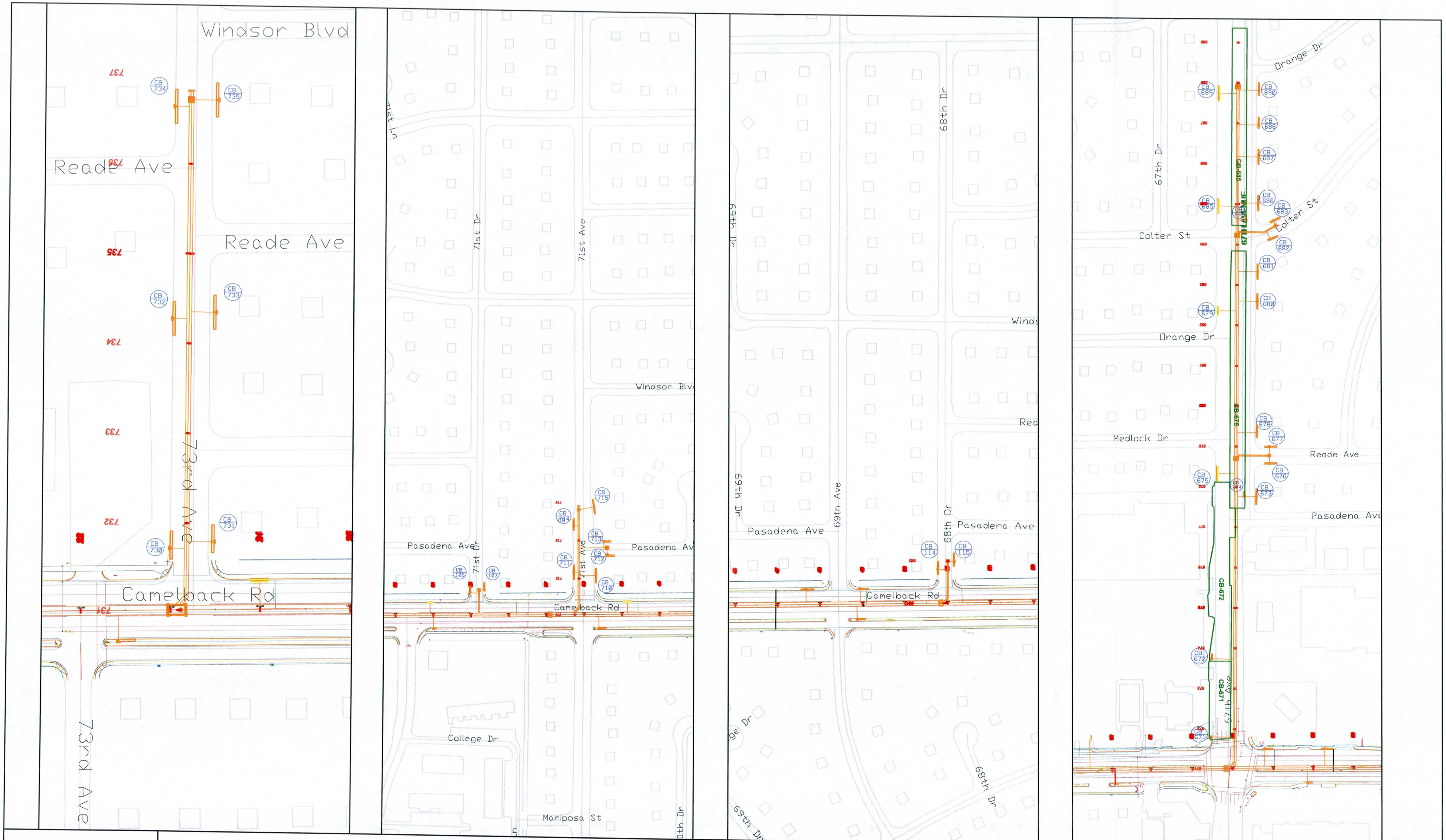
Camelback Rd Storm Drain Project

59th Ave & 67th Ave Street flow Calculation and Inlet Design

Inlet ID No.	Inlet Condition	Curb Type	Drainage Area (acre)	Runoff Coeff. C	Rainfall intensity (in/hr)	Street Flow Q_{10} (cfs)	HEC-1 / Offsite Flow Q_{10} (cfs)	Previous By-Pass Flow (cfs)	Total Flow (cfs)	Gutter Long Slope S_L (ft/ft)	Allowable Spread (ft)	Roadway Cross Slope S_x (ft/ft)	Calculated Spread (ft)	Flow Depth (ft)	Dry lane	Caculated Curb Opening Length (ft)/Grate Size (LxB)	Clogging Factor CF%	Inlet Length after Applying Clogging Factor (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type of Inlet Selected: Type	L1	L2
59th AVENUE																							
CB-596	On Grade	6" Vertical	0.38	0.95	5.72	2.1	-	0	2.1	0.0027	21	0.019	12	0.28	21	10.4	20%	13	2.1	0	M-1	10	0
CB-593	On Grade	6" Vertical	0.40	0.95	5.72	2.2	-	0	2.2	0.0025	25	0.024	11	0.31	26	10.4	20%	13	2.2	0	M-1	10	0
CB-592	On Grade	6" Vertical	0.10	0.95	5.72	0.5		0	0.5	0.0026	11	0.041	5	0.22	19	3.5	20%	4	0.5	0	M-1	3	0
CB-591**	In Sump	6" Vertical	0.37	0.95	5.72	2.0	-	0	2.0	0.0047	30	0.061	3	0.17	39	3' x 1.83'	50%		2.0	0	Existing Grate		
67th AVENUE																							
CB-685	On Grade	6" Vertical	0.41	0.95	5.72	2.2	-	0	2.2	0.0024	21	0.015	14	0.28	19	10.4	20%	13	2.2	0	M-1	10	0
CB-675	On Grade	6" Vertical	0.55	0.95	5.72	3.0	-	0	3.0	0.0038	21	0.026	11	0.29	23	10.4	20%	13	3.0	0	M-1	10	0
CB-672	On Grade	6" Vertical	0.50	0.95	5.72	2.7	-	0	2.7	0.0023	34	0.018	14	0.31	32	10.4	20%	13	2.7	0	M-1	10	0
CB-671	On Grade	6" Vertical	0.23	0.95	5.72	1.3	-	0	1.3	0.0027	33	0.027	8	0.26	37	7	20%	9	1.3	0	P1573 Modified, 3 Grates		

Note: CB-591 ** Existing grate inlet in sag with 1.83' wide and 3' long

Please find Figure X-1 and X-3 in Section D.1 for 67th Ave and 59th Ave street flow drainage area delineation.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FCD PROJ. NO. 2008C024
PCN 620.03.32

OFFSITE CURB INLET LOCATION

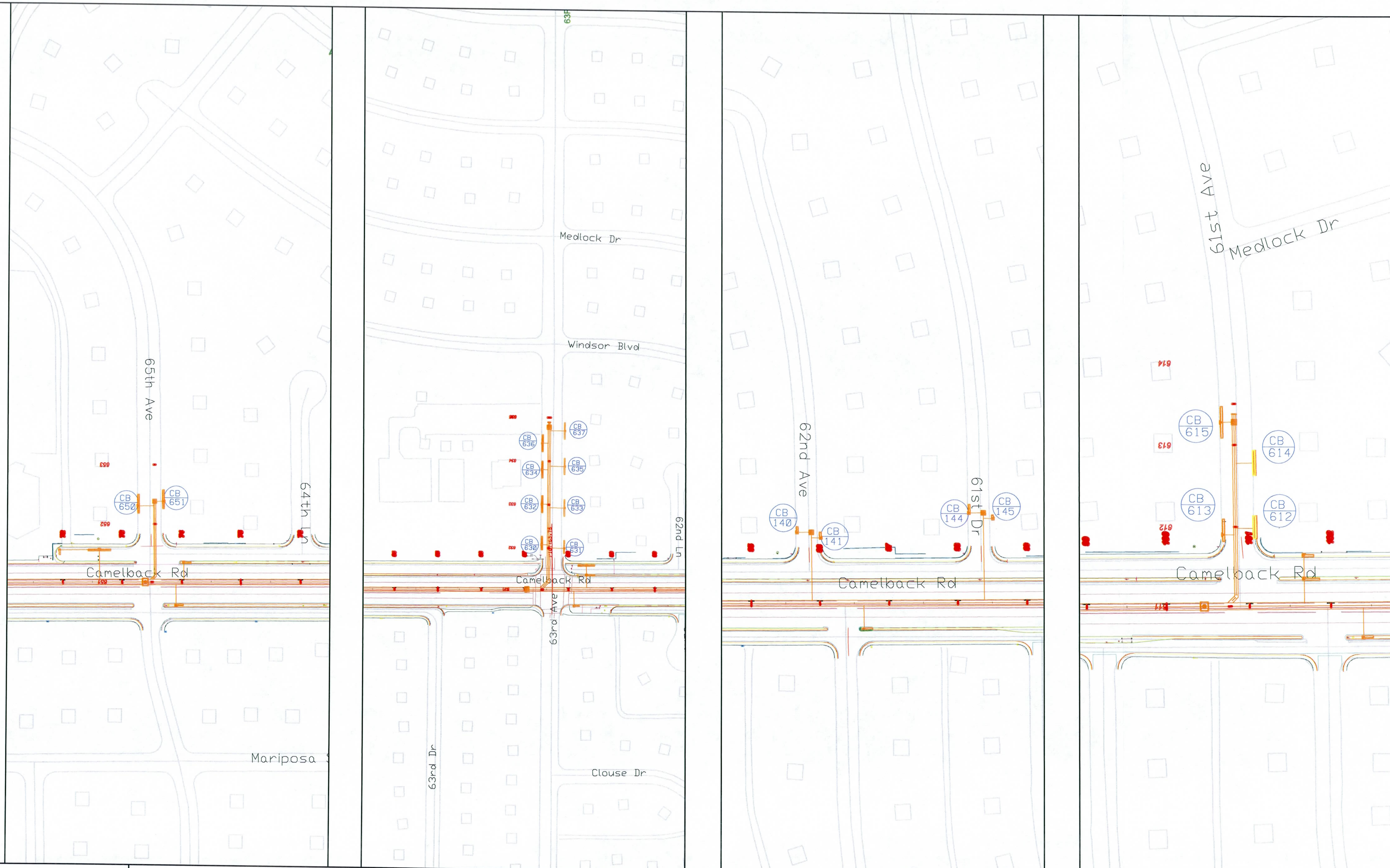
CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

N

SCALE: NTS

OLSSON ASSOCIATES
7250 North 16th Street
Suite 210
Phoenix, AZ 85020
TEL 602.748.1000
FAX 602.748.1001

Figure
X-1



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FCD PROJ. NO. 2008C024
PCN 620.03.32

OFFSITE CURB INLET LOCATION

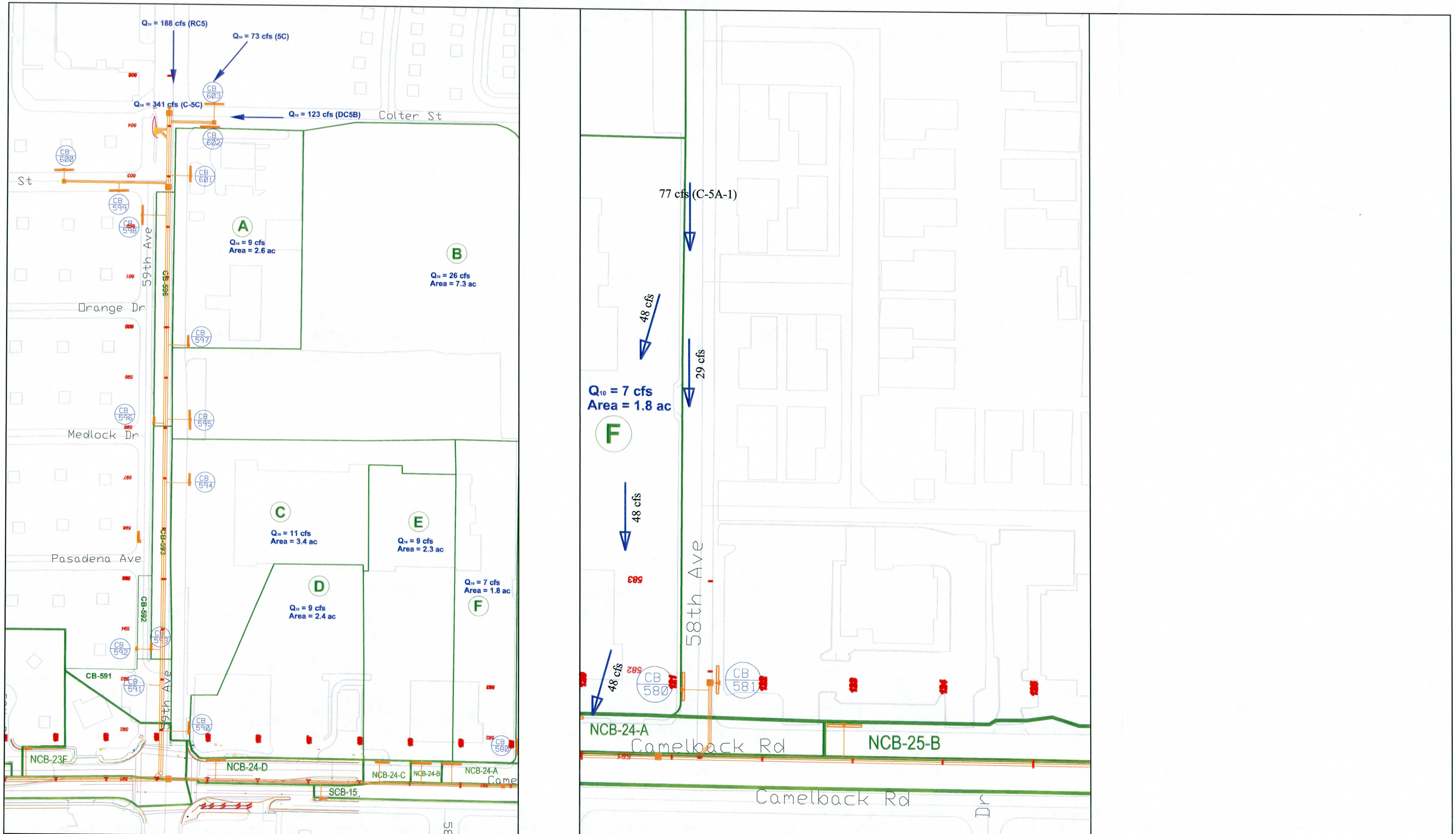
CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

N

SCALE: 1"=1200'

OLSSON ASSOCIATES
7250 North 16th Street
Suite 210
Phoenix, AZ 85020
TEL 602.748.1000
FAX 602.748.1001

Figure X-2



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FCD PROJ. NO. 2008C024
PCN 620.03.32

OFFSITE CURB INLET LOCATION

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

N

SCALE: 1"=1200'

OLSSON ASSOCIATES
7250 North 16th Street
Suite 210
Phoenix, AZ 85020
TEL 602.748.1000
FAX 602.748.1001

Figure

X-3

D.2 Onsite Inlet Hydraulics

Camelback Rd Storm Drain Project

Onsite Curb Opening Inlet Design

North-Half Street Discharge Calculation and Inlet Design along Camelback Road

Inlet ID No.	Inlet Condition	Curb Type	Drainage Area (acre)	Runoff Coeff. C	Rainfall intensity (in/hr)	Street Flow Q_{10} (cfs)	HEC-1 / Offsite Flow Q_{10} (cfs)	Previous By-Pass Flow (cfs)	Total Flow (cfs)	Gutter Long Slope S_L (ft/ft)	Allowable Spread (ft)	Roadway Cross Slope S_x (ft/ft)	Calculated Spread (ft)	Flow Depth (ft)	Dry lane	Caculated Curb Opening Length (ft)	Clogging Factor CF%	Inlet Length after Applying Clogging Factor (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type of Inlet Selected: Type		L1	L2
NCB-1	In Sag	6" Vertical	0.87	0.95	5.72	4.7	-	0	4.7	0.0032	22	0.030	13	0.38	21	8.0	50%	16	4.7	0	Existing			
NCB-2	On Grade	6" Vertical	0.64	0.95	5.72	3.5	-	0	3.5	0.0023	21	0.033	12	0.37	21	9.9	20%	12	3.5	0	P 1573 Modified		4 Grates	
NCB-3	On Grade	6" Vertical	0.93	0.95	5.72	5.1	-	0	5.1	0.0019	21	0.026	14	0.45	19	11.2	20%	14	5.1	0	P 1573 Modified		6 Grates	
NCB-4	On Grade	6" Vertical	0.52	0.95	5.72	2.8	-	0	2.8	0.0022	22	0.022	14	0.32	20	9.6	20%	12	2.8	0	P 1573 Modified		4 Grates	
NCB-5	On Grade	6" Vertical	0.77	0.95	5.72	4.2	-	0	4.2	0.0025	21	0.019	16	0.36	17	12.4	20%	16	4.2	0	P 1573 Modified		6 Grates	
NCB-6	On Grade	6" Vertical	0.15	0.95	5.72	0.8	11.0	0	11.8	0.0040	22	0.024	19	0.50	15	22.8	20%	29	11.8	0	P 1569	M-2	17	10
NCB-7	On Grade	6" Vertical	0.24	0.95	5.72	1.3	-	0	1.3	0.0028	22	0.021	9	0.25	25	6.2	20%	8	1.3	0	P 1569	M-1	6	0
NCB-8A	On Grade	6" Vertical	0.83	0.95	5.72	4.5	3.0	0	7.5	0.0035	22	0.021	16	0.38	18	16.0	20%	20	5.5	0	P 1569	M-1	17	0
NCB-8B	On Grade	6" Vertical	0.42	0.95	5.72	2.3		2	4.3	0.0030	22	0.021	15	0.36	19	12.6	120%	16	4.3	0	P1569	M-1	17	0
NCB-9	In Sag	6" Vertical	3.53	0.85	4.36	13.1	-	0	13.1	0.0025	38	0.026	14	0.46	36	18.4	20%	23	13.1	0	P 1569	M-2	17	3
NCB-10	On Grade	6" Vertical	2.41	0.85	4.36	8.9	-	0	8.9	0.0027	38	0.024	20	0.46	30	19.1	20%	24	8.9	0	P 1569	M-2	17	6
NCB-11	On Grade	6" Vertical	2.52	0.85	4.36	9.4	-	0	9.4	0.0032	30	0.027	17	0.48	25	18.8	20%	24	9.4	0	P 1569	M-2	17	6
NCB-12	On Grade	6" Vertical	2.04	0.85	4.36	7.6	-	0	7.6	0.0031	22	0.026	11	0.33	22	10.4	20%	13	3.0	4.6	P 1569	M-1	10	0
NCB-12A	In Sag	4" Roll Curb	1.99	0.85	4.36	7.4	-	4.6	12.0	0.0027	-	0.021	16	0.40	-	10.4	50%	21	6.0	0	P 1569	M-2	17	3
NCB-12B										0.0014	-	0.018	19	0.40		10.4		21	6.0	0	P 1569	M-2	17	3
NCB-13F-A	On Grade	4" Roll Curb	5.7	0.7	3.7	14.8	-	0	15.0	0.0042	-	0.032	-	0.51	-	16.5	50%	33	11	0	P 1569	M-2	17	17
NCB-13F-B	In Sag	6" Vertical								-	-	0.003	-	0.47	-	4.5	50%	9	4	0	P 1569	M-1	6	0
NCB-14	On Grade	6" Vertical	0.57	0.95	5.72	3.1	-	0	3.1	0.0018	22	0.028	11	0.39	23	8.2	20%	10	3.1	0	P 1569	M-1	10	0
NCB-15F	In Sag	4" Roll Curb	2.46	0.71	4.36	7.6	-	0	7.6	0.0030	-	0.056	7	0.42	-	10.0	50%	20	7.6	0	P 1569	M-1	17	0
NCB-16	On Grade	6" Vertical	0.56	0.95	5.72	3.1	-	0	3.1	0.0022	22	0.028	11	0.37	23	8.7	20%	11	3.1	0	P 1569	M-1	10	0
NCB-17F**	In Sag	6" Vertical	6.36	0.725	3.66	16.9	2.0	0	18.9	0.0032	-	0.050	9	0.48	-	18.5	50%	37	18.9	0	MAG 533	M-2	17	17
NCB-18	On Grade	6" Vertical	0.96	0.95	5.72	5.2	-	0	5.2	0.0031	22	0.027	13	0.42	22	12.6	20%	16	5.2	0	P 1569	M-1	17	0
NCB-19	On Grade	6" Vertical	0.74	0.95	5.72	4.0	-	0	4.0	0.0030	21	0.027	11	0.38	21	10.9	20%	14	4.0	0	P 1569	M-1	17	0
NCB-20F	On Grade	4" Roll Curb	2.07	0.7	4.36	6.3	-	0	6.3	0.0014	-	0.025	18	0.49	-	10.0	20%	12	6.3	0	P 1569	M-1	10	0
NCB-21F	On Grade	4" Roll Curb	0.21	0.95	5.72	1.1	12.0	0	13.1	0.0039	-	0.030	17	0.55	-	18.0	20%	22	13.1	0	P 1569	M-2	17	3
NCB-22F	On Grade	4" Roll Curb	2.70	0.68	4.36	8.0	-	0	8.0	0.0022	-	0.033	15	0.52	-	11.6	20%	14	8.0	0	P 1569	M-1	17	0
NCB-23F	On Grade	4" Roll Curb	0.87	0.85	4.36	3.2	-	0	3.21	0.0030	-	0.031	10	0.35	13	9.6	20%	12	3.2	0	P 1569	M-1	10	0
NCB-24-A	On Grade	6" Vertical	0.29	0.95	5.72	1.6	48.0	0	49.6	0.0028	18	0.027	24	0.70	6	29.6	20%	37	24.0	25.6	P 1569	M-2	17	17
NCB-24-B	On Grade	6" Vertical	0.06	0.95	5.72	0.3	-	25.6	25.9	0.0029	23	0.024	25	0.65	10	29.6	20%	37	22.0	3.9	P 1569	M-2	17	17
NCB-24-C	On Grade	6" Vertical	0.10	0.95	5.72	0.5	9.0	3.9	13.4	0.0022	25	0.026	21	0.60	16	20.8	20%	26	13.4	0.0	P 1569	M-2	17	6
NCB-24-D	In Sag	6" Vertical	0.42	0.95	5.72	2.3	9.0	0.0	11.3	0.0029	28	0.035	12	0.45	28	16.0	50%	32	11.3	0.0	P 1569	M-2	17	17
NCB-25-A	On Grade	6" Vertical	0.23	0.95	5.72	1.3	46.0	-	47.3	0.0026	-	0.028	25	0.74	9	29.6	20%	37	26.0	21.3	P 1569	M-2	17	17
NCB-25-B	On Grade	6" Vertical	0.28	0.95	5.72	1.5	-	21.3	22.8	0.0021	-	0.022	29	0.68	5	29.6	20%	37	22.8	0.0	P 1569	M-2	17	17

Note: NCB-23 F (F= Frontage Road)

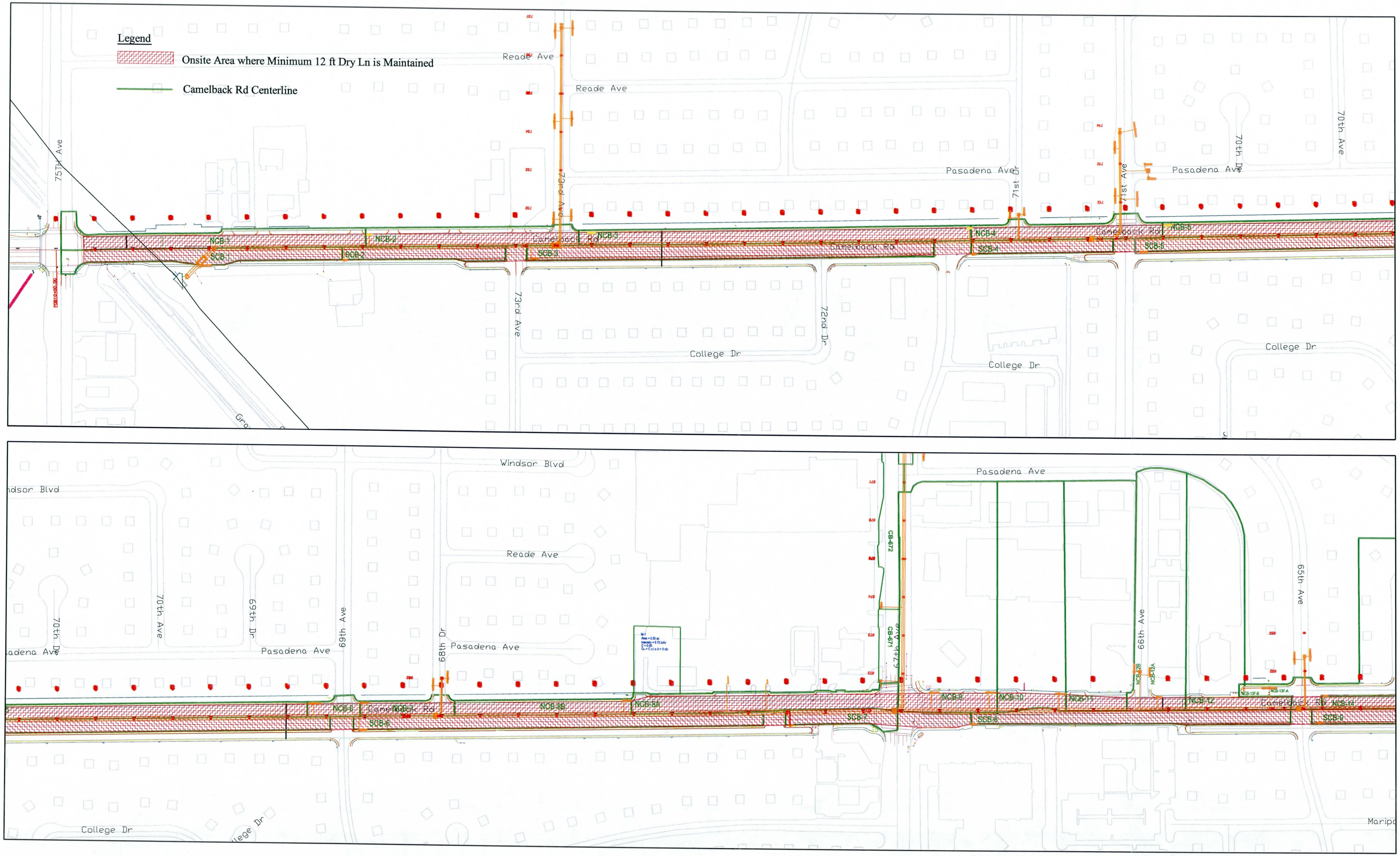
** Combination Inlet MAG Standrad 533 (Grate size 40.5"x26.5")

South-Half Street Discharge Calculation and Inlet Design along Camelback Road

Inlet ID No.	Inlet Condition	Curb Type	Drainage Area (acre)	Runoff Coeff. C	Rainfall intensity (in/hr)	Street Flow Q_{10} (cfs)	HEC-1 Offsite Flow Q_{10} (cfs)	Previous By-Pass Flow (cfs)	Total Flow (cfs)	Gutter Long Slope S_L (ft/ft)	Allowable Spread (ft)	Roadway Cross Slope S_x (ft/ft)	Calculated Spread (ft)	Flow Depth (ft)	Dry lane	Required Caculated Curb Opening Length (ft)	Clogginf Factor CF%	Inlet Length after Applying Clogging Factor (ft)	Intercepted Flow (cfs)	By Pass Flow (cfs)	Type of Inlet Selected: Type		L1	L2
SCB-1	In Sag	6" Vertical	0.62	0.95	5.72	3.3	-	-	3.3	0.0038	24	0.037	6	0.27	30	10	50%	20	3.3	0	P 1569	M-1	17	0
SCB-2	On Grade	6" Vertical	0.34	0.95	5.72	1.9	-	-	1.9	0.0030	20	0.026	9	0.29	23	7	20%	9	1.9	0	P 1569	M-1	6	0
SCB-3	On Grade	6" Vertical	0.95	0.95	5.72	5.2	-	-	5.2	0.0018	20	0.021	17	0.42	15	13	20%	16	5.2	0	P 1569	M-1	17	0
SCB-4	On Grade	6" Vertical	0.29	0.95	5.72	1.6	-	-	1.6	0.0018	21	0.023	10	0.29	23	6	20%	8	1.6	0	P 1569	M-1	6	0
SCB-5	On Grade	6" Vertical	0.79	0.95	5.72	4.28	-	-	4.3	0.0027	23	0.019	16	0.36	19	13	20%	16	4.3	0	P 1569	M-1	17	0
SCB-6	On Grade	6" Vertical	0.84	0.95	5.72	4.56	-	-	4.6	0.0026	22	0.018	17	0.36	17	13	20%	17	4.6	0	P 1569	M-1	17	0
SCB-7	On Grade	6" Vertical	0.28	0.95	5.72	1.55	-	-	1.5	0.0029	24	0.035	7	0.28	29	6	20%	8	1.5	0	P 1569	M-1	6	0
SCB-8	On Grade	6" Vertical	0.69	0.95	5.72	3.77	-	-	3.8	0.0023	13	0.040	10	0.42	15	9	20%	11	3.8	0	P 1569	M-1	10	0
SCB-9	On Grade	6" Vertical	0.74	0.95	5.72	4.02	-	-	4.0	0.0019	22	0.027	13	0.40	21	10	20%	13	4.0	0	P 1569	M-1	10	0
SCB-10	On Grade	6" Vertical	0.47	0.95	5.72	2.58	-	-	2.6	0.0025	22	0.025	11	0.33	23	9	20%	11	2.6	0	P 1569	M-1	10	0
SCB-11	On Grade	6" Vertical	0.67	0.95	5.72	3.66	-	-	3.7	0.0026	21	0.030	13	0.36	20	11	20%	13	3.7	0	P 1569	M-1	10	0
SCB-12	On Grade	6" Vertical	0.45	0.95	5.72	2.43	-	-	2.4	0.0031	22	0.030	10	0.31	23	9	20%	11	2.4	0	P 1569	M-1	10	0
SCB-13	On Grade	6" Vertical	0.49	0.95	5.72	2.67	-	-	2.7	0.0032	22	0.025	11	0.32	24	9	20%	12	2.7	0	P 1569	M-1	10	0
SCB-14	On Grade	6" Vertical	0.64	0.95	5.72	3.50	-	-	3.5	0.0021	22	0.028	12	0.37	22	9	20%	11	3.4	0	P 1569	M-1	10	0
SCB-15	On Grade	6" Vertical	0.87	0.95	5.72	4.73	-	-	4.7	0.0029	13	0.044	10	0.45	15	10	20%	13	4.7	0	P 1569	M-1	10	0

12' dry Lane is consideredto calculate the allowable spread

Note: Please refer PLATE-II for Onsite Drainage Area Delineation and Catch Basin Locations.

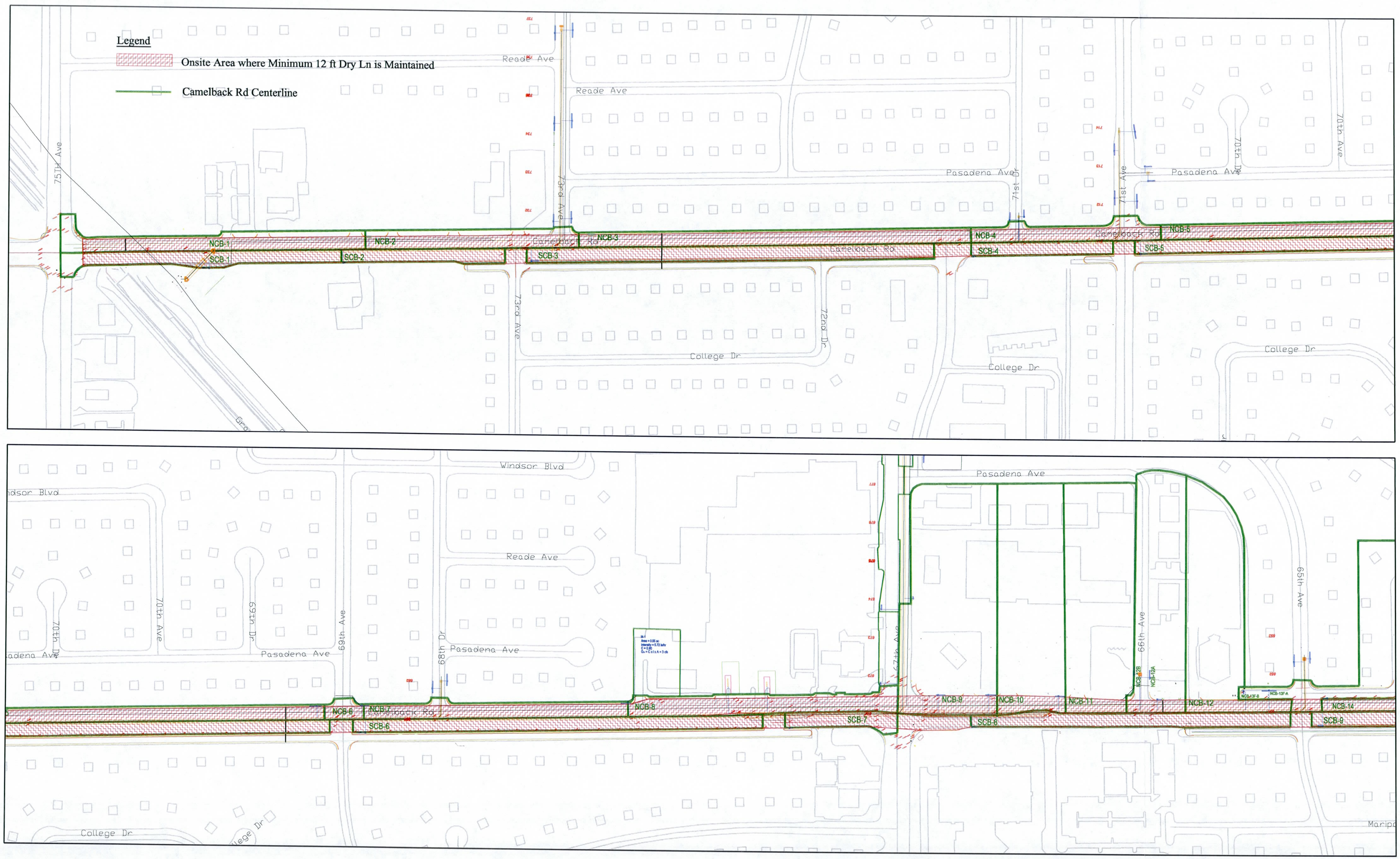


Onsite 12 ft Dry Lane Area

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

OLSSON ASSOCIATES

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FCD PROJ. NO. 2008C024
PCN 620.03.32



Onsite 12 ft Dry Lane Area

CAMELBACK ROAD STORM DRAIN: 59TH AVENUE TO 75TH AVENUE

OLSSON ASSOCIATES
7250 North 16th Street
Suite 210
Phoenix, AZ 85020
TEL 602.748.1000
FAX 602.748.1001

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
FCD PROJ. NO. 2008C024
PCN 620.03.32

Worksheet for NCB-1

Project Description

Solve For	Spread		

Input Data

Discharge		4.70	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.03	ft/ft
Curb Opening Length		8.00	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		90.00	degrees

Results

Spread	12.87	ft
Depth	0.38	ft
Gutter Depression	0.05	ft
Total Depression	0.21	ft

Worksheet for NCB-2

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	3.50	ft³/s
Slope	0.00230	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	9.93	ft
Intercepted Flow	3.50	ft³/s
Bypass Flow	0.00	ft³/s
Spread	12.43	ft
Depth	0.37	ft
Flow Area	2.04	ft²
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.71	ft/s
Equivalent Cross Slope	0.07145	ft/ft
Length Factor	1.00	
Total Interception Length	9.93	ft

Worksheet for NCB-3

Project Description

Solve For	Efficiency

Input Data

Discharge	5.10	ft³/s
Slope	0.00190	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	11.15	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	5.10	ft³/s
Bypass Flow	0.00	ft³/s
Spread	13.63	ft
Depth	0.45	ft
Flow Area	2.82	ft²
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	1.81	ft/s
Equivalent Cross Slope	0.06970	ft/ft
Length Factor	1.00	
Total Interception Length	11.15	ft

Worksheet for NCB-4

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	2.80	ft^3/s
Slope	0.00220	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	9.56	ft
Intercepted Flow	2.80	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	13.96	ft
Depth	0.32	ft
Flow Area	1.89	ft^2
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	1.48	ft/s
Equivalent Cross Slope	0.06372	ft/ft
Length Factor	1.00	
Total Interception Length	9.56	ft

Worksheet for NCB-5

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	4.20	ft^3/s
Slope	0.00250	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	12.44	ft
Intercepted Flow	4.20	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	15.94	ft
Depth	0.36	ft
Flow Area	2.45	ft^2
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	1.71	ft/s
Equivalent Cross Slope	0.05816	ft/ft
Length Factor	1.00	
Total Interception Length	12.44	ft

Worksheet for NCB-6

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	11.80	ft³/s
Slope	0.00400	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	22.81	ft
Intercepted Flow	11.80	ft³/s
Bypass Flow	0.00	ft³/s
Spread	18.70	ft
Depth	0.50	ft
Flow Area	4.23	ft²
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	2.79	ft/s
Equivalent Cross Slope	0.05522	ft/ft
Length Factor	1.00	
Total Interception Length	22.81	ft

Worksheet for NCB-7

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	1.30	ft³/s
Slope	0.00280	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	6.24	ft
Intercepted Flow	1.30	ft³/s
Bypass Flow	0.00	ft³/s
Spread	9.25	ft
Depth	0.25	ft
Flow Area	0.94	ft²
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	1.39	ft/s
Equivalent Cross Slope	0.08558	ft/ft
Length Factor	1.00	
Total Interception Length	6.24	ft

Worksheet for NCB-8A

Project Description

Solve For	Efficiency

Input Data

Discharge	5.50	ft³/s
Slope	0.00346	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	16.00	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	5.50	ft³/s
Bypass Flow	0.00	ft³/s
Spread	16.09	ft
Depth	0.38	ft
Flow Area	2.63	ft²
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	2.09	ft/s
Equivalent Cross Slope	0.05822	ft/ft
Length Factor	1.04	
Total Interception Length	15.35	ft

Worksheet for NCB-8B

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	4.30	ft³/s
Slope	0.00290	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	12.61	ft
Intercepted Flow	4.30	ft³/s
Bypass Flow	0.00	ft³/s
Spread	14.69	ft
Depth	0.36	ft
Flow Area	2.30	ft²
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	1.87	ft/s
Equivalent Cross Slope	0.06226	ft/ft
Length Factor	1.00	
Total Interception Length	12.61	ft

Worksheet for NCB-9

Project Description

Solve For	Spread	

Input Data

Discharge	13.10	ft^3/s
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Curb Opening Length	18.40	ft
Opening Height	4.20	ft
Curb Throat Type	Horizontal	
Local Depression	2.00	in
Local Depression Width	1.42	ft
Throat Incline Angle	90.00	degrees

Results

Spread	13.99	ft
Depth	0.46	ft
Gutter Depression	0.04	ft
Total Depression	0.21	ft

Worksheet for NCB-10

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	8.90	ft^3/s
Slope	0.00270	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	19.05	ft
Intercepted Flow	8.90	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	20.28	ft
Depth	0.46	ft
Flow Area	4.15	ft^2
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	2.14	ft/s
Equivalent Cross Slope	0.05025	ft/ft
Length Factor	1.00	
Total Interception Length	19.05	ft

Worksheet for NCB-11

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	9.40	ft^3/s
Slope	0.00320	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	18.81	ft
Intercepted Flow	9.40	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	17.44	ft
Depth	0.48	ft
Flow Area	3.84	ft^2
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	2.45	ft/s
Equivalent Cross Slope	0.05806	ft/ft
Length Factor	1.00	
Total Interception Length	18.81	ft

Worksheet for NCB-12

Project Description

Solve For	Efficiency

Input Data

Discharge	3.00	ft^3/s
Slope	0.00310	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	10.40	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	3.00	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	11.06	ft
Depth	0.33	ft
Flow Area	1.62	ft^2
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.85	ft/s
Equivalent Cross Slope	0.07682	ft/ft
Length Factor	1.07	
Total Interception Length	9.75	ft

Worksheet for NCB-12A

Project Description

Solve For	Spread		

Input Data

Discharge		6.00	ft³/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		10.40	ft
Opening Height		0.42	ft
Curb Throat Type	Inclined		
Local Depression		4.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		90.00	degrees

Results

Spread	16.36	ft
Depth	0.40	ft
Gutter Depression	0.06	ft
Total Depression	0.39	ft

Worksheet for NCB-12B

Project Description

Solve For	Spread

Input Data

Discharge		6.00	ft³/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		10.40	ft
Opening Height		0.42	ft
Curb Throat Type	Inclined		
Local Depression		4.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		90.00	degrees

Results

Spread	19.09	ft
Depth	0.40	ft
Gutter Depression	0.06	ft
Total Depression	0.39	ft

Worksheet for NCB-13F-A

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	11.00	ft³/s
Slope	0.00420	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	4.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	16.49	ft
Intercepted Flow	11.00	ft³/s
Bypass Flow	0.00	ft³/s
Spread	15.70	ft
Depth	0.51	ft
Flow Area	3.73	ft²
Gutter Depression	0.04	ft
Total Depression	0.37	ft
Velocity	2.95	ft/s
Equivalent Cross Slope	0.09244	ft/ft
Length Factor	1.00	
Total Interception Length	16.49	ft

Worksheet for NCB-13F-B

Project Description

Solve For	Spread		

Input Data

Discharge		4.00	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.00	ft/ft
Curb Opening Length		4.50	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		90.00	degrees

Results

Spread	98.28	ft
Depth	0.47	ft
Gutter Depression	0.08	ft
Total Depression	0.24	ft

Worksheet for NCB-14

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	3.10	ft^3/s
Slope	0.00180	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	8.21	ft
Intercepted Flow	3.10	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	10.94	ft
Depth	0.39	ft
Flow Area	1.94	ft^2
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	1.60	ft/s
Equivalent Cross Slope	0.07975	ft/ft
Length Factor	1.00	
Total Interception Length	8.21	ft

Worksheet for NCB-15F

Project Description

Solve For	Spread		

Input Data

Discharge		7.60	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.06	ft/ft
Curb Opening Length		10.00	ft
Opening Height		0.30	ft
Curb Throat Type	Horizontal		
Local Depression		4.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		90.00	degrees

Results

Spread	7.33	ft
Depth	0.42	ft
Gutter Depression	0.01	ft
Total Depression	0.34	ft

Worksheet for NCB-16

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	3.06	ft³/s
Slope	0.00220	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	8.72	ft
Intercepted Flow	3.06	ft³/s
Bypass Flow	0.00	ft³/s
Spread	10.90	ft
Depth	0.37	ft
Flow Area	1.81	ft²
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	1.69	ft/s
Equivalent Cross Slope	0.07903	ft/ft
Length Factor	1.00	
Total Interception Length	8.72	ft

Worksheet for NCB-17F

Project Description

Solve For	Spread	

Input Data

Discharge	18.85	ft^3/s
Gutter Width	2.16	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.05	ft/ft
Local Depression	2.00	in
Local Depression Width	1.42	ft
Grate Width	2.16	ft
Grate Length	3.33	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	18.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option	Use Both	

Results

Spread	9.08	ft
Depth	0.48	ft
Gutter Depression	0.02	ft
Total Depression	0.19	ft
Open Grate Area	3.24	ft^2
Active Grate Weir Length	5.49	ft

Worksheet for NCB-18

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	5.19	ft³/s
Slope	0.00310	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	12.64	ft
Intercepted Flow	5.19	ft³/s
Bypass Flow	0.00	ft³/s
Spread	12.50	ft
Depth	0.42	ft
Flow Area	2.37	ft²
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	2.19	ft/s
Equivalent Cross Slope	0.07311	ft/ft
Length Factor	1.00	
Total Interception Length	12.64	ft

Worksheet for NCB-19

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	4.02	ft³/s
Slope	0.00300	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	10.90	ft
Intercepted Flow	4.02	ft³/s
Bypass Flow	0.00	ft³/s
Spread	11.41	ft
Depth	0.38	ft
Flow Area	1.98	ft²
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	2.03	ft/s
Equivalent Cross Slope	0.07700	ft/ft
Length Factor	1.00	
Total Interception Length	10.90	ft

Worksheet for NCB-20F

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	6.30	ft^3/s
Slope	0.00140	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	4.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	9.99	ft
Intercepted Flow	6.30	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	17.53	ft
Depth	0.49	ft
Flow Area	3.88	ft^2
Gutter Depression	0.05	ft
Total Depression	0.38	ft
Velocity	1.63	ft/s
Equivalent Cross Slope	0.08340	ft/ft
Length Factor	1.00	
Total Interception Length	9.99	ft

Worksheet for NCB-21F

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	13.10	ft³/s
Slope	0.00390	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	4.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	17.97	ft
Intercepted Flow	13.10	ft³/s
Bypass Flow	0.00	ft³/s
Spread	17.12	ft
Depth	0.55	ft
Flow Area	4.38	ft²
Gutter Depression	0.04	ft
Total Depression	0.37	ft
Velocity	2.99	ft/s
Equivalent Cross Slope	0.08725	ft/ft
Length Factor	1.00	
Total Interception Length	17.97	ft

Worksheet for NCB-22F

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	8.00	ft³/s
Slope	0.00225	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	4.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	11.57	ft
Intercepted Flow	8.00	ft³/s
Bypass Flow	0.00	ft³/s
Spread	14.77	ft
Depth	0.52	ft
Flow Area	3.62	ft²
Gutter Depression	0.04	ft
Total Depression	0.37	ft
Velocity	2.21	ft/s
Equivalent Cross Slope	0.09778	ft/ft
Length Factor	1.00	
Total Interception Length	11.57	ft

Worksheet for NCB-23-F

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	3.21	ft³/s
Slope	0.00300	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	9.63	ft
Intercepted Flow	3.21	ft³/s
Bypass Flow	0.00	ft³/s
Spread	10.46	ft
Depth	0.35	ft
Flow Area	1.67	ft²
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	1.92	ft/s
Equivalent Cross Slope	0.08095	ft/ft
Length Factor	1.00	
Total Interception Length	9.63	ft

Worksheet for NCB-24-A

Project Description

Solve For	Efficiency

Input Data

Discharge	24.00	ft³/s
Slope	0.00280	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	29.60	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	24.00	ft³/s
Bypass Flow	0.00	ft³/s
Spread	24.31	ft
Depth	0.70	ft
Flow Area	8.01	ft²
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	3.00	ft/s
Equivalent Cross Slope	0.05028	ft/ft
Length Factor	1.01	
Total Interception Length	29.21	ft

Worksheet for NCB-24-B

Project Description

Solve For	Efficiency

Input Data

Discharge	22.00	ft³/s
Slope	0.00290	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	29.60	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	22.00	ft³/s
Bypass Flow	0.00	ft³/s
Spread	25.16	ft
Depth	0.65	ft
Flow Area	7.63	ft²
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	2.88	ft/s
Equivalent Cross Slope	0.04721	ft/ft
Length Factor	1.00	
Total Interception Length	29.55	ft

Worksheet for NCB-24-C

Project Description

Solve For	Efficiency

Input Data

Discharge	13.40	ft^3/s
Slope	0.00210	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	20.80	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	13.40	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	21.09	ft
Depth	0.60	ft
Flow Area	5.82	ft^2
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	2.30	ft/s
Equivalent Cross Slope	0.05309	ft/ft
Length Factor	1.02	
Total Interception Length	20.30	ft

Worksheet for NCB-24-D

Project Description

Solve For	Spread		

Input Data

Discharge		11.30	ft^3/s
Gutter Width		1.42	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.04	ft/ft
Curb Opening Length		16.00	ft
Opening Height		4.20	ft
Curb Throat Type	Horizontal		
Local Depression		2.00	in
Local Depression Width		1.42	ft
Throat Incline Angle		90.00	degrees

Results

Spread	11.78	ft
Depth	0.45	ft
Gutter Depression	0.04	ft
Total Depression	0.20	ft

Worksheet for NCB-25-A

Project Description

Solve For	Efficiency

Input Data

Discharge	26.00	ft³/s
Slope	0.00260	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	29.60	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	26.00	ft³/s
Bypass Flow	0.00	ft³/s
Spread	24.84	ft
Depth	0.74	ft
Flow Area	8.67	ft²
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	3.00	ft/s
Equivalent Cross Slope	0.05057	ft/ft
Length Factor	1.01	
Total Interception Length	29.44	ft

Worksheet for NCB-25-B

Project Description

Solve For	Efficiency

Input Data

Discharge	22.80	ft^3/s
Slope	0.00210	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Curb Opening Length	29.60	ft
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Efficiency	100.00	%
Intercepted Flow	22.80	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	28.61	ft
Depth	0.68	ft
Flow Area	9.04	ft^2
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	2.52	ft/s
Equivalent Cross Slope	0.04284	ft/ft
Length Factor	1.03	
Total Interception Length	28.87	ft

Worksheet for SCB-1

Project Description

Solve For	Spread

Input Data

Discharge	3.30	ft^3/s
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.04	ft/ft
Curb Opening Length	10.00	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Local Depression	2.00	in
Local Depression Width	1.42	ft
Throat Incline Angle	90.00	degrees

Results

Spread	6.36	ft
Depth	0.27	ft
Gutter Depression	0.03	ft
Total Depression	0.20	ft

Worksheet for SCB-2

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	1.90	ft^3/s
Slope	0.00300	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	7.47	ft
Intercepted Flow	1.90	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	9.31	ft
Depth	0.29	ft
Flow Area	1.16	ft^2
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.64	ft/s
Equivalent Cross Slope	0.08565	ft/ft
Length Factor	1.00	
Total Interception Length	7.47	ft

Worksheet for SCB-3

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	5.20	ft^3/s
Slope	0.00180	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	12.61	ft
Intercepted Flow	5.20	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	17.31	ft
Depth	0.42	ft
Flow Area	3.19	ft^2
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	1.63	ft/s
Equivalent Cross Slope	0.05601	ft/ft
Length Factor	1.00	
Total Interception Length	12.61	ft

Worksheet for SCB-4

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	1.60	ft^3/s
Slope	0.00180	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	6.24	ft
Intercepted Flow	1.60	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	10.37	ft
Depth	0.29	ft
Flow Area	1.27	ft^2
Gutter Depression	0.05	ft
Total Depression	0.22	ft
Velocity	1.26	ft/s
Equivalent Cross Slope	0.07924	ft/ft
Length Factor	1.00	
Total Interception Length	6.24	ft

Worksheet for SCB-5

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	4.28	ft³/s
Slope	0.00270	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	12.79	ft
Intercepted Flow	4.28	ft³/s
Bypass Flow	0.00	ft³/s
Spread	15.82	ft
Depth	0.36	ft
Flow Area	2.42	ft²
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	1.77	ft/s
Equivalent Cross Slope	0.05846	ft/ft
Length Factor	1.00	
Total Interception Length	12.79	ft

Worksheet for SCB-6

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	4.56	ft³/s
Slope	0.00260	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	13.40	ft
Intercepted Flow	4.56	ft³/s
Bypass Flow	0.00	ft³/s
Spread	16.88	ft
Depth	0.36	ft
Flow Area	2.61	ft²
Gutter Depression	0.06	ft
Total Depression	0.22	ft
Velocity	1.75	ft/s
Equivalent Cross Slope	0.05550	ft/ft
Length Factor	1.00	
Total Interception Length	13.40	ft

Worksheet for SCB-7

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	1.50	ft³/s
Slope	0.00290	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.04	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	6.01	ft
Intercepted Flow	1.50	ft³/s
Bypass Flow	0.00	ft³/s
Spread	7.14	ft
Depth	0.28	ft
Flow Area	0.92	ft²
Gutter Depression	0.03	ft
Total Depression	0.20	ft
Velocity	1.64	ft/s
Equivalent Cross Slope	0.10251	ft/ft
Length Factor	1.00	
Total Interception Length	6.01	ft

Worksheet for SCB-8

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	3.80	ft³/s
Slope	0.00230	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.04	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	9.06	ft
Intercepted Flow	3.80	ft³/s
Bypass Flow	0.00	ft³/s
Spread	9.85	ft
Depth	0.42	ft
Flow Area	1.96	ft²
Gutter Depression	0.03	ft
Total Depression	0.19	ft
Velocity	1.94	ft/s
Equivalent Cross Slope	0.08825	ft/ft
Length Factor	1.00	
Total Interception Length	9.06	ft

Worksheet for SCB-9

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	4.02	ft³/s
Slope	0.00190	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	10.14	ft
Intercepted Flow	4.02	ft³/s
Bypass Flow	0.00	ft³/s
Spread	13.29	ft
Depth	0.40	ft
Flow Area	2.42	ft²
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.66	ft/s
Equivalent Cross Slope	0.06911	ft/ft
Length Factor	1.00	
Total Interception Length	10.14	ft

Worksheet for SCB-10

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	2.58	ft³/s
Slope	0.00250	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	8.63	ft
Intercepted Flow	2.58	ft³/s
Bypass Flow	0.00	ft³/s
Spread	11.14	ft
Depth	0.33	ft
Flow Area	1.58	ft²
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.63	ft/s
Equivalent Cross Slope	0.07613	ft/ft
Length Factor	1.00	
Total Interception Length	8.63	ft

Worksheet for SCB-11

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	3.66	ft³/s
Slope	0.00260	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	10.61	ft
Intercepted Flow	3.66	ft³/s
Bypass Flow	0.00	ft³/s
Spread	12.65	ft
Depth	0.36	ft
Flow Area	2.04	ft²
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.80	ft/s
Equivalent Cross Slope	0.07024	ft/ft
Length Factor	1.00	
Total Interception Length	10.61	ft

Worksheet for SCB-12

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	2.43	ft³/s
Slope	0.00310	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	8.75	ft
Intercepted Flow	2.43	ft³/s
Bypass Flow	0.00	ft³/s
Spread	10.43	ft
Depth	0.31	ft
Flow Area	1.40	ft²
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.74	ft/s
Equivalent Cross Slope	0.07938	ft/ft
Length Factor	1.00	
Total Interception Length	8.75	ft

Worksheet for SCB-13

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	2.67	ft^3/s
Slope	0.00320	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	9.30	ft
Intercepted Flow	2.67	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	10.76	ft
Depth	0.32	ft
Flow Area	1.48	ft^2
Gutter Depression	0.05	ft
Total Depression	0.21	ft
Velocity	1.80	ft/s
Equivalent Cross Slope	0.07784	ft/ft
Length Factor	1.00	
Total Interception Length	9.30	ft

Worksheet for SCB-14

Project Description

Solve For	Curb Opening Length

Input Data

Discharge	3.50	ft^3/s
Slope	0.00210	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

Curb Opening Length	9.50	ft
Intercepted Flow	3.50	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	12.08	ft
Depth	0.38	ft
Flow Area	2.08	ft^2
Gutter Depression	0.04	ft
Total Depression	0.21	ft
Velocity	1.69	ft/s
Equivalent Cross Slope	0.07356	ft/ft
Length Factor	1.00	
Total Interception Length	9.50	ft

Worksheet for SCB-15

Project Description

Solve For	Curb Opening Length

Input Data

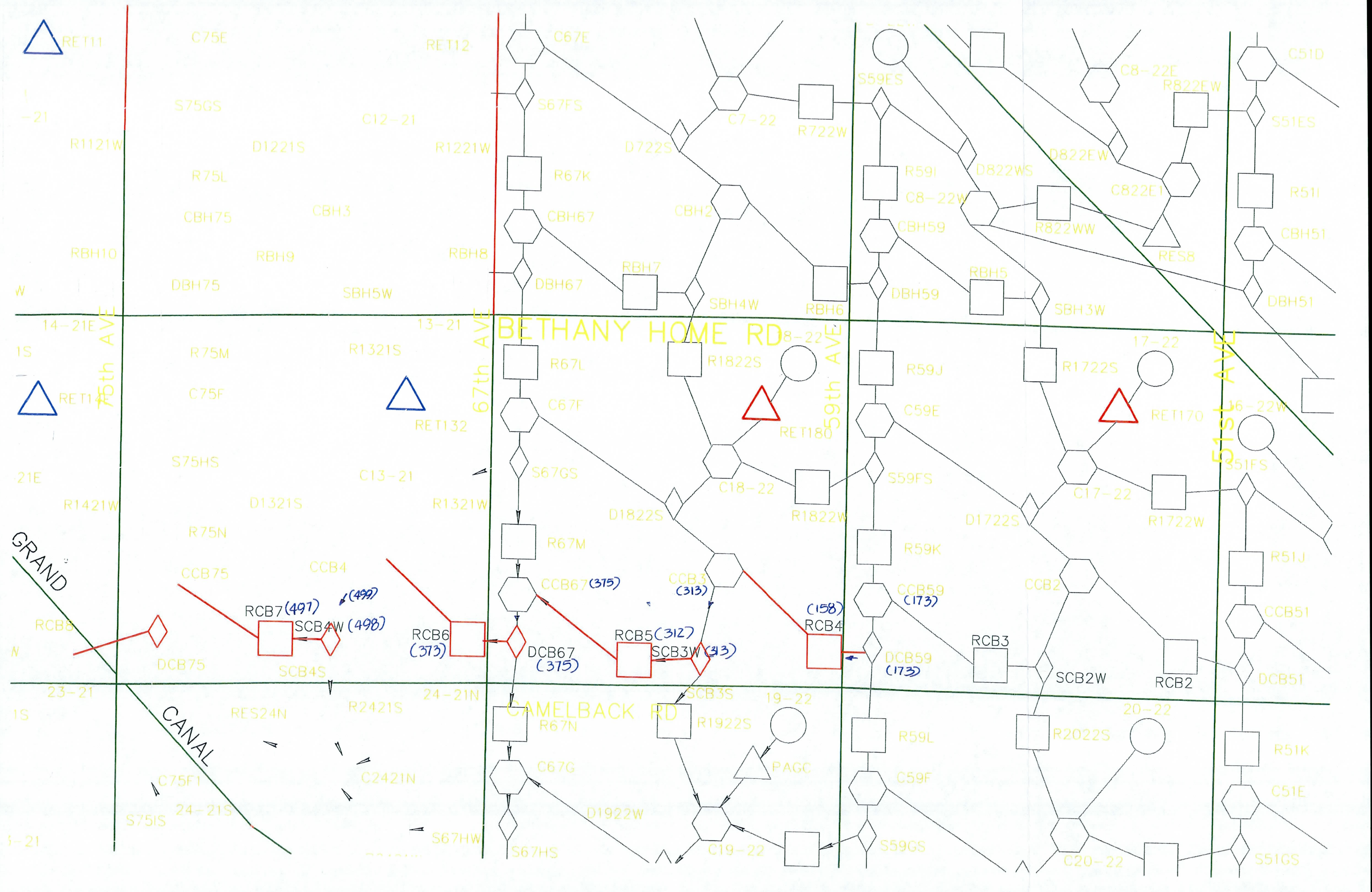
Discharge	4.73	ft^3/s
Slope	0.00290	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.04	ft/ft
Roughness Coefficient	0.015	
Efficiency	100.00	%
Local Depression	2.00	in
Local Depression Width	1.42	ft

Results

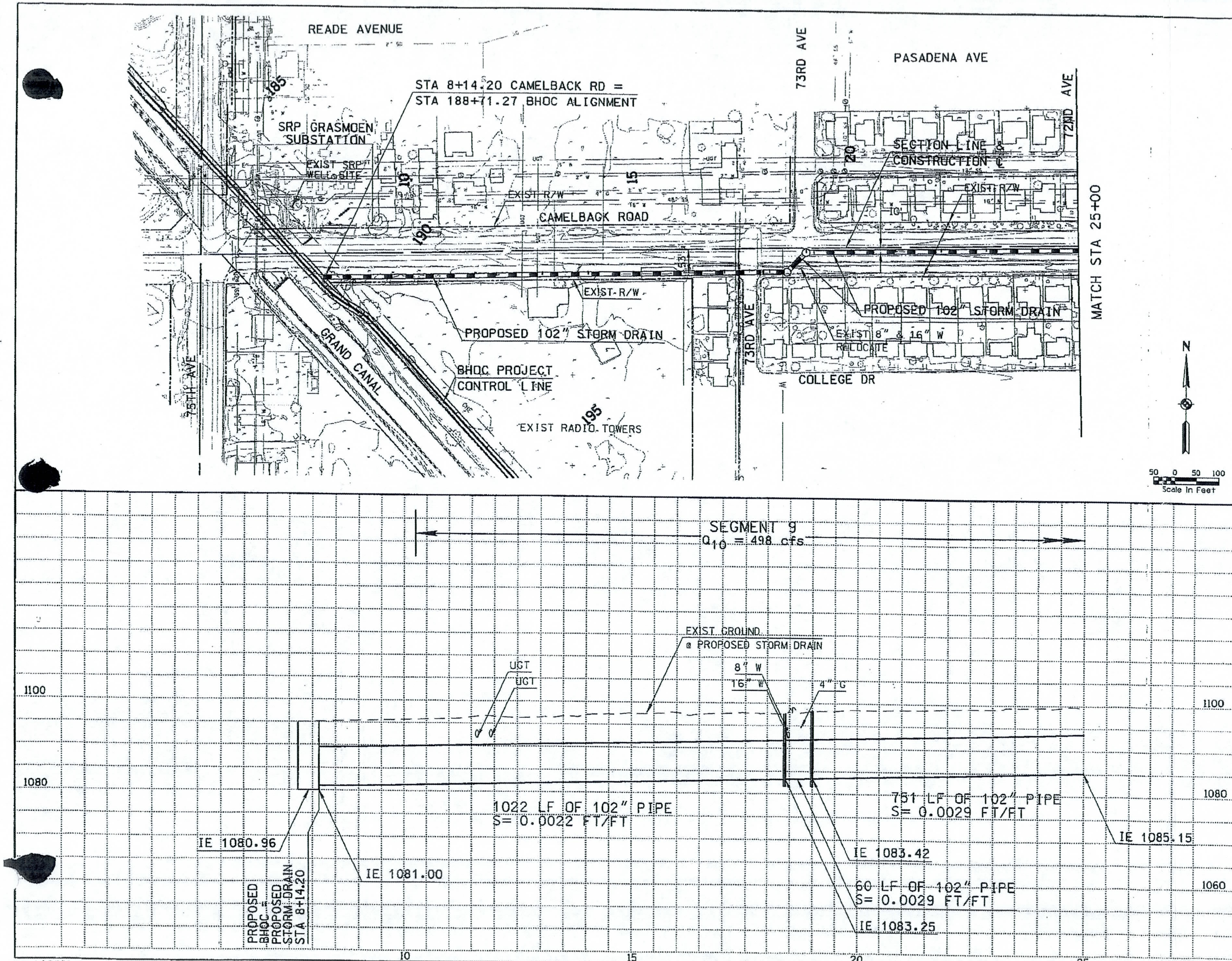
Curb Opening Length	10.45	ft
Intercepted Flow	4.73	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	9.66	ft
Depth	0.45	ft
Flow Area	2.07	ft^2
Gutter Depression	0.02	ft
Total Depression	0.19	ft
Velocity	2.29	ft/s
Equivalent Cross Slope	0.09110	ft/ft
Length Factor	1.00	
Total Interception Length	10.45	ft

D.3 Trunk Line Hydraulics

D.3.1 Excerpts from BH/GC CLOMR Study



RET11
C75E
RET12
C67E
S75GS
C12-21
S67FS
C7-22
R722W
S59ES
C51D
C8-22E
R822EW
S51ES
R1121W
D1221S
R1221W
D722S
R67K
R59I
D822WS
D822EW
C8-22W
C822E1
R51I
R75L
CBH3
CBH75
CBH67
CBH2
CBH59
R822WW
CBH51
RES8
RBH10
RBH9
RBH8
RBH7
RBH5
DBH75
DBH67
DBH59
DBH51
SBH5W
SBH4W
RBH6
SBH3W
14-21E
13-21
BETHANY HOME RD
8-22
17-22
R75M
R1321S
R67L
R1822S
R59J
R1722S
75th AVE
67th AVE
59th AVE
51st AVE
RET14E
C75F
RET132
C67F
RET180
C59E
RET170
16-22W
S75HS
C13-21
S67GS
S59FS
S51FS
D1321S
R1321W
D1822S
C18-22
R1822W
D1722S
C17-22
R1722W
R75N
R67M
R59K
R51J
GRAND
CCB75
CCB4
CCB67 (375)
CCB3 (313)
CCB59 (173)
CCB2
CCB51
(499)
RCB7 (497)
SCB4W (498)
RCB8
RCB6 (373)
DCB67 (375)
RCB5 (312)
SCB3W (313)
(158) RCB4
DCB59 (173)
RCB3
SCB2W
RCB2
DCB51
DCB75
SCB4S
SCB3S
23-21
24-21N
CAMELBACK RD
19-22
20-22
RES24N
R2421S
R67N
R1922S
R59L
R2022S
R51K
CANAL
PAGC
C75F1
C2421N
C67G
C59F
C51E
24-21S
D1922W
S75IS
S67HW
S67HS
C19-22
S59GS
C20-22
S51GS



☐ REMOVE ☐

○ CONSTRUCT ○

RECOMMENDED ALTERNATIVE

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

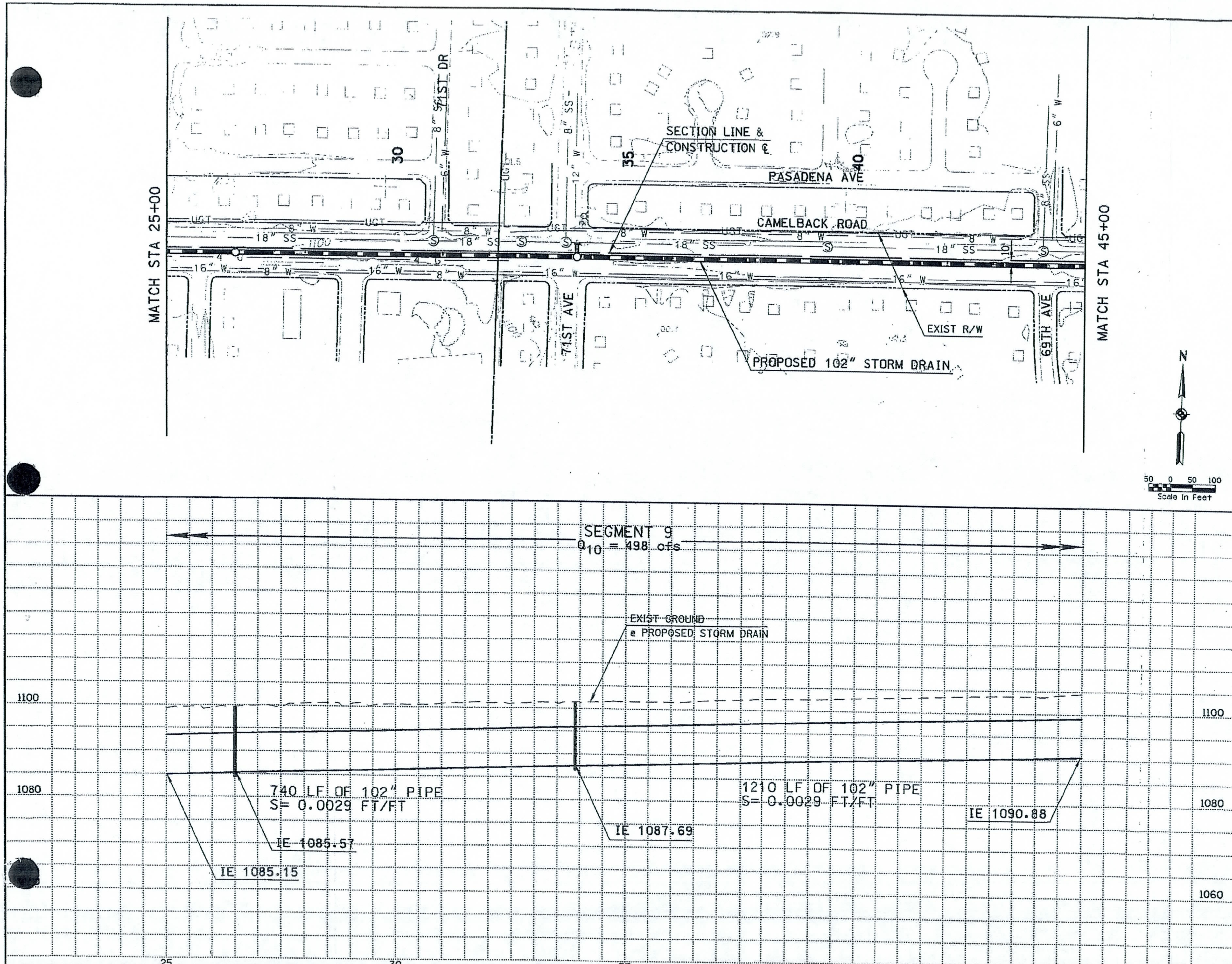
BETHANY HOME OUTFALL CHANNEL, PHASE II
PCN NO. 620 03 32

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

	BY	DATE
DESIGNED	JRG	12/02
DRAWN	CPG/JAE	12/02
CHECKED	JRM	12/02

DMJM+HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 10+00.00 25+00.00 SHEET 32 OF



☐ REMOVE ☐

○ CONSTRUCT ○

RECOMMENDED ALTERNATIVE

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

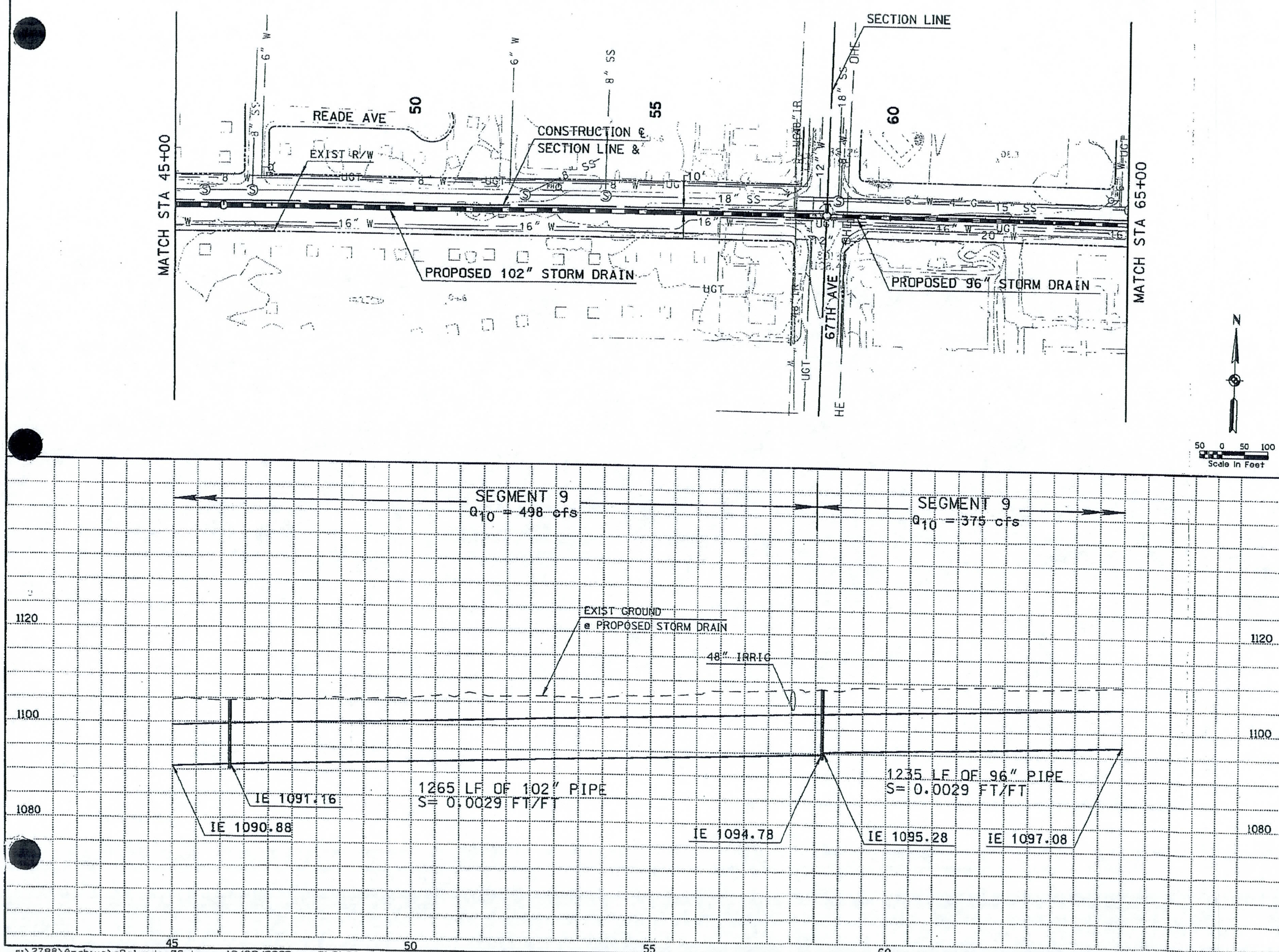
BETHANY HOME/GRAND CANAL
FLOOD CONTROL PROJECT
CAMELBACK ROAD STORM DRAIN

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

	BY	DATE
DESIGNED	JRG	9-00
DRAWN	CPG	9-00
CHECKED	JRM	9-00

DMJM ARIZONA, INC. 2777 E. CAMELBACK ROAD SUITE 200 PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO.	PLAN SHEET STA. 25+00.00 TO 45+00.00	SHEET 33	OF



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☐ REMOVE ☐

◯ CONSTRUCT ◯

RECOMMENDED ALTERNATIVE

NO.	REVISION	BY	DATE
3			
2			
1			

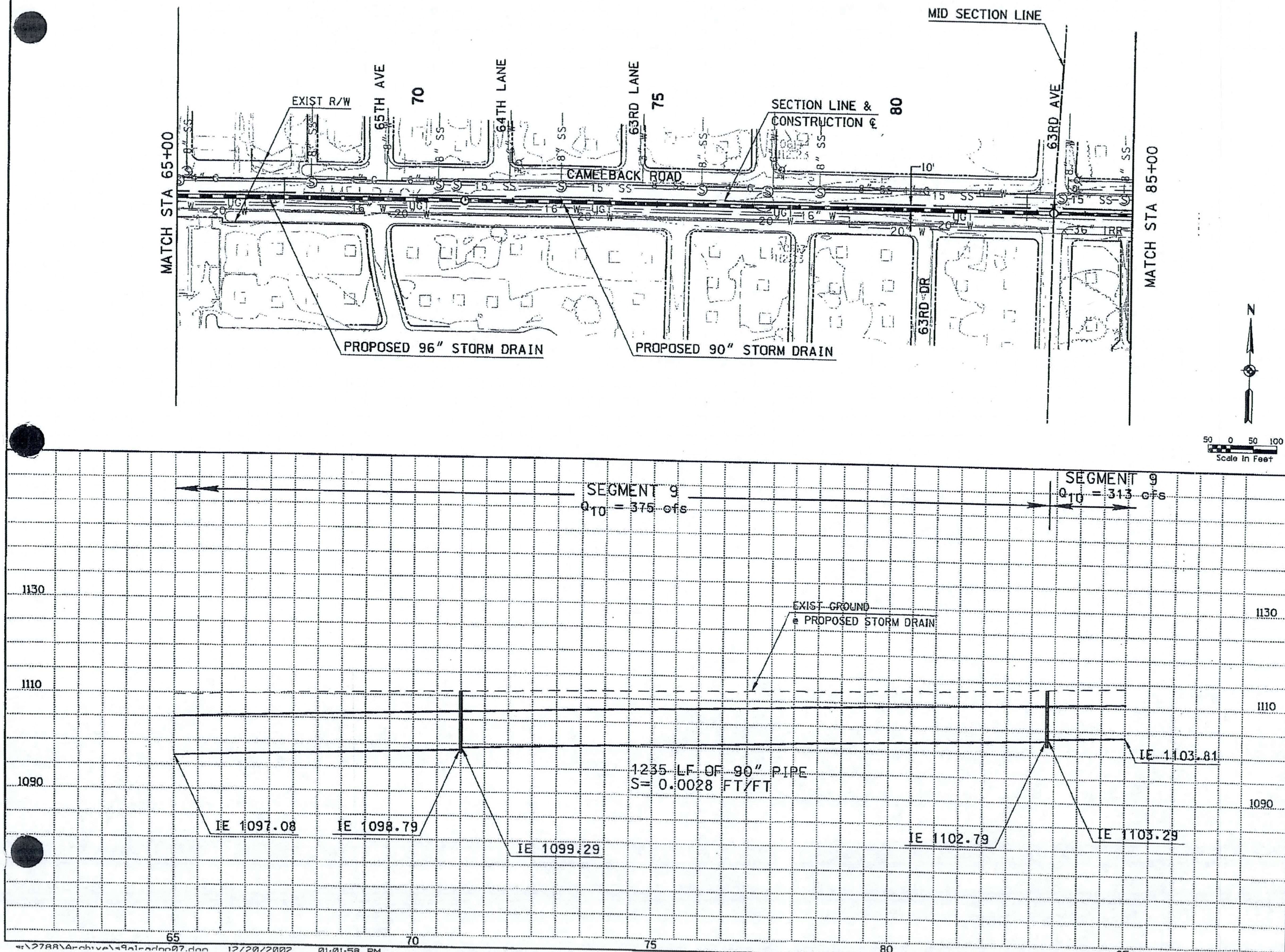
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME/GRAND CANAL FLOOD CONTROL PROJECT
CAMELBACK ROAD STORM DRAIN

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING		BY	DATE
	DESIGNED	JRG	9-00
	DRAWN	CPG	9-00
	CHECKED	JRM	9-00

DMJM ARIZONA, INC. 2777 E. CAMELBACK ROAD SUITE 200 PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO.	PLAN SHEET STA. 45+00.00 TO 65+00.00	SHEET 34 OF



☐ REMOVE ☐

◯ CONSTRUCT ◯

RECOMMENDED ALTERNATIVE

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME/GRAND CANAL FLOOD CONTROL PROJECT
CAMELBACK ROAD STORM DRAIN

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

	BY	DATE
DESIGNED	JRG	9-00
DRAWN	CPG	9-00
CHECKED	JRM	9-00

DMJM ARIZONA, INC. 2777 E. CAMELBACK ROAD SUITE 200 PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO.	PLAN SHEET STA. 65+00.00 TO 85+00.00	SHEET 35 OF

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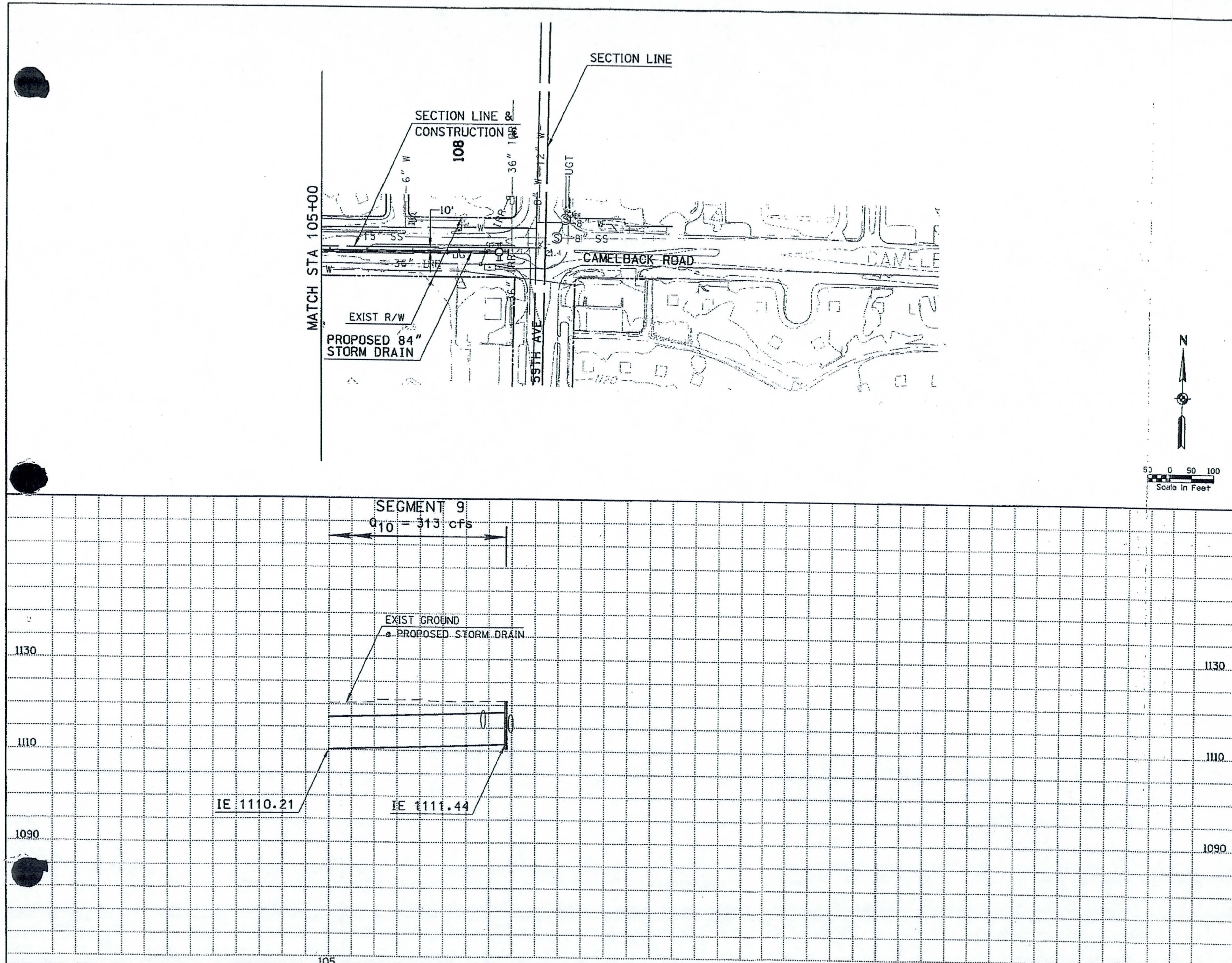

REMOVE

CONSTRUCT

RECOMMENDED ALTERNATIVE

NO.	REVISION	BY	DATE
3			
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

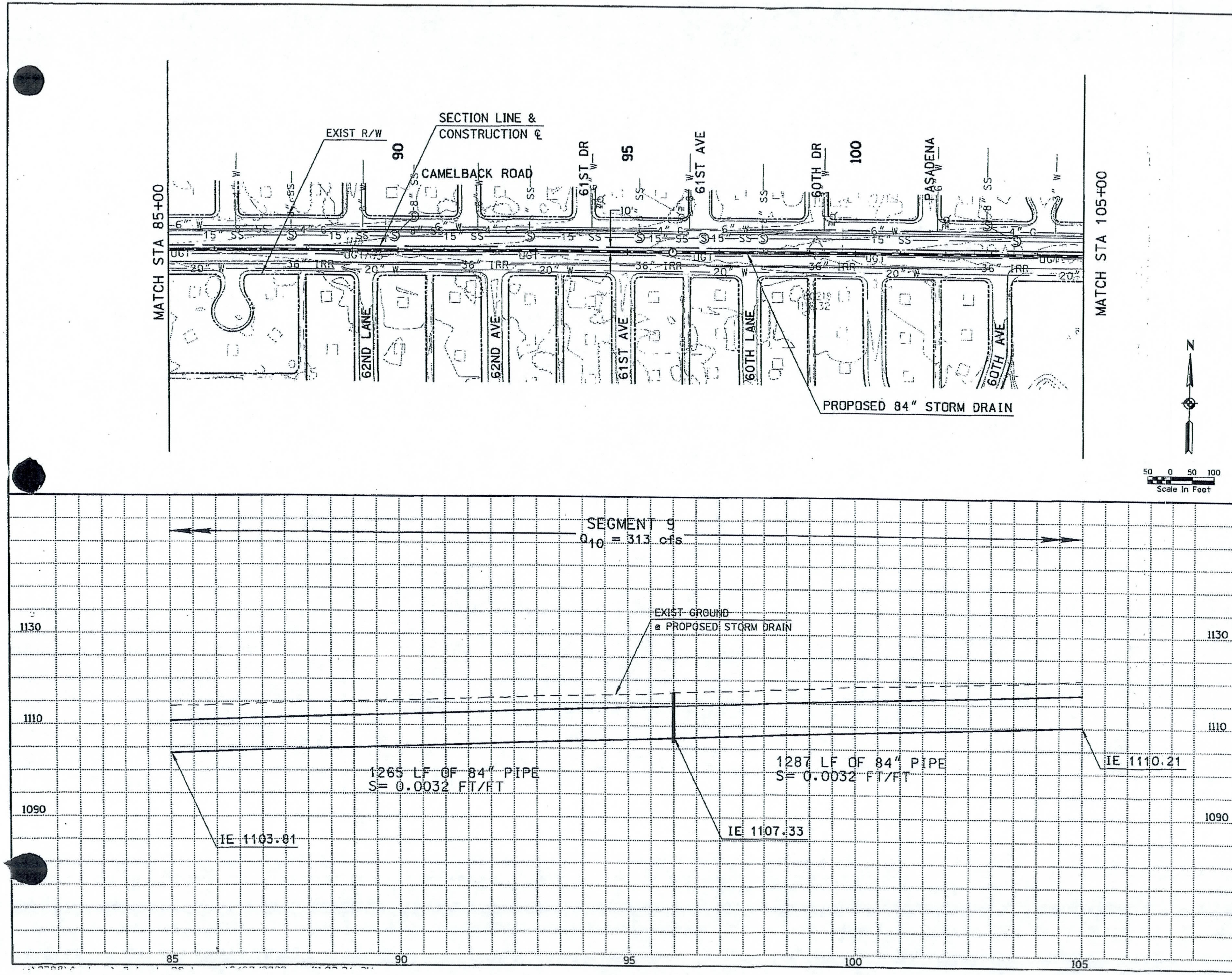
BETHANY HOME/GRAND CANAL FLOOD CONTROL PROJECT
CAMELBACK ROAD STORM DRAIN

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

	BY	DATE
DESIGNED	JRG	9-00
DRAWN	CPG	9-00
CHECKED	JRM	9-00

DMJM ARIZONA, INC. 2777 E. CAMELBACK ROAD SUITE 200 PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO.	PLAN SHEET STA. 105+00.00 TO 108+69.40	SHEET 37 OF



REMOVE

CONSTRUCT

RECOMMENDED ALTERNATIVE

NO.	REVISION	BY	DATE
3			
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME/GRAND CANAL FLOOD CONTROL PROJECT
CAMELBACK ROAD STORM DRAIN

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

	BY	DATE
DESIGNED	JRG	9-00
DRAWN	CPG	9-00
CHECKED	JRM	9-00

DMJM ARIZONA, INC. 2777 E. CAMELBACK ROAD SUITE 200 PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO.	PLAN SHEET STA. 85+00.00 TO 105+00.00	SHEET 36 OF

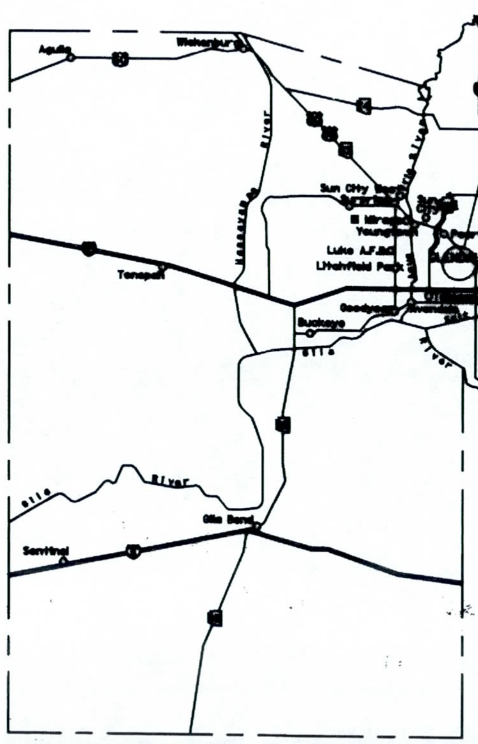
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

IN COOPERATION WITH THE CITIES OF GLENDALE AND PHOENIX

PLANS FOR THE CONSTRUCTION OF:
BETHANY HOME OUTFALL CHANNEL
REACH C - 83rd AVENUE TO 73rd AVENUE
PCN NO. 620 03 32
FCD CONTRACT NO. 2004C055
OCTOBER 2005

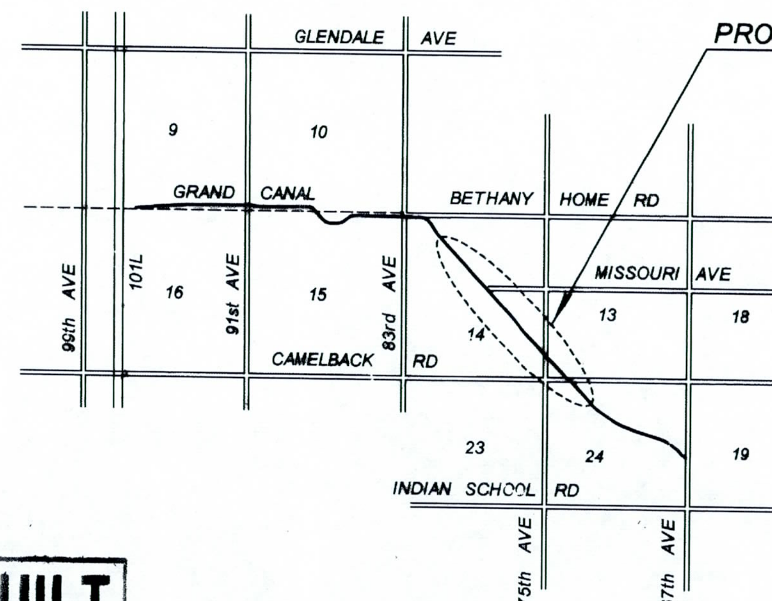
GLENDALE

PROJECT LOCATION



MARICOPA COUNTY
Not to Scale

PROJECT LOCATION



VICINITY MAP
Not to Scale

AS-BUILT

CENTRAL FILES
DRAWER # 19

RECORD DRAWINGS
I HEREBY CERTIFY THAT THE 'RECORD DRAWINGS' MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.
23 JUNE 2007

APPROVED BY:

CITY OF GLENDALE	10-28-05 DATE
CITY OF PHOENIX	10/24/05 DATE
MARICOPA COUNTY DEPT. OF ENVIRONMENTAL SERVICES (T.S. Chisholm 051705)	12/13/05 DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY:

PROJECT MANAGER (C. Scott Vogel)	11/25/05 DATE

ISSUED FOR PUBLIC BIDDING BY:

CHIEF ENGINEER AND GENERAL MANAGER	10/31/05 DATE

BOARD OF DIRECTORS OF THE FLOOD CONTROL DISTRICT

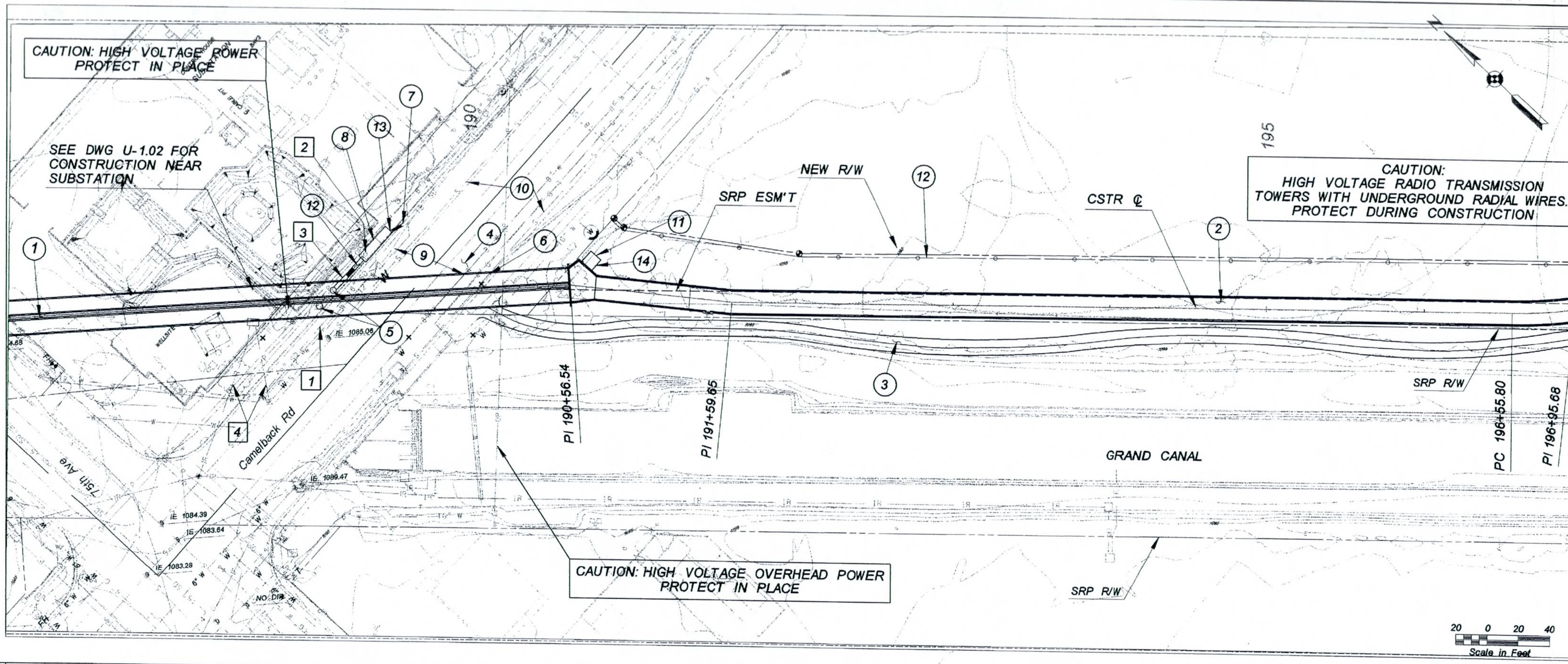
MAX W. WILSON - CHAIRMAN

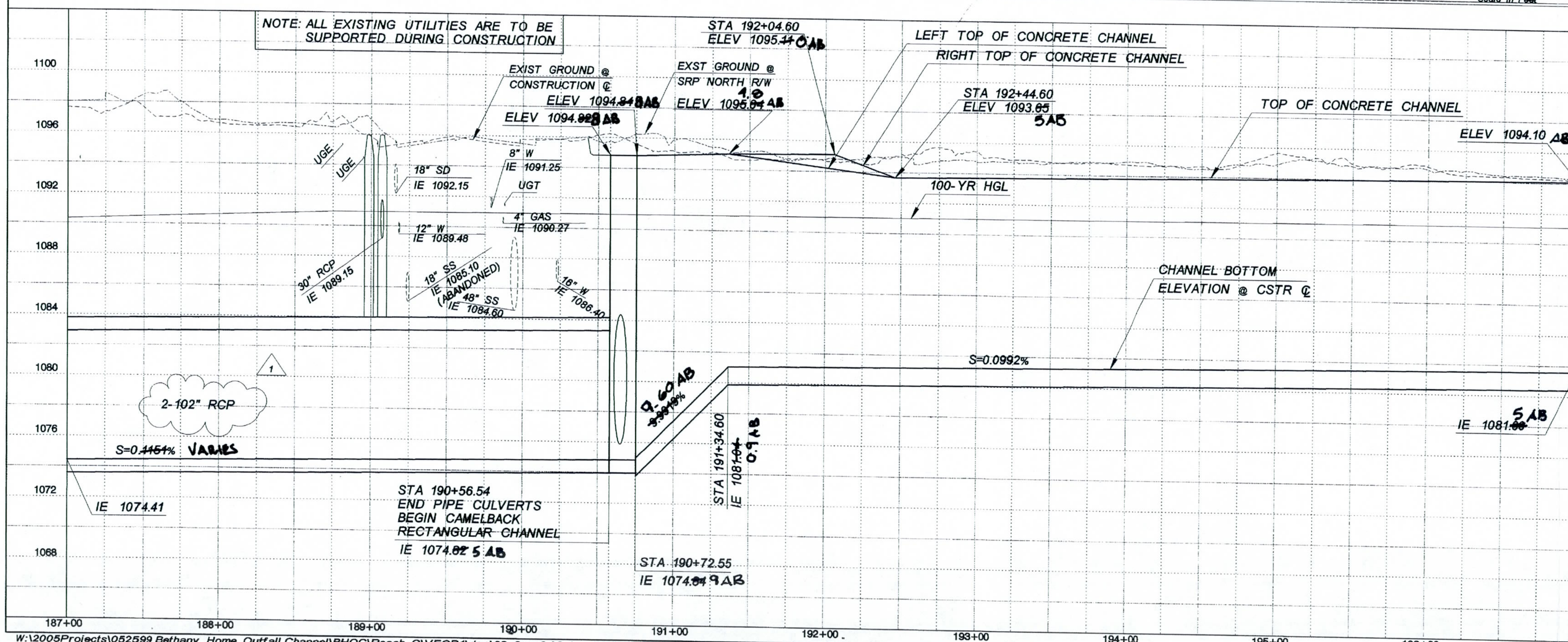
DISTRICT 1	FULTON BROCK
DISTRICT 2	DON STAPLEY
DISTRICT 3	ANDY KUNASEK
DISTRICT 4	MAX W. WILSON
DISTRICT 5	MARY ROSE WILCOX

PHOTOGRAMETRIC CERTIFICATION
THE TOPOGRAPHIC DATA USED FOR THIS PROJECT WAS PREPARED BY KENNEY AERIAL MAPPING WITH METHODS TO NATIONAL MAP ACCURACY STANDARDS. ONE FOOT CONTOUR INTERVALS ARE BASED ON GROUND CONTROL SURVEY DATA PROVIDED BY AZTEC ENGINEERING, INC.

TWO WORKING DAYS BEFORE YOU DIG, CALL 263-1100 BLUE STAKE

Bethany Home Outfall Channel
Reach C-83rd Ave. to 73rd Ave.
FCD 2004C055
620





W:\2005Projects\052599 Bethany Home Outfall Channel\BHOC\Reach C\VECP1\dgn\63c6cpp2.08.dgn Plotted 06/15/2006 at 12:16:51 PM by jrojas

REMOVE

1	EXISTING STORM DRAIN - 85 LF	(LS)
2	EXISTING CATCH BASIN	(LS)
3	EXISTING STORM DRAIN - 46 LF	(LS)
4	EXISTING IRRIGATION LINES - 100 LF	(LS)

CONSTRUCT

1	CONSTRUCT 2-102" RCP CULVERTS	(714 LF)
2	CONSTRUCT CAMELBACK RECTANGULAR CHANNEL, PER DWG S-5.01	(644 LF)
3	CONSTRUCT PRIMARY PEDESTRIAN TRAIL PER DTL D1 DWG D-1.01	(7180 SF)
4	SEE DWG C-5.01 FOR STREET RECONSTRUCTION PLAN	
5	CONSTRUCT MANHOLE PER ADOT STD. C-18.10	(2 EA)
6	PROVIDE PUMP AROUND FOR EXISTING SANITARY SEWER, SEE DRAWINGS IN APPNDX.	
7	CONSTRUCT CONCRETE PIPE COLLAR PER MAG STD DTL 505	(NPI)
8	CONSTRUCT MODIFIED TYPE C CATCH BASIN PER MAG STD DTL 532 W/ L=24' SEE STORM DRAIN PLAN AND PROFILE DWG C-3.02	(1 EA)
9	SEE DWG U-1.01 FOR WATER LINE CONSTRUCTION PLANS	
10	SEE DRAWINGS IN APPENDIX FOR SANITARY SEWER CONSTRUCTION PLANS	
11	CONSTRUCT 102" PIPE PLUG PER MAG DTL 427, INV ELEV=1075.92	(NPI)
12	CONSTRUCT 6' CHAIN LINK FENCE PER MAG STD DTL 160	(618 LF)

INSTALL NEW STORM DRAIN PIPE

NO.	STA. TO STA.	DIAMETER INCHES	LENGTH FEET
12	189+29.52, 23.4' LT TO 189+29.70, 8.38' LT	30	25
13	189+43.83, 39.86' LT TO 189+52.93, 44.17' LT	18	10
14	190+65.25, 12.3' LT TO 190+71.07, 20.29' LT	102	10

NO.	REVISION	BY	DATE
3			
2			
1	2-102" RCP REPLACING 2-8'X7' RCB-VECP	ABM	5/06

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

BETHANY HOME OUTFALL CHANNEL
REACH C
PCN NO. 620 03 32

36583 ALAN B. MORRICE ARIZONA, U.S.A.

	BY	DATE
DESIGNED	WJC	8/05
DRAWN	JRR	8/05
CHECKED	ABM	8/05

DMJM HARRIS
2777 E CAMELBACK ROAD SUITE 200 PHOENIX, AZ 85016-4302 (602) 337-2777

DRAWING NO.		SHEET OF
C-2.08	CHANNEL PLAN & PROFILE STA 187+00 TO STA 197+00	22 R 148

AB BY RM 6/05/07

D.3.2 Headloss through the Trunk Line System

Steady Flow Data - LOMR

File Options Help

Enter/Edit Number of Profiles (2000 max): 2 | Reach Boundary Conditions | Apply Data

Locations of Flow Data Changes

River: BHOC FCP

Reach: LOMR - 100% River Sta.: 28401. | Add A Flow Change Location

	Flow Change Location			Profile Names and Flow Rates	
	River	Reach	RS	Q100	Q10
1	BHOC FCP	LOMR - 100%	28401.	211	105.5
2	BHOC FCP	LOMR - 100%	24948.83	459	229.5
3	BHOC FCP	LOMR - 100%	22439.16	708	354
4	BHOC FCP	LOMR - 100%	21080.27	744	372
5	BHOC FCP	LOMR - 100%	20209.03	784	392
6	BHOC FCP	LOMR - 100%	19072.55	1024	512
7	BHOC FCP	LOMR - 100%	18360.42	1315	657.5
8	BHOC FCP	LOMR - 100%	15678	1428	714
9	BHOC FCP	LOMR - 100%	12299.17	2855	1427.5
10	BHOC FCP	LOMR - 100%	6600	3062	1531
11	BHOC FCP	LOMR - 100%	5450	3084	1542
12	BHOC FCP	LOMR - 100%	1415	4430	2215

Change in water surface between cross section set

Edit Steady flow data for the profiles (cfs)

HEC-RAS Plan: LOMR River: BHOC FCP Reach: LOMR - 100% (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
LOMR - 100%	21492.35	Q100	708.00	1083.32	1090.93		1090.95	0.000097	1.13	624.21	138.11	0.09
LOMR - 100%	21492.35	Q10	354.00	1083.32	1087.43		1087.46	0.000396	1.56	227.04	89.18	0.17
LOMR - 100%	21329.35	Q100	708.00	1083.17	1090.89		1090.93	0.000206	1.61	440.19	100.61	0.14
LOMR - 100%	21329.35	Q10	354.00	1083.17	1087.27		1087.36	0.001042	2.41	146.93	61.53	0.27
LOMR - 100%	21080.27	Q100	744.00	1082.93	1090.85		1090.88	0.000137	1.40	532.58	110.94	0.11
LOMR - 100%	21080.27	Q10	372.00	1082.93	1087.09		1087.15	0.000611	1.97	188.94	72.01	0.21
LOMR - 100%	20849.07	Q100	744.00	1082.72	1090.83		1090.85	0.000097	1.26	591.99	110.89	0.10
LOMR - 100%	20849.07	Q10	372.00	1082.72	1087.00		1087.04	0.000358	1.62	229.65	78.52	0.17
LOMR - 100%	20707.35	Q100	744.00	1082.59	1090.81		1090.84	0.000123	1.36	548.38	109.44	0.11
LOMR - 100%	20707.35	Q10	372.00	1082.59	1086.93		1086.98	0.000519	1.88	197.69	71.23	0.20
LOMR - 100%	20509.35	Q100	744.00	1082.40	1090.77		1090.81	0.000175	1.53	484.89	104.94	0.13
LOMR - 100%	20509.35	Q10	372.00	1082.40	1086.73		1086.83	0.001214	2.55	145.79	62.68	0.29
LOMR - 100%	20274.95	Q100	744.00	1082.16	1090.74		1090.78	0.000080	1.55	479.26	92.89	0.12
LOMR - 100%	20274.95	Q10	372.00	1082.16	1086.60		1086.68	0.000362	2.23	166.46	58.19	0.23
LOMR - 100%	20209.03	Q100	784.00	1082.10	1090.59	1085.25	1090.76	0.000094	3.31	236.90	29.01	0.20
LOMR - 100%	20209.03	Q10	392.00	1082.10	1086.48	1084.20	1086.65	0.000186	3.33	117.59	29.01	0.29
LOMR - 100%	20190		Culvert									
LOMR - 100%	20189.03	Q100	784.00	1082.08	1090.57		1090.73	0.000083	3.18	246.24	29.01	0.19
LOMR - 100%	20189.03	Q10	392.00	1082.08	1086.47		1086.62	0.000143	3.08	127.40	29.01	0.26
LOMR - 100%	20090	Q100	784.00	1081.99	1090.43		1090.70	0.000170	4.22	185.65	22.01	0.26
LOMR - 100%	20090	Q10	392.00	1081.99	1086.33		1086.59	0.000285	4.11	95.42	22.01	0.35
LOMR - 100%	20000	Q100	784.00	1081.90	1090.35		1090.68	0.000217	4.64	168.96	20.01	0.28
LOMR - 100%	20000	Q10	392.00	1081.90	1086.24		1086.55	0.000357	4.52	86.77	20.01	0.38
LOMR - 100%	19800	Q100	784.00	1081.70	1089.84		1090.57	0.000619	6.88	113.96	14.01	0.43
LOMR - 100%	19800	Q10	392.00	1081.70	1085.58		1086.39	0.001179	7.22	54.28	14.01	0.65
LOMR - 100%	19600	Q100	784.00	1081.50	1089.73		1090.44	0.000601	6.80	115.21	14.01	0.42
LOMR - 100%	19600	Q10	392.00	1081.50	1085.30		1086.14	0.001249	7.37	53.21	14.01	0.67
LOMR - 100%	19400	Q100	784.00	1081.30	1089.62		1090.32	0.000584	6.73	116.51	14.01	0.41
LOMR - 100%	19400	Q10	392.00	1081.30	1084.98		1085.88	0.001369	7.61	51.54	14.01	0.70
LOMR - 100%	19200	Q100	784.00	1081.10	1089.51		1090.20	0.000567	6.65	117.85	14.01	0.40
LOMR - 100%	19200	Q10	392.00	1081.10	1084.54	1083.99	1085.57	0.001663	8.14	48.17	14.01	0.77
LOMR - 100%	19134.60	Q100	784.00	1081.04	1089.48		1090.16	0.000563	6.63	118.18	14.01	0.40
LOMR - 100%	19134.60	Q10	392.00	1081.04	1083.93	1083.93	1085.39	0.002762	9.69	40.47	14.00	1.00
LOMR - 100%	19072.55	Q100	1024.00	1074.84	1089.67	1080.34	1090.05	0.000232	4.93	207.76	14.02	0.23
LOMR - 100%	19072.55	Q10	512.00	1074.84	1076.47	1078.31	1084.30	0.026620	22.46	22.80	14.00	3.10
LOMR - 100%	19056.54	Q100	1024.00	1074.82	1089.82	1078.99	1089.98	0.000069	3.21	318.90	21.27	0.15
LOMR - 100%	19056.54	Q10	512.00	1074.82	1080.58	1077.44	1080.85	0.000231	4.18	122.35	21.26	0.31

Camelback Storm Drain Tailwater Elevation

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
LOMR - 100%	18554		Culvert									
LOMR - 100%	18360.42	Q100	1315.00	1074.02	1087.88		1088.19	0.000139	4.46	294.68	21.26	0.21
LOMR - 100%	18360.42	Q10	657.50	1074.02	1079.36	1077.13	1079.88	0.000474	5.80	113.42	21.26	0.44
LOMR - 100%	18305.01	Q100	1315.00	1073.96	1087.81	1079.10	1088.16	0.000165	4.74	277.16	20.02	0.22
LOMR - 100%	18305.01	Q10	657.50	1073.96	1079.24	1077.19	1079.84	0.000568	6.22	105.62	20.01	0.48
LOMR - 100%	16852		Culvert									
LOMR - 100%	15678	Q100	1428.00	1070.95	1083.74	1076.53	1084.27	0.000275	5.87	243.06	19.02	0.29
LOMR - 100%	15678	Q10	714.00	1070.95	1076.44	1074.47	1077.17	0.000678	6.84	104.39	19.01	0.51
LOMR - 100%	13900		Culvert									
LOMR - 100%	12369.17	Q100	1428.00	1067.12	1077.79	1072.53	1078.49	0.000383	6.69	213.57	20.02	0.36
LOMR - 100%	12369.17	Q10	714.00	1067.12	1073.74	1070.54	1074.19	0.000352	5.39	132.41	20.01	0.37
LOMR - 100%	12299.17	Q100	2855.00	1067.04	1077.19	1073.36	1078.40	0.000524	8.83	323.36	31.86	0.49
LOMR - 100%	12299.17	Q10	1427.50	1067.04	1073.34	1071.02	1074.13	0.000520	7.12	200.58	31.85	0.50

Headlosses through the Trunk Line System:

The headlosses in the Camelback Road Trunk Line System were computed for the junctions, manholes, exit, pipe, and transition structures. Methods for determining headlosses was selected from Flood Control District of Maricopa County (FCDMC) Drainage Design Manual Volume-II Hydraulics. Friction losses in the storm drain pipe were calculated using Manning's roughness coefficient of n=0.013.

<u>Junctions and Manhole Structures:</u>

There are several locations along the camelback trunk line where a single lateral connects with the mainline at a junction/manhole as shown in the Figure 1 below. Junction headloss for a single lateral can be determined by the Energy Equation and the Thompson Equation expressed below.

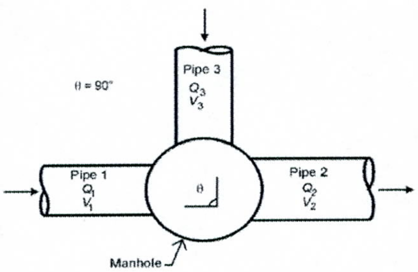


Figure 1: A typical storm drain junction at manhole with single lateral. (*source :FCDMC hydraulics manual*)

$$h_j = \frac{2*(Q_2V_2 - Q_1V_1 - Q_3V_3Cos\theta)}{(A_1 + A_2)g} + \frac{V_1^2}{2g} - \frac{V_2^2}{2g} + \left(\frac{S_{f1} + S_{f2}}{2}\right)L \text{ ....EQ(1)}$$

h_j	=	Junction headloss, ft
A_1	=	Upstream flow area, sq ft
A_2	=	Downstream flow area, sq ft
Q_1	=	Upstream flow rate, cfs
Q_2	=	Downstream flow rate, cfs
Q_3	=	Lateral flow rate, cfs
V_1	=	Upstream flow velocity, ft/s
V_2	=	Downstream flow velocity, ft/s
V_3	=	Lateral flow velocity, ft/s

S_{f1} = Upstream friction slope, ft

S_{f2} = Downstream friction slope, ft

L = Length of transition, ft

$$\boxed{S_f = K\frac{V^2}{2gR^{3/4}}}$$

V = Velocity, ft/s

g = Acceleration due to gravity, 32.2, ft/sec^2

R = Hydraulic radius, ft (D/4, when pipe is full)

$$\boxed{K = \frac{2gn^2}{2.21}}$$

n = Manning's roughness coefficient

A typical junction at 67th Avenue is taken as an example for the discussion on procedure used for determining the headloss at junctions and manhole. Three major steps were used for the headloss calculation; *Step-1 Determination of discharge in the trunk line* and the lateral pipe, *Step-2 Determination of velocity in the pipes*, and *Step-3 Determination of Junction Headloss* using the Energy and the Thompson Equation. Each step is described in detail below.

Step-1: Discharge Determination in the pipes

Two sets of discharge combination were made through the pipes and junction at 67th Avenue. Combination-1 uses CLOMR Pre-Design flow data in trunk line pipe 1 and pipe 2 along Camelback Rd and their difference (Q2-Q1) in lateral pipe 3 along 67th Ave. Figure 2 below exhibits the flow combination-1 through the junction at 67th Avenue.

Combination-1

Pipe-1 = 375 cfs (Pre Design study discharge)

Pipe-2 = 498 cfs (Pre-Design study discharge)

Pipe-3 = Q2-Q1=498 – 375 = 123 cfs

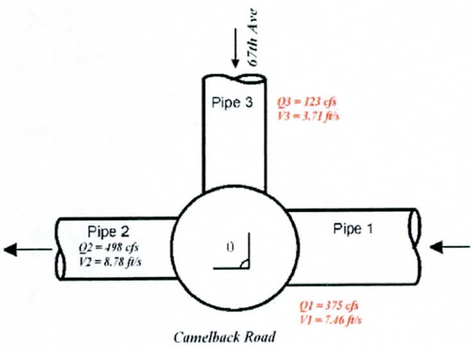


Figure 2: Flow Combination-1 at 67th Ave.

In the second set of flow combination, discharge in trunk line pipe 2 was determined from Pre-Design study and in lateral pipe 3 was obtained from local 10-year, 6hr flow at 67th Ave & Camelback Road. The difference in flow through pipe 2 and pipe 3 (Q2-Q3) was considered as discharge pipe 1. Figure 3 below exhibits the discharge combination-2 through the junction at 67th Ave

Combination-2

Pipe-2 = 498 cfs (Pre-Design study discharge)

Pipe-3 = 355 cfs (10-year HEC-1 flow)

Pipe 1 = Q2-Q3 = 498-355 = 143 cfs

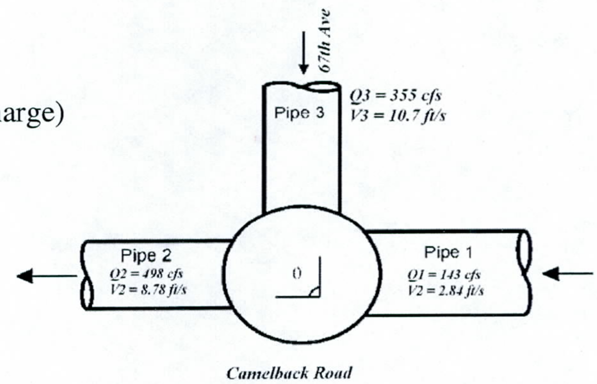


Figure 3: Flow Combination -2 at 67th Ave

Step-2: Velocity determination in the Pipes

Trunk Line

A stormCAD model was created with Pre-Design study plan/profile and discharge based on the procedure described above. With 10-year tailwater elevation at the Grand Canal the trunk line StormCAD model was run such that the pipes were running full and Hydraulic Grade Line (HGL) was 1 ft below the catch basin elevation. Thus, the flow velocity in each pipe is determined. Please find the flow velocity in pipe-1 and pipe-2 in the figure 1 and figure 2 above.

Laterals

A stormCAD model was also created for laterals with initial pipe size based on the full flow capacity and tailwater elevation at 1 ft below the catch basin elevation. Please find figure 1 and figure 2 above for the flow velocity in lateral.

Step-3: Headloss Determination

With the calculated velocity and discharge through trunk line and lateral pipes, as described in Step-1 and Step-2 above, ***junction headlosses (hj)*** at 67th Ave was calculated for flow combination-1 and combination-2. Each flow combination uses the Energy and the Thompson Equation expressed in equation 1. Headloss from both the combinations was compared and higher value was used for junction at 67th Avenue. Please find *Trunk line junction loss calculation* table for headloss calculation at each junction.

FIGURE 4.7A
FORMED OR PREFAB STORM DRAIN JUNCTION

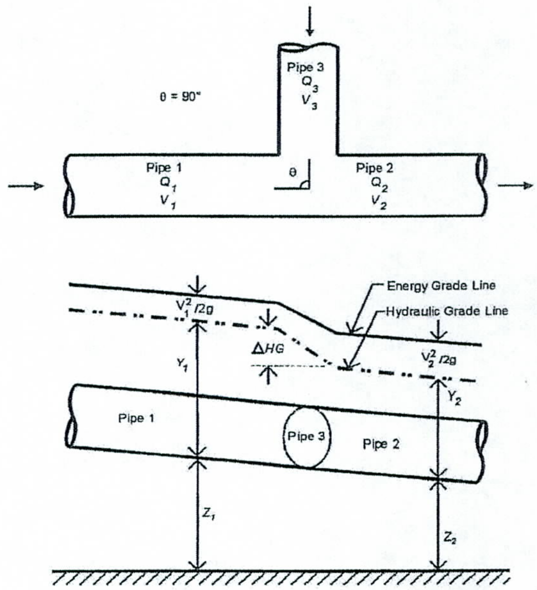
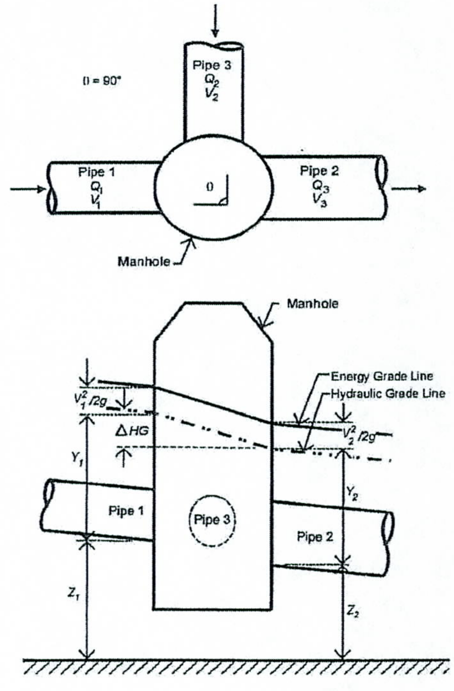


FIGURE 4.7B
STORM DRAIN JUNCTION AT MANHOLE WITH ALIGNED CROWNS UNDER PRESSURE FLOW



$$\Delta HG = \frac{\left(\frac{Q_2 V_2 - Q_1 V_1 - Q_3 V_3 Cos\,\theta}{g}\right)}{\frac{A_1 + A_2}{2}}$$

where:	ΔHG	=	Difference in upstream and downstream hydraulic grade line elevations, ft
	A_1	=	Upstream flow area, sq ft
	A_2	=	Downstream flow area, sq ft
	Q_1	=	Upstream flow rate, cfs
	Q_2	=	Downstream flow rate, cfs
	Q_3	=	Lateral flow rate, cfs
	V_1	=	Upstream flow velocity, ft/sec
	V_2	=	Downstream flow velocity, ft/sec
	V_3	=	Lateral flow velocity, ft/sec
	q	=	Angle between lateral and main line storm drain (See Figure 4.7), degrees

To determine junction headloss h_j, substitute the Thompson Equation into the rewritten Equation (4.1), assuming transition and friction losses at the junction are negligible.

$$\frac{2(Q_2 V_2 - Q_1 V_1 - Q_3 V_3 Cos\,\theta)}{(A_1 + A_2)g} + V_1^2/2g - V_2^2/2g = h_j \qquad (4.10b)$$

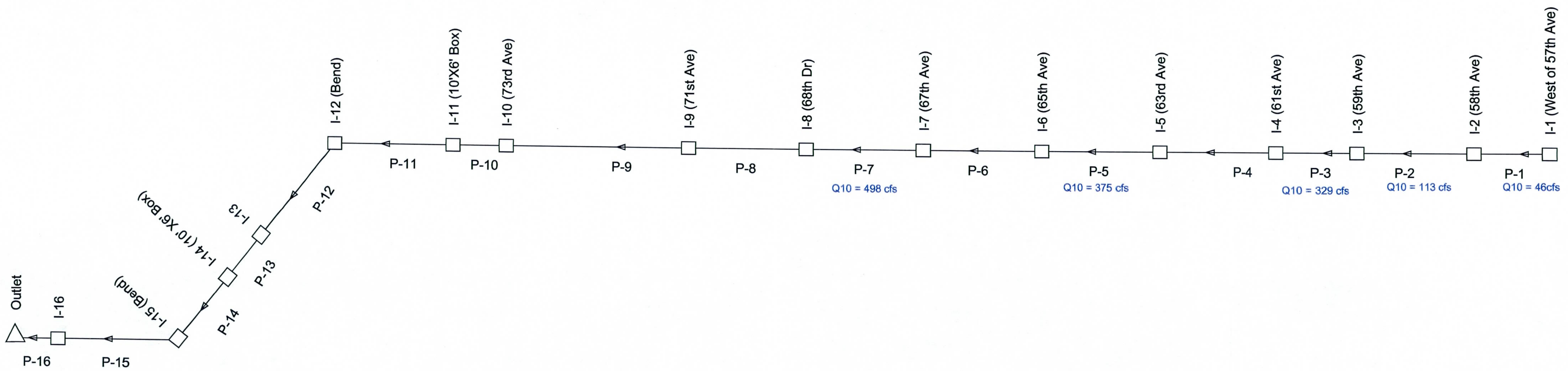
Should friction losses be determined not to be negligible Equation (4.10c) should be used.

$$\frac{2(Q_2 V_2 - Q_1 V_1 - Q_3 V_3 Cos\,\theta)}{(A_1 + A_2)g} + V_1^2/2g - V_2^2/2g + \left(\frac{S_{f1} + S_{f2}}{2}\right)L = h_j \qquad (4.10c)$$

where:	S_{f1}	=	Upstream friction slope, ft
	S_{f2}	=	Downstream friction slope, ft/ft
	L	=	Length of transition, ft

Should transition losses be determined not to be negligible but friction losses are negligible, then Equation (4.10d) should be used for computing junction loss h_j.

CAMELBACK STORM DRAIN PIPE LAYOUT



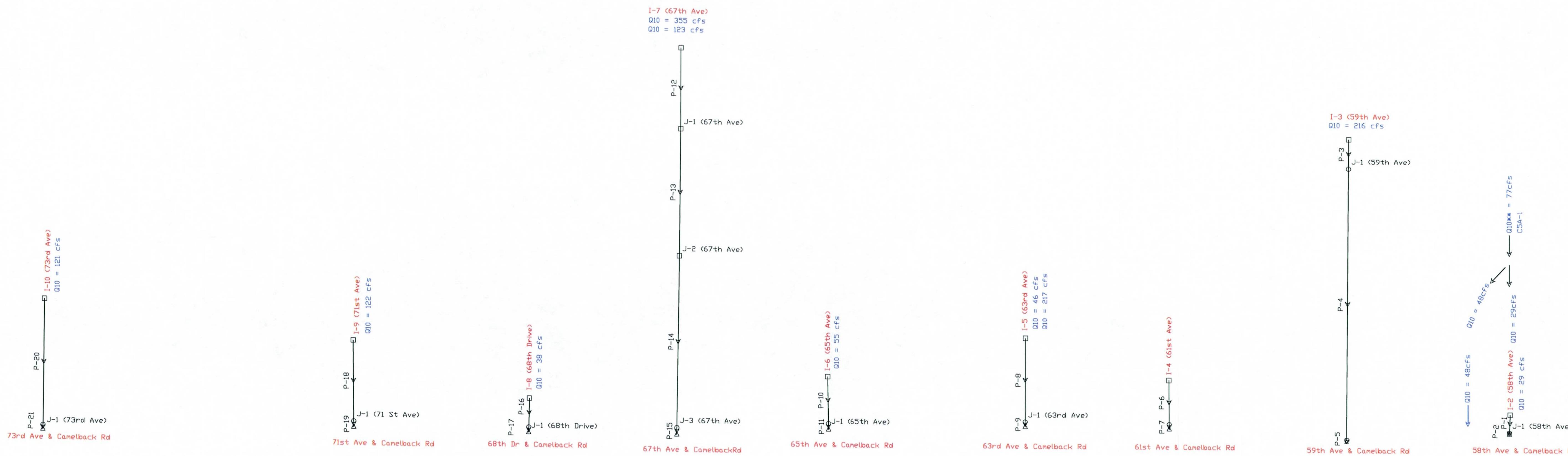
Scenario: Velocity Determination in Trunkline for Headloss Clac at Junctions (Pipe Flowing Full)

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,358.30	0.00285	90 inch	0.013	8.49	409.85	1,094.220	1,090.350
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677

Label	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Hydraulic Slope (ft/ft)	Energy Slope (ft/ft)	Description
P-1	1,122.27	1,121.96	8.63	10.11	1,121.81	1,121.30	1,122.02	1,121.51	0.00103	0.00103	
P-2	1,121.96	1,120.47	10.11	10.99	1,120.67	1,116.61	1,121.93	1,117.87	0.00619	0.00619	
P-3	1,120.47	1,116.59	11.01	11.05	1,116.04	1,112.41	1,117.18	1,113.54	0.00265	0.00265	
P-4	1,116.59	1,112.82	11.05	11.08	1,111.84	1,108.30	1,112.98	1,109.44	0.00265	0.00265	
P-5	1,112.82	1,108.67	11.10	10.82	1,107.74	1,104.50	1,108.86	1,105.62	0.00239	0.00239	
P-6	1,108.67	1,107.32	10.84	11.73	1,104.07	1,102.30	1,104.94	1,103.16	0.00169	0.00169	
P-7	1,107.32	1,103.90	11.74	11.06	1,101.70	1,099.13	1,102.90	1,100.33	0.00216	0.00216	
P-8	1,103.90	1,100.54	11.06	10.84	1,098.53	1,095.58	1,099.73	1,096.78	0.00216	0.00216	
P-9	1,100.54	1,097.55	10.84	11.04	1,094.38	1,091.38	1,095.58	1,092.58	0.00216	0.00216	
P-10	1,097.55	1,097.55	13.54	13.59	1,090.31	1,090.27	1,091.38	1,091.34	0.00228	0.00228	
P-11	1,097.55	1,095.56	11.09	11.13	1,089.07	1,087.17	1,090.27	1,088.36	0.00216	0.00216	
P-12	1,095.56	1,095.43	11.13	11.08	1,086.71	1,086.64	1,087.91	1,087.83	0.00216	0.00216	
P-13	1,095.43	1,095.13	13.57	13.32	1,085.57	1,085.52	1,086.64	1,086.59	0.00228	0.00228	
P-14	1,095.13	1,093.48	10.82	9.28	1,084.32	1,084.22	1,085.52	1,085.42	0.00216	0.00216	
P-15	1,093.48	1,093.48	9.28	9.30	1,083.75	1,083.73	1,084.99	1,084.98	0.00178	0.00187	
P-16	1,093.48	1,093.48	9.30	9.30	1,081.30	1,081.27	1,083.73	1,083.73	0.32184	0.00356	

STORM DRAIN LATERALS (HEAD LOSS DETERMINATION)

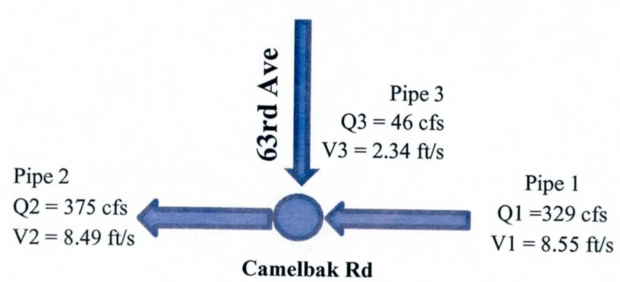


Note: The combine 10-yr, 6hr HEC-1 flow at the intersection of 58th Ave and Camelback Rd is 113 cfs (C-5A-2), which include 77cfs (C-5A-1) from the north along 58th Ave and 46 cfs from the east along Camelback Rd. However, 58th Ave has capacity to convey 29cfs, therefore 48 cfs breaks out into west parking lot and conveyed south. 2 -37' long curb opening inlets were designed along Camelback Rd just west of 58th Ave and Camelback Rd intersection to capture the breakout flow. Therefore 58th Ave junction has flow combination of 29 cfs from north and 46 cfs from the east.

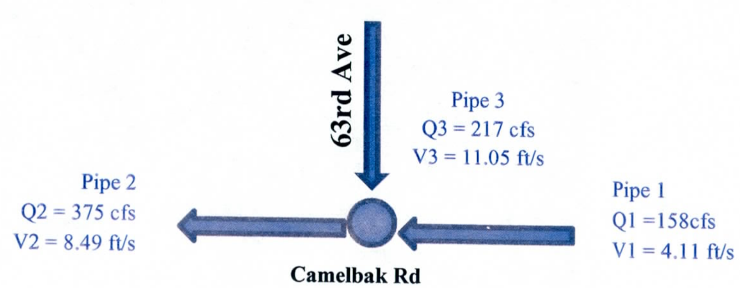
CAMELBACK STORM DRAIN PROJECT
SD Laterals from 58th Ave to 73rd Ave
Velocity Determination in Laterals for Headloss Calculation at Junctions (Pipe Flowing Full)

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Hydraulic Slope (ft/ft)	Description
P-1	**I-2 (58th Ave)**	J-1 (58th Ave)	**29**	84	0.005	30 inch	0.013	**5.91**	29	1,109.94	1,109.52	1,121.96	1,121.96	9.52	9.94	1,121.59	1,121.17	1,122.13	1,121.71	0.005	
P-2	J-1 (58th Ave)	58th Ave & Camelback Rd	29	0.1	0	30 inch	0.013	5.91	0	1,109.52	1,109.52	1,121.96	1,121.96	9.94	9.94	1,120.96	1,120.96	1,121.50	1,121.50	0.005	
P-3	**I-3 (59th Ave)**	J-1 (59th Ave)	**216**	113	0.00425	78 inch	0.013	**6.51**	341.68	1,108.63	1,108.15	1,123.88	1,122.16	8.75	7.51	1,122.31	1,122.12	1,122.97	1,122.78	0.0017	
P-4	J-1 (59th Ave)	J-2 (59th Ave)	216	1,182.00	0.00401	78 inch	0.013	6.51	331.98	1,108.15	1,103.41	1,122.16	1,120.47	7.51	10.56	1,121.73	1,119.72	1,122.39	1,120.38	0.0017	
P-5	J-2 (59th Ave)	59th Ave & Camelback Rd	216	0.1	0	78 inch	0.013	6.51	0	1,103.41	1,103.41	1,120.47	1,120.47	10.56	10.56	1,119.47	1,119.47	1,120.13	1,120.13	0.0017	
P-6	**I-4 (61st Ave)**	J-1 (61st Ave)	**111**	222.13	0.006	42 inch	0.013	**11.54**	78.14	1,103.49	1,102.15	1,116.62	1,116.59	9.63	10.94	1,119.08	1,116.38	1,121.15	1,118.45	0.01217	
P-7	J-1 (61st Ave)	61st Ave & Camelback Rd	111	0.1	0	42 inch	0.013	11.54	0	1,102.15	1,102.15	1,116.59	1,116.59	10.94	10.94	1,115.59	1,115.59	1,117.66	1,117.66	0.01217	
P-8	**I-5 (63rd Ave)**	J-1 (63rd Ave)	**46**	363	0.007	60 inch	0.013	**2.34**	217.85	1,099.39	1,096.85	1,112.97	1,112.82	8.58	10.97	1,111.97	1,111.85	1,112.05	1,111.94	0.00031	
P-9	J-1 (63rd Ave)	63rd Ave & Camelback Rd	46	0.1	0	60 inch	0.013	2.34	0	1,096.85	1,096.85	1,112.82	1,112.82	10.97	10.97	1,111.82	1,111.82	1,111.91	1,111.91	0.00031	
P-8 **	**I-5 (63rd Ave)**	J-1 (63rd Ave)	**217**	363	0.007	60 inch	0.013	**11.05**	217.85	1,099.39	1,096.85	1,112.97	1,112.82	8.58	10.97	1,115.06	1,112.54	1,116.96	1,114.44	0.00694	
P-9**	J-1 (63rd Ave)	63rd Ave & Camelback Rd	217	0.1	0	60 inch	0.013	11.05	0	1,096.85	1,096.85	1,112.82	1,112.82	10.97	10.97	1,111.82	1,111.82	1,113.72	1,113.72	0.00694	
P-10	**I-6 (65th Ave)**	J-1 (65th Ave)	**55**	133	0.007406	36 inch	0.013	**7.78**	57.4	1,095.89	1,094.90	1,109.17	1,108.67	10.29	10.77	1,108.93	1,108.03	1,109.87	1,108.97	0.006801	
P-11	J-1 (65th Ave)	65th Ave & Camelback Rd	55	0.1	0	36 inch	0.013	7.78	0	1,094.90	1,094.90	1,108.67	1,108.67	10.77	10.77	1,107.67	1,107.67	1,108.61	1,108.61	0.006801	
P-12	**I-7 (67th Ave)**	J-1 (67th Ave)	177	345	0.0046	60 inch	0.013	4.51	353.26	1,098.28	1,096.70	1,111.09	1,110.28	7.81	8.58	1,110.68	1,110.28	1,110.99	1,110.60	0.001155	
P-13	J-1 (67th Ave)	J-2 (67th Ave)	285	547	0.0046	78 inch	0.013	8.59	355.55	1,095.20	1,092.68	1,110.28	1,107.98	8.58	8.8	1,109.60	1,107.98	1,110.74	1,109.13	0.002955	
P-14	J-2 (67th Ave)	J-3 (67th Ave)	355	772	0.0046	78 inch	0.013	10.7	355.55	1,092.68	1,089.13	1,107.98	1,107.32	8.8	11.69	1,110.54	1,107.00	1,112.31	1,108.77	0.004585	
P-15	J-3 (67th Ave)	67th Ave & CamelbackRd	355	0.1	0	78 inch	0.013	10.7	0	1,089.13	1,089.13	1,107.32	1,107.32	11.69	11.69	1,106.32	1,106.32	1,108.10	1,108.10	0.004585	
P-12 **	**I-7 (67th Ave)**	J-1 (67th Ave)	**123**	345	0.0046	60 inch	0.013	**3.13**	353.26	1,098.28	1,096.70	1,111.09	1,110.28	7.81	8.58	1,107.58	1,107.38	1,107.73	1,107.54	0.000558	
P-13 **	J-1 (67th Ave)	J-2 (67th Ave)	123	547	0.0046	78 inch	0.013	3.71	355.55	1,095.20	1,092.68	1,110.28	1,107.98	8.58	8.8	1,107.26	1,106.95	1,107.47	1,107.17	0.00055	
P-14 **	J-2 (67th Ave)	J-3 (67th Ave)	123	772	0.0046	78 inch	0.013	3.71	355.55	1,092.68	1,089.13	1,107.98	1,107.32	8.8	11.69	1,106.83	1,106.40	1,107.04	1,106.61	0.00055	
P-15 **	J-3 (67th Ave)	67th Ave & CamelbackRd	123	0.1	0	78 inch	0.013	3.71	0	1,089.13	1,089.13	1,107.32	1,107.32	11.69	11.69	1,106.32	1,106.32	1,106.53	1,106.53	0.00055	
P-16	**I-8 (68th Drive)**	J-1 (68th Drive)	**38**	96	0.010104	30 inch	0.013	**7.74**	41.23	1,091.38	1,090.41	1,104.32	1,103.90	10.44	10.99	1,104.08	1,103.25	1,105.01	1,104.19	0.008584	
P-17	J-1 (68th Drive)	68th Dr & Camelback Rd	38	0.1	0	30 inch	0.013	7.74	0	1,090.41	1,090.41	1,103.90	1,103.90	10.99	10.99	1,102.90	1,102.90	1,103.83	1,103.83	0.008584	
P-18	**I-9 (71st Ave)**	J-1 (71 St Ave)	**122**	284	0.007465	48 inch	0.013	**9.71**	124.1	1,088.00	1,085.88	1,101.40	1,100.54	9.4	10.66	1,102.15	1,100.10	1,103.61	1,101.56	0.007214	
P-19	J-1 (71 St Ave)	71st Ave & Camelback Rd	122	0.1	0	48 inch	0.013	9.71	0	1,085.88	1,085.88	1,100.54	1,100.54	10.66	10.66	1,099.54	1,099.54	1,101.01	1,101.00	0.007214	
P-20	**I-11 (73rd Ave)**	J-1 (73rd Ave)	**121**	553	0.007486	48 inch	0.013	**9.63**	124.28	1,084.14	1,080.00	1,098.75	1,097.55	10.61	13.55	1,101.02	1,097.10	1,102.46	1,098.54	0.007097	
P-21	J-1 (73rd Ave)	73rd Ave & Camelback Rd	121	0.1	0	48 inch	0.013	9.63	0	1,080.00	1,080.00	1,097.55	1,097.55	13.55	13.55	1,096.55	1,096.55	1,097.99	1,097.99	0.007097	

Note: **Two sets of flow combination for Junction @ 63rd Ave and 67th Ave. Figure below shows combinatins for 63rd Ave



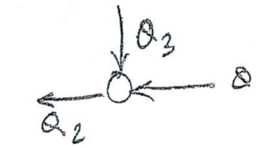
Combination-1 : 46 cfs from 63rd Ave lateral pipe

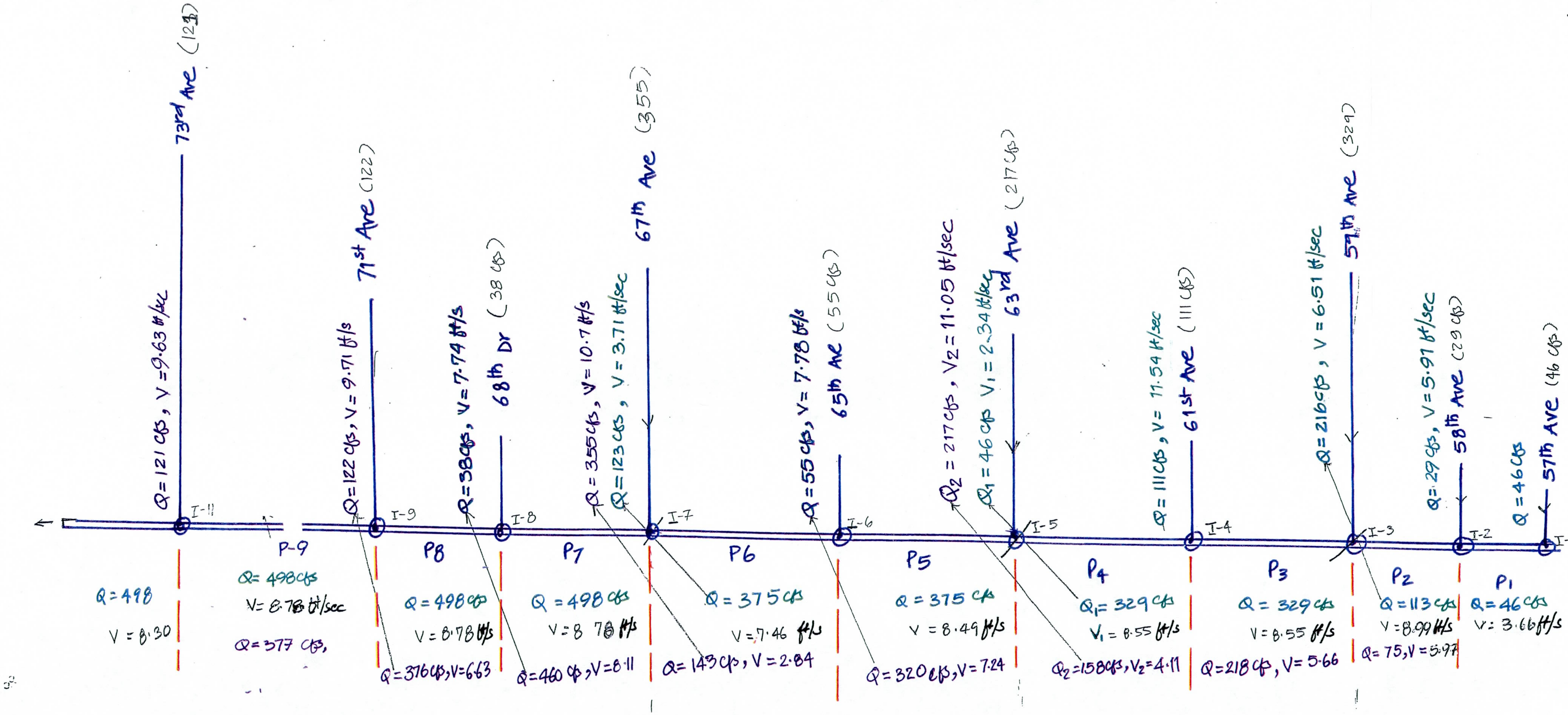


Combination-2: 217 cfs from 63rd Ave lateral pipe

Head loss ...

FLOW COMBINATION AT JUNCTION ALONG CAMELBACK RD FOR HEAD LOSS CALCULATION





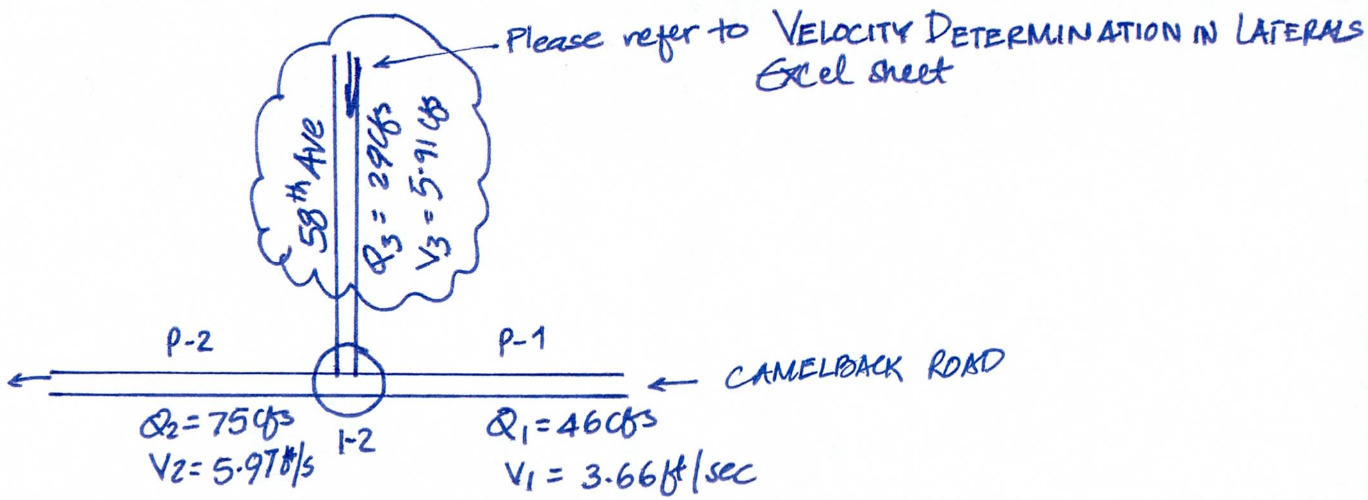
* Q = Discharge (cfs)
V = velocity (ft/sec)

FIGURE: A-A

Scenario: Velocity Determination for Camelback Rd Trunkline : 58th Ave Junction Flow Combination (75 cfs)

Pipe Report

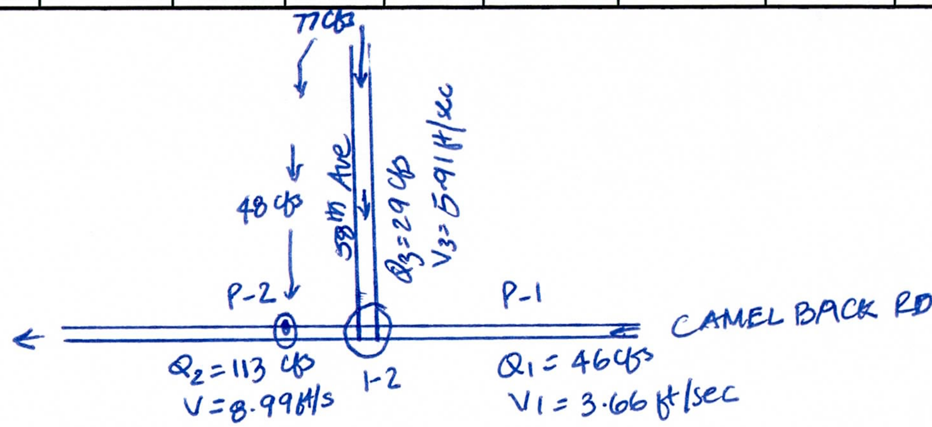
Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	437.00	0.003661	48 inch	0.013	3.66	86.91	1,109.65	1,108.05	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	75.00	711.00	0.003615	48 inch	0.013	5.97	86.36	1,108.05	1,105.48	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,320.00	0.002856	84 inch	0.013	8.55	341.39	1,102.46	1,098.69	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,336.00	0.002852	84 inch	0.013	8.55	341.13	1,098.69	1,094.88	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,408.00	0.002848	90 inch	0.013	8.49	409.77	1,094.36	1,090.35	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,050.00	0.002133	96 inch	0.013	7.46	421.25	1,089.83	1,087.59	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.002301	102 inch	0.013	8.78	514.21	1,087.08	1,084.34	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,292.00	0.002299	102 inch	0.013	8.78	514.00	1,084.34	1,081.37	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,456.00	0.002308	102 inch	0.013	8.78	515.00	1,081.37	1,078.01	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.002500	10 x 6 ft	0.013	8.30	521.40	1,078.01	1,077.96	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	898.00	0.002249	102 inch	0.013	8.78	508.46	1,077.96	1,075.94	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	34.00	0.002059	102 inch	0.013	8.78	486.44	1,075.94	1,075.87	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.003000	10 x 6 ft	0.013	8.30	571.17	1,075.87	1,075.81	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	45.00	0.002222	102 inch	0.013	8.78	505.37	1,075.81	1,075.71	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	3.00	0.003333	102 inch	0.013	8.78	618.95	1,075.71	1,075.70	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.000000	102 inch	0.013	8.78	0.00	1,075.70	1,075.70	1,093.48	1,093.48



Scenario: Velocity Determination for Camelback Trunkline : 58th Ave Junction Flow Combination (113 cfs)

Pipe Report

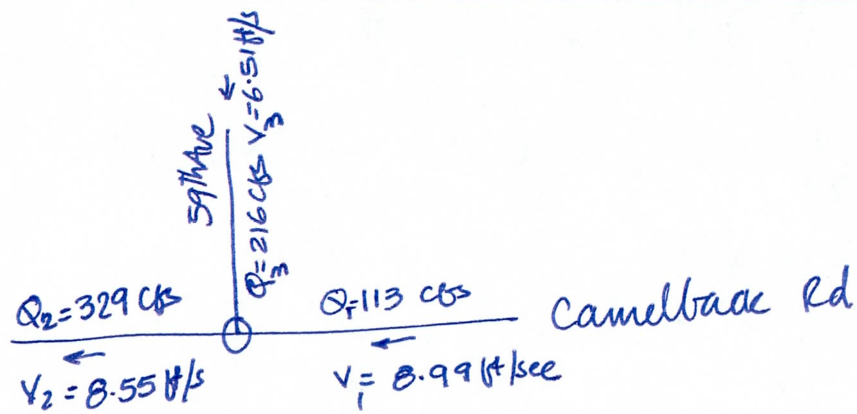
Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	437.00	0.003661	48 inch	0.013	3.66	86.91	1,109.65	1,108.05	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	711.00	0.003615	48 inch	0.013	8.99	86.36	1,108.05	1,105.48	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,320.00	0.002856	84 inch	0.013	8.55	341.39	1,102.46	1,098.69	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,336.00	0.002852	84 inch	0.013	8.55	341.13	1,098.69	1,094.88	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,408.00	0.002848	90 inch	0.013	8.49	409.77	1,094.36	1,090.35	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,050.00	0.002133	96 inch	0.013	7.46	421.25	1,089.83	1,087.59	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.002301	102 inch	0.013	8.78	514.21	1,087.08	1,084.34	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,292.00	0.002299	102 inch	0.013	8.78	514.00	1,084.34	1,081.37	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,456.00	0.002308	102 inch	0.013	8.78	515.00	1,081.37	1,078.01	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.002500	10 x 6 ft	0.013	8.30	521.40	1,078.01	1,077.96	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	898.00	0.002249	102 inch	0.013	8.78	508.46	1,077.96	1,075.94	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	34.00	0.002059	102 inch	0.013	8.78	486.44	1,075.94	1,075.87	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.003000	10 x 6 ft	0.013	8.30	571.17	1,075.87	1,075.81	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	45.00	0.002222	102 inch	0.013	8.78	505.37	1,075.81	1,075.71	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	3.00	0.003333	102 inch	0.013	8.78	618.95	1,075.71	1,075.70	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.000000	102 inch	0.013	8.78	0.00	1,075.70	1,075.70	1,093.48	1,093.48



Scenario: Velocity Determination for Camelback Trunkline: 59th Ave junction Flow Combination

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,358.30	0.00285	90 inch	0.013	8.49	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48



Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	218.00	1,371.20	0.00286	84 inch	0.013	5.66	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,358.30	0.00285	90 inch	0.013	8.49	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Trunkline Pipe : 63rd Ave Juntion flow Combination (46 cfs)

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,358.30	0.00285	90 inch	0.013	8.49	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Trunkline Pipe : 63rd Ave Juntion flow Combination (217 cfs)

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	158.00	1,371.20	0.00286	84 inch	0.013	4.11	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	158.00	1,333.00	0.00285	84 inch	0.013	4.11	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,358.30	0.00285	90 inch	0.013	8.49	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Trunkline Pipe : 65th Ave Juntion flow Combination

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	320.00	1,371.20	0.00286	84 inch	0.013	8.32	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	320.00	1,333.00	0.00285	84 inch	0.013	8.32	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	320.00	1,358.30	0.00285	90 inch	0.013	7.24	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RCI	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Trunkline Pipe : 67th Ave Juntion flow Combination (123 cfs)

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,358.30	0.00285	90 inch	0.013	8.49	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Trunkline Pipe : 67th Ave Juntion flow Combination (355 cfs)

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	143.00	1,371.20	0.00286	84 inch	0.013	3.72	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	143.00	1,333.00	0.00285	84 inch	0.013	3.72	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	143.00	1,358.30	0.00285	90 inch	0.013	3.24	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	143.00	1,049.60	0.00213	96 inch	0.013	2.84	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	337.00	1,358.30	0.00285	90 inch	0.013	7.63	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	337.00	1,049.60	0.00213	96 inch	0.013	6.70	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	460.00	1,191.00	0.00230	102 inch	0.013	8.11	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Trunkline Pipe : 71st Ave Juntion flow Combination

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	376.00	1,358.30	0.00285	90 inch	0.013	8.51	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	376.00	1,049.60	0.00213	96 inch	0.013	7.48	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	376.00	1,191.00	0.00230	102 inch	0.013	6.63	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	376.00	1,367.10	0.00230	102 inch	0.013	6.63	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Trunkline Pipe : 73rd Ave Juntion flow Combination

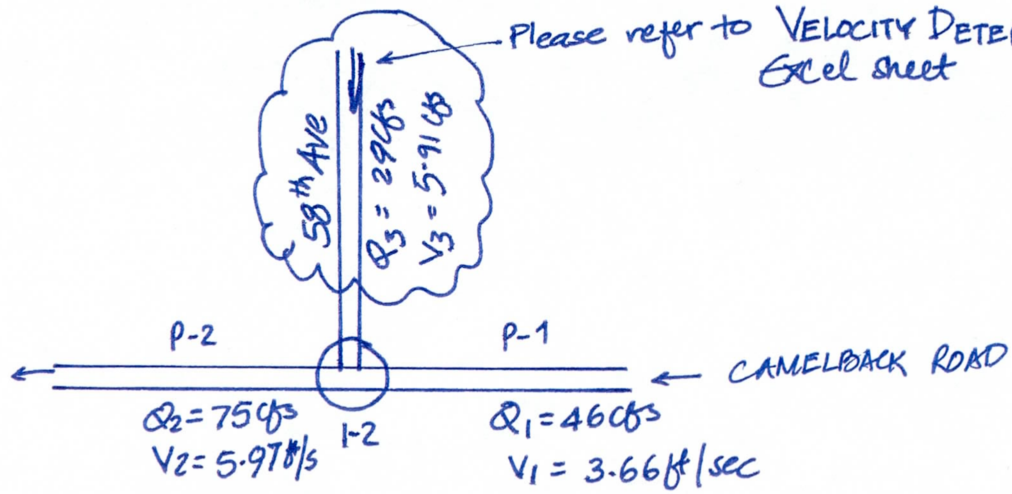
Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	377.00	1,358.30	0.00285	90 inch	0.013	8.53	409.85	1,094.220	1,090.350	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	377.00	1,049.60	0.00213	96 inch	0.013	7.50	421.33	1,089.830	1,087.590	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	377.00	1,191.00	0.00230	102 inch	0.013	9.90	514.21	1,087.080	1,084.340	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	377.00	1,367.10	0.00230	102 inch	0.013	6.64	513.79	1,084.340	1,081.200	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	377.00	1,389.40	0.00230	102 inch	0.013	6.64	513.69	1,081.200	1,078.010	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	377.00	20.00	0.00230	10 x 6 ft	0.013	6.28	500.11	1,078.010	1,077.964	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	377.00	883.63	0.00230	102 inch	0.013	6.64	514.10	1,077.960	1,075.928	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	377.00	33.78	0.00231	102 inch	0.013	6.64	515.15	1,075.928	1,075.850	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RCI	377.00	20.00	0.00230	10 x 6 ft	0.013	6.28	500.11	1,075.860	1,075.814	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	377.00	48.00	0.00230	102 inch	0.013	9.90	514.14	1,075.810	1,075.700	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	377.00	10.00	0.00230	102 inch	0.013	9.90	514.14	1,075.700	1,075.677	1,093.48	1,093.48
P-16	I-16	Outlet	377.00	0.10	0.00000	102 inch	0.013	6.64	0.00	1,075.677	1,075.677	1,093.48	1,093.48

Scenario: Velocity Determination for Camelback Rd Trunkline : 58th Ave Junction Flow Combination (75 cfs)

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	437.00	0.003661	48 inch	0.013	3.66	86.91	1,109.65	1,108.05	1,122.27	1,121.91
P-2	I-2 (58th Ave)	I-3 (59th Ave)	75.00	711.00	0.003615	48 inch	0.013	5.97	86.36	1,108.05	1,105.48	1,121.91	1,120.47
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,320.00	0.002856	84 inch	0.013	8.55	341.39	1,102.46	1,098.69	1,120.47	1,116.59
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,336.00	0.002852	84 inch	0.013	8.55	341.13	1,098.69	1,094.88	1,116.59	1,112.82
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,408.00	0.002848	90 inch	0.013	8.49	409.77	1,094.36	1,090.35	1,112.82	1,108.67
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,050.00	0.002133	96 inch	0.013	7.46	421.25	1,089.83	1,087.59	1,108.67	1,107.32
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.002301	102 inch	0.013	8.78	514.21	1,087.08	1,084.34	1,107.32	1,103.90
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,292.00	0.002299	102 inch	0.013	8.78	514.00	1,084.34	1,081.37	1,103.90	1,100.54
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,456.00	0.002308	102 inch	0.013	8.78	515.00	1,081.37	1,078.01	1,100.54	1,097.55
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.002500	10 x 6 ft	0.013	8.30	521.40	1,078.01	1,077.96	1,097.55	1,097.55
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	898.00	0.002249	102 inch	0.013	8.78	508.46	1,077.96	1,075.94	1,097.55	1,095.56
P-12	I-12 (Bend)	I-13	498.00	34.00	0.002059	102 inch	0.013	8.78	486.44	1,075.94	1,075.87	1,095.56	1,095.43
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.003000	10 x 6 ft	0.013	8.30	571.17	1,075.87	1,075.81	1,095.43	1,095.13
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	45.00	0.002222	102 inch	0.013	8.78	505.37	1,075.81	1,075.71	1,095.13	1,093.48
P-15	I-15 (Bend)	I-16	498.00	3.00	0.003333	102 inch	0.013	8.78	618.95	1,075.71	1,075.70	1,093.48	1,093.48
P-16	I-16	Outlet	498.00	0.10	0.000000	102 inch	0.013	8.78	0.00	1,075.70	1,075.70	1,093.48	1,093.48



Please refer to VELOCITY DETERMINATION IN LATERALS Excel sheet

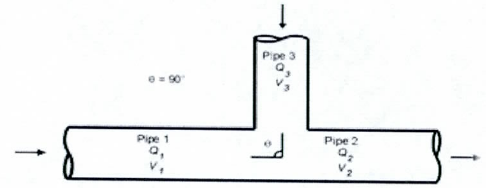
Camelback Strom Drain Project
Trunkline Junction Loss Calculation

Intersection Name	Upstream Flow Q_1 (cfs)	Upstream Flow Velocity V_1 (ft/s)	Upstream Pipe Size (inches)	Upstream Pipe Flow Area A_1 (sq.ft)	Dnstream Flow Q_2 (cfs)	Dnstream Flow Velocity V_2 (ft/s)	Dnstream Pipe Size (inches)	Dnstream Pipe Flow Area A_2 (sq.ft)	Lateral Flow Q_3 (cfs)	Lateral Flow Velocity V_3 (ft/s)	Lateral Pipe Insertion Angle (Degree)	Acceleration due to gravity 'g'	Upstream Friction Slope Sf_1 (ft)	Upstream Pipe P1 manning's n	Dnstream Friction Slope Sf_2 (ft)	Dnstream Pipe P2 Manning's n	Length of Transition L (ft)	Head Loss h_j (ft)
58th Avenue	46	3.66	48	12.57	113	8.99	48	12.57	29	5.91	45	32.2	0.0010	0.013	0.0062	0.013	5	0.8
58th Avenue	46	3.66	48	12.57	75	5.97	48	12.57	29	5.91	45	32.2	0.0010	0.013	0.0000	0.013	5	0.05
59th Avenue	113	8.99	48	12.57	329	8.55	84	38.48	216	6.51	45	32.2	0.0062	0.013	0.0027	0.013	5	1.1
61st Avenue	218	5.66	84	38.48	329	8.55	84	38.48	111	11.54	45	32.2	0.0016	0.013	0.0027	0.013	5	-0.1
63rd Avenue	158	4.11	84	38.48	375	8.49	90	44.18	217	11.05	45	32.2	0.0008	0.013	0.0024	0.013	5	-0.22
63rd Avenue	329	8.55	84	38.48	375	8.49	90	44.18	46	2.34	45	32.2	0.0037	0.013	0.0024	0.013	5	0.3
65th Avenue	320	7.24	90	44.18	375	7.46	96	50.27	55	7.78	45	32.2	0.0025	0.013	0.0017	0.013	5	0.1
67th Avenue	143	2.84	96	50.27	498	8.78	102	56.75	355	10.7	45	32.2	0.0004	0.013	0.0022	0.013	5	-0.32
67th Avenue	375	7.46	96	50.27	498	8.78	102	56.75	123	3.71	45	32.2	0.0025	0.013	0.0022	0.013	5	0.4
68th Drive	460	8.11	102	56.75	498	8.78	102	56.75	38	7.74	45	32.2	0.0029	0.013	0.0022	0.013	5	0.1
71st Avenue	376	6.63	102	56.75	498	8.78	102	56.75	122	9.71	45	32.2	0.0019	0.013	0.0022	0.013	5	0.1

Note: This calculation is done considering full flow condition

$$h_j = \frac{2*(Q_2V_2 - Q_1V_1 - Q_3V_3 Cos\,\theta)}{(A_1 + A_2)g} + \frac{V_1^2}{2g} - \frac{V_2^2}{2g} + \left(\frac{S_{f1} + S_{f2}}{2}\right)L$$

h_j = Junction head loss, ft
A_1 = Upstream flow area, sq ft
A_2 = Downstream flow area, sq ft
Q_1 = Upstream flow rate, cfs
Q_2 = Downstream flow rate, cfs
Q_3 = Lateral flow rate, cfs
V_1 = Upstream flow velocity, ft/s
V_2 = Downstream flow velocity, ft/s
V_3 = Lateral flow velocity, ft/s
S_{f1} = Upstream friction slope, ft
S_{f2} = Downstream friction slope, ft
L = Length of transition, ft



$$S_f = K\frac{V^2}{2gR^{4/3}}$$

V = Velocity, ft/s
g = Acceleration due to gravity, 32.2, ft/sec^2
R = Hydraulic radius, ft (D/4, when pipe is full)

$$K = \frac{2gn^2}{2.21}$$

n = Manning's roughness coefficient

Bend Structure:

There are two locations where the trunk line bend at approximately 45^0 before it outfalls into the Grand Canal. Figure 4.8 from FCDMC Drainage Design Manual Volume-II was used to determine the bend loss coefficient for no special shaping bends. A bend loss coefficient of 0.38 was determined from the graph and used in the trunk line storm drain model.

Similar methodology was also used to determine the bend loss at each lateral as each lateral bend 45^0 before it connects with trunk line.

Transition Structure:

A storm drain transition is a structure of varying cross-section designed to provide smooth flow between conduits. A transition is usually required to change the conduit size or to avoid obstructions. The transition structure for Camelback Strom Drain project has 102" diameter concrete pipe transitioning into a 10' X 6' reinforce concrete box and again into 102" diameter concrete pipe as shown in the figure 4 below. The purpose of this transition is to avoid conflict with 48" sewer line that crosses trunk line at two locations. Detail headloss determination through the transition structure was performed using FCDMC hydraulics manual and is attached in the following pages of this section of the report.

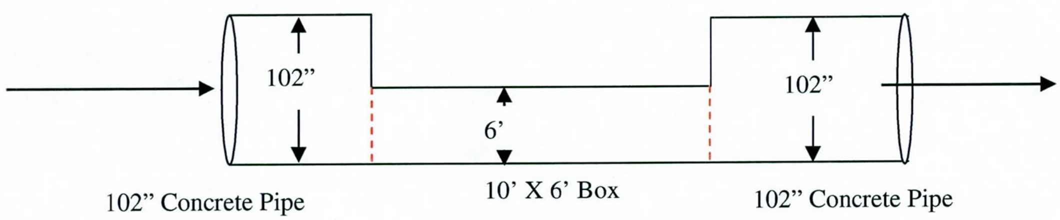
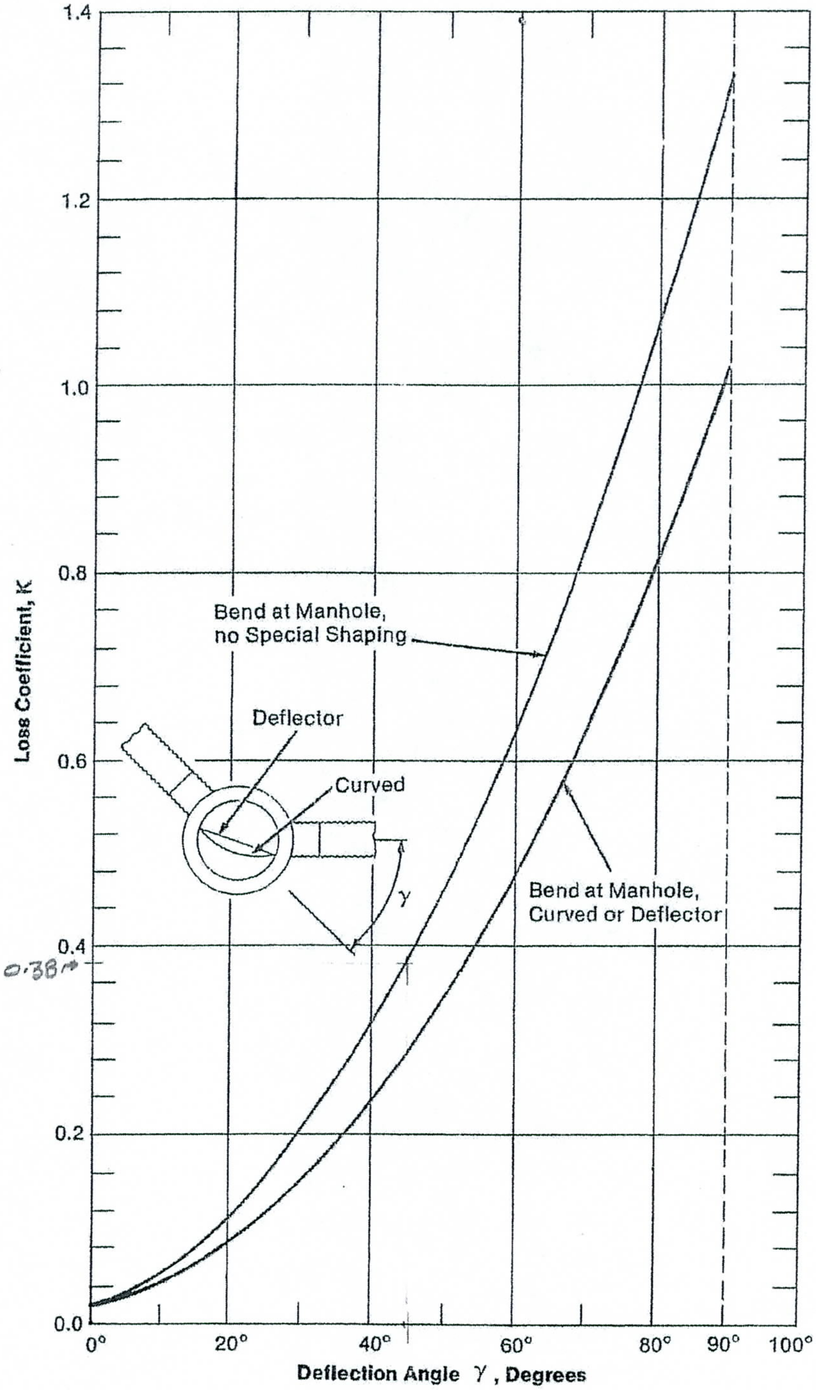


Figure 4: Camelback Storm Drain Transition Structure

The calculation shows that the transition structure has composite headloss of approximately 0.71 ft; however, the project team believes that headloss is very low and decided to consider the total headloss of 2 ft through the structure.

FIGURE 4.8
BEND LOSS COEFFICIENT
(MODIFIED FROM AISI, 1990)



$$K = \frac{2gn^2}{2.21} \tag{4.5}$$

where: g = Acceleration due to gravity, 32.2 ft/sec^2

TABLE 4.1
VALUES OF ROUGHNESS AND FRICTION FORMULA COEFFICIENTS FOR CLOSED CONDUITS

Conduit Material	Manning's n
Asbestos Cement Pipe	0.013
Brick	0.015
Cast Iron Pipe	
Cement lined & seal coated	0.013
Concrete (monolithic)	
Smooth forms	0.013
Rough forms	0.017
Concrete Pipe	0.013
Corrugated Metal Pipe (1/2 x 2 2/3 inch corrugations)	
Plain	0.024
Paved invert	0.020
Spun asphalt lined	0.013
Corrugated Polyethylene Pipe	
15" Diameter	0.018
18" to 36" Diameter	0.020
Plastic Pipe (smooth)	0.013
Vitrified Clay	
Pipes	0.013
Liner plates	0.013

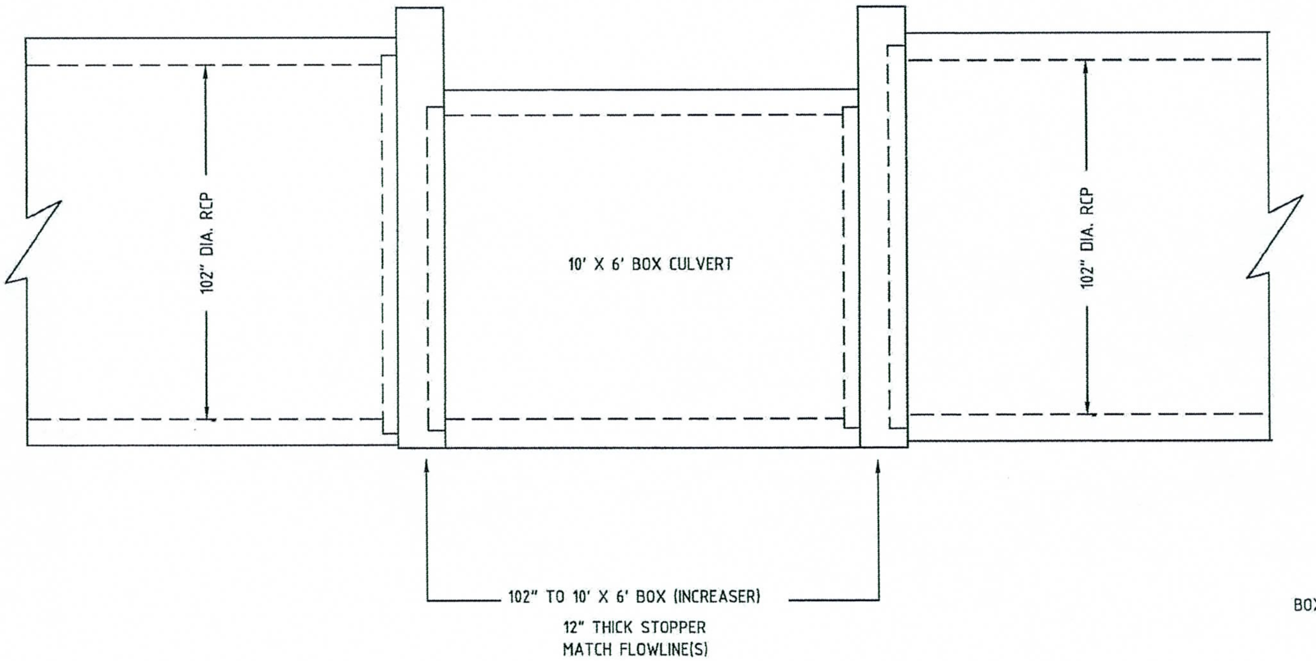
The loss of head due to friction throughout the length of reach (L) is calculated by:

$$h_f = S_f L \tag{4.6}$$

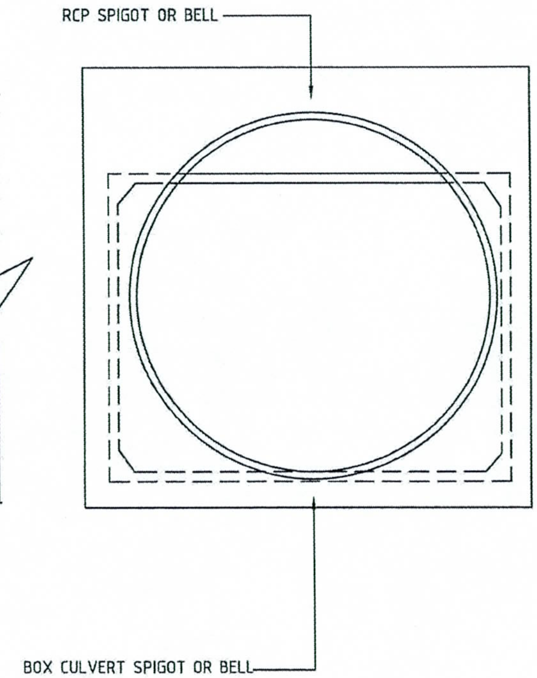
where: h_f = Friction headloss, ft

L = Reach length, ft

BOX TO RCP TRANSITION



PLAN VIEW



END VIEW

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REVISIONS						
A	MATCH FLOWLINES– REVISE TO 10X6	–8–10–09	CHECKED:	#	102" TO 10' X 6' BOX CULVERT TRANSITION	
B	–	–	SOLD BY:	#		
C	–	–	SCALE: N.T.S.	#		
D	–	–	ORDER#	TOTALS: #	DATE: 7–16–09	PAGE: OF

DRAWN BY: –D. HUNTER

FIGURE 4.6
TRANSITION LOSS

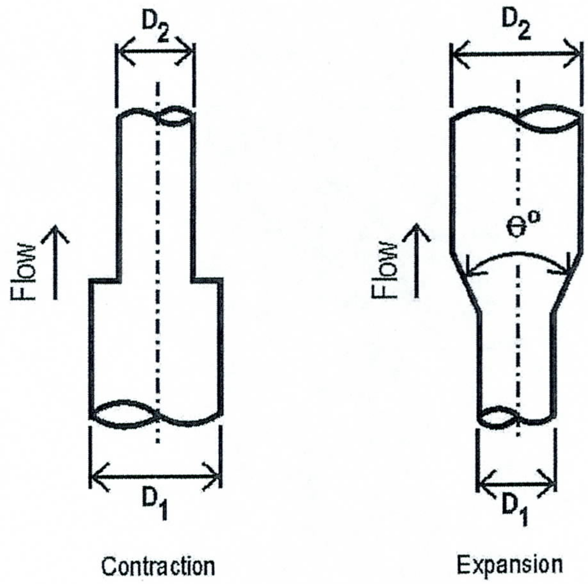


TABLE 4.2
STORM SEWER ENERGY LOSS COEFFICIENTS UNDER OPEN CHANNEL CONDITIONS
(ASCE, 1992)

(a) Contractions (K_c)		**(b) Expansion (K_e)**		
$\frac{D_2}{D_1}$	K_c	θ	$\frac{D_2}{D_1} = 3$	$\frac{D_2}{D_1} = 1.5$
0	0.5	10	0.17	0.17
0.4	0.4	20	0.40	0.40
0.6	0.3	45	0.86	1.06
0.8	0.1	60	1.02	1.21
1.0	0	90	1.06	1.14
		120	1.04	1.07
		180	1.00	1.00

Under pressure flow conditions, the headloss due to contraction and expansion of flow can be expressed as:

$$h = k\frac{V^2}{2g} \tag{4.9}$$

where:

h = Headloss due to a contraction or expansion, ft

k = Coefficient for contraction (k_c) or coefficient for expansion (k_e), see below.

V = Velocity of flow in the smallest diameter pipe, ft/sec

The values for the transition coefficient, k_e, for gradual enlargements are given in Table 4.3a. For sudden enlargements, values for the transition coefficients are listed Table 4.3b. Values for the transition loss coefficient, k_c, for sudden contractions can be found in Table 4.4.

Table 4.3a

COEFFICIENT k_e FOR GRADUAL ENLARGEMENT UNDER PRESSURE FLOW CONDITIONS

(AISI, 1990)

D_2/D_1	Angle of Cone, degrees													
	2	4	6	8	10	15	20	25	30	35	40	45	50	60
1.1	.01	.01	.01	.02	.03	.05	.10	.13	.16	.18	.19	.20	.21	.23
1.2	.02	.02	.02	.03	.04	.09	.16	.21	.25	.29	.31	.33	.35	.37
1.4	.02	.03	.03	.04	.06	.12	.23	.30	.36	.41	.44	.47	.50	.53
1.6	.03	.03	.04	.05	.07	.14	.26	.35	.42	.47	.51	.54	.57	.61
1.8	.03	.04	.04	.05	.07	.15	.28	.37	.44	.50	.54	.58	.61	.65
2.0	.03	.04	.04	.05	.07	.16	.29	.38	.46	.52	.56	.60	.63	.68
2.5	.03	.04	.04	.05	.08	.16	.30	.39	.48	.54	.58	.62	.65	.70
3.0	.03	.04	.04	.05	.08	.16	.31	.40	.48	.55	.59	.63	.66	.71
•	.03	.04	.05	.06	.08	.16	.31	.40	.49	.56	.60	.64	.67	.72

Table 4.3b

COEFFICIENT k_e FOR SUDDEN ENLARGEMENT UNDER PRESSURE FLOW CONDITIONS

(AISI, 1990)

D_2 / D_1	Velocity, V_1, ft/sec												
	2	3	4	5	6	7	8	10	12	15	20	30	40
1.2	.11	.10	.10	.10	.10	.10	.10	.09	.09	.09	.09	.09	.08
1.4	.26	.26	.25	.24	.24	.24	.24	.23	.23	.22	.22	.21	.20
1.6	.40	.39	.38	.37	.37	.36	.36	.35	.35	.34	.33	.32	.32
1.8	.51	.49	.48	.47	.47	.46	.46	.45	.44	.43	.42	.41	.40
2.0	.60	.58	.56	.55	.55	.54	.53	.52	.52	.51	.50	.48	.47
2.5	.74	.72	.70	.69	.68	.67	.66	.65	.64	.63	.62	.60	.58
3.0	.83	.80	.78	.77	.76	.75	.74	.73	.72	.70	.69	.67	.65
4.0	.92	.89	.87	.85	.84	.83	.82	.80	.79	.78	.76	.74	.72
5.0	.96	.93	.91	.89	.88	.87	.86	.84	.83	.82	.80	.77	.75
10.0	1.00	.99	.96	.95	.93	.92	.91	.89	.88	.86	.84	.82	.80
•	1.00	1.00	.98	.96	.95	.94	.93	.91	.90	.88	.86	.83	.81

Table 4.4

COEFFICIENT k_c FOR SUDDEN CONTRACTION UNDER PRESSURE FLOW CONDITIONS

(AISI, 1990)

D_1 / D_2	Velocity, V_2, ft/sec												
	2	3	4	5	6	7	8	10	12	15	20	30	40
1.1	.03	.04	.04	.04	.04	.04	.04	.04	.04	.04	.05	.05	.06
1.2	.07	.07	.07	.07	.07	.07	.07	.08	.08	.08	.09	.10	.11
1.4	.17	.17	.17	.17	.17	.17	.17	.18	.18	.18	.18	.19	.20
1.6	.26	.26	.26	.26	.26	.26	.26	.26	.26	.25	.25	.25	.24
1.8	.34	.34	.34	.34	.34	.34	.33	.33	.32	.32	.31	.29	.27
2.0	.38	.38	.37	.37	.37	.37	.36	.36	.35	.34	.33	.31	.29
2.2	.40	.40	.40	.39	.39	.39	.39	.38	.37	.37	.35	.33	.30
2.5	.42	.42	.42	.41	.41	.41	.40	.40	.39	.38	.37	.34	.31
3.0	.44	.44	.44	.43	.43	.43	.42	.42	.41	.40	.39	.36	.33
4.0	.47	.46	.46	.46	.45	.45	.45	.44	.43	.42	.41	.37	.34
5.0	.48	.48	.47	.47	.47	.46	.46	.45	.45	.44	.42	.38	.35
10.0	.49	.48	.48	.48	.48	.47	.47	.46	.46	.45	.43	.40	.36
•	.49	.49	.48	.48	.48	.47	.47	.47	.46	.45	.44	.41	.38

8. HYDRAULIC RADIUS

The *hydraulic radius* is defined as the area in flow divided by the *wetted perimeter*.[12] (The hydraulic radius is not the same as the radius of a pipe.) The area in flow is the cross-sectional area of the fluid flowing. When a fluid is flowing under pressure in a pipe (i.e., *pressure flow*), the area in flow will be the internal area of the pipe. However, the fluid may not completely fill the pipe and may flow simply because of a sloped surface (i.e., *gravity flow* or *open channel flow*).

The wetted perimeter is the length of the line representing the interface between the fluid and the pipe or channel. It does not include the *free surface* length (i.e., the interface between fluid and atmosphere).

$$r_h = \frac{\text{area in flow}}{\text{wetted perimeter}} = \frac{A}{s} \qquad 16.18$$

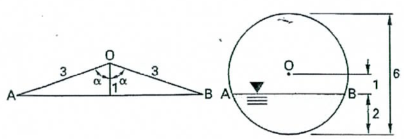
Consider a circular pipe flowing completely full. The area in flow is πr^2. The wetted perimeter is the entire circumference, $2\pi r$. The hydraulic radius is

$$r_{h,\text{pipe}} = \frac{\pi r^2}{2\pi r} = \frac{r}{2} \qquad 16.19$$

The hydraulic radius of a pipe flowing half full is also $r/2$, since the flow area and wetted perimeter are both halved. However, it is time-consuming to calculate the hydraulic radius for pipe flow at any intermediate depth, due to the difficulty in evaluating the flow area and wetted perimeter. Appendix 16.A greatly simplifies such calculations.

Example 16.4

A pipe (internal diameter = 6 units) carries water with a depth of 2 units flowing under the influence of gravity. (a) Calculate the hydraulic radius analytically. (b) Verify the result by using App. 16.A.



Solution

(a) The equations for a circular segment must be used. The radius is $6/2 = 3$.

Points A, O, and B are used to find the central angle of the circular segment.

$$\phi = 2\alpha = 2\left(\arccos\left(\tfrac{1}{3}\right)\right) = (2)(70.53^\circ) = 141.06^\circ$$

ϕ must be expressed in radians.

$$\phi = 2\pi\left(\frac{141.06^\circ}{360^\circ}\right) = 2.46 \text{ rad}$$

The area of the circular segment (i.e., the area in flow) is

$$\begin{aligned} A &= \tfrac{1}{2}r^2(\phi - \sin\phi) \quad [\phi \text{ in radians}] \\ &= (0.5)(3)^2(2.46 \text{ rad} - \sin(2.46 \text{ rad})) \\ &= 8.235 \text{ units}^2 \end{aligned}$$

The arc length (i.e., the wetted perimeter) is

$$s = r\phi = (3)(2.46 \text{ rad}) = 7.38 \text{ units}$$

The hydraulic radius is

$$r_h = \frac{A}{s} = \frac{8.235 \text{ units}^2}{7.38 \text{ units}} = 1.12 \text{ units}$$

(b) The ratio d/D is needed to use App. 16.A.

$$\frac{d}{D} = \frac{2 \text{ units}}{6 \text{ units}} = 0.333$$

From App. 16.A,

$$\frac{r_h}{D} \approx 0.186$$

$$r_h = (0.186)(6 \text{ units}) = 1.12 \text{ units}$$

9. EQUIVALENT DIAMETER

Many fluid, thermodynamic, and heat transfer processes are dependent on the physical length of an object. The general name for this controlling variable is *characteristic dimension*. The characteristic dimension in evaluating fluid flow is the *equivalent diameter* (also known as the *hydraulic diameter*). The equivalent diameter for a full-flowing pipe is simply its inside diameter. The equivalent diameters of other cross sections in flow are given in Table 16.1. If the hydraulic radius is known, it can be used to calculate the equivalent diameter.

$$D_e = 4r_h \qquad 16.20$$

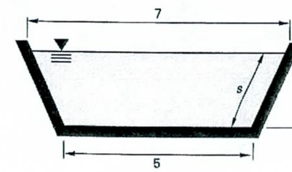
[12] The hydraulic radius can also be calculated as one-fourth of the equivalent diameter of the pipe or channel, as will be subsequently shown. That is, $r_h = {}^1\!/_4 D_e$.

Table 16.1 *Equivalent Diameters for Common Conduit Shapes*

conduit cross section	D_e
flowing full	
annulus (outer diameter D_o, inner diameter D_i)	$D_o - D_i$
square (side L)	L
rectangle (sides L_1 and L_2)	$\dfrac{2L_1L_2}{L_1+L_2}$
flowing partially full	
half-filled circle (diameter D)	D
rectangle (h deep, L wide)	$\dfrac{4hL}{L+2h}$
wide, shallow stream (h deep)	$4h$
triangle (h deep, L broad, s side)	$\dfrac{hL}{s}$
trapezoid (h deep, a wide at top, b wide at bottom, s side)	$\dfrac{2h(a+b)}{b+2s}$

Example 16.5

Determine the equivalent diameter and hydraulic radius for the open trapezoidal channel shown.



Solution

$$s = \sqrt{(3)^2 + (1)^2} = 3.16$$

Using Table 16.1,

$$D_e = \frac{2h(a+b)}{b+2s} = \frac{(2)(3)(7+5)}{5+(2)(3.16)} = 6.36$$

From Eq. 16.20,

$$r_h = \frac{D_e}{4} = \frac{6.36}{4} = 1.59$$

10. REYNOLDS NUMBER

The *Reynolds number*, Re, is a dimensionless number interpreted as the ratio of inertial forces to viscous forces in the fluid.[13]

$$\text{Re} = \frac{\text{inertial forces}}{\text{viscous forces}} \qquad 16.21$$

The inertial forces are proportional to the flow diameter, velocity, and fluid density. (Increasing these variables will increase the momentum of the fluid in flow.) The viscous force is represented by the fluid's absolute viscosity, μ. Thus, the Reynolds number is calculated as

$$\text{Re} = \frac{D_e \text{v} \rho}{\mu} \quad \text{[SI]} \qquad 16.22(a)$$

$$\text{Re} = \frac{D_e \text{v} \rho}{g_c \mu} \quad \text{[U.S.]} \qquad 16.22(b)$$

Since μ/ρ is defined as the *kinematic viscosity*, ν, Eq. 16.22 can be simplified.[14]

$$\text{Re} = \frac{D_e \text{v}}{\nu} \qquad 16.23$$

Occasionally, the *mass flow rate per unit area*, $G = \rho\text{v}$, will be known. This variable expresses the quantity of fluid flowing in kg/m^2·s or lbm/ft^2-sec.

$$\text{Re} = \frac{D_e G}{\mu} \quad \text{[SI]} \qquad 16.24(a)$$

$$\text{Re} = \frac{D_e G}{g_c \mu} \quad \text{[U.S.]} \qquad 16.24(b)$$

11. LAMINAR FLOW

Laminar flow gets its name from the word *laminae* (layers). If all of the fluid particles move in paths parallel to the overall flow direction (i.e., in layers), the flow is said to be *laminar*. (The terms *viscous flow* and *streamline flow* are also used.) This occurs in pipeline flow when the Reynolds number is less than (approximately) 2100. Laminar flow is typical when the flow channel is small, the velocity is low, and the fluid is viscous. Viscous forces are dominant in laminar flow. Laminar

In laminar flow, a stream of dye inserted in the flow will continue from the source in a continuous, unbroken line with very little mixing of the dye and surrounding liquid. The fluid particle paths coincide with imaginary *streamlines*. (Streamlines and velocity vectors are always tangent to each other.) A "bundle" of these streamlines (i.e., a *streamtube*) constitutes a complete fluid flow.

[13] Engineering authors are not in agreement about the symbol for the Reynolds number. In addition to Re (used in this book), engineers commonly use **Re**, R, $\Re$, N_{Re}, and N_R.
[14] This simplification implies a caveat as well. If the viscosity is known or is given in a problem, the units must be used to determine if this viscosity is μ or ν.

Water Resources

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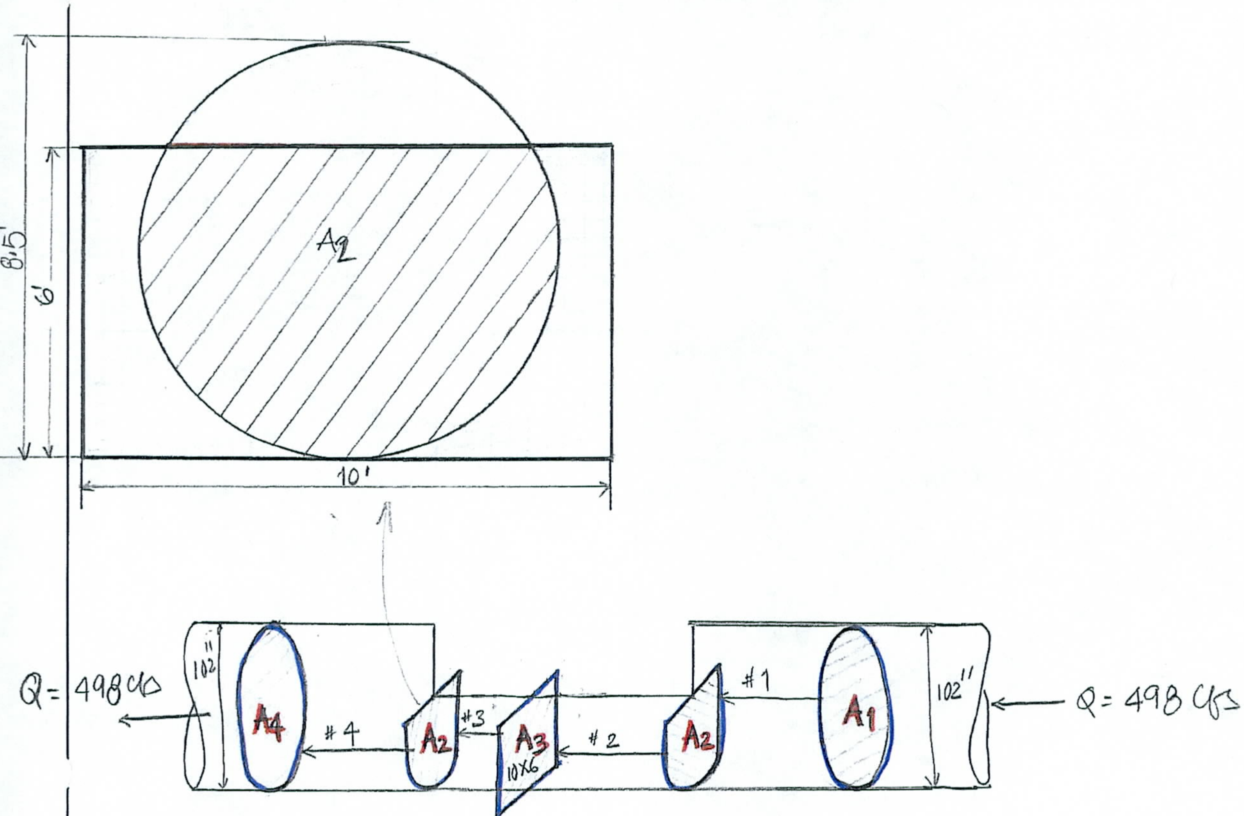

Equivalent Diameter of A_2

Area of $A_2 = 42.82\ ft^2$

Perimeter $= 16.96 + 7.75 = 24.71\ ft$

hydraulic radius $r_h = \dfrac{\text{flow Area } A_2}{\text{wetted perimeter}} = \dfrac{42.82}{24.71} = 1.73\ ft$

$\therefore$ equivalent diameter of A_2 (D_e) $= 4 \times r_h = 4 \times 1.73 = 6.93\ ft$

Equivalent Diameter of A_3 (10'x6' Box)

Area of $A_3 = 10 \times 6 = 60\ ft^2$

Perimeter $= 32\ ft$

hydraulic radius $r_h = \dfrac{60}{32} = 1.875\ ft$

$\therefore$ equivalent Diameter (D_e) $= 4 \times r_h = 4 \times 1.875 = 7.5\ ft$

project:

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Transistion # 1 from shape A_1 to A_2 - Sudden Contraction

SHAPE A-1
Diameter $D_1 = 8.5'$
Velocity $V_1 =$

SHAPE A-2
Eq Diameter $D_2 = 6.93'$
Velocity $V_2 = \frac{Q}{A} = \frac{498}{42.82} = 11.63$ ft/sec

$$\frac{D_1}{D_2} = \frac{8.5}{6.93} = 1.23$$

From Table 4.4 of FCDMC's Hydraulics Manual, Coefficient of sudden contraction under pressure flow condition

D_1/D_2 →	Velocity V_2 10	11.63	12
1.2	0.08	0.08	0.08
1.23		0.095	
1.4	0.18	0.18	0.18

$k_e = 0.095$

∴ head loss @ transistion # 1 due to sudden Contraction =

$$h_c = \frac{K_c V_2^2}{2g} = \frac{0.095 \times 11.63^2}{2 \times 32.2} = 0.199 \approx 0.2 \text{ ft}$$

OLSSON ASSOCIATES

Transistion#2 from Section A_2 to A_3 - Sudden Expansion

Section A-2

Eq Diameter $D_2 = 6.93$ ft

velocity $V_2 = 11.63$ ft/sec

Section A-3

Eq Diameter $D_3 = 7.5$ ft

Velocity $V_3 = 8.3$ ft/sec

$\frac{D_3}{D_2} = \frac{7.5}{6.93} = 1.08 \rightarrow 1.2$ (lowest value from table 4.3b)

Table - 4.3b

D_3/D_2	Velocity V_2 10	11.63	12
1.2	0.09	0.09	0.09

$K_e = 0.09$

∴ head loss @ Transistion #2 due to sudden expansion =

$$h_e = \frac{K_e \times V_2^2}{2g} = \frac{0.09 \times 11.63^2}{2 \times 32.2} = 0.189 \text{ ft}$$

project:

subject

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Transisition #3 from section A3 to A2 - Sudden Contraction

Section A-3

Eq Diameter $D_3 = 7.5$ ft

Velocity $V_3 = 8.3$ ft/sec

Section A-2

Eq Diameter $D_2 = 6.93$ ft

Velocity $V_2 = 11.63$ ft/sec

$$D_3/D_2 = \frac{7.5}{6.93} = 1.08 \sim 1.1$$

Table 4.4

D_3/D_2 → Velocity - V_2

	10	11.63	12
1.1	0.04	0.04	0.04

$K_c = 0.04$

∴ head loss @ transisition #3 due to sudden contraction

$$h_c = \frac{K_c \times V_2^2}{2 \times g} = \frac{0.04 \times 11.63^2}{2 \times 32.2} = 0.084 \text{ ft}$$

project:

subject

drawn by: date: project no.: sheet of

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Transistion #4 from section A2 to A4 - Sudden Expansion

section A2

Eq Diameter $D_2 = 6.93$ ft

Velocity $V_2 = 11.63$ ft/sec

section A4

Diameter $D_4 = 8.5'$

velocity $V_5 =$

$$D_4/D_2 = \frac{8.5}{6.93} = 1.23$$

Table 4.3b

D_4/D_2	Velocity V_2 10	11.63	12
1.2	0.09	0.09	0.09
1.23		0.11	
1.4	0.23	0.23	0.23

$K_e = 0.11$

∴ head loss @ transistion#4 due to Sudden Expansion $h = \frac{K_e V_2^2}{2 \times g}$

$$= \frac{0.11 \times 11.63^2}{2 \times 32.2}$$

$$= 0.233 \text{ ft}$$

Total head loss from Sec A1 to A4

$$= 0.199 + 0.189 + 0.084 + 0.023$$

$$= 0.388 + 0.317 = 0.705 \approx 0.71 \text{ ft}$$

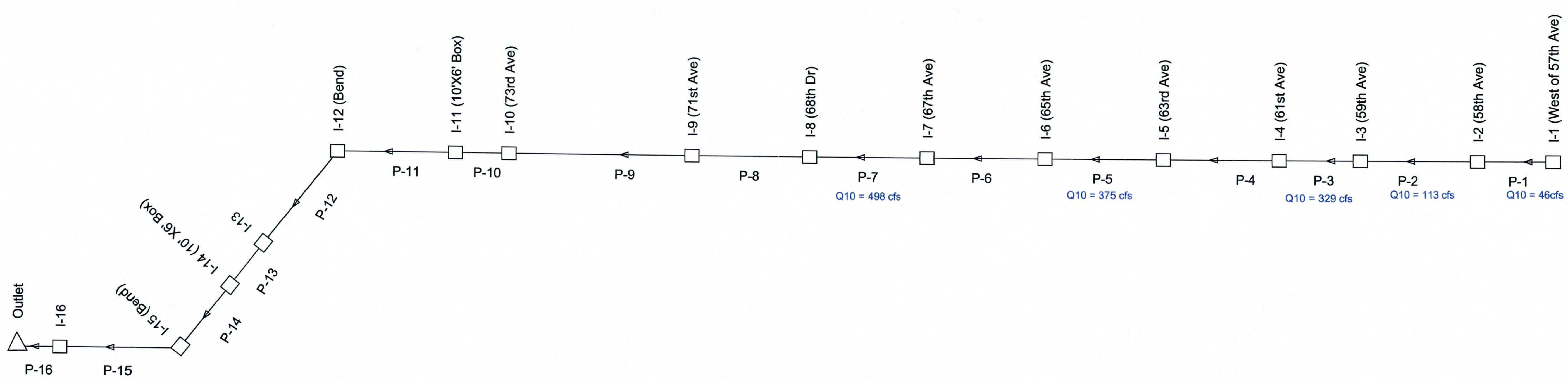
project:

subject

drawn by: date: project no.: sheet of

D.3.3 StormCAD Output Data

CAMELBACK STORM DRAIN PIPE LAYOUT



Scenario: Camelback Storm Drain Trunkline Hydrology

Node Report

Label	Headloss Coefficient	Absolute Headloss (ft)	Sump Elevation (ft)	Rim Elevation (ft)	Total System Flow (cfs)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
I-1 (West of 57th Ave)	1.50		1,109.640	1,122.270	46.00	1,119.44	1,119.13
I-2 (58th Ave)		0.80	1,107.850	1,121.960	113.00	1,118.62	1,117.82
I-3 (59th Ave)		1.10	1,102.460	1,120.470	329.00	1,113.76	1,112.66
I-4 (61st Ave)		0.10	1,098.540	1,116.590	329.00	1,109.02	1,108.92
I-5 (63rd Ave)		0.30	1,094.220	1,112.820	375.00	1,105.38	1,105.08
I-6 (65th Ave)		0.10	1,089.830	1,108.670	375.00	1,101.84	1,101.74
I-7 (67th Ave)		0.40	1,087.080	1,107.320	498.00	1,099.97	1,099.57
I-8 (68th Dr)		0.10	1,084.340	1,103.900	498.00	1,097.00	1,096.90
I-9 (71st Ave)		0.10	1,081.200	1,100.540	498.00	1,093.95	1,093.85
I-10 (73rd Ave)		1.00	1,078.010	1,097.550	498.00	1,090.85	1,089.85
I-11 (10' X 6' RCB)		1.00	1,077.960	1,097.550	498.00	1,089.80	1,088.80
I-12 (Bend)	0.38		1,075.928	1,095.560	498.00	1,086.90	1,086.44
I-13		1.00	1,075.860	1,095.430	498.00	1,086.37	1,085.37
I-14 (10' X6' RCB)		1.00	1,075.810	1,095.130	498.00	1,085.32	1,084.32
I-15 (Bend)	0.38		1,075.700	1,093.480	498.00	1,084.22	1,083.75
I-16	1.00		1,075.677	1,093.480	498.00	1,083.73	1,081.30
Outlet			1,075.677	1,093.480	498.00	1,080.58	1,080.58

NODE REPORT

Scenario: Camelback Storm Drain Trunkline Hydrology

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Hydraulic Slope (ft/ft)	Energy Slope (ft/ft)	Description
P-1	I-1 (West of 57th A	I-2 (58th Ave)	46.00	496.00	0.00361	48 inch	0.013	3.66	86.29	1,109.640	1,107.850	1,122.27	1,121.96	8.63	10.11	1,119.13	1,118.62	1,119.33	1,118.83	0.00103	0.00103	
P-2	I-2 (58th Ave)	I-3 (59th Ave)	113.00	656.30	0.00361	48 inch	0.013	8.99	86.31	1,107.850	1,105.480	1,121.96	1,120.47	10.11	10.99	1,117.82	1,113.76	1,119.07	1,115.01	0.00619	0.00619	
P-3	I-3 (59th Ave)	I-4 (61st Ave)	329.00	1,371.20	0.00286	84 inch	0.013	8.55	341.55	1,102.460	1,098.540	1,120.47	1,116.59	11.01	11.05	1,112.66	1,109.02	1,113.79	1,110.15	0.00265	0.00265	
P-4	I-4 (61st Ave)	I-5 (63rd Ave)	329.00	1,333.00	0.00285	84 inch	0.013	8.55	341.07	1,098.540	1,094.740	1,116.59	1,112.82	11.05	11.08	1,108.92	1,105.38	1,110.05	1,106.52	0.00265	0.00265	
P-5	I-5 (63rd Ave)	I-6 (65th Ave)	375.00	1,358.30	0.00285	90 inch	0.013	8.49	409.85	1,094.220	1,090.350	1,112.82	1,108.67	11.10	10.82	1,105.08	1,101.84	1,106.20	1,102.96	0.00239	0.00239	
P-6	I-6 (65th Ave)	I-7 (67th Ave)	375.00	1,049.60	0.00213	96 inch	0.013	7.46	421.33	1,089.830	1,087.590	1,108.67	1,107.32	10.84	11.73	1,101.74	1,099.97	1,102.61	1,100.83	0.00169	0.00169	
P-7	I-7 (67th Ave)	I-8 (68th Dr)	498.00	1,191.00	0.00230	102 inch	0.013	8.78	514.21	1,087.080	1,084.340	1,107.32	1,103.90	11.74	11.06	1,099.57	1,097.00	1,100.76	1,098.19	0.00216	0.00216	
P-8	I-8 (68th Dr)	I-9 (71st Ave)	498.00	1,367.10	0.00230	102 inch	0.013	8.78	513.79	1,084.340	1,081.200	1,103.90	1,100.54	11.06	10.84	1,096.90	1,093.95	1,098.09	1,095.14	0.00216	0.00216	
P-9	I-9 (71st Ave)	I-10 (73rd Ave)	498.00	1,389.40	0.00230	102 inch	0.013	8.78	513.69	1,081.200	1,078.010	1,100.54	1,097.55	10.84	11.04	1,093.85	1,090.85	1,095.04	1,092.05	0.00216	0.00216	
P-10	I-10 (73rd Ave)	I-11 (10' X 6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,078.010	1,077.964	1,097.55	1,097.55	13.54	13.59	1,089.85	1,089.80	1,090.92	1,090.87	0.00228	0.00228	
P-11	I-11 (10' X 6' RCB)	I-12 (Bend)	498.00	883.63	0.00230	102 inch	0.013	8.78	514.10	1,077.960	1,075.928	1,097.55	1,095.56	11.09	11.13	1,088.80	1,086.90	1,090.00	1,088.09	0.00216	0.00216	
P-12	I-12 (Bend)	I-13	498.00	33.78	0.00231	102 inch	0.013	8.78	515.15	1,075.928	1,075.850	1,095.56	1,095.43	11.13	11.08	1,086.44	1,086.37	1,087.64	1,087.57	0.00216	0.00216	
P-13	I-13	I-14 (10' X6' RC	498.00	20.00	0.00230	10 x 6 ft	0.013	8.30	500.11	1,075.860	1,075.814	1,095.43	1,095.13	13.57	13.32	1,085.37	1,085.32	1,086.44	1,086.39	0.00228	0.00228	
P-14	I-14 (10' X6' RCB)	I-15 (Bend)	498.00	48.00	0.00230	102 inch	0.013	8.78	514.14	1,075.810	1,075.700	1,095.13	1,093.48	10.82	9.28	1,084.32	1,084.22	1,085.52	1,085.42	0.00216	0.00216	
P-15	I-15 (Bend)	I-16	498.00	10.00	0.00230	102 inch	0.013	10.32	514.14	1,075.700	1,075.677	1,093.48	1,093.48	9.28	9.30	1,083.75	1,083.73	1,084.99	1,084.98	0.00178	0.00187	
P-16	I-16	Outlet	498.00	0.10	0.00000	102 inch	0.013	8.78	0.00	1,075.677	1,075.677	1,093.48	1,093.48	9.30	9.30	1,081.30	1,081.27	1,083.73	1,083.73	0.32184	0.00356	

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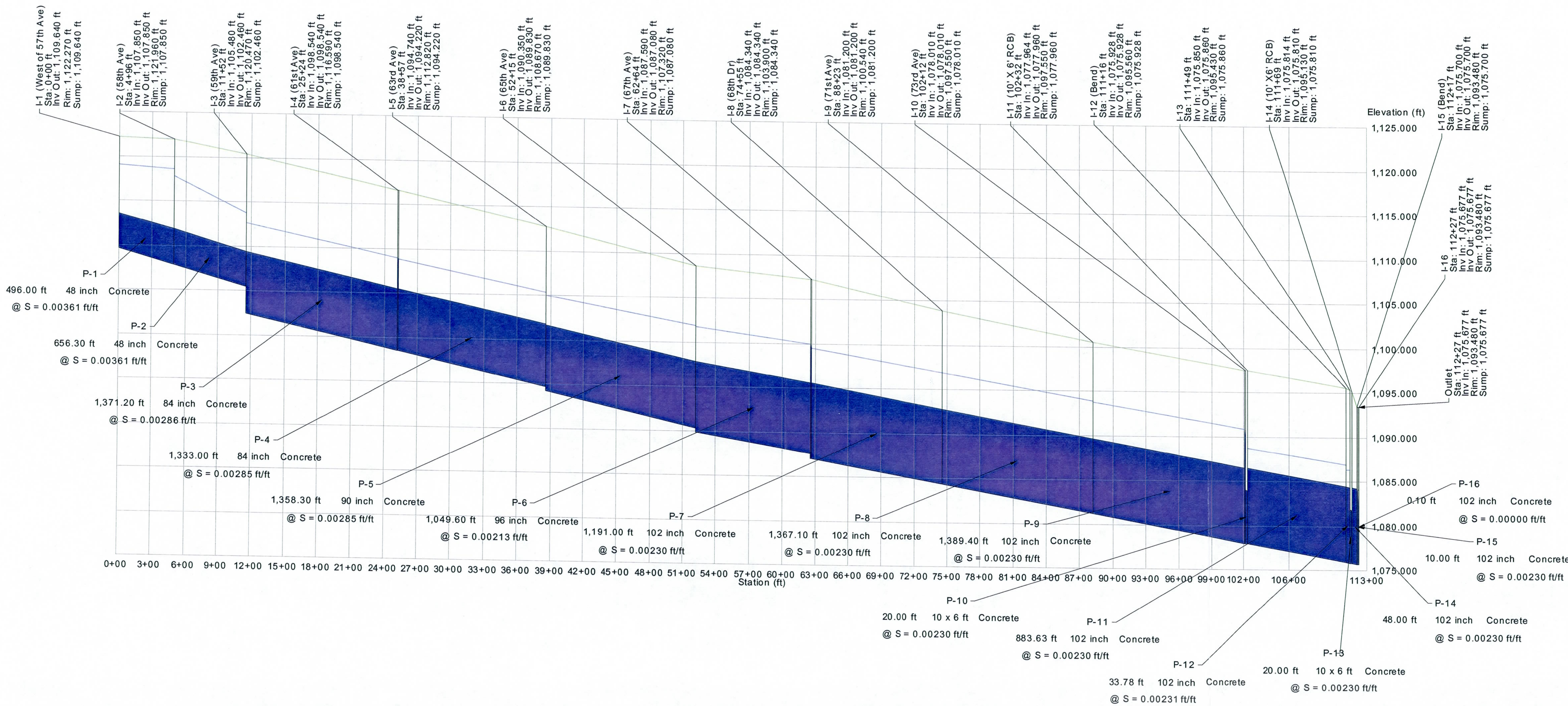
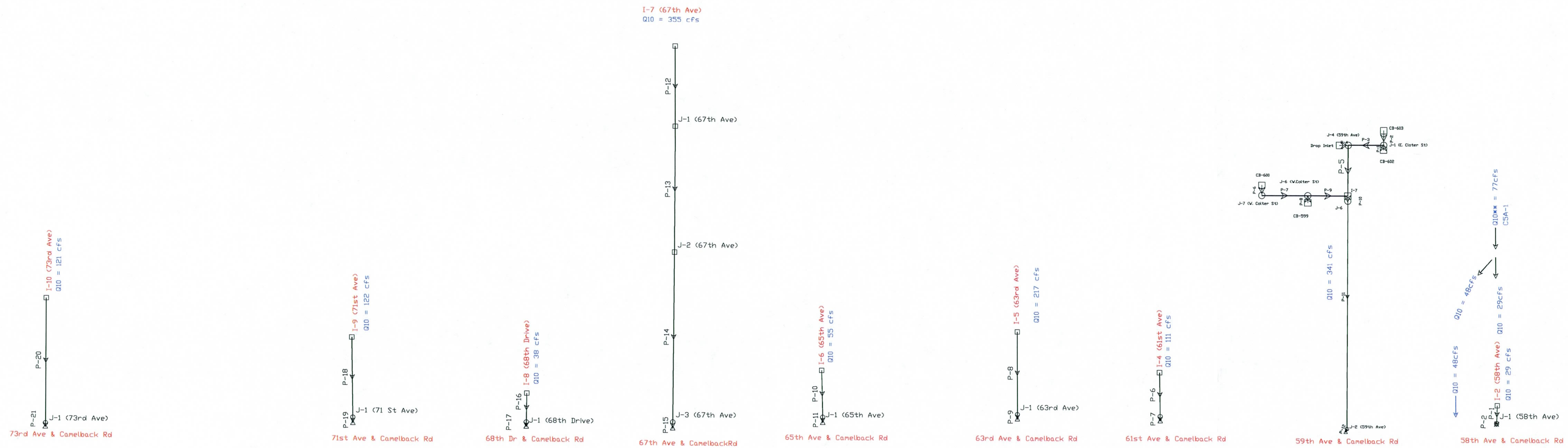
Profile

Scenario: Camelback Storm Drain Trunkline Hydrology

Profile: Camelback Rd Trunk Line Profile : Final Design



STORM DRAIN LATERALS



Note: The combine 10-yr, 6hr HEC-1 flow at the intersection of 58th Ave and Camelback Rd is 113 cfs (C-5A-2), which include 77cfs (C-5A-1) from the north along 58th Ave and 46 cfs from the east along Camelback Rd. However, 58th Ave has capacity to convey 29cfs, therefore 48 cfs breaks out into west parking lot and conveyed south. 2 -37' long curb opening inlets were designed along Camelback Rd just west of 58th Ave and Camelback Rd intersection to capture the breakout flow. Therefore 58th Ave junction has flow combination of 29 cfs from north and 46 cfs from the east.

Scenario: Storm Drain Laterals- 58th Ave to 63rd Ave

Node Report

Label	Headloss Coefficient	Absolute Headloss (ft)	Sump Elevation (ft)	Rim Elevation (ft)	Total System Flow (cfs)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
I-2 (58th Ave)	0.80		1,109.94	1,121.96	29.00	1,119.68	1,119.25
J-1 (58th Ave)	0.38		1,109.52	1,121.96	29.00	1,118.83	1,118.62
58th Ave & Camelback Rd			1,107.85	1,121.96	29.00	1,118.62	1,118.62
I-5 (63rd Ave)	0.80		1,099.44	1,112.97	217.00	1,110.19	1,108.68
J-1 (63rd Ave)	0.38		1,096.85	1,112.82	217.00	1,106.10	1,105.38
63rd Ave & Camelback Rd			1,094.22	1,112.82	217.00	1,105.38	1,105.38
I-4 (61st Ave)	0.80		1,103.49	1,116.62	111.00	1,114.17	1,112.51
J-1 (61st Ave)	0.38		1,102.15	1,116.59	111.00	1,109.81	1,109.02
61st Ave & Camelback Rd			1,098.54	1,116.59	111.00	1,109.02	1,109.02

Scenario: Storm Drain Laterals- 59th Ave & Colter St

Node Report

Label	Headloss Coefficient	Absolute Headloss (ft)	Sump Elevation (ft)	Rim Elevation (ft)	Total System Flow (cfs)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Description
CB-603	0.20		1,116.73	1,123.85	67.00	1,122.49	1,122.34	East Colter St
CB-602		0.20	1,119.15	1,123.92	65.00	1,122.22	1,122.02	East Colter St
J-1 (E. Cloter St)	0.00		1,110.31	1,124.00	132.00	1,122.18	1,122.18	East Colter St
Drop Inlet	0.50		1,119.06	1,123.99	157.00	1,122.55	1,121.83	Drop Structure
J-4 (59th Ave)	0.80		1,108.58	1,124.97	289.00	1,121.41	1,120.47	59th Ave
CB-599	0.20		1,117.58	1,122.29	11.00	1,120.34	1,120.30	West Colter St
J-7 (W. Colter St)	0.00		1,111.68	1,122.65	9.00	1,120.27	1,120.27	West Colter St
CB-600	0.20		1,117.71	1,122.16	9.00	1,120.32	1,120.30	West Colter St
J-6 (W.Colter St)	0.60		1,111.14	1,122.82	20.00	1,120.25	1,120.18	West Colter St
I-7		0.50	1,108.07	1,122.16	340.00	1,120.10	1,119.60	59th Ave
J-6	0.15		1,108.04	1,122.16	340.00	1,119.56	1,119.32	
J-2 (59th Ave)	0.38		1,103.41	1,120.47	340.00	1,114.38	1,113.76	59th Ave & Camelbk
59th Ave & Camelback Rd			1,102.46	1,120.47	340.00	1,113.76	1,113.76	59th Ave & Camelbk

Scenario: Storm Drain Laterals- 58th Ave to 63rd Ave

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Hydraulic Slope (ft/ft)	Energy Slope (ft/ft)	Description
P-1	I-2 (58th Ave)	J-1 (58th Ave)	29.00	84.00	0.005000	30 inch	0.013	5.91	29.00	1,109.94	1,109.52	1,121.96	1,121.96	9.52	9.94	1,119.25	1,118.83	1,119.79	1,119.37	).004999	).004999	
P-2	J-1 (58th Ave)	58th Ave & Cam	29.00	0.10	0.000000	30 inch	0.013	5.91	0.00	1,109.52	1,109.52	1,121.96	1,121.96	9.94	9.94	1,118.62	1,118.62	1,119.16	1,119.16	).004999	).004999	
P-6	I-4 (61st Ave)	J-1 (61st Ave)	111.00	222.13	0.006033	42 inch	0.013	11.54	78.14	1,103.49	1,102.15	1,116.62	1,116.59	9.63	10.94	1,112.51	1,109.81	1,114.58	1,111.88	).012173	).012173	
P-7	J-1 (61st Ave)	61st Ave & Cam	111.00	0.10	0.000000	42 inch	0.013	11.54	0.00	1,102.15	1,102.15	1,116.59	1,116.59	10.94	10.94	1,109.02	1,109.02	1,111.09	1,111.09	).012173	).012173	
P-8	I-5 (63rd Ave)	J-1 (63rd Ave)	217.00	370.67	0.007000	60 inch	0.013	11.05	217.89	1,099.44	1,096.85	1,112.97	1,112.82	8.53	10.97	1,108.68	1,106.10	1,110.57	1,108.00	).006943	).006943	
P-9	J-1 (63rd Ave)	63rd Ave & Cam	217.00	0.10	0.000000	60 inch	0.013	11.05	0.00	1,096.85	1,096.85	1,112.82	1,112.82	10.97	10.97	1,105.38	1,105.38	1,107.28	1,107.28	).006943	).006943	

Scenario: Storm Drain Laterals- 59th Ave & Colter St

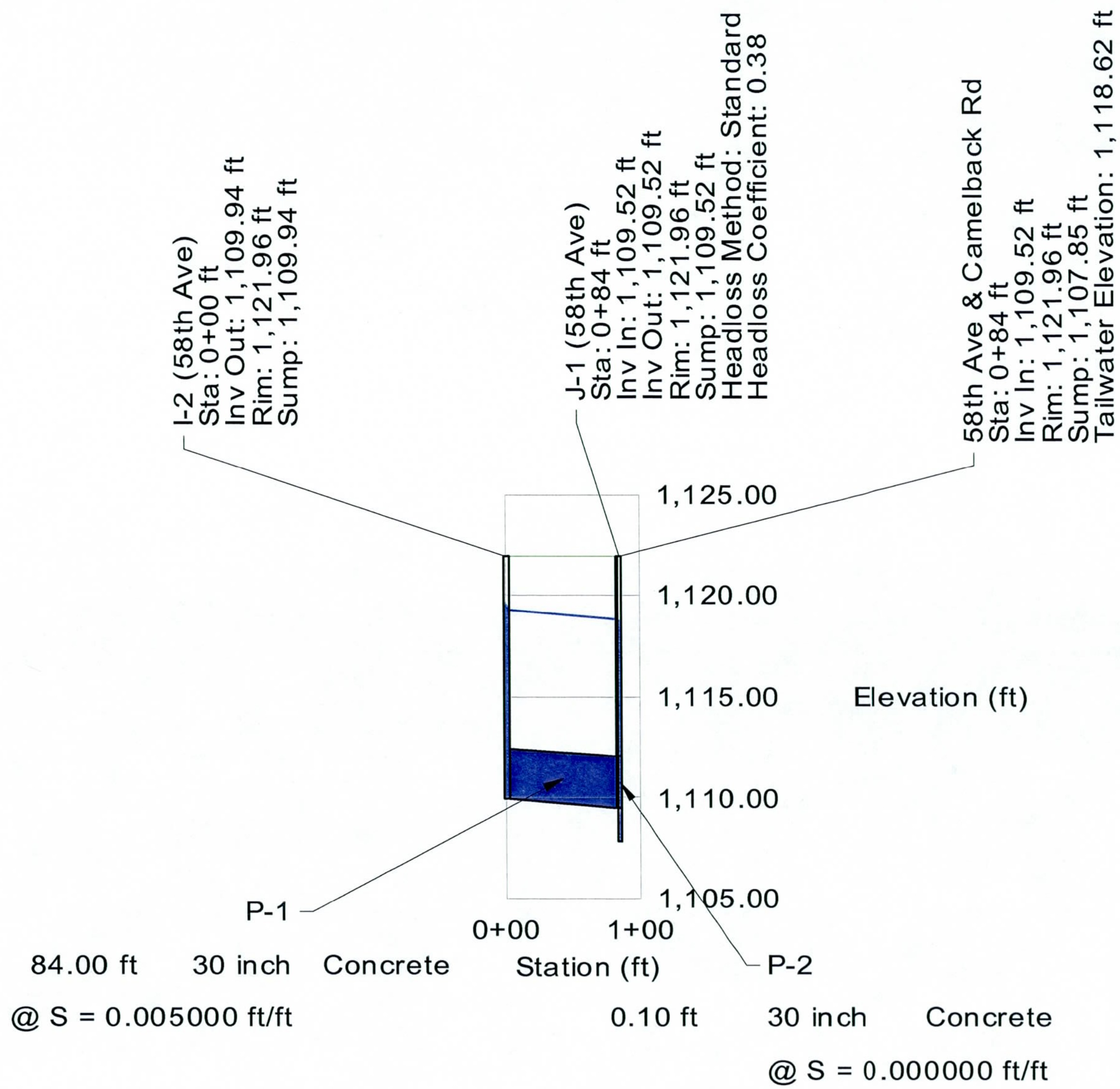
Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Hydraulic Slope (ft/ft)	Energy Slope (ft/ft)	Description
P-1	CB-602	J-1 (E. Cloter St	65.00	12.00	0.429167	42 inch	0.013	43.63	659.07	1,119.15	1,114.00	1,123.92	1,124.00	1.27	6.50	1,122.02	1,122.18	1,122.94	1,122.89	0.013333	).004142	E. Colter St.
P-2	CB-603	J-1 (E. Cloter St	67.00	35.00	0.160000	42 inch	0.013	6.96	402.42	1,116.73	1,111.13	1,123.85	1,124.00	3.62	9.37	1,122.34	1,122.18	1,123.09	1,122.94	0.004435	).004435	E. Colter St.
P-3	J-1 (E. Cloter St)	J-4 (59th Ave)	132.00	91.70	0.005234	48 inch	0.013	10.50	103.92	1,110.31	1,109.83	1,124.00	1,124.97	9.69	11.14	1,122.18	1,121.41	1,123.90	1,123.12	0.008445	).008445	E. Colter St.
P-4	Drop Inlet	J-4 (59th Ave)	157.00	28.81	0.304755	42 inch	0.013	40.81	1,110.76	1,119.06	1,110.28	1,123.99	1,124.97	1.43	11.19	1,121.83	1,121.41	1,123.27	1,122.44	0.014622	).028547	59th Ave
P-5	J-4 (59th Ave)	I-7	289.00	122.00	0.004180	78 inch	0.013	8.71	338.96	1,108.58	1,108.07	1,124.97	1,122.16	9.89	7.59	1,120.47	1,120.10	1,121.64	1,121.27	0.003039	).003039	59th Ave
P-6	CB-600	J-7 (W. Colter S	9.00	14.70	0.331293	24 inch	0.013	2.86	130.20	1,117.71	1,112.84	1,122.16	1,122.65	2.45	7.81	1,120.30	1,120.27	1,120.42	1,120.40	0.001583	).001583	W. Colter St.
P-7	J-7 (W. Colter St)	J-6 (W.Colter St	9.00	107.00	0.005023	36 inch	0.013	1.27	47.27	1,111.68	1,111.14	1,122.65	1,122.82	7.97	8.68	1,120.27	1,120.25	1,120.30	1,120.28	0.000182	).000182	W. Colter St.
P-8	CB-599	J-6 (W.Colter St	11.00	20.50	0.217561	24 inch	0.013	3.50	105.51	1,117.58	1,113.12	1,122.29	1,122.82	2.71	7.70	1,120.30	1,120.25	1,120.49	1,120.44	0.002365	).002365	W. Colter St.
P-9	J-6 (W.Colter St)	I-7	20.00	94.00	0.005000	36 inch	0.013	2.83	47.16	1,111.14	1,110.67	1,122.82	1,122.16	8.68	8.49	1,120.18	1,120.10	1,120.30	1,120.22	0.000899	).000899	W. Colter St.
P-10	I-7	J-6	340.00	8.00	0.004000	78 inch	0.013	10.25	331.56	1,108.07	1,108.04	1,122.16	1,122.16	7.59	7.62	1,119.60	1,119.56	1,121.23	1,121.19	0.004206	).004206	59th Ave
P-11	J-6	J-2 (59th Ave)	340.00	1,173.61	0.003943	78 inch	0.013	10.25	329.21	1,108.04	1,103.41	1,122.16	1,120.47	7.62	10.56	1,119.32	1,114.38	1,120.95	1,116.01	0.004206	).004206	59th Ave
P-12	J-2 (59th Ave)	59th Ave & Cam	340.00	0.10	0.000000	78 inch	0.013	10.25	0.00	1,103.41	1,103.41	1,120.47	1,120.47	10.56	10.56	1,113.76	1,113.76	1,115.39	1,115.39	0.004206	).004206	59th Ave

Profile

Scenario: Storm Drain Laterals- 58th Ave to 63rd Ave

Profile: 58th Ave

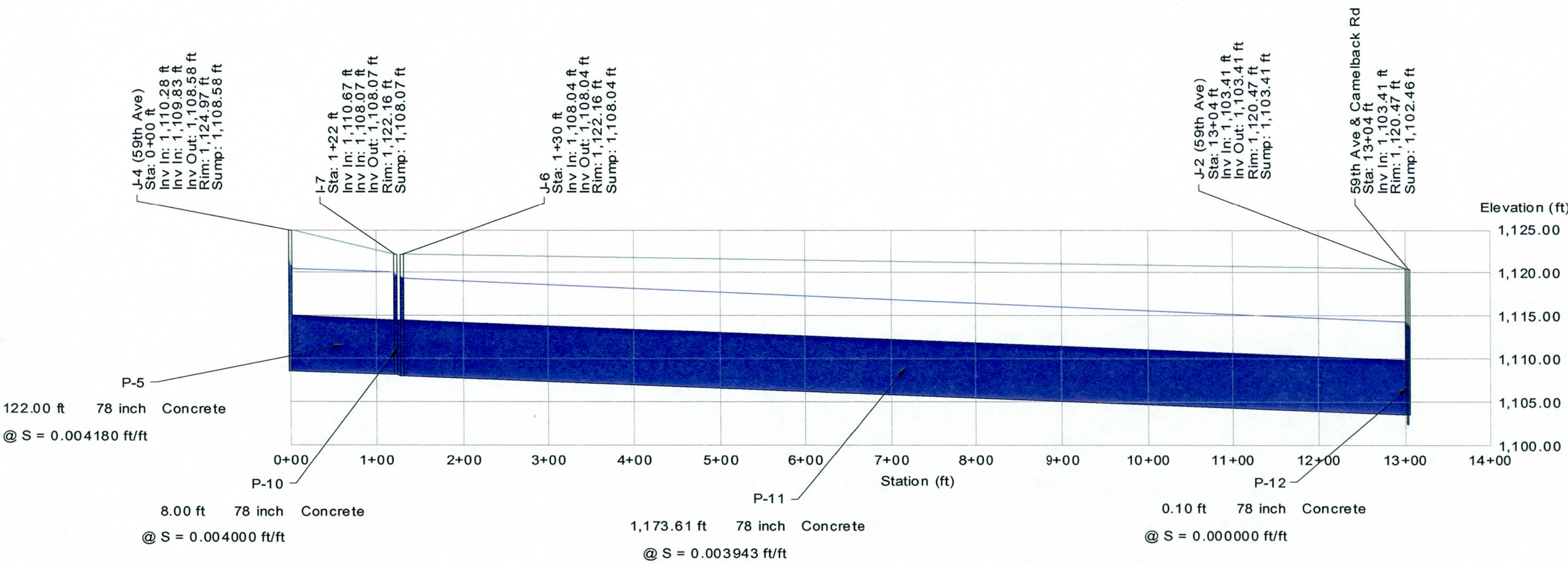


Profile

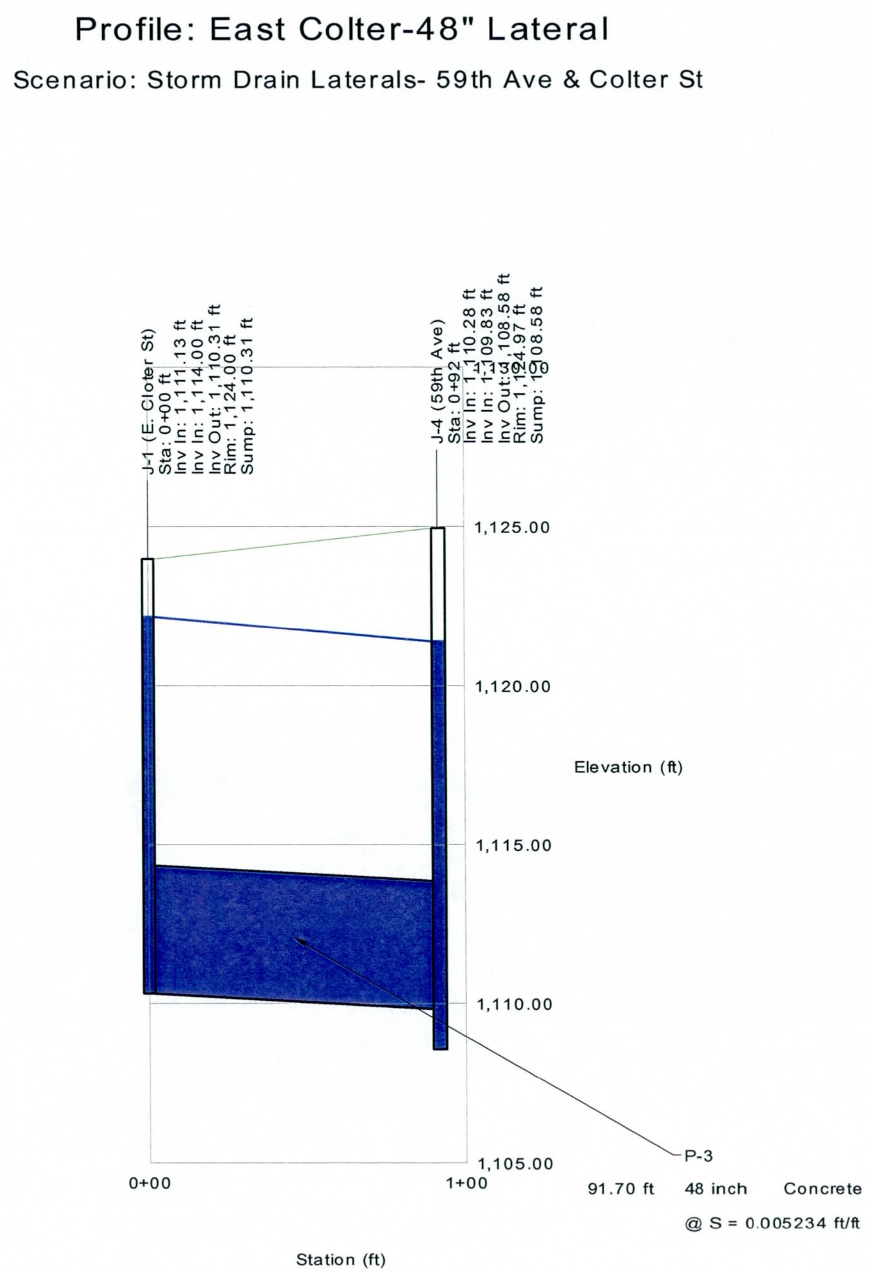
Scenario: Storm Drain Laterals- 59th Ave & Colter St

Profile: E. Colter to Camelback Rd

Scenario: Storm Drain Laterals- 59th Ave & Colter St



Profile
Scenario: Storm Drain Laterals- 59th Ave & Colter St

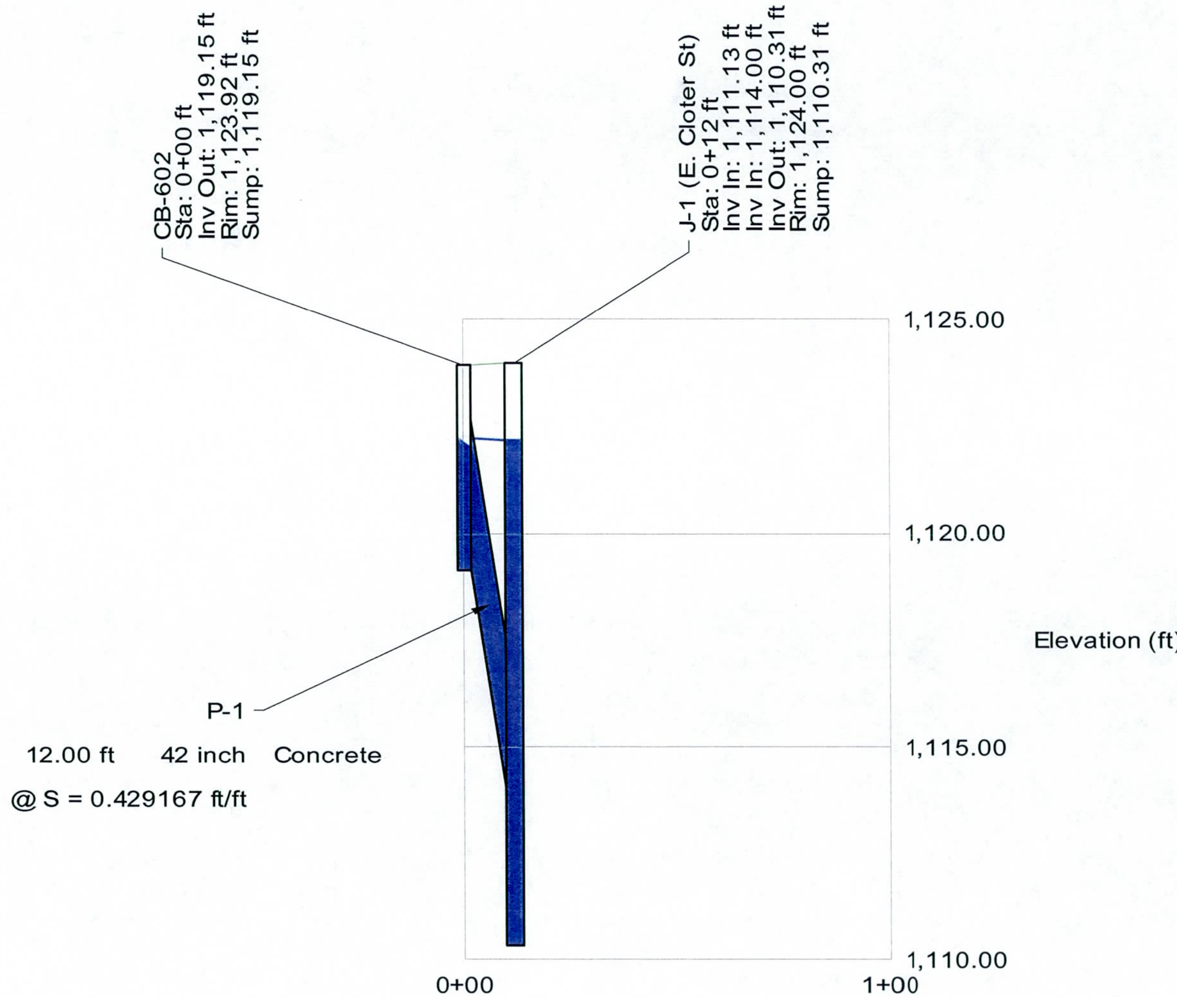


Profile

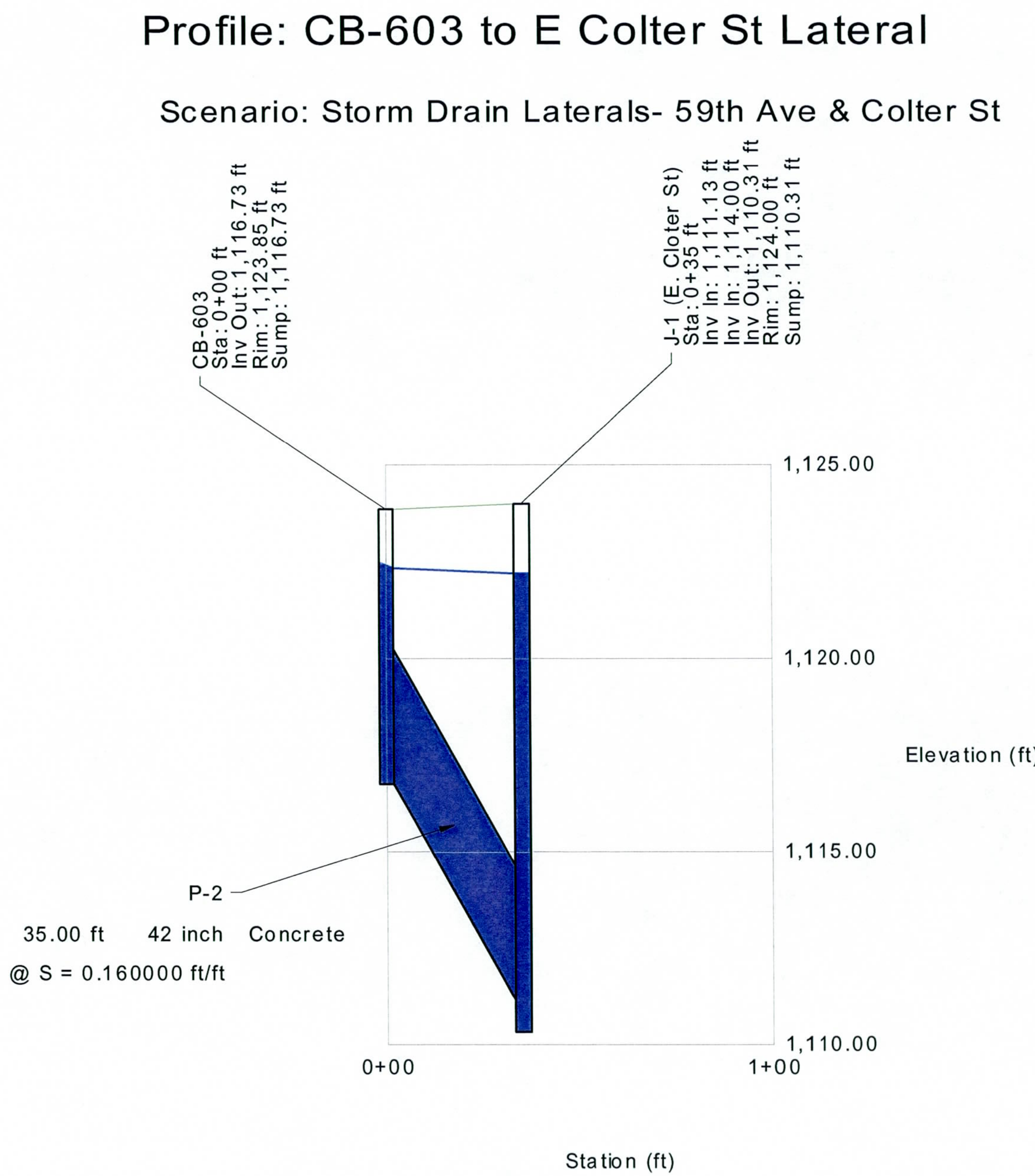
Scenario: Storm Drain Laterals- 59th Ave & Colter St

Profile: CB-602 to E. Colter St Lateral

Scenario: Storm Drain Laterals- 59th Ave & Colter St

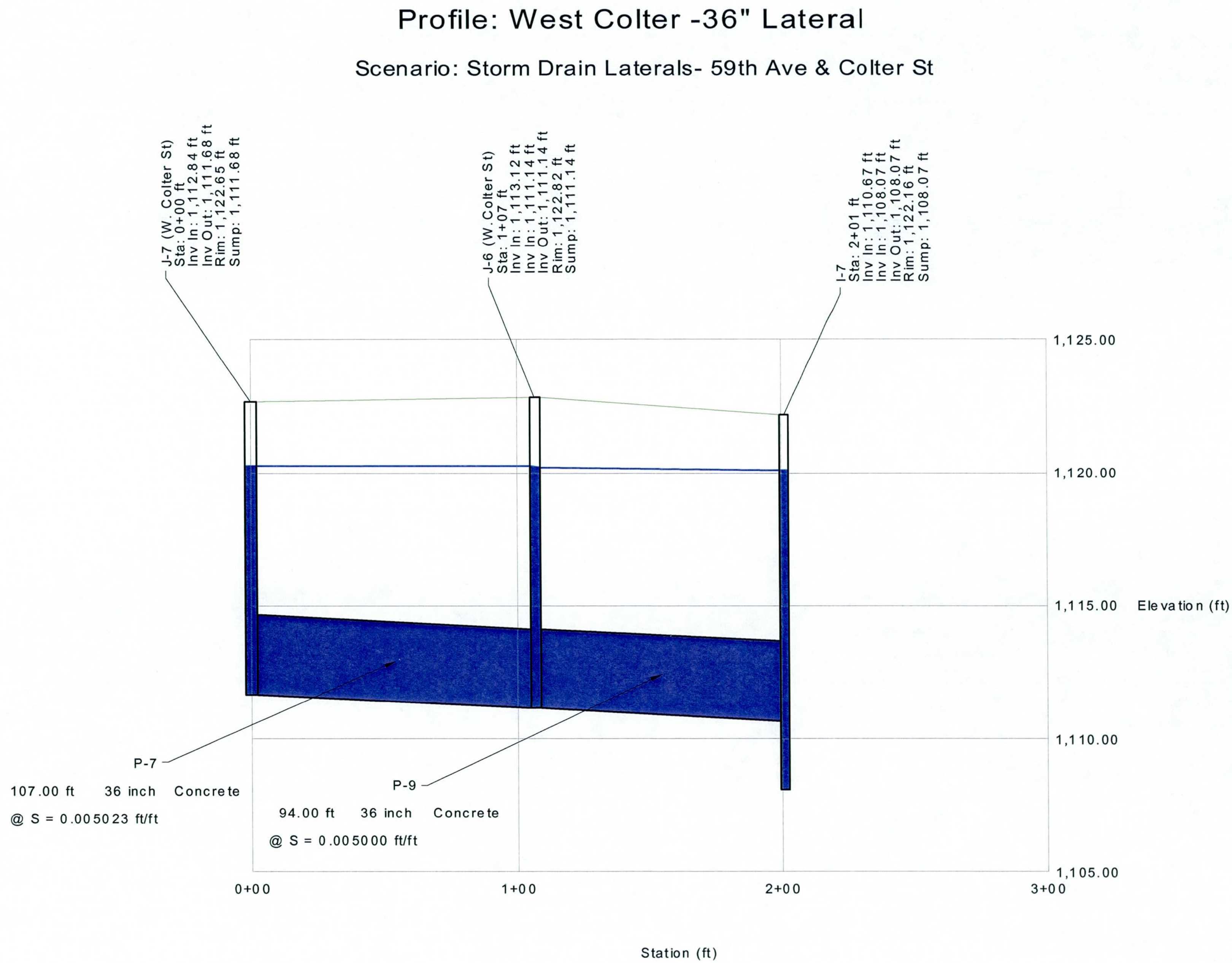


Profile
Scenario: Storm Drain Laterals- 59th Ave & Colter St



Profile

Scenario: Storm Drain Laterals- 59th Ave & Colter St



f:\...\59 ave lateral (10-23-09).stm
12/24/09 07:26:50 AM

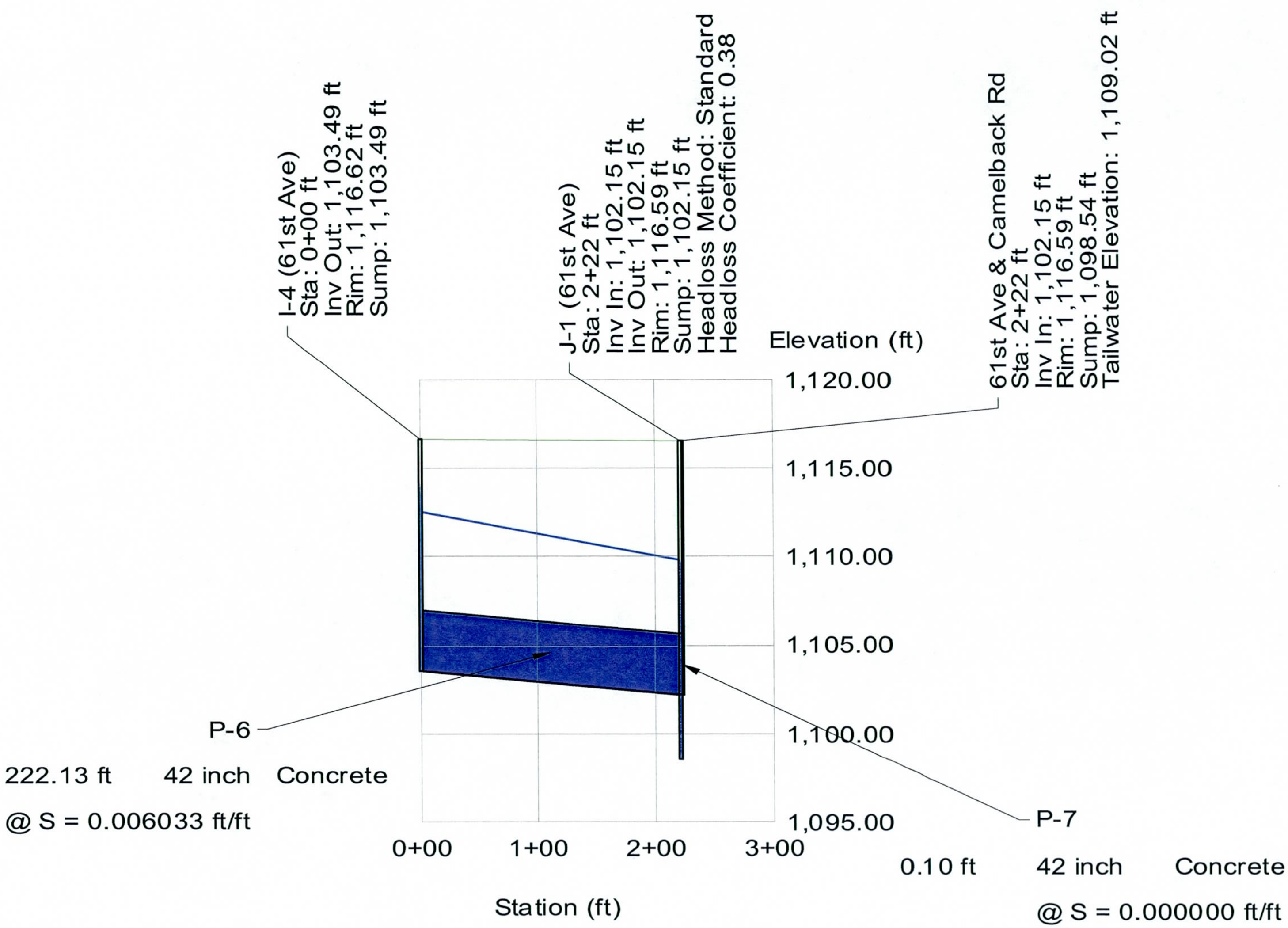
Olsson Associates

Project Engineer: Frank Gu
StormCAD v5.5 [5.5003]

Profile

Scenario: Storm Drain Laterals- 58th Ave to 63rd Ave

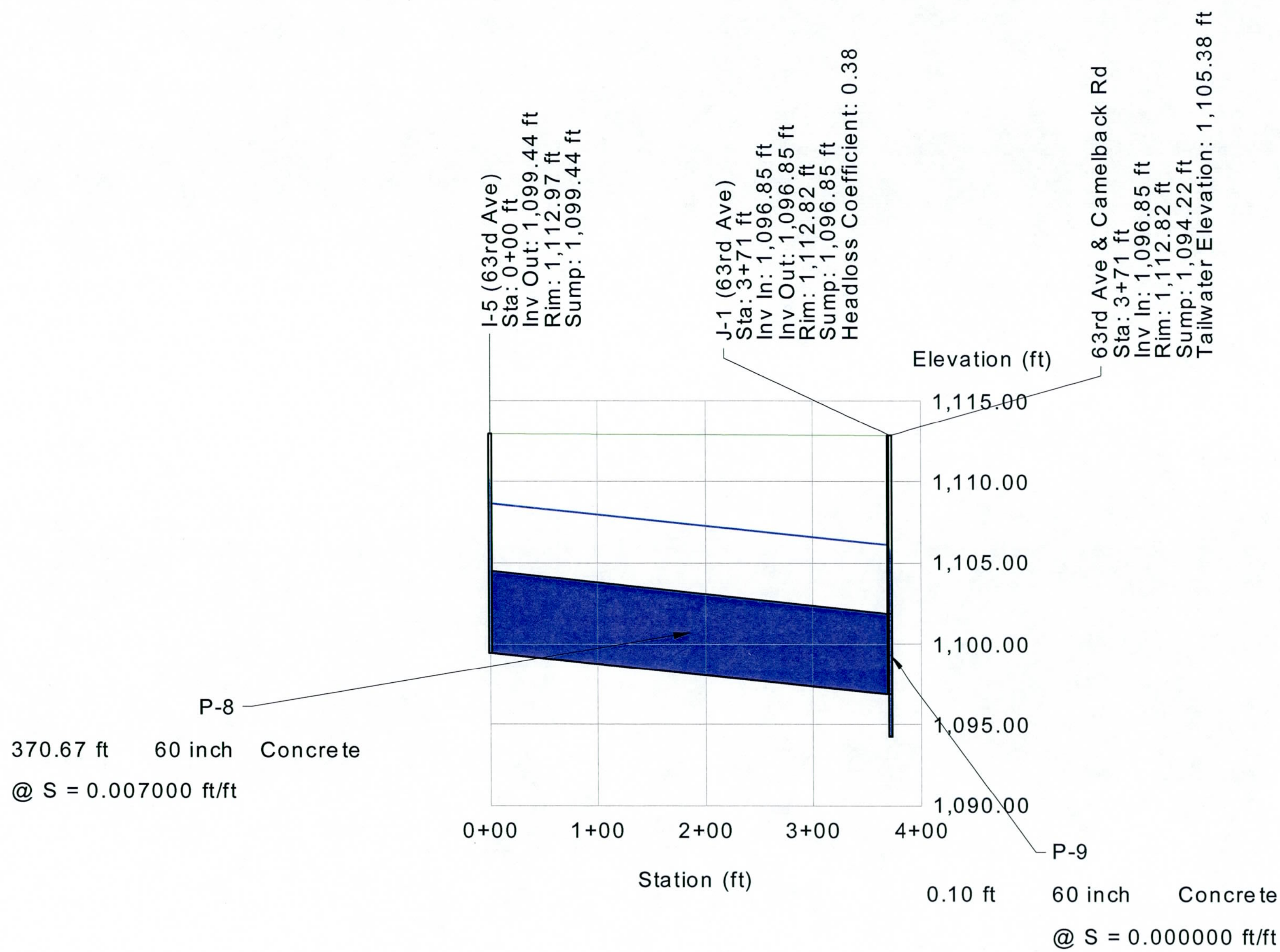
Profile: 61st Ave



Profile

Scenario: Storm Drain Laterals- 58th Ave to 63rd Ave

Profile: 63rd Ave



Scenario: Storm Drain Laterals -73rd Ave to 65th Ave

Node Report

Label	Headloss Coefficient	Absolute Headloss (ft)	Sump Elevation (ft)	Rim Elevation (ft)	Total System Flow (cfs)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
I-6 (65th Ave)	0.80		1,095.89	1,109.17	55.00	1,103.86	1,103.10
J-1 (65th Ave)	0.38		1,094.90	1,108.67	55.00	1,102.20	1,101.84
65th Ave & Camelback Rd			1,089.83	1,108.67	55.00	1,101.84	1,101.84
I-7 (67th Ave)	0.80		1,098.36	1,111.09	177.00	1,108.20	1,107.95
J-1 (67th Ave)	0.60		1,095.17	1,110.28	285.00	1,107.53	1,106.84
J-2 (67th Ave)	0.60		1,092.65	1,107.98	355.00	1,105.22	1,104.16
J-3 (67th Ave)	0.38		1,089.13	1,107.32	355.00	1,100.65	1,099.97
67th Ave & CamelbackRd			1,087.08	1,107.32	355.00	1,099.97	1,099.97
I-8 (68th Drive)	0.80		1,091.38	1,104.32	38.00	1,098.92	1,098.18
J-1 (68th Drive)	0.38		1,090.41	1,103.90	38.00	1,097.35	1,097.00
68th Dr & Camelback Rd			1,084.34	1,103.90	38.00	1,097.00	1,097.00
I-9 (71st Ave)	0.80		1,087.94	1,101.40	122.00	1,097.67	1,096.50
J-1 (71 St Ave)	0.38		1,085.87	1,100.54	122.00	1,094.51	1,093.95
71st Ave & Camelback Rd			1,081.20	1,100.54	122.00	1,093.95	1,093.95
I-10 (73rd Ave)	0.80		1,084.14	1,098.75	121.00	1,096.48	1,095.32
J-1 (73rd Ave)	0.38		1,080.00	1,097.55	121.00	1,091.40	1,090.85
73rd Ave & Camelback Rd			1,078.01	1,097.55	121.00	1,090.85	1,090.85

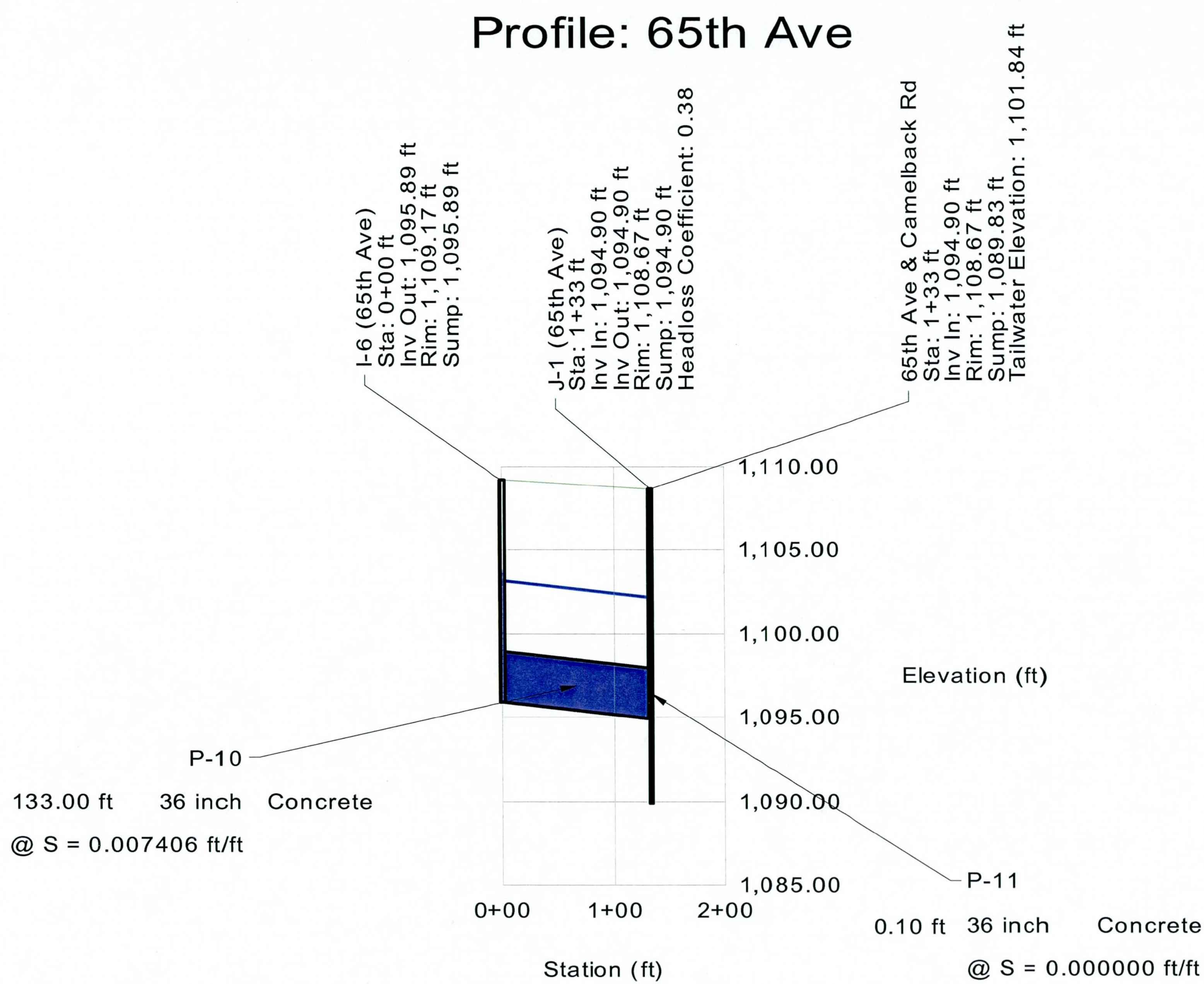
Scenario: Storm Drain Laterals -73rd Ave to 65th Ave

Pipe Report

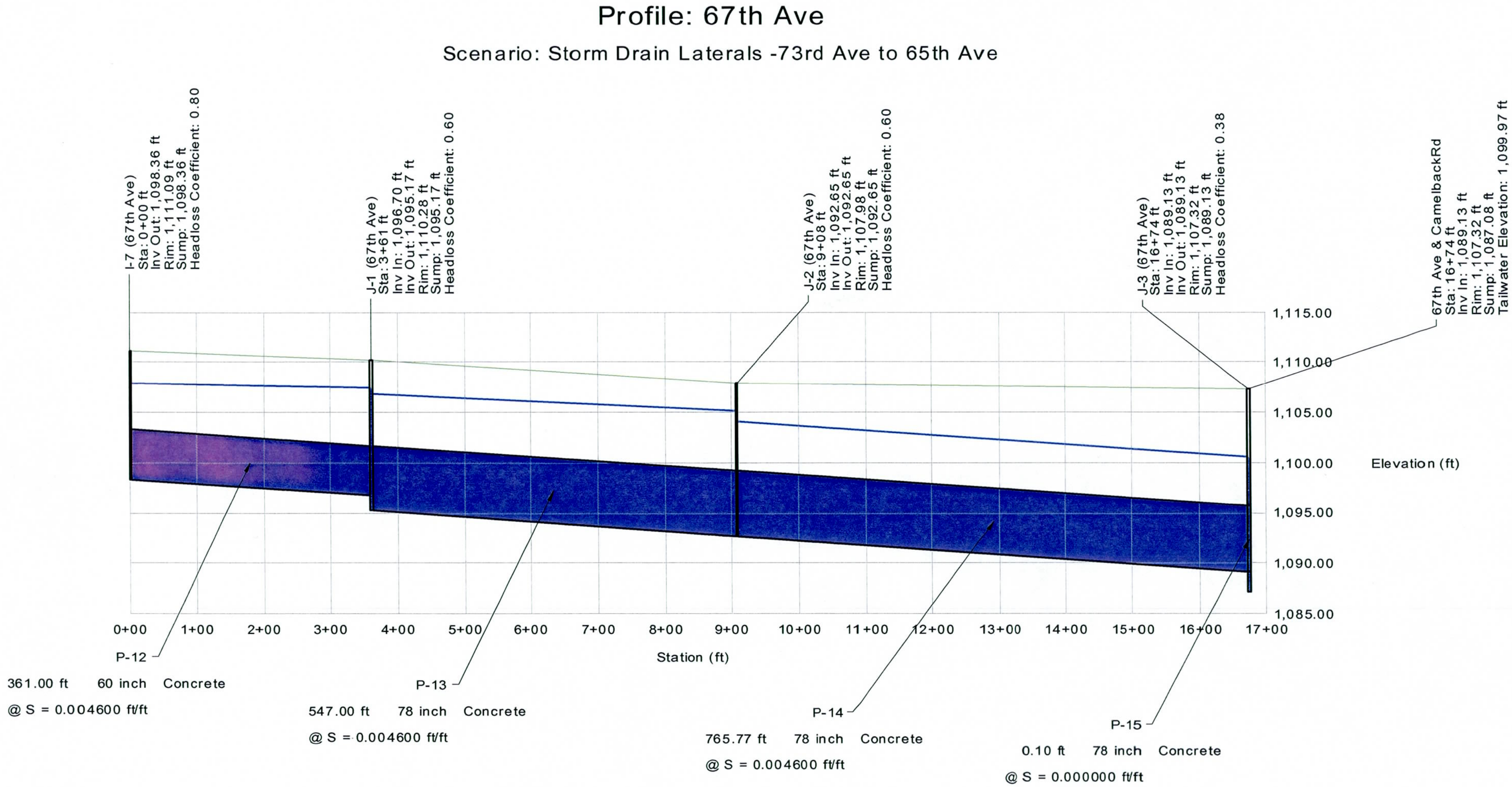
Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Average Velocity (ft/s)	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)	Hydraulic Slope (ft/ft)	Energy Slope (ft/ft)	Description
P-10	I-6 (65th Ave)	J-1 (65th Ave)	55.00	133.00	0.007406	36 inch	0.013	7.78	57.40	1,095.89	1,094.90	1,109.17	1,108.67	10.29	10.77	1,103.10	1,102.20	I,104.04	1,103.14	).006801	).006801	
P-11	J-1 (65th Ave)	65th Ave & Cam	55.00	0.10	0.000000	36 inch	0.013	7.78	0.00	1,094.90	1,094.90	1,108.67	1,108.67	10.77	10.77	1,101.84	1,101.84	I,102.78	1,102.78	).006801	).006801	
P-12	I-7 (67th Ave)	J-1 (67th Ave)	177.00	361.00	0.004600	60 inch	0.013	4.51	353.26	1,098.36	1,096.70	1,111.09	1,110.28	7.73	8.58	1,107.95	1,107.53	I,108.26	1,107.85	).001155	).001155	
P-13	J-1 (67th Ave)	J-2 (67th Ave)	285.00	547.00	0.004600	78 inch	0.013	8.59	355.56	1,095.17	1,092.65	1,110.28	1,107.98	8.61	8.83	1,106.84	1,105.22	I,107.99	1,106.37	).002955	).002955	
P-14	J-2 (67th Ave)	J-3 (67th Ave)	355.00	765.77	0.004600	78 inch	0.013	10.70	355.56	1,092.65	1,089.13	1,107.98	1,107.32	8.83	11.69	1,104.16	1,100.65	I,105.94	1,102.42	).004585	).004585	
P-15	J-3 (67th Ave)	67th Ave & Cam	355.00	0.10	0.000000	78 inch	0.013	10.70	0.00	1,089.13	1,089.13	1,107.32	1,107.32	11.69	11.69	1,099.97	1,099.97	I,101.75	1,101.75	).004585	).004585	
P-16	I-8 (68th Drive)	J-1 (68th Drive)	38.00	96.00	0.010104	30 inch	0.013	7.74	41.23	1,091.38	1,090.41	1,104.32	1,103.90	10.44	10.99	1,098.18	1,097.35	I,099.11	1,098.29	).008584	).008584	
P-17	J-1 (68th Drive)	68th Dr & Came	38.00	0.10	0.000000	30 inch	0.013	7.74	0.00	1,090.41	1,090.41	1,103.90	1,103.90	10.99	10.99	1,097.00	1,097.00	I,097.93	1,097.93	).008584	).008584	
P-18	I-9 (71st Ave)	J-1 (71 St Ave)	122.00	276.00	0.007500	48 inch	0.013	9.71	124.39	1,087.94	1,085.87	1,101.40	1,100.54	9.46	10.67	1,096.50	1,094.51	I,097.96	1,095.97	).007214	).007214	
P-19	J-1 (71 St Ave)	71st Ave & Cam	122.00	0.10	0.000000	48 inch	0.013	9.71	0.00	1,085.87	1,085.87	1,100.54	1,100.54	10.67	10.67	1,093.95	1,093.95	I,095.42	1,095.41	).007214	).007214	
P-20	I-10 (73rd Ave)	J-1 (73rd Ave)	121.00	553.00	0.007486	48 inch	0.013	9.63	124.28	1,084.14	1,080.00	1,098.75	1,097.55	10.61	13.55	1,095.32	1,091.40	I,096.76	1,092.84	).007097	).007097	
P-21	J-1 (73rd Ave)	73rd Ave & Cam	121.00	0.10	0.000000	48 inch	0.013	9.63	0.00	1,080.00	1,080.00	1,097.55	1,097.55	13.55	13.55	1,090.85	1,090.85	I,092.29	1,092.29	).007097	).007097	

Profile

Scenario: Storm Drain Laterals -73rd Ave to 65th Ave

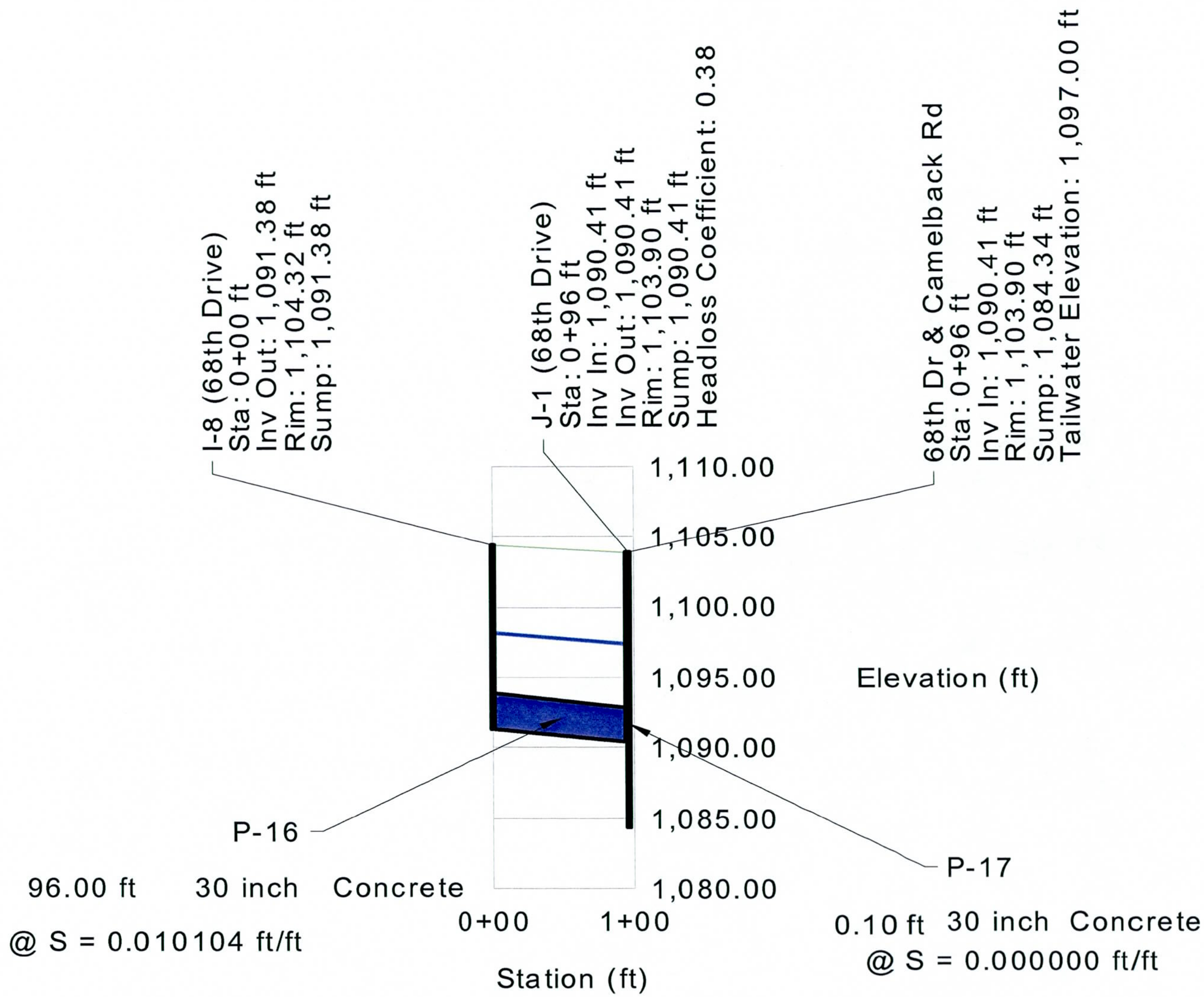


Profile
Scenario: Storm Drain Laterals -73rd Ave to 65th Ave



Scenario: Storm Drain Laterals -73rd Ave to 65th Ave

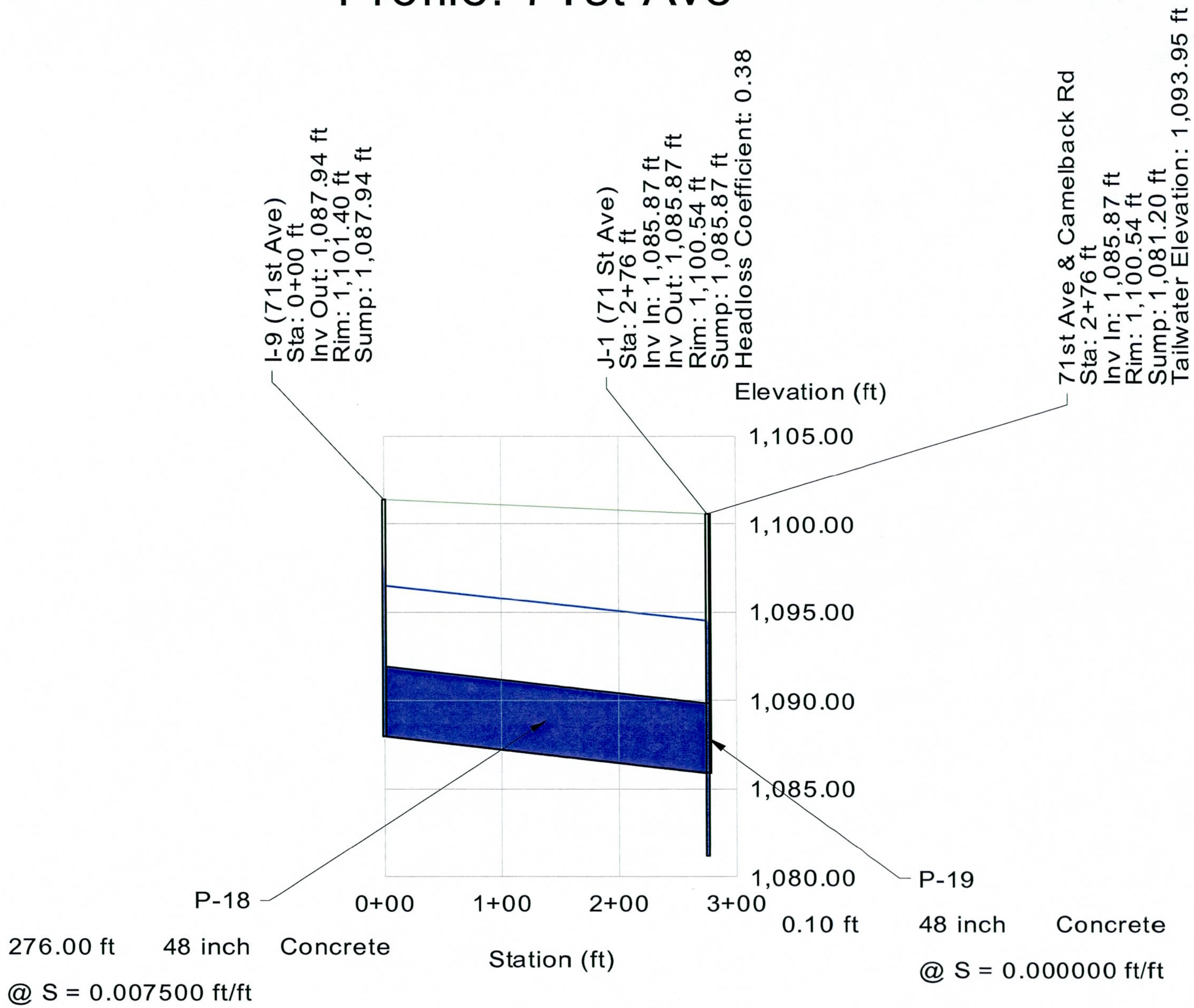
Profile: 68th Drive



Profile

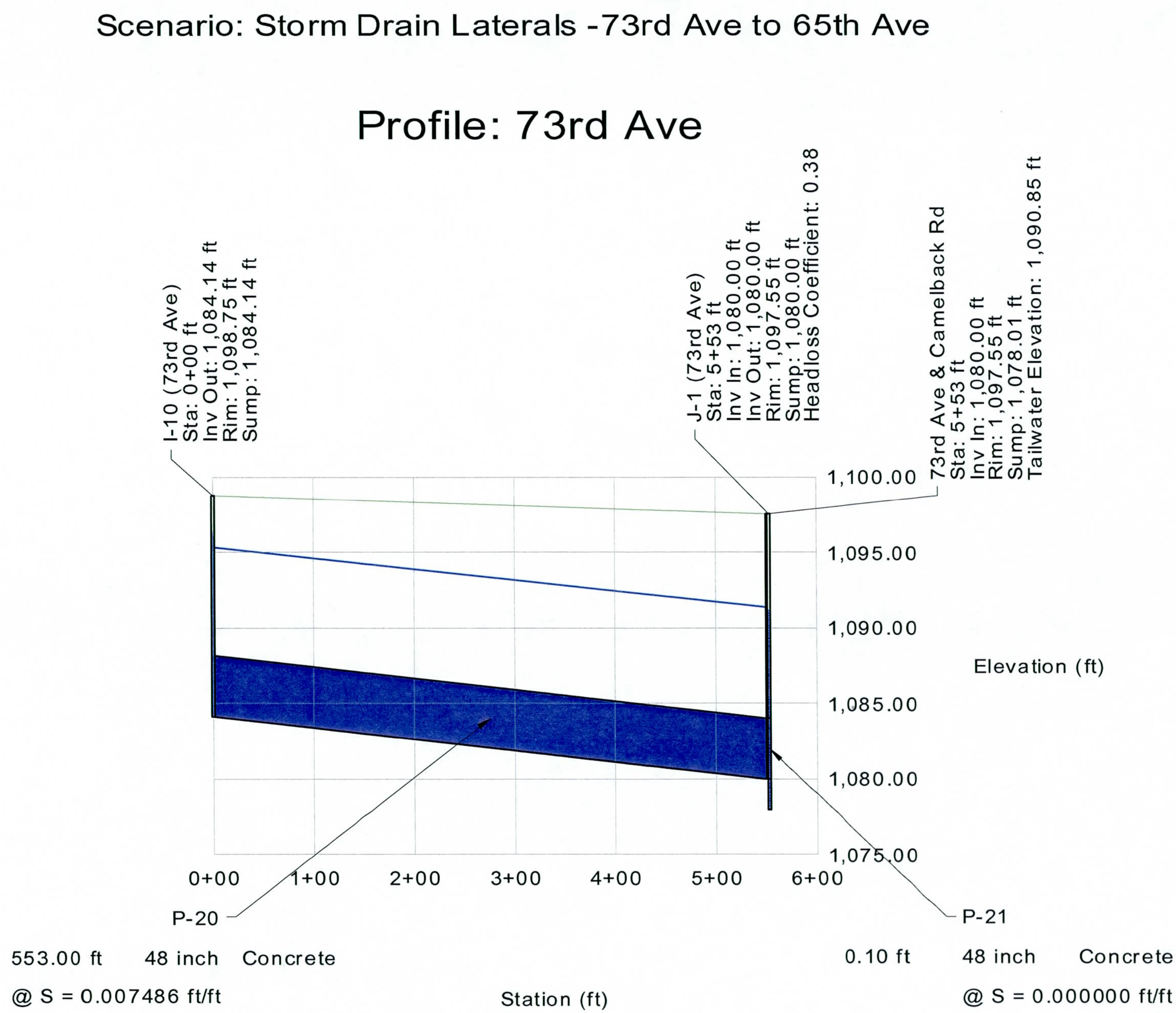
Scenario: Storm Drain Laterals -73rd Ave to 65th Ave

Profile: 71st Ave



Profile

Scenario: Storm Drain Laterals -73rd Ave to 65th Ave

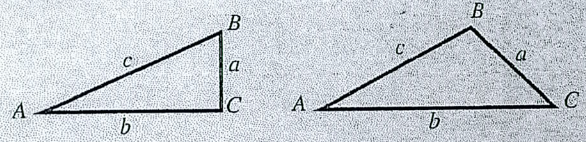


APPENDIX E

Appendix E

Survey Data

FORMULAE FOR SOLVING RIGHT TRIANGLES



$\text{Sin } A = \frac{a}{c} = \text{Cos } B \qquad \text{Cot } A = \frac{b}{a} = \text{Tan } B$

$\text{Cos } A = \frac{b}{c} = \text{Sin } B \qquad \text{Sec } A = \frac{c}{b} = \text{Cosec } B$

$\text{Tan } A = \frac{a}{b} = \text{Cot } B \qquad \text{Cosec } A = \frac{c}{a} = \text{Sec } B$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A, a = c \sin A, b = c \cos A.$
A, b	B, a, c	$B = 90° - A, a = b \tan A, c = \frac{b}{\cos A.}$
A, a	B, b, c	$B = 90° - A, b = a \cot A, c = \frac{a}{\sin A.}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B, c = \sqrt{a^2 + b^2}$

FORMULAE FOR SOLVING OBLIOUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a}, c = \frac{a \sin C}{\sin A},$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C, c = \frac{a \sin C}{\sin A}$
a, b, c	Area	$\text{side} \frac{a+b+c}{2}, \text{area} = \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	$\text{area} = \frac{bc \sin A}{2}$
A, B, C, a	Area	$\text{area} = \frac{a^2 \sin B \sin C}{2 \sin A}$

MADE IN CHINA

08-2678

CAMELBACK ROAD

SEWER MANHOLE

INVERT ASBUILTS

2-26-2009

SUNNY & WARM 82°

S. OLSON

N. CRAIG

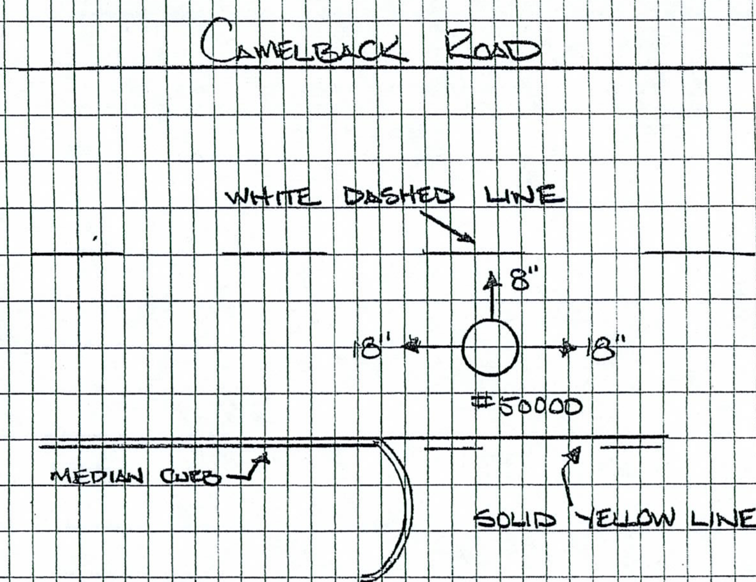
T. SHAFFER

J. HAEHN

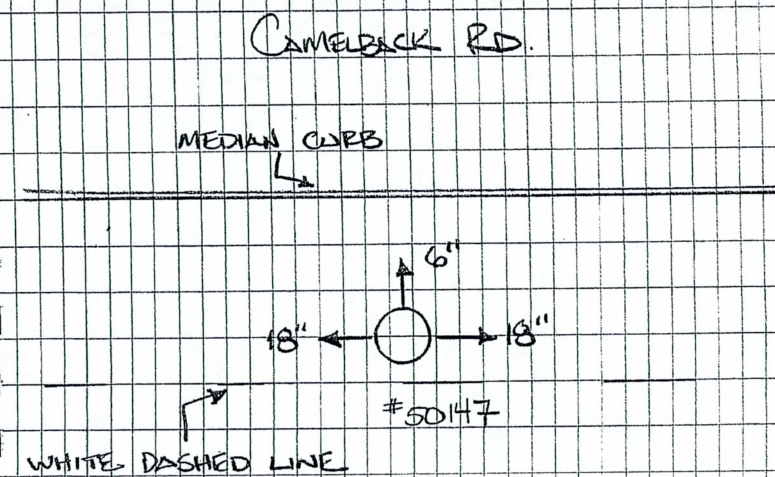
MEASURE DOWNS

STA.	N	S	E	W	RIM
50000	8.77		9.10	9.07	

DESC.

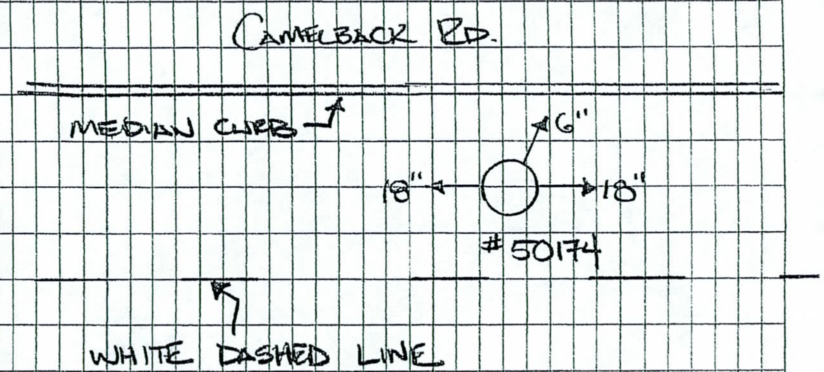


	Measure	Downs				Desc.
Sta.	N	S	E	W	Rim	
50147	8.75		9.34	9.34		



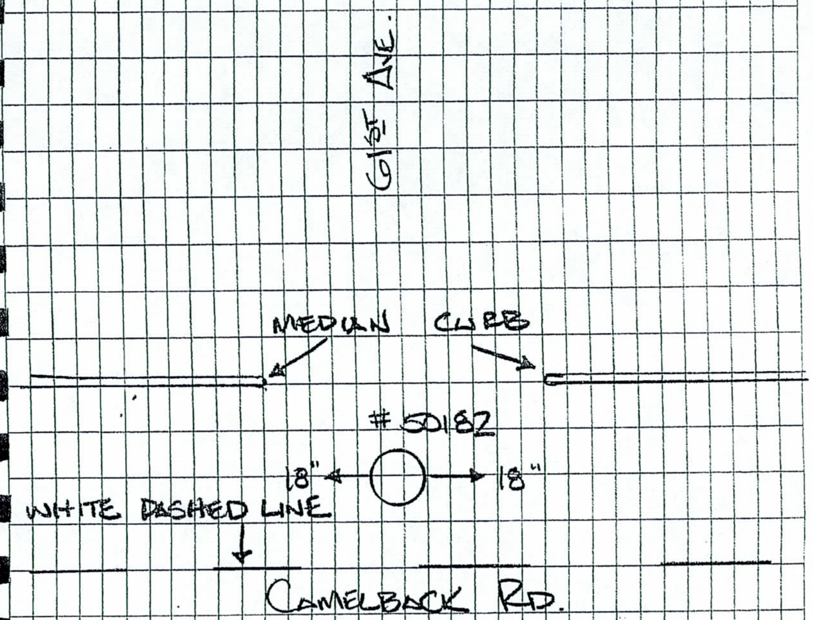
	Measure		Downs		
Sta.	NE	S	E	W	Rim
50174	8.08		8.64	8.66	

Desc.



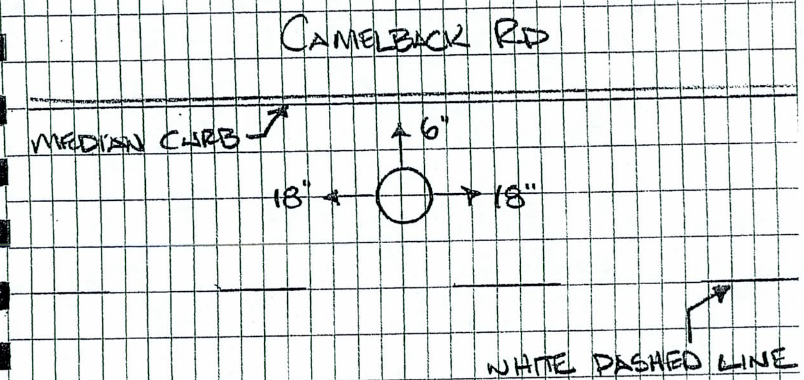
	MEASURE DOWNS				
STA.	N	S	E	W	RIM
50182			8.63	8.59	

DESC.



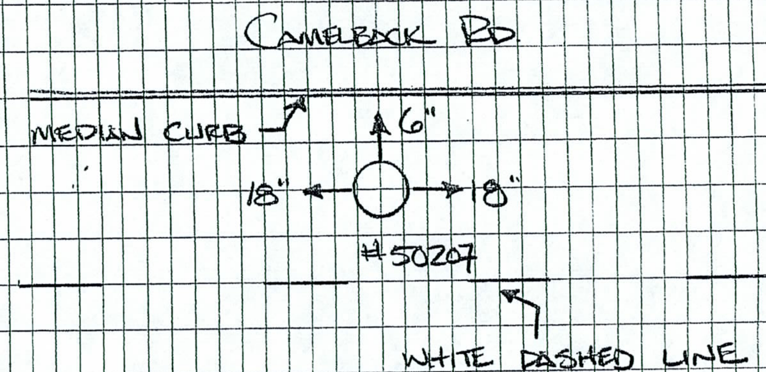
	Measure Downs				
Sta.	N	S	E	W	Rim
50192	7.84		8.50	8.65	

Desc.



STA.	N	S	E	W	RIM
	MEASURE		DOWNS		
50207	7.64		8.45	8.47	

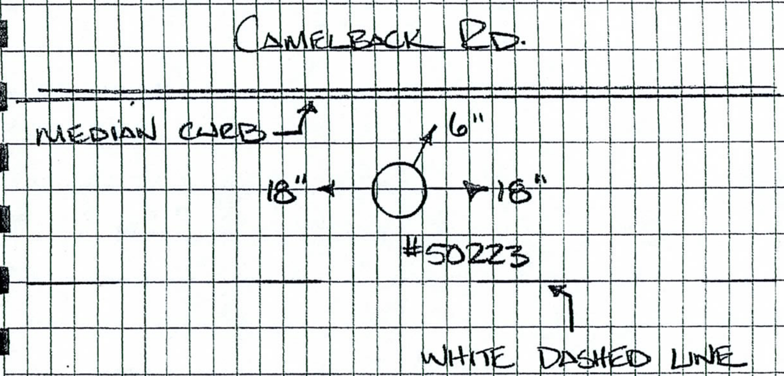
DESC.



MEASURE DOWNS

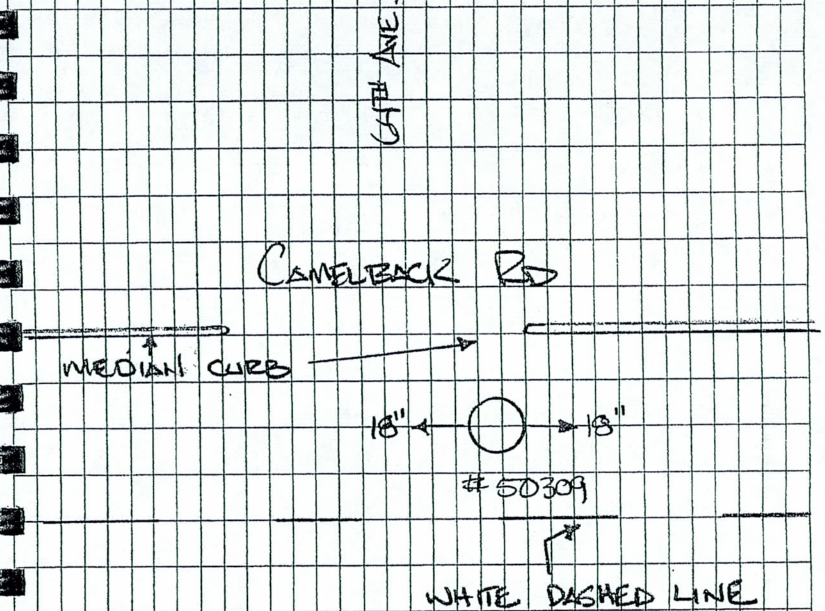
STA.	NE	S	E	W	RIM
50223	7.56		8.05	8.08	

DESC.



STA.	MEASURE N	S	DOWNS E	W	RIM
50309			7.47	7.45	

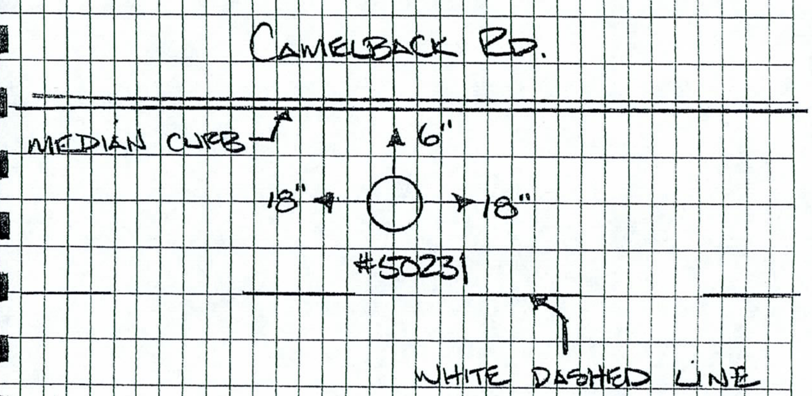
DESC.



MEASURE DOWNS

STA.	N	S	E	W	RIM
50231	7.42		7.90	7.88	

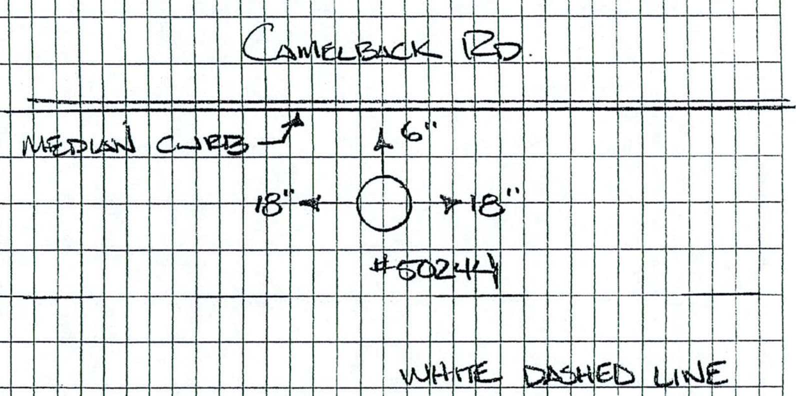
DESC.



MEASURE DOWNS

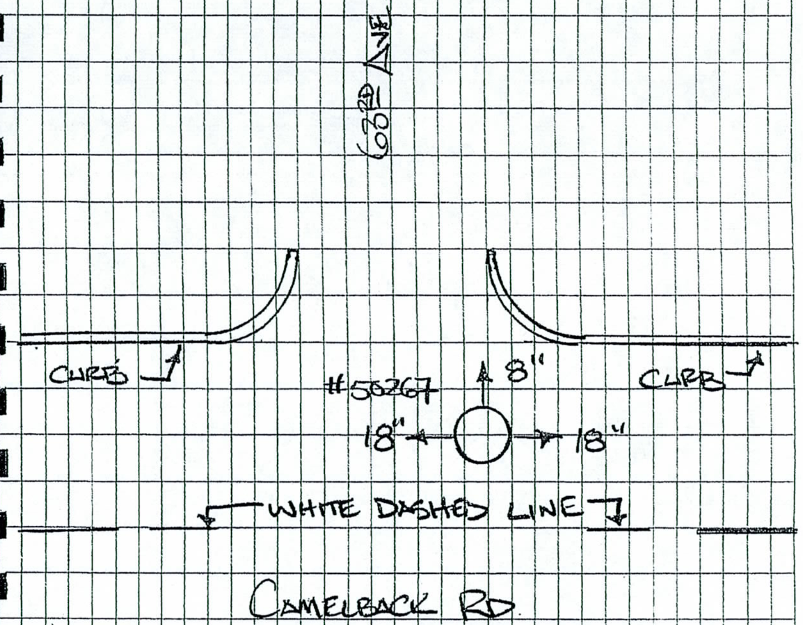
STA.	N	S	E	W	RIM
50244	7.10		7.62	7.63	

DESC.



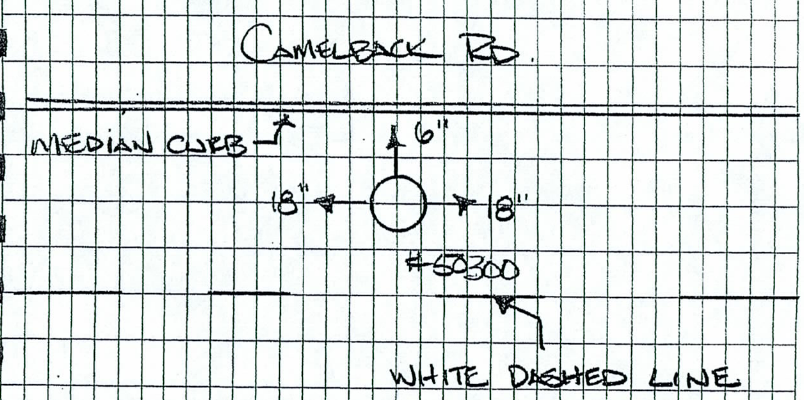
	MEASURE DOWNS				
STA.	N	S	E	W	RIM
50267	7.50		7.70	7.67	

DESC.



STA.	MEASURE DOWNS N	S	E	W	RIM
50300	7.11		7.46	7.45	

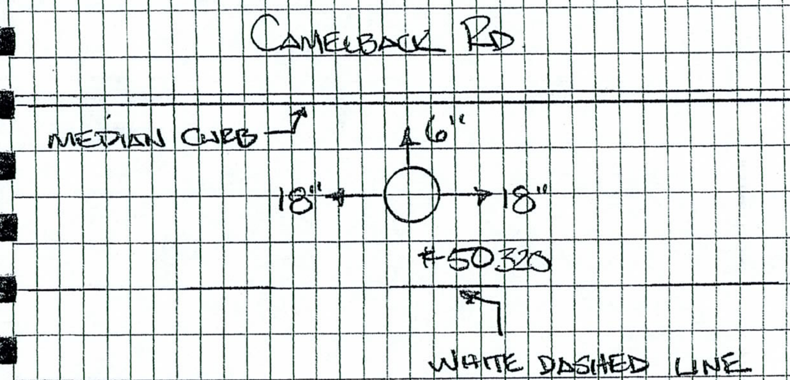
DESC.



MEASURE DOWNS

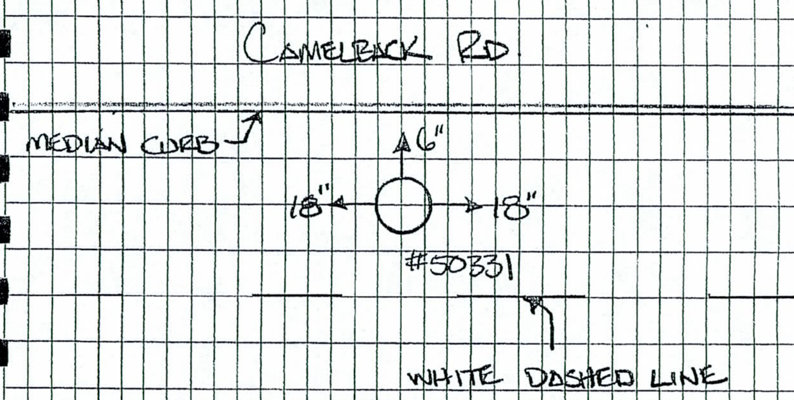
STA.	N	S	E	W	RIM
50320	7.17		7.50	7.50	

DESC.

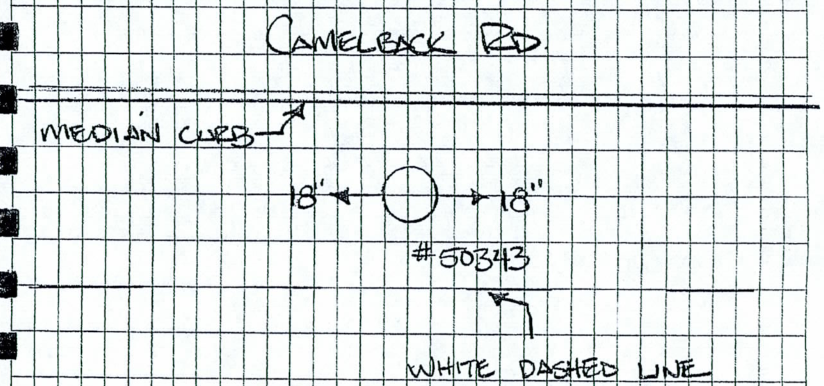


STA	N	S	E	W	RIM
	MEASURE DOWNS				
50331	7.19		7.56	7.56	

DESC.

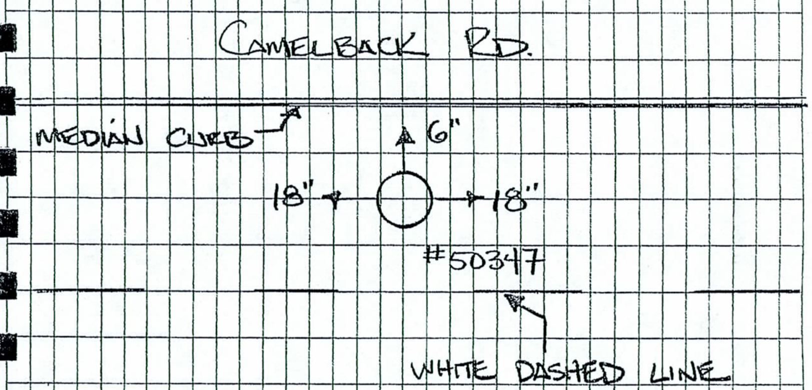


	Measure Downs					
Str.	N	S	E	W	RIM	Desc.
50343			7.71	7.68		



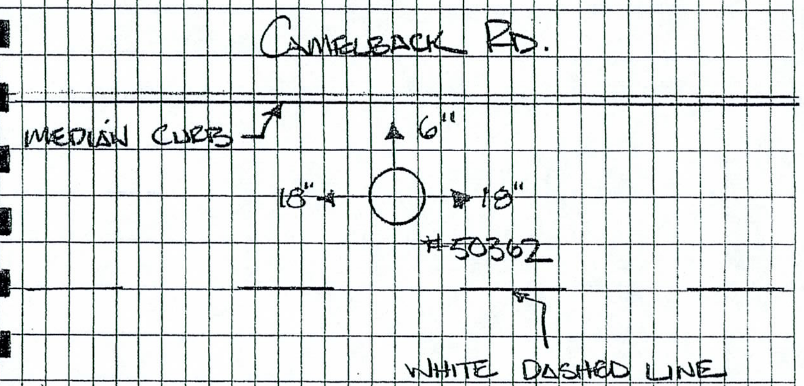
STA.	N	MEASURE S	DOWNS E	W	RIM
50347	7.15		7.70	7.70	

DESC.



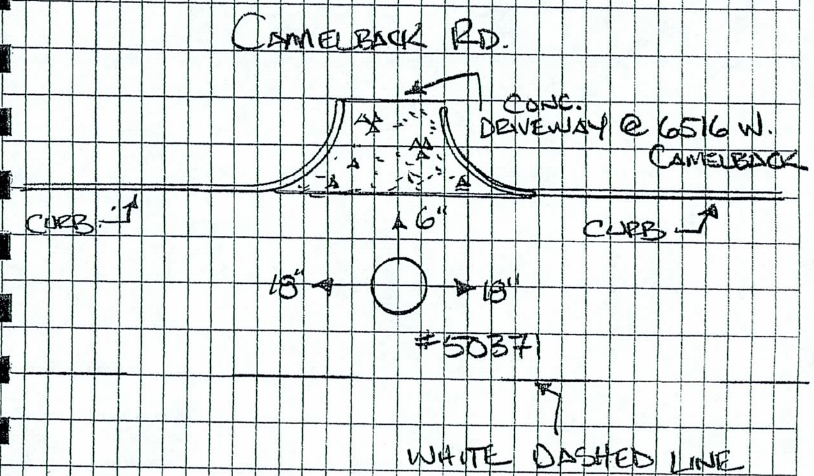
	MEASURE DOWNS				
STA.	N	S	E	W	RIM
50362	7.52		7.59	7.59	

DESC.



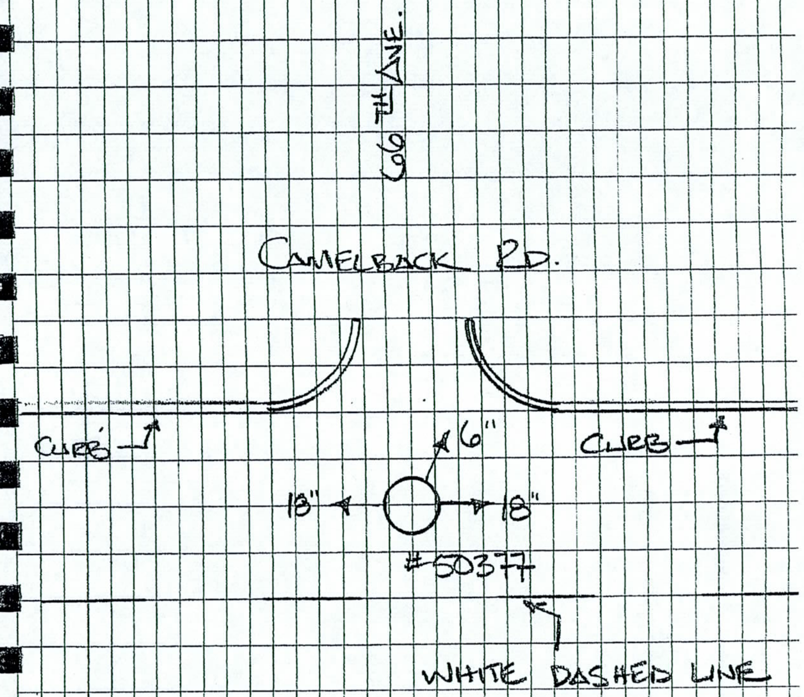
STA.	N	S	E	W	RIM
	MEASURE DOWNS				
50371	6.79		7.55	7.55	

DESC



	MEASURE DOWNS				
STA.	NE	S	E	W	RIM
50377	7.01		7.44	7.40	

DESC.

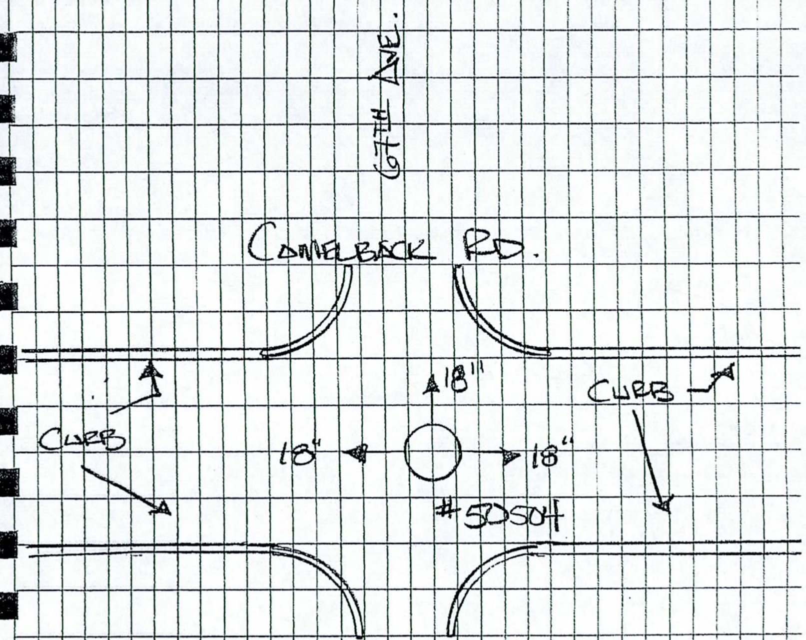


MEASURE DOWNS

STA.	N	S	E	W	RIM
50,504	8.56		8.56	8.60	

LABLED WATER MH

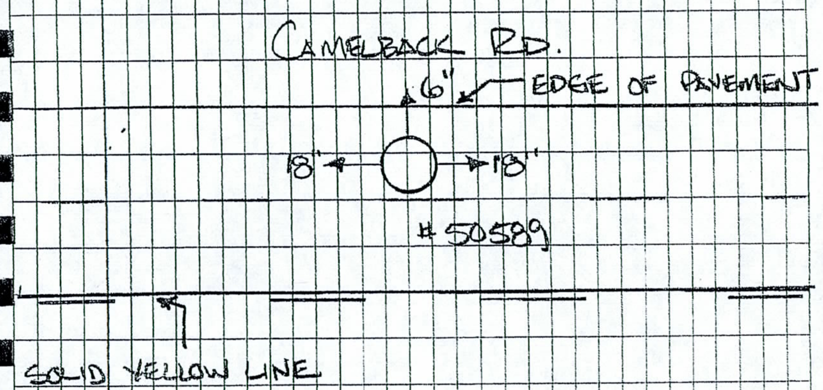
DESC.



Measure Downs

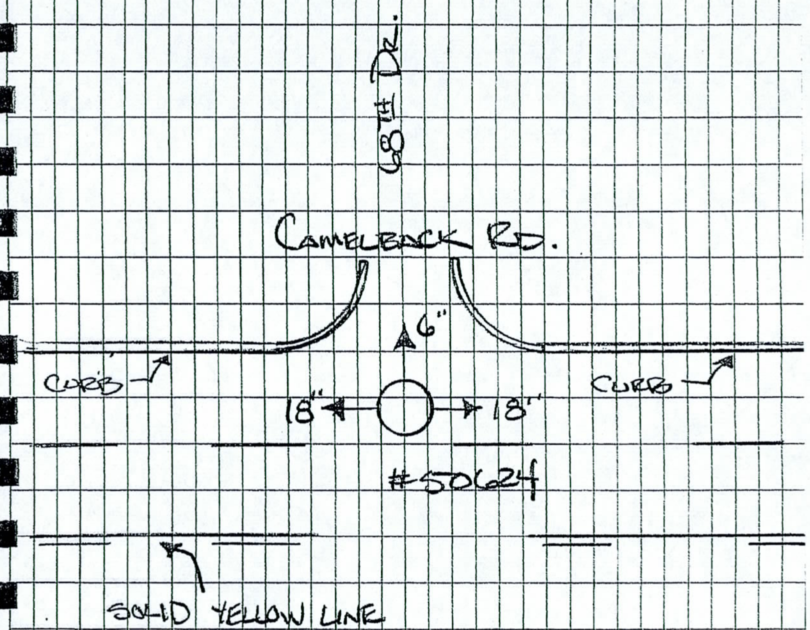
Sta.	N	S	E	W	Rim
50589	7.02		7.81	7.79	

Desc.



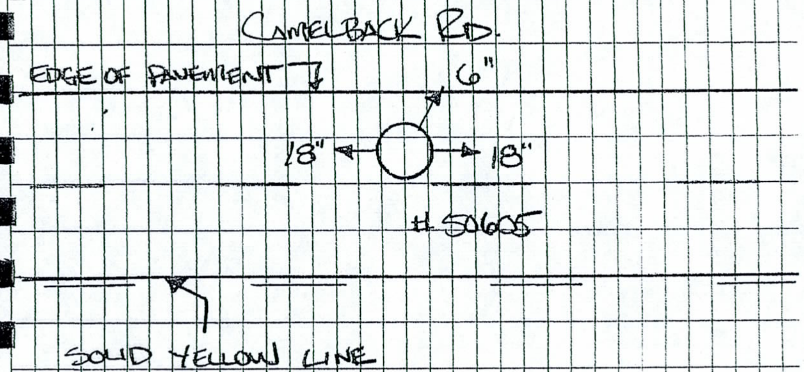
STA.	N	S	E	W	RIM
	MEASURE DOWNS				
50624	7.01		8.06	7.98	

DESC.



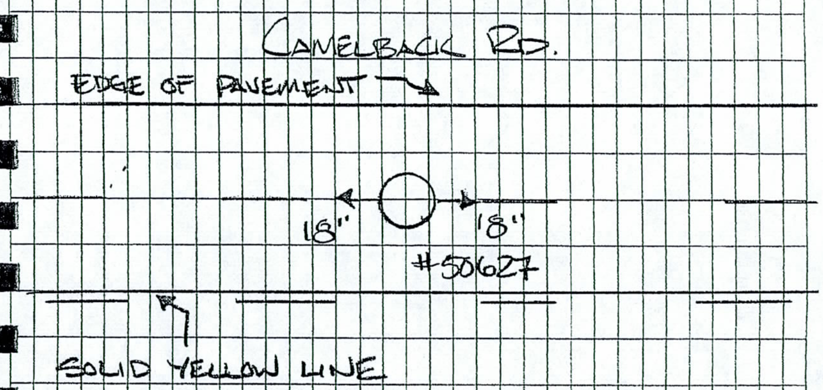
	MEASURE		DOWNS		
STA.	NE	S	E	W	RIM
50605	7.44		8.05	8.05	

DESC.



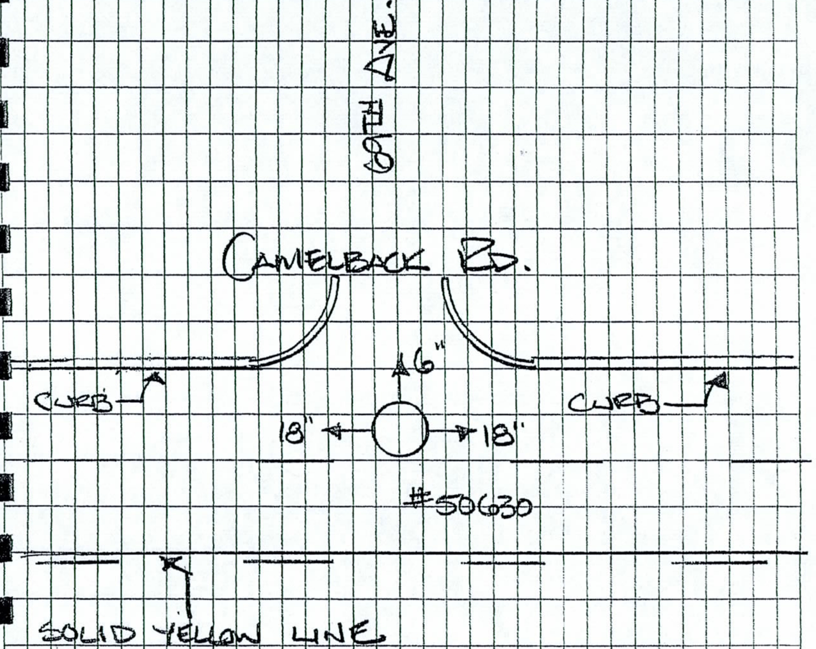
STA	MEASURE DOWNS N	S	E	W	RIM
50627			7.90	7.85	

DESC.



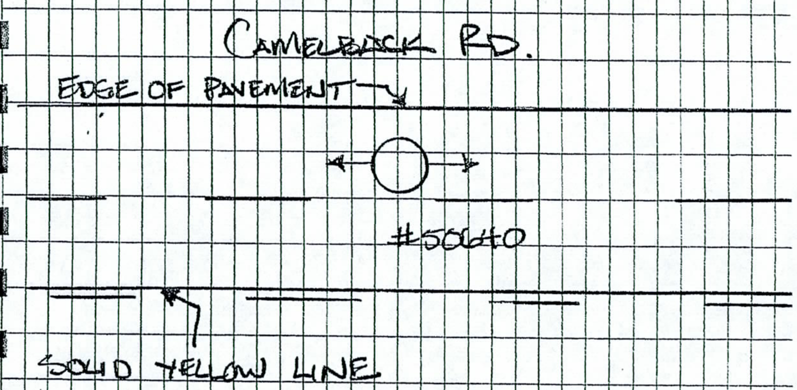
	MEASURE DOWNS				
STA.	N	S	E	W	RIM
50630	7.05		7.98	7.96	

DESC.



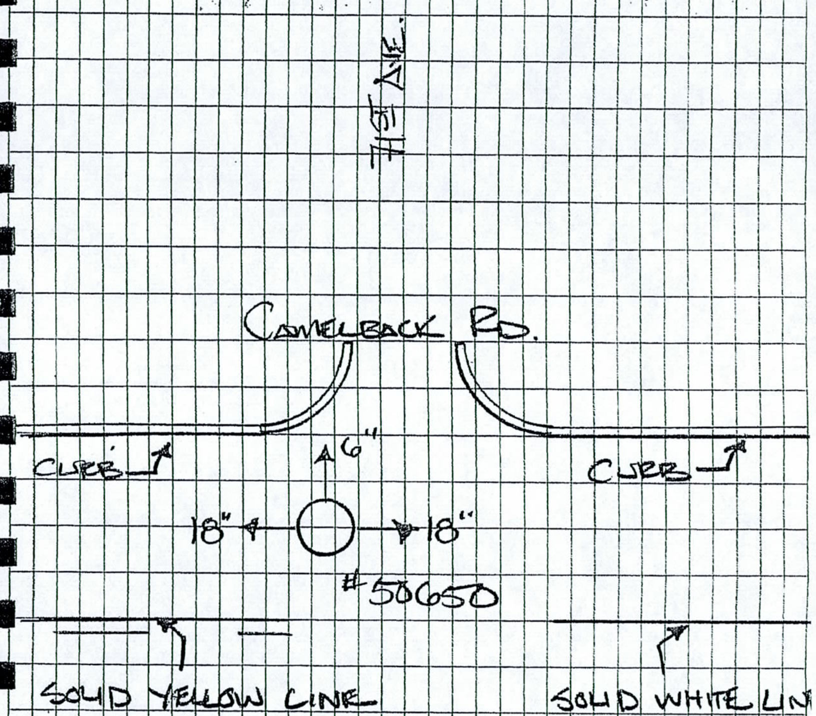
	MEASURE DOWNS				
STA.	N	S	E	W	RIM
50640			8.06	8.12	

DESC.



STA.	N	S	E	W	RIM
50650	7.72		8.54	8.54	

DESC.



STA.	N	S	E	W
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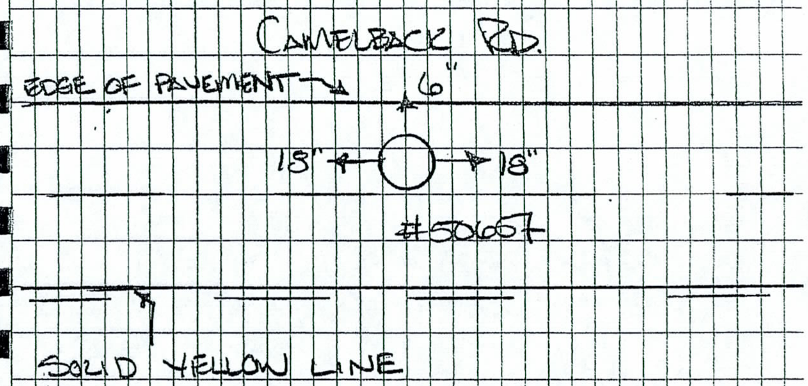
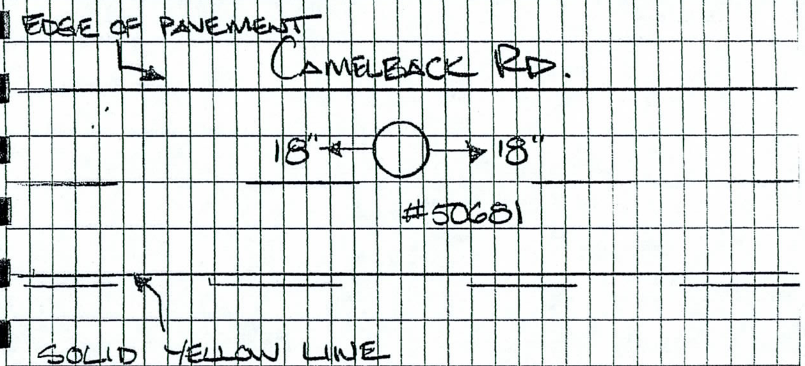
DESC.



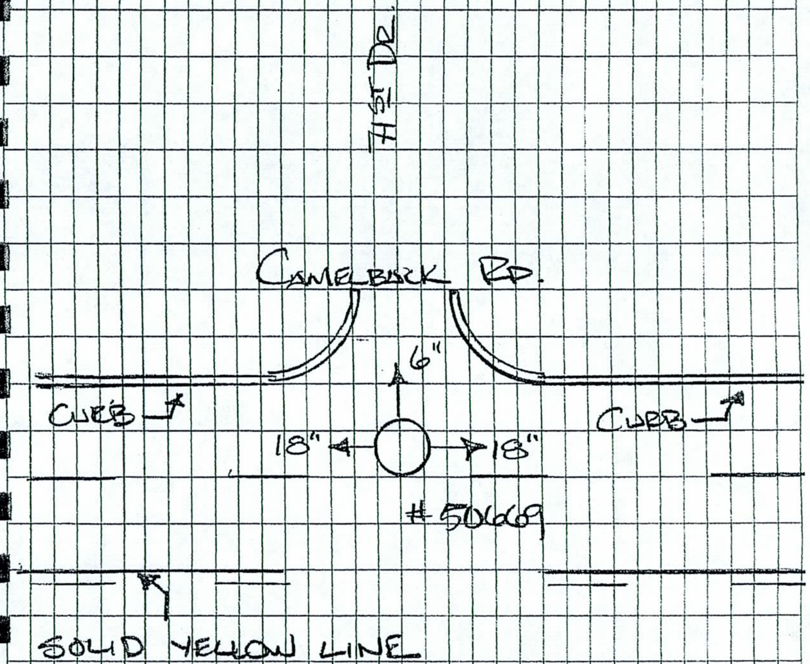
STA.	N	S	E	W	RIM
50681			9.16	9.20	

DESC.



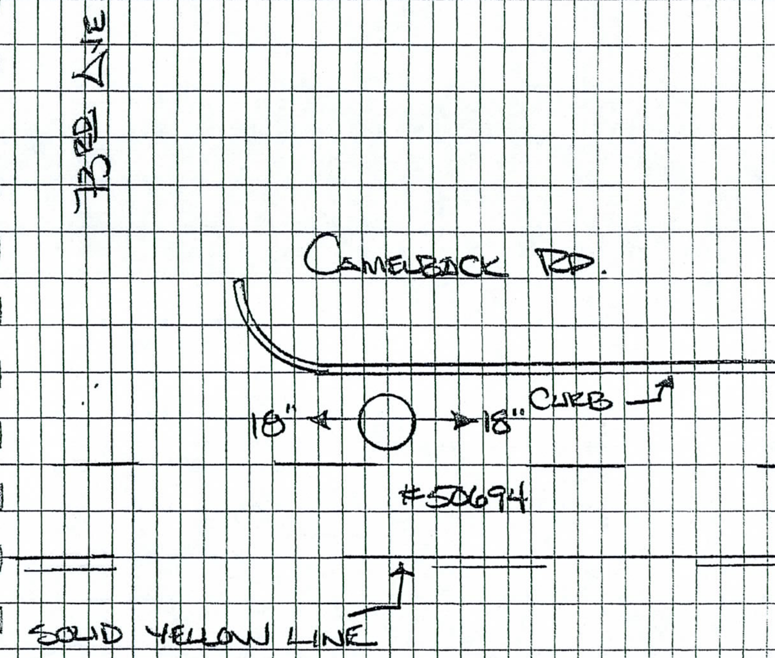
STA.	N	S	E	W	RIM
50669	7.27		8.70	8.70	

DESC.



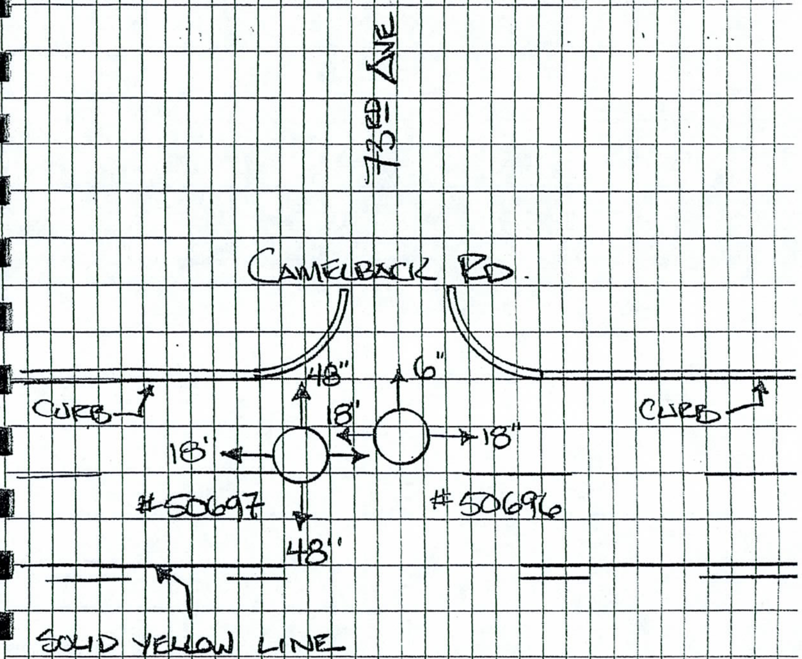
Sta.	N	S	E	W	
50694			9.95	9.95	

Desc.



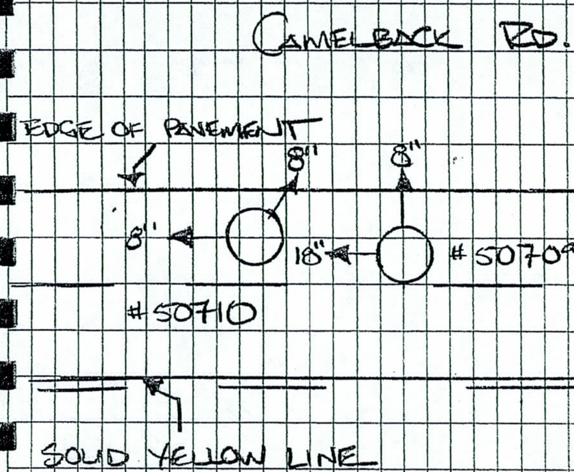
STA.	N	S	E	W	RIM
50696	9.54		10.17	10.17	
50697	11.75	11.94	10.36	10.98	

DESC.

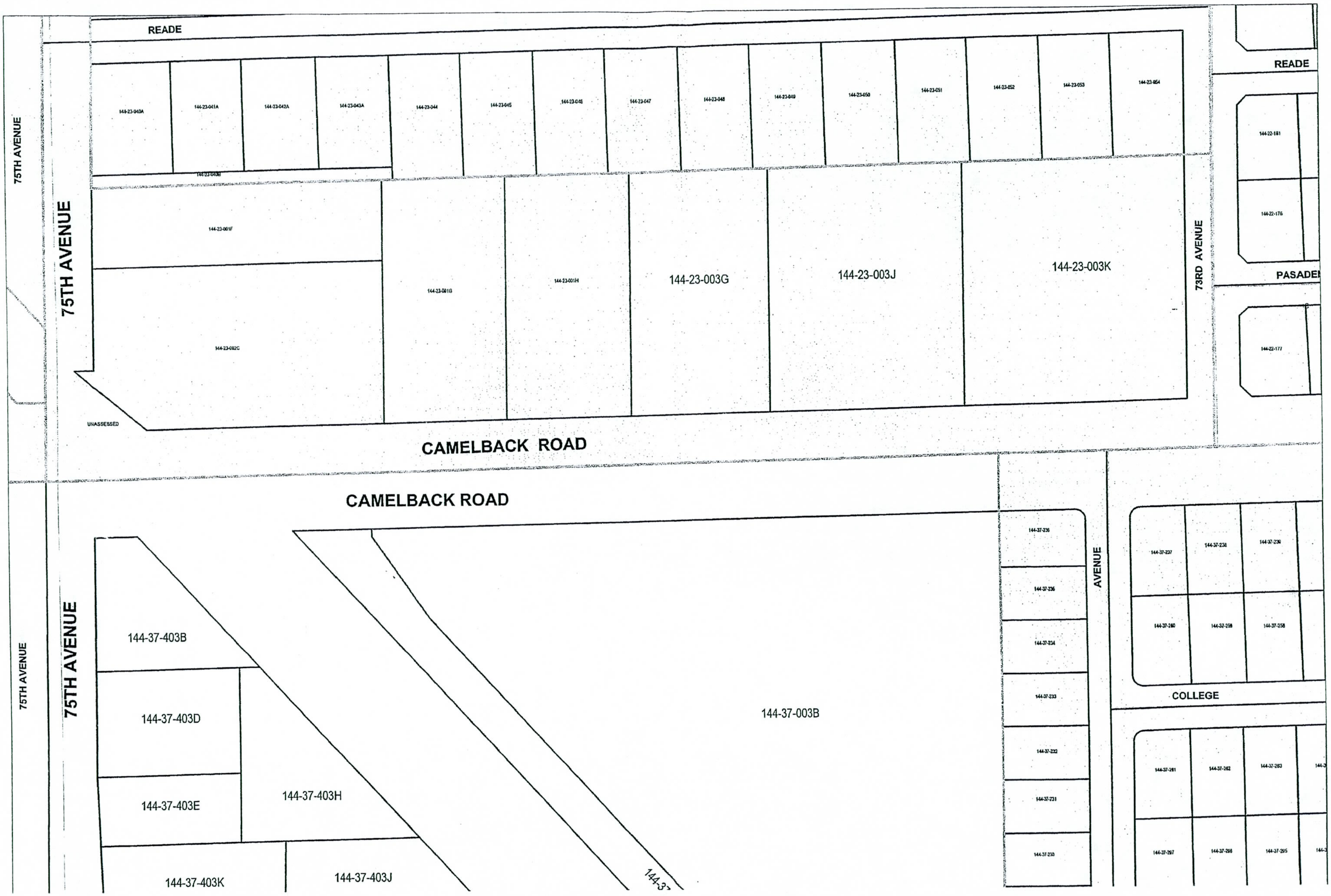


STA.	NE	S	E	W	RIM
50709	9.00			10.10	
50710	6.68			6.70	

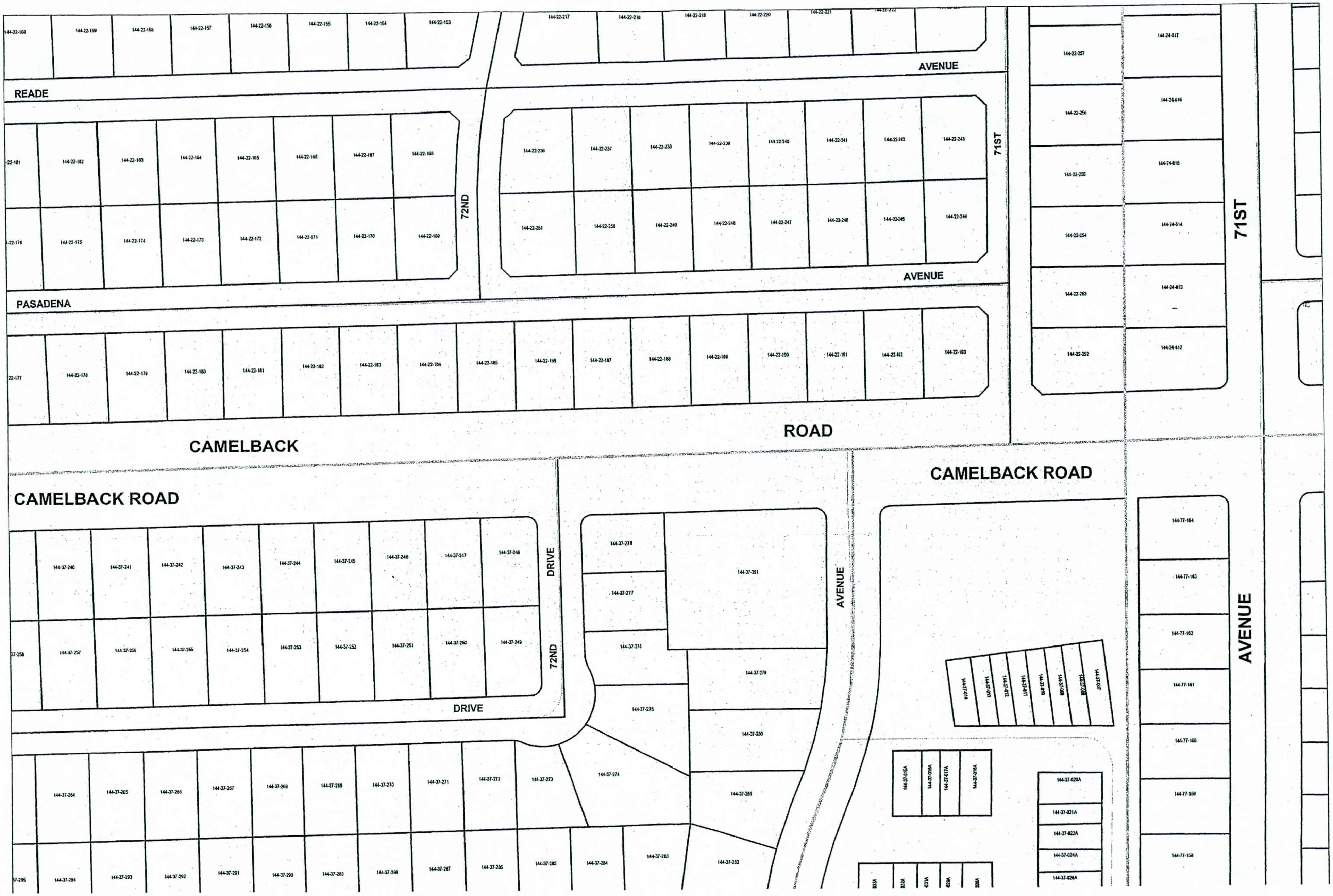
DESC.

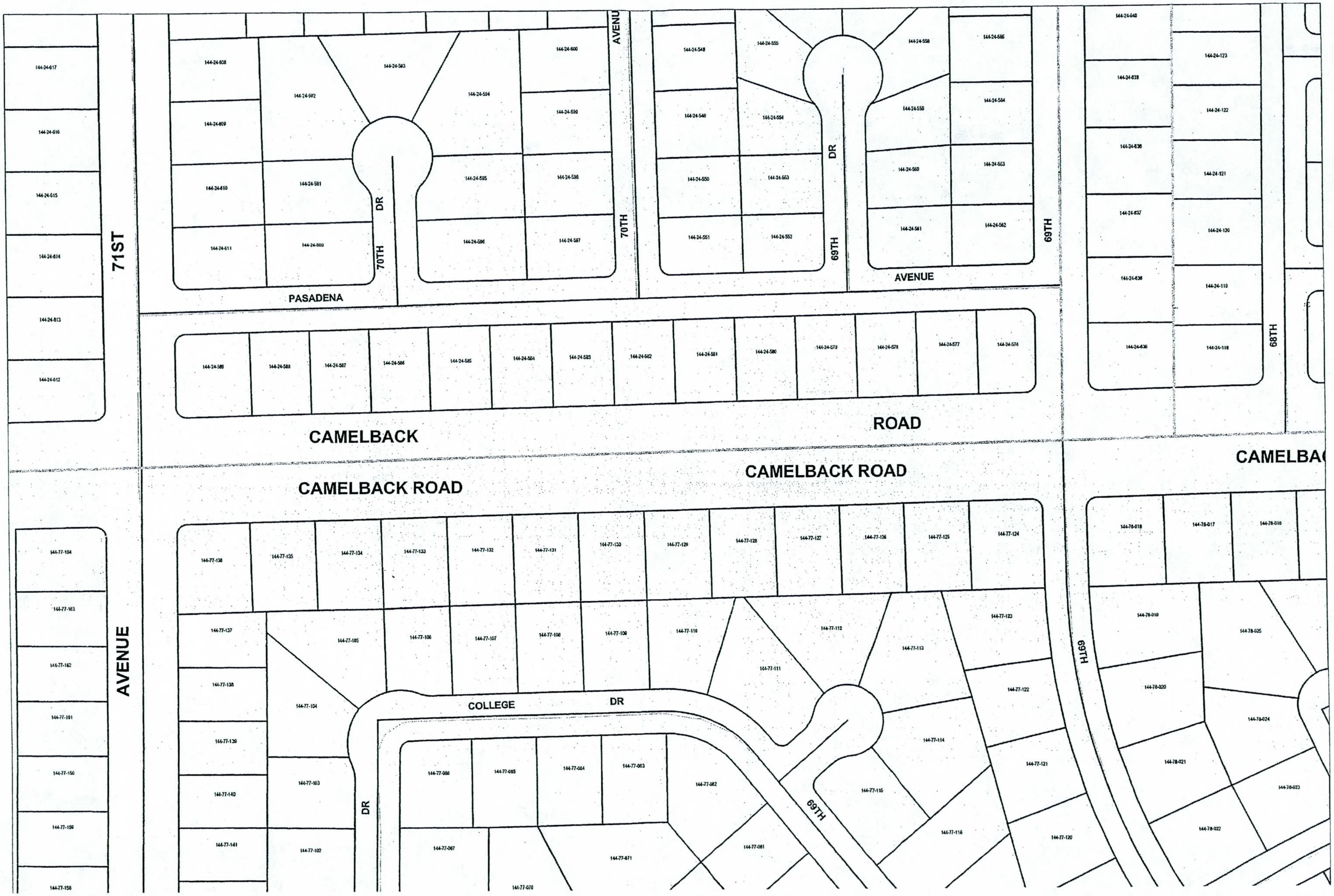


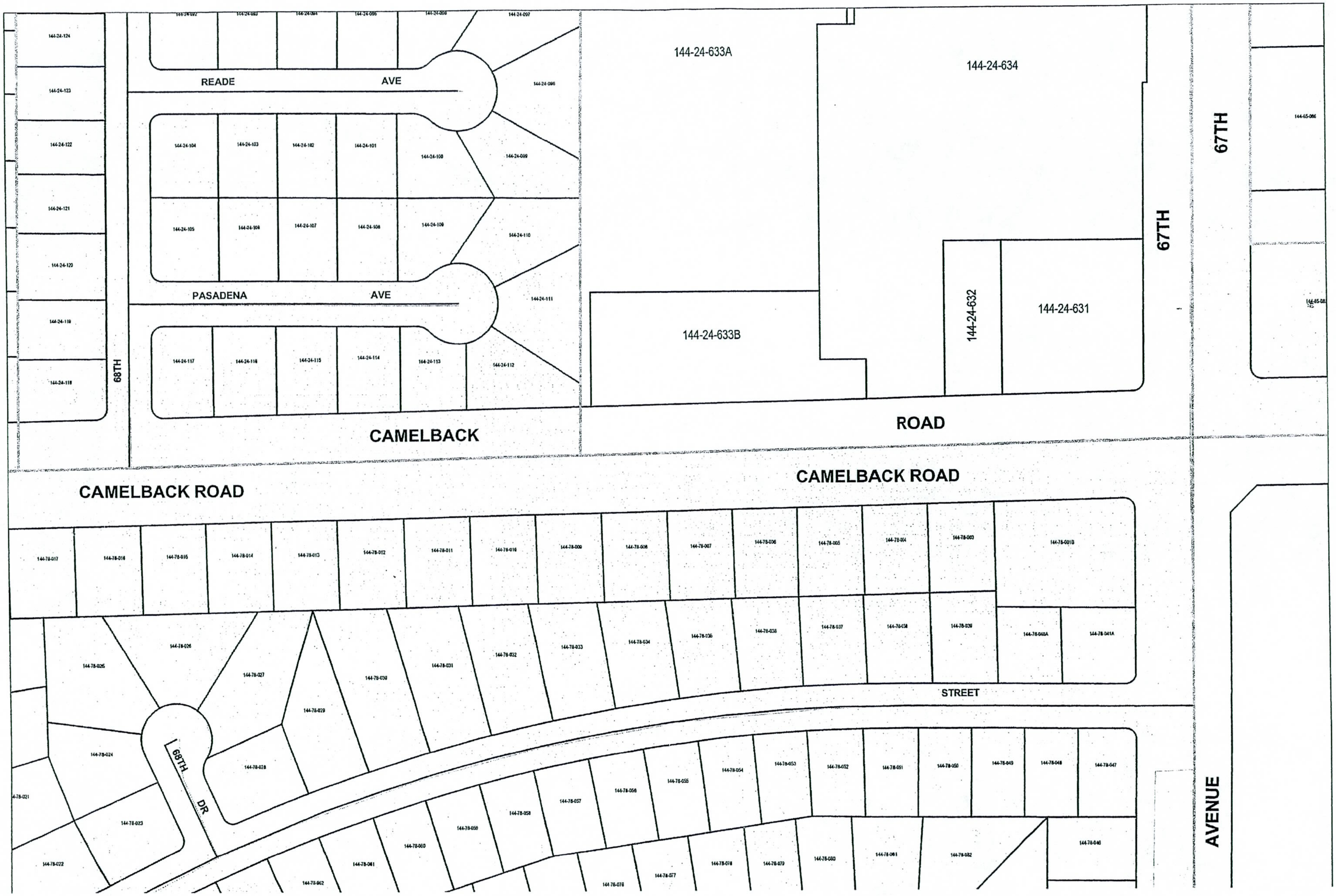
READE AVENUE
75TH LANE
102-08-222K
102-08-223
102-08-222N
PASADENA AVENUE
CAMELBACK ROAD
CAMELBACK ROAD
CAMELBACK ROAD
CAMELBACK ROAD
75TH AVENUE
75TH AVENUE
75TH AVENUE
75TH AVENUE
UNASSESSED
COLLEGE DRIVE
76TH
76TH
102-20-006H
144-37-403B
144-37-403
144-37-403

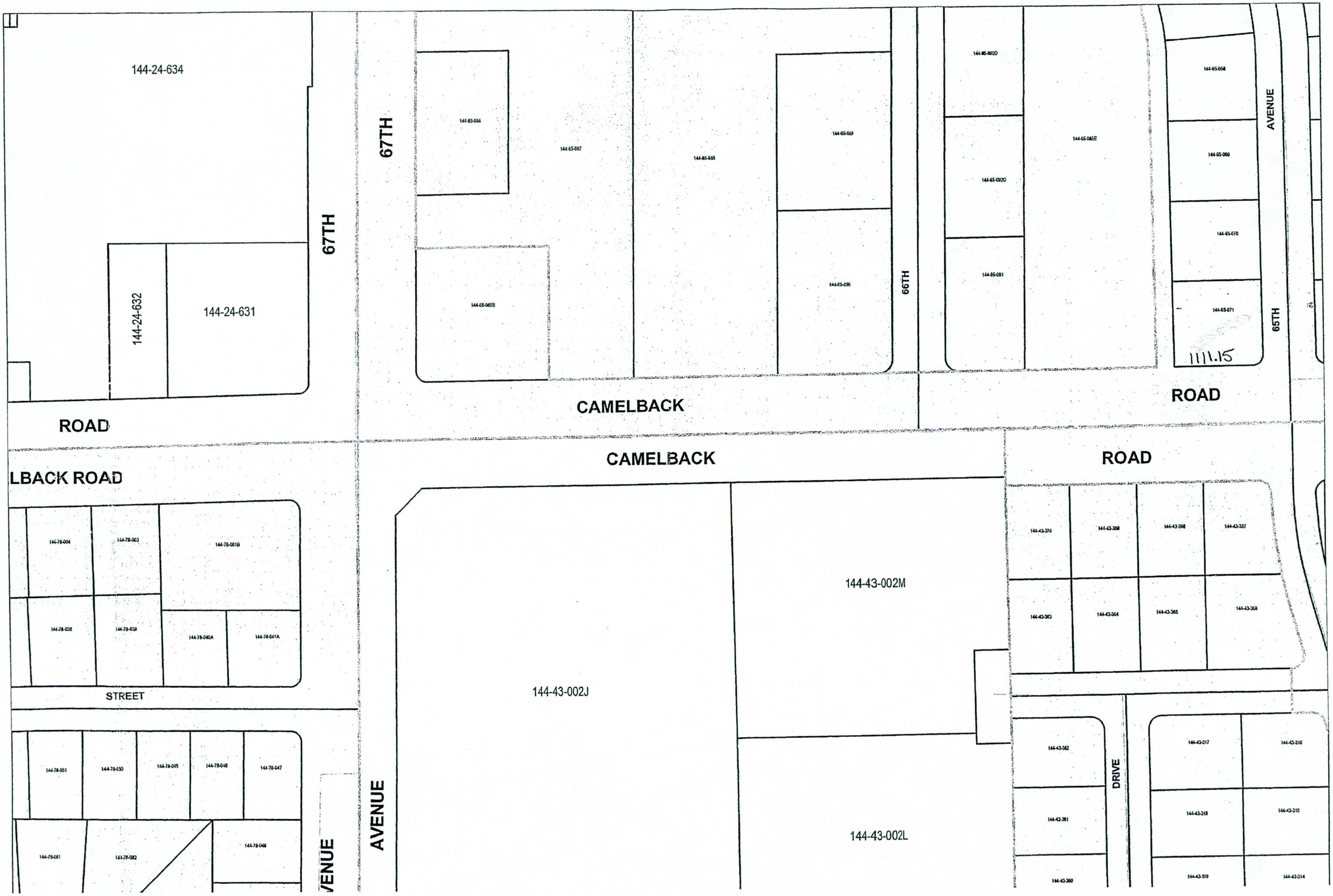


READE
144-23-040A
144-23-041A
144-23-042A
144-23-043A
144-23-044
144-23-045
144-23-046
144-23-047
144-23-048
144-23-049
144-23-050
144-23-051
144-23-052
144-23-053
144-23-054
READE
75TH AVENUE
75TH AVENUE
144-23-001F
144-23-001G
144-23-001H
144-23-003G
144-23-003J
144-23-003K
73RD AVENUE
PASADE
UNASSESSED
CAMELBACK ROAD
CAMELBACK ROAD
75TH AVENUE
75TH AVENUE
144-37-403B
144-37-403D
144-37-403E
144-37-403H
144-37-403K
144-37-403J
144-37-003B
AVENUE
COLLEGE

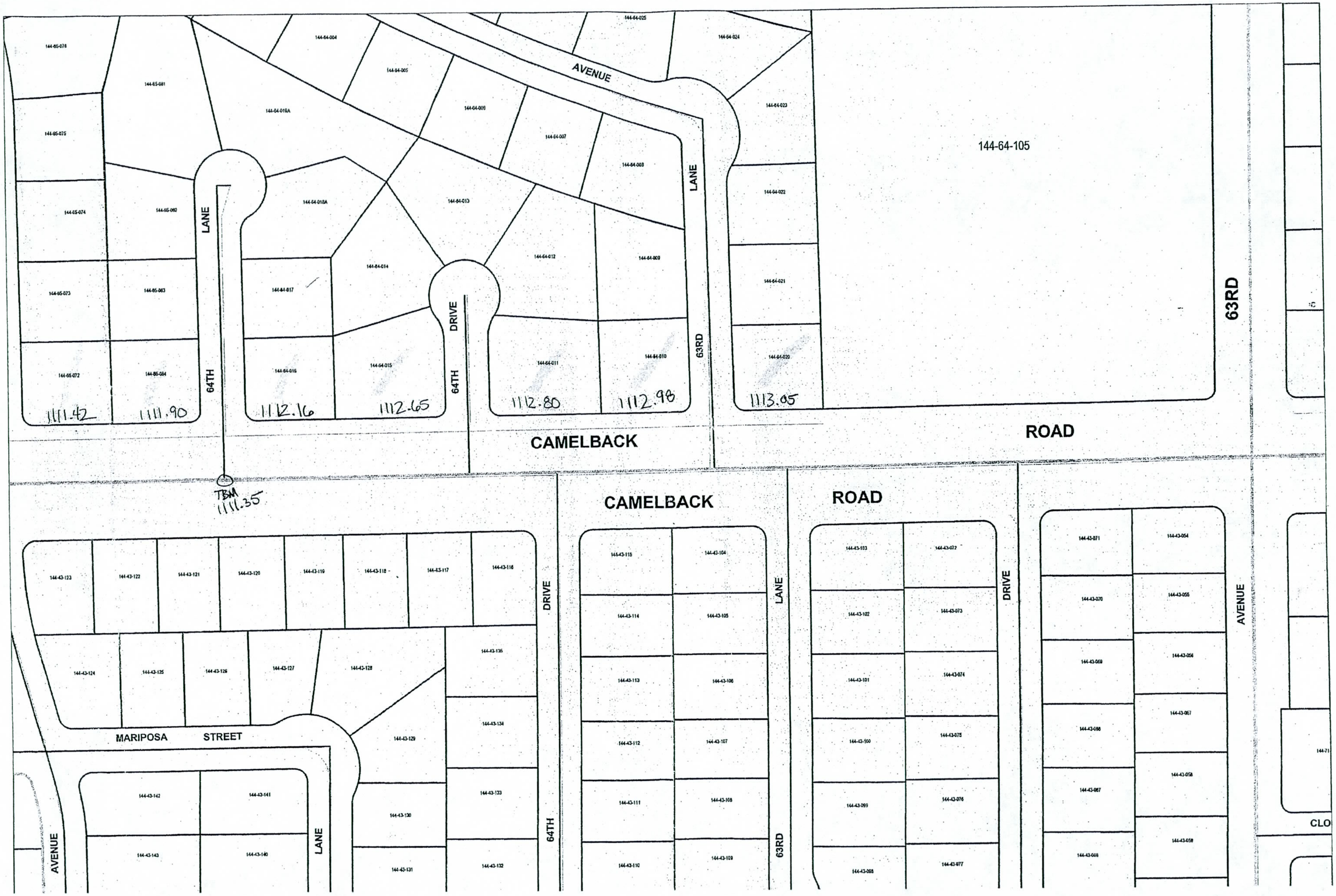

READE
AVENUE
72ND
71ST
PASADENA
AVENUE
71ST
CAMELBACK
ROAD
CAMELBACK ROAD
CAMELBACK ROAD
DRIVE
72ND
DRIVE
AVENUE
AVENUE


71ST
AVENUE
70TH
DR
PASADENA
AVENUE
70TH
69TH
DR
AVENUE
69TH
68TH
CAMELBACK
ROAD
CAMELBACK ROAD
CAMELBACK ROAD
COLLEGE
DR
DR
69TH
69TH

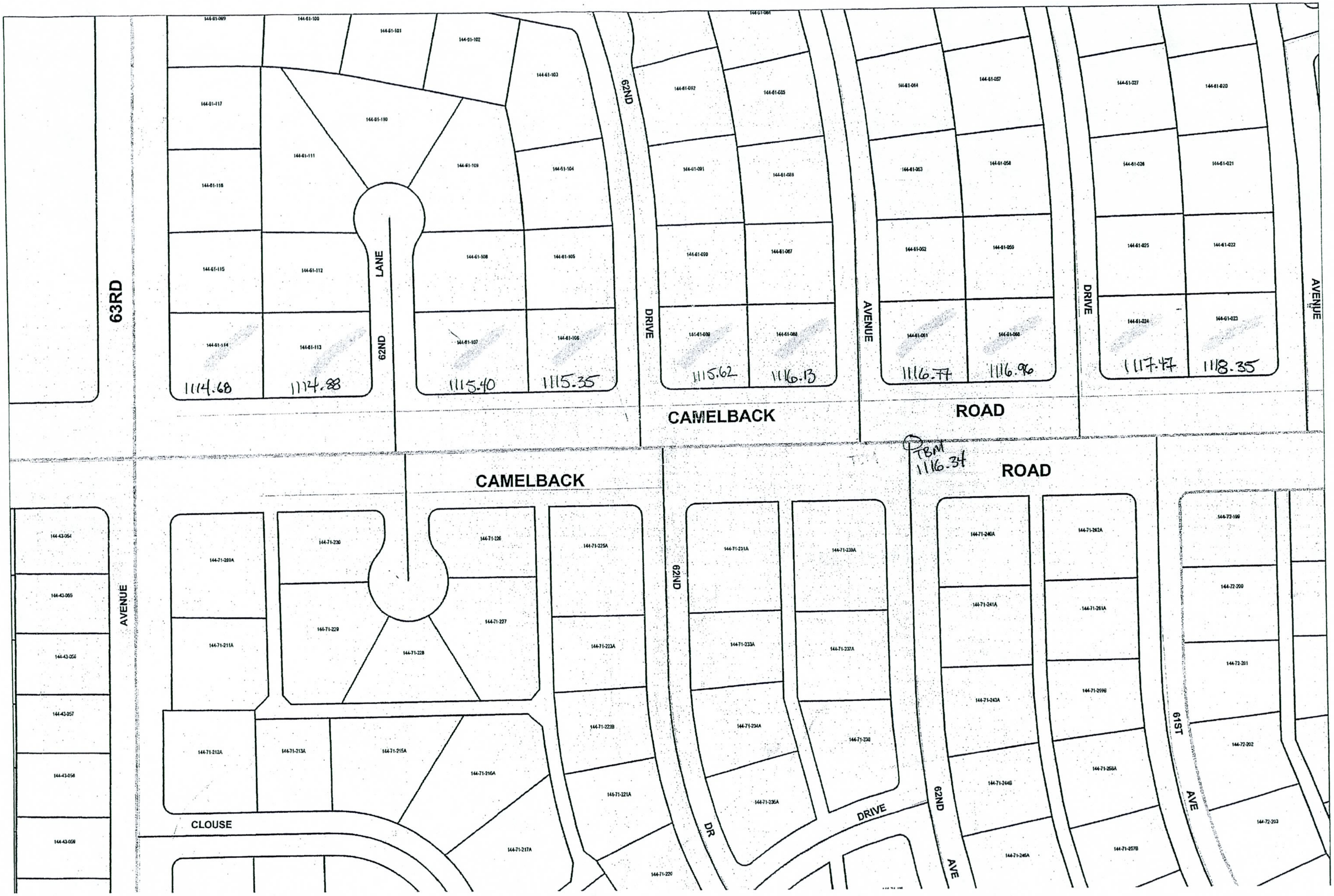

144-24-633A
144-24-634
READE
AVE
67TH
67TH
PASADENA
AVE
144-24-632
144-24-631
144-24-633B
68TH
CAMELBACK
ROAD
CAMELBACK ROAD
CAMELBACK ROAD
STREET
68TH
DR
AVENUE

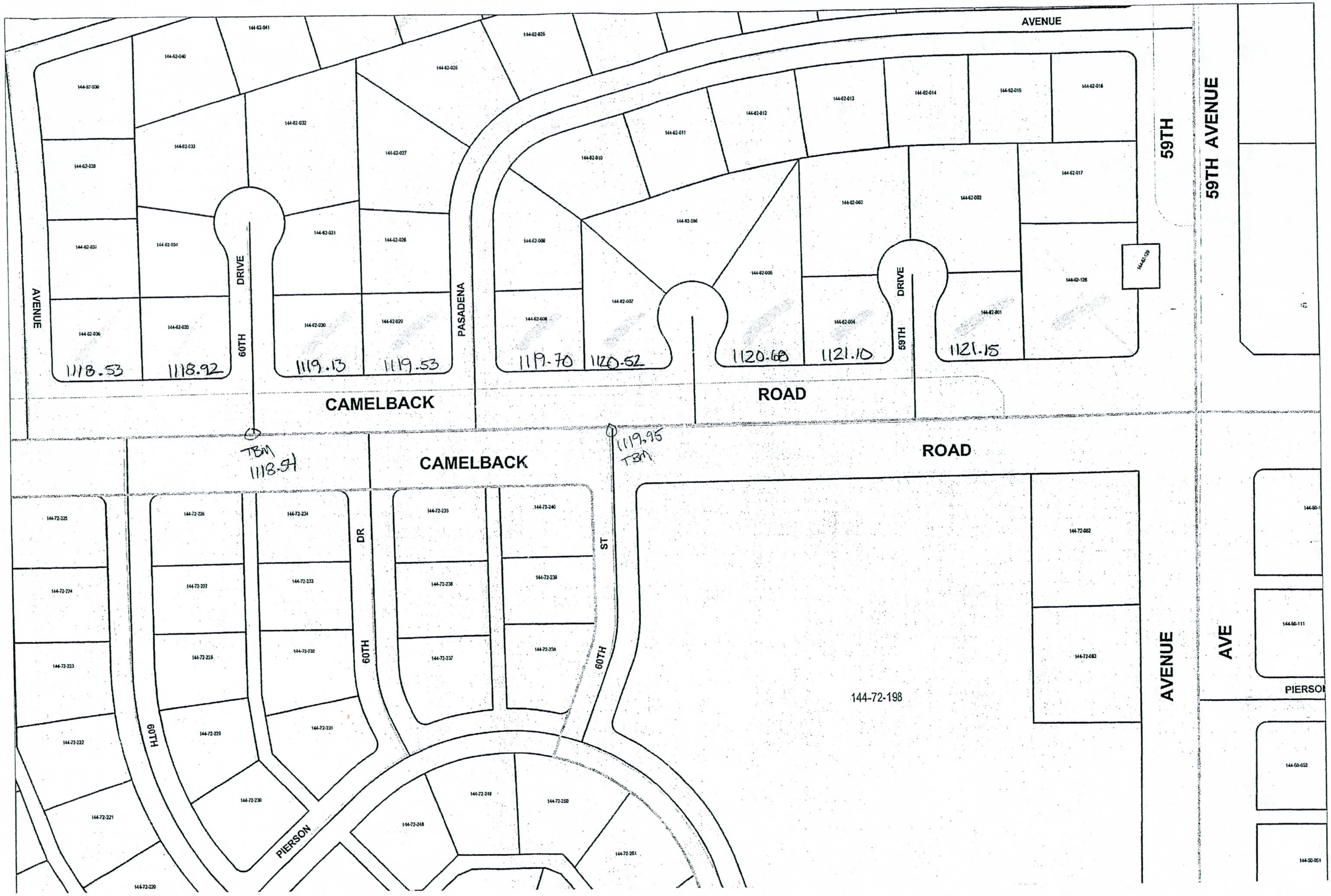


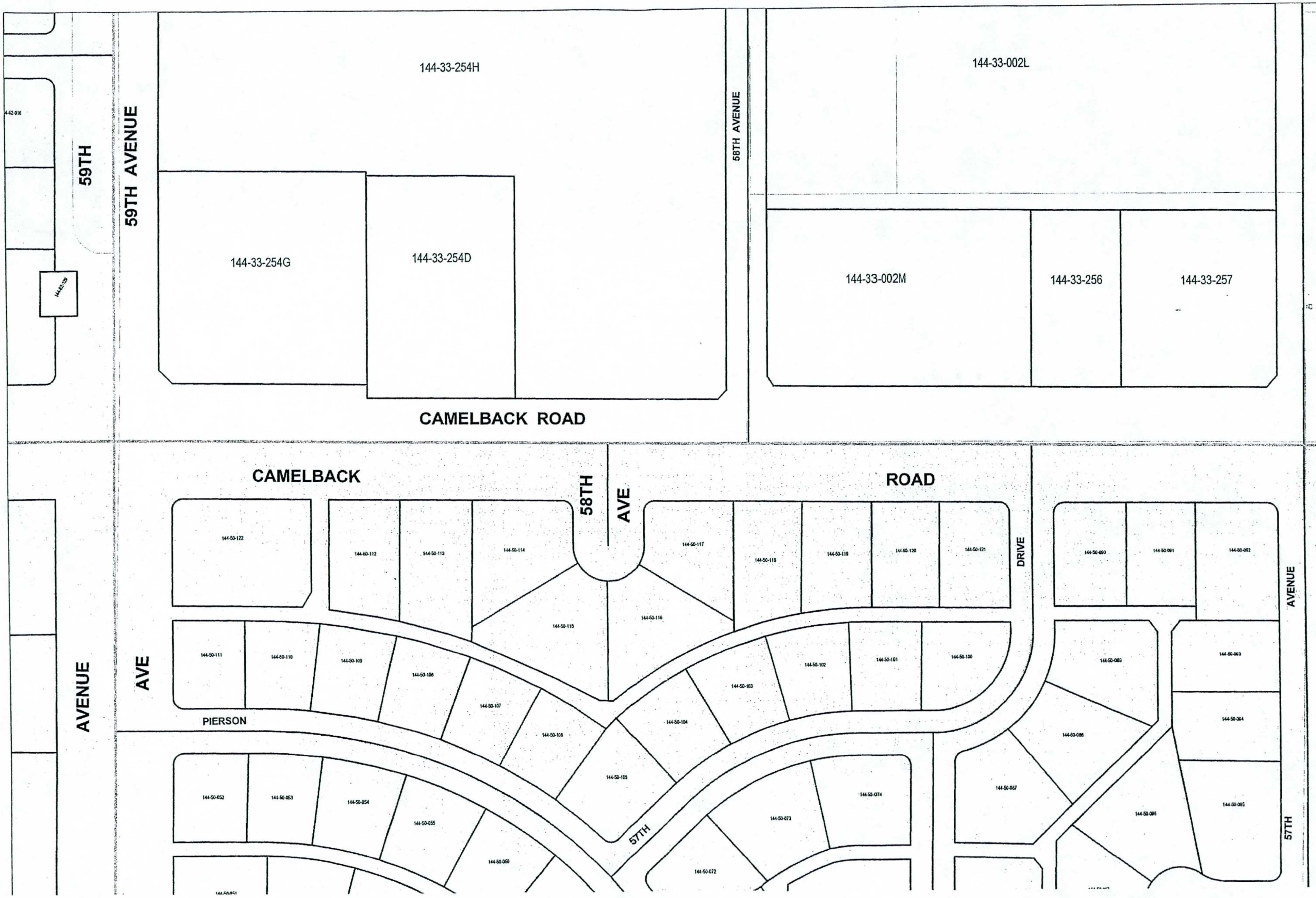
144-24-634
144-24-632
144-24-631
67TH
67TH
66TH
65TH
AVENUE
CAMELBACK
ROAD
ROAD
CAMELBACK
ROAD
LBACK ROAD
STREET
AVENUE
VENUE
DRIVE
144-43-002M
144-43-002J
144-43-002L
1111.15



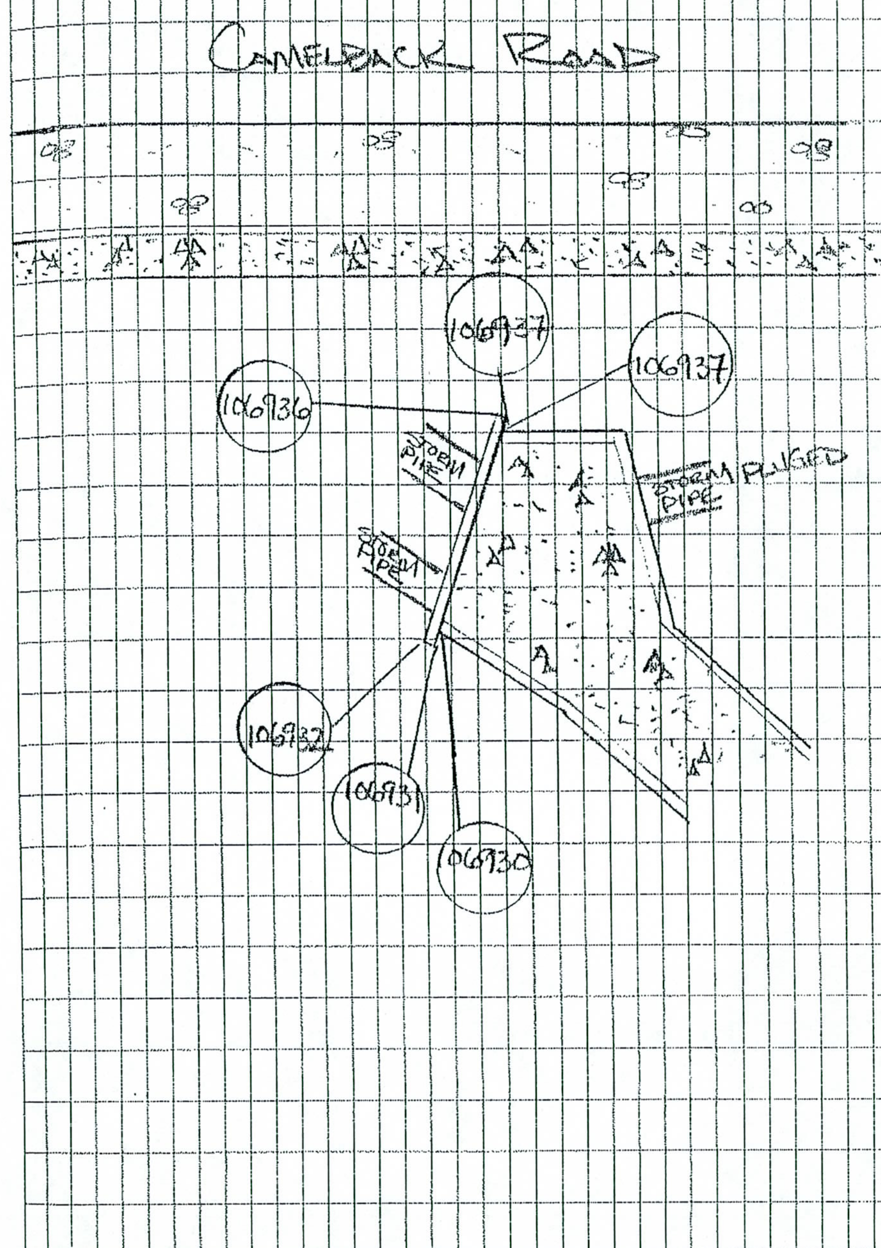
AVENUE
LANE
64TH
DRIVE
64TH
LANE
63RD
144-64-105
63RD
1111.42
1111.90
1112.16
1112.65
1112.80
1112.98
1113.05
CAMELBACK
ROAD
TBM
1111.35
CAMELBACK
ROAD
DRIVE
64TH
LANE
63RD
DRIVE
AVENUE
MARIPOSA
STREET
LANE
AVENUE
CLO


63RD
AVENUE
62ND
LANE
62ND
DRIVE
AVENUE
DRIVE
AVENUE
1114.68
1114.88
1115.40
1115.35
1115.62
1116.13
1116.77
1116.96
1117.47
1118.35
CAMELBACK
ROAD
TBM
1116.34
CAMELBACK
ROAD
62ND
CLOUSE
DR
DRIVE
62ND
AVE
61ST
AVE


AVENUE
59TH
59TH AVENUE
AVENUE
60TH DRIVE
PASADENA
59TH DRIVE
1118.53
1118.92
1119.13
1119.53
1119.70
1120.52
1120.68
1121.10
1121.15
CAMELBACK
ROAD
TBM
1118.54
1119.95
TBM
CAMELBACK
ROAD
DR
60TH
ST
60TH
60TH
PIERSON
144-72-198
AVENUE
AVE
PIERSON


144-33-254H
144-33-002L
59TH
59TH AVENUE
58TH AVENUE
144-33-254G
144-33-254D
144-33-002M
144-33-256
144-33-257
CAMELBACK ROAD
CAMELBACK
58TH
AVE
ROAD
DRIVE
AVENUE
AVE
AVENUE
PIERSON
57TH
57TH

STA.	TOP WALL AVG.	AB INV.
WEST (S) INVERT	1094.68	1074.62
WEST (N) INVERT		1074.62
EAST INVERT		1075.64



BK 55

08-2678

CAMELBACK SD

BENCH LOOP

1-22-2009

CLOUDY & WARM 70°

S. OLSON

T. SHAFFER

STA.	+	HI	−	ELEV.	DESC.
BM#119	5.38			1120.87	BCHH AT THE INTERSECTION OF 59TH AVE. AND CAMEL BACK RD.
		26.25			
C.P.#31			5.04	1121.21	SET REBAR W/ALUM. CAP IN CENTERLINE MEDIAN 300'± WEST OF 59TH AVE.
	3.83				
		25.04			
C.P.#32			6.01	1119.03	BCF IN THE CENTERLINE OF CAMELBACK RD AND 60TH DR.
	4.31				
		23.34			
C.P.#33			6.10	1117.24	BCF IN THE CENTERLINE OF CAMELBACK RD. AND 61ST AVE.
	4.07				
		21.31			
C.P.#34			5.79	1115.52	BCF IN THE CENTERLINE OF CAMELBACK RD. AND 62ND DR.
	4.35				
		19.87			
C.P.#35			7.00	1112.87	SET REBAR W/ALUM. CAP AT THE SW COR.

STA.	+	H.I.	−	ELEV.		DESC.
	4.89					OF CAMELBACK RD. AND 63RD AVE.
		17.76				
C.P.#36			5.74	1112.02		BCF IN THE CENTERLINE OF CAMELBACK RD.
	4.12					AND 64TH DR.
		16.14				
C.P.#37			5.20	1110.94		SET PK NAIL IN THE CENTERLINE OF CAMELBACK
	4.39					RD. 50'± EAST OF 65TH AVE.
		15.33				
C.P.#38			6.05	1109.28		SET REBAR W/ALUM. CAP IN THE CENTERLINE
	4.47					MEDIAN 300'± WEST OF 66TH AVE.
		13.75				
BM#115			5.98	1107.77	1107.78	BCHH AT THE INTERSECTION OF 67TH AVE. AND
	5.62				−0.01	CAMELBACK RD.
		13.40				
C.P.#39			6.01	1107.39	1107.38	SET REBAR W/ALUM. CAP IN THE CENTERLINE

STA	+	HI	−	ELEV.		DESC.
	4.08					MEDIAN SOUTH OF 6710 AUDIO EXPRESS
		11.47				
C.P. #40			6.07	1105.40	1105.38	SET PK NAIL IN THE CENTERLINE OF CAMEL-
	4.60					BACK RD. 300'± EAST OF 68TH DR.
		10.00				
C.P. #41			6.13	1103.87	1103.86	SET PK NAIL IN THE CENTERLINE OF CAMEL-
	4.62					BACK RD. 150'± WEST OF 69TH AVE.
		08.49				
C.P. #42			6.29	1102.20	1102.19	SET PK NAIL IN THE CENTERLINE OF CAMEL-
	4.66					BACK RD. 400'± EAST OF 71ST AVE.
		06.86				
C.P. #43			6.31	1100.55		SET PK NAIL IN THE CENTERLINE OF CAMEL-
	4.98					BACK RD. 100'± EAST OF 72ND AVE.
		05.53				
C.P. #44			6.17	1099.36		SET PK NAIL IN THE CENTERLINE OF CAMEL-

STA.	+	H I	-	ELEV.		DESC.
	4.54					BACK RD. 500'± EAST OF 73RD AVE.
		03.90				
C.P. #45			5.67	1098.23	1098.22	SET PK NAIL IN THE CENTERLINE OF CAMEL-BACK RD. SOUTH OF AMAZING GRACE CHURCH
	4.11					
		02.34				
C.P. #46			5.43	1096.91	1096.90	SET PK NAIL IN THE CENTERLINE OF CAMEL-BACK RD. 500'± EAST OF 75TH AVE.
	4.51					
		01.42				
C.P. #47			6.76	1094.66		SET REBAR W/ALUM. CAP AT THE SW COR. OF 75TH AVE. AND CAMELBACK RD.
	6.73					
		01.39				
C.P. #46			4.50	1096.89	1096.90	SEE DESC. ABOVE
	5.90					
		02.79				
C.P. #45			4.58	1098.21	1098.22	SEE DESC. ABOVE

STA.	+	HI	−	ELEV.		DESC.
	5.84					
		04.05				
C.P.#44			4.70	1199.35		SEE DESC. PG.#13+14
	5.89					
		05.24				
C.P.#43			4.70	1100.54		SEE DESC. PG.#13
	6.10					
		06.64				
C.P.#42			4.46	1102.18	1102.19	SEE DESC. PG.#13
	6.20					
		08.38				
C.P.#41			4.53	1103.85	1103.86	SEE DESC. PG.#13
	6.20					
		10.05				
C.P.#40			4.68	1105.37	1105.38	SEE DESC. PG.#13

STA.	+	H I	−	ELEV.		DESC.
	6.13					
		11.50				
C.P.#39			4.14	1107.36	1107.38	SEE DESC. PG.#12-13
	5.73					
		13.09				
BM#115			5.34	1107.75	1107.78	SEE DESC. PG.#12
					−0.03	