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DRAINAGE DESIGN REPORT
SHEA BOULEVARD
SCOTTSDALE ROAD TO PIMA ROAD

CITY OF SCOTTSDALE, ARIZONA
PROJECT NO. S7501

ARIZONA DEPARTMENT OF TRANSPORTATION
PROJECT NO. M-703(5)

October, 1987
Revised March, 1988

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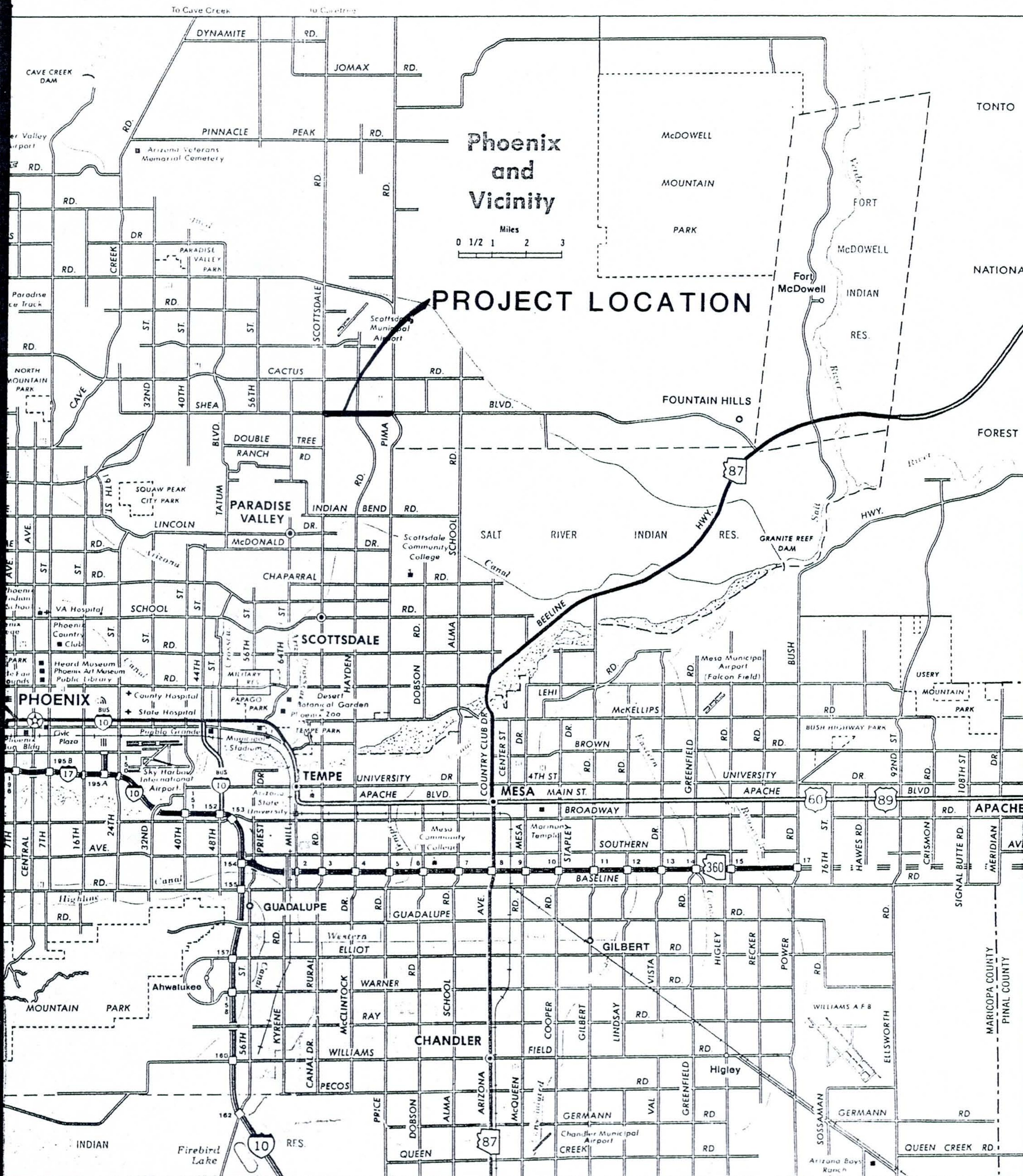
1.0 INTRODUCTION

This drainage design report was prepared in support of the roadway improvement design for Shea Boulevard. The roadway improvement project extends from 500 feet west of Miller Road to 200 feet west of Pima Road (see Location Map).

2.0 BACKGROUND

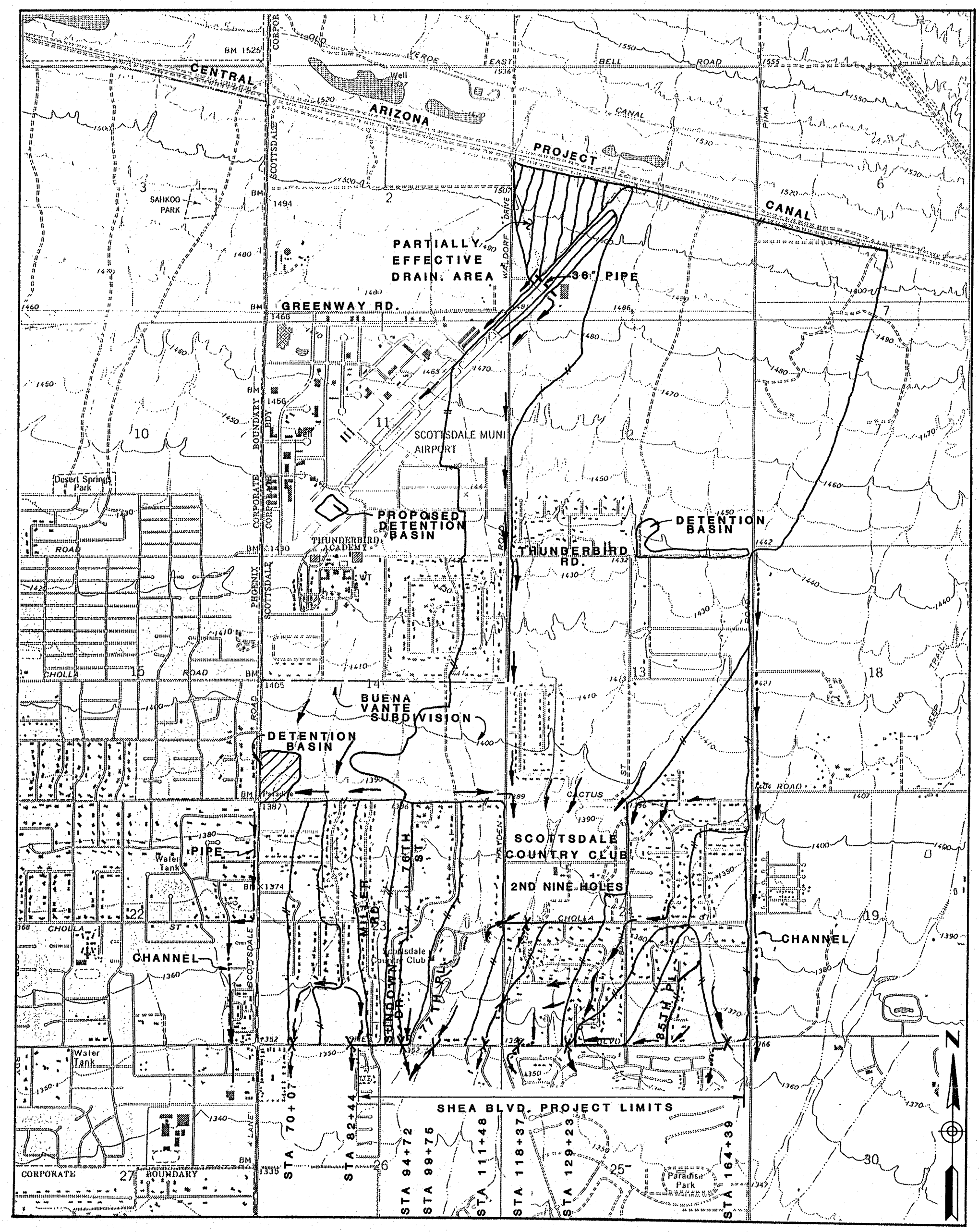
The existing roadway from 500 feet west of Miller Road to 200 feet west of Pima Road consists of two 12-foot lanes in each direction widening out to three lanes at the major intersections of Scottsdale, Miller, Hayden, and Pima Roads. The portion of this project from Scottsdale Road to west of Miller Road has been constructed to its ultimate configuration including pavement and offsite drainage facilities. This project will consist of adding a 12-foot wide third lane in each direction to the existing four lane roadway including curb, gutter, and sidewalk (north side) or bike path (south side). Additional information on the project is provided in the Concept Design Report, June, 1987.

A previous drainage design report (Reference 1) was performed for the project at the time that Shea Boulevard was improved to its present condition in 1982-1983. The 1982-1983 roadway improvements and drainage report attempted to provide for cross-road culverts and pavement drainage facilities for the ultimate roadway improvements. Figure 2 shows the existing cross-road drainage structures within the project including size and location of each structure.



LOCATION MAP
DRAINAGE DESIGN REPORT
SHEA BOULEVARD
SCOTTSDALE ROAD TO PIMA ROAD

FIGURE 1



LEGEND

- DRAINAGE BDY.
- X CULVERT
- FLOW PATTERN

DRAINAGE DESIGN REPORT
SHEA BLVD.
DRAINAGE AREA MAP

A-N WEST 8/87 FIGURE 3

3.0 SCOPE OF WORK

The purpose of this drainage study is to review and evaluate previous drainage reports affecting Shea Boulevard and prepare an updated drainage design report specific to this projects roadway improvements. Some specific issues to be addressed as part of this drainage design report are as follows:

1. A frontage road on the north side of Shea boulevard between 82nd Place and 84th Street proposed as part of the 1982-1983 ultimate roadway improvements has been eliminated for this project. The 1982 drainage design report proposed conveying offsite drainage in this frontage road from 84th Street to 82nd Place and then by channel to a culvert crossing of Shea Boulevard 200 feet west of 82nd Place. This study and report will evaluate and propose an alternate means of conveying the offsite drainage between 82nd Place and 84th Street to an adequate outlet.

2. Drainage problems have occurred near the box culvert crossing of Shea Boulevard 200 feet west of 82nd Place. Headcut erosion has occurred upstream of the culvert into a residential lot along Shea Boulevard west of 82nd Place. Sediment deposition has occurred in the box culvert under Shea Boulevard. This study and report will present the results of an analysis of peak discharges to the box culvert and proposed channel improvements to mitigate drainage problems to the existing residential units along Shea Boulevard at 82nd Place.

4.0 BASIS OF DESIGN

-- The maximum flow depth for water flowing longitudinally in any street shall be eight inches during the peak runoff from a 100-year frequency storm (Section 3-401, Reference 11.)

-- Catch basin or scupper inlets must be sized and located in series along a gutter grade to intercept enough of the longitudinal street flow to limit the spread of the flow to the extent necessary to maintain at least one dry twelve-foot wide lane for vehicle traffic moving in each direction during the peak runoff flow from a 100-year frequency storm. In addition, the inlets must be sized and spaced to insure that the longitudinal street flow at the peak runoff flow rate from 100-year

frequency storm is retained in the public right-of-way and is flowing at a depth no greater than eight inches above the gutter flow line. When inlets are placed in series, the flow bypassing each inlet must be included in the calculation of the flow arriving at the next inlet. (Section 3-501.02, Reference 11.)

-- Major collector and major or minor arterial streets shall have a culvert or bridge which is capable of carrying all of the peak flow of runoff from a 10-year frequency storm beneath the roadway and which is also capable of carrying enough of the peak flow of runoff from a 25-year frequency storm so that the portion of the flow over the roadway is no more than six inches deep. (Section 3-301.02, Reference 11.)

-- Channel crossings shall be designed so that all lots and structures within a development will be accessible from the boundary of that development by at least one route during the period of peak flow of runoff form a 100-year frequency storm. The boundary shall include any adjacent street or streets. Accessibility will be considered to exist if it can be demonstrated by engineer that at the time of the peak flow the depth of flow over the road will be no greater than one foot. (Section 3-301.03, Reference 11.)

5.0 OFFSITE DRAINAGE

5.01 GENERAL

Drainage patterns and drainage area boundaries affecting offsite drainage along Shea Boulevard are shown on Figure 3, Drainage Area Map. Development to date by private interests and local, State, and Federal agencies have altered and influenced drainage patterns and flows to Shea Boulevard.

The Central Arizona Project (CAP) canal and associated flood control facilities form the northernmost drainage area boundary. The extension and improvements to Scottsdale Airport limit flows crossing the airport to approximately the 10-year flood event for the drainage area contributing to a 36-inch pipe across the airport. All other flows are detained and/or diverted southwest along the airport and away from the Shea Boulevard project improvements. A detention basin is proposed at the southwest end of the

airport by the City of Scottsdale to further drain storm runoff north of the airport.

The Buena Vante subdivision between Scottsdale, Hayden, Cactus, and Sweetwater Roads forms a drainage area boundary along Cactus Road between Scottsdale Road and Hayden Road. The Buena Vante subdivision intercepts drainage into the subdivision from Scottsdale Road to a point 4,000 feet to the east and routes the flow to an existing City of Scottsdale detention basis at the northwest corner of Scottsdale Road and Cactus Road. The detention basin is drained out of the project area by a City of Scottsdale storm drain. Drainage entering the Buena Vante subdivision from a point approximately 1,200 feet west of Hayden Road is intercepted and conveyed to a channel along the east side of Hayden Road and then conveyed into the Scottsdale Country Club (SCC) Second Nine Holes subdivision.

A majority of the offsite drainage north of Cactus Road is conveyed by natural and/or manmade channels to the SCC Second Nine Holes subdivision which is generally bounded by Hayden Road, 84th Street, Cholla Road, and Cactus Road. All flow entering this subdivision exists by two multiple culvert openings and a roadway weir section near the intersection of Hayden and Cholla Roads. These flows cross Shea Boulevard at two locations 1,600 feet (Sta. 99+75) and 400 feet (Sta. 111+48) west of Hayden Road.

An existing channel along the east side of Pima Road intercepts and conveys storm runoff from Thunderbird Road south past Shea Boulevard.

5.02 OFFSITE HYDROLOGY AND HYDRAULICS

Numerous drainage studies and reports have been prepared in the past that presented offsite discharges affecting the Shea Boulevard project. The drainage reports obtained and reviewed as part of this study are summarized as References 1 through 7 (see References). The most specific report and the report utilized in establishing the existing drainage facilities along Shea Boulevard is "Shea Boulevard Ultimate Design from Scottsdale to Pima Road, Drainage Report, September, 1982" (Reference 1). Since this report (Reference 1) was performed there has been upstream development as well as changes in the ultimate Shea Boulevard design concept. The evaluation of the offsite hydrology and hydraulics is described below and in Appendix A, Offsite Hydrology, and Appendix B, Hydraulic Calculations as well as Table 1, Summary of Discharges, and Figure 3, Drainage Area Map.

Sundance Drive at Shea Boulevard

Sundance Drive north of Shea Boulevard does not have curb and gutter however, drainage from development adjacent to Sundown Drive flows south along each side of the road to Shea Boulevard. A peak 100-year discharge of 48.4 cfs was computed at Shea Boulevard. The 1982 drainage design report (Reference 1) did not compute a specific discharge for this area.

Shea Boulevard at Sta. 94+72, 10-foot by 2-foot Box Culvert

A total peak 100-year discharge of 145.9 cfs was computed at this location including the drainage area along Sundown Drive for this report (see Appendix A). This discharge agrees with the discharge of 150 cfs computed by Reference 1.

The 1982-1983 road improvement project constructed two grader ditches along the north side of Shea Boulevard to drain flow from the west side of Sundown Drive to a catch basin at Miller Road and flow from the east side of Sundown Drive to the 10-foot by 2-foot box culvert (Sta. 94+72). These existing ditches do not have the capacity to convey the computed 100-year discharges and have left standing water at this intersection after recent storm events. The existing ditches will be built over as part of the new road improvements. The catch basin and 12-inch storm drain at Miller Road has only a 6 cfs capacity and therefore it was not considered practical to reconstruct a grader ditch from the west side of Sundown Drive to Miller Road.

The proposed drainage solution at this location involves a 34-inch by 53-inch oval storm drain pipe along the north side of Shea Boulevard from Sundown Drive to the 10-foot by 2-foot box culvert (Sta. 94+72). An additional new 29-inch by 45-inch oval concrete pipe is also required across Shea Boulevard adjacent to the existing 10-foot by 2-foot box culvert to increase cross road drainage capacity and reduce upstream backwater. The 34-inch by 53-inch oval storm drain would intercept the 100-year storm flow from both the west and east sides of Sundown Drive with minimum regrading of Sundown Drive, no surface ditches or channels and no offsite flow into Shea Boulevard. Due to the shallow outlet depth, cover, and high tailwater constraints a 53-inch by 34-inch by 200-lineal foot oval concrete pipe is proposed from the 10-foot by 2-foot box culvert to a manhole east of Sundown Drive. From the manhole to a grated inlet on the west side of Sundown Drive a 30-inch by 60-lineal foot concrete pipe is proposed. On the east side of Sundown Drive a drop inlet is

proposed north of a residential driveway connected by 30 lineal feet of 30-inch concrete pipe to the manhole. See Appendix B for hydraulic calculations of the existing 10-foot by 2-foot box culvert (Sta. 94+72) and the proposed storm drain system.

Shea Boulevard at Sta. 99+75 and Sta. 111+48

A detailed hydrologic analysis of the drainage to Sta. 99+75 and Sta. 111+48 was not within the scope of work of this report. A detailed hydrologic analysis was also not performed as part of the 1982 drainage design report (Reference 1). According to the 1982 report and street improvement design the culverts at Sta. 99+75 (2 - 12-foot by 3.5-foot box culverts) and Sta. 111+48 (6 - 6-foot by 4-foot box culverts) were constructed with capacity approximately equal to the existing downstream channel capacities of 700 to 730 cfs and 1,100 to 1,250 cfs, respectively.

The hydrologic report referenced and utilized in determining peak discharges along Shea Boulevard in the 1982 drainage design report (Reference 1) was the Erikson & Salmon report, June, 1980 (Reference 4). This report (Reference 3) computed a peak 100-year discharge at the intersection of Cholla and Hayden of 2,480 cfs. A review of this report indicates several reasons that the computed peak discharges may be considered high. The report (Reference 4) states the assumption of a conservative soil type of Type C and a future developed condition curve number of 90. The Scottsdale Airport expansion has also since reduced the effective drainage area assumed as part of the 1980 Erikson & Salmon report (Reference 4). Development since the 1980 report (Reference 4) has constructed significant detention basins at two known locations, the Scottsdale County Club Second Nine Holes subdivision and an unknown subdivision on the north side of Thunderbird Road between 84th Street and Pima Road.

A second drainage report, Scottsdale Country Club (SCC) Second Nine, May, 1985 (Reference 6) computed peak 100-year discharges at the intersection of Hayden and Cholla Roads. This SCC report (Reference 6) computed a peak 100-year discharge of 2,778 cfs after accounting for the detention effect through the proposed SCC subdivision. The SCC report acknowledged that these results were higher than the previous reports and stated that SCC report methodology yielded conservative values. The SCC report went on to state that it would concur with a peak 100-year discharge of 2,200 cfs± at the Hayden/Cholla intersection. Although detailed review of the SCC report (Reference 6) was

not possible for lack of documentation, the SCC report also did not model the recent detention basin constructed on the north side of Thunderbird between Pima Road and 84th Street and may also have overestimated the effective drainage area north of the Scottsdale Airport.

Based on the review of the drainage reports described above, we would estimate 100-year peak discharges of 700 cfs and 1,300 to 1,500 cfs at Sta. 99+75 and Sta. 111+48, respectively. The approximately 20 percent reduction of the total 100-year discharge at the intersection of Cholla and Hayden Roads from the 2,480 cfs to 2,778 cfs reported in previous reports to 2,000 cfs to 2,200 cfs was estimated to reflect the unaccounted for retention, conservative soil types, curve numbers, and additional drainage area assumed in the previous reports.

See Appendix A for hydraulic calculations of the existing 2 - 12-foot by 3.5-foot box culverts (Sta. 99+75) and 6 - 6-foot by 4-foot box culverts (Sta. 111+48). The hydraulic calculations indicate that the 2 - 12-foot by 3.5-foot box culverts can convey 700 cfs (Q_{100}) without any overtopping of Shea Boulevard. The hydraulic calculations for the 6 - 6-foot by 4-foot box culverts indicate that there would be minimal overtopping of Shea Boulevard for a 100-year discharge of 1,300 cfs and overtopping of less than 1-foot deep on the average for a 100-year discharge of 1,500 cfs. (See Calculations, Appendix B, p. B-8 - B-10.) The roadway from this location (Sta. 111+48) through the Hayden Road intersection is improved to the ultimate cross-section design.

A review of drainage reports (Reference 1 and 4) by A-N West indicated that the six 6-foot by 4-foot box culverts at Sta. 111+48 were designed to match downstream road crossing capacities. Some shallow flooding over the road was anticipated and part of the road design at this location. These drainage conditions were discussed with City of Scottsdale officials and it was concluded that no additional cross drainage improvements were warranted at Sta. 111+48.

Shea Boulevard at Sta. 118+37, 8-foot by 2-foot Box Culvert

A peak 100-year discharge of 116 cfs was calculated at this location (see Appendix A). This discharge differs from the peak discharge of 100 cfs presented in the 1982 report (Reference 1) which was obtained from Reference 3 due in part to changes in drainage area through development. The 8-foot by

2-foot box culvert can convey this 100-year discharge of 116 cfs without overtopping of Shea Boulevard (see Appendix B).

Shea Boulevard at Sta. 128+79, 2 - 12-foot by 3-foot Box Culverts

A detailed hydrologic analysis utilizing the Soil Conservation Service TR-20 computer program was performed to determine 100-year peak discharges of 358, 114, 64, and 34 cfs along Shea Boulevard at Sta. 128+79, 82nd Place, 84th Street, and 85th Place, respectively (see Appendix A, Table 1, and Drainage Area Map). These peak discharges will be utilized in the design of a channel or storm drain to intercept and convey offsite flows along Shea Boulevard from 85th Place (Sta. 150+86.5) to Sta. 128+79.

The 1982 drainage report (Reference 1) presented a 100-year peak discharge of 509 cfs at Sta. 128+79 based on a 1977 report by Dashney and Associates (Reference 3). This peak 100-year discharge was later revised to 288 cfs in an addendum report (Reference 2).

As indicated in the scope of work section of this report, several drainage problems exist at this location. Drainage facility improvements are needed to adequately convey the offsite as well as pavement drainage along Shea Boulevard from approximately 85th Place to the existing two 12-foot by 3-foot box culverts across Shea Boulevard.

Two concrete channels are proposed to be constructed north of Shea Boulevard from the two 12-foot by 3-foot box culverts (Sta. 128+79). One channel would proceed north from Sta. 128+79 along the back side of Lots Number 20 and 21 (See Figure 3-1) and along the north side of Lot 21 to the intersection of 82nd Place and Clinton where the channel would cross the intersection in a 12-foot by 3-foot box culvert. This channel would be designed for the 100-year peak discharge of 240 cfs.

The second channel would proceed east along the north side of Shea Boulevard from Sta. 128+79 to 82nd Place. At 82nd Place the channel would cross 82nd Place by a 10-foot by 3-foot box culvert. The 8-foot by 3-foot box culvert would end with a drop inlet that would intercept an existing shallow swale at the northeast corner of 82nd Place and Shea Boulevard. Two 53-inch by 34-inch oval concrete storm drains would also connect to the 8-foot by 3-foot box culvert. One 53-inch by 34-inch oval concrete storm drain pipe would be constructed along Shea Boulevard to 84th Street. At 84th Street a 33-inch

storm drain would be constructed up to 85th Place. The second 53-inch by 34-inch oval concrete pipe leaving the 8-foot by 3-foot box culvert would extend for 100 feet further east, ending at a drop inlet. This pipe would intercept the majority of the 100-year flow of 52 cfs shown as I.D. #5 on Figure B-1.

The design discharges for the storm drain in Shea Boulevard are 26 cfs from 85th Place to 84th Street and 58.8 cfs from 84th Street to 82nd Place. These storm drain design discharges would allow the majority of the 100-year peak offsite flows to be conveyed in the storm drain pipe. Flow in excess of the storm drain capacity or approximately 10 cfs would be conveyed in the street cross-section at a depth of 0.5 feet or less allowing one dry traffic lane in each direction. Catch basins would be installed at 85th Place, 84th Street, and 82nd Place to intercept pavement drainage. A catch basin would also be installed on the south side of Shea Boulevard at 84th Street and connected to the 53-inch by 34-inch storm drains to intercept pavement drainage. Appendix B contains the HEC-2 computer hydraulic backwater program input and output results of the analysis of the concrete channel and the existing and proposed box culverts, as well as hydraulic computations for the storm drain. Figure B-1 in Appendix B shows the HEC-2 cross-section locations and proposed drainage system improvements.

Shea Boulevard at Sta. 164+39, 12-foot by 3-foot Box Culvert

A peak 100-year discharge of 185 cfs was calculated at this location for this report (see Appendix A). This discharge differs from the peak discharge of 252 cfs presented in the 1982 report (Reference 1) due in part to changes in drainage area through development. The 12-foot by 3-foot box culvert has capacity to convey the 100-year peak discharge of 185 cfs as well as the original peak discharge of 252 cfs without overtopping of Shea Boulevard (see Appendix B).

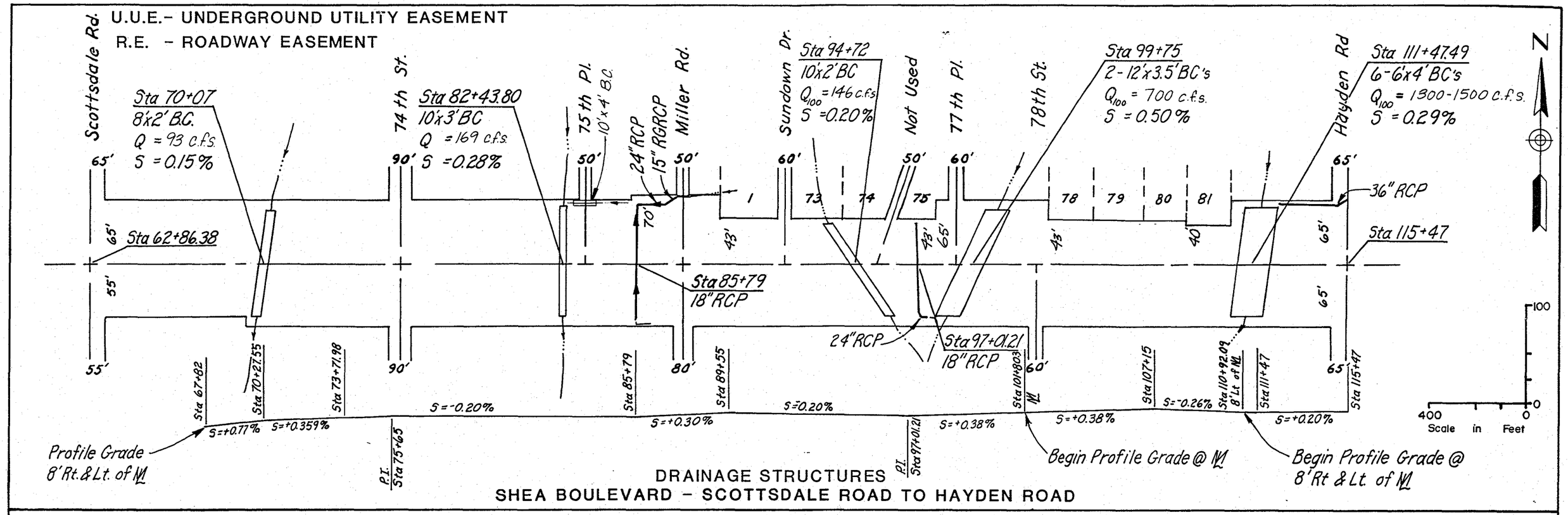
6.0 PAVEMENT DRAINAGE

The Shea Boulevard ultimate street improvements were analyzed for the 100-year frequency storm event, with catch basins sized and located to maintain one dry traffic lane in each direction per City of Scottsdale criteria. The 1982 drainage report (Reference 1) apparently designed and sized catch basins for the 10-year frequency storm event for one dry traffic lane in each direction. Additional catch basins were required beyond those recommended in

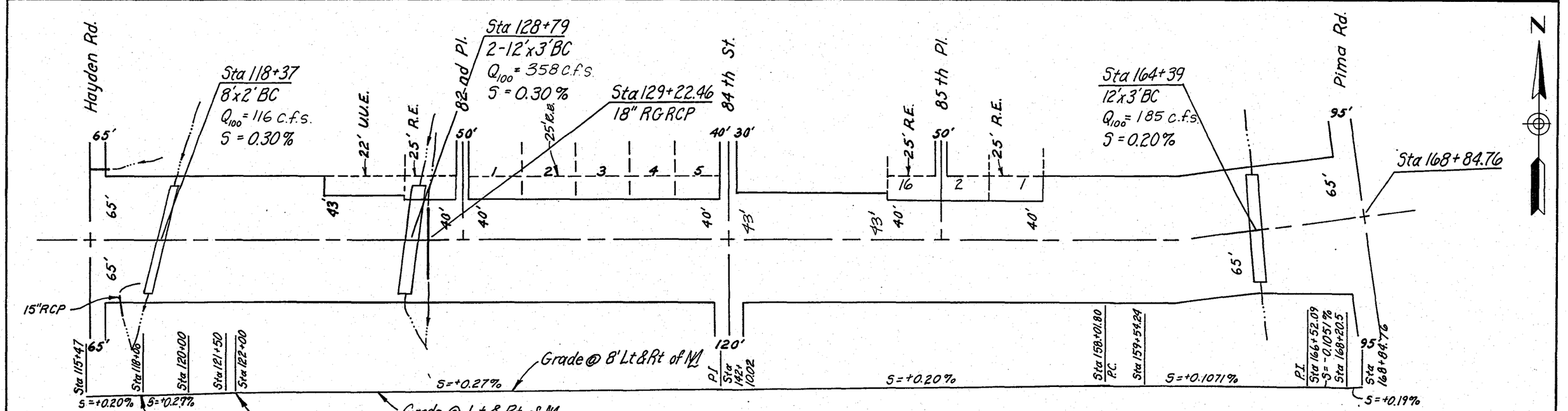
the 1982 report to meet these 100-year pavement drainage requirements. The additional catch basins and storm drains were generally proposed near wash crossings of Shea Boulevard to minimize the lengths of new storm drain and to avoid replacing or supplementing existing storm drains and catch basins.

Existing catch basins at the entrance of 75th Place, Miller Road, and 77th Place intercept offsite drainage at these locations before the flow enters Shea Boulevard. Hayden Road, north of Shea Boulevard also has a series of existing catch basins draining the pavement drainage to the adjacent channels.

As a result of this report catch basins are proposed at Sundown Drive, 84th Street, and 85th Place to intercept offsite drainage before entering Shea Boulevard. Offsite drainage along 82nd Place will also be intercepted by proposed channel improvements along this street before entering Shea Boulevard. The catch basins and storm drains proposed to 84th Street and 85th Place were designed to intercept both offsite drainage and pavement drainage from Shea Boulevard. As a result, additional hydrologic calculations for this combined flow were computed (See Appendix D, p. D-7) to confirm adequate capacity in the proposed catch basin/storm drain system. See Appendix D for the pavement drainage and catch basin sizing calculations.



DRAINAGE STRUCTURES
SHEA BOULEVARD - SCOTTSDALE ROAD TO HAYDEN ROAD



DRAINAGE STRUCTURES
SHEA BOULEVARD - HAYDEN ROAD TO PIMA ROAD

AN WEST INC.

DRAINAGE DESIGN REPORT
SHEA BOULEVARD
SCOTTSDALE ROAD TO PIMA ROAD

TABLE 1

SUMMARY OF OFFSITE DISCHARGES

Location and I.D.[1]	Drainage Area (Acres)	Peak Discharges 100-Year (cfs)	Peak Discharges 10-Year (cfs)	Method of Conveyance Across Shea Boulevard
Sundown Drive at Shea Boulevard	38.8	48.4	28.8	Storm Drain to Sta. 94+72 (Proposed)
Shea Boulevard Sta. 94+72	130.3[2]	145.9	86.6	10-foot by 2-foot RCB (Existing)
Shea Boulevard Sta. 99+75	Undefined[3]	700	----	2- 12-foot by 3.5-foot RCB's (Existing)
Shea Boulevard Sta. 111+48	Undefined[3]	1,300-1,500	----	6 - 6-foot by 4-foot RCB's (Existing)
Shea Boulevard Sta. 118+37	73	116	70.9	1 - 8-foot by 2-foot RCB (Existing)
Shea Boulevard Sta. 128+79	384	358	148	2 - 12-foot by 3-foot RCB's (Existing)
82nd Place at Shea Boulevard	115.0	114	44	1 - 8-foot by 3-foot RCB under 82nd Place to Channel to Sta. 128+79 (Proposed)
84th Street at Shea Boulevard	57.6	64	24	Storm Drain and Street Flow to Sta. 128+79 (Proposed)
85th Place at Shea Boulevard	25.6	34	13	Storm Drain and Street Flow to Sta. 128+79 (Proposed)
Shea Boulevard Sta. 164+39	113.6	185	110.9	1 - 12-foot by 3-foot RCB (Existing)

(1) See Drainage Area Map.
(2) Includes Drainage Area from Sundown Drive.
(3) Total Drainage Area to Sta. 99+76 and Sta. 111+48 is 2,500 Acres.

7.0 REFERENCES

1. Shea Boulevard Ultimate Design from Scottsdale Road to Pima Road, Drainage Report, September 1982 for City of Scottsdale Capital Improvement Engineering, Project No. 8294, by Collar, Williams and White Engineering, Inc.

2. Drainage Study for Area 82nd Place and Shea Boulevard for City of Scottsdale, Sealed Date (not readable), by Collar, Williams and White Engineering, Inc.

3. Report on Changes to McCormick Ranch Master Drainage Plan, Scottsdale, Arizona, Project No. 106-2, July 3, 1979 by Dashney and Associates, Inc.

4. Report on Hayden Roadway Drainage, Shea Boulevard to Cactus Road, Scottsdale, Arizona, Project No. 106-20, June 27, 1980 by Erikson & Salmon, Inc.

5. Report on Drainage Wash Intersection of Cholla and Granite Reef Roads, Scottsdale, Arizona, Project No. 106-8, September 10, 1981 by Erikson & Salmon, Inc.

6. Scottsdale Country Club, Second Nine Final Drainage Report, May, 1985 by Collar, Williams and White Engineering, Inc.

7. Scottsdale Country Club Additional Nine Holes, Addendum to Drainage Report for 84th Street, June, 1985 by Collar, Williams and White Engineering, Inc.

8. Hydraulic Charts for the Selection of Highway Culverts, Hydraulic Engineering Circular No. 5, December, 1965, Reprinted April, 1977, Prepared by the Hydraulics Branch, Bridge Division, Office of Engineering, Federal Highway Administration, Washington, D.C. 20590.

9. Drainage of Highway Pavements, Hydraulic Engineering Circular No. 12, March, 1984, Federal Highway Administration, U.S. Department of Transportation.

10. Drainage Report Preparation, Section 2, Design Procedures and Criteria, Revised July, 1985, City of Scottsdale, Arizona.

11. Design of Facilities to Manage Stormwater Runoff, Section 3, Design Procedures and Criteria, Revised October 31, 1985, City of Scottsdale, Arizona.

12. Concept Design Report, Shea Boulevard, Scottsdale Road to Pima Road, City of Scottsdale, Arizona, Project No. S7501, Arizona Department of Transportation Project No. M-703-3(5), June, 1987 by A-N West, Inc.

Appendix A

ADDENDUM to "HYDROLOGIC DESIGN FOR HIGHWAY DRAINAGE IN ARIZONA" April 1975

Steps to be used to determine precipitation values for various durations and return periods.

STEP 1. From the precipitation maps in the manual "Hydrologic Design for Highway Drainage in Arizona", determine the precipitation values for the 6 and 24 hour duration storms for return periods of 2, 5, 10, 25, 50 and 100 years. Tabulate these values in Table 1 in the column headed 'Map Values'

6/16/87

SHEA BLVD

TABLE 1

Return Period (Years)		Precipitation Values (inches)			
		6 hour duration		24 hour duration	
	1 HR	Map Value	Corrected Value	Map Value	Corrected Value
2	0.89	1.2	1.2	1.5	1.5
5	1.29	1.7	1.7	2.1	2.11
10	1.54	2.1	2.05	2.5	2.52
25	1.86	2.5	2.45	3.2	3.05
50	2.27	2.9	2.85	3.4	3.5
100	2.45	3.20	3.22	4.0	4.0

NOTE: There is a possibility of making an error while reading the maps because, (1) a site is not easy to locate precisely on a series of 12 maps, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. In order to minimize any errors in reading the maps, these values should be plotted on the diagram "Precipitation Depth versus Return Period" Fig. 1.

2 HR-100YR = .341 (3.22) + .659 (2.45) = 2.71
(6 HR) (1 HR)

Project No. _____ Station _____

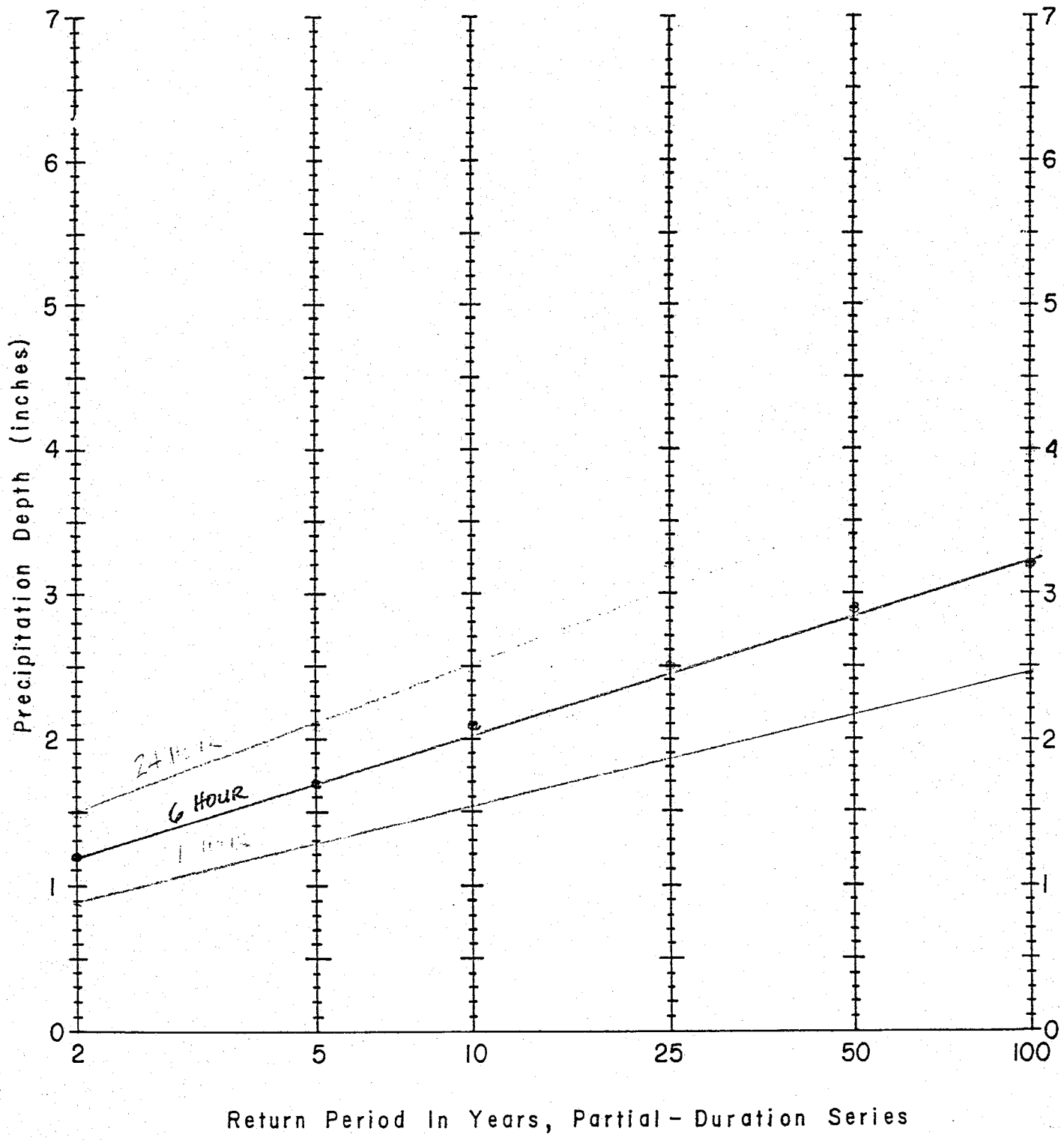


Figure 1 Precipitation Depth Versus Return Period for Partial-Duration Series

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

Highway Shea Blvd County Maricopa
Location Sundown Drive at Shea Blvd
Project No. _____ Station _____
Name of Stream _____

DESIGN DATA

Design Frequency		10	100	years
Drainage Area	A_1		38.8	acres
	A_2			acres
	A_3			acres
Drainage Length			5280	feet
Elevation				
Top of Drainage Area			1386	feet
At Structure			1352	feet
Drainage Area Slope			0.64	%
Precipitation				
P = 6-hour		2.05	3.22	inches
P = 24-hour		2.52	4.00	inches

DESIGN COMPUTATIONS

Precipitation P_1 = 1-hour		1.54	2.45	inches
Time of Concentration	Tc		40.1	minutes - Fig 2-13 Ref. 10
Rainfall Intensity	i	1.9	3.2	inches/hour - Fig 2-7 Ref 10
Runoff Coefficient	C_1		0.39	(CN = 82 R-35 zoning Fig 2-21 Ref. 10)
	C_2			
	C_3			
Weighted Runoff Coefficient	C			
Peak Discharge Qp = CiA =		28.8	48.4	cfs

Computed by GAS (A-N West) Date 8/1/07

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

Highway Shea Blvd. County Maricopa
Location Sta. 94+72 at Shea 1-10'x2' Box Culverts
Project No. _____ Station _____
Name of Stream _____

DESIGN DATA

Design Frequency		10	100	years
Drainage Area	A_1		130.3	acres
	A_2			acres
	A_3			acres
Drainage Length			5280	feet
Elevation				
Top of Drainage Area			1386	feet
At Structure			1352	feet
Drainage Area Slope			0.64	%
Precipitation				
P = 6-hour		2.05	3.22	inches
P = 24-hour		2.52	4.0	inches

DESIGN COMPUTATIONS

Precipitation P_1 = 1-hour		1.54	2.45	inches
Time of Concentration	Tc		40.1	minutes V=2.2 fps From Fig 2-13 Ref 10
Rainfall Intensity	i	1.9	3.2	inches/hour - From Fig 2 Ref 10
Runoff Coefficient	C_1	105.3 X	0.39	(CN=82 R-35 Zoning
	C_2	25 Ac X	0.18	(CN=70 Grass-Golf Course
	C_3			(C) Coeff. From
Weighted Runoff Coefficient	C		0.35	Fig 2-21 Ref 10
Peak Discharge Qp = CiA =		86.6	145.9	cfs

Computed by GAS (A-N West) Date 8/10/87

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

Highway Shea Blvd County Maricopa Co
Location
Project No. Station 118 + 37 1-8'X2' RCB
Name of Stream

DESIGN DATA

Design Frequency		10	100 years	Zoning
Drainage Area	A_1		72.7 acres	12.4 Ac - Commerc.
	A_2		acres	2.0 Ac - R-4
	A_3		acres	58.3 Ac - R-35.
Drainage Length			3200 feet	
Elevation				
Top of Drainage Area			1377 feet	
At Structure			1356 feet	
Drainage Area Slope			0.66 %	
Precipitation				
P = 6-hour		2.10	3.22 inches	
P = 24-hour		2.52	4.00 inches	

DESIGN COMPUTATIONS

Precipitation P_1 = 1-hour		1.54	2.45 inches	
Time of Concentration	Tc		27.0 minutes	From Fig 2-13 Ref. 10
Rainfall Intensity	i	2.5	4.1 inches/hour	From Fig 2-7
Runoff Coefficient	C_1		0.39	Assume CN=82 for R-35 zoning for all of area las exist. commercial development has on-site detention
	C_2			
	C_3			
Weighted Runoff Coefficient	C		0.39	
Peak Discharge Qp = CiA =		70.9	116 cfs	'C' Coeff from Ref. 10 Fig 2-21

Computed by G.A.S. (A-N West) Date 7/24/87

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

Highway Shea Blvd County Maricopa Co
Location
Project No. Station 164+39 - 12 x 3' RCB
Name of Stream

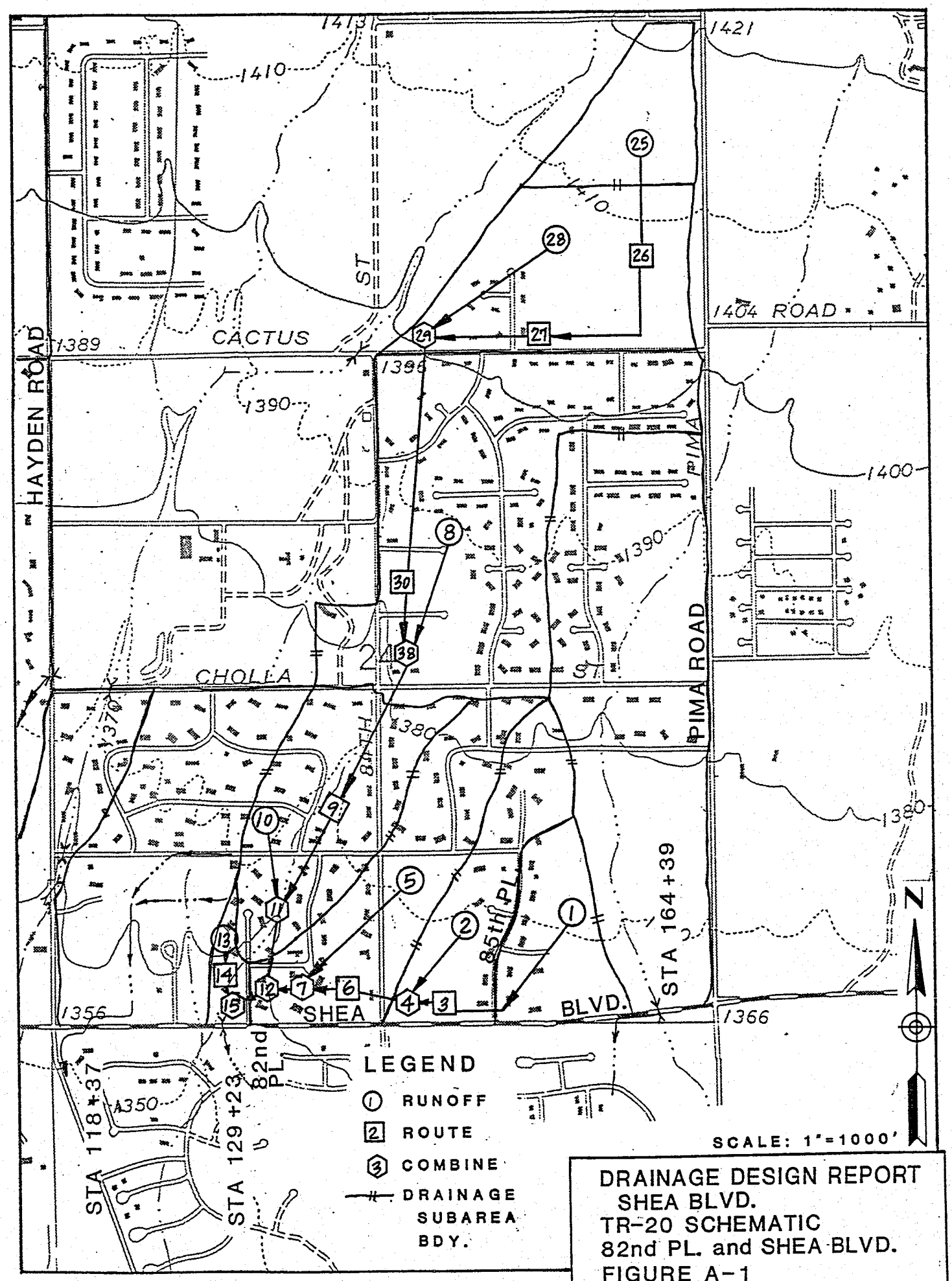
DESIGN DATA

Design Frequency		10	100	years
Drainage Area	A_1		113.6	acres
	A_2			acres
	A_3			acres
Drainage Length			4600	feet
Elevation				
Top of Drainage Area			1398	feet
At Structure			1365	feet
Drainage Area Slope			0.71	%
Precipitation				
P = 6-hour		2.10	3.22	inches
P = 24-hour		2.52	4.0	inches

DESIGN COMPUTATIONS

Precipitation P_1 = 1-hour		1.54	2.45	inches	
Time of Concentration	Tc		34.6	minutes	From Fig 2-13 Ref. 10
Rainfall Intensity	i	2.1	3.50	inches/hour	From Fig. 2-7 Ref 10
Runoff Coefficient	C_1		0.465		Type B soil
	C_2				Fig. 2-21 for CN
	C_3				of 85 (R1-10 zoning)
Weighted Runoff Coefficient	C				and Q_{100} - 1 Hour = 2.4
Peak Discharge Qp = CiA =		110.9	1.85	cfs	(C) Coeff From Fig 2-21 Ref 10

Computed by G.A.S. (A-N-West) Date 7/24/87



DRAINAGE DESIGN REPORT
SHEA BLVD.
TR-20 SCHEMATIC
82nd PL. and SHEA BLVD.
FIGURE A-1

SHEA.IN2

INPUT

UPSTREAM WATERSHEDS (SEE 745) INPUT AS RUNOFF 25 #28

LSM 7/1/91

```
*****************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*****************

JC3 TR-20                                          SUMMARY
TITLE 001 EXISTING CONDITION SHEA BLVD & 92ND ST   (SHEA.IN2)
TITLE 001 1-HR TYPE II  A-N WEST 6-87  SHEA.IN1
 5 RAINFL 1            0.020
 6          0.000      0.006      0.0162     0.0246     0.033
 8          0.042      0.052      0.063      0.074      0.086
 8          0.099      0.112      0.126      0.142      0.160
 8          0.180      0.205      0.255      0.345      0.437
 8          0.530      0.600      0.633      0.660      0.684
 8          0.705      0.724      0.741      0.759      0.775
 8          0.790      0.804      0.818      0.831      0.844
 8          0.856      0.867      0.879      0.890      0.900
 8          0.910      0.920      0.928      0.939      0.948
 8          0.957      0.966      0.974      0.983      0.992
 8          1.000      1.000      1.000      1.000      1.000
 9 ENDTBL
 5 RAINFL 2            0.04
 8          .00        .03        .07        .12        .18
 8          .24        .32        .36        .40        .43
 8          .46        .50        .54        .57        .59
 8          .61        .63        .66        .68        .71
 8          .72        .75        .76        .77        .79
 8          .80        .81        .82        .83        .84
 8          .85        .86        .87        .88        .89
 8          .89        .90        .91        .92        .92
 8          .93        .93        .94        .95        .96
 8          .96        .97        .98        .99        .99
 8          1.0        1.0        1.0        1.0        1.0
 9 ENDTBL
 2 XSECTN    3         1.0        3.5
 8                     0.         0.         0.
 8                     0.25       1.1        0.9
 8                     0.50       3.7        2.0
 8                     1.         10.4       5.0
 8                     2.         54.5       14.0
 8                     3.5        177.2      36.5
 9 ENDTBL
 2 XSECTN    6         1.0        3.5
 8                     0.         0.         0.
 8                     1.         10.4       5.0
 8                     2.         54.5       14.0
 8                     3.5        177.2      36.5
 9 ENDTBL
 2 XSECTN    9         1.0        3.0
 8                     0.         0.         0.
 8                     1.         54.2       13.5
```

INPUT

```
*********************80-80 LIST OF INPUT DATA (CONTINUED)*********************

 8                        2.          146.8       39.
 8                        2.5         173.5       57.5
 8                        3.          253.3       95.
 9 ENDTBL
 2 XSECTN   14            1.0         3.0
 9                        0.          0.          0.
 8                        1.          22.4        6.0
 8                        2.          86.6        16.0
 8                        3.          202.6       30.0
 8                        3.5         263.        38.5
 8                        4.0         321.        43.0
 9 ENDTBL
 2 XSECTN   26            1.0         0.4
 8                        0.          0.          0.
 8                        0.2         3.0         2.0
 8                        0.4         20.5        7.5
 8                        0.6         59.5        17.5
 9 ENDTBL
 2 XSECTN   27            1.0         0.5
 8                        0.          0.          0.
 8                        0.2         1.5         2.0
 8                        0.4         11.2        5.0
 8                        0.5         28.5        12.5
 8                        0.7         57.0        22.0
 9 ENDTBL
 2 XSECTN   30            1.0         0.5
 8                        0.          0.          0.
 8                        0.2         1.5         2.0
 8                        0.4         11.4        5.0
 8                        0.5         44.0        12.0
 8                        0.7         107.0       24.0
 9 ENDTBL
 6 RUNOFF 1 101           5 .041      32.         0.22        1 0 0 0 1
 6 RUNOFF 1   2           6 .147      32.         0.34        1 0 0 0 1
 6 REACH  3   1   3   3 900.                                  1 0 0 0 1
 6 ADDHYD 4   4   7 6 5                                       1 0 0 0 1
 6 RUNOFF 1   5           6 .086      82.         0.98        1 0 0 0 1
 6 REACH  3   6   5   7 1080.                                 1 0 0 0 1
 6 ADDHYD 4   7   6   5                                       1 0 0 0 1
 6 RUNOFF 1  25           1 .124      77.         0.53        1 0 0 0 1
 6 REACH  3  26   1   4 1260.                                 1 0 0 0 1
 6 REACH  3  27   4   6 1560.                                 1 0 0 0 1
 6 RUNOFF 1  28           7 .10       35.         0.39        1 0 0 0 1
 6 ADDHYD 4  29   3 6 4                                       1 0 0 0 1
 6 REACH  3  30   4   7 2640.                                 1 0 0 0 1
 6 RUNOFF 1   8           6 .173      35.         0.72        1 0 0 0 1
```

INPUT

```
*********************80-80 LIST OF INPUT DATA (CONTINUED)*********************

 6 ADDHYD 4  38   3 6 4                                  1 0 0 0 1
 6 REACH  3   9   4   7 2850.                            1 0 0 0 1
 6 RUNOFF 1  10       4 .079        82.        0.65     1 0 0 0 1
 6 ADDHYD 4  11   7 4 6                                  1 0 0 0 1
 6 ADDHYD 4  12   5 6 7                                  1 0 0 0 1
 6 RUNOFF 1  13       6 .013        82.        0.52     1 0 0 0 1
 6 REACH  3  14   7   5 270.                             1 0 0 0 1
 6 ADDHYD 4  15   6 5 7                                  1 0 0 0 1
   ENDATA
 7 LIST
 7 INCREM 6            0.05
 7 COMPUT 7 001   015  0.00        1.54       1.00      1 2  01  01
   ENDCMP 1
 7 INCREM 6            0.05
 7 COMPUT 7 001   015  0.00        2.27       1.00      1 2  01  02
   ENDCMP 1
 7 INCREM 6            0.05
 7 COMPUT 7 001   015  0.00        2.45       1.00      1 2  01  03
   ENDCMP 1
 7 INCREM 6            0.05
 7 COMPUT 7 001   015  0.00        3.71       1.00      1 2  01  04
   ENDCMP 1
   ENDJOB 2

*****************************END OF 80-80 LIST******************************
```

OUTPUT

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1	10 Year - 1 Hour Storm												
XSECTION 1	RUNOFF	.04	1	2	.05	.0	1.54	1.00	.37	---	1.00	12.74	296.3
XSECTION 2	RUNOFF	.05	1	2	.05	.0	1.54	1.00	.37	---	1.18	11.97	254.7
XSECTION 3	REACH	.04	1	2	.05	.0	1.54	1.00	.37	.95	1.10	12.50	290.7
XSECTION 4	ADDHYD	.09	1	2	.05	.0	1.54	1.00	.37	---	1.14	24.27	269.7
XSECTION 5	RUNOFF	.09	1	2	.05	.0	1.54	1.00	.37	---	1.29	19.86	230.9
XSECTION 6	REACH	.09	1	2	.05	.0	1.54	1.00	.37	1.26	1.24	23.90	265.5
XSECTION 7	ADDHYD	.18	1	2	.05	.0	1.54	1.00	.37	---	1.26	43.67	248.1
XSECTION 25	RUNOFF	.05	1	2	.05	.0	1.54	1.00	.23	---	1.08	9.86	182.6
XSECTION 26	REACH	.05	1	2	.05	.0	1.54	1.00	.23	.27	1.22	9.41	174.2
XSECTION 27	REACH	.05	1	2	.05	.0	1.54	1.00	.23	.33	1.45	7.95	147.3
XSECTION 28	RUNOFF	.10	1	2	.05	.0	1.54	1.00	.48	---	1.20	31.82	318.2
XSECTION 29	ADDHYD	.15	1	2	.05	.0	1.54	1.00	.39	---	1.24	38.39	249.3
XSECTION 30	REACH	.15	1	2	.05	.0	1.54	1.00	.39	.46	1.40	36.10	234.4
XSECTION 8	RUNOFF	.18	1	2	.05	.0	1.54	1.00	.48	---	1.06	63.91	359.1
XSECTION 38	ADDHYD	.33	1	2	.05	.0	1.54	1.00	.44	---	1.16	90.88	273.7
XSECTION 9	REACH	.33	1	2	.05	.0	1.54	1.00	.44	1.33	1.36	84.66	255.0
XSECTION 10	RUNOFF	.08	1	2	.05	.0	1.54	1.00	.37	---	1.03	22.92	290.2
XSECTION 11	ADDHYD	.41	1	2	.05	.0	1.54	1.00	.42	---	1.29	101.70	247.5
XSECTION 12	ADDHYD	.59	1	2	.05	.0	1.54	1.00	.41	---	1.28	145.31	247.5
XSECTION 13	RUNOFF	.01	1	2	.05	.0	1.54	1.00	.37	---	.90	4.14	318.7
XSECTION 14	REACH	.59	1	2	.05	.0	1.54	1.00	.41	2.51	1.28	145.31	247.5
XSECTION 15	ADDHYD	.60	1	2	.05	.0	1.54	1.00	.41	---	1.27	147.98	246.6
ALTERNATE 1 STORM 2	50 Year - 1 Hour Storm												
XSECTION 1	RUNOFF	.04	1	2	.05	.0	2.27	1.00	.83	---	.95	29.19	678.9
XSECTION 2	RUNOFF	.05	1	2	.05	.0	2.27	1.00	.83	---	1.14	27.01	574.7
XSECTION 3	REACH	.04	1	2	.05	.0	2.27	1.00	.83	1.38	1.03	28.83	670.4
XSECTION 4	ADDHYD	.09	1	2	.05	.0	2.27	1.00	.83	---	1.07	55.13	612.6
XSECTION 5	RUNOFF	.09	1	2	.05	.0	2.27	1.00	.83	---	1.24	44.74	520.3
XSECTION 6	REACH	.09	1	2	.05	.0	2.27	1.00	.83	2.00	1.16	54.54	606.0
XSECTION 7	ADDHYD	.18	1	2	.05	.0	2.27	1.00	.83	---	1.19	98.71	560.8
XSECTION 25	RUNOFF	.05	1	2	.05	.0	2.27	1.00	.60	---	1.00	25.96	480.8
XSECTION 26	REACH	.05	1	2	.05	.0	2.27	1.00	.60	.42	1.11	25.10	464.6

OUTPUT

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 2													
XSECTION 27	REACH	.05	1	2	.05	.0	2.27	1.00	.60	.51	1.33	22.22	411.4
XSECTION 28	RUNOFF	.10	1	2	.05	.0	2.27	1.00	1.00	---	1.16	66.49	664.9
XSECTION 29	ADDHYD	.15	1	2	.05	.0	2.27	1.00	.86	---	1.20	87.04	565.2
XSECTION 30	REACH	.15	1	2	.05	.0	2.27	1.00	.86	.62	1.34	83.05	539.3
XSECTION 8	RUNOFF	.18	1	2	.05	.0	2.27	1.00	1.00	---	1.02	134.50	755.6
XSECTION 38	ADDHYD	.33	1	2	.05	.0	2.27	1.00	.93	---	1.12	198.24	597.1
XSECTION 9	REACH	.33	1	2	.05	.0	2.27	1.00	.93	2.52	1.36	177.24	533.9
XSECTION 10	RUNOFF	.08	1	2	.05	.0	2.27	1.00	.83	---	.98	52.35	662.6
XSECTION 11	ADDHYD	.41	1	2	.05	.0	2.27	1.00	.91	---	1.28	212.14	516.2
XSECTION 12	ADDHYD	.59	1	2	.05	.0	2.27	1.00	.89	---	1.25	309.41	527.1
XSECTION 13	RUNOFF	.01	1	2	.05	.0	2.27	1.00	.83	---	.85	9.67	743.6
XSECTION 14	REACH	.59	1	2	.05	.0	2.27	1.00	.89	3.63	1.25	309.41	527.1
XSECTION 15	ADDHYD	.60	1	2	.05	.0	2.27	1.00	.89	---	1.24	315.17	525.3
ALTERNATE 1 STORM 3	100 Year 1 Hour Storm												
XSECTION 1	RUNOFF	.04	1	2	.05	.0	2.45	1.00	.96	---	.94	33.82	786.5
XSECTION 2	RUNOFF	.05	1	2	.05	.0	2.45	1.00	.96	---	1.13	31.20	663.8
XSECTION 3	REACH	.04	1	2	.05	.0	2.45	1.00	.96	1.49	1.02	33.44	777.6
XSECTION 4	ADDHYD	.09	1	2	.05	.0	2.45	1.00	.96	---	1.06	63.73	708.6
XSECTION 5	RUNOFF	.09	1	2	.05	.0	2.45	1.00	.96	---	1.24	51.65	600.6
XSECTION 6	REACH	.09	1	2	.05	.0	2.45	1.00	.96	2.11	1.15	63.09	701.0
XSECTION 7	ADDHYD	.18	1	2	.05	.0	2.45	1.00	.96	---	1.18	114.02	647.8
XSECTION 25	RUNOFF	.05	1	2	.05	.0	2.45	1.00	.71	---	.99	30.72	568.9
XSECTION 26	REACH	.05	1	2	.05	.0	2.45	1.00	.71	.45	1.10	29.72	550.4
XSECTION 27	REACH	.05	1	2	.05	.0	2.45	1.00	.71	.53	1.31	26.41	489.1
XSECTION 28	RUNOFF	.10	1	2	.05	.0	2.45	1.00	1.14	---	1.15	75.89	758.9
XSECTION 29	ADDHYD	.15	1	2	.05	.0	2.45	1.00	.99	---	1.19	100.57	653.1
XSECTION 30	REACH	.15	1	2	.05	.0	2.45	1.00	.99	.67	1.33	96.08	623.9
XSECTION 8	RUNOFF	.18	1	2	.05	.0	2.45	1.00	1.14	---	1.01	153.69	863.4
XSECTION 38	ADDHYD	.33	1	2	.05	.0	2.45	1.00	1.07	---	1.11	227.65	685.7
XSECTION 9	REACH	.33	1	2	.05	.0	2.45	1.00	1.07	2.67	1.37	201.08	605.7
XSECTION 10	RUNOFF	.08	1	2	.05	.0	2.45	1.00	.96	---	.97	60.57	766.8
XSECTION 11	ADDHYD	.41	1	2	.05	.0	2.45	1.00	1.05	---	1.29	240.39	584.9
XSECTION 12	ADDHYD	.59	1	2	.05	.0	2.45	1.00	1.02	---	1.25	352.28	600.1
XSECTION 13	RUNOFF	.01	1	2	.05	.0	2.45	1.00	.96	---	.85	11.23	863.7
XSECTION 14	REACH	.59	1	2	.05	.0	2.45	1.00	1.02	3.85	1.25	352.28	600.1
XSECTION 15	ADDHYD	.60	1	2	.05	.0	2.45	1.00	1.02	---	1.24	358.85	598.1

OUTPUT

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 4	100 Year 2 Hour Storm												
XSECTION 1	RUNOFF	.04	2	2	.05	.0	2.71	2.00	1.15	---	1.01	23.98	557.6
XSECTION 2	RUNOFF	.05	2	2	.05	.0	2.71	2.00	1.15	---	1.18	23.39	497.7
XSECTION 3	REACH	.04	2	2	.05	.0	2.71	2.00	1.15	1.25	1.09	23.80	553.4
XSECTION 4	ADDHYD	.09	2	2	.05	.0	2.71	2.00	1.15	---	1.13	46.94	521.6
XSECTION 5	RUNOFF	.09	2	2	.05	.0	2.71	2.00	1.15	---	1.30	40.02	465.3
XSECTION 6	REACH	.09	2	2	.05	.0	2.71	2.00	1.15	1.81	1.22	46.60	517.8
XSECTION 7	ADDHYD	.18	2	2	.05	.0	2.71	2.00	1.15	---	1.25	86.36	490.7
XSECTION 25	RUNOFF	.05	2	2	.05	.0	2.71	2.00	.88	---	1.07	22.30	413.1
XSECTION 26	REACH	.05	2	2	.05	.0	2.71	2.00	.88	.41	1.19	21.77	403.1
XSECTION 27	REACH	.05	2	2	.05	.0	2.71	2.00	.87	.50	1.43	19.96	369.7
XSECTION 28	RUNOFF	.10	2	2	.05	.0	2.71	2.00	1.35	---	1.18	57.44	574.4
XSECTION 29	ADDHYD	.15	2	2	.05	.0	2.71	2.00	1.18	---	1.26	75.65	491.2
XSECTION 30	REACH	.15	2	2	.05	.0	2.71	2.00	1.18	.59	1.42	73.55	477.6
XSECTION 8	RUNOFF	.18	2	2	.05	.0	2.71	2.00	1.35	---	1.06	111.34	625.5
XSECTION 38	ADDHYD	.33	2	2	.05	.0	2.71	2.00	1.27	---	1.20	173.00	521.1
XSECTION 9	REACH	.33	2	2	.05	.0	2.71	2.00	1.27	2.31	1.44	163.45	492.3
XSECTION 10	RUNOFF	.08	2	2	.05	.0	2.71	2.00	1.15	---	1.04	43.33	548.5
XSECTION 11	ADDHYD	.41	2	2	.05	.0	2.71	2.00	1.25	---	1.37	197.66	480.9
XSECTION 12	ADDHYD	.59	2	2	.05	.0	2.71	2.00	1.22	---	1.33	282.75	481.7
XSECTION 13	RUNOFF	.01	2	2	.05	.0	2.71	2.00	1.15	---	.94	7.62	586.0
XSECTION 14	REACH	.59	2	2	.05	.0	2.71	2.00	1.22	3.50	1.33	282.75	481.7
XSECTION 15	ADDHYD	.60	2	2	.05	.0	2.71	2.00	1.22	---	1.32	288.33	480.6

OUTPUT

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

See TR-20 Schematic

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2	3	4	
		10 Year 1 Hour	50 Year 1 Hour	100 Year 1 Hour	100 Year 2 Hour	
XSECTION 1	.04					
ALTERNATE 1		12.74	29.19	33.82	23.98	85TH Place at Shea Blvd.
XSECTION 2	.05					
ALTERNATE 1		11.97	27.01	31.20	23.39	
XSECTION 3	.04					
ALTERNATE 1		12.50	28.83	33.44	23.80	
XSECTION 4	.09					
ALTERNATE 1		24.27	55.13	63.78	46.94	84TH Street at Shea Blvd.
XSECTION 5	.09					
ALTERNATE 1		19.86	44.74	51.65	40.02	
XSECTION 6	.09					
ALTERNATE 1		23.90	54.54	63.09	46.60	
XSECTION 7	.18					
ALTERNATE 1		43.67	98.71	114.02	36.36	82ND Place at Shea Bvd.
XSECTION 8	.18					
ALTERNATE 1		63.91	134.50	153.69	111.34	
XSECTION 9	.33					
ALTERNATE 1		84.66	177.24	201.08	163.45	
XSECTION 10	.08					
ALTERNATE 1		22.92	52.35	60.57	43.33	
XSECTION 11	.41					
ALTERNATE 1		101.70	212.14	240.39	197.66	82ND Place at Clinton St. (500 ft north of Shea)
XSECTION 12	.59					
ALTERNATE 1		145.31	309.41	352.28	282.75	West of 82ND Place at Shea Combined Flow of I.D. 7 & 11
XSECTION 13	.01					
ALTERNATE 1		4.14	9.67	11.23	7.62	
XSECTION 14	.59					
ALTERNATE 1		145.31	309.41	352.28	282.75	

OUTPUT

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

See TR-20 Schematic

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2	3	4
		10 Year 1 Hour	50 Year 1 Hour	100 Year 1 Hour	100 Year 2 Hour
XSECTION 15	.60				
ALTERNATE 1		147.98	315.17	358.85	288.33
XSECTION 25	.05				
ALTERNATE 1		9.86	25.96	30.72	22.30
XSECTION 26	.05				
ALTERNATE 1		9.41	25.10	29.72	21.77
XSECTION 27	.05				
ALTERNATE 1		7.95	22.22	26.41	19.96
XSECTION 28	.10				
ALTERNATE 1		31.82	66.49	75.89	57.44
XSECTION 29	.15				
ALTERNATE 1		38.39	87.04	100.57	75.65
XSECTION 30	.15				
ALTERNATE 1		36.10	83.05	96.08	73.55
XSECTION 38	.33				
ALTERNATE 1		90.88	198.24	227.65	173.00

Sta 129+23 - 2-12' x 3' Box Culverts under Shea Blvd.

Appendix B

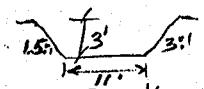
PROJECT: Shea Blvd.

Sta 94+72
EXISTING CAPACITY

DESIGNER: GAS

DATE: 8/6/87

HYDROLOGIC AND CHANNEL INFORMATION



S = 0.0057'/Ft
n = 0.017

For Q=150
d_n = 1.5 ft
V = 7.4 fps

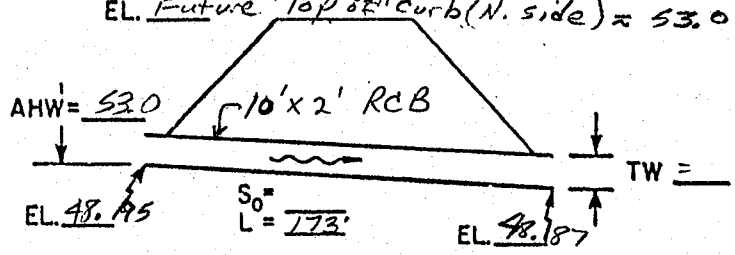
X-Section - Concrete Channel
50' Downstream

Q_1 = 145.9 (Q_{100}) TW_1 = 1.5 ft
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: ℄ Sta. 94+72



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Wingwalls	145.9	10'x2'	1.70	3.4	0.2	1.55	1.88	1.90	1.5	1.90	0.08	3.37	3.4			Inlet or Outlet Control Highwater El. = 52.4 Not over Top of Wall or Curb

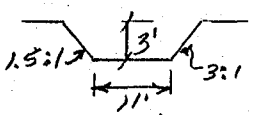
SUMMARY & RECOMMENDATIONS:

B-1

PROJECT: Shea Blvd Sta. 94+72 DESIGNER: GAS

Combined Capacity - Existing 10'x2' RCB and New 29"x45" Oval Concrete DATE: 1/27/88

HYDROLOGIC AND CHANNEL INFORMATION



S = 0.0057 '/Ft For Q = 150 cfs
n = 0.017 dn = 1.55 ft
V = 7.4 fps

X-Section - Concrete Channel 50' Downstream

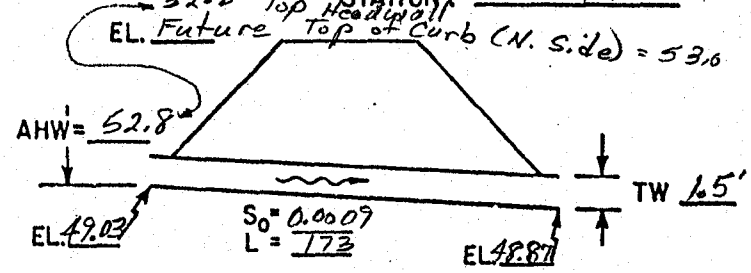
Q_1 = 145.9 (100 Year) TW_1 = 1.5

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Sta 94+72



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h0-LS0: Ke	H	dc	(dc+D)/2	TW	h0	LS0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
29"x45" Oval C.P. Wingwall w/ Beveled End	29	29x45 Oval C.P.	0.92	2.22	0.2	0.58	2.0	2.21	1.5	2.21	0.16	2.63	51.7			Outlet Control Highwater El. = 51.7
10'x2' Box Wingwall w/ Beveled End	116.9	10'x2'	1.33	2.66	0.2	1.0	1.6	1.8	1.5	1.8	0.16	2.64	51.7			Inlet or Outlet Control Highwater El. = 51.7

By Trial & Error for Different Combination of 100 Year Discharge of 145.9 cfs in two conduits

B-2

SUMMARY & RECOMMENDATIONS: 29"x45" Oval C.P. A = 7.4 sq.ft R = 0.736
Vel. = 3.9 fps (H_v = 0.24') for Q = 29 cfs

The proposed new 29"x45" Oval C.P. was proposed in conjuction with proposed storm drain to Sundown Drive. The exist. 10'x2' box culvert caused too much back water for storm drain to Sundown Drive, hence the additional 29"x45" storm drain across Shea Blvd. was proposed.

Project: Shea Boulevard - Scottsdale Road to Pima Road
Location: Sundown Drive to Exist. 10'X2' Box Culvert & Proposed 29"x45" Oval C.P (Sta. 94+72) and Exist. Storm Drain Sta. 97+02 to 99+31
Date: 1/27/88 GAS

STORM SEWER LINE AND LOCATION	PIPE DIA. (in.)	REACH LENGTH (ft.)	SLOPE OF REACH (ft./ft.)	INVERT ELEV. (ft.)	DESIGN DISCHARGE (cfs)	FULL PIPE DISCHARGE (cfs)	DEPTH OF FLOW (ft.)	ACTUAL VELOCITY (fps)	ACTUAL VELOCITY HEAD (fps)	HEAD LOSSES FRICTION H_f (ft.)	HEAD LOSSES SHOCK OR FORM ΔH (ft.)	SLOPE OF ENERGY GRADE (ft./ft.)	GRADE LINE ELEV. ENERGY	GRADE LINE ELEV. HYDRAULIC	REMARKS
Sundown Drive to Sta. 94+72															
Sta 94+72 Lt (@ Shea Blvd)	10'x2' Box and 29"x45 Oval C.P.	—	—	48.87	145.9	—	Full	10'x2' Box 5.8 / 29"x45" Oval C.P. 3.9					51.7		Inlet Energy Head, See Culvert Calcs Sta 94+72
Sta 94+26.2 57.5' Lt (Shea)	Oval C.P. 34"x53"	—	—	49.13	49.4	51.6	Full	4.75	0.35		Outlet Loss 0.2 Hv = 0.	07'	51.77	51.42	
Manhole Sta. 92+24.2 57' Lt	34"x53"	202	0.002	49.53	48.4	51.6	Full	4.75	0.35	0.35'			52.12	51.77	
Manhole Sta. 92+24.2 57' Lt	30"	—	—	49.53	24.2						MH Loss 0.1 Hv = 0.	04'	52.16		
Grate Inlet	30"	59	0.0026	49.70	24.2	22.6	Full	4.93	0.38	0.17	Ent. Loss 0.2 Hv =	0.08'	52.41	52.03	Top Grate El. = 52.7
Manhole Sta 92+24.2 57' Lt	30"	—	—	49.70	24.2						MH Loss 0.1 Hv = 0.	04	52.16		
	30"	40'	0.0025	49.80	24.2	22.6	Full	4.93	0.38	0.12	Ent. Loss 0.2 Hv =	0.08	52.36	51.98	Drop Inlet El. = 52.3
Sta. 97+02 to 99+31															
Sta. 99+31 58' Rt	24"	—	—	47.62	15.2	12.5	Full	4.83	0.36		Exit Loss 0.2 Hv =	0.07'	50.14	50.07	See Culvert Calcs. Sta. 99+75 TW = 50.07 ; 2.7' deep
Sta. 97+02 45' Rt	24"	235	0.0026	48.24	15.2	12.5	Full	4.83	0.36	0.89	MH Loss 0.2 Hv =	0.07'	51.10	50.74	Grate El. = 51.67 (∴ OK)
Sta 97+02 43' Rt	18"	—	—	48.60	8.2	8.2	Full	4.64	0.33				51.10	50.77	
Sta 97+02 45' Lt	18"	85	0.0062	49.04	8.2	8.2	Full	4.64	0.33	0.43	Ent. Loss 0.2 Hv =	0.07'	51.60	51.27	Grate El. = 51.63 (∴ OK)

1. Oval 34"x53" Conc. P. $A = 10.2$ sq. ft $R = 0.875$
2. 'n' = 0.012 storm drain pipe
3. $H_f = \frac{29(n^2)L}{R^{1.33}} \times H_v$

Sump Condition - Grate Inlet Calculations

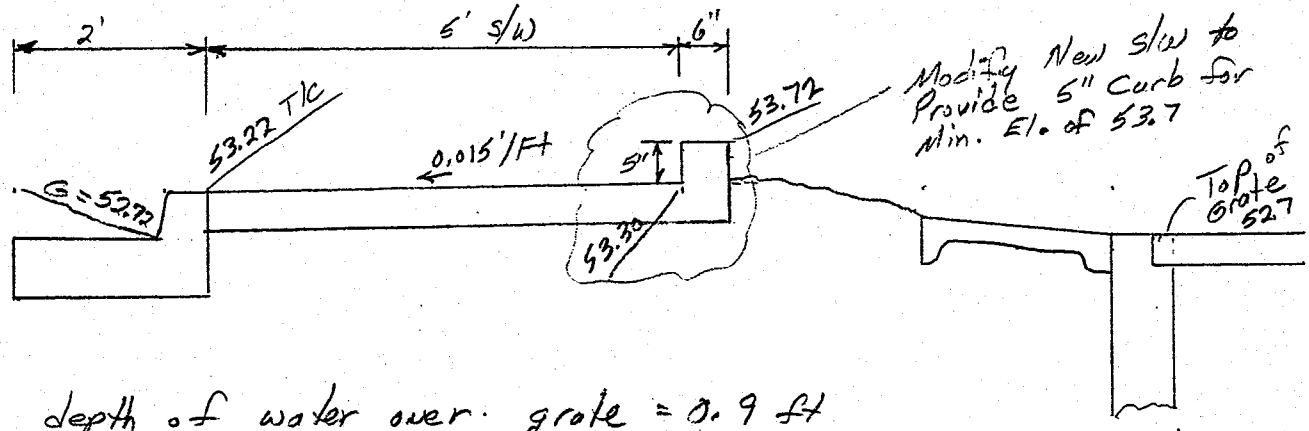
Location : Sta 91+66.9 66' Lt.

Grate Inlet Type Modi C-15.80 6'-2" x 2'-11 3/4"
Grate Inlet opening area
Gross Area = 18.35 sq. ft, including grates.
Net Area = 13.2 sq. ft. (72% of Gross Area)

Design Q = 24.2 cfs (100 Yr)

Top of Grate = 52.7

Low Top of Curb = 53.22
Low Top of Back of Sidewalk = 53.30
+ 0.42 (5" Modified Curb
53.72



For depth of water over grate = 0.9 ft
Discharge per sq. ft. of effective net opening = 3.7 cfs/sq.ft

Q Capacity of grate = 3.7 x 13.2 sq.ft = 48.84 cfs
x 0.5 Clogging Factor
24.42 cfs > 24.2
(∴ Adequate Cap.

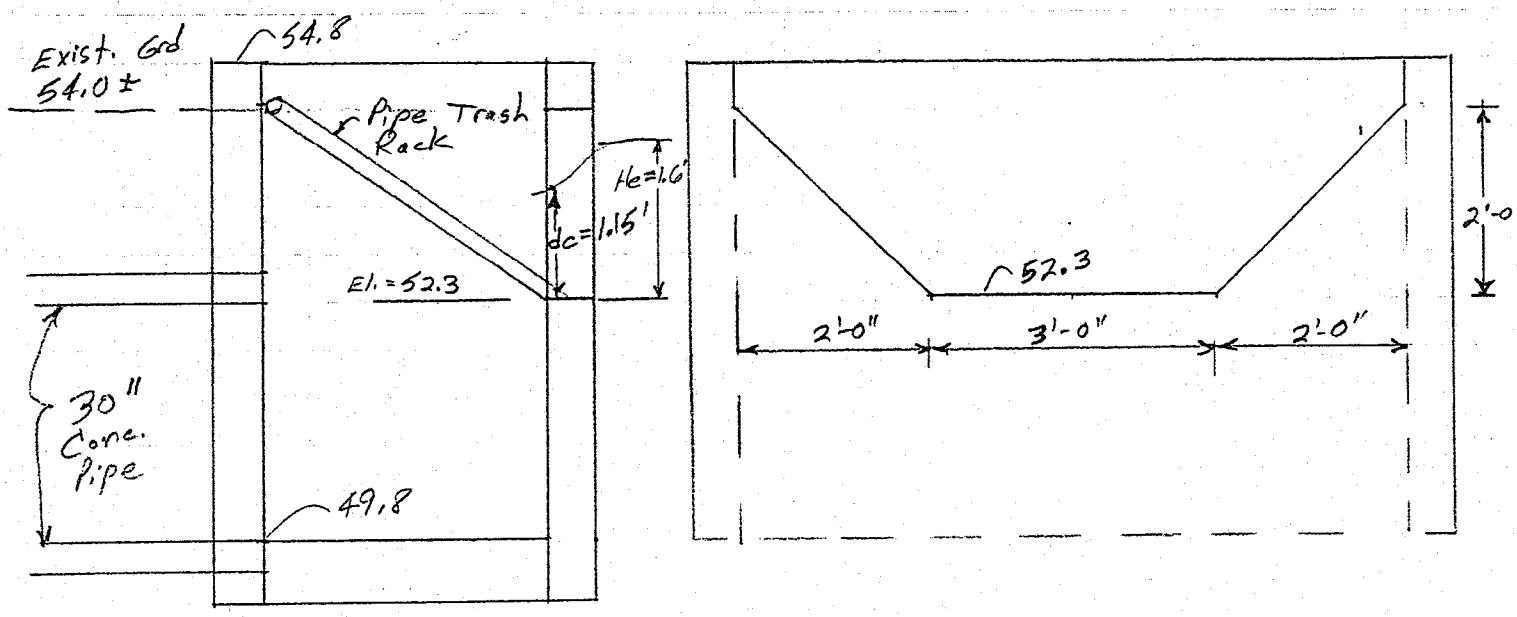
AN WEST INC.
Consulting Engineers
Richmond, California
San Jose, California
Phoenix, Arizona

Proj. No. _____ Sht. ___ of ___

Shea Blvd — Calc. By GAS — Date 2/9/88

Chkd. By _____ Date _____

Hydraulic Calculations - Drop Inlet
Sundown Drive and Shea Blvd.



Q_{100} Design Drop Inlet = 24.2 cfs

By Eqn 4-20 Chow's Open Channel Hydraulics
Critical Discharge Eqn for trapezoidal Section:

is $Q_c = \dfrac{5.67[(b+zy)y]^{1.5}}{(b+2zy)^{0.5}}$ let $b = 3'$, $z = 1:1$

For $y = 1.15'$ $Q_c = 25.67$ cfs $\approx$ 24.2 cfs ($\therefore y_c = 1.15'$)

$V_c = 5.38$ $H_{vc} = 0.45'$

Energy Head $= d_c + H_{vc} = 1.15 + 0.45'$
$= 1.6$

By HEC-5 Manual Inlet Control
For 30 Inch Pipe Q = 24.2 cfs
HW/D = 1.0 for Groove End with Headwall Entrance Type
HW = 1.0 x 2.5 = 2.50 feet HW El = 52.3

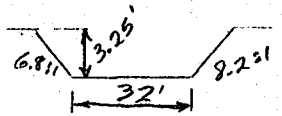
By Outlet Control Pipe Calculations (Appendix B)
Energy Grade in Drop Inlet is 52.36
Therefore no hydraulic backwater of weir flow into drop inlet.

PROJECT: Shea Blvd. Sta. 99+75 EXISTING CAPACITY

DESIGNER: GAS

DATE: 8/6/87

HYDROLOGIC AND CHANNEL INFORMATION



S = 0.005'/Ft For Q = 700 cfs
n = 0.032 d_n = 2.7'
V = 5.1 fps

X-Section - Earth Channel
100' Downstream

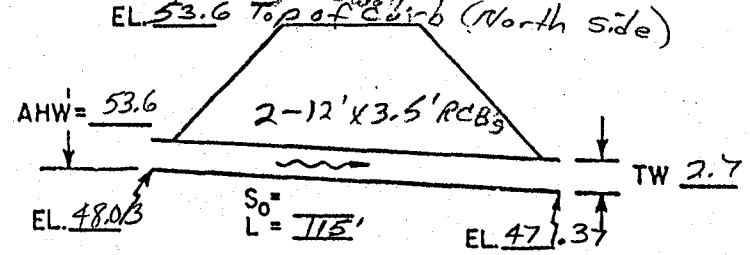
Q_1 = 700 cfs TW_1 = 2.7

Q_2 = ____ TW_2 = ____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: ℄ Sta 99+75



MEAN STREAM VELOCITY = ____

MAX. STREAM VELOCITY = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Wingwalls	700	2-12' X3.5	1.40	4.9	0.2	1.75	2.9	3.2	2.7	3.2	0.66	4.29	4.9			Inlet Control Highwater El = 52.9 @ Inlet Not Over Top of Curb

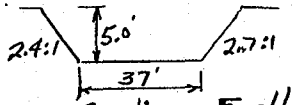
SUMMARY & RECOMMENDATIONS:

PROJECT: Shea Blvd Sta 111 + 47.5
EXISTING CAPACITY

DESIGNER: GAS

DATE: 8/6/87 Revised 2/4/88

HYDROLOGIC AND CHANNEL INFORMATION



S = 0.0037'/Ft
n = 0.032

d_n = 4.0 ft
For Q = 1150 cfs
V = 6.2 fps
d_n = 5.0 ft.
For Q = 1740 cfs
V = 7.0 fps
d_n = 4.6 ft.
For Q = 1500
d_n = 4.3
For Q = 1300

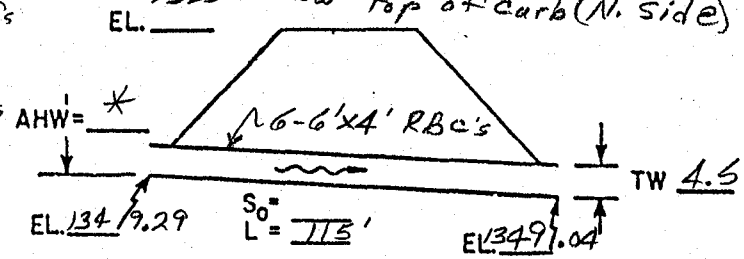
X-Section – Earth/Gross Channel
146' Downstream

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: ℄ Sta. 111 + 47.5
Top of Curb (N. Side)



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Wingwalls with Crown rounded	1500	6-6'x4'	1.7	6.8	0.2	2.8	3.7	3.85	4.6	4.6	0.25	7.15	7.15			Outlet Control Highwater El = 56.44
"	1300	"	1.45	5.8	0.2	2.0	3.4	3.68	4.3	4.3	0.25	6.05	6.05			Outlet Control Highwater El. = 55.34
	1425	"	1.62	6.5	0.2	2.3	3.6	3.8	4.5	4.5	0.25	6.55	6.55			Outlet Control Highwater El. = 55.84

SUMMARY & RECOMMENDATIONS:
For Q_{100} = 1300 cfs Little weir flow over Shea would occur.
For Q_{100} = 1500 cfs Weir flow over Shea would occur with average depths of less than 1 foot deep. The flow would return to the channel downstream of Shea or be diverted over in Shea Blvd and then South in Hayden Road.

* Note - Shallow flow over road occurs. See report text.

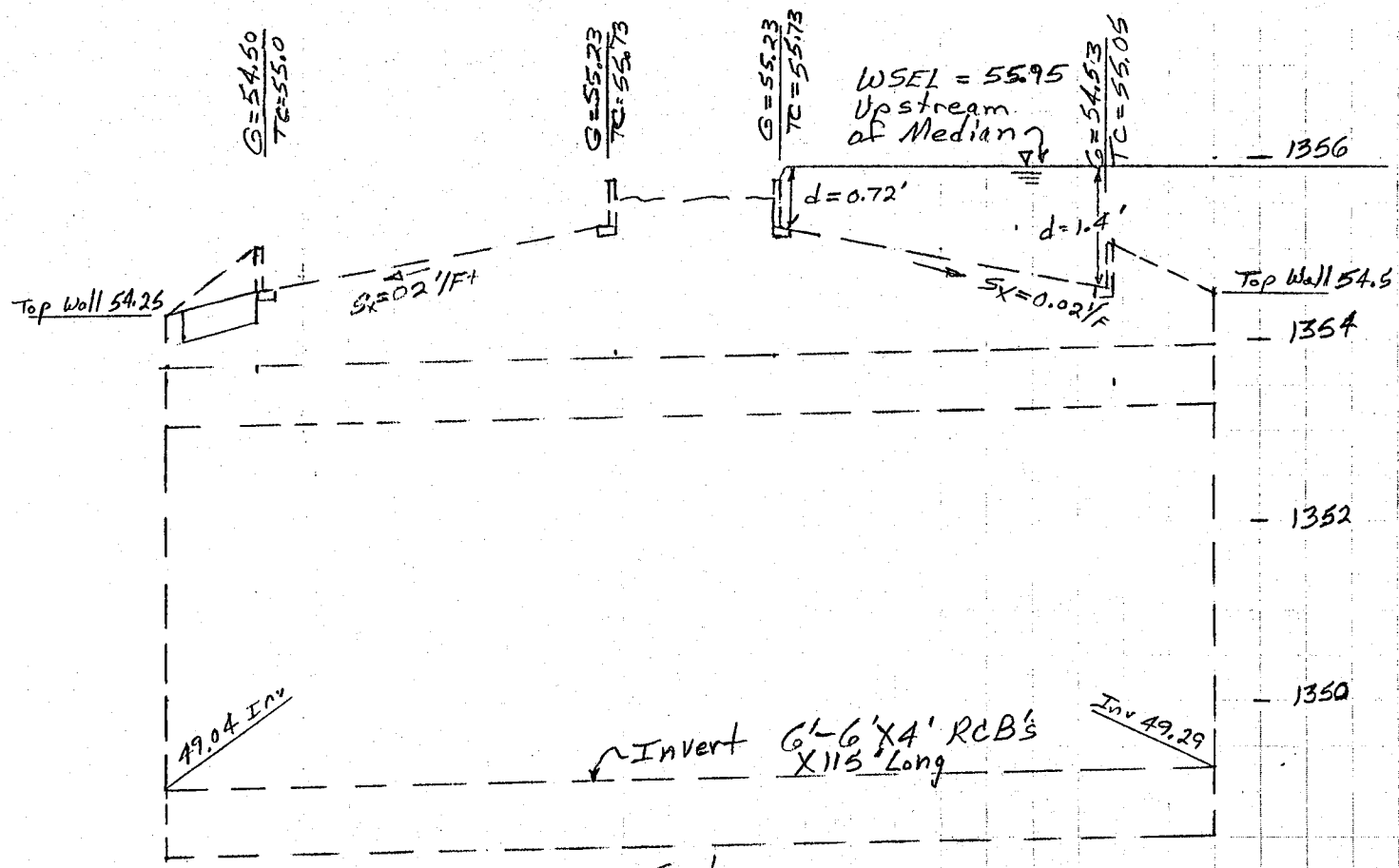
PMWEST INC.
Consulting Engineers
Richmond, California
San Jose, California
Phoenix, Arizona

Proj. No. _____ Sht. ___ of ___

Calc. By GAS Date 1/22/88

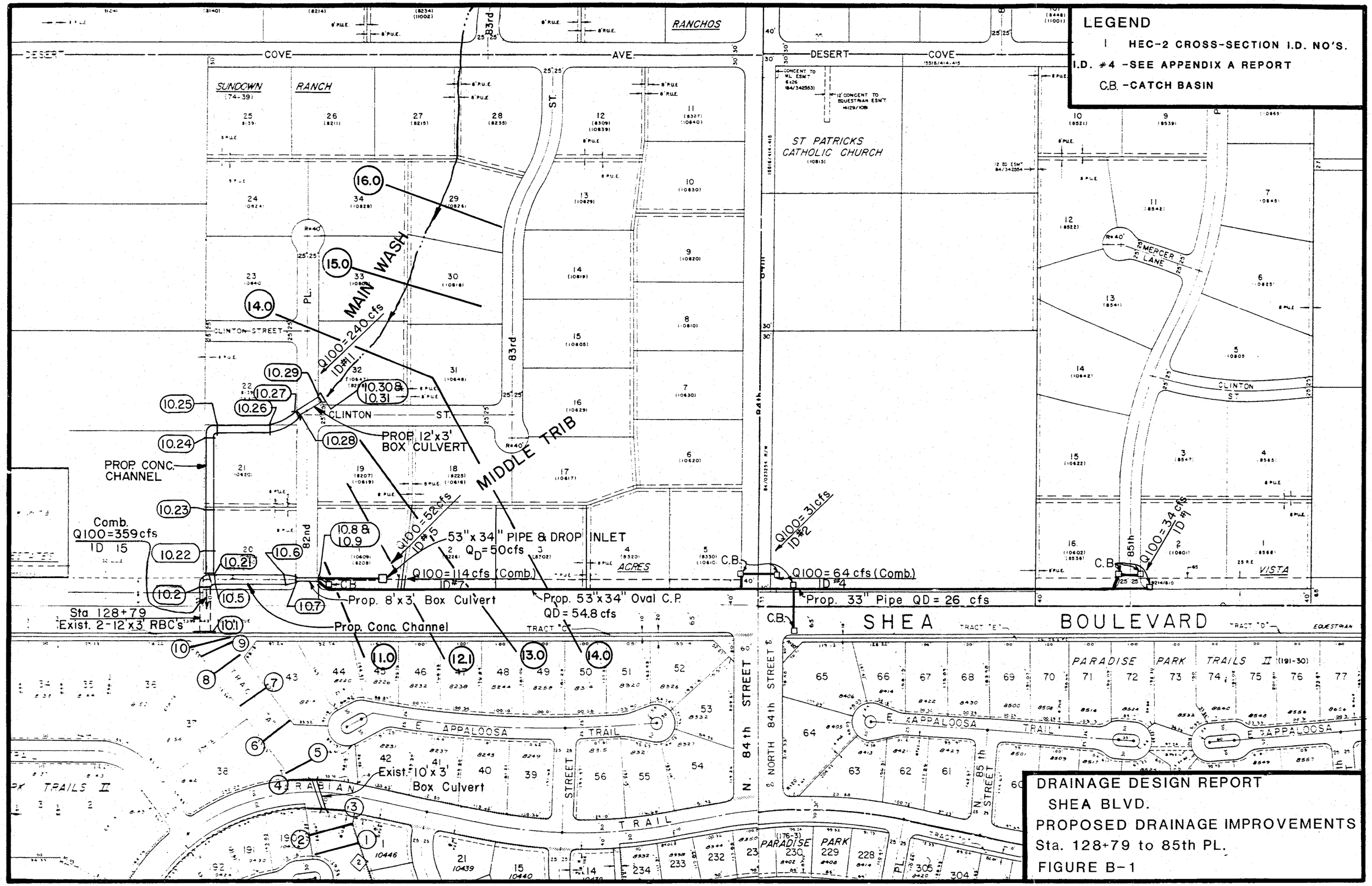
Chkd. By _____ Date _____

Shea Blvd.



Scale
H: 1"=20'
V: 1"=2'

Profile along ℄ 6-6'X4' Box Culverts
Sta. 111+47.5 (℄ Shea Blvd.)
Skewed 40°50'02" Left


LEGEND
1 HEC-2 CROSS-SECTION I.D. NO'S.
I.D. #4 -SEE APPENDIX A REPORT
C.B. -CATCH BASIN
DESERT COVE AVE.
SUNDOWN RANCH
RANCHOS
ST PATRICKS CATHOLIC CHURCH
MERCER LANE
CLINTON ST.
83rd
84th
85th
82nd
MAIN WASH
MIDDLE TRIB
Q100=240 cfs ID#1
Q100=52cfs ID#5
Q100=114 cfs (Comb.) ID#7
Q100=64 cfs (Comb.) ID#4
Q100=31cfs ID#2
Q100=34 cfs ID#3
Comb. Q100=359cfs ID 15
PROP. CONC. CHANNEL
PROP. 12'x3' BOX CULVERT
53"x34" PIPE & DROP INLET
Q_D=50cfs
Prop. 8'x3' Box Culvert
Prop. 53"x34" Oval C.P. QD=54.8 cfs
Prop. 33" Pipe QD=26 cfs
Prop. Conc. Channel
Sta 128+79
Exist. 2-12'x3' RBC's
Exist. 10'x3' Box Culvert
SHEA BOULEVARD
E APPALOOSA TRAIL
N. 84th STREET
N. 85th STREET
PARADISE PARK TRAILS II
DRAINAGE DESIGN REPORT
SHEA BLVD.
PROPOSED DRAINAGE IMPROVEMENTS
Sta. 128+79 to 85th PL.
FIGURE B-1

THIS RUN EXECUTED 01-01-80

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
```

```
C
T1      Shea Blvd. Channel Backwater Analysis          <Shea.hc8>
T2      From Clinton St to Arabian Tr near 82nd PL.,July,1987 revised Feb,1988
T3      Shea Blvd Channel              Q(100)=359 cfs

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        2.        0.        0.   .004000       .00       .0      359.    54.600      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

    -1.000      .000    -1.000      .000      .000      .000      .000      .000      .000      .000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    38.000    43.000     1.000     2.000    26.000    39.000    21.000    22.000    27.000    28.000

    53.000    54.000      .000    38.000    13.000    14.000    15.000    55.000    26.000    56.000

    63.000     1.000    51.000     4.000    42.000    57.000      .000    38.000    39.000    33.000

     3.000    10.000    11.000    12.000     5.000     7.000     8.000    16.000    17.000    18.000

J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********

   -10.000   -10.000      .000      .000      .000      .000      .000      .000      .000      .000

NC      .030      .030      .030      .100      .300      .000      .000      .000      .000      .000
X1     1.000     9.000    16.500    68.000      .000      .000      .000      .000      .000      .000
GR    60.800      .000    56.800      .100    55.800    16.500    52.700    32.000    52.000    38.000
GR    52.500    42.000    56.000    68.000    57.000   103.000    61.000   103.100      .000      .000

X1     2.000     9.000    16.500    68.000    50.000    50.000    50.000      .000      .000      .000
GR    61.000      .000    57.000      .100    56.000    16.500    52.900    32.000    52.200    38.000
GR    52.700    42.000    56.200    68.000    57.200   103.000    61.200   103.100      .000      .000

NC      .000      .000      .016      .000      .000      .000      .000      .000      .000      .000
X1     3.000     8.000    30.000    73.000    59.000    40.000    50.000      .000      .000      .000
GR    61.000      .000    57.000      .100    56.400    30.000    52.500    44.000    52.000    54.000
GR    56.500    73.000    57.000   109.000    61.000   109.100      .000      .000      .000      .000
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SB      .000    1.560    2.630  155.000   10.000     .000   30.000     .000   52.300   52.000
X1     4.000     .000     .000     .000   75.000   75.000   75.000     .000     .300     .000
X2      .000     .000    1.000   55.300   57.000     .000     .000     .000     .000     .000

X1     5.000    9.000   20.000   81.000   94.000   64.000   43.000     .000     .000     .000
GR    60.100     .000   56.100     .100   55.700   20.000   53.400   41.000   53.300   56.000
GR    53.700   61.000   56.200   81.000   56.400  102.000   60.400  102.100     .000     .000

NC      .000     .000     .030     .100     .300     .000     .000     .000     .000     .000
X1     6.000    7.000     .100   63.000  100.000  100.000  100.000     .000     .000     .000
GR    61.100     .000   57.100     .100   53.900   23.000   53.900   43.000   56.200   63.000
GR    56.400   81.000   60.400   81.100     .000     .000     .000     .000     .000     .000

X1     7.000    8.000     .100   62.000  100.000  100.000  100.000     .000     .000     .000
GR    60.700     .000   56.700     .100   54.600   21.000   54.100   37.000   54.500   42.000
GR    56.200   62.000   56.600   81.000   60.600   81.100     .000     .000     .000     .000

X1     8.000    8.000     .100   65.000  100.000  100.000  100.000     .000     .000     .000
GR    60.200     .000   56.200     .100   55.100   19.000   54.600   38.000   54.900   44.000
GR    56.200   65.000   56.600   82.000   60.600   82.100     .000     .000     .000     .000

X1     9.000    8.000    6.000   58.000   46.000   46.000   46.000     .000     .000     .000
GR    58.000     .000   57.300    6.000   54.800   29.000   54.200   40.000   54.300   48.000
GR    56.000   58.000   56.900   83.000   60.900   83.100     .000     .000     .000     .000

X1    10.000    8.000    8.000   59.000    2.000   37.000   20.000     .000     .000     .000
GR    58.000     .000   57.300    8.000   54.700   31.000   54.300   45.000   54.600   53.000
GR    55.400   59.000   57.200   95.000   61.400   95.100     .000     .000     .000     .000

NC      .000     .000     .016     .300     .500     .000     .000     .000     .000     .000
X1    10.100    9.000   65.000   89.400   28.000   28.000   28.000     .000     .000     .000
X2      .000     .000     .000   57.450   59.550     .000     .000     .000     .000     .000
GR    59.750     .000   59.550   65.000   54.450   65.100   54.450   77.100   57.450   77.200
GR    54.450   77.300   54.450   89.300   59.450   89.400   58.550  150.000     .000     .000

X1    10.200   10.000     .000  165.000  110.000  110.000  110.000     .000     .000     .000
X2      .000     .000     .000   57.770   59.550     .000     .000     .000     .000     .000
GR    59.850     .000   59.600  101.000   54.770  101.100   54.770  113.100   57.770  113.200
GR    57.770  113.600   54.770  113.700   54.770  125.700   59.550  125.800   59.450  165.000

QT     1.000  240.000     .000     .000     .000     .000     .000     .000     .000     .000
       Begin Main Wash Concrete Channel North. Bottom width,8 feet. Decrease
       Design 100 Year Discharge to 240 cfs.
X1    10.210    4.000  990.400 1009.600   26.000   26.000   26.000     .000     .000     .000
GR    58.560  990.400   54.860  996.000   54.860 1004.000   58.660 1009.600     .000     .000

NC      .016     .016     .016     .100     .300     .000     .000     .000     .000     .000
X1    10.220     .000     .000     .000     .000     .000   50.000     .000     .150     .000
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X1	10.230	.000	.000	.000	.000	.000	100.000	.000	.300	.000
X1	10.240	.000	.000	.000	.000	.000	170.000	.000	.510	.000
X1	10.250	.000	.000	.000	.000	.000	39.300	.000	.120	.000
X1	10.260	.000	.000	.000	.000	.000	106.000	.000	.320	.000
X1	10.270	.000	.000	.000	.000	.000	80.700	.000	.240	.000
	Begin 12 Foot by 3 Foot Box Culvert Under 82nd Place									
X1	10.280	4.000	994.000	1006.000	.000	.000	3.500	.000	.000	.000
X2	.000	.000	.000	59.500	60.250	.000	.000	.000	.000	.000
GR	60.500	994.000	56.500	994.000	56.500	1006.000	60.500	1006.000	.000	.000
	End Box Culvert									
X1	10.290	.000	.000	.000	.000	.000	55.000	.000	.170	.000
X2	.000	.000	.000	59.670	60.420	.000	.000	.000	.000	.000
X1	10.300	4.000	989.500	1010.500	.000	.000	5.000	.000	.000	.000
GR	60.600	989.500	56.750	989.500	56.750	1010.500	60.600	1010.500	.000	.000
	End Drop Inlet To Box Culvert and Transition to Existing Main Wash									
X1	10.310	4.000	989.500	1010.500	.000	.000	1.000	.000	.000	.000
GR	60.600	989.500	59.250	991.500	59.250	1008.500	60.600	1010.500	.000	.000
NH	3.000	.035	1095.000	.016	1120.000	.035	1260.000	.000	.000	.000
X1	14.000	17.000	992.000	1002.000	150.000	150.000	155.000	.000	.000	.000
GR	64.000	780.000	63.000	875.000	66.000	875.000	66.000	960.000	62.400	960.000
GR	62.000	992.000	60.800	996.000	60.800	998.000	62.000	1002.000	62.100	1095.000
GR	62.100	1120.000	62.000	1140.000	61.700	1170.000	61.700	1195.000	62.000	1225.000
GR	62.300	1260.000	66.000	1260.000	.000	.000	.000	.000	.000	.000
NH	3.000	.035	1205.000	.016	1235.000	.035	1390.000	.000	.000	.000
X1	15.000	20.000	996.000	1006.000	165.000	165.000	190.000	.000	.000	.000
GR	65.000	775.000	65.000	795.000	66.000	795.000	66.000	940.000	64.000	940.000
GR	64.000	990.000	62.000	996.000	61.200	998.000	61.200	1000.000	62.000	1006.000
GR	63.200	1040.000	66.000	1040.000	66.000	1140.000	63.200	1140.000	63.100	1205.000
GR	63.100	1235.000	63.500	1320.000	66.000	1320.000	66.000	1390.000	64.000	1390.000
NH	2.000	.016	790.000	.035	1280.000	.000	.000	.000	.000	.000
	End Existing Main Wash									
X1	16.000	19.000	995.000	1010.000	200.000	200.000	200.000	.000	.000	.000
GR	66.000	750.000	65.600	768.000	65.600	790.000	65.100	836.000	69.000	836.000
GR	69.000	960.000	64.300	960.000	64.000	995.000	62.300	998.000	62.300	1000.000
GR	64.000	1010.000	64.400	1070.000	64.000	1110.000	64.200	1130.000	69.000	1130.000
GR	69.000	1220.000	64.400	1220.000	64.600	1280.000	69.000	1280.000	.000	.000

52cfs And Analyse Middle Trib. Surface Flow

XI	12.100	24.000	995.000	1003.000	165.000	140.000	225.000	.000	.000	.000
GR	61.000	500.000	60.000	560.000	59.300	620.000	59.500	690.000	66.000	690.000
GR	66.000	760.000	59.600	760.000	60.000	805.000	66.000	805.000	66.000	900.000
GR	60.200	900.000	60.200	926.000	60.300	938.000	60.500	950.000	60.300	965.000
GR	60.000	995.000	58.000	998.000	58.000	1000.000	59.800	1003.000	59.900	1018.000
GR	66.000	1018.000	66.000	1150.000	60.000	1150.000	60.000	1200.000	.000	.000
QT	1.000	52.000	.000	.000	.000	.000	.000	.000	.000	.000
ET	.000	7.100	.000	.000	.000	.000	480.000	830.000	.000	.000
NH	4.000	.016	394.000	.035	970.000	.016	1040.000	.035	1300.000	.000
XI	13.000	25.000	1000.000	1040.000	160.000	160.000	190.000	.000	.000	.000
GR	61.400	346.000	61.400	347.000	61.400	348.000	61.400	350.000	61.000	378.000
GR	60.500	394.000	61.000	400.000	61.200	420.000	66.000	420.000	66.000	532.000
GR	60.000	532.000	59.800	550.000	60.000	570.000	60.300	620.000	60.200	720.000
GR	62.000	830.000	61.000	970.000	60.500	1000.000	60.500	1040.000	61.000	1050.000
GR	61.200	1110.000	66.000	1110.000	66.000	1210.000	61.800	1210.000	62.000	1300.000
ET	.000	7.100	.000	.000	.000	.000	400.000	780.000	.000	.000
NH	4.000	.016	210.000	.035	1095.000	.016	1120.000	.035	1260.000	.000

End Middle Trib. Analysis.

XI	14.000	37.000	992.000	1002.000	150.000	150.000	155.000	.000	.000	.000
GR	61.900	161.000	61.900	162.000	61.900	163.000	61.900	164.000	61.900	165.000
GR	61.500	210.000	61.800	267.000	66.000	267.000	66.000	333.000	61.800	333.000
GR	61.800	428.000	61.300	483.000	61.900	528.000	66.000	528.000	66.000	635.000
GR	62.000	635.000	62.000	680.000	62.000	690.000	62.300	715.000	66.000	715.000
GR	64.000	780.000	63.000	875.000	66.000	875.000	66.000	960.000	62.400	960.000
GR	62.000	992.000	60.800	996.000	60.800	998.000	62.000	1002.000	62.100	1095.000
GR	62.100	1120.000	62.000	1140.000	61.700	1170.000	61.700	1195.000	62.000	1225.000
GR	62.300	1260.000	66.000	1260.000	.000	.000	.000	.000	.000	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

THIS RUN EXECUTED 01-01-80

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  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

Shea Blvd Channel

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	VCH	XLCH	STCHL	STCHR	STENCL	STENCR	SSTA	ENDST
	1.000	359.00	55.37	.00	4.53	.00	16.50	68.00	.00	.00	18.63	63.36
	2.000	359.00	55.57	.00	4.54	50.00	16.50	68.00	.00	.00	18.63	63.34
	3.000	359.00	55.66	.00	4.46	50.00	30.00	73.00	.00	.00	32.64	69.47
	4.000	359.00	57.30	.00	2.61	75.00	30.00	73.00	.00	.00	.10	109.00
	5.000	359.00	57.37	.00	1.77	43.00	20.00	81.00	.00	.00	.07	102.02
	6.000	359.00	57.38	.00	2.11	100.00	.10	63.00	.00	.00	.09	81.02
	7.000	359.00	57.43	.00	2.32	100.00	.10	62.00	.00	.00	.06	81.02
	8.000	359.00	57.50	.00	2.33	100.00	.10	65.00	.00	.00	.07	82.02
	9.000	359.00	57.53	.00	2.67	46.00	6.00	58.00	.00	.00	3.97	83.02
	10.000	359.00	57.57	.00	2.39	20.00	8.00	59.00	.00	.00	4.88	95.01
	10.100	359.00	57.46	.00	4.95	28.00	65.00	89.40	.00	.00	65.04	89.36
	10.200	359.00	57.62	.00	5.22	110.00	.00	165.00	.00	.00	101.04	125.76
*	10.210	240.00	57.42	57.42	7.94	26.00	990.40	1009.60	.00	.00	992.13	1007.77
	10.220	240.00	57.73	.00	7.33	50.00	990.40	1009.60	.00	.00	991.89	1008.00
	10.230	240.00	58.00	.00	7.40	100.00	990.40	1009.60	.00	.00	991.92	1007.97
	10.240	240.00	58.46	.00	7.61	170.00	990.40	1009.60	.00	.00	992.00	1007.89
	10.250	240.00	58.60	.00	7.56	39.30	990.40	1009.60	.00	.00	991.98	1007.91

	SECNO	Q	CWSEL	CRIWS	VCH	XLCH	STCHL	STCHR	STENCL	STENCR	SSTA	ENDST
	10.260	240.00	58.94	.00	7.44	106.00	990.40	1009.60	.00	.00	991.94	1007.96
	10.270	240.00	59.16	.00	7.50	80.70	990.40	1009.60	.00	.00	991.96	1007.93
	10.280	240.00	59.17	.00	7.50	3.50	994.00	1006.00	.00	.00	994.00	1006.00
	10.290	240.00	59.33	.00	7.52	55.00	994.00	1006.00	.00	.00	994.00	1006.00
	10.300	240.00	60.10	.00	3.41	5.00	989.50	1010.50	.00	.00	989.50	1010.50
*	10.310	240.00	60.97	60.97	7.20	1.00	989.50	1010.50	.00	.00	989.50	1010.50
	14.000	240.00	62.40	62.29	3.07	155.00	992.00	1002.00	.00	.00	960.00	1260.00
*	15.000	240.00	63.42	63.42	4.82	190.00	996.00	1006.00	.00	.00	991.75	1302.56
	16.000	240.00	64.61	.00	4.35	200.00	995.00	1010.00	.00	.00	960.00	1280.00
	-10.200	359.00	57.62	.00	5.22	110.00	.00	165.00	.00	.00	101.04	125.76
	10.500	114.00	58.02	.00	2.87	20.00	.00	20.00	.00	.00	1.69	18.31
	10.600	114.00	58.07	.00	3.15	166.00	.00	20.00	.00	.00	1.98	18.02
	10.700	114.00	57.97	.00	4.92	17.00	.00	8.20	.00	.00	.02	8.18
	10.800	114.00	58.10	.00	4.70	68.00	.00	8.20	.00	.00	.02	8.18
	10.900	2.00	58.55	.00	.12	6.00	.00	19.00	.00	.00	.00	18.05
*	11.000	2.00	58.56	58.56	.00	190.00	992.00	1002.00	640.00	735.00	649.13	673.25
*	12.100	52.00	59.62	59.62	.00	225.00	995.00	1003.00	555.00	900.00	592.18	762.76
	13.000	52.00	60.45	.00	.00	190.00	1000.00	1040.00	480.00	830.00	532.00	735.81
*	14.000	52.00	61.75	61.75	.00	155.00	992.00	1002.00	400.00	780.00	433.00	517.09

	SECND	QLOB	QCH	QROB	VLOB	VCH	VROB	TELMX	CWSEL	DIFWSX	TOPWID	ELMIN	ALPHA
*	15.000	7.38	91.45	141.17	2.45	4.82	2.16	64.00	63.42	1.02	210.81	61.20	1.56
	16.000	32.35	103.27	104.39	1.97	4.35	1.76	66.00	64.61	1.19	230.00	62.30	1.72
	-10.200	.00	359.00	.00	.00	5.22	.00	59.45	57.62	-6.99	24.31	54.77	1.00
	10.500	.00	114.00	.00	.00	2.87	.00	59.30	58.02	.40	16.61	54.80	1.00
	10.600	.00	114.00	.00	.00	3.15	.00	59.55	58.07	.05	16.04	55.05	1.00
	10.700	.00	114.00	.00	.00	4.92	.00	58.85	57.97	-.10	8.15	55.10	1.00
	10.800	.00	114.00	.00	.00	4.70	.00	58.85	58.10	.13	8.16	55.10	1.00
	10.900	.00	2.00	.00	.00	.12	.00	59.50	58.55	.45	18.05	57.50	1.00
*	11.000	2.00	.00	.00	1.40	.00	.00	59.00	58.56	.02	24.11	58.50	1.00
*	12.100	52.00	.00	.00	2.57	.00	.00	60.00	59.62	1.06	100.58	59.30	1.00
	13.000	52.00	.00	.00	.87	.00	.00	62.00	60.45	.83	203.81	59.80	1.00
*	14.000	52.00	.00	.00	2.72	.00	.00	66.00	61.75	1.30	84.09	61.30	1.00

Project: Shea Boulevard – Scottsdale Road to Pima Road
Location: 82ND Place to 85TH Place
Date 2/3/88 GAS

STORM SEWER LINE AND LOCATION	PIPE DIA. (in.)	REACH LENGTH (ft.)	SLOPE OF REACH (ft./ft.)	INVERT ELEV. (ft.)	DESIGN DISCHARGE (cfs)	FULL PIPE DISCHARGE (cfs)	DEPTH OF FLOW (ft.)	ACTUAL VELOCITY (fps)	ACTUAL VELOCITY HEAD (fps)	HEAD LOSSES FRICTION H_f (ft.)	HEAD LOSSES SHOCK OR FORM ΔH (ft.)	SLOPE OF ENERGY GRADE (ft./ft.)	GRADE LINE ELEV. ENERGY	GRADE LINE ELEV. HYDRAULIC	REMARKS
Sta 131+62, 55' Lt.	53"x34"			55.35	58.8	57.75	Full	5.66	0.50				58.55	58.05	Hyd. Grade at Sec. 10.8 from
Sta 131+79, 38' Lt	"	24	0.0025	55.41	58.8	57.75	Full	5.66	0.50	0.06	Bend 0.1 Hv = 0.05		58.66	58.16	HEC-2 Results (Report)
Sta 141+76 38' Lt	"	100 2	0.0025	57.93	58.8	57.75	Full	5.66	0.50	2.56			61.22	60.72	
Manhole Sta 142+60, 38' Lt	"	79	0.0029	58.13	42.3	57.75	Full	4.15	0.28	0.11			61.33	61.05	
Manhole Sta. 142+60, 38' Lt	33"	—	—	58.21	26.0	28.6	Full	4.38	0.30		MH Loss 0.2 Hv = 0.06		61.39	61.09	
85TH Place	33"	831	0.0025	60.29	26.0	28.6	Full	4.38	0.30	1.71			63.10	62.80	
Sta 142+80 38' Lt	15"	—	—	59.71	4.3	3.1	Full	3.5	0.19	—	MH Loss 0.2 Hv = 0.06		61.39	61.2	
Sta 142+80 45' Rt	15"	84	0.002	59.88	4.3	3.1	Full	3.5	0.19	0.31	Ent. Loss 0.2 Hv = 0.04		61.74	61.55	Gutter El. = 62.7±
Sta 141+76, 38' Lt	24"	—	—	58.35	16	25.68	Full	5.09	0.40		MH Loss 0.2 Hv = 0.08		61.30	60.9	
Sta 141+89, 72' Lt Catch Basin	24"	35	0.006	58.53	16	25.68	Full	5.09	0.40	0.15	Ent. Loss 0.2 Hv = 0.06		61.51	61.1	Gutter El. = 62.8±
Sta 141+89, 72' Lt	18"	—	—	58.63	8	6.2	Full	4.5	0.31		MH Loss 0.2 Hv = 0.08		61.59	61.28	
Sta 142+30 73.5' Lt Catch Basin	18"	40	0.003	58.75	8	6.2	Full	4.5	0.31	0.19	Ent. Loss 0.2 Hv = 0.06		61.84	61.53	Gutter El. = 62.8±
Sta 142+60, 38' Lt	24"	—	—	58.86	12.5	N/c	Full	3.98	0.25		MH Loss 0.2 Hv = 0.06		61.39		
Sta 142+60, 43' Lt	24"	6	0.16	59.06	12.5	N/c	Full	3.98	0.25	0.02	Ent. Loss 0.2 Hv = 0.05		61.46	61.21	Gutter El. = 62.7±
	24	—	—	61.04	16.0		Full	4.77	0.35		MH Loss 0.2 Hv = 0.06		63.16		
Sta 160+92, 72.5' Lt Catch Basin	24	35	0.005	61.22	15.0		Full	4.77	0.35	0.13	Ent. Loss 0.2 Hv = 0.07		63.36	63.01	Gutter El. = 65.0±
Sta 160+92, 72.5' Lt	18"	—	—	61.32	7.5		Full				MH Loss 0.2 Hv = 0.07		63.43		
Sta 161+24, 73.5' Lt Catch Basin	18	32	0.003	61.42	7.5		Full	4.24	0.28	0.14	Ent. Loss 0.2 Hv = 0.06		63.63	63.35	Gutter El. = 65.0±
	24"	—	—	61.04	11		Full	3.5	0.19		MH Loss 0.2 Hv = 0.06		63.16		
Sta. 161+53.5, 45' Lt Catch B.	24"	62	0.003	61.23	11		Full	3.5	0.19	0.12	Ent. Loss 0.2 Hv = 0.04		63.32	63.15	Gutter El. = 64.7±
Sta	53"x34"	—	—	55.39	52										
Sta 132+63.25 59' Lt Drop Inlet	53"x34"	96	0.0015	55.53	52										

$n = 0.012$ (Concrete Pipe)

$$H_f = \frac{29\,(n)^2\,L}{R^{1.33}} \times H_v$$

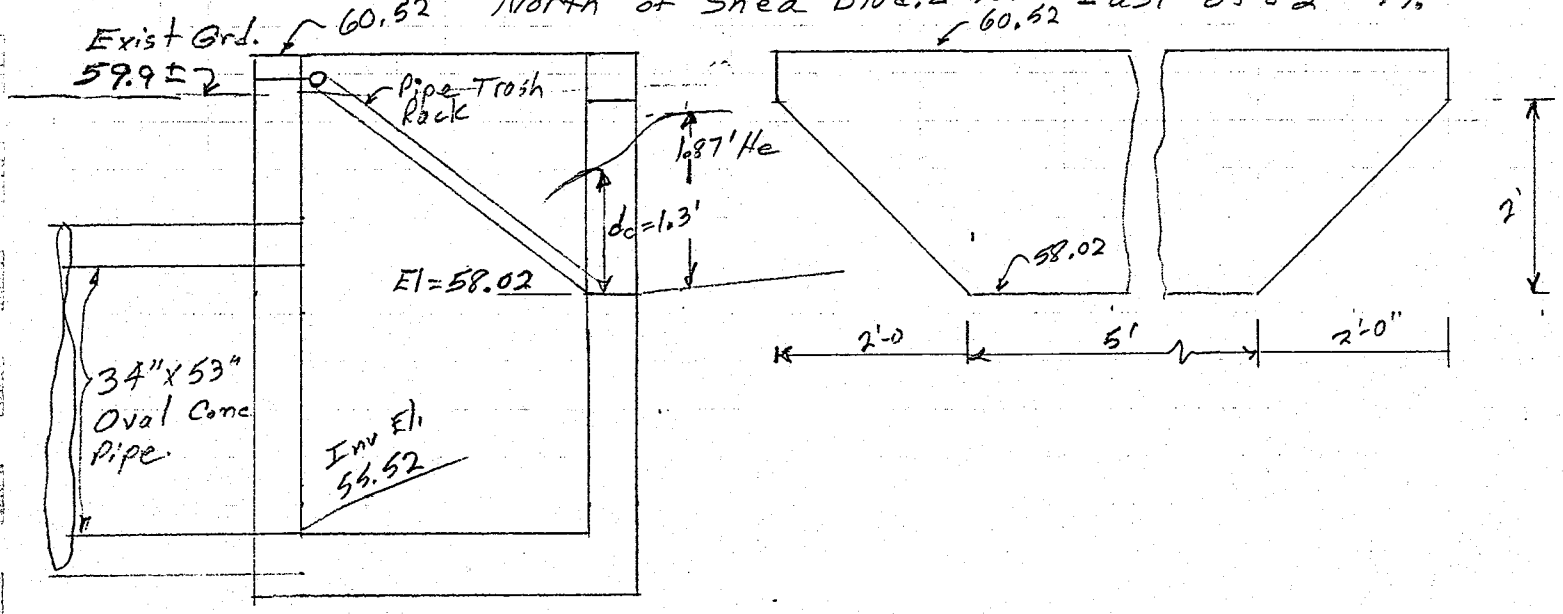
Project: Shea Boulevard - Scottsdale Road to Pima Road
Location: 82ND Place to 85TH Place
Date 2/3/88 GAS

STORM SEWER LINE AND LOCATION	PIPE DIA. (in.)	REACH LENGTH (ft.)	SLOPE OF REACH (ft./ft.)	INVERT ELEV. (ft.)	DESIGN DISCHARGE (cfs)	FULL PIPE DISCHARGE (cfs)	DEPTH OF FLOW (ft.)	ACTUAL VELOCITY (fps)	ACTUAL VELOCITY HEAD (fps)	HEAD LOSSES FRICTION H_f (ft.)	HEAD LOSSES SHOCK OR FORM ΔH (ft.)	SLOPE OF ENERGY GRADE (ft./ft.)	GRADE LINE ELEV. ENERGY	GRADE LINE ELEV. HYDRAULIC	REMARKS
Sta 131+67.25, 59'Lt.	53"x34	—	—	55.39	57.1	44.7	Full	5.6	0.49	—			58.54	58.05	Hyd Grade El. = 58.05 for
Sta 131+75.25, 59'Lt	53"x34	8	0.0015	55.40	57.1	44.7	Full	5.6	0.49	0.02			58.56		Sec 10.8 from HEC-2 (Report)
Sta 132+63.25, 59'Lt	53x34	88	0.0015	55.53	50	44.7	Full	4.9	0.37	0.16			58.72	58.35	depth = 2.82' Drop Inlet
Drop Inlet															Invert = 58.03
Sta 131+75.25 59'Lt	24	—	—	55.78	7.1	N/c	Full	2.26	0.08				58.56		
Sta. 131+83.0 45'Lt.	24	10	0.049	56.27	7.1	N/c	Full	2.26	0.08	0.01			58.57	58.49	Gutter El. = 59.8±

AN WEST INC.
Consulting Engineers
Richmond, California
San Jose, California
Phoenix, Arizona

Proj. No. _____ Sht. ___ of ___
Shea Blvd. Calc. By GAS Date 2/2/88
Chkd. By _____ Date _____

Hydraulic Calculations - Drop Inlet
North of Shea Blvd. & 100'± East of 82ND Pl.



Q_{100} Design Drop Inlet = 50 cfs

By Eqn 4-20 Chow's Open Channel Hydraulics
Critical Discharge eqn for trapezoidal Sections
is $Q_c = \dfrac{5.67[(b+zy)y]^{1.5}}{(b+2zy)^{0.5}}$ let $b = 5'$, $z = 1:1$

For $y = 1.3'$ $Q_c = 48.2 \simeq 50$ cfs (∴ OK)
$V_c = 6.1$ $H_{V_c} = 0.57'$ Energy Head $= d_c + H_{V_c}$
$= 1.3' + 0.57'$
$= 1.87'$

By HEC-5 Manual Inlet Control
For 34" x 53" Oval Conc. Pipe $Q_D = 50$ cfs
$HW/D = 0.96$ for Grove End with Headwall Entrance Type
$HW = 0.96 \times 34/12 = 2.72$ feet HW El = 58.24

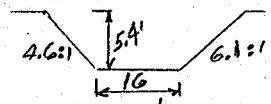
By Outlet Control Pipe Calculation (Appendix B, P B-24)
Energy Grade in Drop Inlet is 58.72

Therefore no significant hydraulic backwater on inlet weir

PROJECT: Shea Blvd Sta 164+39 EXISTING CAPACITY DESIGNER: GAS

DATE: 8/6/87

HYDROLOGIC AND CHANNEL INFORMATION



S = 0.0321 '/FT
n = 0.032

For d_n = 2.5'
Q = 220 cfs
V = 3.0 fps

For d = 2.3
Q = 185 cfs
V = 2.9 fps

X-Section Earth/Gross Channel
280' Downstream

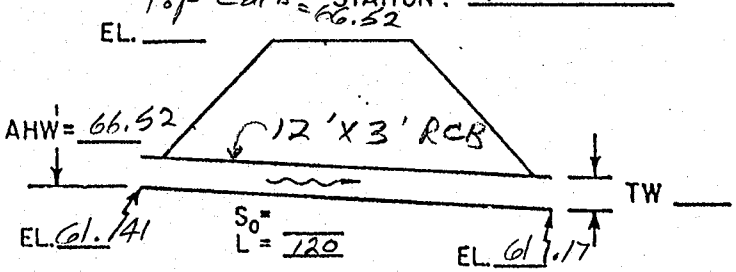
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 164+39



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Wingwalls	185	12x3	1.05	3.15	0.2	.65	1.92	2.5	2.3	2.5	0.24	2.9	3.15			Inlet Control Highwater El = 64.56
																No Flow Over Curb
Crown rounded Wingwalls	* 252	12x3	1.33	4.0	0.2	1.2	2.35	2.67	2.6	2.67	0.24	3.63	4.0			Inlet Control Highwater El = 65.41

SUMMARY & RECOMMENDATIONS:

* Check of original Q_{100} at this location from 1982 report (Reference 1)

B-27

Appendix C

REPORT ON HAYDEN
ROADWAY DRAINAGE
SHEA BOULEVARD TO CACTUS ROAD

SCOTTSDALE, ARIZONA

PROJECT: 106-2a

Registered Professional Engineer (Civil)
CERTIFICATE EXPIRES
ROLF
ERIKSON
DEC. 31, 19
ARIZONA U.S.A.

ERIKSON & SALMON, INC.
2801 North 24th Street
Phoenix, Arizona 85008

June 27, 1980

C-1

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PROCEDURES.....6

CONCLUSIONS AND RESULTS.....8

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Alternate "A-1".....11
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Alternate "D".....15

RECOMMENDATIONS.....15

APPENDIX I

Drainage Area Map

APPENDIX II

Hydrologic Computations

APPENDIX III

Aerial Photograph (February 17, 1949) Showing Natural Runoff Patterns Before Development of Brusally Ranch
Aerial Photograph (January 26, 1954) Showing Runoff Patterns Immediately After Development of Brusally Ranch

APPENDIX IV

Runoff Rates (Existing Conditions) 10-Year Event
Runoff Rates (Existing Conditions) 25-Year Event
Runoff Rates (Existing Conditions) 100-Year Event (In Enclosure Inside Back Cover)

APPENDIX V

Plan and Profile Alternate "A" (In Enclosure Inside Back Cover)
Plan and Profile Alternate "A-1" (In Enclosure Inside Back Cover)
Plan and Profile Alternate "B" (In Enclosure Inside Back Cover)
Plan Alternate "C"
Plan Alternate "D"

APPENDIX VI

Costs Summaries Alternates "A", "A-1", "B", "C", and "D"

APPENDIX VII

Box Culvert Hydraulic Computations for Alternates "A", "A-1", "B", and "D"
Hydrograph for Alternate "D" Detention Basin

APPENDIX VIII

Channel Cross-Sections Alternates "A", "A-1", and "B", Sta. 0+72 to 9+50
Channel Cross-Sections Alternate "A", Sta. 14+73 to 27+06
Channel Cross-Sections Alternate "A-1", Sta. 24+40 to 27+06
Channel Cross-Sections Alternate "B", Sta. 14+56 to 27+06

BIBLIOGRAPHY

PROCEDURES

In order to determine the runoff rates for the 10-, 25-, and 100-year events, the areas of the various watersheds were delineated on the conventional 1" = 2000' U.S.G.S. Quadrangle Maps of Paradise Valley, Sawick Mountain, Curry's Corner, and McDowell Mountains. The areas were also verified by field inspection and examination of 1" = 400' scale City of Scottsdale aerial photographs.

The hydrology (computations, Appendix II) for the watershed areas under study was developed on the basis of current Arizona Department of Transportation (ADOT) standards and procedures. Specifically, Soil Conservation Service (SCS) procedures were adopted, since the watersheds were all over 0.10 square mile in area. In the case of Areas "1" and "3", Part II of the ADOT version of SCS procedure was used, since these were small, and the length/width ratio was at or beyond the "upper confidence limit" (meaning that these computationally function as long and narrow drainage areas). For the purposes of developing peak discharges, Part I of the ADOT version of SCS procedure was used for Area "2", since its length/width ratio was about average (i.e., the watershed functions as an average drainage area). However, in order to develop storage capacity for one of the drainage solutions (i.e., Alternate "D") discussed later in this report, Part II was also used for Area "2", since Part I will not give an accurate representation of the total volume of storm runoff.

Although the soils over the watershed could be classified as Type "B", according to the "General Soil Map - Maricopa County, Arizona" (see Bibliography), the more conservative ADOT classification of Type "C" was adopted for estimating runoff (page 44a of their "Hydrologic Design for Highway Drainage in Arizona" - see Bibliography).

Type C Soil assumed

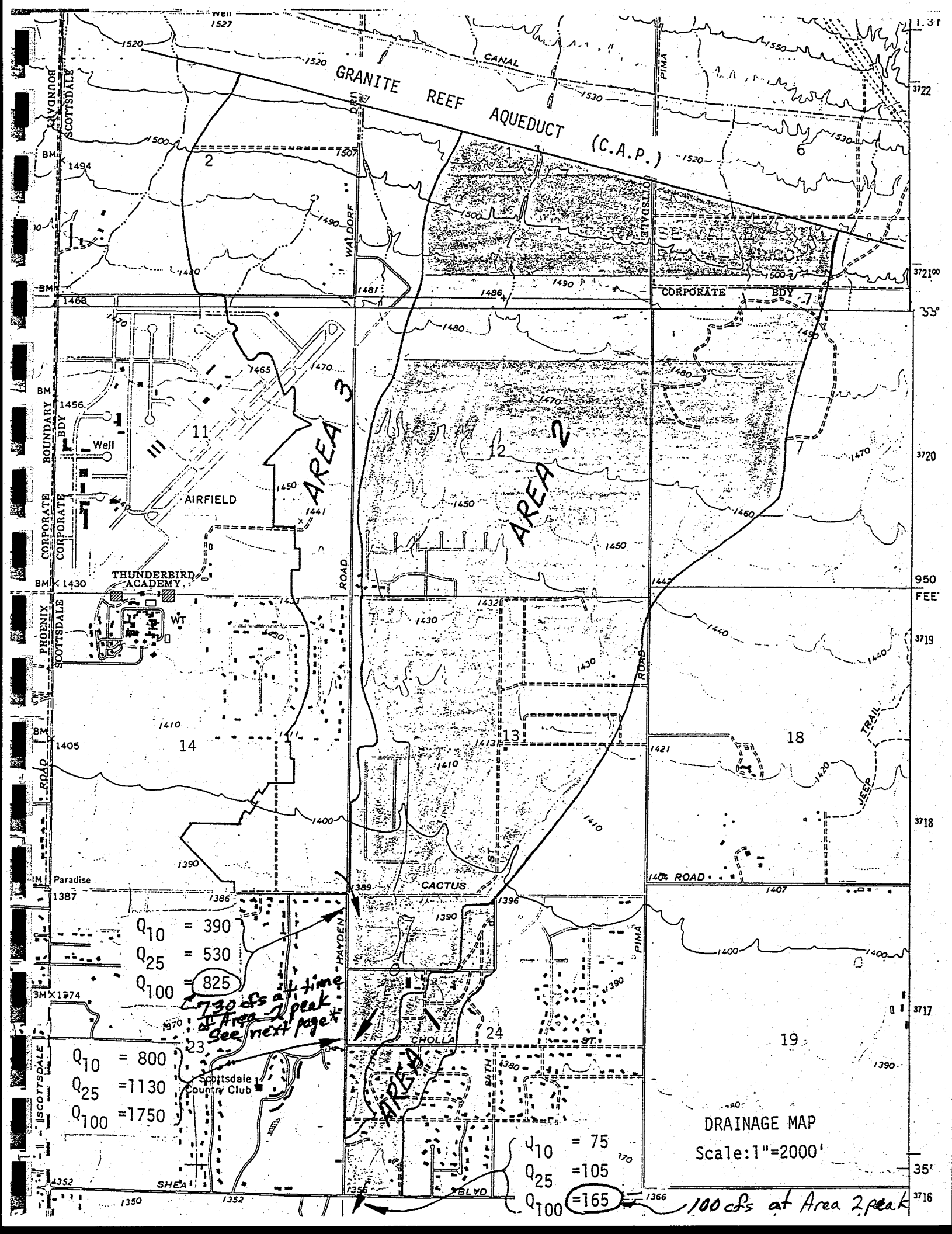
While Type "C" soils with desert brush of 10% density would yield a SCS curve number of 89, this was increased to 90 to provide, within the watersheds, for future developments which could be expected ultimately to create impervious surfaces amounting to 20% of the total area.

The precipitation rates used in the development of the various runoff rates were those given for the Phoenix Weather Bureau Office on page 37 of "Estimated Return Periods for Short Duration Precipitation in Arizona" (Technical Memorandum WBTM WR-44, U.S. Department of Commerce, Environmental Services Administration, October, 1969).

The time of concentration for each portion of the watershed was determined by the average slope, as represented in the middle 1/3 of the respective areas in the aformentioned 1" = 2000' scale topographic maps.

The water surface elevations created by the 10-, 25-, and 100-year events were computed by means of the standard-step backwater method through use of a Monroe 1880 computer. Cross-sections of the existing conditions were those from various surveys of Collar, Williams & White Engineering Inc. of Scottsdale, Arizona. Generally, these were used with no editing - with the following exceptions:

1. The elevations for the cross-sections taken in the main channel at Desert Cove and Cholla Street were found, after a field check by City of Scottsdale surveying crews, to be one foot lower than the datum used along Hayden Road. All survey cross-sectional elevations in the main


GRANITE REEF AQUEDUCT (C.A.P.)
CANAL
CORPORATE BDY
AIRFIELD
THUNDERBIRD ACADEMY
Well
WT
AREA 3
AREA 2
AREA 1
WALDORF
ROAD
HAYDEN
PIMA
CACTUS
CHOLLA
ST.
140th ROAD
JEEP TRAIL
Paradise
Scottsdale Country Club
SHEA
BLVD
SCOTTSDALE
PHOENIX
BOUNDARY
Q_{10} = 390
Q_{25} = 530
Q_{100} = 825
730 cfs at time of Area 2 peak
See next page
Q_{10} = 800
Q_{25} = 1130
Q_{100} = 1750
Q_{10} = 75
Q_{25} = 105
Q_{100} = 165
100 cfs at Area 2 peak
DRAINAGE MAP
Scale: 1"=2000'

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET
SCS METHOD: PART II

LOCATION DATA:

Highway Hayden Road County Maricopa
Location Shea Boulevard
Project No. _____ Station 250' East of Hayden
Name of Stream AREA 1

DESIGN DATA:

Design Frequency	10/25/100	years
Drainage Area	0.18	square miles
Drainage Length	5800	feet
Elevation		
Top of Drainage area	1396	feet
At Structure	1353	feet
Drainage Area Slope	0.75	%
Vegetative Cover Type	Desert Brush	
Vegetative Cover Density	10	%
Soil Group	C	
Precipitation		
P = 6 hour =	2.07/2.57/3.35	inches
P = 24 hour =	2.53/3.12/4.04	inches

$L/W = \frac{5800}{865} = 6.7$

DESIGN COMPUTATION:

Curve Number	90 (Future development)	
Time of Concentration	0.67	hours
Peak Design Discharge	1.65 (at Area 2 peak)	
$Qp = \frac{484AQ}{\frac{D}{2} + .6Tc} =$	$\frac{87.12Q}{D/2 + 0.40}$	cfs

$\frac{87.12Q}{D/2 + 0.99}$ (at Area 2 peak)

Storm Duration	Point Precipitation	Areal Reduction	Areal Precipitation	Direct Runoff	Peak Discharge
30 min	1.27/1.60/2.10		1.27/1.60/2.10	0.50/0.79/1.18	67/106/158
1 hour	1.61/2.02/2.66		1.61/2.02/2.66	0.80/1.10/1.70	77/106/165 *
2 hour	1.72/2.15/2.82		1.72/2.15/2.82	0.86/1.22/1.82	54/76/113
3 hour	1.82/2.27/2.97		1.82/2.27/2.97	0.95/1.35/1.95	43/62/89
6 hour	2.07/2.57/3.35		2.07/2.57/3.35	1.15/1.60/2.30	29/41/59

*. 47/64/99 @ Area 2 peak

Computed by: RE Date March 1980

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET
SCS METHOD: PART II

LOCATION DATA:

Highway Hayden Road County Maricopa
Location 600' South of Shea
Project No. _____ Station _____
Name of Stream Area 1 — after Brusally development

DESIGN DATA:

Design Frequency	10/25/100	years
Drainage Area	0.10	square miles
Drainage Length	3000	feet
Elevation		$L/W = \frac{3000}{924} = 3.2$
Top of Drainage area	1376	feet
At Structure	1353	feet
Drainage Area Slope	0.75	%
Vegetative Cover Type	Desert Brush	
Vegetative Cover Density	10	%
Soil Group	C	
Precipitation		
P = 6 hour =	2.07/2.57/3.35	inches
P = 24 hour =	2.53/3.12/4.04	inches

DESIGN COMPUTATION:

Curve Number	90 (Future development)	
Time of Concentration	0.42	hours
Peak Design Discharge		
$Qp = \frac{484AQ}{\frac{D}{2} + .6Tc} =$	$\frac{48.4\,Q}{D/2 + 0.25}$	cfs

Storm Duration	Point Precipitation	Areal Reduction	Areal Precipitation	Direct Runoff	Peak Discharge
30 min	1.27/1.60/2.10		1.27/1.60/2.10	0.50/0.79/1.18	61/96/143
1 hour	1.61/2.02/2.66		1.61/2.02/2.66	0.80/1.10/1.70	52/71/110
2 hour					
3 hour					
6 hour					

Computed by: RE Date March 1980

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET

S C S METHOD: PART I

LOCATION DATA:

Highway Hayden Road County Maricopa
Location Cholla Street
Project No. _____ Station 103+00 & 26+56
Name of Stream AREA 2

DESIGN DATA:

Design Frequency	10/25/100	years
Drainage Area	2.92	square miles
Drainage Length	19000	feet
Elevation		
Top of Drainage Area	1510	feet
At Structure	1353	feet
Drainage Area Slope	0.8	%
Drainage Width	4200	feet
Width factor W_f	0.89	
Vegetative Cover Type	Desert Brush	
Vegetative Cover Density	10	%
Soil Group	C	
Precipitation		
P = 6 hour =	2.07/2.57/3.35	inches
P = 24 hour =	2.53/3.12/4.04	inches

DESIGN COMPUTATION:

Precipitation	P = 1 hour =	1.61/2.02/2.66	inches
Curve Number		90 (Future development)	
Runoff	Q =	0.77/1.10/1.70	inches
Time of Concentration	Tc	1.55	hours
Time of Peak	Tp = (Tc)(W_f)	1.38	hours
Peak Discharge	$Qp = \frac{484\,AQ}{Tp} =$	1024.12 Q	

(For Volume)
$Tp = D/2 + .6\,Tc$
$Tp = 0.5 + 0.93 = 1.43$

= 789/1127/1740 cfs

(use 800/1130/1750)

Computed by RE Date March 1980

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

HYDROLOGIC DESIGN DATA SHEET
SCS METHOD: PART II

LOCATION DATA:

Highway Hayden Road County Maricopa
Location Cactus Road
Project No. _____ Station 101+ (Hayden)
Name of Stream AREA 3

DESIGN DATA:

Design Frequency	10/25/100	years
Drainage Area	1.19	square miles
Drainage Length	14,000	feet
Elevation		
Top of Drainage area	1515	feet
At Structure	1389	feet
Drainage Area Slope	0.9	%
Vegetative Cover Type	Desert Brush	
Vegetative Cover Density	10	%
Soil Group	C	
Precipitation		
P = 6 hour =	2.07/2.57/3.35	inches
P = 24 hour =	2.53/3.12/4.04	inches

DESIGN COMPUTATION:

Curve Number	90 (Future development)	
Time of Concentration	1.15	hours
Peak Design Discharge	1.40 (@ Area 2 peak)	
$Qp = \frac{484AQ}{\frac{D}{2} + .6Tc} =$	$\frac{575.96\,Q}{D/2 + 0.69}$	cfs

$\frac{575.96\,Q}{D/2 + 0.84}$ (at Area 2 peak)

Storm Duration	Point Precipitation	Areal Reduction	Areal Precipitation	Direct Runoff	Peak Discharge
1 hour	1.61/2.02/2.66		1.61/2.02/2.66	0.80/1.10/1.70	387/532/823 *
2 hour	1.72/2.15/2.82		1.72/2.15/2.82	0.86/1.22/1.82	293/416/620
3 hour	1.82/2.27/2.97		1.82/2.27/2.97	0.95/1.35/1.95	249/355/513
6 hour	2.07/2.57/3.35		2.07/2.57/3.35	1.15/1.60/2.30	179/250/359

* 343/473/730 @ Area 2 peak

Computed by: RE Date March 1980

Appendix D

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

PAVEMENT DRAINAGE WORKSHEET

LOCATION DATA
Highway: Shea Boulevard
Location: Scottsdale Rd - Pima Rd.
Project No.: M-703-3 ( )

DESIGN DATA
Frequency: 100 years
P_6= 3.22 in. P_{24}= 4.0 in. P_1= 2.45 in.
T_{all} = 24' n = 0.015

RUNOFF CALCULATIONS West Bound - North Side Curb Height = 6"

From Station	To Station	L ft.	W ft.	D.A. acr.	C	T_c min.	I in/hr	Q cfs	Q_c cfs	Q_T cfs	S_o ft/ft	S_x ft/ft	z/n	D ft.	T ft.
168+00	164+39	361	50	0.41	.95	10	6.65	2.59	—	2.59	0.001	0.02	3333	0.31	15.5
164+39	161+00	339	50	0.39	.95	10	6.65	2.46	2.0	4.46	0.002	0.02	3333	0.33	16.5
161+00	151+08	992	42-50	1.0	.95	11.8	6.3	6.0	—	6.0	0.002	0.02	3333	0.37	18.5
151+08	142+10	898	42-50	0.92	.95	10.7	6.50	5.68	—	5.68	0.002	0.02	3333	0.36	18.0
142+10	131+83	1027	50	1.17	.95	10.7	6.4	7.11	—	7.11	0.0027	0.02	3333	0.40	20.0
131+00	122+90	810	42-56	0.82	.95	10.0	6.65	5.18	—	5.18	0.0027	0.02	3333	0.34	17.0
122+90	116+00	690	42-53	1.09	.95	10.0	6.65	6.89	—	6.89	0.002	0.02	3333	0.39	19.5

INLET CALCULATIONS

	Station	Inlet Type	D ft.	Q_i cfs	$Q_c = Q_T - Q_i$	
Exist CB	164+39	C-15.10 Tw-2.0 Grate	0.31	Q_i = 0.59	2.0	
New C.B.	162+00	60LF Slotted Drain	0.33	4.46	0 Sag	
New C.B.	151+53	MAG 533-1 Type D, L=17' a=2"	0.37	11.7	0	Sumped 0.3'
New C.B.	142+60	MAG 533-1 Type D, L=17' a=2"	0.4	12.8	0	Sumped 0.3'
New C.B.	131+83	MAG 533-1 Type D, L=19' a=2"	0.40	5.7	1.41	Flows by into 82" Place and channel
New C.B.	122+90	MAG 533-1 Type D L=10' a=2"	0.34	5.18	0	Sumped 0.25'

Inlet Type: C-4.01 Single
Double

C-4.02 Single
Double

Note: North Side Area includes 5' Sidewalk

Computed by: GAS (A-N West) Checked by: _____ Date: 9/13/87

D-1

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

PAVEMENT DRAINAGE WORKSHEET

LOCATION DATA
Highway: Shea Boulevard
Location: Scottsdale Rd - Pima Rd
Project No.: M-703-3( )

DESIGN DATA
Frequency: 100 years
P_6 = 3.22 in. P_{24} = 4.0 in. P_1 = 2.45 in.
T_{all} = 24' n = 0.015

RUNOFF CALCULATIONS West Bound North Side Curb Height = 6".

From Station	To Station	L ft.	W ft.	D.A. acr.	C	T_c min.	I in/hr	Q cfs	Q_c cfs	Q_T cfs	S_o ft/ft	S_x ft/ft	z/n	D ft.	T ft.
114+65	107+50	395	42-50	0.75	.95	10.0	6.65	4.74	Sag	4.75	0.0026	0.02	3333	0.325	16.25
100+25	107+50	725	42-50	1.17	.95	10.0	6.65	7.39	—	7.39	0.0016	0.02	3333	0.42	21.0
89+40	100+25	760	42-50	1.30	.95	10.0	6.65	8.2	—	8.2	0.002	0.02	3333	0.42	21.0
75+65	89+40	1015	42-53	1.40	.95	12.1	6.1	8.1	—	8.1	0.002	0.02	3333	0.42	21.0
					.95										
					.95										
					.95										

INLET CALCULATIONS

	Station	Inlet Type	D ft.	Q_i cfs	$Q_c = Q_T - Q_i$
Exist CB	111+47	C-15.10	0.45	4.74	0 Sag
New CB	100+30	35 LF Slotted Drain	0.42	7.39	0
New CB	97+00	MAG 533-1 Type B L=10	0.42	8.2	0 Sag
Exist. CB	85+80	C-15.10	0.47	8.1	0 Sag

Inlet Type: C-4.01 Single, Double
C-4.02 Single, Double

Computed by: GAS (A-N West) Checked by: _____ Date: 9/13/87

D-2

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

PAVEMENT DRAINAGE WORKSHEET

LOCATION DATA
Highway: Shea Boulevard
Location: Scottsdale Rd - Pima Rd
Project No.: M-703-3( )

DESIGN DATA
Frequency: 100 years
P_6= 3.22 in. P_{24}= 4.0 in. P_1= 2.45 in.
T_{all} = 24' n = 0.015

RUNOFF CALCULATIONS East Bound - South Side Curb Height = 6".

From Station	To Station	L ft.	W ft.	D.A. acr.	C	T_c min.	I in/hr	Q cfs	Q_c cfs	Q_T cfs	S_o ft/ft	S_x ft/ft	z/n	D ft.	T ft.
168+00	164+39	361	40-50	0.50	.95	10	6.65	3.16	—	3.16	0.001	0.02	3333	0.33	16.5
164+39	161+25	314	37-40	0.27	.95	10	6.65	1.7	2.5	4.20	0.0015	0.02	3333	0.34	17.0
161+25	142+75	1850	37-50	1.74	.95	22.0	4.6	7.6	—	7.6	0.002	0.02	3333	0.41	20.5
142+75	129+21	1355	45	1.41	.95	14.11	5.7	7.64	5.0	12.64	0.0024	0.02	3333	0.47	23.5
129+21	118+07	1114	37-50	1.06	.95	11.6	6.30	6.34	4.44	10.78	0.006	0.02	3333	0.38	19
118+07	116+36	171	37	0.15	.95	10	6.65	0.94	0	0.94	0.0027	0.02	3333	0.18	9
114+65	107+50	395	45-98	0.7	.95	10	6.65	4.42	0	4.42	0.0027	0.02	3333	0.32	16

D-3

INLET CALCULATIONS

	Station	Inlet Type	D ft.	Q_i cfs	$Q_c = Q_T - Q_i$
Exist. CB	164+39	C-15.10 Tw-20 Grate	0.33	Qx: 0.66	2.5
New CB	162+00	30 LF Slotted Drain	0.34	4.2	0 Sag
New C.B	142+79	MAG 532 a=2"	0.41	2.6	5.0
New C.B	129+21	MAG 533-1 Type D L=17' a=2"	0.47	8.2	4.44
New C.B	118+07	60 LF Slotted Drain	0.38	10.78	0
Exist CB	116+36	C-15.10	0.18	0.69	0.25
Exist CB.	111+45	C-15.10	0.42	4.42	0 Sag

Inlet Type: ~~C-4.01 Single~~ ~~Double~~

~~C-4.02 Single~~ ~~Double~~

Note: South side does not include sidewalk on south side

Sumped 0.22' flows south on Hayden

Computed by: GAS (A-N West) Checked by: _____ Date: 9/13/87

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

PAVEMENT DRAINAGE WORKSHEET

LOCATION DATA
Highway: Shea Boulevard
Location: Scottsdale Rd - Pima Rd
Project No.: M-703-3( )

DESIGN DATA
Frequency: 100 years
P_6 = 3.22 in. P_{24} = 4.0 in. P_1 = 2.45 in.
T_{all} = 24' n = 0.015

RUNOFF CALCULATIONS Eastbound (South Side) Curb Height = 6".

From Station	To Station	L ft.	W ft.	D.A. acr.	C	T_c min.	I in/hr	Q cfs	Q_c cfs	Q_T cfs	S_o ft/ft	S_x ft/ft	z/n	D ft.	T ft.
107+50	99+76	774	38.50	0.88	.95	10.0	6.65	5.6	—	5.6	0.003	0.02	3333	0.34	17
89+40	99+76	760	37.55	1.10	.95	10.0	6.65	7.0	—	7.0	0.0078	0.02	3333	0.31	15.5
75+60	89+40	1020	37.45	1.41	.95	12.1	6.1	8.15	—	8.17	0.002	0.02	3333	0.42	21
					.95										
					.95										
					.95										
					.95										

D-4

INLET CALCULATIONS

	Station	Inlet Type	D ft.	Q_i cfs	$Q_c = Q_T - Q_i$
New CB	99+76	35LF Slotted Drain	0.34	5.6	0
New CB	99+01	MAG533-1 Type D L=10	0.34	7.0	0 Sag
Exist. CB	85+80	C-15.10	0.47	8.17	0 Sag

Inlet Type: ~~C-4.01 Single~~ Double

~~C-4.02 Single~~ ~~Double~~

Computed by: GAS (A-N West) Checked by: _____ Date: 9/13/87

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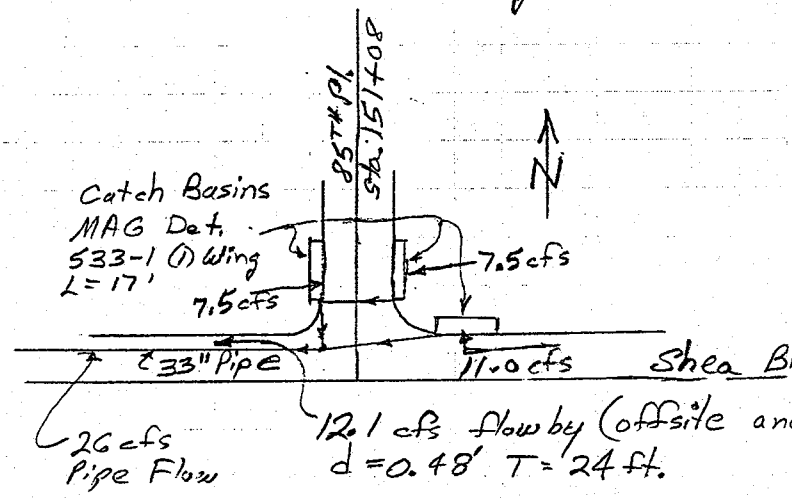
San Jose, California
Phoenix, Arizona

Proj. No. _____ Sht. ___ of ___

Shea Blvd — Calc. By GAS — Date 9/13/87

85TH Place & Shea Blvd — Chkd. By _____ Date _____

Assumed Design Inflow To Catch Basins



By Rational Method
Total Q_{100} Pavement & Offsite at 85TH Place & Shea = 38.1 cfs, T_c = 37.2 min
See Sheet D-7

By TR-20 Method
Total Q_{100} Offsite only at 85TH Place & Shea = 34 cfs

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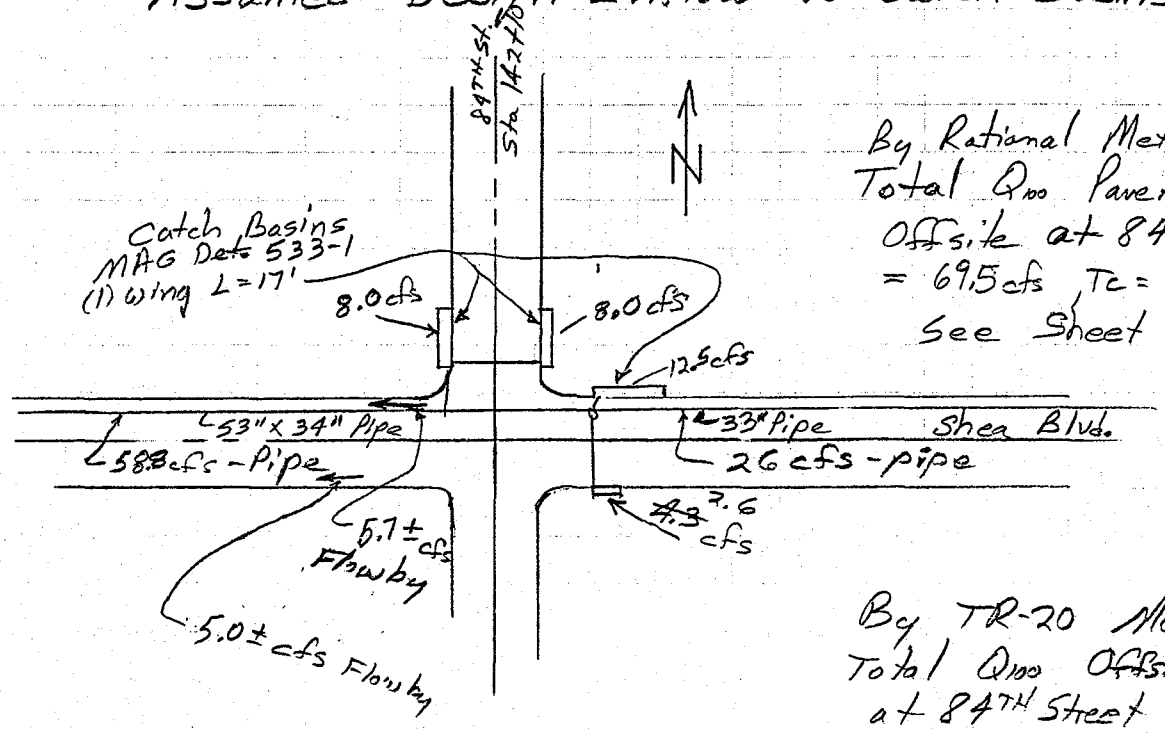
Proj. No. _____ Sht. ___ of ___

Shea Blvd. — Calc. By GAS — Date 9/13/87

84TH St. & Shea Blvd — Chkd. By _____ — Date _____

Assumed Design Inflow To Catch Basins



By Rational Method
Total Q_{100} Pavement & Offsite at 84TH Street
= 69.5 cfs, Tc = 50.4 min.
See Sheet D-7

By TR-20 Method
Total Q_{100} Offsite at 84TH Street & Shea
= 64 cfs

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

PAVEMENT DRAINAGE WORKSHEET

Offsite and Pavement Drainage Combined

For Check of catch basin design at 85TH Place & Shea and 84TH Street & Shea

LOCATION DATA
Highway: Shea Boulevard
Location: Scottsdale Rd - Pima Rd
Project No.: M-703-3

DESIGN DATA
Frequency: 100 years
P_6 = 3.22 in. P_{24} = 4.0 in. P_1 = 2.45 in.
T_{all} = 24' n = 0.015
Curb Height = 6".

RUNOFF CALCULATIONS

	From Station	To Station	L ft.	W ft.	D.A. acr.	C	T_c min.	I in/hr	Q cfs	Q_c cfs	Q_T cfs	S_o ft/ft	S_x ft/ft	z/n	D ft.	T ft.
85TH Pl.	161+00	to 150+86			28.52	.41	37.2	3.3	38.1							
84TH St.	161+00	to 142+10			61.26	.42	50.4	2.70	69.5							
						.95										
						.95										
						.95										
						.95										
						.95										

INLET CALCULATIONS

Station	Inlet Type	D ft.	Q_i cfs	$Q_c = Q_T - Q_i$

Inlet Type: C-4.01 Single
Double

C-4.02 Single
Double

Computed by: GAS (A-N West) Checked by: _____ Date: 9/14/87

Sta. 99+76 45' Rt. Shea Blvd.

Given : $Q_{100} = 5.6$ cfs

$S_o = 0.02$ ft/ft
$S_x = 0.003$ ft/ft
$d = 0.34$ ft
$T = 17$ ft

Try MAG Det. 533-1 Type D, L=17 Total Length = 20'
Effective Width (clogging factor = 1.25) = 16'

$Q_o/L_a = 0.23$ from Fig 3-46
$a/d = 0.167/0.34 = 0.49$

$L_a = 5.6\text{ cfs}/0.23 = 24.3$
$L/L_a = 16/24.3 = 0.66$
$Q/Q_a = 0.8$
$Q = (0.8)(5.6\text{ cfs}) = 4.48$ cfs

Try slotted drain

$L_r = 4.762\ Q^{0.427}\ S^{0.305}\ Z^{0.766}$ by Eqn Fig 3-49
$= 4.762\ (5.6)^{0.427}(0.003)^{0.305}\ (50)^{0.766}$
$= 33.8$ L.F.

Use 35 LF slotted drain

Sta. 100+25 45' Lt Shea Blvd

$Q_{100} = 7.39$ cfs
$d = 0.42'$
$T = 21'$
$S_x = 0.02$ '/Ft
$S_o = 0.0016$ '/Ft
$a = 2''$

Try MAG Det. 533-1 Type D, L=17 Total Length = 20'

Effective Length (clogging factor = 1.25) = 16'

$Q_a/L_a = 0.3$
$a/d = 0.40$
$L_a = 7.39/0.3 = 24.6$
$L/L_a = 16/24.6 = 0.65$
$Q/Q_a = 0.8$
$Q = (0.8)(7.39) = 5.9$ cfs

Try slotted drain

$L_r = 4.762 \; Q^{0.427} \; S^{0.305} \; Z^{0.766}$ by Eqn Fig 3-49
$= 4.762 \; (7.39)^{0.427} \; (0.0016)^{0.305} \; (50)^{0.766}$
$= 31.4$ LF

Use 35 LF Slotted drain

Sta 129+21.0 45' Rt Shea Blvd

$Q_T = 12.64$ cfs
$d = 0.47'$
$T = 23.5'$
$S_x = 0.02$
$S_o = 0.0024$

Try MAG Det. 533-1 Type D, L = 17' Total Length = 20'
Effective Length (assume clogging safety factor of 1.25) = 16'

$Q_a/L_a = 0.35$ From Fig 3-46
$a/d = 0.167/0.47 = 0.35$
$L_a = 12.64/0.35 = 36.1$
$L/L_a = 16/36.1 = 0.44$
$Q/Q_a = 0.65$
$Q = 0.65 \times 12.64 = 8.2$ cfs

Sta 131+83.0, 45' Lt. Shea

Given
$Q_{100} = 7.11$ cfs Pavement Only $T_c = 10.7$ min
$Q_{100} = 5.7 \pm$ cfs Offsite Flow by $T_c = 50+$ min.
$d = 0.40$ ft
$T = 20$ ft.
$S_x = 0.02$ ft/ft
$S_o = 0.0027$ ft/ft

Try MAG Det. 533-1 Type D $L = 17'$ Total Length $= 20'$
Effective Length (clogging factor $= 1.25$) $= 16$

$Q_a/L_a = 0.28$ from Fig 3-46
$a/d = 0.42$
$L_a = 7.11$ cfs $/ 0.28 = 25.0$ ft
$L/L_a = 16/25 = 0.64$

$Q/Q_a = 0.80$ From Fig 3-46
$Q = 0.80 \times 7.11$ cfs $= 5.7$ cfs

Sta. 141+89, 72' Lt. Shea Blvd & 84TH Street
and Sta 142+30, 73.5' Lt Shea Blvd. & 84TH Street

Given: 100 year peak discharge = 31 cfs for offsite subarea #2 from TR-20 analysis

Assume 15.5 cfs each side of street

$S_o = 0.005$ ft/ft

$S_x = 0.02$ ft/ft

$d = 0.45$ ft

$T = 22.5$ ft

Try MAG Det 533-1 Type D $L = 17'$ Total Length = 20'

Effective Length (Clogging factor = 1.25) = 16'

depression = 2"

$Q_a/L_a = 0.33$ from Fig. 3-46

$a/d = 0.167/0.45 = 0.37$

$L_a = 15.5 \text{ cfs}/0.33 = 47.0$

$L/L_a = 16'/47' = 0.34$

$Q/Q_a = 0.52$

$Q = (0.52)(15.5) = 8.0$ cfs each catch basin.

Sta 142+60, 42' Lt. Shea Blvd

Given Q_{100} design = 12.5 cfs
Sump = 0.3 ft.
Depth of Flow at Catch Basin = 0.4'
Sx = 0.02 ft/ft

Try MAG Det. 533-1 Type D L=17' Total Length = 20'
Effective Length (Clogging factor=1.25) = 16'
depression = 2"

For depth = 0.4 ft, 5 inch opening ht.
Q/L = 0.8 cfs/ft Length

Q = 0.8 X 16' = 12.8 cfs – Use MAG Det 533-1
Type D, L=17' C.B.

Sta. 142+80 45' Rt Shea Blvd.

Given : $Q_T = 7.6$ cfs (100 yr)
$D = 0.41$ ft
$T = 20.5$ ft
$S_x = 0.02$ ft/ft
$S_o = 0.002$ ft/ft

Try MAG. Det. 532 Catch Basin $L = 8.0'$
Effective Length (" use 1.25 clogging safety factor) = 6.4'
depression; $a = 2''$

$Q_a/L_a = 0.28$ from Fig. 3-46

$a/d = 0.167/0.28 = 0.60$
$L_a = 7.60 \text{ cfs}/0.28 = 27.1$

$L/L_a = 6.0/27.1 = 0.22$
$Q/Q_a = 0.34$
$Q = (0.34)(7.6) = 2.6$ cfs

Sta. 150+92.0, 72.5' Lt Shea Blvd
and Sta. 151+24.0, 73.5' Lt Shea Blvd.

Given: 100 year peak discharge = 34 cfs total offsite to 85TH Pl & Shea
See TR-20 #1

Assume 17.0 cfs each side of street

$S_o = 0.005$ ft/ft
$S_x = 0.02$ ft/ft
$d = 0.46$
$T = 22.5$

Try MAG Det 533-1 Type D, L = 17' Total Length = 20'
Effective Length (Clogging factor = 1.25) = 16'
depression = 2"

$Q_o/L_a = 0.33$ Fig 3-46
$a/d = 0.167/0.46 = 0.36$

$L_a = 17.0/0.33 = 51.5$ ft
$L/L_a = 16/51.5 = 0.31$

$Q/Q_a = 0.5$
$Q = (0.5)(17) = 8.5$ cfs each catch basin
This is greater than assumed design inflow distribution (∴ OK)

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Proj. No. _____ Sht. ___ of ___
Shea Blvd — Calc. By GAS — Date 9/13/87
Chkd. By _____ Date _____

Sta. 151+52, 46' Lt Shea Blvd @ 85TH Place

Given Q_{100} Design = 11.0 cfs
Sump = 0.3 ft
Depth of Flow at Catch Basin = 0.4'
Sx = 0.02 ft/ft

Try MAG Det 533-1 Type D L = 17 Total Length = 20'
Effective Length (Clogging factor = 1.25) = 16'
depression = 2"

For depth = 0.4 ft, 5 inch opening ht.
Q/L = 0.8 cfs/ft length

Q = 0.8 cfs × 16' = 12.8 cfs This is greater than Q_{100} Design = 11 cfs (∴ OK)