91ST AVENUE RAMPS TO THE AGUA FRIA FREEWAY (101L)

TRACS NO. 060 MA 160 H5137 01 C

RAM 060-B-503

ADOT Contract No. 00-55

FINAL DRAINAGE REPORT

Prepared for:

ARIZONA DEPARTMENT OF TRANSPORTATION

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October, 2000

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CERTIFICATE NO.
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FRANK E.
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Date Signed 10/27/00
ARIZONA, U.S.A.

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1.0 Introduction

1.1 Purpose

This report documents the storm water runoff analysis and storm water conveyance system design for the new connecting ramps from 91st Avenue to the Agua Fria Freeway (101L). This report summarizes the design criteria, the design procedures, the on site storm water drainage analysis and the off site storm water analysis.

1.2 Project Area

The project is located in the City of Peoria, Maricopa County, Arizona. The construction limits extend from Cactus Road on the south to approximately one quarter mile south of the Thunderbird Road ramps. (See Figure 1.) The project site is within the developed City of Peoria area and includes small commercial enterprise on the north west corner of the 91st Avenue intersection with Cactus Road. Agricultural fields adjoin the east side of 91st Avenue and open land adjoins the west side of 91st Avenue. Single dwelling residences exist on half mile east of 91st Avenue. It is anticipated the open space and agricultural areas will develop soon after the ramps are complete. No drainage affect is anticipated from future development since the City of Peoria storm water detention code requires 100 year on site detention.

1.3 Project Description

Grand Avenue and the adjacent Burlington Northern Santa Fe Railroad (BNSF) cut diagonally through the West Valley creating six-legged intersections with the east-west and north-south arterial streets. The three minute traffic signal light lengths combined with the BNSF train activities create long motorist delays. The Arizona Department of Transportation (ADOT) completed a Major Investment Study (MIS) in cooperation with the Maricopa Association of Governments (MAG) and local jurisdictions in September 1999. The MIS addressed the traffic congestion problems The MIS study recommended grade separation improvements for seven intersections and new connecting ramps to the Agua Fria Freeway (101L). The proposed improvements for 91st Avenue include a new off ramp fly over structure for south bound traffic and a new at grade on ramp for north bound traffic.

Storm water collection improvements will intercept the off site runoff along the east side of the Ramp 91B and convey the pavement runoff. The concrete lined channel will convey the storm water to a new storm drain outfall to the existing Agua Fria Channel in ADOT right of way.

FIGURE 1

VICINITY MAP – GRAND AVENUE – CACTUS ROAD / 91ST AVE

2.0 Drainage

2.1 Existing Conditions

This project is located at the north end of the 100 square mile Maryvale Drainage Area. The Maryvale Drainage Area includes portions of the City of Phoenix, the City of Glendale, the City of Peoria, the City of Avondale and unincorporated areas of Maricopa County. The Maryvale Drainage Area storm water runoff was analyzed and modeled in *the Maryvale Area Drainage Master Floodplain Mitigation Study (ADMS)* for the Flood Control District of Maricopa (FCDMC) in November 1997. The natural drainage pattern for the area is generally northeast to southwest at an approximate 0.4 percent grade. The only land use within the approximate 106 acre drainage area is agricultural.

The FCDMC and the City of Peoria constructed a 120 inch diameter storm drain in Cactus Road that out falls into the ADOT channel. The 120 inch storm drain is sized for a 10 year event and included 30 cfs capacity at 91st Avenue.

3.0 Roadway Drainage (On site)

3.1 Roadway Drainage Design Criteria

Roadway (on site) drainage facilities were designed in accordance with *ADOT Roadway Design Guidelines, (RDG)* Chapter 600, Highway Drainage Design. Storm water runoff from the new pavement areas was analyzed utilizing the Rational Method for a 10-year, 6-hour storm event. Flows were calculated using ADOT's recommended 10 minute time of concentration. Catch basins were located and sized to capture the storm water and control the spread within allowable limits. Catch basins were also located at sump areas and at superelevation transitions to prevent runoff from crossing the travel lanes. Storm drain laterals and trunk lines were sized to convey the storm water using the Manning equation and also adhering to the minimum recommended pipe sizes. Flow spreads and inlet capacities were determined utilizing the ADOT Pavement Drainage Analysis Program (Version 3.40). The project design criteria are:

Design Storm Frequency
10-year, 6 hour storm (Table 603.2B)

Flow Spreads

Mainline Shoulder	16 feet (10-foot shoulder + ½ of adjacent travel lane)
Mainline Median	10 feet (4-foot shoulder + ½ of adjacent travel lane)
Ramp 91A	10 feet (4-foot shoulder + ½ of adjacent travel lane)
	16 feet (10-foot shoulder + ½ of adjacent travel lane)
Ramp 91B	15.5 feet (9.5-foot shoulder + ½ of adjacent travel lane)

Inlet Capture Ratio (Table 606.2)
Grate Inlets on grade – 0.50
Grate Inlets at sumps – 0.50
Combined slotted drain and grate inlet on grade
Grate Inlet – 0.50
Slotted Drain – 0.67
Combined slotted drain and grate inlet at sumps
Grate Inlet – 0.50
Slotted Drain – 0.50

Catch Basins
The project will utilize standard ADOT catch basins at the following locations:

Barrier Rails	C-15.92
Curb and Gutter	C-15.91
Median Areas	C-15.80
Slotted Drains	C-13.60

Storm Drain

Trunk lines	24-inch diameter minimum
Lateral lines	18-inch diameter minimum

3.1.1 Rational Method Hydrology

The pavement drainage discharge computations were accomplished in accordance with Chapter 2.0, Section 2.2, of the *Arizona Department of Transportation Highway Drainage Design Manual (HDDM)*, rational method. The design storm frequency for non-depressed roadway segments is in accordance with Table 603.2B of the Roadway Design Guidelines. The hydrologic computations were accomplished using English units.

The fill slope surface is decomposed granite. The pavement, shoulder and fill slope drainage areas were delineated using the roadway plan, profile and cross section plans.

The following runoff coefficient (C) values were determined from Figure 2.3 of the *HDDM* for a 10-year rainfall depth of 1.5 inches:

- Paved surfaces, C = 0.95
- Highway slopes, C = 0.74

The following runoff coefficients (C) values were determined from Figure 2.3 of the *HDDM* for a 50-year rainfall depth of 2.0 inches:

- Paved surfaces, C = 0.95
- Highway slopes, C = 0.80

The intensity / duration / frequency (IDF) graph was accomplished in accordance with Section 2.0 of the *HDDM*. The minimum time of concentration used in the hydrologic computation is 10 minutes. The 10-year rainfall intensity for a 10-minute time of concentration is 4.52 inches per hour. The 50-year rainfall intensity for a 10-minute time of concentration is 6.13 inches per hour. Rainfall intensity / duration / frequency computation sheets are provided in Appendix A.

Hydrologic computations were computed utilizing ADOT program HD-1. Hydrologic design data sheets for the on-site discharge determinations are provided in Appendix B.

3.1.2 Catch Basins

Catch basins were located to limit the flow spread during the 10-year return period to the width of the roadway gutter, shoulder, parking lane and/or distress lane, and one-half of the adjacent lane. This equates to a maximum allowable spread for Ramp 91A of 16 feet and Ramp 91B of 12 feet. Since the ramps width vary, a minimum of one lane width (12 feet) will remain dry.

The *RDG* criteria requires the 10-year flow depth not exceed the top of curb elevation. The curb height along Ramp 91A and Ramp 91B is three inches. Along several segments of the project, the flow spread is less than the maximum spread because the height of the curb divided by the pavement cross slope is less than the allowable spread. For instance a curb height of 3 inches along the segment of pavement with a 4.5% cross slope results in an allowable spread of 5.6 feet (which is significantly less than the lane spread criteria discussed above). Therefore, the allowable spread was determined as the lessor of the lane spread criteria discussed above and the limiting spread as determined by the height of the curb and the pavement cross-slope. The

discharge that can be conveyed within the gutter, shoulder and lane at the maximum allowable spread was determined for each different slope/cross-slope segment of the project. Catch basin locations were determined based upon the drainage area required to generate that discharge.

The allowable spread shall not exceed the width of the roadway gutter, shoulder, parking lane and/or distress lane plus the adjacent lane or 22 feet.

ADOT Standard C-15.91 catch basins were used along Ramp 91A and Ramp 91B where Type C curb is used. ADOT Standard C-15.92 catch basins were used at retaining wall and barrier locations. In some instances, slotted drains are included to optimize inlet capacity. ADOT standard C-15.80 catch basins will be used for the sloped areas. These catch basins will be located during final design for the open areas behind the curbs.

Slotted drain lengths at each catch basin are given in 5-foot increments with a 10-foot minimum. The combined capacity of the grate and slotted drain intercepts 95% to 100% of the design flow. By-pass flow is negligible at all catch basins.

Flanking catch basin inlets were placed on each side of the sag to reduce the possibility of ponding and to provide relief for the sag point catch basin should it become clogged. The flanking catch basin locations were determined by procedures outlined in Section 9.2 of HEC Circular No. 12, Drainage of Highway Pavements.

Grate and slotted drain inlet capacities were determined using ADOT's *Pavement Drainage Analysis Program, Version 3.40.* Computation sheets for are provided in Appendix C.

3.1.3 Storm Drain System

The storm drain system was sized after inlet locations were established. The storm drain system hydraulic design was completed using FHWA computer program HYDRAIN (Version 6.0). The storm drain system design criteria is outlined in Chapter 600 of the RDG. Minimum pipe size for the storm drain trunk line is 24 inch diameter and 18 inch diameter for catch basin laterals. Minimum velocity for full flowing conditions is 3 fps. Pipe roughness coefficients used for all computations was 0.016. The hydraulic grade line at the storm drain outlet is based on the detention basin water surface elevation for the same storm frequency. Maximum hydraulic grade line is at least six inches below catch basin grates or manhole rims. Hydraulic calculations are included in Appendix D.

4.0 Off-Site Drainage

4.1 Hydrology

The off site drainage facilities were designed in accordance with Chapter 600, Highway Drainage Design, of *the ADOT Roadway Design Guidelines*.

4.1.1 Rainfall

The design storm frequency for the offsite drainage improvements is the 50-year, 24 hours storm (Table 603.2A). The source of the design rainfall information is based upon the rainfall depths/duration/frequency statistics for Arizona given in NOAA Atlas 2, Volume VIII, Arizona (Knorr and Others, 1973). The values derided from the NOAA Atlas 2 are point rainfall depths. These point rainfall depths were determined based upon figure 1-2 of the *Highway Drainage Design Manual*, ADOT Report #FHWA-AZ93-281 (March 1993). The point rainfall depths for the 50-year, 24-hour return period storm at the Grand Avenue/91st Avenue interchange was determined by this methodology to be 3.46 inches.

4.1.2 Rainfall Losses

The methodology used to estimate rainfall losses is based upon procedures given in Chapter 3 of the *HDDMl*, Hydrology, ADOT Report #FHWA-AZ93-281 (March 1993). This method requires estimating the surface retention loss and the rainfall infiltration loss by the Green and Ampt equation. The Green and Ampt equation parameters are estimated as a function of soil texture. Surface loss retention was estimated based upon the land use and surface cover types given in Table 3.1 of the *HDDM*. Green and Ampt infiltration equation loss rate parameters are based upon Table 3.2.

4.1.3 Rainfall/Runoff Procedures

One point of concentration for offsite runoff was defined for the project site. This concentration point is located at the 91st Avenue intersection with Cactus Road. The tributary drainage area is 106 acres of farmland north and east of the 91st Avenue/Cactus Road intersection. The watershed area tributary to the intersection is shown on Figure 2. The HEC-1 model and Green and Ampt procedure were utilized to determine the discharge rate at this point of concentration even though the watershed area is less than 160 acres. This was done to characterize the surface soils and slope parameters which (for farmland) will significantly reduce the peak runoff rate.

4.1.4 HEC-1 Model Results

The peak flow rate for 50-year discharge is 94 cfs at the 91st Avenue intersection with Cactus Road concentration point (CP-1). HEC-1 model input/output and hydraulic calculations are provided in Appendix E.

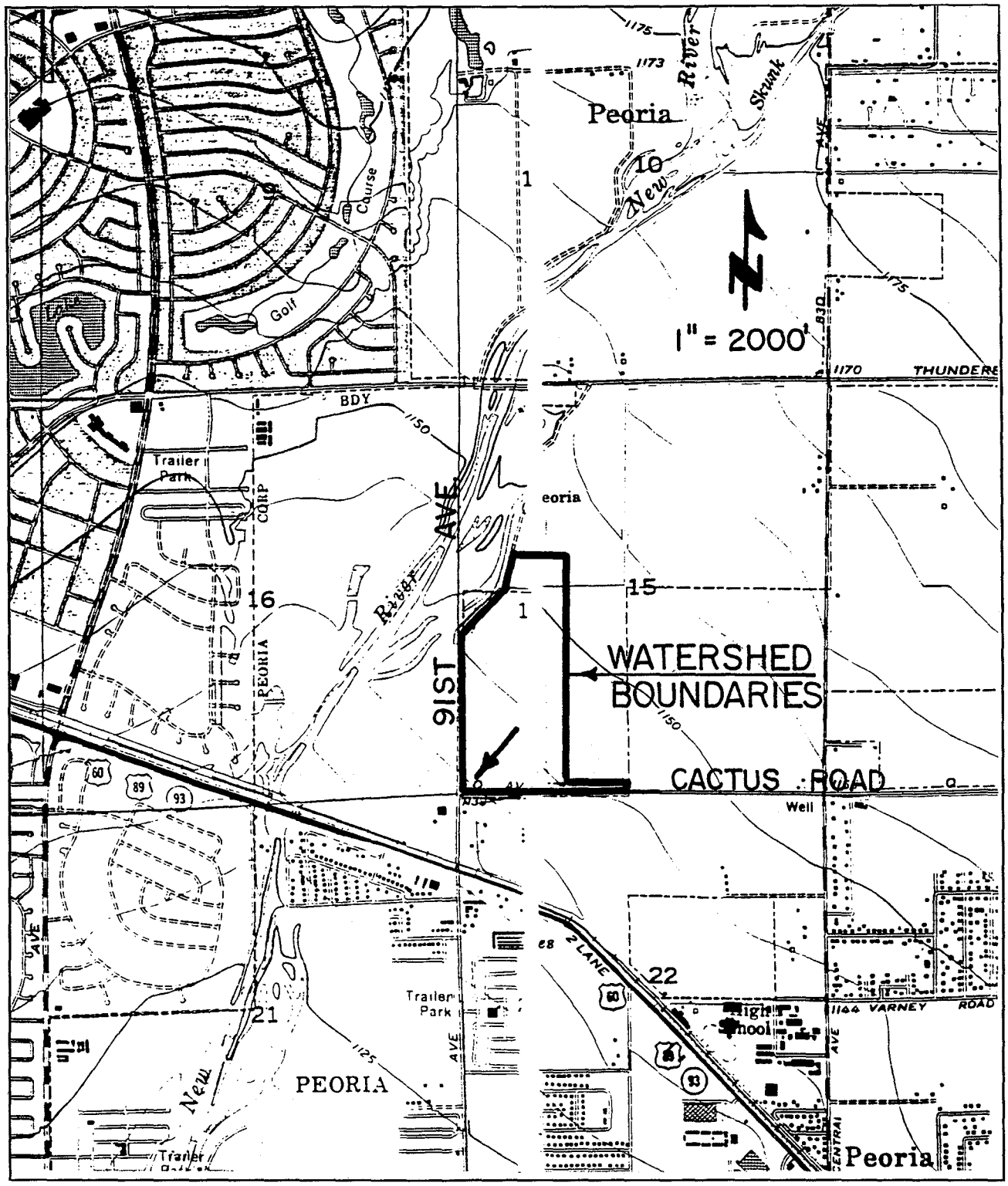

FIGURE 2

GRAND AVENUE – CACTUS ROAD / 91ST AVENUE WATERSHED MAP

4.2 Recommended Drainage Collection Facilities

Offsite runoff draining toward the 91st Avenue/Cactus Road intersection will be collected along the east side of the interchange within a concrete-lined channel, which extends approximately 1000 feet north of Cactus Road. This channel will have a 4 feet wide bottom, 3:1 side slopes with an approximate 2.5 foot depth. The concrete lined channel maintains a longitudinal slope of approximately 0.22%. The channel capacity is 94 cfs and includes 1 foot for freeboard. The channel will convey flow to the Cactus Road intersection through a drop structure and into a 48 inch storm drain pipe. This storm drain pipe will convey the off site flow and the pavement drainage from the new ramps to the existing channel in ADOT 101L right of way. The proposed storm drain system is shown in Appendix F.

APPENDIX A

RAINFALL I-D-F COMPUTATION SHEETS

91st AVENUE RAMPS - TIE IN TO AGUA FRIA FREEWAY (101L)

RAINFALL DEPTH-DURATION-FREQUENCY (D-D-F) WORKSHEET

PART A

Determine rainfall depths from the isopluvial maps.

		Rainfall depth, inches
2-year, 6-hour	$P_{2,6'}$	1.2
2-year, 24-hour	$P_{2,24'}$	1.4
100-year, 6-hour	$P_{100,6'}$	3.2
100-year, 24-hour	$P_{100,24'}$	3.9

PART B

Compute the following:

2-year, 1-hour	$P_{2,1'}$	0.96
100-year, 1-hour	$P_{100,1'}$	2.48
2-year, 2-hour	$P_{2,2'}$	1.04
2-year, 3-hour	$P_{2,3'}$	1.10
2-year, 12-hour	$P_{2,12'}$	1.30
100-year, 2-hour	$P_{100,2'}$	2.72
100-year, 3-hour	$P_{100,3'}$	2.89
100-year, 12-hour	$P_{100,12'}$	3.55

PART C

Compute the short duration rainfall zone — Zone = 8

Determine the Short Duration Rainfall Ratios (Table 1-1)

Duration (minutes)	Ratio 2-year		100-year	
5	A=	0.34	E=	0.30
10	B=	0.51	F=	0.46
15	C=	0.62	G=	0.59
30	D=	0.82	H=	0.80

Compute the following:

2-year, 5-minute	$P_{2,5''}$	0.33
2-year, 10-minute	$P_{2,10''}$	0.49
2-year, 15-minute	$P_{2,15''}$	0.59
2-year, 30-minute	$P_{2,30''}$	0.79
100-year, 5-minute	$P_{100,5''}$	0.74
100-year, 10-minute	$P_{100,10''}$	1.14
100-year, 15-minute	$P_{100,15''}$	1.46
100-year, 30-minute	$P_{100,30''}$	1.98

PART D

For any flood frequency (T-year) other than the 2-year or the 100-year, calculate the rainfall depth for each rainfall duration (t) by the following equation:

$$P_{T,t} \quad (X)P2_{T,t} + (Y)P_{100,t}$$

where X and Y for a selected frequency (T-year) are:

Frequency (T-year)	X	Y
5-year	0.674	0.278
10-year	0.496	0.449
25-year	0.293	0.669
50-year	0.146	0.835
500-year	-0.337	1.381

Selected frequency = 5 year		X = 0.674	Y = 0.278
5-min	$P_{5,5''}$	0.43	
10-min	$P_{5,10''}$	0.65	
15-min	$P_{5,15''}$	0.81	
30-min	$P_{5,30''}$	1.08	
1-hour	$P_{5,1'}$	1.33	
2-hour	$P_{5,2'}$	1.46	
3-hour	$P_{5,3'}$	1.54	
6-hour	$P_{5,6'}$	1.70	
12-hour	$P_{5,12'}$	1.86	
24-hour	$P_{5,24'}$	2.03	

Selected frequency = 10 year		X = 0.496	Y = 0.449
5-min	$P_{10,5''}$	0.50	
10-min	$P_{10,10''}$	0.75	
15-min	$P_{10,15''}$	0.95	
30-min	$P_{10,30''}$	1.28	
1-hour	$P_{10,1'}$	1.59	
2-hour	$P_{10,2'}$	1.74	
3-hour	$P_{10,3'}$	1.84	
6-hour	$P_{10,6'}$	2.03	
12-hour	$P_{10,12'}$	2.24	
24-hour	$P_{10,24'}$	2.45	

Selected frequency = 25 year			X = 0.293	Y = 0.669				
5-min		$P_{25,5''}$	0.59					
10-min		$P_{25,10''}$	0.91					
15-min		$P_{25,15''}$	1.15					
30-min		$P_{25,30''}$	1.56					
1-hour		$P_{25,1'}$	1.94					
2-hour		$P_{25,2'}$	2.13					
3-hour		$P_{25,3'}$	2.25					
6-hour		$P25_{5,6'}$	2.49					
12-hour		$P_{25,12'}$	2.76					
24-hour		$P_{25,24'}$	3.02					
Selected frequency = 50 year			X = 0.146	Y = 0.835				
5-min		$P_{50,5''}$	0.67					
10-min		$P_{50,10''}$	1.02					
15-min		$P_{50,15''}$	1.31					
30-min		$P_{50,30''}$	1.77					
1-hour		$P_{50,1'}$	2.21					
2-hour		$P_{50,2'}$	2.43					
3-hour		$P_{50,3'}$	2.57					
6-hour		$P_{50,6'}$	2.85					
12-hour		$P_{50,12'}$	3.15					
24-hour		$P_{50,24'}$	3.46					
Selected frequency = 500 year			X = -0.337	Y = 1.381				
5-min		$P_{500,5''}$	0.92					
10-min		$P_{500,10''}$	1.41					
15-min		$P_{500,15''}$	1.82					
30-min		$P_{500,30''}$	2.47					
1-hour		$P_{500,1'}$	3.10					
2-hour		$P_{500,2'}$	3.41					
3-hour		$P_{500,3'}$	3.62					
6-hour		$P_{500,6'}$	4.01					
12-hour		$P_{500,12'}$	4.46					
24-hour		$P_{500,24'}$	4.91					

PART E

Tabulate the rainfall Depth-Duration-Frequency statistics below:

Duration	Rainfall depth, inches						
	Frequency, years						
	2	5	10	25	50	100	500
5-min	0.33	0.43	0.50	0.59	0.67	0.74	0.92
10-min *	0.49	0.65	0.75	0.91	1.02	1.14	1.41
15-min	0.59	0.81	0.95	1.15	1.31	1.46	1.82
30-min *	0.79	1.08	1.28	1.56	1.77	1.98	2.47
1-hour	0.96	1.33	1.59	1.94	2.21	2.48	3.10
2-hour	1.04	1.46	1.74	2.13	2.43	2.72	3.41
3-hour	1.10	1.54	1.84	2.25	2.57	2.89	3.62
6-hour	1.20	1.70	2.03	2.49	2.85	3.20	4.01
12-hour	1.30	1.86	2.24	2.76	3.15	3.55	4.46
24-hour	1.40	2.03	2.45	3.02	3.46	3.90	4.91

* NOTE 10-min and 30-min values are not coded into the pH record

Rainfall Intensity-Duration-Frequency Worksheet:

Duration	Rainfall Intensity, inches/hour						
	Frequency, years						
	2	5	10	25	50	100	500
5-min	3.91	5.11	5.94	7.11	8.01	8.91	10.99
10-min	2.93	3.88	4.52	5.43	6.13	6.83	8.45
15-min	2.38	3.23	3.80	4.61	5.23	5.84	7.27
30-min	1.57	2.16	2.56	3.11	3.54	3.96	4.94
1-hour	0.96	1.33	1.59	1.94	2.21	2.48	3.10
2-hour	0.52	0.73	0.87	1.06	1.21	1.36	1.70
3-hour	0.37	0.51	0.61	0.75	0.86	0.96	1.21
6-hour	0.20	0.28	0.34	0.42	0.47	0.53	0.67
12-hour	0.11	0.16	0.19	0.23	0.26	0.30	0.37
24-hour	0.06	0.08	0.10	0.13	0.14	0.16	0.20

APPENDIX B

HYDROLOGIC COMPUTATIONS

RATIONAL METHOD

10 -YEAR EVENT

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 31+28 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.315
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	1.353

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 35+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.261
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	1.121

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 39+90 LT CHECKER - PAGE
Ver 3.40: December 1995

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.300
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	1.288

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 45+10 RT (BRIDGE)
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.035
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	0.150

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 45+60 RT (BRIDGE)
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.035
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	0.150

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 46+10 RT (BRIDGE)
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.910
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	3.908

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 55+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.354
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	1.520

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 58+95 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
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PAGE

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.261
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	1.121

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91B STA 101+26 RT
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.271
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	1.164

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91B STA 105+00 RT CHECKER - PAGE
Ver 3.40: December 1995

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.298
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	1.280

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91B STA 105+00 LT
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.612
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	2.047

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91B STA 110+00 RT CHECKER - PAGE
Ver 3.40: December 1995

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.085
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	0.365

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91B STA 110+00 LT
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	1.194
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	4.520
Discharge-CFS--Q	=	3.994

RATIONAL METHOD

50 -YEAR EVENT

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 31+28 LT
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.315
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	1.834

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 35+00 LT
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.261
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	1.520

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 39+90 LT
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.300
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	1.747

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 45+10 RT (BRIDGE)
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.035
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	0.204

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 45+60 RT (BRIDGE)
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.035
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	0.204

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 46+10 RT (BRIDGE)
Ver 3.40: December 1995

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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.910
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	5.299

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 55+00 LT CHECKER - PAGE
Ver 3.40: December 1995

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.354
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	2.062

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 58+95 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.261
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	1.520

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91B STA 101+26 RT CHECKER - PAGE
Ver 3.40: December 1995

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.271
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	1.578

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91G STA 105+00 RT CHECKER - PAGE
Ver 3.40: December 1995

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.298
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	1.735

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91B STA 105+00 LT CHECKER - PAGE
Ver 3.40: December 1995

*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.612
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	2.776

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91B STA 110+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.085
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	0.495

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91B STA 110+00 LT
Ver 3.40: December 1995

TRACS NO.-
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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	1.194
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	6.130
Discharge-CFS--Q	=	5.416

APPENDIX C

CATCH BASIN INLET COMPUTATIONS

10 - YEAR EVENT

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 31+28 LT
Ver 3.40: December 1995

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.480
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.353
SPREAD-Ft.--T	=	9.243
Average Velocity-V-fps	=	1.579
FLOW in Gutter-CFS--Q	=	0.773
% Flow in Gutter-CFS	=	57.129
Velocity of Flow in Gutter-fps	=	1.922
Depth at Curb Line-Inches--d	=	2.242

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	3.003
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.220
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.383	0.519	0.745	1.264	0.089	93.45
10.000	0.682	0.923	0.419	1.343	0.010	99.23
15.000	0.890	1.204	0.149	1.353	0.000	100.00
20.000	0.994	1.345	0.008	1.353	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 35+00 LT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.950
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.121
SPREAD-Ft.--T	=	7.570
Average Velocity-V-fps	=	1.947
FLOW in Gutter-CFS--Q	=	0.739
% Flow in Gutter-CFS	=	65.961
Velocity of Flow in Gutter-fps	=	2.321
Depth at Curb Line-Inches--d	=	1.841

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	2.544
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.840
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.359	0.402	0.677	1.079	0.042	96.28
10.000	0.645	0.723	0.394	1.118	0.003	99.73
15.000	0.854	0.957	0.164	1.121	0.000	100.00
20.000	0.977	1.095	0.026	1.121	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 39+90 LT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	4.450
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.288
SPREAD-Ft.--T	=	5.959
Average Velocity-V-fps	=	3.602
FLOW in Gutter-CFS--Q	=	0.990
% Flow in Gutter-CFS	=	76.876
Velocity of Flow in Gutter-fps	=	4.162
Depth at Curb Line-Inches--d	=	1.454

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	2.067
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	36.687
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.232	0.299	0.958	1.257	0.031	97.60
10.000	0.436	0.562	0.720	1.282	0.006	99.50
15.000	0.612	0.788	0.500	1.288	0.000	99.99
20.000	0.758	0.976	0.312	1.288	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 45+10 RT (BRIDGE)
Ver 3.40: December 1995

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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.591
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.020
Gutter Depression-Inches--	=	0.490
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.151
SPREAD-Ft.--T	=	2.931
Average Velocity-V-fps	=	1.723
FLOW in Gutter-CFS--Q	=	0.144
% Flow in Gutter-CFS	=	95.319
Velocity of Flow in Gutter-fps	=	1.827
Depth at Curb Line-Inches--d	=	0.718

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	1.250
Grate Width---Ft.	=	1.920
Grate Area--Sq. Ft.	=	2.400
Capture Ratio -- GRATE	=	0.670
Effective Perimeter--Ft.	=	5.090
Splash-Over Velocity--FPS	=	5.090
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.151
GUTTER FLOW at INLET-CFS--Q	=	0.144
Gutter Velocity at INLET-fps	=	1.827
Depth at INLET Curb Line-Inches--d	=	0.718
Frontal Flow Intercepted by GRATE--CFS	=	0.142
Lateral Flow Intercepted by GRATE--CFS	=	0.001
TOTAL Flow Intercepted by GRATE--CFS	=	0.143
% FLOW Intercepted	=	94.800
By-pass Flow--CFS	=	0.008

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 45+60 RT CHECKER - PAGE
Ver 3.40: December 1995 (BRIDGE)

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.267
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.041
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.041
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.041
Gutter Depression-Inches--	=	0.979
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.220
SPREAD-Ft.--T	=	2.244
Average Velocity-V-fps	=	2.141
FLOW in Gutter-CFS--Q	=	0.219
% Flow in Gutter-CFS	=	99.746
Velocity of Flow in Gutter-fps	=	2.161
Depth at Curb Line-Inches--d	=	1.099

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	1.250
Grate Width---Ft.	=	1.920
Grate Area--Sq. Ft.	=	2.400
Capture Ratio -- GRATE	=	0.670
Effective Perimeter--Ft.	=	5.090
Splash-Over Velocity--FPS	=	5.090
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.220
GUTTER FLOW at INLET-CFS--Q	=	0.219
Gutter Velocity at INLET-fps	=	2.161
Depth at INLET Curb Line-Inches--d	=	1.099
Frontal Flow Intercepted by GRATE--CFS	=	0.219
Lateral Flow Intercepted by GRATE--CFS	=	0.000
TOTAL Flow Intercepted by GRATE--CFS	=	0.219
% FLOW Intercepted	=	99.625
By-pass Flow--CFS	=	0.001

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 46+10 RT (BRIDGE)
Ver 3.40: December 1995

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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.942
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.058
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.058
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.058
Gutter Depression-Inches--	=	1.392
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.910
SPREAD-Ft.--T	=	3.158
Average Velocity-V-fps	=	3.146
FLOW in Gutter-CFS--Q	=	0.847
% Flow in Gutter-CFS	=	93.121
Velocity of Flow in Gutter-fps	=	3.385
Depth at Curb Line-Inches--d	=	2.198

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	1.250
Grate Width---Ft.	=	1.920
Grate Area--Sq. Ft.	=	2.400
Capture Ratio -- GRATE	=	0.670
Effective Perimeter--Ft.	=	5.090
Splash-Over Velocity--FPS	=	5.090
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.910
GUTTER FLOW at INLET-CFS--Q	=	0.847
Gutter Velocity at INLET-fps	=	3.385
Depth at INLET Curb Line-Inches--d	=	2.198
Frontal Flow Intercepted by GRATE--CFS	=	0.835
Lateral Flow Intercepted by GRATE--CFS	=	0.007
TOTAL Flow Intercepted by GRATE--CFS	=	0.842
% FLOW Intercepted	=	92.530
By-pass Flow--CFS	=	0.068

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SRDIC DESIGNER -
LOCATION - RAMP 91A STA 55+00 RT CHECKER - PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.840
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.031
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.031
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.520
SPREAD-Ft.--T	=	3.720
Average Velocity-V-fps	=	4.647
FLOW in Gutter-CFS--Q	=	1.484
% Flow in Gutter-CFS	=	97.603
Velocity of Flow in Gutter-fps	=	4.883
Depth at Curb Line-Inches--d	=	2.458

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	8.489
Depth at INLET Curb Line-Inches--d	=	3.204
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	21.548
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.378	0.575	0.945	1.520	0.000	100.00
10.000	0.675	1.025	0.495	1.520	0.000	100.00
15.000	0.883	1.342	0.178	1.520	0.000	100.00
20.000	0.991	1.507	0.013	1.520	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 58 + 95 LT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.650
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.121
SPREAD-Ft.--T	=	3.957
Average Velocity-V-fps	=	3.707
FLOW in Gutter-CFS--Q	=	1.098
% Flow in Gutter-CFS	=	97.961
Velocity of Flow in Gutter-fps	=	3.905
Depth at Curb Line-Inches--d	=	2.350

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	8.489
Depth at INLET Curb Line-Inches--d	=	3.064
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	16.964
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.467	0.523	0.598	1.121	0.000	100.00
10.000	0.799	0.895	0.226	1.121	0.000	100.00
15.000	0.979	1.098	0.023	1.121	0.000	100.00
20.000	1.000	1.121	0.000	1.121	0.000	100.00

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PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91B STA 101+26 RT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.520
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.164
SPREAD-Ft.--T	=	8.603
Average Velocity-V-fps	=	1.567
FLOW in Gutter-CFS--Q	=	0.701
% Flow in Gutter-CFS	=	60.246
Velocity of Flow in Gutter-fps	=	1.895
Depth at Curb Line-Inches--d	=	2.089

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	2.830
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.012
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.404	0.470	0.642	1.112	0.052	95.54
10.000	0.713	0.829	0.332	1.161	0.003	99.75
15.000	0.917	1.068	0.096	1.164	0.000	100.00
20.000	1.000	1.164	0.000	1.164	0.000	100.00

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PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
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LOCATION - RAMP 91B STA 105+00 RT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.520
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.280
SPREAD-Ft.--T	=	8.916
Average Velocity-V-fps	=	1.605
FLOW in Gutter-CFS--Q	=	0.751
% Flow in Gutter-CFS	=	58.682
Velocity of Flow in Gutter-fps	=	1.947
Depth at Curb Line-Inches--d	=	2.164

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	2.915
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.028
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.387	0.495	0.711	1.206	0.074	94.24
10.000	0.687	0.879	0.393	1.273	0.007	99.45
15.000	0.894	1.145	0.135	1.280	0.000	100.00
20.000	0.996	1.274	0.006	1.280	0.000	100.00

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10-23-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91B STA 110+00 RT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.531
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.365
SPREAD-Ft.--T	=	5.528
Average Velocity-V-fps	=	1.185
FLOW in Gutter-CFS--Q	=	0.293
% Flow in Gutter-CFS	=	80.229
Velocity of Flow in Gutter-fps	=	1.353
Depth at Curb Line-Inches--d	=	1.351

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	1.930
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.314
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.650	0.237	0.128	0.365	0.000	100.00
10.000	0.979	0.357	0.008	0.365	0.000	100.00
15.000	1.000	0.365	0.000	0.365	0.000	100.00
20.000	1.000	0.365	0.000	0.365	0.000	100.00

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PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 31+28 LT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.480
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.834
SPREAD-Ft.--T	=	10.365
Average Velocity-V-fps	=	1.703
FLOW in Gutter-CFS--Q	=	0.960
% Flow in Gutter-CFS	=	52.331
Velocity of Flow in Gutter-fps	=	2.094
Depth at Curb Line-Inches--d	=	2.512

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	3.300
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	24.889
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.332	0.609	1.007	1.616	0.218	88.14
10.000	0.603	1.107	0.666	1.773	0.061	96.65
15.000	0.810	1.486	0.344	1.830	0.004	99.78
20.000	0.947	1.736	0.098	1.834	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
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10-23-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 35+00 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.950
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.520
SPREAD-Ft.--T	=	8.492
Average Velocity-V-fps	=	2.101
FLOW in Gutter-CFS--Q	=	0.924
% Flow in Gutter-CFS	=	60.819
Velocity of Flow in Gutter-fps	=	2.536
Depth at Curb Line-Inches--d	=	2.062

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	2.800
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	26.729
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.311	0.473	0.920	1.393	0.127	91.65
10.000	0.570	0.866	0.624	1.490	0.030	98.03
15.000	0.773	1.175	0.344	1.519	0.001	99.91
20.000	0.916	1.393	0.127	1.520	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 39+90 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	4.450
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.747
SPREAD-Ft.--T	=	6.687
Average Velocity-V-fps	=	3.885
FLOW in Gutter-CFS--Q	=	1.251
% Flow in Gutter-CFS	=	71.622
Velocity of Flow in Gutter-fps	=	4.561
Depth at Curb Line-Inches--d	=	1.629

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	2.288
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	42.541
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.202	0.352	1.282	1.634	0.113	93.55
10.000	0.383	0.669	1.034	1.702	0.045	97.44
15.000	0.543	0.948	0.788	1.736	0.011	99.37
20.000	0.681	1.190	0.556	1.746	0.001	99.96

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 45+10 RT (BRIDGE)
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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.591
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.020
Gutter Depression-Inches--	=	0.490
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.220
SPREAD-Ft.--T	=	3.376
Average Velocity-V-fps	=	1.893
FLOW in Gutter-CFS--Q	=	0.200
% Flow in Gutter-CFS	=	90.889
Velocity of Flow in Gutter-fps	=	2.063
Depth at Curb Line-Inches--d	=	0.826

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	1.250
Grate Width---Ft.	=	1.920
Grate Area--Sq. Ft.	=	2.400
Capture Ratio -- GRATE	=	0.670
Effective Perimeter--Ft.	=	5.090
Splash-Over Velocity--FPS	=	5.090
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.220
GUTTER FLOW at INLET-CFS--Q	=	0.200
Gutter Velocity at INLET-fps	=	2.063
Depth at INLET Curb Line-Inches--d	=	0.826
Frontal Flow Intercepted by GRATE--CFS	=	0.197
Lateral Flow Intercepted by GRATE--CFS	=	0.002
TOTAL Flow Intercepted by GRATE--CFS	=	0.198
% FLOW Intercepted	=	90.178
By-pass Flow--CFS	=	0.022

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 45+60 RT (BRIDGE)
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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.267
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.041
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.041
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.041
Gutter Depression-Inches--	=	0.979
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.352
SPREAD-Ft.--T	=	2.677
Average Velocity-V-fps	=	2.408
FLOW in Gutter-CFS--Q	=	0.343
% Flow in Gutter-CFS	=	97.458
Velocity of Flow in Gutter-fps	=	2.507
Depth at Curb Line-Inches--d	=	1.311

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	1.250
Grate Width---Ft.	=	1.920
Grate Area--Sq. Ft.	=	2.400
Capture Ratio -- GRATE	=	0.670
Effective Perimeter--Ft.	=	5.090
Splash-Over Velocity--FPS	=	5.090
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	0.352
GUTTER FLOW at INLET-CFS--Q	=	0.343
Gutter Velocity at INLET-fps	=	2.507
Depth at INLET Curb Line-Inches--d	=	1.311
Frontal Flow Intercepted by GRATE--CFS	=	0.340
Lateral Flow Intercepted by GRATE--CFS	=	0.002
TOTAL Flow Intercepted by GRATE--CFS	=	0.342
% FLOW Intercepted	=	97.070
By-pass Flow--CFS	=	0.010

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-20-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101
LOCATION - RAMP 91A STA 46+10 RT (BRIDGE)
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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.942
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.058
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.058
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.058
Gutter Depression-Inches--	=	1.392
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.230
SPREAD-Ft.--T	=	3.536
Average Velocity-V-fps	=	3.392
FLOW in Gutter-CFS--Q	=	1.097
% Flow in Gutter-CFS	=	89.187
Velocity of Flow in Gutter-fps	=	3.729
Depth at Curb Line-Inches--d	=	2.461

GRATE TYPE: NON-STD. GRATE

Grate Length--Ft.	=	1.250
Grate Width---Ft.	=	1.920
Grate Area--Sq. Ft.	=	2.400
Capture Ratio -- GRATE	=	0.670
Effective Perimeter--Ft.	=	5.090
Splash-Over Velocity--FPS	=	5.090
Local Gutter Depression-Inches	=	0.000
Flow-CFS--Q	=	1.230
GUTTER FLOW at INLET-CFS--Q	=	1.097
Gutter Velocity at INLET-fps	=	3.729
Depth at INLET Curb Line-Inches--d	=	2.461
Frontal Flow Intercepted by GRATE--CFS	=	1.078
Lateral Flow Intercepted by GRATE--CFS	=	0.010
TOTAL Flow Intercepted by GRATE--CFS	=	1.088
% FLOW Intercepted	=	88.461
By-pass Flow--CFS	=	0.142

ARIZONA DEPARTMENT OF TRANSPORTATION
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HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91A STA 55+00 RT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.840
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.031
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.031
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.062
SPREAD-Ft.--T	=	4.457
Average Velocity-V-fps	=	4.893
FLOW in Gutter-CFS--Q	=	1.934
% Flow in Gutter-CFS	=	93.807
Velocity of Flow in Gutter-fps	=	5.351
Depth at Curb Line-Inches--d	=	2.735

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	8.489
Depth at INLET Curb Line-Inches--d	=	3.592
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	24.492
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.337	0.695	1.367	2.062	0.000	100.00
10.000	0.611	1.260	0.802	2.062	0.000	100.00
15.000	0.818	1.688	0.374	2.062	0.000	100.00
20.000	0.953	1.965	0.097	2.062	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91A STA 58+95 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.650
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.520
SPREAD-Ft.--T	=	5.012
Average Velocity-V-fps	=	3.828
FLOW in Gutter-CFS--Q	=	1.423
% Flow in Gutter-CFS	=	93.587
Velocity of Flow in Gutter-fps	=	4.260
Depth at Curb Line-Inches--d	=	2.603

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Splash-Over Velocity--FPS	=	8.489
Depth at INLET Curb Line-Inches--d	=	3.434
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	19.279
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.417	0.635	0.885	1.520	0.000	100.00
10.000	0.732	1.112	0.408	1.520	0.000	100.00
15.000	0.933	1.419	0.101	1.520	0.000	100.00
20.000	1.000	1.520	0.000	1.520	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.- _____
HIGHWAY NAME- SR101L DESIGNER - _____
LOCATION - RAMP 91B STA 101+26 RT CHECKER - _____ PAGE _____
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.520
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.578
SPREAD-Ft.--T	=	9.648
Average Velocity-V-fps	=	1.691
FLOW in Gutter-CFS--Q	=	0.873
% Flow in Gutter-CFS	=	55.307
Velocity of Flow in Gutter-fps	=	2.066
Depth at Curb Line-Inches--d	=	2.339

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	3.111
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.462
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.350	0.553	0.881	1.434	0.144	90.87
10.000	0.632	0.997	0.551	1.548	0.030	98.12
15.000	0.840	1.326	0.251	1.577	0.001	99.96
20.000	0.968	1.528	0.050	1.578	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS TRACS NO.-
HIGHWAY NAME- SR101L DESIGNER -
LOCATION - RAMP 91B STA 105+00 RT CHECKER - PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.520
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.735
SPREAD-Ft.--T	=	9.999
Average Velocity-V-fps	=	1.731
FLOW in Gutter-CFS--Q	=	0.934
% Flow in Gutter-CFS	=	53.812
Velocity of Flow in Gutter-fps	=	2.122
Depth at Curb Line-Inches--d	=	2.424

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	3.204
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	24.658
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.335	0.581	0.965	1.546	0.189	89.11
10.000	0.608	1.055	0.631	1.686	0.049	97.18
15.000	0.815	1.414	0.319	1.733	0.002	99.86
20.000	0.950	1.649	0.086	1.735	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-23-2000

PROJECT NAME- 91ST AVE RAMPS
HIGHWAY NAME- SR101L
LOCATION - RAMP 91B STA 110+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.531
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	8.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.021
Gutter Depression-Inches--	=	0.624
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.495
SPREAD-Ft.--T	=	6.204
Average Velocity-V-fps	=	1.278
FLOW in Gutter-CFS--Q	=	0.371
% Flow in Gutter-CFS	=	75.045
Velocity of Flow in Gutter-fps	=	1.485
Depth at Curb Line-Inches--d	=	1.513

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--C15.91

Grate Length--Ft.	=	3.354
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.171
Splash-Over Velocity--FPS	=	8.494
Depth at INLET Curb Line-Inches--d	=	2.142
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	13.060
Capture Ratio -- SLOTTED DRAIN	=	0.500
Capture Ratio -- GRATE	=	0.670

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.581	0.287	0.208	0.495	0.000	99.98
10.000	0.927	0.459	0.036	0.495	0.000	100.00
15.000	1.000	0.495	0.000	0.495	0.000	100.00
20.000	1.000	0.495	0.000	0.495	0.000	100.00

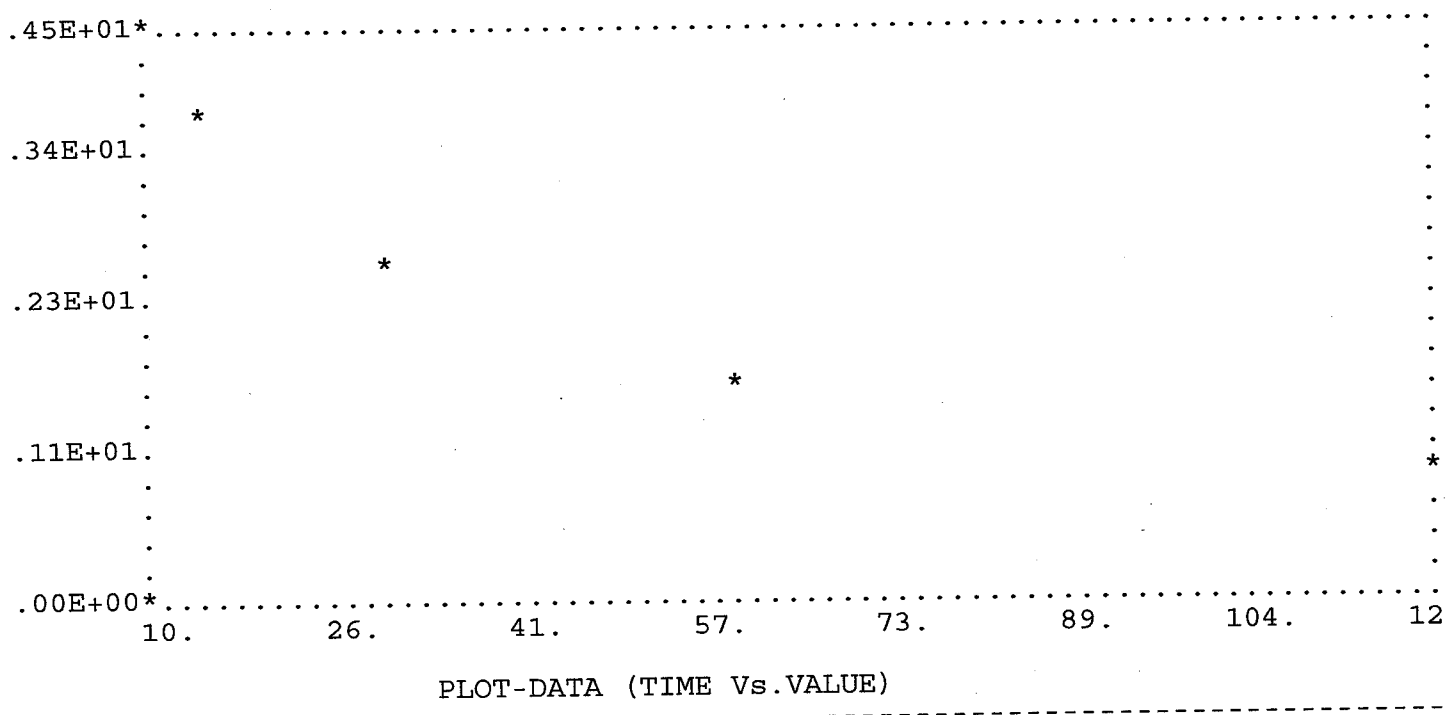
APPENDIX D

HYDRAIN MODEL INPUT / OUTPUT

SD OUTLET TO CHANNEL RAMP 91B STA 101+26

```
+++ Commands Read From File C:\HYDRA\91HYD01.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.52 15 3.80 30 2.56 60 1.59 120 0.87
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.52	120.	.87	0.	.00	0.	.00	0.	.00
15.	3.80	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.56	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.59	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1139.00
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT RAMP 91A STA 31+28 LT
  STO0.315 0.95 10
  PIP60 1139.87 1139.66 1134.74 1134.44 18
+++ Tc =  10.0 min
+++ CA =     .3
+++ Link #  1,  Flow depth =     .43 ft
```

SD OUTLET TO CHANNEL RAMP 91B STA 101+26

```
  PNC1 2 3 0 0
  REMCB AT RAMP 91B STA 101+26 RT
  STO0.271 0.95 10
  PIP5 1139.66 1140.56 1133.94 1133.915 24
+++ Tc =  10.3 min
+++ CA =     .6
+++ Link #  2,  Flow depth =     .54 ft
  PNC2 3 0 45 1
  PIP32 1140.56 1140.00 1133.915 1133.755 24
+++ Tc =  10.3 min
+++ CA =     .6
+++ Link #  3,  Flow depth =     .54 ft
  PNC3 4 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CHANNEL RAMP 91B STA 101+26

***

Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	60	18	1134.74 1134.44	.00500	5.1 5.2	3.5	3.2 4.2	1.35 7.45	0.
2	5	24	1133.94 1133.92	.00500	5.7 6.6	3.6	3.7 5.1	2.49 16.05	0.
3	32	24	1133.92 1133.76	.00500	6.6 6.2	4.1	3.7 5.1	2.49 16.04	0.

Length = 97. ft Total length = 97. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CHANNEL RAMP 91B STA 101+26

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1139.09	1135.94	Y	1139.66	Y	5.15	.74
2	3	1139.01	1135.92	Y	1140.56	Y	5.10	.00
3	4	1139.00	1135.76	Y	1140.00	Y	.00	.00

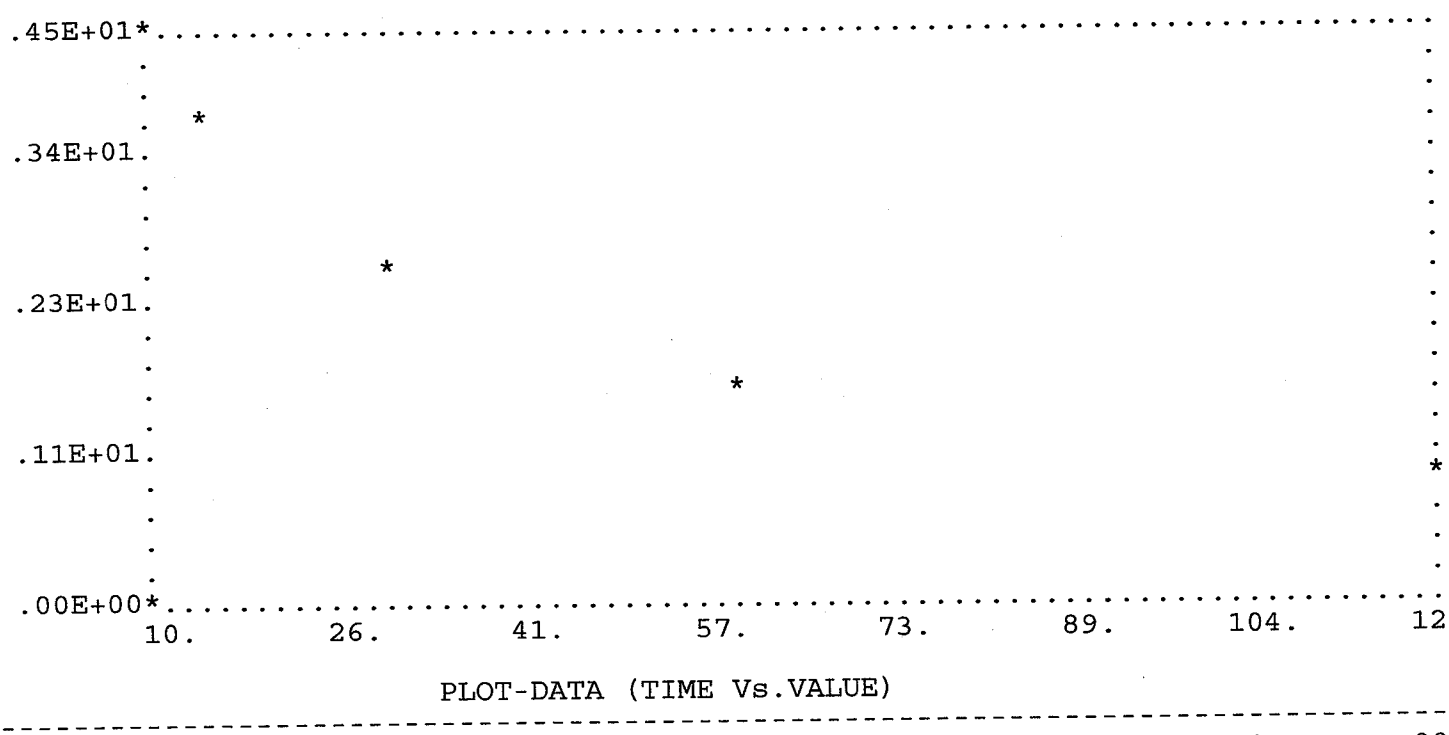
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1139.36	1139.87	1.50

NORMAL END OF HYDRA

SD OUTLET TO CHANNEL RAMP 91B STA 105+00

```
+++ Commands Read From File C:\HYDRA\91HYD02.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.52 15 3.80 30 2.56 60 1.59 120 0.87
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.52	120.	.87	0.	.00	0.	.00	0.	.00
15.	3.80	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.56	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.59	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1139.75
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT RAMP 91A STA 35+00 LT
  STO0.261 0.95 10
  PIP36 1141.89 1140.75 1138.38 1138.27 18
+++ Tc =  10.0 min
+++ CA =    .2
+++ Cover at lower manhole     .86 ft
```

SD OUTLET TO CHANNEL RAMP 91B STA 105+00

```
+++ Link #  1,  Flow depth =    .45 ft
  PNC1 2 3 0 0
  REMCB AT RAMP 91B STA 105+00 LT
  STO0.612 0.74 10
  PIP36 1140.75 1141.69 1138.27 1138.16 18
+++ Tc =  10.2 min
+++ CA =    .7
+++ Cover at upper manhole     .86 ft
+++ Link #  2,  Flow depth =    .80 ft
  PNC2 3 3 0 0
  REMCB AT RAMP 91B STA 105+00 RT
  STO0.298 0.95 10
  PIP36 1142.05 1141.26 1138.38 1138.26 24
+++ Tc =  10.4 min
+++ CA =   1.0
+++ Cover at lower manhole     .83 ft
+++ Link #  3,  Flow depth =    .80 ft
  PNC3 4 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CHANNEL RAMP 91B STA 105+00

***

Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	36	18	1138.38	.00306	3.5	.9	2.5	1.12	0.
			1138.27		2.5		3.3	5.82	
2	36	18	1138.27	.00305	2.5	.9	3.4	3.14	0.
			1138.16		3.5		3.3	5.82	
3	36	24	1138.38	.00333	3.7	.8	3.8	4.39	0.
			1138.26		3.0		4.2	13.10	

Length = 108. ft Total length = 108. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CHANNEL RAMP 91B STA 105+00

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1140.10	1139.77	Y	1140.75	N	1.74	1.06
2	3	1139.90	1139.66	Y	1142.05	N	1.45	.62
3	4	1139.75	1140.26	N	1141.26	N	.00	.00

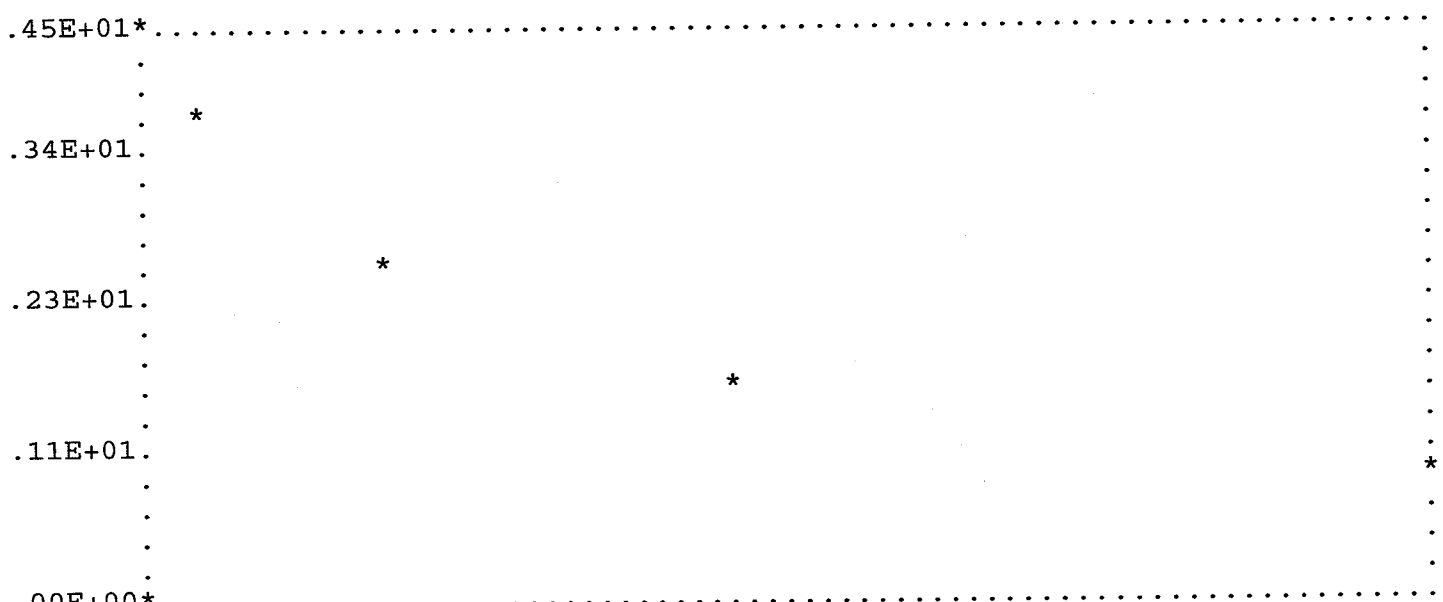
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1140.27	1141.89	1.50

NORMAL END OF HYDRA

SD OUTLET TO CHANNEL RAMP 91B STA 110+00

```
+++ Commands Read From File C:\HYDRA\91HYD03.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.52 15 3.80 30 2.56 60 1.59 120 0.87
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.52	120.	.87	0.	.00	0.	.00	0.	.00
15.	3.80	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.56	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.59	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1140.85
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT RAMP 91A STA 39+90 LT
  STO0.300 0.95 10
  PIP84 1154.90 1142.50 1140.08 1139.66 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Cover at lower manhole    1.21 ft
```

SD OUTLET TO CHANNEL RAMP 91B STA 110+00

```
+++ Link #  1,  Flow depth =    .43 ft
  PNC1 2 3 0 0
  REMCB AT RAMP 91B STA 110+00 LT
  STO1.194 0.74 10
  PIP46 1142.50 1144.37 1139.56 1139.33 18
+++ Tc =  10.4 min
+++ CA =   1.2
+++ Cover at upper manhole    1.31 ft
+++ Link #  2,  Flow depth =    .93 ft
  PNC2 3 3 0 0
  REMCB AT RAMP 91B STA 110+00 RT
  STO0.085 .95 10
  PIP36 1144.37 1142.76 1139.23 1139.05
+++ Tc =  10.6 min
+++ CA =   1.2
+++ Link #  3,  Flow depth =    .98 ft
  PNC3 4 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CHANNEL RAMP 91B STA 110+00

***

Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	84	18	1140.08	.00500	14.8	1.2	3.2	1.29	0.
			1139.66		2.8		4.2	7.45	
2	46	18	1139.56	.00500	2.9	1.3	4.6	5.21	0.
			1139.33		5.0		4.2	7.45	
3	36	18	1139.23	.00500	5.1	2.1	4.6	5.54	0.
			1139.05		3.7		4.2	7.45	

Length = 166. ft Total length = 166. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CHANNEL RAMP 91B STA 110+00

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1141.62	1141.16	Y	1142.50	Y	1.89	1.06
2	3	1141.24	1140.83	Y	1144.37	Y	1.83	1.06
3	4	1140.85	1140.55	Y	1142.76	N	.00	.00

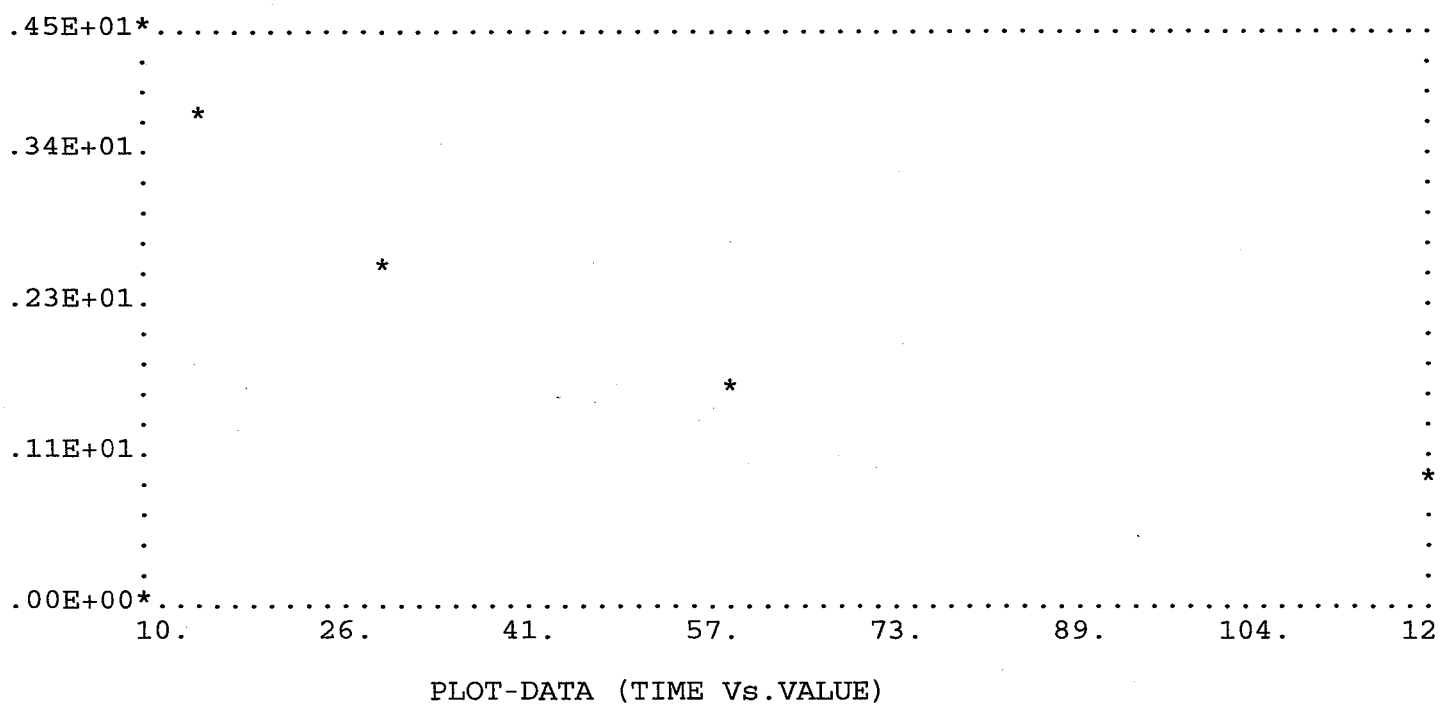
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1141.89	1154.90	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM RAMP 91A STA 45+10

```
+++ Commands Read From File C:\HYDRA\91HYD04.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.52 15 3.80 30 2.56 60 1.59 120 0.87
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.52	120.	.87	0.	.00	0.	.00	0.	.00
15.	3.80	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.56	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.59	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1137.50
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT RAMP 91A STA 46+10 RT
  STO0.212 0.95 10
  PIP50 1177.50 1176.76 1172.50 1171.76 8
+++ Tc =  10.0 min
+++ CA =    .2
+++ Link #  1,  Flow depth =    .36 ft
```

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM RAMP 91A STA 45+10

```
  PNC1 2 3 0 0
  REMCB AT RAMP 91A STA 45+60 RT
  STO0.035 0.95 10
  PIP50 1176.76 1175.91 1171.76 1170.91 8
+++ Tc =  10.2 min
+++ CA =    .2
+++ Link #  2,  Flow depth =    .37 ft
  PNC2 3 3 0 0
  REMCB AT RAMP 91A STA 45+10 RT
  STO0.035 0.95 10
  PIP136 1175.91 1142.00 1138.60 1137.24 18
+++ Tc =  10.4 min
+++ CA =    .3
+++ Link #  3,  Flow depth =    .35 ft
  PNC3 4 3 90 0
  REMCB AT RAMP 91A STA 45+10 150' RT
  STO0.500 0.74 10
  PIP170 1142.00 1142.00 1136.74 1135.89 24
+++ Tc =  10.9 min
+++ CA =    .6
+++ Link #  4,  Flow depth =    .58 ft
  PNC4 5 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM RAMP 91A STA 45+10

*** Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	50	9	1172.50	.01480	5.0	4.2	4.4	.91	0.
			1171.76		5.0		4.6	2.02	
2	50	9	1171.76	.01700	5.0	4.2	4.9	1.05	0.
			1170.91		5.0		4.9	2.16	
3	136	18	1138.60	.01000	37.3	3.1	4.0	1.20	0.
			1137.24		4.8		6.0	10.53	
4	170	24	1136.74	.00500	5.3	3.1	3.8	2.80	0.
			1135.89		6.1		5.1	16.04	

Length = 406. ft Total length = 406. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM RAMP 91A STA 45+10

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1172.51	1172.51	Y	1176.76	Y	.56	1.04
2	3	1171.28	1171.66	N	1175.91	Y	1.44	9.04
3	4	1137.65	1138.74	N	1142.00	Y	.91	.61
4	5	1137.50	1137.89	N	1142.00	Y	.00	.00

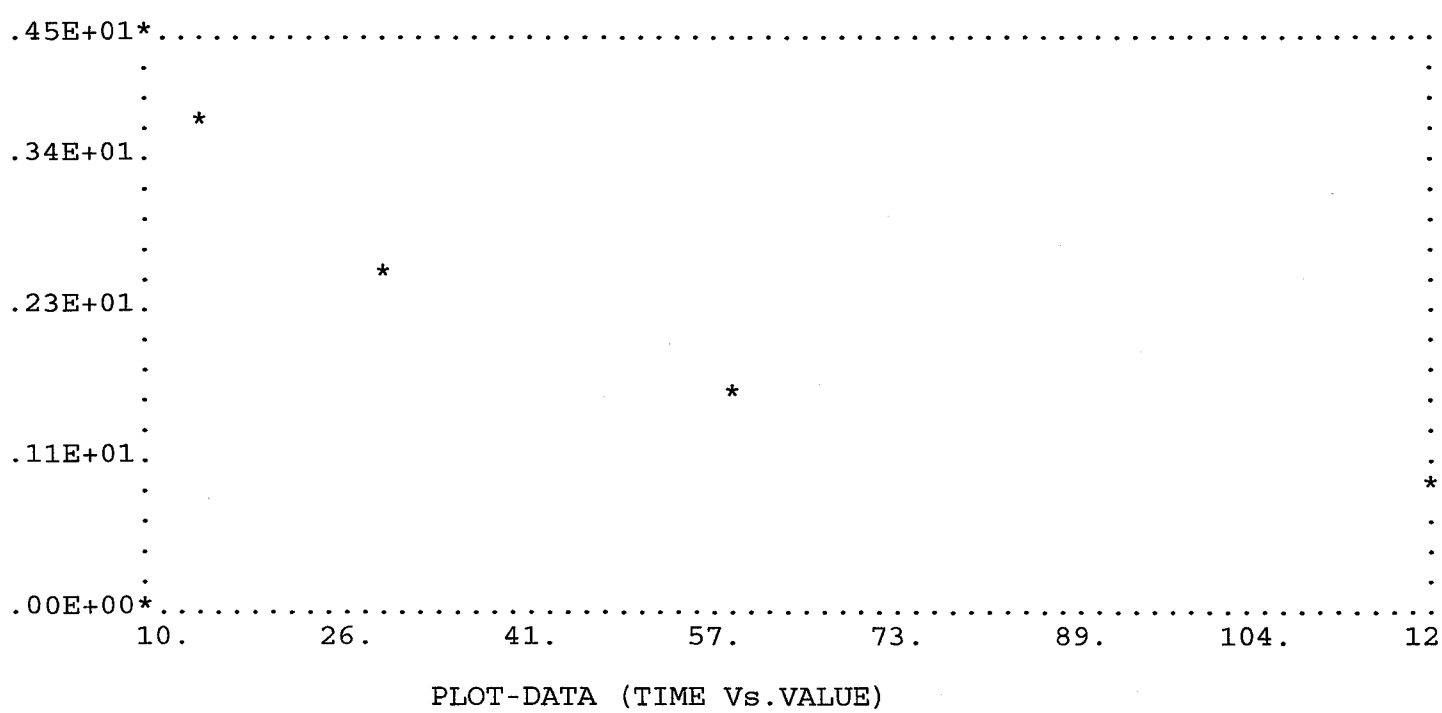
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1173.31	1177.50	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXIST DITCH RAMP 91A STA 55+00

```
+++ Commands Read From File C:\HYDRA\91HYD05.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.52 15 3.80 30 2.56 60 1.59 120 0.87
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.52	120.	.87	0.	.00	0.	.00	0.	.00
15.	3.80	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.56	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.59	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1140.00
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT RAMP 91A STA 55+00 RT
  STO0.418 0.95 10
  PIP112 1169.30 1145.50 1145.12 1144.00 18
+++ Tc =  10.0 min
+++ CA =    .4
+++ Cover at lower manhole    -.13 ft
```

SD OUTLET TO EXIST DITCH RAMP 91A STA 55+00

```
+++ Link #  1,  Flow depth =    .42 ft
  PNC1 2 0 0 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXIST DITCH RAMP 91A STA 55+00

***

Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	112	18	1145.12	.01000	24.2	-.1	4.4	1.79	0.
			1144.00		1.5		6.0	10.53	

Length = 112. ft Total length = 112. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXIST DITCH RAMP 91A STA 55+00

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1144.42	1145.50	N	1145.50	Y	.00	.00

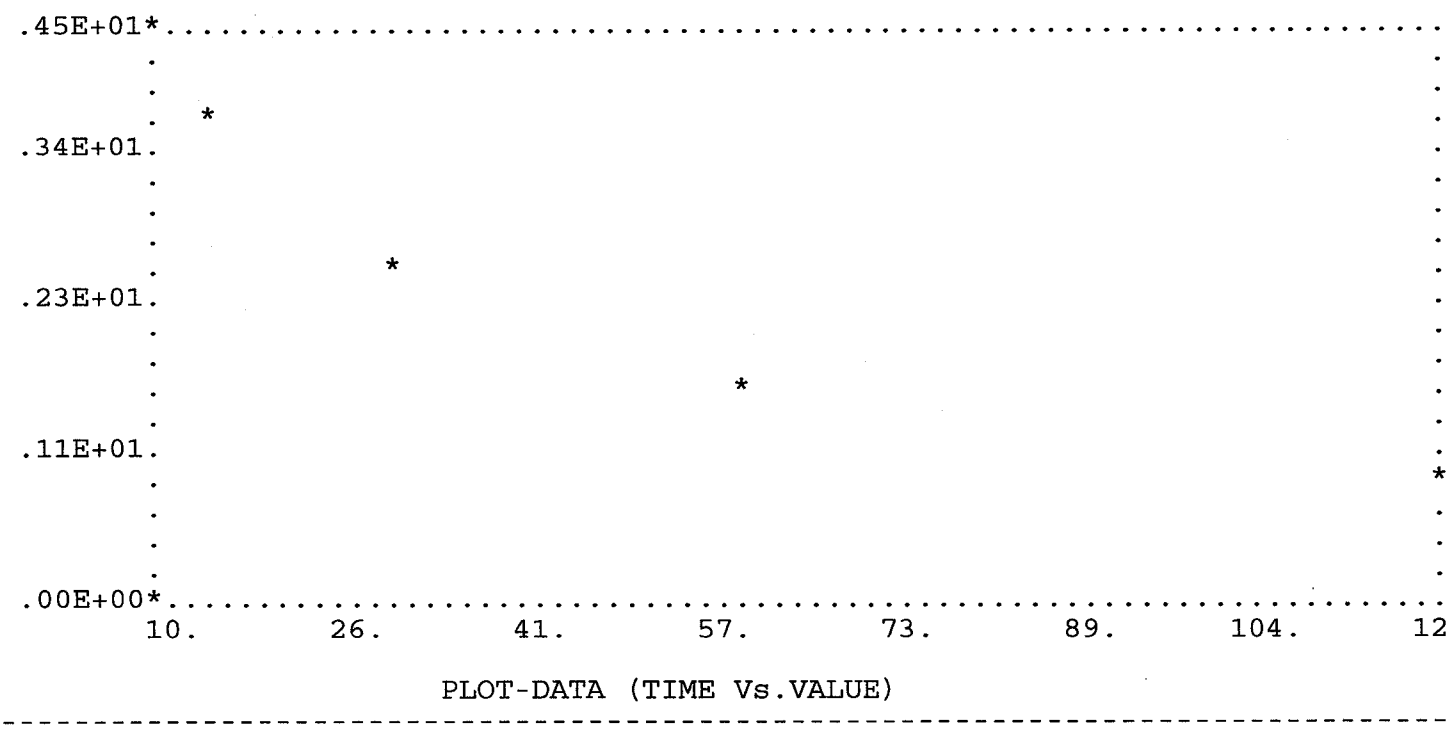
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1146.00	1169.30	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXIST DITCH RAMP 91A STA 58+95

```
+++ Commands Read From File C:\HYDRA\91HYD06.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.52 15 3.80 30 2.56 60 1.59 120 0.87
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.52	120.	.87	0.	.00	0.	.00	0.	.00
15.	3.80	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.56	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.59	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1140.00
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT RAMP 91A STA 58+95 RT
  STO0.280 0.95 10
  PIP54 1155.34 1146.50 1145.56 1145.00 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Cover at lower manhole    -.13 ft
```

SD OUTLET TO EXIST DITCH RAMP 91A STA 58+95

```
+++ Link #  1,  Flow depth =    .35 ft
  PNC1 2 0 0 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXIST DITCH RAMP 91A STA 58+95

*** Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	54	18	1145.56	.01037	9.8	-.1	4.0	1.20	0.
			1145.00		1.5		6.1	10.73	

Length = 54. ft Total length = 54. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXIST DITCH RAMP 91A STA 58+95

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1145.34	1146.50	N	1146.50	Y	.00	.00

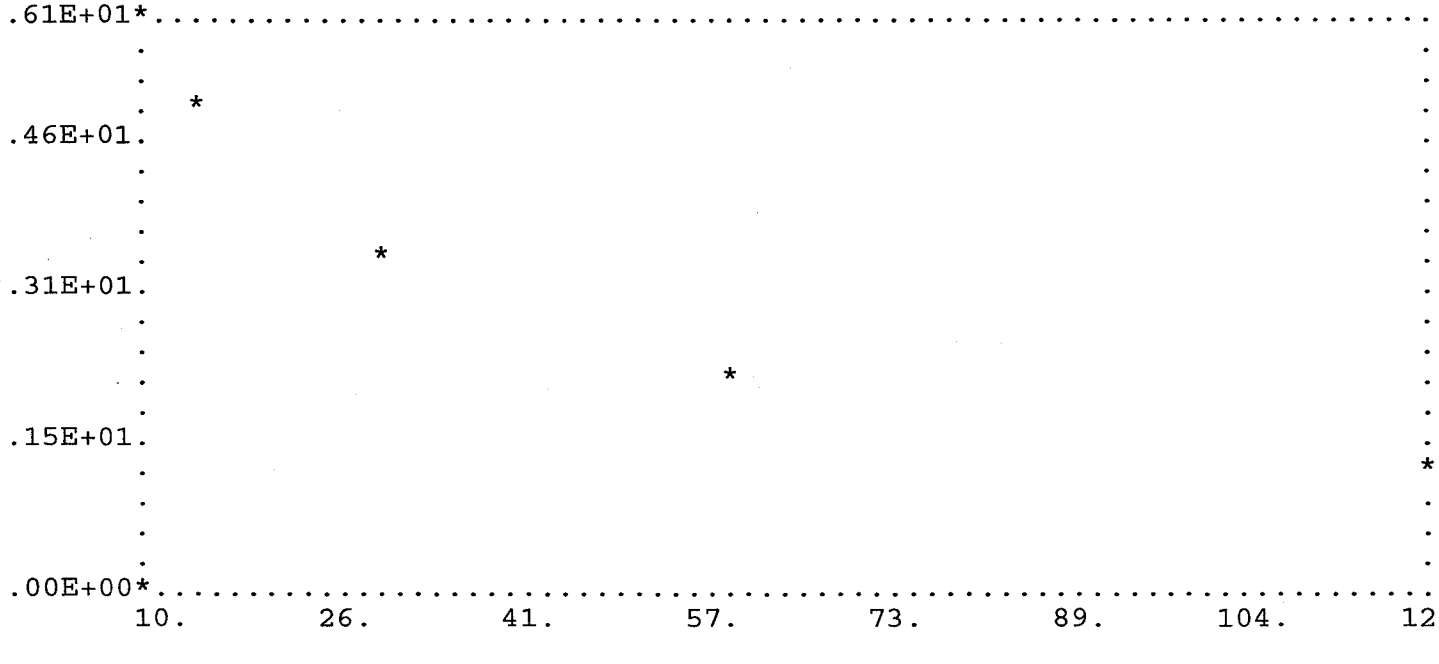
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1146.27	1155.34	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM CACTUS RD

```
+++ Commands Read From File C:\HYDRA\CACTUS.HDA
  JOB
  SWI2
  REMRDDF FOR 50 YEAR EVENT
  RAI10 6.13 15 5.23 30 3.54 60 2.21 120 1.21
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	6.13	120.	1.21	0.	.00	0.	.00	0.	.00
15.	5.23	0.	.00	0.	.00	0.	.00	0.	.00
30.	3.54	0.	.00	0.	.00	0.	.00	0.	.00
60.	2.21	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1126.50
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMOUTLET FROM RAMP 91B INTERCEPTOR CHANNEL
  STO105 0.15 10
  PIP79.2 1140.00 1138.80 1132.00 1131.37 48
+++ Tc =  10.0 min
+++ CA =  15.8
+++ Link #  1,  Flow depth =   2.60 ft
```

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM CACTUS RD

```
  PNC1 2 5 45 0
  PIP527 1138.80 1135.50 1131.37 1127.15 48
+++ Tc =  10.1 min
+++ CA =  15.8
+++ Link #  2,  Flow depth =   2.60 ft
  PNC2 3 5 0 0
  PIP527 1135.50 1137.00 1127.15 1122.93 48
+++ Tc =  10.9 min
+++ CA =  15.8
+++ Link #  3,  Flow depth =   2.56 ft
  PNC3 4 5 30 0
  PIP103.5 1137.00 1137.00 1122.93 1122.11 48
+++ Tc =  11.7 min
+++ CA =  15.8
+++ Link #  4,  Flow depth =   2.52 ft
  PNC4 5 0 60 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM CACTUS RD

***

Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	79	48	1132.00	.00795	8.0	3.1	11.2	96.55	0.
			1131.37		7.4		10.2	128.46	
2	527	48	1131.37	.00801	7.4	3.1	11.3	96.21	0.
			1127.15		8.3		10.3	128.89	
3	527	48	1127.15	.00801	8.3	4.0	11.2	94.00	0.
			1122.93		14.1		10.3	128.89	
4	104	48	1122.93	.00792	14.1	9.7	11.1	91.78	0.
			1122.11		14.9		10.2	128.21	

Length = 1237. ft Total length = 1237. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXIST AGUA FRIA CHANNEL FROM CACTUS RD

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1135.96	1135.37	Y	1138.80	Y	3.58	1.02
2	3	1131.68	1131.15	Y	1135.50	Y	3.53	1.02
3	4	1128.65	1126.93	Y	1137.00	Y	4.72	1.04
4	5	1126.50	1126.11	Y	1137.00	Y	.00	.00

Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1139.01	1140.00	1.50

NORMAL END OF HYDRA

APPENDIX E

HEC-1 / HEC-RAS MODELS

```
1****************************************                    ***********************************
*                                      *                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS
*           SEPTEMBER 1990             *                    *   HYDROLOGIC ENGINEERING CENTER
*            VERSION 4.0               *                    *        609 SECOND STREET
*                                      *                    *      DAVIS, CALIFORNIA 95616
*  RUN DATE  01/05/1980  TIME  13:09:16 *                    *          (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


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

  1           ID
  2           ID   GRAND AVE AT 91ST AVE RAMP
  3           ID   MODEL FOR OFFSITE AREA DRAINING TO 91ST AVE / CACTUS ROAD INTERSECTION
  4           ID   EARTH TECH FILE : MV91-ET.DAT
              *DIAGRAM
  5           IT      30                     100
  6           IO       5
  7           IN      30
  8           JD    3.46    0.01
  9           PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
 10           PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
 11           PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
 12           PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
 13           PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
 14           PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
 15           PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
 16           PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
 17           PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
 18           PC    .983    .986    .989    .992    .995    .998   1.000
 19           JD    3.46   10.00
              *
              *

 20           KK     CP1
 21           KM    DRAINAGE AREA IS 106 ACRES TO NORTHEAST OF SITE
 22           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 23           BA   .1668
 24           LG    .450    .250   3.500    .150  15.000
```

```
25          UC   .5153   .3540
26          UA       0       5      16      30      65      77      84      90      94      97
27          UA     100
            *
28          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

   20        CP1

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *            SEPTEMBER 1990             *
 *             VERSION 4.0               *
 *                                       *
 *  RUN DATE  01/05/1980  TIME  13:09:16 *
 *                                       *
 *****************************************
```

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

```
                    GRAND AVE AT 91ST AVE RAMP
                    MODEL FOR OFFSITE AREA DRAINING TO 91ST AVE / CACTUS ROAD INTERSECTION
                    EARTH TECH FILE : MV91-ET.DAT

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

    IT        HYDROGRAPH TIME DATA
                     NMIN         30  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1    0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        100  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      3    0  ENDING DATE
                   NDTIME       0130  ENDING TIME
                    ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL     .50 HOURS
                     TOTAL TIME BASE   49.50 HOURS

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

  8 JD        INDEX STORM NO. 1
                    STRM       3.46  PRECIPITATION DEPTH
                    TRDA        .01  TRANSPOSITION DRAINAGE AREA

  9 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	.01	.01	.00	.01	.00	.01
.01	.00	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.02	.02	.02	.03	.10	.28	.04	.03
.02	.02	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00				

19 JD INDEX STORM NO. 2

STRM 3.46 PRECIPITATION DEPTH

TRDA 10.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.01	.01	.00	.01	.00	.01
.01	.00	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.02	.02	.02	.03	.10	.28	.04	.03
.02	.02	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00				

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	CP1	94.	24.00	21.	6.	3.	.17		

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

GRAND AVE. AT 91 ST AVE INTERCHANGE
CROSS-SECTION - COLLECTOR CHANNEL 2:1 SIDESLOPES & 8FT BOTTOMWIDTH

STA:	.00	5.00	13.00	18.00
ELEV:	2.50	.00	.00	2.50

DISCHARGE = 94. WSEL = 1.37 SLOPE = .0030

SECTION AND SUBSECTION HYDRAULIC DATA

	TOTAL SECTION	SUBSECTION #: 1
DISCHARGE (CFS) =	94.16	94.16
VELOCITY (FT/S) =	6.42	6.42
AREA (SQUARE FT) =	14.66	14.66
TOPWIDTH (FT) =	13.46	13.46
DEPTH (FT) =	1.37	1.37
HYD. DEPTH (FT) =	1.09	1.09
WET. PERIM. (FT) =	14.11	14.11
HYD. RADIUS (FT) =	1.04	1.04
FROUDE NUMBER =	1.08	1.08
MANNINGS N VALUE =	.0130	.0130

SUBSECTION 1 = STATION .00 TO STATION 18.00

GRAND AVE. AT 91 ST AVE INTERCHANGE
CROSS-SECTION - COLLECTOR CHANNEL 3:1 SIDESLOPES & 4FT BOTTOMWIDTH

STA:	.00	7.50	11.50	19.00
ELEV:	2.50	.00	.00	2.50

DISCHARGE = 94. WSEL = 1.65 SLOPE = .0030

SECTION AND SUBSECTION HYDRAULIC DATA

	TOTAL SECTION	SUBSECTION #: 1
DISCHARGE (CFS) =	94.04	94.04
VELOCITY (FT/S) =	6.36	6.36
AREA (SQUARE FT) =	14.79	14.79
TOPWIDTH (FT) =	13.91	13.91
DEPTH (FT) =	1.65	1.65
HYD. DEPTH (FT) =	1.06	1.06
WET. PERIM. (FT) =	14.44	14.44
HYD. RADIUS (FT) =	1.02	1.02
FROUDE NUMBER =	1.09	1.09
MANNINGS N VALUE =	.0130	.0130

SUBSECTION 1 = STATION .00 TO STATION 19.00

CALCULATE Tc & R FOR AREA DRAINING TO NE CORNER OF 91ST AVE AND CACTUS RD.

SUMMARY OF INPUT PARAMETERS

AREA ID	A (SQmi)	L (mi)	LC (Mi)	S (ft/mi)	RTIMP
CP#1	0.1668	0.663	0.331	23	10

SUMMARY OF RESULTS

AREA ID	TC (HRS)	TR (HRS)
CP#1	0.5153	0.3541

APPENDIX F

30% DRAINAGE PLANS

HEC-RAS September 1998 Version 2.2
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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

PROJECT DATA
Project Title: 91st Ave
Project File : 91StAve.prj
Run Date and Time: 10/23/00 8:07:28 PM

Project in English units

PLAN DATA

Plan Title: Plan 01
Plan File : C:\HEC\RAS\91StAve.p01

Geometry Title: 91StAve Interceptot channel
Geometry File : C:\HEC\RAS\91StAve.g01

Flow Title : Flow 01
Flow File : C:\HEC\RAS\91StAve.f01

Plan Summary Information:

Number of:	Cross Sections	= 7	Mulitple Openings	=	0
	Culverts	= 0	Inline Weirs	=	0

Bridges = 0

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

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

FLOW DATA

Flow Title: Flow 01
Flow File : C:\HEC\RAS\91StAve.f01

Flow Data (cfs)

River	Reach	RS	PF 1
interceptor	chan1	11143	94

Boundary Conditions

River	Reach	Profile	Up stream	Downstream
interceptor	chan1	PF 1	Norma l S = .0022	Critical

GEOMETRY DATA

```
Geometry Title: 91StAve Interceptot channel
Geometry File : C:\HEC\RAS\91StAve.g01

CROSS SECTION          RIVER: interceptor chan
REACH: 1                  RS: 11143

INPUT
Description: sta 111+43
Station Elevation Data     num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1142.36       9 1139.36      13 1139.36      22 1142.36

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .013       0    .013      22    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff
Contr.   Expan.
             0      22              143     143     143
  .1       .3

CROSS SECTION          RIVER: interceptor chan
REACH: 1                  RS: 11000

INPUT
Description: sta 110+00
Station Elevation Data     num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1142.05       9 1139.05      13 1139.05      22 1142.05

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .013       0    .013      22    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff
Contr.   Expan.
             0      22              100     100     100
  .1       .3

CROSS SECTION          RIVER: interceptor chan
REACH: 1                  RS: 10900

INPUT
Description: sta 109+00
Station Elevation Data     num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1141.83       9 1138.83      13 1138.83      22 1141.83
```

```
Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .013       0    .013       22    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff
Contr.   Expan.
             0      22               200     200     200
  .1       .3

CROSS SECTION           RIVER: interceptor chan
REACH: 1                   RS: 10700

INPUT
Description: sta 107+00
Station Elevation Data      num=        4
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0 1141.39       9 1138.39       13 1138.39       22 1141.39

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .013       0    .013       22    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff
Contr.   Expan.
             0      22               200     200     200
  .1       .3

CROSS SECTION           RIVER: interceptor chan
REACH: 1                   RS: 10500

INPUT
Description: sta 105+00
Station Elevation Data      num=        4
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0 1140.95       9 1137.95       13 1137.95       22 1140.95

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .013       0    .013       22    .013

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff
Contr.   Expan.
             0      22               200     200     200
  .1       .3

CROSS SECTION           RIVER: interceptor chan
```

REACH: 1 RS: 10300

INPUT
Description: sta 103+00
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1140.51	9	1137.51	13	1137.51	22	1140.51

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.013	0	.013	22	.013

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	22	183	183	183	.1	.3

CROSS SECTION RIVER: interceptor chan
REACH: 1 RS: 10117

INPUT
Description: sta 101+17
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1140.11	9	1137.11	13	1137.11	22	1140.11

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.013	0	.013	22	.013

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	22	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:interceptor chan

Reach	River Sta.	n1	n2	n3
1	11143	.013	.013	.013
1	11000	.013	.013	.013
1	10900	.013	.013	.013

1	10700	.013	.013	.013
1	10500	.013	.013	.013
1	10300	.013	.013	.013
1	10117	.013	.013	.013

SUMMARY OF REACH LENGTHS

River: interceptor chan

Reach	River Sta.	Left	Channel	Right
1	11143	143	143	143
1	11000	100	100	100
1	10900	200	200	200
1	10700	200	200	200
1	10500	200	200	200
1	10300	183	183	183
1	10117	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: interceptor chan

Reach	River Sta.	Contr.	Expan.
1	11143	.1	.3
1	11000	.1	.3
1	10900	.1	.3
1	10700	.1	.3
1	10500	.1	.3
1	10300	.1	.3
1	10117	.1	.3

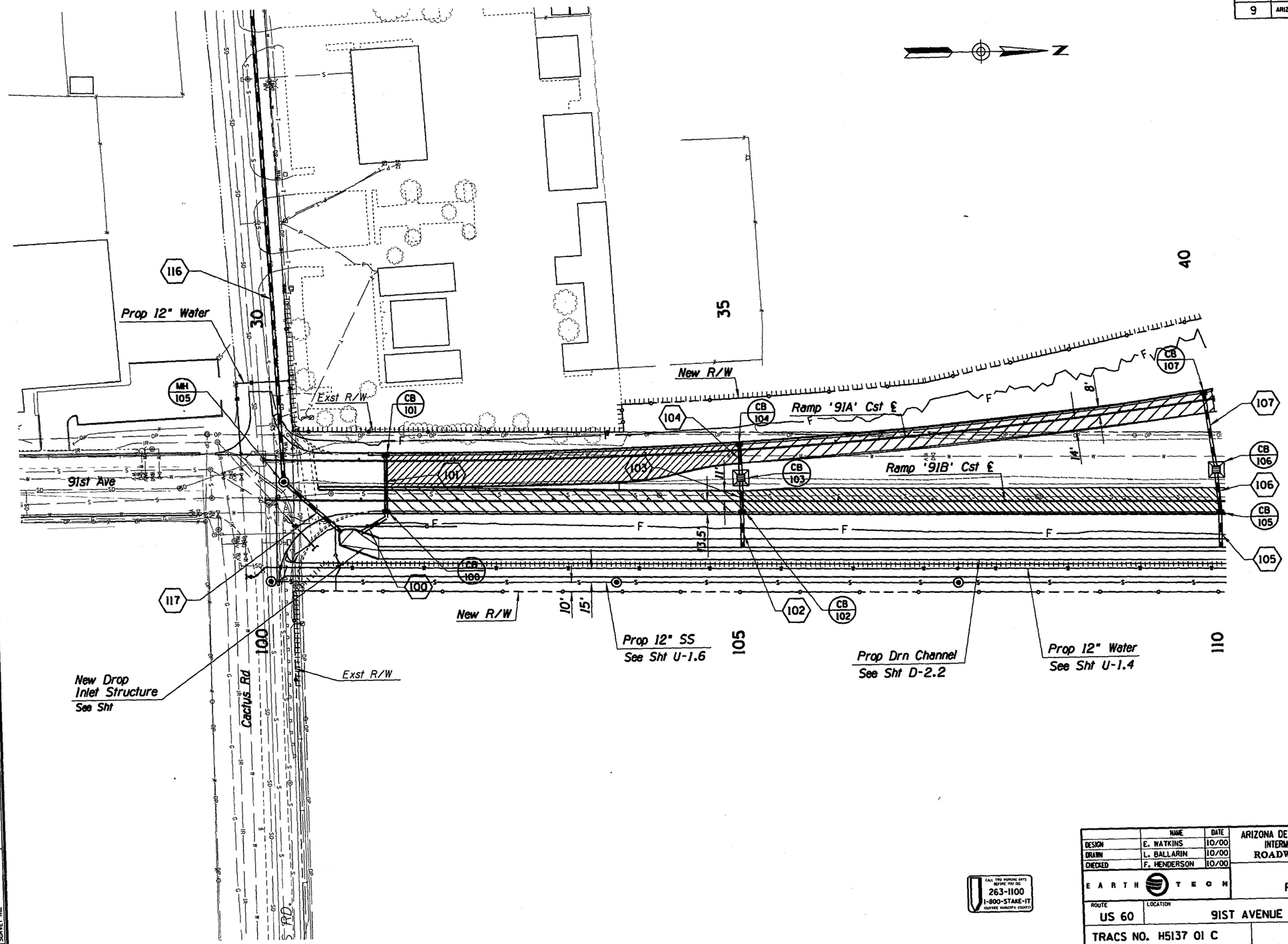
HEC-RAS Plan: Plan 01 River: interceptor chan Reach: 1

Reach	River Sta	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)	
1	11143	94.00	1139.36	1141.14		1141.64	0.002176	5.65	16.64	14.69	0.93
1	11000	94.00	1139.05	1140.83		1141.33	0.002201	5.67	16.57	14.66	0.94
1	10900	94.00	1138.83	1140.61		1141.11	0.002200	5.67	16.58	14.66	0.94
1	10700	94.00	1138.39	1140.17		1140.67	0.002198	5.67	16.58	14.66	0.94
1	10500	94.00	1137.95	1139.72	1139.67	1140.23	0.002233	5.70	16.48	14.62	0.95
1	10300	94.00	1137.51	1139.35		1139.80	0.001887	5.36	17.54	15.05	0.87
1	10117	94.00	1137.11	1138.82	1138.82	1139.38	0.002564	6.00	15.66	14.28	1.01

APPENDIX F

60% DRAINAGE PLANS

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B-503			
		060 MA 160			



CALL TWO WORKING DAYS BEFORE YOU DIG
263-1100
1-800-STAKE-IT
(OUTSIDE MARICOPA COUNTY)

	NAME	DATE
DESIGN	E. WATKINS	10/00
DRAWN	L. BALLARIN	10/00
CHECKED	F. HENDERSON	10/00

EARTH TECH

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

DRAINAGE PLAN
RAMPS 91A & 91B

ROUTE: US 60
LOCATION: 91ST AVENUE RAMPS - 101L

TRACS NO. H5137 01 C
060-B-503

PRELIMINARY
60%
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-1.1
___ OF ___

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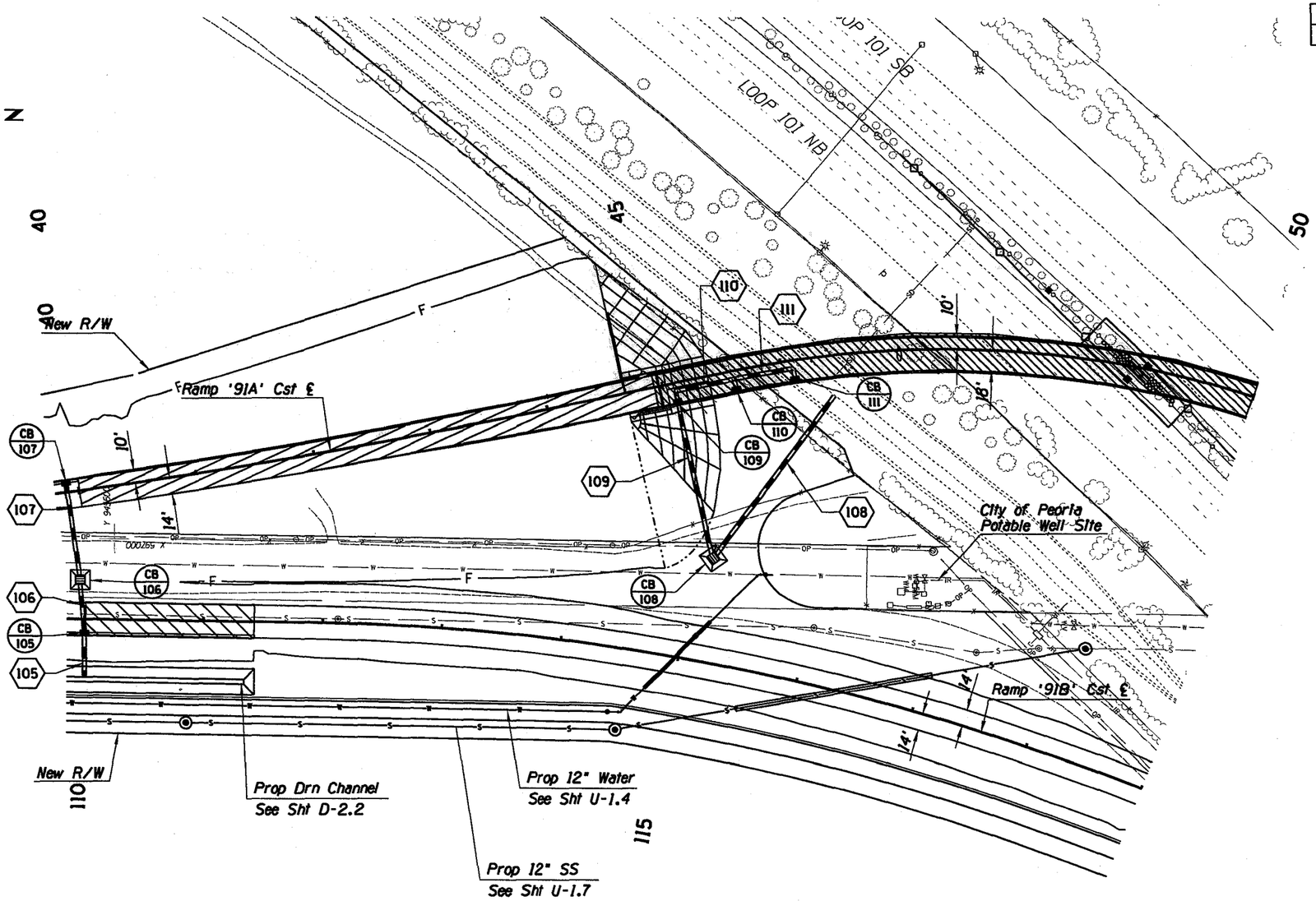
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B-503			

060 MA 160



CALL TWO WORKING DAYS BEFORE YOU DIG
263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

	NAME	DATE
DESIGN	E. WATKINS	10/00
DRAWN	L. BALLARIN	10/00
CHECKED	F. HENDERSON	10/00

EARTH TECH

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

DRAINAGE PLAN
RAMPS 91A & 91B

ROUTE: US 60
LOCATION: 91ST AVENUE RAMPS - 101L

TRACS NO. H5137 01 C
060-B-503

PRELIMINARY
60%
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-1.2
___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

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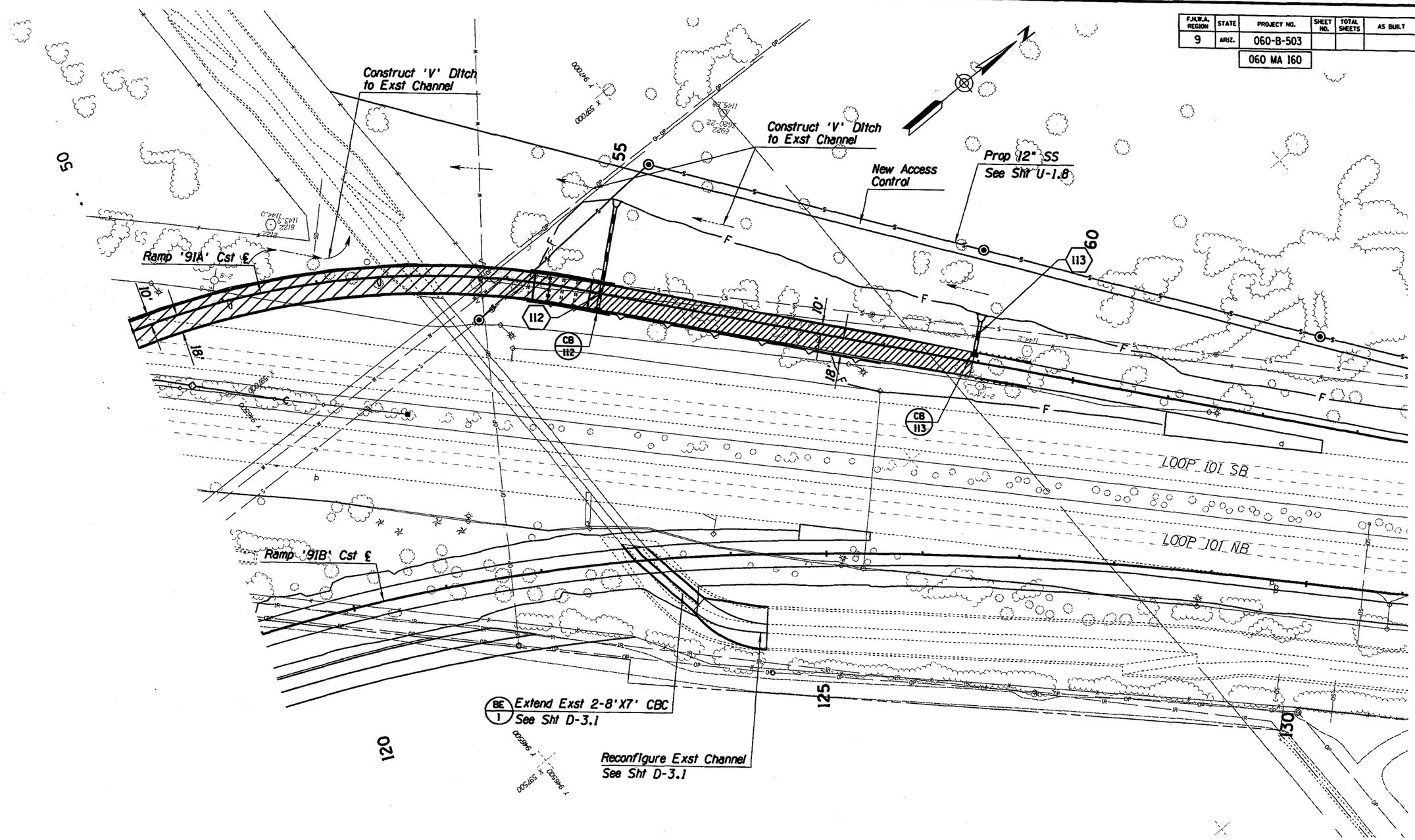
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B-503			
		060 MA 160			



	NAME	DATE	ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION ROADWAY DESIGN SERVICES	PRELIMINARY 60% NOT FOR CONSTRUCTION OR RECORDING
DESIGN	E. WATKINS	10/00		
DRAWN	L. BALLARIN	10/00		
CHECKED	F. HENDERSON	10/00		
EARTH TECH			DRAINAGE PLAN RAMPS 91A & 91B	
ROUTE US 60	LOCATION 91ST AVENUE RAMPS - 101L			DWG. NO. D-1.3
TRACS NO. H5137 01 C			060-B-503	___ OF ___

CALL TWO WORKING DAYS BEFORE YOU DIG 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

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