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FINAL DRAINAGE REPORT

Prepared for:

ARIZONA DEPARTMENT OF TRANSPORTATION

ADOT

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1.0 Introduction

1.1 Purpose

This report documents the storm water analysis and conveyance system design for the Grand Avenue grade separation project at the 27th Avenue and Thomas Road intersection. This report summarizes the design criteria, the design procedures, the on site storm water drainage analysis and the off site storm water runoff analysis.

1.2 Project Area

The project is located in the City of Phoenix, Maricopa County, Arizona. The construction limits extend approximately one-half mile either side of the 27th Avenue and Thomas Road intersection on Grand Avenue (US 60 Milepost 160.4). (See Figure 1.) The project site is within the developed City of Phoenix area and includes small commercial enterprise as well as single dwelling residential units. The surrounding area will not incur additional development since the area is completely developed. The existing flow patterns will not be affected by future development.

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 the Grand Avenue intersection with 27th Avenue and Thomas Road include elevating Grand Avenue over Thomas Road, 27th Avenue and the BNSF railroad spur.

The storm water collection system improvements will intercept the off site runoff north of Street Connector 27D in an open channel and collect the runoff from the new pavements in catch basins and storm drains. The storm water will be through a concrete box culvert to two new detention facilities located at the northwest corner of the Thomas Road intersection with 26th Avenue and at the southwest corner of the Thomas Road intersection with I-17. The new detention facilities will provide compensatory storage for the flood water volume displaced by the Grand Avenue embankment. The new detention basin capacities will lower the existing flood water surface elevation since the total capacity provided exceeds the flood water volume displaced by the new Grand Avenue embankment.

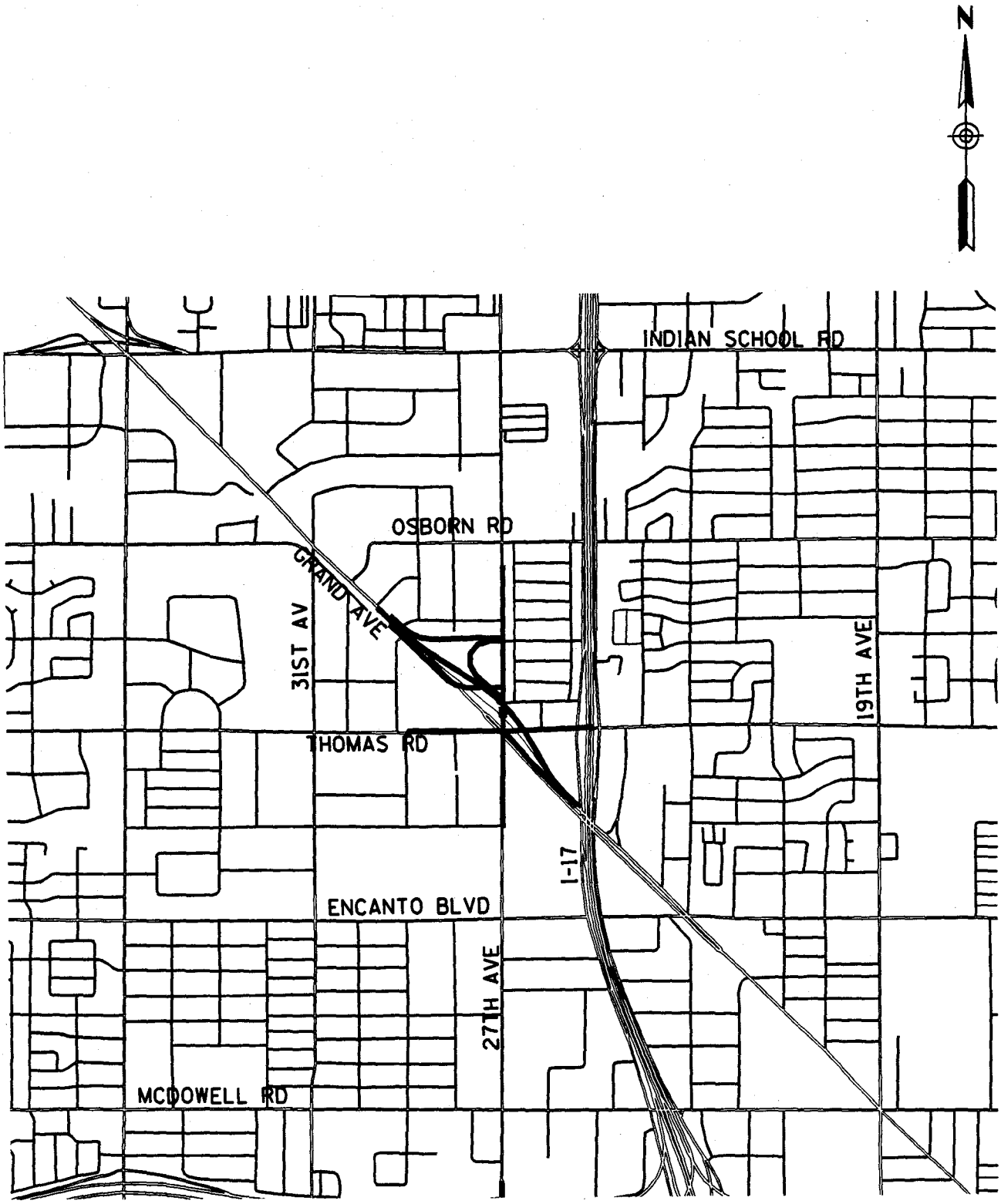

FIGURE 1

VICINITY MAP – GRAND AVENUE – THOMAS RD / 27TH AVE

2.0 Drainage

2.1 Existing Conditions

This project is located in 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 in November 1997. The natural drainage pattern for the area is generally northeast to southwest at an approximate 0.4 percent grade. The primary land use within the drainage area is urbanized single-family residential. Small commercial and industrial businesses are located along the BNSF railroad and Grand Avenue corridor.

The land area surrounding the project area has exhibited a flooding history. The BNSF Railroad track bed and urban development block the natural drainage pattern and diverts the storm water runoff along Grand Avenue to the I-17 frontage road and eventually overtops onto the I-17 corridor. Stormwater runoff from the minor rain events flows within the street sections and is captured by the local storm drain systems. However, the storm drain system capacity is exceeded during major storm events resulting in overland flow throughout the area with localized ponding.

The watershed is interrupted north of the project site by the Grand Canal which traverses from east to west approximately 0.6 mile north of Thomas Road. The canal intercepts and conveys minor storm water runoff from the north. The watershed south of the Grand Canal that is immediately tributary to the 27th Avenue intersection is less than 0.2 square miles. The tributary area topography is shown on Figure 2. The HEC model for this project site reflects only the area south of the Grand Canal since this area is tributary to the project site for the design event. Unless the Grand Canal is breached by a major event, the local runoff from the project watershed is modest and localized ponding results from blockages caused by the existing urban development and BNSF Railroad.

History indicates the Grand Canal is breached by storm water from major (100 year) storm events. The major event runoff greatly increases the water surface elevations in the immediate project area. The storm event that will overtop the Grand Canal and the breach locations are outside the project watershed and the scope of this analysis.

The only storm drain conveyance system out of the project area is a 66 inch diameter pipe in 27th Avenue that drains to the south across Grand Avenue and the BNSF railroad spur. The 36 inch diameter pipe in Thomas Road from the west and the 18 inch diameter pipe from the east in Thomas Road connect to the 66 inch pipe in the Grand Avenue intersection. The 54 inch diameter pipe in Grand Avenue from the east and the 30 inch diameter pipe from the west in Grand Avenue connect to the 66inch diameter pipe in the Grand Avenue intersection.

2.2 *Maryvale ADMS*

The project area was analyzed and modeled as part of the *Maryvale ADMS* for the Flood Control District of Maricopa County (FCDMC) in 1997. The *Maryvale ADMS* identified a history of flooding and ponding along the Grand Avenue near the 27th intersection. The flooding is created by the elevated BNSF Railroad bed. The stormwater runoff will pond along the Grand Avenue and BNSF corridor and eventually spill into the I-17 frontage road.

The *Maryvale ADMS* identified several mitigation alternatives in the project area and recommended a detention basin north east of the Thomas Road intersection with 27th Avenue to mitigate the flood waters. The study recommended a detention basin to capture the storm water runoff and eliminate the flooding resulting from a breach of the Grand Canal. The detention facility was not funded since the estimated property acquisition for the detention basin was approximately the same area subject to the flood water.

The *Maryvale ADMS* estimated the existing storm drain capacities are adequate for the 2 year to 10 year events.

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)
Single Lane Street Connector
4 feet (4-foot shoulder)
Multi-Lane Street Connector
10 feet (4-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
This project is classified as a non-freeway project. All catch basin grates are ADOT standard C-15.50 to meet the ADOT's bicycle and pedestrian safe requirement for urban non freeway projects. The project will utilize standard ADOT catch basins at the following locations:

Barrier Rails	C-15.92
Curb and Gutter	C-15.30
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 *HDD*M, 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 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 developed 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 4.43 inches per hour. The 50-year rainfall intensity for a 10-minute time of concentration is 5.97 inches per hour. Rainfall IDF 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 calculations 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, distress lane, and one-half of the adjacent lane. This equates to a maximum allowable spread for Grand Avenue of 16 feet along the outside lanes and 10 feet for the median. Since the street connector widths 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 Grand Avenue curb height is six 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 6 inches along the segment of pavement with a 4.5% cross slope results in an allowable spread of 11.2 feet which is less than the lane spread criteria. 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 cross slope segment. Catch basin locations were determined based on the drainage area required to generate that discharge.

The allowable spread shall not exceed the width of the roadway gutter, shoulder, parking lane and distress lane plus the adjacent lane or 22 total feet for the 50 year storm.

ADOT Standard C-15.30 catch basins were used along Grand Avenue and street collectors where Type D 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 sloped areas. These catch basins will be located during final design for the open areas behind the curbs.

Slotted drain lengths are given in 5-foot increments with a 10 foot minimum length. 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 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. A 0.016 pipe roughness coefficients was used for all computations. 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. Calculations are included in Appendix D.

Some of the new pavement runoff will be conveyed to the existing storm drains in Grand Avenue. The existing Grand Avenue pavement area drains to the existing storm drains. The runoff conveyed to the existing Grand Avenue storm drains from the relocated Grand Avenue pavements is less than the runoff currently conveyed to the existing storm drains. The hydraulic calculations for this situation are shown in Appendix E.

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 was 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 *HDDM*, 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 3.38 inches.

4.1.2 Rainfall Losses

The methodology used to estimate rainfall losses is based upon procedures given in Chapter 3 of the *HDDM*, Hydrology, ADOT Report #FHWA-AZ93-281 (March 1993). This method requires estimation of the surface retention loss and the estimation of 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 of the same reference.

4.1.3 Rainfall/Runoff Procedures

The HEC-1 hydrologic model was used to determine the 50 year, 24 hour event. The HEC-1 model that was developed as a part of the *Maryvale ADMS* was utilized in establishing the offsite flows for the project areas. The HEC-1 model for the Maryvale ADMS was amended to analyze only the area south of the Grand Canal tributary to the Grand Avenue/27th Avenue interchange. In addition, the model was amended to identify three points of concentration for offsite flows intersecting the interchange ramps and drainage facilities. The watershed areas draining to the Grand Avenue/27th Avenue intersection are shown on Figure 2.

4.1.4 HEC-1 Model Results

The peak flow rate at each of the defined concentration points within the project area is given in Table 1. For the Grand Avenue intersection with 27th Avenue, the combined flow for each of the concentration points which will be collectively intercepted by proposed drainage facilities is 293 cfs. HEC-1 model input/output and hydraulic calculations are provided in Appendix F.

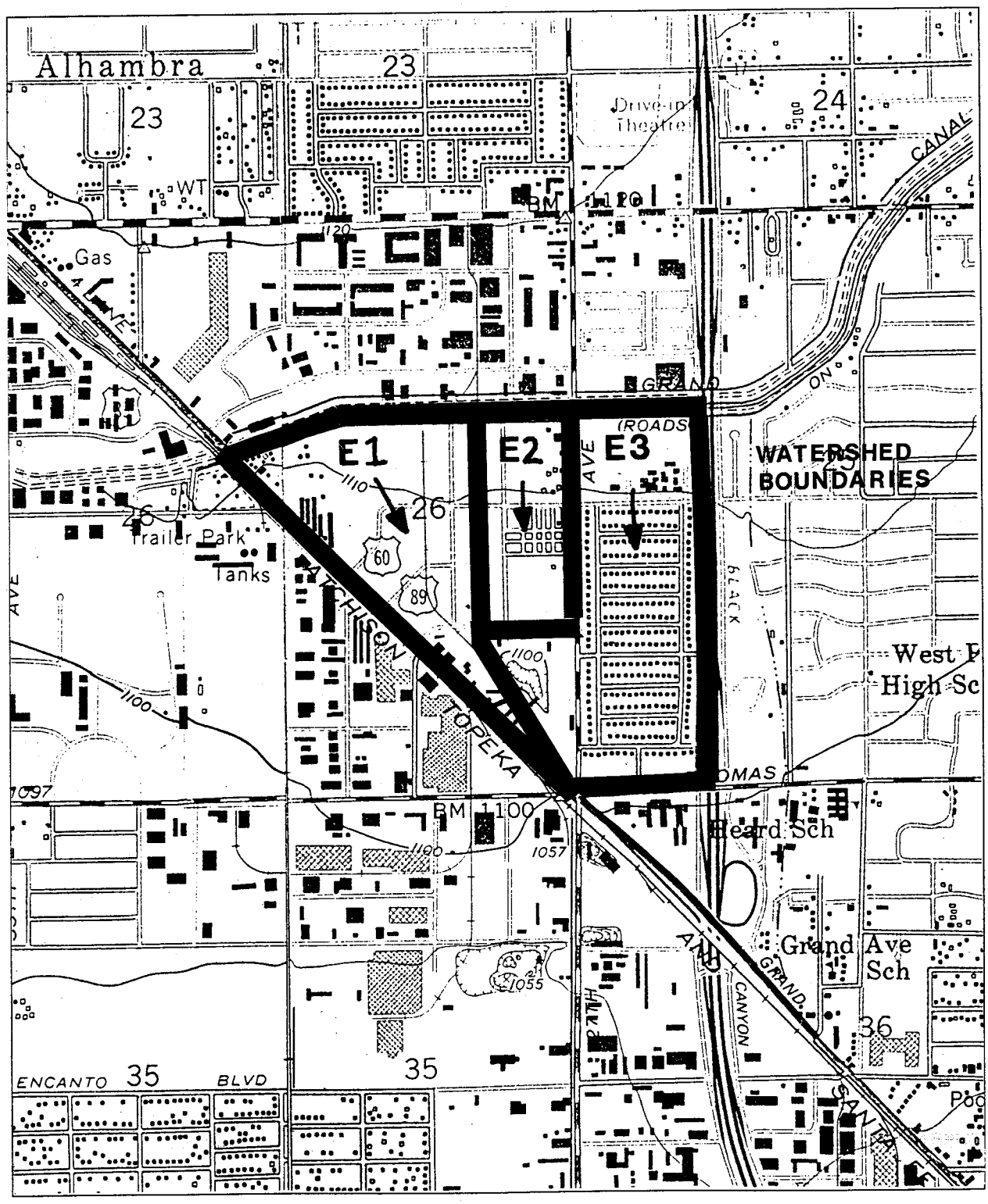

FIGURE 2

GRAND AVENUE – THOMAS ROAD / 27TH AVENUE WATERSHED MAP

Table 1 – Summary of Discharge Rates

Concentration Point	Drainage Area	50-Year Discharge
26-22E1	0.091 sq. mi.	69 cfs
26-22E2	0.074 sq. mi.	89 cfs
26-22E3	0.134 sq. mi.	135 cfs
C26-22E	0.299 sq. mi.	293 cfs

4.2 Recommended Drainage Collection Facilities

The preliminary drainage report for *Grand Avenue at 27th Avenue/Thomas Road Design Concept Report* prepared by URS Greiner (May 2, 2000) recommended offsite drainage improvements that were influenced by the fact that the project will require 204,000 cubic yards of earth for embankment construction. The intent was to maximize the onsite source of material and the need for a regional detention facility as identified in the Maryvale ADMS. The concept report further recommended the new detention system must, at a minimum, replace the theoretical ponding storage displaced by the new Grand Avenue embankment (approximately 18 acre-feet).

The storm water collection and conveyance system shown on the plans in Appendix G is generally consistent with the concept drainage report. The small detention basin facilities identified in the concept report have been combined into two large basins on each side of Thomas Road. The proposed storm water system will convey the off site flows and the on site pavement runoff to the detention basins in a single cell concrete box culvert.

The proposed interceptor channel along the north side of Street Connector D has an 8 feet wide bottom, 2:1 side slopes and a depth that varies from 1.9 feet to 5.0 feet. The channel west of the railroad spur (concentration point 26-22E1) collects off site storm water (69 cfs) and conveys it under the railroad spur through two 30 inch diameter reinforced concrete pipes (RCP). The channel continues approximately 100 feet to a drop inlet and combines with the off site storm water (concentration point 26-22E2) flow (89 cfs). The total flow under Street Connector D is 158 cfs.

The combined off site storm water flow crosses under Street Connector D in a 6 foot by 4 foot concrete box culvert. The 6 foot by 4 foot box culvert increases to a 6 foot by 6 foot box culvert between Street Connector D and Street Connector B. The 6 foot by 6 foot CBC continues south east across Street Connector B, 27th Avenue and Verde Lane. The box culvert discharges into a concrete lined open channel between Verde Lane and Thomas Road. The channel bottom is 8 foot wide with 2:1 side slopes and a depth that varies between 6.5 foot to 8 foot. The discharge channel provides 1 foot freeboard for the 50 year event and discharges into the smaller detention basin north of Thomas Road. The smaller detention basin is connected to the larger detention basin on the south side of Thomas Road by a 5 foot by 6 foot box culvert across Thomas Road. Channel and box culvert outlets will include rip rap for erosion protection.

The HEC-1 model included an analysis of the peak flow reduction benefits of the detention basins. Specifically, the model included an analysis of the 293 cfs flow to the basin during the 50-year, 24-hour return period storm. The detention basin outlet is a 24 inch diameter pipe with an 18 inch orifice which connects to the existing 66-inch storm drain in 27th Avenue. The detention routing analysis results determined that the 293 cfs peak runoff rate is attenuated by the detention basins and reduced to 25 cfs during the 50 year storm event. This analysis assumes the 66-inch storm drain has capacity available to accommodate the 25 cfs detention basin outflow. The existing 66 inch diameter storm drain in 27th Avenue capacity is approximately 160 cfs. Storm water flow in the 66 inch storm drain must recede from the full flow condition of 160 cfs by 25 cfs to accommodate the detention basin discharge.

The detention basin north of Thomas Road is approximately 9 feet deep for an approximate total storage capacity of 9.3 acre-feet. The detention basin south of Thomas Road is approximately 13 feet deep for an approximate total storage capacity of 50.2 acre-feet. The total detention volume provided by the new basins (59.5 acre-feet) is approximately 32% of the detention volume (192 acre-feet) identified in the Maryvale ADMS. The HEC-1 routing analysis determined the 50 year, 24 hour storm event water depth in the large basin is approximately 9 feet and the water depth in the small basin is approximately 5 feet. Therefore, each basin provides approximately 4 feet of freeboard for storm water detention until flow in the 66 inch diameter storm drain recedes from 160 cfs full flow condition to approximately 135 cfs to accept the 25 cfs detention basin outflow. Storm events in excess of the 50 year 24 hour event will spill into the I-17 frontage road similar to existing conditions.

Offsite runoff from watershed 26-22E3 (area east of 27th Avenue) will conveyed into the detention basins with curb cut spillways along Thomas Road.

APPENDIX A

RAINFALL I-D-F COMPUTATION SHEETS

GRAND AVENUE - THOMAS ROAD/27TH AVE

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	$P_{100,6'}$	3.1
100-year, 24-hour	$P_{100,24'}$	3.8

PART B

Compute the following:

2-year, 1-hour	$P_{2,1'}$	0.96
100-year, 1-hour	$P_{100,1'}$	2.40
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	$P_{100,2'}$	2.64
100-year, 3-hour	$P_{100,3'}$	2.80
100-year, 12-hour	$P_{100,12'}$	3.45

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	$P_{100,5''}$	0.72
100-year, 10-minute	$P_{100,10''}$	1.11
100-year, 15-minute	$P_{100,15''}$	1.42
100-year, 30-minute	$P_{100,30''}$	1.92

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	$P_{5,5''}$	0.42
10-min	$P_{5,10''}$	0.64
15-min	$P_{5,15''}$	0.79
30-min	$P_{5,30''}$	1.06
1-hour	$P_{5,1'}$	1.31
2-hour	$P_{5,2'}$	1.44
3-hour	$P_{5,3'}$	1.52
6-hour	$P_{5,6'}$	1.67
12-hour	$P_{5,12'}$	1.84
24-hour	$P_{5,24'}$	2.00

Selected frequency = 10 year		X = 0.496 Y = 0.449
5-min	$P_{10,5''}$	0.49
10-min	$P_{10,10''}$	0.74
15-min	$P_{10,15''}$	0.93
30-min	$P_{10,30''}$	1.25
1-hour	$P_{10,1'}$	1.55
2-hour	$P_{10,2'}$	1.70
3-hour	$P_{10,3'}$	1.80
6-hour	$P_{10,6'}$	1.99
12-hour	$P_{10,12'}$	2.19
24-hour	$P_{10,24'}$	2.40

Selected frequency = 25 year		X = 0.293	Y = 0.669
5-min	$P_{25,5''}$	0.58	
10-min	$P_{25,10''}$	0.88	
15-min	$P_{25,15''}$	1.12	
30-min	$P_{25,30''}$	1.52	
1-hour	$P_{25,1'}$	1.89	
2-hour	$P_{25,2'}$	2.07	
3-hour	$P_{25,3'}$	2.19	
6-hour	$P25_{5,6'}$	2.43	
12-hour	$P_{25,12'}$	2.69	
24-hour	$P_{25,24'}$	2.95	
Selected frequency = 50 year		X = 0.146	Y = 0.835
5-min	$P_{50,5''}$	0.65	
10-min	$P_{50,10''}$	0.99	
15-min	$P_{50,15''}$	1.27	
30-min	$P_{50,30''}$	1.72	
1-hour	$P_{50,1'}$	2.15	
2-hour	$P_{50,2'}$	2.36	
3-hour	$P_{50,3'}$	2.50	
6-hour	$P_{50,6'}$	2.76	
12-hour	$P_{50,12'}$	3.07	
24-hour	$P_{50,24'}$	3.38	
Selected frequency = 500 year		X = -0.337	Y = 1.381
5-min	$P_{500,5''}$	0.89	
10-min	$P_{500,10''}$	1.36	
15-min	$P_{500,15''}$	1.76	
30-min	$P_{500,30''}$	2.39	
1-hour	$P_{500,1'}$	3.00	
2-hour	$P_{500,2'}$	3.30	
3-hour	$P_{500,3'}$	3.50	
6-hour	$P_{500,6'}$	3.88	
12-hour	$P_{500,12'}$	4.33	
24-hour	$P_{500,24'}$	4.78	

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	0.42	0.49	0.58	0.65	0.72	0.89
10-min *	0.49	0.64	0.74	0.88	0.99	1.11	1.36
15-min	0.59	0.79	0.93	1.12	1.27	1.42	1.76
30-min *	0.79	1.06	1.25	1.52	1.72	1.92	2.39
1-hour	0.96	1.31	1.55	1.89	2.15	2.40	3.00
2-hour	1.04	1.44	1.70	2.07	2.36	2.64	3.30
3-hour	1.10	1.52	1.80	2.19	2.50	2.80	3.50
6-hour	1.20	1.67	1.99	2.43	2.76	3.10	3.88
12-hour	1.30	1.84	2.19	2.69	3.07	3.45	4.33
24-hour	1.40	2.00	2.40	2.95	3.38	3.80	4.78

* 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	5.04	5.82	6.93	7.80	8.65	10.63
10-min	2.93	3.82	4.43	5.30	5.97	6.63	8.17
15-min	2.38	3.18	3.73	4.49	5.08	5.67	7.03
30-min	1.57	2.13	2.51	3.03	3.44	3.85	4.78
1-hour	0.96	1.31	1.55	1.89	2.15	2.40	3.00
2-hour	0.52	0.72	0.85	1.04	1.18	1.32	1.65
3-hour	0.37	0.51	0.60	0.73	0.83	0.93	1.17
6-hour	0.20	0.28	0.33	0.40	0.46	0.52	0.65
12-hour	0.11	0.15	0.18	0.22	0.26	0.29	0.36
24-hour	0.06	0.08	0.10	0.12	0.14	0.16	0.20

APPENDIX B

HYDROLOGIC COMPUTATIONS

RATIONAL METHOD

10 -YEAR EVENT

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 98+25 LT (SAG)
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	=	4.430
Discharge-CFS--Q	=	1.326

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 98+75 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.305
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.284

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 100+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.257
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.082

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - GRAND AVE STA 100+00 RT CHECKER - PAGE
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.366
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.540

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 103+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.473
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.991

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- IS 60 DESIGNER -
LOCATION - GRAND AVE STA 103+00 RT CHECKER - PAGE
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.610
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	2.567

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 108+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.312
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.313

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 108+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.403
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.696

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 111+30 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.463
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.949

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 111+30 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.610
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	2.567

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 119+30 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.340
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.431

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 119+30 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.464
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.953

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 124+30 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.473
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.991

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 124+30 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.473
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.991

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 129+90 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.617
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	2.597

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 129+90 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.529
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	2.226

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - GRAND AVE STA 131+69.08 LT CHECKER - PAGE
Ver 3.40: December 1995 SAG.

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

DRAINAGE AREA--ACRES--A	=	0.551
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	2.319

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - GRAND AVE STA 121+69.08 RT CHECKER - PAGE
Ver 3.40: December 1995 (SAG)

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

DRAINAGE AREA--ACRES--A	=	0.664
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	2.794

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 134+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.225
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	0.947

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 134+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.241
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.014

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 130-48 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.378
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.591

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 130+48 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.378
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.591

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN A STA 3+60 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.074
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	0.311

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN A STA 8+60 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.260
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.094

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN A STA 10+60 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.203
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	0.854

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN B STA 7+50 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.343
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.444

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN B SIA 11+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.300
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.263

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN @ STA 12+33 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.327
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.376

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN C STA 0+40 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.165
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	0.694

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN C STA 5+50 RT (SAG)
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.331
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.393

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - SB CONN C STA 9+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.242
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.018

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN D STA 0+75 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.223
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	0.938

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE TRACS NO.- _____
HIGHWAY NAME- US 60 DESIGNER - _____
LOCATION - ST CONN D STA 6+80.18 RT CHECKER - _____ PAGE _____
Ver 3.40: December 1995 (SA 1)

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

DRAINAGE AREA--ACRES--A	=	0.459
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.932

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST COND D STA 6+80.18 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	1.079
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	3.537

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - THOMAS RD STA 22+27 RT CHECKER - PAGE
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.781
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	2.560

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - 27TH AVE STA 21+73 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.390
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	4.430
Discharge-CFS--Q	=	1.278

RATIONAL METHOD

50 -YEAR EVENT

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 98+25 LT (SAG)
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	=	5.970
Discharge-CFS--Q	=	1.787

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE 98+75 RT (SA-1)
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER -
PAGE

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

DRAINAGE AREA--ACRES--A	=	0.305
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.730

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 100+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.257
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.458

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 100+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.366
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.076

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 103+00 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.473
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.683

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 103+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.610
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	3.460

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US60 DESIGNER -
LOCATION - GRAND AVE STA 108+00 LT CHECKER - PAGE
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.312
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.770

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 108+00 RT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.403
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.286

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-26-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- U60
LOCATION - GRAND AVE STA 111+30 LT
Ver 3.40: December 1995

TRACS NO.-
DESIGNER -
CHECKER - PAGE

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

DRAINAGE AREA--ACRES--A	=	0.463
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.626

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 111+20 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.610
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	3.460

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 119+30 LT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.340
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.928

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 194+30 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.464
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.632

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 124+30 LT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.473
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.683

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE SIA 124+30 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.473
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.683

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 129+90 LT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.617
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	3.499

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 129+90 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.529
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	3.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 131+69.08 LT (SAG)
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.551
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	3.125

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE TRACS NO.- _____
HIGHWAY NAME- US60 DESIGNER - _____
LOCATION - GRAND AVE STA 131+69.08 RT (SAG) CHECKER - _____ PAGE _____
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*** RATIONAL EQN: Q=CIA ***

DRAINAGE AREA--ACRES--A	=	0.664
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	3.766

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 134+00 LT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.225
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.276

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 134+00 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.241
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.367

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 136+48 LT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.378
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.144

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 136+48 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.378
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.144

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN A STA 3+60 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.074
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	0.420

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST COMM A STA 8+60 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.260
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.475

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN @ STA 10+60 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.203
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.151

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN B STA 7450 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.343
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.945

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- CRUM AVE
HIGHWAY NAME- US60
LOCATION - ST COUNT B STA 11+00 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.300
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.701

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN B STA 12+33 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.327
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.855

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN C STA 0+40 LT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.165
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	0.936

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN C STA 5+50 RT (SKC1)
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.331
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.877

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN @ STA 9+00 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.242
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.373

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN D STA 0+75 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.223
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.265

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN D STA 6+80.18 ET (SKC)
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.459
Runoff Coefficient---C	=	0.950
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	2.603

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN D STA 6+80.18 ET
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	1.079
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	4.767

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - THOMAS RD STA 22+27 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.781
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	3.450

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-21-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - 27th AVE STA 21+73 RT
Ver 3.40: December 1995

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

DRAINAGE AREA--ACRES--A	=	0.390
Runoff Coefficient---C	=	0.740
RAINFALL INTENSITY--Inches/Hour--I	=	5.970
Discharge-CFS--Q	=	1.723

APPENDIX C

CATCH BASIN INLET COMPUTATIONS

10 - YEAR EVENT

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.- _____
HIGHWAY NAME- US60 DESIGNER - _____
LOCATION - GRAND AVE STA 098+25 LT CHECKER - _____ PAGE_____
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GRATE INLET--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.014
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.014
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Local Gutter Depression-Inches	=	2.000
Depth at INLET Curb Line-Inches--d	=	3.041
Depth at C.G. of Grate Flow--In.	=	3.689
SPREAD-Ft.--T	=	8.787
Depth for WEIR FLOW, inches	=	5.041
Depth for ORIFICE FLOW, inches	=	0.019

Q(INLET) = 1.326 cfs is Based on WEIR flow

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 098+75 RT
Ver 3.40: December 1995

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GRATE INLET--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.030
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Local Gutter Depression-Inches	=	1.000
Depth at INLET Curb Line-Inches--d	=	3.642
Depth at C.G. of Grate Flow--In.	=	3.502
SPREAD-Ft.--T	=	7.549
Depth for WEIR FLOW, inches	=	4.642
Depth for ORIFICE FLOW, inches	=	0.035

Q(INLET) = 1.284 cfs is Based on WEIR flow

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - GRAND AVE STA 100+00 LT CHECKER - PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.179
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.050
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	=	1.082
SPREAD-Ft.--T	=	3.193
Average Velocity-V-fps	=	3.526
FLOW in Gutter-CFS--Q	=	1.069
% Flow in Gutter-CFS	=	98.791
Velocity of Flow in Gutter-fps	=	3.625
Depth at Curb Line-Inches--d	=	2.416

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.136
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	11.763
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.631	0.682	0.400	1.082	0.000	100.00
10.000	0.967	1.046	0.036	1.082	0.000	100.00
15.000	1.000	1.082	0.000	1.082	0.000	100.00
20.000	1.000	1.082	0.000	1.082	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - GRAND AVE STA 100+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	=	2.179
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.540
SPREAD-Ft.--T	=	3.864
Average Velocity-V-fps	=	3.768
FLOW in Gutter-CFS--Q	=	1.355
% Flow in Gutter-CFS	=	88.007
Velocity of Flow in Gutter-fps	=	4.211
Depth at Curb Line-Inches--d	=	2.743

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.302
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.526
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.503	0.775	0.765	1.540	0.000	100.00
10.000	0.844	1.300	0.240	1.540	0.000	100.00
15.000	0.998	1.537	0.003	1.540	0.000	100.00
20.000	1.000	1.540	0.000	1.540	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 103+00 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	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.050
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	=	1.991
SPREAD-Ft.--T	=	4.185
Average Velocity-V-fps	=	4.064
FLOW in Gutter-CFS--Q	=	1.849
% Flow in Gutter-CFS	=	92.891
Velocity of Flow in Gutter-fps	=	4.415
Depth at Curb Line-Inches--d	=	3.011

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.931
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	15.267
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.510	1.016	0.975	1.991	0.000	100.00
10.000	0.853	1.698	0.293	1.991	0.000	100.00
15.000	0.999	1.990	0.001	1.991	0.000	100.00
20.000	1.000	1.991	0.000	1.991	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 103+00 RT
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	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.567
SPREAD-Ft.--T	=	4.765
Average Velocity-V-fps	=	4.257
FLOW in Gutter-CFS--Q	=	2.035
% Flow in Gutter-CFS	=	79.265
Velocity of Flow in Gutter-fps	=	4.940
Depth at Curb Line-Inches--d	=	3.284

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.924
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	19.837
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.407	1.045	1.436	2.481	0.086	96.66
10.000	0.717	1.841	0.726	2.567	0.000	100.00
15.000	0.921	2.365	0.202	2.567	0.000	100.00
20.000	1.000	2.567	0.000	2.567	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE 108+00 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.031
Shoulder Width-Ft.--	=	5.750
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	=	1.271
SPREAD-Ft.--T	=	3.948
Average Velocity-V-fps	=	3.586
FLOW in Gutter-CFS--Q	=	1.227
% Flow in Gutter-CFS	=	96.565
Velocity of Flow in Gutter-fps	=	3.816
Depth at Curb Line-Inches--d	=	2.544

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.322
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	12.644
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.596	0.757	0.514	1.271	0.000	100.00
10.000	0.940	1.195	0.076	1.271	0.000	100.00
15.000	1.000	1.271	0.000	1.271	0.000	100.00
20.000	1.000	1.271	0.000	1.271	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE 108+00 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.031
Shoulder Width-Ft.--	=	10.000
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	=	1.646
SPREAD-Ft.--T	=	4.584
Average Velocity-V-fps	=	3.747
FLOW in Gutter-CFS--Q	=	1.531
% Flow in Gutter-CFS	=	93.036
Velocity of Flow in Gutter-fps	=	4.124
Depth at Curb Line-Inches--d	=	2.782

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.660
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	14.094
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.546	0.898	0.748	1.646	0.000	100.00
10.000	0.892	1.468	0.178	1.646	0.000	100.00
15.000	1.000	1.646	0.000	1.646	0.000	100.00
20.000	1.000	1.646	0.000	1.646	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

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HIGHWAY NAME- US60
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.045
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.045
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	=	1.991
SPREAD-Ft.--T	=	4.356
Average Velocity-V-fps	=	4.026
FLOW in Gutter-CFS--Q	=	1.837
% Flow in Gutter-CFS	=	92.253
Velocity of Flow in Gutter-fps	=	4.404
Depth at Curb Line-Inches--d	=	3.002

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.931
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	15.267
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.510	1.016	0.975	1.991	0.000	100.00
10.000	0.853	1.698	0.293	1.991	0.000	100.00
15.000	0.999	1.990	0.001	1.991	0.000	100.00
20.000	1.000	1.991	0.000	1.991	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.045
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.045
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	=	2.567
SPREAD-Ft.--T	=	4.881
Average Velocity-V-fps	=	4.251
FLOW in Gutter-CFS--Q	=	2.267
% Flow in Gutter-CFS	=	88.317
Velocity of Flow in Gutter-fps	=	4.761
Depth at Curb Line-Inches--d	=	3.286

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.320
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.007
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.466	1.195	1.372	2.567	0.000	100.00
10.000	0.797	2.047	0.520	2.567	0.000	100.00
15.000	0.979	2.512	0.055	2.567	0.000	100.00
20.000	1.000	2.567	0.000	2.567	0.000	100.00

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.451
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.032
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	=	1.431
SPREAD-Ft.--T	=	4.746
Average Velocity-V-fps	=	3.074
FLOW in Gutter-CFS--Q	=	1.316
% Flow in Gutter-CFS	=	91.949
Velocity of Flow in Gutter-fps	=	3.411
Depth at Curb Line-Inches--d	=	2.852

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.759
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	11.709
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.633	0.906	0.525	1.431	0.000	100.00
10.000	0.969	1.386	0.045	1.431	0.000	100.00
15.000	1.000	1.431	0.000	1.431	0.000	100.00
20.000	1.000	1.431	0.000	1.431	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.451
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.032
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	=	1.953
SPREAD-Ft.--T	=	5.586
Average Velocity-V-fps	=	3.247
FLOW in Gutter-CFS--Q	=	1.686
% Flow in Gutter-CFS	=	86.308
Velocity of Flow in Gutter-fps	=	3.734
Depth at Curb Line-Inches--d	=	3.166

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.221
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	13.354
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.570	1.114	0.839	1.953	0.000	100.00
10.000	0.917	1.791	0.162	1.953	0.000	100.00
15.000	1.000	1.953	0.000	1.953	0.000	100.00
20.000	1.000	1.953	0.000	1.953	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 124+30 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.791
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.019
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.019
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	=	1.991
SPREAD-Ft.--T	=	5.468
Average Velocity-V-fps	=	4.598
FLOW in Gutter-CFS--Q	=	1.823
% Flow in Gutter-CFS	=	91.560
Velocity of Flow in Gutter-fps	=	5.219
Depth at Curb Line-Inches--d	=	2.677

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.553
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.942
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.445	0.885	1.106	1.991	0.000	100.00
10.000	0.769	1.532	0.459	1.991	0.000	100.00
15.000	0.961	1.914	0.077	1.991	0.000	100.00
20.000	1.000	1.991	0.000	1.991	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.791
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
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	=	1.991
SPREAD-Ft.--T	=	5.335
Average Velocity-V-fps	=	4.625
FLOW in Gutter-CFS--Q	=	1.829
% Flow in Gutter-CFS	=	91.869
Velocity of Flow in Gutter-fps	=	5.225
Depth at Curb Line-Inches--d	=	2.680

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.553
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.942
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.445	0.885	1.106	1.991	0.000	100.00
10.000	0.769	1.532	0.459	1.991	0.000	100.00
15.000	0.961	1.914	0.077	1.991	0.000	100.00
20.000	1.000	1.991	0.000	1.991	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.118
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.032
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	=	2.597
SPREAD-Ft.--T	=	6.763
Average Velocity-V-fps	=	3.091
FLOW in Gutter-CFS--Q	=	2.027
% Flow in Gutter-CFS	=	78.048
Velocity of Flow in Gutter-fps	=	3.690
Depth at Curb Line-Inches--d	=	3.637

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.876
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	14.178
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.543	1.410	1.187	2.597	0.000	99.98
10.000	0.889	2.309	0.288	2.597	0.000	100.00
15.000	1.000	2.597	0.000	2.597	0.000	100.00
20.000	1.000	2.597	0.000	2.597	0.000	100.00

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.118
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.032
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.226
SPREAD-Ft.--T	=	6.571
Average Velocity-V-fps	=	2.920
FLOW in Gutter-CFS--Q	=	1.539
% Flow in Gutter-CFS	=	69.141
Velocity of Flow in Gutter-fps	=	3.596
Depth at Curb Line-Inches--d	=	3.380

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.094
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.026
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.490	1.091	1.099	2.189	0.037	98.36
10.000	0.828	1.843	0.383	2.226	0.000	100.00
15.000	0.993	2.210	0.016	2.226	0.000	100.00
20.000	1.000	2.226	0.000	2.226	0.000	100.00

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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.032
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	2.000
Flow-CFS--Q	=	2.319

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.318	1.000	2.494	3.787
10.000	1.789	0.529	1.471	1.838
15.000	2.174	0.145	1.016	1.270
20.000	2.208	0.111	0.516	0.645

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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.032
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.794

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.436	1.357	3.759	7.559
10.000	2.018	0.777	2.762	4.961
15.000	2.300	0.493	2.132	3.321
20.000	2.462	0.353	1.705	2.210

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 134+00 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	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.030
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	=	0.947
SPREAD-Ft.--T	=	5.181
Average Velocity-V-fps	=	1.831
FLOW in Gutter-CFS--Q	=	0.848
% Flow in Gutter-CFS	=	89.511
Velocity of Flow in Gutter-fps	=	2.071
Depth at Curb Line-Inches--d	=	2.965

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.932
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	7.152
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.885	0.838	0.109	0.947	0.000	100.00
10.000	1.000	0.947	0.000	0.947	0.000	100.00
15.000	1.000	0.947	0.000	0.947	0.000	100.00
20.000	1.000	0.947	0.000	0.947	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 134+00 RT
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	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.030
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.014
SPREAD-Ft.--T	=	5.729
Average Velocity-V-fps	=	1.786
FLOW in Gutter-CFS--Q	=	0.774
% Flow in Gutter-CFS	=	76.372
Velocity of Flow in Gutter-fps	=	2.156
Depth at Curb Line-Inches--d	=	2.967

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.630
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.711
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.785	0.796	0.218	1.014	0.000	100.00
10.000	1.000	1.014	0.000	1.014	0.000	100.00
15.000	1.000	1.014	0.000	1.014	0.000	100.00
20.000	1.000	1.014	0.000	1.014	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 136+48 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	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.017
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.017
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.591
SPREAD-Ft.--T	=	9.667
Average Velocity-V-fps	=	1.741
FLOW in Gutter-CFS--Q	=	0.930
% Flow in Gutter-CFS	=	58.477
Velocity of Flow in Gutter-fps	=	2.313
Depth at Curb Line-Inches--d	=	3.226

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.007
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.775
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.630	1.003	0.581	1.584	0.007	99.54
10.000	0.967	1.538	0.053	1.591	0.000	100.00
15.000	1.000	1.591	0.000	1.591	0.000	100.00
20.000	1.000	1.591	0.000	1.591	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 136+48 RT
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	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.037
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.037
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.591
SPREAD-Ft.--T	=	6.255
Average Velocity-V-fps	=	2.035
FLOW in Gutter-CFS--Q	=	1.111
% Flow in Gutter-CFS	=	69.858
Velocity of Flow in Gutter-fps	=	2.478
Depth at Curb Line-Inches--d	=	3.504

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.213
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.870
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.670	1.066	0.524	1.590	0.001	99.95
10.000	0.989	1.574	0.017	1.591	0.000	100.00
15.000	1.000	1.591	0.000	1.591	0.000	100.00
20.000	1.000	1.591	0.000	1.591	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- 1160
LOCATION - ST CONN 27A STA 3+60 RT
Ver 3.40: December 1995

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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.030
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.311
SPREAD-Ft.--T	=	2.277
Average Velocity-V-fps	=	2.030
FLOW in Gutter-CFS--Q	=	0.311
% Flow in Gutter-CFS	=	99.914
Velocity of Flow in Gutter-fps	=	2.044
Depth at Curb Line-Inches--d	=	1.725

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.250
Splash-Over Velocity--FPS	=	4.088
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.311
GUTTER FLOW at INLET-CFS--Q	=	0.311
Gutter Velocity at INLET-fps	=	2.298
Depth at INLET Curb Line-Inches--d	=	2.065
Frontal Flow Intercepted by GRATE--CFS	=	0.311
Lateral Flow Intercepted by GRATE--CFS	=	0.000
TOTAL Flow Intercepted by GRATE--CFS	=	0.311
% FLOW Intercepted	=	100.000
By-pass Flow--CFS	=	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN 27A STA 6+60 RT
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	=	3.290
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.094
SPREAD-Ft.--T	=	4.420
Average Velocity-V-fps	=	3.762
FLOW in Gutter-CFS--Q	=	0.995
% Flow in Gutter-CFS	=	90.958
Velocity of Flow in Gutter-fps	=	4.285
Depth at Curb Line-Inches--d	=	2.206

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	2.706
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.060
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.516	0.565	0.529	1.094	0.000	100.00
10.000	0.860	0.940	0.154	1.094	0.000	100.00
15.000	1.000	1.094	0.000	1.094	0.000	100.00
20.000	1.000	1.094	0.000	1.094	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - ST CONN 27A STA 10+60 RT CHECKER - PAGE
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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.000
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.854
SPREAD-Ft.--T	=	5.470
Average Velocity-V-fps	=	2.164
FLOW in Gutter-CFS--Q	=	0.711
% Flow in Gutter-CFS	=	83.304
Velocity of Flow in Gutter-fps	=	2.595
Depth at Curb Line-Inches--d	=	2.458

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.250
Splash-Over Velocity--FPS	=	4.088
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.854
GUTTER FLOW at INLET-CFS--Q	=	0.830
Gutter Velocity at INLET-fps	=	2.855
Depth at INLET Curb Line-Inches--d	=	3.056
Frontal Flow Intercepted by GRATE--CFS	=	0.830
Lateral Flow Intercepted by GRATE--CFS	=	0.010
TOTAL Flow Intercepted by GRATE--CFS	=	0.840
% FLOW Intercepted	=	98.304
By-pass Flow--CFS	=	0.014

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - ST CONN 27B STA 7+50 RT CHECKER - PAGE
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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	5.465
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.060
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.060
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	=	1.444
SPREAD-Ft.--T	=	2.872
Average Velocity-V-fps	=	5.383
FLOW in Gutter-CFS--Q	=	1.439
% Flow in Gutter-CFS	=	99.627
Velocity of Flow in Gutter-fps	=	5.447
Depth at Curb Line-Inches--d	=	2.268

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	2.000
Flow-CFS--Q	=	1.444
GUTTER FLOW at INLET-CFS--Q	=	1.444
Gutter Velocity at INLET-fps	=	6.410
Depth at INLET Curb Line-Inches--d	=	2.941
Frontal Flow Intercepted by GRATE--CFS	=	1.444
Lateral Flow Intercepted by GRATE--CFS	=	0.000
TOTAL Flow Intercepted by GRATE--CFS	=	1.444
% FLOW Intercepted	=	100.000
By-pass Flow--CFS	=	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US60 DESIGNER -
LOCATION - ST CONN 273 STA 11+00 RT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.263

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.768	0.494	2.136	2.851
10.000	1.148	0.115	1.582	1.947
15.000	1.184	0.079	1.011	1.245
20.000	1.203	0.060	0.678	0.835

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - ST CONN 27B STA 12+33 RT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.408
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.015
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.015
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.376
SPREAD-Ft.--T	=	10.365
Average Velocity-V-fps	=	1.510
FLOW in Gutter-CFS--Q	=	0.787
% Flow in Gutter-CFS	=	57.226
Velocity of Flow in Gutter-fps	=	2.038
Depth at Curb Line-Inches--d	=	3.131

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.921
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.515
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.687	0.945	0.430	1.375	0.001	99.95
10.000	0.996	1.370	0.006	1.376	0.000	100.00
15.000	1.000	1.376	0.000	1.376	0.000	100.00
20.000	1.000	1.376	0.000	1.376	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN 27C STA 0+40 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	=	0.570
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.006
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.006
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.694
SPREAD-Ft.--T	=	11.960
Average Velocity-V-fps	=	1.289
FLOW in Gutter-CFS--Q	=	0.467
% Flow in Gutter-CFS	=	67.328
Velocity of Flow in Gutter-fps	=	1.862
Depth at Curb Line-Inches--d	=	2.318

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.060
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	7.780
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.843	0.585	0.109	0.694	0.000	100.00
10.000	1.000	0.694	0.000	0.694	0.000	100.00
15.000	1.000	0.694	0.000	0.694	0.000	100.00
20.000	1.000	0.694	0.000	0.694	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US 60 DESIGNER -
LOCATION - ST CONN 27C STA 5+50 RT CHECKER - PAGE
Ver 3.40: December 1995

GRATE INLET--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.058
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.058
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Local Gutter Depression-Inches	=	1.000
Depth at INLET Curb Line-Inches--d	=	3.812
Depth at C.G. of Grate Flow--In.	=	3.664
SPREAD-Ft.--T	=	5.143
Depth for WEIR FLOW, inches	=	4.812
Depth for ORIFICE FLOW, inches	=	0.041

Q(INLET) = 1.393 cfs is Based on WEIR flow

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN 270 STA 9+00 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.883
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.018
SPREAD-Ft.--T	=	6.233
Average Velocity-V-fps	=	2.104
FLOW in Gutter-CFS--Q	=	0.790
% Flow in Gutter-CFS	=	77.644
Velocity of Flow in Gutter-fps	=	2.594
Depth at Curb Line-Inches--d	=	2.641

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.294
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.219
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.702	0.714	0.304	1.018	0.000	100.00
10.000	0.999	1.017	0.001	1.018	0.000	100.00
15.000	1.000	1.018	0.000	1.018	0.000	100.00
20.000	1.000	1.018	0.000	1.018	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN 270 STA 0+75 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.506
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.938
SPREAD-Ft.--T	=	6.895
Average Velocity-V-fps	=	1.643
FLOW in Gutter-CFS--Q	=	0.684
% Flow in Gutter-CFS	=	72.923
Velocity of Flow in Gutter-fps	=	2.065
Depth at Curb Line-Inches--d	=	2.800

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.491
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.565
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.794	0.744	0.194	0.938	0.000	100.00
10.000	1.000	0.938	0.000	0.938	0.000	100.00
15.000	1.000	0.938	0.000	0.938	0.000	100.00
20.000	1.000	0.938	0.000	0.938	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.932

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.073	0.858	2.918	7.389
10.000	1.471	0.461	2.047	3.759
15.000	1.764	0.118	1.624	2.000
20.000	1.840	0.092	1.228	1.511

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ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 098+25 LT
Ver 3.40: December 1995

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GRATE INLET--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.014
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.014
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Local Gutter Depression-Inches	=	2.000
Depth at INLET Curb Line-Inches--d	=	3.728
Depth at C.G. of Grate Flow--In.	=	4.334
SPREAD-Ft.--T	=	12.934
Depth for WEIR FLOW, inches	=	5.728
Depth for ORIFICE FLOW, inches	=	0.034

Q(INLET) = 1.787 cfs is Based on WEIR flow

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

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GRATE INLET--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.030
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Local Gutter Depression-Inches	=	1.000
Depth at INLET Curb Line-Inches--d	=	4.309
Depth at C.G. of Grate Flow--In.	=	4.140
SPREAD-Ft.--T	=	9.382
Depth for WEIR FLOW, inches	=	5.309
Depth for ORIFICE FLOW, inches	=	0.063

Q(INLET) = 1.730 cfs is Based on WEIR flow

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- 1260
LOCATION - GRAND AVE STA 100+00 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.179
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.050
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	=	1.458
SPREAD-Ft.--T	=	3.659
Average Velocity-V-fps	=	3.769
FLOW in Gutter-CFS--Q	=	1.406
% Flow in Gutter-CFS	=	96.450
Velocity of Flow in Gutter-fps	=	3.981
Depth at Curb Line-Inches--d	=	2.696

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.507
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	13.332
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.571	0.832	0.626	1.458	0.000	100.00
10.000	0.918	1.338	0.120	1.458	0.000	100.00
15.000	1.000	1.458	0.000	1.458	0.000	100.00
20.000	1.000	1.458	0.000	1.458	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 100+00 RT
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	=	2.179
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.076
SPREAD-Ft.--T	=	4.380
Average Velocity-V-fps	=	4.031
FLOW in Gutter-CFS--Q	=	1.722
% Flow in Gutter-CFS	=	82.941
Velocity of Flow in Gutter-fps	=	4.611
Depth at Curb Line-Inches--d	=	3.053

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.662
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.844
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.447	0.927	1.141	2.069	0.007	99.65
10.000	0.772	1.603	0.473	2.076	0.000	100.00
15.000	0.963	2.000	0.076	2.076	0.000	100.00
20.000	1.000	2.076	0.000	2.076	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AV S/A 103+00 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.050
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	=	2.683
SPREAD-Ft.--T	=	4.755
Average Velocity-V-fps	=	4.347
FLOW in Gutter-CFS--Q	=	2.374
% Flow in Gutter-CFS	=	88.487
Velocity of Flow in Gutter-fps	=	4.844
Depth at Curb Line-Inches--d	=	3.353

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.391
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.333
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.458	1.229	1.454	2.683	0.000	100.00
10.000	0.787	2.113	0.570	2.683	0.000	100.00
15.000	0.973	2.610	0.073	2.683	0.000	100.00
20.000	1.000	2.683	0.000	2.683	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 103+00 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.460
SPREAD-Ft.--T	=	5.378
Average Velocity-V-fps	=	4.561
FLOW in Gutter-CFS--Q	=	2.552
% Flow in Gutter-CFS	=	73.756
Velocity of Flow in Gutter-fps	=	5.393
Depth at Curb Line-Inches--d	=	3.652

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.333
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.953
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.357	1.237	1.902	3.139	0.321	90.71
10.000	0.643	2.225	1.212	3.437	0.023	99.32
15.000	0.852	2.947	0.513	3.460	0.000	100.00
20.000	0.975	3.374	0.086	3.460	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 108+00 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.031
Shoulder Width-Ft.--	=	5.750
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	=	1.713
SPREAD-Ft.--T	=	4.686
Average Velocity-V-fps	=	3.772
FLOW in Gutter-CFS--Q	=	1.583
% Flow in Gutter-CFS	=	92.401
Velocity of Flow in Gutter-fps	=	4.173
Depth at Curb Line-Inches--d	=	2.821

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.715
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	14.333
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.538	0.922	0.791	1.713	0.000	100.00
10.000	0.884	1.514	0.199	1.713	0.000	100.00
15.000	1.000	1.713	0.000	1.713	0.000	100.00
20.000	1.000	1.713	0.000	1.713	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 108+00 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.031
Shoulder Width-Ft.--	=	10.000
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	=	2.218
SPREAD-Ft.--T	=	5.371
Average Velocity-V-fps	=	3.947
FLOW in Gutter-CFS--Q	=	1.949
% Flow in Gutter-CFS	=	87.853
Velocity of Flow in Gutter-fps	=	4.500
Depth at Curb Line-Inches--d	=	3.078

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.093
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	15.976
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.491	1.089	1.129	2.218	0.000	100.00
10.000	0.830	1.840	0.378	2.218	0.000	100.00
15.000	0.993	2.204	0.014	2.218	0.000	100.00
20.000	1.000	2.218	0.000	2.218	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.045
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.045
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	=	2.683
SPREAD-Ft.--T	=	4.977
Average Velocity-V-fps	=	4.292
FLOW in Gutter-CFS--Q	=	2.350
% Flow in Gutter-CFS	=	87.581
Velocity of Flow in Gutter-fps	=	4.825
Depth at Curb Line-Inches--d	=	3.337

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.391
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.338
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.458	1.229	1.454	2.683	0.000	100.00
10.000	0.787	2.112	0.571	2.683	0.000	100.00
15.000	0.973	2.610	0.073	2.683	0.000	100.00
20.000	1.000	2.683	0.000	2.683	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	2.213
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.045
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.045
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	=	3.460
SPREAD-Ft.--T	=	5.557
Average Velocity-V-fps	=	4.538
FLOW in Gutter-CFS--Q	=	2.876
% Flow in Gutter-CFS	=	83.127
Velocity of Flow in Gutter-fps	=	5.208
Depth at Curb Line-Inches--d	=	3.651

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.806
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	19.449
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.414	1.433	2.016	3.449	0.011	99.70
10.000	0.727	2.516	0.944	3.460	0.000	100.00
15.000	0.930	3.217	0.243	3.460	0.000	100.00
20.000	1.000	3.460	0.000	3.460	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 119+30 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.451
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.032
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	=	1.928
SPREAD-Ft.--T	=	5.542
Average Velocity-V-fps	=	3.241
FLOW in Gutter-CFS--Q	=	1.669
% Flow in Gutter-CFS	=	86.586
Velocity of Flow in Gutter-fps	=	3.721
Depth at Curb Line-Inches--d	=	3.153

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.202
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	13.280
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.573	1.104	0.824	1.928	0.000	100.00
10.000	0.919	1.772	0.156	1.928	0.000	100.00
15.000	1.000	1.928	0.000	1.928	0.000	100.00
20.000	1.000	1.928	0.000	1.928	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 119+30 RT
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	=	1.451
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.032
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	=	2.632
SPREAD-Ft.--T	=	6.457
Average Velocity-V-fps	=	3.434
FLOW in Gutter-CFS--Q	=	2.113
% Flow in Gutter-CFS	=	80.294
Velocity of Flow in Gutter-fps	=	4.065
Depth at Curb Line-Inches--d	=	3.495

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.690
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	15.300
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.509	1.341	1.291	2.632	0.000	99.99
10.000	0.852	2.242	0.390	2.632	0.000	100.00
15.000	0.999	2.630	0.002	2.632	0.000	100.00
20.000	1.000	2.632	0.000	2.632	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
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LOCATION - GRAND AVE STA 124+30 LT CHECKER - PAGE
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.791
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.019
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.019
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	=	2.683
SPREAD-Ft.--T	=	6.612
Average Velocity-V-fps	=	4.755
FLOW in Gutter-CFS--Q	=	2.283
% Flow in Gutter-CFS	=	85.091
Velocity of Flow in Gutter-fps	=	5.656
Depth at Curb Line-Inches--d	=	2.937

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.974
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	20.337
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.398	1.069	1.614	2.683	0.000	100.00
10.000	0.704	1.889	0.794	2.683	0.000	100.00
15.000	0.910	2.442	0.241	2.683	0.000	100.00
20.000	0.999	2.681	0.002	2.683	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 124+30 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.791
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
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	=	2.683
SPREAD-Ft.--T	=	6.435
Average Velocity-V-fps	=	4.792
FLOW in Gutter-CFS--Q	=	2.296
% Flow in Gutter-CFS	=	85.560
Velocity of Flow in Gutter-fps	=	5.667
Depth at Curb Line-Inches--d	=	2.944

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	3.974
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	20.337
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.398	1.069	1.614	2.683	0.000	100.00
10.000	0.704	1.889	0.794	2.683	0.000	100.00
15.000	0.910	2.442	0.241	2.683	0.000	100.00
20.000	0.999	2.681	0.002	2.683	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 16+90 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.118
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.032
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	=	3.499
SPREAD-Ft.--T	=	7.736
Average Velocity-V-fps	=	3.283
FLOW in Gutter-CFS--Q	=	2.513
% Flow in Gutter-CFS	=	71.807
Velocity of Flow in Gutter-fps	=	4.006
Depth at Curb Line-Inches--d	=	4.010

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	5.359
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	16.523
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.477	1.670	1.807	3.477	0.022	99.36
10.000	0.812	2.842	0.657	3.499	0.000	100.00
15.000	0.986	3.451	0.048	3.499	0.000	100.00
20.000	1.000	3.499	0.000	3.499	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 127+70 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.118
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.032
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.000
SPREAD-Ft.--T	=	7.470
Average Velocity-V-fps	=	3.111
FLOW in Gutter-CFS--Q	=	1.891
% Flow in Gutter-CFS	=	63.044
Velocity of Flow in Gutter-fps	=	3.896
Depth at Curb Line-Inches--d	=	3.725

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.476
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.838
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.426	1.278	1.545	2.823	0.177	94.11
10.000	0.744	2.232	0.766	2.998	0.002	99.94
15.000	0.943	2.829	0.171	3.000	0.000	100.00
20.000	1.000	3.000	0.000	3.000	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 131+59.08 LT
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.032
Gutter Width-Ft.--W	=	2.500
Gutter Slope-Ft./Ft.--Sw	=	0.067
Gutter Depression-Inches--	=	2.000

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Effective Perimeter--Ft.	=	7.350
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	2.000
Flow-CFS--Q	=	3.125

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.569	1.555	3.393	6.129
10.000	2.319	0.808	2.127	2.830
15.000	2.615	0.510	1.412	1.765
20.000	2.976	0.149	1.070	1.337

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE SIA 13/+67.08 RT
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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.032
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.032
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.766

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.634	2.132	4.848	10.394
10.000	2.601	1.166	3.455	6.766
15.000	3.000	0.765	2.739	4.901
20.000	3.230	0.537	2.242	3.608

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - GRAND AVE STA 134+00 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	5.750
Shoulder Slope-Ft./Ft.--Ss	=	0.030
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	=	1.276
SPREAD-Ft.--T	=	6.037
Average Velocity-V-fps	=	1.930
FLOW in Gutter-CFS--Q	=	1.068
% Flow in Gutter-CFS	=	83.700
Velocity of Flow in Gutter-fps	=	2.255
Depth at Curb Line-Inches--d	=	3.273

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	=	7.350
Depth at INLET Curb Line-Inches--d	=	4.388
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	8.133
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.820	1.047	0.229	1.276	0.000	100.00
10.000	1.000	1.276	0.000	1.276	0.000	100.00
15.000	1.000	1.276	0.000	1.276	0.000	100.00
20.000	1.000	1.276	0.000	1.276	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - GRAND AVE STA 134+00 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.030
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.367
SPREAD-Ft.--T	=	6.563
Average Velocity-V-fps	=	1.895
FLOW in Gutter-CFS--Q	=	0.957
% Flow in Gutter-CFS	=	69.982
Velocity of Flow in Gutter-fps	=	2.338
Depth at Curb Line-Inches--d	=	3.267

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.976
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.213
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.702	0.960	0.407	1.367	0.000	100.00
10.000	0.999	1.366	0.001	1.367	0.000	100.00
15.000	1.000	1.367	0.000	1.367	0.000	100.00
20.000	1.000	1.367	0.000	1.367	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- 1560
LOCATION - GRAND AVE STA 136+48 LT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.017
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.017
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.144
SPREAD-Ft.--T	=	11.044
Average Velocity-V-fps	=	1.846
FLOW in Gutter-CFS--Q	=	1.118
% Flow in Gutter-CFS	=	52.129
Velocity of Flow in Gutter-fps	=	2.483
Depth at Curb Line-Inches--d	=	3.513

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.327
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.121
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.545	1.168	0.880	2.047	0.097	95.49
10.000	0.891	1.910	0.234	2.144	0.000	100.00
15.000	1.000	2.144	0.000	2.144	0.000	100.00
20.000	1.000	2.144	0.000	2.144	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

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PROJECT NAME- GRAND AVE
HIGHWAY NAME- 1560
LOCATION - GRAND AVE STA 136+48 RT
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.500
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.037
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.037
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.144
SPREAD-Ft.--T	=	7.089
Average Velocity-V-fps	=	2.173
FLOW in Gutter-CFS--Q	=	1.371
% Flow in Gutter-CFS	=	63.955
Velocity of Flow in Gutter-fps	=	2.689
Depth at Curb Line-Inches--d	=	3.872

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.617
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.726
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.593	1.271	0.844	2.115	0.029	98.64
10.000	0.938	2.010	0.134	2.144	0.000	100.00
15.000	1.000	2.144	0.000	2.144	0.000	100.00
20.000	1.000	2.144	0.000	2.144	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST COND 27A STA 3+60 RT
Ver 3.40: December 1995

TRACS NO.-
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CHECKER - PAGE

GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.125
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.030
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.030
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.420
SPREAD-Ft.--T	=	2.832
Average Velocity-V-fps	=	2.146
FLOW in Gutter-CFS--Q	=	0.413
% Flow in Gutter-CFS	=	98.424
Velocity of Flow in Gutter-fps	=	2.231
Depth at Curb Line-Inches--d	=	1.924

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.250
Splash-Over Velocity--FPS	=	4.088
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	0.420
GUTTER FLOW at INLET-CFS--Q	=	0.420
Gutter Velocity at INLET-fps	=	2.477
Depth at INLET Curb Line-Inches--d	=	2.311
Frontal Flow Intercepted by GRATE--CFS	=	0.420
Lateral Flow Intercepted by GRATE--CFS	=	0.000
TOTAL Flow Intercepted by GRATE--CFS	=	0.420
% FLOW Intercepted	=	100.000
By-pass Flow--CFS	=	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN 27A STA 8+60 RT
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	=	3.290
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.475
SPREAD-Ft.--T	=	5.318
Average Velocity-V-fps	=	3.900
FLOW in Gutter-CFS--Q	=	1.246
% Flow in Gutter-CFS	=	84.441
Velocity of Flow in Gutter-fps	=	4.645
Depth at Curb Line-Inches--d	=	2.421

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.007
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.258
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.460	0.678	0.778	1.456	0.019	98.74
10.000	0.790	1.165	0.310	1.475	0.000	100.00
15.000	0.974	1.437	0.038	1.475	0.000	100.00
20.000	1.000	1.475	0.000	1.475	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN 27A STA 10+60 ET
Ver 3.40: December 1995

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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.000
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.151
SPREAD-Ft.--T	=	6.434
Average Velocity-V-fps	=	2.260
FLOW in Gutter-CFS--Q	=	0.877
% Flow in Gutter-CFS	=	76.184
Velocity of Flow in Gutter-fps	=	2.804
Depth at Curb Line-Inches--d	=	2.689

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.250
Splash-Over Velocity--FPS	=	4.088
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.151
GUTTER FLOW at INLET-CFS--Q	=	1.051
Gutter Velocity at INLET-fps	=	3.088
Depth at INLET Curb Line-Inches--d	=	3.355
Frontal Flow Intercepted by GRATE--CFS	=	1.051
Lateral Flow Intercepted by GRATE--CFS	=	0.026
TOTAL Flow Intercepted by GRATE--CFS	=	1.077
% FLOW Intercepted	=	93.589
By-pass Flow--CFS	=	0.074

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST COMM 27B STA 250 RT
Ver 3.40: December 1995

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GRATE INLET DESIGN -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	5.465
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.060
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.060
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	=	1.945
SPREAD-Ft.--T	=	3.242
Average Velocity-V-fps	=	5.785
FLOW in Gutter-CFS--Q	=	1.911
% Flow in Gutter-CFS	=	98.253
Velocity of Flow in Gutter-fps	=	5.978
Depth at Curb Line-Inches--d	=	2.534

GRATE TYPE: ADOT STD.--C15.92

Grate Length--Ft.	=	3.350
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	5.590
Capture Ratio -- GRATE	=	0.500
Effective Perimeter--Ft.	=	7.350
Splash-Over Velocity--FPS	=	7.350
Local Gutter Depression-Inches	=	2.000
Flow-CFS--Q	=	1.945
GUTTER FLOW at INLET-CFS--Q	=	1.945
Gutter Velocity at INLET-fps	=	6.905
Depth at INLET Curb Line-Inches--d	=	3.289
Frontal Flow Intercepted by GRATE--CFS	=	1.945
Lateral Flow Intercepted by GRATE--CFS	=	0.000
TOTAL Flow Intercepted by GRATE--CFS	=	1.945
% FLOW Intercepted	=	100.000
By-pass Flow--CFS	=	0.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US 60
LOCATION - ST CONN 27B S/A 11+00 RT
Ver 3.40: December 1995

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SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.050
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.050
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	1.701

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	0.971	0.729	2.666	3.735
10.000	1.361	0.407	1.893	2.447
15.000	1.594	0.107	1.453	1.789
20.000	1.620	0.081	1.046	1.288

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.- _____
HIGHWAY NAME- US60 DESIGNER - _____
LOCATION - ST CONN 27B STA 12+33 RT CHECKER - _____ PAGE _____
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.408
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.015
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.015
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.855
SPREAD-Ft.--T	=	11.864
Average Velocity-V-fps	=	1.598
FLOW in Gutter-CFS--Q	=	0.942
% Flow in Gutter-CFS	=	50.772
Velocity of Flow in Gutter-fps	=	2.184
Depth at Curb Line-Inches--d	=	3.400

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	4.222
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.669
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.595	1.104	0.699	1.803	0.052	97.18
10.000	0.939	1.743	0.112	1.855	0.000	100.00
15.000	1.000	1.855	0.000	1.855	0.000	100.00
20.000	1.000	1.855	0.000	1.855	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US60 DESIGNER -
LOCATION - ST CONN 27C STA 0+40 LT CHECKER - PAGE
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.570
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.006
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.006
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.936
SPREAD-Ft.--T	=	14.198
Average Velocity-V-fps	=	1.321
FLOW in Gutter-CFS--Q	=	0.545
% Flow in Gutter-CFS	=	58.276
Velocity of Flow in Gutter-fps	=	1.970
Depth at Curb Line-Inches--d	=	2.474

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.273
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.474
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.741	0.693	0.243	0.936	0.000	100.00
10.000	1.000	0.936	0.000	0.936	0.000	100.00
15.000	1.000	0.936	0.000	0.936	0.000	100.00
20.000	1.000	0.936	0.000	0.936	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN 270 STA 5+20 RT
Ver 3.40: December 1995

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GRATE INLET--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.058
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.058
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Local Gutter Depression-Inches	=	1.000
Depth at INLET Curb Line-Inches--d	=	4.511
Depth at C.G. of Grate Flow--In.	=	4.336
SPREAD-Ft.--T	=	6.147
Depth for WEIR FLOW, inches	=	5.511
Depth for ORIFICE FLOW, inches	=	0.074

Q(INLET) = 1.877 cfs is Based on WEIR flow

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.-
HIGHWAY NAME- US60 DESIGNER -
LOCATION - ST CONN 270 STA 94+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	=	0.883
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.373
SPREAD-Ft.--T	=	7.258
Average Velocity-V-fps	=	2.207
FLOW in Gutter-CFS--Q	=	0.968
% Flow in Gutter-CFS	=	70.493
Velocity of Flow in Gutter-fps	=	2.800
Depth at Curb Line-Inches--d	=	2.887

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.595
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.054
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.619	0.850	0.523	1.373	0.000	100.00
10.000	0.959	1.316	0.057	1.373	0.000	100.00
15.000	1.000	1.373	0.000	1.373	0.000	100.00
20.000	1.000	1.373	0.000	1.373	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE
HIGHWAY NAME- US60
LOCATION - ST CONN 27TH SIA OF 75 AT
Ver 3.40: December 1995

TRACS NO.-
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.506
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.265
SPREAD-Ft.--T	=	7.974
Average Velocity-V-fps	=	1.730
FLOW in Gutter-CFS--Q	=	0.833
% Flow in Gutter-CFS	=	65.875
Velocity of Flow in Gutter-fps	=	2.226
Depth at Curb Line-Inches--d	=	3.058

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Splash-Over Velocity--FPS	=	4.088
Depth at INLET Curb Line-Inches--d	=	3.797
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.158
Capture Ratio -- SLOTTED DRAIN	=	0.670
Capture Ratio -- GRATE	=	0.500

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% CAPT.
5.000	0.705	0.892	0.373	1.265	0.000	100.00
10.000	0.999	1.264	0.001	1.265	0.000	100.00
15.000	1.000	1.265	0.000	1.265	0.000	100.00
20.000	1.000	1.265	0.000	1.265	0.000	100.00

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

10-25-2000

PROJECT NAME- GRAND AVE TRACS NO.- _____
HIGHWAY NAME- US60 DESIGNER - _____
LOCATION - ST CONN 27D STA 6+80.18 RT CHECKER - _____ PAGE_____
Ver 3.40: December 1995

SLOTTED DRAIN W/ GRATE--IN SUMP

GUTTER FLOW HYDRAULICS

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	10.000
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.000
Gutter Slope-Ft./Ft.--Sw	=	0.068
Gutter Depression-Inches--	=	1.625

GRATE TYPE: ADOT STD.--L 1.0

Grate Length--Ft.	=	3.250
Grate Width---Ft.	=	2.000
Grate Area--Sq. Ft.	=	3.970
Effective Perimeter--Ft.	=	7.250
Capture Ratio -- GRATE	=	0.500
Capture Ratio -- SLOTTED DRAIN	=	0.500
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.530

LENGTH	Q(Slot. Dn)	Q(Grate)	d(inches)	SPREAD,Ft.
5.000	1.327	1.202	3.514	9.872
10.000	1.855	0.676	2.556	5.881
15.000	2.104	0.427	1.952	3.362
20.000	2.353	0.334		

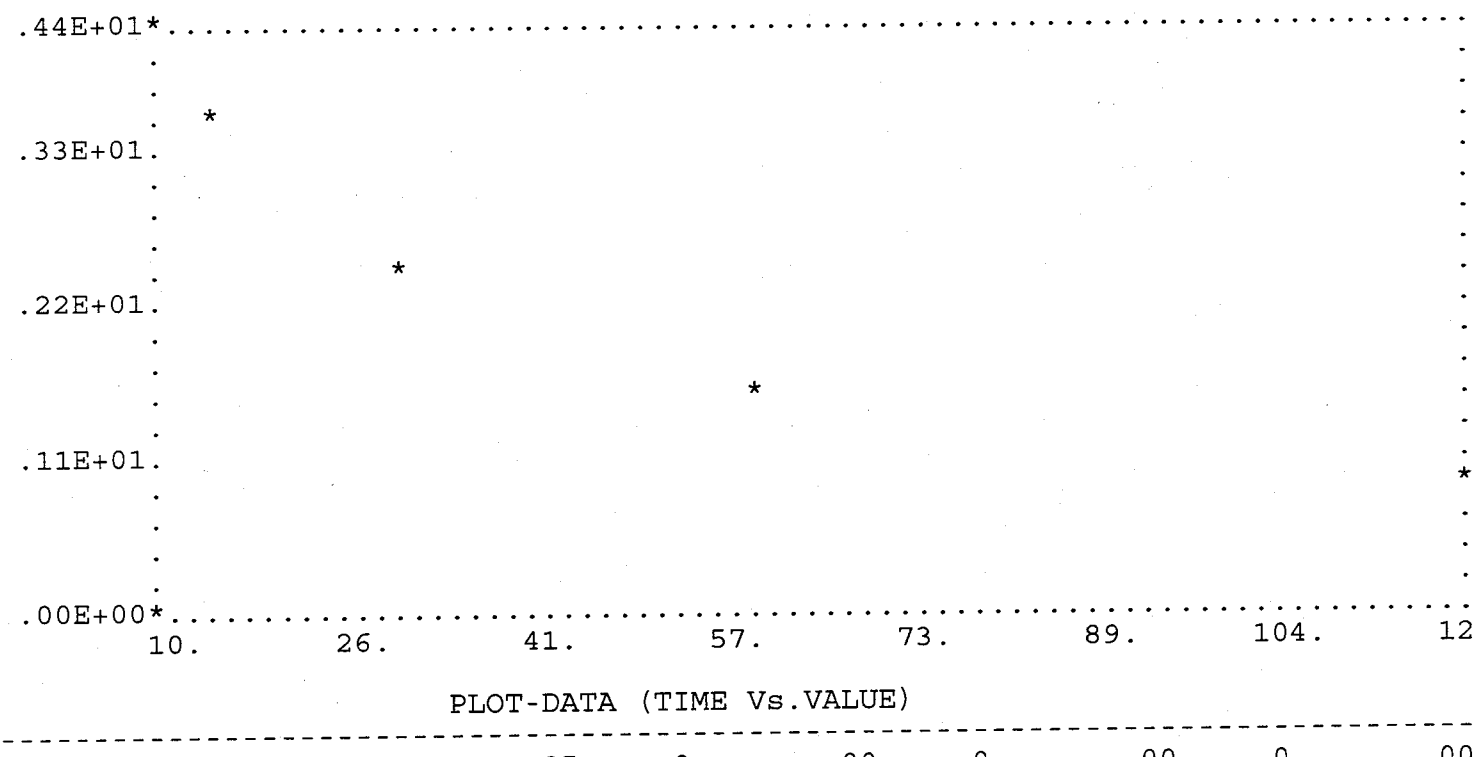
APPENDIX D

HYDRAIN MODEL INPUT / OUTPUT

SD OUTLET TO DETENTION BASIN AT STA 100+00

```
+++ Commands Read From File C:\HYDRA\HYDRA01.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STA 098+25 LT
  STO0.315 0.95 10
  PIP70 1099.59 1099.32 1094.01 1093.31 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Link #  1,  Flow depth =    .36 ft
```

SD OUTLET TO DETENTION BASIN AT STA 100+00

```
  PNC1 2 3 45 0
  REMCB AT STA 098+75 RT
  STO0.305 0.95 10
  PIP122 1099.32 1100.55 1092.81 1092.20 24
+++ Tc =  10.3 min
+++ CA =     .6
+++ Link #  2,  Flow depth =     .56 ft
  PNC2 4 3 90 0
  HOL1
  REMCB AT STA 100+00 LT
  STO0.257 0.95 10
  PIP54 1101.31 1100.55 1093.24 1092.70 18
+++ Tc =  10.8 min
+++ CA =     .8
+++ Link #  3,  Flow depth =     .61 ft
  PNC3 4 3 0 0
  REMCB AT STA 100+00 RT
  STO0.366 0.95 10
  REC1
  PIP124 1100.55 1097.00 1091.70 1089.22 30
+++ Tc =  11.0 min
+++ CA =   1.8
+++ Link #  4,  Flow depth =     .63 ft
  PNC4 5 0 0 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO DETENTION BASIN AT STA 100+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	70	18	1094.01	.01000	5.6	4.0	4.1	1.33	0.
			1093.31		6.0		6.0	10.53	
2	122	24	1092.81	.00500	6.5	4.3	3.7	2.59	0.
			1092.20		8.4		5.1	16.04	
3	54	18	1093.24	.01000	8.1	6.2	5.4	3.59	0.
			1092.70		7.9		6.0	10.53	
4	124	30	1091.70	.02000	8.9	5.1	8.2	7.59	0.
			1089.22		7.8		11.8	58.16	

Length = 370. ft Total length = 562. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO DETENTION BASIN AT STA 100+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	1095.31	1094.81	Y	1099.32	Y	2.50	.65
2	4	1095.19	1094.20	Y	1100.55	Y	5.15	3.19
3	4	1098.51	1094.20	Y	1100.55	Y	5.15	3.19
4	5	1095.00	1091.72	Y	1097.00	Y	.00	.00

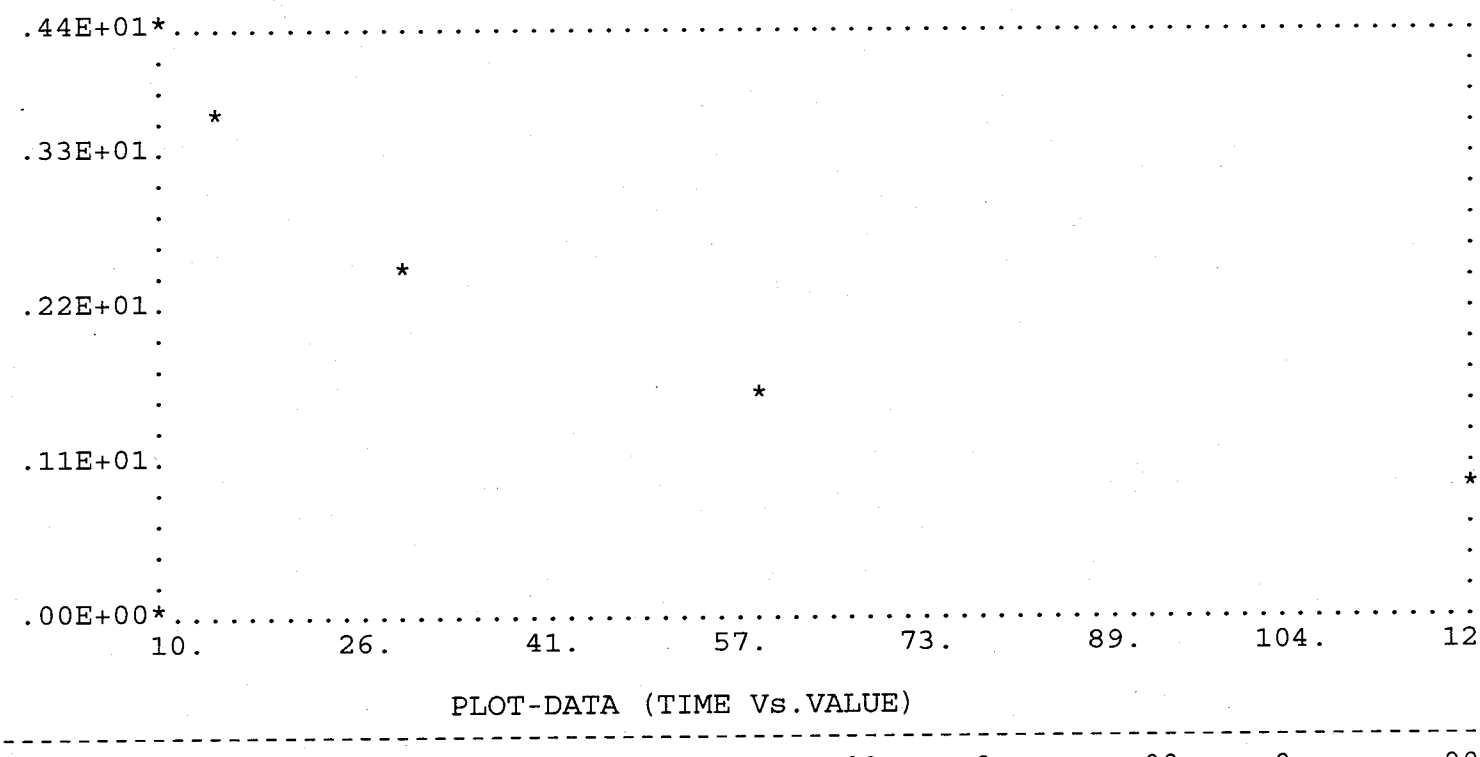
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1095.75	1099.59	1.50
3	3	1099.27	1101.31	1.50

NORMAL END OF HYDRA

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 103+00

```
+++ Commands Read From File C:\HYDRA\HYDRA02.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR A STA 3+60 RT
  STO0.074 0.95 10
  PIP58 1109.64 1107.94 1089.59 1089.01 18
+++ Tc =  10.0 min
+++ CA =    .1
+++ Link #  1,  Flow depth =    .18 ft
```

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 103+00

```
  PNC1 2 3 0 0
  REMCB AT GRAND AVE STA 103+00 LT
  STO0.473 0.95 10
  PIP54 1107.94 1107.18 1088.51 1087.97 24
+++ Tc =  10.4 min
+++ CA =     .5
+++ Link #  2,  Flow depth =     .44 ft
  PNC2 3 3 0 0
  REMCB AT GRAND AVE STA 103+00 RT
  STO0.61 0.95 10
  PIP126 1107.18 1097.00 1087.47 1084.95 30
+++ Tc =  10.6 min
+++ CA =   1.1
+++ Link #  3,  Flow depth =     .50 ft
  PNC3 4 0 0 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 103+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	58	18	1089.59	.01000	20.1	17.3	2.7	.31	0.
			1089.01		18.9		6.0	10.53	
2	54	24	1088.51	.01000	19.4	17.0	4.6	2.28	0.
			1087.97		19.2		7.2	22.68	
3	126	30	1087.47	.02000	19.7	9.3	7.2	4.78	0.
			1084.95		12.0		11.8	58.16	

Length = 238. ft Total length = 238. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 103+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	1095.48	1090.51	Y	1107.94	Y	6.97	.75
2	3	1095.32	1089.97	Y	1107.18	Y	7.85	.44
3	4	1095.00	1087.45	Y	1097.00	Y	.00	.00

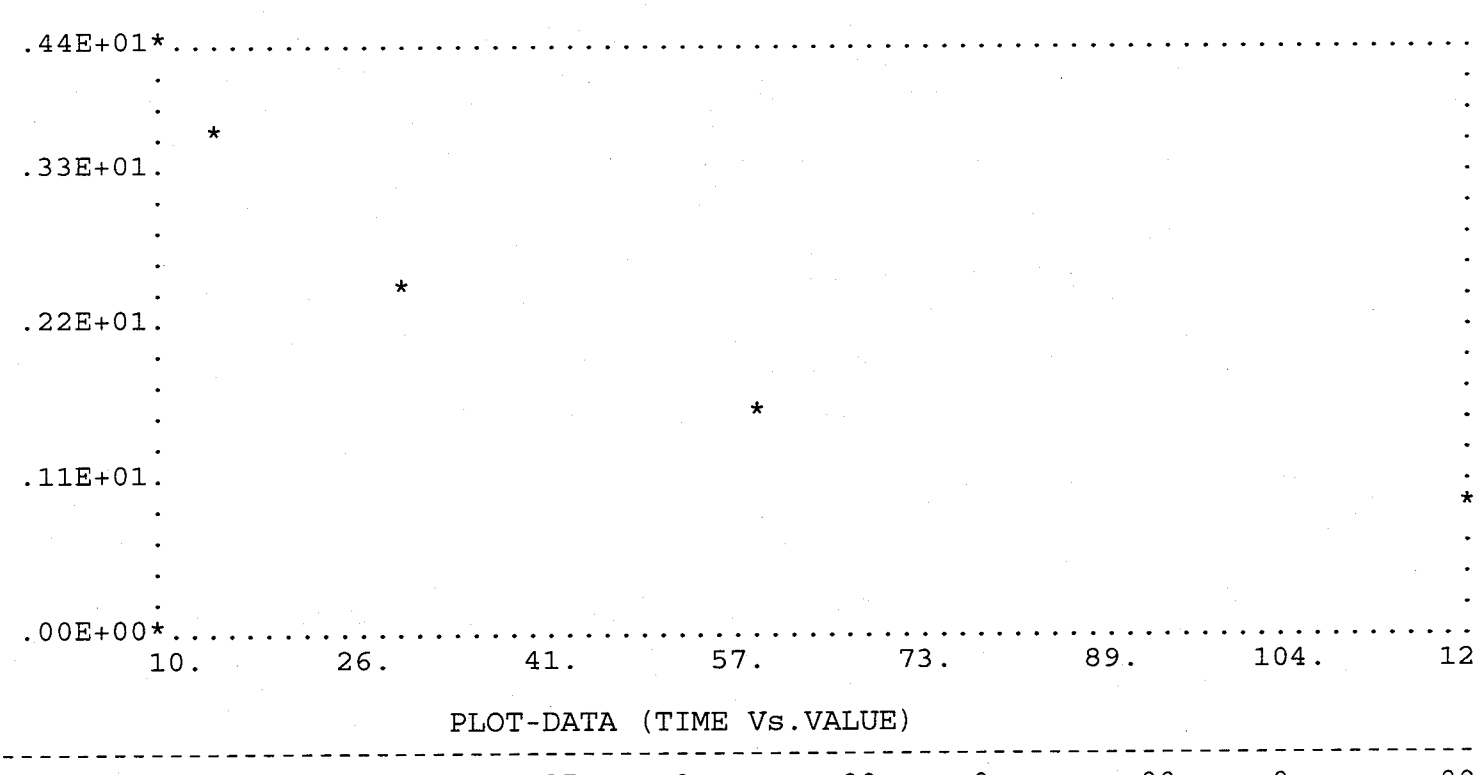
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1095.66	1109.64	1.50

NORMAL END OF HYDRA

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 107+10

```
+++ Commands Read From File C:\HYDRA\HYDRA03.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 108+00 LT
  STO0.312 0.95 10
  PIP42 1119.26 1119.28 1088.12 1087.70 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Link #  1,  Flow depth =    .36 ft
```

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 107+10

```
  PNC1 2 3 35 0
  REMCB AT GRAND AVE STA 108+00 RT
  STO0.403 0.95 10
  PIP215 1119.28 1097.00 1087.20 1085.05 24
+++ Tc =  10.2 min
+++ CA =    .7
+++ Link #  2,  Flow depth =    .50 ft
  PNC2 3 0 0 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 107+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	42	18	1088.12	.01000	31.1	29.5	4.1	1.31	0.
			1087.70		31.6		6.0	10.53	
2	215	24	1087.20	.01000	32.1	9.8	5.0	2.99	0.
			1085.05		11.9		7.2	22.68	

Length = 257. ft Total length = 257. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO DETENTION BASIN AT GRAND AVE STA 107+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	1095.31	1089.20	Y	1119.28	Y	8.11	.75
2	3	1095.00	1087.05	Y	1097.00	Y	.00	.00

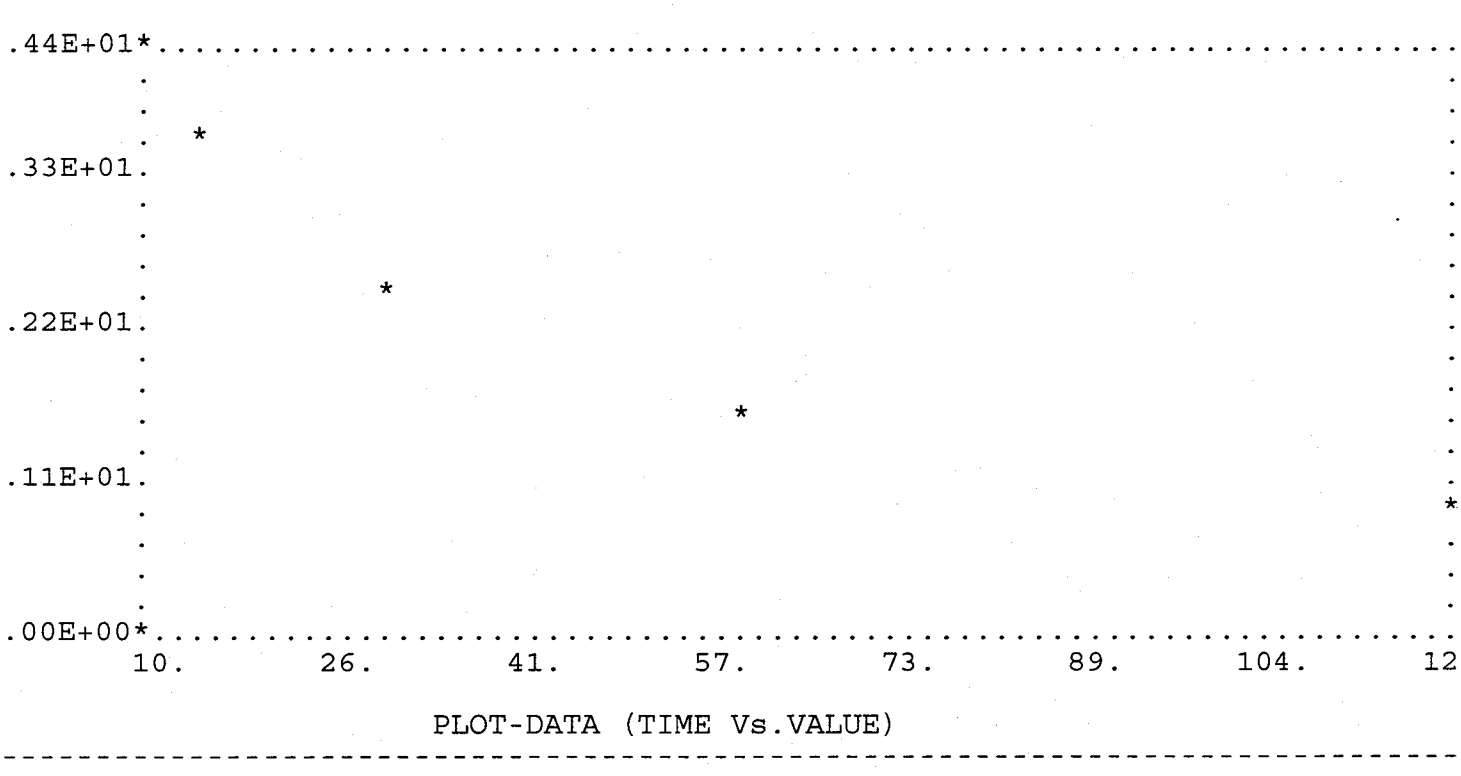
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1095.72	1119.26	1.50

NORMAL END OF HYDRA

SD OUTLET TO CHANNEL AT GRAND AVE STA 111+30

```
+++ Commands Read From File C:\HYDRA\HYDRA04.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 111+30 LT
  STO0.462 0.95 10
  PIP42 1126.26 1126.37 1089.61 1089.19 18
+++ Tc =  10.0 min
+++ CA =    .4
+++ Link #  1,  Flow depth =    .45 ft
```

SD OUTLET TO CHANNEL AT GRAND AVE STA 111+30

```
  PNC1 2 3 0 0
  REMCB AT GRAND AVE STA 111+30 RT
  STO0.61 0.95 10
  PIP94 1126.37 1096.00 1088.69 1087.75 24
+++ Tc =  10.2 min
+++ CA =   1.0
+++ Link #  2,  Flow depth =    .62 ft
  PNC2 3 0 0 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CHANNEL AT GRAND AVE STA 111+30

*** 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	42	18	1089.61	.01000	36.7	35.0	4.5	1.94	0.
			1089.19		37.2		6.0	10.53	
2	94	24	1088.69	.01000	37.7	6.1	5.6	4.49	0.
			1087.75		8.3		7.2	22.68	

Length = 136. ft Total length = 136. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CHANNEL AT GRAND AVE STA 111+30

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1095.27	1090.69	Y	1126.37	Y	6.58	.75
2	3	1095.00	1089.75	Y	1096.00	Y	.00	.00

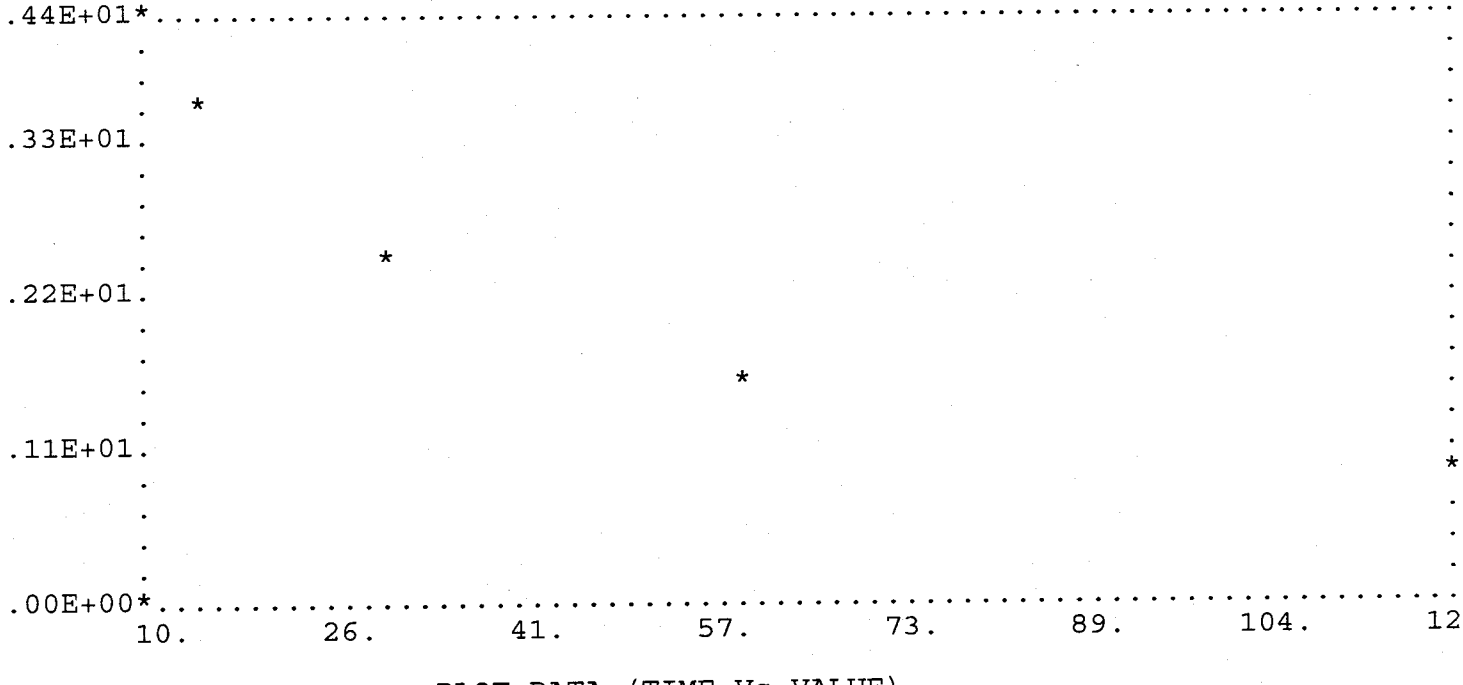
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1095.79	1126.26	1.50

NORMAL END OF HYDRA

SD OUTLET TO CBC AT GRAND AVE STA 119+30

```
+++ Commands Read From File C:\HYDRA\HYDRA05.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 119+30 LT
  STO0.340 0.95 10
  PIP42 1129.91 1129.22 1093.56 1093.14 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Link #  1,  Flow depth =    .38 ft
```

```
 SD OUTLET TO CBC AT GRAND AVE STA 119+30

  PNC1 2 3 15 0
  REMCB AT GRAND AVE STA 119+30 RT
  STO0.464 0.95 10
  PIP84 1129.22 1096.00 1092.64 1091.80 24
+++ Tc =  10.2 min
+++ CA =    .8
+++ Link #  2,  Flow depth =    .54 ft
  PNC2 3 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CBC AT GRAND AVE STA 119+30

*** 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	42	18	1093.56	.01000	36.3	34.5	4.2	1.43	0.
			1093.14		36.1		6.0	10.53	
2	84	24	1092.64	.01000	36.6	2.0	5.2	3.37	0.
			1091.80		4.2		7.2	22.68	

Length = 126. ft Total length = 126. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CBC AT GRAND AVE STA 119+30

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1095.20	1094.64	Y	1129.22	Y	2.56	.66
2	3	1095.00	1093.80	Y	1096.00	Y	.00	.00

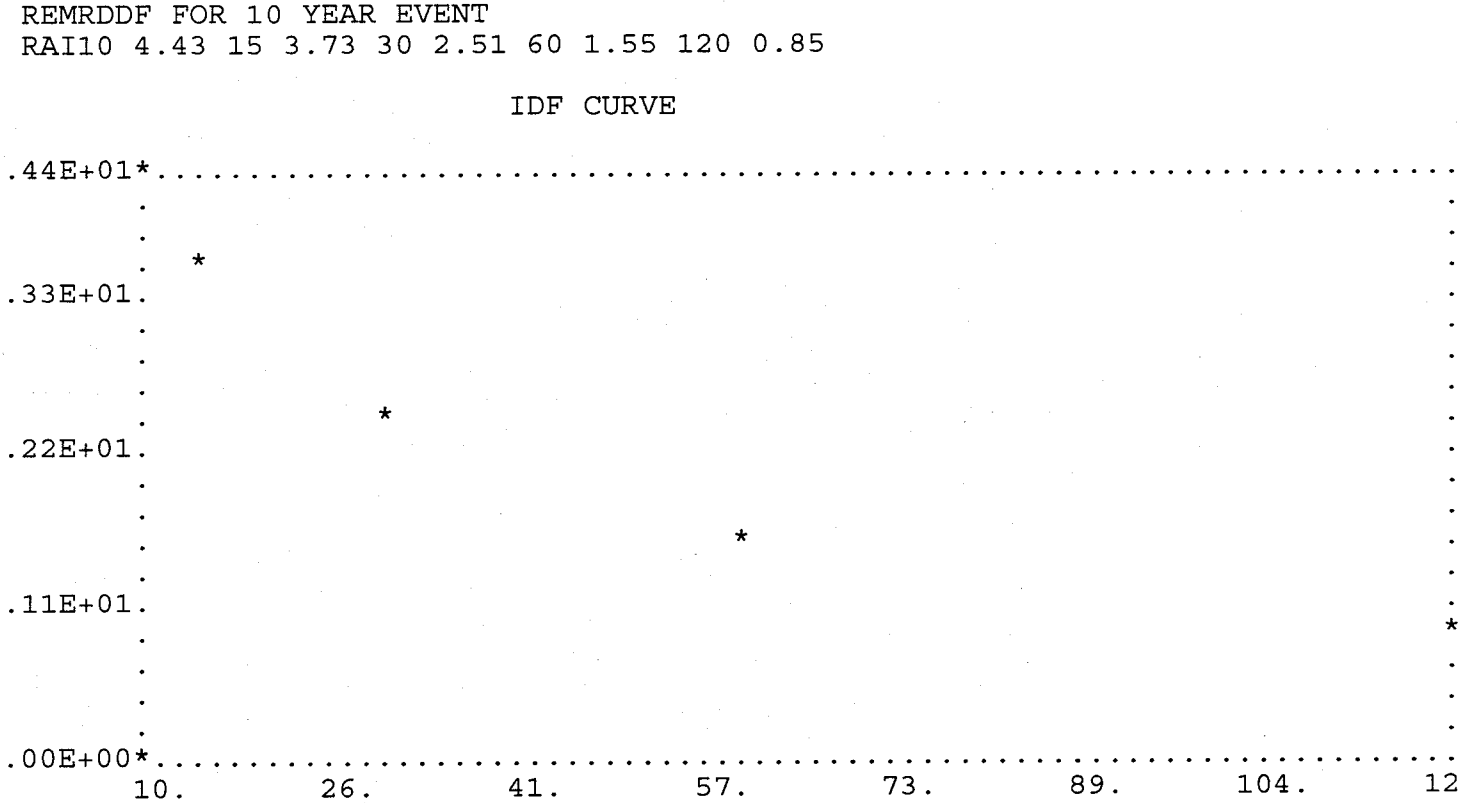
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1095.64	1129.91	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 124+30

```
+++ Commands Read From File C:\HYDRA\HYDRA06.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1098
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 124+30 RT
  STO0.473 0.95 10
  PIP75 1117.06 1116.91 1097.46 1096.71 18
+++ Tc =  10.0 min
+++ CA =    .4
+++ Link #  1,  Flow depth =    .45 ft
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 124+30

```
  PNC1 2 3 0 0
  REMCB AT GRAND AVE STA 124+30 LT
  STO0.473 0.95 10
  PIP126 1116.91 1099.33 1096.21 1094.95 24
+++ Tc =  10.3 min
+++ CA =    .9
+++ Link #  2,  Flow depth =    .58 ft
  PNC2 3 3 15 0
  REMCB AT STREET CONNECTOR C STA 9+00
  STO0.242 0.95 10
  PIP6 1099.33 1099.50 1094.95 1094.89 24
+++ Tc =  10.7 min
+++ CA =   1.1
+++ Link #  3,  Flow depth =    .64 ft
  PNC3 4 0 90 1
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 124+30

***

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	75	18	1097.46	.01000	19.6	18.0	4.6	1.99	0.
			1096.71		20.2		6.0	10.53	
2	126	24	1096.21	.01000	20.7	2.2	5.4	3.95	0.
			1094.95		4.4		7.2	22.68	
3	6	24	1094.95	.01001	4.4	2.2	5.8	4.90	0.
			1094.89		4.6		7.2	22.69	

Length = 207. ft Total length = 207. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 124+30

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1098.82	1098.21	Y	1116.91	Y	2.61	.66
2	3	1098.56	1096.95	Y	1099.33	Y	3.33	1.08
3	4	1098.00	1096.89	Y	1099.50	Y	.00	.00

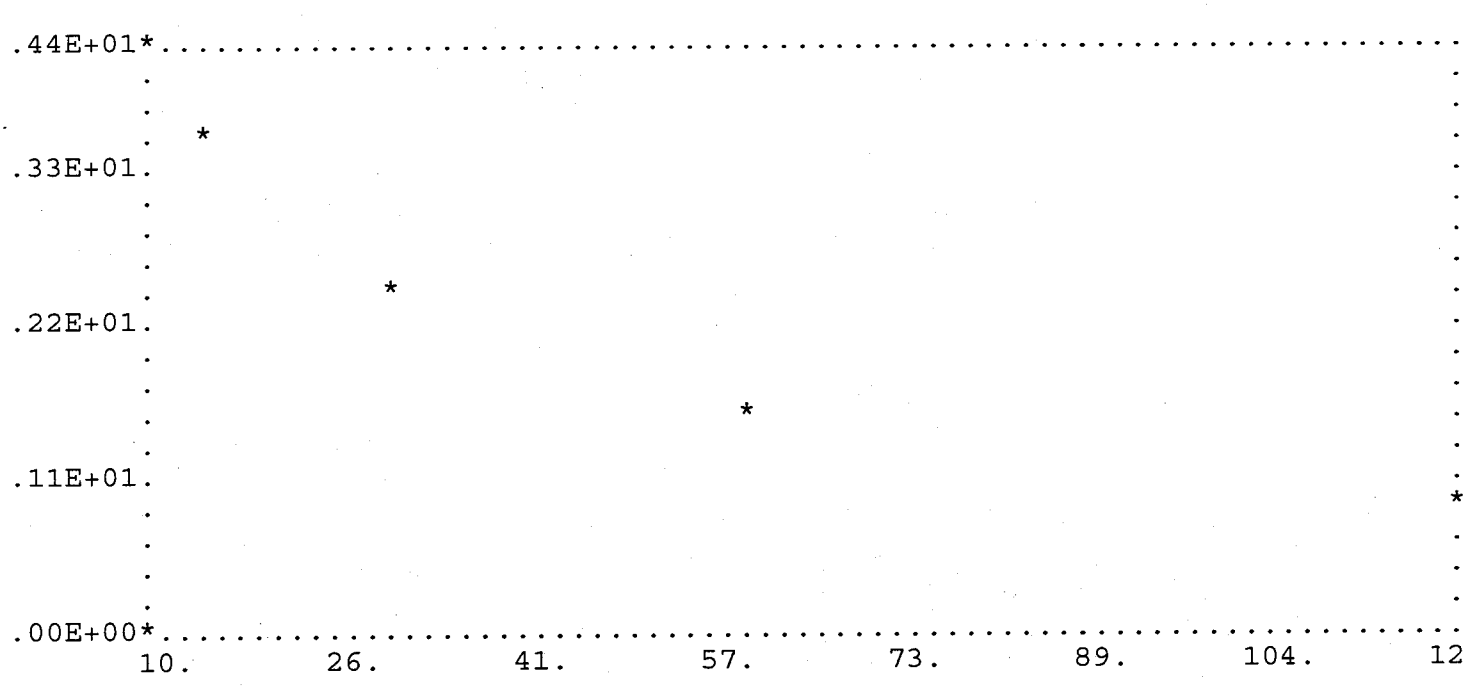
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1099.38	1117.06	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 129+90

```
+++ Commands Read From File C:\HYDRA\HYDRA07.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1098.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 129+90 RT
  STO0.529 0.95 10
  PIP42 1101.19 1101.21 1096.60 1096.39 18
+++ Tc =  10.0 min
+++ CA =    .5
+++ Link #  1,  Flow depth =    .57 ft
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 129+90

```
  PNC1 2 3 15 0
  REMCB AT GRAND AVE STA 129+90 LT
  STO0.617 0.95 10
  PIP60 1101.21 1103.00 1095.89 1095.59 24
+++ Tc =  10.2 min
+++ CA =   1.1
+++ Link #  2,  Flow depth =    .76 ft
  PNC2 3 0 90 1
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 129+90

*** 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	42	18	1096.60	.00500	4.6	3.0	3.7	2.23	0.
			1096.39		4.8		4.2	7.45	
2	60	24	1095.89	.00500	5.3	3.2	4.5	4.79	0.
			1095.59		7.4		5.1	16.04	

Length = 102. ft Total length = 102. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 129+90

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1098.14	1097.89	Y	1101.21	Y	2.25	.65
2	3	1098.00	1097.59	Y	1103.00	Y	.00	.00

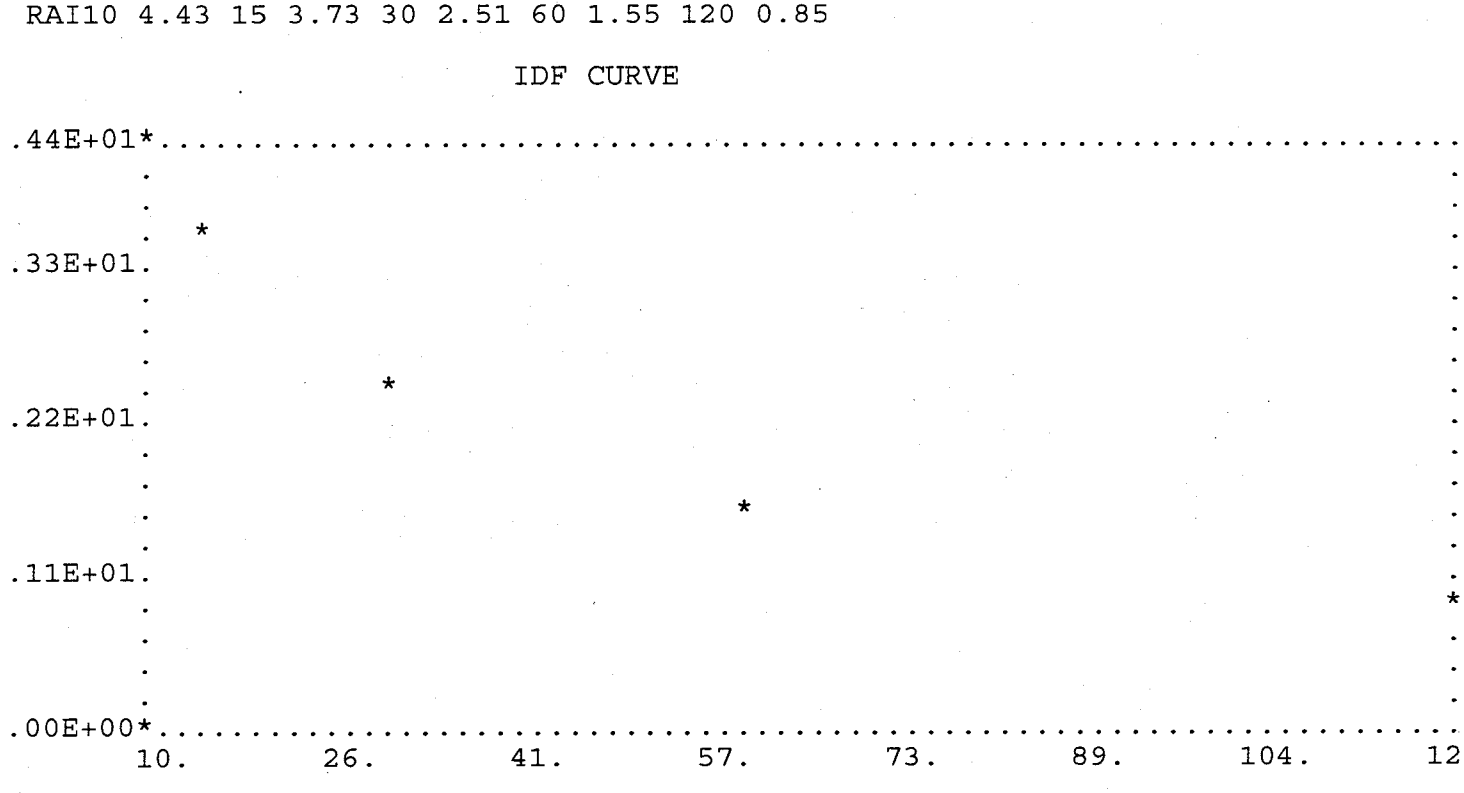
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1098.48	1101.19	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 131+69.08

```
+++ Commands Read From File C:\HYDRA\HYDRA08.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1098.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 131+69.08 RT
  STO0.664 0.95 10
  PIP60 1099.69 1100.21 1096.82 1096.52 18
+++ Tc =  10.0 min
+++ CA =    .6
+++ Cover at upper manhole    1.24 ft
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 131+69.08

```
+++ Link #  1,  Flow depth =    .64 ft
  PNC1 2 3 0 0
  REMCB AT GRAND AVE STA 131+69.08 LT
  STO0.551 0.95 10
  PIP44 1100.21 1101.25 1096.02 1095.80 24
+++ Tc =  10.3 min
+++ CA =   1.2
+++ Link #  2,  Flow depth =    .78 ft
  PNC2 3 0 90 1
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 131+69.08

***

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	1096.82	.00500	2.9	1.2	3.9	2.79	0.
			1096.52		3.7		4.2	7.45	
2	44	24	1096.02	.00500	4.2	2.0	4.5	5.07	0.
			1095.80		5.4		5.1	16.04	

Length = 104. ft Total length = 104. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 131+69.08

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1098.13	1098.02	Y	1100.21	Y	2.11	.64
2	3	1098.00	1097.80	Y	1101.25	Y	.00	.00

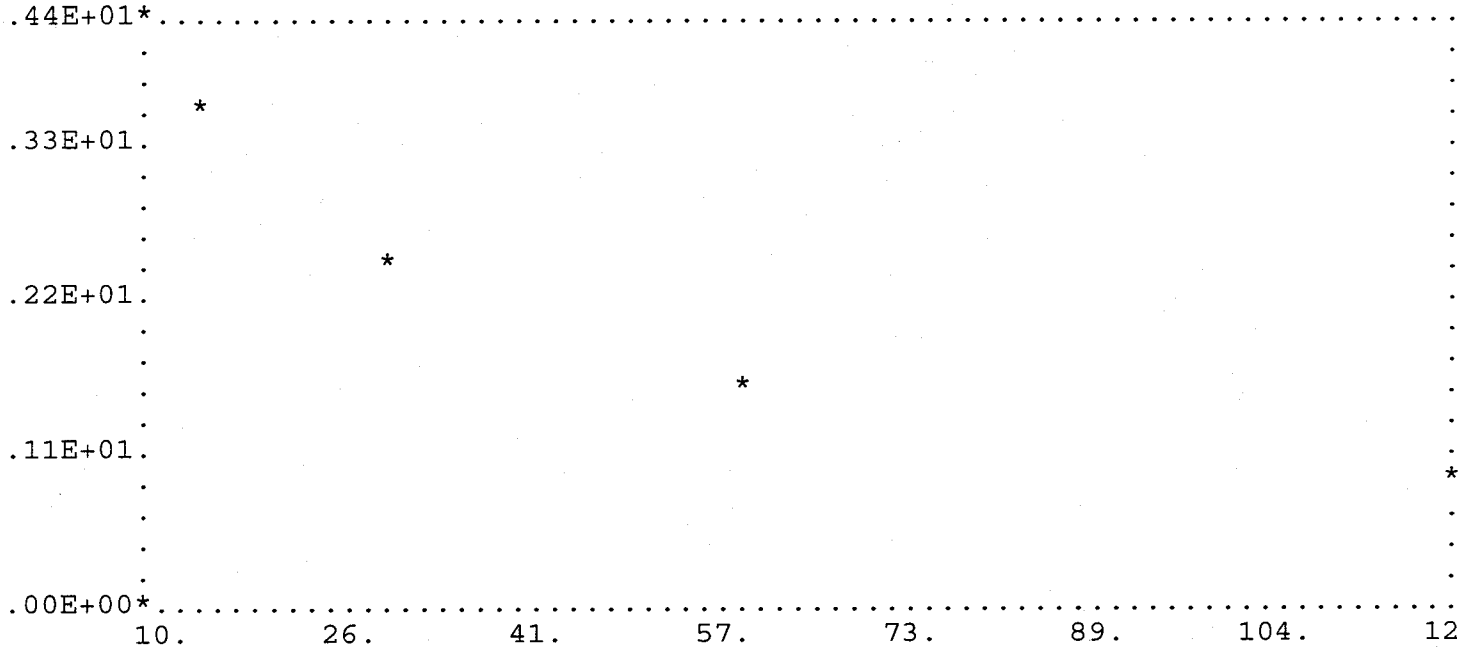
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1098.53	1099.69	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 134+00

```
+++ Commands Read From File C:\HYDRA\HYDRA09.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1098
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 134+00 RT
  STO0.253 0.95 10
  PIP44 1100.53 1101.18 1096.83 1096.61 18
+++ Tc =  10.0 min
+++ CA =    .2
+++ Link #  1,  Flow depth =    .39 ft
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 134+00

```
  PNC1 2 3 0 0
  REMCB AT GRAND AVE STA 134+00 LT
  STO0.225 0.95 10
  PIP26 1101.18 1102.56 1096.51 1096.38 24
+++ Tc =  10.2 min
+++ CA =    .5
+++ Link #  2,  Flow depth =    .48 ft
  PNC2 3 0 90 1
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 134+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	44	18	1096.83	.00500	3.7	2.1	3.0	1.06	0.
			1096.61		4.6		4.2	7.45	
2	26	24	1096.51	.00500	4.7	2.5	3.5	2.00	0.
			1096.38		6.2		5.1	16.04	

Length = 70. ft Total length = 70. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 134+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	1098.07	1098.11	N	1101.18	Y	1.56	.63
2	3	1098.00	1098.38	N	1102.56	Y	.00	.00

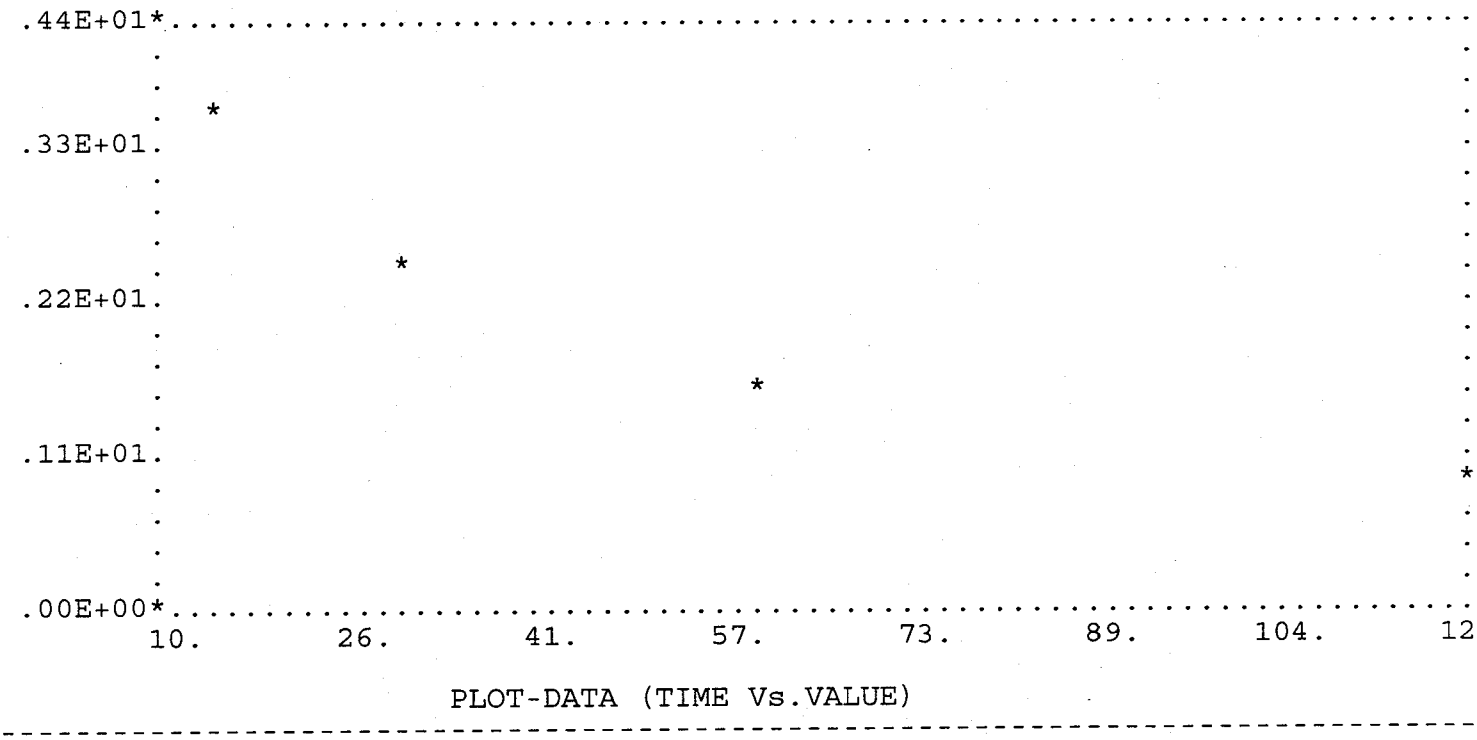
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1098.29	1100.53	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 136+48

```
+++ Commands Read From File C:\HYDRA\HYDRA10.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1098.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT GRAND AVE STA 136+48 RT
  STO0.359 0.95 10
  PIP80 1102.10 1102.59 1097.49 1097.09 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Link #  1,  Flow depth =    .46 ft
```

```
 SD OUTLET TO EXISTING SD FROM GRAND AVE STA 136+48

  PNC1 2 3 0 0
  REMCB AT GRAND AVE STA 136+48 LT
  STO0.359 0.95 10
  PIP6 1102.59 1102.61 1096.99 1096.96 24
+++ Tc =  10.4 min
+++ CA =    .7
+++ Link #  2,  Flow depth =    .60 ft
  PNC2 3 0 90 1
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 136+48

***

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	80	18	1097.49	.00500	4.6	3.0	3.3	1.51	0.
			1097.09		5.5		4.2	7.45	
2	6	24	1096.99	.00498	5.6	3.4	3.9	2.98	0.
			1096.96		5.6		5.1	16.01	

Length = 86. ft Total length = 86. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM GRAND AVE STA 136+48

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1098.08	1098.59	N	1102.59	Y	1.09	.62
2	3	1098.00	1098.96	N	1102.61	Y	.00	.00

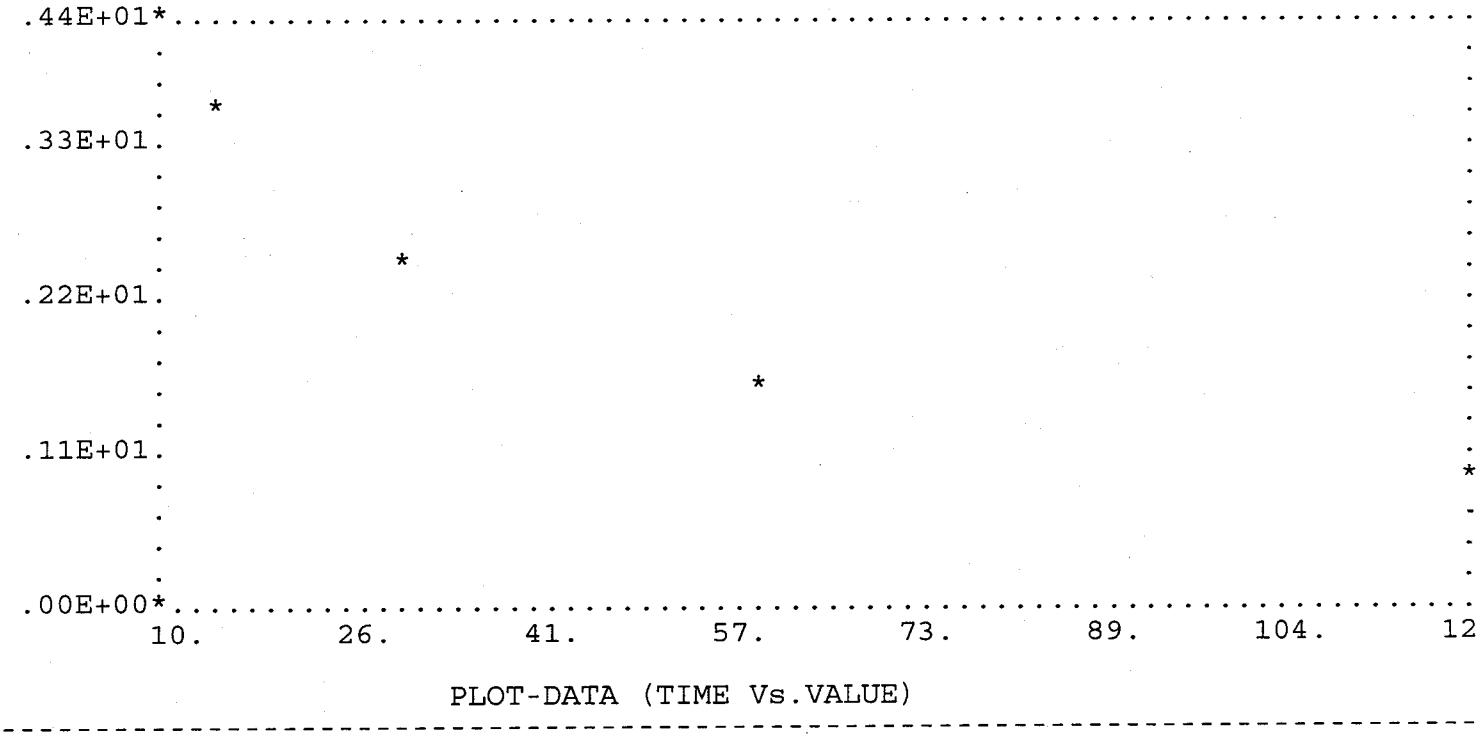
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1098.33	1102.10	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 8+60

```
+++ Commands Read From File C:\HYDRA\HYDRA11.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1090.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR A STA 8+60 RT
  STO0.260 0.95 10
  PIP42 1103.09 1096.70 1087.18 1086.76 18
+++ Tc =  10.0 min
+++ CA =    .2
+++ Link #  1,  Flow depth =    .33 ft
```

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 8+60

```
 PNC1 2 0 90 1
 END
END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 8+60

*** 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	42	18	1087.18	.01000	15.9	8.3	3.8	1.09	0.
			1086.76		9.9		6.0	10.53	

Length = 42. ft Total length = 42. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 8+60

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1090.00	1088.26	Y	1096.70	Y	.00	.00

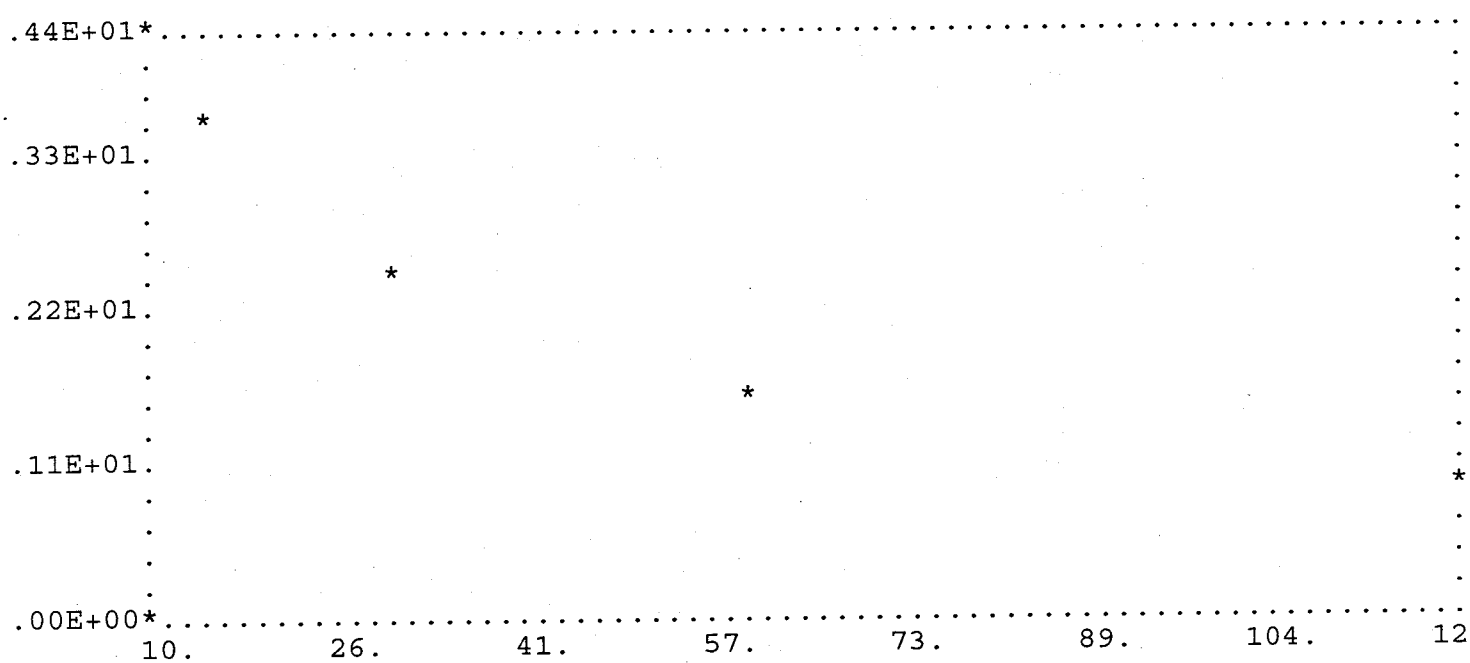
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1090.37	1103.09	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 10+60

```
+++ Commands Read From File C:\HYDRA\HYDRA12.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1090.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR A STA 10+60 RT
  STO0.135 0.95 10
  PIP60 1098.00 1098.50 1087.12 1086.52 18
+++ Tc =  10.0 min
+++ CA =    .1
+++ Link #  1,  Flow depth =    .24 ft
```

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 10+60

```
 PNC1 2 0 90 1
 END
END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 10+60

***

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	1087.12	.01000	10.9	9.3	3.2	.57	0.
			1086.52		12.0		6.0	10.53	

Length = 60. ft Total length = 60. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR A STA 10+60

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1090.00	1088.02	Y	1098.50	Y	.00	.00

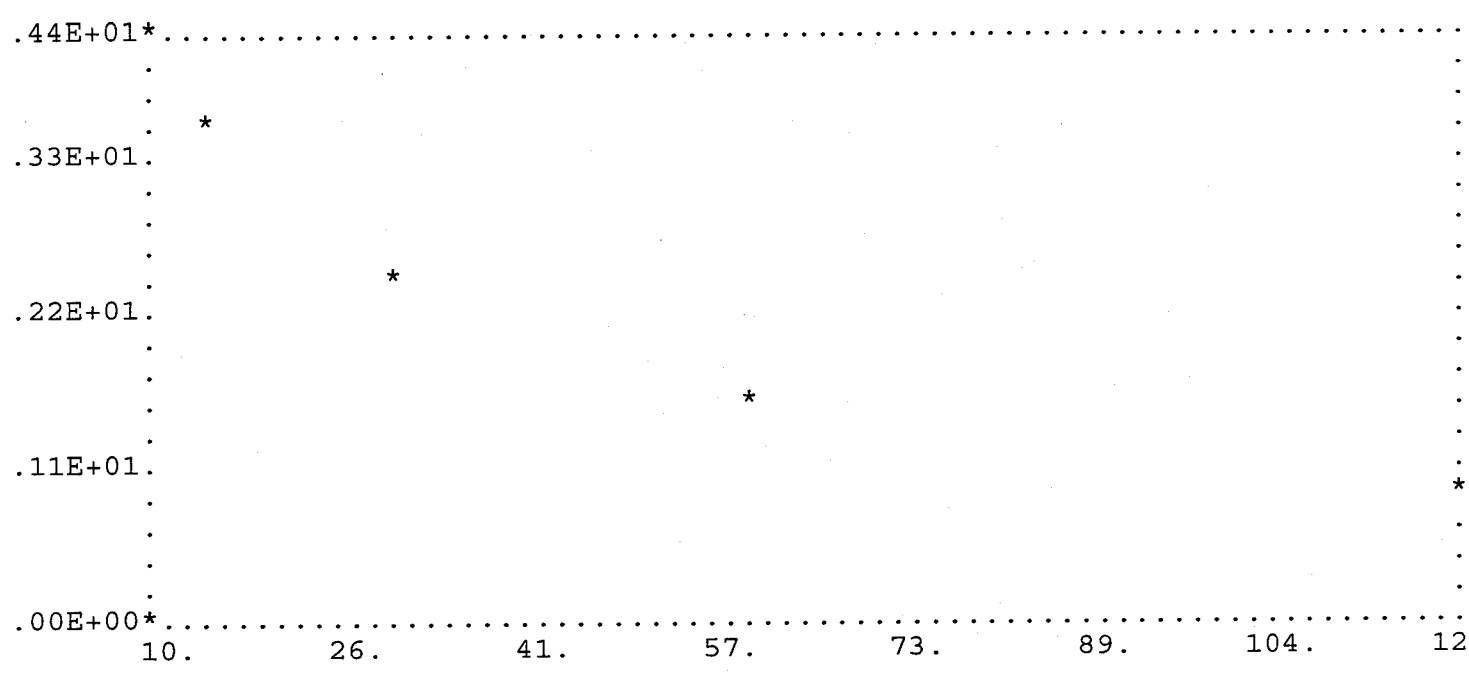
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1090.26	1098.00	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR B STA 7+50

```
+++ Commands Read From File C:\HYDRA\HYDRA13.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1098.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR B STA 7+50 RT
  STO0.343 0.95 10
  PIP6 1113.98 1113.0 1091.56 1091.50 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Link #  1,  Flow depth =    .39 ft
```

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR B STA 7+50

```
 PNC1 2 0 90 2
 END
END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR B STA 7+50

***

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	6	18	1091.56 1091.50	.01001	22.4 21.5	19.9	4.2 6.0	1.44 10.54	0.

Length = 6. ft Total length = 6. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD FROM STREET CONNECTOR B STA 7+50

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1098.00	1093.00	Y	1113.00	Y	.00	.00

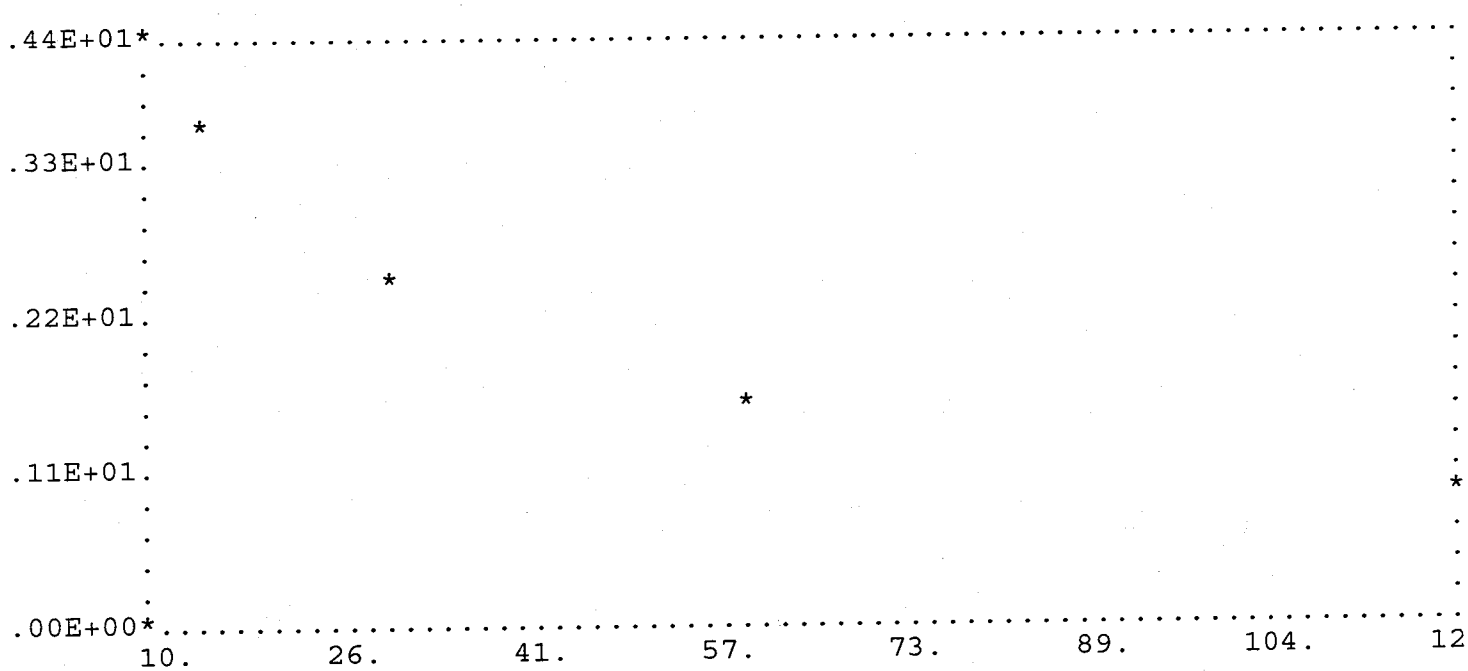
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1098.41	1113.98	1.50

NORMAL END OF HYDRA

SD OUTLET TO CONCRETE BOX CULVERT STA 4+16

```
+++ Commands Read From File C:\HYDRA\HYDRA14.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1096.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR D STA 0+75
  STO0.223 0.95 10
  PIP78 1100.00 1099.36 1095.85 1095.46 18
+++ Tc =  10.0 min
+++ CA =    .2
+++ Link #  1,  Flow depth =    .38 ft
```

```
 SD OUTLET TO CONCRETE BOX CULVERT STA 4+16


  PNC1 2 3 45 0
  REMCB AT STREET CONNECTOR B STA 12+33
  STO0.327 0.95 10
  PIP10 1099.36 1099.00 1094.96 1094.86 24
+++ Tc =  10.5 min
+++ CA =    .5
+++ Link #  2,  Flow depth =    .44 ft
  PNC2 3 5 90 0
  REMMH 103 TO MH 102
  PIP133 1099.00 1099.50 1094.86 1094.46 24
+++ Tc =  10.5 min
+++ CA =    .5
+++ Link #  3,  Flow depth =    .60 ft
  PNC3 5 5 15 0
  HOL1
  REMCB AT STREET CONNECTOR B STA 11+00
  STO0.300 0.95 10
  PIP10 1098.91 1099.50 1095.56 1095.46 18
+++ Tc =  11.2 min
+++ CA =    .8
+++ Link #  4,  Flow depth =    .60 ft
  PNC4 5 5 105 0
  REC1
  REMMH 102 TO MH 101
  PIP133 1099.50 1100.40 1094.46 1094.06 30
+++ Tc =  11.3 min
+++ CA =   1.3
+++ Link #  5,  Flow depth =    .88 ft
  PNC5 6 5 15 0
  REMMH 101 TO OUTLET
  PIP116 1100.20 1100.00 1094.06 1093.71 30
+++ Tc =  11.8 min
+++ CA =   1.3
+++ Link #  6,  Flow depth =    .85 ft
  PNC6 7 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CONCRETE BOX CULVERT STA 4+16

*** 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	78	18	1095.85	.00500	4.1	2.3	2.9	.94	0.
			1095.46		3.9		4.2	7.45	
2	10	24	1094.96	.01000	4.4	2.0	4.6	2.28	0.
			1094.86		4.1		7.2	22.68	
3	133	24	1094.86	.00301	4.1	2.0	3.0	2.28	0.
			1094.46		5.0		4.0	12.44	
4	10	18	1095.56	.01000	3.3	1.7	5.3	3.44	0.
			1095.46		4.0		6.0	10.53	
5	133	30	1094.46	.00301	5.0	2.3	3.8	5.66	0.
			1094.06		6.3		4.6	22.56	
6	116	30	1094.06	.00302	6.1	3.4	3.8	5.55	0.
			1093.71		6.3		4.6	22.59	

Length = 480. ft Total length = 701. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CONCRETE BOX CULVERT STA 4+16

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1096.77	1096.96	N	1099.36	Y	1.81	.67
2	3	1096.74	1096.86	N	1099.00	Y	1.80	1.10
3	5	1096.55	1096.46	Y	1099.50	N	2.21	3.14
4	5	1096.67	1096.96	N	1099.50	Y	2.21	3.14
5	6	1096.27	1096.56	N	1100.20	N	2.09	1.03
6	7	1096.00	1096.21	N	1100.00	N	.00	.00

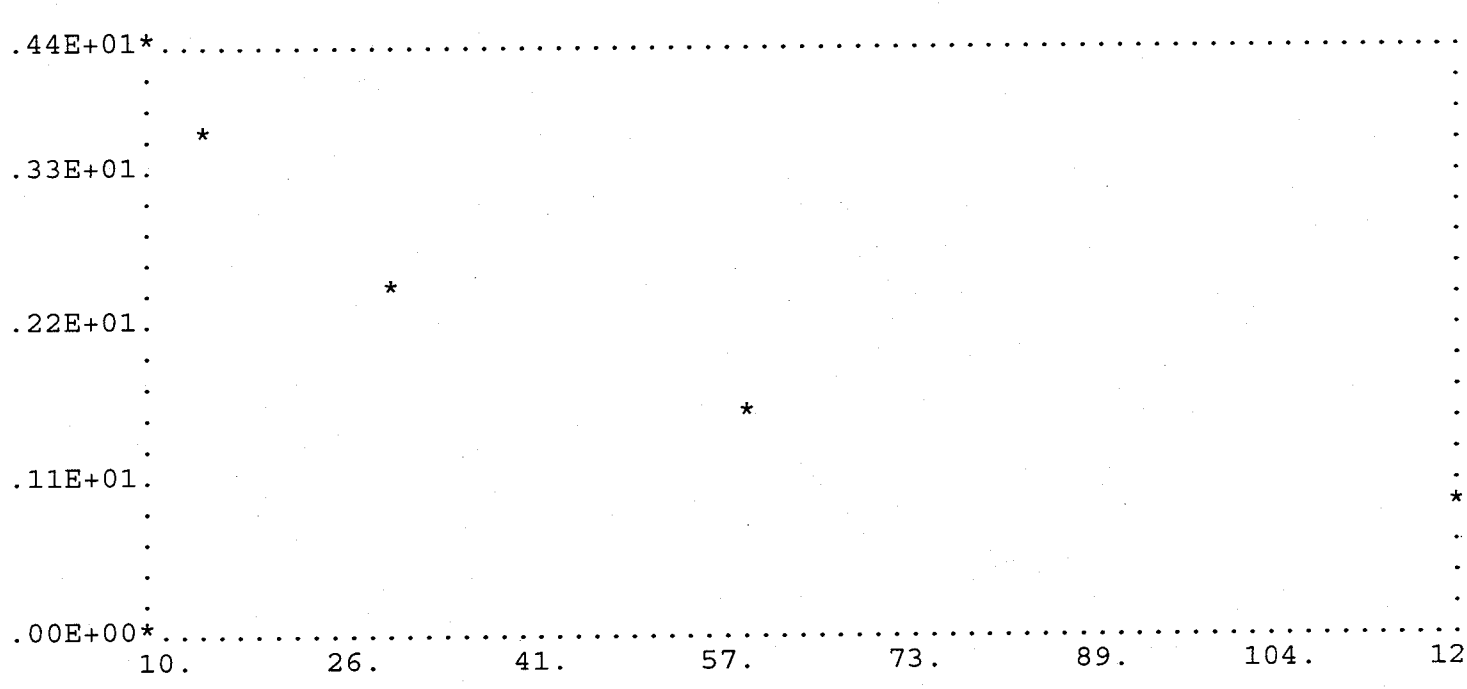
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1096.97	1100.00	1.50
4	4	1097.37	1098.91	1.50

NORMAL END OF HYDRA

SD OUTLET TO CBC STREET CONNECTOR C STA 00+40

```
+++ Commands Read From File C:\HYDRA\HYDRA15.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1096.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR C STA 00+40 LT
  STO0.165 0.95 10
  PIP14 1096.76 1096.50 1091.43 1091.29 18
+++ Tc =  10.0 min
+++ CA =    .2
+++ Link #  1,  Flow depth =    .27 ft
```

SD OUTLET TO CBC STREET CONNECTOR C STA 00+40

```
  PNC1 2 0 45 1
  PIP14 1096.50 1097.0 1091.29 1091.15 18
+++ Tc =  10.1 min
+++ CA =    .2
+++ Link #  2,  Flow depth =    .27 ft
  PNC2 3 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CBC STREET CONNECTOR C STA 00+40

***

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	14	18	1091.43	.01001	5.3	3.6	3.4	.69	0.
			1091.29		5.2		6.0	10.54	
2	14	18	1091.29	.00999	5.2	3.6	3.4	.69	0.
			1091.15		5.8		6.0	10.53	

Length = 28. ft Total length = 28. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CBC STREET CONNECTOR C STA 00+40

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1096.01	1092.79	Y	1096.50	Y	4.72	.00
2	3	1096.00	1092.65	Y	1097.00	Y	.00	.00

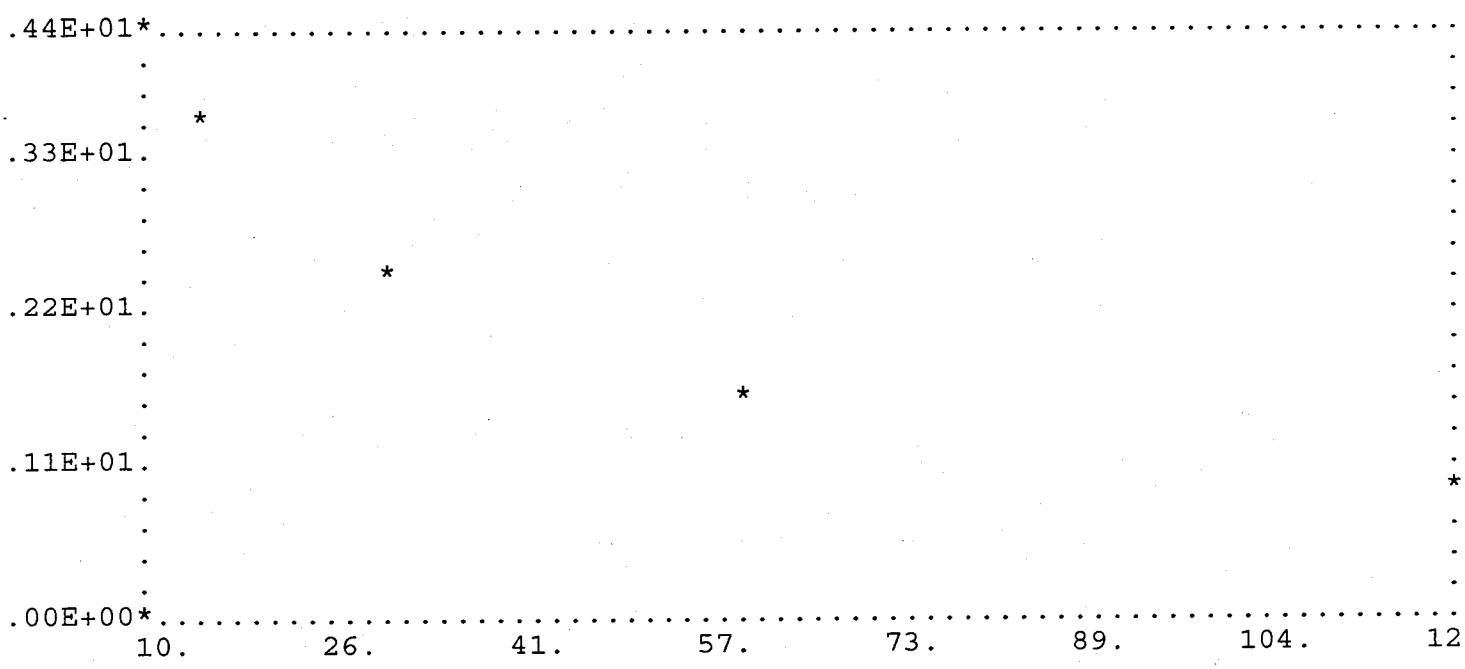
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1096.28	1096.76	1.50

NORMAL END OF HYDRA

SD OUTLET TO EXISTING SD STREET CONNECTOR C STA 05+50

```
+++ Commands Read From File C:\HYDRA\HYDRA16.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1096.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR C STA 05+50 RT
  STO0.331 0.95 10
  PIP54 1096.21 1096.50 1092.77 1092.50 18
+++ Tc =  10.0 min
+++ CA =    .3
+++ Link #  1,  Flow depth =    .45 ft
```

SD OUTLET TO EXISTING SD STREET CONNECTOR C STA 05+50

```
  PNC1 2 0 125 1
  PIP48 1096.50 1098.00 1092.50 1092.26 18
+++ Tc =  10.3 min
+++ CA =    .3
+++ Link #  2,  Flow depth =    .45 ft
  PNC2 3 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO EXISTING SD STREET CONNECTOR C STA 05+50

***

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	1092.77	.00500	3.4	1.8	3.2	1.39	0.
			1092.50		4.0		4.2	7.45	
2	48	18	1092.50	.00500	4.0	2.4	3.2	1.38	0.
			1092.26		5.7		4.2	7.45	

Length = 102. ft Total length = 102. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO EXISTING SD STREET CONNECTOR C STA 05+50

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1096.02	1094.00	Y	1096.50	Y	3.52	.00
2	3	1096.00	1093.76	Y	1098.00	Y	.00	.00

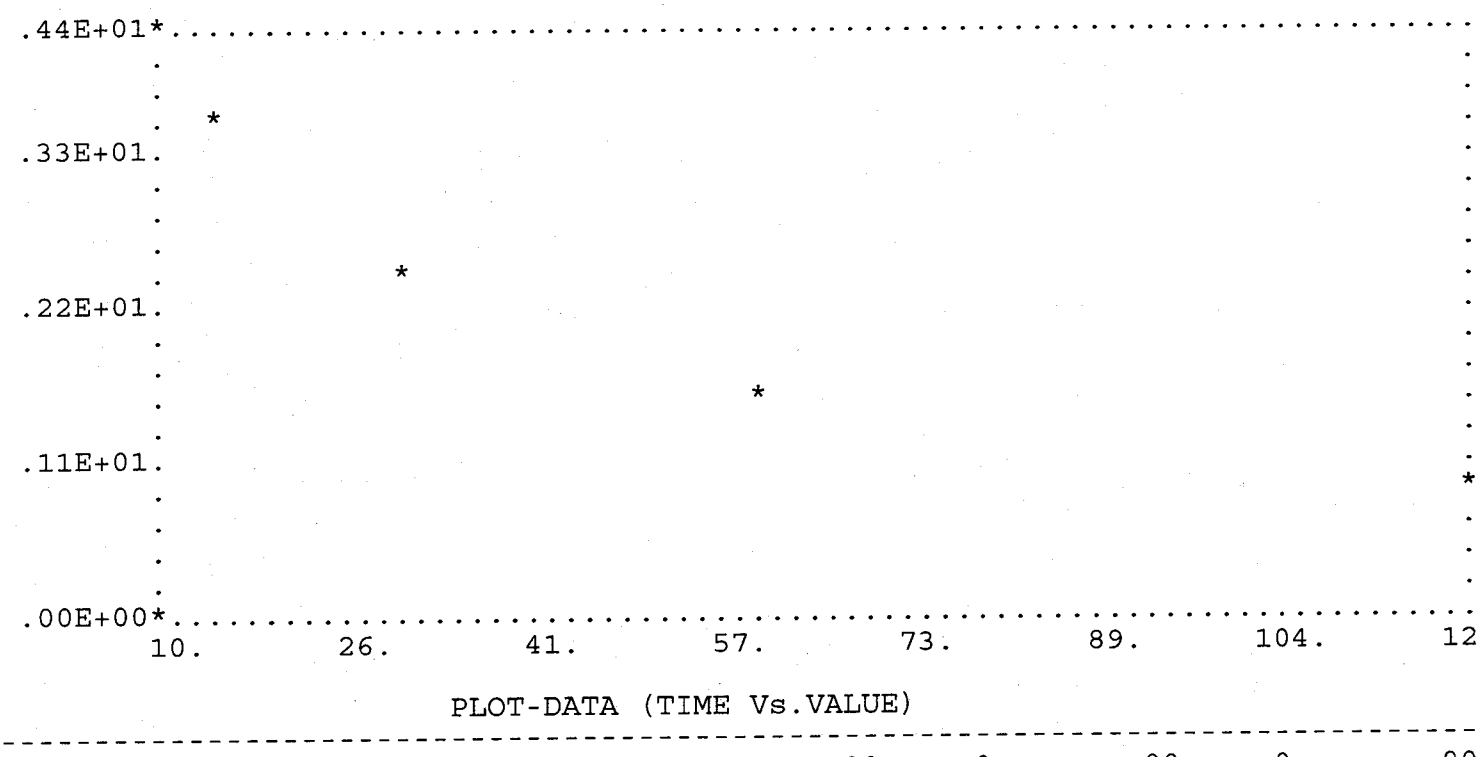
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1096.29	1096.21	1.50

NORMAL END OF HYDRA

SD OUTLET TO CHANNEL STREET CONNECTOR D STA 06+80.18

```
+++ Commands Read From File C:\HYDRA\HYDRA17.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT STREET CONNECTOR D STA 06+80.18 LT
  STO1.079 0.74 10
  PIP33 1097.00 1098.54 1094.83 1094.50 18
+++ Tc =  10.0 min
+++ CA =    .8
+++ Cover at upper manhole     .54 ft
```

SD OUTLET TO CHANNEL STREET CONNECTOR D STA 06+80.18

```
+++ Link #  1,  Flow depth =    .60 ft
  PNC1 2 3 0 0
  REMCB AT STREET CONNECTOR D STA 06+80.18 RT
  STO0.459 0.95 10
  PIP24 1098.54 1100.30 1094.50 1094.38 18
+++ Tc =  10.1 min
+++ CA =   1.2
+++ Link #  2,  Flow depth =    .96 ft
  PNC2 3 0 90 2
  END
 END OF INPUT DATA.
```

SD OUTLET TO CHANNEL STREET CONNECTOR D STA 06+80.18

***

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	33	18	1094.83	.01000	2.2	.5	5.4	3.54	0.
			1094.50		4.0		6.0	10.53	
2	24	18	1094.50	.00500	4.0	2.4	4.6	5.45	0.
			1094.38		5.9		4.2	7.45	

Length = 57. ft Total length = 57. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO CHANNEL STREET CONNECTOR D STA 06+80.18

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1095.79	1096.00	N	1098.54	Y	1.12	1.03
2	3	1095.33	1095.88	N	1100.30	N	.00	.00

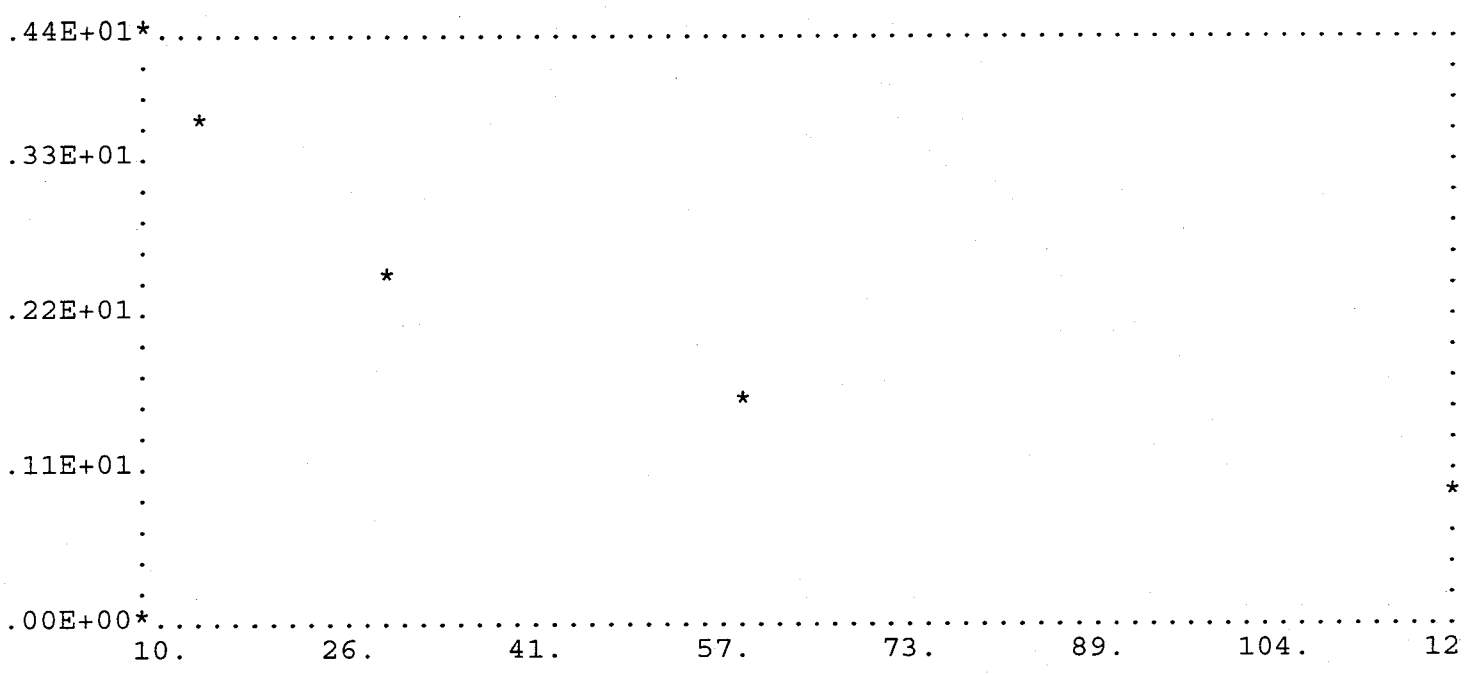
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1096.49	1097.00	1.50

NORMAL END OF HYDRA

SD OUTLET TO BASIN OUTLET PIPE @ THOMAS ROAD

```
+++ Commands Read From File C:\HYDRA\HYDRA18.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT THOMAS ROAD STA 22+27 RT
  STO0.781 0.74 10
  PIP50 1097.00 1097.40 1091.50 1091.00 18
+++ Tc =  10.0 min
+++ CA =    .6
+++ Link #  1,  Flow depth =    .51 ft
```

SD OUTLET TO BASIN OUTLET PIPE @ THOMAS ROAD

```
 PNC1 2 0 90 2
 END
END OF INPUT DATA.
```

SD OUTLET TO BASIN OUTLET PIPE @ THOMAS ROAD

***

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	18	1091.50	.01000	5.5	3.9	4.9	2.56	0.
			1091.00		6.4		6.0	10.53	

Length = 50. ft Total length = 50. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO BASIN OUTLET PIPE @ THOMAS ROAD

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1095.00	1092.50	Y	1097.40	Y	.00	.00

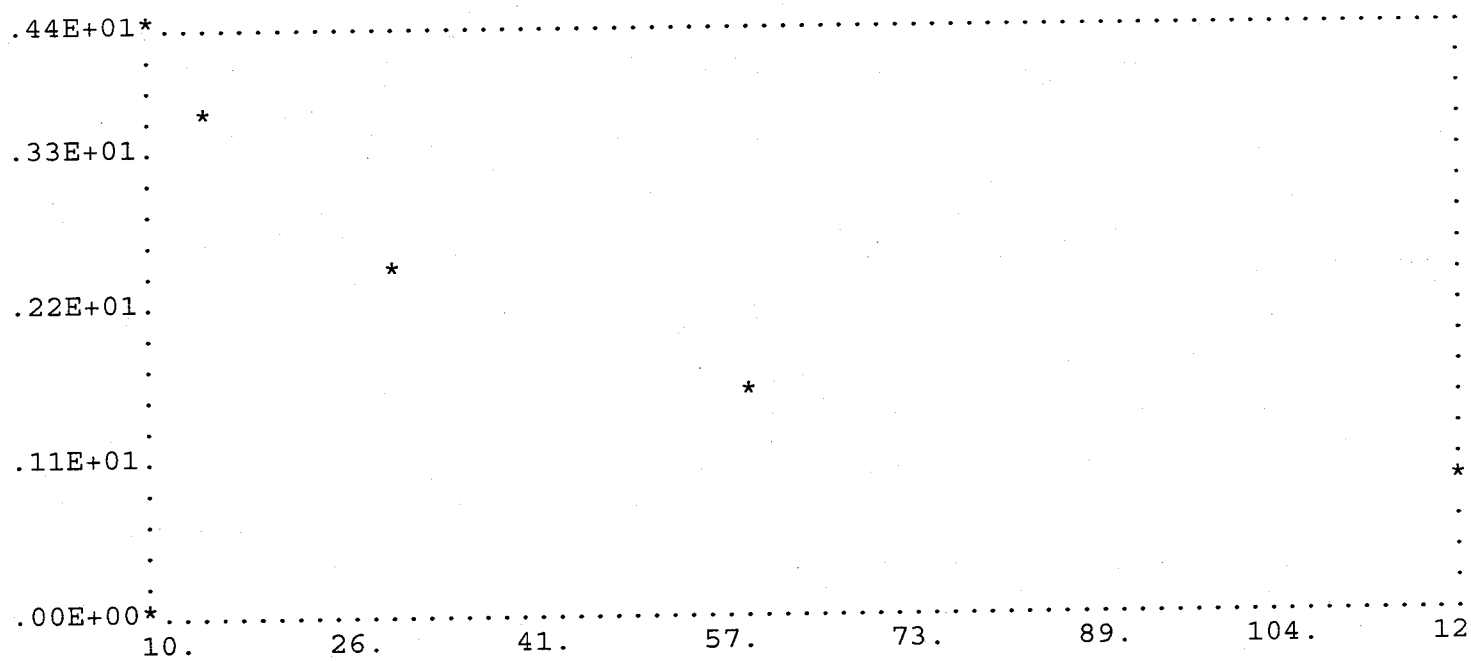
Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1095.62	1097.00	1.50

NORMAL END OF HYDRA

SD OUTLET TO BASIN OUTLET PIPE @ 27TH AVE

```
+++ Commands Read From File C:\HYDRA\HYDRA19.HDA
  JOB
  SWI2
  REMRDDF FOR 10 YEAR EVENT
  RAI10 4.43 15 3.73 30 2.51 60 1.55 120 0.85
```

IDF CURVE



PLOT-DATA (TIME Vs.VALUE)

10.	4.43	120.	.85	0.	.00	0.	.00	0.	.00
15.	3.73	0.	.00	0.	.00	0.	.00	0.	.00
30.	2.51	0.	.00	0.	.00	0.	.00	0.	.00
60.	1.55	0.	.00	0.	.00	0.	.00	0.	.00

```
  TWE1095.0
  REMASSUME PAVEMENT THICKNESS IS 18 INCHES
  PDA0.013 18 3.75 1.5 2 0.0001
  HGL1
  REMCB AT 27TH AVENUE STA 21+73 RT
  STO0.39 0.74 10
  PIP50 1096.50 1097.00 1091.00 1090.50 18
+++ Tc =  10.0 min
+++ CA =     .3
+++ Link #  1,  Flow depth =     .36 ft
```

SD OUTLET TO BASIN OUTLET PIPE @ 27TH AVE

```
 PNC1 2 0 90 2
 END
END OF INPUT DATA.
```

SD OUTLET TO BASIN OUTLET PIPE @ 27TH AVE

***

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	18	1091.00	.01000	5.5	3.9	4.0	1.28	0.
			1090.50		6.5		6.0	10.53	

Length = 50. ft Total length = 50. ft
Cost = 0. Total Cost = 0.

SD OUTLET TO BASIN OUTLET PIPE @ 27TH AVE

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Manhole Depth	Loss Coef
1	2	1095.00	1092.00	Y	1097.00	Y	.00	.00

Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.
1	1	1095.41	1096.50	1.50

NORMAL END OF HYDRA

APPENDIX E

POST VS. PRE DRAINAGE CALCULATIONS FOR GRAND AVENUE

EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

CLIENT ADOT
PROJECT GRAND AVE

SUBJECT POST VS PRE
GRAND AVE SD

PAGE 1 OF 2
PROJECT NO. 39743
Prepared by EAW Date 6/15
Checked by RGH Date 6/20
Revised by Date

SD IN GRAND AVE

POST VS. PRE CONDITIONS FOR PAVEMENT DRAINAGE

EXISTING SD BETWEEN I-17 AND INT THOMAS/27TH

$A \cong 128{,}000\ FT^2 = 2.94\ AC.$

PRE

10-YR EVENT

$Q = CIA$

$C = 0.95$

$i = 3.84\ in/hr$

$Q = 10.73\ cfs$

POST

Q FROM SD INLETS

PIPE # 125 $Q = 0.92\ cfs$

PIPE # 126 $Q = 0.74\ cfs$

$Q_T = 1.66\ cfs$

$Q_{pre} = 10.73\ cfs$

$Q_{post} = 1.66\ cfs$

I-17 TO INTERSECTION

54" SD.

EARTH TECH

A tyco INTERNATIONAL LTD COMPANY

CALCULATION SHEET

PROJECT NO. _____

Prepared by _____ Date _____

Checked by _____ Date _____

Revised by _____ Date _____

CLIENT ADOT

PROJECT GRAND AVE

SUBJECT _____

FROM INTERSECTION WEST ON GRAND

36" SD

PRE -

$A \cong 200{,}000\ FT^2 = 4.59\ AC$

PRE

$Q = CIA$

$C = 0.95$

$I = 3.84$

$Q = 16.74\ cfs$

POST

Q FROM SD INLETS

PIPE #	117	4.04 cfs
PIPE #	119	4.43 cfs
PIPE #	121	1.70 cfs
PIPE	123	2.76 cfs

$Q = 12.93\ cfs$

$Q_{pre} = 16.74\ cfs$

$Q_{POST} = 12.93\ cfs$

FROM INT. WEST TO END OF PROJ.

36" SD

APPENDIX F

HEC-1 / HEC-RAS MODELS

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            SEPTEMBER 1990            *
*             VERSION 4.0              *
*                                      *
*  RUN DATE  10/26/2000  TIME  13:08:46 *
*                                      *
****************************************
```

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

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

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

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


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

  1           ID   Grand Ave. Interchange at 27th Ave.
  2           ID   Model for Area south of Grand Canal
  3           ID   Project Conditions
  4           ID   50Yr-24Hr Event
  5           ID   Clark Unit Hydrograph
  6           ID   24-Hour SCS TYPE II Rainfall Pattern was used to determine TC & R
  7           ID   Green-Ampt Precipitation Losses
  8           ID   Earth Tech File Name : MV27-ET.DAT
  9           ID  ******************************************************************************
              *DIAGRAM
 10           IT      30                    100
 11           IO       5
 12           IN      30
 13           JD    3.38    0.01
 14           PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
 15           PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
 16           PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
 17           PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
 18           PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
 19           PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
 20           PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
 21           PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
 22           PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
 23           PC    .983    .986    .989    .992    .995    .998   1.000
 24           JD    3.38   10.00
              *
              *  SUB-AREA 26-22E1 SOUTH OF GRAND CANAL
```

```
                *
 26             KK  26-22E1
 27             KM   SUB-BASIN 26-22E1
 28             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 29             KM     L =  .437  Kb = .040  Adj. Slope =   19.0
 30             BA    .091
 31             LG    .160    .150   8.400    .090  53.000
 32             UC   .2394   .1630
 33             UA       0       5      16      30      65      77      84      90      94      97
 34             UA     100
                *
                *  SUB-AREA 26-22E2 SOUTH OF GRAND CANAL

 35             KK  26-22E2
 36             KM   SUB-BASIN 26-22E2
 37             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 38             KM     L =  .436  Kb = .040  Adj. Slope =   19.0
 39             BA    .116
 40             LG    .160    .150   8.400    .090  53.000
 41             UC   .2188   .1555
 42             UA       0       5      16      30      65      77      84      90      94      97
 43             UA     100
                *
                *  SUB-AREA 26-22E3 SOUTH OF GRAND CANAL
```



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

 44             KK  26-22E3
 45             KM   SUB-BASIN 26-22E3
 46             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 47             KM     L =  .644  Kb = .040  Adj. Slope =   19.0
 48             BA    .177
 49             LG    .160    .150   8.400    .090  53.000
 50             UC   .2822   .2009
 51             UA       0       5      16      30      65      77      84      90      94      97
 52             UA     100

 53             KK  C2622E
 54             KM   SUB-BASIN COMBINE
 55             HC       3   0.384

 56             KK  RES26E1
 57             KM   THOMAS ROAD DETENTION BASIN RESERVOIR ROUTING
 58             KM   BASIN NORTH OF THOMAS ROAD
 59             KM   DETENTION BASIN AND PART OF AN OVERPASS TO BE CONSTRUCTED ON GRAND AVE.
 60             KM   FLOW OUT OF THE BASIN WILL BE A 24" RCP TO EXISTING 66" RCP IN 27TH AVE.
 61             KM   SUB-BASIN 26-22E
 62             KO               2
 63             RS       1    FLOW      0.
 64             SV       0    0.37    1.48    3.36    5.95
 65             SE  1087.0  1089.0  1091.0  1093.0  1095.0
 66             SQ       0      45     165     215     300
                *
                *

 67             KK  RES26E2
 68             KM   THOMAS ROAD DETENTION BASIN RESERVOIR ROUTING
 69             KM   DETENTION BASIN AND PART OF AN OVERPASS TO BE CONSTRUCTED ON GRAND AVE.
 70             KM   FLOW OUT OF THE BASIN WILL BE A 24" RCP TO EXISTING 66" RCP IN 27TH AVE.
 71             KM   SUB-BASIN 26-22E
 72             KO               2
 73             RS       1    FLOW      0.
 74             SV       0    6.27   13.08   20.41   28.26   36.64   38.69
```

```
          75          SE  1084.5  1086.5  1088.5  1090.5  1092.5  1094.5    1095
          76          SQ       0       9      16      20      24      29      31
          77          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

   26      26-22E
                .
                .
   35           .      26-22E
                .           .
                .           .
   44           .           .      26-22E
                .           .           .
                .           .           .
   53      C2622E.......................
                V
                V
   56      RES26E
                V
                V
   67      RES26E

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
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  10/26/2000  TIME  07:39:54 *                                    *          (916) 756-1104
*                                      *                                    *
****************************************                                    ***********************************
```

Grand Ave. Interchange at 27th Ave.
Model for Area south of Grand Canal
Project Conditions
100Yr-24Hr Event (Revised to 50Yr-24Hr event and detention capacity added for Grand Ave. borrow area)
Clark Unit Hydrograph
24-Hour SCS TYPE II Rainfall Pattern was used to determine TC & R
Green-Ampt Precipitation Losses
Earth Tech File Name : MV27-ET.DAT

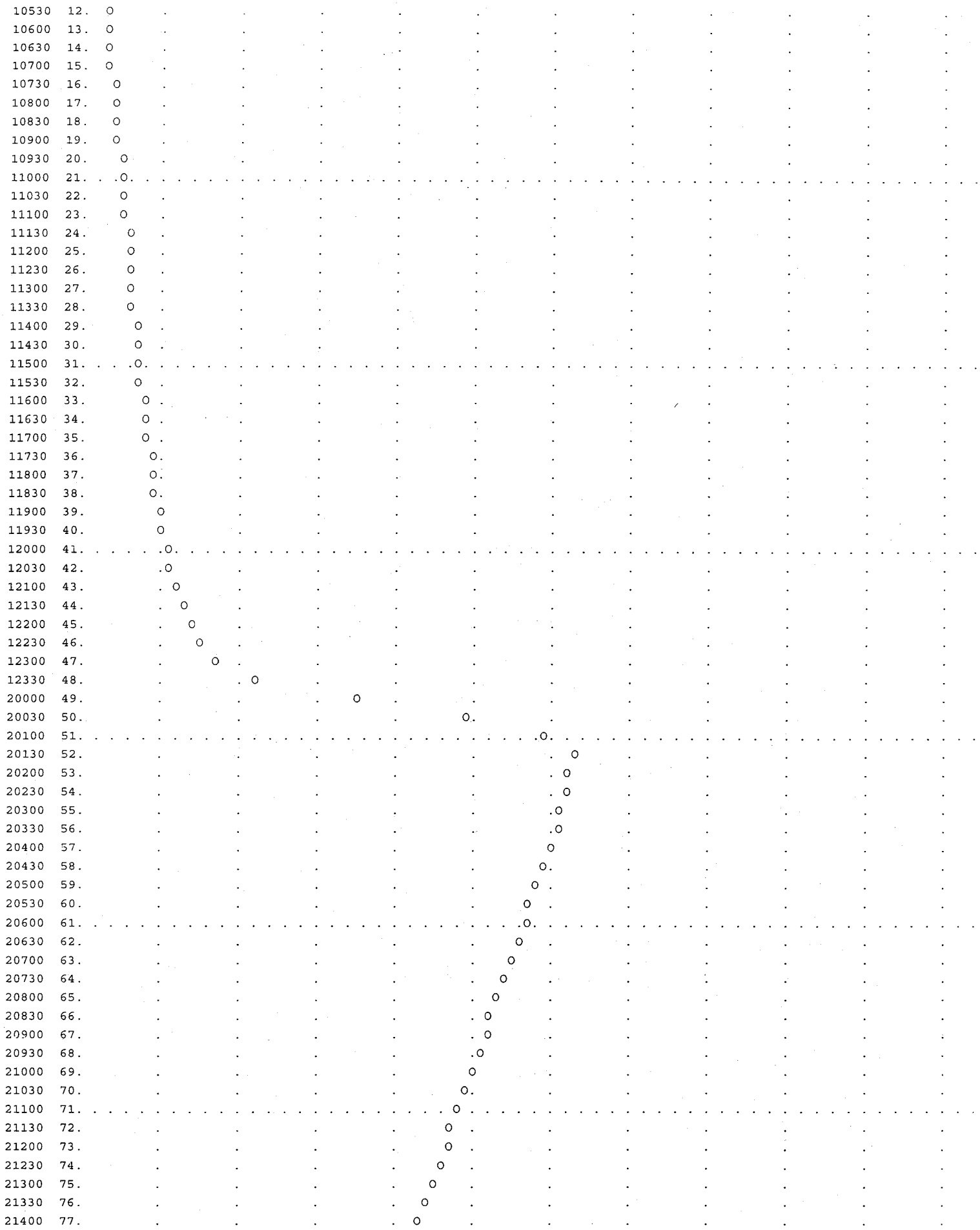
****

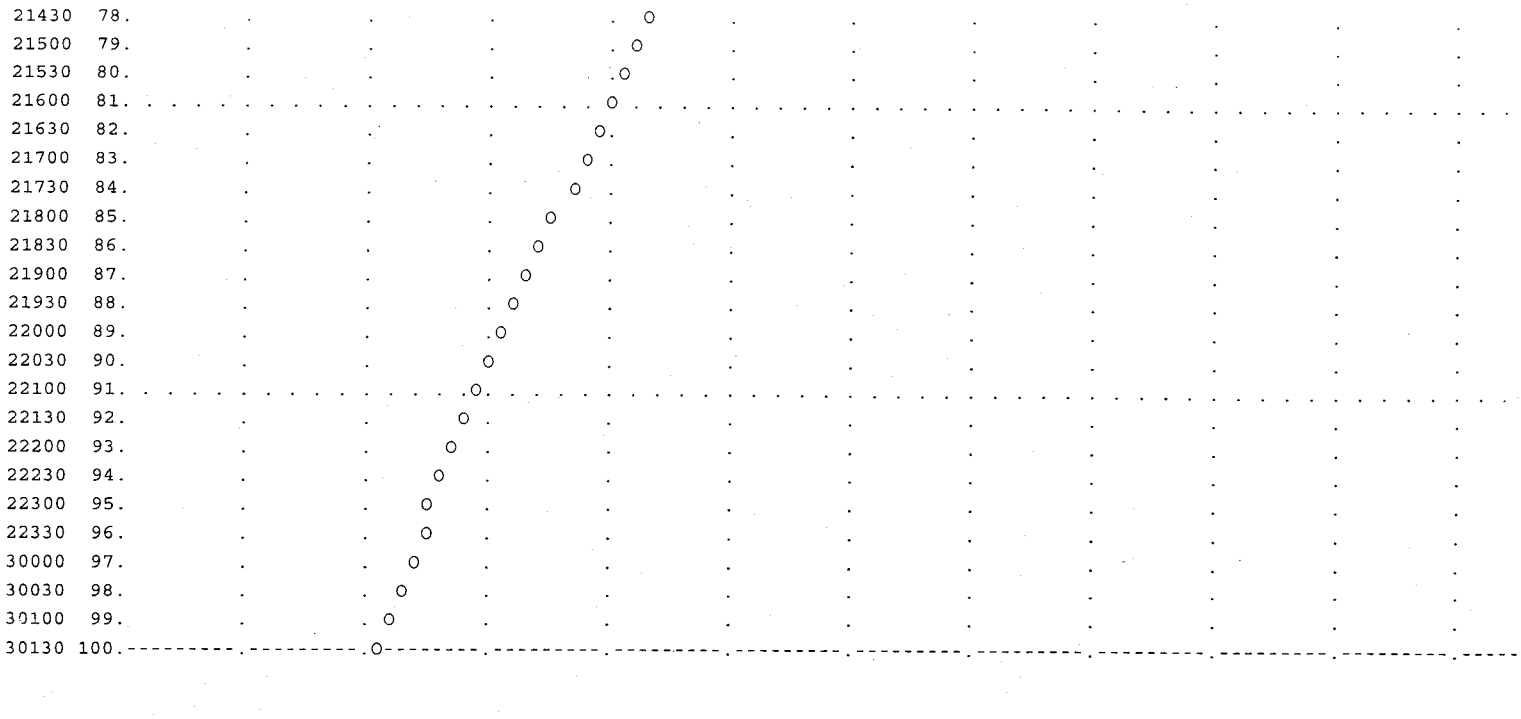
```
 12 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    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

  14 JD          INDEX STORM NO. 1
                       STRM        3.38  PRECIPITATION DEPTH
                       TRDA         .01  TRANSPOSITION DRAINAGE AREA

  15 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

  25 JD          INDEX STORM NO. 2
                       STRM        3.38  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

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

          **************
          *            *
  56 KK   *    RES26E  *     1
          *            *
          **************

  62 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           2  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
1                                                 STATION   RES26E

                       (O) OUTFLOW
        0.       40.       80.      120.      160.      200.      240.      280.        0.        0.        0.        0.
DAHRMN PER
 10000   1O---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.-----
```

```
10030   2O
10100   3O
10130   4.O
10200   5.O
10230   6.O
10300   7.O
10330   8.O
10400   9.O
10430  10.O
10500  11.O
10530  12.O
10600  13.O
10630  14.O
10700  15.O
10730  16.O
10800  17.O
10830  18.O
10900  19.O
10930  20.O
11000  21.O
11030  22.O
11100  23.O
11130  24.O
11200  25.O
11230  26.O
11300  27.O
11330  28.O
11400  29.O
11430  30.O
11500  31.O
11530  32.O
11600  33.O
11630  34.O
11700  35.O
11730  36. O
11800  37. O
11830  38. O
11900  39. O
11930  40. O
12000  41. O
12030  42. O
12100  43. O
12130  44.  O
12200  45.   O
12230  46.   O
12300  47.    O
12330  48.        O
20000  49.                O
20030  50.                    O
20100  51.                O
20130  52O
20200  53.      O
20230  54.  O
20300  55.   O
20330  56.  O
20400  57. O
20430  58. O
20500  59. O
20530  60. O
20600  61. O
20630  62. O
20700  63.O
20730  64.O
20800  65.O
20830  66.O
20900  67.O
```

```
 20930  68.O
 21000  69.O
 21030  70.O
 21100  71.O.
 21130  72.O
 21200  73.O
 21230  74.O
 21300  75.O
 21330  76.O
 21400  77.O
 21430  78.O
 21500  79.O
 21530  80.O
 21600  81.O.
 21630  82.O
 21700  83.O
 21730  84.O
 21800  85.O
 21830  86.O
 21900  87.O
 21930  88.O
 22000  89.O
 22030  90.O
 22100  91.O.
 22130  92.O
 22200  93.O
 22230  94.O
 22300  95.O
 22330  96.O
 30000  97.O
 30030  98O
 30100  99O
 30130 100O---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.-----
1


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


            **************
            *            *
 67 KK      *    RES26E  *     2
            *            *
            **************


 72 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          2  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE
1                                                 STATION   RES26E

                        (O) OUTFLOW
        0.        4.        8.       12.       16.       20.       24.       28.        0.        0.        0.        0.
DAHRMN PER
 10000   1O---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.-----
 10030   2O
 10100   3O
 10130   4.O
 10200   5.O
 10230   6.O
 10300   7. O
 10330   8. O
 10400   9. O
 10430  10. O
 10500  11. .O.
```


10530 12.
10600 13.
10630 14.
10700 15.
10730 16.
10800 17.
10830 18.
10900 19.
10930 20.
11000 21.
11030 22.
11100 23.
11130 24.
11200 25.
11230 26.
11300 27.
11330 28.
11400 29.
11430 30.
11500 31.
11530 32.
11600 33.
11630 34.
11700 35.
11730 36.
11800 37.
11830 38.
11900 39.
11930 40.
12000 41.
12030 42.
12100 43.
12130 44.
12200 45.
12230 46.
12300 47.
12330 48.
20000 49.
20030 50.
20100 51.
20130 52.
20200 53.
20230 54.
20300 55.
20330 56.
20400 57.
20430 58.
20500 59.
20530 60.
20600 61.
20630 62.
20700 63.
20730 64.
20800 65.
20830 66.
20900 67.
20930 68.
21000 69.
21030 70.
21100 71.
21130 72.
21200 73.
21230 74.
21300 75.
21330 76.
21400 77.



1
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	26-22E	69.	24.00	16.	5.	3.	.09		
+	HYDROGRAPH AT	26-22E	89.	24.00	20.	6.	4.	.12		
+	HYDROGRAPH AT	26-22E	135.	24.00	30.	10.	5.	.18		
+	3 COMBINED AT	C2622E	293.	24.00	66.	21.	12.	.38		
+	ROUTED TO	RES26E	254.	24.50	67.	21.	12.	.38		
+	ROUTED TO	RES26E	25.	25.50	24.	18.	10.	.38		

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

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: GRAND AVE AT 27TH AVE
Project File : GRAND27.prj
Run Date and Time: 10/26/2000 12:58:58 PM

Project in English units

****
****

PLAN DATA

Plan Title: Plan 01
Plan File : C:\HEC\RAS\GRAND27.p01

Geometry Title: 27TH AVE. DRAINAGE SYSTEM
Geometry File : C:\HEC\RAS\GRAND27.g01

Flow Title : Flow 01
Flow File : C:\HEC\RAS\GRAND27.f01

Plan Summary Information:

Number of:	Cross Sections	= 8	Mulitple Openings	=	0
	Culverts	= 3	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\GRAND27.f01

Flow Data (cfs)
************************************************************
* River           Reach           RS      *            PF 1 *
* GRAND AVE DRAINA1               2113    *              69 *
* GRAND AVE DRAINA1               1172    *             158 *
************************************************************

Boundary Conditions
*********************************************************************
********************************
* River           Reach           Profile          *            Upstrea
m                 Downstream    *
*********************************************************************
********************************
* GRAND AVE DRAINA1               PF 1             *         Normal S =
 .0035          Known WS = 1094 *
*********************************************************************
********************************

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

GEOMETRY DATA

Geometry Title: 27TH AVE. DRAINAGE SYSTEM
Geometry File : C:\HEC\RAS\GRAND27.g01

CROSS SECTION          RIVER: GRAND AVE DRAINA
REACH: 1                  RS: 2113

INPUT
Description: CHANNEL STA 13+59
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
```

```
       0 1103.97      14 1096.97      22 1096.97      36 1103.97

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .02       0     .02      36     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr
.   Expan.
             0      36              510     510     510             .1
      .3

CROSS SECTION          RIVER: GRAND AVE DRAINA
REACH: 1                  RS: 1603

INPUT
Description: CHANNEL STA 8+49
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1101.95      14 1094.95      22 1094.95      36 1101.95

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .02       0     .02      36     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr
.   Expan.
             0      36               75      75      75             .1
      .3

CULVERT                RIVER: GRAND AVE DRAINA
REACH: 1                  RS: 1602

INPUT
Description:
Distance from Upstream XS =       1
Deck/Roadway Width        =      74
Weir Coefficient          =     2.6
Bridge Deck/Roadway Skew  =
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
*********************************************
       0    1102       0      36    1102       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1101.95      14 1094.95      22 1094.95      36 1101.95
```

```
Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
*********************************************
       0     .02        0     .02       36     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0      36             .1       .3

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
*********************************************
       0    1102       0       36    1102       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=        4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*************************************************************
       0 1101.68      14 1094.68      22 1094.68      36 1101.68

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
*********************************************
       0     .02        0     .02       36     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0      36             .1       .3

Upstream Embankment side slope              =       0 horiz. to 1.0 ver
tical
Downstream Embankment side slope            =       0 horiz. to 1.0 ver
tical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1      Circular     2.5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss
 Coef
                 1      74       .013                   .3
    1
Number of Barrels =  2
Upstream   Elevation =  1094.95
```

```
Centerline Stations
    Sta.     Sta.
      16       20
Downstream Elevation =  1094.68
Centerline Stations
    Sta.     Sta.
      16       20

CROSS SECTION           RIVER: GRAND AVE DRAINA
REACH: 1                   RS: 1528

INPUT
Description: CHANNEL STA 7+74
Station Elevation Data     num=        4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1101.68      14 1094.68      22 1094.68      36 1101.68

Manning's n Values         num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .02       0     .02      36     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr
.   Expan.
             0      36              356     356     356             .1
      .3

CROSS SECTION           RIVER: GRAND AVE DRAINA
REACH: 1                   RS: 1172

INPUT
Description: CHANNEL STA 4+18
Station Elevation Data     num=        4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1100.46      14 1093.46      22 1093.46      36 1100.46

Manning's n Values         num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .02       0     .02      36     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr
.   Expan.
             0      36                1       1       1             .1
      .3

CROSS SECTION           RIVER: GRAND AVE DRAINA
REACH: 1                   RS: 1171

INPUT
```

```
Description: INLET OF 6' X 4' CBC
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1099.45       0 1093.45       6 1093.45       6 1099.45

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .02       0     .02       6     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr
.   Expan.
             0       6               99      99      99              .1
      .3

CULVERT                 RIVER: GRAND AVE DRAINA
REACH: 1                   RS: 1170

INPUT
Description: INLET OF 6' X 5' CBC
Distance from Upstream XS =       1
Deck/Roadway Width        =      98
Weir Coefficient          =     2.6
Bridge Deck/Roadway Skew  =
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
************************************************
       0    1100       0       6    1100       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1099.45       0 1093.45       6 1093.45       6 1099.45

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .02       0     .02       6     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0       6             .1       .3

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
************************************************
       0    1100       0       6    1100       0

Downstream Bridge Cross Section Data
```

```
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1098.46       0 1092.46       6 1092.46       6 1098.46

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .02       0     .02       6     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0       6             .1       .3

Upstream Embankment side slope              =       0 horiz. to 1.0 ver
tical
Downstream Embankment side slope            =       0 horiz. to 1.0 ver
tical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1           Box       4       6
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss
 Coef
                 1      99       .013                   .3
    1
Upstream   Elevation =  1093.45
           Centerline Station =  3
Downstream Elevation =  1092.45
           Centerline Station =  3

CROSS SECTION          RIVER: GRAND AVE DRAINA
REACH: 1                  RS: 1072

INPUT
Description: OUTLET OF 6' X 4' CBC
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1098.46       0 1092.46       6 1092.46       6 1098.46

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
```

```
       0      .02        0      .02        6      .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr
.   Expan.
             0       6                 1       1       1             .1
      .3

CROSS SECTION          RIVER: GRAND AVE DRAINA
REACH: 1                  RS: 1071

INPUT
Description: INLET OF 6' X 6' CULVERT
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1098.45       0 1092.45       6 1092.45       6 1098.45

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .02       0     .02       6     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr
.   Expan.
             0       6             1071    1071    1071             .3
      .5

CULVERT                RIVER: GRAND AVE DRAINA
REACH: 1                  RS: 1070

INPUT
Description:
Distance from Upstream XS =       1
Deck/Roadway Width        =    1070
Weir Coefficient          =     2.6
Bridge Deck/Roadway Skew  =
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
*************************************************
       0    1100       0       6    1100       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************
       0 1098.45       0 1092.45       6 1092.45       6 1098.45

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .02       0     .02       6     .02
```

```
Bank Sta: Left   Right    Coeff Contr.   Expan.
            0       6             .3       .5

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
**********************************************
       0    1100       0       6    1100       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
***************************************************************
       0    1095       0  1088.3       6  1088.3       6    1095

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
**********************************************
       0     .02       0     .02       6     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
            0       6             .3       .5

Upstream Embankment side slope              =       0 horiz. to 1.0 ver
tical
Downstream Embankment side slope            =       0 horiz. to 1.0 ver
tical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1           Box       6       6
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss
 Coef
                  1    1070       .013                    .3
    1
Upstream   Elevation =  1092.29
           Centerline Station =  3
Downstream Elevation =  1088.35
           Centerline Station =  3

CROSS SECTION           RIVER: GRAND AVE DRAINA
REACH: 1                   RS: 0
```

```
INPUT
Description: NORTH DETENTION BASIN
Station Elevation Data     num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*************************************************************
       0     1095        0   1088.3        6   1088.3        6     1095

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*********************************************
       0      .02        0      .02        6      .02

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr
.   Expan.
             0        6                 0        0        0              .3
      .5

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

SUMMARY OF MANNING'S N VALUES

River:GRAND AVE DRAINA
*************************************************************
*     Reach       *   River Sta.   *   n1     *   n2     *   n3     *
*************************************************************
*1                *    2113        *      .02*      .02*      .02*
*1                *    1603        *      .02*      .02*      .02*
*1                *    1602        *Culvert  *        *        *
*1                *    1528        *      .02*      .02*      .02*
*1                *    1172        *      .02*      .02*      .02*
*1                *    1171        *      .02*      .02*      .02*
*1                *    1170        *Culvert  *        *        *
*1                *    1072        *      .02*      .02*      .02*
*1                *    1071        *      .02*      .02*      .02*
*1                *    1070        *Culvert  *        *        *
*1                *    0           *      .02*      .02*      .02*
*************************************************************

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

SUMMARY OF REACH LENGTHS

River: GRAND AVE DRAINA
*************************************************************
*     Reach       *   River Sta.   *  Left    * Channel *  Right   *
*************************************************************
*1                *    2113        *      510*      510*      510*
*1                *    1603        *       75*       75*       75*
*1                *    1602        *Culvert  *        *        *
```

```
*1                 *    1528         *       356*       356*       356*
*1                 *    1172         *         1*         1*         1*
*1                 *    1171         *        99*        99*        99*
*1                 *    1170         *Culvert  *          *          *
*1                 *    1072         *         1*         1*         1*
*1                 *    1071         *      1071*      1071*      1071*
*1                 *    1070         *Culvert  *          *          *
*1                 *    0            *         0*         0*         0*
*****************************************************************
```

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

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: GRAND AVE DRAINA

```
*****************************************************
*     Reach       *   River Sta.    * Contr.   * Expan.   *
*****************************************************
*1                 *    2113     *        .1*        .3*
*1                 *    1603     *        .1*        .3*
*1                 *    1602     *Culvert  *          *
*1                 *    1528     *        .1*        .3*
*1                 *    1172     *        .1*        .3*
*1                 *    1171     *        .1*        .3*
*1                 *    1170     *Culvert  *          *
*1                 *    1072     *        .1*        .3*
*1                 *    1071     *        .3*        .5*
*1                 *    1070     *Culvert  *          *
*1                 *    0        *        .3*        .5*
*****************************************************
```

HEC-RAS Plan: Plan 01 River: GRAND AVE DRAINA 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	2113	69.00	1096.97	1099.65		1099.71	0.000308	1.93	35.84	18.73	0.25
1	1603	69.00	1094.95	1099.65	1096.14	1099.66	0.000033	0.84	81.67	26.78	0.09
1	1602	Culvert									
1	1528	69.00	1094.68	1098.14		1098.16	0.000114	1.34	51.54	21.83	0.15
1	1172	158.00	1093.46	1098.04		1098.10	0.000189	2.01	78.62	26.32	0.20
1	1171	158.00	1093.45	1097.32	1096.23	1098.04	0.004174	6.81	23.20	6.00	0.61
1	1170	Culvert									
1	1072	158.00	1092.46	1095.98		1096.85	0.005321	7.48	21.13	6.00	0.70
1	1071	158.00	1092.45	1095.98	1095.22	1096.84	0.005302	7.47	21.16	6.00	0.70
1	1070	Culvert									
1	0	158.00	1088.30	1094.00	1091.07	1094.33	0.001571	4.62	34.20	6.00	0.34

Plan: Plan 01 River: GRAND AVE DRAINA Reach:1 Riv Sta: 1602 Profile: PF 1 Culvert ID: Culvert #1

Culv Q (cfs)	69.00	Culv Vel In (ft/s)	7.03
# Barrels	2	Culv Vel Out (ft/s)	7.03
Q Barrel (cfs)	34.50	Culv Inv El Up (ft)	1094.95
E.G. US. (ft)	1099.66	Culv Inv El Dn (ft)	1094.68
W.S. US. (ft)	1099.65	Culv Frctn Ls (ft)	0.52
Delta EG (ft)	1.49	Culv Ext Lss (ft)	0.74
Delta WS (ft)	1.51	Culv Ent Lss (ft)	0.23
E.G. IC (ft)	1098.59	Q Weir (cfs)	
E.G. OC (ft)	1099.66	Weir Sta Lft (ft)	
Culvert Control	Outlet	Weir Sta Rgt (ft)	
Culv WS In (ft)	1097.45	Weir Submerg	
Culv WS Out (ft)	1097.18	Weir Max Depth (ft)	
Culv Nml Depth (ft)		Weir Avg Depth (ft)	
Culv Crt Depth (ft)	2.00	Wr Flw Area (sq ft)	
Culv Ful Lngh (ft)	74.00	Min Top Rd (ft)	1102.00

Plan: Plan 01 River: GRAND AVE DRAINA Reach:1 Riv Sta: 1602 Profile: PF 1 Culvert ID: Culvert #1

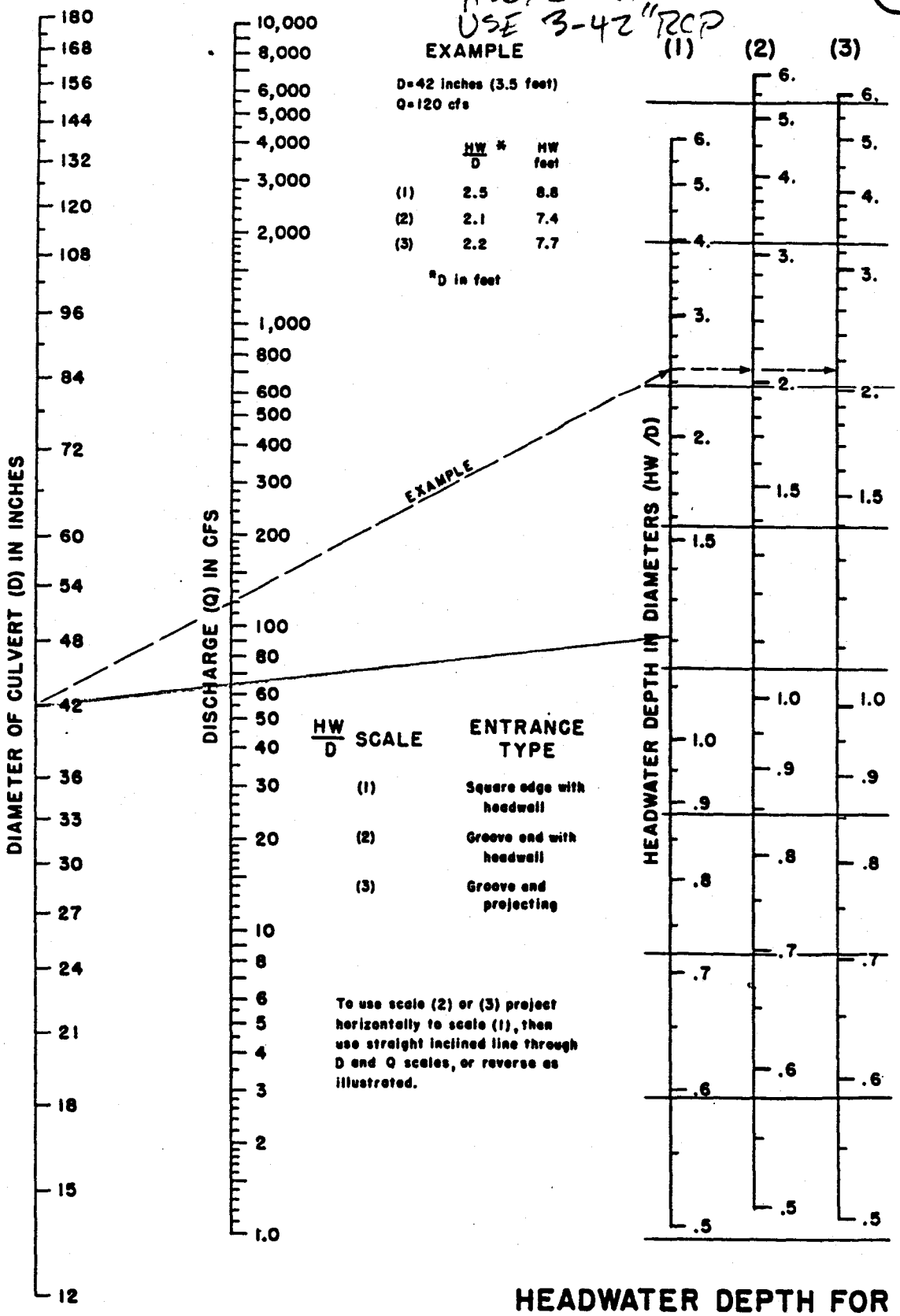
Culv Q (cfs)	69.00	Culv Vel In (ft/s)	7.03
# Barrels	2	Culv Vel Out (ft/s)	7.03
Q Barrel (cfs)	34.50	Culv Inv El Up (ft)	1094.95
E.G. US. (ft)	1099.66	Culv Inv El Dn (ft)	1094.68
W.S. US. (ft)	1099.65	Culv Frctn Ls (ft)	0.52
Delta EG (ft)	1.49	Culv Ext Lss (ft)	0.74
Delta WS (ft)	1.51	Culv Ent Lss (ft)	0.23
E.G. IC (ft)	1098.59	Q Weir (cfs)	
E.G. OC (ft)	1099.66	Weir Sta Lft (ft)	
Culvert Control	Outlet	Weir Sta Rgt (ft)	
Culv WS In (ft)	1097.45	Weir Submerg	
Culv WS Out (ft)	1097.18	Weir Max Depth (ft)	
Culv Nml Depth (ft)		Weir Avg Depth (ft)	
Culv Crt Depth (ft)	2.00	Wr Flw Area (sq ft)	
Culv Ful Lngh (ft)	74.00	Min Top Rd (ft)	1102.00

Plan: Plan 01 River: GRAND AVE DRAINA Reach:1 Riv Sta: 1602 Profile: PF 1 Culvert ID: Culvert #1

Culv Q (cfs)	69.00	Culv Vel In (ft/s)	7.03
# Barrels	2	Culv Vel Out (ft/s)	7.03
Q Barrel (cfs)	34.50	Culv Inv El Up (ft)	1094.95
E.G. US. (ft)	1099.66	Culv Inv El Dn (ft)	1094.68
W.S. US. (ft)	1099.65	Culv Frctn Ls (ft)	0.52
Delta EG (ft)	1.49	Culv Ext Lss (ft)	0.74
Delta WS (ft)	1.51	Culv Ent Lss (ft)	0.23
E.G. IC (ft)	1098.59	Q Weir (cfs)	
E.G. OC (ft)	1099.66	Weir Sta Lft (ft)	
Culvert Control	Outlet	Weir Sta Rgt (ft)	
Culv WS In (ft)	1097.45	Weir Submerg	
Culv WS Out (ft)	1097.18	Weir Max Depth (ft)	
Culv Nml Depth (ft)		Weir Avg Depth (ft)	
Culv Crt Depth (ft)	2.00	Wr Flw Area (sq ft)	
Culv Ful Lngh (ft)	74.00	Min Top Rd (ft)	1102.00

RAMP 27D CULVERT
Q50 = 158 CFS
HW = 4.2 FT
HW/D = 1.2
USE 3-42" RCP

3-4.1 Concrete Pipe (Inlet Control Nomograph)



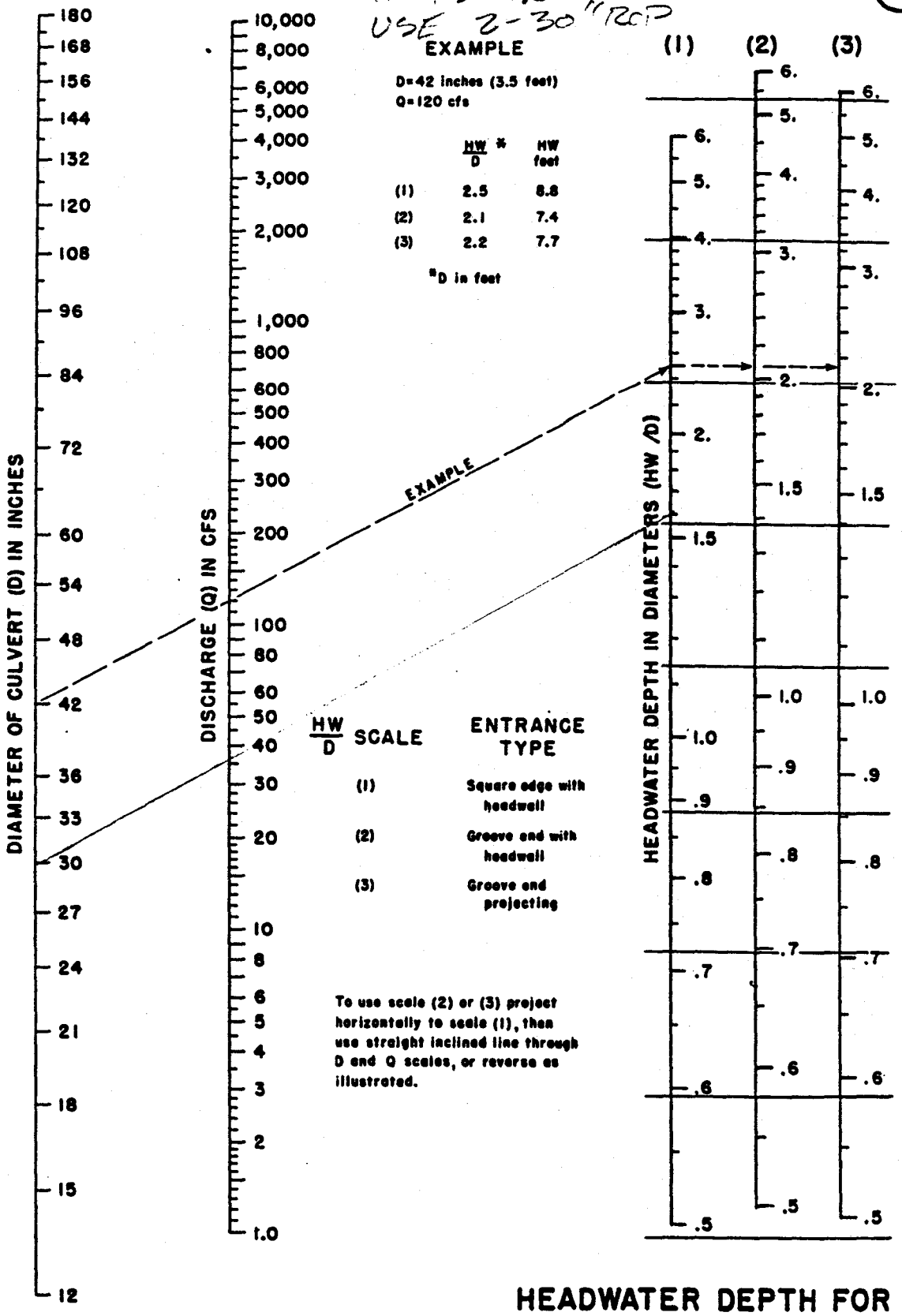
HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

RAILROAD SPUR CROSSING
Q50 = 69 CFS
HW = 4.0 FT
HW/D = 1.6
USE 2-30" RCP

3-4.1 Concrete Pipe (Inlet Control Nomograph)



EXAMPLE

D=42 inches (3.5 feet)
Q=120 cfs

	HW/D *	HW feet
(1)	2.5	8.8
(2)	2.1	7.4
(3)	2.2	7.7

*D in feet

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

CALCULATE Tc & R FOR SUB-AREAS
SOUTH OF GRAND CANAL

SUMMARY OF INPUT PARAMETERS

SUB-AREA ID	A (SQ MI)	L (MI)	Lc (MI)	S (FT/MI)	RTIMP
26-22E1	0.091	0.473	0.265	18	53
26-22E2	0.074	0.436	0.218	18	53
26-22E3	0.134	0.644	0.322	18	53

SUMMARY OF RESULTS

SUB-AREA ID	Tc* (HRS)	R (HRS)
26-22E1	0.2394	0.1630
26-22E2	0.2188	0.1555
26-22E3	0.2822	0.2009

* Tc - Based on Eq 4-3

APPENDIX G

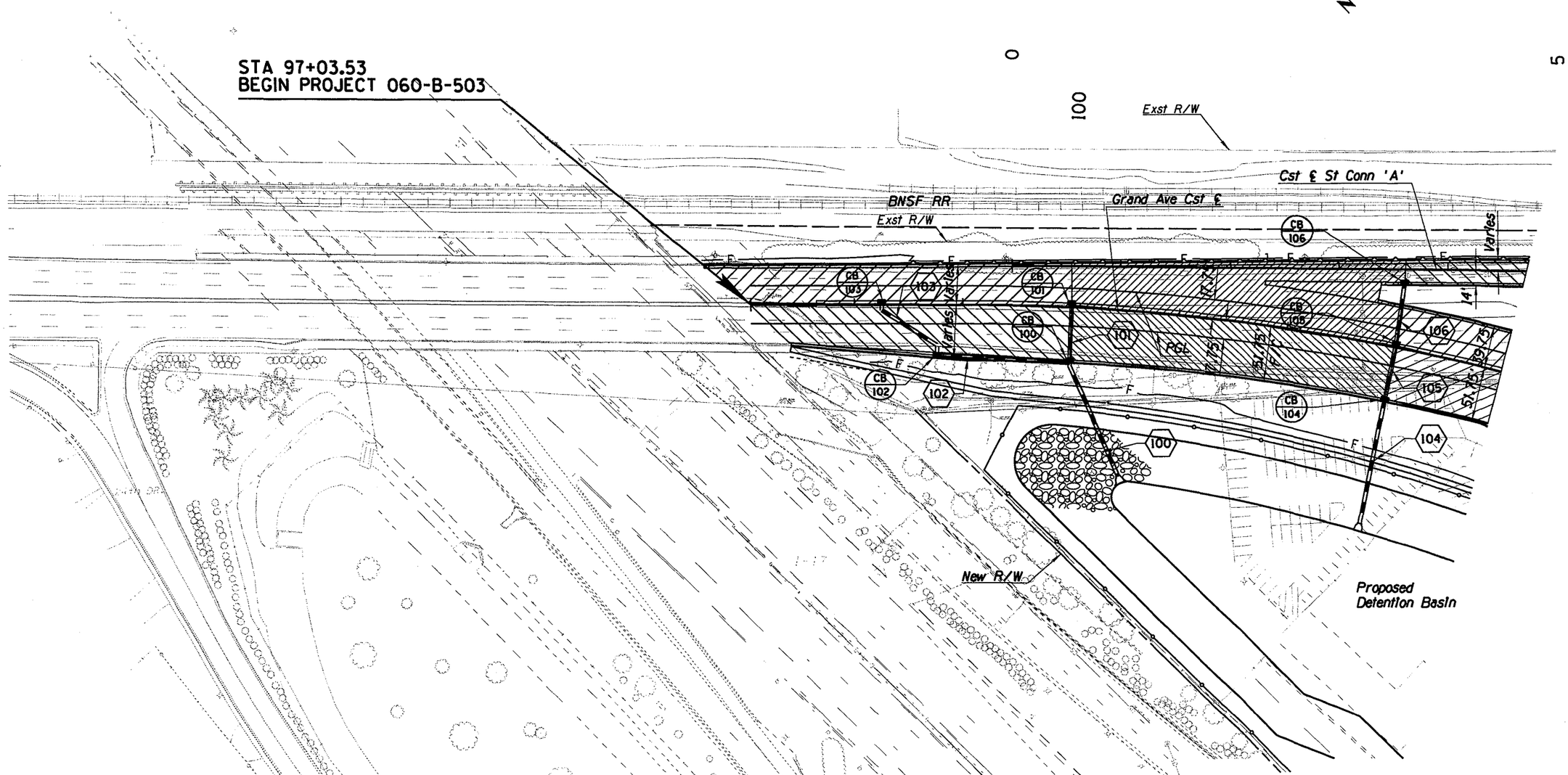
60% DRAINAGE PLANS

APPENDIX G

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	J. WAHL	10/00
CHECKED	F. HENDERSON	10/00

E A R T H T E C H

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

GRAND AVENUE
DRAINAGE PLANS
STA 97+03.53 TO STA 104+00.00

PRELIMINARY
60%
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: THOMAS ROAD - 27TH AVENUE
DWG. NO. D-1.1

TRACS NO. H5137 01 C
060-B-503
___ OF ___

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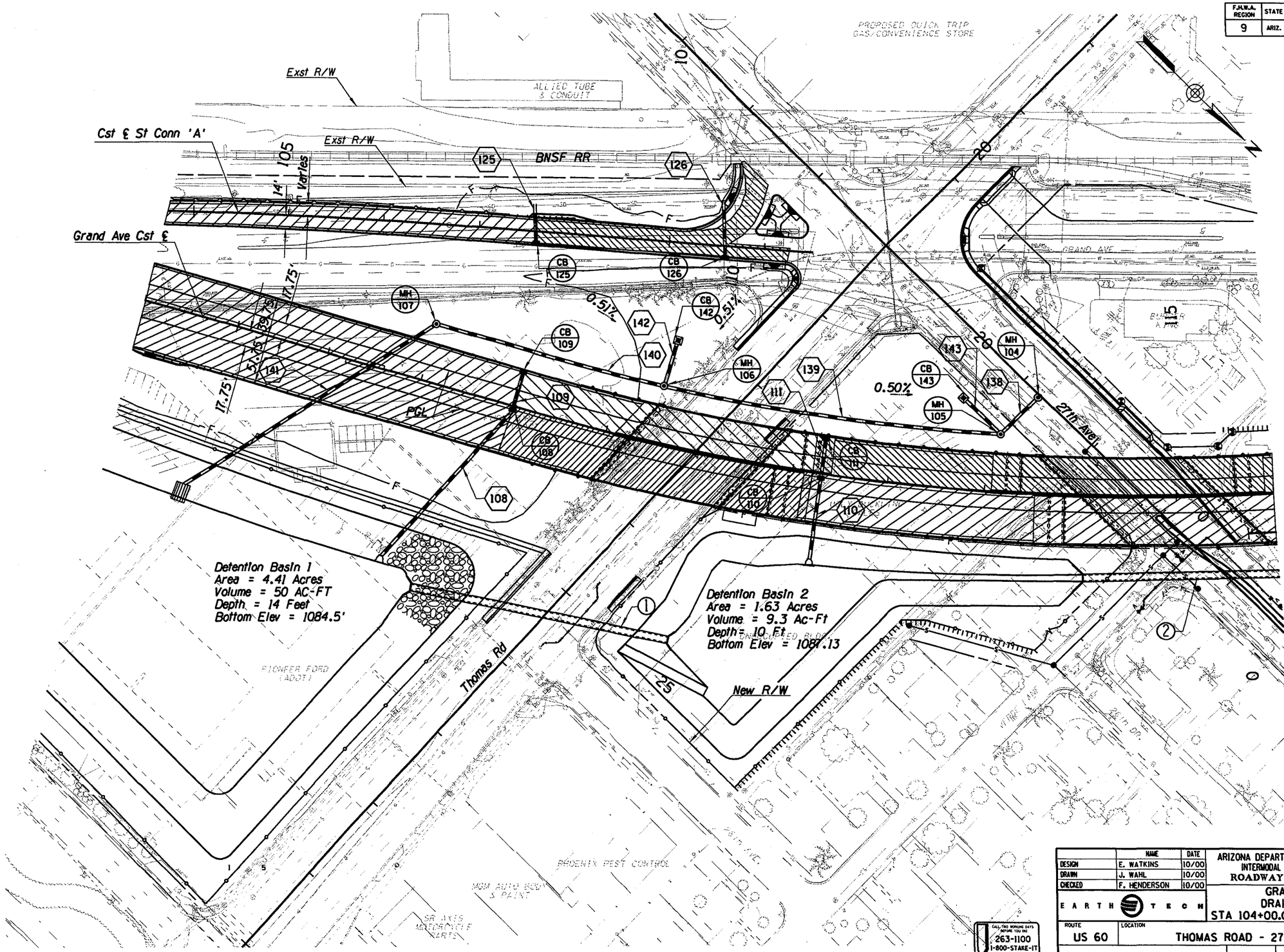
SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

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



	NAME	DATE
DESIGN	E. WATKINS	10/00
DRAWN	J. WAHL	10/00
CHECKED	F. HENDERSON	10/00

EARTH TECH

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

GRAND AVENUE
DRAINAGE PLANS
STA 104+00.00 TO STA 116+00.00

ROUTE: US 60
LOCATION: THOMAS ROAD - 27TH AVENUE

PRELIMINARY
60%
NOT FOR CONSTRUCTION OR RECORDING

DWG. NO. D-1.2
___ OF ___

TRACS NO. H5137 01 C
060-B-503

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

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REFERENCE FILE 2 = C:\projects\39943\27THAVE\h27rwu0-0.dgn
Levels On= 1-5,8-12,63
REFERENCE FILE 3 = C:\projects\39943\27THAVE\h27rwm0-0.dgn
Levels On= 1-63
REFERENCE FILE 4 = C:\projects\39943\27THAVE\h27pro-0.dgn
Levels On= 1,3-28,31-33,35-37,39-45,47-62
REFERENCE FILE 5 = C:\projects\39943\27THAVE\h27dep00.dgn
Levels On= 1-27,29-63
REFERENCE FILE 6 = C:\projects\39943\27THAVE\h27sdp-0.dgn
Levels On= 1-26,62,63
REFERENCE FILE 7 = ws: ref name=
Levels On= ws: ref levels=
REFERENCE FILE 8 = ws: ref name=
Levels On= ws: ref levels=
REFERENCE FILE 9 = ws: ref name=
Levels On= ws: ref levels=
REFERENCE FILE 10 = ws: ref name=
Levels On= ws: ref levels=
$$$$DATE
$$$$TIME

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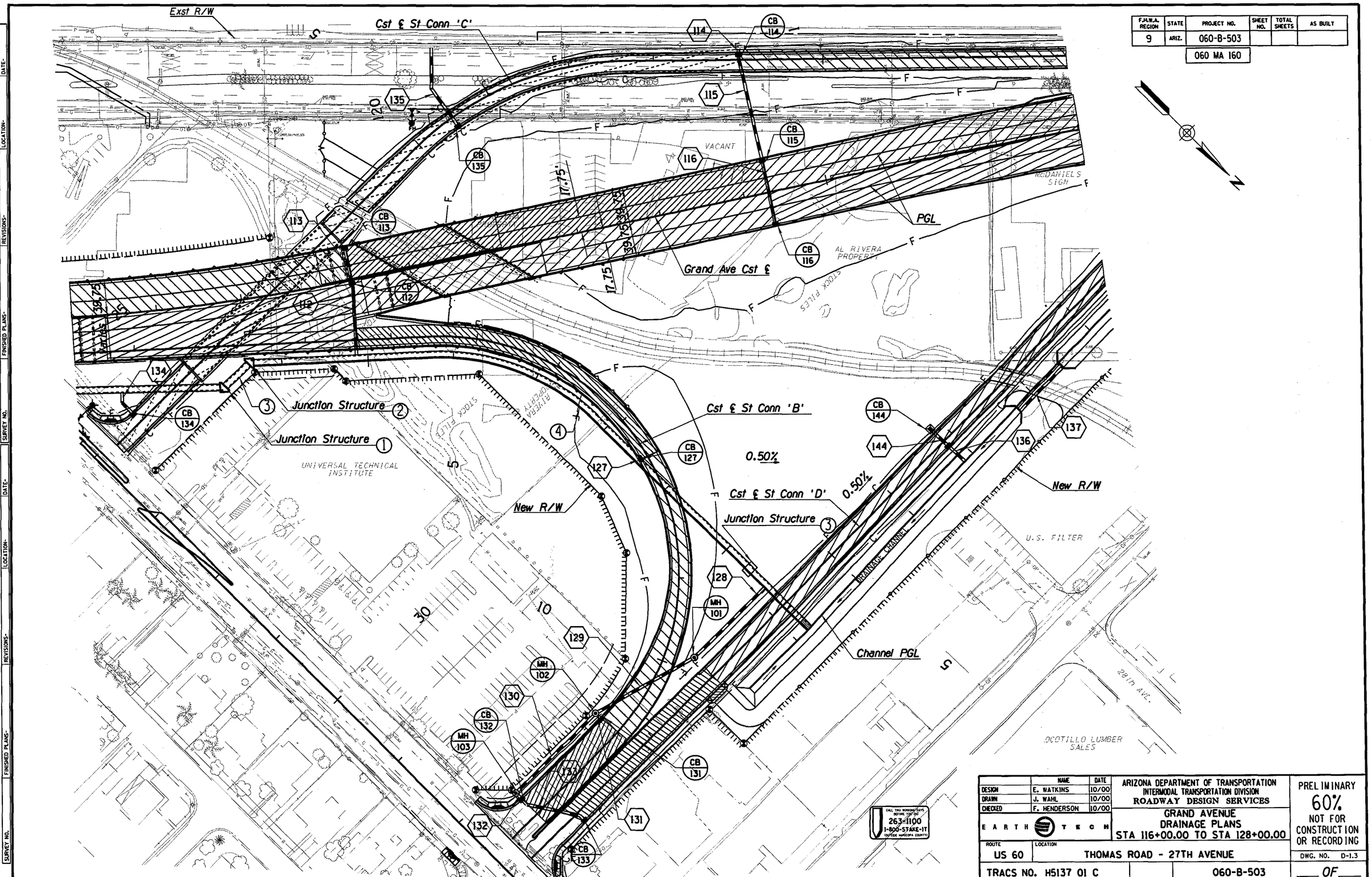
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	060-B-503			
		060 MA 160			



	NAME	DATE
DESIGN	E. WATKINS	10/00
DRAWN	J. WAHL	10/00
CHECKED	F. HENDERSON	10/00

EARTH TECH

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

GRAND AVENUE
DRAINAGE PLANS
STA 116+00.00 TO STA 128+00.00

PRELIMINARY
60%
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
US 60	THOMAS ROAD - 27TH AVENUE

DWG. NO. D-1.3

TRACS NO. H5137 01 C | 060-B-503 | ___ OF ___

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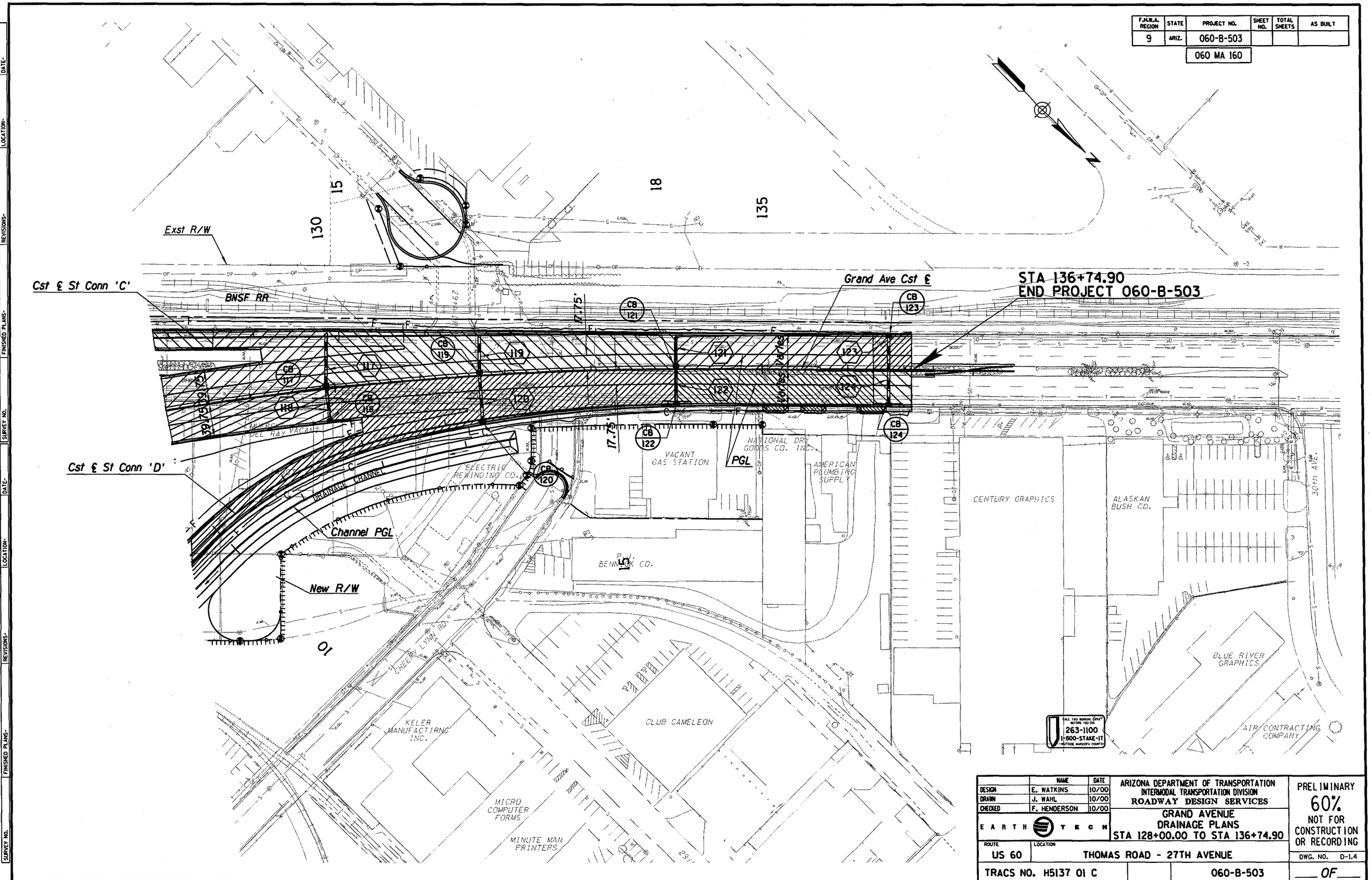
SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

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



	NAME	DATE
DESIGN	E. WATKINS	10/00
DRAWN	J. WAHL	10/00
CHECKED	F. HENDERSON	10/00

E A R T H T E C H

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

GRAND AVENUE
DRAINAGE PLANS
STA 128+00.00 TO STA 136+74.90

PRELIMINARY
60%
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: US 60
LOCATION: THOMAS ROAD - 27TH AVENUE
DWG. NO. D-1.4
TRACS NO. H5137 01 C
060-B-503
___ OF ___

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