Washes No. 1-8 and Tributaries
Product 1 of 2 - Text

SUN VALLEY PARKWAY NORTH
FLOOD INSURANCE STUDY
HYDROLOGY REPORT

(2)

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

Prepared for:

The Flood Control District
of Maricopa County

January 24, 1991
Revised March 6, 1991

Prepared by:

A-N WEST, INC.
7600 North 15th Street, Suite 200
Phoenix, AZ 85020

FCD Job No. 90-04
A-N West Job No. 7158-01

Registered Professional Engineer (Civil)
15290
GREGORY A. SCHUELKE
Date Signed 3/6/91
ARIZONA, U.S.A.

SUN VALLEY PARKWAY NORTH
FLOOD INSURANCE STUDY
HYDROLOGY REPORT

Prepared for:

The Flood Control District
of Maricopa County

January 24, 1991
Revised March 6, 1991

Prepared by:

A-N WEST, INC.
7600 North 15th Street, Suite 200
Phoenix, AZ 85020

FCD Job No. 90-04
A-N West Job No. 7158-01

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
2.0	SCOPE OF WORK	1
3.0	DESCRIPTION OF THE WATERSHED	3
	3.1 GENERAL	3
	3.2 EXISTING DRAINAGE CHARACTERISTICS	4
	3.3 EXISTING DRAINAGE SYSTEMS	5
4.0	PREVIOUS STUDIES AND REPORTS	5
5.0	METHODOLOGY	6
	5.1 HYDROGRAPH COMPUTATION	7
	5.2 SUBBASIN AREAS	8
	5.3 PRECIPITATION PARAMETER	9
	5.4 LAG TIME	9
	5.5 CHANNEL ROUTING	10
	5.6 CURVE NUMBERS	11
	5.7 STORAGE ROUTING	12
	5.8 DIVERSIONS	13
6.0	ASSUMPTIONS	14
7.0	RESULTS	14
8.0	COMPARISON OF THE RESULTS WITH OTHER STUDIES AND/OR STREAM GAGES	15
9.0	CONCLUSION	19
10.0	REFERENCES/CONTACTS	20

FIGURES

FIGURE 1 - Vicinity Map	Follows page 1
FIGURE 2 - Watershed Map	Follows page 3
FIGURE 3 - Hydrologic Soils Group Map	In Back Cover
FIGURE 4 - Current Land Use Map	In Back Cover
FIGURE 5 - Drainage Area Map	In Back Cover
FIGURE 6 - HEC-1 Schematic	In Back Cover
FIGURE 7 - Comparison Plot of Peak Discharges	Follows page 17

TABLES

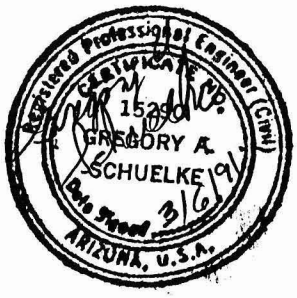
TABLE 1 - Kinematic Wave Input Parameters	Follows page 7
TABLE 2 - S-Graph Unit Hydrograph Input Parameters	Follows page 8
TABLE 3 - Weighted Curve Number Calculations	Follows page 11
TABLE 4 - Summary of Peak Discharges	Follows page 15
TABLE 5 - Existing Culvert Flow Capacities and Distribution	Follows page 15
TABLE 6 - Comparison of Peak Discharges	Follows page 17

TABLE OF CONTENTS (Cont'd.)

APPENDICES

APPENDIX A.1 - Aerial Photography and Mapping Coverage
Figure A-1 - Aerial Photography - Photo and Mapping Index Map A-1
APPENDIX A.2 - Vegetative Cover Survey
Exhibits 1-15: Photographs of Typical Vegetative Cover and Estimated Density A-2 - A-6
APPENDIX A.3 - Existing Culvert Crossings
Table A-1: Summary of Existing Culvert Crossings A-7 - A-8
APPENDIX A.4 - Area Flood Frequency Analysis Data
Table 2: Stream Gages from U.S. Corps of Engineer Report (Ref. 15) A-9
Plate 8: Precipitation and Stream Gage Stations (Ref. 15) A-10
Plate 58: Discharge Frequency Curve, Aqua Fria Tributary at Youngtown, Arizona (Ref. 15) A-11
Plate 5: Isohyetal Map, Storm of August 1951 (Ref. 15) A-12
APPENDIX B - Kinematic Wave Input Parameters B-1 - B-18
APPENDIX C - Channel Routing and Cross-Sections C-1 - C-29
APPENDIX D - Culvert Capacity Calculations D-1 - D-31
APPENDIX E - Detention Basin Storage Routing Parameters E-1 - E-46
APPENDIX F - Split Flow Input Parameters F-1 - F-14
APPENDIX G - HEC-1 Model Input/Output - Hard Copy and Diskette (1.2 MB, 5-1/4") (under separate cover)

File Names: SUNVP2.DAT - Watershed Only
WTM100Y2.DAT - Watershed Model (SUNVP2.DAT) Incorporated with Wittman ADMS Model to Trilby Wash/McMicken Dam Intersection



SUN VALLEY PARKWAY NORTH FLOOD INSURANCE STUDY HYDROLOGY REPORT

1.0 INTRODUCTION

The goal of the Sun Valley Parkway North Flood Insurance Study (FIS) is to develop 100-year floodplain delineations for several washes north of the White Tank Mountains in Maricopa County, Arizona (See Vicinity Map). The floodplain study areas include ponding upstream of the Sun Valley Parkway from 1 mile west to 8.5 miles west of McMicken Dam and several washes extending between the Sun Valley Parkway and Trilby Wash to the north (See Watershed Map).

This study includes the development of topographic mapping within floodplain mapping study areas, a hydrologic analysis to determine peak 100-year discharges to the study areas, and a hydraulic analysis to delineate 100-year floodplains and floodways.

The results of Sun Valley Parkway North FIS will be presented in two reports. This report, Hydrology Report, summarizes the results of the hydrology study and explains the methods and assumptions used in developing the 100-year peak discharges to the study areas.

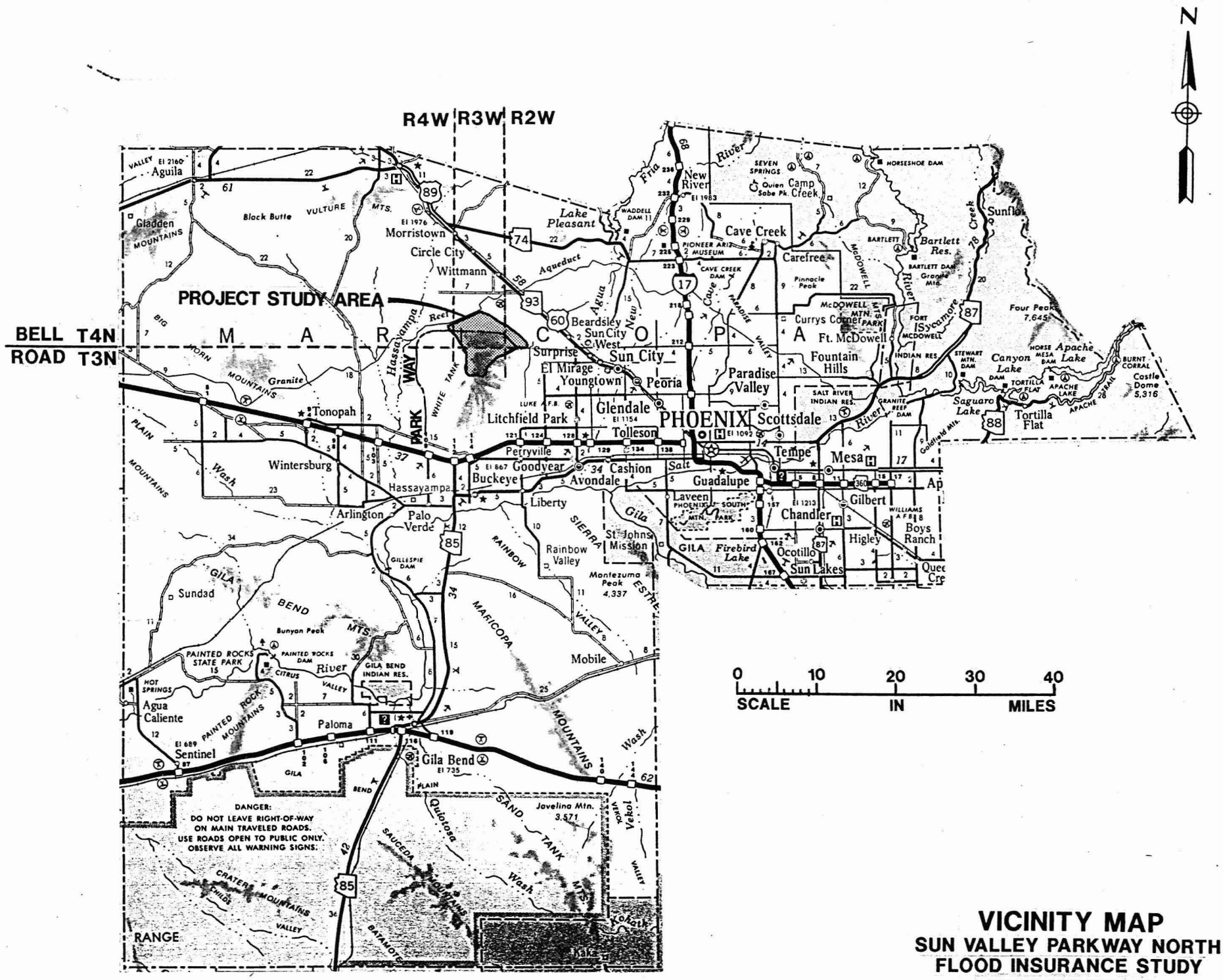
The second report, the Flood Insurance Study Report, summarizes the results of the hydraulics study and explains the methods and assumptions used in developing the 100-year floodplains and floodways.

2.0 SCOPE OF WORK

The scope of work in performing the hydrologic analysis and report preparation is summarized below.

TASK 1 - DATA COLLECTION

Existing pertinent information was collected and reviewed for use in the study. This information is discussed further in later sections and summarized in the References section. A brief summary of pertinent information collected is as follows, with Reference numbers indicated.



VICINITY MAP
SUN VALLEY PARKWAY NORTH FLOOD INSURANCE STUDY
HYDROLOGY REPORT

FIGURE 1

- As-Built Plans for the Sun Valley Parkway Road and Associated Drainage Facilities (Reference 1).

- Drainage Report for Sun Valley Parkway Drainage Facility Design (Reference 2).

- Wittman Area Master Drainage Study Report of which the project study area was a part thereof (Reference 3).

- Floodplain Maps Adjacent to Project (400 scale, 4' C.I.) produced in conjunction with Wittman Area Master Plan (Reference 4).

- Soils Mapping for the Determination of Hydrologic Soils Types (References 5 and 6).

- Topographic Maps by U.S.G.S. for use in preparation of base maps (Reference 7).

- Aerial Photography by Landis Aerial (scale 1":1200') (Reference 8) and Orthophoto Mapping from the Arizona State Land Department (scale 1:24000) (Reference 13) was obtained to provide further detail in identifying flow patterns.

- Hydrology Study Reports of Phoenix Area Streams, including Trilby Wash area near the study area, by the U.S. Army Corps of Engineers which provided historical flooding information, stream gage data, and limited flood flow frequency estimates in the general area (References 14, 15, 16, and 17).

In addition to the collection of this existing information, site visits were made to:

- Estimate vegetative cover type and density for evaluation of runoff potential.

- Field survey channel sections to determine capacity for routing and estimate splits in flow patterns.

TASK 2 - TOPOGRAPHIC MAPPING

Existing mapping was compiled along the northern edge of the watershed area as part of the Wittman ADMS (Reference 3) and Floodplain Mapping (Ref. 4) project. This existing mapping was compiled at a scale of 1" = 400' and contour interval of 4 feet.

New aerial photography and topographic mapping was compiled for use on the project (Reference 12). The new mapping was needed primarily for the hydraulic analysis of floodplains along the south side of the Sun Valley Parkway, and between the Parkway and the existing floodplains developed along Trilby Wash (Reference 4). The new mapping from 200 feet south of the

Parkway to the existing Trilby Wash topographic mapping was flown at a photo scale of 1:8000 and mapping scale of 1" = 400', and contour interval of 2 feet (Reference 12). New mapping was also obtained in a strip of approximately 1 mile width along the south side of the Parkway to aid in identifying flow patterns for the hydrologic analysis. This photography was flown at a scale of 1:15,000 and mapping scale of 1" = 400', and 4-foot contour interval. Figure A-1, Aerial Photography Photo and Mapping Index Map, shows the approximate coverage of new aerial photography and mapping for the project.

TASK 3 - HYDROLOGY

The HEC-1 computer model by the U.S. Army Corps of Engineering was utilized to develop a hydrologic model of the study watershed area. The June 1985 version of the HEC-1 model with modification to allow modeling of 900 hydrograph ordinates was utilized (Ref. 24) to match the Wittman ADMS model. The study watershed area is part of the watershed area for the Wittman Area Drainage Master Study (ADMS) (References 3 and 4). The Wittman ADMS, completed in 1989, included delineation of 100-year floodplains along Trilby Wash and its tributaries which form the northern boundary of this study.

The Sun Valley Parkway North (SVPN) hydrologic analysis utilizes the same methodology as the Wittman, ADMS to maintain compatibility with the existing hydrology and hydraulics. The SVPN Study will include more drainage areas and concentration points to enable the determination of peak 100-year discharges along the Parkway drainage structures.

3.0 DESCRIPTION OF THE WATERSHED

3.1 GENERAL

The watershed area for the Sun Valley Parkway North FIS is approximately 28 square miles in size. The southern watershed boundary is the drainage divide formed by the White Tank Mountains, the western boundary is the divide between easterly flow to McMicken Dam and westerly flow to the Hassayampa River, the northern boundary is the Central Arizona Canal (CAP) and the floodplain of the Trilby Wash and tributaries, the eastern boundary is the McMicken Dam floodpool (see Figure 2, Watershed Area Map).

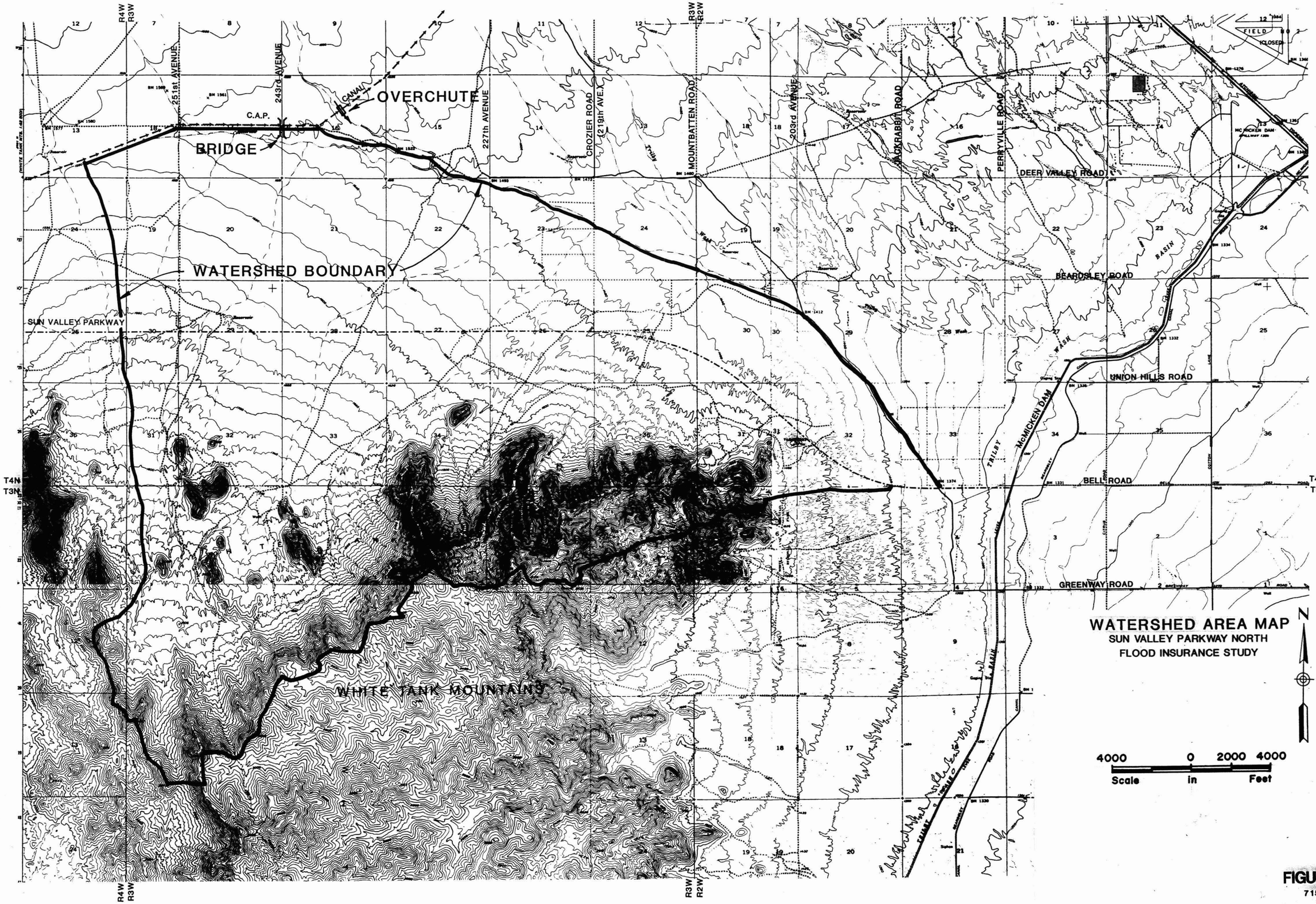


FIGURE 2
7158-01

The watershed area is currently unpopulated and undeveloped, except for the Sun Valley Parkway, completed in 1988, an overhead electric transmission line parallel, and 1-1/2 miles north of the Parkway. Current land ownership in the watershed includes private (18%), State Land (36%), Bureau of Land Management (1%), and County Park (45%) (see Figure 4, Current Land Use Map).

3.2 EXISTING DRAINAGE CHARACTERISTICS

The majority of the study area drains north to northeast towards Trilby Wash. Slopes within the drainage area are well above 20 percent near the White Tank Mountain peaks, decreasing near the Sun Valley Parkway to 1 to 2 percent with some slopes near Trilby Wash approaching 0.5 percent.

Hydrologic soil groups in the Sun Valley Parkway North FIS are classified as B, C, and D. Hydrologic soil groups refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and, thus, a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Figure 3, the Hydrologic Soils Group Map, shows the distribution of these soils as obtained from the Soil Conservation Service (SCS) Soil Surveys of the area (References 5 and 6).

Vegetative cover consists primarily of creosote brush with other desert brush and cacti. A field survey of cover density was conducted at approximately 15 locations through the watershed, wherein a 100-foot long tape was extended along a reach of vegetation representative of the area. The intercepts of vegetative cover at a distance of 3 feet above ground as well as litter on the ground were noted and a percent cover estimated per the procedure discussed in the Hydrologic Design Manual for Highway Drainage in Arizona (Reference 18).

Exhibits 1 through 15 in Appendix A.2 show photos of representative cover, location, description, and density as estimated from this survey.

3.3 EXISTING DRAINAGE SYSTEMS

The watershed has many natural washes that convey flow to Trilby Wash and McMicken Dam. The washes are typically small at 1- to 2-foot depth and 10- to 20-foot width. The Sun Valley Parkway has culverts at many of these washes. Table A-1 in Appendix A.3 includes a summary of these culverts, including a Structure I.D. Number, which is referenced in the HEC-1 model; the calculations and the Drainage Area Map (Figure 5); and HEC-1 schematic (Figure 6). Table A-1 also references the corresponding station and description of culverts from the Sun Valley Parkway As-Built Plans (Reference 1).

4.0 PREVIOUS STUDIES AND REPORTS

Several previous hydrologic/drainage related studies have been performed which addressed hydrology within the study watershed area. These studies are summarized below:

- Wittman Area Drainage Master Study, Part A: Hydrology and Hydraulics, Prepared for the Flood Control District of Maricopa County by The WLB Group, Phoenix, Arizona; March 10, 1989 (References 2 and 3).

  Summary: The study involved two reports: Part A: Hydrology and Hydraulics summarized the analysis by HEC-1 model of the 322 square mile drainage area contributing to McMicken Dam and outlet channel. The analysis developed peak discharges and volumes for the 2-, 5-, 10-, 50-, and 100-year flood (24-hour duration) and the Standard Project Flood (SPF), and Probable Maximum Flood (PMF).

  The second report, Part B: Stormwater Management Plans addressed impact of future development, existing drainage problems, solutions, and cost estimates.

  Detailed topographic mapping was also generated for selected areas and approximately 90 stream miles of floodplain were delineated.

- Drainage Report, Sun Valley Parkway Phase I, Maricopa County, Arizona, prepared for The Adams Group by Collar, Williams & White Engineering; March 30, 1987 (Reference 2).

  Summary: This report summarizes the hydrologic analysis which was used in final design of the 60 culverts across the Sun Valley Parkway from McMicken Dam to 9 miles west. The hydrologic analysis involved a 100-year, 1-hour

analysis of six larger drainage subareas by HEC-1 model with the remaining smaller drainage subareas by Rational Method. The analysis included provision for future development in computation of runoff through increased curve numbers. The report includes calculations for design of pavement drainage facilities, culverts and collector channels, and detention basins.

- Design Memorandum No. 1, Hydrology and Hydraulic Design for Trilby Wash Detention Basin and Outlet Channel by U.S. Army Corps of Engineers, Los Angeles District; November, 1953 (Reference 14).

  Summary: This report summarizes the development of the Standard Project Flood (SPF) and Probable Maximum Flood (PMF) hydrographs for the design of the Trilby Wash (aka, McMicken Dam) and Outlet Channel (Reference 14). The report includes descriptions of historical storms and flooding.

5.0 METHODOLOGY

The U.S. Army Corps of Engineers HEC-1 computer program was used to generate peak discharges in the Sun Valley Parkway North (SVPN) watershed area for the 100-year event. The watershed area was divided into approximately 60 subareas in order to develop peak discharges at all areas of interest.

The SVPN watershed area is part of the watershed area of the Wittman ADMS (References 3 and 4) which has already established hydrology for Trilby Wash and its tributaries to the north. This hydrology was utilized to perform delineation of 100-year floodplains along the Trilby Wash and tributaries. In order to develop more detailed hydrologic information for the SVPN study and maintain compatibility with the existing Wittman ADMS study, the same HEC-1 model was used with, as much as possible, the same methodology as was used in the Wittman ADMS.

The HEC-1 computer model used in the Wittman ADMS and the SVPN study was the 1985 version modified to allow computation of 900 hydrograph ordinates (Reference 24). The 900 ordinate modification was performed for the Wittman ADMS study to allow use of a 3-minute time interval to define peak discharges for small watersheds and allow definition of peak volumes for the standard project storm.

The SVPN watershed area alone was modeled to obtain peak discharges pertinent to the study based on the HEC-1 routing schematic shown on Figure 6. The input and output for this analysis is included in Appendix G as File I.D. SUNVP2.

In order to compare the impact of the remodeled SVPN watershed area on the Wittman ADMS model, the SUNVP2 data was input to Wittman ADMS model through the intersection of Trilby Wash and McMicken Dam. The input and output for this analysis is included in Appendix G as File I.D. WTM100Y2.

5.1 HYDROGRAPH COMPUTATION

Two methods of completing flood hydrographs were used in the HEC-1 computer program. The kinematic wave method was used in the relatively mild sloped (0.5 to 2.5 percent) foothills area and the unit hydrograph method was used in the steep sloped mountainous areas.

The kinematic wave method was used in the foothills areas because its use of overland flow to collector and main channels seemed appropriate to the shallow braided flow occurring in this area. Input parameters include overland flow, collector and/or main channel length, slope and roughness coefficients, and channel slope, width and side slopes for collector and/or main channels. These parameters also can be modified to simulate future development.

The flow patterns of subareas in the foothill area consisted of many small washes running relatively parallel from the upstream end of the watershed to the downstream end. The kinematic wave method was used to model an overland flow component of runoff followed by a main channel component. The main channel component simulated the numerous small parallel washes running the length of the subareas. The overland flow length element was estimated by visually counting from aerial photography the number of small parallel washes within each subarea. The width of the subarea was divided by the number of washes and then divided by 2 (assuming overland flows into the wash from either side). The overland flow slope was assumed to be approximately the same as the longitudinal wash slope. The main channel width was estimated by using Manning's equation through trials to determine a width that conveyed the initial estimated peak discharge with a flow depth of approximately 1 to 1.5 feet deep. This width was also compared to an estimated total width of washes within a subarea taken from aerial photography.

Table 1, Kinematic Wave Input Parameters, provides a summary of these parameters. Appendix B contains kinematic wave model input parameter calculations.

TABLE 1
KINEMATIC WAVE INPUT PARAMETERS

HEC-1 SUBAREA I.D.	OVERLAND FLOW				COLLECTOR AND/OR MAIN CHANNEL					
	CHANNEL LENGTH (FT.)	SLOPE (FT./FT.)	ROUGHNESS COEFF.	PERCENT CONTRIB. AREA TO	LENGTH (FT.)	SLOPE (FT./FT.)	ROUGHNESS	SHAPE*	BOTTOM WIDTH (FT.)	SIDE SLOPES (H):(V)
1	175	0.02	0.20	100	5,500	0.019	0.05	--	20	10
2	225	0.01	0.13	100	12,500	0.01	0.05	--	200	10
3	100	0.016	0.20	100	3,000	0.016	0.05	--	20	10
4	333	0.011	0.13	100	11,000	0.011	0.05	--	140	10
5	200	0.019	0.20	100	8,500	0.019	0.05	--	45	10
6	460	0.011	0.13	100	7,200	0.011	0.05	--	125	10
7	100	0.02	0.20	100	1,500	0.018	0.05	--	2	6
8	175	0.02	0.20	100	1,200	0.018	0.05	--	15	6
10	325	0.018	0.20	100	5,000	0.018	0.05	--	50	10
11	100	0.015	0.20	100	1,000	0.019	0.05	--	2	6
12	275	0.019	0.20	100	3,500	0.019	0.05	--	15	10
13	200	0.03	0.25	100	10,000	0.03	0.05	--	40	10
14	150	0.0175	0.20	100	8,000	0.0175	0.05	--	90	10
15	333	0.010	0.13	100	6,500	0.010	0.05	--	120	10
16	125	0.012	0.13	100	7,500	0.012	0.05	--	60	10
17	330	0.010	0.13	100	4,000	0.010	0.05	--	120	10
18	180	0.012	0.13	100	8,000	0.012	0.05	--	150	10
19	450	0.016	0.20	100	6,300	0.016	0.05	--	40	10
20	250	0.024	0.20	100	12,500	0.024	0.05	--	160	10
21	400	0.011	0.13	100	10,500	0.011	0.05	--	150	10
22	420	0.01	0.13	100	9,000	0.01	0.05	--	260	10
23	180	0.019	0.25	100	7,500	0.019	0.05	--	45	10
25A	200	0.016	0.20	100	2,500	0.016	0.05	--	8	6
25B	200	0.017	0.20	100	5,300	0.017	0.05	--	16	10
25C	230	0.016	0.20	100	8,000	0.016	0.05	--	40	10
25D	250	0.0256	0.25	100	12,500	0.0256	0.05	--	80	10
26	260	0.011	0.15	100	7,000	0.011	0.05	--	250	10

*Trapezoidal Channel = default value.

TABLE 1 (CONT'D.)

HEC-1 SUBAREA I.D.	OVERLAND FLOW				COLLECTOR AND/OR MAIN CHANNEL					
	CHANNEL LENGTH (FT.)	SLOPE (FT./FT.)	ROUGHNESS COEFF.	PERCENT CONTRIB. AREA TO	LENGTH (FT.)	SLOPE (FT./FT.)	ROUGHNESS	SHAPE*	BOTTOM WIDTH (FT.)	SIDE SLOPES (H):(V)
27	200	0.010	0.13	100	7,000	0.010	0.05	--	200	10
28	150	0.0167	0.20	100	6,500	0.0167	0.05	--	8	10
29	160	0.015	0.20	100	6,000	0.015	0.05	--	30	10
31	300	0.025	0.20	100	8,500	0.025	0.05	--	30	10
32A	250	0.014	0.20	100	1,900	0.014	0.05	--	6	10
33	200	0.01	0.15	100	3,000	0.008	0.05	--	250	10
34	350	0.0129	0.13	100	4,500	0.0129	0.05	--	25	10
35	200	0.01	0.15	100	3,100	0.008	0.05	--	250	10
36	250	0.011	0.13	100	9,000	0.011	0.05	--	60	10
38	300	0.011	0.13	100	7,000	0.011	0.05	--	120	10
40	250	0.01	0.13	100	6,000	0.0092	0.05	--	80	10
43	200	0.01	0.13	100	4,500	0.009	0.05	--	120	10
44	170	0.017	0.20	100	3,500	0.017	0.05	--	18	10
45	375	0.01	0.13	100	4,500	0.01	0.05	--	60	10
47	300	0.01	0.13	100	4,500	0.01	0.05	--	40	10
48	110	0.03	0.20	100	3,000	0.03	0.05	--	40	10
49	150	0.011	0.20	100	4,500	0.011	0.05	--	100	10
50	175	0.026	0.20	100	4,500	0.026	0.05	--	20	10
51	150	0.016	0.15	100	4,500	0.016	0.05	--	50	10
53	125	0.05	0.25	100	3,000	0.05	0.05	--	15	6
54	160	0.016	0.20	100	4,500	0.016	0.05	--	120	10
55	100	0.025	0.25	100	1,800	0.025	0.05	--	18	6
56	160	0.0167	0.20	100	3,000	0.0167	0.05	--	60	10

*Trapezoidal Channel = default value.

The Phoenix Mountain S-graph was used to derive unit hydrographs in the mountainous areas of the watershed. A unit hydrograph is the runoff hydrograph that results from 1 inch of rainfall excess occurring uniformly over a watershed in a specified period of time. The Los Angeles District's normal unit hydrograph procedure utilizes the S-graph, which is a summation graph of discharge in percent of ultimate discharge versus time in percent of lag time. Lag time is defined as the time required for 50 percent of the total volume (ultimate discharge) of the unit hydrograph to occur. The basin lag time for ungaged watersheds can be approximated by the use of the lag relationship presented in Section 5.4, Lag Time. The basin n-value is a variable in the lag equation that permits adjustment of the lag time depending on the type of ground cover and other characteristics affecting basin response to rainfall excess.

The Phoenix Mountain S-graph was generated by the U.S. Army Corps of Engineers through historic flood reconstitution analysis derived from the New River near Rock Springs and New River at New River stream gage data.

The LAPRE-1 program (Reference 21) developed by the U.S. Corps of Engineers, L.A. District was used to convert the S-graph input parameters to unit hydrograph ordinates for input to HEC-1.

Table 2, S-graph Unit Hydrograph Input Parameters, summarizes these input parameters to the LAPRE-1 program and HEC-1 model. Figure 5, Drainage Area Map, shows the longest watercourse flow path used in the S-graph method.

5.2 SUBBASIN AREAS

The watershed was divided into approximately 60 subbasins to allow the computation of flood peak hydrographs at the majority of the culverts along Sun Valley Parkway and at confluences of washes with Trilby Wash and tributaries. The watershed area was divided into subareas based on identification of flow patterns, from the U.S.G.S. quadrangle maps (Reference 7), aerial photography (References 8, 12, and 13), the Sun Valley Parkway Drainage Report (Reference 2), the Wittman ADMS Report (Reference 4), the topographic mapping (Reference 12), and field visits and surveys. Figure 5, Drainage Area Map, shows these basin subareas.

TABLE 2

S-GRAPH UNIT HYDROGRAPH INPUT PARAMETERS

Subarea I.D.	XL (L) (miles)	XLCA (L_{CA}) (miles)	S (s) (ft./mile)	BN (n)	NNT
9	3.79	2.08	253	0.05	16
24	4.55	2.84	295	0.05	16
30	3.79	2.08	275	0.05	16
32	2.2	1.14	445	0.05	16
39	1.80	0.72	333	0.05	16
41	2.92	1.57	415	0.05	16
42	1.89	0.95	485	0.05	16
46	1.89	0.95	440	0.05	16
52	3.13	1.63	485	0.05	16
57	2.08	1.13	385	0.05	16

Input Parameters to LAPRE-1 Program $U card:

Note: Letters in parentheses indicate equivalent parameter for Lag Time Equation.

XL(L) = Length of longest water course in the subarea (miles).

XLCA(LcA) = Length along the longest water course, measured upstream to point opposite center of area (miles).

S (s) = Slope of longest watercourse in feet/mile.

BN (n) = Visually estimated mean of Manning's 'n' values for all channels within area.

NNT = Specifies desired S-graph from LAPRE-1 program library of stored S-graphs.
15 = Phoenix Valley S-graph.
16 = Phoenix Mountain S-graph.

5.3 PRECIPITATION PARAMETERS

The precipitation values for the 100-year, 24-hour duration storm event were obtained from the NOAA Atlas No. 2 (Reference 18). Point rainfall values were aerially reduced by the use of the depth area curve in the NOAA Atlas No. 2. The following tables show the precipitation values used in this study.

PRECIPITATION VALUES

Return Interval (years)	Duration (hours)	Point Rainfall (inches)
100	24	4.21

POINT RAINFALL AREAL REDUCTION
24-HOUR DURATION

Area (sq. mi.)	Percent Point Rainfall	Rainfall (inches)
1	100	4.21
10	99	4.17
50	95	4.00

The precipitation depth-area relation (JD card) was incorporated into the model to maintain consistency between successive downstream hydrographs by generating each from precipitation quantities that correspond to that particular basin size.

The SCS Type II rainfall distribution was used to distribute the above rainfall amounts over the 24-hour period. The time increment used in the distribution was 15 minutes.

5.4 LAG TIME

Basin Lag time is required S-graph input for the unit hydrograph method. The following equation was used to compute Lag time:

$$\text{Lag} = 24n\left[\frac{L \times L_{CA}}{S^{1/2}}\right]^{0.38}$$

Where:

Lag = Lag time in hours.
L = Length of longest water course in miles.
L_{CA} = Length along longest watercourse, measured upstream to point opposite center of area, miles.
n = Visually estimated mean of the Manning's 'n' values for all channels within area.
s = Overall slope of longest watercourse in feet/miles.

This equation was taken from Plate 24 of the "Gila River Basin, New River, and Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology Part 2" (Reference 15).

5.5 CHANNEL ROUTING

Although the kinematic wave method was used to compute most of the subbasin hydrographs, it was not used for channel routing because it does not provide for attenuation of the flood wave. To better provide for attenuation due to channel storage, the normal depth channel or modified puls routing option of HEC-1 was used.

Field surveyed cross-sections were taken along most channel routing reaches to obtain a representative routing channel section. Study mapping and field visits were used on some reaches as noted in calculations. Appendix C, Channel Routing and Cross-Sections, provides information on development of channel routing parameters.

It was discovered that some field surveyed cross-sections did not have adequate capacity to convey the computed peak discharge to the routing reach. This was anticipated as the drainage patterns in the area consist typically of numerous small channels of 1- to 2-foot depth and 10- to 15-foot width with relatively level ground in between. These inadequate field surveyed cross-sections were modified by widening and raising the outside channel banks to convey the computed peak discharge. The channels were widened sufficiently to maintain the routed flow in subcritical flow and the depth from low-flow channel invert to less than 4 feet. The criteria of maintaining subcritical flow and depth less than 4 feet was considered appropriate where the flow was not confined.

The number of steps to be used in the storage routing or (NSTPS) in the HEC-1 RS card was determined by first estimating the average velocity in the routing channel for the discharge computed from initial computer runs. The NSTPS value was then obtained by dividing the routing length by average velocity of which this quantity was then divided by time interval.

Transmission losses were modeled in the channel routing of peak discharges north of the Sun Valley Parkway. An infiltration rate of 1 cfs/acre was utilized based on estimates made from a 1970 flood event in Cave Creek Wash by the Corps of Engineers (Ref. 5). The majority of the soil in the Cave Creek Wash has similiar permeability parameters. (i.e. 2.0 - 6.0 in/hr.) as the study area based on the soil survey (Ref. 6). The channel loss option (RL card) of HEC-1 was utilized (See Appendix C, Channel Routing and Cross-Sections for HEC-1 input).

5.6 CURVE NUMBERS

The Soil Conservation Service curve number method was used to calculate precipitation losses. Curve numbers were interpolated from SCS Technical Release No. 55 (Reference 19). This document provides correlation between curve number and hydrologic soil group, soil cover type and density, land use type, and antecedent moisture conditions. The following table shows the range of curve numbers that were considered in the Sun Valley Parkway Study. The fair condition desert shrub curve numbers were utilized in the study.

The field survey of vegetative cover density ranged from 5 to 36 percent, with an average of approximately 25 to 30 percent (see Section 3.3 and Appendix A.2). This cover density would suggest the use of higher curve numbers from the table above than what was used. However, the fair condition curve numbers were utilized for two reasons:

a) The fair condition curve numbers were used in the Wittman ADMS hydrology study, of which this study has incorporated the same methodology as deemed appropriate. These curve numbers were considered appropriate in comparison of results to other studies.

b) Lower curve numbers were selected as a method of addressing transmission losses on small subareas where significant losses can occur before a peak discharge is routed through a channel.

TABLE 3

WEIGHTED CURVE NUMBER CALCULATIONS

Subarea I.D.	Drainage Area (sq. mi.)	Drainage Area (acres)	Area Associated With Each Curve Number and Soil Type: 86(D) (acres)	81(C) (acres)	72(B) (acres)	Weighted Curve Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	0.147	93.939	--	2.847	91.092	72.3
2	1.199	767.123	81.129	209.228	476.766	75.9
3	0.105	66.896	--	9.963	56.933	73.3
4	0.727	465.425	4.270	--	461.155	72.1
5	0.191	122.405	--	8.540	113.865	72.6
6	0.632	404.222	61.203	--	343.019	74.1
7	0.013	8.540	--	2.301	6.239	74.1
8	0.020	12.810	--	12.810	--	81.0
9	1.250	799.905	419.879	326.145	53.881	83.0
10	0.182	116.712	--	76.859	39.853	78.0
11	0.027	17.080	--	--	17.080	72.0
12	0.022	14.230	--	14.230	--	81.0
13	0.423	270.431	34.16	198.209	38.062	80.4
14	0.503	321.62	38.453	163.635	119.535	78.3
15	0.316	202.111	--	32.736	169.375	73.5
16	0.396	253.351	--	--	253.351	72
17	0.149	95.362	11.387	--	83.975	73.7
18	0.656	419.879	14.233	--	405.646	72.7
19	0.191	122.409	1.041	--	121.364	72.1
20	0.812	519.879	87.190	179.338	253.351	77.4
21	1.128	721.622	--	--	721.622	72
22	1.136	727.316	--	--	727.316	72
23	0.287	183.608	--	--	183.608	72
24	2.860	1830.38	907.114	591.636	331.6	81.8
25A	0.0378	24.15	--	--	24.15	72
25B	0.098	62.63	--	--	62.63	72
25C	0.180	115.24	--	--	115.24	72
25D	0.652	417.08	54.086	69.743	293.52	75.4
26	0.574	367.216	--	--	367.216	72
27	0.318	203.535	--	--	203.535	72
28	0.089	56.933	--	--	56.933	72
29	0.178	113.865	--	--	113.865	72
30	2.722	1742.325	657.573	918.270	166.482	82.0
31	0.340	217.768	24.196	128.099	65.473	78.8
32	0.480	307.44	140.909	133.792	32.74	82.2
32A	0.033	21.40	--	--	21.40	72.0
33	0.105	66.894	--	--	66.896	72
34	0.198	126.675	--	--	126.675	72
35	0.093	59.779	--	--	59.779	72

TABLE 3 (Cont'd.)

Subarea I.D.	Drainage Area (sq. mi.)	Drainage Area (acres)	Area Associated With Each Curve Number and Soil Type: 86(D) (acres)	81(C) (acres)	72(B) (acres)	Weighted Curve Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)
36	0.369	236.271	--	--	236.271	72
38	0.556	355.830	--	--	355.830	72
39	0.707	452.61	86.822	230.578	135.22	79.3
40	0.285	182.185	--	--	182.185	72
41	1.156	740.08	533.699	129.522	76.859	83.7
42	0.418	267.583	85.399	157.988	24.196	81.8
43	0.158	101.010	--	--	101.010	72
44	0.096	61.203	--	5.693	55.510	72.8
45	0.218	139.485	--	--	139.485	72
46	1.094	700.27	190.725	294.627	214.921	79.6
47	0.305	194.995	--	--	194.995	72
48	0.205	130.945	--	14.233	116.712	73
49	0.556	355.830	--	--	355.830	72
50	0.102	65.473	--	65.473	--	81
51	0.218	139.485	--	--	139.485	72
52	1.212	775.709	715.930	59.779	--	85.6
53	0.156	99.632	28.466	71.166	--	82.5
54	0.514	328.787	--	--	328.787	72
55	0.064	41.276	--	41.276	--	81
56	0.198	203.33	--	--	203.33	72
57	0.396	253.351	136.639	116.712	--	83.7

$$\text{Weighted Curve Number} = \frac{(\text{Col. 4 X 86})+(\text{Col. 5 X 81})+(\text{Col. 6 X 72})}{\text{Col. 3}}$$

Table 3 provides a summary of subareas' sizes and the calculation of the weighted curve number based on the portion of each hydrologic soil type within each subarea.

CURVE NUMBERS

Land Use Type	Hydrologic Soil Group B	C	D
Desert Shrub			
Poor Condition	77	85	88
Fair Condition	72	81	86
Good Condition	68	79	84

Hydrologic Conditions:
Poor - 0-30% Cover Density
Fair - 30-70% Cover Density
Good - 70-100% Cover Density

5.7 STORAGE ROUTING

Reservoir routing was used in the HEC-1 model to account for the effects of storage upstream of the Sun Valley Parkway. The RS, SQ, SV, and SE cards were utilized in the HEC-1 model to simulate the storage routing. The Hydraulic Engineering Circular 5 (HEC-5), Hydraulic Charts for Selection of Highway Culverts (Reference 21), was used in conjunction with the Parkway As-Built plans (Reference 1) to determine stage vs. discharge relationships for the culverts. These culvert calculations are included in Appendix D. The Parkway plans were also used to determine stage vs. storage relationships at culverts along the roadway. Storage was modeled at natural washes due to the ponding effect of the culverts as well as at designed detention basins along the roadway. The designed detention basins are shown on Figures 5 and 6 along the Parkway.

At many locations along the Parkway, flood flows to one culvert or set of culverts will exceed the capacity of these culverts and a portion of the flow will split, flowing downstream along the roadway to the next set of culverts. The split in flow at the culverts was defined by using the Parkway As-Built plans to define the elevation and channel cross-section area at various elevations, thus defining the stage vs. discharge capacity of flow splits to adjacent culverts.

Flow splits over the grouted rock levees or into the channels along the road were estimated using the weir equation at the breakout location. A 'c' coefficient of 2.63 was used based on a breadth of crest of weir of 15 feet from Table 5-3 of Brater and King (Reference 22). A check of the weir flow rating curve calculations at Structure No. 50 was made by a HEC-2 analysis of a section of channel along the road. The weir flow calculations are shown on page E-34. The HEC-2 input and output follow on pages E-35 through E-40.

The detention basin storage routing parameters are included in Appendix E, which include the stage vs. discharge, storage and split flow occurring at culverts modeled. Some split flow calculations are also included in Appendix F.

5.8 DIVERSIONS

Diversions were used in the HEC-1 hydrology model for two modeling situations:

1. To model the flow splits to adjacent culverts occurring at culverts along the Sun Valley Parkway.

2. To model flow splits in channel braiding that are necessary to better define flow to specific locations.

In some cases, the culverts along the Parkway do not have sufficient capacity to pass the 100-year, 24-hour flood. Some culverts are designed with detention basins upstream of the culverts along the road that provide storage and conveyance capability. Where the detention basins were built, the basins generally have weirs that cause a portion of the flow to go through the culvert before weiring over and flowing downstream along the road to the next culvert. A channel was constructed almost continually along the upstream side of the roadway where detention basins were not constructed, such that if a culvert did not have adequate capacity, excess flow could flow along the road to the next culvert in the channel. The Parkway roadway plans (Reference 1) were used to define the elevation at which split flow occurred and the cross-sectioned area and capacity for development of stage vs. discharge relationships.

Where channel braiding resulted in flow splits that need definition, a cross-section was field surveyed or obtained from the topographic mapping (Reference 12). A stage vs. elevation relationship was then estimated which was used to define flow splits.

The flow split calculations and diversion input data to HEC-1 are included in Appendix F.

6.0 ASSUMPTIONS

In the kinematic wave parameter selection, it was assumed that the overland length element was equal to the subarea width divided by the number of washes (visually estimated from photography) and then divided again by 2 (one overland length element contributing to each side of the wash or 2 elements per wash). The overland flow element slope was assumed to be equal to the subarea main channel slope.

When field surveys were taken to obtain typical channel cross-sections for routing flow or evaluating channel flow splits, it was found that many cross-sections would not contain the computed peak 100-year discharge. These small channels are also evident on aerial photography and topographic mapping. The channels are typically only 1 to 2 feet deep and 10 to 15 feet wide. It was necessary to assume a channel width and an artificial barrier to contain flow to the channel section for routing or split flow analysis. The channel width was selected wide enough to maintain relatively shallow flow (i.e., 4 feet from low-flow invert) and subcritical flow which would be expected if flow were not contained.

When hydrologic soil groups were mapped for the Sun Valley Parkway North FIS watershed area, a difference in soil groups was noticed from that used in the Wittman ADMS. The Wittman ADMS soils group mapping showed a band of Type B soil along the north base of the White Tank Mountains followed by primarily Type C soil north to Trilby Wash. The Wittman ADMS referenced the Soil Conservation Service (SCS) "General Soil Map for Maricopa County, Arizona, March, 1973 as the source of this information. The Sun Valley Parkway North FIS used Reference 6, Soil Survey of Aguila - Carefree Area, parts off Maricopa and Pinal Counties, Arizona, April, 1986 in mapping soil groups.

This source indicated a Type C soil band along the north base of the White Tank Mountains followed by Type B soil to Trilby Wash. This source was used in the FIS as it was completed more recently and was of greater detail and, therefore, assumed to be more accurate.

7.0 RESULTS

A summary of the peak discharges at significant concentration points is provided in Table 4. The summary includes peak discharges into all modeled culverts along the Parkway and into downstream washes to be delineated for 100-year floodplains. The Drainage Area Map (Figure 5) shows the drainage subareas and their identification numbers, and the HEC-1 Schematic (Figure 6) shows the complete HEC-1 routing.

A summary of existing culvert flow capacities and distribution is provided in Table 5. This can be used in conjunction with Figures 5 and 6 to review the distribution of peak discharges through the culverts at the Sun Valley Parkway. The complete HEC-1 model input/output is included in Appendix G.

8.0 COMPARISON OF THE RESULTS TO OTHER STUDIES AND/OR STREAM GAGES

No stream gages exist within the immediate watershed area for the Sun Valley Parkway FIS.

Several hydrologic studies have been undertaken in the Phoenix area by the U.S. Army Corps of Engineers for the design of a number of flood control structures, including McMicken Dam, New River Dam, Adobe Mountain Dam, Dreamy Draw Dam, the Arizona Canal Diversion Channel, and Indian Bend Wash (References 14, 15, 16, and 17).

The Hydrology Report, Gila River Basin, New River, and Phoenix City Streams Design Memorandum No. 2, Part 1 (Reference 15) indicated several stream gages in the general Phoenix metro area which were considered in its analysis. These stream gages were summarized on Table 2 and Plate 8 of Ref. 15 and one presented in Appendix A.4. Discharge frequency curves were developed for several stream gage stations from Table 8. The stream gage drainage areas

TABLE 4

SUMMARY OF PEAK DISCHARGES

HEC-1 I.D.	Drainage Area (sq. mi.)	100-Year, 24-Hour (cfs)	Remarks
SUB 01	0.15	102	Struc. #1
RO 01	0.15	102	Struc. #1
SUB 02	1.20	505	
SUB 03	0.10	113	Struc. #2
RO 03	0.10	102	Struc. #2
SUB 05	0.19	94	Struc. #3
CO 05	0.30	175	Outflow - Struc. #2-3 (Study Wash)
SUB 04	0.73	242	
CO 04	1.02	349	
CO 04.1	2.37	803	
SUB 06	0.63	321	
CO 06	3.00	912	
SUB 07	0.01	17	Struc. #4
RO 07	0.01	17	Struc. #4
SUB 08	0.02	35	
DIV 08	--	17	Struc. #5
SUB 09	1.25	871	
DIV 09	--	366	
SUB 10	0.18	158	
CO 10	--	401	Struc. #6 & 7
RO 10	--	401	Struc. #6 & 7
CO 10.1	--	407	
SUB 11	0.03	35	
DIV 11	--	27	Struc. #9
CO 11	--	411	Outflow - Struc. #4-9
SUB 12	0.02	24	
CO 12	--	24	
RO 12	--	22	
DIV 12	--	22	Struc. #10
CO 12.1	--	419	Outflow - Struc. #4-10
SUB 13	0.42	425	
CO 13	--	777	
SUB 14	0.50	372	
CO 14	--	859	
RO 14	--	859	Struc. #11
DIV 14	--	859	
RO 14.1	--	0	Struc. #12
CO 14.2	2.44	1,250	Outflow - Struc. #4-12 (Study Wash)
SUB 15	0.32	148	
SUB 16	0.40	224	
CO 16	--	1,273	
SUB 17	0.15	84	
CO 17	3.30	1,293	

TABLE 4 (Cont'd.)

HEC-1 I.D.	Drainage Area (sq. mi.)	100-Year, 24-Hour (cfs)	Remarks
CO 17.1	6.30	2,124	
SUB 18	0.66	322	
CO 18	6.96	2,157	
SUB 19	0.19	86	Struc. #13
RO 19	0.19	86	Struc. #13
SUB 20	0.81	456	
DIV 20A	--	191	
RO 20	--	187	Struc. #14
DIV 20C	--	171	Struc. #14
CO 20	--	283	
RO 20.1	--	282	Struc. #15
CO 20.2	1.01	532	Outflow Struc. #13-15
SUB 21	1.13	415	
CO 21	2.14	766	
CO 21.1	9.10	2,731	Confluence with Trib. 5 West
SUB 22	1.14	402	Confluence with Trib. 5 West
SUB 23	0.29	158	
RO 23	--	151	Struc. #16
DIV 23	--	151	Struc. #16
SUB 24	2.86	1,714	
CO 24	--	1,714	
DIV 24A	--	766	Struc. #17
RO 24A	--	767	Struc. #17
DIV 24C	--	815	Struc. #18
RO 24C	--	816	Struc. #18
DIV 24D	--	134	Struc. #19
RO 24D	--	134	Struc. #19
CO 24.1	--	1,825	Outflow - Struc. #16-19
SUB 25A	0.04	32	
CO 25.1	--	1,834	Outflow - Struc. #16-21
SUB 25B	0.10	62	Struc. #22 & 23
CO 25.2	--	1,866	Outflow - Struc. #16-23
DIV 25C1	--	82	Struc. #24
CO 25.3	--	1,939	Struc. #16-24
DV 25D1	--	350	Struc. #25
CO 25.4	--	2,240	Struc. #16-25
SUB 28	0.09	54	
CO 28.1	4.20	2,270	Outflow - Struc. #16-26 (Study Wash)
SUB 26	0.57	228	
CO 28.2	4.78	2,322	
SUB 27	0.32	113	
CO 27	5.10	2,275	Confluence with Trib. 5 West
SUB 36	0.37	154	
CO 36	--	2,622	Confluence with Trib. 5 West
SUB 29	0.18	108	
SUB 30	2.72	1,841	

TABLE 4 (Cont'd.)

HEC-1 I.D.	Drainage Area (sq. mi.)	100-Year, 24-Hour (cfs)	Remarks
CO 30	2.90	1,911	
RO 30.1	2.90	1,905	Struc. #27
SUB 31	0.34	300	
SUB 32	0.48	455	
CO 32	0.82	754	
RO 32	0.82	748	Struc. #28
SUB 32A	0.03	25	Struc. #29
DV32A1	--	15	Struc. #29
CO 32.1	3.75	2,397	Outflow Struc. #27-29 (Study Wash)
SUB 34	0.20	129	
SUB 33	0.10	51	
CO 34	4.06	2,472	
SUB 35	0.09	42	
CO 35	4.15	2,469	
CO 35.1	10.75	4,274	Confluence with Trib. 5 West
SUB 38	0.56	265	Confluence with Trilby Wash
SUB 39	0.71	675	
RO 39	--	676	Struc. #30
DIV 39	--	522	Struc. #30
SUB 40	0.28	140	
CO 40	0.99	589	Confluence with Trilby Wash
DIV 391	--	154	
SUB 41	1.16	996	
CO 41	--	1,094	
DIV 41	--	924	Struc. #31
RO 41	--	925	Struc. #31
DIV 411	--	170	
SUB 42	0.42	426	
CO 42.1	--	413	
RO 41.1	--	412	Struc. #32
DIV 42C	--	89	Struc. #33
RO 42	--	79	Struc. #33
CO 42	1.57	1,401	Outflow Struc. #31-33 (Study Wash)
SUB 43	0.16	78	
CO 43	1.73	1,408	Confluence with Trilby Wash
SUB 44	0.10	82	
CO 44	--	163	Struc. #34 & 35
SUB 45	0.22	120	
CO 45	0.31	230	Confluence with Trilby Wash
SUB 47	0.31	195	
SUB 46	1.09	1,009	Struc. #36 (Study Wash)
SUB 48	0.20	245	Struc. #37-47
SUB 49	0.56	388	
CO 49	1.86	1,248	Confluence with Trilby Wash

TABLE 4 (Cont'd.)

HEC-1 I.D.	Drainage Area (sq. mi.)	100-Year, 24-Hour (cfs)	Remarks
SUB 50	0.10	137	Struc. #48-49
SUB 51	0.22	173	
CO 51	0.32	274	
SUB 52	1.21	1,107	
RO 52	1.21	1,109	Struc. #50
DIV 52A	--	891	Struc. #50
DIV 52B	--	217	
RO 52.1	--	219	Struc. #51
DIV 52C	--	91	Struc. #51
DIV 52D	--	128	Struc. #52
RO 52.2	--	119	Struc. #52
DIV 52E	--	2	Struc. #52
DIV 52F	--	2	Struc. #52
CO 52	1.21	1,096	Outflow Struc. #50-53 (Study Wash)
SUB 54	0.51	370	
CO 53	1.71	1,234	
SUB 53	0.16	328	Struc. #54
DIV 53A	--	267	Struc. #54
RO 53	--	190	Struc. #54
DIV 53B	--	61	
SUB 55	0.06	125	
CO 55	--	186	Struc. #55-60
SUB 56	0.20	173	
CO 56	0.42	435	
SUB 57	0.40	396	

TABLE 5
SUN VALLEY PARKWAY
SUMMARY OF EXISTING CULVERT FLOW CAPACITIES AND DISTRIBUTION

STRUCTURE I.D.	STATION	DESCRIPTION	CAPACITY AT BREAKOUT (CFS)	PEAK 100-YEAR DISCHARGE (CFS)	PEAK CULVERT FLOW (CFS)	BREAKOUT FLOW (CFS)	TO CULVERT I.D.
1	4+30.50	10' X 3' R.C.B.C.	200	102	102	--	--
2	16+19.50	THREE 49" X 33" C.S.P.A.	150	113	102	--	--
3	26+06.25	10' X 3' R.C.B.C.	205	94	94	--	--
4	30+35.50	TWO 49" X 33" C.S.P.A.	106	17	17	--	--
5	33+07.50	28" X 20" C.S.P.A.	13	35	17	18	#6-7
6	36+92.50	SIX 10' X 4' R.C.B.C.	2070	[401 (c)	[401 (c)	--	--
7	38+84.50	TWO 10' X 3' R.C.B.C.	312	]	]	--	--
8	45+39	10' X 8' R.C.B.C.	600	N/A	--	--	--
9	47+60.25	35" X 24" C.S.P.A.	26.5	30	27	3	#10
10	51+76.50	35" X 24" C.S.P.A.	24	24	22	--	--
11	64+99.00	FIVE 12' X 4' R.C.B.C.	1,410	859	859	--	--
12	67+33	FIVE 12' X 3' R.C.B.C.	1,120	--	--	--	--
13	74+15	FOUR 10' X 4' R.C.B.C.	920	86	86	--	--
14	79+21.50	10' X 3' R.C.B.C.	165	191	171	17	#15
15	84+67	FOUR 10' X 3' R.C.B.C.	492	283	282	--	--
16	99+09.75	10' X 3' R.C.B.C.	160	158	151	--	--
17	102+17	SIX 12' X 4' R.C.B.C.	2,052	766	766	--	--
18	106+83.50	SIX 12' X 4' R.C.B.C.	2,016	815	816	--	--
19	110+99	FIVE 12' X 4' R.C.B.C.	1,360	134	134	--	--
20	114+09	35" X 24" C.S.P.A.	25	[32 (c)	[32 (c)	--	--
21	116+05.50	10' X 8' R.C.B.C.	740	]	]	--	--
22	124+23	TWO 42" X 29" C.S.P.A.	58	[62 (c)	[62 (c)	--	--
23	127+67	35" X 24" C.S.P.A.	15.5	]	]	--	--
24	136+16.50	42" X 29" C.S.P.A.	80	82	82	--	--
25	146+50.50	THREE 8' X 3' R.C.B.C.	456	352	350	--	--
26	154+43.50	FOUR 35" X 24" C.S.P.A.	72	54	--	--	--
27	197+74.50	SIX 12' X 4' R.C.B.C.	2,664	1,911	1,905	--	--
28	207+57.50	SIX 12' X 8' R.C.B.C.	3,600	754	748	--	--
29	210+68.50	TWO 42" X 29" C.S.P.A.	14	25	15	10	#30
30	236+91	THREE 8' X 3' R.C.B.C.	312	684	522	154	#31
31	254+82.50	10' X 4' R.C.B.C.	740	1,094	925	170	#32
32	260+98.50	SIX 12' X 6' R.C.B.C.	2,376	413	412	--	--

TABLE 5 (CONT'D.)

STRUCTURE I.D.	STATION	DESCRIPTION	CAPACITY AT BREAKOUT (CFS)	PEAK 100-YEAR DISCHARGE (CFS)	PEAK CULVERT FLOW (CFS)	BREAKOUT FLOW (CFS)	TO CULVERT I.D.
33	264+99.50	TWO 42" X 29" C.S.P.A.	72	426	79	253	#32
						84	#34
34	279+17	FOUR 8' X 3' R.C.B.C.	496	163 (c)	163 (c)	--	--
35	282+90	TWO 28" X 20" C.S.P.A.	16			--	--
36	304+13.00	FOUR 10' X 4' R.C.B.C.	1,400	1,009	1,009	--	--
37	307+78.50	TWO 28" X 20" C.S.P.A.	26	245 (c)	245 (c)	--	--
38	310+12.50	TWO 28" X 20" C.S.P.A.	10			--	--
39	312+27	28" X 20" C.S.P.A.	24			--	--
40	315+02.50	28" X 20" C.S.P.A.	12			--	--
41	316+36.50	10' X 8' R.C.B.C.	670			--	--
42	318+88	28" X 20" C.S.P.A.	10			--	--
43	320+57.50	42" X 29" C.S.P.A.	52			--	--
44	322+99	42" X 29" C.S.P.A.	38			--	--
45	324+95.5	28" X 20" C.S.P.A.	11			--	--
46	327+30	42" X 29" C.S.P.A.	62			--	--
47	328+91	42" X 29" C.S.P.A.	54			--	--
48	336+58.50	49" X 33" C.S.P.A.	26	137 (c)	137 (c)	--	--
49	341+76.50	TWO 10' X 8' R.C.B.C.	1,220			--	--
50	347+26	THREE 10' X 3' R.C.B.C.	570	1,107	891	217	#51
51	349+18	TWO 42" X 29" C.S.P.A.	70	217	91	128	#52
52	352+92	TWO 49" X 33" C.S.P.A.	116	128	117	2	#53
53	357+26	48" C.S.P.	110	2	1	--	--
54	369+17.50	72" C.S.P.	240	328	267	61	#55-60
55	370+82	60" C.S.P.	150	186 (c)	186 (c)		
56	373+07	C.S.P.A.	12				
57	374+90	28" X 20" C.S.P.A.	7.5				
58	378+96	36" C.S.P.	59				
59	379+85	24" C.S.P.	24				
60	384+06	42" X 29" C.S.P.A.	34				
61	473+08	TWO 10' X 10' C.B.C.	4,600	N/C	N/C		

NOTES:

1. STRUCTURE I.D. SHOWN ON DRAINAGE AREA MAP.
2. STATION NUMBER FROM SUN VALLEY PARKWAY DESIGN PLANS.
3. (c) INDICATES COMBINED FLOWS WITHIN BRACKETED STRUCTURES.

EXPLANATION:

R.C.B.C. = REINFORCED CONCRETE BOX CULVERT
C.S.P.A. = CORRUGATED STEEL PIPE ARCH
C.S.P. = CORRUGATED STEEL PIPE
N/C = NOT COMPUTED.

were generally much greater than the drainage areas analyzed as part of the Sun Valley Parkway FIS. However, one stream gage of Agua Fria Tributary at Youngtown, Arizona was in the range of drainage areas analyzed and was also one of the closer existing stream gage stations available. The discharge frequency curve developed in the Corps report (Reference 15) was presented on Plate 58 and is included in Appendix A.4. The 100-year discharge estimated at this gage was 220 cfs with a drainage area of 0.13 sq. mi. To compare this estimated 100-year discharge with others, it was plotted on an enveloping curve of peak discharges in the Phoenix area as obtained from Plate 33 of Reference 16. This curve shown as Figure 8, compares drainage area to discharge in cfs/square miles (csm).

A search for reports of historic flooding events in the watershed area revealed the following description of the flood of August 26-29, 1951 from References 14 and 16.

> **Storm and Flood of August 26-29, 1951.** A tropical hurricane entered the mainland of Mexico from the east of the vicinity of Tampico on August 22. Moist air associated with this storm crossed Mexico to the eastern coast of the Gulf of California. This moist air, augmented by moisture outflow from a tropical storm on the west side of Mexico, began flowing into southwestern Arizona during the 26th, mostly in the vicinity of Organ Pipe Cactus National Monument. By the morning of the 27th, precipitation had become quite general over southern and central Arizona. Heavy precipitation spread northward and northeastward to the northern border of Arizona by the 29th. Moderate to heavy precipitation continued from the 27th through the 29th. The storm was most severe east and north of Phoenix. The total storm precipitation at Phoenix was 3.85 inches. Heaviest precipitation for the period was 13.55 inches at Crown King and 12.11 inches at Sunflower. About 65 percent of the total rainfall occurred during the maximum 24-hour period. The isohyets of the total storm precipitation are shown on Plate 5 (included in Appendix A.4). An estimate by the U.S. Soil Conservation Service, based on high water marks at numerous breaks in the Beardsley Canal in the Trilby Wash area (about 25 miles northwest of Phoenix), indicated a total peak discharge of 35,000 cfs assuming all the numerous flood peaks along Beardsley Canal had occurred at the same time. The total volume of runoff for this flood was estimated at 10,600 acre-feet. The peak discharge at Luke Air Force Base was estimated at 5,000 cubic feet per second by the U.S. Geological Survey. No flood estimates are available for the study area (References 14 and 16).

The Sun Valley Parkway Drainage Design Report (Ref. 2) computed peak discharges using the HEC-1 model for eight of the larger subareas analyzed and the Rational method for the remaining subareas. Storm peak discharges were computed by the HEC-1 model using the 100-year, 1-hour storm precipitation and the HEC-1 (PH card) hypothetical rainfall distribution. Only B and D hydrologic soil groups were considered with curve numbers of 83 and 92, respectively. The report indicated that higher curve numbers were used to account for projected future development.

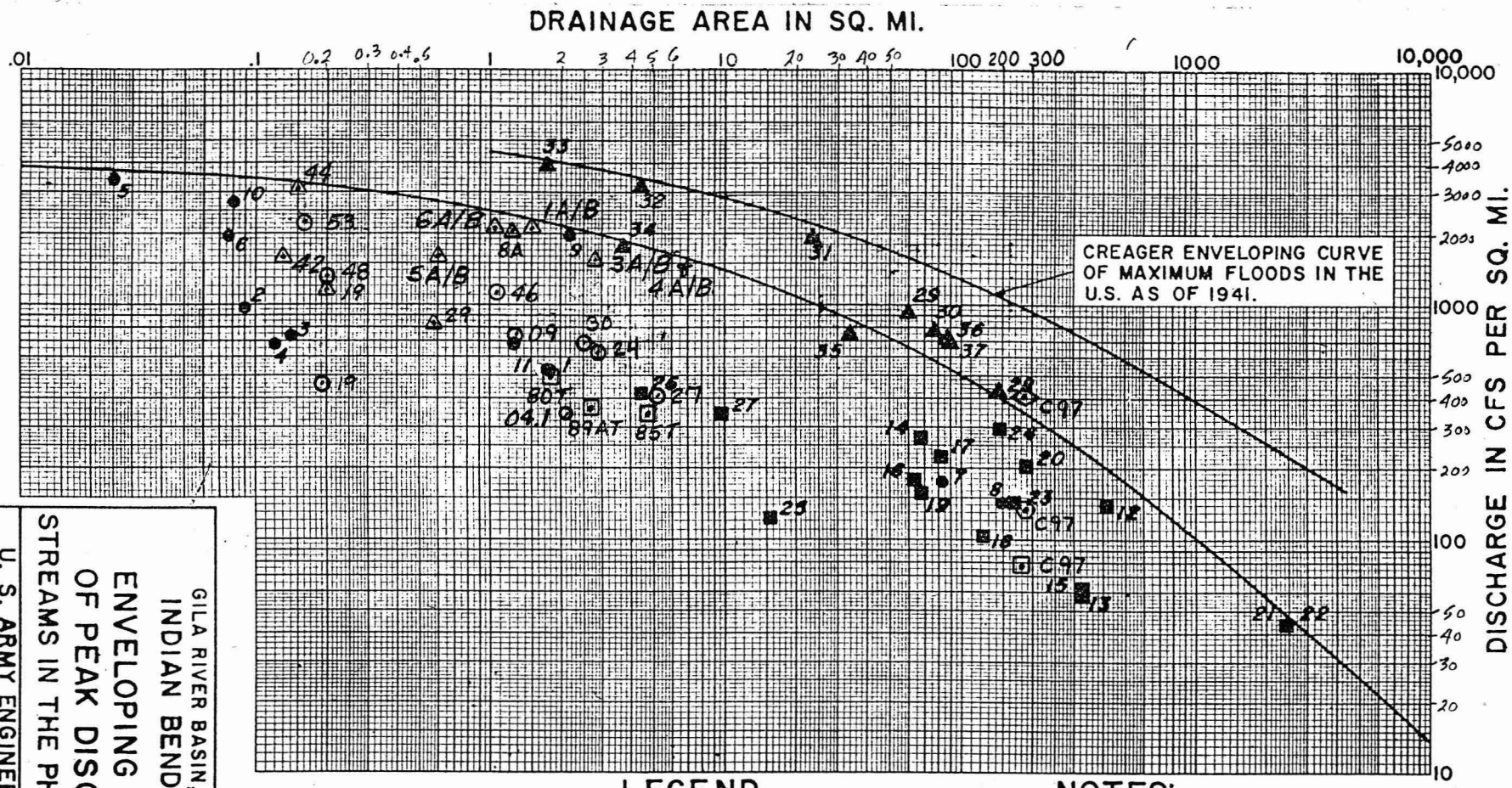
Several representative peak 100-year discharges from the Sun Valley Parkway Drainage Design (Ref. 2) are shown on Table 6 directly across from peak discharges from the Sun Valley Parkway North FIS for approximately the same drainage area. Several of these peak discharges were also plotted on Figure 7, Comparison Plot of Peak Discharges. In general the Drainage Design Report (Ref. 2) peak discharges appeared higher than the FIS results. These higher discharges are attributed to the use of higher curve numbers for future development. These higher range discharges also plot near the curve of maximum recorded and estimated peak discharges in Arizona and are, therefore, considered high for the 100-year event flood.

The Wittman Area Drainage Master Study (ADMS) (Ref. 3) computed peak discharges using the HEC-1 model. The Wittman ADMS methodology was utilized in the Sun Valley Parkway FIS study. Several representative peak 100-year discharges from the Wittman ADMS are shown on Table 6 directly across from peak discharges from the Sun Valley Parkway North FIS for approximately the same drainage area. Several of these peak discharges were also plotted on Figure 7, Comparison Plot of Peak Discharges. In general, the Wittman ADMS (Ref. 3) peak discharges within the watershed area were lower than the FIS peak discharges. The lower peak discharges are suspected to occur because of differences in hydrologic soils group identifications. The Wittman ADMS report indicated a band of Type B soil along the base of the White Tank Mountains followed by Type C soil north to the Trilby Wash area. This FIS report's soil survey data indicated a band of Type C soil along the base of the White Tank Mountains followed by Type B soil north to the Trilby Wash area. The two reports utilized different soil survey data for the area north of the White Tank Mountains; the Sun Valley Parkway FIS used Reference 6,

TABLE 6
COMPARISON OF PEAK DISCHARGES

WITTMAN ADMS REPORT (REF. 3)					SUN VALLEY PARKWAY NORTH FIS				SUN VALLEY PARKWAY DRAINAGE REPORT (REF. 2)			
CONC. POINT	D.A. (SQ. MI.)	WTD. CN	100-YEAR PEAK DISCHARGE (CFS)	100-YEAR PEAK DISCHARGE (CSM)	CONC. POINT	D.A. (SQ. MI.)	100-YEAR PEAK DISCHARGE (CFS)	100-YEAR PEAK DISCHARGE (CSM)	CONC. POINT	D.A. (SQ. MI.)	100-YEAR PEAK DISCHARGE (CFS)	100-YEAR PEAK DISCHARGE (CSM)
C FILE:	WTM100YR				C FILE:	SUNVP2						
90 T	2.23	74	824	(369)	CO 04	2.37	803	(339)				
89 AT	2.69	80	1,006	(373)	CO 14.2	2.44	1,250	(512)				
85 T	4.75	80	1,626	(342)	CO 27	5.1(1)	2,275	(446)				
80 T	1.83	82	938	(513)	SUB 41	1.16	996	(928)	6A & B	1.09	2,283	(2,095)
77 T	2.15	77	1,054	(490)	CO 49	1.86	1,270	(650)				
75	1.51	83	798	(528)	SUB 52	1.21	1,107	(915)	8A	1.23	2,545	(2,069)
					SUB 09	1.25	871	(697)	1A & B	1.52	2,627	(2,102)
					CO 14	0.93(1)	859	(924)	2A & B	0.93	948	(1,019)
					SUB 24	2.86	1,714	(599)	3A & B	2.96	4,492	(1,518)
					SUB 30	2.72	1,841	(677)	4A & B	2.72	4,198	(1,543)
					SUB 46	1.09	1,009	(1,092)	7A & B	0.99	1,185	(1,197)
					SUB 32	0.48	455	(948)	5A & B	0.60	1,010	(1,683)
					SUB 25D	0.65	352	(542)	29	0.58	480	(827)
					SUB 53	0.16	328	(2,050)	44	0.15	474	(3,089)
					SUB 48	0.20	245	(1,225)	42	0.13	206	(1,596)
					SUB 19	0.19	86	(452)	19	0.20	242	(1,153)
C97	258.9	--	20,431	79.2								
C97	258.9	--	37,503	144.9								
C97	258.9	--	110,374	426	C FILE:	WTM100Y2						
C89T(4)	16.86	--	3,717	(220)	C89T	16.86	3,717	(220)				
C76T(5)	106.7	--	11,427	(107.1)	C76T	112.16	12,313	(109.8)				
C76T(6)	139.04	--	14,002	(100.7)	C76T	138.40	14,756	(106.6)				

NOTES:
(1)ESTIMATED AREA - PORTION OF PEAK DISCHARGE FROM DIVERSION (FLOW-SPLIT).
(2)STANDARD PROJECT FLOOD (SPF) AT McMICKEN DAM OUTLET.
(3)PROBABLE MAXIMUM FLOOD (PMF) AT McMICKEN DAM OUTLET.
(4)TRIBUTARY 5 WEST U/S OF TRILBY WASH
(5)TRILBY WASH U/S OF MCMICKEN DAM
(6)TRILBY WASH U/S OF MCMICKEN DAM
(7)C FILE = COMPUTER FILE I.D.



GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH
ENVELOPING CURVE
OF PEAK DISCHARGES
STREAMS IN THE PHOENIX AREA

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY DESIGN MEMO

LEGEND

- (1) ● JUNE 22, 1972 STORM.
- (1) ■ MAJOR STORMS OF RECORD.
- (1) ▲ STANDARD PROJECT FLOODS FOR INDIAN BEND WASH.
- (2) ⊙ SUN VALLEY PARKWAY FIS (100-YEAR PEAK)
- (2) △ SUN VALLEY PARKWAY DRAINAGE REPORT (100-YEAR PEAK)
- (2) ⊡ WITTMAN ADMS (100 YEAR PEAK) (REF. 3)
- (2) ⬡ WITTMAN ADMS (SPF PEAK) (REF. 3)
- (2) ◈ WITTMAN ADMS (PMF PEAK) (REF. 3)

NOTES:

(1) Numbers correspond to those in Table-10 of Ref. 16

(2) Numbers from Table -8 of Sun Valley Parkway North FIS

SOURCE: PLATE 33 (REFERENCE 16)

COMPARISON PLOT OF PEAK 100 YEAR DISCHARGE

FIGURE 7

"Soil Survey of Aguila - Carefree Area - Parts of Maricopa and Pinal Counties, Arizona;" the Wittman ADMS used the SCS, General Soil Map, Maricopa Co., Arizona. The Sun Valley Parkway FIS Soil Survey data was a more recent and detailed soil survey and was thus used for the FIS.

The Wittman ADMS computed 100-year, Standard Project Flood (SPF) and a Probable Maximum Flood (PMF), peak discharges of 20,431 cfs, 37,503 cfs, and 110,374 cfs, respectively at the McMicken Dam spillway to the McMicken Dam outlet channel (Drainage Area = 258.9 sq. mi.). These values are also shown on Table 6 and Figure 7.

The Design Memorandum No. 1, Hydrology and Hydraulic Design for Trilby Wash (a.k.a., McMicken Dam) Detention Basin and Outlet Channel (Reference 14) generated SPF and PMF peak discharges of 35,000 cfs and 120,000 cfs, respectively (Drainage Area = 247 sq. mi.). A SPF flood volume of 32,800 acre-feet was computed with no volume stated for the PMF.

Although the Design Memorandum No. 1 (Reference 14) did not compute 100-year peak discharges, the SPF and PMF results do compare well with the Wittman ADMS results.

A further check was made to compare the results of inserting the hydrology for the Sun Valley Parkway North FIS into the Wittman ADMS's hydrology model. This computer file was identified as WTM100Y2.

As shown on Table 6 Comparison of Peak Discharges Concentration Point North C89T which is located approximately 1 mile dowstream of the CAP over chute in Section 15, and just upstream of any changes made in the Wittman ADMS Study model. Hence peak discharges are the same at this location.

The next concentration point No. C76T, in Table 6 is located on Trilby Wash just upstream of its confuence with McMicken Dam. The Wittman ADMS study completed a 100-year peak discharge of 11427 cfs (D.A. = 106.7 sq.mi.) at this location versus a peak discharge of 12313 cfs (D.A. = 112.1 sq. mi.) computed for the modified model (File = WTM100Y2), the modified model (WTM100Y2) resulted in a 7.8 percent increase in peak discharge over the Wittman ADMS model at this location. A portion of this discharge increase is attributed to an increase in drainage area (5 percent) at this point.

The last concentration point No. C76T is located in the McMicken Dam flood pool just downstream of the Trilby Wash confluence. The Wittman ADMS Study computed a 100-year peak discharge of 14002 cfs (D.A. = 139.0 sq.mi.) at this location versus a peak discharge of 14756 cfs (D.A. = 138.4 sq. mi.) computed for the modified model (File; WTM100Y2). The modified model (WTM100Y2) resulted in a 5.4 percent increase in peak discharge at this location with no change on drainage area. The changes in peak discharges are attributed to differences in soil types (discussed earlier) and routing of subeareas.

The differences in peak discharges between the Wittman ADMS and the modified model (WTM100Y2) resulting from incorporation of the Sun Valley model (SUNVP2) were not considered significant. An analysis of relationship of the discharges using confidence limits per FEMA 37 and Bulletin No. 17B was not possible as stream gage station data was not available for use in the hydrologic analysis.

9.0 CONCLUSION

This report presents the results of a hydrologic analysis of the Sun Valley Parkway North Flood Insurance Study (FIS) watershed area. The report provides 100-year peak discharges at culvert locations along the Parkway and for washes between the Parkway and Trilby Wash and its tributaries to the north for use in hydraulic analysis of 100-year floodplains.

10.0 REFERENCES

1. a) Sun Valley Parkway Grading, Drainage, and Paving Plans, Phase 1A (39 sheets), Sta. 0+00 to 370+00 by Collar, Williams & White Engineering, dated March 30, 1987.

   b) Sun Valley Parkway Drainage Enhancement Plan, Phase IIB (13 sheets) by Collar, Williams & White Engineering, dated October 27, 1988.

   c) Sun Valley Parkway Paving Plans, Phase 1B (13 sheets) Station 370+00 to 491+98 by Collar, Williams & White Engineering, dated March 30, 1987.

2. Drainage Report, Sun Valley Parkway Phase I, Maricopa County, Arizona, CWW No. 850840-6, Prepared for The Adams Group, Prepared by Collar, Williams & White Engineering, dated March 30, 1987.

3. Wittman Area Drainage Master Study, Part A, Hydrology and Hydraulics, Prepared for the Flood Control District of Maricopa County, Prepared by The WLB Group, Inc., dated March 10, 1989.

4. Floodplain Maps, Nos. MC-2, 5, 6, 8, 9, 13, and 14 of 100-Year Floodplain along Trilby Wash, 400-Scale, 4-Foot C.I. by The WLB Group, Inc. and Cooper Aerial Survey Co. for Flood Control District of Maricopa County, date flown 12/11/86.

5. "Soil Survey of Maricopa County, Arizona Central Part," Prepared by United States Department of Agriculture, Soil Conservation Service in cooperation with University of Arizona Agricultural Experiment Station. Report Issued September, 1977.

6. "Soil Survey of Aguila - Carefree Area, Parts of Maricopa and Pinal Counties, Arizona," Prepared by United States Department of Agriculture, Soil Conservation Service in cooperation with Bureau of Indian Affairs, Bureau of Land Management and Arizona Agricultural Experiment Station. Soil Survey compiled in 1978, Report Issued April, 1986.

7. Topographic Maps, by United States Geological Survey 7.5 Minute Series: White Tank Mountains N.E. Arizona, 1957 (Photo revised 1971), White Tank Mountains S.E. Arizona, 1957 (Photo revised 1971), McMicken Dam, Arizona, 1957 (Photo revised 1981), Waddell, Arizona 1957 (Photo revised 1971).

8. Aerial Photography by Landis Aerial Surveys, Scale: 1" = 1,200 feet, Date Flown: Nov. 20 and Dec. 11, 1987, Photo Nos. J-8, 9, and 10, and K-8 and 10.

9. Topographic Mapping, 1/4 Section Mapping, Scale: 1" = 100', 1-foot C.I., Date Flown: 1987, Prepared for The Adams Group, was reviewed at the Office of the Flood Control District of Maricopa County on October 4, 1990. Several Maps with I.D. Nos. 15-12, 16-12, 17-12, 18-12, and 19-12 were Noted to Provide Topographic Coverage Adjacent to the Western Drainage Area Boundary of the Study, but did not provide useful information for the Sun Valley Parkway North FIS.

10. "Hydraulic Charts for the Selection of Highway Culverts," Hydrologic Engineering Circular No. 5 (HEC-5), Federal Highway Administration, Dec., 1965.

11. "Hydrologic Design for Highway Drainage in Arizona," Arizona Highway Department, Bridge Division, by Eugene I. Jencsok, December 1, 1968, Revised March 1969.

12. Aerial Photography (Flown 9/28/90) and Topographic Mapping by Cooper Aerial of Phoenix, Inc. Aerial Photography Flown (1:15,000 Scale) and 400-Scale, 4-Foot C.I., Topographic Mapping Compiled for 1-Mile Wide (approximate) strip along south side of Sun Valley Parkway. Aerial Photography Flown (1:8200 Scale) and 400-Scale, 2-Foot C.I. Topographic Mapping Compiled From Sun Valley Parkway to Northern Study Limits with Existing Trilby Wash Floodplain.

13. Orthophoto Mapping from Arizona State Land Department and Acme Blueprint, Phoenix. Scale: 1:24000. White Tank Mountains N.E. Arizona, No. 2077, Photo Date, Nov. 1972, and McMicken Dam, Arizona, No. 2177, Photo Date, June 1971.

14. Design Memorandum No. 1, Hydrology and Hydraulic Design for Trilby Wash Detention Basin and Outlet Channel, Corps of Engineers, U.S. Army, Los Angeles District, Nov. 1953.

15. Design Memorandum No. 2, Hydrology, Part 1, Gila River Basin, New River and Phoenix City Streams, Arizona U.S. Army Engineer District, Los Angeles, Corps of Engineers, 1974.

16. Design Memorandum No. 1, General Design Memorandum - Phase I, Plan Formulation for Indian Bend Wash, Gila River Basin, Arizona, Los Angeles District, U.S. Army Corps of Engineers, October, 1973.

17. Design Memorandum No. 2, Hydrology Part 2, Gila River Basin, Phoenix, Arizona and Vicinity (including New River), U.S. Army Corps of Engineers, Los Angeles District, 1982.

18. NOAA Atlas 2, Precipitation - Frequency Atlas of the Western United States, Volume III - Arizona by U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), 1973.

19. "Urban Hydrology for Small Watersheds," Technical Release 55 (TR-55), United States Department of Agriculture, Soil Conservation Service (SCS), June 1986.

20. LAPRE-1, Los Angeles District Preprocessor to HEC-1, Los Angeles District, U.S. Corps of Engineers, January 1989.

21. Hydraulic Charts for the Selection of Highway Culverts, Hydraulic Engineering Circular No. 5 (HEC-5), U.S. Department of Transportation, Federal Highway Administration, December 1965, Reprinted April, 1977.

22. Handbook of Hydraulics, Sixth Edition by Ernest F. Brater and Horace Williams King, 1976.

23. HEC-2 Computer Program, Water Surface Profiles, September 1988 Version by U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California 95616.

24. HEC-1 Computer Program, Flood Hydrograph Package, Revised June 1985 Version by U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California, 900 Ordinate Version 3.1a Modification by Haestad Methods, Waterbury, Conn.

Appendix A.1-

Aerial Photography and Mapping Coverage

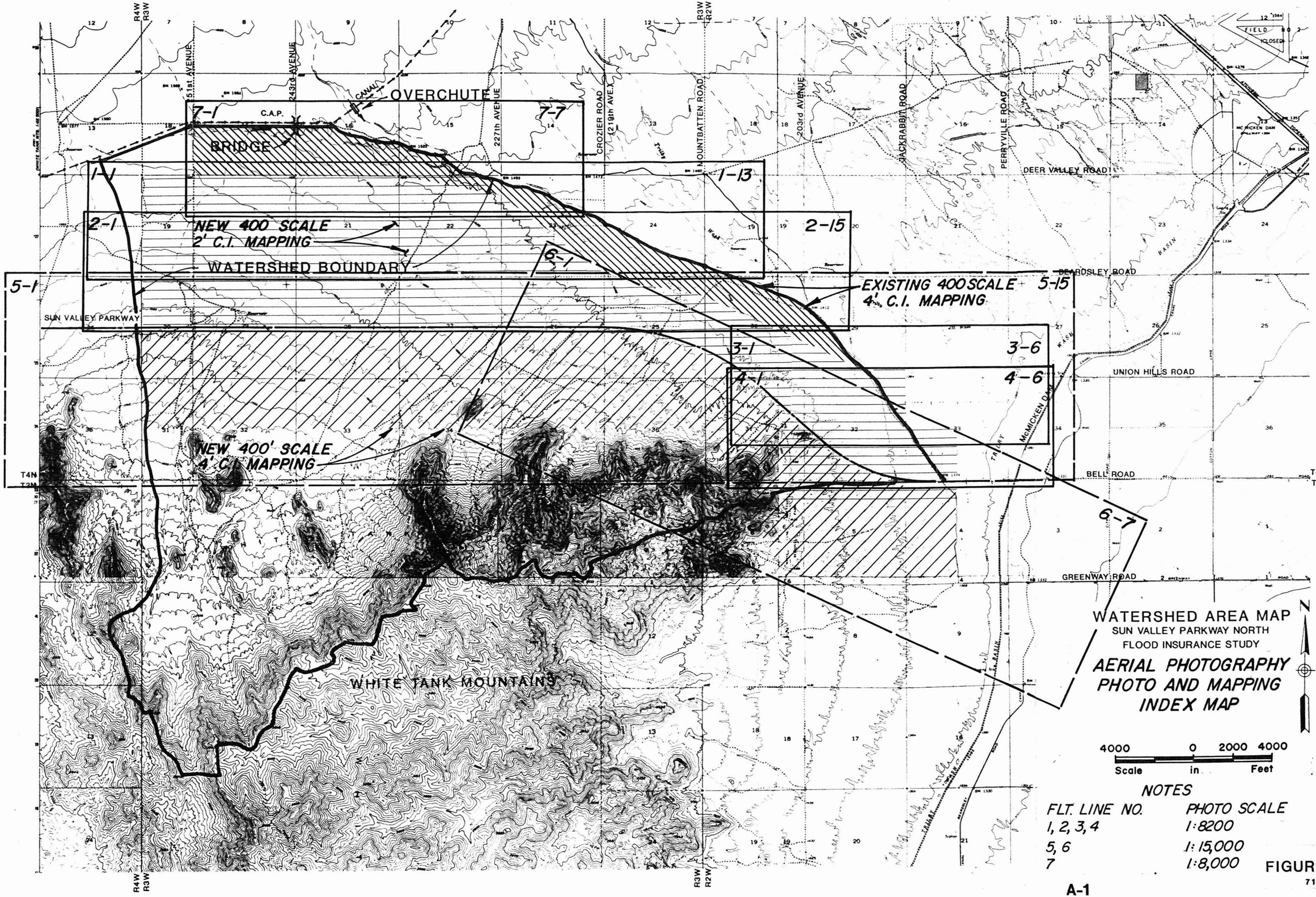


FIGURE A-1

7158-01

Appendix A.2-

Vegetative Cover Survey

EXHIBIT 1

N.E. from the S.1/4 Corner
Section 16 T.4N., R.3W
Creosote on barren soil.
Cover 25%

EXHIBIT 2

N.E. from the S.1/4 Corner
Section 21 T.4N., R.3W.
Creosote on barren soil.
Cover 18%

EXHIBIT 3

N.E. from the S.1/4 Corner
Section 22 T.4N., R.3W.
Creosote on barren soil.
Cover 36%

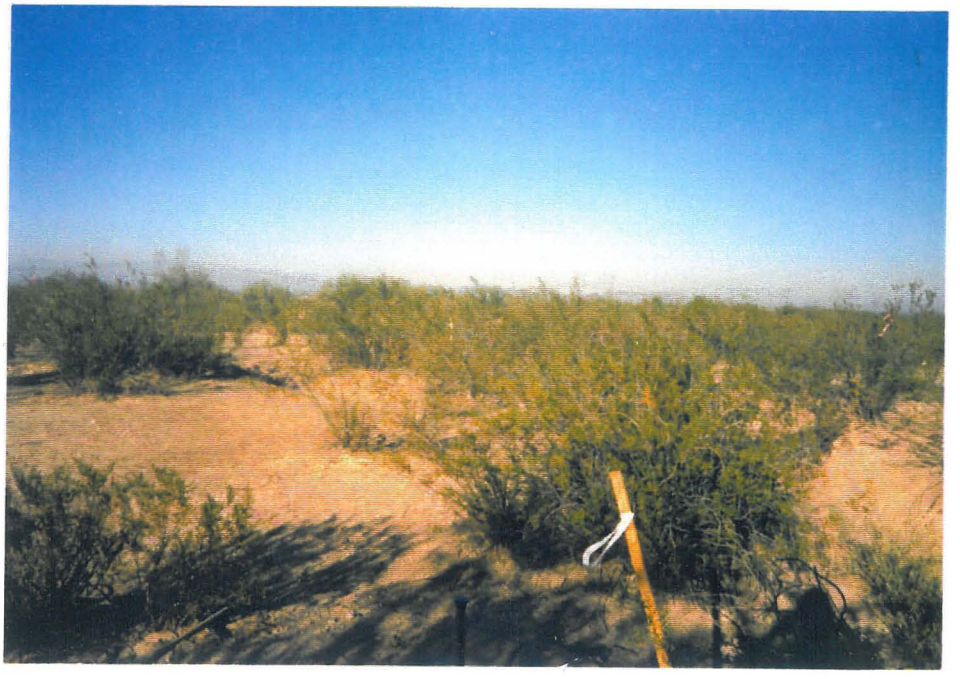


EXHIBIT 4

N.E. from the S.1/4 Corner
Section 22 T.4N., R.3W.
Creosote on barren soil
Cover 36%

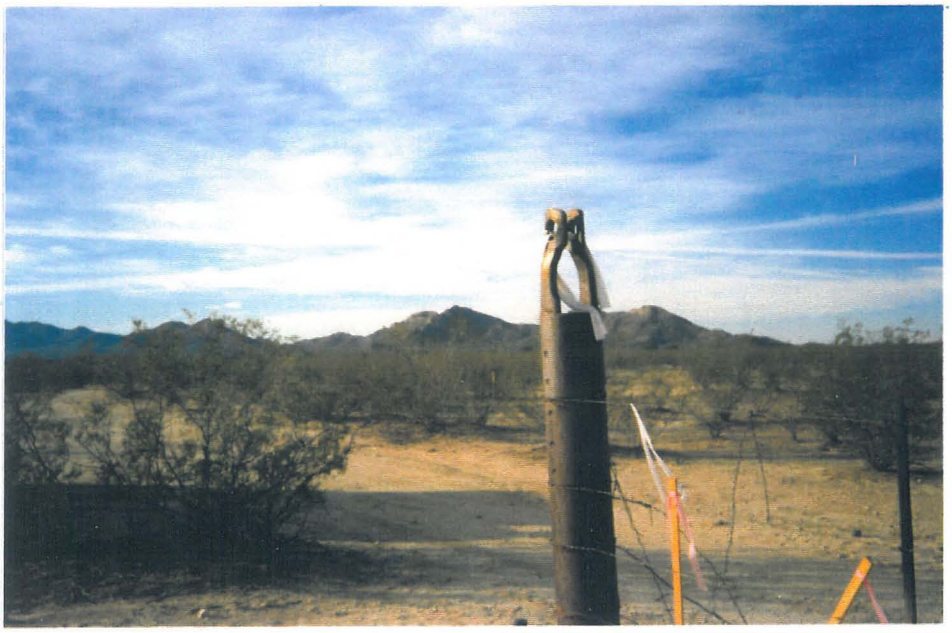


EXHIBIT 5

S.W. from the S.W. Corner
Section 20 T.4N., R.3W.
Creosote on barren soil.
Cover 21%

EXHIBIT 6

N.E. of the W.1/4 Corner
Section 20 T.4N., R.3W.
Creosote on barren soil
Cover 5%

EXHIBIT 7

S.W. of the W.1/4 Corner
Section 33 T.4N., R.2W
Light brush.
Cover 6%

EXHIBIT 8

N.E. of the S.W. Corner
Section 29 T.4N., R.2W.
Brush & creosote on barren soil.
Cover 21%

EXHIBIT 9

In the N.W.1/4 Section 30
T.4N., R.2W.
Light brush.
Cover 15%

EXHIBIT 10
S.E. from the N.W. Corner
Section 24 T.4N., R.3W.
Creosote on barren soil.
Cover 19%

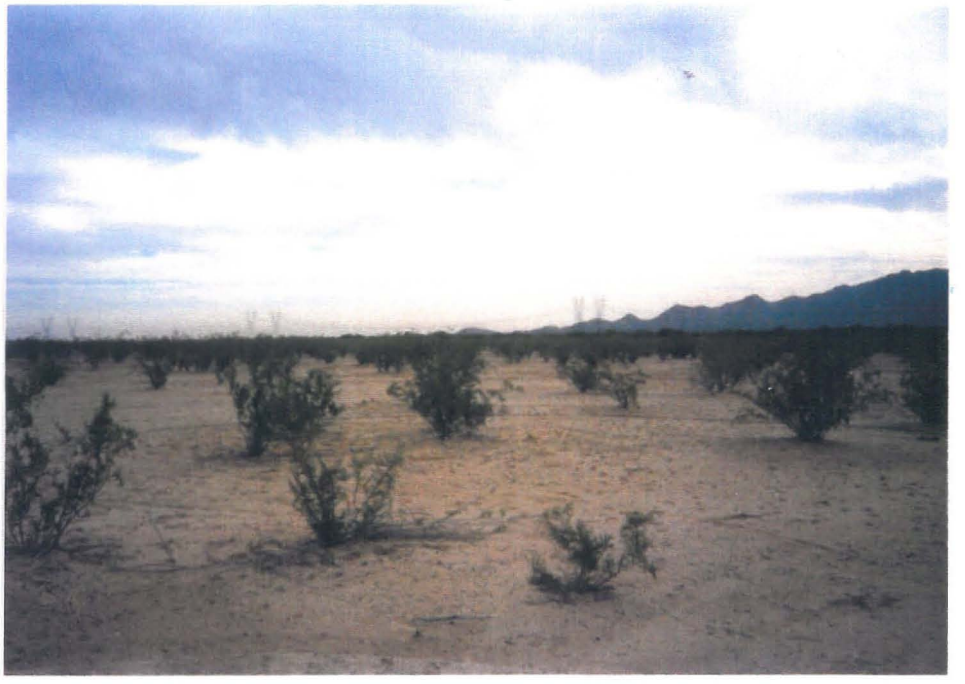


EXHIBIT 11
S.E. from the N.W. Corner
Section 23 T.4N., R.3W.
Creosote on barren soil.
Cover 16%

EXHIBIT 12
S.W. from the N.E. Corner of
the N.1/2S.E.1/4 of Section 23
T.4N., R.3W.
Creosote on barren soil.
Cover 27%

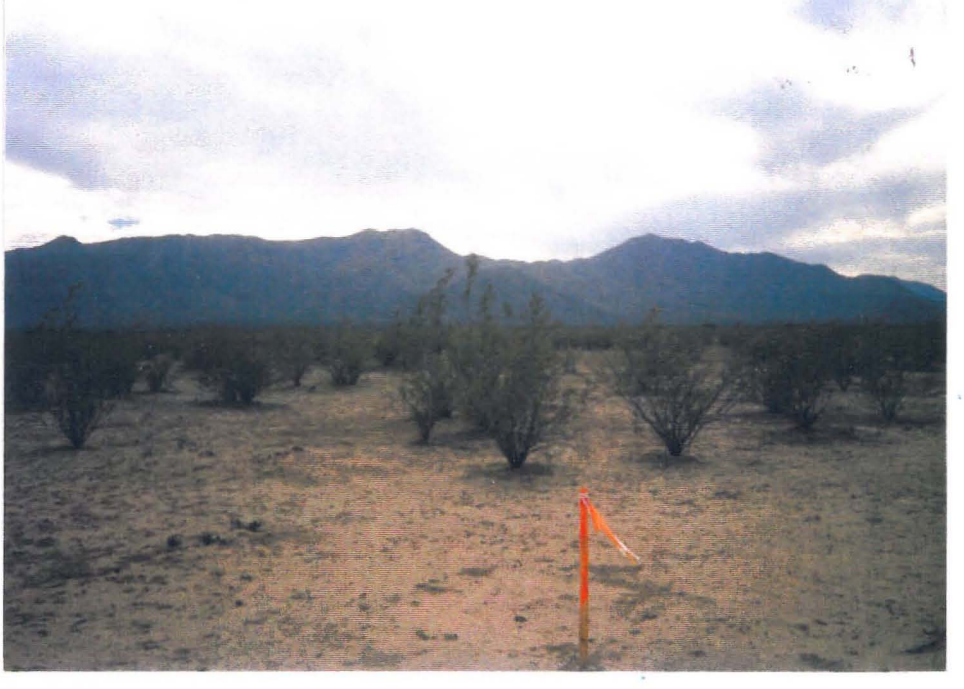


EXHIBIT 13

N.E. from the N.W. Corner
Section 33 T.4N., R.3W.
Creosote, light brush & cactus.
Cover 33%

EXHIBIT 14

Near the N.1/4 Corner
Section 34 T.4N., R.3W.
Creosote, cactus, & brush.
Cover 32%

EXHIBIT 15

1000' West of the E.1/4 Corner
Section 31 T.4N., R.2W.
Cactus & brush.
Cover 29%

Appendix A.3-

Existing Culvert Crossings

TABLE A-1

SUN VALLEY PARKWAY
SUMMARY OF EXISTING CULVERT CROSSINGS

Structure I.D.	Station	Description
1	4+30.50	140 L.F., 10' X 3' R.C.B.C.
2	16+19.50	146 L.F., three 49" X 33" C.S.P.A.
3	26+06.25	134 L.F., 10' X 3' R.C.B.C.
4	30+35.50	223 L.F., two 49" X 33" C.S.P.A.
5	33+07.50	147 L.F., 28" X 20" C.S.P.A.
6	36+92.50	141 L.F., six 10' X 4' R.C.B.C.
7	38+84.50	163 L.F., two 10' X 3' R.C.B.C.
8	45+39	184 L.F., 10' X 8' R.C.B.C.
9	47+60.25	147 L.F., 35" X 24" C.S.P.A.
10	51+76.50	140 L.F., 35" X 24" C.S.P.A.
11	64+99.00	145 L.F., five 12' X 4' R.C.B.C.
12	67+33	140 L.F., five 12' X 3' R.C.B.C.
13	74+15	154 L.F., four 10' X 4' R.C.B.C.
14	79+21.50	138 L.F., 10' X 3' R.C.B.C.
15	84+67	158 L.F., four 10' X 3' R.C.B.C.
16	99+09.75	133 L.F., 10' X 3' R.C.B.C.
17	102+17	137 L.F., six 12' X 4' R.C.B.C.
18	106+83.50	148 L.F., six 12' X 4' R.C.B.C.
19	110+99	135 L.F., five 12' X 4' R.C.B.C.
20	114+09	140 L.F., 35" X 24" C.S.P.A.
21	116+05.50	145 L.F., 10' X 8' R.C.B.C.
22	124+23	135 L.F., two 42" X 29" C.S.P.A.
23	127+67	135 L.F., 35" X 24" C.S.P.A.
24	136+16.50	137 L.F., 42" X 29" C.S.P.A.
25	146+50.50	141 L.F., three 8' X 3' R.C.B.C.
26	154+43.50	161 L.F., four 35" X 24" C.S.P.A.
27	197+74.50	137 L.F., six 12' X 4' R.C.B.C.
28	207+57.50	159 L.F., six 12' X 8' R.C.B.C.
29	210+68.50	144 L.F., two 42" X 29" C.S.P.A.
30	236+91	214 L.F., three 8' X 3' R.C.B.C.
31	254+82.50	170 L.F., 10' X 4' R.C.B.C.
32	260+98.50	144 L.F., six 12' X 6' R.C.B.C.
33	264+99.50	135 L.F., two 42" X 29" C.S.P.A.
34	279+17	142 L.F., four 8' X 3' R.C.B.C.
35	282+90	139 L.F., two 28" X 20" C.S.P.A.
36	304+13.00	147 L.F., four 10' X 4' R.C.B.C.
37	307+78.50	139 L.F., two 28" X 20" C.S.P.A.
38	310+12.50	137 L.F., two 28" X 20" C.S.P.A.

TABLE A-1 (Cont'd.)

Structure I.D.	Station	Description
39	312+27	141 L.F., 28" X 20" C.S.P.A.
40	315+02.50	157 L.F., 28" X 20" C.S.P.A.
41	316+36.50	149 L.F., 10' X 8' R.C.B.C.
42	318+88	155 L.F., 28" X 20" C.S.P.A.
43	320+57.50	160 L.F., 42" X 29" C.S.P.A.
44	322+99	155 L.F., 42" X 29" C.S.P.A.
45	324+95.5	139 L.F., 28" X 20" C.S.P.A.
46	327+30	177 L.F., 42" X 29" C.S.P.A.
47	328+91	166 L.F., 42" X 29" C.S.P.A.
48	336+58.50	136 L.F., 49" X 33" C.S.P.A.
49	341+76.50	136 L.F., two 10' X 8' R.C.B.C.
50	347+26	169 L.F., three 10' X 3' R.C.B.C.
51	349+18	155 L.F., two 42" X 29" C.S.P.A.
52	352+92	169 L.F., two 49" X 33" C.S.P.A.
53	357+26	192 L.F., 48" C.S.P.
54	369+17.50	198 L.F., 72" C.S.P.
55	370+82	174 L.F., 60" C.S.P.
56	373+07	28" X 20" C.S.P.A.
57	374+90	136 L.F., 28" X 20" C.S.P.A.
58	378+96	36" C.S.P.
59	379+85	24" C.S.P.
60	384+06	42" X 29" C.S.P.A.
61	473+08	192 L.F., two 10' X 10' C.B.C.

Notes:
1. Structure I.D. shown on Drainage Area Map.
2. Station Number from Sun Valley Parkway Design Plans.

Appendix A.4

Area Flood Frequency Analysis Data

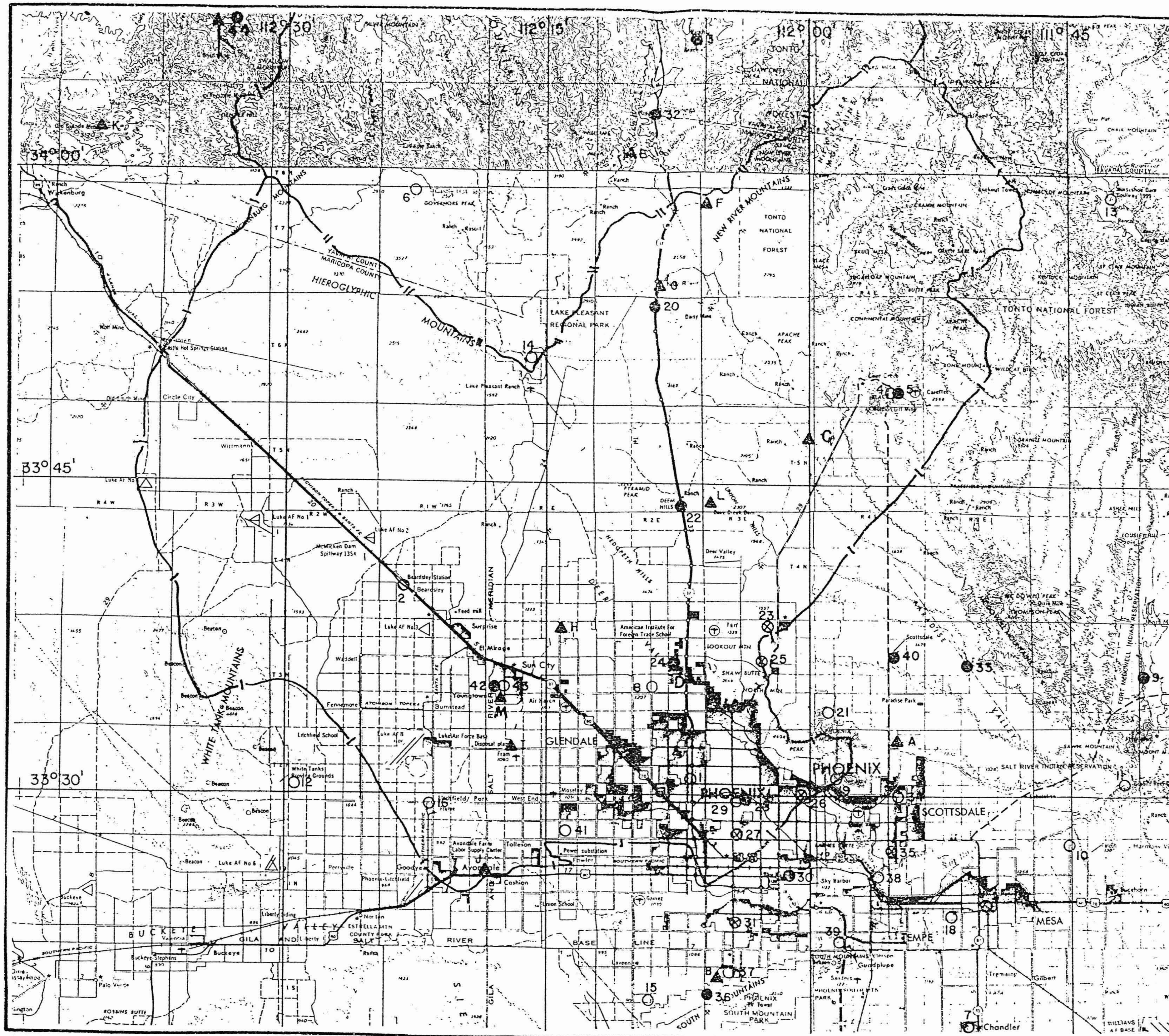
SOURCE: REFERENCE 15

TABLE 2

Stream Gages

Letter	Stream Gage Name	USGS No.	Drainage Area (sq. miles)	Period of Record	Maximum Discharge (c.f.s.)	Date of Maximum Discharge
A	Indian Bend Wash near Scottsdale, AZ	09512100	142	1961 to present	20,000	June 22, 1972
B	Salt River Tributary in South Mountain Park, at Phoenix, AZ	09512200	1.75	1961 to present	670	Sept. 4, 1965
C	Cave Creek near Cave Creek, AZ	09512300	121	1963 to present	12,400	Dec. 19, 1967
D	Cave Creek at Phoenix, AZ	09512400	252	1957 to present	4,080	Dec. 19, 1967
E	Agua Fria River near Rock Springs, AZ	09512800	1,130	1970 to present	40,100	Sept. 5, 1970
F	New River near Rock Springs, AZ	09513780	67.3	1962 to present	18,600	Sept. 5, 1970
G	New River at New River, AZ	09513800	85.7	1960 to present	19,500	Sept. 5, 1970
H	New River at Bell Road, near Peoria, AZ	09513835	187	1965 to present	14,600	Dec. 19, 1967
I	New River near Glendale, AZ	09513910	323	1961 to present	19,800	Dec. 19, 1967
J	Agua Fria River at Avondale, AZ	09513970	2,013	1960 to present	20,600	Sept. 6, 1970
K	Hassayampa River at Box damsite, near Wickenburg, AZ	09515500	417	1946 to present	58,000	Sept. 5, 1970
L	Skunk Creek near Phoenix, AZ	09513860	64.6	1960 to present	11,500	Aug. 1, 1964
M	Agua Fria River Tributary at Youngtown, AZ	09513700	0.13	1961 to 1968	73	Oct. 16, 1964

Note: See plate 8 for stream gage locations



LEGEND

—I— BOUNDARY OF DRAINAGE AREA.

—II— BOUNDARY OF DRAINAGE SUBAREA.

● RECORDING GAGE

○ STANDARD 8" NON-RECORDING GAGE.

⊗ OTHER NON-RECORDING GAGE.

◐ RECORDING + STANDARD 8" NON-RECORDING GAGES.

▲ STREAMGAGE

N

SCALE IN MILES

5 0 5 10

NOTE: REFER TO TABLES 1 & 2

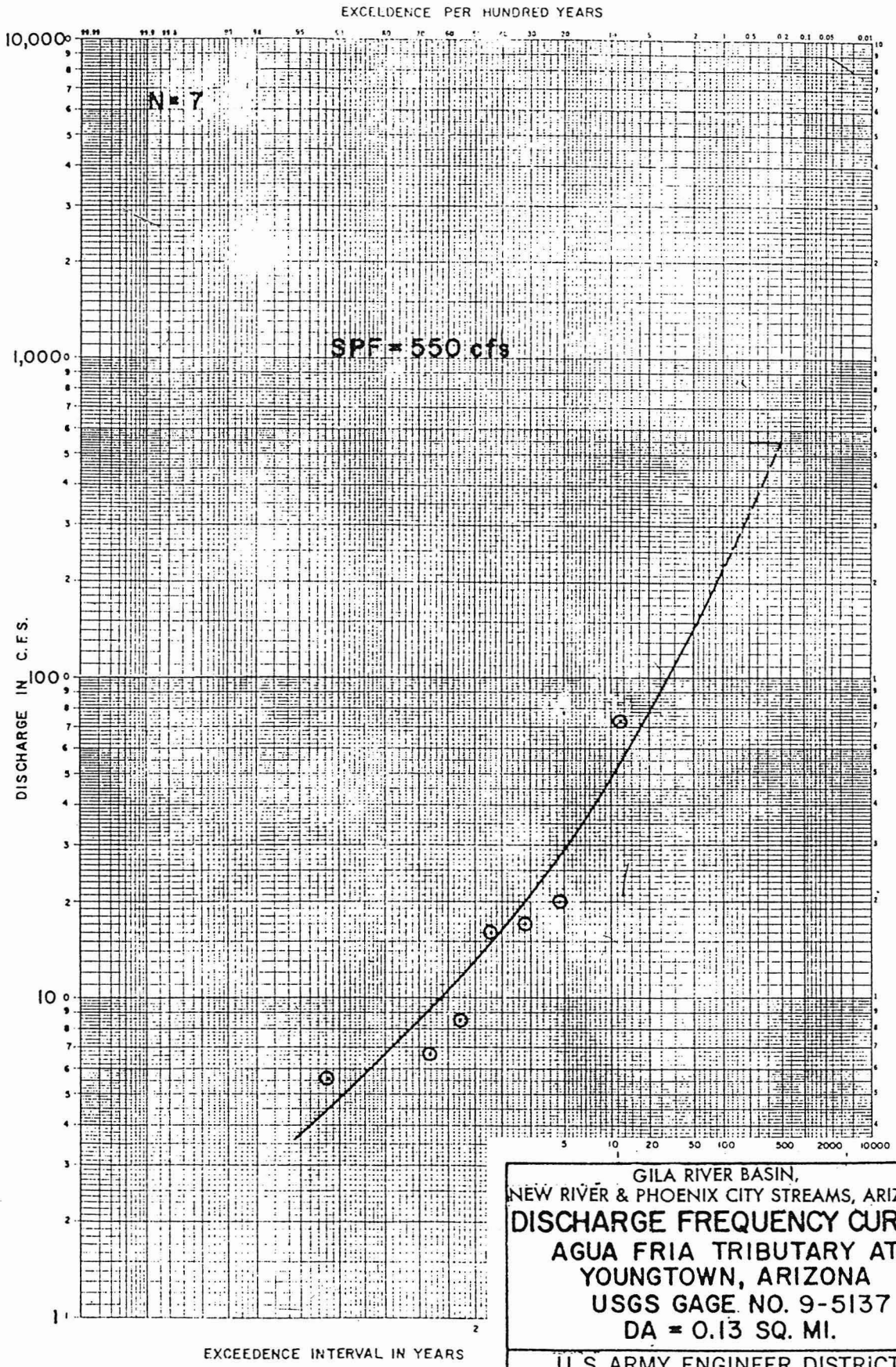
GILA RIVER BASIN,
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA

PRECIPITATION AND STREAMGAGE STATIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY DESIGN MEMO NO. 2

SOURCE: REFERENCE 15

PLATE 8



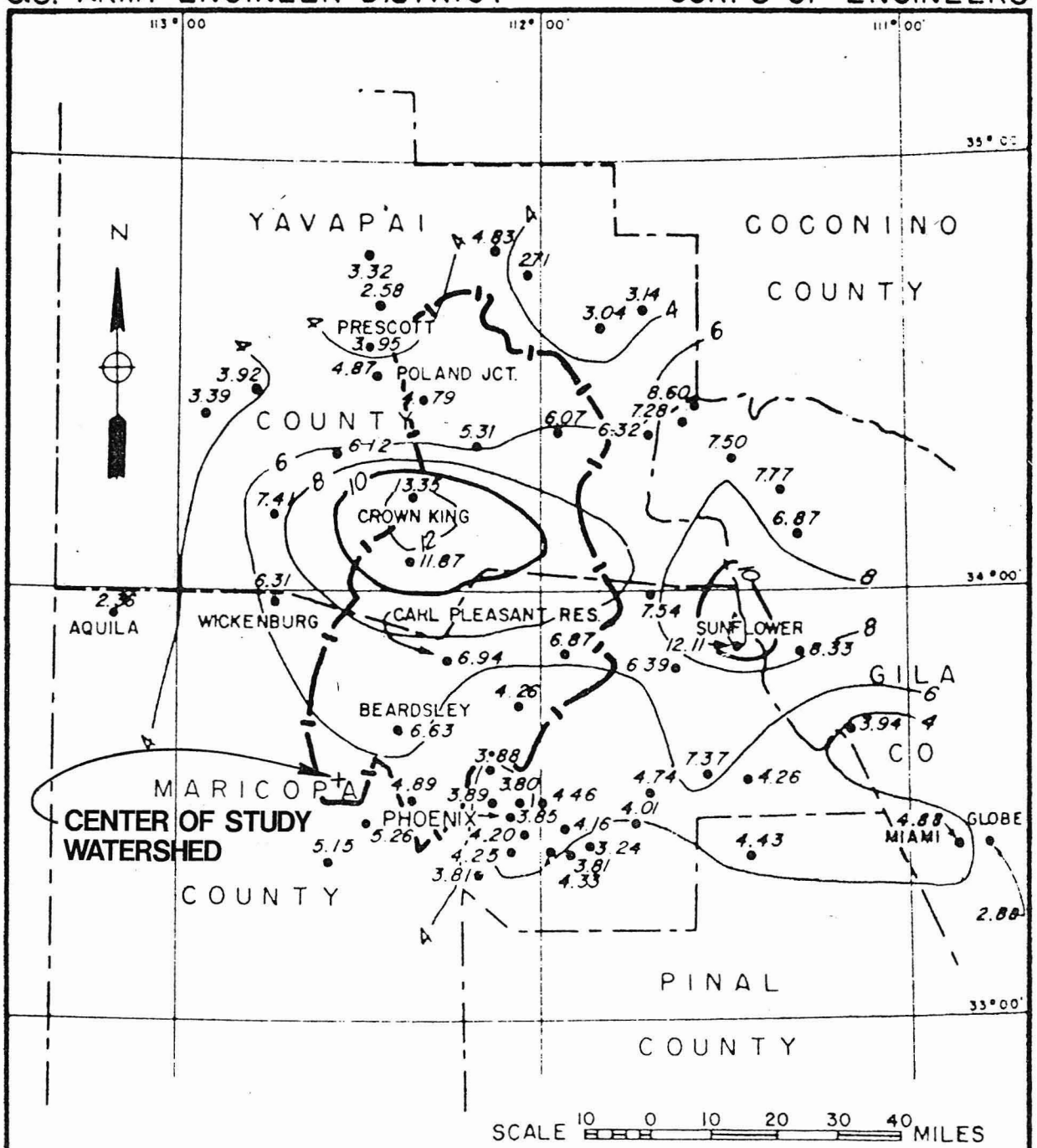
GILA RIVER BASIN,
NEW RIVER & PHOENIX CITY STREAMS, ARIZON

DISCHARGE FREQUENCY CURVE
AGUA FRIA TRIBUTARY AT YOUNGTOWN, ARIZONA
USGS GAGE NO. 9-5137
DA = 0.13 SQ. MI.

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY DESIGN MEMO NO. 2

SOURCE: REFERENCE 15

PLATE 58



LEGEND

—1— BOUNDARY OF DRAINAGE AREA.

—8— LINE OF EQUAL PRECIPITATION IN INCHES.

● 6.31 RECORDED PRECIPITATION DEPTH IN INCHES.

GILA RIVER BASIN, ARIZONA
INDIAN BEND WASH

ISOHYETAL MAP

STORM OF AUG. 26-29, 1951

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY DESIGN MEMO

SOURCE: REFERENCE 15

FILE NO. 238/7 APPENDIX I PLATE 5

Appendix B-

Kinematic Wave Input Parameters

AMWEST INC. Consulting Engineers

Project 7158-01 Sht. 1 of ____

Sun Valley Parkway FIS

Calc. By GAS Date 11/15/90

Chkd. ____ Date ____

Unit Graph / Kinematic Wave Data

SUB 01

	(L)	(S)	(N)	(A)				
UK	175	0.02	0.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	5500	.019	.05	—	—	20	10	—

UK card Overland Flow Length = 200' width of Subarea / 2 No. Washes × 2 sides/wash
= 175'

SUB 02

	(L)	(S)	(N)	(A)				
UK	225	.01	0.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	12,500	.010	0.05	—	—	200	10	—

UK card Overland Flow Length = 1800' width of Subarea / 4 No. Washes × 2 sides/wash
= 225'

SUB 03

	(L)	(S)	(N)	(A)				
UK	100	.016	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3000	.016	.05	—	—	20	10	—

UK Card Overland Flow Length = 1000' width of subarea / 5 No. Washes × 2 sides/wash
= 100'

Unit Graph / Kinematic Wave Data

SUB 04

	(L)	(S)	(N)	(A)				
UK	333'	.011	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	11000	.011	.05	—	—	140	10	Yes —

UK card Overland Flow Length = 2000 width of Subarea / 3 No. Washes x 2 sides/wash
= 333'

SUB 06

	(L)	(S)	(N)	(A)				
UK	460	.011	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	7200	.011	.05	—	—	125	10	

UK card Overland Flow Length = 2800' width of Subarea / 3 No. Washes x 2 sides/wash
= 460

SUB 07

	(L)	(S)	(N)	(A)				
UK	100	.02	.2	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	1500	.018	.05	—	—	2	6	

UK Card Overland Flow Length = 200' Width of Subarea / 1 No. Washes x 2 sides/wash
= 100'

PAWEST INC.
Consulting Engineers

Project 7158-01 Sht. 3 of
Sun Valley Parkway FIS Calc. By GAS Date 11/15/90
Chkd. Date

Unit Graph / Kinematic Wave Data

SUB 08

	(L)	(S)	(N)	(A)
UK	175	.02	0.20	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	1200	.018	.05	—	—	15	6	

UK card Overland Flow Length = 350' width of Subarea / 1 No. Washes x 2 sides/wash
= 175'

SUB 05

	(L)	(S)	(N)	(A)
UK	200	.019	.20	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	8500	.019	.05	—	—	45	10	

UK card Overland Flow Length = 800' width of Subarea / 2 No. Washes x 2 sides/wash
= 200'

SUB 10

	(L)	(S)	(N)	(A)
UK	325	.018	.20	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	5000	.018	.05	—	—	50	10	~~Yes~~ —

UK Card Overland Flow Length = 1300' width of Subarea / 2 No. Washes x 2 sides/wash
= 325'

Unit Graph / Kinematic Wave Data

SUB 11

	(L)	(S)	(N)	(A)				
UK	100'	.015	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	1000	.019	.05	—	—	2	6	—

UK card Overland Flow Length = 200' width of Subarea / 1 No. washes x 2 sides/wash
= 100'

SUB 12

	(L)	(S)	(N)	(A)				
UK	275	.019	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3500	.019	.05	—	—	15	10	—

UK card Overland Flow Length = 1100' width of Subarea / 2 No. washes x 2 sides/wash
= 275'

SUB 13

	(L)	(S)	(N)	(A)				
UK	200'	.03	.25	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	10000	.03	.05	—	—	40	10	—

UK Card Overland Flow Length = 1200' Width of Subarea / 3 No. Washes x 2 sides/wash
= 200'

Unit Graph / Kinematic Wave Data

SUB 14

	(L)	(S)	(N)	(A)					
UK	150	.0175	.2	100					
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)	
RK	8000	.0175	.05	—	—	90	10	~~Yes~~	—

UK card Overland Flow Length = 1500' width of Subarea / 5 No. Washes x 2 sides/wash
= 150'

SUB 15

	(L)	(S)	(N)	(A)				
UK	333	.010	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	6500	.010	.05	—	—	120	10	~~Yes~~ —

UK card Overland Flow Length = 1000' width of Subarea / 6 No. Washes x 2 sides/wash
= 333'

SUB 16

	(L)	(S)	(N)	(A)				
UK	125	.012	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	7500	0.012	.05	—	—	60	10	

UK Card Overland Flow Length = 1500' width of subarea / 6 No. Washes x 2 sides/wash
= 125'

Unit Graph / Kinematic Wave Data

SUB 17

	(L)	(S)	(N)	(A)
UK	330	.010	.13	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4000	.010	.05	—	—	120	10	Yes —

UK card Overland Flow Length = 1000' width of Subarea / 1.5 No. Washes x 2 sides/wash
= 330'

SUB 18

	(L)	(S)	(N)	(A)
UK	180	.012	.13	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	8000	.012	.05	—	—	150	10	

UK card Overland Flow Length = 2500' width of Subarea / 7 No. Washes x 2 sides/wash
= 180'

SUB 20

	(L)	(S)	(N)	(A)
UK	250	.024	.20	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	12500	.024	.05	—	—	160	10	

UK Card Overland Flow Length = 2000' Width of Subarea / 4 No. Washes x 2 sides/wash
= 250'

Unit Graph / Kinematic Wave Data

SUB 21

	(L)	(S)	(N)	(A)				
UK	400	.011	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	10500	.011	.05	—	—	150	10	—

UK card Overland Flow Length = 4000' width of Subarea / 5 No. Washes × 2 sides/wash
= 400'

SUB 22

	(L)	(S)	(N)	(A)				
UK	420	.01	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	9000	.01	.05	—	—	260	10	—

UK card Overland Flow Length = 5000' width of Subarea / 6 No. Washes × 2 sides/wash
= 420

SUB 23

	(L)	(S)	(N)	(A)				
UK	180	.019	.25	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	7500	.019	.05	—	—	45	10	—

UK Card Overland Flow Length = 1100' width of subarea / 3 No. Washes × 2 sides/wash
= 180'

Unit Graph / Kinematic Wave Data

superceded by 25A, 25B, 25C and 25D

SUB 25

	(L)	(S)	(N)	(A)				
UK	180'	.0256	.25	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	12500	.0256	.05	—	—	120	10	—

UK card Overland Flow Length = 2500' width of Subarea / 1 No. Washes x 2 sides/wash
= 180'

SUB 26

	(L)	(S)	(N)	(A)				
UK	260	.011	.15	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	7000	.011	.05	—	—	250	10	~~Yes~~ —

UK card Overland Flow Length = 3200' width of Subarea / 6 No. Washes x 2 sides/wash
= 260'

SUB 27

	(L)	(S)	(N)	(A)				
UK	200'	.010	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	7000	.010	.05	—	—	200	10	~~Yes~~ —

UK Card Overland Flow Length = 1300' Width of Subarea / 3 No. Washes x 2 sides/wash
200'

Unit Graph / Kinematic Wave Data

SUB 28

	(L)	(S)	(N)	(A)				
UK	150'	.0167	0.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	6500	.0167	.05	—	—	8	10	—

UK card Overland Flow Length = 300 width of Subarea / 1 No. Washes x 2 sides/wash
= 150'

SUB 29

	(L)	(S)	(N)	(A)				
UK	160	.015	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	6000	.015	.05	—	—	30	10	—

UK card Overland Flow Length = 1000' width of Subarea / 3 No. Washes x 2 sides/wash
= 160'

SUB 33

	(L)	(S)	(N)	(A)				
UK	200'	0.01	.15	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3000	.008	.05	—	—	250	10	~~Yes~~ —

UK Card Overland Flow Length = 800 Width of Subarea / 2 No. Washes x 2 sides/wash
= 200

Unit Graph / Kinematic Wave Data

SUB 34

	(L)	(S)	(N)	(A)				
UK	350	.0129	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	.0129	.05	—	—	25	10	—

UK card Overland Flow Length = 1400' width of Subarea / 2 No. Washes × 2 sides/wash
= 350'

SUB 35

	(L)	(S)	(N)	(A)				
UK	200	.01	.15	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3100	.008	.05	—	—	250	10	~~Yes~~ —

UK card Overland Flow Length = 800' width of Subarea / 2 No. Washes × 2 sides/wash
= 200'

SUB 36

	(L)	(S)	(N)	(A)				
UK	250	.011	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	9000	.011	.05	—	—	60	10	—

UK Card Overland Flow Length = 1000' Width of Subarea / 2 No. Washes × 2 sides/wash
= 250

Unit Graph / Kinematic Wave Data

SUB 31

	(L)	(S)	(N)	(A)				
UK	300	.025	0.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	8500	.025	.05	—	—	30	10	—

UK card Overland Flow Length = 1200' width of Subarea / 3 No. Washes × 2 sides/wash
= 300'

SUB 38

	(L)	(S)	(N)	(A)				
UK	300	.011	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	7000	.011	.05	—	—	120	10	—

UK card Overland Flow Length = 2500 width of Subarea / 4 No. Washes × 2 sides/wash
= 300

SUB 40

	(L)	(S)	(N)	(A)				
UK	250	.01	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	6000	.0092	.05	—	—	80	10	~~Yes~~ —

UK Card Overland Flow Length = 1500' width of Subarea / 3 No. Washes × 2 sides/wash
= 250'

Unit Graph / Kinematic Wave Data

SUB 43

	(L)	(S)	(N)	(A)
UK	200	.01	.13	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	.009	.05	—	—	120	10	~~Yes~~ —

UK card Overland Flow Length = 800' width of Subarea / 2 No. Washes x 2 sides/wash
= 200'

SUB 44

	(L)	(S)	(N)	(A)
UK	170	.017	.20	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3500	.017	.05	—	—	18	10	—

UK card Overland Flow Length = 1000' width of Subarea / 3 No. Washes x 2 sides/wash
= 170

SUB 45

	(L)	(S)	(N)	(A)
UK	375	.01	.13	100

	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	.01	.05	—	—	60	10	~~Yes~~ —

UK Card Overland Flow Length = 1500 width of subarea / 2 No. Washes x 2 sides/wash

Unit Graph / Kinematic Wave Data

SUB 47

	(L)	(S)	(N)	(A)				
UK	300	.01	.13	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	.01	.05	—	—	40	10	—

UK card Overland Flow Length = 1800' width of Subarea / 3 No. Washes x 2 sides/wash
= 300'

SUB 48

	(L)	(S)	(N)	(A)				
UK	110	.03	.2	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3000	.03	.05	—	—	40	10	—

UK card Overland Flow Length = 2500' Width of Subarea / 11 No. Washes x 2 sides/wash
= 110'

SUB 49

	(L)	(S)	(N)	(A)				
UK	150	.011	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	.011	.05	—	—	100	10	Yes

UK Card Overland Flow Length = 3000 Width of Subarea / 10 No. Washes x 2 sides/wash
= 150'

Unit Graph / Kinematic Wave Data

SUB 50

	(L)	(S)	(N)	(A)				
UK	175	.026	.2	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	.026	.05	—	—	20	10	—

UK card Overland Flow Length = 700' width of Subarea / 2 No. Washes × 2 sides/wash
= 175'

SUB 51

	(L)	(S)	(N)	(A)				
UK	150	.016	.15	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	.016	.05	—	—	50	10	~~Yes~~

UK card Overland Flow Length = 1500' width of Subarea / 5 No. Washes × 2 sides/wash
= 150'

SUB 54

	(L)	(S)	(N)	(A)				
UK	160	.016	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	4500	0.016	.05	—	—	120	10	~~Yes~~ —

UK Card Overland Flow Length = 3000 Width of Subarea / 9 No. Washes × 2 sides/wash
= 160'

Unit Graph / Kinematic Wave Data

SUB 53

	(L)	(S)	(N)	(A)				
UK	125	.05	.25	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3000	.05	.05	—	—	15	6	—

UK card overland Flow Length = 1500' width of Subarea / 6 No. Washes x 2 sides/wash
= 125'

SUB 55

	(L)	(S)	(N)	(A)				
UK	100'	.025	.25	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	1800	.025	.05	—	—	18	6	—

UK card Overland Flow Length = 1200 width of Subarea / 6 No. Washes x 2 sides/wash
= 100'

SUB 56

	(L)	(S)	(N)	(A)				
UK	160	.0167	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	3000	.0167	.05	—	—	60	10	~~Yes~~

UK Card Overland Flow Length = 2000 Width of Subarea / 6 No. Washes x 2 sides/wash
= 160

Unit Graph / Kinematic Wave Data

SUB 19

	(L)	(S)	(N)	(A)				
UK	450	.016	.20	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	6300	.016	.05	—	—	40	10	

UK card Overland Flow Length = 900' width of Subarea / 1 No. Washes x 2 sides/wash
=

SUB ____

	(L)	(S)	(N)	(A)				
UK								
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK								

UK card Overland Flow Length = ___ width of Subarea / ___ No. Washes x 2 sides/wash
=

SUB ____

	(L)	(S)	(N)	(A)				
UK								
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK								

UK Card Overland Flow Length = ___ Width of Subarea / ___ No. Washes x 2 sides/wash

Unit Graph / Kinematic Wave Data

SUB 25D

	(L)	(S)	(N)	(A)				
UK	250	.0256	.25	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	12 600	.0256	.05	—	—	80	10	—

UK card Overland Flow Length = 1500 width of Subarea / 3 No. Washes x 2 sides/wash
= 250'

SUB 32A

	(L)	(S)	(N)	(A)				
UK	250	.014	.2	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	1900	.014	.05	—	—	6	10	

UK card Overland Flow Length = 500 width of Subarea / 1 No. Washes x 2 sides/wash
= 250

SUB ____

	(L)	(S)	(N)	(A)				
UK								
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK								

UK Card Overland Flow Length = ___ Width of subarea / ___ No. Washes x 2 sides/wash

Unit Graph / Kinematic Wave Data

SUB 25A

	(L)	(S)	(N)	(A)				
UK	200	.016	.2	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	2500	.016	.05	—	—	8	6	—

UK card Overland Flow Length = 400' width of Subarea / 1 No. Washes x 2 sides/wash
= 200'

SUB 25B

	(L)	(S)	(N)	(A)				
UK	200	.017	.2	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	5300	.017	.05	—	—	16	10	—

UK card Overland Flow Length = 400 width of Subarea / 1 No. Washes x 2 sides/wash
= 200'

SUB 25C

	(L)	(S)	(N)	(A)				
UK	230	.016	.2	100				
	(L)	(S)	(N)	(CA)	(SHAPE)	(WD)	(Z)	(UPSTQ)
RK	8000	.016	.05	—	—	40	10	—

UK Card Overland Flow Length = 700 Width of Subarea / 1.5 No. Washes x 2 sides/wash
= 230'

Appendix C-

Channel Routing and Cross-Sections

AMWEST INC.
Consulting Engineers

Modified based on channel (field) measurements

Project _____ Sht. ___ of ___

Calc. By OTS Date 12/11/90

Chkd. GAS Date 1/7/91

|| Rev. 2/26/91

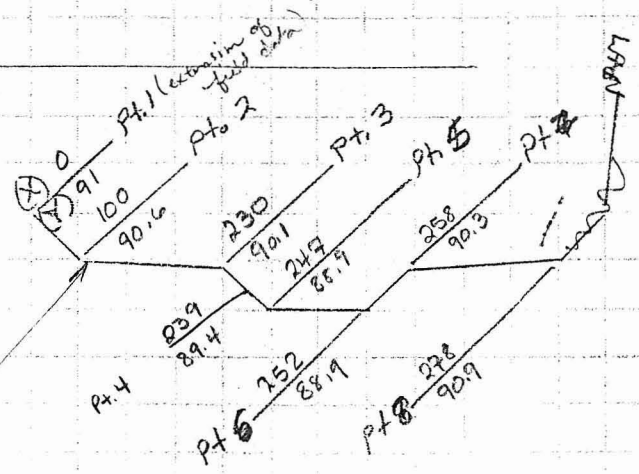
Modified Puls (Normal-Depth) Channel Routing Data

Location: _____

HEC-1 Routing I.D.: R01.1

W.S. 90.6 A = 70.6 □ Q = 131 cfs
P = 168 V = 1.86 fps
R = 0.42

W.S. 90.9 A = 134 □ Q = 289
P = 253 V = 2.16
R = .53



See Field Surveyed X-Section on Next Page.

$$NSTPS = \frac{L/V}{\Delta t} = \frac{12{,}500' / 2.16\,fps}{3\,min \times 60\,s/min} = 32.2 \sim 32$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0 || 89.5 ||					
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 32	Flow	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC 0.05	0.045	0.05	12,500	0.010					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	100	230	239	247	252	258	278		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 91	90.6	90.1	89.4	88.9	88.9	90.3	90.9		

All Sections looking downstream

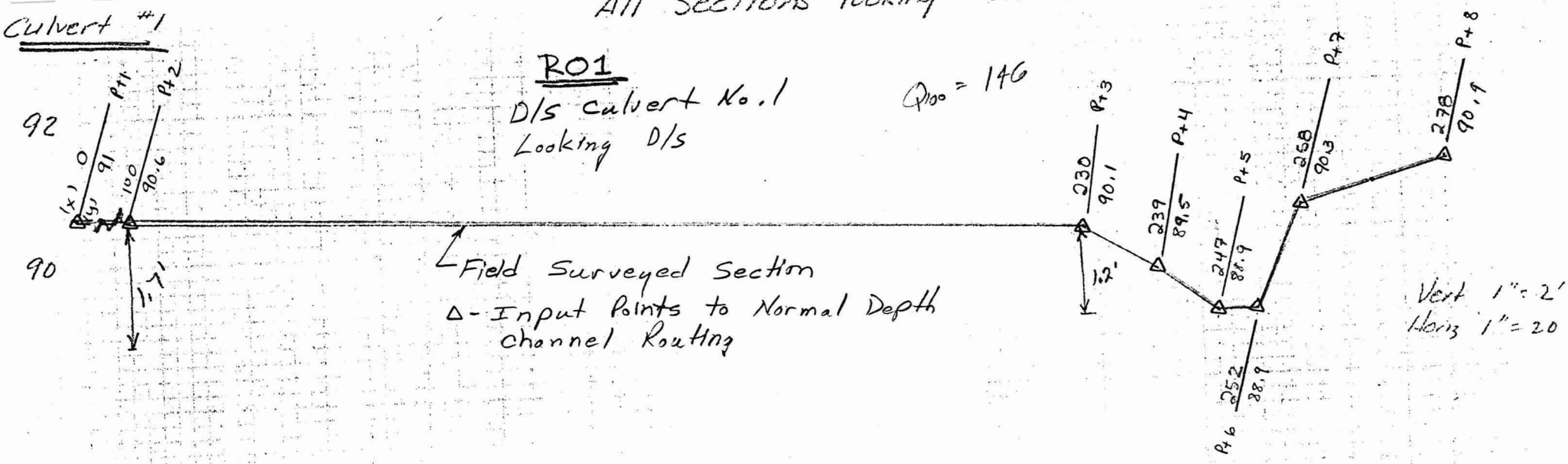
Culvert #1

RO1

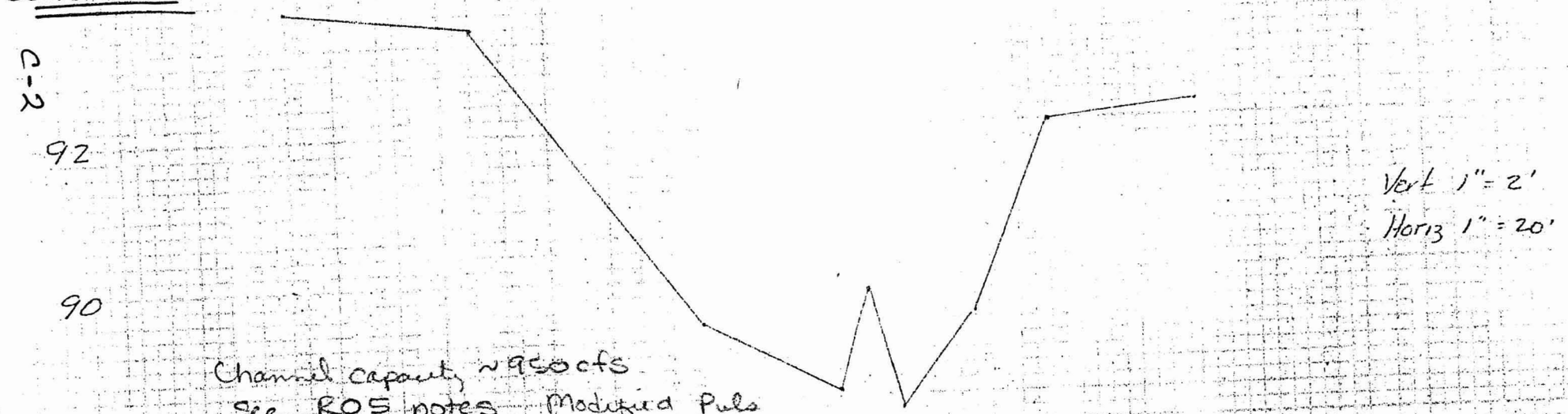
D/S culvert No. 1

Looking D/S

Q_{100} = 146



Culvert #2



Channel capacity ~950 cfs

See ROS notes Modified Puls

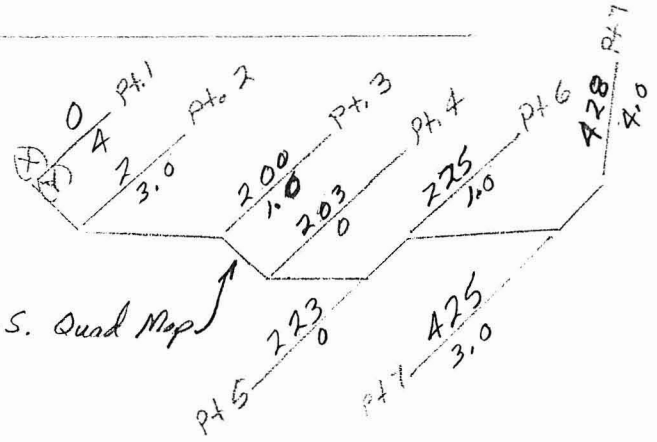
AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 11/21/90
Chkd. ___ Date ___
1 Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: ___

HEC-1 Routing I.D: RO 4
and RO 17



Typical Cross-Section Estimated From Field Visit and U.S.G.S. Quad Map

$NSTPS = L/V\Delta t = \frac{4500'/2.8\,fps\,(ave)}{3\,min \times 60\,s/min}$
$= 8.9$ say 9

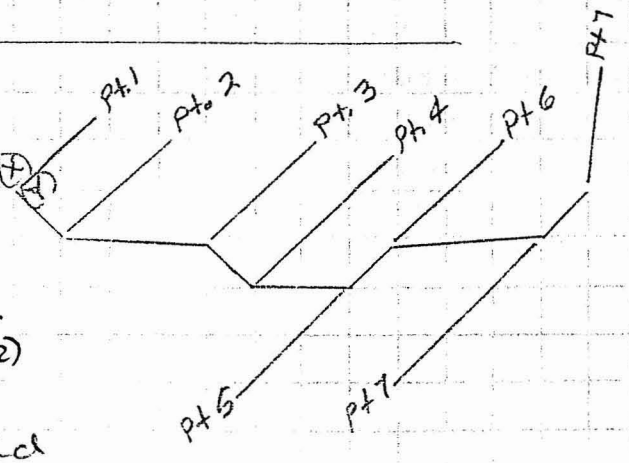
At d = 3.0 $A_{ch} = 72.5\ \square'$ $A_{OB} = 400\ \square'$
$R_{ch} = 2.75'$ $R_{OB} = 1.0'$
$V_{ch} = 4.4\ fps$ $V_{OB} = 2.2\ fps$
$Q_{ch} = 320\ cfs$ $Q_{OB} = 898\ cfs$
$Q_{total} = 1218\ cfs \simeq 1102\ cfs$
CO 4

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS RL	CLOSS	PERCRT 1 1.0	ELVINV 1 1.5						
RS Record - Storage Routing									
NSTPS RS 9	ITYP FLOW	RSVRIC -1	X						
RC Record - Normal Depth Channel Routing									
ANL RC .05	ANCH .05	ANR .05	RLNTH 4500	SEL .0057	ELMAX				
RX Record - Cross-Section X Coordinates									
X(1) RX 0	X(2) 2	X(3) 200	X(4) 203	X(5) 223	X(6) 225	X(7) 425	X(8) 428		
RY Record - Cross-Section Y Coordinates									
Y(1) RY 4.0	Y(2) 3.0	Y(3) 1.0	Y(4) 0	Y(5) 0	Y(6) 1.0	Y(7) 3.0	Y(8) 4.0		

Modified Puls (Normal-Depth) channel Routing Data

Location:

HEC-1 Routing I.D: R05.1



Actual profiles made downstream of culverts #2 + 3 - Before they combined to form R05.1.

Note: Field data delineated a deep wide channel (4' x 65') (culvert #2) w/ a capacity of ~950 cfs. This is much larger than the predicted Q100. The field measured channel is probably not representative of R05.1. Therefore, I recommend using the original office generate channel section or section downstream from culvert #3 for R05.1 (Culvert #3 modified Puls attached)

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL									
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS									
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC									
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX									
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY									

PWEST INC.
Consulting Engineers

Modified based on field measurements downstream of culvert #3

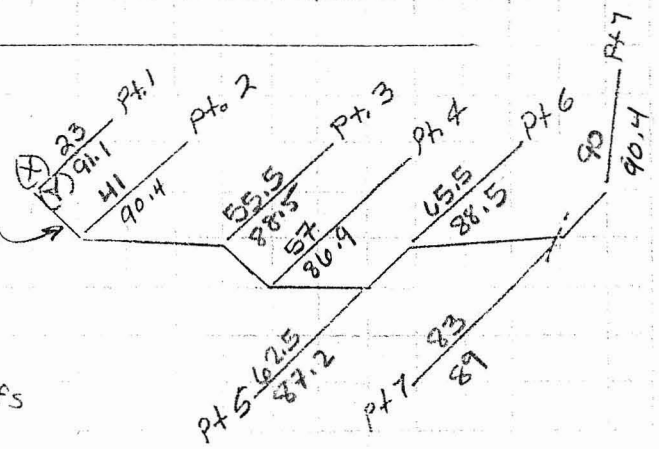
Project 7158-01 Sht. ___ of ___
Calc. By GTS Date 12/26/90
Chkd. GAS Date 1/7/91
Rev 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: _____

HEC-1 Routing I.D: R05.1

Based on field section downstream of culvert #3 (See Next Page)



w.s. el. 88.5 Ac = 11.95
Rc = .8
Pc = 14.9
S = 0.011
Q = 35.8 cfs

w.s. el. 90.4 Ac = 77.15
Rc = 1.48
Q = 348 cfs
V = 4.52

$$NSTPS = \frac{L/V}{\Delta t} = \frac{11{,}000/4.52}{3\,min \times 60\,s/min} = 13.5 = 14$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS RL	CLOSS	PERCRT 1.0	ELVINV 88.7						
RS Record - Storage Routing									
NSTPS RS 14	ITYP Flow	RSVRIC -1	X						
RC Record - Normal Depth Channel Routing									
ANL RC .05	ANCH .045	ANR .05	RLNTH 11,000	SEL 0.011	ELMAX				
RX Record - Cross-Section X Coordinates									
X(1) RX 23	X(2) 41	X(3) 55.5	X(4) 57	X(5) 62.5	X(6) 65.5	X(7) 83	X(8) 90		
RY Record - Cross-Section Y Coordinates									
Y(1) RY 91.1	Y(2) 90.4	Y(3) 88.5	Y(4) 86.9	Y(5) 87.2	Y(6) 88.5	Y(7) 89	Y(8) 90.4		

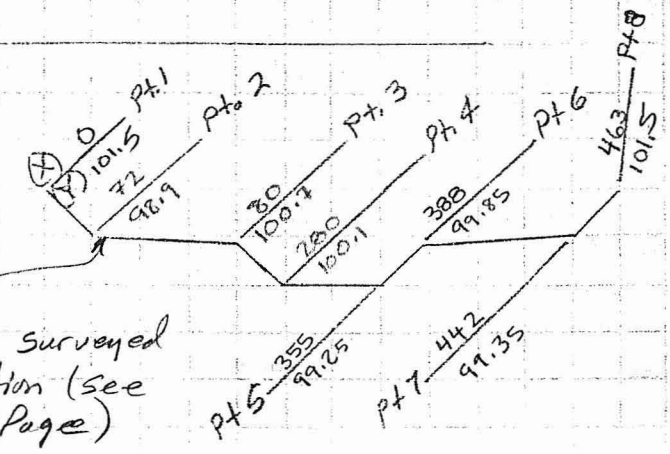
RMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By OTS Date 12/26/90
Chkd. GAS Date 1/7/91
Rev 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: _____

HEC-1 Routing I.D: RO 14.2 *
and RO 16 **



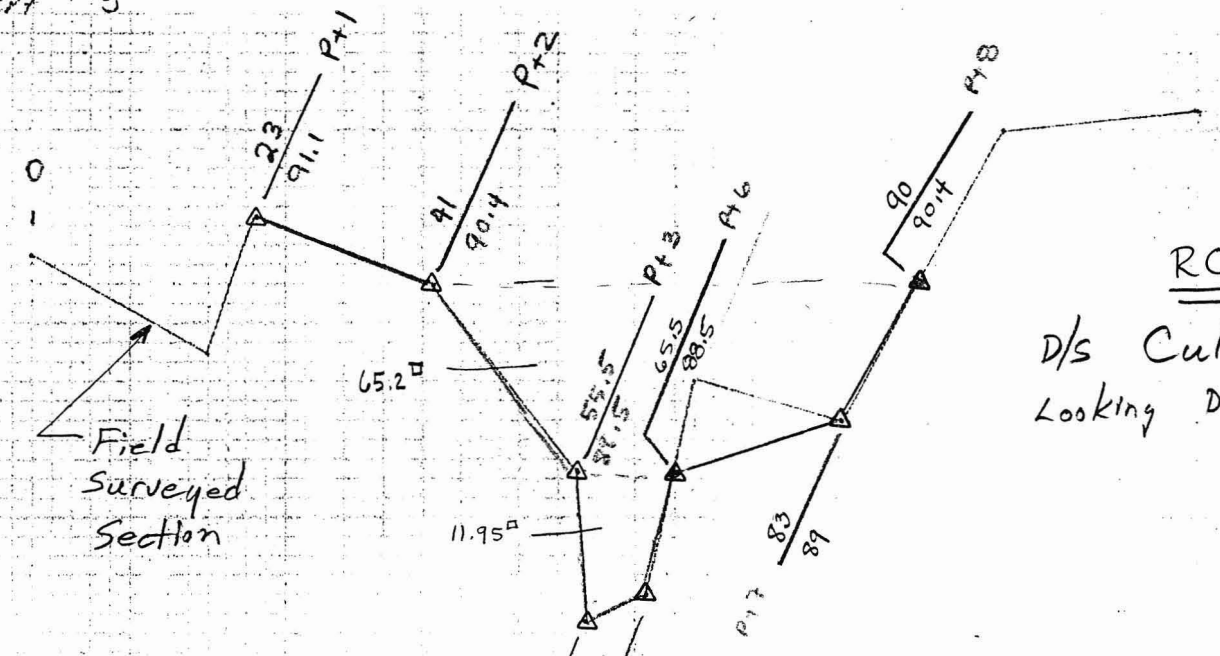
W.el. 101.2 Ach = 575
R = 1.25
Qch = 2209 cfs
v = 3.84 fps

Field surveyed X-section (see Next Page)

$$NSTPS = \frac{L/V}{\Delta t} = \frac{6500/3.8}{3 \times 60} \approx 10^{*}$$

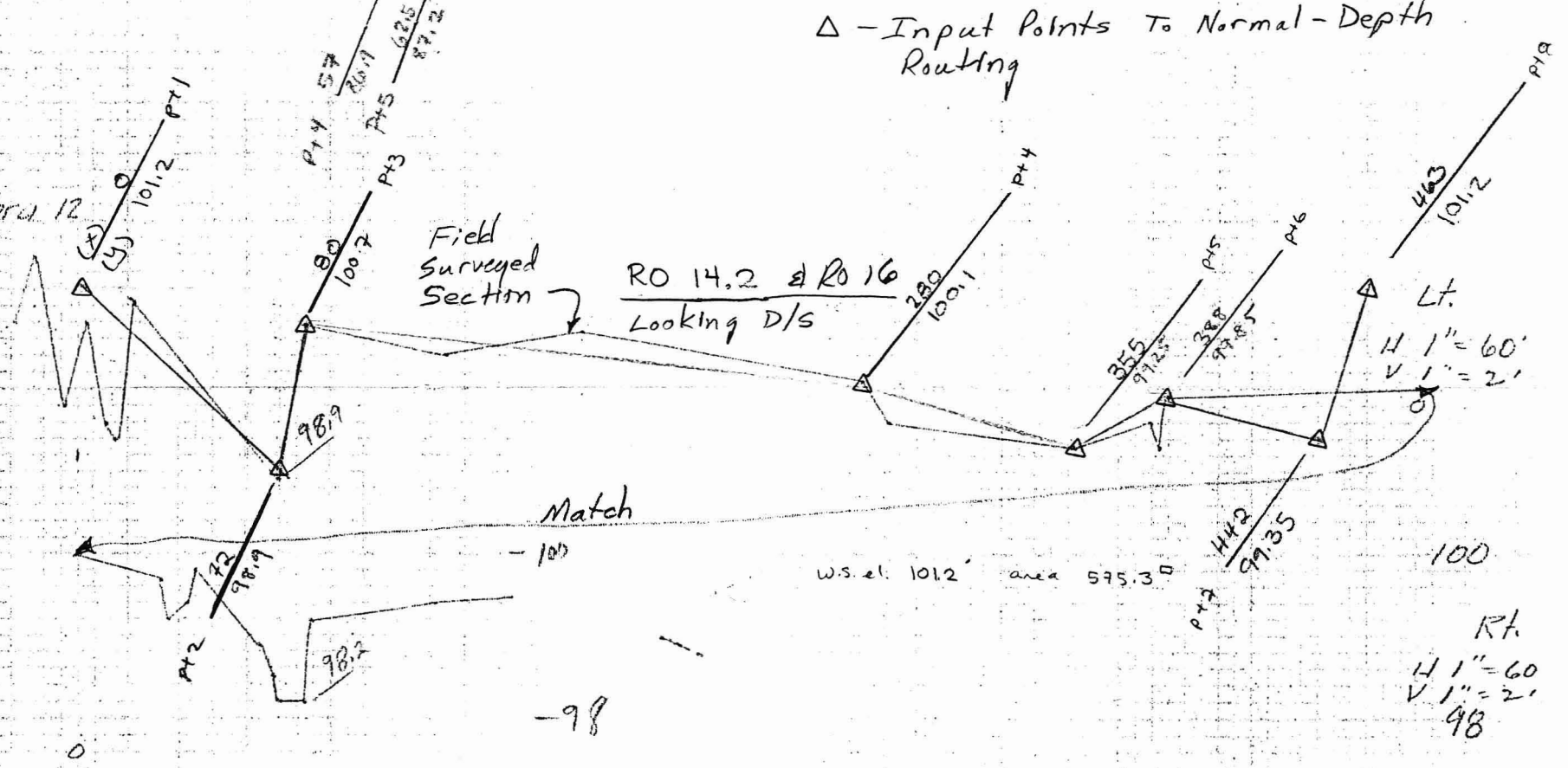
(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0	99.7						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 10*/6**	FLOW	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	6500*/4000**	0.01					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	72	80	289	355	388	442	463		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 101.5	98.9	100.7	100.1	99.25	99.85	99.35	101.5		

Culvert #3



L-7

Culverts 4 thru 12



PWEST INC. Consulting Engineers

Channel shape based on field data

Project 7158-01 Sht. ___ of ___

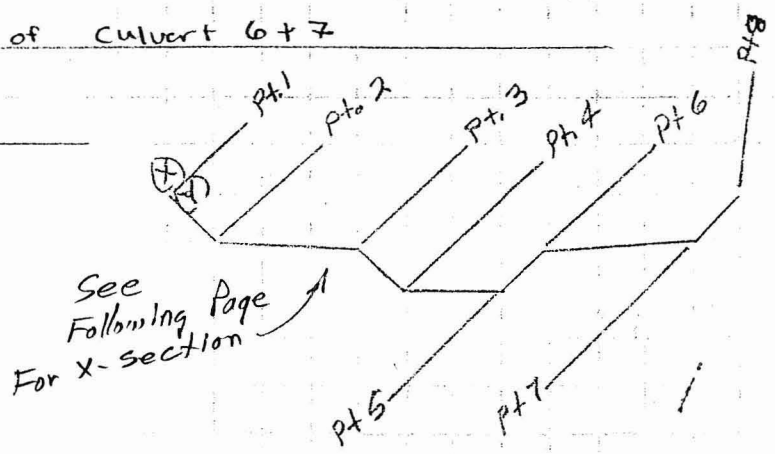
Calc. By OTS Date 12/26/90

Chkd. GAS Date 1/7/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: Split Flow upstream of Culvert 6 + 7

HEC-1 Routing I.D.: R009



Q_{100} after split To Be Routed $\simeq$ 500 cfs

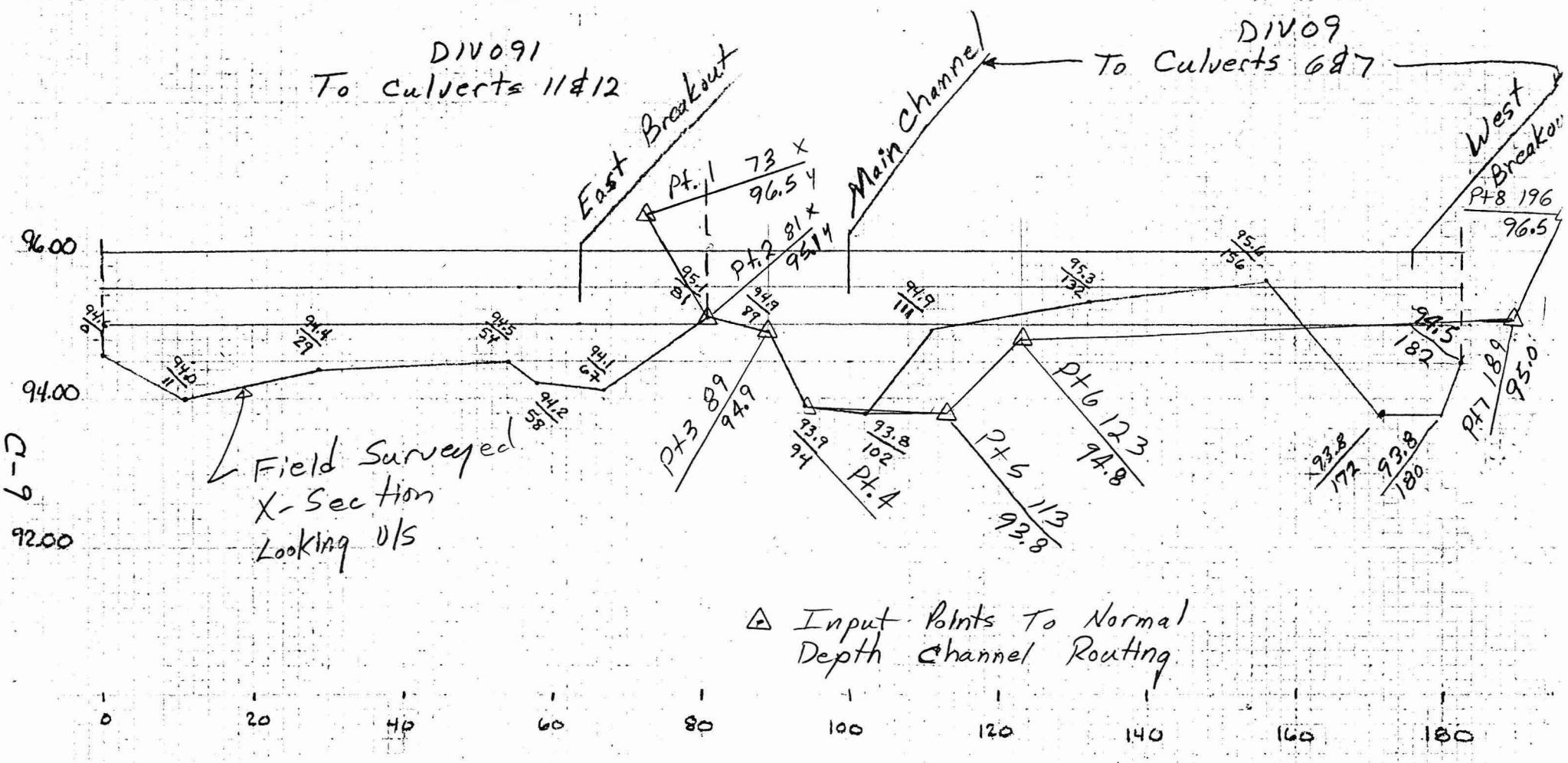
At El. 96.0
$A = 166\ ft^2$
$R = 1.4\ ft$
$n = .048$ (ave.)
$S = 0.0167\ ft/ft$
$V = 5.0\ fps$
$Q = 832\ cfs > Q_{100} \simeq 500\ cfs$

$$NSTPS = \frac{L/V}{\Delta t} = \frac{5000/5.0}{3min \times 60 s/m} = 5.5 \quad Use\ 6$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL									
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 6	Flow	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	5000	.0167					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 73	81	89	94	113	123	189	196		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 96.5	95.1	94.9	93.9	93.8	94.8	95.0	96.5		

Split flow X-sec Upstream of Culvert 6+7
East to West

R009



12/20/90

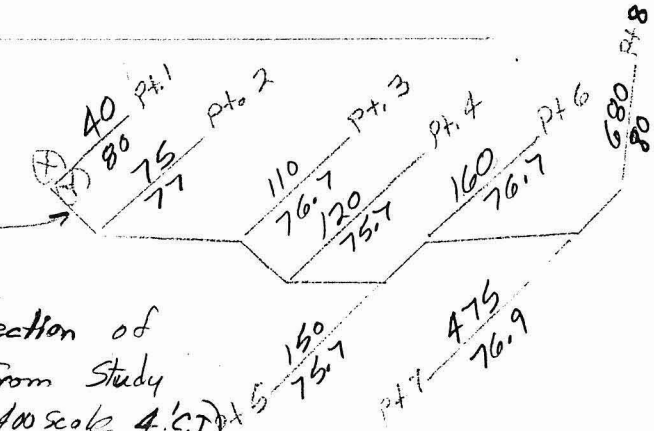
AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 11/20/90
Chkd. ___ Date ___

Modified Puls (Normal-Depth) Channel Routing Data

Location: ___

HEC-1 Routing I.D: RO 13



See Typical X-section of channel from Study Mapping (400 scale 4' C.I.) on Following sheet

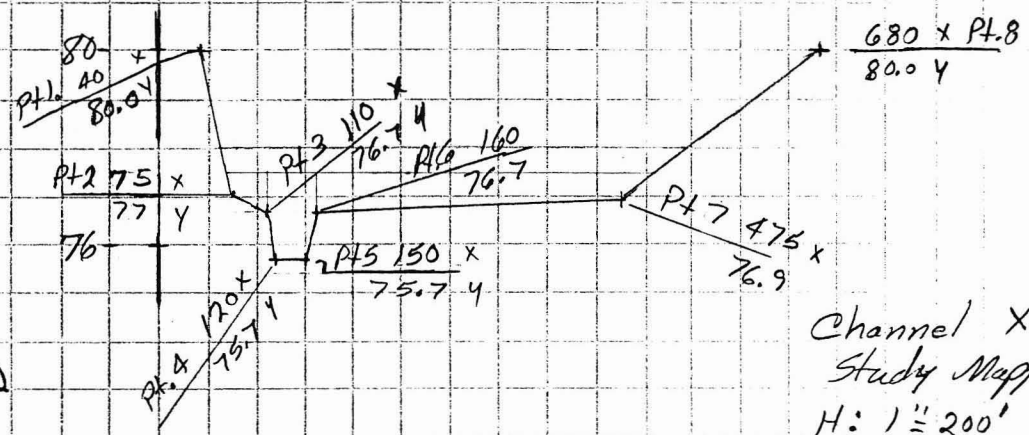
$$NSTPS = \frac{L/v}{\Delta t} = \frac{8000^{ft}/4.3\ fps\ (ave)}{3\ min. \times 60^{s}/min}$$
$$= 10$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL									
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 10	FLOW	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	8000	.0175					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 40	75	110	120	150	160	475	680		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 80	77	76.7	75.7	75.7	76.7	76.9	80		

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

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/7/91
Chkd. ___ Date ___

R013

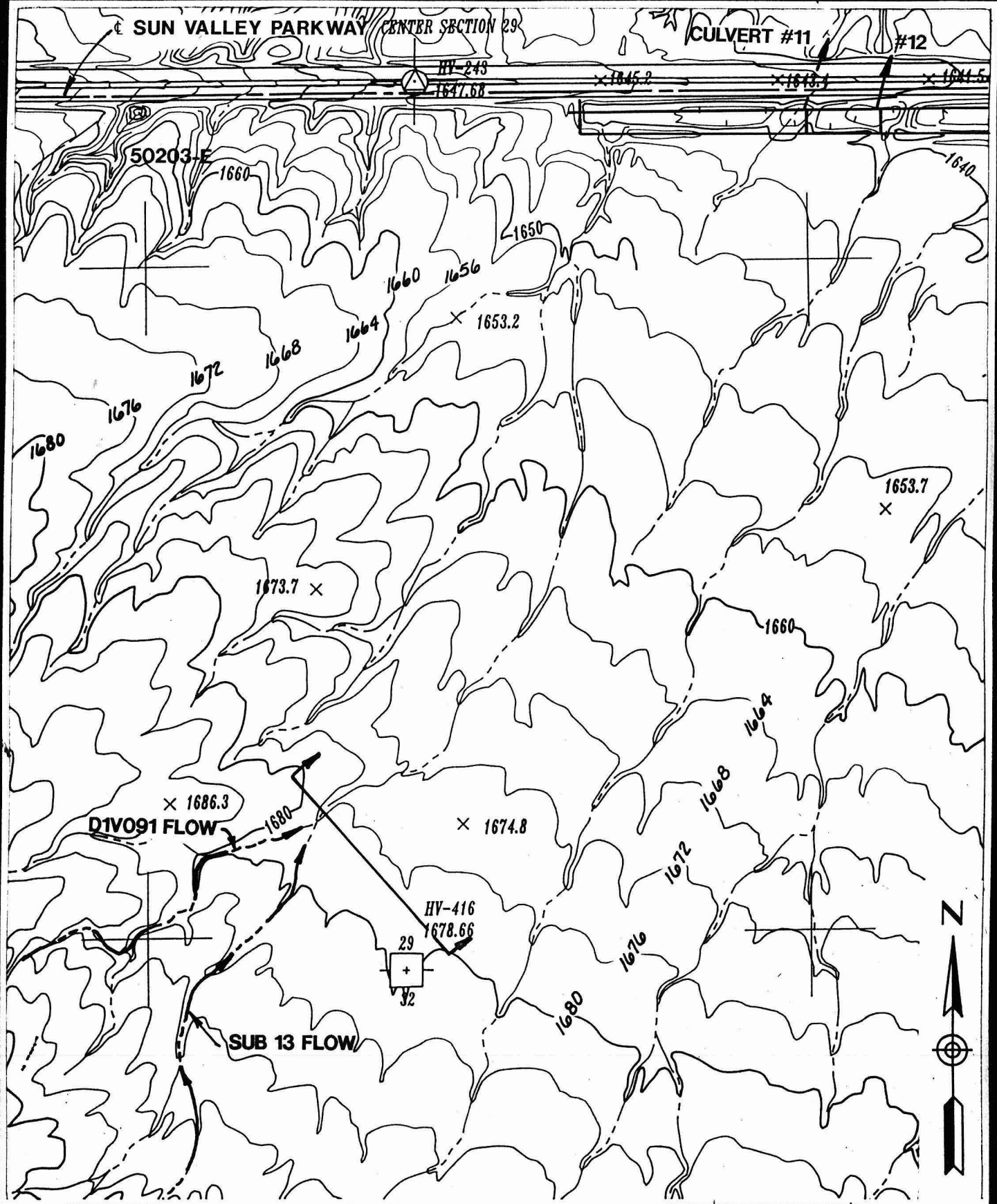


Channel X-Section from Study Mapping (See Next page)
H: 1" = 200'
V: 1" = 4'

	Channel	Overbank
Elev	= 77.5	
Area (ft²) =	86.8	285.6
Hyd. Radius (ft) =	1.73	0.75
Mannings n =	0.045	0.05
Slope ft/ft =	0.0175	0.0175
Vel. fps =	6.3	3.2

Discharge cfs = 547 + 924 = 1471 cfs > Q_{100} = 1075 cfs

C-11



Mapping Source: Reference 12
Mapping Scale 1"=400', 4' C.I.

CROSS-SECTION FOR CHANNEL ROUTING
I.D. RO13

A-NWEST INC.
Consulting Engineers

NOTE: See calcs p C-10 & C-11

SUN VALLEY PARKWAY NORTH
FLOOD INSURANCE STUDY
HYDROLOGY REPORT

AMWEST INC. Consulting Engineers

Revised section based on field data

Project 7158-01 Sht. ___ of ___

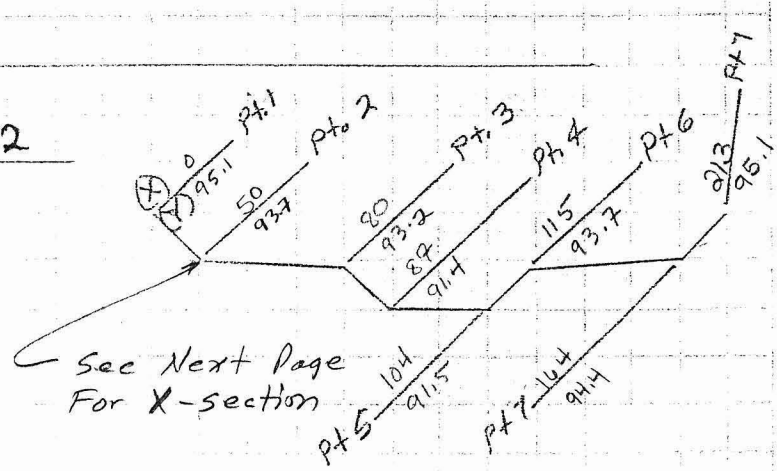
Calc. By OTS Date 12/11/90

Chkd. GAS Date 1/7/91; 1/ Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: _____

HEC-1 Routing I.D: RO 20.2



W.el. 93.2' Ach = 43.75
Rch = 1.33
Qch = 184 cfs
v = 4.2 fps

W.el. 93.7' Ach = 69
Rch = 1.06
Qch = 249 cfs
v = 3.6 fps

W.el. = 94.4 Ach = 131
Rch = .94
Qch = 436 cfs
v = 3.33 fps

Wel = 95.1 Ach = 263
Rch = 1.23
Q = 1002 cfs
v = 3.8 fps

$$NSTPS = \frac{L/V}{\Delta t} = \frac{10500/3.8}{3\,min \times 60\,sec/min} = 15.4 - Use\ 15$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0 ⊥	92.75 ⊥						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 15	Flow	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	11000	0.011					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	50	80	87	104	115	164	213		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 95.1	93.7	93.2	91.4	91.5	93.7	94.4	95.1		

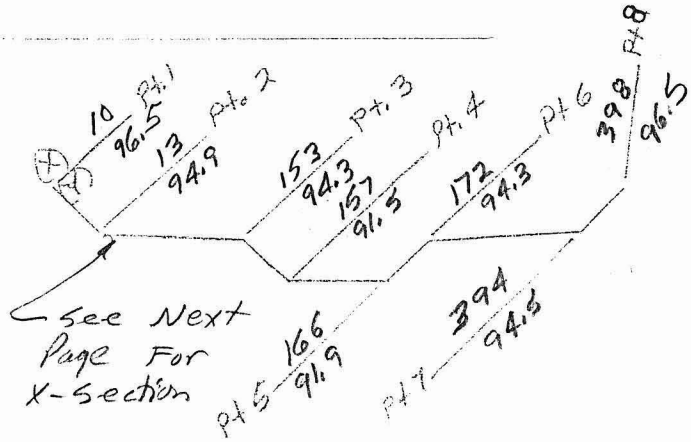
AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 11/20/90
Chkd. ___ Date ___
⊥ Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: ___

HEC-1 Routing I.D: Ro 28 and Ro 28.1



$$NSTPS = \frac{L/V}{\Delta t} = \frac{7000\,ft / 4.8\,fps}{3\,min. \times 60\,s/min} = 8.1 \text{ Use } 8$$

d = 95.5

$A_{ch} = 69.8\,\square'$ $A_{OB} = 425\,\square'$

$R_{ch} = 3.7'$ $R_{OB} = 1.15'$

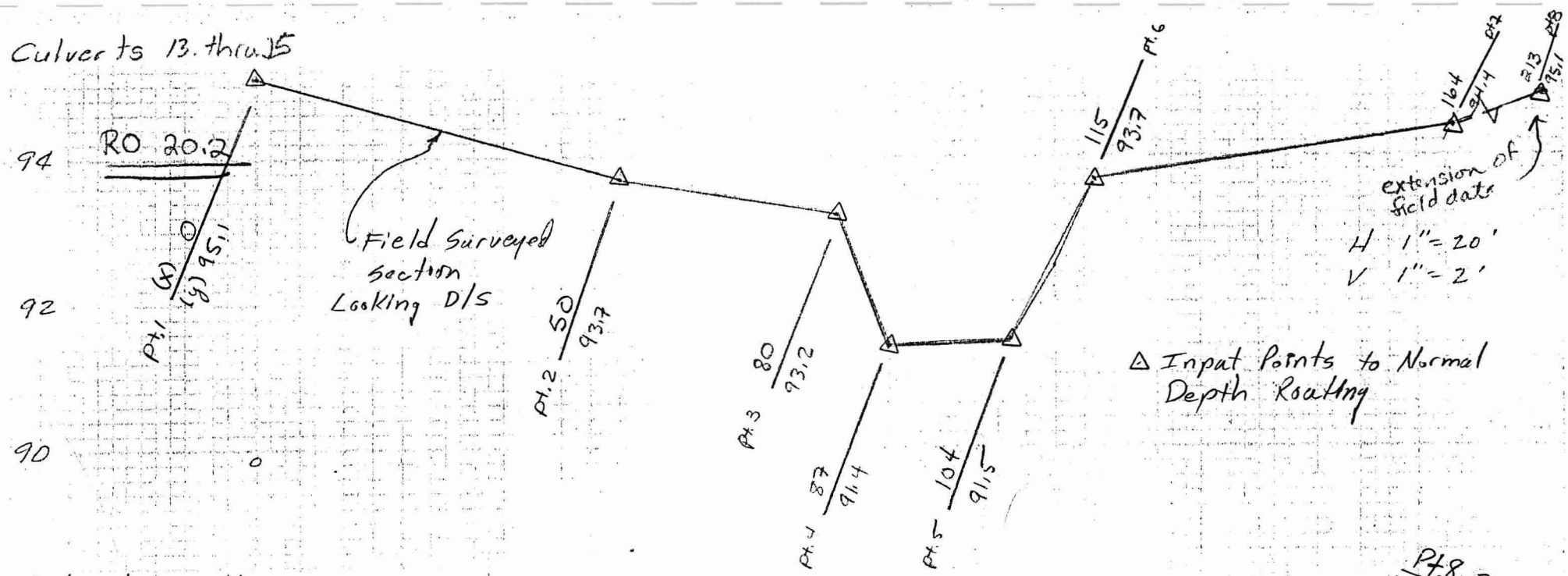
$V_{ch} = 8.28\,fps$ $V_{OB} = 3.43\,fps$

$Q_{ch} = 578\,cfs$ $Q_{OB} = 1459\,cfs$

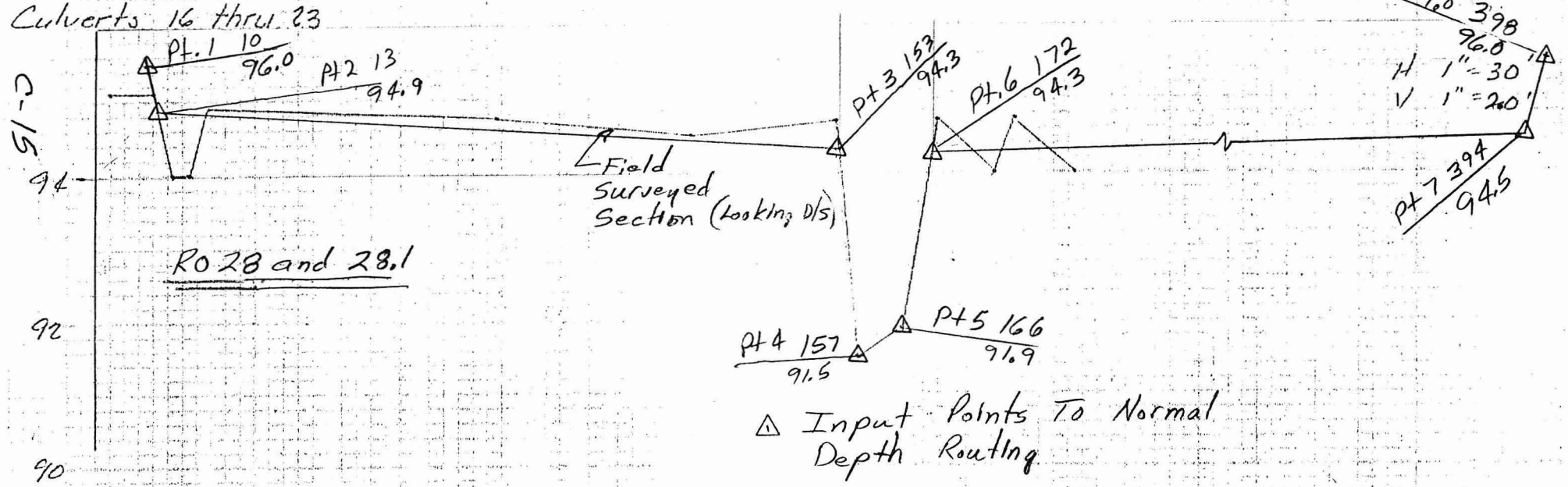
$Q_{total} = 2037\,cfs \simeq 2721\,cfs$ Cd 28

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0 ⊥	93.5	⊥					
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 8	FLOW	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	7000	.011					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 10	13	153	157	166	172	394	398		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 96.5	94.9	94.3	91.5	91.9	94.3	94.5	96.5		

Culverts 13 thru 15



Culverts 16 thru 23



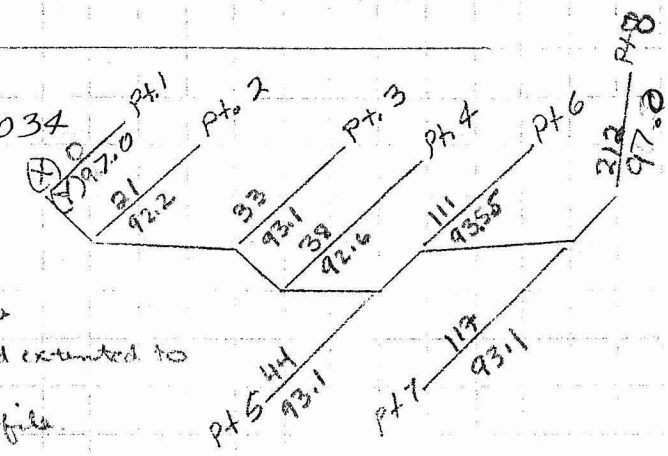
PWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By OTS Date 12/11/90
Chkd. GAS Date 1/8/91
⊥ Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: _____

HEC-1 Routing I.D: RO 32.1 and RO34



Field section measured grossly inadequate to carry predicted Q100. Either section is not representative or unchannelized flow dominates

Assumed if field section had been skewed and extended to delineate confining rises — section would look like that which is defined in this profile.

W.S. 96.4' area = 506 □
P = 2.35
Q = 2650 cfs
V = 5.24 fps

$NSTPS = \frac{L/V}{\Delta t} = 3000/5.2 / 3\times60 = 3.2 \sim 3$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0 ⊥	943 ⊥						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 3	Flow	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	3000	.008					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	21	33	38	44	111	117	212		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 97.0	92.2	93.1	92.6	93.1	93.55	93.1	97.0		

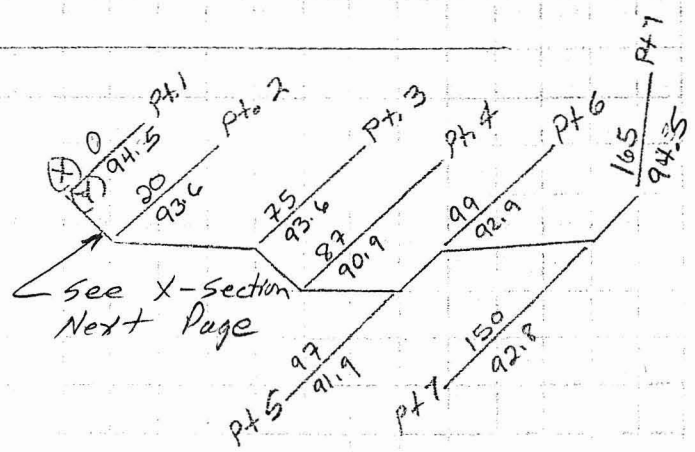
AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By OTS Date 12/11/90
Chkd. GAS Date 1/9/91
‖ Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: _____

HEC-1 Routing I.D.: RO 39.1

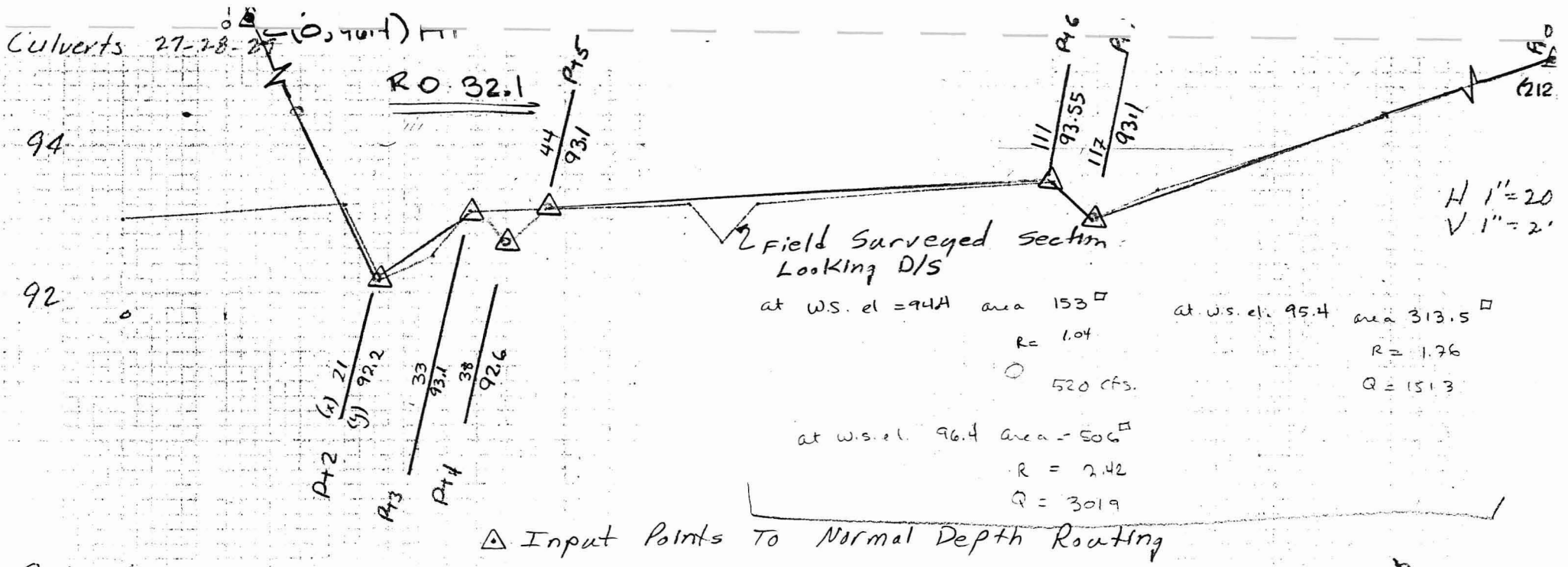


W.S.el. 94.2 area = 173.7 □
R = 1.05
Q = 571 cfs
V = 3.3 fps

$$NPSTPS = \frac{L/V}{\Delta t} = \frac{6000/3.3}{3 \times 60} = 10$$

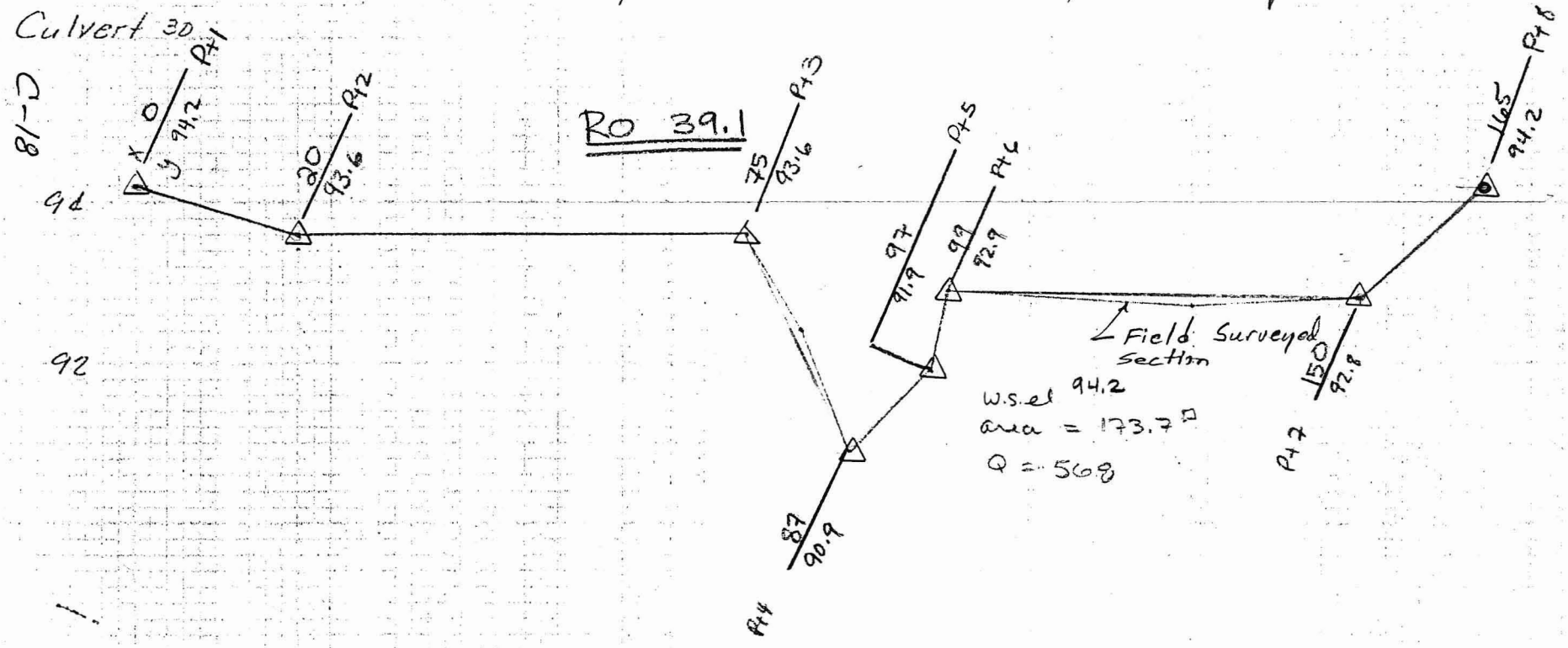
(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV	‖					
RL		1.0 ‖	92.2						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 10	Flow	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	6000	.0092					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	20	75	87	97	99	150	165		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 94.5	93.6	93.6	90.9	91.9	92.9	92.8	94.5		

Culverts 27-28-29



△ Input Points To Normal Depth Routing

Culvert 30



RMWEST INC.
Consulting Engineers

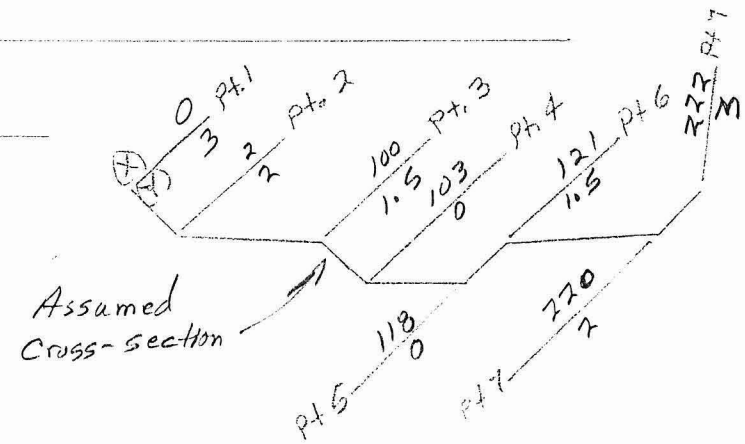
Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 11/20/90
Chkd. ___ Date ___

11 Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: ___

HEC-1 Routing I.D: Ro 44



$d = 2.0$ $A_{ch} = 37.5\ ft^2$
$R_{ch} = 1.72'$
$V_{ch} = 4.75$
$Q_{ch} = 178\ cfs \simeq 122\ cfs$
SUB 44

$$NSTPS = \frac{L/V}{\Delta t} = \frac{4500'/4.5\ fps}{3\ min \times 60\ s/min} = 5.5 \text{ say } 5$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0 -1	1.0 -1						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 5	FLOW	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	4500	.01					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	2	100	103	118	121	220	222		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 3	2	1.5	0	0	1.5	2	3		

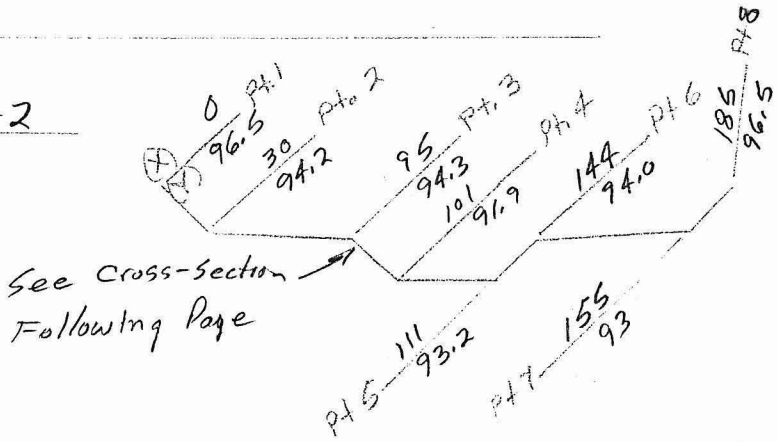
AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 11/20/90
Chkd. ___ Date ___
Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: ___

HEC-1 Routing I.D: RO 42



$NSTPS = \frac{L/V}{\Delta t} = \frac{4500'/4.4fps}{3\ min. \times 60 s/min}$
$= 5.7$ Use 6

At El. 96.0
A = 337.0 □'
R = 1.82'
S = 0.009 ft/ft
n = 0.048 (ave)
V = 4.4 fps
Q = 1480 cfs

Q_{100} = 1905 cfs
C042

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0	93.7						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 6	FLOW	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	4500	.009					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	30	95	101	111	144	155	185		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 96.5	94.2	94.3	91.9	93.2	94.0	93.0	96.5		

AMWEST INC. Consulting Engineers

Revised section based on field data

Project 7158-01 Sht. ___ of ___

Calc. By OTS Date 12/11/90

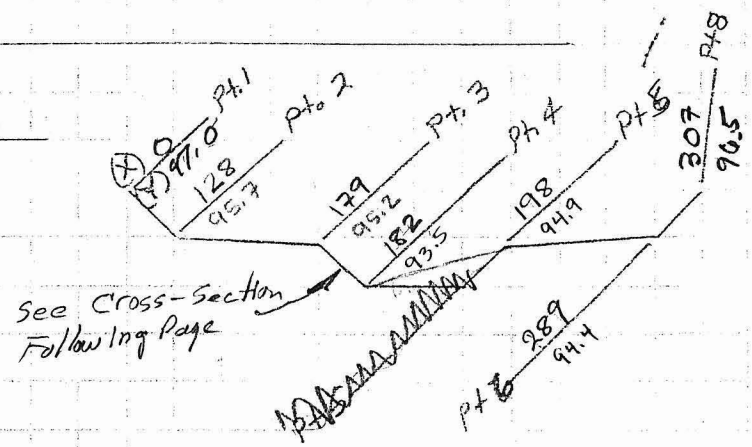
Chkd. GAS Date 1/8/91

Rev 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: _____

HEC-1 Routing I.D: RO 46



at w.el. 95.7 Ach = 146□'
R = .85'
Q = 455 cfs

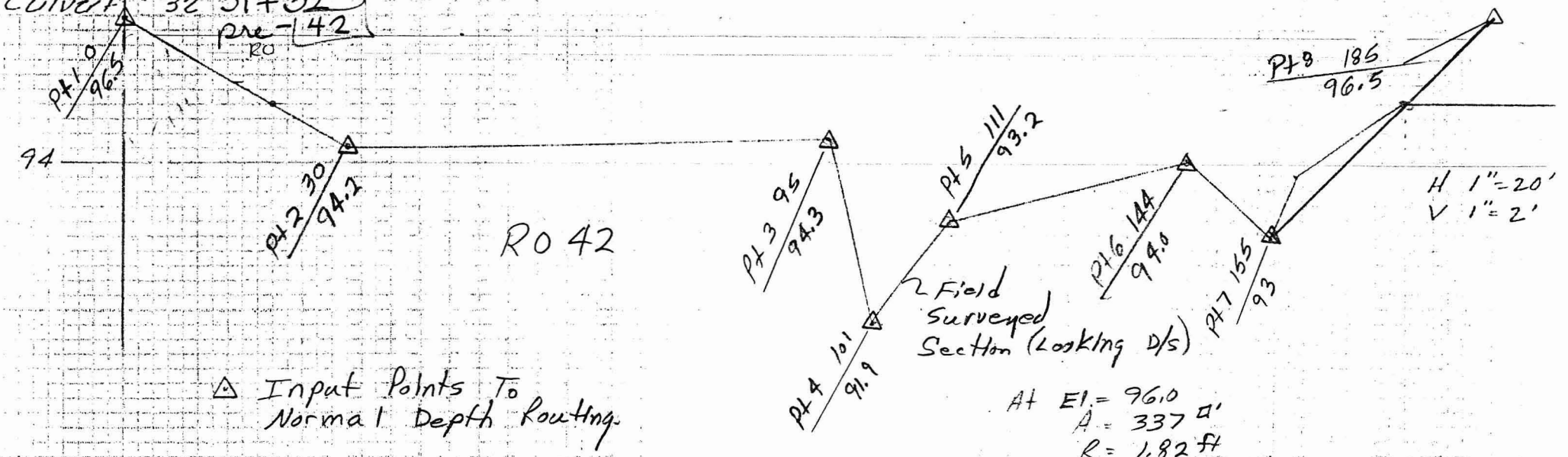
at w.el. 96 Ach. 199□'
R = 1.14
Q = 753

at w.el. 96.5 Ach = 300□'
R = 1.5
Q = 1365 cfs
V = 4.55 fps

$$NSTPS = \frac{L/V}{\Delta t} = \frac{5000/(4.55)}{3m \times 60sec.} = 6.1 \sim 6$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0	94.75						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 6	flow	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	5400	.011					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	128	179	182	198	289	307	310		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 97.0	95.7	95.2	93.5	94.9	94.4	96.5	97.0		

Culvert #32 31+32 pre-142 RO



RO 42

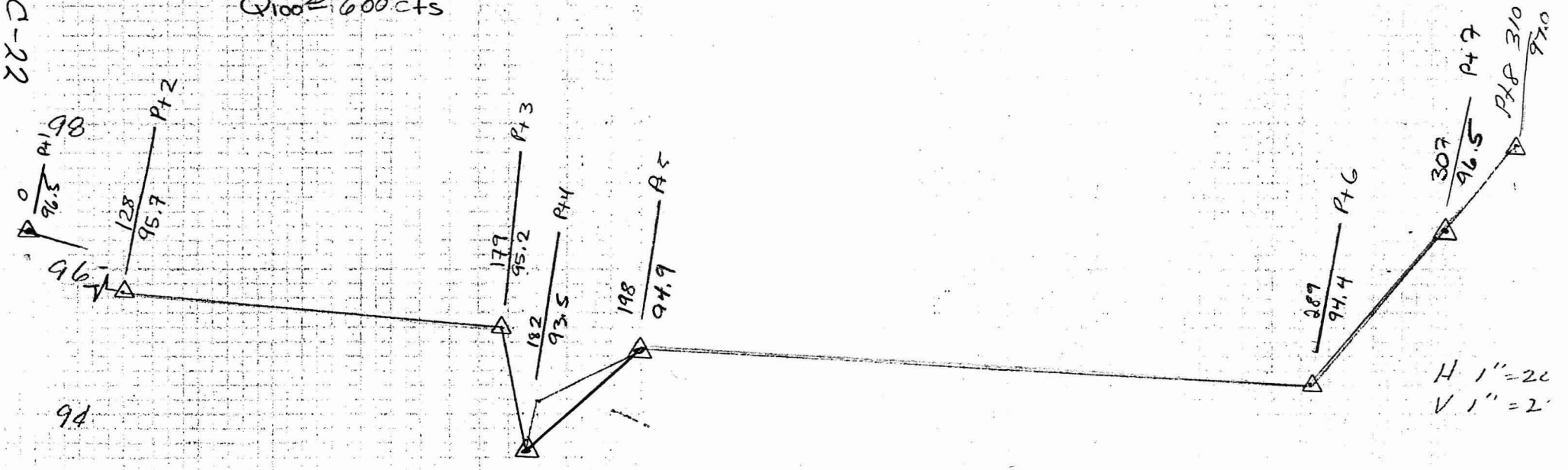
△ Input Points To Normal Depth Routing

Field Surveyed Section (Looking D/s)

At El. = 96.0
A = 337 □'
R = 1.82 ft
S = 0.009 '/Ft
n = 0.048 (ave)
V = 4.4 fps
Q = 1480 cfs ≈ CO 42 Q_{100} = 1905 cfs

Culvert #36 RO 46

Q_{100} ≈ 600 cfs



AMWEST INC. Consulting Engineers

channel shaped based on field data

Project 7158-01 Sht. ___ of ___

Calc. By OTS Date 12/26/90

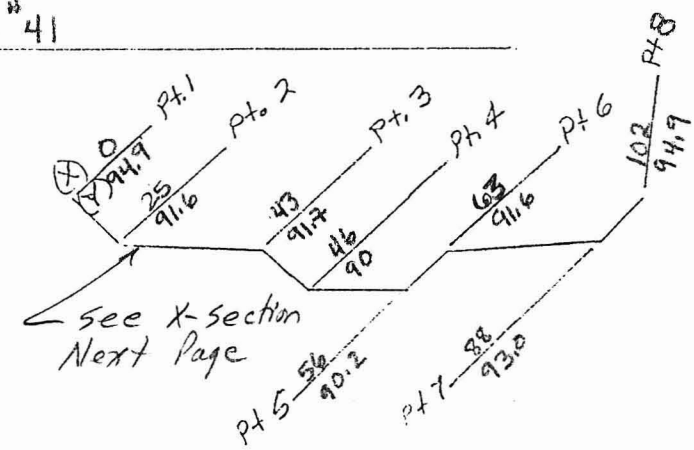
Chkd. GAS Date 1/8/91

‡ Rev. 2/26/91

Modified Puls (Normal-Depth) channel Routing Data

Location: Downstream of culvert #41

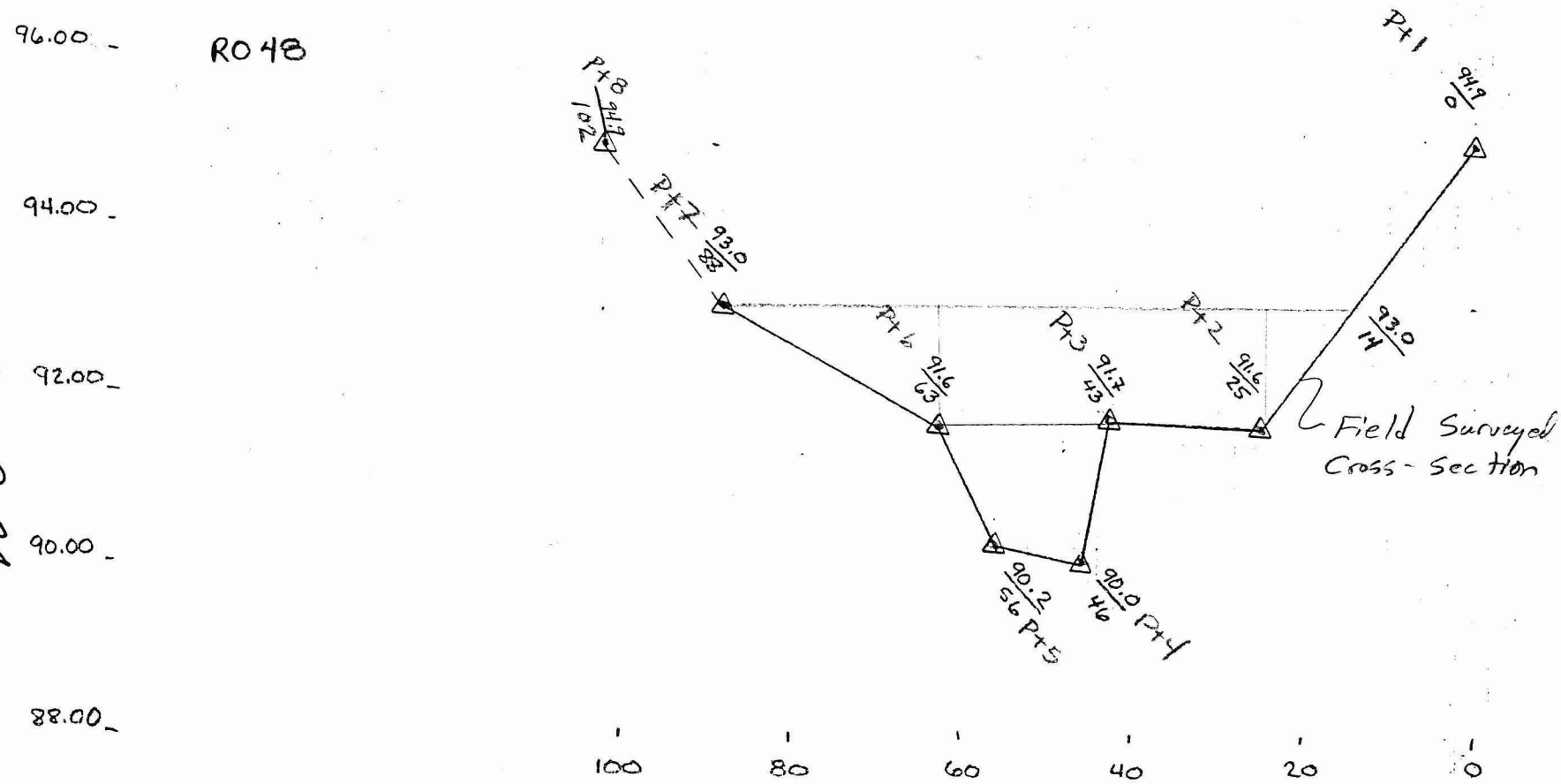
HEC-1 Routing I.D: R048



$$NSTPS = \frac{L/V}{\Delta t} = \frac{5000/6.5}{3m \times 60s/m} = 4.27 \sim 4$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS RL	CLOSS	PERCRT 1.0 ‡	ELVINV 91.95 ‡						
RS Record - Storage Routing									
NSTPS RS 4	ITYP FLOW	RSVRIC -1	X						
RC Record - Normal Depth Channel Routing									
ANL RC .05	ANCH .045	ANR .05	RLNTH 5000	SEL .011	ELMAX				
RX Record - Cross-Section X Coordinates									
X(1) RX 0	X(2) 25	X(3) 43	X(4) 46	X(5) 56	X(6) 63	X(7) 88	X(8) 102		
RY Record - Cross-Section Y Coordinates									
Y(1) RY 94.9	Y(2) 91.6	Y(3) 91.7	Y(4) 90.0	Y(5) 90.2	Y(6) 91.6	Y(7) 93.0	Y(8) 94.9		

Culvert #41 downstream
X-sec East to west



W.S el. = 94.9
Ach = 269
Rch = 2.54
Qch = 1738 cfs
Vch = 6.46 fps

W.S. el. = 93.0
Ach = 102
Rch = 1.32
Qch = 427 cfs
Vch = 4.2 fps

S = .011

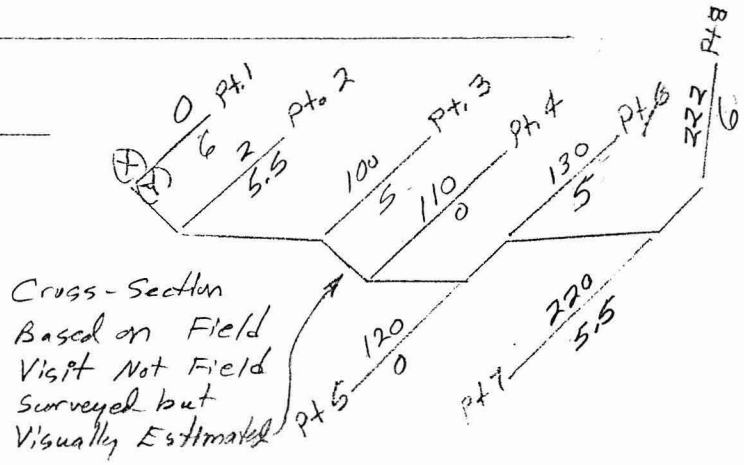
AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 11/21/90
Chkd. ___ Date ___
Rev. 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: ___

HEC-1 Routing I.D: RO 50



$NSTPS = \frac{L/V}{\Delta t} = \frac{4500'/5.4\,fps}{3\,min. \times 60\,s/min}$
$= 4.6$ say 5

$d = 2.0'$ $A_{ch} = 28\,\square'$
$R_{ch} = 1.5'$
$V_{ch} = 5.4$ fps
$Q_{ch} = 152$ cfs $\approx Q_{100} = 173$ Sub 50

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0	2.5						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 5	FLOW	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	4500	.016					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	2	100	110	120	130	220	222		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 6	5.5	5	0	0	5	5.5	6		

RMWEST INC.
Consulting Engineers

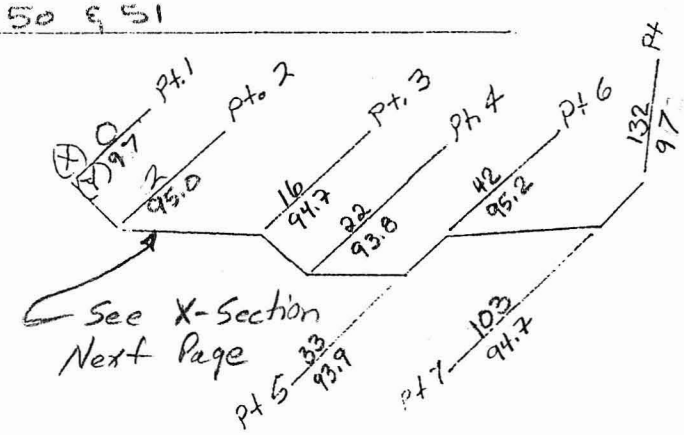
Channel shape based on field data

Project 7158-01 Sht. ___ of ___
Calc. By OTS Date 12/26/90
Chkd. GAS Date 1/9/91
‖ Rev 2/26/91

Modified Puls (Normal-Depth) Channel Routing Data

Location: Downstream of Culvert 50 & 51

HEC-1 Routing I.D: RO 52

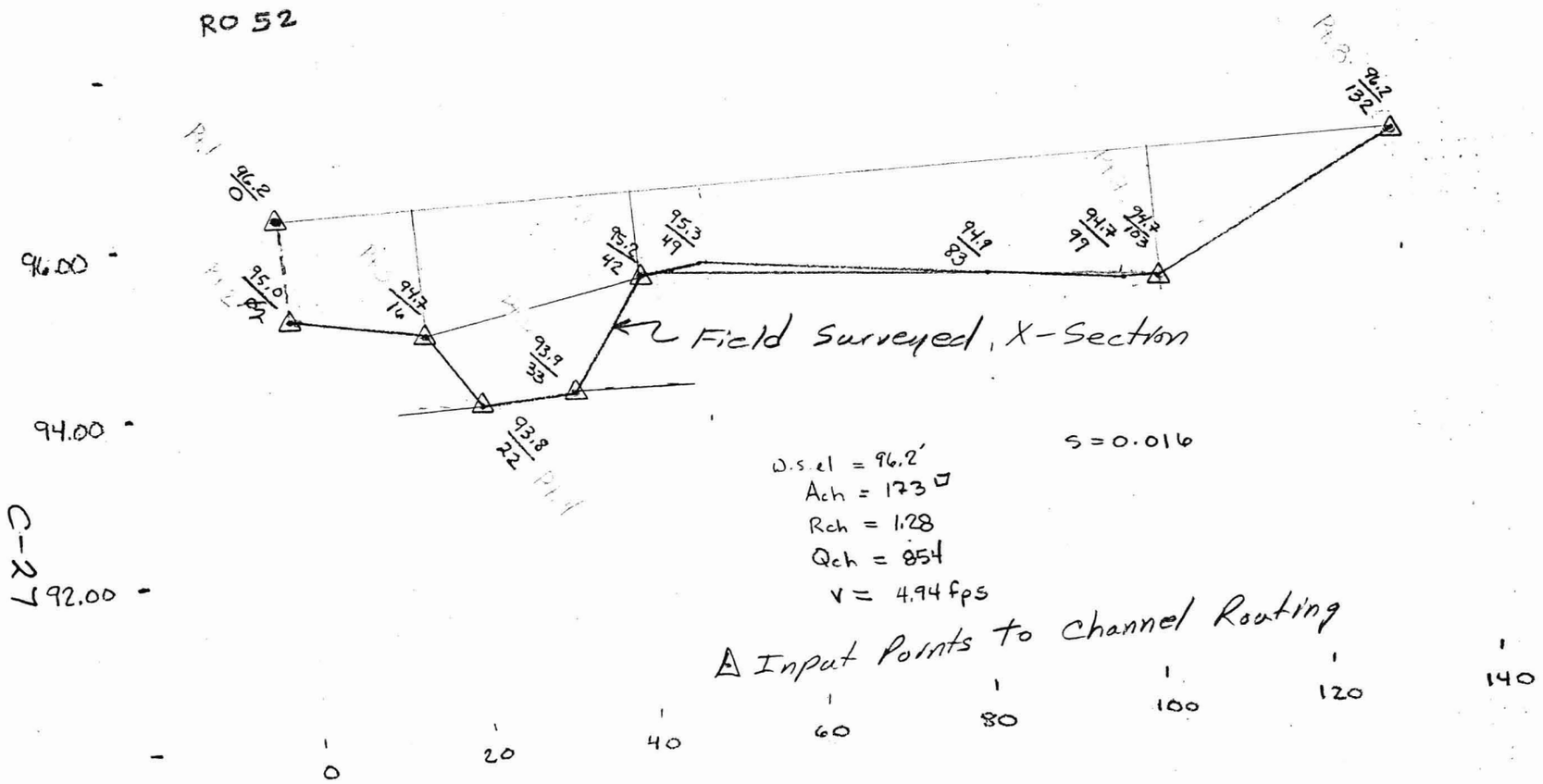


$$NSTPS = \frac{L/\Delta V}{\Delta t} = \frac{4500/1.94}{3m \times 60 s/m} = 5.06$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS RL	CLOSS	PERCRT 1.0 ‖	ELVINV 94.9	‖					
RS Record - Storage Routing									
NSTPS RS 5	ITYP FLOW	RSVRIC -1	X						1
RC Record - Normal Depth Channel Routing									
ANL RC .05	ANCH .045	ANR .05	RLNTH 4500	SEL .016	ELMAX				
RX Record - Cross-Section X Coordinates									
X(1) RX 0	X(2) 2	X(3) 16	X(4) 22	X(5) 33	X(6) 42	X(7) 103	X(8) 132		
RY Record - Cross-Section Y Coordinates									
Y(1) RY 97	Y(2) 95.0	Y(3) 94.7	Y(4) 93.8	Y(5) 93.9	Y(6) 95.2	Y(7) 94.7	Y(8) 97		

Culvert 50 & 51 downstream
X-sec West to East

RO 52



S = 0.016

D.S. el = 96.2'
Ach = 173 □
Rch = 1.28
Qch = 854
V = 4.94 fps

▲ Input Points to Channel Routing

AN WEST INC. Consulting Engineers

Channel shape based on field data

Project 7158-01 Sht. ___ of ___

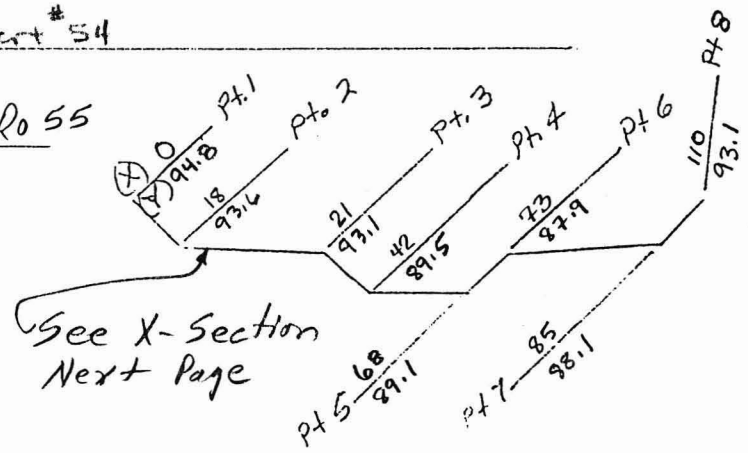
Calc. By OTS Date 12/26/90

Chkd. ___ Date ___

Modified Puls (Normal-Depth) Channel Routing Data

Location: Downstream of culvert #54

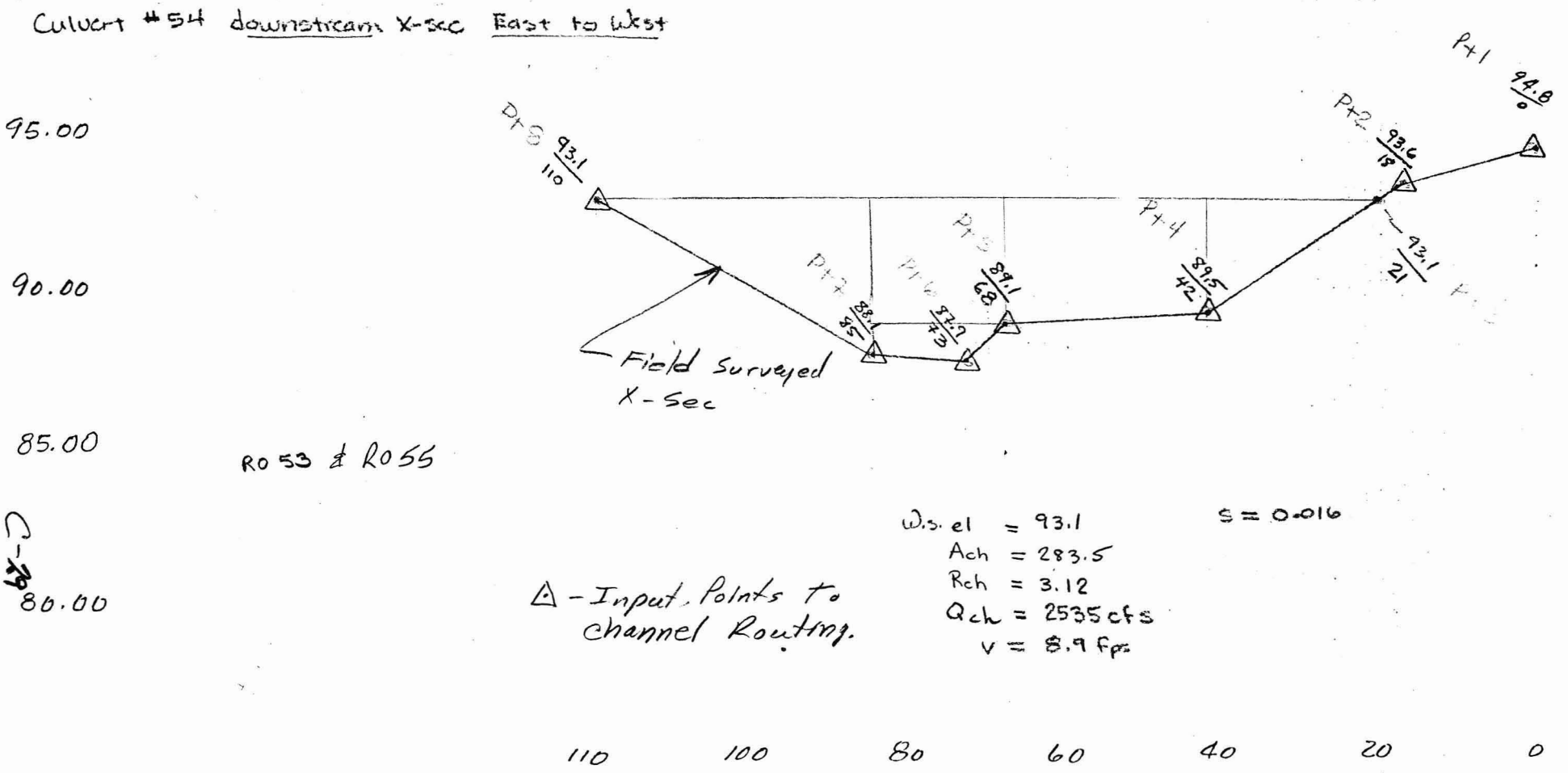
HEC-1 Routing I.D: RO 53 & RO 55



$$NSTPS = \frac{L/v}{\Delta t} = \frac{4500/8.9}{3\text{min} \times 60\text{s/m}} = 2.8 \sim 3$$

(Field) 1	2	3	4	5	6	7	8	9	10
RL Record - Channel Loss									
QLOSS	CLOSS	PERCRT	ELVINV						
RL		1.0	90.9						
RS Record - Storage Routing									
NSTPS	ITYP	RSVRIC	X						
RS 3	FLOW	-1							
RC Record - Normal Depth Channel Routing									
ANL	ANCH	ANR	RLNTH	SEL	ELMAX				
RC .05	.045	.05	4500	0.016					
RX Record - Cross-Section X Coordinates									
X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)		
RX 0	18	21	42	68	73	85	110		
RY Record - Cross-Section Y Coordinates									
Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)		
RY 94.8	93.6	93.1	89.5	89.1	87.9	88.1	93.1		

Culvert #54 downstream X-sec East to West



Appendix D-

Culvert Capacity Calculations

PROJECT: Sun Valley Parkway FIS
7158-01

DESIGNER: GAS

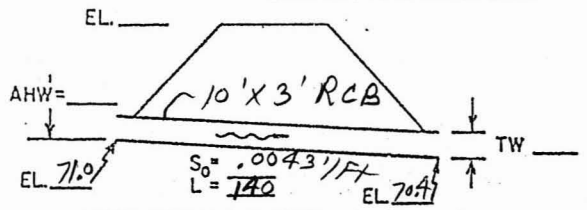
DATE: 11/9/90

HYDROLOGIC AND CHANNEL INFORMATION

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: 4+30.50 #1



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
30° to 75°	55	10'x3'	.5	1.5	.2	.05	.97	2.0	—	2.0	.6	1.5	1.5			Inlet or outlet Control HW El.= 72.5
Flare	150		1.0	3.0	"	.65	1.88	2.44	—	2.44	"	2.7	3.0			Inlet Control HW El = 74.0
	200		1.25	3.75	"	1.15	2.28	2.63	—	2.6		3.2	3.75			Inlet Control HW El= 74.7

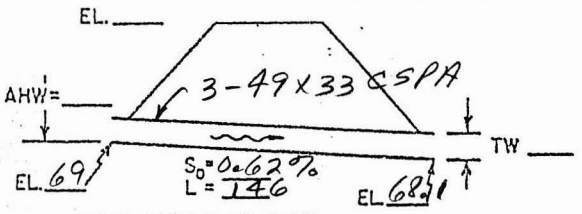
SUMMARY & RECOMMENDATIONS: Grade Break channel to East at El. 74.70
" " " " west at El. _____

HYDROLOGIC AND CHANNEL INFORMATION

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: 16+19.50 #2



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
Headwall	27	see above	.39	1.0	.5	—	.6	1.6	—	1.6	.9	.7	1.0			Inlet Control HW El.= 70.0
"	87	"	.77	2.0	.5	.9	1.25	1.9	—	1.9	.9	1.9	2.0			" HW El = 71.0
"	150	"	1.16	3.0	.5	2.7	1.70	2.1	—	2.1	.9	3.9	3.9			Outlet Control HW El.= 72.9
"	183	"	1.43	3.7	.5	3.9	1.90	2.2	—	2.2	.9	5.2	5.2			outlet Control HW El = 74.2
	198	"	1.55	4.0	.5	4.6	1.95	2.3	—	2.3	.9	6.0	6.0			Outlet Control HW El = 75.0
	240	"	1.93	5.0	.5	6.8	2.15	2.4	—	2.4	.9	8.3	8.3			" "

SUMMARY & RECOMMENDATIONS: Grade Break channel to west at El 74.70
" " " to East " El. 72.70

PROJECT: Sun Valley Parkway FIS 7158-01

DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

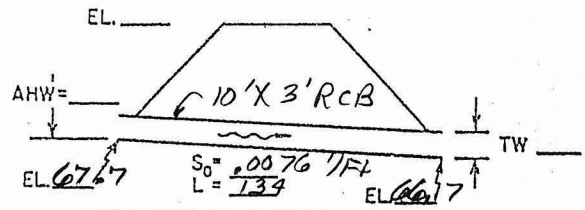
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH #3

STATION: 26+06



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
45° Headwall	43	10'X 3'	.43	1.3	0.2	—	.82	1.91	—	1.91	1.0		1.3			Inlet control HW El = 69.0
"	105	"	.77	2.3	0.2	0.3	1.49	2.25	—	2.25	"	1.65	2.3			" " HW El = 70.0
"	170	"	1.10	3.3	0.2	0.8	2.04	2.62	—	2.62	"	2.3	3.3			" " HW El. = 71.0
"	225	"	1.43	4.3	0.2	1.35	2.46	2.73	—	2.7	"	3.1	4.3			" " HW El. = 72.0
	205	"	1.3	3.9												" " HW El = 71.6

SUMMARY & RECOMMENDATIONS: Grade Break channel to west El. = 72.7
" " " to East El. = 71.6

HYDROLOGIC AND CHANNEL INFORMATION

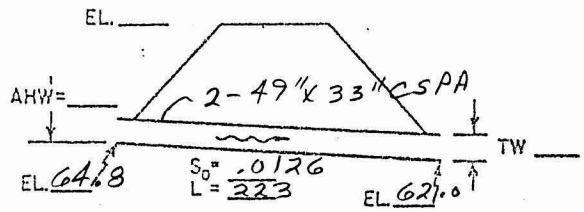
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH #4

STATION: 30+35.0



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
Headwall	24	See above	.46	1.2	.5	—	.7	1.6	—	1.6	2.8	—	1.2			Inlet control HW El = 66.0
	66	"	.85	2.2	"	1.2	1.3	1.9	—	1.9	"	.3	2.2			Inlet control HW El = 67.0
	106	"	1.24	3.2	"	2.9	1.75	2.2	—	2.2	"	2.3	3.2			" " HW El = 68.0

SUMMARY & RECOMMENDATIONS: Grade Break Channel to West El. = 71.6
Grade Break channel to East El = 68.0

PROJECT: Sun Vly Parkway FIS 7158-01

DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

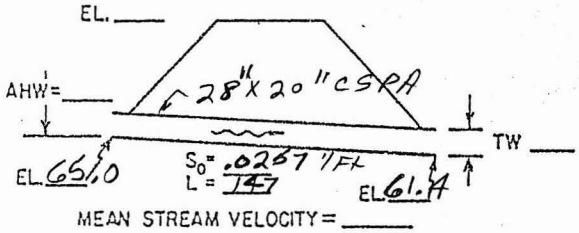
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 33+07.50 #5



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	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
Flared End Sect.	6	see above	.67	1.0	.5	.6	.65	1.16	—	1.16	3.6	—	1.0			Inlet cont. HW El. = 66.0
	13		1.2	2.0	.5	2.7	1.0	1.33	—	1.33	3.6	.43	2.0			Inlet Control HW El. = 67.0
	19.5		1.8	3.0	.5	6.3	1.25	1.45	—	1.45	3.6	4.2	4.2			Outlet control HW El = 69.2
	18		1.65	2.75	.5	5.2	1.18	1.42	—	1.36	3.6	3.0	3.0			HW El = 68.0

SUMMARY & RECOMMENDATIONS: Grade Break channel to West El = 68.0
" " " " East El = 67.0

HYDROLOGIC AND CHANNEL INFORMATION

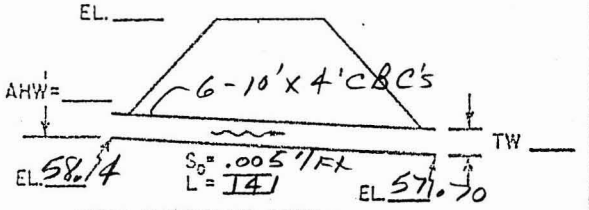
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 36+92.5 #6



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	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
Headwall 45°	210	see Above	.25	1.0	.2	—	.72	2.4	-	2.4	.7		1.0			Inlet Cont. HW El = 59.4
"	504	"	.5	2.0	"	—	1.28	2.6	-	2.6	"		2.0			" " HW El = 60.4
"	948	"	.75	3.0	"	.4	1.95	3.0	—	3.0	"		3.0			HW El. = 61.4
	1380	"	1.0	4.0	"	.85	2.49	3.2	—	3.2	"	3.4	4.0			HW El = 62.4
	1800	"	1.25	5.0	"	1.45	2.97	3.6	—	3.6	"	4.25	5.0			HW El. = 63.4
	2070	"	1.4	5.6												HW El = 64.0

SUMMARY & RECOMMENDATIONS: Grade Break Channel to West = 67.0
" " " " East = 64.0

PROJECT: Sun Valley Parkway FIS 7158-01

DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

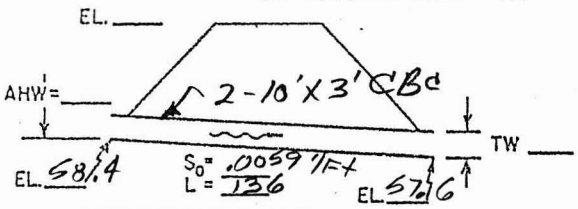
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 38+84.50 #7



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h_0−LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Headwall 30° to 70°	60	See Above	.33	1.0	.2	—	.65	1.8	—		.8		1.0			Inlet control HW El. = 59.4
	170		.67	2.0	.2	.2	1.3	2.2	—	2.2	"	1.6	2.0			" HW El. = 60.4
	300		1.0	3.0	.2	.68	1.9	2.5	—	2.5	"	2.4	3.0			" HW El. = 61.4
	420		1.33	4.0	.2	1.65	2.3	2.7	—	2.7	"	3.7	4.0			" HW El = 62.4

SUMMARY & RECOMMENDATIONS: Grade Break Channel West El = 64.0
Grade Break Channel East El = 61.5

HYDROLOGIC AND CHANNEL INFORMATION

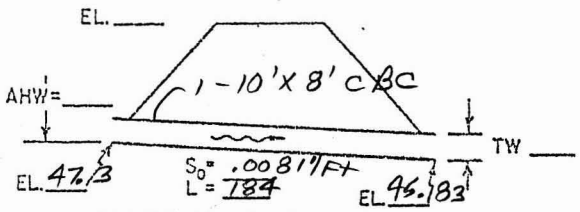
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 45+39 #8



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h_0−LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Headwall 30° to 70°	90	See Above	.25	2.0	.2	—					1.5		2.0			HW El. = 49.3
	160	"	.378	3.0	"	—					"		3.0			HW El = 50.3
	240	"	.5	4.0	"	.2					"		4.0			HW El = 51.3
	340	"	.63	5.0	"	.43	3.2	5.6	—	5.6	"	4.5	5.0			Inlet Control HW = 52.3
	440		.75	6.0	"	.7	3.8	5.9	—	5.9	"	5.1	6.0			Inlet Control HW = 53.3
	550		.88	7.0	"	1.1	4.4	6.2	—	6.2	"	5.8	7.0			Inlet Control HW = 54.3
	600		.94	7.5	"	1.3	4.7	6.3	—	6.3	"	6.1	7.5			Inlet Control HW El = 54.8

SUMMARY & RECOMMENDATIONS: Grade Break Channel to East El = 54.8

PROJECT: Sun Valley Parkway FIS 7158-01

DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

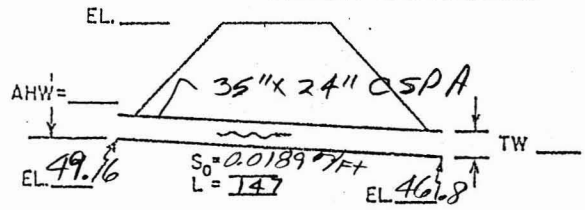
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 47+60.25 (#9)



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
Flared End Sect.	7	See above	.54	1.0	.5	.2	.65	1.24	–	1.24	2.4	.96	1.0			Inlet control HW El = 50.16
"	19	"	1.1	2.0	.5	2.0	1.13	1.48	–	1.48	"	1.08	2.0			" HW El 51.16
"	30	"	1.63	3.0	"	5.1	1.45	1.73	–	1.73	"	4.4	4.4			Outlet control HW El = 53.5
	25	"	1.35	2.7	"	3.7	1.33	1.67	–	1.67	"	3.0	3.0			outlet Control HW El = 52.16
	26.5				"	4.1	1.4	1.7	–	1.7	"	3.4	3.4			" HW El = 52.56

SUMMARY & RECOMMENDATIONS: Grade Break channel to East El. = 52.5

HYDROLOGIC AND CHANNEL INFORMATION

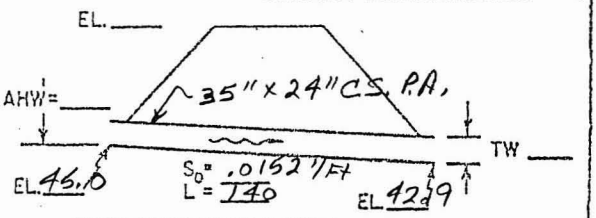
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 51+76.5 (#10)



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
Flared End Sect.	7	See Above	.54	1.0	.5	.2	.65	1.24	–	1.24	2.01	.96	1.0			Inlet contr. HW El. = 46.0
"	19	"	1.1	2.0	.5	2.0	1.13	1.48	–	1.48	"	1.38	2.0			Inlet control HW El. = 47.0
"	30	"		3.0	.5	5.2	1.45	1.64	–	1.64	"	4.4	4.4			Outlet Contr. HW El. = 49.4
"	25	"	1.35	2.7	"	3.7	1.33	1.67	–	1.67	"	3.3	3.3			" HW El = 48.3
"	26.5		1.45	2.9	"	4.1	1.4	1.7	–	1.7	"	3.7	3.7			" HW El = 48.7
	24		1.3	2.6	"	3.2	1.2	1.6	–	1.6	"	2.7	2.6			Inlet contr. HW El = 47.6

SUMMARY & RECOMMENDATIONS: Grade Break Channel to East El. = 47.6

PROJECT: Sun Valley Parkway FIS 7158-01

DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

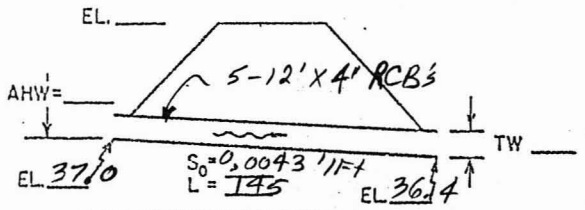
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 64+99 (#11)



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
Headwall 30 to 70°	210	See Above	.25	1.0	.2	—	.7	2.4	—	2.4	.6	—	1.0			Inlet Control HW El = 38.0
"	510	"	.50	2.0	"	.1	1.3	2.7	—	2.7	"	2.0	2.0			HW El = 39.0
"	930	"	.75	3.0	"	.4	1.9	3.0	—	3.0	"	2.8	3.0			HW El. = 40.0
"	1410	"	1.00	4.0	"	.8	2.5	3.3	—	3.3	"	3.5	4.0			HW El = 41.0
	1800	"	1.25	5.0	"	1.3	3.0	3.5	—	3.5	"	4.2	5.0			Inlet Control HW El. = 42.0

SUMMARY & RECOMMENDATIONS: Channel Grade Break East El = 41.0

HYDROLOGIC AND CHANNEL INFORMATION

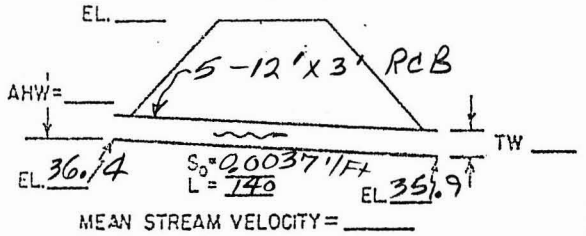
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 67+33 (#12)



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
Headwall 30° to 70°	360	See Above	.53	1.6	.2	.1	1.0	2.0	—	2.0	.5	1.6	1.6			El = 38.0
	750	"	.87	2.6	"	.65	1.7	2.3	—	2.3	"	2.5	2.6			Inlet Control HW El = 39.0
	1140	"	1.20	3.6	"	1.6	2.2	2.6	—	2.6	"	3.7	3.7			Outlet Cont. HW El = 40.1
	1440	"	1.53	4.6	"	2.5	2.6	2.8	—	2.8	"	4.8	4.8			Outlet contr HW El = 41.2

SUMMARY & RECOMMENDATIONS: Channel Grade Break East El. = 40.0

PROJECT: _____ DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

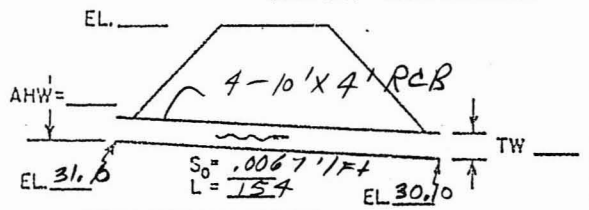
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 74+15 #13



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	d_c	(d_c+D)/2	TW	h₀	LS₀	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Headwall 30° to 70°	140	See Above	.25	1.0	.2	—	.72	2.4	—	2.4	1.0		1.0			HW El = 32.0
	340	"	.50	2.0	.2	.06	1.29	2.6	—	2.6	1.0	1.65	2.0			HW El = 33.0
	620	"	.75	3.0	.2	.4	1.92	3.0	—	3.0	1.0	2.4	3.0			HW El = 34.0
	920	"	1.0	4.0	.2	.84	2.49	3.2	—	3.2	1.0	3.0	4.0			HW El = 35.0
	1200	"	1.25	5.0	.2	1.4	2.97	3.5	—	3.5	1.0	3.9	5.0			HW El = 36.0

SUMMARY & RECOMMENDATIONS: Grade Break Channel to East El. = 35.0

HYDROLOGIC AND CHANNEL INFORMATION

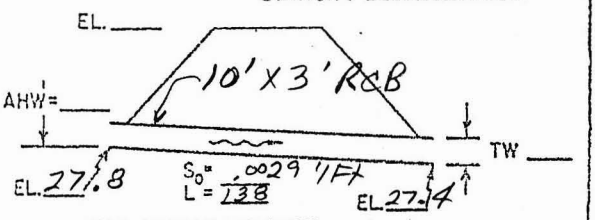
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 79+21.5 #14



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	d_c	(d_c+D)/2	TW	h₀	LS₀	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Headwall 30° to 70°	40	See Above	.4	1.2	.2	—	.72	1.86	—	1.86	.4		1.2			HW El. = 29.0
	97	"	.73	2.2	.2	.25	1.4	2.2	—	2.2	.4	2.05	2.2			HW El. = 30.0
	165	"	1.07	3.2	.2	.8	2.0	2.5	—	2.5	.4	2.9	3.2			HW El. = 31.0
	220	"	1.4	4.2	.2	1.4	2.4	2.7	—	2.7	.4	3.7	4.2		Inlet Contr.	HW El = 32.0
	245	"	1.57	4.7												

SUMMARY & RECOMMENDATIONS: Grade Break Channel to East El = 31.0

PROJECT: _____ DESIGNER: GAS

DATE: 11/2/90

HYDROLOGIC AND CHANNEL INFORMATION

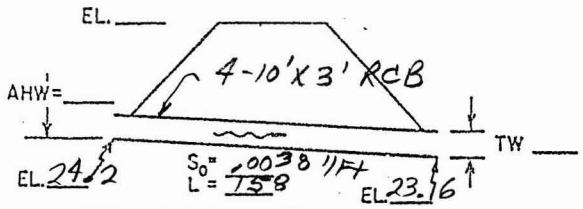
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 84+67 #15



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	
Headwall 30° to 70°	100	See Above	.27	0.8	0.2	—	.57	1.8	—	1.8	0.6	0.8				HW	El = 25.0
	288	"	0.6	1.8	"	.1	1.16	2.1	—	2.1	"	1.6	1.8			HW	El. = 26.0
	492	"	.87	2.6	"	.45	1.66	2.3	—	2.3	"	2.2	2.6			Inlet contr. HW	El = 26.8
	760		1.2	3.6	"	1.08	2.2	2.6	—	2.6	"	3.1	3.6			Inlet contr. HW	El = 27.8

SUMMARY & RECOMMENDATIONS: Grade Break Channel to East El. 26.8

HYDROLOGIC AND CHANNEL INFORMATION

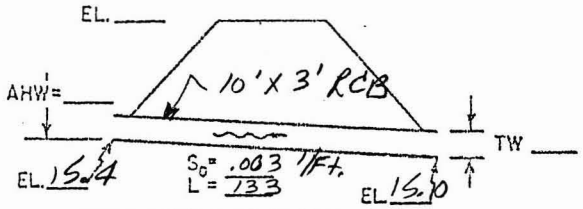
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 99+09.75 #16



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	
Headwall 30° to 70°	60	See Above	.53	1.6	.2	.05	1.0	2.0	—	2.0	.4		1.6			HW	El = 17.0
	123		.87	2.6	"	.4	1.65	2.3	—	2.3	"	2.3	2.6			HW	El = 18.0
	160		1.03	3.1	"	.7	1.96	2.5	—	2.5	"	2.8	3.1			HW	El = 18.5
	185		1.20	3.6	"	.95	2.16	2.6	—	2.6	"	3.2	3.6			HW	El = 19.0

SUMMARY & RECOMMENDATIONS: Grade Break channel to East El = 18.5

PROJECT: _____ DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

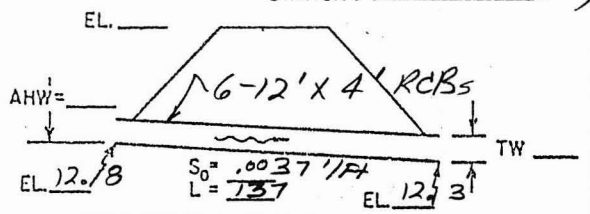
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 102+17 (#17)



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	
Headwall 30° to 70°	288	See Above	.3	1.2	.2						.5					HW	El = 14.0
"	706	"	.55	2.2	"						"					"	" = 15.0
"	1224	"	.8	3.2	"						"					"	" = 16.0
"	1764	"	1.05	4.2	"						"					"	" = 17.0
"	2052	"	1.18	4.7	"	1.15	2.8	3.4	–	3.4	"	4.1	4.7			Inlet contr HW	El. = 17.5
"	2520	"	1.43	5.7	"						"					"	" = 18.5

SUMMARY & RECOMMENDATIONS: Channel Breakout to East El. = 17.50

HYDROLOGIC AND CHANNEL INFORMATION

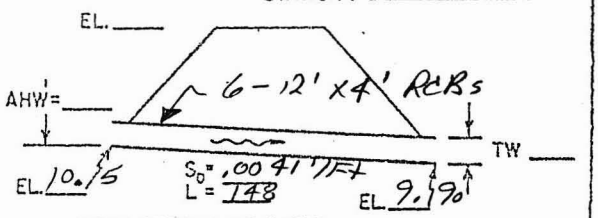
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: Sta 106+83.5 (#18)



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	
Headwall 30° to 70°	418	See Above	.38	1.5	.2						.6					HW	El = 12.0
"	864	"	.63	2.5	"						"					HW	El = 13.0
"	1404	"	.88	3.5	"						"		3.5			HW	El = 14.0
"	2016	"	1.13	4.5	"	1.15	2.8	3.4	–	3.4	"	4.0	4.5			Inlet Contr HW	El. = 15.0
"	2448	"	1.38	5.5							"					HW	El = 16.0

SUMMARY & RECOMMENDATIONS: Channel Breakout to East El = 15.0

PROJECT: _____ DESIGNER: GAS

DATE: 11/12/90

HYDROLOGIC AND CHANNEL INFORMATION

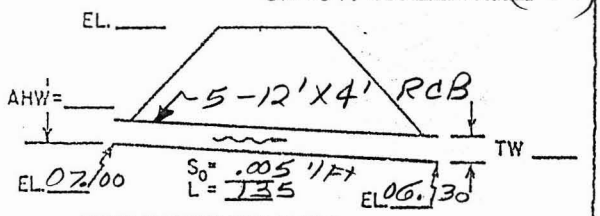
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 110+99 (#19)



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	
Headwall 30° to 70°	510	See Above	.50	2.0	0.2						.7	—	2.0			Inlet contr. HW	El = 9.0
"	930	"	.75	3.0	"	.35	1.92	3.0	—	3.0	"	2.6	3.0			Inlet Contr. HW	El. = 10.0
"	1380	"	1.00	4.0	"	.75	2.5	3.2	—	3.2	"	3.3	4.0			HW	El = 11.0
"	1800	"	1.25	5.0	"	1.3	3.0	3.5	—	3.5	"	4.1	5.0			HW	El = 12.0

SUMMARY & RECOMMENDATIONS: Channel Breakout Elev. to East El=10.9

HYDROLOGIC AND CHANNEL INFORMATION

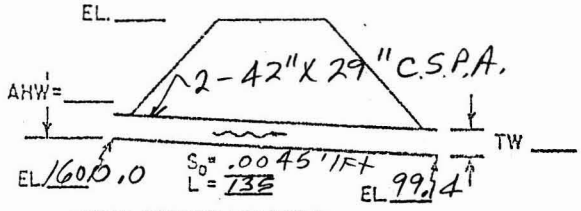
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 124+23 (#22)



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	
Headwall 30° to 70°	41	See Above	.79	1.9	.5	.85	1.07	1.7	—	1.7	.6	1.95	1.95			HW	El. = 1601.9
	72	"	1.2	2.9	.5	2.5	1.48	1.9	—	1.9	.6	3.8	3.8			HW	El = 1603.8
	58				"	1.7	1.22	1.8	—	1.8	"	2.9				HW	El = 1602.9

SUMMARY & RECOMMENDATIONS: Channel Breakout to East El. 1602.9

PROJECT: 7158-01

DESIGNER: GAS

DATE: 1/15/91

HYDROLOGIC AND CHANNEL INFORMATION

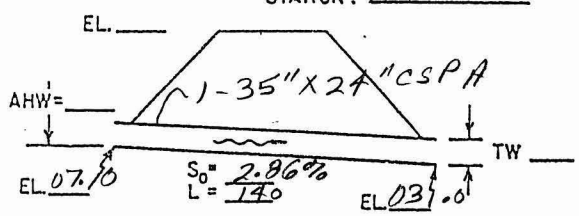
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 114+09 #20



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h₀-LS₀: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Flared End Section	19.5	See Above	1.09	2.0	0.5	2.1	1.15	1.5	—	1.5	4.0	—	2.0			Inlet contr. HW El. = 9.0
	25	"	1.36	2.5	0.5	3.4	1.32	1.57	—	1.57	"	1.6	2.5			Inlet contr. HW El. = 9.5
	30		1.63	3.0	"	4.9	1.45	1.64	—	1.64	"	2.5	3.0			Outlet contr. HW El. 10.6

SUMMARY & RECOMMENDATIONS: Breakout to East at Elev 09.5

HYDROLOGIC AND CHANNEL INFORMATION

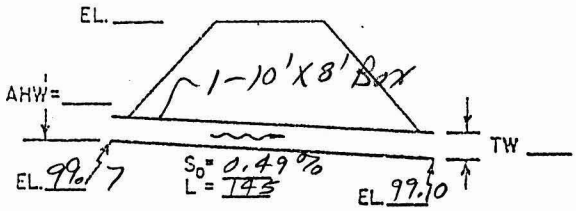
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 116+05.5 #21



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h₀-LS₀: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Head wall 30° to 75°	240	See Above	.5	4	.2											
	340	"	.63	5	"											
	440	"	.75	6	"											
	550	"	.88	7	"											
	740	"	1.1	8.8	"	1.9	5.3	6.7	—	6.7	.7	7.9	8.8			Inlet control HW El = 08.5

SUMMARY & RECOMMENDATIONS: Breakout East El. 108.5

PROJECT: _____ DESIGNER: GAS

DATE: 11/13/90

HYDROLOGIC AND CHANNEL INFORMATION

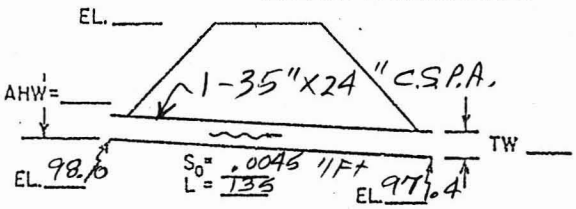
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 127+67 (#23)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h0-LS0: Ke	H	dc	(dc+D)/2	TW	h0	LS0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	
Flared End Section	7	see Above	.55	1.1	.5	—	.65	1.3	—	1.3	.6	—	1.1			Inlet Contr. Hw	El. = 99.1
"	19	"	1.05	2.1	.5	1.8	1.13	1.6	—	1.6	.6	2.8	2.8			Outlet Contr. Hw	El = 1600.8
"	29	"	1.55	3.1	.5	4.2	1.45	1.7	—	1.7	.6	5.3	5.3			Outlet Contr. Hw	El = 1603.3
"	15	"	.875	1.75	"	1.1	.95	1.48	—	1.48	.6	2.0	2.0			" Hw	El = 1600.0

SUMMARY & RECOMMENDATIONS: Channel Breakout East El. = 1600.10

HYDROLOGIC AND CHANNEL INFORMATION

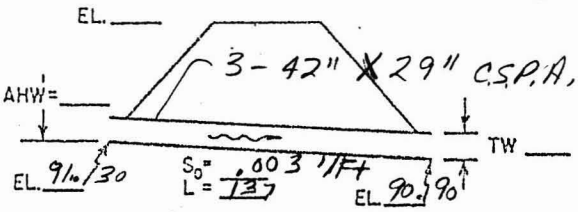
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 136+16.5 (#24)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h0-LS0: Ke	H	dc	(dc+D)/2	TW	h0	LS0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	
Headwall	13.5	see Above	.29	.7	.5	—	.4	1.4			.4	—	.7			Inlet Contr. Hw	El = 92.0
"	52.5	"	.70	1.7	.5	.56	.96	1.7	—	1.7	.4	1.9	1.9			Outlet Hw	El = 93.2
"	99	"	1.11	2.7	"	2.1	1.4	1.9	—	1.9	"	3.6	3.6			" Hw	El. = 94.9
"	120	"	1.32	3.2	"	2.9	1.58	2.0	—	2.0	"	4.5	4.5			" Hw	El. = 95.8
"	138	"	1.53	3.7	"	3.8	1.68	2.0	—	2.0	"	5.4	5.4			" Hw	El. = 96.7
	90	"	1.03	2.5	"	1.66	1.33	1.9	—	1.9	"	3.1	3.1			" Hw	El = 94.4
	81				"	1.39	1.25	1.83	—	1.83	"	2.8	2.8			Hw	El = 94.1

SUMMARY & RECOMMENDATIONS: Channel Breakout to East El. = 94.0

PROJECT: _____ DESIGNER: GAS

DATE: 11/13/90

HYDROLOGIC AND CHANNEL INFORMATION

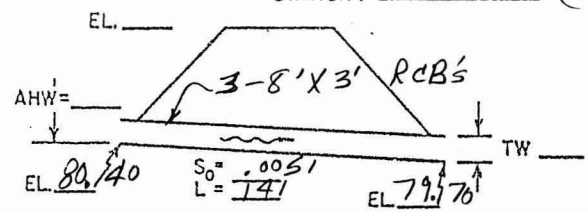
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 146+50.5 (#25)



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	
Head wall 30° to 70°	144	See Above	.53	1.6	0.2	—					.7					HW	El. 82.0
"	293	"	.86	2.6	0.2	.44					.7					HW	El 83.0
"	380	"	1.03	3.1	0.2	.7	1.95	2.5	—	2.5	.7	2.5	3.1			Inlet Contr. HW	El 83.5
"	516	"	1.36	4.1	"	1.4					"					HW	El 84.5
"	456	"	1.2	3.6	"	.88	2.2	2.6	—	2.6		2.8	3.6			Inlet cont. HW	El 84.0

SUMMARY & RECOMMENDATIONS: Channel Breakout to East El = 84.0

HYDROLOGIC AND CHANNEL INFORMATION

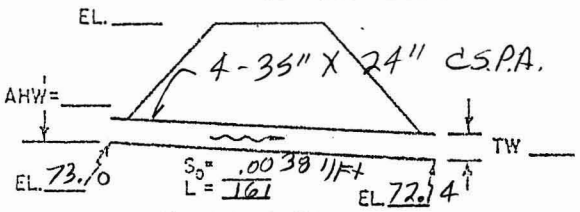
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 154+43.5 (#26)



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	
Headwall	24	See Above	0.5	1.0	.5	—	.55	1.3	—	1.3	.6	—	1.0			Inlet Contr. HW	El = 74.0
"	72		1.0	2.0	.5	1.95	1.1	1.55	—	1.6	.6	2.1	2.1			Outlet Contr. HW	El = 75.1
	92		1.25	2.5	.5	3.2	1.25	1.60	—	1.6	"	4.2	4.2			" HW	El = 77.2
	112		1.5	3.0	.5	4.7	1.4	1.7	—	1.7	"	5.8	5.8			" HW	El = 78.8
	76		1.05	2.1	"	2.2	1.12	1.6	—	1.6	"	3.2	3.2			" HW	El = 76.2

SUMMARY & RECOMMENDATIONS: Channel Break To East El. = 75.0

PROJECT: _____ DESIGNER: GAS

DATE: 11/13/90

HYDROLOGIC AND CHANNEL INFORMATION

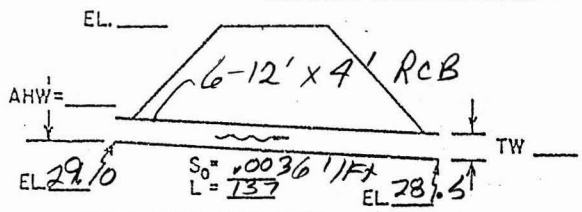
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 197+74.5 (# 27)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q =	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h₀−LS₀: Kₑ	H	d_c	(d_c+D)/2	TW	h₀	LS₀	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	
Head wall 30° to 70°	612	see Above	.5	2.0	.2						.5		2.0			HW	El = 31.0
"	1116		.75	3.0	"						"		3.0			HW	El = 32.0
"	1656		1.0	4.0	"	.75	2.5	3.2	–	3.2	"	3.5	4.0			Inlet contr. HW	El = 33.0
"	2160		1.25	5.0	"	1.3	2.9	3.5	–	3.5	"	4.3	5.0			Inlet contr. HW	El = 34.0
"	2664		1.50	6.0	"						"		6.0			HW	El = 35.0

SUMMARY & RECOMMENDATIONS: Channel Breakover Elev. to East = 35.0

HYDROLOGIC AND CHANNEL INFORMATION

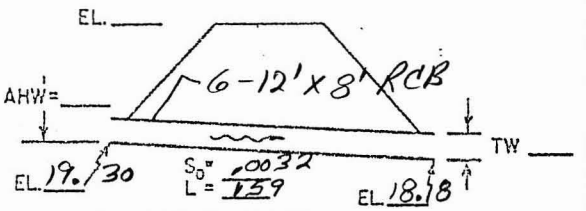
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 207+57.5 (# 28)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q =	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h₀−LS₀: Kₑ	H	d_c	(d_c+D)/2	TW	h₀	LS₀	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	
Headwall 30° to 70°	576	See Above	.21	1.7	0.2						0.5		1.7			HW	El. = 21.0
	972		.34	2.7	"						"		2.7			HW	El = 22.0
	1512		.46	3.7	"	.1	2.3	5.2	–	5.2	"		3.7			HW	El = 23.0
	2160		.58	4.7	"	.3					"		4.7			HW	El. = 24.0
	2880		.71	5.7	"	.57	3.6	5.8			"		5.7			HW	El. = 25.0
	3600		.83	6.7	"	.83	4.2	6.1	–	6.1	"	6.4	6.7			Inlet Contr. HW	El. 26.0

SUMMARY & RECOMMENDATIONS: Grade Break to East El = 26.0±

PROJECT: _____ DESIGNER: GAS

DATE: 11/13/90

HYDROLOGIC AND CHANNEL INFORMATION

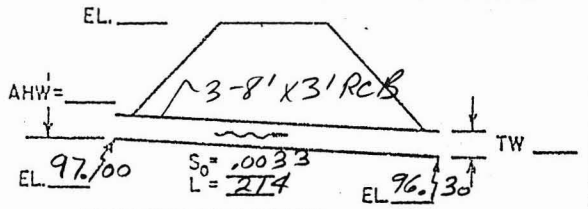
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 236+91 (# 30)



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	
Headwall 30° to 70°	72	See Above	.33	1.0	0.2		.65	1.8	—	1.8	.7	—	1.0			HW	El = 98.0
"	204	"	.67	2.0	"	.25	1.3	2.1	—	2.1	.7	1.65	2.0			Inlet contr. "	" = 99.0
"	312	"	0.9	2.7	"	.6	1.7	2.4	—	2.4	.7	2.3	2.7			" "	" = 99.7
"	468	"	1.23	3.7	"	1.3	2.2	2.6	—	2.6	.7	3.2	3.7			" "	" = 100.7
"	528	"	1.4	4.2	"	1.6	2.4	2.7	—	2.7	.7	3.6	4.2			" "	" = 101.2
"	588	"	1.56	4.7	"	2.0							4.7			" "	" = 101.7

SUMMARY & RECOMMENDATIONS: Channel Grade Break to East El. 99.7

HYDROLOGIC AND CHANNEL INFORMATION

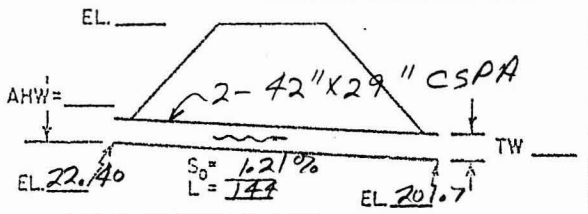
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 210+68.5 #29



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	
Headwall	14	See Above	0.62	1.5	.5	.4	.85	1.6	—	1.6	1.7	.3	1.5			HW	El = 23.9
	22	"	0.82	2.0	"	1.1	1.1	1.8	—	1.8	1.7	1.2	2.0			HW	El. = 24.4
	30	"	1.03	2.5	"	2.0	1.34	1.9	—	1.9	1.7	2.2	2.5			Inlet Cont. HW	El = 24.9

SUMMARY & RECOMMENDATIONS: Breakout To East Elev. 23.9

PROJECT: _____ DESIGNER: GAS

DATE: 11/13/90

HYDROLOGIC AND CHANNEL INFORMATION

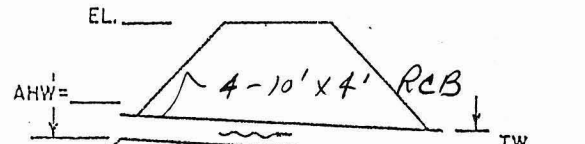
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 254+82.5 (#31)



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	
Headwall 30° to 70°	200	See Above	.35	1.4	.2	—					.3		1.4			HW	El = 88.0
"	448	"	.6	2.4	"	—					"		2.4			HW	El = 89.0
"	740	"	.85	3.4	"	.55	2.2	3.0	—	3.0	"	3.3	3.4			HW	El. 90.0
"	1040	"	1.1	4.4	"	1.05	2.7	3.3	—	3.3	"	4.0	4.4			HW	El. 91.0
"	1200	"	1.23	4.9	"	1.4	2.9	3.5	—	3.5	"	4.6	4.9			HW	El 92.0

SUMMARY & RECOMMENDATIONS: Breakout to East at Elev. = 90.0

HYDROLOGIC AND CHANNEL INFORMATION

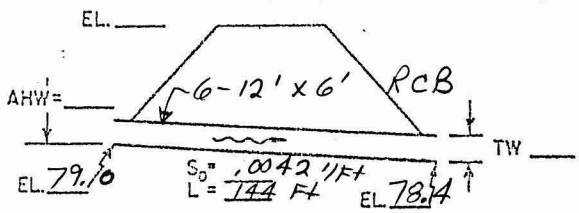
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 260+98.5 (#32)



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	
Headwall 30° to 70°		See Above															
"	612	"	.33	2.0	0.2	—	1.3	3.6	—	3.6	0.6	—	2.0			HW	El. = 81.0
"	1116	"	.50	3.0	"	—	1.9	3.95	—	3.95	"	—	3.5			HW	El = 82.0
"	1728	"	.67	4.0	"	.38	2.6	4.3	—	4.3	"	4.0	4.0			HW	El = 83.0
"	2376	"	.83	5.0	"	.7	3.2	4.6	—	4.6	"	4.7	5.0			HW	El = 84.0

SUMMARY & RECOMMENDATIONS: Channel Breakout to East Elev. = 84.0

PROJECT: _____ DESIGNER: GAS

DATE: 11/13/90

HYDROLOGIC AND CHANNEL INFORMATION

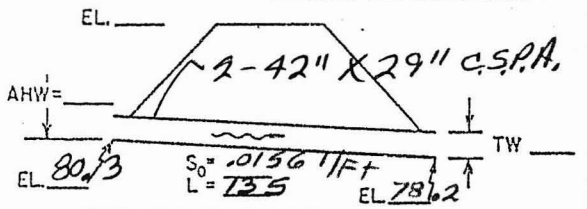
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 264+99.5 (# 33)



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_0−LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Headwall	12	See Above	.37	.9	.5	–	.6	1.5	–	1.5	2.1	–	.9			Inlet Contr. HW El. 81.2
	42		.79	1.9	"	.9	1.07	1.74	–	1.74	"	0.54	1.9			Inlet Contr. HW El 82.2
	72		1.2	2.9	"	2.7	1.48	1.9	–	1.9	"	2.5	2.9			Inlet Contr. HW El. 83.2
	96		1.6	3.9	"	4.8	1.74	2.1	–	2.1	"	4.8	4.8			" HW El. 85.1
	105		1.8	4.4	"	5.7	1.82	2.1	–	2.1	"	5.7	5.7			" HW El 86
	85		1.43	3.5	"	3.7	1.7	2.06	–	2.06	"	3.7	3.7			" HW el 84.0
	114		2.1	5.0	"	6.5	1.9	2.16	–	2.16	"	6.56	6.56			HW el. 86.9
	110		1.94	4.7	"	6.2	1.86	2.14	–	2.14	"	6.24	6.24			hw.el. 86.5
	102		1.72	4.16	"	5.4	1.8	2.1	–	2.1	2.1	5.4				HW El 85.7

SUMMARY & RECOMMENDATIONS: Channel Breakout to East El. 83.2

HYDROLOGIC AND CHANNEL INFORMATION

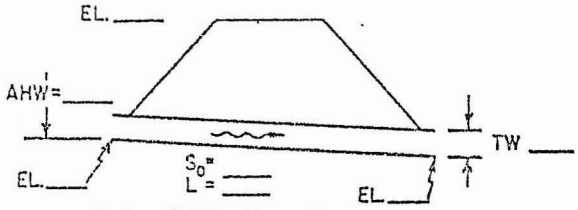
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: _____



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_0−LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS

SUMMARY & RECOMMENDATIONS:

PROJECT: _____

DESIGNER: OTS CK GAS

DATE: 12/6/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

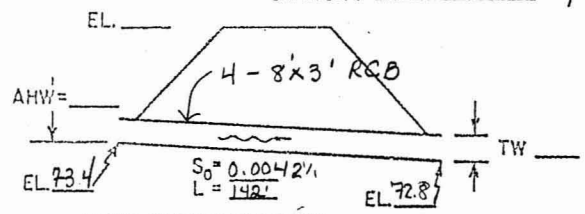
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 279+17 (#34)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h₀−LS₀: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	Hw EL=
Headwall 30°-70°	112	See Above	0.37	1.1	0.2	—							1.1			Inlet control	= 74.5
	288	"	0.70	2.1	"	0.22	1.36	2.18	—	2.2	0.6	1.8	2.1			Inlet control	= 75.5
	496	"	1.03	3.1	0.2	0.7	1.95	2.48	—	2.5	0.6	2.6	3.1			Inlet control	= 76.5
	608	"	1.2	3.6	"	1.05	2.24	2.62	-	2.6	0.6	3.1	3.6			Inlet control	= 77.0
	672	"	1.37	4.1	"	1.26	2.4	2.7	-	2.7	0.6	3.4	4.1			Inlet control	= 77.5

SUMMARY & RECOMMENDATIONS:

Channel Breakout to east at el. 76.5

HYDROLOGIC AND CHANNEL INFORMATION

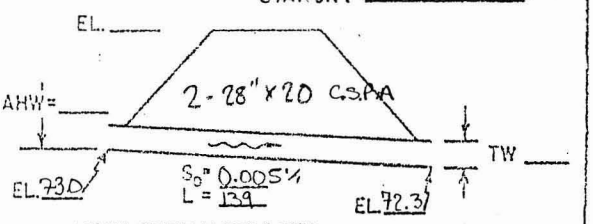
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 282+90 (#35)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h₀−LS₀: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	hw =
Headwall	—	see above	0.3	0.5	0.5	—											
	10	"	0.6	1.0	"	.37	0.55	1.1	—	1.1	0.7	0.77	1.0			inlet control	= 74.0
	18	"	0.9	1.5	"	1.2	0.8	1.23		1.2	0.7	1.7	1.7			outlet control	= 74.7
	26	"	1.2	2.0	"	2.5	1.0	1.3		1.3	0.7	3.1	3.1			outlet control	= 76.1
	32	"	1.5	2.5	"	3.9	1.1	1.4		1.4	0.7	4.6	4.6			outlet control	= 77.6
	17	"	0.84	1.4	"	1.1	0.75	1.21		1.2	0.7	1.6	1.6			outlet control	= 74.6
	15	"	0.78	1.3	"	0.86	0.72	1.19		1.2	0.7	1.35	1.4			outlet control	= 74.4

SUMMARY & RECOMMENDATIONS:

Channel Breakout to east at el. 74.5

PROJECT: _____

DESIGNER: OTS CK GAS

DATE: 12/6/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

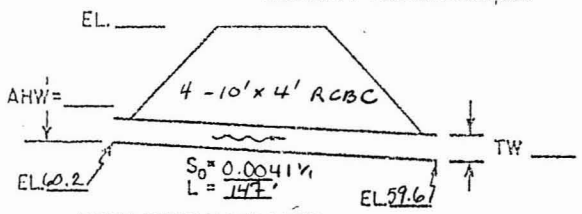
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 304+1.3 (#36)



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	HW el =
Headwall 30°-70°	840	see above	.95	3.8	0.2	.73	2.4	3.2	-	3.2	.6	3.33	3.8			Inlet control	= 64'
	1160	"	1.2	4.8	"	1.25	2.97	3.5	-	3.5	.6	4.1	4.8			"	= 65'
	1400	"	1.45	5.8	0.2	1.87	3.4	3.7	-	3.7	0.6	5.0	5.8			inlet control	= 66.0'
	1520	"	1.58	6.3	"	2.2	3.6	3.8	-	3.8	0.6	5.4	6.3			"	= 66.5'
	1640	"	1.7	6.8	"	2.6	3.7	3.9	-	3.9	0.6	5.9	6.8			"	67.0'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 66.0

or at Station 298+00 breakout over median curb at el 66.0

HYDROLOGIC AND CHANNEL INFORMATION

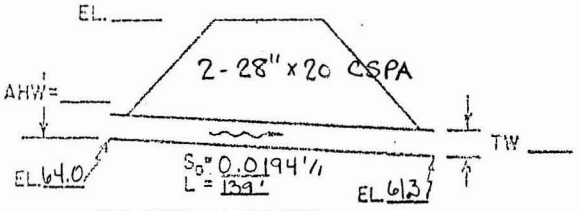
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 307+78.5 (#37)



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	hw el =
Headwall	10	See above	0.6	1.0	0.5	0.35	0.55	1.1	-	1.1	2.7	0	1.0			Inlet control	= 65'
	18		0.9	1.5	0.5	1.2	0.8	1.2	-	1.2	2.7	0	1.5			Inlet control	= 65.5'
	26	"	1.2	2.0	0.5	2.5	1.0	1.3	-	1.3	2.7	1.1	2.0			Inlet Control	= 66.0'
	32		1.5	2.5	0.5	3.9	1.1	1.4	-	1.4	2.7	2.6	2.6			Outlet control	= 66.6'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east and west at el. 66.0

PROJECT: _____

DESIGNER: OTS CKGAS

DATE: 12/6/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

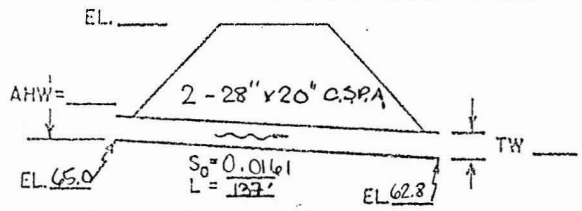
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 310+12.50 (#38)



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	hwel =
Headwall		see above															
	—	"	0.3	0.5													
	10	"	0.6	1.0	0.5	.35	.55	1.1	–	1.1	2.2	0	1.0			inlet control	= 66.0
	18	"	0.9	1.5													= 66.5'
	26	"	1.2	2.0	0.5	2.6	1.0	1.3	–	1.3	2.2	1.7	2.0			inlet control	= 67.0'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el. 66.0

HYDROLOGIC AND CHANNEL INFORMATION

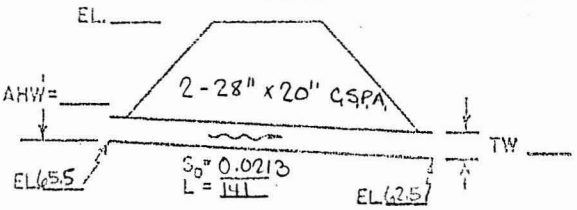
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 312+27 (#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	Hwel =
Headwall	10	see above	0.6	1.0													=66.5'
	18	"	0.9	1.5													= 67'
	24	"	1.1	1.9	0.5	2.2	0.95	1.3	–	1.3	3	0.5	1.9			inlet control	Hw el. = 67.4'
	32	"	1.5	2.5	0.5	3.8	1.1	1.4	–	1.4	3	2.2	2.5			inlet control	" = 68.0
	38	"	1.8	3.0	0.5	5.5	1.2	1.4	–	1.4	3	3.9	3.9			outlet control	Hw = 69.4

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el' 67.4

PROJECT: _____

DESIGNER: OTS CKGAS

DATE: 12/6/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

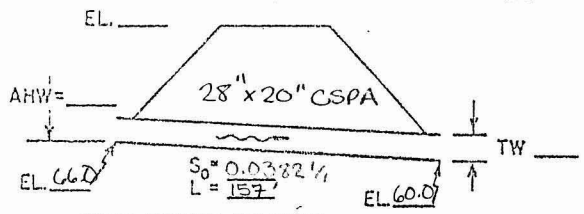
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 315+02.50 (#40)



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	
Flared end section –	—	see above	0.3	0.5												inlet control	hw el =
used type 12 [mitered to	4.7	"	0.6	1.0												"	
conform to slope] for	12	"	1.2	2.0	0.5	2.4	.94	1.3	–	1.3	6	7	2			"	= 68.0'
analysis	17	"	1.8	3.0	0.5	4.9	1.15	1.4	-	1.4	6	.3	3			"	= 69.0
	22	"	2.4	4.0	0.5	8.2	1.3	1.5	–	1.5	6	3.7	4			"	= 70.0

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el. 68.0

HYDROLOGIC AND CHANNEL INFORMATION

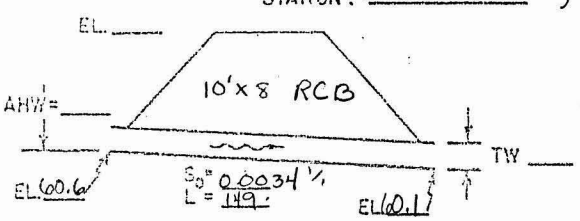
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 316+36.50 (#41)



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	
Headwall	290	see above	0.55	4.4									4.4				hw el = = 65'
30° - 70°	470	"	0.8	6.4	0.2	.73	4.09	6.05	–	6.1	0.5	6.3	6.4			Inlet control	= 67'
	670	"	1.01	8.1	0.2	1.5	5.19	6.6	–	6.6	0.5	7.6	8.1			inlet control	= 68.7'
	750	"	1.11	8.9	0.2	1.9	5.6	6.8	-	6.8	0.5	8.2	8.9			inlet control	= 69.5'
	1200	"	1.18	9.4	0.2	4.8	7.7	7.8	–	7.8	0.5	12.1	12.1			outlet control	= 72.7

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el 68.7

PROJECT: _____ DESIGNER: OTS CKGAS

DATE: 12/7/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

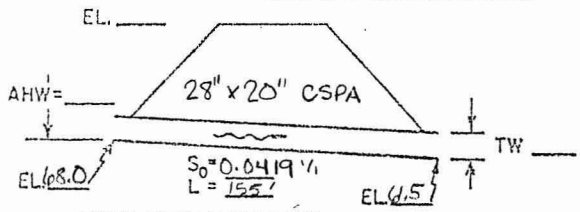
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 318+88 (#42)



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	hwel=
Flared end section –		see above															
used type (2)	4.7	"	0.6	1.0									1.0			inlet control	69.0'
[mitered to conform to	10	"	1.02	1.7	0.5	1.65	0.85	1.26	–	1.3	6.5	-0	1.7			"	69.7'
slope] for analysis	12.5	"	1.2	2.0									2			"	70.'
	17	"	1.8	3.0	0.5	4.7	1.15	1.4	–	1.4	6.5	∅	3.			"	71.'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el 69.7'

HYDROLOGIC AND CHANNEL INFORMATION

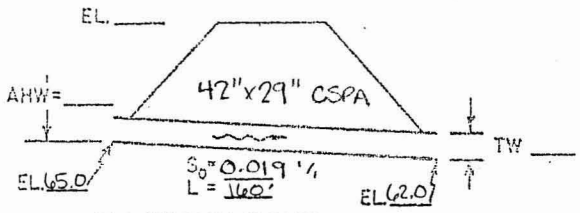
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 320+57.50 # 43



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	hw. el =
Flared end section –	33	see above	1.2	3.0												inlet control	68'
used type (2)	45	"	1.7	4.0	0.5	4.7	1.67	2.0	–	2.0	3	3.7	4			inlet control	69'
[mitered to conform to	56	"	2.3	5.5	0.5	7.25	1.85	2.1	–	2.1	3	6.4	6.4			outlet control	71.4'
slope] for analysis	60	"	2.5	6.0	0.5	8.4	1.95	2.2	–	2.2	3	7.6	7.6			"	72.6'
	67	"	2.9	7.0	0.5	10.4	2	2.2	–	2.2	3	9.6	9.6			"	74.6'
	48	"	1.86	4.5	0.5	5.5	1.75	2.1	–	2.1	3	4.6	4.6			"	69.6'
	52	"	2.07	5.0	0.5	6.1	1.82	2.1	–	2.1	3	5.2	5.2			"	70.2'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el 70.5'

PROJECT: _____

DESIGNER: OTS CKGAS

DATE: 12/7/90 1/3/91

HYDROLOGIC AND CHANNEL INFORMATION

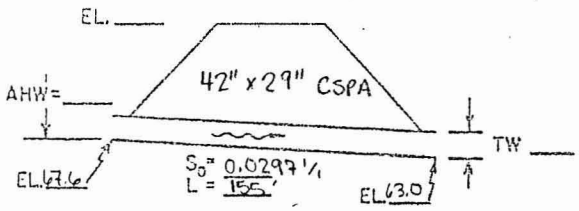
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 322+99 (#44)



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	hw. el. =
Flared end	13	see above	.6	1.4									1.4			inlet control	69.0'
Section	28	"	1.0	2.4									2.4			inlet control	70.0'
used type(2)	38	"	1.41	3.4	0.5	3.2	1.54	2	-	2	4.6	0.6	3.4			inlet control	71.0'
	46	"	1.8	4.4									4.4			"	72.0'
	55	"	2.2	5.4	0.5	6.7	1.86	2.1	-	2.1	4.6	4.2	5.4			"	73.0'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el. 71.0

HYDROLOGIC AND CHANNEL INFORMATION

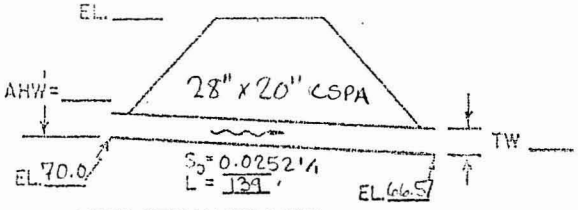
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 324+95.50 (#45)



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	hw.el.
Flared end		See above															
Section	4.7	"	0.6	1.0									1.0			inlet control	71.0'
used type (2)	11	"	1.08	1.8									1.8			"	71.8'
	17	"	1.8	3.0	0.5	4.4	1.15	1.4	-	1.4	3.5	2.3	3			"	73.0'
	21	"	2.4	4.0	0.5	6.8	1.29	1.5	-	1.5	3.5	4.8	4.8			Outlet contr	74.8'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el 71.8'

PROJECT: _____ DESIGNER: OTS CKGAS

DATE: 12/7/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

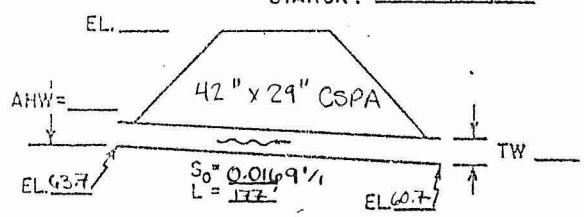
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 327+30 (#46)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	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	Hw. el =
Flared end section		see above															
Used type (2)	37	"	1.4	3.3	0.5	3.38	1.5	1.95	-	2.0	3	2.38	3.3			inlet control	67'
	55	"	2.2	5.3	0.5	7.4	1.75	2.1	-	2.1	3	6.5	6.5			outlet control	70.2'
	75	"	3.6	8.7	0.5	14	2.1	2.3	-	2.3	3	13.3	13.3			outlet control	77.0'
	58	"	2.36	5.7	0.5	8.6	1.92	2.2	-	2.2	3	7.8	7.8			"	71.5'
	62	"			0.5	9.4	1.95	2.2	-	2.2	3	8.6	8.6			"	72.3'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el. 72.4'

HYDROLOGIC AND CHANNEL INFORMATION

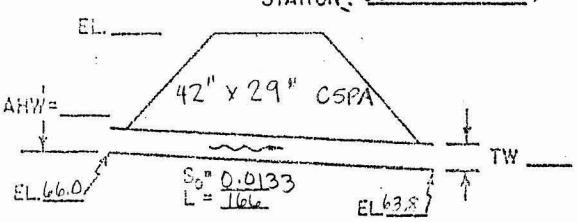
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 328+91 (#47)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - "	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	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	h.w. el. =
Flared end section	47	see above	1.86	4.5	0.5	4.9	1.72	2.1	-	2.1	2.2	4.8	4.8			outlet control	70.8'
Used type (2)	55	"	2.2	5.3	0.5	6.9	1.86	2.1	-	2.1	2.2	6.8	6.8			outlet control	72.8'
	67	"	2.9	7.0	0.5	10.1	2.02	2.2	-	2.2	2.2	10.1	10.1			outlet control	76.1'
	73	"	3.3	8.0	0.5	12.3	2.1	2.3	-	2.3	2.2	12.4	12.4			"	78.4'
	54	"	2.15	5.2	0.5	6.8	1.85	2.1	-	2.1	2.2	6.7	6.7			"	72.7'
	57	"	2.3	5.6	0.5	7.5	1.9	2.16	-	2.16	2.2	7.5	7.5			"	73.5'
	56	"	2.2	5.4	0.5	7.3	1.9	2.1	-	2.1	2.2	7.2	7.2			"	73.2'

SUMMARY & RECOMMENDATIONS:

Channel Breakout to west at el 73.0

PROJECT: _____

DESIGNER: OTS CKGAS

DATE: 12/7/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

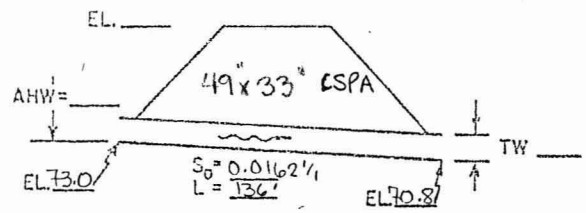
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 336+58.50 (#48)



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	hw. el. =
Flared end		see above															
Section	7.2		.36	1.0													74.0'
used type	26	"	0.73	2.0	0.5	.67	1.2	2.	-	2.0	2.2	.5	2			inlet control	75.0'
(2)	44		1.1	3.0												"	76.0'
	51		1.45	4.0	0.5	2.6	1.7	2.2	-	2.2	2.2	2.6	4			"	77.0'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el. 75.0'

HYDROLOGIC AND CHANNEL INFORMATION

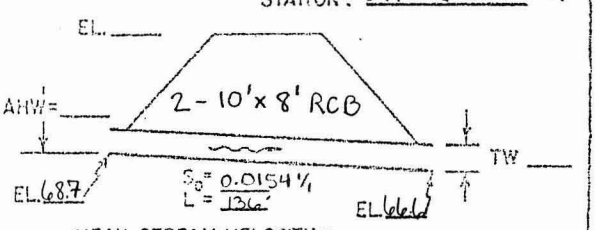
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 341+76.50 (#49)



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	hw. el
Headwall		see above			0.2												
30°-75°	880	"	.75	6.0	"	.64	3.9	6.0	-	6.	2.1	4.54	6.			inlet control	74.7'
	1220	"	.95	7.6	0.2	1.28	4.9	6.4	-	6.4	2.1	5.6	7.6			"	76.3
	960	"	.81	6.5									6.5			"	75.2
	1340	"	1.04	8.3	0.2	1.55	5.18	6.6	-	6.6	2.1	6	8.3			"	77.0

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el. 76.3'

PROJECT: _____

DESIGNER: OTO CKGAS

DATE: 12/7/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

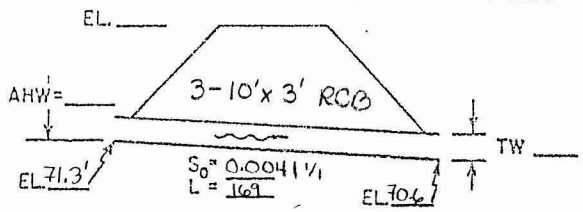
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 347+26 (#50)



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	hw el =
Headwall	198	See above	.57	1.7									1.7			inlet control	73'
30°-75°	390	"	.9	2.7									2.7			inlet control	74'
	570	"	1.23	3.7	0.2	1.05	2.2	2.6	-	2.6	0.7	3	3.7			Inlet control	75'
	735	"	1.57	4.7	0.2	1.85	2.7	2.8	-	2.8	0.7	4	4.7			"	76'
	885	"	1.9	5.7	"	2.6	2.9			2.97		4.8	5.7			"	77'
	960			6.3	"	3.1	3.0			3.0		5.4	6.3			"	77.6

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 75.0

HYDROLOGIC AND CHANNEL INFORMATION

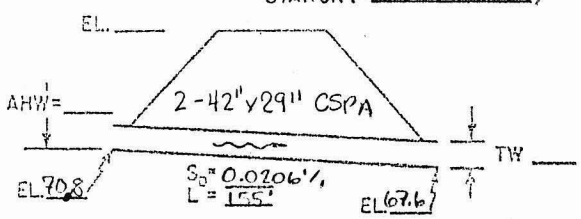
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 349+18 (#51)



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	hw. el. =
Headwall	19	See above	0.5	1.2									1.2			inlet control	72.0
	50	"	0.91	2.2									2.2			inlet control	73.0
	70	"	1.2	2.9	0.5	2.75	1.45	1.9	-	1.9	3.2	1.5	2.9			inlet control	73.7'
	76	"	1.32	3.2	0.5	3.3	1.53	2	-	2	3.2	2.1	3.2			"	74.0
	108	"	1.74	4.2	0.5	6.7	1.85		-	2.1	3.2	7.5	7.5			Outlet control	78.3
	90	"	1.53	3.7	0.5	4.5	1.7		-	2.1	3.2	3.4	3.7			Inlet	74.5
	95		1.6	3.85		5.0	1.8			2.1	3.2	3.9	3.9			Outlet	74.7

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 73.7'

PROJECT: _____

DESIGNER: OTS CK GAS

DATE: 12/7/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

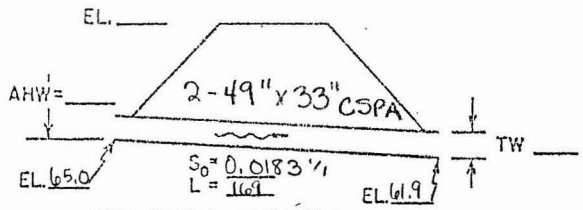
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 352+92 (#52)



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	hw.el.
Headwall	52	see above	.73	2.0									2			inlet control	67'
	90	"	1.1	3.0									3			"	68'
	116	"	1.38	3.8	0.5	4	1.85	2.3	-	2.3	3.1	3.2	3.8			inlet control	68.8'
	150	"	1.82	5.0	"	6.5	2.1	2.4	-	2.4	3.1	5.8	5.8			outlet control	70.8
	140	"	1.64	4.5	"	5.6	2.05	2.4	-	2.4	3.1	4.9	4.9			outlet control	69.9'
	15	"	.36	1.0												inlet control	66'
	170	"	2.18	6.0	0.5	8	2.25	2.5	-	2.5	3.1	7.4	7.4			outlet control	72.4'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 68.8

HYDROLOGIC AND CHANNEL INFORMATION

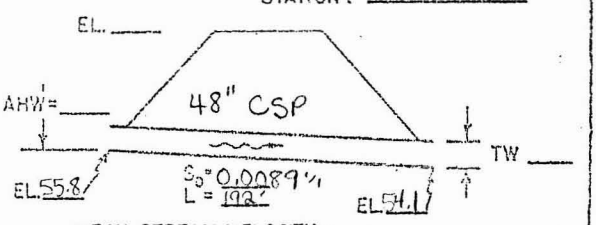
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 357+26 (#53)



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	hw.el.
Flared end	107	see above	1.63	6.5	0.5	5.4	3.1	3.55	-	3.6	1.7	7.3	7.3			outlet control	63.1
section	110	"	1.65	6.6	0.5	5.6	3.1	3.55	-	3.6	1.7	7.5	7.5			outlet control	63.3
Used type	120	"	1.9	7.6	0.5	6.7	3.2	3.6	-	3.6	1.7	8.6	8.6			outlet control	64.4
(2)	90	"	1.3	5.2	0.5	3.8	2.8	3.4	-	3.4	1.7	5.5	5.5			"	61.3
	133	"	2.05	8.2	0.5	8.3	3.5	3.75	-	3.8	1.7	10.4	10.4			"	66.2
	46	"	.75	3.0	0.5	1.0	2	3	-	3	1.7	2.3	3			inlet control	58.8
	150	"	2.5	10	0.5	10.5	3.6	3.8	-	3.8	1.7	12.6	12.6			Out. control	68.4

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 63.4'

PROJECT: _____

DESIGNER: OTS CK GAS

DATE: 12/7/90 1/4/91

HYDROLOGIC AND CHANNEL INFORMATION

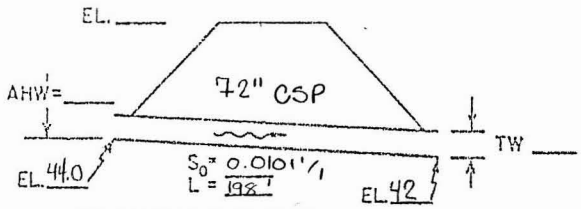
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 369+17.50 (#54)



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	hw. el. =
headwall		See above	.33	2	—								2			Inlet control	46.0'
	105	"	.67	4									4			"	48.0
	200	"	1.0	6	0.5	2.6	3.8	4.9	–	4.9	2	5.5	6			Inlet control	50.0
	240	"	1.17	7	0.5	3.75	4.25	5.13	–	5.1	2	6.9	7			"	51.0
	280	"	1.33	8	"	5.2	4.6	5.3	–	5.3	2	8.5	8.5			Outlet cont	52.5'
	287	"	1.37	8.22	"	5.6	4.7	5.35	–	5.35	2	8.95	9.0			outlet con-	53.0
	350	"	1.67	10	"	8.2	5.1	5.55	–	5.6	2	11.8	11.8			outlet cont.	55.8
	400	"	2	12	"	10.7	5.4	5.7	–	5.7	2	14.4	14.4			outlet control	58.4

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 51.0

* ← not labeled on plans. used scale.

HYDROLOGIC AND CHANNEL INFORMATION

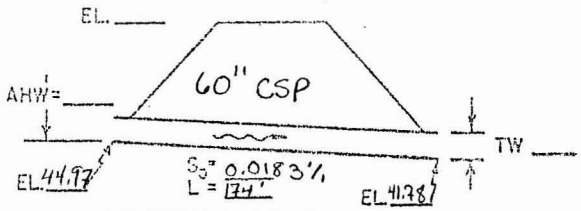
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 370+82 (#55)



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	hw. el =
Flared	88	See above	0.8	4.03									4			Inlet control	49.0'
end section	121	"	1.0	5.03									5			"	50.0'
used type	150	"	1.2	6.03	0.5	3.4	3.5	4.25	–	4.25	3.19	4.46	6			Inlet control	51.0'
(2)	168	"	1.4	7.03	0.5	4.3	3.7	4.35	–	4.35	3.19	5.46	7			"	52.0'
	185	"	1.6	8.03	0.5	5.2	3.9	4.45	–	4.45	3.19	6.46	8			"	53.0'

SUMMARY & RECOMMENDATIONS:

Channel breakout to west at el. 51.0

PROJECT: _____

DESIGNER: OTS CKGAS

DATE: 12/7/90 1/2/91

HYDROLOGIC AND CHANNEL INFORMATION

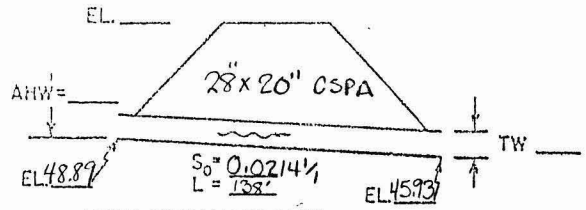
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 373+07 (#56)



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	hw.el =
Flared end section		see above															
used type (2)	5.5	"	.66	1.11									1.11			inlet control	50.0
	12	"	1.15	1.91	0.5	2.15	0.95	1.31	-	1.31	2.96	0.5	1.91			inlet control	50.8'
	13	"	1.27	2.11	0.5	2.57	0.97	1.32	-	1.32	2.96	0.9	2.11			"	51.0'
	17.5	"	1.87	3.11	0.5	4.7	1.15	1.41	-	1.41	2.96	3.15	3.15			Outlet control	52.04'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 50.8'

HYDROLOGIC AND CHANNEL INFORMATION

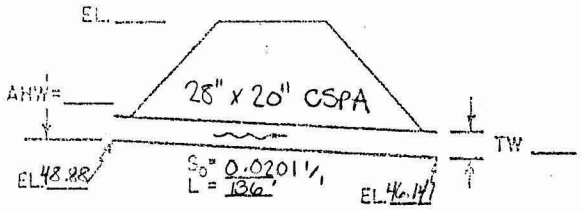
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 374+90 (#57)



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	hw.el =
Flared end section		see above															
used type (2)	5.6	"	.67	1.12									1.12			inlet control	= 50.0'
	7.5	"	0.8	1.32									1.32			"	= 50.2'
	13	"	1.27	2.12	0.5	2.5	.97	1.32	-	1.32	2.74	1.08	2.12			"	= 51.0'
	17.5	"	1.87	3.12	0.5	4.6	1.15	1.41	-	1.41	2.74	3.3	3.6			Outlet control	= 52.15'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 50.2

PROJECT: _____ DESIGNER: OTS ckGAS

DATE: 12/10/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

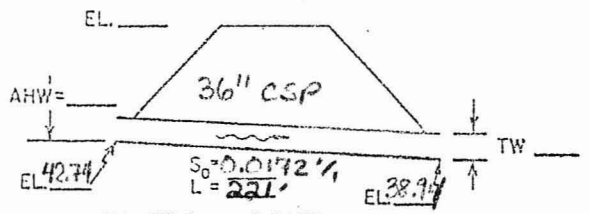
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION 378+96 (#58)



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	hw. el.
Flared end	48	see above	1.42	4.26	0.5	5.1	2.25	2.63	-	2.63	3.8	3.9	4.26			inlet control	47.0
Section	57	"	1.75	5.26	0.5	6.9	2.4	2.7	-	2.7	3.8	5.8	5.8			outlet control	48.54'
Used type	70	"	2.32	6.96	0.5	10.6	2.7	2.85	-	2.85	3.8	9.65	9.65			Outlet control	52.39'
(2)	62	"	1.92	5.75	0.5	8.3	2.5	2.75	-	2.75	3.8	7.25	7.25			"	49.99'
	60	"	1.87	5.60	0.5	7.8	2.5	2.75	-	2.75	3.8	6.75	6.75			"	49.49'
	58	"	1.83	5.50	0.5	7.4	2.5	2.75	-	2.75	3.8	6.35	6.35			"	49.09

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 49.7

HYDROLOGIC AND CHANNEL INFORMATION

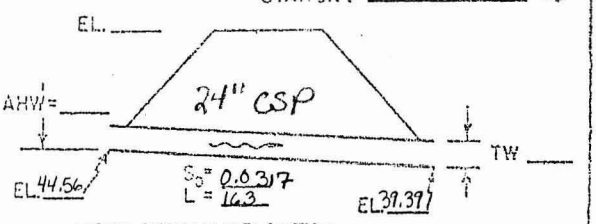
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 379+85 (#59)



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	hw. el. =
Flared	15.5	see above	1.22	2.44									2.4			inlet control	= 47.0'
end section	20	"	1.72	3.44	0.5	5.5	1.6	1.8	-	1.8	5.17	2.1	3.4			inlet control	= 48.0'
used type	26	"	2.32	4.64	0.5	9.3	1.8	1.9	-	1.9	5.17	6.03	6.03			Outlet control	= 50.59'
(2)	23	"	2	4.0	0.5	7.4	1.75	1.88	-	1.88	5.17	4.11	4.11			"	= 48.69'
	24	"	2.1	4.2	0.5	7.9	1.75	1.88	-	1.88	5.17	4.61	4.61			"	= 49.17'
	30	"	2.82	5.64	0.5	12.3	1.9	1.95	-	1.95	5.17	9.08	9.08			"	= 53.64'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el 49.2

PROJECT: _____ DESIGNER: OTS dkGAS

DATE: 12/10/90 1/7/91

HYDROLOGIC AND CHANNEL INFORMATION

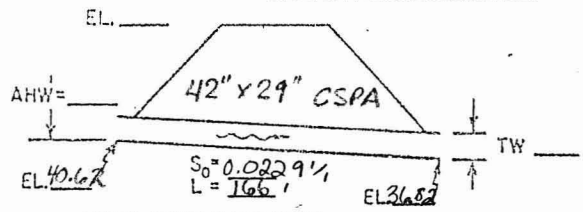
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 384+06 (#60)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

2.4167

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - cfs	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h₀-LS₀: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	hw. el. =
Flared end	12	see above	.59	1.38									1.4			inlet control	42.0'
section	27	"	.98	2.38									2.4			"	43.0'
used type	34	"	1.24	3	0.5	2.7	1.44	1.93	-	1.93	3.8	.83	3			"	43.0'
(2)	46	"	1.81	4.38	0.5	4.8	1.7	2.06	-	2.06	3.8	3.06	4.4			"	45.0
	55	"	2.23	5.38	0.5	6.9	1.87	2.14	-	2.14	3.8	5.24	5.38			"	46.0'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 1443.6'

HYDROLOGIC AND CHANNEL INFORMATION

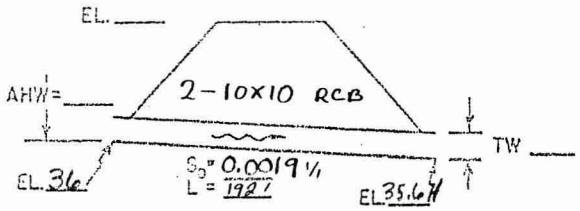
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

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

SKETCH

STATION: 473+08 (#61)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q - cfs	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h₀-LS₀: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	hw. el =
headwall	2900	see above	1.5	15									15			inlet control	51.0'
30°-75°	3700	"	2.0	20									20			"	56.0
	4600	"	2.7	27	.2	13	10	10	—	10	.36	22.6	27			inlet control	= 63'
	5200	"	3.2	32	.2	14.5	10	10	-	10	.36	24.1	32			"	= 68'

SUMMARY & RECOMMENDATIONS:

Channel breakout to east at el. 1363.

100 yr. w.s.-el = 1354.5

Appendix E-

Detention Basin Storage Routing Parameters

AN WEST INC.
Consulting Engineers

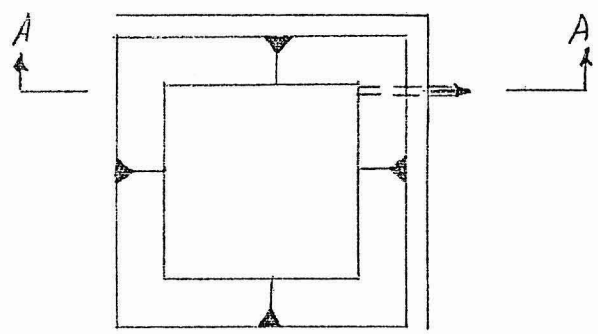
Project 7158-01 Sht. 1 of
Calc. By GAS Date 11/20/90
Chkd. Date

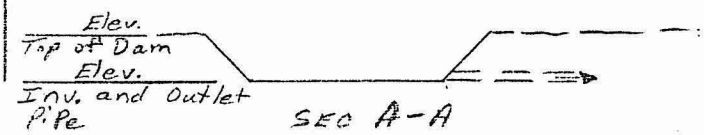
Retention / Detention Basin Data

Location: Sta 4+30.50 Structure #1

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. R01

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)
71.0	0	0	0
72.5	.013	.010	55
73.0	.017	.018	85
74.0	.260	.16	150
74.75	.79	.55	200





HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	STOR or FLOW	-1						
SV Record - Reservoir Storage									
SV	0	0.01	0.018	0.16	0.55				
SQ Record - Discharge									
SQ	0	55	85	150	200				
SE Record - Elevation									
SE	71	72.5	73.0	74.0	74.75				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST						E-1			

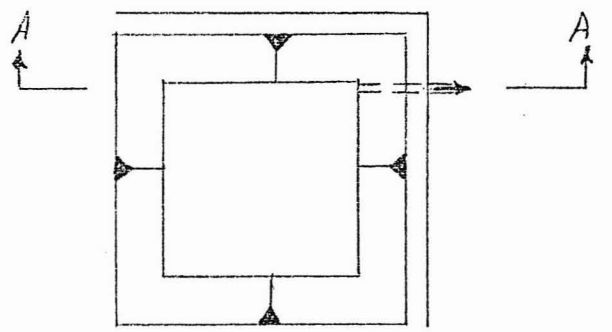
Retention / Detention Basin Data

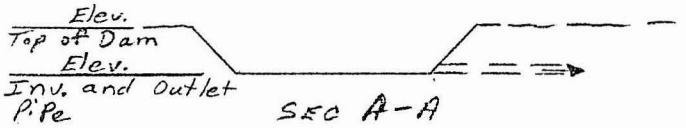
Location: Sta 16+19.50 Structure #2

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. R03

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)
69.0	0.0	0	0
70.0	0.09	0.045	27
71.0	0.25	0.22	87
72.0	0.41	0.55	118
72.9	0.56	0.99	150
74.2	0.71 *	1.82	183

* Estimated





HEC-1 Routing Input Data

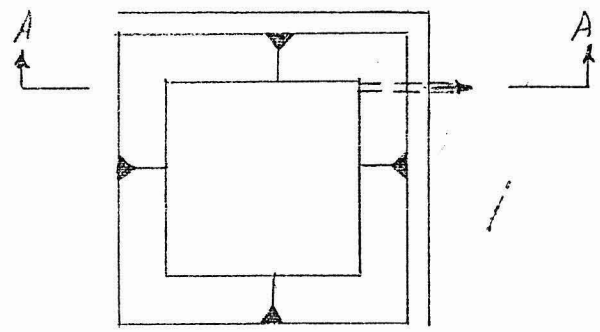
Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	STOR or FLOW	-1						
SV Record - Reservoir Storage									
SV	0	.045	.22	.55	.99	1.82			
SQ Record - Discharge									
SQ	0	27	87	118	150	183			
SE Record - Elevation									
SE	69	70.0	71.0	72.0	72.9	74.2			
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST						E-2			

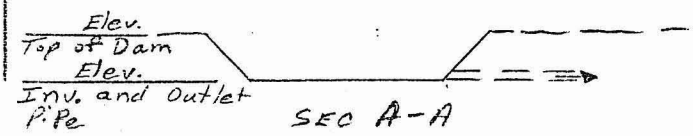
Retention / Detention Basin Data

Location : Sta 26+06 Structure # 3

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 5

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)
67.8	0	0	0
69.0	.003	.002	43
70.0	.023	.015	105
71.0	.046	.050	170
72.0	.13	.138	225





HEC-1 Routing Input Data

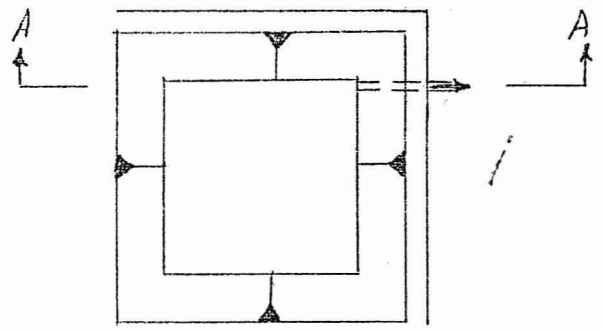
Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	STOR or FLOW	-1						
SV Record - Reservoir Storage									
SV	0	.002	.015	.050	.138				
SQ Record - Discharge									
SQ	0	43	105	170	225				
SE Record - Elevation									
SE	67.8	69.0	70	71	72				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST						E-3			

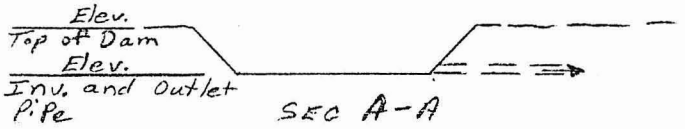
Retention / Detention Basin Data

Location : 30+35.0 Structure #4

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 7

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)
64.8	0	0	0
66	.024		24
67	.076		66
68	.118		106





HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	STOR or FLOW	-1						
SV Record - Reservoir Storage									
SV	0	.024	.076	.118					
SQ Record - Discharge									
SQ	0	24	66	106					
SE Record - Elevation									
SE	64.8	66	67	68					
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST					E-4				

Retention / Detention Basin Data

Location : Sta. 36+92 and 38+84 Strac. #6 & #7

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 10

Elevation	Area (Ac.)	Accumulated Volu. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
58.4	0	0	0		
59.4	.081	0.041	270		
60.4	.20	0.182	674		
61.4	.33	0.447	1248		
62.4	.46	0.842	1800		

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	STOR or FLOW	-1						
SV Record - Reservoir Storage									
SV	0	.041	.182	.447	.842				
SQ Record - Discharge									
SQ	0	270	674	1248	1800				
SE Record - Elevation									
SE	58.4	59.4	60.4	61.4	62.4				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-S				
ST									

Retention / Detention Basin Data

Location : Sta 47+60.25 Struc. #9

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 11

See Split Flow Calcs. (DIV 11)

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway I.E.: 52.5 Spillway Discharge (cfs)	Total Discharge (cfs)
49.16	0	0	0		0
50.16	.004	.002	7		7
51.16	.019	.014	19		19
52.16	.053	.05	25		25
52.5	0.076	.082	26.5	0	26.5
53.16	.10	.126	29	10.8	39.8
53.5	.13	.165	30	24	54.0

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR FLOW	or 0 -1							
SV Record - Reservoir Storage									
SV 0	.002	.014	.05	.082	.126	.165			
SQ Record - Discharge									
SQ 6	7	19	25	26.5	39.8	54.0			
SE Record - Elevation									
SE 49.2	50.2	51.2	52.2	52.6	53.2	53.5			
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-6				
ST									

Retention / Detention Basin Data

Location: Sta 51+76.5 Struct. #10

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 12

Spillway IE = 47.6 — See Spillway Calcs for Split Flow at DIV12

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
46.0	0	0	0		0
46.0	.008	.004	7		7
47.0	.035	.026	19		19
47.6	.059	.097	24	0	24
48.3	.081	.144	25	12.0	37
48.7	.101	.180	26.5	28.5	55.0
49.4	.132	.262	30	77.5	107.5

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1 or STOR FLOW	0 or -1							
SV Record - Reservoir Storage									
SV	0	.004	.026	.097	.144	.180	.262		
SQ Record - Discharge									
SQ	0	7	19	24	37	55	107.5		
SE Record - Elevation									
SE	46.0	46.0	47.0	47.6	48.3	48.7	49.4		
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST						E-7			

Retention / Detention Basin Data

Location : Sta 64+99 Struct. #11

Basin I.D. No.

HEC-1 Concentration Point (C.P.) No. RO 14

Spillway
L = 115' C = 2.63 - From Plans
I.E. = 41.0

Elevation	Area (Ac.)	Accumulated Volo (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
37.0	0	0	0		0
38.0	.053	.027	210		210
39.0	.335	.221	510		510
40.0	.884	.831	930		930
41.0	1.265	1.876	1410	0	1410
42.0	1.34	3.149	1800	302	2102

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR/FLOW	or 0/-1							
SV Record - Reservoir Storage									
SV 0	.027	.221	.831	1.876	3.149				
SQ Record - Discharge									
SQ 0	210	510	930	1410	2102				
SE Record - Elevation									
SE 37.0	38.0	39.0	40.0	41.0	42.0				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-8				
ST									

Retention / Detention Basin Data

Location : Sta 67+33 Struct. #12

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 14.1

Spillway
L = 75' C = 2.63 — From Plans.
I.E. = 40.0

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft.)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
36.4	0	0	0		0
38.0	0.413	.207	360		360
39.0	0.505	.666	750		750
40.0	0.637	1.237	1140	0	1140
41.0	0.820	1.966	1440	197	1637

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	STOR or FLOW	0 or -1							
SV Record - Reservoir Storage									
SV 0	.207	.666	1.237	1.966					
SQ Record - Discharge									
SQ 0	360	750	1140	1637					
SE Record - Elevation									
SE 36.4	38.0	39.0	40.0	41.0					
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-9				
ST									

Retention / Detention Basin Data

Location : Sta 74+15 Struc #13

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. R019

Spillway to Struc. #14
L = 75' C = 2.63
IE = 35.0

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
31.0	0	0	0		0
32	.068	.034	140		140
33	.70	.418	340		340
34	.87	1.20	620		620
35	1.02	2.15	920	0	920
36	1.14	3.23	1200	197	1397

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	STOR or FLOW	0 or -1							
SV Record - Reservoir Storage									
SV 0	.034	.42	1.2	2.15	3.23				
SQ Record - Discharge									
SQ 0	140	340	620	920	1397				
SE Record - Elevation									
SE 31.0	32.0	33.0	34.0	35.0	36.0				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-10				
ST									

Retention / Detention Basin Data

Location : Sta. 79 +21.50 Struct. #14

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 20

Spillway to Struc. #15
L = 60' C = 2.63
I.E. = 31.0

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
27.8	0	0	0		0
29.0	.23	.14	40		40
30.0	.63	.57	97		97
31.0	.82	1.30	165	0	165
32.0	.98	2.20	220	158	378
32.5	1.05	2.71	245	290	539

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR FLOW	or 0 -1							
SV Record - Reservoir Storage									
SV 0	.14	.57	1.30	2.20	2.71				
SQ Record - Discharge									
SQ 0	40	97	165	378	539				
SE Record - Elevation									
SE 27.8	29.0	30.0	31.0	32.0	32.5				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-11				
ST									

Retention / Detention Basin Data

Location : Sta 84+67 Struct. #15

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 20.1

Elevation	Area (Ac.)	Accumulated Volo (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
24.2	0	0	0		
25.0	.073	.029	100		
26.0	.74	.436	288		
26.8	1.23	1.22	492	0	
27.8	1.45	2.56	760		

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR / FLOW	or 0 / -1							1
SV Record - Reservoir Storage									
SV 0	.029	.44	1.22	2.56					
SQ Record - Discharge									
SQ 0	100	288	492	760					
SE Record - Elevation									
SE 24.2	26.0	26.0	26.8	27.8					
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-12				
ST									

Retention / Detention Basin Data

Location : Sta 99+09.75 Struct. #16

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. R023

Spillway L = 65' C = 2.63 IE = 18.5 — From Plans.

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
15.4	0	0	0		0
17.0	.049	.039	60		60
18.0	.504	.316	123		123
18.5	.716	.621	160	0	160
19.0	.927	1.032	185	60	245

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or ~~FLOW~~ STOR	or -1 0							
SV Record - Reservoir Storage									
SV 0	.039	.316	.621	1.032					
SQ Record - Discharge									
SQ 0	60	123	160	245					
SE Record - Elevation									
SE 15.4	17.0	18.0	18.5	19.0					
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-13				
ST									

Retention / Detention Basin Data

Location: Sta. 102+17 Struct. # 17

Basin I.D. No.

HEC-1 Concentration Point (C.P.) No. RO 24A

Spillway
L = 80', C = 2.63
IE = 17.5

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
12.8	0	0	0		0
14	.056	.034	288		288
15	.36	.242	706		706
16	.48	.662	1224		1224
17	.63	1.217	1764		1764
17.5	.67	1.542	2062	0	2062
18.5	.71	1.89	2520	210	2730

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	STOP or FLOW	0 or -1						
SV Record - Reservoir Storage									
SV	0	.034	.242	.662	1.217	1.542	1.89		
SQ Record - Discharge									
SQ	0	288	706	1224	1764	2062	2730		
SE Record - Elevation									
SE	12.8	14	15	16	17	17.5	18.5		
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow						E-14			
ST									

Retention / Detention Basin Data

Location : Sta 106+83.50 Struc. #18

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 24C

Spillway L = 75', C = 2.63 IE = 16.0

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
10.5	0	0	0		0
12	.20	.15	418		418
13	.58	.54	864		864
14	.70	1.18	1404		1404
15	.82	1.94	2016	0	2016
16	.95	2.83	2448	197	2645

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	STOR or FLOW	0 or -1							
SV Record - Reservoir Storage									
SV 0	.15	.54	1.18	1.94	2.83				
SQ Record - Discharge									
SQ 0	418	864	1404	2016	2645				
SE Record - Elevation									
SE 10.5	12	13	14	15	16				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-15				
ST									

Retention / Detention Basin Data

Location : Sta. 110+99 Struct. #19

Basin I.D. No.
HEC-1 Concentration Point (C.P.) No. RO 24D

Spillway, outlet
Bottom width = 5'
Z = 4(H):1(V)
I_E = 11.9

Elevation	Area (Ac.)	Accumulated Volu. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
7.0	0	0	0		0
9.0	.44	.44	510		510
10.0	.61	.96	930		930
11.0	.68	1.61	1380	0	1380
12.0	.80	2.35	1800	28.5	1828.5

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	STOR or FLOW	0 or -1							
SV Record - Reservoir Storage									
SV 0	.44	.96	1.61	2.35					
SQ Record - Discharge									
SQ 0	510	930	1380	1829					
SE Record - Elevation									
SE 7	9	10	11	12					
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-16				
ST									

HWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/14/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location : Sta. 136+16.5 Struc. #24

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. R025c

See following sheet for spillway calcs.

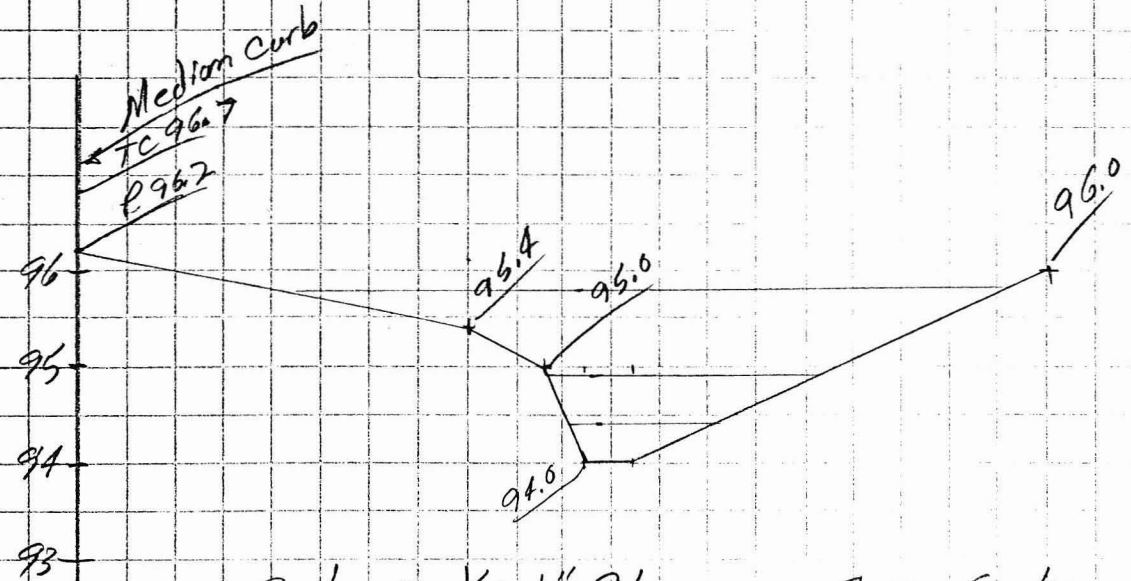
Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
91.3	0	0	0	0	0
93.2	.027	.026	52.5	0	52.5
94.1	.049	.060	81	0	81
94.4	.062	.075	90	4	94
94.9	.094	.111	99	40	139
95.8	.36	.31	120	209	329

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS or 1 or STOR FLOW		or 0 or -1							
SV Record - Reservoir Storage									
SV 0	.026	.060	.075	.111	.31				
SQ Record - Discharge									
SQ 0	52.5	81	94	139	329				
SE Record - Elevation									
SE 91.3	93.2	94.1	94.4	94.9	95.8				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-17				
ST									

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

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 2/14/91
Chkd. ___ Date ___



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

Cross-Section at Sta 136+30
for Breakout at struc. #24

Elev	94.4	94.9	95.8
Area (A) ft²	2.5	16	59.5
Head or Depth (H) ft	0.4	0.9	1.8
Ave Length (A/H)(L) ft	6.2	17.7	33.0
$Q = C L H^{3/2}$	4.0 cfs	40 cfs	209
let C = 2.63			

AHWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAG Date 1/7/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location : 146+50.5 Struc. #25

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. R025D

Spillway
Bottom width = 5', Z = 4:1, C = 2.63
I.E. = 83.5

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
80.4	0	0	0		0
82.0	0.357	.286	144		144
83.0	0.458	.694	293		293
83.5	0.549	.946	380	0	380
84.5	0.714	1.578	516	24	540

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOP FLOW	0 or -1							
SV Record - Reservoir Storage									
SV 0	.286	.694	.946	1.578					
SQ Record - Discharge									
SQ 0	144	293	380	540					
SE Record - Elevation									
SE 80.4	82.0	83.0	83.5	84.5					
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-19				
ST									

AN WEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/14/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location: Most upstream Detention Basin cell West of Struc. #27 (One of Three Cells)

Basin I.D. No. ___

HEC-1 Concentration Point (C.P.) No. RO 30

12" Pipe IE 39.0 | Spillway L=75.0 IE=42.0 C=2.63 — From Plans

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
39.0	0	0	0		0
40.0	.25	.125	3.0		3.0
41.0	.55	.525	5.2		5.2
42.0	.68	1.14	6.7	0	6.7
43.0	.78	1.87	8.0	197	205
44.0	.92	2.72	9.0	558	567
45.0	1.06	3.71	10.0	1024	1034
46.5	1.13	4.26	11.0	1291	1302

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	STOR or FLOW	0 or -1						
SV Record - Reservoir Storage									
SV	0	.125	.525	1.14	1.87	2.72	3.71	4.26	
SQ Record - Discharge									
SQ	0	3	5.2	6.7	205	567	1034	1302	
SE Record - Elevation									
SE	39	40	41	42	43	44	45	46.5	
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST					E-20				

AN WEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/14/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location : sta 197+74.50 Struc. #27

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. RO 30.1

spillway
L = 135
IE = 36.0

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
29.0	0	0	0		
31.0	.56	.56	612		
32.0	1.11	1.40	1116		
33.0	1.25	2.58	1656		
34.0	.83 *	3.62	2160		
35.0	.96 *	4.52	2664	0	
36.0	1.09 *	5.55			

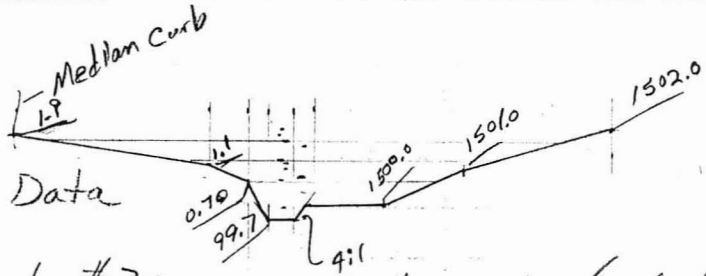
* Area decreases above El. 33.0 as no further area is considered effective in 2nd basin upstream of Sta 197+74.5

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR/FLOW	0 or -1							
SV Record - Reservoir Storage									
SV 0.	.56	1.40	2.58	3.62	4.52				
SQ Record - Discharge									
SQ 0	612	1116	1656	2160	2664				
SE Record - Elevation									
SE 29	31	32	33	34	35				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-21				
ST									

AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/14/91
Chkd. ___ Date ___



Retention / Detention Basin Data

Location: Sta 236+91 Struct. #30 See at Sta. 239+00 (Grade Break) to East

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. R039

Spillway
Bottom width = 5' Use C = 2.63
I.E. = 99.7 Z = 4:1

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
97.	0	0	0	0	0
98	.036	.018	72	0	72
99	.098	.085	204	0	204
99.7	.348	.241	312	0	312
100.7	.899	.865	468	65	533
101.2	.95	1.32	528	165	693
101.7	1.20	1.86	588	357 cfs	947

At El. 100.7 (H=1.0')
A = 24.8 ft²
L = A/H = 24.8'
$Q = C L H^{3/2}$
$= (2.63)(24.8)(1)^{3/2}$
= 65 cfs

At El. 101.2 (H=1.5')
A = 51.1 ft²
L = A/H = 34.1'
Q = 165 cfs

At El. 101.7 (H=2.0')
A = 96.1 ft²
L = A/H = 48'
Q = 357

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR FLOW	or 0 -1							
SV Record - Reservoir Storage									
SV 0	.018	.085	.241	.865	1.32	1.86			
SQ Record - Discharge									
SQ 0	72	204	312	533	693	947			
SE Record - Elevation									
SE 97	98	99	99.7	100.7	101.2	101.7			
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-22				
ST									

AN WEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/14/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location : Sta 207+57.5 Struc. # 28

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. RO 32

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
19.3	0	0	0		
21.0	.73	0.62	576		
22.0	1.21	1.59	972		
23.0	1.64	3.02	1512		
24.0	1.73	4.71	2160		
25.0	1.78	6.47	2880		
26.0	2.05	8.39	3600		

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR/FLOW	or 0/-1							
SV Record - Reservoir Storage									
SV 0	.62	1.59	3.02	4.71	6.47	8.39			
SQ Record - Discharge									
SQ 0	576	972	1512	2160	2880	3600			
SE Record - Elevation									
SE 19.3	21.0	22.0	23.0	24.0	25.0	26.0			
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST					E-23				

AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/14/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location: Sta 210+68.5 Struc #29

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. R0 32A

see following sheet for calcs

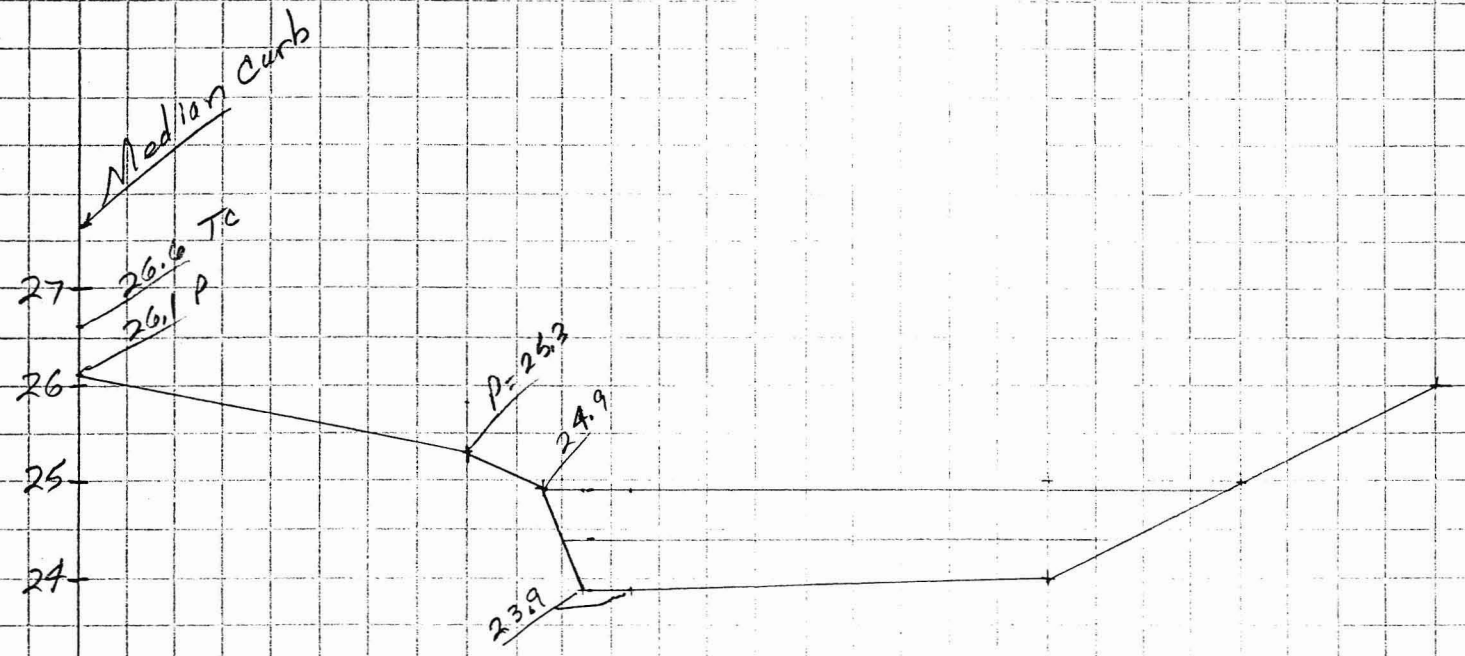
Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
22.4	0	0	0	0	0
23.9	.19	.14	14	0	14
24.4	.30	.26	22	50.4	72
24.9	.62	.49	30	152.5	182

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	or STOR FLOW	-1						
SV Record - Reservoir Storage									
SV									
SQ Record - Discharge									
SQ									
SE Record - Elevation									
SE									
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-24				
ST									

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

Project 7158-01 Sht. ___ of ___
Calc. By GRS Date 1/14/91
Chkd. ___ Date ___



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

X Section Looking D/S
Sta 213+00 at
Breakout from Struc. #29

Elev	24.4	24.9
Area (A) (ft²)	25.2	58
Head or Depth (H) (ft)	.5	1.0
Ave. Length = (A/H) = (L) ft	50.4	58
$Q = CLH^{3/2}$	46.9 cfs	152.5 cfs

let C = 2.63

AMWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/4/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location : Sta 254+82.5 Struct. #31

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. RO 41

Spillway
L = 105', let c = 2.63 } From Plans
I.E. = 90.0

Elevation	Area (Ac.)	Accumulated Volo (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
86.6	0	0	0		0
88.0	.35	.25	200		200
89.0	.66	.75	448		448
90.0	.95	1.56	740	0	740
91.0	1.12	2.60	1040	276	1316
92.0	1.29	3.81	1200	781	1981

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1 or STOR	FLOW or 0 -1							
SV Record - Reservoir Storage									
SV	0	.25	.75	1.56	2.60	3.81			
SQ Record - Discharge									
SQ	0	200	448	740	1316	1981			
SE Record - Elevation									
SE	86.6	88	89	90	91	92			
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST						E-26			

PWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/14/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location: Sta 260 + 98.5 Struc. # 32

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. R04.1

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway (IE = 84.0) Spillway Discharge (cfs)	Total Discharge (cfs)
79.0	0	0	0	0	
81.0	.37	.37	612		
82.0	.67	.89	1116		
83.0	.92	1.69	1728		
84.0	1.56	2.93	2376		

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1	or STOR FLOW	or 0 -1						
SV Record - Reservoir Storage									
SV	0	.37	.89	1.69	2.93				
SQ Record - Discharge									
SQ	0	612	1116	1728	2376				
SE Record - Elevation									
SE	79	81.0	82.0	83.0	84.0				
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST						E-27			

AN WEST INC.
Consulting Engineers

Project 7158-01-03 Sht. ___ of ___
Calc. By OTS Date 12/10/90
Chkd. GAS Date 1/7/91

Retention / Detention Basin Data

Location : Sta. 264+99.50 Structure #33

Basin I.D. No. 42
HEC-1 Concentration Point (C.P.) No. R042

Sect. at Sta. 267+00 (grade break to east)
Sect at Sta 262+30 (grade break to west)

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs) East	Spillway Discharge (cfs) West	Total Discharge (cfs)
80.3	0	0	0			0
81.2	0.04	0.018	12	0	0	12
82.2	0.26	0.168	42	0	0	42
83.2	0.53	0.563	72	0	0	72
84	0.83	1.107	85	20	0	95
85.1	1.23	2.24	96	117	125	338
85.7	2.00	3.21	102	270	312	684

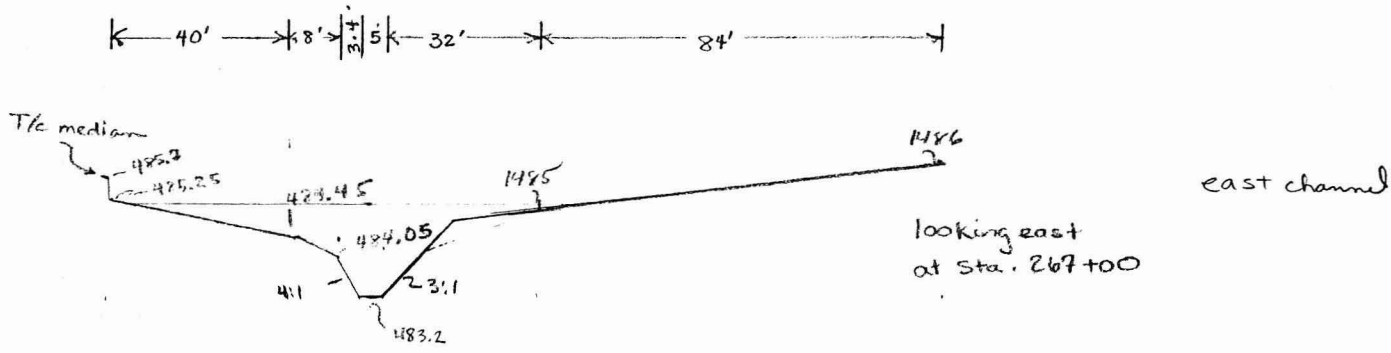
see attached calc

* at el. > 85.7 breakout over median

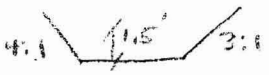
HEC-1 Routing Input Data

	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing										
? → RS	1	STOR or FLOW	0 or -1							
SV Record - Reservoir Storage										
SV	0	0.018	.168	.563	1.107	2.24	3.21			
SQ Record - Discharge										
SQ	0	12	42	72	95	338	684			
SE Record - Elevation										
SE	80.3	81.2	82.2	83.2	84	85.1	85.7			
SS Record - Spillway Characteristics										
SS										
ST Record - Top of Dam Overflow						E-28				
ST										

1" = 4' vert.
1" = 40' horz



Spillway
Bottom width = 5'
Use C = 2.63
I.E. = 483.2'



At elev. 84.7' $\underline{H = 1.5'}$

*note can also breakover to west at this elev.

Area = 15.4 $L = A/H = 15.4/1.5 = 10.3$

$Q = CLH^{3/2}$
$= 2.63(10.3)(1.5)^{3/2} = 50$ cfs

At elev. 85.1' $H = 1.9'$
area = 32.32 $L = A/H = 32.32/1.9 = 17.0$

$Q = 2.63(17)(1.9)^{3/2} = 117$ cfs

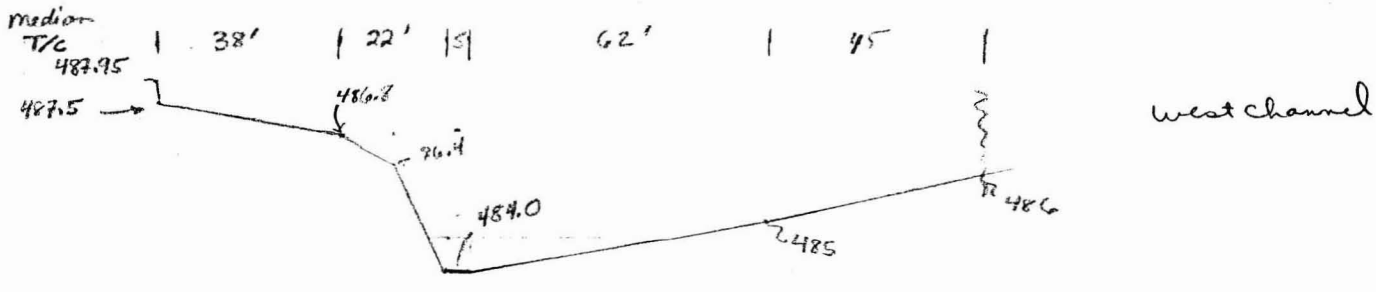
At elev. 84.0 $H = 0.8'$
$L = 5 + 3.2 + 2.4 = 10.6$

$Q = CLH^{3/2}$
$= 2.63(10.6)(0.8)^{3/2} = 20$ cfs

At elev. 485.7 $H = 2.5'$
area = $\frac{1}{2}(40)(.8) + .45(40) + 5(2.5) + (.85)(3.4)(\frac{1}{2}) + 1.65(3.4)$
$(.4)(8)\frac{1}{2} + 1.25(8) = 65.16$
$L = 65.16/2.5 = 26$

$Q = CLH^{3/2}$
$= 2.63(26)(2.5)^{3/2} = 270$ cfs

Sta. 262 + 30



Spillway
Bottom width = 5'
use C = 2.63
I.E. = 484.0

at elev. 84.7 H = 0.7'

$A = 0.7(5) + \frac{1}{2}(.7)2.8 + \frac{1}{2}(42)(.7) = 19.18$
$L = A/H = 19.18/.7 = 27.4$

$Q = CLH^{3/2} = 2.63(27.4)(.7)^{3/2} = 42.2$ cfs

at elev. 85.1 H = 1.1'

$A = (1.1)(5) + \frac{1}{2}(1.1)4.4 + 68(1.1)(\frac{1}{2}) = 45.32$
$L = A/H = 45.32/1.1 = 41.2$

$Q = CLH^{3/2} = 2.63(41.2)(1.1)^{3/2} = 125$ cfs

at elev. 86.9 H = 2.9'

$A = 243$ $L = A/H = 243/2.9 = 84'$

$Q = CLH^{3/2} = 2.63(84)(2.9)^{3/2} = 1091$ cfs

At elev. 85.7' H = 1.7'

$A = 5 \times 1.7 + (90(1.7)\frac{1}{2} + 1.7(68)(\frac{1}{2})) = 91$
$L = A/H = 91/1.7 = 53.5$

$Q = CLH^{3/2} = 2.63(53.5)(1.7)^{1.5} = 312$ cfs

AMWEST INC.
Consulting Engineers

Project 7158-01-03 Sht. ___ of ___
Calc. By OTS Date 12/11/90
Chkd. GAS Date 1/7/91

Retention / Detention Basin Data

Location : 369+17.50 Structure # 54

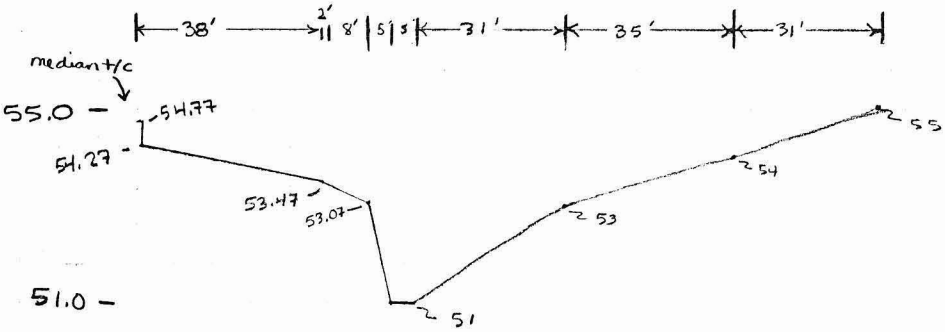
Section at sta. 369+95 (grade break to east)

Basin I.D. No. 53
HEC-1 Concentration Point (C.P.) No. R053

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
44.0	0	0	0	0	0
48.0	0.39	0.78	105	0	105
50.0	0.61	1.78	200	0	200
51.0	0.73	2.45	240	0	240
52.5	0.91	3.68	280	89	369
53.0	1.00	4.16	287	171	458

HEC-1 Routing Input Data

	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
	RS Record - Storage Routing									
? →	RS	1	or STOR FLOW	-1						
	SV Record - Reservoir Storage									
	SV	0	0.78	1.78	2.45	3.68	4.16			
	SQ Record - Discharge									
	SQ	0	105	200	240	369	458			
	SE Record - Elevation									
	SE	44.0	48.0	50.0	51.0	52.5	53.0			
	SS Record - Spillway Characteristics									
? →	SS									
? →	ST Record - Top of Dam Overflow						E-31			
	ST									



Section @
Sta. 369 + 95

Spillway
Bottom width 5'
use C = 2.63
I.E. 51.0

At elev. 52.5 H = 1.5

Area = $5 \times 1.5 + 3.62(1.5)(1/2) + 23.25(1.5)(1/2) = 27.65\ ft^2$
$L = A/H = 27.65/1.5 = 18.44'$

$Q = 2.63(18.44)(1.5)^{3/2} = 89$ cfs

At elev. 53.0 H = 2.0

Area = $5 \times 2 + 1/2(5)(2) + 1/2(31)(2) = 46\ ft^2$
$L = A/H = 46/2 = 23$

$Q = 2.63(23)(2)^{3/2} = 171$ cfs

HWEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/3/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location: Sta 347+26 Struc # 50

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. R062

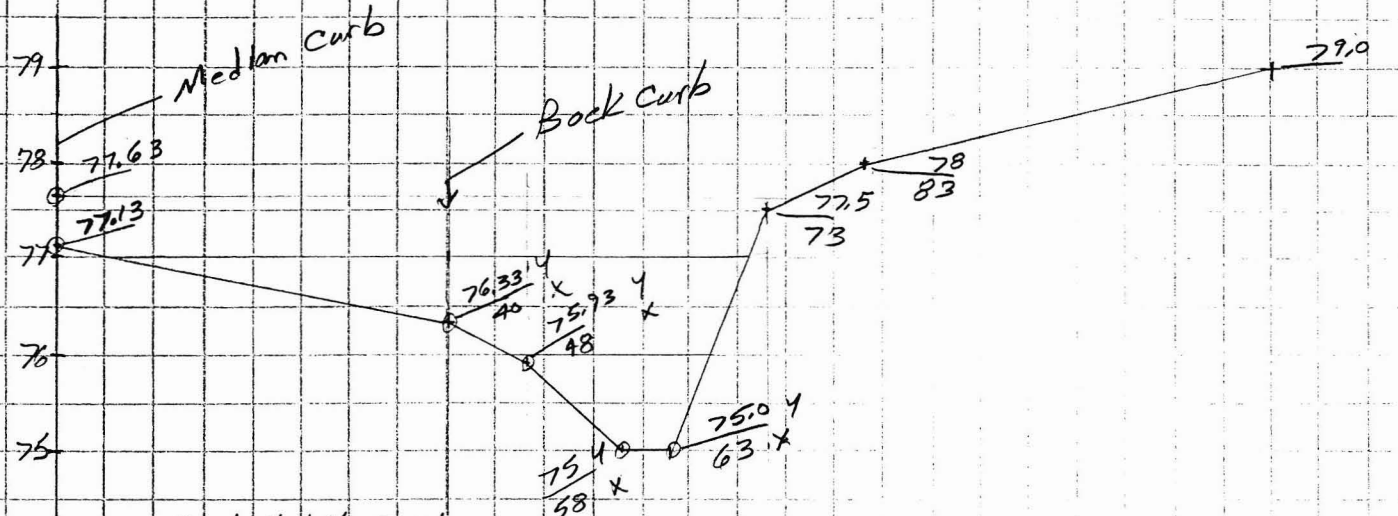
Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
71.3	0	0	0		0
73	0.082	0.029	198		198
74	0.115	0.128	390		390
75	0.255	0.31	570	—	570
76	0.345	0.61	735	34	769
77	0.447	1.0	885	199	1084
77.6	0.55	1.3	960	417	1377
78		1.4	980	450	1430

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS	1 or STOR FLOW	or 0 or -1							
SV Record - Reservoir Storage									
SV	0	0.029	0.128	0.31	0.61	1.0	1.3	1.4	
SQ Record - Discharge									
SQ	0	198	390	570	769	1084	1377	1430	
SE Record - Elevation									
SE	71.3	73	74	75	76	77	77.6	78	
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow						E-33			
ST									

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

Project 7158-01 Sht. ___ of ___
Calc. By BAS Date 1/3/91
Chkd. ___ Date ___



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

Section at Sta 347+36 Looking D/s
Break out To East of Struc. No 50

Elev.	76	77	77.63
Area (A)	13.02 □'	53.32 □'	97.96 □'
Head or Depth (H)	1 Ft	2 Ft	2.63'
Ave Length (A/H)=(L)	13.0 Ft	26.7 Ft	37.2 Ft
$Q = CLH^{3/2}$	34	199	417
let C = 2.63			

E-34

THIS RUN EXECUTED 1/23/91 9:36: 5

```
**********************************************
 HEC2 RELEASE DATED SEPT 88

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

T3      HEC-2 ANALYSIS OF BREAKOUT TO NORTH OF CULVERT NO.50

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

     10        2                          -1                                 75.5

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

     1         0       -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    38        39        43        42        23        24         1         2         3         4
     8        26        17         0        38        43        13        14        15        16
    17        18        33        53        21        22        54         0        38        43
    42        41        23        24         1         2         3        26         4         5

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

   -10       -10

NC     .016      .035      .030
QT        3       100       200       400       600
       SECTIONS CODED FROM LEFT TO RIGHT LOOKING DOWNSTREAM
       SECTION 1 AT PARKWAY STA.34671
       SECTION RATING CURVE ANALYSIS TO CHECK WEIR FLOW ESTIMATES OF BREAKOUT
       OF FLOW ADJACENT TO CULVERT ALONG ROAD
X1        1         8        40        73         0         0         0
GR    76.99         0     76.49         0     75.69        40     73.29        48     74.36        58
GR    74.36        63     76.85        73     77.36        83

       SECTION 2 AT PARKWAY STA.34736 WHICH CORRESPONDS WITH WEIR SECTION
       LOCATION. ENERGY GRADE ELEV. AT THIS SEC. OR SEC.3 SHOULD AGREE
       RESONABLY WELL WITH WEIR FLOW CALCULATIONS
X1        2         8        40        73        65        65        65
GR    77.63         0     77.13         0     76.33        40     75.93        48        75        58
GR       75        63      77.5        73        78        83
```

SECTION 3 AT PARKWAY STA.34766 LOCATED 30 FT. UPSTREAM OF WEIR SECTION

X1	3	8	40	90	30	30	30			
GR	77.93	0	77.47	0	76.63	40	76.23	48	73	60
GR	73	66	77	90	78	120				

THIS RUN EXECUTED 1/23/91 9:36:11

****
HEC2 RELEASE DATED SEPT 88

****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

HEC-2 ANALYSIS OF BREAKO

SUMMARY PRINTOUT

	SECNO	XLCH	Q	ELMIN	XLBEL	RBEL	CWSEL	CRIWS	EG	TOPWID	DEPTH	VCH	K*XNCH
*	1.000	.00	100.00	73.29	75.69	76.85	74.93	74.93	75.36	22.73	1.64	5.28	30.00
*	1.000	.00	200.00	73.29	75.69	76.85	75.46	75.46	76.06	26.62	2.17	6.25	30.00
*	1.000	.00	400.00	73.29	75.69	76.85	76.38	76.38	76.91	65.45	3.09	6.06	30.00
*	1.000	.00	600.00	73.29	75.69	76.85	76.70	76.70	77.35	72.38	3.41	6.76	30.00
*	2.000	65.00	100.00	75.00	76.33	77.50	76.33	76.33	76.70	28.25	1.33	4.91	30.00
*	2.000	65.00	200.00	75.00	76.33	77.50	76.83	76.83	77.21	55.27	1.83	5.09	30.00
*	2.000	65.00	400.00	75.00	76.33	77.50	77.29	77.29	77.77	72.17	2.29	5.62	30.00
*	2.000	65.00	600.00	75.00	76.33	77.50	77.61	77.61	78.24	75.26	2.61	5.95	30.00
*	3.000	30.00	100.00	73.00	76.63	77.00	76.70	.00	76.72	51.74	3.70	1.10	30.00
*	3.000	30.00	200.00	73.00	76.63	77.00	77.20	.00	77.24	82.89	4.20	1.69	30.00
*	3.000	30.00	400.00	73.00	76.63	77.00	77.73	.00	77.82	111.94	4.73	2.45	30.00
*	3.000	30.00	600.00	73.00	76.63	77.00	78.17	.00	78.28	120.00	5.17	2.84	30.00

HEC-2 ANALYSIS OF BREAKO

SUMMARY PRINTOUT

	SECNO	Q	QLOB	QCH	QROB	K*XNL	K*XNCH	K*XNR	K*CHSL	SSTA	STCHL	STCHR	ENDST
*	1.000	100.00	.00	100.00	.00	.00	30.00	.00	.00	42.55	40.00	73.00	65.27
*	1.000	200.00	.00	200.00	.00	.00	30.00	.00	.00	40.78	40.00	73.00	67.40
*	1.000	400.00	43.52	356.48	.00	16.00	30.00	.00	.00	5.65	40.00	73.00	71.10
*	1.000	600.00	133.93	466.07	.00	16.00	30.00	.00	.00	.00	40.00	73.00	72.38
*	2.000	100.00	.00	100.00	.00	.00	30.00	.00	26.31	40.06	40.00	73.00	68.31
*	2.000	200.00	21.50	178.50	.00	16.00	30.00	.00	26.31	15.05	40.00	73.00	70.32
*	2.000	400.00	121.62	278.38	.00	16.00	30.00	.00	26.31	.00	40.00	73.00	72.17
*	2.000	600.00	242.97	356.96	.06	16.00	30.00	35.00	26.31	.00	40.00	73.00	75.26
*	3.000	100.00	.02	99.98	.00	16.00	30.00	.00	-66.67	36.49	40.00	90.00	88.22
*	3.000	200.00	6.04	193.85	.10	16.00	30.00	35.00	-66.67	13.01	40.00	90.00	95.90
*	3.000	400.00	48.62	347.04	4.34	16.00	30.00	35.00	-66.67	.00	40.00	90.00	111.94
*	3.000	600.00	117.34	465.48	17.18	16.00	30.00	35.00	-66.67	.00	40.00	90.00	120.00

HEC-2 ANALYSIS OF BREAKO

SUMMARY PRINTOUT

	SECNO	Q	ELMIN	ELLC	XLBEL	RBEL	CWSEL	CRIWS	EG	VCH	TOPWID	10*KS
*	1.000	100.00	73.29	.00	75.69	76.85	74.93	74.93	75.36	5.28	22.73	147.67
*	1.000	200.00	73.29	.00	75.69	76.85	75.46	75.46	76.06	6.25	26.62	127.73
*	1.000	400.00	73.29	.00	75.69	76.85	76.38	76.38	76.91	6.06	65.45	65.63
*	1.000	600.00	73.29	.00	75.69	76.85	76.70	76.70	77.35	6.76	72.38	69.87
*	2.000	100.00	75.00	.00	76.33	77.50	76.33	76.33	76.70	4.91	28.25	153.78
*	2.000	200.00	75.00	.00	76.33	77.50	76.83	76.83	77.21	5.09	55.27	88.03
*	2.000	400.00	75.00	.00	76.33	77.50	77.29	77.29	77.77	5.62	72.17	73.32
*	2.000	600.00	75.00	.00	76.33	77.50	77.61	77.61	78.24	5.95	75.26	65.80
*	3.000	100.00	73.00	.00	76.63	77.00	76.70	.00	76.72	1.10	51.74	2.18
*	3.000	200.00	73.00	.00	76.63	77.00	77.20	.00	77.24	1.69	82.89	3.89
*	3.000	400.00	73.00	.00	76.63	77.00	77.73	.00	77.82	2.45	111.94	6.21
*	3.000	600.00	73.00	.00	76.63	77.00	78.17	.00	78.28	2.84	120.00	6.91

HH WEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/10/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location: Sta 349+18 Struc. # 51

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. RO 52.1

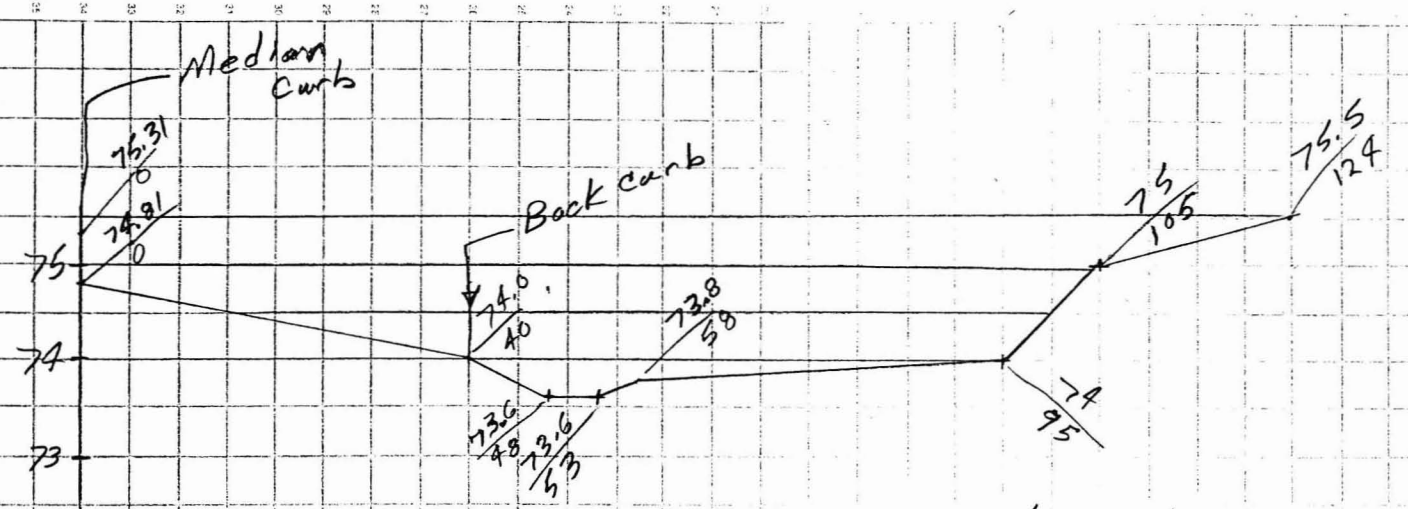
Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
70.8	0	0	0	0	0
72	0.06	.024	19	0	19
73	0.117	0.113	50	0	50
73.7	0.13	0.20	70	0	70
74.0	0.170	0.25	76	14	90
74.5	0.196	0.34	90	105	195
75.0	0.223	0.44	98	285	383
75.5	0.25	0.56	102	535	637

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	STOR or FLOW	0 or -1							
SV Record - Reservoir Storage									
SV 0	.024	0.113	.20	.25	.34	.44	.56		
SQ Record - Discharge									
SQ 0	19	50	70	90	195	383	637		
SE Record - Elevation									
SE 70.8	72	73	73.7	74.0	74.5	75.0	75.5		
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST					E-40				

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

Project 7158-01
Calc. By GAS
Chkd.
Date 1/10/91
Sht. ___ of ___
Date



Section at Sta 349+70 Looking D/S
Breakout To East of Struc. No 51

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

Elev	74.0	75.0	75.5	74.5
Area	8.68 ft²	91.76 ft²	148.8 ft²	42 ft²
Head (H) or Depth	0.4 ft	1.4 ft	1.9 ft	0.9 ft
Ave. Length (L) = (A/H)	21 ft	65.5 ft	78.3 ft	46.7 ft
$Q = C L H^{3/2}$ let C = 2.63	14.0	285.3	539.3	105

HWEST INC.
Consulting Engineers

Project 2158-01 Sht. ___ of ___
Calc. By GAS Date 1/30/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location : Sta 352+92 Struc #52

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. RO 52.2

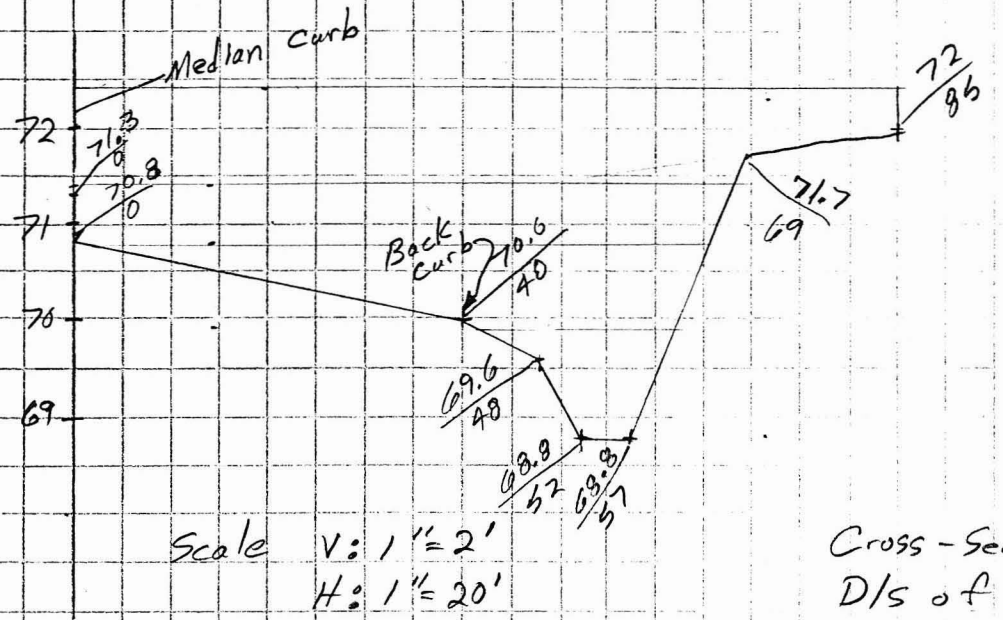
Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
65	0	0	0	0	0
66	0.036	.018	15	0	15
67	0.07	.071	52	0	52
68	0.11	.161	90	0	90
68.8	0.14	.261	116	0	116
69.9	0.18	.437	140	39	179
70.8	0.29	.649	150	196	346
71.4	0.32	.82	162.5	383	545.5
72.4	0.38	1.17	170	824	994

HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOR FLOW	or -1							
SV Record - Reservoir Storage									
SV 0	.018	.071	.161	.261	.437	.649	.82	1.17	
SQ Record - Discharge									
SQ 0	15	52	90	116	179	346	545.5	994	
SE Record - Elevation									
SE 65	66	67	68	68.8	69.9	70.8	71.4	72.4	
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow					E-42				
ST									

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

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/12/91
Chkd. ___ Date ___



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

Cross-Section at Sta 353+64 Looking DS
D/s of Struc. #52

Elev	69.9	70.8	71.4	72.4
Area	14.2 ft²	52.7 ft²	90.4 ft²	165.2 ft²
Head (H) or depth	1.1 ft	2.0 ft	2.6 ft	3.6 ft
Ave Length (L) = (A/H)	12.9 ft	26.4 ft	34.8 ft	45.9 ft
$Q = CLH^{3/2}$, let C = 2.63	39 cfs	196 cfs	383 cfs	824 cfs

AN WEST INC.
Consulting Engineers

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/13/91
Chkd. ___ Date ___

Retention / Detention Basin Data

Location: Sta. 357+26 Struc # 53

Basin I.D. No. ___
HEC-1 Concentration Point (C.P.) No. R052.3

See following calc. sheet for cap. calc of spillway

Elevation	Area (Ac.)	Accumulated Vol. (Ac-Ft)	Pipe Discharge (cfs)	Spillway Discharge (cfs)	Total Discharge (cfs)
55.8	0	0	0	0	0
58.8	.13	.20	46	0	46
61.3	.26	.69	90	0	90
63.1	.50	1.37	107	0	107
63.3	.55	1.47	110	0	110
64.4	.57	2.1	120	21	141
66.12	.84	2.3	133	350	483

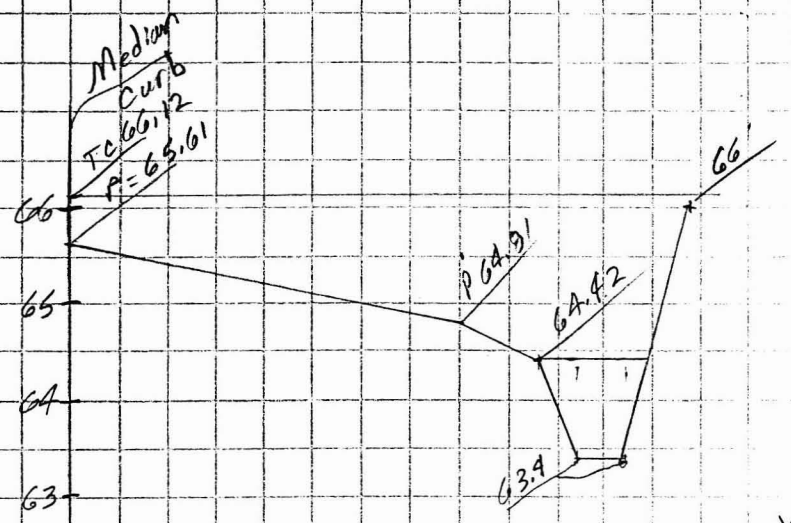
HEC-1 Routing Input Data

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
RS Record - Storage Routing									
RS 1	or STOP FLOW	or 0 or -1							
SV Record - Reservoir Storage									
SV 0.	.20	.69	1.37	1.47	2.1	2.3			
SQ Record - Discharge									
SQ 0	46	90	107	110	141	483			
SE Record - Elevation									
SE 55.8	58.8	61.3	63.1	63.3	64.4	66.1			
SS Record - Spillway Characteristics									
SS									
ST Record - Top of Dam Overflow									
ST									

E-44

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

Project 7150-01 Sht. ___ of ___
Calc. By GAS Date 1/23/96
Chkd. ___ Date ___



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

X-Section Looking D/S
Sta 358+88
at Breakout from Struc. #53

Elev	64.4	66.12	
Area (ft²)	8.0 ft²	81.2	ft²
Head or Depth (ft)	1.0 ft	2.7	ft
Ave. Length (A/H)	8.0 ft	30.1	ft
$Q = CLH^{3/2}$	21.0 cfs	350	cfs

let C = 2.63

F-45

Appendix F-

Split Flow Input Parameters

Split Flow

Superceded

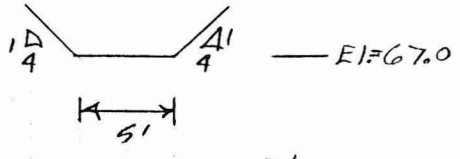
KK DIV09
KM DIVERT PORTION OF SUB09 TO DIV09 (30%)
DT DIV091

DI	0	10	100	500	1000				
DQ	0	7	70	350	700				

KK DIV08
KM DIVERT (DIV08) FLOW THROUGH STRUC. #5, REMAINDER (DIV081) TO STRUC. #6
DT DV081

DI	0	6	13	42	555		
DQ	0	0	0	24	37.0		

Weir Section East of Structure 5



$Q_{weir} = C L H^{3/2}$, let $C = 2.63$ for broad crested weir

At El = 68.0, depth (H) = 1.0 A = 9 □', let $L = A/H = 9.0/1.0 = 9.0$ ft
$Q = C L (H)^{3/2} = 2.63 (9) (1)^{3/2} = 24$ cfs
At El = 68.25, depth (H) = 1.25' A = 12.5 □', let $L = A/H = 12.5/1.25 = 10.0$ ft
$Q = C L (H)^{3/2} = 2.63 (10.0) (1.25)^{3/2} = 37.0$ cfs

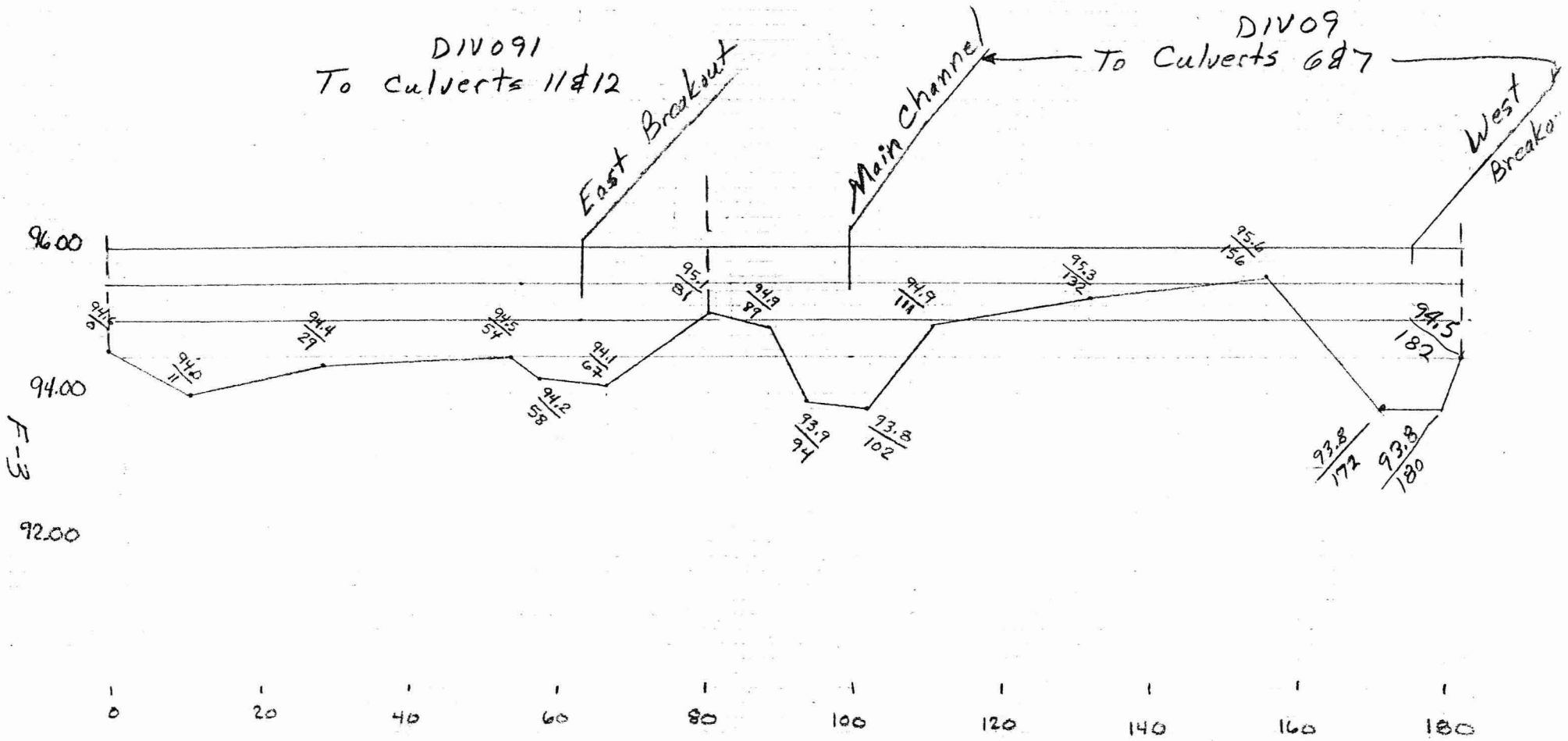
Split Flow

	DIV09 To Culverts 6 & 7				DIV091 To Culverts 11 & 12			
Elevation	94.5	95.0	95.5	96.0	94.5	95.0	95.5	96.0
Area (sq.ft.)	17.4	36.6	73.2	121.5	15.5	51.5	89.3	134.5
Hyd. Radius (ft)	0.4	0.76	0.79	1.19	0.22	0.65	1.10	1.66
Mannings 'n'	= 0.045 →				.045 →			
Slope ft/ft	= .018 →				.016 →			
Velocity (fps)	2.4	3.7	3.8	5.0	1.5	3.1	4.5	5.9
Discharge (cfs)	42	135	278	608	23.	160	402	789

KK DIV 09
KM DIVERT (DIV 09) FLOW To Struc. # 6 & 7, Remainder (DIV 091) To Strucs. 11 & 12
DT DIV091

DI	0	65	295	680	1397
DQ	0	23	160	402	789

Split flow x-sec Upstream of Culvert 6+7
East to West



F-3

12/20/90

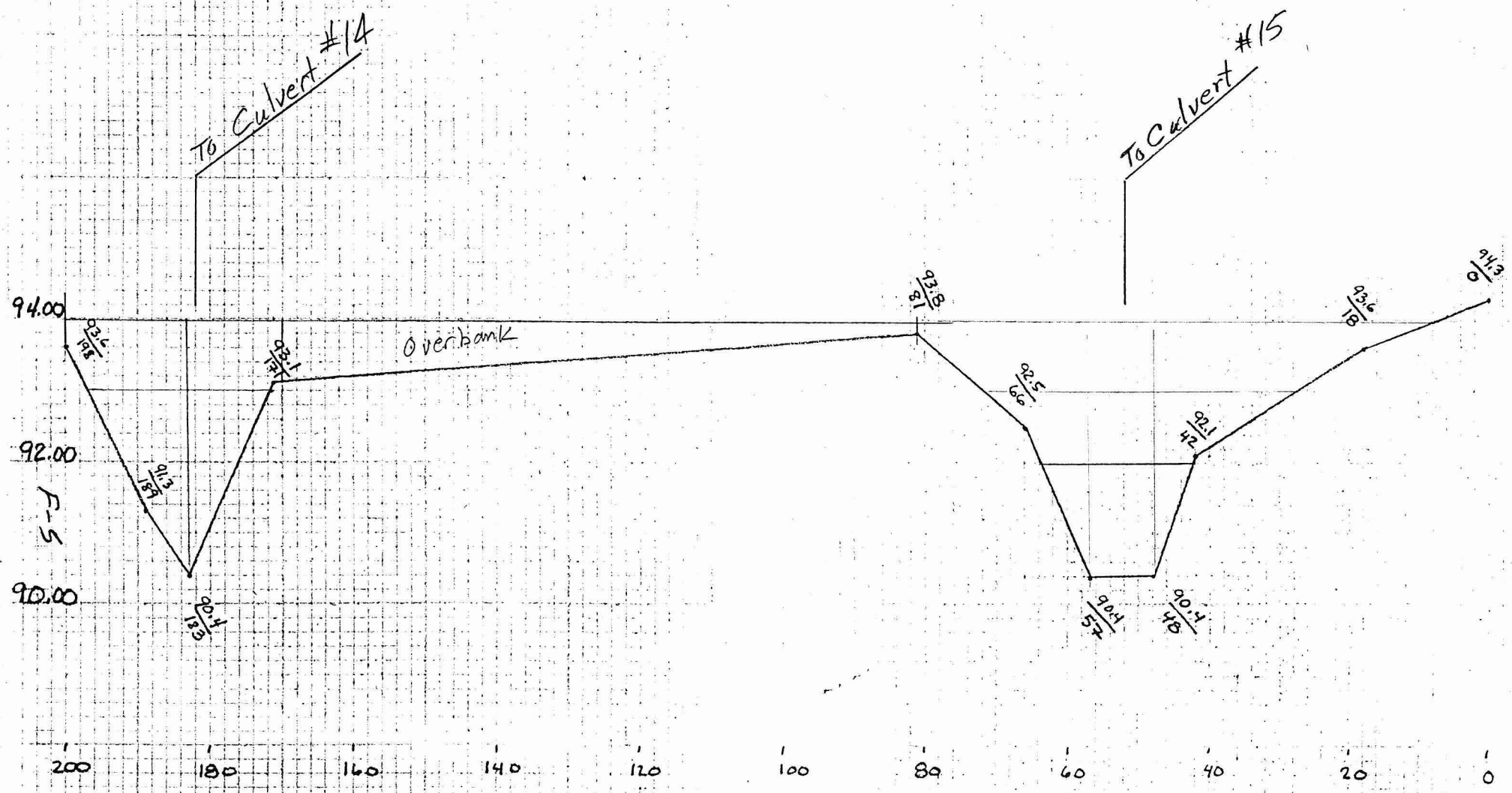
Split Flow

	To Culvert #14				To Culvert #15		
Elevation	92	93	94	94	92	93	94
			Chann	Overbank			
Area (sq.ft)	14.88	35.34	65.72	47.12	24.18	57.04	112.84
Hyd. Radius	0.91	1.68	2.15	.52	1.12	1.31	1.58
Manning's 'n' = 0.045							
Slope ft/ft = .014							
Velocity (fps) =	3.67	5.5	6.5	2.5	4.2	4.7	5.3
Discharge (cfs) =	54.6	194.4	427.1	117.8	101.6	268	599

KK DIV20A
KM DIVERT (DIV20A) FLOW THROUGH STRUC #14, REMAINDER (DIV 20B) TO STRUC #15
DT DIV20B

DI	0	156	462.4	1143.8
DQ	0	102	268	599

Culvert 14 + 15
2 channel X-sec. South of Parkway
East to West

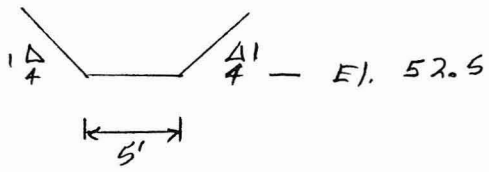


Split Flow

KK DIV 11
KM DIVERT (DIV 11) FLOW THROUGH STRUC. #9, REMAINDER (DV 111) to Struc. 12
DT DIV 111

DI	0	7	19	25	26.5	39.8	54.0
DQ	0	0	0	0	0	10.8	24

Weir Sec. East of Struct. #9 from Plans



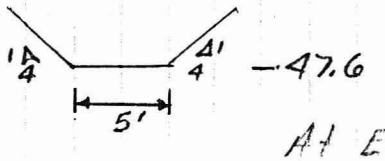
$Q_{weir} = CLH^{3/2}$, let $C = 2.63$ for broadcrested weir

At El. = 53.16, depth (H) = 0.66' $A = 5.04^{\square'}$ let $L = A/H = 7.64'$
$Q = 2.63(7.64)(0.66)^{3/2} = 10.8$ cfs
At El = 53.5 depth H = 1.0' $A = 9.0^{\square}$ $L = 9.0$ ft'
$Q = 2.63(9)(1)^{3/2} = 24$ cfs

KK DIV 12
KM DIVERT (DIV 12) FLOW THROUGH STRUC #10, REMAINDER (DIV 121) To Struc. #11
DT DIV 121

DI	0	7	19	24	37	55	107.5
DQ	0	0	0	0	12	28.5	77.5

Weir Sec. East of Struc. #10 from Plans



$Q_{weir} = CLH^{3/2}$, let $C = 2.63$ for broadcrested weir

At El. = 48.3, H = 0.7', $A = 5.5^{\square'}$, $L = A/H = 7.8'$, Q = 12.0
At El. 48.7, H = 1.1', $A = 10.34^{\square'}$, $L = A/H = 9.4'$, Q = 28.5 cfs
At El 49.4', H = 1.8' $A = 22.0^{\square'}$, $L = A/H = 12.2'$, Q = 77.5 cfs

SPLIT FLOW

KK DIV 39
KM DIVERT (DIV39) FLOW THROUGH STRUC. #30, REMAINDER TO STRUC. #31
DT DIV 391

DI	0	72	204	312	533	693	947
DQ	0	0	0	0	65	165	357

KK DIV 41
KM DIVERT (DIV41) FLOW THROUGH STRUC # 31, REMAINDER TO STRUC. # 32
DT DIV 411

DI	0	200	448	740	1316	1981
DQ	0	0	0	0	276	781

} see Detention Basin Calcs for RO 41 for Split Flow Calcs

SUPERCEDED

KK DIV 20A
KM DIVERT (DIV20A) FLOW TO STRUC #14, REMAINDER TO STRUC. #15
DT DIV 20B

DI	0	10	100	1000	3000
DQ	0	6	60	600	1800

KK DIV 30A
KM DIVERT (DIV30A) FLOW TO DETENTION (RO30), REMAINDER TO STRUC. #27
DT DIV 30B

DI	0	10	100	1000	3000
DQ	0	5	50	500	1500

) Assume 50% Split To upstream Cell Based on Viewing Aerial Photos and Following 400 scale 4' C.I. Mapping

SPLIT FLOW

KK DIV 39
KM DIVERT (DIV39) FLOW THROUGH STRUC. #30, REMAINDER TO STRUC. #31
DT DIV 391

DI	0	72	204	312	533	693	947
DQ	0	0	0	0	65	165	357

KK DIV 41
KM DIVERT (DIV41) FLOW THROUGH STRUC # 31, REMAINDER TO STRUC. # 32
DT DIV411

DI	0	200	448	740	1316	1981
DQ	0	0	0	0	276	781

} see Detention Basin Calcs for RO 41 for Split Flow Calcs

SUPERCEDED

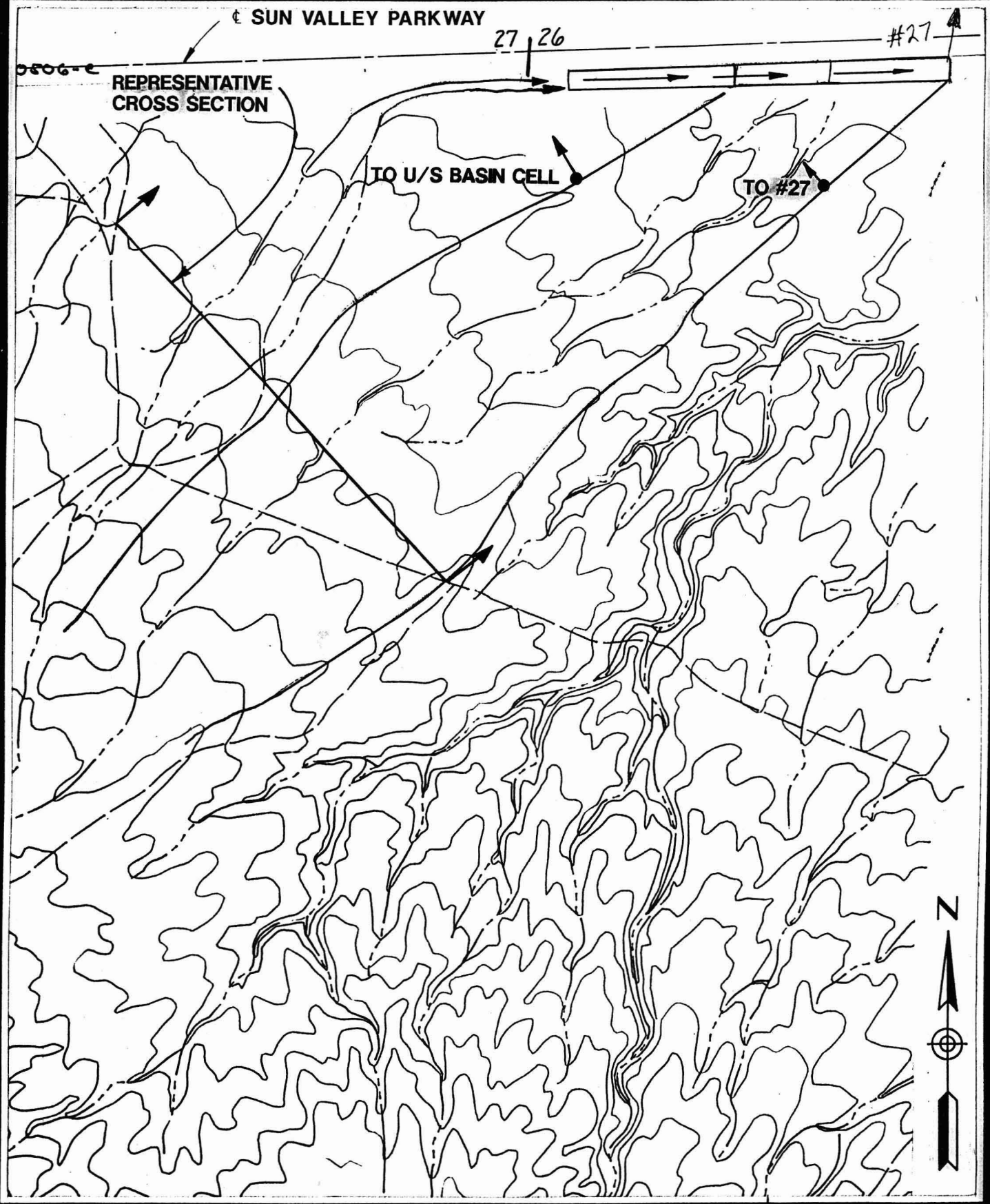
KK DIV 20A
KM DIVERT (DIV20A) FLOW TO STRUC #14, REMAINDER TO STRUC. #15
DT DIV 20B

DI	0	10	100	1000	3000
DQ	0	6	60	600	1800

KK DIV 30A
KM DIVERT (DIV30A) FLOW TO DETENTION (RO30), REMAINDER TO STRUC. #27
DT DIV 30B

DI	0	10	100	1000	3000
DQ	0	5	50	500	1500

) Assume 50% split to upstream cell Based on Viewing Aerial Photos and Following 400 scale 4' C.I. Mapping



Mapping Source: Reference 12
Mapping Scale 1"=400', 4' C.I.

FLOW DISTRIBUTION TO CULVERT NO. 27 AND DETENTION BASINS

A-N WEST INC.
Consulting Engineers

SUN VALLEY PARKWAY NORTH
FLOOD INSURANCE STUDY
HYDROLOGY REPORT

SPLIT FLOW

KK DIV14
KM DIVERT (DIV 14) FLOW THROUGH STRUC #11, REMAINDER (DIV141) TO STRUC. #12
DT DIV141

DI	0	210	510	930	1410	2102		
DQ	0	0	0	0	0	302 *		

* See RO 14.1 For Calcs on Split Flow

KK DIV20C
KM DIVERT (DIV20C) FLOW THROUGH STRUC. #14, REMAINDER (DIV20D) TO STRUC. #15
DT DIV20D

DI	0	40	97	165	378	539
DQ	0	0	0	0	158	290 *

* see RO 20 For Calcs on Split Flow

KK DIV23
KM DIVERT (DIV 23) FLOW THROUGH STRUC #16, REMAINDER (DIV 231) TO STRUC. #17
DT DIV231

DI	0	60	123	160	245	
DQ	0	0	0	0	60 *	

* see RO 23 Detention Basin Routing Sheet for Split Flow Calcs

KK DIV 24A
KM DIVERT (DIV 24A) FLOW THROUGH STRUC #17, REMAINDER (DIV 24B) TO STRUC. #18/19
DT DIV 24B

DI	0	408	783	1717
DQ	0	330	347	950

) See Flow Distribution Calcs. To Culverts 17, 18 & 19

KK DIV24C
KM DIVERT (DIV 24C) FLOW THROUGH STRUC. #18, REMAINDER (DIV24D) To Struc. #19
DT DIV 24D

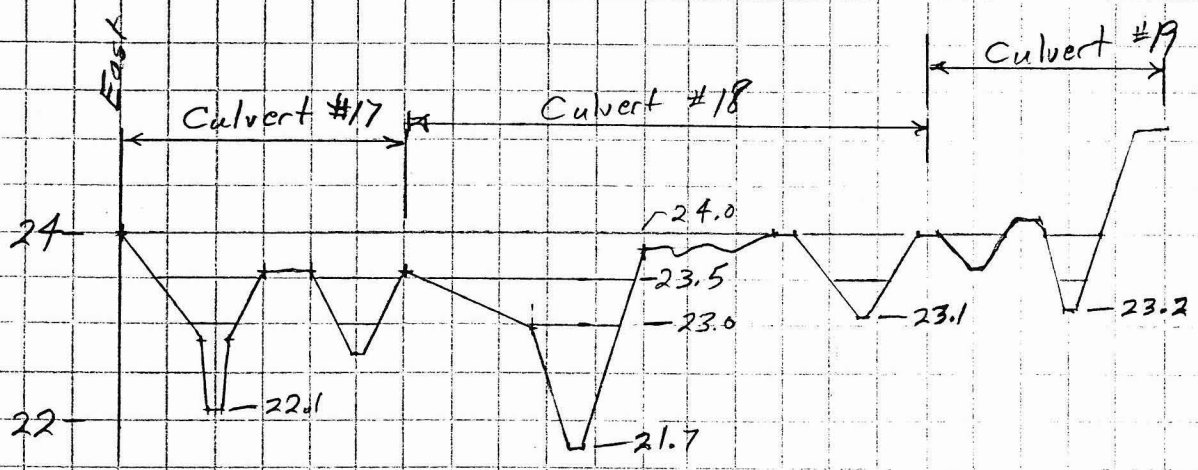
DI	0	330	501	950
DQ	0	0	17	134

) See Flow Distribution Calcs. To Culverts 17, 18 & 19

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

Project 7158-01 Sht. ___ of ___
Calc. By GAS Date 1/8/91
Chkd. ___ Date ___

Flow Distribution Calcs To Culverts 17, 18 & 19

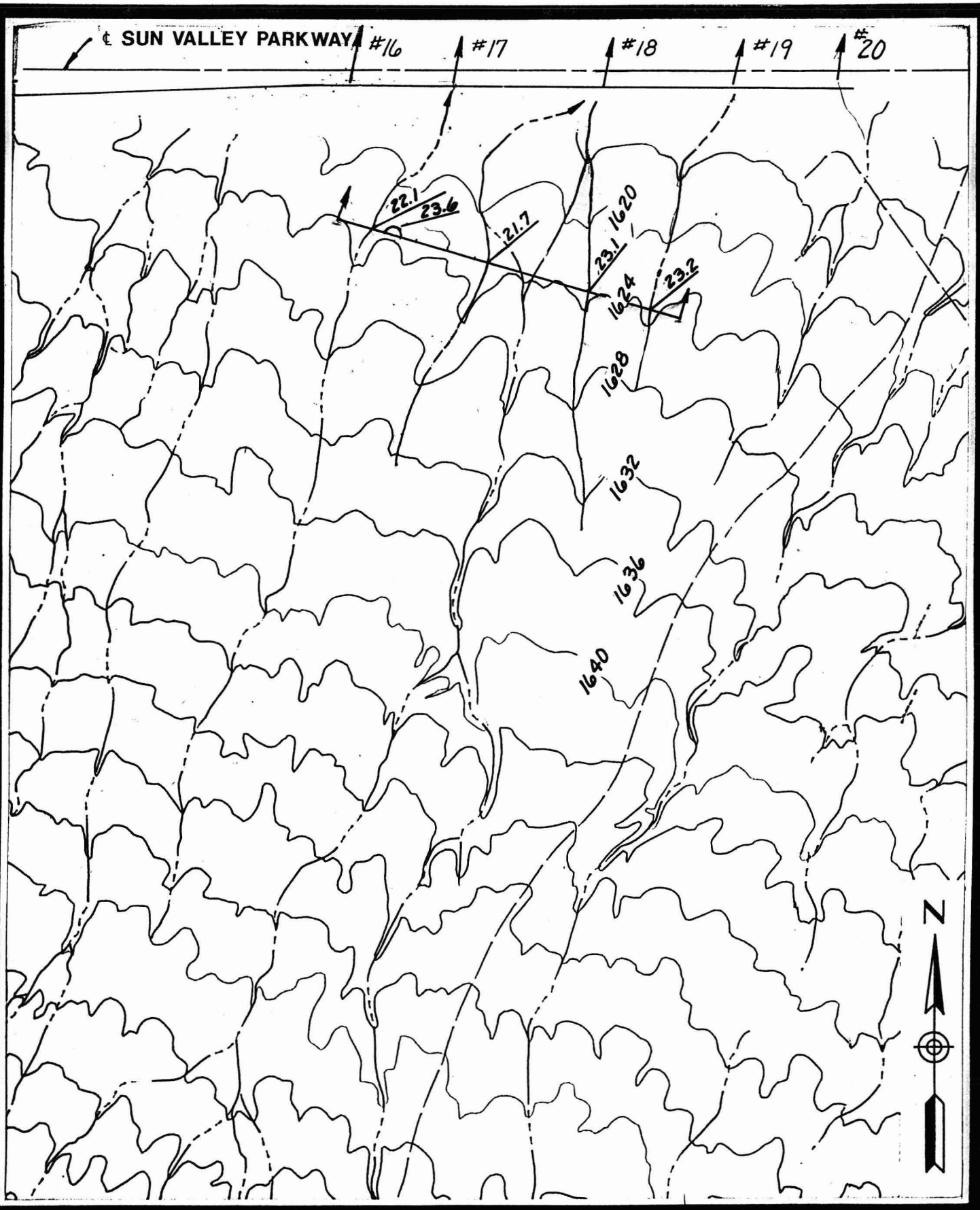


Cross-Section Upstream of Culverts (From 4' C.I. Topo.)

V: 1" = 2'
H: 1" = 200'

	Culvert #17			Culvert #18			Culvert #19		
Elev.	23	23.5	24	23	23.5	24	23	23.5	24
Area (ft.²)	37.2	108.4	232.5	86.8	176.7	297.6	—	9.3	55.8
Hyd. Rad. (ft)	.41	.54	.775	.96	.59	.59	—	.31	.49
Manning's 'n'	.045	→							
Slope (ft/ft)	.014	→							
Velocity (fps)	2.1	2.6	3.3	3.8	2.7	2.7	—	1.8	2.4
Discharge (cfs)	78	282	767	330	484	816	—	16.7	134

F-10



Mapping Source: Reference 12
Mapping Scale 1"=400', 4' C.I.

CROSS-SECTION FOR FLOW DISTRIBUTION TO CULVERT NO. 17,18,19

A-N WEST INC.
Consulting Engineers

NOTE: See cross-section plot p F-10

SUN VALLEY PARKWAY NORTH
FLOOD INSURANCE STUDY
HYDROLOGY REPORT

Split Flow

KK DIV 42A
KM DIVERT (DIV42A) FLOW TO STRUC. # 32, REMAINDER TO STRUC. #33 & 34
DT DIV 42 B

DI	0	12	42	72	95	338	684
DQ	0	0	0	0	0	125	312

See Detention Basin Calc. Sheet RO 42 for Struc. # 33 for Split Flow Distribution

KK DIV 42 B
KM DIVERT (DIV 42 C) FLOW TO STRUC #33, REMAINDER TO STRUC. #34
DT DIV 42D

DI	0	12	42	72	95	213	372
DQ	0	0	0	0	20	117	270

See Detention Basin Calc sheet RO 42 for Struc #33 for Split Flow Distribution

KK DIV 53A
KM Divert (DIV 53A) Flow to Struc. # 54, Remainder to Struc. # 55
DT DIV 53B

DI	0	105	200	240	369	458
DQ	0	0	0	0	89	171

See Detention Basin Calc. Sheet RO 52 for Struc. #50

SPLIT FLOW

KK DIV 52A
KM Divert (DIV 52A) FLOW To STRUC. No 50, Remainder To #51, 52, 53
DT DIV 52B

DI	0	198	390	570	769	1084	1377
DQ	0	0	0	0	34	199	417

See Detentention Basin Calc. Sheet for RO 52.1 Struc. # 51

KK DIV 52C
KM TAKE RO 52.1 FLOW, DIVERT DIV 52C TO STRUC. 51, REMAINDER TO STRUC 52, 53
DT DIV 52D

DI	0	19	50	70	90	195	383	637
DQ	0	0	0	0	14	105	285	535

*See Detention Basin Calc. Sheet for RO 52.2 Struc. #51

KK DIV 52E
KM Take RO 52.2 FLOW, DIVERT DIV 52E TO STRUC. 52, REMAINDER TO STRUC 53
DT DIV 52F

DI	0	15	52	90	116	179	346	545.5	994
DQ	0	0	0	0	0	39	196	383	824

*

SPLIT FLOW

KK DV25C1
KM DIVERT (DV25C1) FLOW TO STRUC. #24, Remainder To Struc. #25
DT DV25C2

DI	0	52.5	81	94	139	329
DQ	0	0	0	4	40	329

KK DV25D1
KM DIVERT (DIV25D1) FLOW TO STRUC #25, Remainder To Struc. #26
DT DV25D2

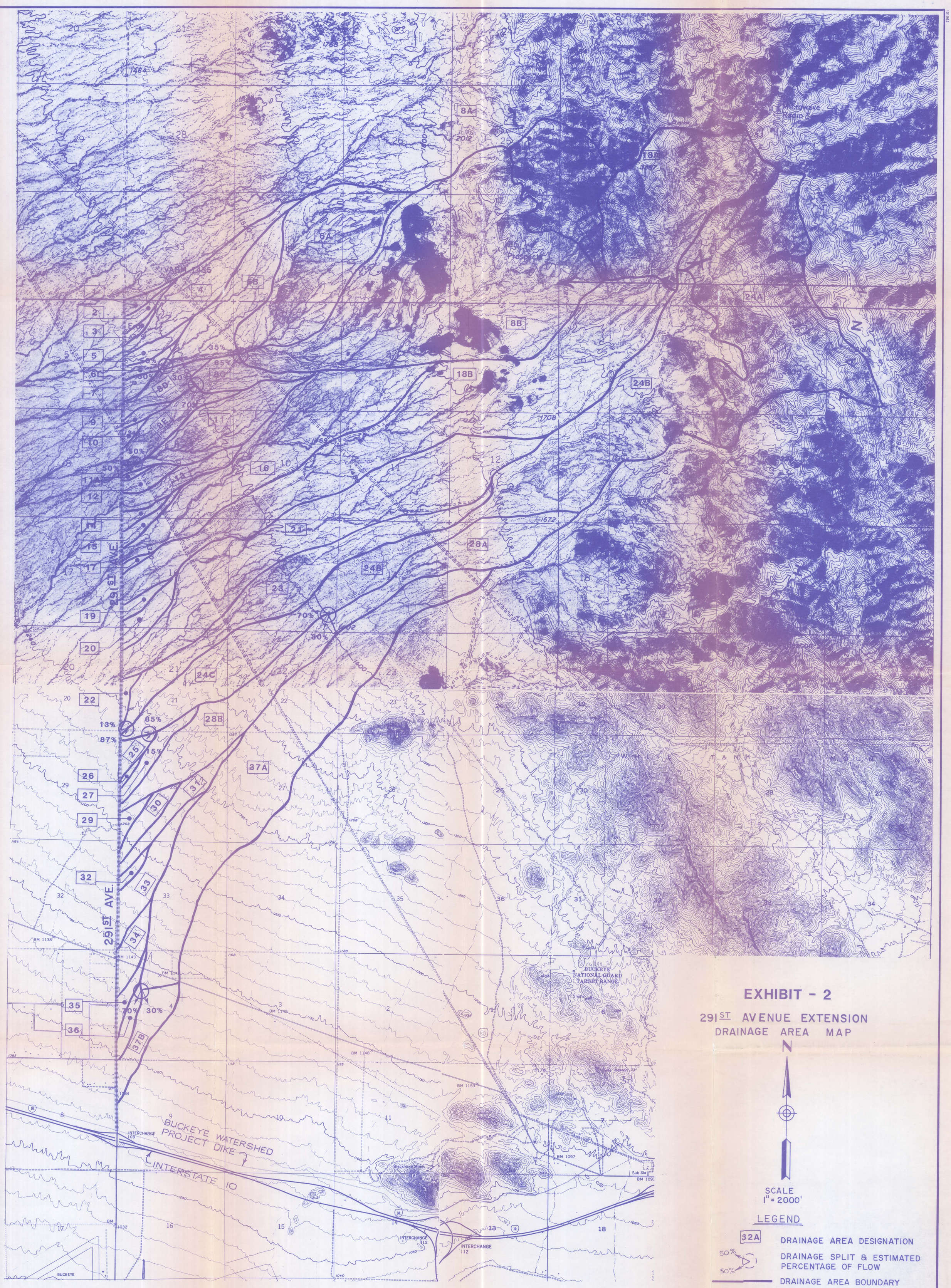
DI	0	144	293	380	540
DQ	0	0	0	0	24

KK DV32A1
KM DIVERT (DV32A1) FLOW TO STRUC #29, Remainder To Struc #30
DT DV32A2

DI	0	14	72	182
DQ	0	0	50.4	152.5

KK DIV52G
KM DIVERT (DIV52G) FLOW TO struc. #53, Remainder To Struc. #54
DT DIV52H

DI	0	46	90	107	110	141	483
DQ	0	0	0	0	0	21	353



SUN VALLEY PARKWAY

291st. AVE. (I-10 to Northern Ave.)

DRAINAGE AREA MAP

SHEET 1 OF 1

SURVEY PROJECT NO.

DESIGN PROJECT NO. 850840-7

SCALE: 1" = 2000'

DATE 1/14/87

CHECKED C.J.L.

DRAWN T.A.

DESIGNED R.A.D.

REVISIONS

NO	DATE	APP.	DESCRIPTION

Collar, Williams & White Engineering, Inc.
Consulting Engineers
2702 N. 44TH STREET, SUITE 205-B
PHOENIX, ARIZONA 85008
(602) 957-3350
2922 NORTH 70TH STREET
SCOTTSDALE, ARIZONA 85251
(602) 947-5433

EXHIBIT - 2

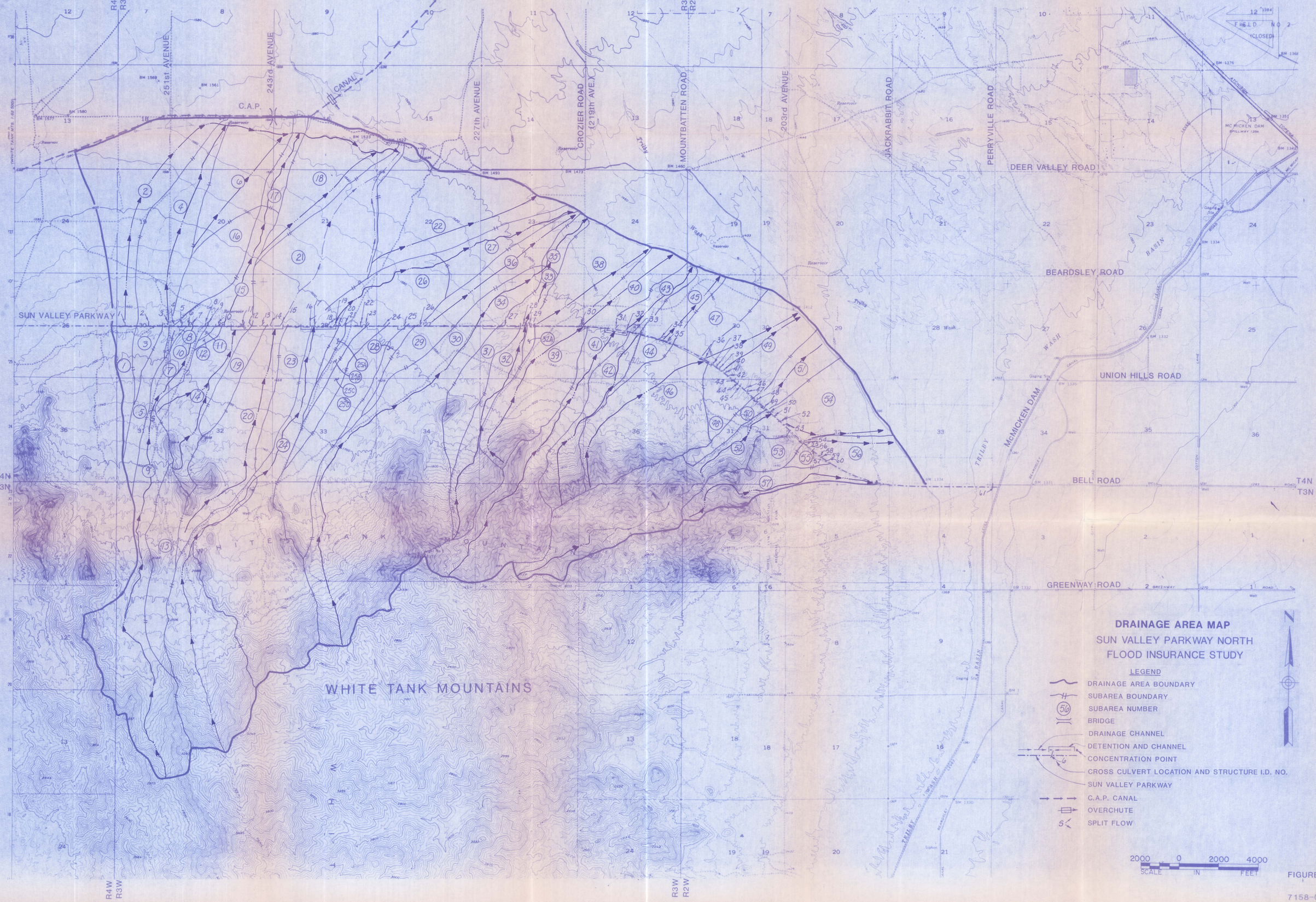
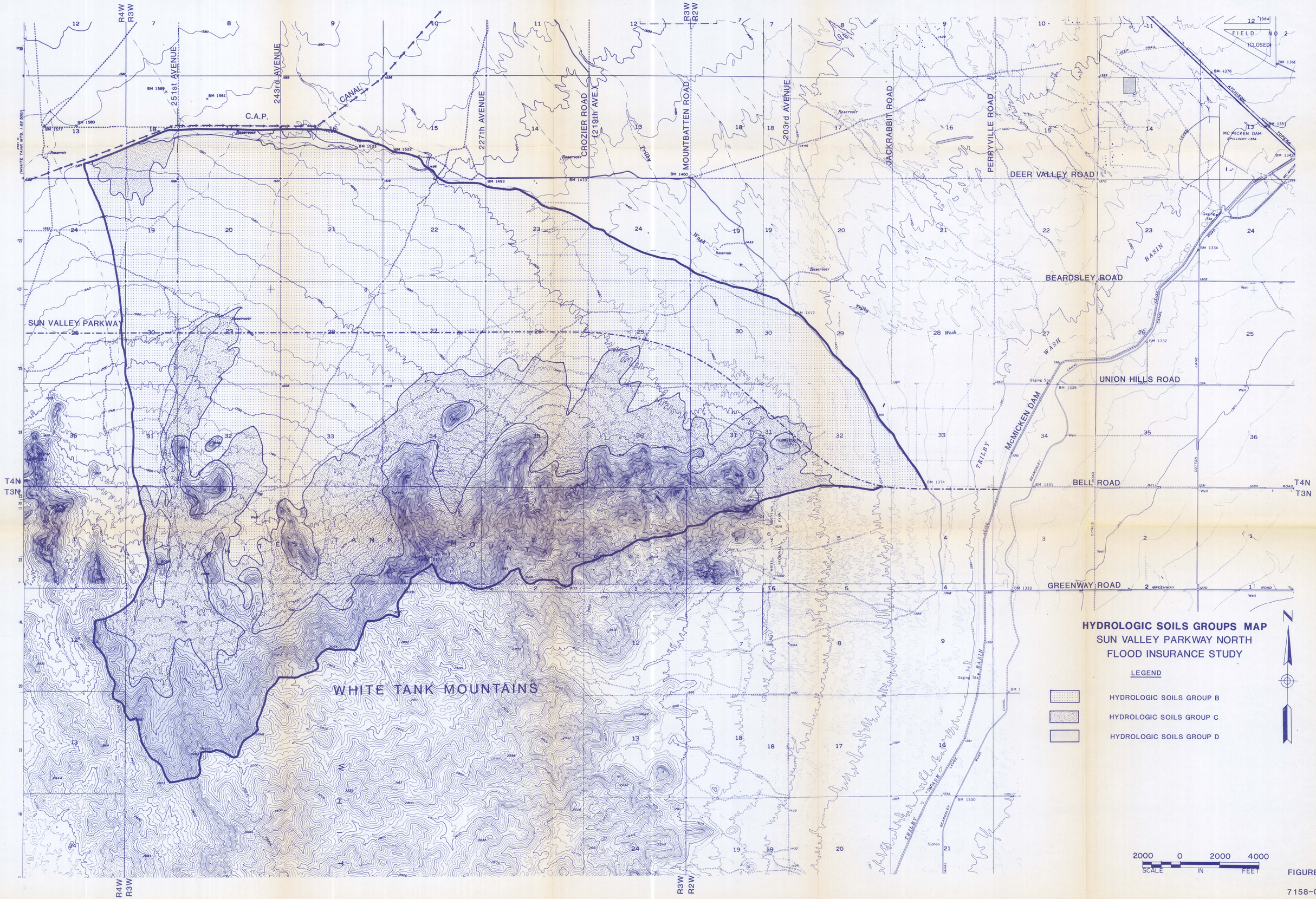


FIGURE 5

7158-01


HYDROLOGIC SOILS GROUPS MAP
SUN VALLEY PARKWAY NORTH
FLOOD INSURANCE STUDY
LEGEND
HYDROLOGIC SOILS GROUP B
HYDROLOGIC SOILS GROUP C
HYDROLOGIC SOILS GROUP D
N
2000 0 2000 4000
SCALE IN FEET
FIGURE 3
7158-01
R4W
R3W
R2W
T4N
T3N
251st AVENUE
243rd AVENUE
227th AVENUE
219th AVE.
203rd AVENUE
CROZIER ROAD
MOUNTBATTEN ROAD
JACKRABBIT ROAD
PERRYVILLE ROAD
C.A.P.
CANAL
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS ROAD
BELL ROAD
GREENWAY ROAD
SUN VALLEY PARKWAY
WHITE TANK MOUNTAINS
McMICKEN DAM
TRILBY WASH
FIELD NO 2 (CLOSED)
ATCHISON TOPEKA & SANTA FE

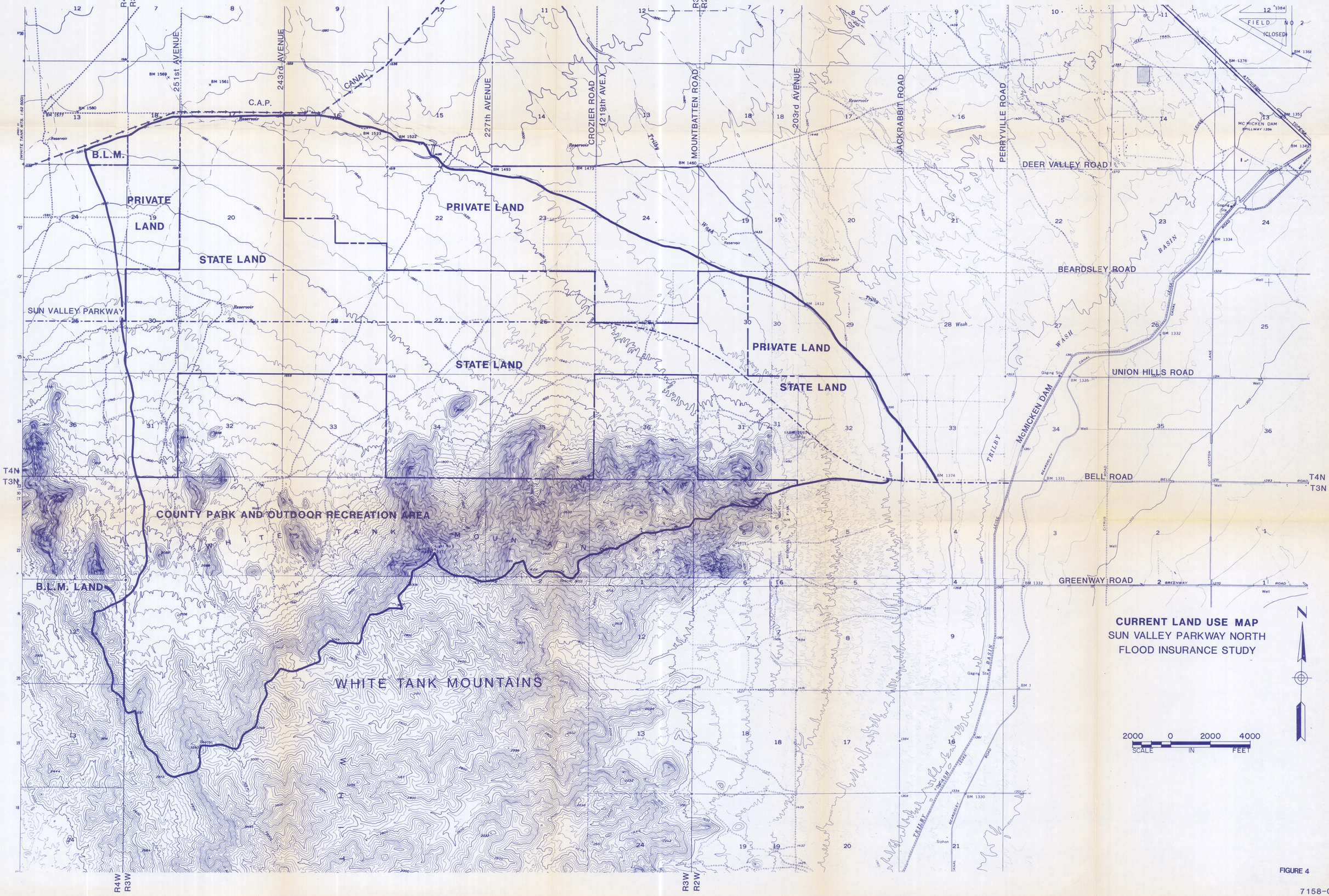
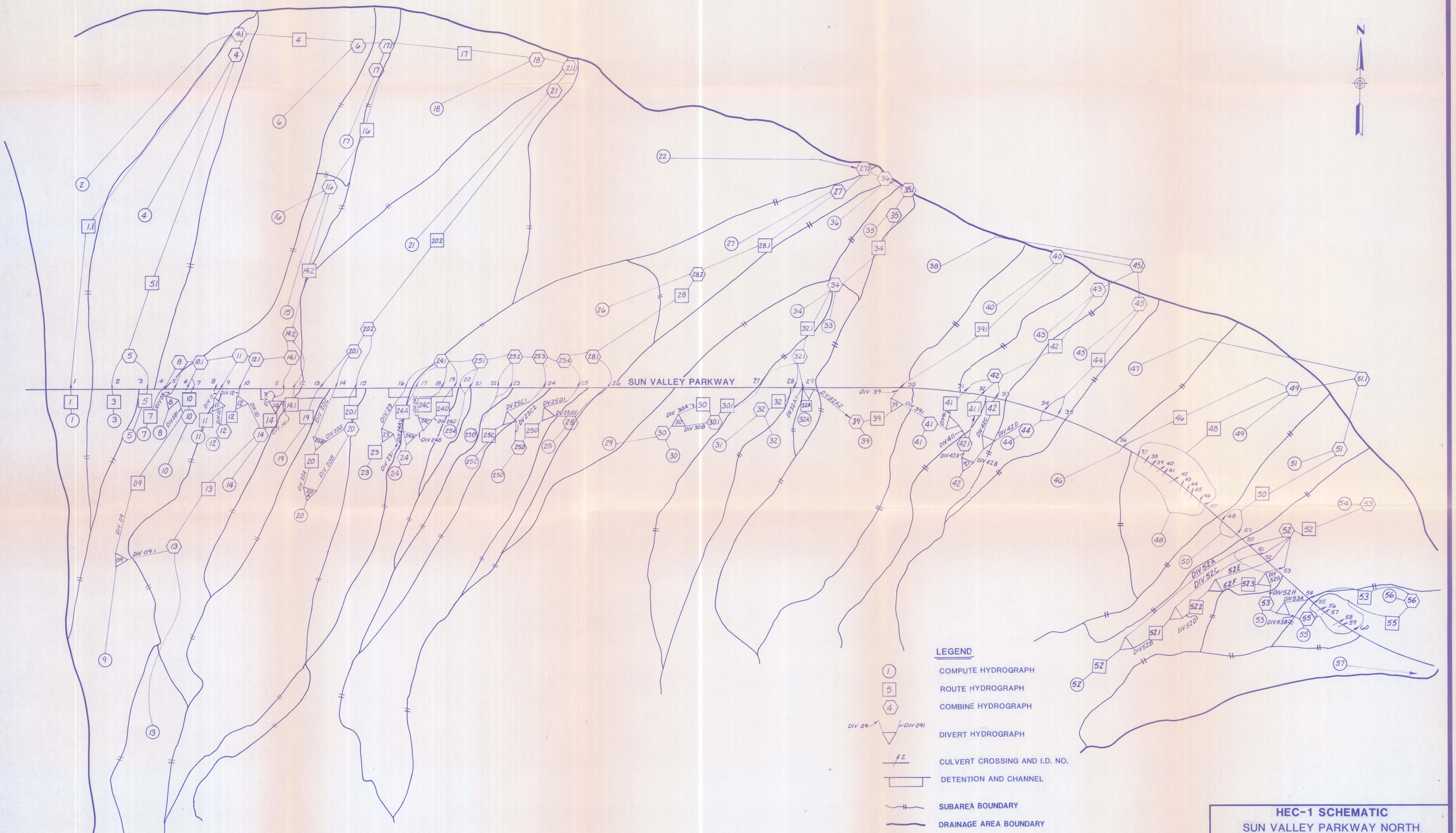


FIGURE 4

7158-01



REV.	DESCRIPTION	BY	DATE
	Added CO 4.1, 17.1, 21.1, 27.1, 35.1		2/27/91

HEC-1 SCHEMATIC
SUN VALLEY PARKWAY NORTH FLOODPLAIN DELINEATION STUDY

DESIGN	SCALE	JOB NO.	DATE	SHEET
DRAWN	HORZ.	7158-01		1 OF 1
CHECK	VERT.			

A-NWEST INC.
Consulting Engineers
7600 NORTH 15TH STREET, SUITE 200
PHOENIX, ARIZONA 85020
(602) 861-2200

FIGURE 6