APACHE JUNCTION GILBERT WATERSHED
WATERSHED PROTECTION AND FLOOD PREVENTION PROJECT
MARICOPA COUNTY ARIZONA

SPOOKHILL OUTLET DESIGN

REVISED: 6-17-92

REVISED: SEPTEMBER 1992

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1. DISCRIPTION OF JOB

Spookhill Outlet Channel and Sediment Basin project is located in the East Maricopa County area. It is part of the Buckhorn-Mesa Watershed project. The Buckhorn-Mesa structures control a watershed area of approximately 42 square miles north of the study area, and are designed for a 100-year event.

The Spookhill Outlet structure is constructed to convey flows from the Spookhill dam into the Salt River. The outlet is an earth channel at this time. The outlet intercepts the Bush Highway through a Concrete Box Culvert which recently was improved (from 2 Boxes to 4 Boxes) to carry the required capacity flow. The conveyed flow deposites its sediments into an existing basin at the end of the channel, prior to reaching the Salt River in the vicinity of the Granite Reef dam.

The design limits for this project start at the north end of Bush Highway Concrete Box Culvert, and end at the oulet of the sediment basin to the Salt River Project.

2. DESIGN OBJECTIVE

The objective of this project is to design a new channel from the Bush Highway, northwest to the existing sediment basin and into the Salt River, upstream of the Granite Reef Dam.

3. BASIS FOR DESIGN

1. The SCS collected material handbook.
2. Engineering Design Standards, Far West States, June 1979.
3. Design of Open Channels, TR-25, October 1977.
4. HEC-2, Water Surface Profiles, September 1990.
5. HEC-1, Flood Hydrology Package, September 1981.
6. Drainage Design Manual for Maricopa County, Volume II, Hydraulics, 1991.
7. Hydraulic Carts for the Selection of Highway Culverts, HEC-5, December 1965.

4. DISCUSSION

4.1- Hydrology

The hydrology for the Spookhill Outlet was completed by the Soil Conservation Service (SCS) in 1975 and used to design the Spookhill Floodway. Since the hydrology has been approved, there have been minor changes in SCS's hydrologic procedures. The first known change in the hydrology procedures is a change to the Att-Kin versus the Improved Coefficient method of routing in the TR-20 program. The second change is the time increment for the type II, 24-hour storm from 0.50 hours to 0.25 hours. These changes might tend to increase the peaks to some extent, but they should not be significant. There was no need to re-evaluate the hydrology for the outlet design. SCS recommended that the 1975 hydrology be used to design the floodway outlet. The discharges could be increased about 10% to account for possible increase in computed peak flows.

In the July 24, 1990, meeting between Flood Control District of Maricopa County (FCD) and SCS representatives, the above decision was agreed to and the proposed flow discharge for Bush Highway Culvert was set for 2650 cfs. In this study, the 2650 cfs is used to design the proposed outlet channel.

4.2- Survey

The proposed channel plan and profile design is based on the field survey information which was conducted by the SCS personnel during 1990. The 1990 survey covers the topo information from the old Bush Highway, all the way north along the existing dike to the Salt River. The survey topo uses the centerline of the channel dike as the survey centerline and provides cross section stationing and topographic profiles for approximately each 100 feet. The SCS field survey information is used to develop a topographic one foot contour map for the site. The topographic map is used to do the hydraulic and hydrology design of the channel outlet and sediment basin. **Appendix A provides a copy of the topographic map developed for the study.**

4.3- Location and Layout

The location and layout are along the existing channel and sediment basin, in accordance with the as-built survey drawings and the Spookhill Floodway 1977 design, by the U.S. Department of Agriculture Soil Conservation Service.

4.4- Geology

In 1975 and 1976, the SCS Geologist prepared a preliminary geologic investigation report for the site. According to the report, ten hand borings and examinations of exposed rock were made. The selected boring sites are located within the channel and sediment basin area between the Spookhill Dam and the Salt River. The average annual deposition of bedload in the outlet channel was estimated to be 0.1 ac-ft. The geological analysis indicate that the sediment materials would be moved through the channel by the 10-year event. A copy of the report and the soils test analysis is available in Appendix A.

5. HYDRAULICS AND SEDIMENT TRANSPORT ANALYSIS

5.1- Channel Design:

5.1.1- Engineering Methods:

Standard hydraulic methods were used to determine different alternative solutions for the proposed channel. Cross-sections for the water surface profiles were selected from the survey by SCS. Using the SCS survey information, the FCD developed a topographic map with **1' contour intervals,** which is used for a base map and plan profile map.

Location of selected cross-sections used in hydraulic analysis are shown in Appendix B. Station 400 is located at the Bush Highway Box Culvert outlet and HEC-2 stationing increases, going north along the proposed channel centerline.

Water surface elevations for the 2650 cfs flow discharge were computed through use of the COE HEC-2 step water surface profile computer program.

HEC-2 Supercritical flow condition was selected to design the channel. Under supercritical conditions, the culvert is said to be inlet-controlled. The Hydraulic Charts for the Selection of Highway Culverts (by: U.S. Department of Commerce, Bureau of Public Roads) is used to determine the starting water surface elevation. A copy of the calculations is available in Appendix B.

A steep slope on the north side of the Bush Highway Box Culvert causes high velocity and develops a super critical hydraulic condition. Due to the high velocity along the channel, the earth type of channel will be unstable and therefore, it is not recommended. In order to stabilize the channel, different types of structures were examined.

The proposed channel curve is designed to limit superelevation to one foot above calculated water surface elevation or 10% of water surface width, whichever is the least. The following formula is used to calculate superelevation depth for the curve:

$$S=1.2(V^2 \times b)/gR$$

The required freeboard was computed using the following formula from the Flood Control District Drainage Design Manual:

$$FB = 0.25\ (y+(V^2/2g))$$

y=Depth of flow
V=Average velocity
g=Gravity acceleration

Spookhill Channel Outlet slope sharply changes at the intersection of proposed channel and basin. In peak flow conditions, when the water is introduced at a high velocity in the channel, the velocity will be reduced through a hydraulic jump at the sediment basin.

To insure that the channel peak flow runoff will not overtop the channel and basin where hydraulic jump occurred, height of the hydraulic jump at channel intersection with the basin is calculated. The height of the jump is approximately 7 feet and the water surface elevation at that location is approximately 1322 feet (1315+7=1322). There is no overtopping flow problem with channel or basin at this location. See Appendix B for calculations.

5.1.2- Channel Alternatives:

Using the above criteria and engineering methodologies, for a 40 foot width rectangular channel, in **Alternative No. 1**, a reinforced concrete channel was tested. The results are as follows:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 1

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S	TIME
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54	.00
400.00	2653.00	37.24	39.67	46.50	24.42	2.75	108.64	40.00	86.00	34.49	275.66	.00
500.00	2653.00	34.04	36.56	44.01	25.34	2.62	104.71	40.00	100.00	31.42	213.62	.00
660.00	2653.00	28.98	31.64	40.16	26.83	2.48	98.88	40.00	160.00	26.50	256.30	.00
800.00	2653.00	26.60	29.11	36.52	25.27	2.62	104.97	40.00	140.00	23.98	211.90	.01
900.00	2653.00	24.88	27.33	34.35	24.70	2.69	107.43	40.00	100.00	22.19	196.90	.01

SECNO= Cross section station identification
Q= Discharge runoff, cfs.
CWSEL= Water surface elevation, ft.
CRIWS= Critical water surface elevation, ft.
EG= Energy line elevation, ft.
VCH= Velocity, fps.
DEPTH= Depth of water, ft.
AREA= Wetted area, ft.
TOPWID= Top width of the channel, ft.
XLCH= Distance between the cross section stations, ft.
ELMIN= Channel invert flow line elevation, ft.

Alternative No. 2, tried concrete retaining walls for the sides and grouted rock bottom. The profile starts with a steep slope (3.0731%) and changes to a flatter grade (1.9818%) to match the existing elevation. The following table is the results of HEC-2 model:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 2

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49	713.97
500.00	2653.00	35.27	36.55	39.87	17.21	3.85	154.18	40.00	100.00	31.42	252.56
660.00	2653.00	30.11	31.63	35.35	18.35	3.61	144.54	40.00	160.00	26.50	308.97
800.00	2653.00	28.08	28.87	31.69	15.24	4.35	174.07	40.00	140.00	23.73	173.25
1020.00	2653.00	23.48	24.51	27.50	16.09	4.12	164.87	40.00	220.14	19.36	204.99
1240.00	2653.00	19.20	20.13	23.07	15.80	4.20	167.93	40.00	220.14	15.00	193.63

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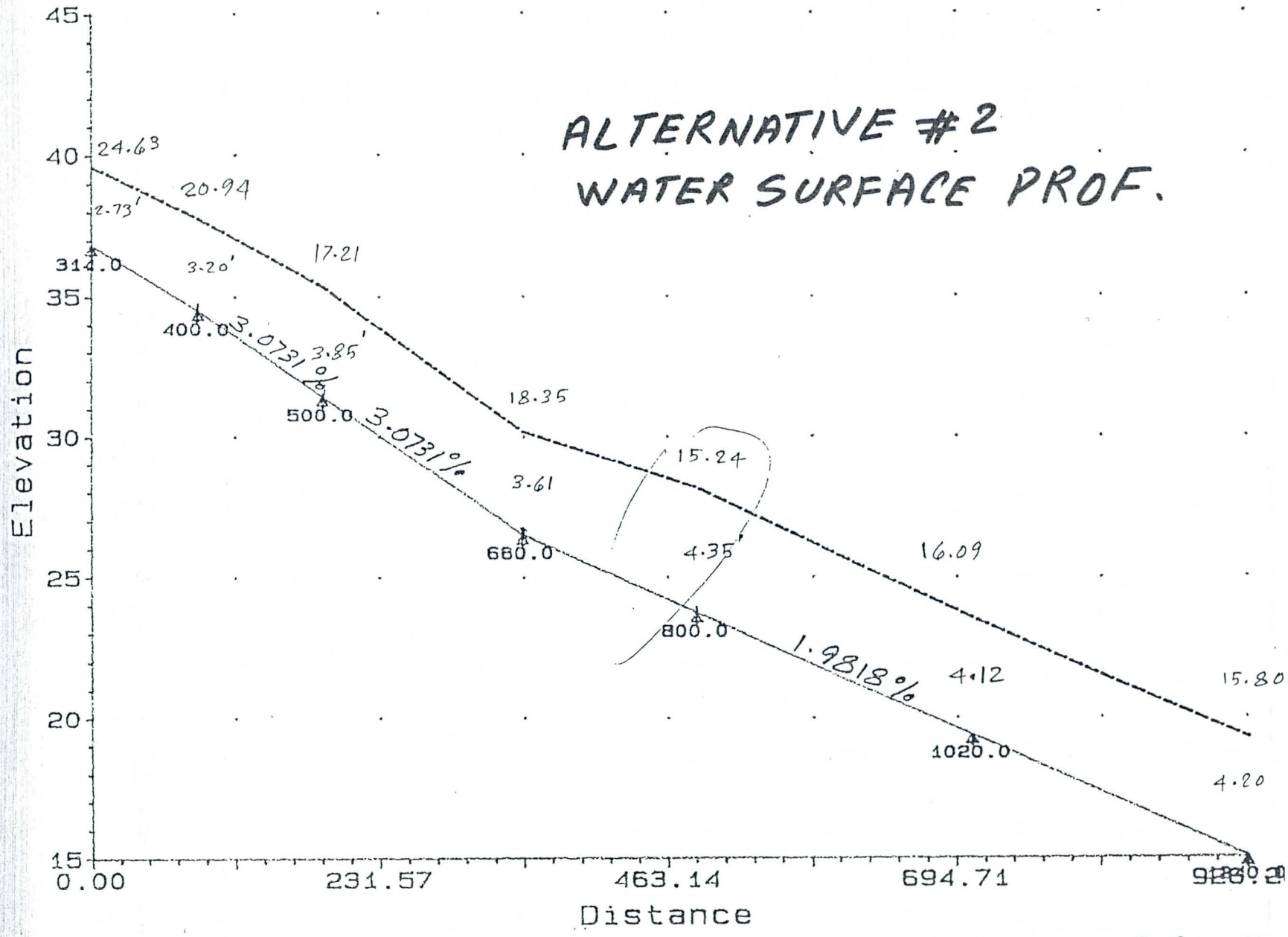
SPKHL2.DAT



WATER SURF. PROF.

what hydraulic jump?

Alternative No. 3, looking at the water surface profile of Alternative No. 2, there is a small hydraulic jump between stations 660 and 800. This jump is caused by the extensive change between the channel profile grades. To eliminate the jump and to have a more uniform flow, a similar channel material with more comparable grades was used (2.6885% and 2.0651%) to have smaller variances between the grades and therefore, a more uniform hydraulic flow condition. The following table is the results of this attempt:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 3

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49	713.97
500.00	2653.00	35.81	36.93	40.06	16.54	4.01	160.36	40.00	100.00	31.80	223.44
660.00	2653.00	31.28	32.63	36.08	17.58	3.78	150.87	40.00	160.00	27.50	270.25
800.00	2653.00	28.85	29.75	32.65	15.65	4.24	169.53	40.00	140.00	24.61	188.02
1032.60	2653.00	23.88	24.93	27.98	16.26	4.08	163.18	40.00	232.65	19.80	211.67
1265.30	2653.00	19.14	20.13	23.13	16.04	4.14	165.42	40.00	232.65	15.00	202.88

Alternative No. 4. Alternative No. 3 resulted in a more uniform hydraulic condition for the water surface profile. It also shows that the attempt for eliminating the hydraulic jump is in the right direction. Alternative No. 4 goes a step further to eliminate this problem. We used concrete retaining walls for the sides and grouted rock bottom with the flattest slopes (2.3038% and 2.1418%) for more uniform flow (see the water surface profile figure), as follows:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 4

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49	713.97
500.00	2653.00	36.38	37.32	40.27	15.82	4.19	167.75	40.00	100.00	32.19	194.29
660.00	2653.00	32.45	33.63	36.82	16.77	3.95	158.18	40.00	160.00	28.50	233.18
800.00	2653.00	29.61	30.63	33.65	16.13	4.11	164.44	40.00	140.00	25.50	206.65
1045.10	2653.00	24.30	25.38	28.46	16.37	4.05	162.11	40.00	245.16	20.25	216.04
1290.30	2653.00	19.07	20.13	23.19	16.29	4.07	162.90	40.00	245.16	15.00	212.80

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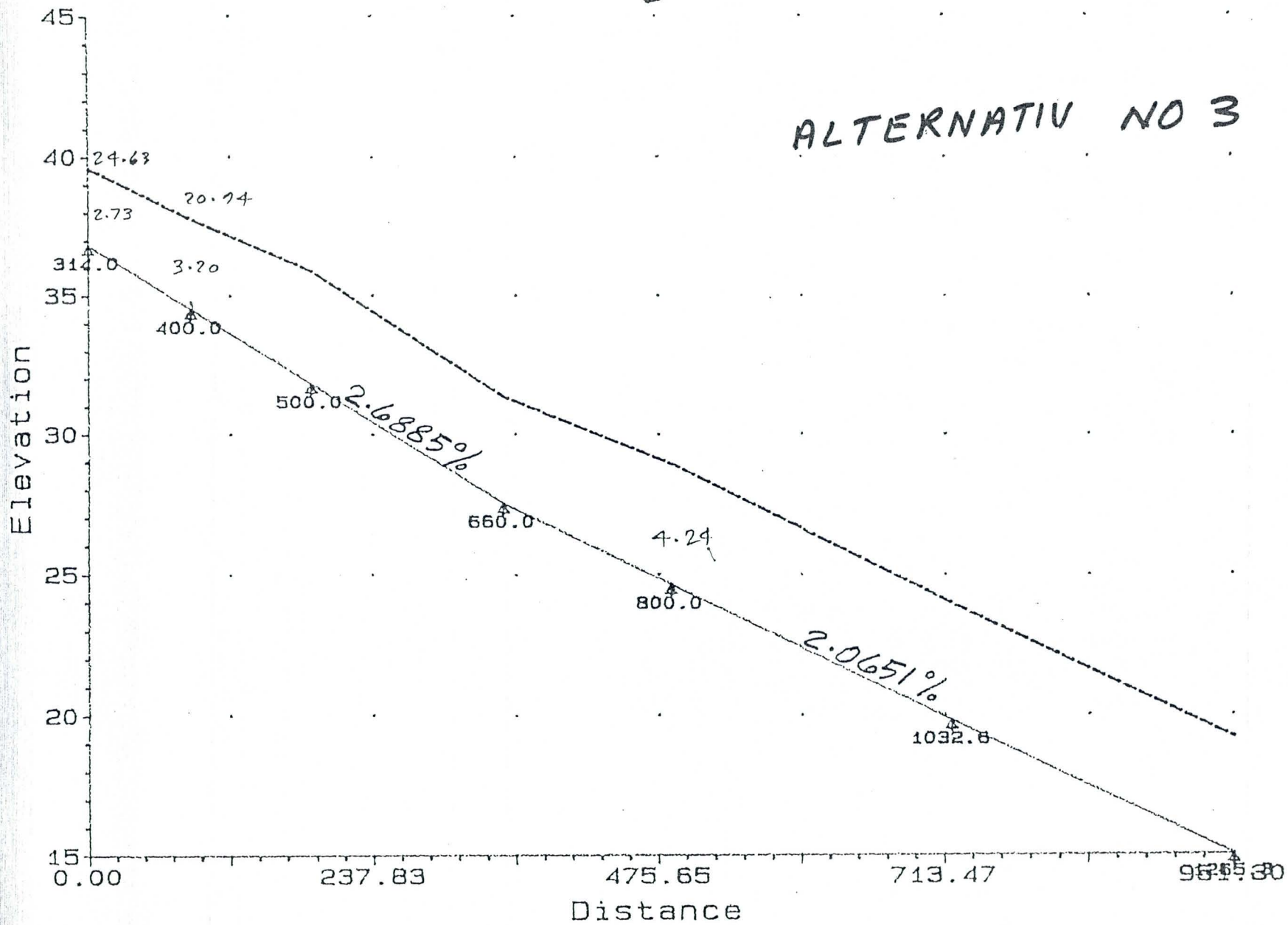

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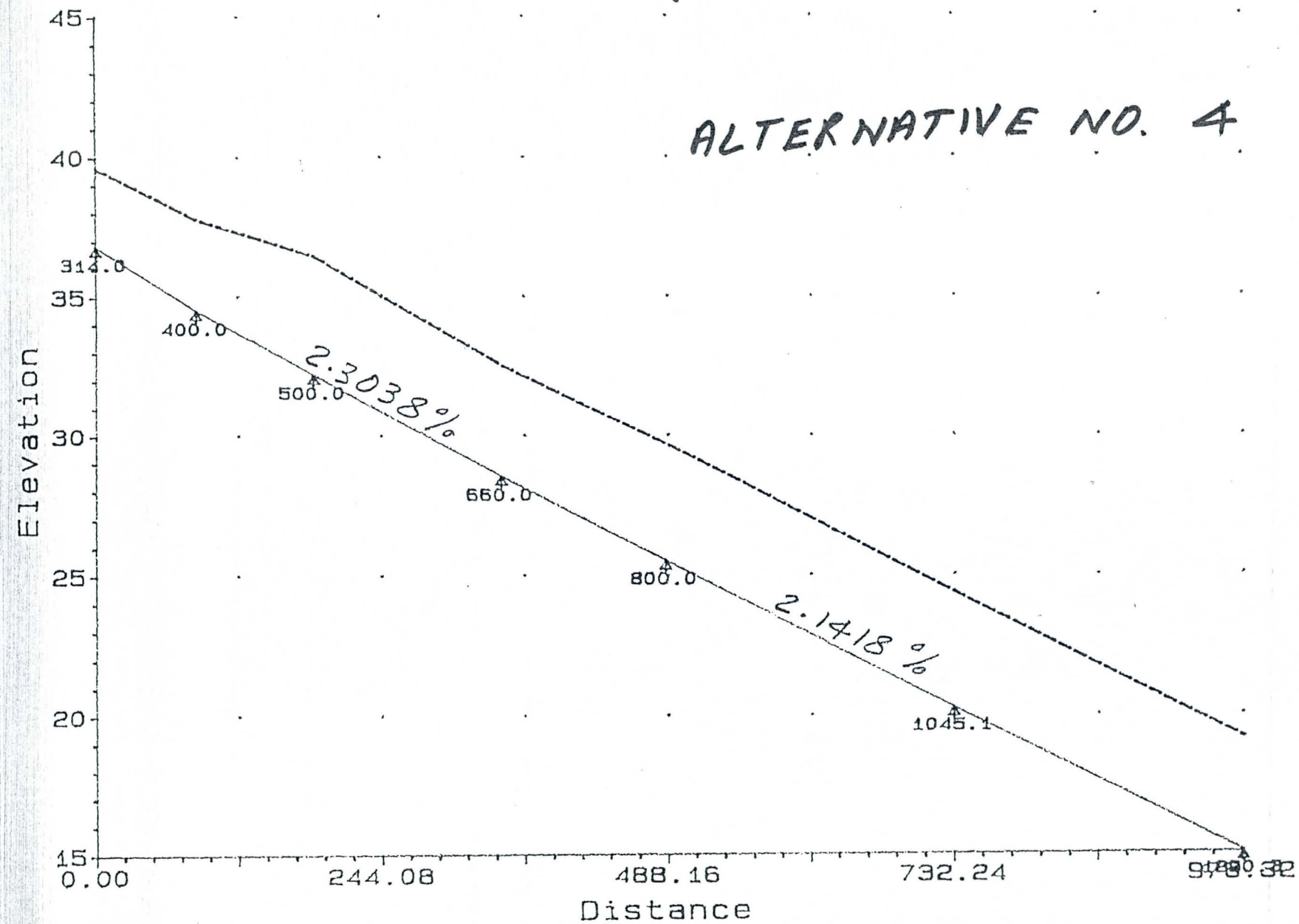


WATER SURF. PROF.

The following table summarizes the results of the above alternatives:

	H	Hc	Rc	Lc	L
Alternative #1			910	1138	
Alternative #2	6.33	7.25	386	483	883
Alternative #3	6.25	7.17	394	493	893
Alternative #4	6.25	7.17	399	500	900

H= depth of channel, ft.
Hc= depth of channel at curve, ft.
Rc= radius of curve, ft.
Lc= length of curve, ft.
L= total length of channel, ft.

The final results of the above tables indicate that Alternative No. 1 needs to have a very large radius for the curve area, due to the high flow velocity (approximately 26 fps), and the proposed channel alignment will be outside of the existing channel. It will be the longest channel and more earthwork and concrete materials will be needed to construct the channel. Alternatives 2, 3 and 4 appear to have similar hydraulic characteristics. However, in Alternative No. 2, which is the preferred alternative, the proposed channel alignment fits within the existing channel and the profile of the proposed channel matches the existing channel profile. Therefore, much less earthwork is needed and the shortest channel length will be required. Alternative No. 2 will be the least expensive method and perhaps the most suitable alternative to use.

A concrete retaining wall and grouted rock bottom, using Alternative No. 2 profile, is recommended.

5.1.3- Final Design:

The SCS 30 percent review of the Spookhill Outlet channel plans and design analysis indicates that the SCS is agreed with the FCD that Alternative No. 2 should be finalized as the preferred alternative.

The channel alignment was adjusted to match the centerline of the sediment basin. This prevents channel runoff from being directed at north side sediment basin dike and therefore, it eliminates erosion to the north side dike. The centerline adjustment reduced the channel length. The channel profile was revised based on the above adjustment. The profile starts with a steep slope which matches to the existing channel profile, and changes to a flatter grade to match the existing elevation of 1315.00 where it enters the sediment basin. The following table is a summery of the HEC-2 results:

HEC-2 SUMMARY TABLE

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
319.00	2653.00	41.97	41.97	44.56	12.92	5.17	205.33	40.00	.00	36.80
400.00	2653.00	38.13	39.66	43.39	18.40	3.64	144.15	40.00	81.00	34.49
500.00	2653.00	35.14	36.43	39.74	17.22	3.85	154.10	40.00	100.00	31.29
650.00	2653.00	30.08	31.63	35.42	18.55	3.58	143.04	40.00	150.00	26.50
722.33	2653.00	29.21	30.22	33.20	16.02	4.13	165.56	40.00	72.33	25.08
850.00	2653.00	26.80	27.72	30.64	15.73	4.22	168.67	40.00	127.67	22.58
979.98	2653.00	24.22	25.17	28.13	15.85	4.18	167.36	40.00	129.98	20.04
1100.00	2653.00	21.87	22.82	25.77	15.86	4.18	167.25	40.00	120.02	17.69
1237.60	2653.00	19.19	20.13	23.08	15.83	4.19	167.62	40.00	137.62	15.00

Stability and Scour analysis where the Channel enters the Sediment Basin:
The velocity for the channel tends to be very high and the Hydraulic characteristic of the channel is at the super-critical condition stage. However, there is no scour along the channel and sediment basin at the existing condition. This is because, during the storm event, while the runoff in the channel is increasing to reach the peak flow condition, the basin water surface elevation is also increasing to reach the maximum storage capacity. The sediment basin water surface elevation will reach the Basin Weir outlet invert elevation within an hour after the start of the storm. By that time, the runoff flow will reach its peak, and the basin water surface depth will increase more than 7 feet (22.50-15.00=7.50) in depth.

As the water surface elevation increases in the sediment basin, so does the buffering, which provides protection for the basin and channel entrance to the basin. The existing basin condition indicates that the basin water storage should be adequate to prevent any scour at the channel entrance.

The most severe scour occurs when the basin is empty and runoff is increasing. The channel is expected to have a scour problem where it enters the sediment basin. The major scour develops during the first hour of storm runoff (prior to the basin water surface reaching the wier outlet invert elevation). During the first hour, the sediment basin is empty or has less than 3 feet of water. Runoff within the first hour will reach approximately 140 cfs (see the hydrology). At that time the basin water surface elevation will be about 3 feet. However, since the major scour occurs when the basin is empty (when runoff is much smaller than 140 cfs), it is conservative enough to use 100 cfs for calculating the scour depth. The maximum velocity is approximately 4 fps for 100 cfs discharge. Scour depth at the channel entrance is calculated for approximately 2 feet. Soil tests in the vicinity of the sediment basin indicates the existence of the

rock at approximately 3 feet depth of the basin proposed finished grade. Therefore, it is recommended that a 3 foot deep cut-off wall be used where the channel enters the basin, to prevent erosion.

The engineering methods of calculations which are described in Section 5.1.1 are used to determine the channel required freeboard and superelevation depths. The following table displays the results of this effort:

SUMMERY OF CALCULATION FOR THE PROPOSED CHANNEL

STA. No.	Water Depth ft.	Freeboard ft.	Super Elev. ft.	Min. Channel Depth Inside	Outside
319.00	5.17	1.94	N/A	6'-0"	6'-0"
400.00	3.64	2.22	N/A	6'-0"	6'-0"
500.00	3.85	2.11	N/A	6'-0"	6'-0"
650.00	3.58	2.23	N/A	6'-0"	6'-0"
722.33	4.13	2.03	0.00	6'-2"	6'-2"
850.00	4.22	2.02	0.50	6'-3"	6'-9"
979.98	4.18	2.02	1.00	6'-3"	7'-3"
1100.00	4.18	2.02	0.53	6'-3"	6'-9"
1237.60	4.19	2.02	0.00	6'-3"	6'-3"

Sedimentation Removal: The channel is in the supercritical condition, and it is expected to be self cleaned with no sediment deposition. The Flood Control District Operation and Maintenance Division will be able to remove the sediment deposition by using an Front End loader (compatible to the 624E John Deere loader) with out damaging the rock.

5.2- Sediment Basin Outlet Analysis:

5.2.1- Sediment Analysis:

Most of sediment will be dropped at the lower 10-12 feet of the Spookhill Reservoir pool by the time the flow reaches the principal spillway outlet. Don Clark (SCS Geologist) has estimated that 95% of the sediment will remain in the Spookhill Reservoir. Suspended sediment contributed to this project from the reservoir is estimated 0.14 ac-ft suspended load.

Mr. Clark estimated that the average erosion rate for the natural channel is approximately 0.25 ac-ft/sq.mi-yr. Half of the sediment from the watershed area is suspended load, of which 90 percent is transported to the basin. The other half is bed load, and 70 percent of that transports to the basin.

Other contributing areas downstream from the reservoir are subareas 23, 24, 25 and 26 (from TR-20 hydrology study dated 3/75 by SCS). Areas 23, 24 and 25 contribute 0.05 ac-ft suspended load and 0.04 ac-ft bed load. Area 26 contributes approximately 0.29 ac-ft suspended load and 0.18 ac-ft bed load. Total sediment transported to the basin is estimated 0.70 ac-ft/yr. The Flood Control District currently cleans out the basin once every two years. The maximum sediment volumes in the basin should not increase more than 1.40 ac-ft (2-year X 0.70 ac-ft/yr = 1.40 ac-ft/yr). The proposed basin capacity will be well above the requirement **(W=100', L=650', D=3', side slope Z=2:1, and total basin volume will reach 4.7452 ac-ft prior to the weir outlet activation). Appendix B provides backup documentation for the sediment study by the SCS personnel.**

5.2.2- Hydraulic Analysis:

The sediment basin is built to capture sediment flows prior to entering into the Granite Reef Dam. Through the years of cleaning and reconstruction of the sediment basin dikes, some of the features like driveway ramp entrances and drop structure at the end of channel, which were part of the original design, have disappeared. The existing basin has no driveway entrance and drop structure. Hydraulic analysis indicates that there is a need for increasing the dike's profile elevations around the sediment basin in order to insure the flow will only exit through the sediment basin outlet.

FCD had previously developed a HEC-1 model to compute the outlet from the Spookhill Dam. This model, which was developed by FCD watershed branch, simulates the outlet hydrograph from the dam and routes it though the existing outlet channel, then computes the runoff hydrograph from the downstream side of the dam and combines the two hydrographs to determine the peak discharge at Bush Highway.

The FCD HEC-1 model was revised to account for the 10% additional discharge from the watershed. This was suggested by the SCS personnel (see the hydrology section of this report). The hydrology model was improved by routing the combined hydrograph at the Bush Highway Culvert through the new four-barrel culvert, the proposed (Alternative No. 2) channel, and then into the sediment basin structure. It was assumed that the basin has a maximum of one foot sediment deposits (see the sediment basin calculation section of this report) during the time of peak discharge hydrograph routing.

The basin will have two feet of storage depth prior to activating and conveying the outlet flow. The weir outlet elevation sits at 1318 and the bottom width of trapezoidal weir is 150 feet.

Using the stage storage method of calculations for routing through the basin, the HEC-1 model resolutes that, at the maximum stage, the water surface profile will reach **1322.50.** This water surface elevation is calculated using the final HEC-2 model water surface computation.

Stage Storage Data

Volume, acre-feet	0	1.582	3.223	4.924	6.685	8.506	10.386
Elevation, feet	1316	1317	1318	1319	1320	1321	1322

Based on the HEC-1 computation, the water surface elevation will reach **1322.50.** It is recommended that the dikes around the sediment basin be raised to **1324.00** feet.

5.3- Sediment Basin Analysis

There is an existing trapezoidal sediment basin outlet which is designed to direct runoffs from the basin to the Salt River. The area between the basin outlet and the Salt River is a wetland area. This area is covered with vegetations and trees. The runoff should go though this area and find its way out to the Salt River. Using SCS's survey information, a HEC-2 model was developed to compute the water surface elevation for the sediment basin outlet. The model runs under subcritical condition and the stationing starts from 0+00 station at Salt River and runs southeasterly along the sediment basin outlet centerline to approximately 3+60 station at the weir outlet.

The field reconnaissance during the monsoon session and prior to that, indicate that a higher manning "n" value for the wetland area should be considered to reflect the effect of dense brush and trees. For the final design, Table 3 page 11 of "Estimated Manning's Roughness Coefficients for Stream channels and Flood Plains in Maricopa County, Arizona" is used. This document is prepared by the U.S. Geological Survey for Flood Control District of Maricopa County. A copy of Table 3 is presented in Appendix B. The HEC-2 model for the sediment basin outlet was revised due to the higher n value.

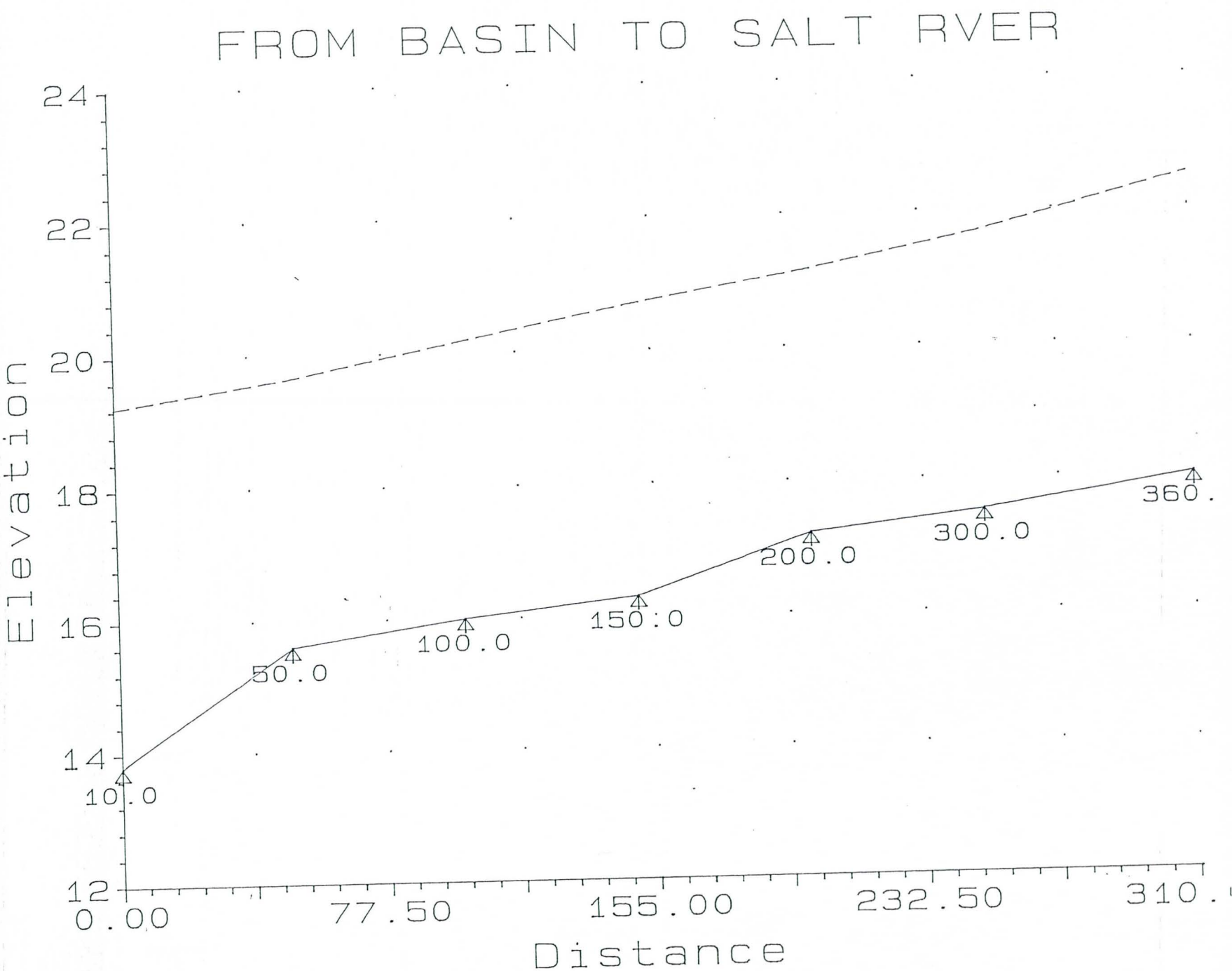
Appendix B provides a copy of the HEC-2 model, HEC-2 map and cross-section locations, water surface profile, and HEC-2 cross-section profiles.

The following table provides a summary of the results for the HEC-2 sediment basin model:

HEC-2 SUMMARY TABLE FOR THE SEDIMENT BASIN

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA
10.00	2650.00	19.22	17.00	19.25	1.47	5.42	1927.7
50.00	2650.00	19.63	17.52	19.67	1.67	4.03	1723.4
100.00	2650.00	20.16	18.43	20.22	2.00	4.16	1410.8
150.00	2650.00	20.69	18.87	20.77	2.30	4.39	1189.0
200.00	2650.00	21.14	19.16	21.26	2.80	3.94	964.7
300.00	2650.00	21.68	19.47	21.86	3.52	4.18	760.9
360.00	2650.00	22.50	20.11	22.71	3.71	4.50	714.6

According to the HEC-2 results, the water surface elevation at sediment outlet will be approximately 1322.50. Increasing the sediment basin levee top up to 1324 feet, will provide more than one foot of freeboard at the weir outlet.


FROM BASIN TO SALT RVER
Elevation
24
22
20
18
16
14
12
10.0
50.0
100.0
150.0
200.0
300.0
360.
0.00
77.50
155.00
232.50
310.
Distance

6. STRUCTURAL DESIGN

Channel walls are basically designed as cantilever retaining walls of varying heights, with grouted riprap section between the channel walls. AASHTO standard specifications for highway bridges with applicable live loads is used for design.

Concrete used is Class AA, compressive strength 4000 psi. Reinforcing steel shall conform to ASTM specifications A615 Grade 60.

Existing wing walls, footings, apron and cutoff walls to be removed before the new channel construction. Dowels from existing box to remain in place and to be doweled into the new wing wall.

All walls shall have construction joints spaced at intervals of 30 feet minimum and 50 feet maximum. Expansion joints shall be provided at intervals not exceeding 90'-0 and as per details shown on drawings. Appendix C provides design calculations for retaining walls.

7. O&M ROAD DESIGN

The O&M road will be built on both sides of the channel. To protect the O&M road from future erosion, the project consists of protecting the maintenance road from erosion by applying a gravel cover. Gravel road surfacing will be compacted to approximately 4 inches thick. The gradation for the gravel road surfacing was based on the Maricopa Association of Governments (MAG) specification for aggregated base.

8. ENVIRONMENTAL CONSIDERATIONS

The gravel road surfacing on the maintenance roads will reduce dust produced by vehicles. The gravel road surfacing will have a positive impact on the visual aspects of the channel.

Water will be used to abate dust generated by construction. No negative impact on the conservation of biological or water resources is anticipated by construction of the proposed channel and sediment basin.

9. CONSTRUCTION DRAWINGS

The Computer Aid Drafting Design was used to produce and store the drawings, using Auto-CAD Software, Version 11.

10. SPECIFICATIONS

The NEH section 20 standard specifications have been used for this project, and no special written specifications were required.

11. COST ESTIMATE

There are no unusual materials or construction methods involved. Most of the work involves the use of concrete, grouted riprap, and gravel road.

12. CONSTRUCTION SCHEDULE

The construction schedule was based on an average contractor doing the work. Total construction time is approximately five months.

13. OPERATION AND MAINTENANCE

The improvement will reduce maintenance requirements in the channel, sediment basin, and maintenance roads. A regular maintenance program should be initiated to check for broken grouted riprap and concrete and these areas should be immediately repaired to prevent plant growth. After each major storm the channel and basin should be checked to assure that it is functioning properly, that debris and sediment is removed, and that no damage has occurred. The sediment basin should be scheduled to be cleaned a minimum of once every two years.

14. CONSTRUCTION REVIEW

All channel retaining walls, grouted riprap, and maintenance roads should be inspected regularly during the construction process.

A preconstruction conference will be held, at which time questions about the repair or design can be discussed.

APPENDIX A

A.1

SCS SOIL TEST INFORMATION

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
#2		Spookhill Outlet Buckhorn Mesa WF		
BY Tom Joyd	DATE 7/9/90	CHECKED BY	DATE	JOB NO.
SUBJECT Test Hole Location For Geologic Investigation				SHEET 1 OF

SEDIMENT BASIN

STA Location

21+00 63' left ℄ Dike 2402

19+00 68' left ℄ Dike 2403

16+98.2 Forward 66' left ℄ Dike 2404

14+00 60' left ℄ Dike 2405

12+00 46' left ℄ Dike 2406

11+00 59' left ℄ Dike 2407

10+57 69' left ℄ Dike

PT44 (+10') ℄ channel 54' left of USFS boundary Fence (above bridge)

2401 23+00 63' Left ℄ Dike

2402 21+00 65' Left ℄ Dike

(5) 44+10 2409

(5) 44+00 2410

44+25 2411

44+42 2412

U. RTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-533
REV. 3-57

WATERSHED BUCKHORN-MESA	SUB-WATERSHED	SITE NO. SPOOK HILL OUTLET
LOCATION MARICOPA CO.	OWNER	STATE AZ.
LOGGED BY A.C. SANDERS JR. / DATE 7/10/90	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT CASE 580 BACKHOE	LOCATION OF HOLES OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
2401	63' Left	0.0	1.0	SILT; CLAYEY, SANDY, SL. PLAS., DRY, TAN		ML-CL	-							
	STA. 23+00 ℄ DIKE	1.0	2.0	GRAVEL; V. SANDY, SILTY, CLAYEY, W/ APPROX. 10%		GC	—							
				COBBLES, DRY, TAN.										
		2.0	6.0	COBBLES; GRAVELLY, SANDY, Tr. SILT, DRY. MAX.		—								
				DIAM. 18", MEDIAN DIAM. EST. 5".										
2402	65' LEFT	0.0	2.5	SILT; SANDY, V. SL. PLAS, DRY, TAN		ML	-							
	STA. 21+00 ℄ DIKE	2.5	5.0	COBBLES; V. SANDY, GRAVELLY, SL. MOIST, TAN TO										
				GRAY. MAX. DIAM. APPROX. 8", MEDIAN DIAM. APPROX. 3.5"		—								
		5.0	6.0	SAME AS ABOVE EXCEPT COBBLES TO 18" DIAM.										
				W/ MEDIAN DIAM. APPROX. 6".										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

USDA-SCS-HYATTSVILLE, MD. 1968

2

U. RTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG TEST HOLES

SCS-533
REV. 3-57

WATERSHED BUCKHORN - MESA		SUB-WATERSHED	SITE NO. SPOOK HILL OUTLET
LOCATION MARICOPA CO.		OWNER	STATE AZ.
LOGGED BY A.C. SANDERS JR.	DATE 7/10/90	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT CASE 580 BACKHOE		LOCATION OF HOLES OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	RI C.[3] %
2403	63' LEFT	0.0	1.5	SAND; SL. SILTY, FINE TO COARSE, LOOSE, DRY		SM-SP	–							
	STA. 19+00	1.5	3.0	SILT; V. SANDY, V. SL. PLAS, TAN, DRY		ML								
	℄ DIKE	3.0	4.0	SAND; GRAVELLY, FINE TO COARSE, TR. SILT, SL. MOIST.		SP-SM								
		4.0	6.0	COBBLES; GRAVELLY, SANDY. MAX. DIAM. 18" MEDIAN 6"		–								
2404	63' LEFT	0.0	3.0	SAND; SL. SILTY, FN-CRSE. GRN., LOOSE		SM-SP								
	STA. 17+00 ℄ DIKE	3.0	5.0	SAND; SILTY, FN.-CRSE, MOIST, MED. DENSE		SM								
		5.0	7.0	COBBLES; GRAVELLY, W/ SOFT WET SILT IN INTERSTICES, WET.		–								
2405	60' LEFT 14+00 ℄ DIKE	0.0	16.0	SAND; FINE TO COARSE, GRAVELLY, SL. SILTY, LOOSE TO MED DENSE. MOIST AT 2'.		SP SM								

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

USDA-SCS-HYATTSVILLE, MD 1968

W

U. [illegible]RTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-533
REV. 3-67

WATERSHED: BUCKHORN-MESA	SUB-WATERSHED	SITE NO.: SPOOK HILL OUTLE
LOCATION: MARICOPA CO.	OWNER	STATE: AZ.
LOGGED BY: A.C. SANDERS JR. / DATE: 7/10/90	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT: CASE 580 BACKHOE	LOCATION OF HOLES: OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
2406	45' LEFT 12+00 ℄ DIKE	0.0	13.5	SAND; FN.-CRSE., GRAVELLY, SL. SILTY, W/OCC. COBBLE, MED. DENSE, MOIST @ 2'.		SP-SM								
2407	55' LEFT 11+00 ℄ DIKE	0.0	4.5	SAND; FN-CRSE, SL. SILTY, DRY, MED. DNSE.		SP-SM								
		4.5	13.5	SAND; FN-CRSE, CLAYEY, SILTY, W/OCC. COBBLE, MOIST, REDDISH-BROWN.		SC-SM								
		13.5		GRANITE; WEATHERED, FRACTURED		—								
? 2408	42' D/S FROM CENTER PIER OF BRIDGE (LEFT SIDE OF CHANNEL)	0.0	4.5	SAND; FN-CRSE., GRAVELLY, SL. SILTY		SP-SM	-							
		4.5	7.3	SAND; FN-CRSE., GRAVELLY, W/OCC. COBBLE		SP-SM	-							
		7.3		GRANITE; WEATHERED, FRACTURED										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

A

USDA-SCS-FAYETTEVILLE, NC 1988

U. [illegible]RTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG[illegible] TEST HOLES

SCS-5[illegible]3
REV. 3-67

WATERSHED BUCKHORN-MESA		SUB-WATERSHED	SITE NO. SPOOK HILL OUT[illegible]
LOCATION MARICOPA CO		OWNER	STATE AZ.
LOGGED BY ACS	DATE 7/10/9	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT CASE 580 BACKHOE		LOCATION OF HOLES OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	R.C.[3] %
2409	POINT 44+10'	0.0	4.0	SAND; GRAVELLY, SL. SILTY, LOOSE, DRY, W/SOME COBBLES		SP-SM	-							
		4.0		GRANITE, WEATHERED, FRACTURED.		-								
2410	PT. 44 - 39 ft 10'/0-5 ft ℄	0.0	4.0	SAND; SILTY, GRAVELLY, DRY, TAN, LOOSE		SP-SM	-							
		4.0	9.5	SAND; CLAYEY, SILTY, FN-CRSE, GRAVELLY, REDDISH BRWN.		SC	-							
		9.5		GRANITE; MOD. WEA., FRACTURED										
2411	PT. 44 +25 Ft 42 Rt. ℄	0.0	2.0	SAND; SILTY, FN-MED. GRN., DRY		SM								
		2.0	2.5	GRANITE, WEATHERED, FRACTURED		-								
2412	PT. 44 +42 Ft. 30' Rt ℄L	0.0	3.0	SAND; SILTY, FN-MED. GRN., GRAVELLY, DRY		SM								
		3.0		GRANITE; WEATHERED, FRACTURED		-								

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

4

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-ENG-363
2-80

MATERIALS TESTING REPORT: SOIL CLASSIFICATION

and state: SPOOK HILL OUTLET Sample location: _____ Laboratory No.: 3

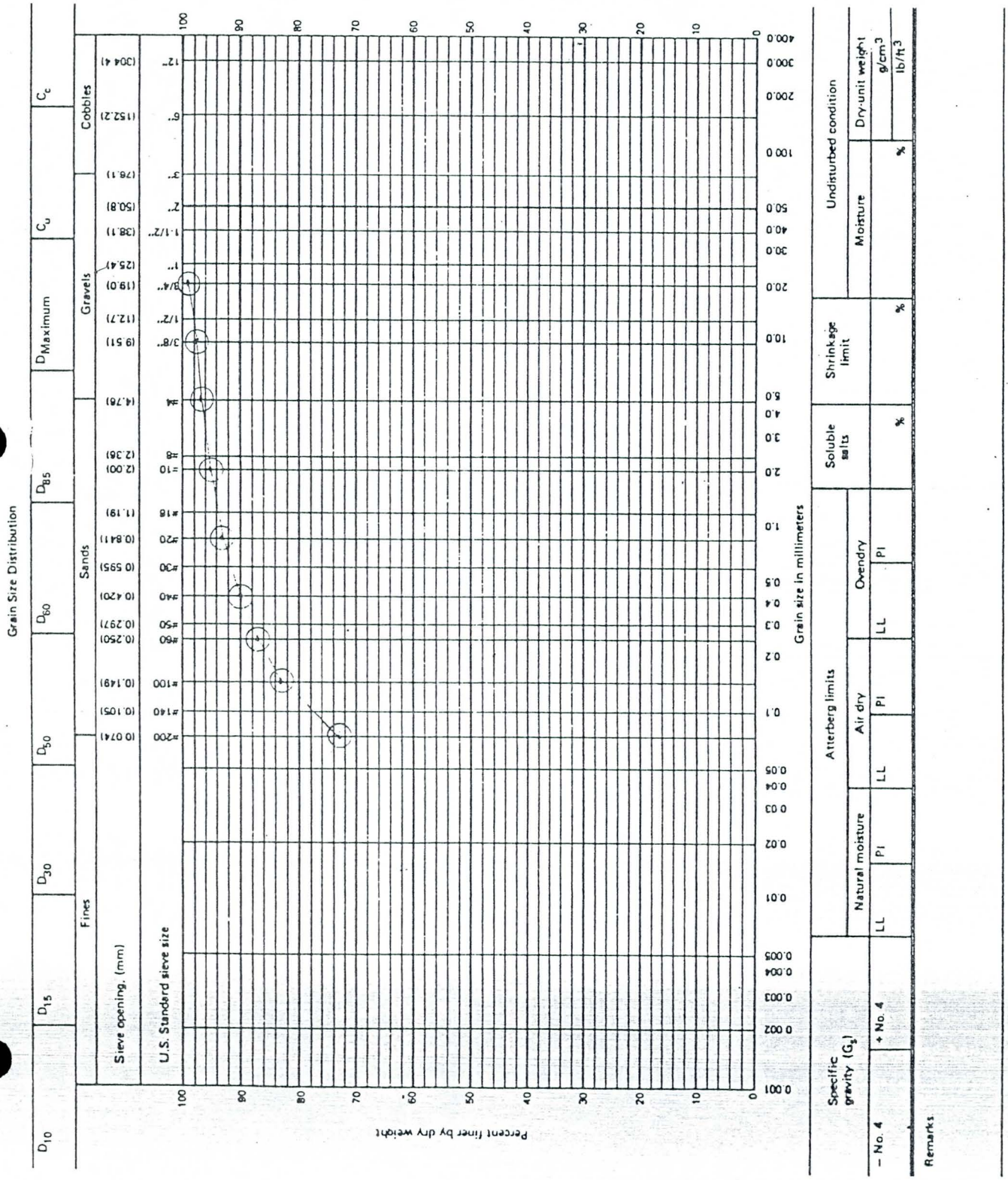
ample No.: 1,1 Depth: 0-1' Geologic origin: _____

sample: BAG. Tested at: M.P.O. Approved by: G. MASON Date: 7-16-90

Symbol: CL Description: CLAY (BORDER LINE)

(ABOUT 10-15% ORGANIC MATERIAL IN THIS SAMPLE)

CRUMB TEST #1



6

SCS-ENG-361
REV. 2-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SAMPLE # 1.1 0-1'

WORK SHEET FOR ATTERBERG LIMITS

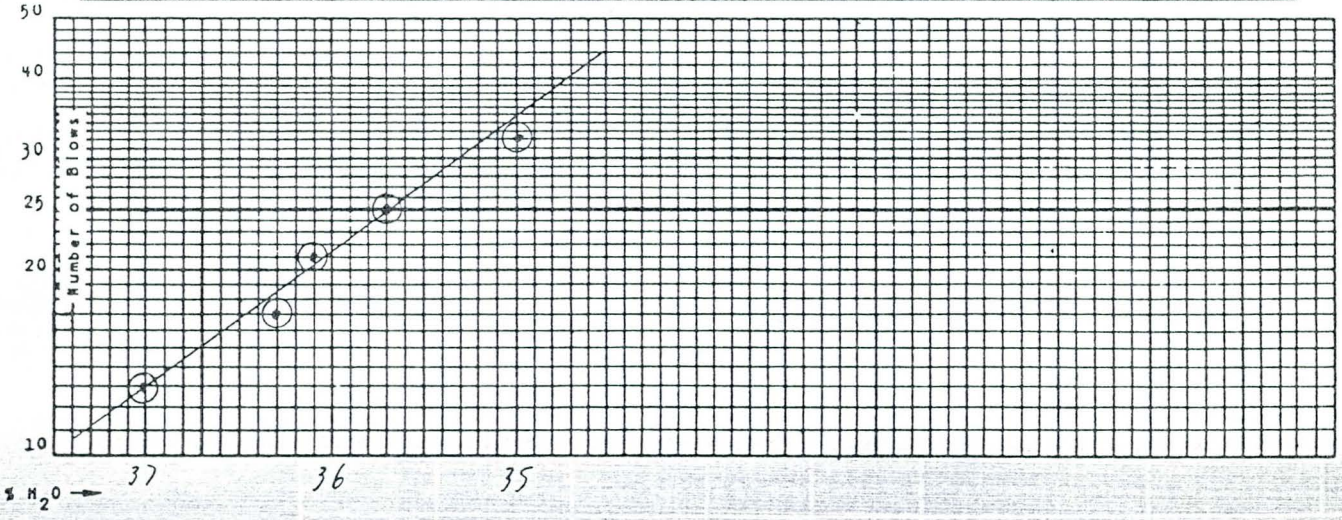
7-16-90

LIQUID LIMIT DATA

① Can No.	② Wet Wt.	③ Dry Wt.	④ H_2O Wt. ②-③	⑤ Empty Wt.	⑥ Dry Soil ③-⑤	⑦ % H_2O $\frac{100 \times ④}{⑥}$	⑧ No. Blows	Laboratory Sample Number
501	28.41	23.84	4.57	11.48	12.36	37.0	13	
502	29.84	24.98	4.86	11.58	13.40	36.3	17	L.L. = 35.7
503	26.90	22.89	4.01	11.79	11.10	36.1	21	P.L. = 23.4
507	30.72	25.76	4.96	11.85	13.91	35.7	25	P.I. = 12.3
514	29.94	25.18	4.76	11.58	1360	35.0	32	
								L.L. =
								P.L. =
								P.I. =
								L.L. =
								P.L. =
								P.I. =
								L.L. =
								P.L. =
								P.I. =
								L.L. =
								P.L. =
								P.L. =
								L.L. =
								P.L. =
								P.I. =

PLASTIC LIMIT DATA

81	11.98	11.19	.79	7.76	3.43	23.0	23.4
89	13.80	12.67	1.13	7.91	4.76	23.7	



Completed by: _____ Recorded by: _____

Checked by: _____ Date: _____

59M-96

7

TSC-PO-ENG-9
12-74

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service

MTS No. 2

MECHANICAL ANALYSIS

Project SPOOKHILL Outlet Date 7-18-9

Sample No. 2.1 0-2.5 Operator G. Nelson

Hole 4402 65' left of STA 4100 @ Dike

M1 — SIEVE ANALYSIS 4 AND (3)

Coarse		Fine				
					% Finer	
Wt. Sample, Air Dry	5.73	Sieve	Wt.	%	Obs.	Corr.
Wt. Sample, Oven Dry		.15 10	0.14	.14	99.86	99.9
Wt. Ret. No. 4, Oven Dry		.18 20	0.22	.23	99.63	99.6
% Ret. No. 4 Sieve	0	.53 40	0.50	.52	99.11	99.1
% Finer No. 4 Sieve	100	.84 60	0.83	.86	98.25	98.3
		1.90 100	1.87	1.93	96.32	96.3
		10.10 200	10.34	10.66	85.66	85.7

HYDROMETER ANALYSIS

Wt. Dispersed Sample: Air Dry 100 Hydr. No. _____

Oven Dry 97.02 Jar No. _____

Hydr. Reading			Time (Min.)	Temp. °C	Grain Size (MM)	% Finer	
Calgon	Real	Corr.				Obs.	Corr.
			1				
			2				
			5				
			15				
			30				
			60				
			120				

USDA SCS-PORTLAND, OREG. 1965

8

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

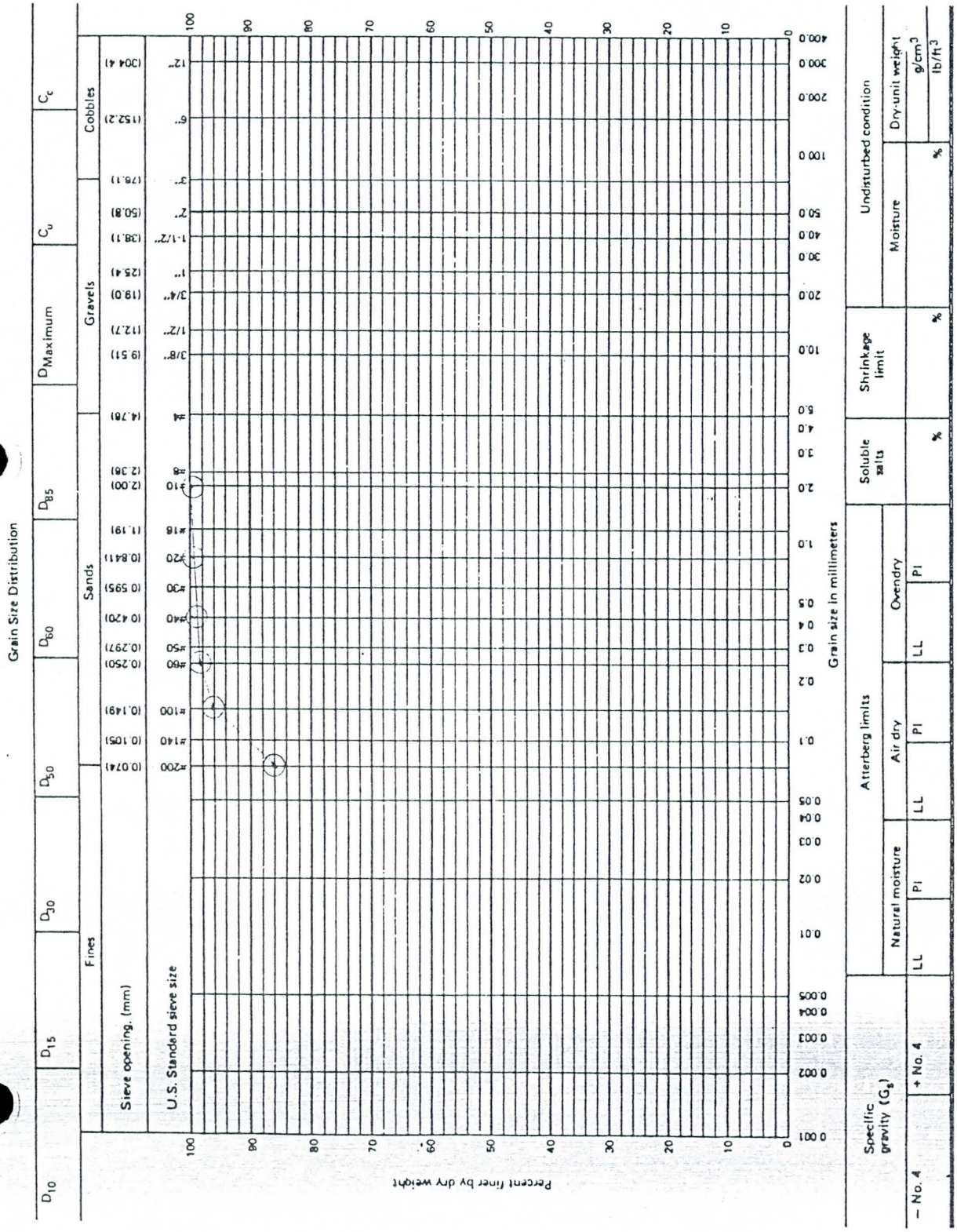
SCS-ENG-363
2-80

MATERIALS TESTING REPORT: SOIL CLASSIFICATION

and state: SPOOK HILL OUTLET
Sample location:
Laboratory No.: 2
Sample No.: 211
Depth: 0-2.5'
Geologic origin:
of sample:
Tested at: M.P.O.
Approved by: G. MASON
Date: 7-16-90
Symbol: ML
Description: SILT

(ABOUT 10-15% OF ORGANIC MATERIAL IN SAMPLE)

CRUMB TEST #1



SCS-ENG-361
REV. 2-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SAMPLE #2,1 0-2.5'

WORK SHEET FOR ATTERBERG LIMITS

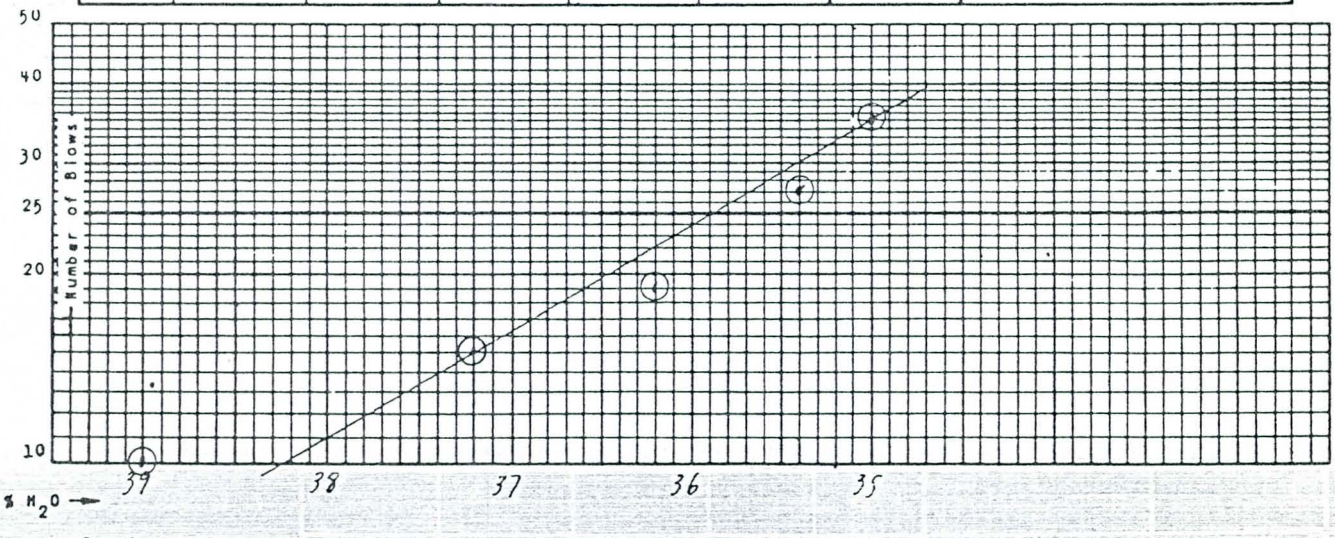
7-16-90

LIQUID LIMIT DATA

① Can No.	② Wet Wt.	③ Dry Wt.	④ H_2O Wt. ②-③	⑤ Empty Wt.	⑥ Dry Soil ③-⑤	⑦ % H_2O $\frac{100 \times ④}{⑥}$	⑧ No. Blows	Laboratory Sample Number
508	26.49	22.38	4.11	11.83	10.55	39.0	10	
509	29.99	25.03	4.96	11.69	13.34	37.2	15	L.L. = 35.9
510	28.78	24.17	4.61	11.45	12.72	36.2	19	P.L. = 26.0
513	29.16	24.62	4.54	11.78	12.84	35.4	27	P.I. = 10
506	29.20	24.62	4.58	11.52	13.10	35.0	35	
								L.L. =
								P.L. =
								P.I. =
								L.L. =
								P.L. =
								P.I. =
								L.L. =
								P.L. =
								P.I. =
								L.L. =
								P.L. =
								P.L. =
								L.L. =
								P.L. =
								P.I. =

PLASTIC LIMIT DATA

24	13.34	12.15	1.19	7.63	4.52	26.3	26.0
96	11.15	10.46	.69	7.77	2.69	25.7	



Completed by: _____ Recorded by: _____

Checked by: _____ Date: _____

59M-96

10

TSC-PO-ENG-9
12-74

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service

MTS No. 1

MECHANICAL ANALYSIS

Project SPOON HILL Dam Date 7-16-90

Sample No. 5.1 2-4.5 Operator G. MASON

Hole # 2485 60' left of ℄ Dike

M-6 -P-15-

SIEVE ANALYSIS 2

Coarse		Fine				
				% Finer		
Wt. Sample, Air Dry	15.46	Sieve	Wt.	%	Obs.	Corr.
Wt. Sample, Oven Dry		10	22.96	23.1	76.9	63.4
Wt. Ret. No. 4, Oven Dry		20	29.55	29.7	47.2	38.9
% Ret. No. 4 Sieve	17.5	40	19.95	20.0	27.2	22.4
% Finer No. 4 Sieve	82.5	60	10.20	10.2	17.0	14.0
		100	6.35	6.4	10.6	8.7
		200	4.62	4.6	6.0	5.0

HYDROMETER ANALYSIS

Wt. Dispersed Sample: Air Dry 100 Hydr. No.

Oven Dry 99.54 Jar No.

Hydr. Reading			Time (Min.)	Temp. °C	Grain Size (MM)	% Finer	
Calgon	Real	Corr.				Obs.	Corr.
			1				
			2				
			5				
			15				
			30				
			60				
			120				

USDA SCS PORTLAND, OREG. 1969

11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-ENG-363
2-80

MATERIALS TESTING REPORT: SOIL CLASSIFICATION

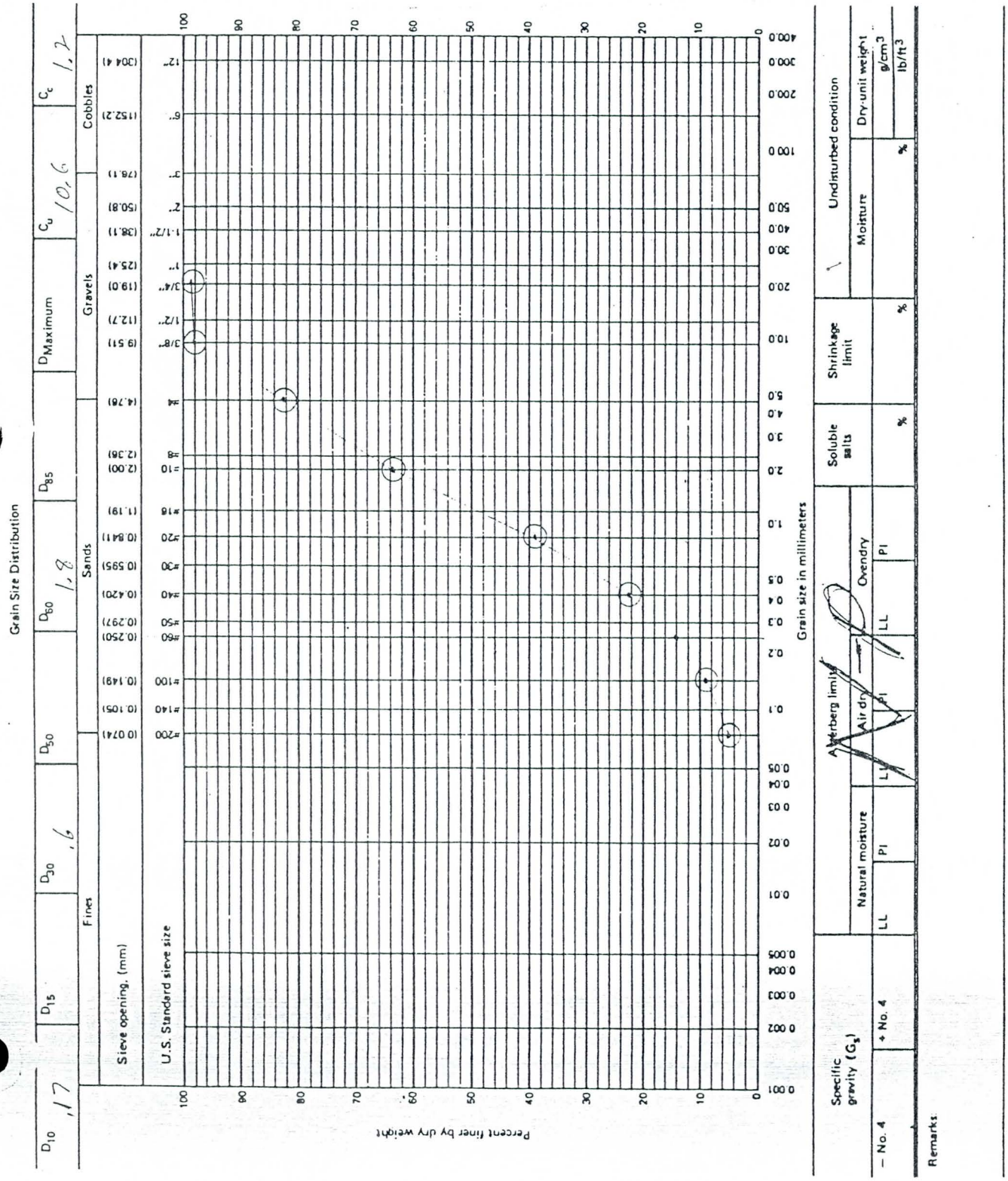
Project and state: SPOOK HILL OUTLET — Sample location: — Laboratory No.: 1

Sample No.: 5, P — Depth: 2-4.5' — Geologic origin:

Type of sample: BAG. — Tested at: M.P.O. — Approved by: G. MASON. — Date: 7-16-90

Symbol: SW — Description: WELL GRADED SAND

(ON BORDERLINE FOR DUAL CLASSIFICATION.) IN THAT CASE CALL IT A NON-PLASTIC



12

APPENDIX A

A.2

GEOLOGIC EVALUATION REPORT

Date: October 1992

GEOLOGIC EVALUATION REPORT
for
SPOOK HILL OUTLET CHANNEL

A geologic investigation was undertaken in order to evaluate geologic conditions along the proposed alignment of the outlet channel and a sediment basin. Four test pits were excavated upstream from Bush Highway and eight test pits were excavated downstream from the highway. Logs of the test pits are attached to this report.

FINDINGS

Weathered granite is either exposed at the surface or is present at shallow depths upstream from Bush Highway. For a distance of at least 150 feet downstream from Bush Highway weathered granite is present at a depth of no more than 13.5 feet. Immediately downstream from the bridge the granite is locally exposed at the surface. Proceeding downstream from the bridge the weathered granite is buried progressively deeper by fine to coarse, slightly silty gravelly sand (SP-SM) with a few cobbles. Excavation to a depth of 16 feet in the vicinity of station 7+50 failed to reach bedrock. Further downslope, toward the Salt River, soil materials become more varied and stratified. Sporadically presesnt as surficial material is clayey silt (ML-CL) or silt (ML) to depths up to about three feet. These materials represent recent deposits of the Salt River. Elsewhere, at the surface, and beneath the silts are fine to coarse, slightly silty to silty sands (SM-SP and SM) to depths of about four feet. Some lenticular deposits of clayey, sandy gravel (GC) are present in the silty sand stratum. Cobbles, with sand, gravel and silt, are present at depths of four feet or less in this portion of the channel and sediment basin. Moisture conditions encountered generally ranged from dry to moist, except at one location. In the vicinity of station 10+50 the silt filling the interstices between cobbles was wet.

CONCLUSIONS

Geologic conditions for the proposed works is generally favorable. Foundation conditions should not pose any major problems. Some difficulty may be experienced in excavating and maintaining neat lines due to the presence of cobbles and ravelling sands. There is a slight possibility that ripping may be required to execavate a small quantity of weathered granite in the vicinity of Bush Highway.

Aubrey C. Sanders Jr

Aubrey C. Sanders, Jr.
Geologist

U. RTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG TEST HOLES

SCS-521
REV. 3-67

WATERSHED BUCKHORN-MESA		SUB-WATERSHED	SITE NO. SPOOK HILL OUTLET
LOCATION MARICOPA CO.		OWNER	STATE AZ.
LOGGED BY A.C. SANDERS JR.	DATE 7/10/90	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT CASE 580 BACKHOE		LOCATION OF HOLES OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
2401	63' Left	0.0	1.0	SILT; CLAYEY, SANDY, SL. PLAS., DRY, TAN		ML-CL								
	STA. 23+00 ℄ DIKE	1.0	2.0	GRAVEL; V. SANDY, SILTY, CLAYEY, W/ APPROX. 10% COBBLES, DRY, TAN.		GC.	—							
		2.0	6.0	COBBLES; GRAVELLY, SANDY, TR. SILT, DRY. MAX. DIAM. 18", MEDIAN DIAM. EST. 5".		—								
2402	65' LEFT	0.0	2.5	SILT; SANDY, V. SL. PLAS., DRY, TAN		ML	-							
	STA. 21+00 ℄ DIKE	2.5	5.0	COBBLES; V. SANDY, GRAVELLY; SL. MOIST, TAN TO GRAY. MAX. DIAM. APPROX. 8", MEDIAN DIAM. APPROX. 3.5"		—								
		5.0	6.0	SAME AS ABOVE EXCEPT COBBLES TO 18" DIAM. W/ MEDIAN DIAM. APPROX. 6".										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

USDA-SCS-HYATTSVILLE, MD. 1968

U. [illegible]RTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG [illegible] TEST HOLES

SCS-531
REV. 3-57

WATERSHED: BUCKHORN - MESA	SUB-WATERSHED	SITE NO.: SPOOK HILL OUTLET
LOCATION: MARICOPA CO.	OWNER	STATE: AZ.
LOGGED BY: A.C. SANDERS JR. / DATE: 7/10/90	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT: CASE 580 BACKHOE	LOCATION OF HOLES: OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	RI C.[3] %
2403	63' LEFT	0.0	1.5	SAND; SL. SILTY, FINE TO COARSE, LOOSE, DRY		SM-SP	-							
	STA. 19+00	1.5	3.0	SILT; V. SANDY, V. SL. PLAS, TAN, DRY		ML								
	℄ DIKE	3.0	4.0	SAND; GRAVELLY, FINE TO COARSE, TR. SILT, SL. MOIST		SP-SM								
		4.0	6.0	COBBLES; GRAVELLY, SANDY. MAX. DIAM. 18" MEDIAN 6"		—								
2404	63' LEFT	0.0	3.0	SAND; SL. SILTY, FN-CRSE. GRN., LOOSE		SM-SP								
	STA. 17+00	3.0	5.0	SAND; SILTY, FN.-CRSE, MOIST, MED. DENSE		SM								
	℄ DIKE	5.0	7.0	COBBLES; GRAVELLY, W/ SOFT WET SILT IN INTERSTICES, WET.		—								
2405	60' LEFT 14+00 ℄ DIKE	0.0	16.0	SAND; FINE TO COARSE, GRAVELLY, SL. SILTY, LOOSE TO MED DENSE. MOIST AT 2'.		SP SM								

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

U. [illegible]TMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG [illegible] TEST HOLES

SCS-531
REV. 3-67

WATERSHED BUCKHORN-MESA		SUB-WATERSHED	SITE NO. SPOOK HILL OUTLE
LOCATION MARICOPA CO.		OWNER	STATE AZ.
LOGGED BY A.C. SANDERS JR.	DATE 7/10/90	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT CASE 580 BACKHOE		LOCATION OF HOLES OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
2406	45' LEFT	0.0	13.5	SAND; FN.-CRSE., GRAVELLY, SL. SILTY, W/OCC.		SP-SM								
	12+00			COBBLE, MED. DENSE, MOIST @ 2'.										
	℄ DIKE													
2407	55' LEFT	0.0	4.5	SAND; FN-CRSE, SL. SILTY, DRY, MED. DNSE.		SP-SM								
	11+00	4.5	13.5	SAND; FN-CRSE, CLAYEY, SILTY, W/OCC. COBBLE,		SC-SM								
	℄ DIKE			MOIST, REDDISH-BROWN.										
		13.5		GRANITE; WEATHERED, FRACTURED		—								
2408	42' D/S	0.0	4.5	SAND; FN-CRSE., GRAVELLY, SL. SILTY		SP-SM	-							
4442	FROM CENTER	4.5	7.3	SAND; FN-CRSE., GRAVELLY, W/OCC COBBLE		SP-SM	-							
	PIER OF	7.3		GRANITE; WEATHERED, FRACTURED										
	BRIDGE (LEFT													
	SIDE OF													
	CHANNEL)													

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

USDA-SCS-NV-ATTERSVILLE, MD 1968

U. [illegible]RTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG TEST HOLES

SCS-5[illegible]
REV. 3 57

WATERSHED BUCKHORN-MESA		SUB-WATERSHED	SITE NO. SPOOK HILL CYCLE
LOCATION MARICOPA CO		OWNER	STATE AZ.
LOGGED BY ACS	DATE 7/10/9	PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT CASE 580 BACKHOE		LOCATION OF HOLES OUTLET CHANNEL	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	R.C.[3] %
2409	POINT 44+10'	0.0	4.0	SAND; GRAVELLY, SL. SILTY, LOOSE, DRY, W/SOME COBBLES		SP-SM	-							
		4.0		GRANITE, WEATHERED, FRACTURED		—								
2410	PT. 44 -39 ft ~~RT~~ ℄	0.0	4.0	SAND; SILTY, GRAVELLY, DRY, TAN, LOOSE		SP-SM	-							
		4.0	9.5	SAND; CLAYEY, SILTY, FN-CRSE, GRAVELLY, REDDISH BROWN.		SC	-							
		9.5		GRANITE; MOD. WEA., FRACTURED										
2411	PT. 44 +25 FT 42 RT ℄	0.0	2.0	SAND; SILTY, FN-MED. GRN., DRY		SM								
		2.0	2.5	GRANITE, WEATHERED, FRACTURED		—								
2412	PT. 44 +42 FT. 30' RT ℄L	0.0	3.0	SAND, SILTY, FN-MED. GRN., GRAVELLY, DRY		SM								
		3.0		GRANITE; WEATHERED, FRACTURED		-								

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

USDA-SCS-NYATTSVILLE, MD 1963

Addendum

Preliminary Geologic Investigation

Site No. 4 (Spook Hill)

Buckhorn-Mesa Watershed

Arizona

Outlet: The principal spillway discharge of Floodwater Retarding Structure Site No. 4 will outlet into a channel to be cut into Precambrian granite with smaller intrusions of Laramide granite. The outlet channel will empty into a natural channel also in the granite outcrop. While ~~much~~ some of the granite along the proposed outlet channel is decomposed, there are zones of hard rock sufficiently closely spaced to prevent serious degradation. The natural channel contains thin bedload deposits which are underlain by granite sufficiently durable to withstand the 100-year flow with only minor plucking. Also, the natural channel passes through a concrete box culvert under Bush Highway before spreading over the Salt River alluvium just above Granite Reef Dam.

The estimated average annual yield of bedload size material to the outlet channel is ~~0.2~~ 0.1 acre-feet.

Use of the Schoklitsch Bedload Equation indicates that the bedload will not be transported efficiently by the outlet channel. Thus, these materials should be removed periodically to insure proper functioning of the channel. The estimated average cost of removal is $200 to $300 per year.

Bedload transport analysis for the natural channel indicates that discharge from the Spook Hill FRS with the 10-year storm has the capacity to transport the available bedload to the Salt River. There are only about 1.5 acre-feet of loose bedload available, however. There is a thin horizon of compact cobbles, boulders, sand, and silt which is generally present between the loose bedload and the granite upstream from the Salt River flood plain. Analysis indicates that both the 10-year and 100-year discharges have capacities to transport these coarse materials along the reach upstream from a point about 500 ft. northeast Bush Highway but will deposit the materials downstream from ~~Bush Highway.~~ this point.

Geologic Investigation Addendum

Salt River flood plain deposits are primarily very fine-grained, silty sand. These soils are highly erodible, but flows on the nearly level flood plain will spread widely through dense growth of mesquite trees and cattails. Major erosion problems are not anticipated if the soils and vegetation are left undisturbed. It is recommended that (1) either the culverts under Bush Highway ~~either~~ be protected from undercutting at the time that the FRS is constructed or (2) the channel condition near the culverts be watched closely and the protection be provided if warranted.

Charles D. Clarke

Charles D. Clarke
Geologist

7/15/75

Addendum

Report of Geologic Investigation

B-1-Channel Stability
B-2

BUCKHORN-MESA WATERSHED

SPOOK HILL DAMSITE

Natural Stream Downstream from Outlet Channel

The outlet channel will empty into a natural channel in the SE¼, Sec. 19, T. 2 N., R. 7 E. The natural channel courses northwestward across the NW¼ of Sec. 19, crosses the corner of Sec. 18 where it flows through a culvert on Bush Highway and spreads onto the Salt River flood plain in Sec. 13, T. 2 N., R. 6 E. The stream is an ephemeral sand bed wash which, except for the Salt River flood plain, is located on a granite outcrop.

Ten hand borings and examination of exposed rock were made between the end of the outlet channel and a marsh near the Salt River.

The natural channel contains thin bedload material deposits underlain by granite which is fractured but sufficiently durable to withstand the 100-year flow with only minor plucking. The granite is abundantly exposed on channel banks and, in places, protrudes above the bed material load.

Use of the Schoklitsch bedload transport equation indicates that the bedload will not be transported efficiently from the outlet channel to the natural wash. The estimated average annual deposition of bedload in the outlet channel is 0.1 acre-feet.

Bedload transport analysis for the natural channel indicates that the 10-year discharge from the floodwater retarding structure will transport essentially all available bedload to the marsh area on the Salt River flood plain. There are only about 1.5 acre-feet of loose bedload presently in the channel upstream from Bush Highway, and there is a thin horizon of compact cobbles, boulders, sand, and silt generally present between the loose bedload and the granite. Analysis indicates that these latter materials would be moved through the culvert by the 10-year discharge but would be deposited on an existing fan between Bush Highway and the marsh.

Salt River flood plain alluvium consists mainly of deep, fine grained, silty sand. These soils are highly erodible, but due to the shallow nature of flows and the dense vegetation, major erosion problems are not anticipated, assuming soils and vegetation are left undisturbed.

The culvert at Bush Highway is located where the granite dissappears beneath alluvial deposits. The culvert should be inspected after flows for possible undercutting and protected if warranted.

12/6/76
CRC

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF HOLES

SCS-533
REV. 3-67

WATERSHED: Buckhorn-Mesa
SUB-WATERSHED:
SITE NO.: Spook Hill
LOCATION:
OWNER: Forest Service (Tonto NF)
STATE: Arizona
LOGGED BY: C. Don Clarke
DATE: 7/3/75
PROJECT: WP-07 ____ WP-08 X ____ FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Hand
LOCATION OF HOLES: Outlet (Natural Wash)

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
401	50' u.s. fr. culvert ℄ channel (263+20)	0.0	0.5	Sand, cse, grn. sl/G., W., lse., granitic, bedload, tan-gray		SW		401.1		0.0	0.5	10	3"	
		0.5	1.0	Sand, M, cse. grn., sl/G. & cbl., dns., sl./ind., lt. brown.		SM		401.2		0.5	1.0	10	3"	
402	2000' u.s. fr. culvert ℄ channel (244+00)	0.0	0.4	Sand, cse. grn., sl/G. W., lse., granitic, bedload, tan-gray		SW		402.1		0.0	0.4			
		0.4	1.5	Sand, cse. grn., sl/G., W., mod. dns., bedload, gray		SW		402.2		0.4	1.5			
		1.5	2.0	Gravel, S., cse. grn., sl/cbl., lse., tan-gray		GP		402.3		1.5	2.0			
403	3000' u.s. fr. culvert ℄ channel (234+00)	0.0	0.4	Sand, cse. grn., lse., bedload, tan-gray (Like Sample #402.1)		SW								
		0.4	0.8	Sand, cse. grn., mod. dns., bedload, gray (Like Sample #402.2)		SW								
		0.8	1.0	Sand, sl/C., M., G., sl/cbl., med., wea. granite, red		SM		403.1		0.8	1.0			
		1.0	+	Granite, Hd. 5, frac., gray										
				Note: At point of discharge into natural wash, rock at surface is moderately fractured, gray granite (Hd. 5). Should withstand flows with only minor plucking. Ch. width - 7'										

1. DISTURBED-UNDISTURBED-ROCK CORE
2. COARSE MATERIAL REMOVED
3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 3 SHEETS

USDA-SCS-HYATTSVILLE, MD. 1968

SCS-ENG-533
REV. 7-77

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF HOLES

WATERSHED	Buckhorn-Mesa	SUB-WATERSHED	SITE NO. Spook Hill
LOCATION		OWNER	STATE AZ
LOGGED BY Charles D. Clarke	DATE 7/10/75	PROJECT: WP-07 ____ WP-08 X FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT Hand Auger		LOCATION OF HOLES Outlet (Natural Wash)	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	TYPE[1]	FROM FT.	TO FT.	CSE. %	REM.[2] MIN. DIAM.	REC.[3] %
404	266+00	0.0	0.3	Like 401.1										
	℄ Wash	0.3	1.0	Like 401.2										
	(150' DS fr. culvert	1.0	1.5	Sand, cbl., bld., M. mixture (like 402.3) unable to penetrate										
3010	269+00			Like 402.3 (unable to penetrate) max. size 2'										
405	271+00	0.0	0.8	Sand, G., M., sl./cbl. (like 402.3)										
	℄ Wash	0.8	+	Like 402.3 (unable to penetrate)										
406	271+50	0.0	0.2	Silt, v./Fn. S., lse, gray-brown		ML								
	℄ Wash	0.2	1.2	Sand, G., M., W., lse-mod. dns., gray		SW-SM								
		1.2	4.8	Sand, v/Fn. Grn., v/M, lse-med., thin lenses gravelly SM, reddish tan (cbl. horizon @ 4.8-unable to penetrate)		SM		406.1		1.2	4.8			
407	273+00	0.0	0.5	Sand, v/Fn. Grn., v/M, lse., reddish tan (like 406.1)		SM								
		0.5	2.8	Sand, v/Fn. Grn., sl./M, lse, tan		SP								
		2.8	4.0	Sand, v/Fn. Grn., v/M, lse-med., sl./moist, reddish tan		SM		407.1	D	3.0	4.0			
				(Unable to penetrate, root at 4.0)										
408	273+75	0.0	3.0	Sand, Fn. Grn., sl./M-M, lse., tan		SM		408.1	D	0.0	3.0			
	5' fr	3.0	4.5	Silt, v/Fn. S., Med., moist mottled, rust-tannish gray		ML		408.2	D	3.0	4.5			
	edge marsh	4.5	6.0	Sand, v/M, sl./C, thin C lenses, wt @ 6.0, dk gray		SM		408.3	D	4.5	6.0			

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

FILE CODE ENG-22

LABORATORY NO.

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

SAMPLE LOCATION: 50' u.s. fr Bush Hwy, Outlet (Natural Wash)

FIELD SAMPLE NO.: 401.1

DEPTH: 0.0 - 0.5

GEOLOGIC ORIGIN:

TYPE OF SAMPLE: D

TESTED AT: Phoenix

APPROVED BY: [illegible]

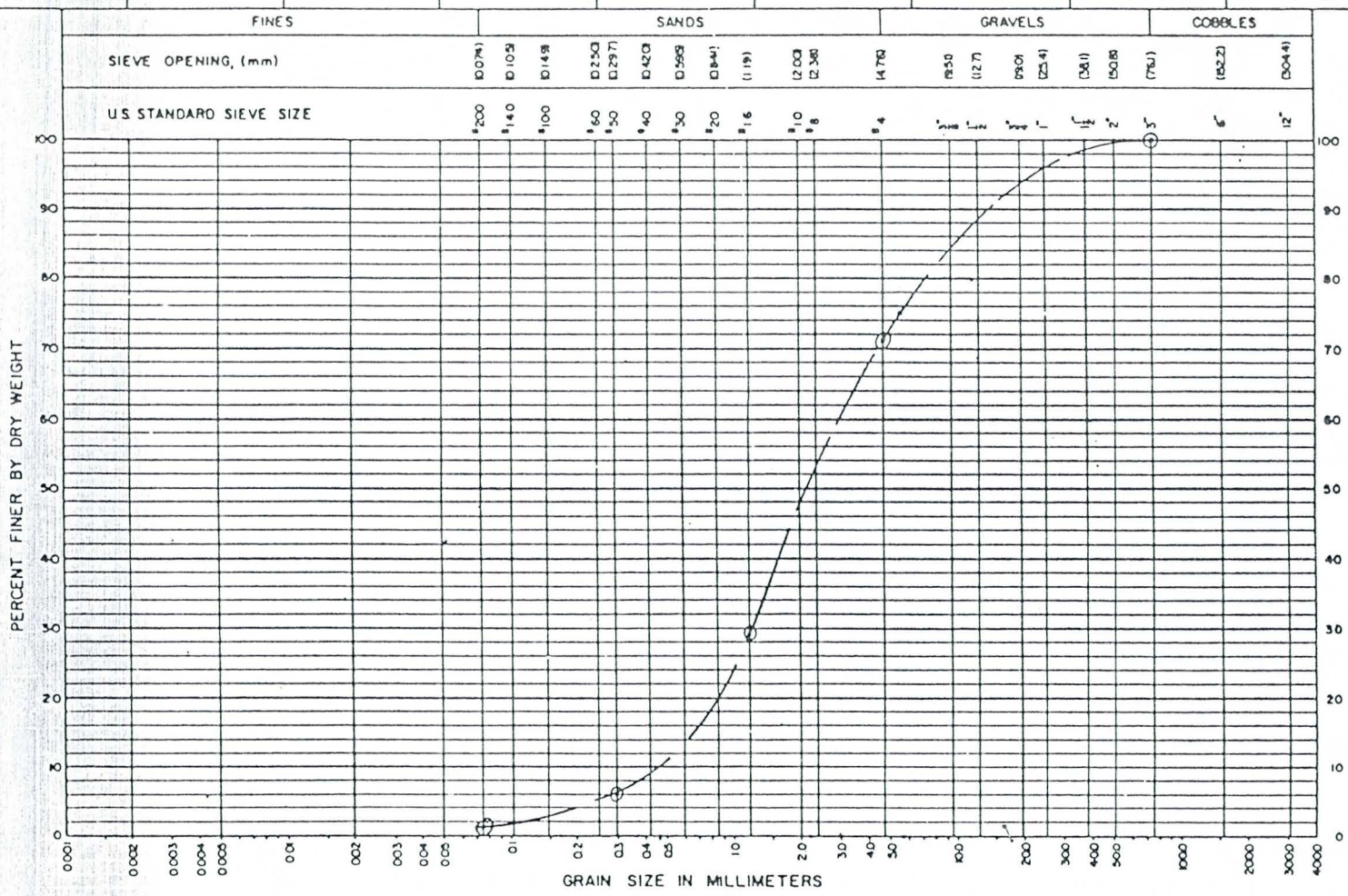
DATE: 7/8/75

SYMBOL: SW

DESCRIPTION: Loose, gravelly, granitic sand (bedload)

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
.47		1.5	2.2 mm	3.0 mm			6.38	1.6



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS:

D_{75} = 5.8 mm

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. _____

PROJECT and STATE Buckhorn-Mesa, Spook Hill Site

SAMPLE LOCATION 50' u.s. fr. Bush Hwy culvert; E Channel (nat. wash)

FIELD SAMPLE NO. 401.2

DEPTH 0.5-1.0

GEOLOGIC ORIGIN

TYPE OF SAMPLE D

TESTED AT Phoenix

APPROVED BY ccc

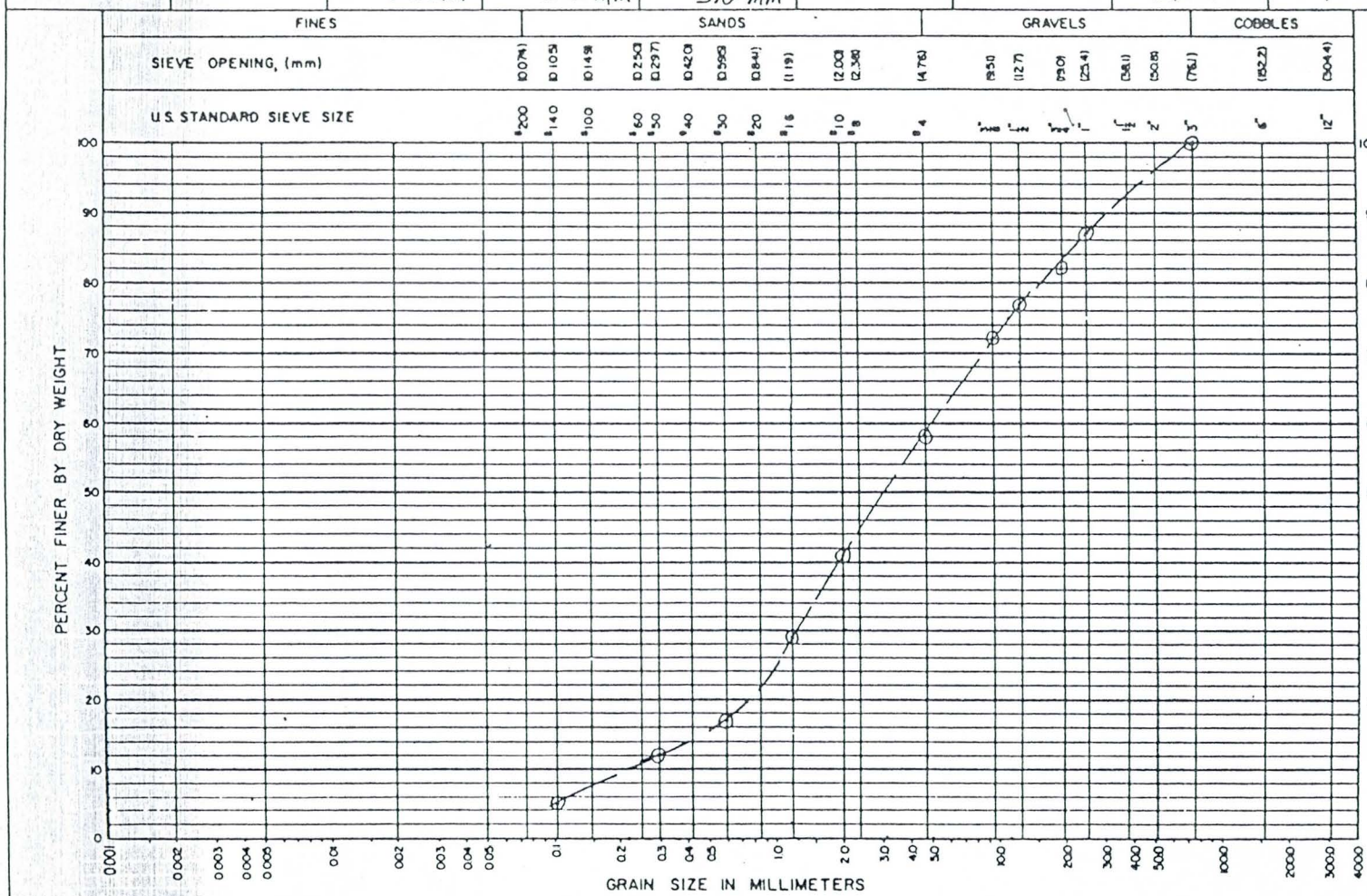
DATE 7/9/25

SYMBOL SW-SM

DESCRIPTION Loose, gravelly, slightly silty, dense sand (old bedload)

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
.22 mm		1.3 mm	3.2 mm	5.0 mm			22.7	1.54



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS: D_{75} = 12 mm

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 158

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

FIELD SAMPLE NO.: 402.1

DEPTH: 0.0-0.4

GEOLOGIC ORIGIN:

SAMPLE LOCATION: 2000' u.s. fr. Bush Hwy. culvert; ¢ Channel (nat. wash)

TYPE OF SAMPLE: D

TESTED AT: Phoenix

APPROVED BY: CDC

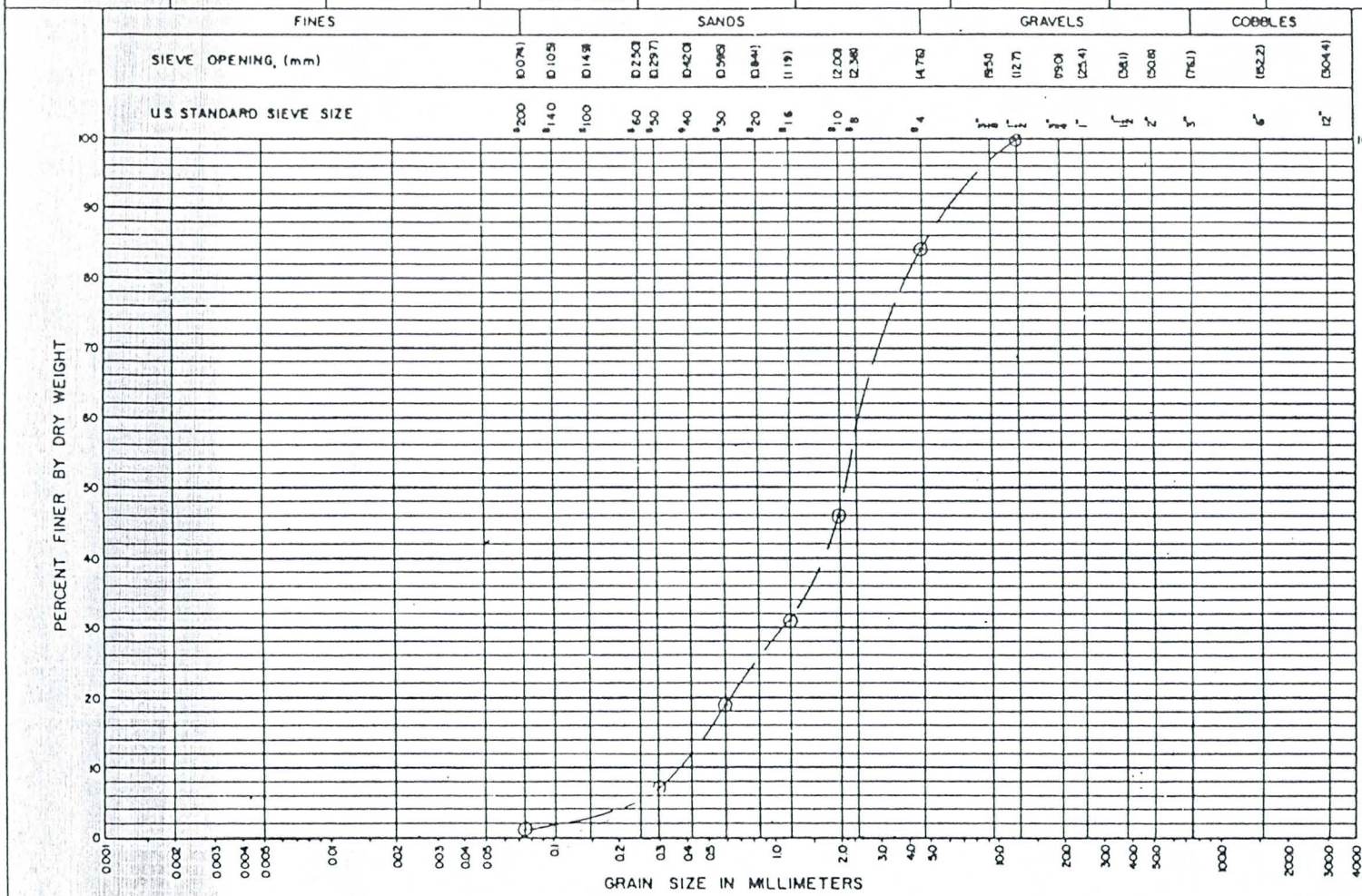
DATE: 7/9/75

SYMBOL: SW

DESCRIPTION: Loose, gravelly, granitic sand (bedload)

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
0.37 mm		1.2 mm	2.2 mm	2.5 mm.			6.75	1.56



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS: D_{75} = 3.4 mm

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. _____

PROJECT and STATE Buckhorn-Mesa, Spook Hill Site

SAMPLE LOCATION 2000' u.s. fr. Bush Hwy. culvert; E. channel

FIELD SAMPLE NO. 4D2.2

DEPTH 0.4-1.5

GEOLOGIC ORIGIN

TYPE OF SAMPLE D

TESTED AT Phoenix

APPROVED BY CDC

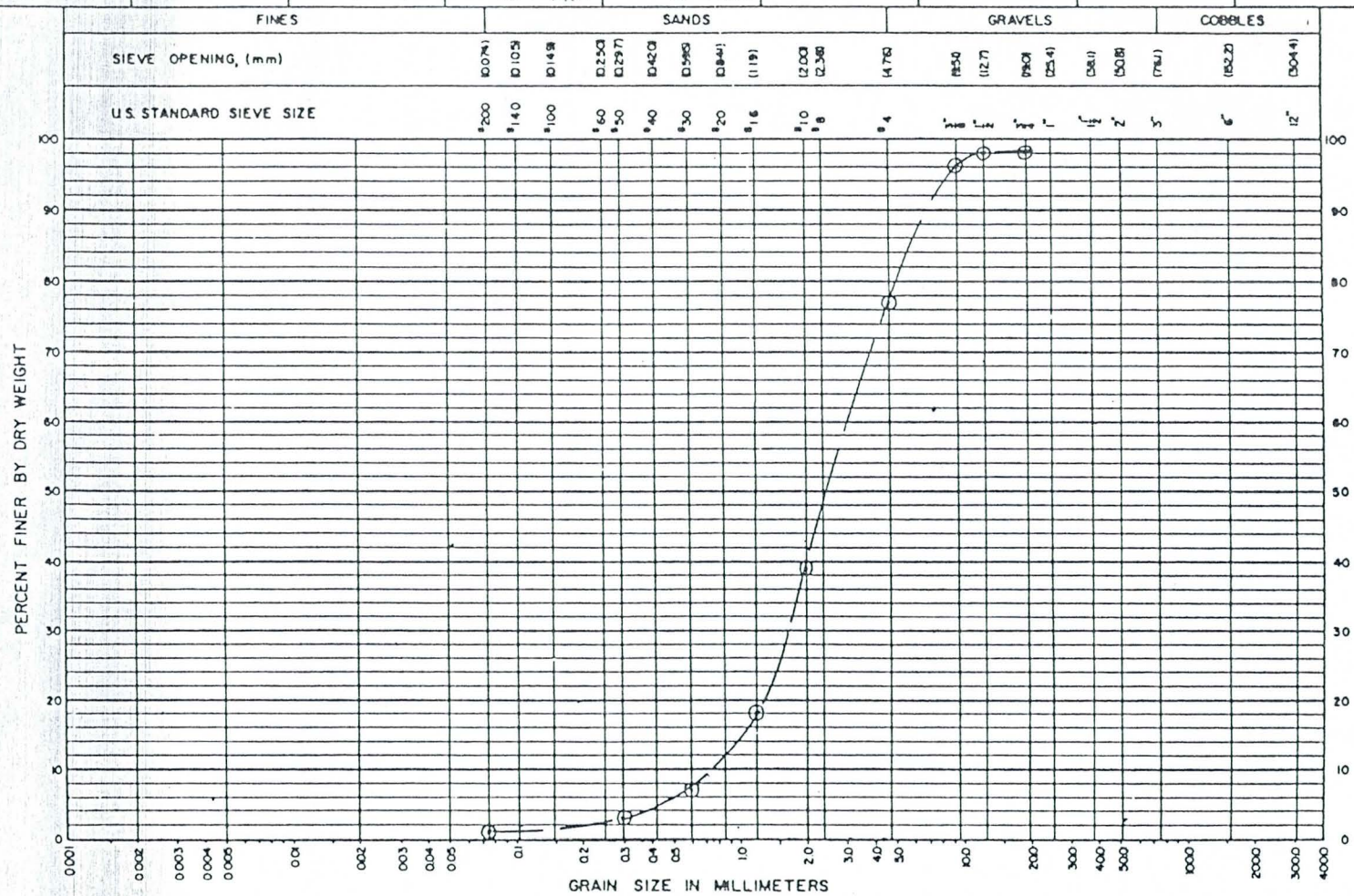
DATE 7/9/75

SYMBOL

DESCRIPTION Loose, gravelly, moderately dense granitic sand (Bedload)

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
.75 mm		1.7 mm	2.7 mm	3.1 mm				



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS:

D_{75} = 4.4 mm.

SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. ____

PROJECT and STATE: Buckhorn-Mesa, Spook Hill Site

FIELD SAMPLE NO.: 402.3

DEPTH: 1.5-2.0

SAMPLE LOCATION: 2000' U.S. fr. Bush Hwy. culvert; E Channel (nat. wash)

TYPE OF SAMPLE: D

TESTED AT: Phx.

GEOLOGIC ORIGIN:

APPROVED BY: CDC

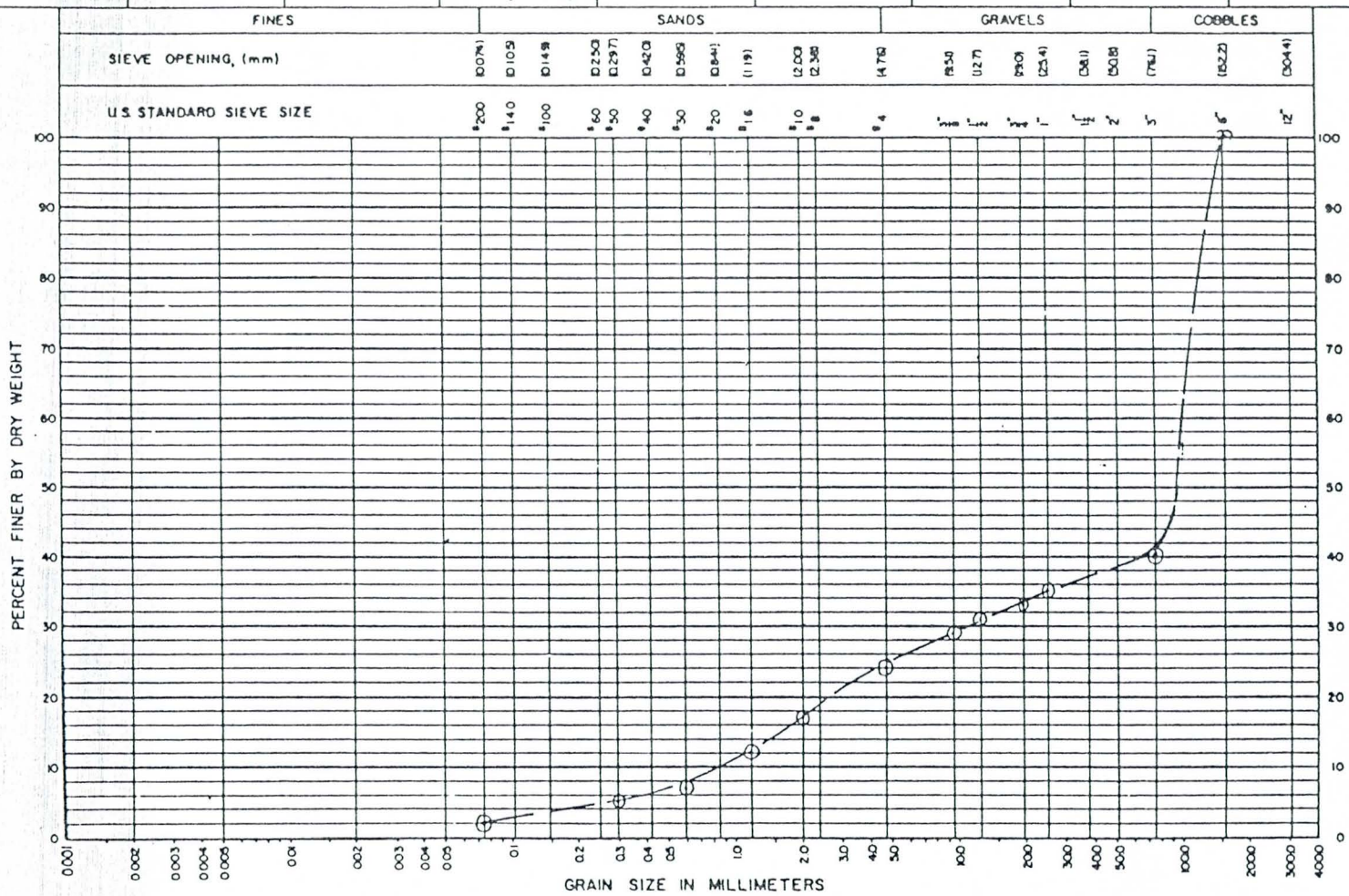
DATE: 7/11/75

SYMBOL: GP

DESCRIPTION:

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50} (3.5 in) 90 mm	D_{60}	D_{85}	D_{MAX}	C_u	C_c



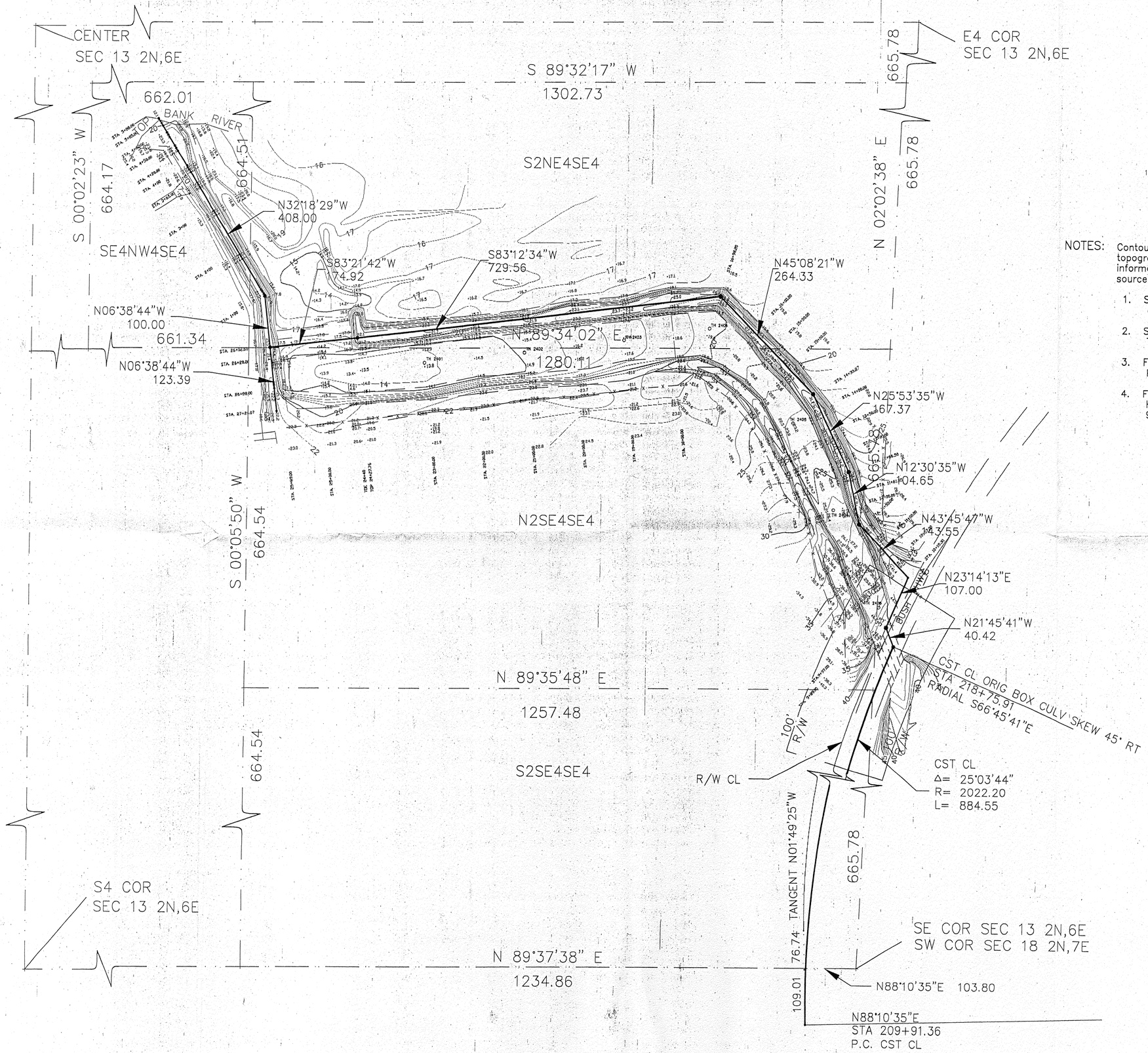
SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS:

APPENDIX A

A.3

TOPOGRAPHIC SURVEY MAP and SCS FIELD SURVEY INFORMATION



NOTES: Contour lines represent the approximate topography at the site. Topographic survey information was taken from the following sources:

1. SCS survey by D. Clough dating from Feb–May 1990
2. SCS Spookhill Outlet – River Outlet Topography by Tom Jayo 6/90
3. FCDMC Land Managemet Division Ken Green
4. FCDMC – Construction Plans for Bush Highway Box Culvert FCD Project No. 91–22

		DATE	
Designed	B. Katibiou, FCDMC	10/92	Approved State Conservation Engineer
Drawn	S. Webster, FCDMC	10/92	Title
Checked			Title
Checked	SCS		

TOPOGRAPHIC SURVEY

SPOOKHILL OUTLET CHANNEL AND SEDIMENT BASIN

MARICOPA COUNTY, ARIZONA

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE

CAD FILE NO. SHOUT02.dwg

DRAWING NO. AZ 93001 CH

SHEET NO. 2 OF 11

SPOOKHILL SEDIMENT BASIN

1

INDEX

TRAVERSE from Spookhill Fox to Spookhill Sediment Basin pp. 5-8

Sediment Basin Dike LAYOUT p. 10

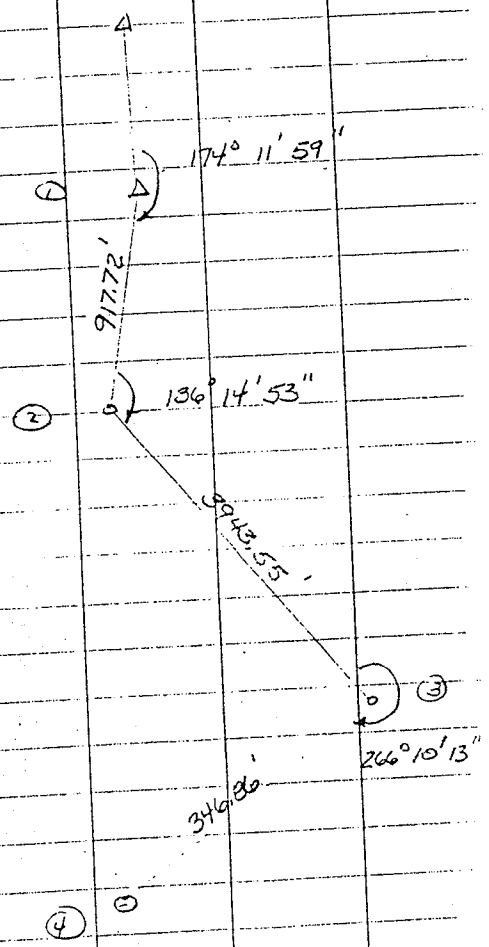
Sediment Basin x-Sections pp. 12-31

x-Sections upstream of Bush Highway Bridge pp. 32-

TRAVERSE of BM's

SPOOKHILL OUTLET

Circled numbers are filed on data tape: "Desm" File: "BM"



D. Clough
A. Rutledge
G. Mason

Feb 1990

Clear, calm, 55°

Rebar in Conc @ sta 205+00, 75' Lt Fwy ℄

Rebar in Conc @ sta 208+20, 75' Lt Fwy ℄

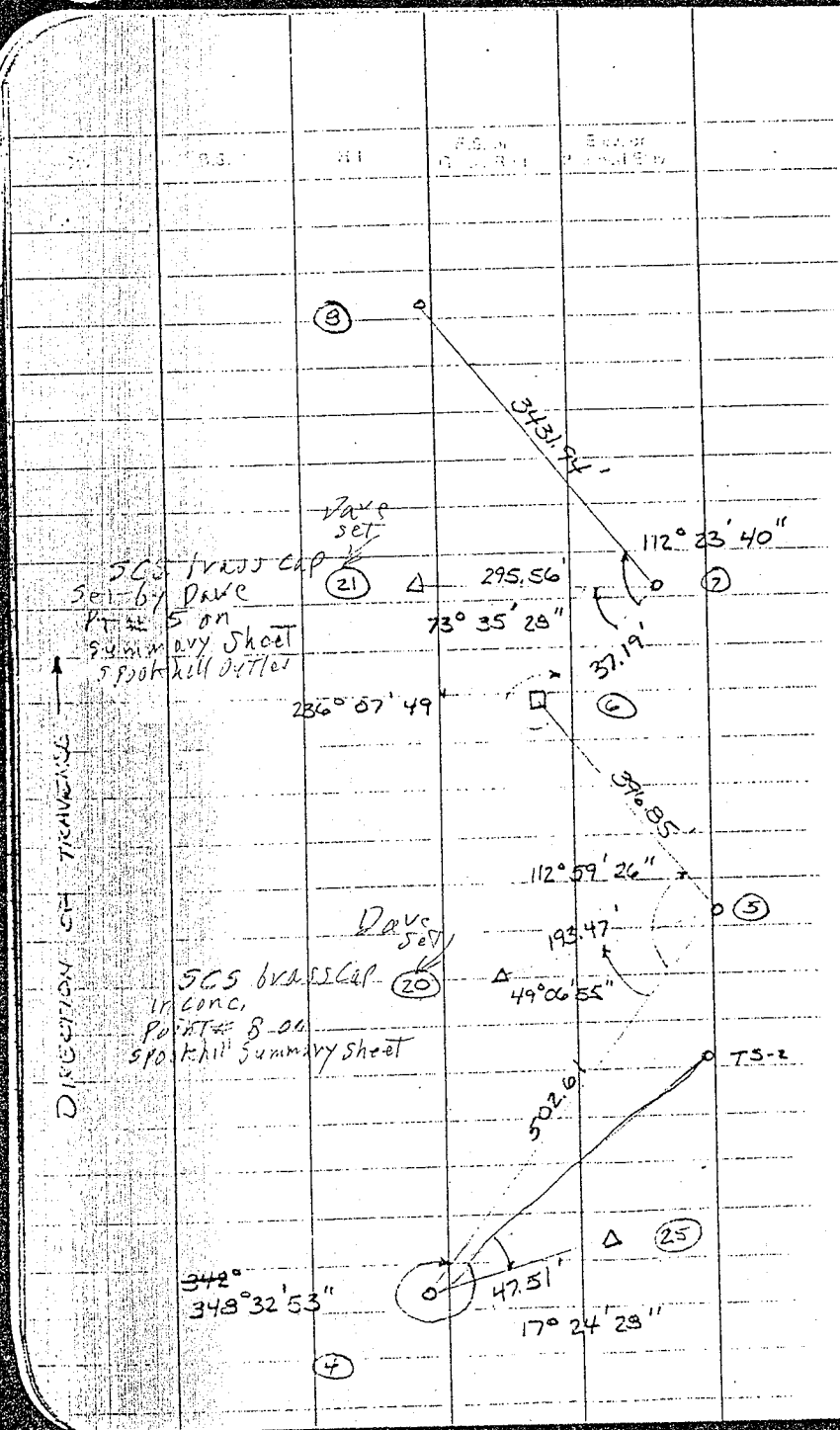
Spindle in ground, TS-1

Hub & Tick, TS-2

Aluminum Cap on Rebar, Aerial MARKER

Reads: WPR
80017
SRWW
1987

2/90



TS-4 Spindle in ground = TS-1

Alum Cap on Robary Aerial Marker, Roads.
{ WPP 80018
SRWW
1987 }

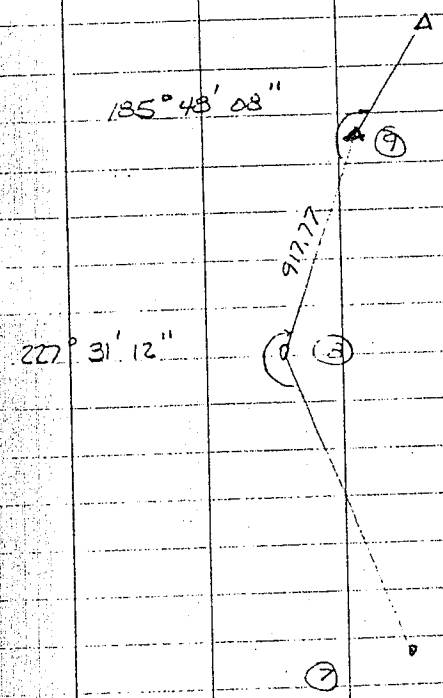
Sec Corner T 2N R6E R7E
{ S13 S18
S24 S19 }

TS-3 H&T

H&T (Backsight)

Brass cap ADOT Top of bridge

DIRECTION OF TRAVERSE



Rebar in Conc @ sta 205+00, 75' Lt Fwy ℄

Rebar in Conc @ sta 208+20, 75' Lt Fwy ℄
(Closing station)

TS-4 Spindle in ground, (TS-1)

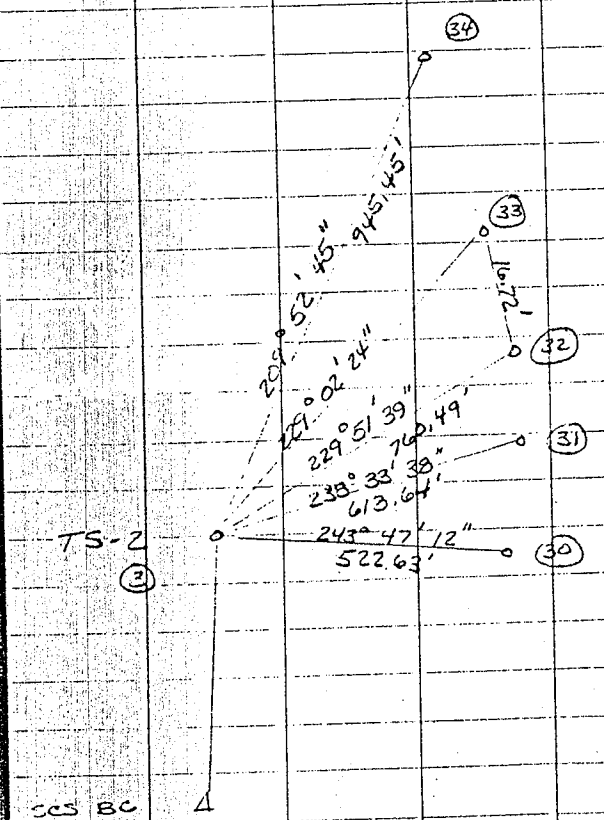
Alum. Cap WPP 8008 SRWW 1997
BACKSIGHT

Radial Traverse of
Cr's @ Spoon Hill Sediment Basin

D. Clough
B. Covey

Feb 1990

9



(34) Alum Cap on rebar, aerial marker, reads: WP 8000.9, SRWW, 1987. Top of Dike

(33) Rebar in conc, SCS const. BM, Station unknown

(32) Rebar in conc, SCS const. BM, Station unknown
Witness post reads: 14+?? elev = 1321.73

(31) Rebar in conc, SCS const. BM, Station unknown

(30) Rebar in conc, SCS const. BM, 11+61.95
Post reads: elev = 1329.49

LAYOUT OF DIKE B
SPOONHILL SEDIMENT BASIN

D. Clough III ⊼
B. Covey δ π
G. Mason π

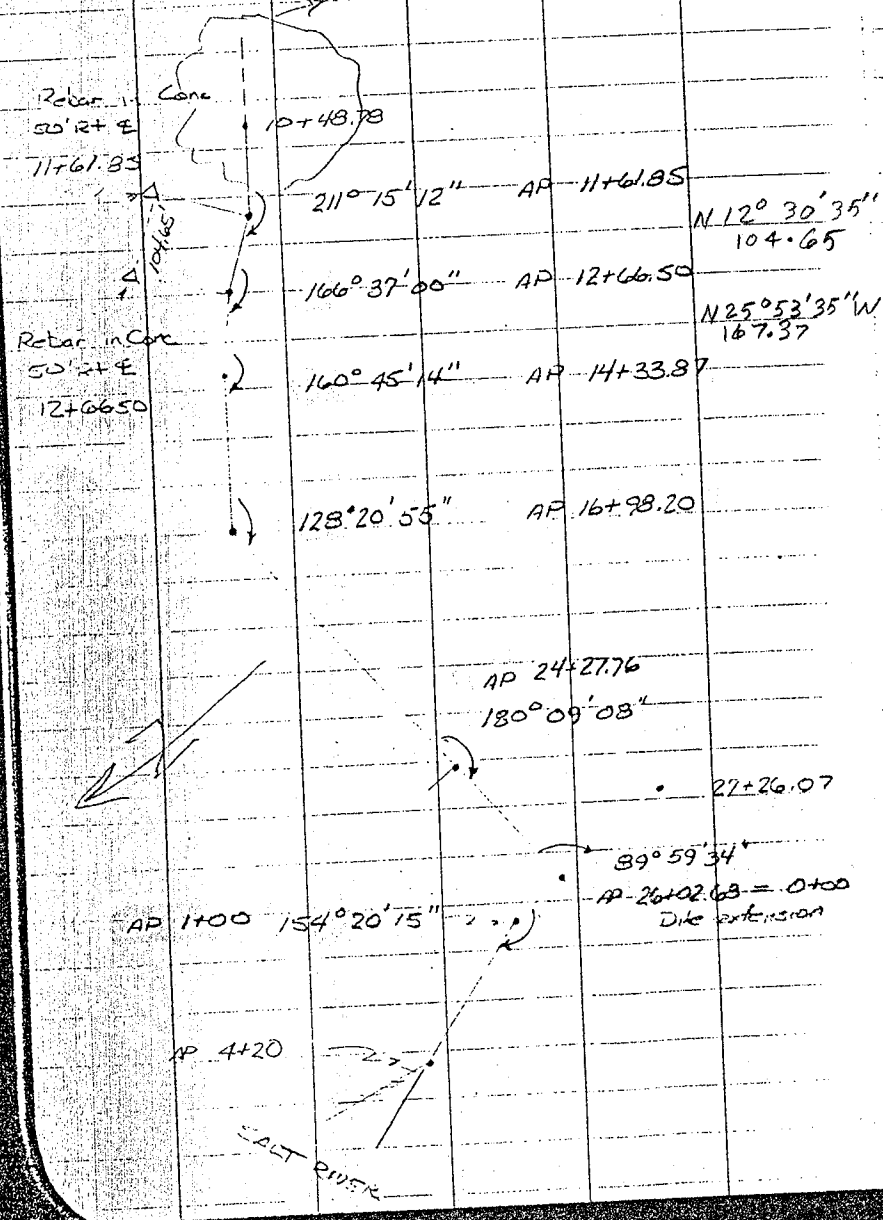
APRIL 17, 1990
clear, calm, 45°

10

additional sketch on Page 27

STATIONS & ANGLE TAKEN FROM
Survey notes on Sediment Basin Layout
done 3/77 by SCS

Control for x-sections
is ℄ Right Dike



SPOOK HILL SEDIMENT BASIN

X- Sections

Sta.	F.S.	H.I.	F.S. or Grade Elev.	Elev. or Proposed Elev.	
11+61.85 A-BAR 10 COL SITE.	13.22	1342.72	~~12.22~~	1329.50	elev. of ck 2.01'
11+00					
11+50					

G. MASON ☑ T
S. Carey ☑
D. Clough ☑

APRIL 19, 1990

Clear, breezy, 80°

A ℄ L

29.2 31.2 33.2 34.2 38.2 39.2 39.2 29.2 28.2 27.2 27.2 28.5 29.2 28.5

80 44 19 16 7 0 6 23 47 50 57 57 66 77

13.5 10.8 8.8 8.2 4.2 5.6 7.5 13.6 14.2 15.7 15.3 14.2 13.7 15.2

34.2 37.2 37.2 36.2 36.2 30.2 28.2 27.2 27.2

117 120 117 108 95 91 84 57 75

8.4 4.8 5.7 6.4 6.2 12.4 14.0 14.8 15.2

34.2 34.2 34.2

F

200 176 145

8.2 7.9 7.3

28.2 28.2 29.2 36.2 38.2

F

100 57 34 16 3

14.3 14.0 13.5 5.9 4.5

27.2 27.2 26.2 26.5

11 35 79 48

15.0 15.5 16.1 16.2

36.2 36.2 35.2 35.2 36.2 36.2 26.2 27.5

103 93 91 80 78 73 60 51

6.0 6.1 7.0 7.1 6.5 6.5 15.8 15.2

34.2 32.9 33.2 33.2

F

130 140 125 110

9.4 9.8 9.5 9.5

Cked - TSB 5/90

9+77		1349,87				

44 5	41 3
5 4	8 6
4	80

N. EDGE ROAD.

45 2	46 2	42 0	31 6	31 8
4 7	3 7	7 9	18 3	18 1
10	51	57	73	110

32 9	36 1	38 2	39 1	40 2
7 0	13 8	11 7	10 8	9 7
113	130	147	174	206

Ctied 5/10/259

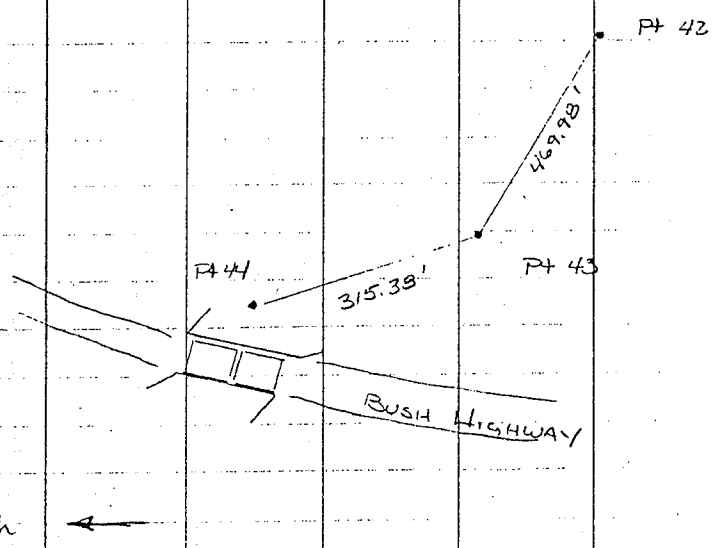
9+89		1349.57			
T.B.M.			3.50	1346.37	32. HWY A.C. ON S. SIDE OF BRIDGE AT PUSH AND SEDIMENT BASIN.

45^{3}	46^{5}	43^{5}	44^{5}	41^{8}
4^{6}	7^{4}	6^{4}	5^{4}	8^{1}
56	53	40	42	62
		Edge of Road		Road Edge
			44^{4}	
			5^{5}	
			67	

39^{7}	38^{7}	34^{2}	34^{0}	31^{7}
10^{2}	11^{2}	15^{7}	15^{9}	18^{2}
67	75	75	93	98
				BOTTOM GALIT

31^{7}	33^{3}	36^{2}	38^{3}	40^{3}
9^{2}	16^{6}	13^{7}	11^{6}	9^{6}
109	114	137	186	198
			R-A	

CKed 5/17/89


Pt 42
469.98'
Pt 44
315.38'
Pt 43
BUSH HIGHWAY
North

D. Clough ⊼ ⊡
L. Moltor ⊘ ⊼
B. Covey ⊘

June 5, 1990

Clear, calm, 105°

TBM	10.33	1353.47		1342.59	
Pt 14					
-50'					
TP	17.24	1356.84	13.97	1339.60	
~~TP~~ -100 PT					

Aluminum cap [illegible] monument, WP 80017

42.6	38.9	37.1	37.4	37.9	39.2	40.9	41.7
10.9	14.6	16.4	16.1	15.6	14.3	12.6	11.8
20	19	9	℄	6	11	19	27
Walkway							USFS Fence

48.6	48.1	48.6	42.3	44.6	48.0
4.9	5.4	4.9	11.2	8.9	5.5
45	36	31	45	62	75
E. edge of Back Hwy.					

41.4	41.2	39.7	38.7	39.1	37.9	41.4	46.3	45.9	44.5
12.1	12.3	13.8	14.8	14.4	15.6	12.1	7.2	7.6	8.0
13	19	17	10	℄	14	18	34	47	74

50.6	49.9	50.7	43.0	49.8
2.9	3.6	2.8	10.5	3.7
51	45	42	83	19

Spindle ⊘ ℄

5/5/90

		1356.84				43.5	42.7	41.5	40.4	39.6	39.3	42.7	44.2	49.0		
-100						13.3 ~~13.5~~	14.1	15.3	16.4	17.2	17.5	14.1	12.6	7.8		
						33	21	17	3	℄	10	17	24	32		
						52.5	51.7	52.4	51.8	45.6	50.1	47.0	46.9	45.7	49.9	
						13	5.1	4.2	5.0	11.2	6.7	9.8	9.9	11.1	6.9	
						64	~~67~~ 57	56	51	39	53	92	106	108	125	
TBM			16.56	1340.28		℄ SPINDLE										
T																

4-19-90

Sta.	S.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
11+ A-B CO	12+00			
11				
BM 11+61.85				
~~12+66.5~~	~~+3.27~~		13.22	
12+66.50				
12+66.50 A-BMA 1W CONCRETE	11.60	1332.50		1325.90
13+00				

L

26.5	25.1	25.2	26.4	26.5	26.3	36.8
16.2	12.6	12.5	16.3	16.2	16.5	5.9
75	69	60	56	26	17	4

R

36.8	36.1	28.5	27.7	28.2
5.9	6.6	14.2	15.0	14.5
3	10	21	57	86
			F	

32.6	32.6	29.2	29.2	29.2
10.1	10.1	13.4	13.4	13.5
81	96	103	125	175
			F	

25.5	25.2	24.6	34.1	34.8
17.2	17.4	18.1	8.6	7.9
60	40	18	12	9

15.9	34.2	26.2	25.2	26.9
7.7	8.1	16.1	17.1	15.8
0	4	20	71	110
			F	

18.1	18.6	18.2	12.7	12.3	15.2	14.8	15.4
81	83	90	92	111	117	136	180
24.2	24.1	24.5	30.0	30.4	27.5	27.2	27.3
						F	

24.0	24.2	25.0	24.5	32.7	32.7	34.2	34.3
12.5	12.8	12.5	13.0	4.8	4.8	3.3	2.2
79	78	60	26	13	10	7	0

33.2	26.0	24.5	25.5	24.9	
4.0	11.5	13.0	12.0	12.6	
7	27	56	93	150	
			F		

24.3	29.5	29.7	26.9	27.2	27.2
13.2	8.1	7.8	10.6	10.3	10.2
91	95	108	117	134	153
				F	

28.1	26.3
9.4	11.2
162	185

cked - 252 5/90

4-19-90

STA.	BS	H.I.	F.S.		
		1337.5	~~H.I.~~		
13+50					
					FINAL O.K. 03
14+33.87 A-DAM IN CONCRETE	13.93	1335.71		1321.78	
14+00					
			13.93		
15+00					

38.1 33.0 L
28 31
7 4
12 7

33.1 32.5 24.1 R 22.9
31 30 22 21
4 5 13 14
0 8 23 75

30.1 23.9 24.1 23.8 23.7 23.0 23.8
28 22 23 21 19 21 22
6 13 13 13 13 14 13
15 27 38 60 80 87 95

27.7 29.1 26.1 25.2 26.0 26.1 25.1
22 23 24 23 24 24 23
7 8 11 12 11 11 11
77 108 115 119 134 155 155
F

22.5 23.0 23.2 23.3 30.1 31.6 31.4 31.7
17 21 25 25 31 33 33 35
12 12 12 12 5 4 4 4
40 77 60 25 13 10 6 0
A FEW ROCK

31.1 22.7 22.0
29 24 23
4 13 13
6 24 100

23.1 30.1 30.0 25.6 25.1 25.0 24.5
24 31 31 27 26 26 24
5 5 5 10 10 10 11
92 99 117 121 135 157 200
F

21.7 27.6 26.9 29.3
24 25 26 31
3 8 6
29 16 13 8

29.4 28.8 19.5 19.6
27 30 21 19
6 6 16 16
0 8 22 91

21.8 22.0 21.8 29.0 28.0 24.2 23.6 24.1 23.6
18 20 20 28 27 20 25 23 20
13 13 7 7 11 12 11 12
37 100 77 95 103 117 118 129 179
F

Cted 5/1 KLJ

STA	BS	HI	F.S.	
WP80008 ALUM C:A	4.73	1330.77		1326.04
15+50				
16+00				
16+98.20				

L

27.3	27.1	21.0	21.2	20.2	27.6	25.9	28.5	28.4	27.9	19.4
37	98	96	99	72	49	23	24	29	114	110
88	77	60	30	18	13	9	0	7	20	60

23.1	28.5	22.2	21.2	22.4
73	86	89	84
113	176	149	155	185

F

20.6	27.5	20.4	26.4	25.9	21.4	22.0
33	104	44	49	94	88	92
23	10	89	97	113	121	135

F

21.6	23.8	27.3	26.8	19.5	19.2
70	79	42	113	116
205	0	5	20	70

25.4	19.2	19.8	19.5	28.0	27.0	26.2	26.6	18.6	18.5
54	109	110	113	28	38	46	42	127	123
110	121	80	30	13	8	0	3	19	50

24.8	21.5	21.0	21.6	21.5	22.8
92	98	92	93	81
150	157	181	178	215	230

161 F

Ckd 5/90 EJJ

4-25-90
CLEAR-WARM 78°

STA.	B.S.	H.I.	F.S.		L	R
WP80008 ALUM. CAP	2.08	1328.12 ~~1326.01~~ ~~1323.96~~		1326.04		
19+00					17.6 / 36.7 / 10.5 / 90 17.6 / 36.3 / 10.5 / 56 17.6 / 10.5 / 26 24.7 / 3.4 / 13 23.7 / 4.4 / 1 23.2 / 4.9 / 0 23.7 / 4.4 / 6 19.6 / 8.5 / 13 17.9 / 10.2 / 21 16.9 / 11.2 / 52 16.7 / 11.4 / 85	
					17.7 / 10.4 / 103 21.0 / 7.1 / 126 21.1 / 7.0 / 150 21.2 / 6.9 / 159 21.2 / 6.9 / 189 22.6 / 5.5 / 196 F 23.4 / 1.1 / 250	
20+00					16.7 / 7 / 25 23.2 / 4.9 / 11	23.1 / 5.0 / 0 22.9 / 5.2 / 15 17.3 / 10.8 / 25 16.8 / 11.3 / 43 17.1 / 11.0 / 58
					16.2 / 11.9 / 64 16.2 / 11.9 / 90 17.3 / 10.8 / 121 23.1 / 5.0 / 140 23.7 / 4.4 / 150	
					~~23.5~~ / 4.6 / 160 22.4 / 5.7 / 163 21.7 / 6.2 / 190 23.5 / 4.6 / 195 24.5 / 3.6 / 250	

cked 5/90

4-19-90

STA	B.S.	H.I.	F.S.
		1330.77	
18+00			4.73

L

19^{0}	18^{6}	18^{2}	26^{0}
~~5~~	~~8~~	~~3~~	~~3~~
11^{5}	12^{2}	12^{1}	4^{8}
103	70	23	19

R

25^{0}	25^{2}	19^{4}	17^{1}
~~4~~	~~1~~	~~3~~	~~2~~
5^{8}	5^{6}	11^{7}	13^{7}
0	17	28	50

22^{8}	22^{4}	20^{8}	20^{6}	21^{3}	22^{9}	28^{0}
~~7~~	~~4~~	~~7~~	~~5~~	~~2~~	~~8~~	~~9~~
5^{0}	8^{4}	10^{0}	10^{2}	9^{5}	7^{9}	7^{8}
107	128	175	161	191	198	216
116			F			

Cked 5/90 ESJ

D. Clough
B. Conry
G. Macon

APRIL 26, 1990

Clear, calm, 80°

2" Hub top [illegible] left bank, sta. 23+85±

Elev = 1321.61, p. 18

STA.	B.S.	H.I.	F.S.		
TBM	5.13	1326.74	~~5.13~~	1321.61	
23+00					

L

13.8	13.9	14.4	15.7	15.9	22.2	21.7	22.0	15.9	16.5	16.7
12.9	12.8	12.3	11.0	10.8	4.5	5.0	4.7	10.8	10.2	10.0
70	38	28	23	21	11	4	9	22	59	100

21.1	21.7	22.3	20.6 ~~20.1~~	21.2	19.8
12.6	5.0	4.4	6.1	5.5	6.9
109	134	~~165~~ 155	159	185	192
			F		

21.2	21.9
5	4.8
198	220

A

Cked 5/90 CJG

4-25-90

STA.	B.S.	H.I.	F.S.		
21+00					
TBM	5.64		6.51	133.14	
BIA	1		1.23		

L | R

15.2	14.9	15.4	15.5	21.5	21.9	21.8	16.1	16.7
12.9	13.2	12.7	12.6	6.6	6.2	6.3	12.0	11.4
105	90	71	26	12	0	5	17	52

16.1	20.9	23.0	22.9	21.7	
2.0	7.2	5.1	5.2	6.4	
79	143	134	155	157	160 F

21.7	21.9	22.8
6.4	6.2	5.3
167	186	250

15.9	19.8				22.0	15.7	16.2
12.2	8.3	20.0	21.6		6.1	12.4	11.9
20	12	8	5	0	8	19	51

15.9	14.5	14.5	14.5	19.3
12.2	13.6	13.6	13.6	8.8
23	27	66	100	118

23.0	23.3	21.9	21.5	22.0
7.1	4.8	6.2	6.6	6.1
133	159 F	162	184	250

2" Hub in ground, top of line of left bank sta 23+85 ±
Close @ Alum Cap

Ckd: 5/90 [illegible]

APRIL 26 90

STA.	B.S.	H.I.	F.S.	
T.B.M.	5.10	1326.71		1321.61
23+72.16	TOP RIGHT SHOLDER OF WELL			

8" HMA TOP OF LEFT BAY 4, STA. 23+85±
ELEV. 1321.61 P.18

A					R					
21.7					22.1	21.8	14.8	13.9	14.5	17.0
5.9					4.6	4.9	11.9	12.8	12.2	9.7
10					4	45	62	82	91	100
15.5	14.7	13.5	14.0	15.1						
11.2	12.0	13.2	12.7	11.6						
23	33	63	90	105						
21.0	21.3	19.6	20.5	21.0						
5.7	5.4	7.1	6.2	5.7						
125	158	167	179	200						
	F									

ckd 5/9/90 EJZ

4-26-90

STA.	B.S.	H.I.	F.S.		L	R
		1326.71	~~5.10~~			
24+40	RIGHT	TOE OF	WEIR		14.6 14.0 13.4 13.8 16.3 17.2 17.5 17.9 17.4 16.0 14.2 14.1 12.1/74 12.7/90 13.3/67 12.9/45 10.4/21 9.5/9 9.2/℄ 8.8/12 9.3/36 10.7/52 12.5/68 12.6/100	
					15.5 20.9 21.2 20.0 20.7 20.6 11.2/107 5.8/127 5.5/158 6.7/166 6.0/174 6.1/200 Fence	
	4.74	1326.35		1321.61	14.1 15.4 16.4 12.3/31 11.0/19 10.0/9	17.8 16.8 16.4 14.3 14.2 8.6/14 9.6/31 10.0/44 12.1/81 12.2/100 ℄
25+08	CENTER	OF	WEIR.		13.9 14.2 15.4 15.7 12.5/60 12.2/79 11.0/86 10.7/104	
					19.8 20.2 22.2 21.0 21.3 6.6/127 6.2/158 4.2/159 5.4/176 5.1/200 F=? fence	

CKed 5/90 CSP

4-26-90

STA	B.S.	H.I.	F.S.
		1324.35	
25+86	LEFT TOE OF WEIR		

ALL SHOTS EX. ℄ 22'L FALL ON ~~SHOLDER~~ TOE OF EXTITION DIKE.

26+07.68 RIGHT side is the West Side of DIKE

26+78

26+88

~~27+29.5~~ 27+26.07

L

22.3	21.8	17.4	16.4	16.9	17.5
4.1	4.6	9.0	10.0	9.5	8.9
158	107	81.7	27	22	℄
F					
23.0					
3.4					
200					

R

17.8
8.6
100

17.5	21.3	21.5	21.4	16.7
8.9	5.1	4.9	5.0	9.7
17	6	℄	8	29

15.1	16.4	18.5	21.2	21.4	21.4	17.0
11.5	10.0	7.9	5.2	5.0	5.0	9.4
34	19	9	3	℄	10	30

14.9	15.9	21.8	22.0	22.2	21.9	18.2
11.5	10.5	5.1	4.4	4.2	4.5	8.2
35	22	6	℄	3	11	22
1						

20.2	22.2	22.3	19.5	18.6
6.2	4.2	4.1	6.9	7.8
42	℄	9	23	32

Cked 5/90

4-26-90

STA	B.S.	H.I.	F.S.		L	R
		1326.35				
0+50	DYKE	EXTITION.			16.1 21.5 21.6 21.5 16.0 $\frac{10^3}{31}$ $\frac{4^9}{8}$ $\frac{4^8}{\text{℄}}$ $\frac{4^9}{7}$ $\frac{10^4}{17}$ —	
		RIGHT SIDE OF Dike is the EAST Side				
AP 1+00					15.8 17.5 21.5 21.9 22.0 15.6 14.2 14.0 15.7 18.2 $\frac{10^6}{50}$ $\frac{8^9}{24}$ $\frac{4^9}{10}$ $\frac{4^5}{\text{℄}}$ $\frac{4^4}{3}$ $\frac{10^8}{23}$ $\frac{12^2}{80}$ $\frac{12^4}{137}$ $\frac{10^7}{146}$ $\frac{8^2}{152}$	
1+40					15.4 18.3 21.7 21.8 21.6 19.2 17.0 15.8 15.9 15.7 18.8 $\frac{11^0}{46}$ $\frac{8^1}{18}$ $\frac{4^7}{5}$ $\frac{4^6}{\text{℄}}$ $\frac{4^8}{5}$ $\frac{7^2}{12}$ $\frac{9^4}{22}$ $\frac{10^6}{38}$ $\frac{10^5}{83}$ $\frac{10^7}{161}$ $\frac{7^6}{171}$	
1+50					15.4 18.6 21.5 21.3 21.5 17.0 15.4 15.9 22.4 $\frac{11^0}{47}$ $\frac{7^8}{16}$ $\frac{4^9}{6}$ $\frac{4^6}{\text{℄}}$ $\frac{4^9}{6}$ $\frac{9^4}{18}$ $\frac{11^0}{44}$ $\frac{10^5}{59}$ $\frac{4^0}{74}$	
TBM	4.11		4.50	1321.85	COTTON SPINDLE AT STA 1+00 DYKE EXTITION	
			4.35	1321.85	3" HUB TOP OF LEFT BANK, STA. 23+85± ELEV. 1321.61 P.18	

cked 5/90 ℄ SB

STA.	B.S.	HI	FS		
TBM.		1326.50	~~4.65~~	1321.85	
	4.65				
2+00					
TOP OF 8" PVC AT ELBOW +60' TO TOP OF 8" PVC AT BRUSH LINE					
TBM	4.61	1326.46	~~4.61~~	1321.85	
3+00					
3+65					

L R

COTTON SPINDLE AT STA. 1+00 DIKE EXTENSION

15.3 16.4 19.3 21.4 21.6 21.7 17.3 15.9 16.7 20.5
~~15.2~~ ~~16.3~~ ~~19.2~~ ~~21.3~~ ~~21.5~~ ~~21.6~~ ~~17.2~~ ~~15.8~~ ~~16.6~~ ~~20.4~~

11.2 10.1 8.2 5.1 4.9 4.8 9.2 10.6 9.8 6.0
38 31 15 5 ℄ 4 16 35 66 77

~~22.5~~ 22.6
3.7 ~~20.3~~ 20.4
6.1
+60

COTTON SPINDLE AT STA. 1+00 DIKE EXTENSION

15.3 18.0 21.5 21.7 21.4 17.3 16.8 17.5 22.4 23.4 20.0
11.2 8.5 5.0 4.8 5.1 9.2 9.7 9.0 4.1 3.1 6.5
35 16 6 ℄ 6 19 39 53 61 66 75

15.0 17.6 21.8 22.0 21.3 19.0 17.9 18.0 23.1
11.5 8.9 4.7 4.5 4.7 7.5 8.6 8.5 3.4
42 23 7 ℄ 5 12 23 30 40

Road Raised to Top of Dike from Gravel ~~Yard~~ yard } @ STA 3+65

Cked 5/90 EJJ

4-26-90

STA	B.S.	H.I.	F.S.	
4+00 TBM	2.73 ~~2.84~~		2.34 ~~2.73~~	1323.62
			4.50	1321.85
T.B.M.	S-W EDGE OF CONCRETE BLOCK HEAD WALL ON RIGHT SIDE AT DIKE STA. 4+30 ±			
TBM	4.63	1328.25 ~~1326.18~~	~~4.63~~	1323.62
4+50				
~~T.B.M.~~			4.6	

	L						R				
	21.8	22.6	20.9	22.1	22.0		22.0	19.5	18.5	22.4	19.4
	4.7	3.9	5.6	4.4	4.5		4.5	7.0	8.0	4.1	7.1
	48	30	14	6	℄		6	15	37	55	63

Close @ Spindle @ 1+00 Dike Ex.

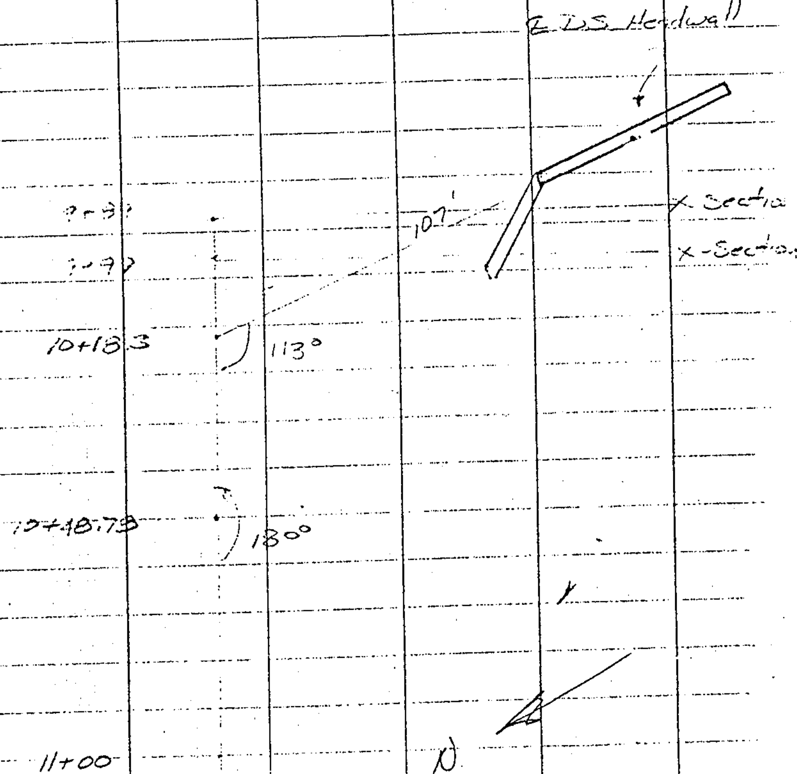
? ★ S.W. edge of concrete block headwall on right side of dike @ sta ± 4+30 ~~elev = 1321.85, p. 23~~

	L						R				
	24.1	20.6	10.9	20.3	24.2	23.9	22.0	19.1	18.8	13.8	19.2
	~~22.4~~	~~19.9~~ 4.8	~~17.5~~	~~18.4~~	~~21.4~~	~~20~~	~~20.3~~	~~21~~	~~17.1~~	~~12.1~~	~~17.5~~
	4.1	7.6	9.2	7.9	4.0	4.3	6.2	9.1	9.4	14.4	9.0
	39	33	24	14	16	℄	23	42	65	64	74

OLD DRAINAGE DITCH 12' WIDE — RIVER BANK

ckd 5/10/90

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Ground Elev.



D. Clough
B. Covey
G. Mason

April 27, 1990

Clear, calm, 30°

STA	B.S.	H.I.	F.S.	Elev.
		~~1326.73~~ 1328.25		
4+80				
5+05				
5+08				
T.B.M.			4.63	~~1321.85~~

25.4	20.2	19.7	25.3	23.8	23.3	22.1	20.8	16.9	12.9
3.7	~~18.5~~	~~19.0~~	~~23.6~~	~~22.1~~	~~21.6~~	~~20.4~~	~~19.1~~	~~15.2~~	~~11.6~~
8.9	8.5	2.9	4.4	4.9	6.1	7.4	11.3	15.3	
100 85	64	54	46	16	℄	23	39	44	

OLD DRAINAGE DITCH 12' WIDE

RIVER BANK

18.0
~~16.5~~
10.2
℄
RIVER BANK
~~10.4~~ 12.1
16.1
℄
EDGE OF WATER

F.W. EDGE OF CONCRETE BLOCK HEADWALL STA. 7+20± RIGHT SIDE OF DYKE.

Ckd 5/90 ISD

Sta.	B.S.	H.I.	F.S. or Elev. Diff.	Elev. or Point Elev.
BM	3.50	1349.87		1346.37
10+52				
~~10+40~~				

4/27/90

L R

N2 Hwy Int PC on U.S. edge of bridge ℄
Back Hwy [illegible] Insim

30^{2}	30^{0}	38^{3}	40^{5}	41^{4}	40^{6}	40^{1}	35^{9}	34^{4}
19^{7}	19^{9}	11^{6}	9^{4}	8^{5}	9^{3}	9^{8}	14^{9}	15^{5}
49	41	20	15	10	6	11	31	~~50~~ 45
		END ACH		BEGIN ACH				

29^{0}	28^{3}	28^{2}	29^{0}	30^{2}	28^{9}
20^{7}	21^{6}	21^{7}	20^{9}	19^{7}	21^{4}
58	58	62	62	84	89

29^{1}	37^{8}	38^{2}	38^{3}	36^{3}
$[illegible]^{8}$	12^{1}	11^{7}	11^{6}	13^{6}
97	113	120	134	139

37^{4}	37^{1}	36^{8}	36^{9}
$[illegible]^{5}$	12^{8}	13^{1}	13^{0}
154	164	180	200
	F		

ckd 5/90 ESD

APPENDIX A

A.4

LETTER OF LAND DEDICATION

Form ASO 2800-12
Rev Dec. 1976
R/W General

DKT 13108 PG 421

295430 D 13 913

EASEMENT (ES)

IN REPLY REFER TO
A 3959 R/W
(943)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
ARIZONA STATE OFFICE
2400 VALLEY BANK CENTER
PHOENIX, ARIZONA 85073
(602) 261-4774

Recorded at Request of
Board of Supervisors.

WHEN RECORDED RETURN TO:
County Highway Department
Real Estate Division

March 30, 1977

Chief Engr.	2	Engrm.	
Deputy	3	SHB	
P.& A.	4	JLS	4/12
C.A.O.			
	5.		SF.2.11

MARICOPA COUNTY
HIGHWAY DEPT.
1976 SEP 11 PM 12: 52

DECISION

RIGHT-OF-WAY GRANTED

Details of Grant

Serial Number of Grant: A 3959, Phase I

Name of Grantee: Flood Control District of Maricopa County

Map Showing the Location and Dimensions of Grant:

Map Designations: Buckhorn-Mesa Watershed Project (Phase I-Spook Hill Floodwater Retarding Dam; Spook Hill Floodway Sediment Basin.)

Date Filed: June 13, 1969, as amended and supplemented by maps filed January 30, 1975 and March 3, 1977.

Permitted Use by Grantee: Easement for flood control and drainage structures.

Authority for Grant: Act of October 21, 1976, 90 Stat. 2776, 43 U.S.C. 1761 (Public Law 94-579)

Regulations Applicable to Grant:

Code Reference: 43 CFR 2800, as applicable

Circular Numbers: 2384, as applicable

Date of Grant: March 29, 1977

Expiration Date of Grant: March 28, 2007

Rental: None. Municipally operated project.

MARICOPA COUNTY RECORDER ARIZONA

3-28-2007

SF 2.2.11

Terms and Conditions of Grant

Pursuant to the authority vested in the undersigned officer by Bureau Order No. 701 of July 23, 1964 (29 F.R. 10526), a right-of-way, the details of which are shown above, is hereby granted, subject to the following terms and conditions:

1. All valid rights existing on the date of the grant;

2. All applicable regulations in 43 CFR 2800 and regulations to be promulgated by the Secretary of the Interior pursuant to Public Law 94-579;

3. The right-of-way herein granted shall be subject to the express covenant that it will be modified, adapted, or discontinued if found by the Secretary to be necessary, without liability or expense to the United States, so as not to conflict with the use and occupancy of the land for any authorized works which may be hereafter constructed thereon under the authority of the United States;

4. At least 10 days in advance of beginning construction activities on the public lands, the grantee shall submit a timetable of construction to the BLM District Manager, Phoenix District Office, 2929 West Clarendon Ave., Phoenix, Arizona 85017.

   (If construction is to begin upon receipt of the permit, the grantee shall immediately contact the District Manager to advise him of the immediate construction, and to discuss the timetable of construction.)

5. Permittee shall survey and clearly mark the exterior limits of the right-of-way. All activities directly or indirectly associated with construction or maintenance must be conducted within the limits of the right-of-way; removal of vegetation shall be restricted to that absolutely essential to construction or maintenance;

6. The permittee shall immediately report to the Bureau of Land Management authorized officer any archaeological (prehistoric and historic) or paleontological remains that are encountered during construction or maintenance, and will suspend all work in connection with the right-of-way until final archaeological or paleontological clearance is granted;

7. The permittee shall not use any pesticides on the Federal lands herein involved without specific prior authorization from the BLM authorized officer;

8. A period of five years from date of this grant is allowed for completion of construction. Within 90 days after completion of construction or after all restoration stipulations have been complied with, whichever is later, proof of construction, on forms approved by the Director, shall be submitted to the authorized officer.

9. Upon completion of construction, the lands shall be restored to as near their natural condition as possible, subject to approval by the District Manager.

10. This right-of-way reserves to the Secretary of the Interior, or his lawful delegate, the right to grant addtional rights-of-way or permits for compatible uses over, under or adjacent to the land involved in this grant.

11. This right-of-way may be renewed subject to regulations existing at the time of renewal and such other terms and conditions deemed necessary to protect the public interest.

12. Salvageable vegetation removed during construction will be replanted on retardation and retention structures to minimize visual impact.

13. A water sprinkling system will be installed on the Spook Hills retardation structure to augment vegetative recovery as identified in Buckhorn-Mesa Watershed Environmental Impact Statement.

14. Haul roads will be watered during construction to suppress dust and reduce erosion. Applicable State and Federal laws and regulations will be adhered to in minimizing air and noise pollution.

15. Final dressing of water retardation structure slopes by construction equipment will be accomplished in a horizontal direction (parallel to structure top) to reduce water runoff and associated soil erosion.

16. No storing or storage areas will be allowed on right-of-way grant areas without prior approval of the authorized officer, Bureau of Land Management.

17. Grantee will permit use of any part of the subject lands lying within Withdrawal No. 164 (AR 6) for stock driveway purposes.

18. Material dredged from the sediment basin will not be placed on national resource lands.

19. Subject to Civil Rights Stipulations copy attached.

A-3959

20. Subject to Bureau of Reclamation stipulations, copy attached.

21. Future grants of easement relating to the Spook Hill project will carry the same termination date as this Phase I grant.

Public lands affected by this permit are:

T. 2 N., R. 6 E., GSR Mer., Arizona
sec. 13, S½NE¼SE¼, N½SE¼SE¼, SE¼NW¼SE¼.

T. 1 N., R. 7 E., GSR Mer., Arizona
sec. 8, NW¼, S½(partly patented, subject to right-of-way)

Mario L. Lopez
Chief, Branch of Lands
and Minerals Operations

cc:
Bureau of Reclamation
Phoenix District Office

Form 300-8(a)

STIPULATION

There is reserved to the United States, its successors and assigns, the prior right to use any of the land herein described to construct, reconstruct, operate, and maintain dams, dikes, levees, reservoirs, canals, wasteways, laterals, ditches, drainage works, flood channels, telephone and telegraph lines, electric transmission lines, roadways, and appurtenant irrigation structures, without any payment made by the United States, or its successors and assigns, for such right, with the agreement on the part of the applicant that if the construction or reconstruction of any or all of such dams, dikes, levees, reservoirs, canals, wasteways, laterals, ditches, telephone and telegraph lines, electric transmission lines, roadways, or appurtenant irrigation structures across, over, or upon said lands should be made more expensive by reason of the existence of improvements or workings of the applicant thereon, such additional expense is to be estimated by the Secretary of the Interior, whose estimate is to be final and binding upon the parties hereto, and that within thirty days after demand is made upon the applicant for payment of such sums, the applicant will make payment thereof to the United States, or its successors and assigns, constructing or reconstructing such dams, dikes, levees, reservoirs, canals, wasteways, laterals, ditches, telephone and telegraph lines, electric transmission lines, roadways, or appurtenant irrigation structures across, over, or upon said lands. There is also reserved to the United States the right of its officers, agents, employees, licensees, and permittees, at all proper times and places freely to have ingress to, passage over, and egress from all of said lands for the purpose of exercising, enforcing, and protecting the rights reserved herein.

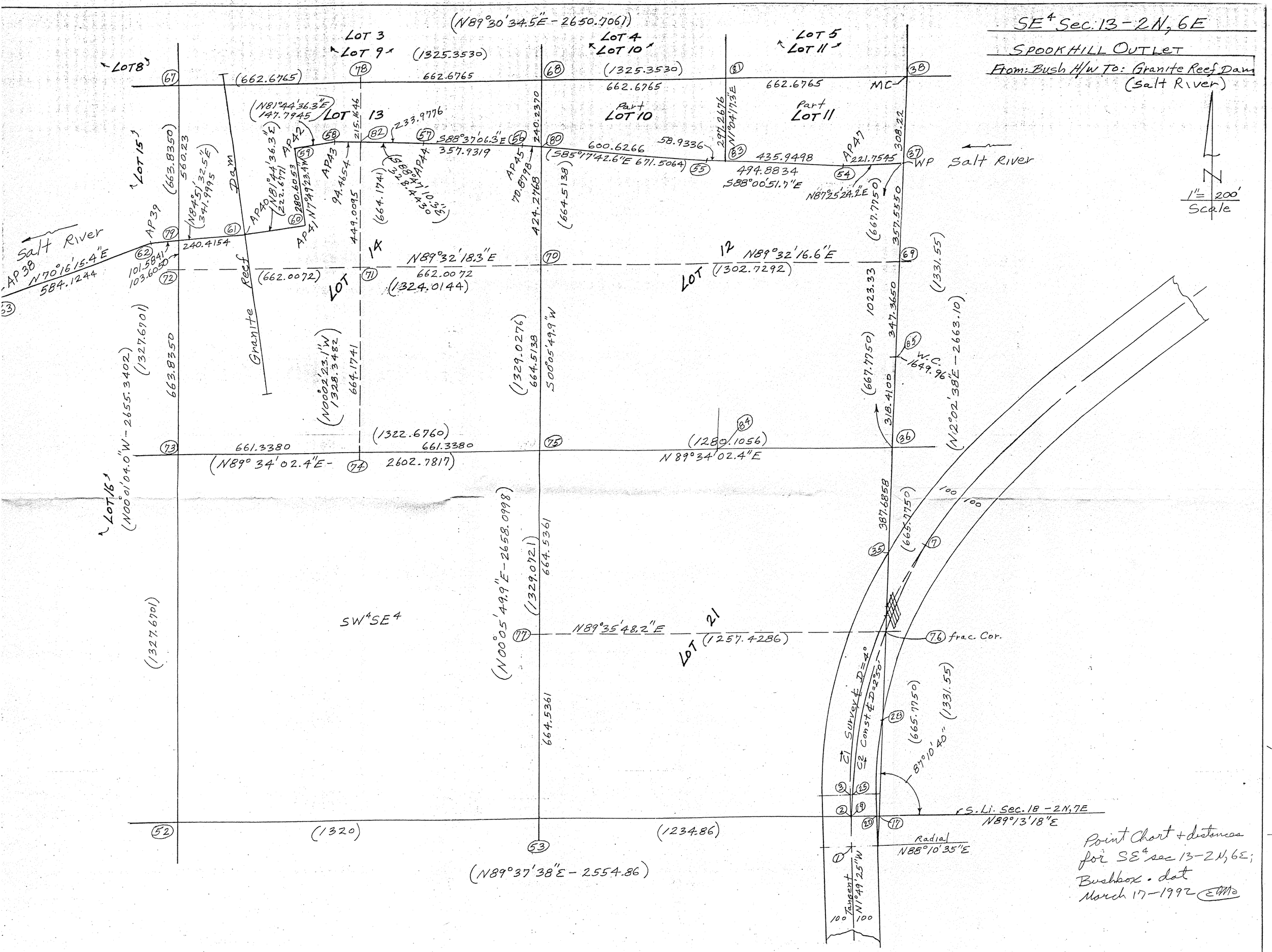
Applicant further agrees that the United States, its officers, agents, employees, and assigns, shall not be liable for any damage to the improvements or works of the applicant resulting from the construction, reconstruction, operation, or maintenance of any of the works hereinabove enumerated.

RECEIVED
B.L.M. LAND OFFICE
MAR 8 - 1976
REG. A.M.
PHOENIX, ARIZONA

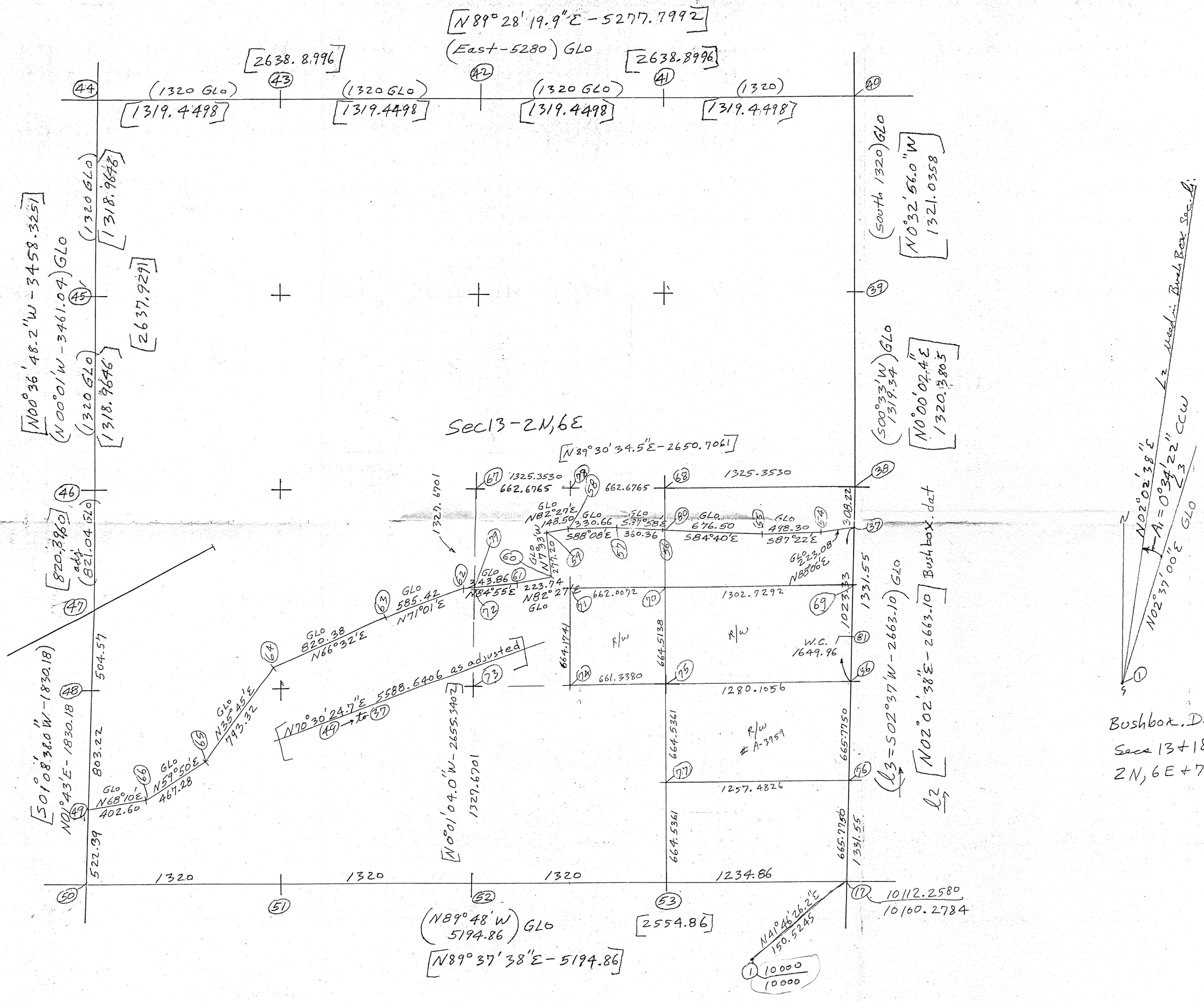
SE⁴ Sec. 13 - 2N, 6E

SPOOKHILL OUTLET

From: Bush H/W To: Granite Reef Dam (Salt River)



Point Chart + distances for SE⁴ sec 13-2N, 6E; Bushbox.dat March 17-1992 EMO


[N89°28'19.9"E-5277.7992]
(East-5280) GLO
[2638.8996]
[2638.8996]
(1320 GLO)
(1320 GLO)
(1320 GLO)
(1320)
[1319.4498]
[1319.4498]
[1319.4498]
[1319.4498]
(1320 GLO)
[1318.9646]
[N00°36'48.2"W-3458.3251]
(N00°01'W-3461.04) GLO
[2637.9291]
(1320 GLO)
[1318.9646]
(South 1320) GLO
[N0°32'56.0"W
1321.0358]
(S00°33'W
1319.34) GLO
[N0°00'02.4"E
1320.3805]
Sec13-2N,6E
[N89°30'34.5"E-2650.7061]
1325.3530
662.6765
662.6765
1325.3530
1327.6701
GLO N82°27'E 148.50
GLO 330.66
GLO 5.37°
GLO 676.50
GLO 498.30
308.22
588°08'E
360.36
584°40'E
587°22'E
GLO 223.08 N88°06'E
GLO N7°33'W 271.20
GLO 343.86 N84°55'E
223.74 N82°27'E GLO
662.0072
1302.7292
1331.55
1023.33
GLO 585.42 N71°01'E
GLO 820.38 N66°32'E
R/W
R/W
W.C. 1649.96
664.1741
664.5138
661.3380
1280.1056
[820.3860]
adj (821.04 GLO)
[S01°08'32.0"W-1830.18]
N01°43'E-1830.18
504.57
803.22
522.39
GLO N35°45'E 793.32
[N70°30'24.7"E 5588.6406 as adjusted]
to
GLO N59°50'E 467.28
GLO N68°10'E 402.60
[N0°01'04.0"W-2655.3402]
1327.6701
664.5361
R/W
A-3959
665.7750
1257.4826
664.5361
665.7750
1331.55
(S02°37'W-2663.10) GLO
[N02°02'38"E-2663.10]
Bushbox.dat
1320
1320
1320
1234.86
(N89°48'W
5194.86) GLO
[N89°37'38"E-5194.86]
[2554.86]
N41°46'26.2"E
150.5245
10000
10000
10112.2580
10100.2784
N02°02'38"E
A1 = 0°34'22" CCW
N02°37'00"E
GLO
Bushbox.Dat
Secs 13+18
2N, 6E + 7E

CEAL filename:
Bushbox.dat

```
 *-* DATA RESTORE COMPLETE * * *
.list
 Last restored data filename: DATA\BUSHBOX

                    STORED
                 ************
POINTS                1 TO   85
ANGLES              A1
LINES               L1  TO L3
CURVES             C1   TO C13

            STORED  CLASS      STATION
            ******  ********   ************
CHAIN        A001   13-2N6E    0+00.00
CHAIN        A002   13-2N6E    0+00.00
CHAIN        A003   13-2N6E    0+00.00
CHAIN        A004   13-2N6E    0+00.00
CHAIN        A005   13-2N6E    0+00.00
CHAIN        A006   13-2N6E    0+00.00
CHAIN        B001   18-2N7E    0+00.00
CHAIN        B002   18-2N7E    0+00.00
CHAIN        B003   18-2N7E    0+00.00
.

.list  a001 to a006 b001 to b003
 Last restored data filename: DATA\BUSHBOX

A001  13-2N6E
17 38 39 40 44 47 50 17
A002  13-2N6E
37 49 66 65 64 63 62 61 60 59 58 57 56 55 54 37
A003  13-2N6E
17 53 75 36 1
A004  13-2N6E
36 75 80 55 54 37 36
A005  13-2N6E
75 73 79 61 60 59 58 57 56 80 75
A006  13-2N6E
76 36 69 70 71 74 75 77 76

B001  18-2N7E
5 14 C9 13 6 24 12 C8 T 11 23 5
B002  18-2N7E
26 9 C13 12 C8 T 26
B003  18-2N7E
29 34 12 C8 T 11 29
.\
 \

 PT.   1 N    10000.0000    E    10000.0000
```

PT.	2	N	10108.9548	E	9996.5310
PT.	3	N	10185.6559	E	9994.0889
PT.	4	N	10350.8886	E	9998.3695
PT.	5	N	10628.3661	E	10049.5154
PT.	6	N	10971.0321	E	10199.1939
PT.	7	N	11083.9716	E	10274.8452
PT.	8	N	10932.2095	E	10176.6008
PT.	9	N	10981.1466	E	10089.3932
PT.	10	N	10342.5355	E	10098.0200
PT.	11	N	10600.6414	E	10145.5953
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PT.	13	N	11022.6795	E	10113.5636
PT.	14	N	10656.0909	E	9953.4355
PT.	15	N	10674.5444	E	10093.2342
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PT.	24	N	10964.3408	E	10210.2881
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PT.	26	N	10615.8735	E	10093.9693
PT.	27	N	10341.6599	E	10108.4653
PT.	28	N	10456.6486	E	10112.5690
PT.	29	N	10608.6066	E	10117.9920
PT.	30	N	10763.0147	E	10123.5025
PT.	31	N	10833.2399	E	10126.0086
PT.	32	N	10877.4589	E	10127.5867
PT.	33	N	10958.0991	E	10130.4646
PT.	34	N	11011.3398	E	10132.3646
PT.	35	N	11055.5217	E	10133.9414
PT.	36	N	11442.9608	E	10147.7682
PT.	37	N	12465.6398	E	10184.2653
PT.	38	N	12773.6637	E	10195.2580
PT.	39	N	14094.0443	E	10195.2734
PT.	40	N	15415.0195	E	10182.6180
PT.	41	N	15402.8650	E	8863.2242
PT.	42	N	15390.7105	E	7543.8304
PT.	43	N	15378.5561	E	6224.4365
PT.	44	N	15366.4016	E	4905.0427
PT.	45	N	14047.5126	E	4919.1625
PT.	46	N	12728.6236	E	4933.2823
PT.	47	N	11908.2747	E	4942.0648
PT.	48	N	11403.8052	E	4931.9919
PT.	49	N	10600.7441	E	4915.9574
PT.	50	N	10078.4594	E	4905.5284
PT.	51	N	10087.0475	E	6225.5005
PT.	52	N	10095.6357	E	7545.4725
PT.	53	N	10104.2238	E	8865.4446
PT.	54	N	12455.6708	E	9962.7350
PT.	55	N	12472.8181	E	9468.1488
PT.	56	N	12527.8968	E	8798.9050
PT.	57	N	12536.5268	E	8441.0771
PT.	58	N	12543.4843	E	8112.7078
PT.	59	N	12522.2600	E	7966.4452
PT.	60	N	12244.2663	E	8004.6401
PT.	61	N	12212.2885	E	7784.2711
PT.	62	N	12181.6431	E	7443.6473
PT.	63	N	11984.4586	E	6893.8113
PT.	64	N	11648.3094	E	6146.5313
PT.	65	N	10995.3224	E	5688.1092
PT.	66	N	10755.1173	E	5287.1034
PT.	67	N	12750.9757	E	7544.6490

PT.	68	N	12762.3197	E 8869.9535
PT.	69	N	12108.3123	E 10171.5131
PT.	70	N	12097.8069	E 8868.8263
PT.	71	N	12092.4738	E 8206.8406
PT.	72	N	12087.1407	E 7544.8549
PT.	73	N	11423.3057	E 7545.0608
PT.	74	N	11428.2999	E 8206.3799
PT.	75	N	11433.2940	E 8867.6991
PT.	76	N	10777.6094	E 10124.0233
PT.	77	N	10768.7589	E 8866.5718
PT.	78	N	12756.6477	E 8207.3013
PT.	79	N	12190.7457	E 7544.8228
PT.	80	N	12522.0831	E 8869.5460
PT.	81	N	12767.9917	E 9532.6057
PT.	82	N	12541.4832	E 8207.1520
PT.	83	N	12470.7761	E 9527.0470
PT.	84	N	11438.1274	E 9507.7336
PT.	85	N	11761.1683	E 10159.1243

ANGLE A1 00-34'22.0"

LINE	L1	N 01-49'25.0"W	N	10000.0000	E	10000.0000
LINE	L2	N 02-02'38.0"E	N	10112.2580	E	10100.2784
LINE	L3	N 02-37'00.0"E	N	10000.0000	E	10000.0000

	DELTA +	38-21'32.6"						
	T	498.2388		PC1	N	10185.6559	E	9994.0889
	L	958.9765	DB N 01-49'25.0"W					
CURVE	R	1432.3945		PI1	N	10683.6424	E	9978.2337
C1	LC	941.1669	DC N 17-21'21.3"E					
	E	84.1792		CC1	N	10231.2385	E	11425.7580
	M	79.5068	DA N 36-32'07.6"E					
	DEGREE	04-00'00.0"		PT1	N	11083.9716	E	10274.8452
	DELTA +	32-06'09.6"						
	T	581.8191		PC2	N	10000.0000	E	10000.0000
	L	1133.0356	DB N 01-49'25.0"W					
CURVE	R	2022.2040		PI2	N	10581.5244	E	9981.4850
C2	LC	1118.2729	DC N 14-13'39.8"E					
	E	82.0352		CC2	N	10064.3519	E	12021.1798
	M	78.8370	DA N 30-16'44.6"E					
	DEGREE	02-50'00.0"		PT2	N	11083.9716	E	10274.8452
	DELTA +	06-36'54.7"						
	T	82.7820		PC3	N	10185.6559	E	9994.0889
	L	165.3800	DB N 01-49'25.0"W					
CURVE	R	1432.3945		PI3	N	10268.3960	E	9991.4546
C3	LC	165.2882	DC N 01-29'02.4"E					
	E	2.3901		CC3	N	10231.2385	E	11425.7580
	M	2.3861	DA N 04-47'29.7"E					
	DEGREE	04-00'00.0"		PT3	N	10350.8886	E	9998.3695
	DELTA +	11-18'15.8"						
	T	141.7652		PC4	N	10350.8886	E	9998.3695
	L	282.6100	DB N 04-47'29.7"E					
CURVE	R	1432.3945		PI4	N	10492.1584	E	10010.2114
C4	LC	282.1518	DC N 10-26'37.6"E					
	E	6.9982		CC4	N	10231.2385	E	11425.7580
	M	6.9642	DA N 16-05'45.6"E					
	DEGREE	04-00'00.0"		PT4	N	10628.3661	E	10049.5154
	DELTA +	15-00'00.0"						
	T	188.5783		PC5	N	10628.3661	E	10049.5154
	L	375.0000	DB N 16-05'45.6"E					

```
CURVE   R     1432.3945
C5      LC     373.9300 DC N 23-35'45.6"E
        E       12.3601
        M       12.2543 DA N 31-05'45.6"E
   DEGREE  04-00'00.0"

   DELTA + 05-26'22.1"
        T       68.0444
        L      135.9865 DB N 31-05'45.6"E
CURVE   R     1432.3945
C6      LC     135.9355 DC N 33-48'56.6"E
        E        1.6153
        M        1.6135 DA N 36-32'07.6"E
   DEGREE  04-00'00.0"

   DELTA - 01-47'48.5"
        T       22.4618
        L       44.9200 DB S 31-05'45.6"W
CURVE   R     1432.3945
C7      LC      44.9182 DC S 30-11'51.3"W
        E         .1761
        M         .1761 DA S 29-17'57.1"W
   DEGREE  04-00'00.0"

   DELTA + 15-00'00.0"
        T      175.4131
        L      348.8201 DB N 16-05'45.6"E
CURVE   R     1332.3945
C8      LC     347.8248 DC N 23-35'45.6"E
        E       11.4972
        M       11.3988 DA N 31-05'45.6"E
   DEGREE  04-18'00.8"

   DELTA + 15-00'00.0"
        T      201.7436
        L      401.1799 DB N 16-05'45.6"E
CURVE   R     1532.3945
C9      LC     400.0352 DC N 23-35'45.6"E
        E       13.2230
        M       13.1098 DA N 31-05'45.6"E
   DEGREE  03-44'20.3"

   DELTA + 25-03'44.1"
        T      449.4645
        L      884.5500 DB N 01-49'25.0"W
CURVE   R     2022.2040
C10     LC     877.5149 DC N 10-42'27.1"E
        E       49.3479
        M       48.1724 DA N 23-14'19.1"E
   DEGREE  02-50'00.0"

   DELTA + 07-02'25.5"
        T      124.3994
        L      248.4856 DB N 23-14'19.1"E
CURVE   R     2022.2040
C11     LC     248.3293 DC N 26-45'31.9"E
        E        3.8227
        M        3.8155 DA N 30-16'44.6"E
   DEGREE  02-50'00.0"

   DELTA + 17-55'10.6"
        T      225.8389
        L      447.9900 DB N 01-49'25.0"W
CURVE   R     1432.3945
C12     LC     446.1664 DC N 07-08'10.3"E
        E       17.6942
```

PI5	N	10809.5519	E	10101.7982
CC5	N	10231.2385	E	11425.7580
PT5	N	10971.0321	E	10199.1939
PC6	N	10971.0321	E	10199.1939
PI6	N	11029.2987	E	10234.3370
CC6	N	10231.2385	E	11425.7580
PT6	N	11083.9716	E	10274.8452
PC7	N	10971.0321	E	10199.1939
PI7	N	10951.7980	E	10187.5930
CC7	N	10231.2385	E	11425.7580
PT7	N	10932.2095	E	10176.6008
PC8	N	10600.6414	E	10145.5953
PI8	N	10769.1780	E	10194.2281
CC8	N	10231.2385	E	11425.7580
PT8	N	10919.3848	E	10284.8242
PC9	N	10656.0909	E	9953.4355
PI9	N	10849.9258	E	10009.3684
CC9	N	10231.2385	E	11425.7580
PT9	N	11022.6795	E	10113.5636
PC10	N	10000.0000	E	10000.0000
PI10	N	10449.2368	E	9985.6969
CC10	N	10064.3519	E	12021.1798
PT10	N	10862.2360	E	10163.0383
PC11	N	10862.2360	E	10163.0383
PI11	N	10976.5428	E	10212.1215
CC11	N	10064.3519	E	12021.1798
PT11	N	11083.9716	E	10274.8452
PC12	N	10185.6559	E	9994.0889
PI12	N	10411.3804	E	9986.9022
CC12	N	10231.2385	E	11425.7580

```
      M        17.4783 DA N 16-05'45.6"E
   DEGREE   04-00'00.0"                          PT12   N   10628.3661   E   10049.5154

   DELTA + 01-47'48.5"
      T        24.0300                           PC13   N   10981.1466   E   10089.3932
      L        48.0560 DB N 29-17'57.1"E
CURVE  R     1532.3945                           PI13   N   11002.1025   E   10101.1528
C13   LC       48.0540 DC N 30-11'51.3"E
      E         .1884                            CC13   N   10231.2385   E   11425.7580
      M         .1884 DA N 31-05'45.6"E
   DEGREE   03-44'20.3"                          PT13   N   11022.6795   E   10113.5636
```

```
*****************************************************************************
        A001            13-2N6E
*****************************************************************************
 - 17                              N    10112.2580  E    10100.2784  S     0+00
   N 02-02'38.0"E   2663.1000
  38                               N    12773.6637  E    10195.2580  S   26+63.1000
   N 00-00'02.4"E   1320.3805
  39                               N    14094.0443  E    10195.2734  S   39+83.4805
   N 00-32'56.0"W   1321.0358
  40                               N    15415.0195  E    10182.6180  S   53+04.5164
   S 89-28'19.9"W   5277.7992
  44                               N    15366.4016  E     4905.0427  S  105+82.3156
   S 00-36'48.2"E   3458.3251
  47                               N    11908.2747  E     4942.0648  S  140+40.6407
   S 01-08'38.0"W   1830.1800
  50                               N    10078.4594  E     4905.5284  S  158+70.8207
   N 89-37'38.0"E   5194.8600
  17                               N    10112.2580  E    10100.2784  S  210+65.6807
 LENGTH=     21065.6807   AREA=     27779214.0423 SF        637.7230 ACRES
```

```
*****************************************************************************
        A002            13-2N6E
*****************************************************************************
  37                               N    12465.6398  E    10184.2653  S     0+00
   S 70-30'24.7"W   5588.6406
  49                               N    10600.7441  E     4915.9574  S   55+88.6406
   N 67-24'56.8"E    401.9706
  66                               N    10755.1173  E     5287.1034  S   59+90.6112
   N 59-04'41.2"E    467.4443
  65                               N    10995.3224  E     5688.1092  S   64+58.0555
   N 35-04'13.2"E    797.8363
  64                               N    11648.3094  E     6146.5313  S   72+55.8919
   N 65-46'49.2"E    819.4045
  63                               N    11984.4586  E     6893.8113  S   80+75.2963
   N 70-16'15.4"E    584.1244
  62                               N    12181.6431  E     7443.6473  S   86+59.4208
   N 84-51'32.5"E    341.9995
  61                               N    12212.2885  E     7784.2711  S   90+01.4203
   N 81-44'36.3"E    222.6771
  60                               N    12244.2663  E     8004.6401  S   92+24.0974
   N 07-49'23.4"W    280.6053
  59                               N    12522.2600  E     7966.4452  S   95+04.7027
   N 81-44'36.3"E    147.7945
  58                               N    12543.4843  E     8112.7078  S   96+52.4973
   S 88-47'10.3"E    328.4430
  57                               N    12536.5268  E     8441.0771  S   99+80.9403
   S 88-37'06.3"E    357.9319
  56                               N    12527.8968  E     8798.9050  S  103+38.8722
   S 85-17'42.6"E    671.5064
  55                               N    12472.8181  E     9468.1488  S  110+10.3787
   S 88-00'51.7"E    494.8834
  54                               N    12455.6708  E     9962.7350  S  115+05.2620
   N 87-25'24.2"E    221.7545
```

```
 37                                N    12465.6398  E    10184.2653  S  117+27.0165
LENGTH=     11727.0165  AREA=      2330099.3649 SF        53.4917 ACRES

*****************************************************************************
        A003            13-2N6E
*****************************************************************************
 17                                N    10112.2580  E    10100.2784  S    0+00
  S 89-37'38.0"W  1234.8600
 53                                N    10104.2238  E     8865.4446  S   12+34.8600
  N 00-05'49.9"E  1329.0721
 75                                N    11433.2940  E     8867.6991  S   25+63.9321
  N 89-34'02.4"E  1280.1056
 36                                N    11442.9608  E    10147.7682  S   38+44.0378
  S 05-50'49.4"W  1450.5073
  1                                N    10000.0000  E    10000.0000  S   52+94.5451
LENGTH=      5294.5451

*****************************************************************************
        A004            13-2N6E
*****************************************************************************
 36                                N    11442.9608  E    10147.7682  S    0+00
  S 89-34'02.4"W  1280.1056
 75                                N    11433.2940  E     8867.6991  S   12+80.1056
  N 00-05'49.9"E  1088.7906
 80                                N    12522.0831  E     8869.5460  S   23+68.8963
  S 85-17'42.6"E   600.6266
 55                                N    12472.8181  E     9468.1488  S   29+69.5229
  S 88-00'51.7"E   494.8834
 54                                N    12455.6708  E     9962.7350  S   34+64.4063
  N 87-25'24.2"E   221.7545
 37                                N    12465.6398  E    10184.2653  S   36+86.1608
  S 02-02'38.0"W  1023.3300
 36                                N    11442.9608  E    10147.7682  S   47+09.4908
LENGTH=      4709.4908  AREA=      1350295.7707 SF        30.9985 ACRES

*****************************************************************************
        A005            13-2N6E
*****************************************************************************
 75                                N    11433.2940  E     8867.6991  S    0+00
  S 89-34'02.4"W  1322.6760
 73                                N    11423.3057  E     7545.0608  S   13+22.6760
  N 00-01'04.0"W   767.4401
 79                                N    12190.7457  E     7544.8228  S   20+90.1161
  N 84-51'32.5"E   240.4154
 61                                N    12212.2885  E     7784.2711  S   23+30.5315
  N 81-44'36.3"E   222.6771
 60                                N    12244.2663  E     8004.6401  S   25+53.2086
  N 07-49'23.4"W   280.6053
 59                                N    12522.2600  E     7966.4452  S   28+33.8139
  N 81-44'36.3"E   147.7945
 58                                N    12543.4843  E     8112.7078  S   29+81.6085
  S 88-47'10.3"E   328.4430
 57                                N    12536.5268  E     8441.0771  S   33+10.0515
  S 88-37'06.3"E   357.9319
 56                                N    12527.8968  E     8798.9050  S   36+67.9834
  S 85-17'42.6"E    70.8798
 80                                N    12522.0831  E     8869.5460  S   37+38.8632
  S 00-05'49.9"W  1088.7906
 75                                N    11433.2940  E     8867.6991  S   48+27.6539
LENGTH=      4827.6539  AREA=      1322945.7124 SF        30.3707 ACRES

*****************************************************************************
        A006            13-2N6E
*****************************************************************************
 76                                N    10777.6094  E    10124.0233  S    0+00
  N 02-02'38.0"E   665.7750
```

```
 36                                N    11442.9608  E    10147.7682  S    6+65.7750
  N 02-02'38.0"E    665.7750
 69                                N    12108.3123  E    10171.5131  S   13+31.5500
  S 89-32'16.6"W   1302.7292
 70                                N    12097.8069  E     8868.8263  S   26+34.2792
  S 89-32'18.3"W    662.0072
 71                                N    12092.4738  E     8206.8406  S   32+96.2863
  S 00-02'23.1"W    664.1741
 74                                N    11428.2999  E     8206.3799  S   39+60.4604
  N 89-34'02.4"E    661.3380
 75                                N    11433.2940  E     8867.6991  S   46+21.7984
  S 00-05'49.9"W    664.5361
 77                                N    10768.7589  E     8866.5718  S   52+86.3345
  N 89-35'48.2"E   1257.4826
 76                                N    10777.6094  E    10124.0233  S   65+43.8172
LENGTH=      6543.8172  AREA=      2141652.1063 SF        49.1656 ACRES

*****************************************************************************
       B001            18-2N7E
*****************************************************************************
  5                                N    10628.3661  E    10049.5154  S    0+00
  N 73-54'14.4"W    100.0000
 14                                N    10656.0909  E     9953.4355  S    1+00.0000
null distance and bearing
PC9   DB =   N 16-05'45.6"E  N    10656.0909  E     9953.4355  S    1+00.0000
       T =  201.7436    L =  401.1799    DEL = + 15-00'00.0"
PI9   DC =   N 23-35'45.6"E  N    10849.9258  E    10009.3684  S    3+01.7436
      LC =   400.0352   R = 1532.3945    DEG =  03-44'20.3"
PT9   DA =   N 31-05'45.6"E  N    11022.6795  E    10113.5636  S    5+01.1799
null distance and bearing
 13                               N    11022.6795  E    10113.5636  S    5+01.1799
  S 58-54'14.4"E    100.0000
  6                               N    10971.0321  E    10199.1939  S    6+01.1799
  S 58-54'14.4"E     12.9558
 24                               N    10964.3408  E    10210.2881  S    6+14.1358
  S 58-54'14.4"E     87.0442
 12                               N    10919.3848  E    10284.8242  S    7+01.1799
null distance and bearing
PT8   DB =   S 31-05'45.6"W  N    10919.3848  E    10284.8242  S    7+01.1799
  TR   T =  175.4131    L =  348.8201    DEL = - 15-00'00.0"
PI8   DC =   S 23-35'45.6"W  N    10769.1780  E    10194.2281  S    8+76.5930
      LC =   347.8248   R = 1332.3945    DEG =  04-18'00.8"
PC8   DA =   S 16-05'45.6"W  N    10600.6414  E    10145.5953  S   10+50.0000
null distance and bearing
 11                               N    10600.6414  E    10145.5953  S   10+50.0000
  N 73-54'14.4"W     71.4546
 23                               N    10620.4520  E    10076.9418  S   11+21.4546
  N 73-54'14.4"W     28.5454
  5                               N    10628.3661  E    10049.5154  S   11+50.0000
LENGTH=      1150.0000  AREA=        75000.0000 SF         1.7218 ACRES

*****************************************************************************
       B002            18-2N7E
*****************************************************************************
 26                               N    10615.8735  E    10093.9693  S    0+00
  N 00-43'03.9"W    365.3017
  9                               N    10981.1466  E    10089.3932  S    3+65.3017
null distance and bearing
PC13  DB =   N 29-17'57.1"E  N    10981.1466  E    10089.3932  S    3+65.3017
       T =   24.0300    L =   48.0560    DEL = + 01-47'48.5"
PI13  DC =   N 30-11'51.3"E  N    11002.1025  E    10101.1528  S    3+89.3317
      LC =   48.0540   R = 1532.3945    DEG =  03-44'20.3"
PT13  DA =   N 31-05'45.6"E  N    11022.6795  E    10113.5636  S    4+13.3577
  S 58-54'14.4"E    200.0000
 12                               N    10919.3848  E    10284.8242  S    6+13.3577
null distance and bearing
```

```
PT8    DB =    S 31-05'45.6"W  N     10919.3848  E     10284.8242  S     6+13.3577
  TR    T =   175.4131     L =  348.8201     DEL = - 15-00'00.0"
PI8    DC =    S 23-35'45.6"W  N     10769.1780  E     10194.2281  S     7+88.7708
       LC =    347.8248    R = 1332.3945     DEG =  04-18'00.8"
PC8    DA =    S 16-05'45.6"W  N     10600.6414  E     10145.5953  S     9+62.1778
   N 73-33'41.3"W     53.8262
  26                           N     10615.8735  E     10093.9693  S    10+16.0040
 LENGTH=      1016.0040  AREA=        47005.0156 SF          1.0791 ACRES

*****************************************************************************
        B003            18-2N7E
*****************************************************************************
  29                           N    .10608.6066  E     10117.9920  S     0+00
   N 02-02'38.0"E    402.9896
  34                           N     11011.3398  E     10132.3646  S     4+02.9896
   S 58-54'14.4"E    178.0440
 - 12                          N     10919.3848  E     10284.8242  S     5+81.0335
 null distance and bearing
PT8    DB =    S 31-05'45.6"W  N     10919.3848  E     10284.8242  S     5+81.0335
  TR    T =   175.4131     L =  348.8201     DEL = - 15-00'00.0"
PI8    DC =    S 23-35'45.6"W  N     10769.1780  E     10194.2281  S     7+56.4466
       LC =    347.8248    R = 1332.3945     DEG =  04-18'00.8"
PC8    DA =    S 16-05'45.6"W  N     10600.6414  E     10145.5953  S     9+29.8536
 null distance and bearing
  11                           N     10600.6414  E     10145.5953  S     9+29.8536
   N 73-54'14.4"W     28.7295
  29                           N     10608.6066  E     10117.9920  S     9+58.5831
 LENGTH=       958.5831  AREA=        33669.2967 SF           .7729 ACRES
```

APPENDIX B

B.1

HEC-2 MODEL ALTERNATIVE NO. 1

SPKHL1.DAT

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*-----------------------------------*
|            S U M P O              |
|                                   |
|  Interactive Summary Printout     |
|  for MS/PC-DOS micro computers    |
|            May 1991               |
*-----------------------------------*
```

~~SPOORFIC.DAT~~

N = .015

NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

4-13-92

Summary Printout

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S	TIME
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54	.00
400.00	2653.00	37.24	39.67	46.50	24.42	2.75	108.64	40.00	86.00	34.49	275.66	.00
500.00	2653.00	34.04	36.56	44.01	25.34	2.62	104.71	40.00	100.00	31.42	213.62	.00
660.00	2653.00	28.98	31.64	40.16	26.83	2.48	98.88	40.00	160.00	26.50	256.30	.00
800.00	2653.00	26.60	29.11	36.52	25.27	2.62	104.97	40.00	140.00	23.98	211.90	.01
900.00	2653.00	24.88	27.33	34.35	24.70	2.69	107.43	40.00	100.00	22.19	196.90	.01

H =

R = 909.45 ≈ 910'

FB = 3.04

L = 1,138 { OUT = 1163.26
IN = 1113.23

ALT. #1

SPKHL1.OUT

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    01JUN92    TIME   14:37:31 *
*******************************************
```

```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

THIS RUN EXECUTED 01JUN92 14:37:31

```
************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************


THIS IS AN ARCHIVAL RUN ALL DATA AND RESULTS ARE SAVED ON UNIT   96

AC
AC AERIAL MAPPING: FLOOD CONTROL DISTRICT OF MARICOPA COUNTY   4-13-92
AC                 2801 W. DURANGO  PHX. AZ. 85009
AC                 PHONE (602) 501-1501
AC
AC SURVEY CONTROL: SOIL CONSERVATION SERVISE  DATE: 7-24-90
AC                 201 E. INDIANOLA AVE., SUITE 200
AC                 PHOENIX. ARIZONA 85012   TEL: (602) 640-5143
AC
AC   ************************************************************
AC   *                                                          *
AC   *  SPOOKHILL OUTLET DESIGN  SUPPER CRITICAL CONDITION      *
AC   *                                                          *
AC   ************************************************************
AC
AC   OUTLET CHANNEL WIDTH ..................................... 40 FEET
AC   OUTLET CHANNEL DEPTH  ..................................  5 FEET
AC   DISCHARGE FOR THE 100-YEAR BY FCD ....................  2653 CFS
AC   CULVERT INFORMATION OUT LET ELEVATION  ...............  1334.49
AC   BY FCD PROPOSED CONDITION MAP
AC   THERE ARE 4-10x10 CULVERTS
AC   THE MANNING N FOR THE CULVERT .........................     0.015
AC   THE MANNING N FOR THE CONCRET RETAINING ..............     0.015
AC   WALLS FOR SIDES AND GROUTED ROCK BOTTOM
AC
AC
AC
AC
T1 SPOOKHILL OUTLET DESIGN FOR THE SOIL CONSERVATION SERVICE
T2 FCD 6C300S  100 YEAR FLOW - PROPOSED CONDITION
T3 DATE: 4-13-92

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

      0        0        0        1    0.0285       0        0     2653      40       0

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

      1        0       -1        0        0        0       -1        0        0        15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT
```

38 43 1 2 3 26 25 8 4 39

50

NC	.065	.065	.015	.3	.5					
X1	314	28	76.58	123.42	86	86	86			
X3	10							49.00	46.80	
GR	43.80	67.75	36.80	74.75	36.80	75.75	43.80	75.75	43.80	76.58
GR	37.63	76.58	36.80	77.42	36.80	85.75	37.63	86.58	43.80	86.58
GR	43.80	88.75	37.63	88.75	36.80	89.58	36.80	97.92	37.63	98.75
GR	43.80	98.75	43.80	101.25	36.80	101.25	36.80	111.25	43.80	111.25
GR	43.80	113.42	36.80	113.42	36.80	123.42	43.80	123.42	43.80	124.25
GR	36.80	124.25	36.80	125.25	43.80	131.25				
NC	0.065	.065	.015	0.1	.3					
X1	400	28	76.58	123.42	124	76	100			
X3	10							49.00	46.80	
GR	41.49	67.75	34.49	74.75	34.49	75.75	41.49	75.75	41.49	76.58
GR	35.32	76.58	34.49	77.42	34.49	85.75	35.32	86.58	41.49	86.58
GR	41.49	88.75	35.32	88.75	34.49	89.58	34.49	97.92	35.32	98.75
GR	41.49	98.75	41.49	101.25	34.49	101.25	34.49	111.25	41.49	111.25
GR	41.49	113.42	34.49	113.42	34.49	123.42	41.49	123.42	41.49	124.25
GR	34.49	124.25	34.49	125.25	41.49	131.25				
X1	500	4	80	120	160	160	160			
GR	38.42	80	31.42	80	31.42	120	38.42	120		
X1	660	4	80	120	140	140	140			
GR	33.5	80	26.50	80	26.50	120	33.50	120		
X1	800	4	80	120	100	100	100			
GR	30.98	80	23.98	80	23.98	120	30.98	120		
X1	900	4	80	120	0	0	0			
GR	29.19	80	22.19	80	22.19	120	29.19	120		

[illegible]ECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
[illegible]Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .300 CEHV= .500
*SECNO 314.000

3265 DIVIDED FLOW

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

314.000	2.73	39.53	41.97	40.00	48.95	9.42	.00	.00	43.80
2653.0	.0	2653.0	.0	.0	107.7	.0	.0	.0	43.80
.00	.00	24.63	.00	.000	.015	.000	.000	36.80	76.58
.028254	0.	0.	0.	0	14	4	.00	40.00	123.42

FLOW DISTRIBUTION FOR SECNO= 314.00 CWSEL= 39.53

ST[illegible] 77. 123.
PER Q= 100.0
AREA= 107.7
VEL= 24.6
DEPTH= 2.7

CCHV= .100 CEHV= .300
*SECNO 400.000

3265 DIVIDED FLOW

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

400.000	2.75	37.24	39.67	.00	46.50	9.26	2.40	.05	41.49
2653.0	.0	2653.0	.0	.0	108.6	.0	.2	.1	41.49
.00	.00	24.42	.00	.000	.015	.000	.000	34.49	76.58
.027566	86.	86.	86.	8	14	0	.00	40.00	123.42

FLOW DISTRIBUTION FOR SECNO= 400.00 CWSEL= 37.24

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

STA= 77. 123.
PER Q= 100.0
AREA= 108.6
VEL= 24.4
DEPTH= 2.7

*SECNO 500.000

3301 HV CHANGED MORE THAN HVINS

500.000	2.62	34.04	36.56	.00	44.01	9.97	2.42	.07	38.42
2653.0	.0	2653.0	.0	.0	104.7	.0	.5	.2	38.42
.00	.00	25.34	.00	.000	.015	.000	.000	31.42	80.00
.021362	124.	100.	76.	6	14	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 500.00 CWSEL= 34.04

STA= 80. 120.
PER Q= 100.0
AREA= 104.7
VEL= 25.3
DEPTH= 2.6

*SECNO 660.000

3301 HV CHANGED MORE THAN HVINS

660.000	2.48	28.98	31.64	.00	40.16	11.18	3.74	.12	33.50
2653.0	.0	2653.0	.0	.0	98.9	.0	.8	.3	33.50
.00	.00	26.83	.00	.000	.015	.000	.000	26.50	80.00
.025630	160.	160.	160.	5	14	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 660.00 CWSEL= 28.98

STA= 80. 120.
PER Q= 100.0
AREA= 98.9
VEL= 26.8
DEPTH= 2.5

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 800.000

3301 HV CHANGED MORE THAN HVINS

800.000	2.62	26.60	29.11	.00	36.52	9.92	3.26	.38	30.98
2653.0	.0	2653.0	.0	.0	105.0	.0	1.2	.4	30.98
.01	.00	25.27	.00	.000	.015	.000	.000	23.98	80.00
.021190	140.	140.	140.	6	17	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 800.00 CWSEL= 26.60

STA= 80. 120.
PER Q= 100.0
AREA= 105.0
VEL= 25.3
DEPTH= 2.6

*SECNO 900.000

[illegible].000	2.69	24.88	27.33	.00	34.35	9.47	2.04	.13	29.19
[illegible]53.0	.0	2653.0	.0	.0	107.4	.0	1.4	.5	29.19
.01	.00	24.70	.00	.000	.015	.000	.000	22.19	80.00
.019690	100.	100.	100.	8	14	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 900.00 CWSEL= 24.88

STA= 80. 120.
PER Q= 100.0
AREA= 107.4
VEL= 24.7
DEPTH= 2.7

THIS RUN EXECUTED 01JUN92 14:37:33

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

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

4-13-92

SUMMARY PRINTOUT

SECNO	Q	CWSEL	CRIWS	EG	VCH	AREA	DEPTH	TOPWID	XLCH
314.000	2653.00	39.53	41.97	48.95	24.63	107.71	2.73	40.00	.00
400.000	2653.00	37.24	39.67	46.50	24.42	108.64	2.75	40.00	86.00
500.000	2653.00	34.04	36.56	44.01	25.34	104.71	2.62	40.00	100.00
660.000	2653.00	28.98	31.64	40.16	26.83	98.88	2.48	40.00	160.00
800.000	2653.00	26.60	29.11	36.52	25.27	104.97	2.62	40.00	140.00
900.000	2653.00	24.88	27.33	34.35	24.70	107.43	2.69	40.00	100.00

92

SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
314.000	.00	.00	.00	36.80	2653.00	39.53	41.97	48.95	282.54	24.63	107.71	157.83
400.000	86.00	.00	.00	34.49	2653.00	37.24	39.67	46.50	275.66	24.42	108.64	159.79
500.000	100.00	.00	.00	31.42	2653.00	34.04	36.56	44.01	213.62	25.34	104.71	181.52
660.000	160.00	.00	.00	26.50	2653.00	28.98	31.64	40.16	256.30	26.83	98.88	165.72
800.000	140.00	.00	.00	23.98	2653.00	26.60	29.11	36.52	211.90	25.27	104.97	182.25
900.000	100.00	.00	.00	22.19	2653.00	24.88	27.33	34.35	196.90	24.70	107.43	189.07

-92

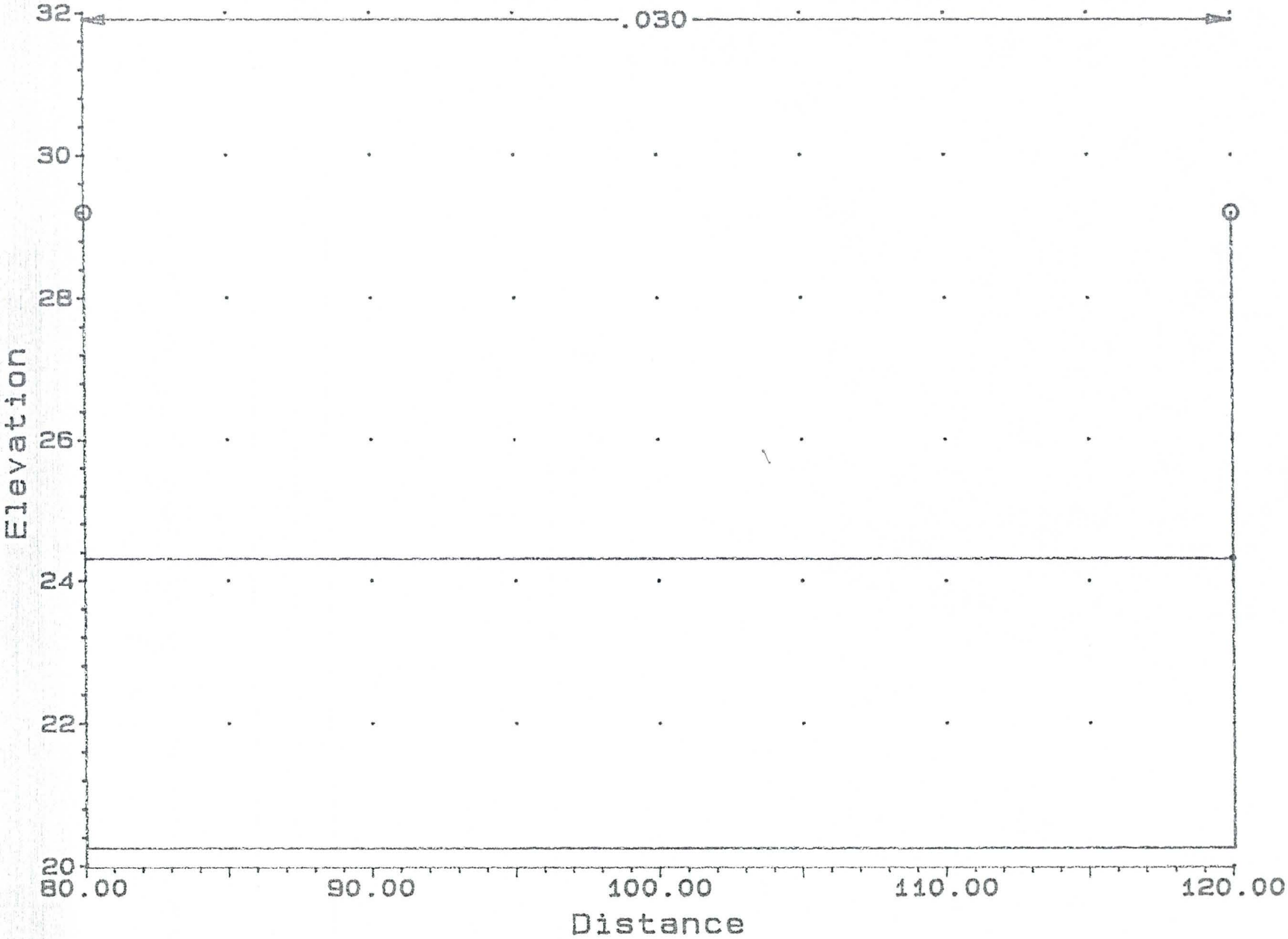
SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
314.000	2653.00	39.53	.00	.00	-.47	40.00	.00
400.000	2653.00	37.24	.00	-2.29	.00	40.00	86.00
500.000	2653.00	34.04	.00	-3.20	.00	40.00	100.00
660.000	2653.00	28.98	.00	-5.07	.00	40.00	160.00
800.000	2653.00	26.60	.00	-2.37	.00	40.00	140.00
900.000	2653.00	24.88	.00	-1.73	.00	40.00	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

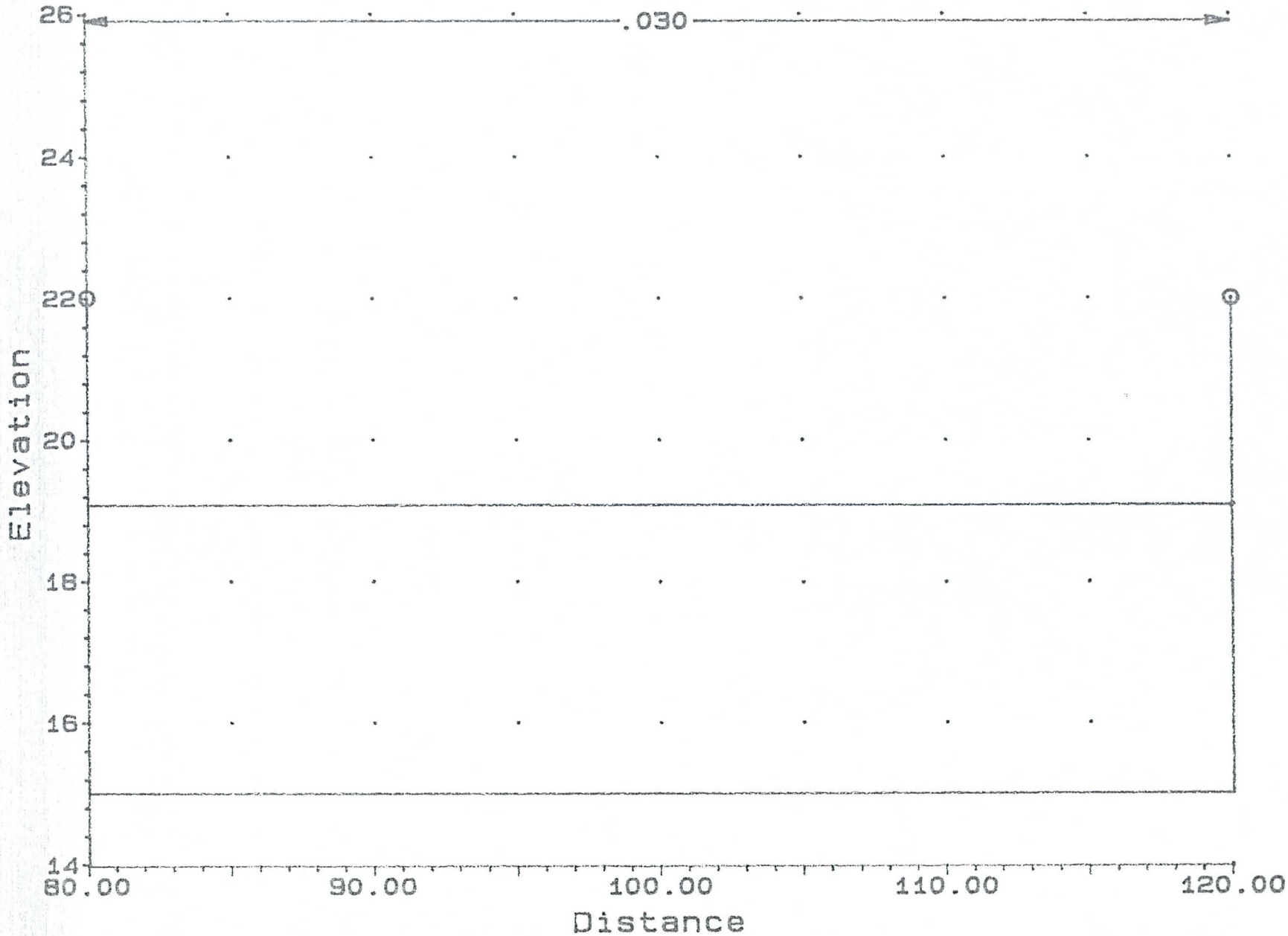
4-13-92

Cross-section 1045.100



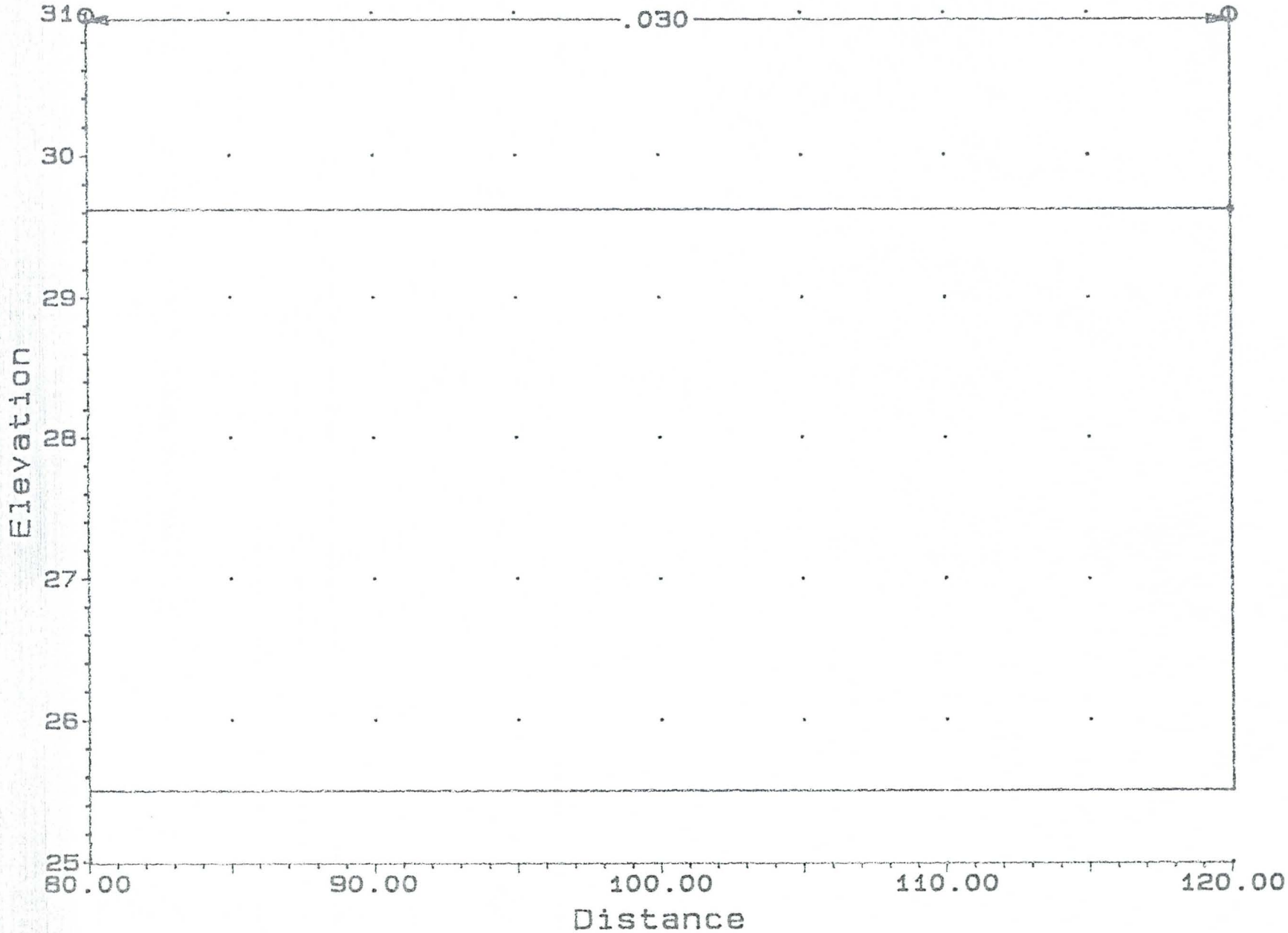
4-13-92

Cross-section 1290.300



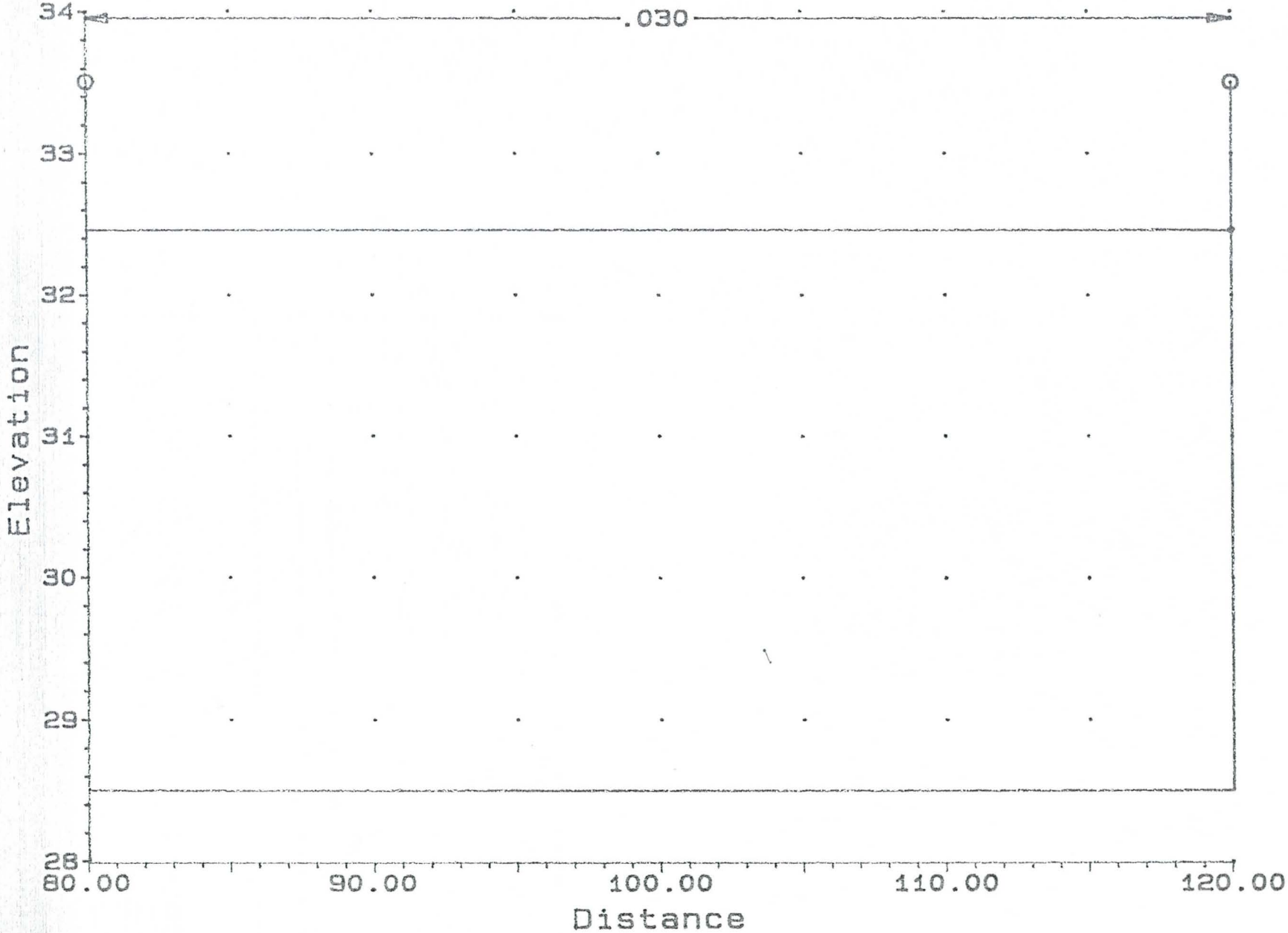
4-13-92

Cross-section 800.000



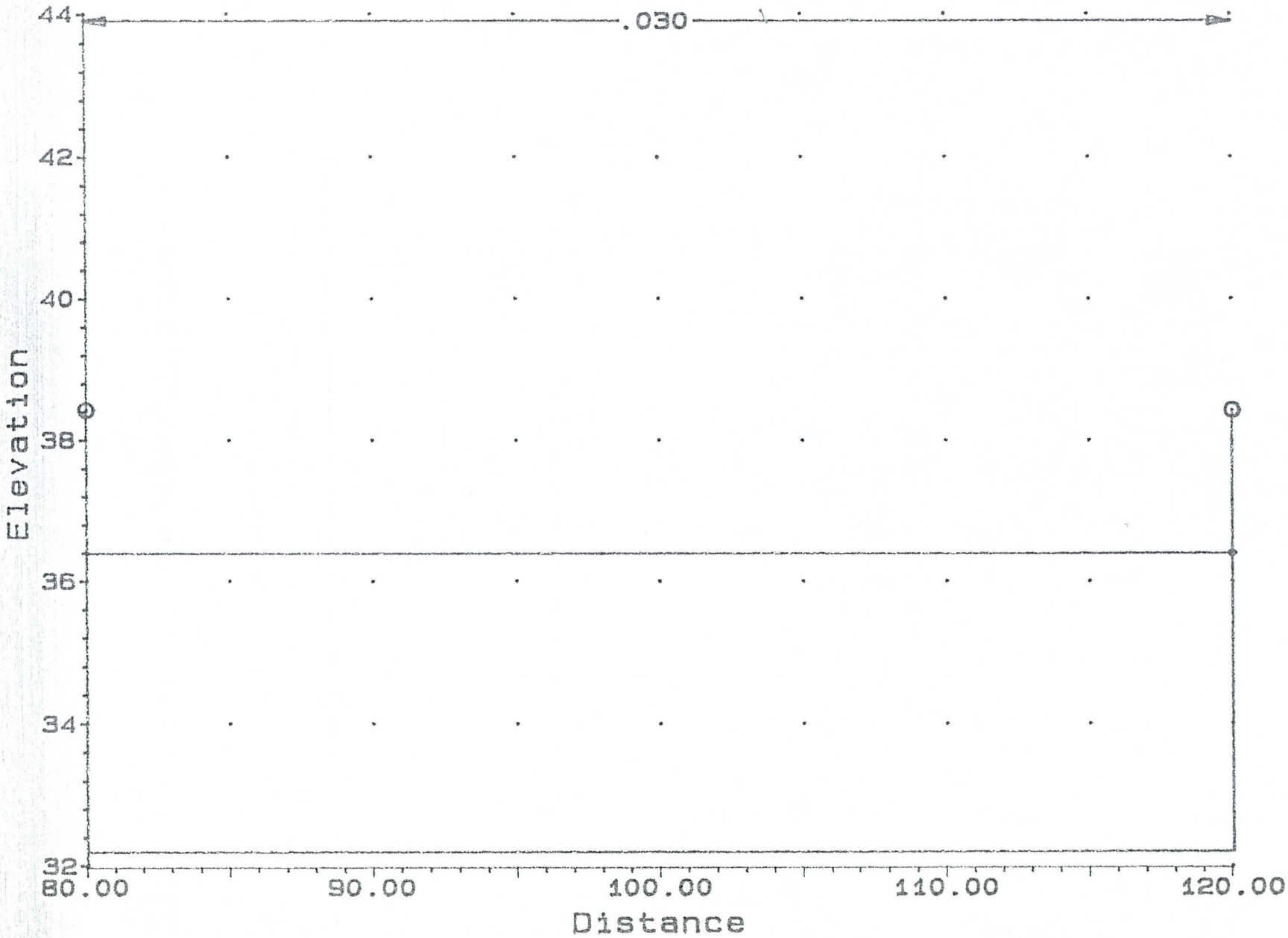
4-13-92

Cross-section 660.000



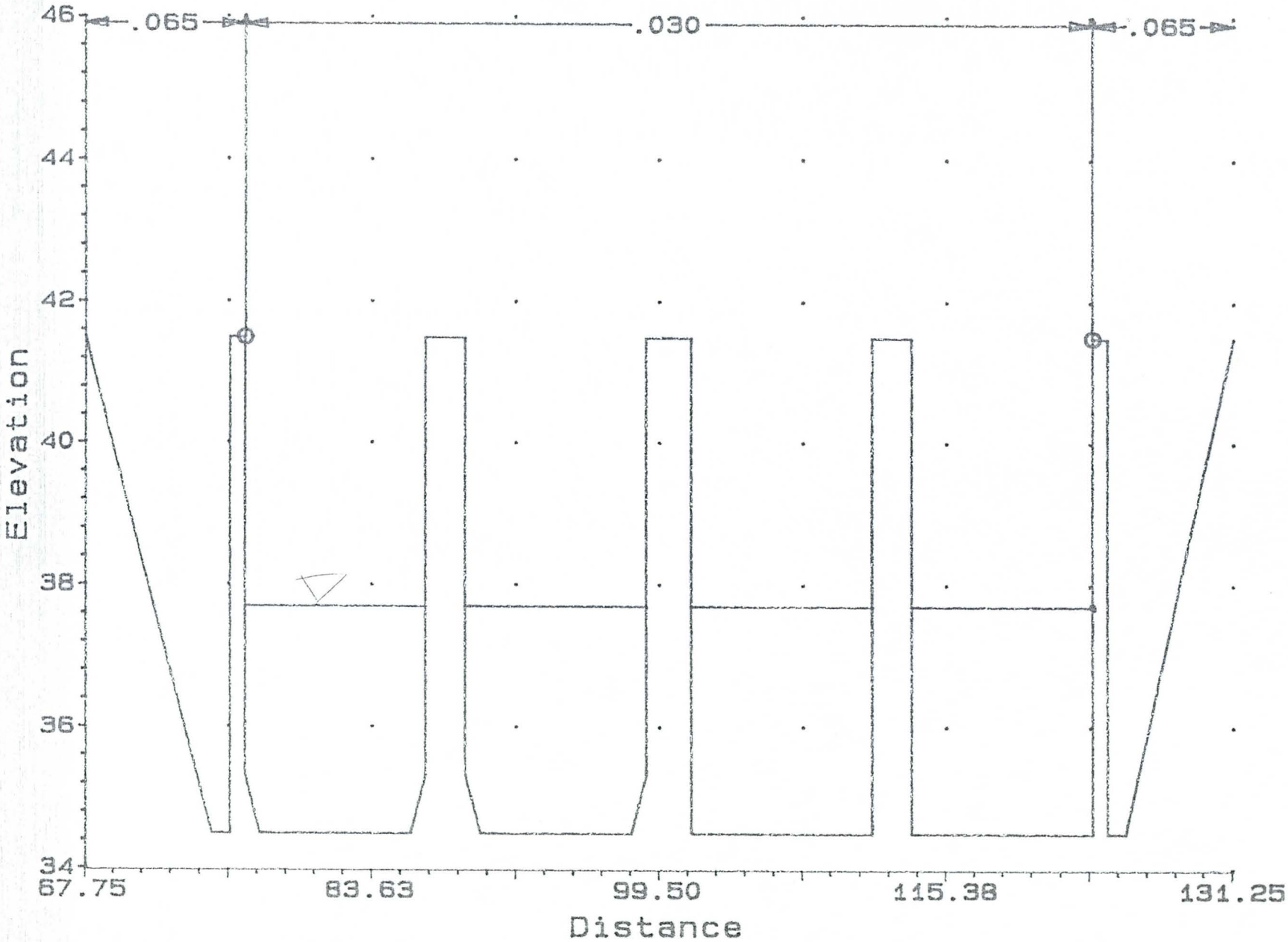
4-13-92

Cross-section 500.000



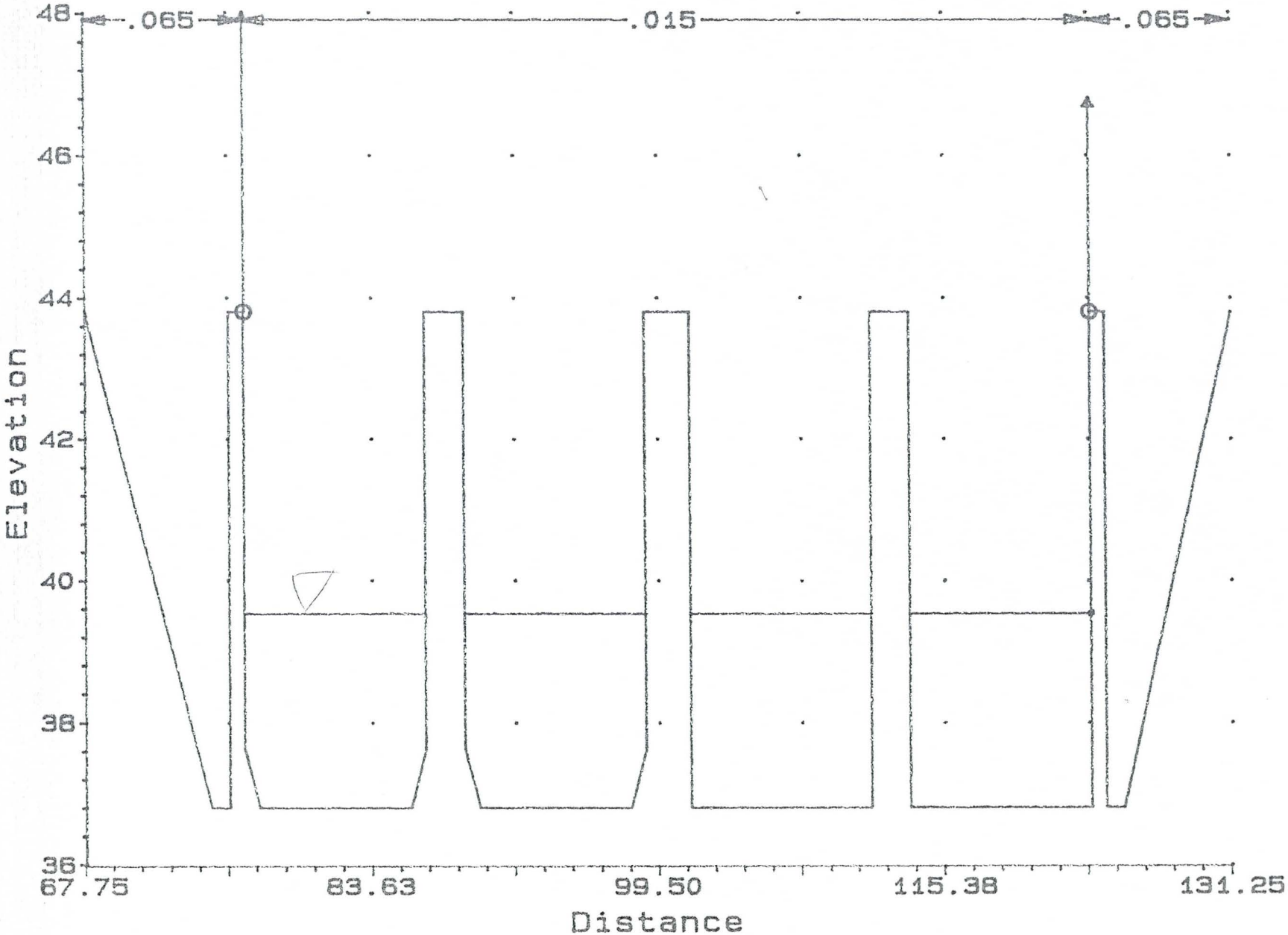
4-13-92

Cross-section 400.000



4-13-92

Cross-section 314.000



APPENDIX B

B.2

HEC-2 MODEL ALTERNATIVE NO. 2

ALT. #2

SPKHL 2.OUT

~~SPKHL 1.DAT~~

CHANNEL WIDTH = 40'

D = 5'

Q = 2653 CFS

Culvert outlet Elev = 1334.49

Manning N = .030

```
*-----------------------------------*
|            S U M P O              |
|                                   |
|  Interactive Summary Printout     |
|  for MS/PC-DOS micro computers    |
|            May 1991               |
*-----------------------------------*
```

NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

4-13-92

Summary Printout

	SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S	TIME
	314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54	.00
*	400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49	713.97	.00
*	500.00	2653.00	35.27	36.55	39.87	17.21	3.85	154.18	40.00	100.00	31.42	252.56	.00
	660.00	2653.00	30.11	31.63	35.35	18.35	3.61	144.54	40.00	160.00	26.50	308.97	.01
	800.00	2653.00	28.08	28.87	31.69	15.24	4.35	174.07	40.00	140.00	23.73	173.25	.01
	1020.00	2653.00	23.48	24.51	27.50	16.09	4.12	164.87	40.00	220.14	19.36	204.99	.01
	1240.00	2653.00	19.20	20.13	23.07	15.80	4.20	167.93	40.00	220.14	15.00	193.63	.02

	STA	FB		CHANNEL Depth
STA:	400	2.50	0	5.70
	500	2.11	0	5.96
	660	2.21	0	5.82
Curve	800	1.99	0	6.34
	1020	2.04	1	7.16
	1240	2.02	1	7.22

R = 385.92'

L = 482.72'

H = 6.34' L1 = 400'

Hc = 7.22' L2 = 483'

883

800 → Curve starts
660

L1 = 800 − 660 = 140

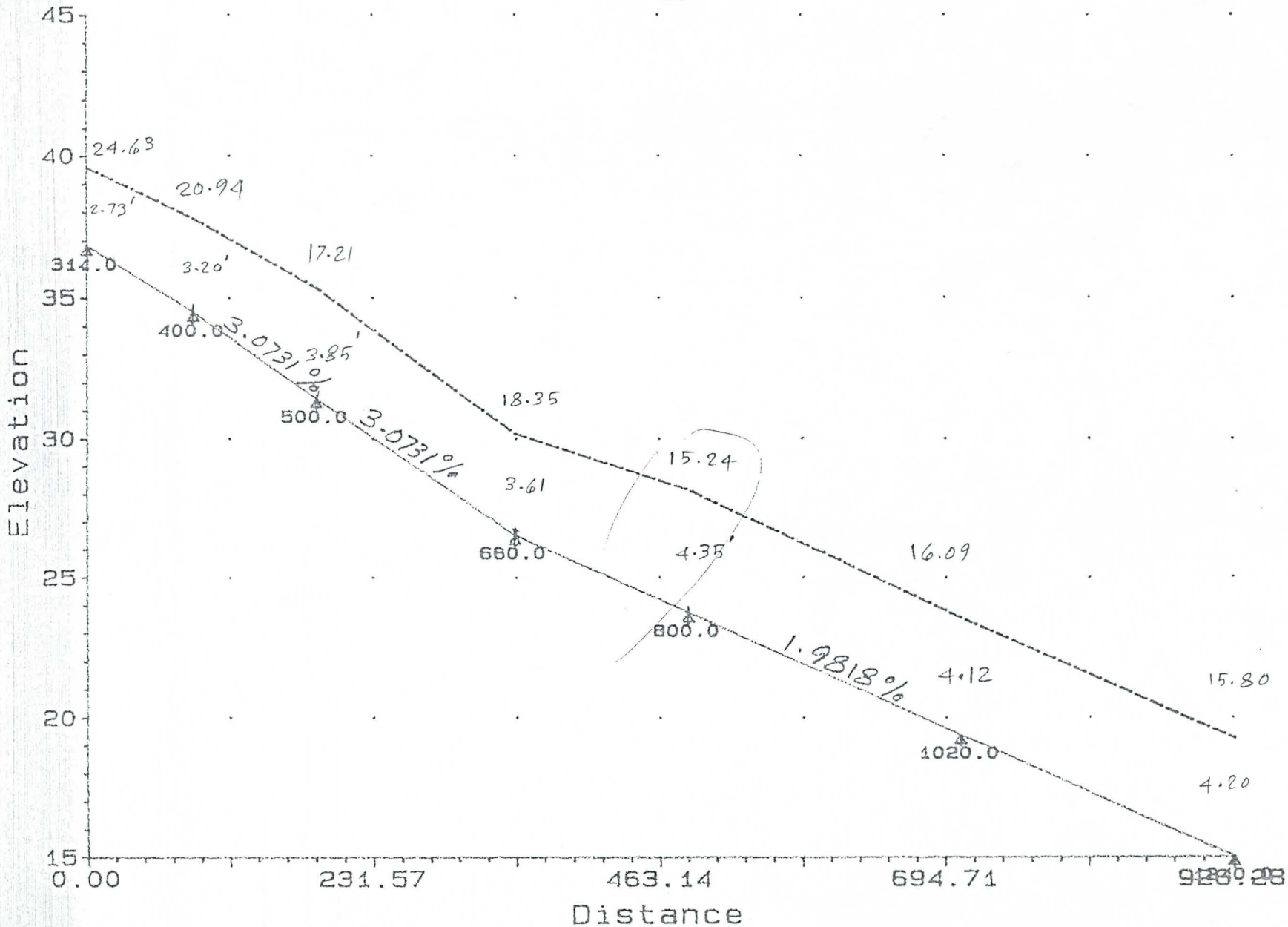
L2 = 483

= 140 + 483 = 623'

PREFERED METHOD

4-13-92

SPKHL2.DAT



ALT. #2

~~SPKHL1~~

SPKHL2

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    01JUN92    TIME   14:46:28 *
*******************************************
```

```
*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  HYDROLOGIC ENGINEERING CENTER    *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616-4687     *
*          (916) 756-1104           *
*************************************
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

THIS RUN EXECUTED 01JUN92 14:46:29

```
************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************



THIS IS AN ARCHIVAL RUN ALL DATA AND RESULTS ARE SAVED ON UNIT   96

AC
AC AERIAL MAPPING: FLOOD CONTROL DISTRICT OF MARICOPA COUNTY   4-13-92
AC                 2801 W. DURANGO  PHX. AZ. 85009
AC                 PHONE (602) 501-1501
AC
AC SURVEY CONTROL: SOIL CONSERVATION SERVISE  DATE: 7-24-90
AC                 201 E. INDIANOLA AVE., SUITE 200
AC                 PHOENIX. ARIZONA 85012   TEL: (602) 640-5143
AC
AC   ************************************************************
AC   *                                                          *
AC   *  SPOOKHILL OUTLET DESIGN  SUPPER CRITICAL CONDITION      *
AC   *                                                          *
AC   ************************************************************
AC
AC   OUTLET CHANNEL WIDTH ..................................... 40 FEET
AC   OUTLET CHANNEL DEPTH  ..................................  5 FEET
AC   DISCHARGE FOR THE 100-YEAR BY FCD ....................  2653 CFS
AC   CULVERT INFORMATION OUT LET ELEVATION  ...............  1334.49
AC   BY FCD PROPOSED CONDITION MAP
AC   THERE ARE 4-10x10 CULVERTS
AC   THE MANNING N FOR THE CULVERT .......................     0.015
AC   THE MANNING N FOR THE CONCRET RETAINING ..............     0.030
AC   WALLS FOR SIDES AND GROUTED ROCK BOTTOM
AC
AC
AC
AC
T1 SPOOKHILL OUTLET DESIGN FOR THE SOIL CONSERVATION SERVICE
T2 FCD 6C300S  100 YEAR FLOW - PROPOSED CONDITION
T3 DATE: 4-13-92

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0         0         0         1    0.0285         0         0      2653        40         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

            0        -1         0         0         0        -1         0         0        15

J3  VARIABLE CODES FOR SUMMARY PRINTOUT
```

38 43 1 2 3 26 25 8 4 39

Date: Bush HWY Box Culvert
Sht. 6 of 13
Culvert Detail
Section A-A
Inflow: 1336.80
outflow: 1334.49
L = 81

50

NC	.065	.065	.015	.3	.5					
X1	314	28	76.58	123.42	86	86	86			
X3	10							49.00	46.80	
GR	43.80	67.75	36.80	74.75	36.80	75.75	43.80	75.75	43.80	76.58
GR	37.63	76.58	36.80	77.42	36.80	85.75	37.63	86.58	43.80	86.58
GR	43.80	88.75	37.63	88.75	36.80	89.58	36.80	97.92	37.63	98.75
GR	43.80	98.75	43.80	101.25	36.80	101.25	36.80	111.25	43.80	111.25
GR	43.80	113.42	36.80	113.42	36.80	123.42	43.80	123.42	43.80	124.25
GR	36.80	124.25	36.80	125.25	43.80	131.25				
NC	0.065	.065	.030	0.1	.3					
X1	400	28	76.58	123.42	124	76	100			
X3	10							49.00	46.80	
GR	41.49	67.75	34.49	74.75	34.49	75.75	41.49	75.75	41.49	76.58
GR	35.32	76.58	34.49	77.42	34.49	85.75	35.32	86.58	41.49	86.58
GR	41.49	88.75	35.32	88.75	34.49	89.58	34.49	97.92	35.32	98.75
GR	41.49	98.75	41.49	101.25	34.49	101.25	34.49	111.25	41.49	111.25
GR	41.49	113.42	34.49	113.42	34.49	123.42	41.49	123.42	41.49	124.25
GR	34.49	124.25	34.49	125.25	41.49	131.25				
X1	500	4	80	120	160	160	160			
GR	38.42	80	31.42	80	31.42	120	38.42	120		
X1	660	4	80	120	140	140	140			
GR	33.5	80	26.50	80	26.50	120	33.50	120		
X1	800	4	80	120	207.64	232.65	220.14			
GR	30.98	80	23.73	80	23.73	120	30.98	120		
X1	1020	4	80	120	207.64	232.65	220.14			
GR	29.19	80	19.36	80	19.36	120	29.19	120		
X1	1240	4	80	120	0	0	0			
GR	22	80	15	80	15	120	22	120		

[illegible]ECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
[illegible]	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .300 CEHV= .500
*SECNO 314.000

3265 DIVIDED FLOW

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

314.000	2.73	39.53	41.97	40.00	48.95	9.42	.00	.00	43.80
2653.0	.0	2653.0	.0	.0	107.7	.0	.0	.0	43.80
.00	.00	24.63	.00	.000	.015	.000	.000	36.80	76.58
.028254	0.	0.	0.	0	14	4	.00	40.00	123.42

FLOW DISTRIBUTION FOR SECNO= 314.00 CWSEL= 39.53

S[illegible] 77. 123.
PER Q= 100.0
AREA= 107.7
VEL= 24.6
DEPTH= 2.7

CCHV= .100 CEHV= .300
*SECNO 400.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.59

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

400.000	3.20	37.69	39.67	.00	44.50	6.81	3.66	.78	41.49
2653.0	.0	2653.0	.0	.0	126.7	.0	.2	.1	41.49
.00	.00	20.94	.00	.000	.030	.000	.000	34.49	76.58
.071397	86.	86.	86.	7	14	0	.00	40.00	123.42

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 400.00 CWSEL= 37.69

STA= 77. 123.
PER Q= 100.0
AREA= 126.7
VEL= 20.9
DEPTH= 3.2

*SECNO 500.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .59

500.000	3.85	35.27	36.55	.00	39.87	4.60	3.97	.66	38.42
2653.0	.0	2653.0	.0	.0	154.2	.0	.6	.2	38.42
.00	.00	17.21	.00	.000	.030	.000	.000	31.42	80.00
.025256	124.	100.	76.	5	14	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 500.00 CWSEL= 35.27

STA= 80. 120.
PER Q= 100.0
AREA= 154.2
VEL= 17.2
DEPTH= 3.9

*SECNO 660.000

3301 HV CHANGED MORE THAN HVINS

660.000	3.61	30.11	31.63	.00	35.35	5.23	4.46	.06	33.50
2653.0	.0	2653.0	.0	.0	144.5	.0	1.1	.3	33.50
.01	.00	18.35	.00	.000	.030	.000	.000	26.50	80.00
.030897	160.	160.	160.	6	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 660.00 CWSEL= 30.11

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

STA= 80. 120.
PER Q= 100.0
AREA= 144.5
VEL= 18.4
DEPTH= 3.6

*SECNO 800.000

3301 HV CHANGED MORE THAN HVINS

800.000	4.35	28.08	28.87	.00	31.69	3.61	3.17	.49	30.98
2653.0	.0	2653.0	.0	.0	174.1	.0	1.6	.4	30.98
.01	.00	15.24	.00	.000	.030	.000	.000	23.73	80.00
.017325	140.	140.	140.	5	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 800.00 CWSEL= 28.08

STA= 80. 120.
PER Q= 100.0
AREA= 174.1
VEL= 15.2
DEPTH= 4.4

*SECNO 1020.000

1020.000	4.12	23.48	24.51	.00	27.50	4.02	4.14	.04	29.19
2653.0	.0	2653.0	.0	.0	164.9	.0	2.5	.6	29.19
.01	.00	16.09	.00	.000	.030	.000	.000	19.36	80.00
.020499	208.	220.	233.	7	8	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1020.00 CWSEL= 23.48

STA= 80. 120.
PER Q= 100.0
AREA= 164.9
VEL= 16.1
DEPTH= 4.1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1240.000

1240.000	4.20	19.20	20.13	.00	23.07	3.88	4.38	.04	22.00
2653.0	.0	2653.0	.0	.0	167.9	.0	3.3	.9	22.00
.02	.00	15.80	.00	.000	.030	.000	.000	15.00	80.00
.019363	208.	220.	233.	6	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1240.00 CWSEL= 19.20

STA=	80.	120.
PER Q=	100.0	
AREA=	167.9	
VEL=	15.8	
DEPTH=	4.2	

THIS RUN EXECUTED 01JUN92 14:46:32

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

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

4-13-92

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	EG	VCH	AREA	DEPTH	TOPWID	XLCH
	314.000	2653.00	39.53	41.97	48.95	24.63	107.71	2.73	40.00	.00
*	400.000	2653.00	37.69	39.67	44.50	20.94	126.70	3.20	40.00	86.00
*	500.000	2653.00	35.27	36.55	39.87	17.21	154.18	3.85	40.00	100.00
	660.000	2653.00	30.11	31.63	35.35	18.35	144.54	3.61	40.00	160.00
	800.000	2653.00	28.08	28.87	31.69	15.24	174.07	4.35	40.00	140.00
	1020.000	2653.00	23.48	24.51	27.50	16.09	164.87	4.12	40.00	220.14
	1240.000	2653.00	19.20	20.13	23.07	15.80	167.93	4.20	40.00	220.14

4 92

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	314.000	.00	.00	.00	36.80	2653.00	39.53	41.97	48.95	282.54	24.63	107.71	157.83
*	400.000	86.00	.00	.00	34.49	2653.00	37.69	39.67	44.50	713.97	20.94	126.70	99.29
*	500.000	100.00	.00	.00	31.42	2653.00	35.27	36.55	39.87	252.56	17.21	154.18	166.94
	660.000	160.00	.00	.00	26.50	2653.00	30.11	31.63	35.35	308.97	18.35	144.54	150.93
	800.000	140.00	.00	.00	23.73	2653.00	28.08	28.87	31.69	173.25	15.24	174.07	201.56
	1020.000	220.14	.00	.00	19.36	2653.00	23.48	24.51	27.50	204.99	16.09	164.87	185.30
	1240.000	220.14	.00	.00	15.00	2653.00	19.20	20.13	23.07	193.63	15.80	167.93	190.66

-92

SUMMARY PRINTOUT TABLE 150

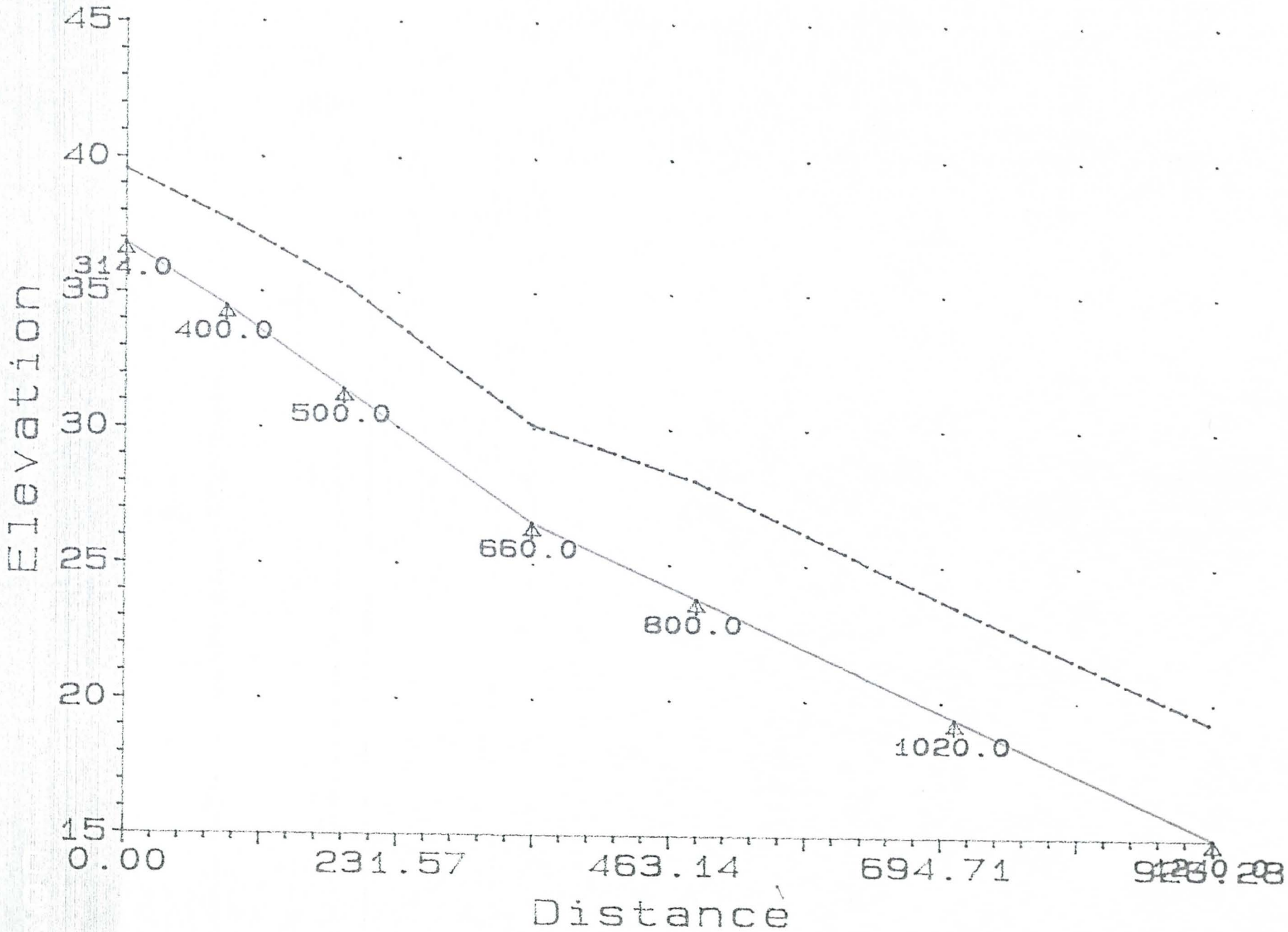
	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	314.000	2653.00	39.53	.00	.00	-.47	40.00	.00
*	400.000	2653.00	37.69	.00	-1.83	.00	40.00	86.00
*	500.000	2653.00	35.27	.00	-2.42	.00	40.00	100.00
	660.000	2653.00	30.11	.00	-5.15	.00	40.00	160.00
	800.000	2653.00	28.08	.00	-2.04	.00	40.00	140.00
	1020.000	2653.00	23.48	.00	-4.60	.00	40.00	220.14
	1240.000	2653.00	19.20	.00	-4.28	.00	40.00	220.14

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO= 400.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

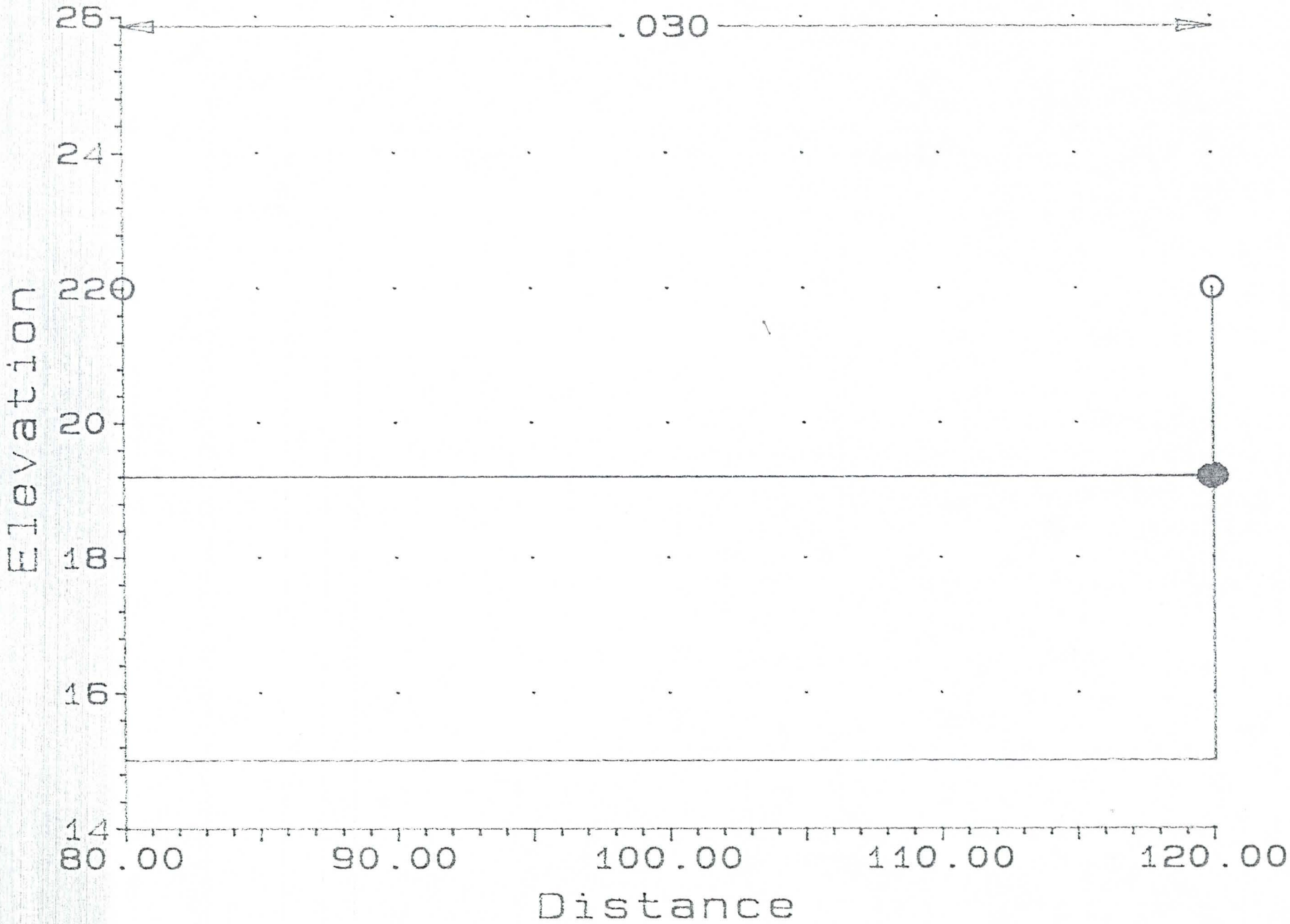
WARNING SECNO= 500.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

4-13-92


45
40
35
30
25
20
15
Elevation
314.0
400.0
500.0
660.0
800.0
1020.0
0.00
231.57
463.14
694.71
Distance

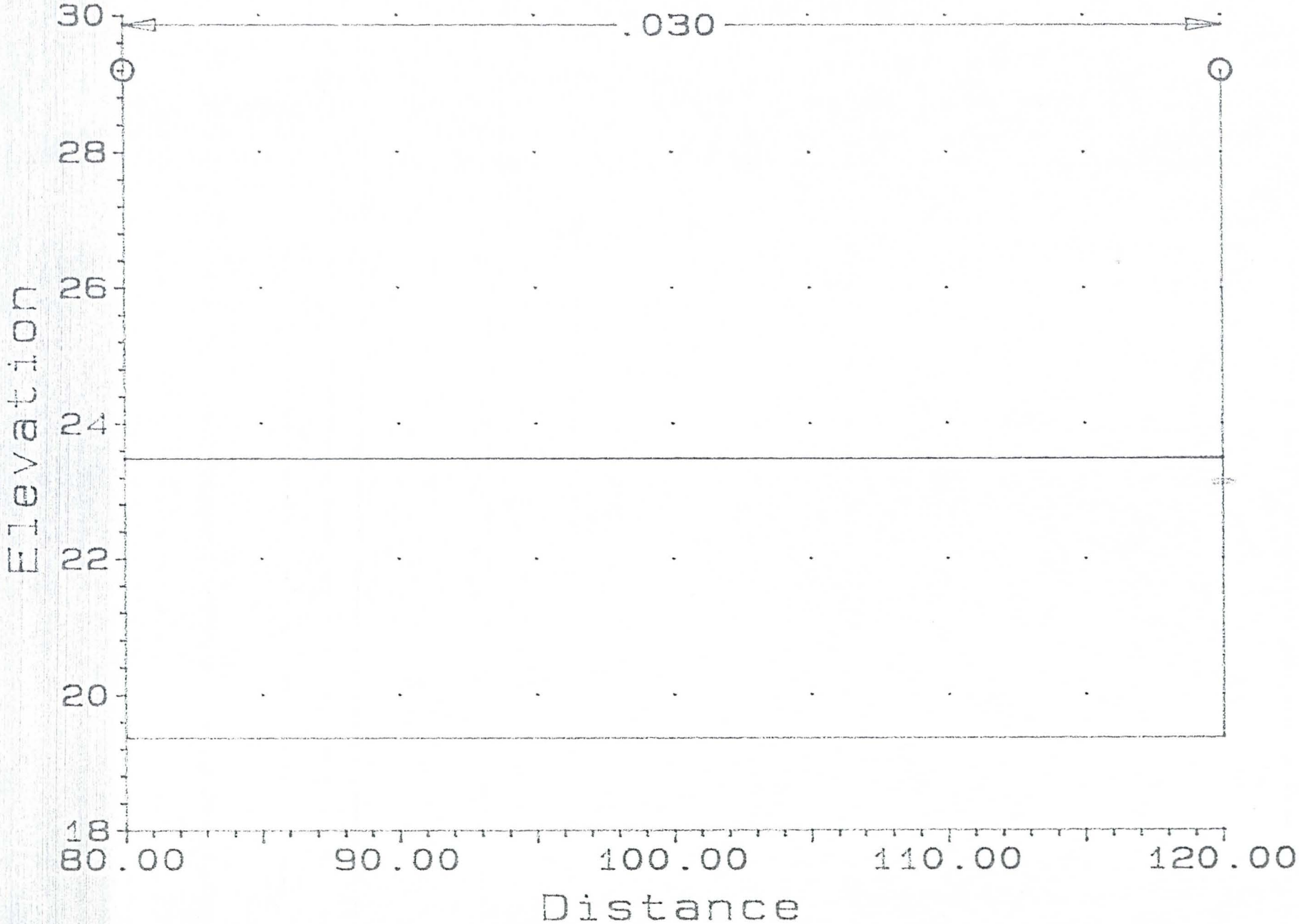
4-13-92

Cross-section 1240.000



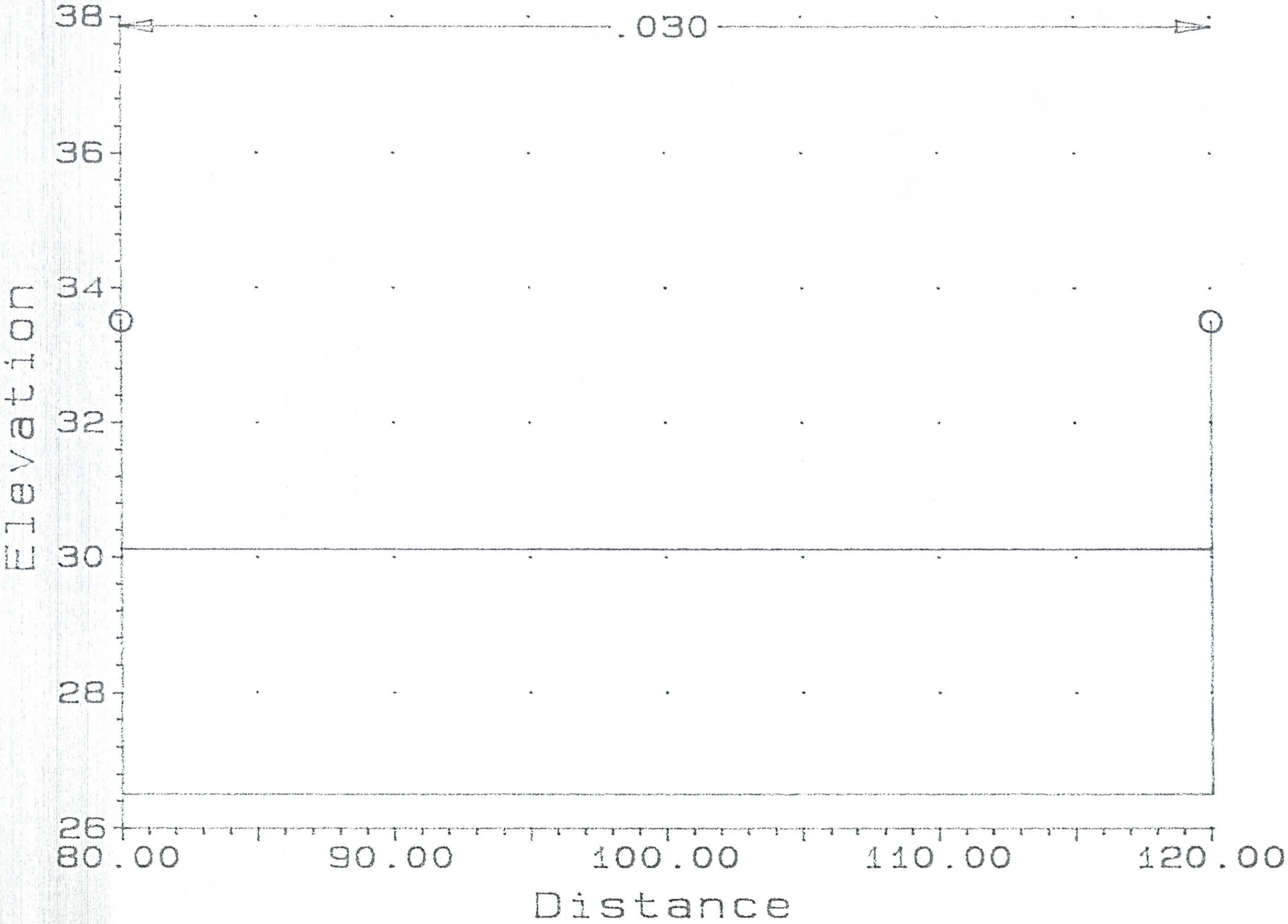
4-13-92

Cross-section 1020.000



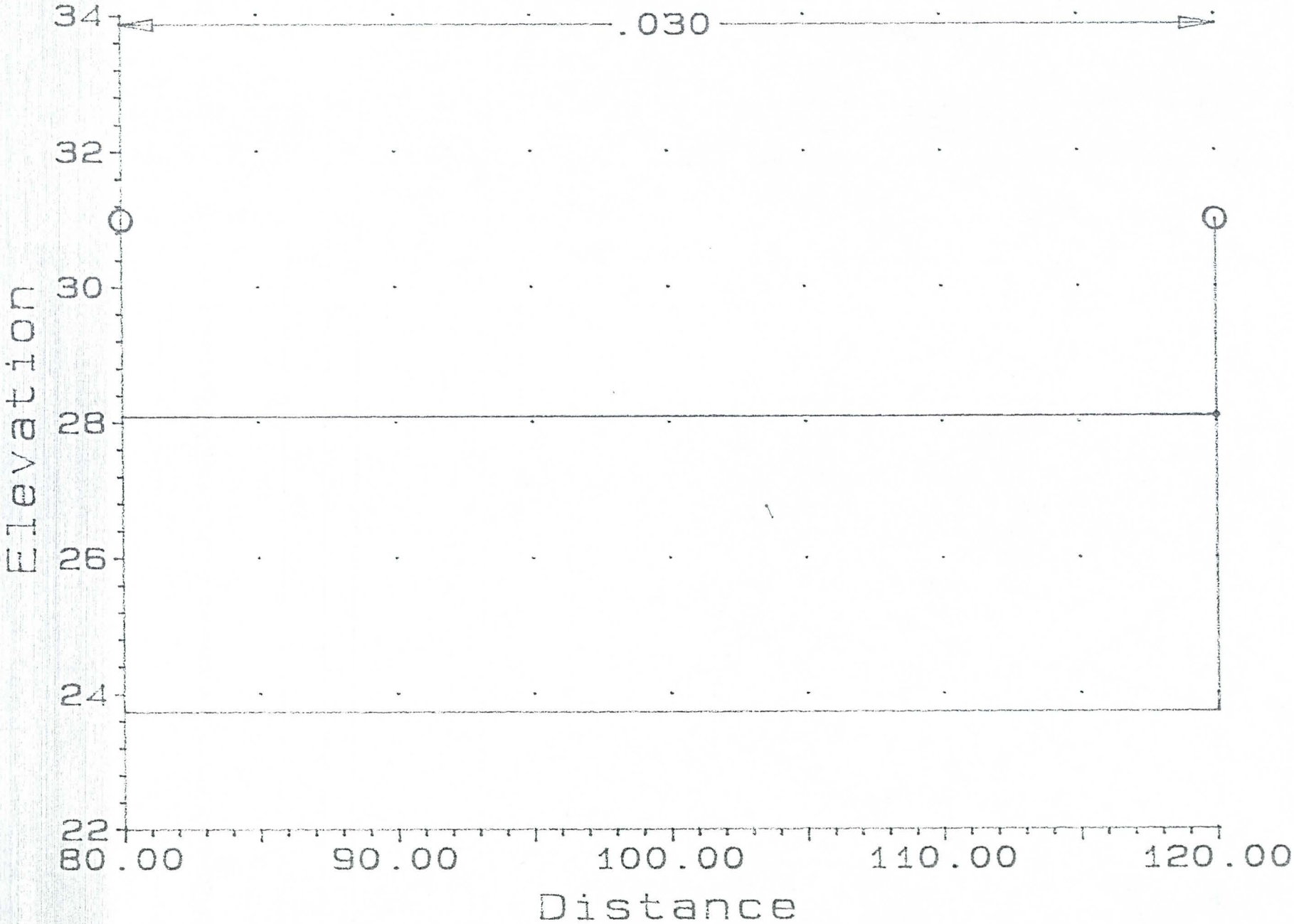
4-13-92

Cross-section 660.000



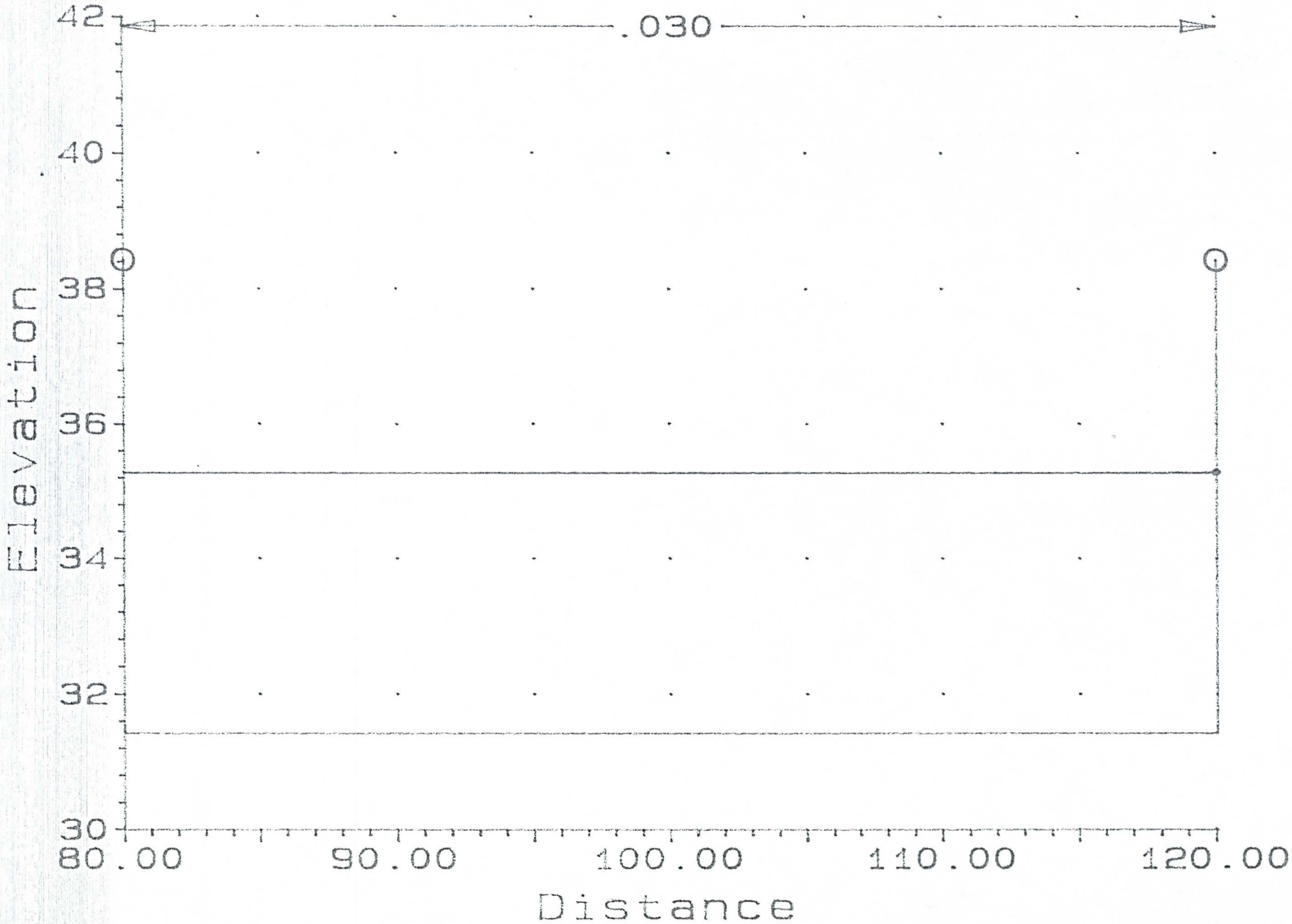
4-13-92

Cross-section 800.000



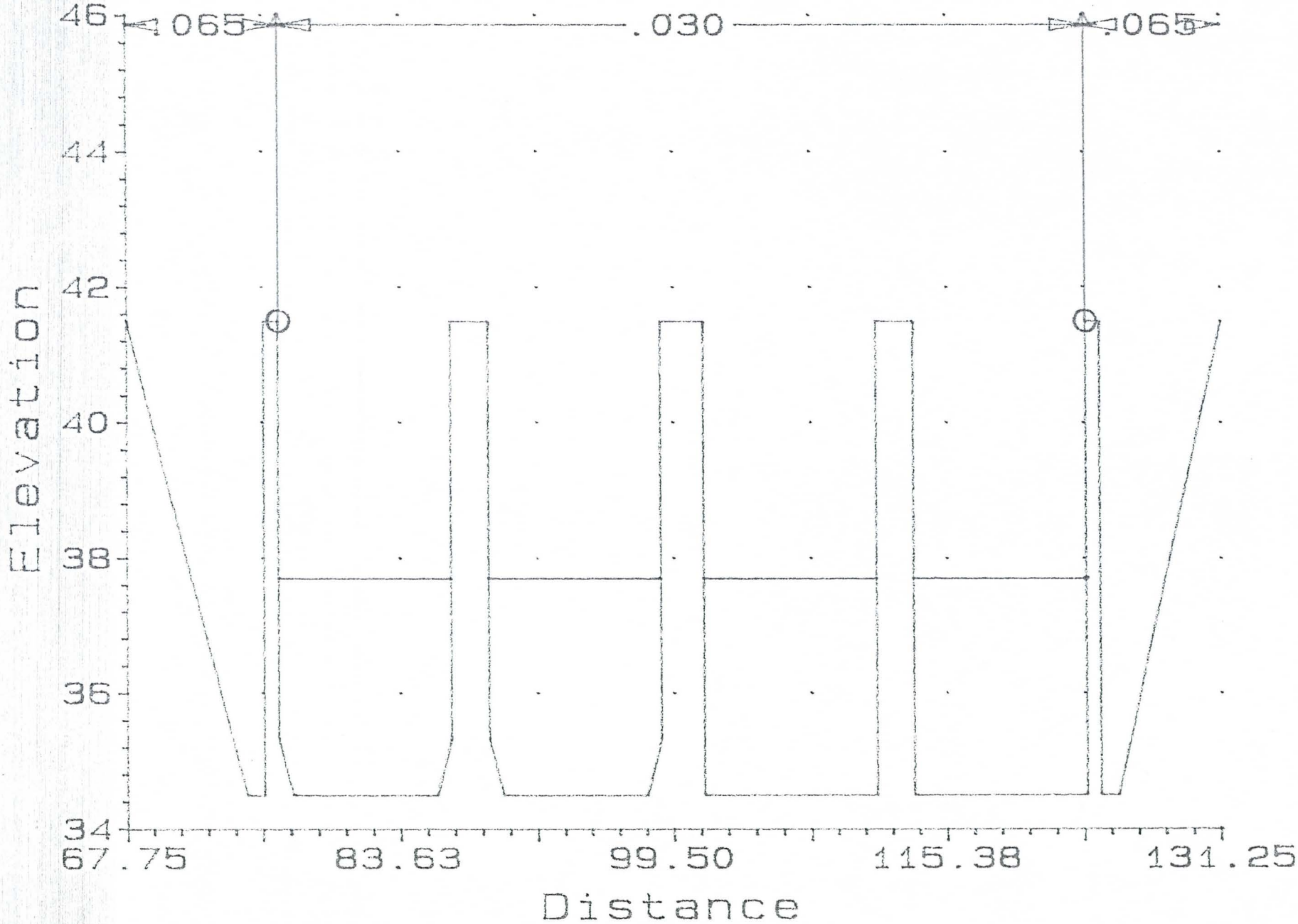
4-13-92

Cross-section 500.000



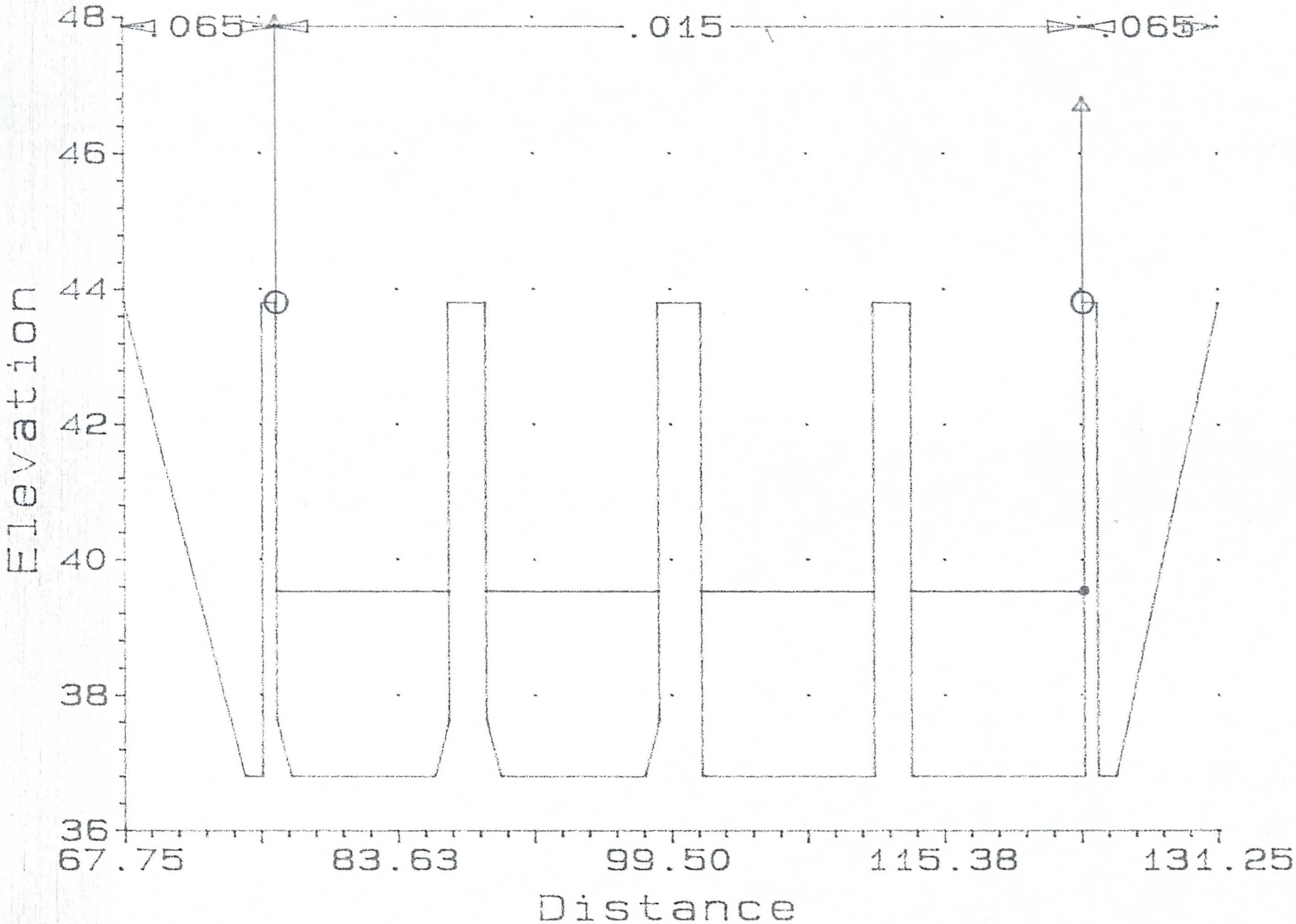
4-13-92

Cross-section 400.000



4-13-92

Cross-section 314.000



APPENDIX B

B.3

HEC-2 MODEL ALTERNATIVE NO. 3

SPKHL 3.00T

ALT #3

```
*-----------------------------------*
|              S U M P O            |
|                                   |
|   Interactive Summary Printout    |
|   for MS/PC-DOS micro computers   |
|             May 1991              |
*-----------------------------------*
```

NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

4-13-92

Summary Printout

	SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S	TIME
	314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54	.00
*	400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49	713.97	.00
*	500.00	2653.00	35.81	36.93	40.06	16.54	4.01	160.36	40.00	100.00	31.80	223.44	.00
	660.00	2653.00	31.28	32.63	36.08	17.58	3.78	150.87	40.00	160.00	27.50	270.25	.01
	800.00	2653.00	28.85	29.75	32.65	15.65	4.24	169.53	40.00	140.00	24.61	188.02	.01
	1032.60	2653.00	23.88	24.93	27.98	16.26	4.08	163.18	40.00	232.65	19.80	211.67	.01
	1265.30	2653.00	19.14	20.13	23.13	16.04	4.14	165.42	40.00	232.65	15.00	202.88	.02

STA	FB	Curve	CHANNEL Depth
4+00	2.50		5.70
5+00	2.06		6.07
6+60	2.14		5.92
8+00	2.01		6.25
10+32	2.05		7.13
12+65	2.03		7.17

R = 394.12

L = 492.97

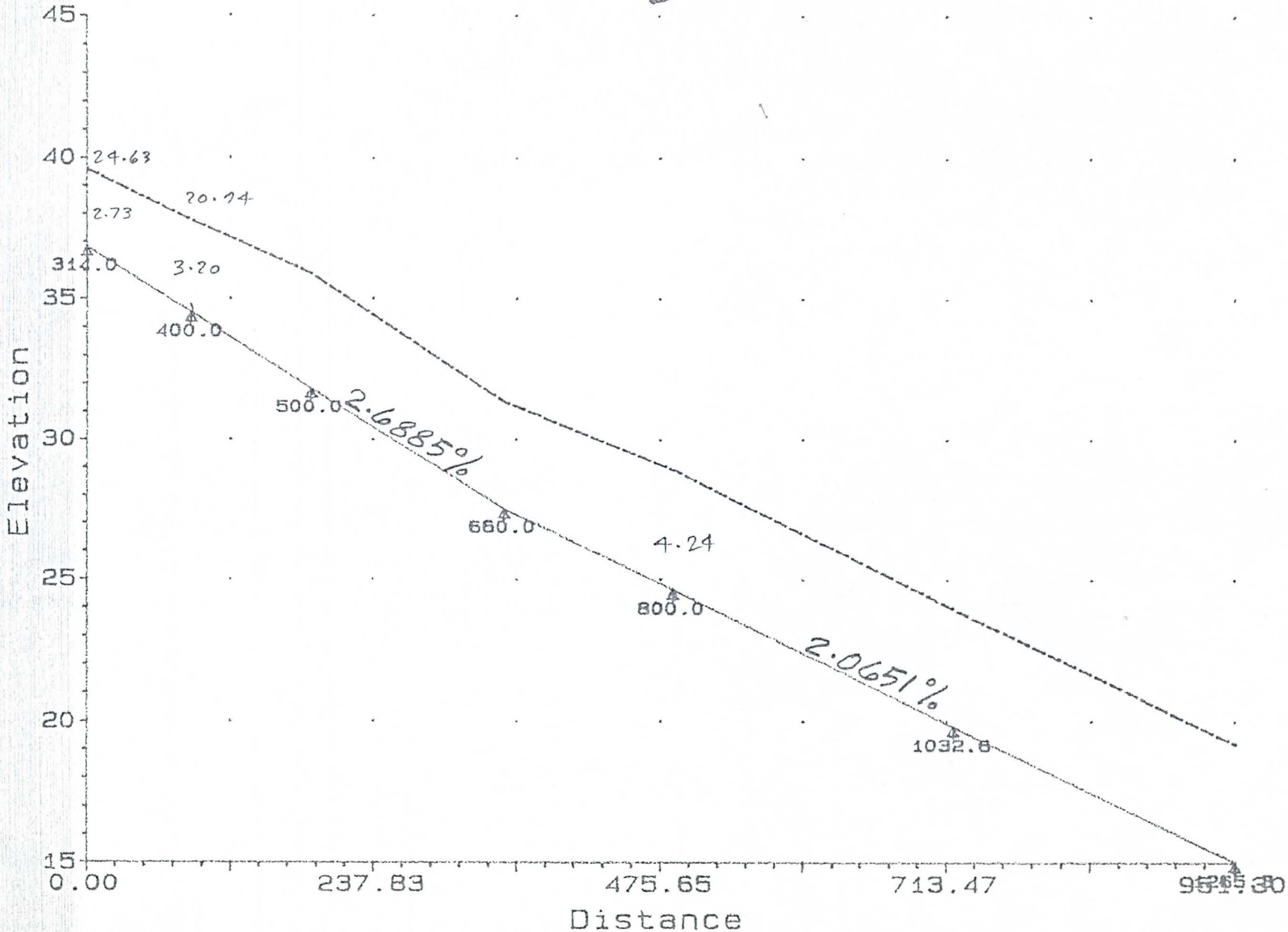
H = 6.25 L_1 = 400

H_c = 7.13 L_2 = 493

893

4-13-92

SPKHL3.DAT



ALT. # 3

~~SPKHL2~~

SPKHL3

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    01JUN92    TIME   14:50:01  *
*******************************************
```

```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

THIS RUN EXECUTED 01JUN92 14:50:01

```
************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************


THIS IS AN ARCHIVAL RUN ALL DATA AND RESULTS ARE SAVED ON UNIT   96

AC
AC AERIAL MAPPING: FLOOD CONTROL DISTRICT OF MARICOPA COUNTY   4-13-92
AC                 2801 W. DURANGO  PHX. AZ. 85009
AC                 PHONE (602) 501-1501
AC
AC SURVEY CONTROL: SOIL CONSERVATION SERVISE  DATE: 7-24-90
AC                 201 E. INDIANOLA AVE., SUITE 200
AC                 PHOENIX. ARIZONA 85012   TEL: (602) 640-5143
AC
AC   ************************************************************
AC   *                                                          *
AC   *  SPOOKHILL OUTLET DESIGN  SUPPER CRITICAL CONDITION      *
AC   *                                                          *
AC   ************************************************************
AC
AC   OUTLET CHANNEL WIDTH ..................................... 40 FEET
AC   OUTLET CHANNEL DEPTH  ..................................  5 FEET
AC   DISCHARGE FOR THE 100-YEAR BY FCD ....................  2653 CFS
AC   CULVERT INFORMATION OUT LET ELEVATION  ...............  1334.49
AC   BY FCD PROPOSED CONDITION MAP
AC   THERE ARE 4-10x10 CULVERTS
AC   THE MANNING N FOR THE CULVERT .........................     0.015
AC   THE MANNING N FOR THE CONCRET RETAINING ...............     0.030
AC   WALLS FOR SIDES AND GROUTED ROCK BOTTOM
AC
AC
AC
AC
T1 SPOOKHILL OUTLET DESIGN FOR THE SOIL CONSERVATION SERVICE
T2 FCD 6C300S  100 YEAR FLOW - PROPOSED CONDITION
T3 DATE: 4-13-92

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

      0        0        0        1    0.0285       0        0     2653      40       0

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

      1        0       -1        0        0        0       -1        0        0       15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT
```

38 43 1 2 3 26 25 8 4 39

[illegible]0

NC	.065	.065	.015	.3	.5					
X1	314	28	76.58	123.42	86	86	86			
X3	10							49.00	46.80	
GR	43.80	67.75	36.80	74.75	36.80	75.75	43.80	75.75	43.80	76.58
GR	37.63	76.58	36.80	77.42	36.80	85.75	37.63	86.58	43.80	86.58
GR	43.80	88.75	37.63	88.75	36.80	89.58	36.80	97.92	37.63	98.75
GR	43.80	98.75	43.80	101.25	36.80	101.25	36.80	111.25	43.80	111.25
GR	43.80	113.42	36.80	113.42	36.80	123.42	43.80	123.42	43.80	124.25
GR	36.80	124.25	36.80	125.25	43.80	131.25				
NC	0.065	.065	.030	0.1	.3					
X1	400	28	76.58	123.42	124	76	100			
X3	10							49.00	46.80	
GR	41.49	67.75	34.49	74.75	34.49	75.75	41.49	75.75	41.49	76.58
GR	35.32	76.58	34.49	77.42	34.49	85.75	35.32	86.58	41.49	86.58
GR	41.49	88.75	35.32	88.75	34.49	89.58	34.49	97.92	35.32	98.75
GR	41.49	98.75	41.49	101.25	34.49	101.25	34.49	111.25	41.49	111.25
GR	41.49	113.42	34.49	113.42	34.49	123.42	41.49	123.42	41.49	124.25
GR	34.49	124.25	34.49	125.25	41.49	131.25				
X1	500	4	80	120	160	160	160			
GR	38.42	80	31.80	80	31.80	120	38.42	120		
X1	660	4	80	120	140	140	140			
GR	33.5	80	27.50	80	27.50	120	33.50	120		
X1	800	4	80	120	220.14	245.16	232.65			
GR	30.98	80	24.61	80	24.61	120	30.98	120		
X1	1032.6	4	80	120	220.14	245.16	232.65			
GR	29.19	80	19.80	80	19.80	120	29.19	120		
X1	1265.3	4	80	120	0	0	0			
GR	22.00	80	15.00	80	15.00	120	22.00	120		

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .300 CEHV= .500
*SECNO 314.000

3265 DIVIDED FLOW

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

314.000	2.73	39.53	41.97	40.00	48.95	9.42	.00	.00	43.80
2653.0	.0	2653.0	.0	.0	107.7	.0	.0	.0	43.80
.00	.00	24.63	.00	.000	.015	.000	.000	36.80	76.58
.028254	0.	0.	0.	0	14	4	.00	40.00	123.42

FLOW DISTRIBUTION FOR SECNO= 314.00 CWSEL= 39.53

ST 77. 123.
PER Q= 100.0
AREA= 107.7
VEL= 24.6
DEPTH= 2.7

CCHV= .100 CEHV= .300
*SECNO 400.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.59

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

400.000	3.20	37.69	39.67	.00	44.50	6.81	3.66	.78	41.49
2653.0	.0	2653.0	.0	.0	126.7	.0	.2	.1	41.49
.00	.00	20.94	.00	.000	.030	.000	.000	34.49	76.58
.071397	86.	86.	86.	7	14	0	.00	40.00	123.42

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 400.00 CWSEL= 37.69

STA= 77. 123.
PER Q= 100.0
AREA= 126.7
VEL= 20.9
DEPTH= 3.2

*SECNO 500.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .56

500.000	4.01	35.81	36.93	.00	40.06	4.25	3.68	.77	38.42
2653.0	.0	2653.0	.0	.0	160.4	.0	.6	.2	38.42
.00	.00	16.54	.00	.000	.030	.000	.000	31.80	80.00
.022344	124.	100.	76.	7	14	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 500.00 CWSEL= 35.81

STA= 80. 120.
PER Q= 100.0
AREA= 160.4
VEL= 16.5
DEPTH= 4.0

*SECNO 660.000

3301 HV CHANGED MORE THAN HVINS

660.000	3.78	31.28	32.63	.00	36.08	4.80	3.92	.06	33.50
2653.0	.0	2653.0	.0	.0	150.9	.0	1.1	.3	33.50
.01	.00	17.58	.00	.000	.030	.000	.000	27.50	80.00
.027025	160.	160.	160.	3	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 660.00 CWSEL= 31.28

```
 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
           QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
  TIME     VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
  SLOPE    XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


STA=      80.     120.
  PER Q=    100.0
   AREA=    150.9
    VEL=     17.6
  DEPTH=      3.8

*SECNO 800.000

3301 HV CHANGED MORE THAN HVINS

   800.000      4.24     28.85     29.75       .00     32.65      3.80      3.13       .30     30.98
    2653.0        .0    2653.0        .0        .0     169.5        .0       1.6        .4     30.98
       .01       .00     15.65       .00      .000      .030      .000      .000     24.61     80.00
   .018802      140.      140.      140.         6        11         0       .00     40.00    120.00


FLOW DISTRIBUTION FOR SECNO=    800.00          CWSEL=     28.85

STA=      80.     120.
  PER Q=    100.0
   AREA=    169.5
    VEL=     15.6
  DEPTH=      4.2

*SECNO 1032.600
  1032.600      4.08     23.88     24.93       .00     27.98      4.10      4.64       .03     29.19
    2653.0        .0    2653.0        .0        .0     163.2        .0       2.5        .7     29.19
       .01       .00     16.26       .00      .000      .030      .000      .000     19.80     80.00
   .021167      220.      233.      245.         7        11         0       .00     40.00    120.00


FLOW DISTRIBUTION FOR SECNO=   1032.60          CWSEL=     23.88

STA=      80.     120.
  PER Q=    100.0
   AREA=    163.2
    VEL=     16.3
  DEPTH=      4.1
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1265.300

1265.300	4.14	19.14	20.13	.00	23.13	3.99	4.82	.03	22.00
2653.0	.0	2653.0	.0	.0	165.4	.0	3.4	.9	22.00
.02	.00	16.04	.00	.000	.030	.000	.000	15.00	80.00
.020288	220.	233.	245.	6	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1265.30 CWSEL= 19.14

STA=	80.	120.
PER Q=	100.0	
AREA=	165.4	
VEL=	16.0	
DEPTH=	4.1	

THIS RUN EXECUTED 01JUN92 14:50:04

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

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

4-13-92

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	EG	VCH	AREA	DEPTH	TOPWID	XLCH
	314.000	2653.00	39.53	41.97	48.95	24.63	107.71	2.73	40.00	.00
*	400.000	2653.00	37.69	39.67	44.50	20.94	126.70	3.20	40.00	86.00
*	500.000	2653.00	35.81	36.93	40.06	16.54	160.36	4.01	40.00	100.00
	60.000	2653.00	31.28	32.63	36.08	17.58	150.87	3.78	40.00	160.00
	800.000	2653.00	28.85	29.75	32.65	15.65	169.53	4.24	40.00	140.00
	1032.600	2653.00	23.88	24.93	27.98	16.26	163.18	4.08	40.00	232.65
	1265.300	2653.00	19.14	20.13	23.13	16.04	165.42	4.14	40.00	232.65

4 92

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	314.000	.00	.00	.00	36.80	2653.00	39.53	41.97	48.95	282.54	24.63	107.71	157.83
*	400.000	86.00	.00	.00	34.49	2653.00	37.69	39.67	44.50	713.97	20.94	126.70	99.29
*	500.000	100.00	.00	.00	31.80	2653.00	35.81	36.93	40.06	223.44	16.54	160.36	177.48
	660.000	160.00	.00	.00	27.50	2653.00	31.28	32.63	36.08	270.25	17.58	150.87	161.38
	800.000	140.00	.00	.00	24.61	2653.00	28.85	29.75	32.65	188.02	15.65	169.53	193.48
	1032.600	232.65	.00	.00	19.80	2653.00	23.88	24.93	27.98	211.67	16.26	163.18	182.35
	1265.300	232.65	.00	.00	15.00	2653.00	19.14	20.13	23.13	202.88	16.04	165.42	186.26

4 -92

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	314.000	2653.00	39.53	.00	.00	-.47	40.00	.00
*	400.000	2653.00	37.69	.00	-1.83	.00	40.00	86.00
*	500.000	2653.00	35.81	.00	-1.88	.00	40.00	100.00
	660.000	2653.00	31.28	.00	-4.53	.00	40.00	160.00
	800.000	2653.00	28.85	.00	-2.43	.00	40.00	140.00
	1032.600	2653.00	23.88	.00	-4.97	.00	40.00	232.65
	1265.300	2653.00	19.14	.00	-4.74	.00	40.00	232.65

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO= 400.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 500.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

APPENDIX B

B.4

HEC-2 MODEL ALTERNATIVE NO. 4

ALT #4
SPKHL4.OUT
~~BPKHL3.DAT~~

```
*-----------------------------------*
|              S U M P O            |
|                                   |
|  Interactive Summary Printout     |
|  for MS/PC-DOS micro computers    |
|             May 1991              |
*-----------------------------------*
```

NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

4-13-92

Summary Printout

	SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S	TIME
	314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80	282.54	.00
*	400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49	713.97	.00
*	500.00	2653.00	36.38	37.32	40.27	15.82	4.19	167.75	40.00	100.00	32.19	194.29	.00
	660.00	2653.00	32.45	33.63	36.82	16.77	3.95	158.18	40.00	160.00	28.50	233.18	.01
	800.00	2653.00	29.61	30.63	33.65	16.13	4.11	164.44	40.00	140.00	25.50	206.65	.01
	1045.10	2653.00	24.30	25.38	28.46	16.37	4.05	162.11	40.00	245.16	20.25	216.04	.01
	1290.30	2653.00	19.07	20.13	23.19	16.29	4.07	162.90	40.00	245.16	15.00	212.80	.02

STA	FB	CURVE	CHANNEL Depth
		5.70	5.70
400	2.50		6.21
500	2.02		6.03
660	2.08		6.15
800	2.04		7.10
1045	2.05	1	7.12
1290	2.05	1	

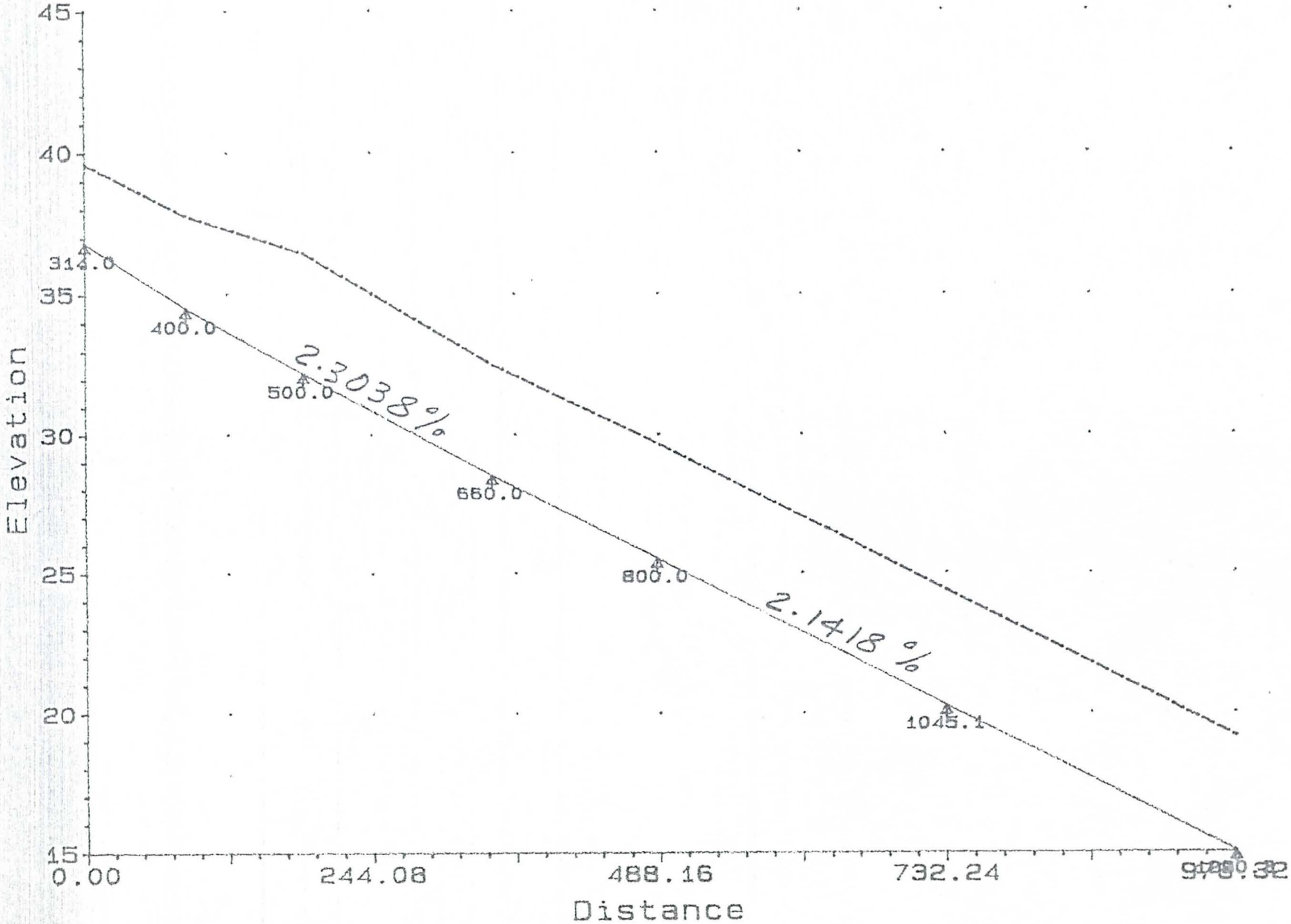
R = 399.47'
L = 499.66'

H = 6.21 L_1 = 400

HC = 7.12 L_2 = 500

900'

4-13-92
SPKHL4.DAT



ALT # 4

~~SPKH 4~~

SPKHL 4

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    01JUN92    TIME   14:54:15 *
*******************************************
```

```
*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  HYDROLOGIC ENGINEERING CENTER    *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616-4687     *
*          (916) 756-1104           *
*************************************
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

THIS RUN EXECUTED 01JUN92 14:54:15

```
************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************


THIS IS AN ARCHIVAL RUN ALL DATA AND RESULTS ARE SAVED ON UNIT   96

AC
AC AERIAL MAPPING: FLOOD CONTROL DISTRICT OF MARICOPA COUNTY   4-13-92
AC                 2801 W. DURANGO  PHX. AZ. 85009
AC                 PHONE (602) 501-1501
AC
AC SURVEY CONTROL: SOIL CONSERVATION SERVISE  DATE: 7-24-90
AC                 201 E. INDIANOLA AVE., SUITE 200
AC                 PHOENIX. ARIZONA 85012   TEL: (602) 640-5143
AC
AC   ************************************************************
AC   *                                                          *
AC   *  SPOOKHILL OUTLET DESIGN  SUPPER CRITICAL CONDITION      *
AC   *                                                          *
AC   ************************************************************
AC
AC   OUTLET CHANNEL WIDTH ..................................... 40 FEET
AC   OUTLET CHANNEL DEPTH ..................................... 5 FEET
AC   DISCHARGE FOR THE 100-YEAR BY FCD ....................  2653 CFS
AC   CULVERT INFORMATION OUT LET ELEVATION  ...............  1334.49
AC   BY FCD PROPOSED CONDITION MAP
AC   THERE ARE 4-10X7 CULVERTS
AC   THE MANNING N FOR THE CULVERT .........................     0.015
AC   THE MANNING N FOR THE CONCRET RETAINING ..............     0.030
AC   WALLS FOR SIDES AND GROUTED ROCK BOTTOM
AC
AC
AC
AC
T1 SPOOKHILL OUTLET DESIGN FOR THE SOIL CONSERVATION SERVICE
T2 FCD 6C300S  100 YEAR FLOW - PROPOSED CONDITION
T3 DATE: 4-13-92

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

      0        0        0        1    0.0285       0        0     2653      40       0

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

             0        -1       0        0        0        -1       0        0        15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT
```

38 43 1 2 3 26 25 8 4 39

150

NC	.065	.065	.015	.3	.5					
X1	314	28	76.58	123.42	86	86	86			
X3	10							49.00	46.80	
GR	43.80	67.75	36.80	74.75	36.80	75.75	43.80	75.75	43.80	76.58
GR	37.63	76.58	36.80	77.42	36.80	85.75	37.63	86.58	43.80	86.58
GR	43.80	88.75	37.63	88.75	36.80	89.58	36.80	97.92	37.63	98.75
GR	43.80	98.75	43.80	101.25	36.80	101.25	36.80	111.25	43.80	111.25
GR	43.80	113.42	36.80	113.42	36.80	123.42	43.80	123.42	43.80	124.25
GR	36.80	124.25	36.80	125.25	43.80	131.25				
NC	0.065	.065	.030	0.1	.3					
X1	400	28	76.58	123.42	124	76	100			
X3	10							49.00	46.80	
GR	41.49	67.75	34.49	74.75	34.49	75.75	41.49	75.75	41.49	76.58
GR	35.32	76.58	34.49	77.42	34.49	85.75	35.32	86.58	41.49	86.58
GR	41.49	88.75	35.32	88.75	34.49	89.58	34.49	97.92	35.32	98.75
GR	41.49	98.75	41.49	101.25	34.49	101.25	34.49	111.25	41.49	111.25
GR	41.49	113.42	34.49	113.42	34.49	123.42	41.49	123.42	41.49	124.25
GR	34.49	124.25	34.49	125.25	41.49	131.25				
X1	500	4	80	120	160	160	160			
GR	38.42	80	32.19	80	32.19	120	38.42	120		
X1	660	4	80	120	140	140	140			
GR	33.5	80	28.5	80	28.5	120	33.50	120		
X1	800	4	80	120	232.65	257.67	245.16			
GR	30.98	80	25.50	80	25.50	120	30.98	120		
X1	1045.1	4	80	120	232.65	257.67	245.16			
GR	29.19	80	20.25	80	20.25	120	29.19	120		
X1	1290.3	4	80	120	0	0	0			
GR	22.00	80	15.00	80	15.00	120	22.00	120		

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .300 CEHV= .500
*SECNO 314.000

3265 DIVIDED FLOW

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

314.000	2.73	39.53	41.97	40.00	48.95	9.42	.00	.00	43.80
2653.0	.0	2653.0	.0	.0	107.7	.0	.0	.0	43.80
.00	.00	24.63	.00	.000	.015	.000	.000	36.80	76.58
.028254	0.	0.	0.	0	14	4	.00	40.00	123.42

FLOW DISTRIBUTION FOR SECNO= 314.00 CWSEL= 39.53

S 77. 123.
PER Q= 100.0
AREA= 107.7
VEL= 24.6
DEPTH= 2.7

CCHV= .100 CEHV= .300
*SECNO 400.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.59

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

400.000	3.20	37.69	39.67	.00	44.50	6.81	3.66	.78	41.49
2653.0	.0	2653.0	.0	.0	126.7	.0	.2	.1	41.49
.00	.00	20.94	.00	.000	.030	.000	.000	34.49	76.58
.071397	86.	86.	86.	7	14	0	.00	40.00	123.42

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 400.00 CWSEL= 37.69

STA= 77. 123.
PER Q= 100.0
AREA= 126.7
VEL= 20.9
DEPTH= 3.2

*SECNO 500.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .52

500.000	4.19	36.38	37.32	.00	40.27	3.88	3.36	.88	38.42
2653.0	.0	2653.0	.0	.0	167.7	.0	.6	.2	38.42
.00	.00	15.82	.00	.000	.030	.000	.000	32.19	80.00
.019429	124.	100.	76.	6	14	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 500.00 CWSEL= 36.38

STA= 80. 120.
PER Q= 100.0
AREA= 167.7
VEL= 15.8
DEPTH= 4.2

*SECNO 660.000

660.000	3.95	32.45	33.63	.00	36.82	4.37	3.40	.05	33.50
2653.0	.0	2653.0	.0	.0	158.2	.0	1.2	.3	33.50
.01	.00	16.77	.00	.000	.030	.000	.000	28.50	80.00
.023318	160.	160.	160.	6	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 660.00 CWSEL= 32.45

STA= 80. 120.
PER Q= 100.0
AREA= 158.2
VEL= 16.8
DEPTH= 4.0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 800.000

800.000	4.11	29.61	30.63	.00	33.65	4.04	3.07	.10	30.98
2653.0	.0	2653.0	.0	.0	164.4	.0	1.7	.4	30.98
.01	.00	16.13	.00	.000	.030	.000	.000	25.50	80.00
.020665	140.	140.	140.	7	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 800.00 CWSEL= 29.61

STA= 80. 120.
PER Q= 100.0
AREA= 164.4
VEL= 16.1
DEPTH= 4.1

*SECNO 1045.100

1045.100	4.05	24.30	25.38	.00	28.46	4.16	5.18	.01	29.19
2653.0	.0	2653.0	.0	.0	162.1	.0	2.6	.7	29.19
.01	.00	16.37	.00	.000	.030	.000	.000	20.25	80.00
.021604	233.	245.	258.	7	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1045.10 CWSEL= 24.30

STA= 80. 120.
PER Q= 100.0
AREA= 162.1
VEL= 16.4
DEPTH= 4.1

*SECNO 1290.300

1290.300	4.07	19.07	20.13	.00	23.19	4.12	5.26	.01	22.00
2653.0	.0	2653.0	.0	.0	162.9	.0	3.5	.9	22.00
.02	.00	16.29	.00	.000	.030	.000	.000	15.00	80.00
.021280	233.	245.	258.	6	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1290.30 CWSEL= 19.07

STA= 80. 120.
PER Q= 100.0
AREA= 162.9
VEL= 16.3
DEPTH= 4.1

THIS RUN EXECUTED 01JUN92 14:54:17

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

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

4-13-92

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	EG	VCH	AREA	DEPTH	TOPWID	XLCH
	314.000	2653.00	39.53	41.97	48.95	24.63	107.71	2.73	40.00	.00
*	400.000	2653.00	37.69	39.67	44.50	20.94	126.70	3.20	40.00	86.00
*	500.000	2653.00	36.38	37.32	40.27	15.82	167.75	4.19	40.00	100.00
	660.000	2653.00	32.45	33.63	36.82	16.77	158.18	3.95	40.00	160.00
	800.000	2653.00	29.61	30.63	33.65	16.13	164.44	4.11	40.00	140.00
	1045.100	2653.00	24.30	25.38	28.46	16.37	162.11	4.05	40.00	245.16
	1290.300	2653.00	19.07	20.13	23.19	16.29	162.90	4.07	40.00	245.16

4 92

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	314.000	.00	.00	.00	36.80	2653.00	39.53	41.97	48.95	282.54	24.63	107.71	157.83
*	400.000	86.00	.00	.00	34.49	2653.00	37.69	39.67	44.50	713.97	20.94	126.70	99.29
*	500.000	100.00	.00	.00	32.19	2653.00	36.38	37.32	40.27	194.29	15.82	167.75	190.33
	660.000	160.00	.00	.00	28.50	2653.00	32.45	33.63	36.82	233.18	16.77	158.18	173.74
	800.000	140.00	.00	.00	25.50	2653.00	29.61	30.63	33.65	206.65	16.13	164.44	184.55
	1045.100	245.16	.00	.00	20.25	2653.00	24.30	25.38	28.46	216.04	16.37	162.11	180.50
	1290.300	245.16	.00	.00	15.00	2653.00	19.07	20.13	23.19	212.80	16.29	162.90	181.86

92

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	314.000	2653.00	39.53	.00	.00	-.47	40.00	.00
*	400.000	2653.00	37.69	.00	-1.83	.00	40.00	86.00
*	500.000	2653.00	36.38	.00	-1.31	.00	40.00	100.00
	660.000	2653.00	32.45	.00	-3.93	.00	40.00	160.00
	800.000	2653.00	29.61	.00	-2.84	.00	40.00	140.00
	1045.100	2653.00	24.30	.00	-5.31	.00	40.00	245.16
	1290.300	2653.00	19.07	.00	-5.23	.00	40.00	245.16

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO= 400.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 500.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

APPENDIX B

B.5

SEDIMENT TRANSPORT INFORMATION

See Appendix A.2 for 1992
1992 "Geologic Evolution Report"

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Az		PROJECT Spookhill outlet		
BY Tom Jayo	DATE 6-13-90	CHECKED BY	DATE	JOB NO.
SUBJECT Sediment Questions				SHEET 1 OF 4

1. We No longer have the marsh that we had when sediment basin was designed. Are we concerned with suspended sediment anymore? Do we have to size sediment basin size for suspended sediment or do we let it go into Salt River?

2. Previously design called for reducing suspended sediment by ½ with project so that suspended sediment would be equal to suspended sediment without the project. This was all based on 3 acres of marsh. Now we have no marsh

3. Using Don Clarks estimates for sediment and updating drainage areas per 3/75 Hydrology study –

Arrive @ Are erosion rate = 0.25 $\frac{\text{AC-FT}}{\text{sq mi-yr.}}$ - Per Don Clark

2. 0.48 AC-FT/yr suspended
3. 0.22 AC-FT/yr bed load – } For Total = 0.70 AC-FT/yr.

Present sediment basin size = 6-AC-FT.

Sizing basin for 100% of bedload & 50% of suspended load

= 0.24 + 0.22 = 0.46 AC-FT/yr

Years storage = $\frac{6}{0.46}$ = 13 years –
8.6 years for 100% bedload & suspended –

Conclusion – present sediment basin is satisfactory –

MCFCD will need to continue cleaning basin every 2 years or so to keep it functional.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT Spook Hill OUTLET		
BY Tom Joyo	DATE 6-14-90	CHECKED BY	DATE	JOB NO.
SUBJECT SEDIMENT BASIN DESIGN CHECK				SHEET 12 OF

1. Sediment movement from Spookhill FRS to Sediment basin -

Per SCS Geologist Don Clark - most of the sediment will have dropped to the lower 10' to 12' of the reservoir pool by the time the flow reaches the principal spillway outlet. Some sediment will move through the slide gate as the sediment pool is drained. Don Clark estimated that 95% of the sediment will remain in the reservoir.

(His figures are based on preliminary design figures)

Drainage Area = 13.57 sq mi → Per Lew Burton 3/25/75
Sediment yield = 0.2 AC-FT/sqmi/yr

2.71 AC-FT/yr X 0.05 = 0.14 AC-FT/yr - (suspended sediment)

From TR-20 routing Hydrology Study dated 3/75

Drainage area #26 represents the natural wash that flow will be added to.

Area NO	Area sq-mi
23	0.92
24	1.26
25	0.75
	2.93
Natural wash → 26	0.42

These areas add sediment from Spookhill floodway.

Note - The marsh that provided the nesting area for the Yuma Clapper Rail bird was washed out during the 1979 and 1980 Floods and is no longer a concern for design purposes.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT Spookhill Outlet		
BY Tom Joyd	DATE 6-14-90	CHECKED BY	DATE	JOB NO.
SUBJECT SEDIMENT BASIN DESIGN CHECK				SHEET 23 OF

2. Determine Sediment estimates for sediment basin

Sediment information from Geologist Don Clark (1975)

average erosion rate for natural channel $= 0.25 \frac{AC\text{-}FT}{sq\,mi\text{-}yr.}$
50% bed load
50% suspended load
90% of suspended load is delivered to Sediment basin area
70% of the bed load " " " " " "

0.42 sq. mi $\times 0.25 \frac{AC\text{-}FT}{sq\,mi\text{-}yr} = 0.11$ AC-FT/yr.

90% $\times$ 0.05 $=$ 0.05 " " (suspended)

70% $\times$ 0.05 $=$ 0.04 " " (bedload)

Natural movement of sediment without project $=$ 0.09 AC-FT/yr

When the project is developed an additional 2.93 sq-mi of area will be added. A decrease in the percentage of sediment delivered to the sediment basin area is justifiable since some sediment will be trapped and not allowed to enter the floodway. Junction structures have been designed for the major washes, such that a large percentage of bedload will enter the floodway.

80% of suspended load and 50% of bed load will be delivered to the sediment basin area via the floodway

2.93 sq mi $\times 0.25 \frac{AC\text{-}FT}{sq\,mi\text{-}yr} \times 0.5 \times 0.8 = 0.29$ suspended load

2.93 " $\times$ 0.25 " $\times 0.5 \times 0.5 =$ 0.18 bed load

0.47 AC-FT/yr

TOTAL Sediment For Project

Suspended load	Bed load	
0.14 AC-FT from FRS page 2	0 AC-FT from FRS	
0.05 " " " Area #26	0.04 " " " Area #26	
0.29 " " " floodway	0.18	TOTAL
0.48 AC-FT/yr	0.22 AC-FT/yr	0.70 AC-FT/yr

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT SPOOKHILL OUTLET		
BY Tom Jayo	DATE 6-17-90	CHECKED BY	DATE	JOB NO.
SUBJECT SEDIMENT BASIN DESIGN CHECK				SHEET B4 OF

3. Determine sediment basin size Required –

Sediment basin will immediately remove all bed load (.22 AC-FT) Don Clark has estimated that sediment will accumulate in a 50 acre area without the project and in a 100 acre area with the project. Original sediment basin design was based on providing enough sediment storage in basin so that sediment yield with project would equal sediment yield (suspended) without project. This was based on maintaining the sediment yield to the 3 Acre marsh area on a yield equal to that without the project.

Now since marsh is no longer there, suspended sediment is no longer a problem. The EIS indicated that 0.5 AC-FT per year of suspended sediment would enter the Salt River with 400 PPM sediment concentration from the Spookhill structures. This concentration does not significantly affect the fishery in this reach of the river. See page 93 of EIS.

Assuming we remove ½ the suspended sediment and all of the bed load sediment

$$\left(\overset{\text{susp}}{0.24\,AC\text{-}FT} + \overset{\text{bed load}}{0.22\,AC\text{-}FT}\right) = 0.46\,AC\text{-}FT/yr$$ that must be removed or stored

Size of existing sediment basin

$$= \left(\frac{100 + 118}{2}(3)(800)\right) \div (43{,}560) = 6\,AC\text{-}FT$$ for sediment storage

$$\text{Years storage} = \frac{6}{0.46} = 13 \text{ years}$$

Present sediment basin will take care of the average yearly sediment for 13 years. With a maintenance program by the MCFCD where they clean out the sediment basin every 2 to 4 years, present sediment basin is adequate.

Conclusion – Present sediment basin is satisfactory other then we need to raise dikes for added freeboard.

APPENDIX B

B.6

HEC-1 MODEL SEDIMENT BASIN

SPKHEC11

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            FEBRUARY 1981             *
*           REVISED  6 FEB 87          *
*                                      *
*  RUN DATE  08/17/1992  TIME  09:59:44 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*  THE HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*  (916) 440-3285 OR (FTS) 448-3285    *
*                                      *
****************************************
```

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

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

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

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

  1           ID      BUSH HWY CULVERTS AND NEW CHANNEL
  2           ID      VALERIE WASH (THE WASH WHERE SPOOKHILL FLOODWAY TERMINATES)
  3           ID      FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
  4           ID      AMM   9/88
  5           ID
  6           ID      REVISION £1: 1) ........ WE USE THE ORIGINAL HEC-1 MODEL BY HYDROLOGY
  7           ID                                DEPARTMENT.AND MODEL THE NEW CHANNEL, SEDIMENT
  8           ID                   2) ........ WE ADJUST THE HYDROGRAPH FROM THE DAM TO REFLECT
  9           ID                                THE PROPOSED DISCHARGE USED TO DESIGNE THE
 10           ID                                NEW BUSH HWY DISCHARGE.  SCS AND FCD AGGREED TO
 11           ID                                USE Q=2653 CFS FOR THE 100-YR. 24-HR. EVENT.
 12           ID                   3) ........ WE MODEL NEW CHANNEL FROM BUSH HWY CULVERT TO
 13           ID                                THE SEDIMENT BASIN.  USING W=40', D=5', S=3.0731%
 14           ID                                AND 1.9818%, AND THE MANNING N=0.030
 15           ID                   4)........ WE MODEL THE SEDIMENT BASIN TO CALCULAT MIN. WSE.
 16           ID                                SEDIMENT BASIN: W=100', L=650'
 17           ID                                WEIR OUTLET: W=150', C=1.85, E=1.5
 18           ID                                             WEIR FLOWLINE ELEVETION IS 1818
 19           ID                   DATE ...... JULY, 92
 20           ID                   BY ........ BKH
 21           ID
 22           ID
 23           ID
              *DIAGRAM
 24           IT       5                    300
 25           IO       1

 26           KK     SPK
 27           KM        INFLOW FROM SPOOKHILL FLOODWAY
 28           IN     879
 29           QI       1    2339       1

 30           KK    ROUT
 31           KM
 32           RK    4000    .045    .035            TRAP      40       5

 33           KK       A
 34           KM        BASIN A
 35           IN      15
 36           PB     4.1
 37           PC       0       0       0     .01     .01     .01     .02     .02     .02     .03
 38           PC     .03     .03     .04     .04     .04     .04     .05     .05     .06     .06
 39           PC     .06     .07     .07     .08     .08     .08     .09     .10     .10     .11
 40           PC     .11     .12     .12     .13     .13     .14     .15     .15     .16     .17
 41           PC     .18     .19     .20     .22     .24     .26     .28     .39     .66     .71
 42           PC     .74     .76     .78     .79     .80     .81     .82     .83     .84     .85
 43           PC     .86     .86     .87     .88     .88     .89     .89     .90     .90     .91
 44           PC     .91     .92     .92     .93     .93     .93     .94     .94     .95     .95
 45           PC     .95     .96     .96     .96     .97     .97     .97     .97     .98     .98
 46           PC     .98     .99     .99     .99    1.00    1.00    1.00    1.00    1.00    1.00
 47           BA     .81
 48           LS             84
 49           UD     .66
```

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

  50          KK    BUSH
  51          KM        COMBINE FLOWS AT BUSH
  52          HC       2

  53          KK   RBUSH
  54          KM         ROUT HYDROGRAPH FROM BUSH HWY TO SEDIMENT BASIN
  55          KM         IN PROPOSED CHANNEL W=40, H=8', S=0.030
  56          RK     346  .03731    .030            TRAP      40       0

  57          KK  RBUSH2
  58          KM         ROUT HYDROGRAPH FROM BUSH HWY TO SEDIMENT BASIN
  59          KO       2       2
  60          RK     623 .019818    .030            TRAP      40       0

  61          KK   BASIN
  62          KM         SEDIMENT BASIN CAPACITY
  63          KM         BASIN CARACTERISTICS: W=100, L=650, Z=2:1
  64          RS       0    ELEV    1316
  65          SV       0   1.582   3.223   4.924   6.685   8.506  10.386  12.326  14.325
  66          SE    1316    1317    1318    1319    1320    1321    1322    1323    1324
  67          SS    1318     150    1.85     1.5
  68          ZZ
```

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

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

*** HEC1 ERROR 4 *** NO HYDROGRAPHS AVAILABLE TO ROUTE
                V
                V
   30         ROUT
                .
                .
   33           .           A
                .           .
                .           .
   50         BUSH............
                V
                V
   53        RBUSH
                V
                V
   57       RBUSH2
                V
                V
   61        BASIN

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

        1 ERRORS IN STREAM SYSTEM
```

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            FEBRUARY 1981             *
*          REVISED  6 FEB 87           *
*                                      *
*  RUN DATE  08/17/1992  TIME  09:59:44 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*  THE HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*  (916) 440-3285 OR (FTS) 448-3285    *
*                                      *
****************************************
```

```
BUSH HWY CULVERTS AND NEW CHANNEL
VALERIE WASH (THE WASH WHERE SPOOKHILL FLOODWAY TERMINATES)
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
AMM   9/88

REVISION £1: 1) ........ WE USE THE ORIGINAL HEC-1 MODEL BY HYDROLOGY
                         DEPARTMENT.AND MODEL THE NEW CHANNEL, SEDIMENT
             2) ........ WE ADJUST THE HYDROGRAPH FROM THE DAM TO REFLECT
                         THE PROPOSED DISCHARGE USED TO DESIGNE THE
                         NEW BUSH HWY DISCHARGE.  SCS AND FCD AGGREED TO
                         USE Q=2653 CFS FOR THE 100-YR. 24-HR. EVENT.
             3) ........ WE MODEL NEW CHANNEL FROM BUSH HWY CULVERT TO
                         THE SEDIMENT BASIN.  USING W=40', D=5', S=3.0731%
                         AND 1.9818%, AND THE MANNING N=0.030
             4) ........ WE MODEL THE SEDIMENT BASIN TO CALCULAT MIN. WSE.
                         SEDIMENT BASIN: W=100', L=650'
                         WEIR OUTLET: W=150', C=1.85, E=1.5
                                      WEIR FLOWLINE ELEVETION IS 1818
             DATE ...... JULY, 92
             BY ........ BKH


25 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

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

              COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE   24.92 HOURS

         ENGLISH UNITS
              DRAINAGE AREA          SQUARE MILES
              PRECIPITATION DEPTH    INCHES
              LENGTH, ELEVATION      FEET
              FLOW                   CUBIC FEET PER SECOND
```

STORAGE VOLUME ACRE-FEET
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

*** ***

```
          **************
          *            *
 26 KK    *       SPK  *
          *            *
          **************
```

INFLOW FROM SPOOKHILL FLOODWAY

```
 28 IN          TIME DATA FOR INPUT TIME SERIES
                     JXMIN         879  TIME INTERVAL IN MINUTES
                    JXDATE      1    0  STARTING DATE
                    JXTIME           0  STARTING TIME

            SUBBASIN RUNOFF DATA

  0 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA
```

***

****

HYDROGRAPH AT STATION SPK

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	1.	1		0615	76	998.	1		1230	151	1996.	1		1845	226	1685.
1		0005	2	14.	1		0620	77	1012.	1		1235	152	2009.	1		1850	227	1671.
1		0010	3	28.	1		0625	78	1025.	1		1240	153	2022.	1		1855	228	1658.
1		0015	4	41.	1		0630	79	1038.	1		1245	154	2036.	1		1900	229	1645.
1		0020	5	54.	1		0635	80	1052.	1		1250	155	2049.	1		1905	230	1631.
1		0025	6	67.	1		0640	81	1065.	1		1255	156	2062.	1		1910	231	1618.
1		0030	7	81.	1		0645	82	1078.	1		1300	157	2076.	1		1915	232	1605.
1		0035	8	94.	1		0650	83	1092.	1		1305	158	2089.	1		1920	233	1592.
1		0040	9	107.	1		0655	84	1105.	1		1310	159	2102.	1		1925	234	1578.
1		0045	10	121.	1		0700	85	1118.	1		1315	160	2116.	1		1930	235	1565.
1		0050	11	134.	1		0705	86	1131.	1		1320	161	2129.	1		1935	236	1552.
1		0055	12	147.	1		0710	87	1145.	1		1325	162	2142.	1		1940	237	1538.
1		0100	13	161.	1		0715	88	1158.	1		1330	163	2155.	1		1945	238	1525.
1		0105	14	174.	1		0720	89	1171.	1		1335	164	2169.	1		1950	239	1512.
1		0110	15	187.	1		0725	90	1185.	1		1340	165	2182.	1		1955	240	1498.
1		0115	16	200.	1		0730	91	1198.	1		1345	166	2195.	1		2000	241	1485.
1		0120	17	214.	1		0735	92	1211.	1		1350	167	2209.	1		2005	242	1472.
1		0125	18	227.	1		0740	93	1225.	1		1355	168	2222.	1		2010	243	1459.
1		0130	19	240.	1		0745	94	1238.	1		1400	169	2235.	1		2015	244	1445.
1		0135	20	254.	1		0750	95	1251.	1		1405	170	2249.	1		2020	245	1432.
1		0140	21	267.	1		0755	96	1264.	1		1410	171	2262.	1		2025	246	1419.
1		0145	22	280.	1		0800	97	1278.	1		1415	172	2275.	1		2030	247	1405.
1		0150	23	294.	1		0805	98	1291.	1		1420	173	2288.	1		2035	248	1392.
1		0155	24	307.	1		0810	99	1304.	1		1425	174	2302.	1		2040	249	1379.

1	0200	25	320.	*	1	0815	100	1318.	*	1	1430	175	2315.	*	1	2045	250	1365.
1	0205	26	333.	*	1	0820	101	1331.	*	1	1435	176	2328.	*	1	2050	251	1352.
1	0210	27	347.	*	1	0825	102	1344.	*	1	1440	177	2336.	*	1	2055	252	1339.
1	0215	28	360.	*	1	0830	103	1358.	*	1	1445	178	2323.	*	1	2100	253	1326.
1	0220	29	373.	*	1	0835	104	1371.	*	1	1450	179	2310.	*	1	2105	254	1312.
1	0225	30	387.	*	1	0840	105	1384.	*	1	1455	180	2296.	*	1	2110	255	1299.
1	0230	31	400.	*	1	0845	106	1397.	*	1	1500	181	2283.	*	1	2115	256	1286.
1	0235	32	413.	*	1	0850	107	1411.	*	1	1505	182	2270.	*	1	2120	257	1272.
1	0240	33	427.	*	1	0855	108	1424.	*	1	1510	183	2257.	*	1	2125	258	1259.
1	0245	34	440.	*	1	0900	109	1437.	*	1	1515	184	2243.	*	1	2130	259	1246.
1	0250	35	453.	*	1	0905	110	1451.	*	1	1520	185	2230.	*	1	2135	260	1233.
1	0255	36	466.	*	1	0910	111	1464.	*	1	1525	186	2217.	*	1	2140	261	1219.
1	0300	37	480.	*	1	0915	112	1477.	*	1	1530	187	2203.	*	1	2145	262	1206.
1	0305	38	493.	*	1	0920	113	1491.	*	1	1535	188	2190.	*	1	2150	263	1193.
1	0310	39	506.	*	1	0925	114	1504.	*	1	1540	189	2177.	*	1	2155	264	1179.
1	0315	40	520.	*	1	0930	115	1517.	*	1	1545	190	2163.	*	1	2200	265	1166.
1	0320	41	533.	*	1	0935	116	1530.	*	1	1550	191	2150.	*	1	2205	266	1153.
1	0325	42	546.	*	1	0940	117	1544.	*	1	1555	192	2137.	*	1	2210	267	1139.
1	0330	43	560.	*	1	0945	118	1557.	*	1	1600	193	2124.	*	1	2215	268	1126.
1	0335	44	573.	*	1	0950	119	1570.	*	1	1605	194	2110.	*	1	2220	269	1113.
1	0340	45	586.	*	1	0955	120	1584.	*	1	1610	195	2097.	*	1	2225	270	1100.
1	0345	46	599.	*	1	1000	121	1597.	*	1	1615	196	2084.	*	1	2230	271	1086.
1	0350	47	613.	*	1	1005	122	1610.	*	1	1620	197	2070.	*	1	2235	272	1073.
1	0355	48	626.	*	1	1010	123	1624.	*	1	1625	198	2057.	*	1	2240	273	1060.
1	0400	49	639.	*	1	1015	124	1637.	*	1	1630	199	2044.	*	1	2245	274	1046.
1	0405	50	653.	*	1	1020	125	1650.	*	1	1635	200	2030.	*	1	2250	275	1033.
1	0410	51	666.	*	1	1025	126	1663.	*	1	1640	201	2017.	*	1	2255	276	1020.
1	0415	52	679.	*	1	1030	127	1677.	*	1	1645	202	2004.	*	1	2300	277	1006.
1	0420	53	693.	*	1	1035	128	1690.	*	1	1650	203	1991.	*	1	2305	278	993.
1	0425	54	706.	*	1	1040	129	1703.	*	1	1655	204	1977.	*	1	2310	279	980.
1	0430	55	719.	*	1	1045	130	1717.	*	1	1700	205	1964.	*	1	2315	280	967.
1	0435	56	732.	*	1	1050	131	1730.	*	1	1705	206	1951.	*	1	2320	281	953.
1	0440	57	746.	*	1	1055	132	1743.	*	1	1710	207	1937.	*	1	2325	282	940.
1	0445	58	759.	*	1	1100	133	1756.	*	1	1715	208	1924.	*	1	2330	283	927.
1	0450	59	772.	*	1	1105	134	1770.	*	1	1720	209	1911.	*	1	2335	284	913.
1	0455	60	786.	*	1	1110	135	1783.	*	1	1725	210	1897.	*	1	2340	285	900.
1	0500	61	799.	*	1	1115	136	1796.	*	1	1730	211	1884.	*	1	2345	286	887.
1	0505	62	812.	*	1	1120	137	1810.	*	1	1735	212	1871.	*	1	2350	287	873.
1	0510	63	826.	*	1	1125	138	1823.	*	1	1740	213	1858.	*	1	2355	288	860.
1	0515	64	839.	*	1	1130	139	1836.	*	1	1745	214	1844.	*	2	0000	289	847.
1	0520	65	852.	*	1	1135	140	1850.	*	1	1750	215	1831.	*	2	0005	290	834.
1	0525	66	865.	*	1	1140	141	1863.	*	1	1755	216	1818.	*	2	0010	291	820.
1	0530	67	879.	*	1	1145	142	1876.	*	1	1800	217	1804.	*	2	0015	292	807.
1	0535	68	892.	*	1	1150	143	1889.	*	1	1805	218	1791.	*	2	0020	293	794.
1	0540	69	905.	*	1	1155	144	1903.	*	1	1810	219	1778.	*	2	0025	294	780.
1	0545	70	919.	*	1	1200	145	1916.	*	1	1815	220	1764.	*	2	0030	295	767.
1	0550	71	932.	*	1	1205	146	1929.	*	1	1820	221	1751.	*	2	0035	296	754.
1	0555	72	945.	*	1	1210	147	1943.	*	1	1825	222	1738.	*	2	0040	297	740.
1	0600	73	959.	*	1	1215	148	1956.	*	1	1830	223	1725.	*	2	0045	298	727.
1	0605	74	972.	*	1	1220	149	1969.	*	1	1835	224	1711.	*	2	0050	299	714.
1	0610	75	985.	*	1	1225	150	1983.	*	1	1840	225	1698.	*	2	0055	300	701.
				*					*					*				

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.92-HR
2336.	14.67	(CFS)	2100.	1361.	1314.	1314.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	1041.	2700.	2706.	2706.

CUMULATIVE AREA = .00 SQ MI

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          **************
          *            *
30 KK     *      ROUT  *
          *            *
          **************
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HYDROGRAPH ROUTING DATA

32 RK KINEMATIC WAVE STREAM ROUTING

L	4000.	CHANNEL LENGTH
S	.0450	SLOPE
N	.035	CHANNEL ROUGHNESS COEFFICIENT
CA	.00	CONTRIBUTING AREA
SHAPE	TRAP	CHANNEL SHAPE
WD	40.00	BOTTOM WIDTH OR DIAMETER
Z	5.00	SIDE SLOPE

***

KINEMATIC STREAM ROUTING USED FOR THIS REACH

COMPUTED KINEMATIC PARAMETERS

ALPHA	M	DT (MIN)	DX (FT)
1.2041	1.495	2.50	2000.00

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HYDROGRAPH AT STATION ROUT

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	1.	*	1		0615	76	988.	*	1		1230	151	1987.	*	1		1845	226	1694.
1		0005	2	1.	*	1		0620	77	1001.	*	1		1235	152	2001.	*	1		1850	227	1680.
1		0010	3	3.	*	1		0625	78	1014.	*	1		1240	153	2014.	*	1		1855	228	1667.
1		0015	4	9.	*	1		0630	79	1028.	*	1		1245	154	2027.	*	1		1900	229	1654.
1		0020	5	21.	*	1		0635	80	1041.	*	1		1250	155	2041.	*	1		1905	230	1641.
1		0025	6	38.	*	1		0640	81	1054.	*	1		1255	156	2054.	*	1		1910	231	1627.
1		0030	7	57.	*	1		0645	82	1068.	*	1		1300	157	2067.	*	1		1915	232	1614.
1		0035	8	73.	*	1		0650	83	1081.	*	1		1305	158	2081.	*	1		1920	233	1601.
1		0040	9	89.	*	1		0655	84	1095.	*	1		1310	159	2094.	*	1		1925	234	1587.
1		0045	10	104.	*	1		0700	85	1108.	*	1		1315	160	2107.	*	1		1930	235	1574.
1		0050	11	119.	*	1		0705	86	1121.	*	1		1320	161	2121.	*	1		1935	236	1561.
1		0055	12	133.	*	1		0710	87	1135.	*	1		1325	162	2134.	*	1		1940	237	1548.
1		0100	13	147.	*	1		0715	88	1148.	*	1		1330	163	2147.	*	1		1945	238	1534.
1		0105	14	161.	*	1		0720	89	1161.	*	1		1335	164	2161.	*	1		1950	239	1521.
1		0110	15	175.	*	1		0725	90	1175.	*	1		1340	165	2174.	*	1		1955	240	1508.

1	0115	16	188.	*	1	0730	91	1188.	*	1	1345	166	2187.	*	1	2000	241	1495.
1	0120	17	202.	*	1	0735	92	1201.	*	1	1350	167	2200.	*	1	2005	242	1481.
1	0125	18	216.	*	1	0740	93	1215.	*	1	1355	168	2214.	*	1	2010	243	1468.
1	0130	19	230.	*	1	0745	94	1228.	*	1	1400	169	2227.	*	1	2015	244	1455.
1	0135	20	243.	*	1	0750	95	1241.	*	1	1405	170	2240.	*	1	2020	245	1441.
1	0140	21	257.	*	1	0755	96	1255.	*	1	1410	171	2254.	*	1	2025	246	1428.
1	0145	22	270.	*	1	0800	97	1268.	*	1	1415	172	2267.	*	1	2030	247	1415.
1	0150	23	284.	*	1	0805	98	1281.	*	1	1420	173	2280.	*	1	2035	248	1402.
1	0155	24	298.	*	1	0810	99	1295.	*	1	1425	174	2294.	*	1	2040	249	1388.
1	0200	25	311.	*	1	0815	100	1308.	*	1	1430	175	2307.	*	1	2045	250	1375.
1	0205	26	325.	*	1	0820	101	1321.	*	1	1435	176	2320.	*	1	2050	251	1362.
1	0210	27	338.	*	1	0825	102	1335.	*	1	1440	177	2332.	*	1	2055	252	1349.
1	0215	28	352.	*	1	0830	103	1348.	*	1	1445	178	2331.	*	1	2100	253	1335.
1	0220	29	365.	*	1	0835	104	1361.	*	1	1450	179	2318.	*	1	2105	254	1322.
1	0225	30	379.	*	1	0840	105	1375.	*	1	1455	180	2305.	*	1	2110	255	1309.
1	0230	31	392.	*	1	0845	106	1388.	*	1	1500	181	2291.	*	1	2115	256	1295.
1	0235	32	406.	*	1	0850	107	1401.	*	1	1505	182	2278.	*	1	2120	257	1282.
1	0240	33	419.	*	1	0855	108	1415.	*	1	1510	183	2265.	*	1	2125	258	1269.
1	0245	34	432.	*	1	0900	109	1428.	*	1	1515	184	2251.	*	1	2130	259	1256.
1	0250	35	446.	*	1	0905	110	1441.	*	1	1520	185	2238.	*	1	2135	260	1242.
1	0255	36	459.	*	1	0910	111	1455.	*	1	1525	186	2225.	*	1	2140	261	1229.
1	0300	37	473.	*	1	0915	112	1468.	*	1	1530	187	2212.	*	1	2145	262	1216.
1	0305	38	486.	*	1	0920	113	1481.	*	1	1535	188	2198.	*	1	2150	263	1203.
1	0310	39	500.	*	1	0925	114	1495.	*	1	1540	189	2185.	*	1	2155	264	1189.
1	0315	40	513.	*	1	0930	115	1508.	*	1	1545	190	2172.	*	1	2200	265	1176.
1	0320	41	520.	*	1	0935	116	1521.	*	1	1550	191	2158.	*	1	2205	266	1163.
1	0325	42	533.	*	1	0940	117	1534.	*	1	1555	192	2145.	*	1	2210	267	1150.
1	0330	43	547.	*	1	0945	118	1548.	*	1	1600	193	2132.	*	1	2215	268	1136.
1	0335	44	560.	*	1	0950	119	1561.	*	1	1605	194	2119.	*	1	2220	269	1123.
1	0340	45	573.	*	1	0955	120	1574.	*	1	1610	195	2105.	*	1	2225	270	1110.
1	0345	46	587.	*	1	1000	121	1588.	*	1	1615	196	2092.	*	1	2230	271	1097.
1	0350	47	600.	*	1	1005	122	1601.	*	1	1620	197	2079.	*	1	2235	272	1083.
1	0355	48	614.	*	1	1010	123	1614.	*	1	1625	198	2065.	*	1	2240	273	1070.
1	0400	49	627.	*	1	1015	124	1628.	*	1	1630	199	2052.	*	1	2245	274	1057.
1	0405	50	640.	*	1	1020	125	1641.	*	1	1635	200	2039.	*	1	2250	275	1044.
1	0410	51	654.	*	1	1025	126	1654.	*	1	1640	201	2026.	*	1	2255	276	1030.
1	0415	52	667.	*	1	1030	127	1668.	*	1	1645	202	2012.	*	1	2300	277	1017.
1	0420	53	680.	*	1	1035	128	1681.	*	1	1650	203	1999.	*	1	2305	278	1004.
1	0425	54	694.	*	1	1040	129	1694.	*	1	1655	204	1986.	*	1	2310	279	990.
1	0430	55	707.	*	1	1045	130	1708.	*	1	1700	205	1972.	*	1	2315	280	977.
1	0435	56	721.	*	1	1050	131	1721.	*	1	1705	206	1959.	*	1	2320	281	964.
1	0440	57	734.	*	1	1055	132	1734.	*	1	1710	207	1946.	*	1	2325	282	951.
1	0445	58	747.	*	1	1100	133	1748.	*	1	1715	208	1933.	*	1	2330	283	937.
1	0450	59	761.	*	1	1105	134	1761.	*	1	1720	209	1919.	*	1	2335	284	924.
1	0455	60	774.	*	1	1110	135	1774.	*	1	1725	210	1906.	*	1	2340	285	911.
1	0500	61	787.	*	1	1115	136	1788.	*	1	1730	211	1893.	*	1	2345	286	898.
1	0505	62	801.	*	1	1120	137	1801.	*	1	1735	212	1879.	*	1	2350	287	885.
1	0510	63	814.	*	1	1125	138	1814.	*	1	1740	213	1866.	*	1	2355	288	871.
1	0515	64	828.	*	1	1130	139	1828.	*	1	1745	214	1853.	*	2	0000	289	858.
1	0520	65	841.	*	1	1135	140	1841.	*	1	1750	215	1840.	*	2	0005	290	845.
1	0525	66	854.	*	1	1140	141	1854.	*	1	1755	216	1826.	*	2	0010	291	832.
1	0530	67	868.	*	1	1145	142	1868.	*	1	1800	217	1813.	*	2	0015	292	818.
1	0535	68	881.	*	1	1150	143	1881.	*	1	1805	218	1800.	*	2	0020	293	805.
1	0540	69	894.	*	1	1155	144	1894.	*	1	1810	219	1787.	*	2	0025	294	792.
1	0545	70	908.	*	1	1200	145	1908.	*	1	1815	220	1773.	*	2	0030	295	779.
1	0550	71	921.	*	1	1205	146	1921.	*	1	1820	221	1760.	*	2	0035	296	765.
1	0555	72	934.	*	1	1210	147	1934.	*	1	1825	222	1747.	*	2	0040	297	752.
1	0600	73	948.	*	1	1215	148	1947.	*	1	1830	223	1733.	*	2	0045	298	739.
1	0605	74	961.	*	1	1220	149	1961.	*	1	1835	224	1720.	*	2	0050	299	726.
1	0610	75	974.	*	1	1225	150	1974.	*	1	1840	225	1707.	*	2	0055	300	712.

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

 PEAK FLOW     TIME                                MAXIMUM AVERAGE FLOW
   (CFS)       (HR)                    6-HR        24-HR        72-HR      24.92-HR
   2332.      14.67        (CFS)      2100.        1360.        1312.        1312.
                         (INCHES)      .000         .000         .000         .000
                          (AC-FT)     1041.        2697.        2701.        2701.

                          CUMULATIVE AREA =      .00 SQ MI


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


          **************
          *            *
 33 KK    *         A  *
          *            *
          **************
                              BASIN A

 35 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN          15  TIME INTERVAL IN MINUTES
                     JXDATE      1    0  STARTING DATE
                     JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

 47 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .81  SUBBASIN AREA

                PRECIPITATION DATA

 36 PB                STORM        4.10  BASIN TOTAL PRECIPITATION

 37 PI            INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .01       .01       .01       .01
                      .01       .01       .01       .01       .01       .01       .01       .01       .04       .04
                      .04       .09       .09       .09       .02       .02       .02       .01       .01       .01
                      .01       .01       .01       .01       .01       .01       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
```

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00								

48 LS SCS LOSS RATE

STRTL	.38	INITIAL ABSTRACTION
CRVNBR	84.00	CURVE NUMBER
RTIMP	.00	PERCENT IMPERVIOUS AREA

49 UD SCS DIMENSIONLESS UNITGRAPH

TLAG	.66	LAG

***

UNIT HYDROGRAPH

42 END-OF-PERIOD ORDINATES

24.	75.	144.	240.	361.	465.	529.	555.	554.	523.
477.	421.	350.	277.	225.	184.	152.	128.	106.	86.
71.	59.	49.	40.	33.	27.	22.	18.	15.	13.
10.	8.	7.	6.	5.	4.	3.	3.	2.	1.
1.	0.								

****

HYDROGRAPH AT STATION A

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DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
								*								
1		0000	1	.00	.00	.00	0.	*	1		1230	151	.04	.01	.03	648.
1		0005	2	.00	.00	.00	0.	*	1		1235	152	.03	.00	.02	653.
1		0010	3	.00	.00	.00	0.	*	1		1240	153	.03	.00	.02	635.
1		0015	4	.00	.00	.00	0.	*	1		1245	154	.03	.00	.02	599.
1		0020	5	.00	.00	.00	0.	*	1		1250	155	.03	.00	.02	552.
1		0025	6	.00	.00	.00	0.	*	1		1255	156	.03	.00	.02	497.
1		0030	7	.00	.00	.00	0.	*	1		1300	157	.03	.00	.02	440.
1		0035	8	.01	.01	.00	0.	*	1		1305	158	.01	.00	.01	389.
1		0040	9	.01	.01	.00	0.	*	1		1310	159	.01	.00	.01	347.
1		0045	10	.01	.01	.00	0.	*	1		1315	160	.01	.00	.01	311.
1		0050	11	.00	.00	.00	0.	*	1		1320	161	.01	.00	.01	279.
1		0055	12	.00	.00	.00	0.	*	1		1325	162	.01	.00	.01	251.
1		0100	13	.00	.00	.00	0.	*	1		1330	163	.01	.00	.01	225.
1		0105	14	.00	.00	.00	0.	*	1		1335	164	.01	.00	.01	201.
1		0110	15	.00	.00	.00	0.	*	1		1340	165	.01	.00	.01	181.
1		0115	16	.00	.00	.00	0.	*	1		1345	166	.01	.00	.01	164.
1		0120	17	.01	.01	.00	0.	*	1		1350	167	.01	.00	.01	148.
1		0125	18	.01	.01	.00	0.	*	1		1355	168	.01	.00	.01	135.
1		0130	19	.01	.01	.00	0.	*	1		1400	169	.01	.00	.01	124.
1		0135	20	.00	.00	.00	0.	*	1		1405	170	.01	.00	.01	115.
1		0140	21	.00	.00	.00	0.	*	1		1410	171	.01	.00	.01	107.
1		0145	22	.00	.00	.00	0.	*	1		1415	172	.01	.00	.01	101.
1		0150	23	.00	.00	.00	0.	*	1		1420	173	.01	.00	.01	96.
1		0155	24	.00	.00	.00	0.	*	1		1425	174	.01	.00	.01	92.
1		0200	25	.00	.00	.00	0.	*	1		1430	175	.01	.00	.01	89.

1	0205	26	.01	.01	.00	0.	*	1	1435	176	.01	.00	.01	86.
1	0210	27	.01	.01	.00	0.	*	1	1440	177	.01	.00	.01	84.
1	0215	28	.01	.01	.00	0.	*	1	1445	178	.01	.00	.01	82.
1	0220	29	.00	.00	.00	0.	*	1	1450	179	.01	.00	.01	80.
1	0225	30	.00	.00	.00	0.	*	1	1455	180	.01	.00	.01	79.
1	0230	31	.00	.00	.00	0.	*	1	1500	181	.01	.00	.01	78.
1	0235	32	.00	.00	.00	0.	*	1	1505	182	.00	.00	.00	77.
1	0240	33	.00	.00	.00	0.	*	1	1510	183	.00	.00	.00	75.
1	0245	34	.00	.00	.00	0.	*	1	1515	184	.00	.00	.00	72.
1	0250	35	.01	.01	.00	0.	*	1	1520	185	.01	.00	.01	69.
1	0255	36	.01	.01	.00	0.	*	1	1525	186	.01	.00	.01	65.
1	0300	37	.01	.01	.00	0.	*	1	1530	187	.01	.00	.01	61.
1	0305	38	.00	.00	.00	0.	*	1	1535	188	.01	.00	.01	58.
1	0310	39	.00	.00	.00	0.	*	1	1540	189	.01	.00	.01	56.
1	0315	40	.00	.00	.00	0.	*	1	1545	190	.01	.00	.01	54.
1	0320	41	.00	.00	.00	0.	*	1	1550	191	.00	.00	.00	54.
1	0325	42	.00	.00	.00	0.	*	1	1555	192	.00	.00	.00	54.
1	0330	43	.00	.00	.00	0.	*	1	1600	193	.00	.00	.00	54.
1	0335	44	.00	.00	.00	0.	*	1	1605	194	.01	.00	.01	54.
1	0340	45	.00	.00	.00	0.	*	1	1610	195	.01	.00	.01	53.
1	0345	46	.00	.00	.00	0.	*	1	1615	196	.01	.00	.01	51.
1	0350	47	.01	.01	.00	0.	*	1	1620	197	.00	.00	.00	49.
1	0355	48	.01	.01	.00	0.	*	1	1625	198	.00	.00	.00	48.
1	0400	49	.01	.01	.00	0.	*	1	1630	199	.00	.00	.00	46.
1	0405	50	.00	.00	.00	0.	*	1	1635	200	.01	.00	.01	45.
1	0410	51	.00	.00	.00	0.	*	1	1640	201	.01	.00	.01	43.
1	0415	52	.00	.00	.00	0.	*	1	1645	202	.01	.00	.01	41.
1	0420	53	.01	.01	.00	0.	*	1	1650	203	.00	.00	.00	40.
1	0425	54	.01	.01	.00	0.	*	1	1655	204	.00	.00	.00	40.
1	0430	55	.01	.01	.00	0.	*	1	1700	205	.00	.00	.00	40.
1	0435	56	.00	.00	.00	0.	*	1	1705	206	.01	.00	.01	40.
1	0440	57	.00	.00	.00	0.	*	1	1710	207	.01	.00	.01	39.
1	0445	58	.00	.00	.00	0.	*	1	1715	208	.01	.00	.01	38.
1	0450	59	.00	.00	.00	0.	*	1	1720	209	.00	.00	.00	38.
1	0455	60	.00	.00	.00	0.	*	1	1725	210	.00	.00	.00	38.
1	0500	61	.00	.00	.00	0.	*	1	1730	211	.00	.00	.00	38.
1	0505	62	.01	.01	.00	0.	*	1	1735	212	.01	.00	.01	38.
1	0510	63	.01	.01	.00	0.	*	1	1740	213	.01	.00	.01	38.
1	0515	64	.01	.01	.00	0.	*	1	1745	214	.01	.00	.01	37.
1	0520	65	.00	.00	.00	0.	*	1	1750	215	.00	.00	.00	37.
1	0525	66	.00	.00	.00	0.	*	1	1755	216	.00	.00	.00	37.
1	0530	67	.00	.00	.00	0.	*	1	1800	217	.00	.00	.00	38.
1	0535	68	.01	.01	.00	0.	*	1	1805	218	.01	.00	.01	38.
1	0540	69	.01	.01	.00	0.	*	1	1810	219	.01	.00	.01	38.
1	0545	70	.01	.01	.00	0.	*	1	1815	220	.01	.00	.01	37.
1	0550	71	.00	.00	.00	0.	*	1	1820	221	.00	.00	.00	37.
1	0555	72	.00	.00	.00	0.	*	1	1825	222	.00	.00	.00	37.
1	0600	73	.00	.00	.00	0.	*	1	1830	223	.00	.00	.00	38.
1	0605	74	.00	.00	.00	0.	*	1	1835	224	.00	.00	.00	38.
1	0610	75	.00	.00	.00	0.	*	1	1840	225	.00	.00	.00	36.
1	0615	76	.00	.00	.00	0.	*	1	1845	226	.00	.00	.00	34.
1	0620	77	.01	.01	.00	0.	*	1	1850	227	.01	.00	.01	32.
1	0625	78	.01	.01	.00	0.	*	1	1855	228	.01	.00	.01	29.
1	0630	79	.01	.01	.00	0.	*	1	1900	229	.01	.00	.01	28.
1	0635	80	.01	.01	.00	0.	*	1	1905	230	.00	.00	.00	27.
1	0640	81	.01	.01	.00	0.	*	1	1910	231	.00	.00	.00	27.
1	0645	82	.01	.01	.00	0.	*	1	1915	232	.00	.00	.00	27.
1	0650	83	.00	.00	.00	0.	*	1	1920	233	.01	.00	.01	28.
1	0655	84	.00	.00	.00	0.	*	1	1925	234	.01	.00	.01	29.
1	0700	85	.00	.00	.00	0.	*	1	1930	235	.01	.00	.01	30.

1	0705	86	.01	.01	.00	0.	*	1	1935	236	.00	.00	.00	32.
1	0710	87	.01	.01	.00	0.	*	1	1940	237	.00	.00	.00	33.
1	0715	88	.01	.01	.00	0.	*	1	1945	238	.00	.00	.00	34.
1	0720	89	.00	.00	.00	1.	*	1	1950	239	.00	.00	.00	35.
1	0725	90	.00	.00	.00	1.	*	1	1955	240	.00	.00	.00	34.
1	0730	91	.00	.00	.00	1.	*	1	2000	241	.00	.00	.00	32.
1	0735	92	.01	.01	.00	1.	*	1	2005	242	.01	.00	.01	30.
1	0740	93	.01	.01	.00	1.	*	1	2010	243	.01	.00	.01	28.
1	0745	94	.01	.01	.00	2.	*	1	2015	244	.01	.00	.01	27.
1	0750	95	.00	.00	.00	2.	*	1	2020	245	.00	.00	.00	26.
1	0755	96	.00	.00	.00	2.	*	1	2025	246	.00	.00	.00	26.
1	0800	97	.00	.00	.00	2.	*	1	2030	247	.00	.00	.00	27.
1	0805	98	.01	.01	.00	3.	*	1	2035	248	.00	.00	.00	28.
1	0810	99	.01	.01	.00	3.	*	1	2040	249	.00	.00	.00	28.
1	0815	100	.01	.01	.00	3.	*	1	2045	250	.00	.00	.00	27.
1	0820	101	.00	.00	.00	3.	*	1	2050	251	.01	.00	.01	26.
1	0825	102	.00	.00	.00	4.	*	1	2055	252	.01	.00	.01	25.
1	0830	103	.00	.00	.00	4.	*	1	2100	253	.01	.00	.01	24.
1	0835	104	.01	.01	.00	4.	*	1	2105	254	.00	.00	.00	24.
1	0840	105	.01	.01	.00	4.	*	1	2110	255	.00	.00	.00	24.
1	0845	106	.01	.01	.00	5.	*	1	2115	256	.00	.00	.00	25.
1	0850	107	.01	.01	.00	5.	*	1	2120	257	.00	.00	.00	26.
1	0855	108	.01	.01	.00	5.	*	1	2125	258	.00	.00	.00	27.
1	0900	109	.01	.01	.00	6.	*	1	2130	259	.00	.00	.00	27.
1	0905	110	.00	.00	.00	7.	*	1	2135	260	.00	.00	.00	25.
1	0910	111	.00	.00	.00	8.	*	1	2140	261	.00	.00	.00	23.
1	0915	112	.00	.00	.00	8.	*	1	2145	262	.00	.00	.00	21.
1	0920	113	.01	.01	.00	9.	*	1	2150	263	.01	.00	.01	18.
1	0925	114	.01	.01	.00	9.	*	1	2155	264	.01	.00	.01	16.
1	0930	115	.01	.01	.00	9.	*	1	2200	265	.01	.00	.01	15.
1	0935	116	.01	.01	.00	9.	*	1	2205	266	.00	.00	.00	16.
1	0940	117	.01	.01	.00	10.	*	1	2210	267	.00	.00	.00	17.
1	0945	118	.01	.01	.00	10.	*	1	2215	268	.00	.00	.00	20.
1	0950	119	.01	.01	.00	11.	*	1	2220	269	.00	.00	.00	22.
1	0955	120	.01	.01	.00	12.	*	1	2225	270	.00	.00	.00	23.
1	1000	121	.01	.01	.00	13.	*	1	2230	271	.00	.00	.00	24.
1	1005	122	.01	.01	.00	14.	*	1	2235	272	.01	.00	.01	23.
1	1010	123	.01	.01	.00	16.	*	1	2240	273	.01	.00	.01	22.
1	1015	124	.01	.01	.00	17.	*	1	2245	274	.01	.00	.01	22.
1	1020	125	.01	.01	.00	18.	*	1	2250	275	.00	.00	.00	22.
1	1025	126	.01	.01	.00	19.	*	1	2255	276	.00	.00	.00	23.
1	1030	127	.01	.01	.00	20.	*	1	2300	277	.00	.00	.00	24.
1	1035	128	.03	.02	.01	21.	*	1	2305	278	.00	.00	.00	26.
1	1040	129	.03	.02	.01	23.	*	1	2310	279	.00	.00	.00	26.
1	1045	130	.03	.02	.01	24.	*	1	2315	280	.00	.00	.00	26.
1	1050	131	.03	.02	.01	26.	*	1	2320	281	.01	.00	.01	25.
1	1055	132	.03	.02	.01	29.	*	1	2325	282	.01	.00	.01	24.
1	1100	133	.03	.02	.01	32.	*	1	2330	283	.01	.00	.01	24.
1	1105	134	.03	.02	.01	36.	*	1	2335	284	.00	.00	.00	23.
1	1110	135	.03	.02	.01	40.	*	1	2340	285	.00	.00	.00	24.
1	1115	136	.03	.01	.01	44.	*	1	2345	286	.00	.00	.00	25.
1	1120	137	.03	.01	.01	48.	*	1	2350	287	.00	.00	.00	26.
1	1125	138	.03	.01	.01	52.	*	1	2355	288	.00	.00	.00	27.
1	1130	139	.03	.01	.01	56.	*	2	0000	289	.00	.00	.00	26.
1	1135	140	.15	.07	.08	61.	*	2	0005	290	.00	.00	.00	25.
1	1140	141	.15	.07	.09	69.	*	2	0010	291	.00	.00	.00	23.
1	1145	142	.15	.06	.09	82.	*	2	0015	292	.00	.00	.00	21.
1	1150	143	.37	.12	.25	105.	*	2	0020	293	.00	.00	.00	18.
1	1155	144	.37	.10	.27	146.	*	2	0025	294	.00	.00	.00	15.
1	1200	145	.37	.08	.29	206.	*	2	0030	295	.00	.00	.00	12.

1	1205	146	.07	.01	.05	284.	*	2	0035	296	.00	.00	.00	10.
1	1210	147	.07	.01	.06	375.	*	2	0040	297	.00	.00	.00	8.
1	1215	148	.07	.01	.06	471.	*	2	0045	298	.00	.00	.00	7.
1	1220	149	.04	.01	.03	556.	*	2	0050	299	.00	.00	.00	6.
1	1225	150	.04	.01	.03	616.	*	2	0055	300	.00	.00	.00	5.
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TOTAL RAINFALL = 4.10, TOTAL LOSS = 1.64, TOTAL EXCESS = 2.46

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.92-HR
653.	12.58	(CFS)	172.	53.	52.	52.
		(INCHES)	1.980	2.456	2.456	2.456
		(AC-FT)	86.	106.	106.	106.

CUMULATIVE AREA = .81 SQ MI

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              *            *
50 KK         *      BUSH  *
              *            *
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COMBINE FLOWS AT BUSH

52 HC HYDROGRAPH COMBINATION

ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION BUSH

SUM OF 2 HYDROGRAPHS

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	1.	*	1		0615	76	988.	*	1		1230	151	2635.	*	1		1845	226	1728.
1		0005	2	1.	*	1		0620	77	1001.	*	1		1235	152	2653.	*	1		1850	227	1712.
1		0010	3	3.	*	1		0625	78	1014.	*	1		1240	153	2649.	*	1		1855	228	1696.
1		0015	4	9.	*	1		0630	79	1028.	*	1		1245	154	2626.	*	1		1900	229	1682.
1		0020	5	21.	*	1		0635	80	1041.	*	1		1250	155	2592.	*	1		1905	230	1667.
1		0025	6	38.	*	1		0640	81	1054.	*	1		1255	156	2551.	*	1		1910	231	1654.
1		0030	7	57.	*	1		0645	82	1068.	*	1		1300	157	2508.	*	1		1915	232	1641.
1		0035	8	73.	*	1		0650	83	1081.	*	1		1305	158	2470.	*	1		1920	233	1629.
1		0040	9	89.	*	1		0655	84	1095.	*	1		1310	159	2441.	*	1		1925	234	1617.
1		0045	10	104.	*	1		0700	85	1108.	*	1		1315	160	2418.	*	1		1930	235	1605.
1		0050	11	119.	*	1		0705	86	1121.	*	1		1320	161	2400.	*	1		1935	236	1592.
1		0055	12	133.	*	1		0710	87	1135.	*	1		1325	162	2385.	*	1		1940	237	1581.
1		0100	13	147.	*	1		0715	88	1148.	*	1		1330	163	2372.	*	1		1945	238	1569.
1		0105	14	161.	*	1		0720	89	1162.	*	1		1335	164	2362.	*	1		1950	239	1556.
1		0110	15	175.	*	1		0725	90	1175.	*	1		1340	165	2355.	*	1		1955	240	1542.

1	0115	16	188.	*	1	0730	91	1189.	*	1	1345	166	2351.	*	1	2000	241	1527.
1	0120	17	202.	*	1	0735	92	1202.	*	1	1350	167	2349.	*	1	2005	242	1511.
1	0125	18	216.	*	1	0740	93	1216.	*	1	1355	168	2349.	*	1	2010	243	1496.
1	0130	19	230.	*	1	0745	94	1229.	*	1	1400	169	2351.	*	1	2015	244	1482.
1	0135	20	243.	*	1	0750	95	1243.	*	1	1405	170	2355.	*	1	2020	245	1468.
1	0140	21	257.	*	1	0755	96	1257.	*	1	1410	171	2361.	*	1	2025	246	1454.
1	0145	22	270.	*	1	0800	97	1270.	*	1	1415	172	2368.	*	1	2030	247	1442.
1	0150	23	284.	*	1	0805	98	1284.	*	1	1420	173	2377.	*	1	2035	248	1429.
1	0155	24	298.	*	1	0810	99	1297.	*	1	1425	174	2386.	*	1	2040	249	1416.
1	0200	25	311.	*	1	0815	100	1311.	*	1	1430	175	2396.	*	1	2045	250	1402.
1	0205	26	325.	*	1	0820	101	1324.	*	1	1435	176	2406.	*	1	2050	251	1388.
1	0210	27	338.	*	1	0825	102	1338.	*	1	1440	177	2415.	*	1	2055	252	1374.
1	0215	28	352.	*	1	0830	103	1352.	*	1	1445	178	2413.	*	1	2100	253	1360.
1	0220	29	365.	*	1	0835	104	1365.	*	1	1450	179	2398.	*	1	2105	254	1346.
1	0225	30	379.	*	1	0840	105	1379.	*	1	1455	180	2384.	*	1	2110	255	1333.
1	0230	31	392.	*	1	0845	106	1392.	*	1	1500	181	2369.	*	1	2115	256	1321.
1	0235	32	406.	*	1	0850	107	1406.	*	1	1505	182	2354.	*	1	2120	257	1309.
1	0240	33	419.	*	1	0855	108	1420.	*	1	1510	183	2339.	*	1	2125	258	1296.
1	0245	34	432.	*	1	0900	109	1434.	*	1	1515	184	2324.	*	1	2130	259	1282.
1	0250	35	446.	*	1	0905	110	1448.	*	1	1520	185	2307.	*	1	2135	260	1268.
1	0255	36	459.	*	1	0910	111	1462.	*	1	1525	186	2290.	*	1	2140	261	1253.
1	0300	37	473.	*	1	0915	112	1476.	*	1	1530	187	2273.	*	1	2145	262	1237.
1	0305	38	486.	*	1	0920	113	1490.	*	1	1535	188	2256.	*	1	2150	263	1221.
1	0310	39	500.	*	1	0925	114	1503.	*	1	1540	189	2241.	*	1	2155	264	1206.
1	0315	40	513.	*	1	0930	115	1517.	*	1	1545	190	2226.	*	1	2200	265	1191.
1	0320	41	520.	*	1	0935	116	1530.	*	1	1550	191	2213.	*	1	2205	266	1178.
1	0325	42	533.	*	1	0940	117	1544.	*	1	1555	192	2199.	*	1	2210	267	1167.
1	0330	43	547.	*	1	0945	118	1558.	*	1	1600	193	2186.	*	1	2215	268	1156.
1	0335	44	560.	*	1	0950	119	1572.	*	1	1605	194	2172.	*	1	2220	269	1145.
1	0340	45	573.	*	1	0955	120	1586.	*	1	1610	195	2158.	*	1	2225	270	1133.
1	0345	46	587.	*	1	1000	121	1601.	*	1	1615	196	2143.	*	1	2230	271	1120.
1	0350	47	600.	*	1	1005	122	1615.	*	1	1620	197	2128.	*	1	2235	272	1106.
1	0355	48	614.	*	1	1010	123	1630.	*	1	1625	198	2113.	*	1	2240	273	1092.
1	0400	49	627.	*	1	1015	124	1645.	*	1	1630	199	2098.	*	1	2245	274	1079.
1	0405	50	640.	*	1	1020	125	1659.	*	1	1635	200	2084.	*	1	2250	275	1066.
1	0410	51	654.	*	1	1025	126	1674.	*	1	1640	201	2069.	*	1	2255	276	1053.
1	0415	52	667.	*	1	1030	127	1688.	*	1	1645	202	2054.	*	1	2300	277	1041.
1	0420	53	680.	*	1	1035	128	1702.	*	1	1650	203	2039.	*	1	2305	278	1029.
1	0425	54	694.	*	1	1040	129	1717.	*	1	1655	204	2026.	*	1	2310	279	1017.
1	0430	55	707.	*	1	1045	130	1732.	*	1	1700	205	2012.	*	1	2315	280	1003.
1	0435	56	721.	*	1	1050	131	1747.	*	1	1705	206	1999.	*	1	2320	281	989.
1	0440	57	734.	*	1	1055	132	1763.	*	1	1710	207	1985.	*	1	2325	282	975.
1	0445	58	747.	*	1	1100	133	1780.	*	1	1715	208	1971.	*	1	2330	283	961.
1	0450	59	761.	*	1	1105	134	1797.	*	1	1720	209	1957.	*	1	2335	284	948.
1	0455	60	774.	*	1	1110	135	1814.	*	1	1725	210	1944.	*	1	2340	285	935.
1	0500	61	787.	*	1	1115	136	1832.	*	1	1730	211	1931.	*	1	2345	286	923.
1	0505	62	801.	*	1	1120	137	1849.	*	1	1735	212	1918.	*	1	2350	287	911.
1	0510	63	814.	*	1	1125	138	1866.	*	1	1740	213	1904.	*	1	2355	288	898.
1	0515	64	828.	*	1	1130	139	1883.	*	1	1745	214	1890.	*	2	0000	289	885.
1	0520	65	841.	*	1	1135	140	1902.	*	1	1750	215	1877.	*	2	0005	290	870.
1	0525	66	854.	*	1	1140	141	1923.	*	1	1755	216	1864.	*	2	0010	291	855.
1	0530	67	868.	*	1	1145	142	1949.	*	1	1800	217	1851.	*	2	0015	292	839.
1	0535	68	881.	*	1	1150	143	1986.	*	1	1805	218	1838.	*	2	0020	293	823.
1	0540	69	894.	*	1	1155	144	2040.	*	1	1810	219	1824.	*	2	0025	294	807.
1	0545	70	908.	*	1	1200	145	2114.	*	1	1815	220	1810.	*	2	0030	295	791.
1	0550	71	921.	*	1	1205	146	2205.	*	1	1820	221	1797.	*	2	0035	296	775.
1	0555	72	934.	*	1	1210	147	2309.	*	1	1825	222	1784.	*	2	0040	297	760.
1	0600	73	948.	*	1	1215	148	2418.	*	1	1830	223	1771.	*	2	0045	298	746.
1	0605	74	961.	*	1	1220	149	2517.	*	1	1835	224	1758.	*	2	0050	299	731.
1	0610	75	974.	*	1	1225	150	2590.	*	1	1840	225	1743.	*	2	0055	300	717.

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

 PEAK FLOW     TIME                                MAXIMUM AVERAGE FLOW
   (CFS)       (HR)                    6-HR        24-HR        72-HR      24.92-HR
   2653.      12.58        (CFS)      2271.        1413.        1363.        1363.
                         (INCHES)    26.065       64.895       64.988       64.988
                          (AC-FT)     1126.        2803.        2807.        2807.

                         CUMULATIVE AREA =      .81 SQ MI


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


            **************
            *            *
 53 KK      *     RBUSH  *
            *            *
            **************
                                 ROUT HYDROGRAPH FROM BUSH HWY TO SEDIMENT BASIN
                                 IN PROPOSED CHANNEL W=40, H=8', S=0.030

              HYDROGRAPH ROUTING DATA

 56 RK          KINEMATIC WAVE STREAM ROUTING
                            L        346.  CHANNEL LENGTH
                            S       .0373  SLOPE
                            N        .030  CHANNEL ROUGHNESS COEFFICIENT
                           CA         .00  CONTRIBUTING AREA
                        SHAPE        TRAP  CHANNEL SHAPE
                           WD       40.00  BOTTOM WIDTH OR DIAMETER
                            Z         .00  SIDE SLOPE

                                                                  ***


         KINEMATIC STREAM ROUTING USED FOR THIS REACH


          COMPUTED KINEMATIC PARAMETERS
              ALPHA        M      DT (MIN)   DX (FT)
              .8202    1.667        2.50      173.00

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

                                                HYDROGRAPH AT STATION    RBUSH

*****************************************************************************************************************************
                                   *                                   *                                   *
   DA MON HRMN  ORD      FLOW      *  DA MON HRMN  ORD      FLOW      *  DA MON HRMN  ORD      FLOW      *  DA MON HRMN  ORD      FLOW
                                   *                                   *                                   *
    1    0000    1        1.       *   1    0615   76      987.       *   1    1230  151     2634.       *   1    1845  226     1728.
    1    0005    2        1.       *   1    0620   77     1000.       *   1    1235  152     2653.       *   1    1850  227     1713.
    1    0010    3        2.       *   1    0625   78     1014.       *   1    1240  153     2649.       *   1    1855  228     1697.
    1    0015    4        6.       *   1    0630   79     1027.       *   1    1245  154     2627.       *   1    1900  229     1682.
    1    0020    5       18.       *   1    0635   80     1041.       *   1    1250  155     2594.       *   1    1905  230     1668.
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1	0025	6	35.	*	1	0640	81	1054.	*	1	1255	156	2552.	*	1	1910	231	1655.
1	0030	7	54.	*	1	0645	82	1067.	*	1	1300	157	2509.	*	1	1915	232	1642.
1	0035	8	71.	*	1	0650	83	1081.	*	1	1305	158	2471.	*	1	1920	233	1630.
1	0040	9	87.	*	1	0655	84	1094.	*	1	1310	159	2442.	*	1	1925	234	1617.
1	0045	10	102.	*	1	0700	85	1107.	*	1	1315	160	2419.	*	1	1930	235	1605.
1	0050	11	117.	*	1	0705	86	1121.	*	1	1320	161	2400.	*	1	1935	236	1593.
1	0055	12	131.	*	1	0710	87	1134.	*	1	1325	162	2385.	*	1	1940	237	1581.
1	0100	13	145.	*	1	0715	88	1148.	*	1	1330	163	2372.	*	1	1945	238	1569.
1	0105	14	159.	*	1	0720	89	1161.	*	1	1335	164	2362.	*	1	1950	239	1556.
1	0110	15	173.	*	1	0725	90	1175.	*	1	1340	165	2356.	*	1	1955	240	1542.
1	0115	16	187.	*	1	0730	91	1188.	*	1	1345	166	2351.	*	1	2000	241	1527.
1	0120	17	201.	*	1	0735	92	1202.	*	1	1350	167	2349.	*	1	2005	242	1512.
1	0125	18	215.	*	1	0740	93	1215.	*	1	1355	168	2349.	*	1	2010	243	1497.
1	0130	19	228.	*	1	0745	94	1229.	*	1	1400	169	2351.	*	1	2015	244	1482.
1	0135	20	242.	*	1	0750	95	1242.	*	1	1405	170	2355.	*	1	2020	245	1468.
1	0140	21	256.	*	1	0755	96	1256.	*	1	1410	171	2361.	*	1	2025	246	1455.
1	0145	22	269.	*	1	0800	97	1270.	*	1	1415	172	2368.	*	1	2030	247	1442.
1	0150	23	283.	*	1	0805	98	1283.	*	1	1420	173	2376.	*	1	2035	248	1430.
1	0155	24	296.	*	1	0810	99	1297.	*	1	1425	174	2385.	*	1	2040	249	1417.
1	0200	25	310.	*	1	0815	100	1310.	*	1	1430	175	2395.	*	1	2045	250	1403.
1	0205	26	324.	*	1	0820	101	1324.	*	1	1435	176	2406.	*	1	2050	251	1389.
1	0210	27	337.	*	1	0825	102	1338.	*	1	1440	177	2415.	*	1	2055	252	1374.
1	0215	28	351.	*	1	0830	103	1351.	*	1	1445	178	2413.	*	1	2100	253	1360.
1	0220	29	364.	*	1	0835	104	1365.	*	1	1450	179	2399.	*	1	2105	254	1347.
1	0225	30	378.	*	1	0840	105	1378.	*	1	1455	180	2384.	*	1	2110	255	1334.
1	0230	31	391.	*	1	0845	106	1392.	*	1	1500	181	2370.	*	1	2115	256	1321.
1	0235	32	405.	*	1	0850	107	1405.	*	1	1505	182	2355.	*	1	2120	257	1309.
1	0240	33	418.	*	1	0855	108	1419.	*	1	1510	183	2340.	*	1	2125	258	1296.
1	0245	34	432.	*	1	0900	109	1433.	*	1	1515	184	2324.	*	1	2130	259	1283.
1	0250	35	445.	*	1	0905	110	1447.	*	1	1520	185	2308.	*	1	2135	260	1268.
1	0255	36	458.	*	1	0910	111	1461.	*	1	1525	186	2291.	*	1	2140	261	1253.
1	0300	37	472.	*	1	0915	112	1475.	*	1	1530	187	2274.	*	1	2145	262	1238.
1	0305	38	485.	*	1	0920	113	1489.	*	1	1535	188	2257.	*	1	2150	263	1222.
1	0310	39	499.	*	1	0925	114	1503.	*	1	1540	189	2241.	*	1	2155	264	1206.
1	0315	40	512.	*	1	0930	115	1516.	*	1	1545	190	2227.	*	1	2200	265	1192.
1	0320	41	519.	*	1	0935	116	1530.	*	1	1550	191	2213.	*	1	2205	266	1179.
1	0325	42	532.	*	1	0940	117	1544.	*	1	1555	192	2200.	*	1	2210	267	1167.
1	0330	43	546.	*	1	0945	118	1557.	*	1	1600	193	2186.	*	1	2215	268	1156.
1	0335	44	559.	*	1	0950	119	1572.	*	1	1605	194	2173.	*	1	2220	269	1145.
1	0340	45	573.	*	1	0955	120	1586.	*	1	1610	195	2158.	*	1	2225	270	1134.
1	0345	46	586.	*	1	1000	121	1600.	*	1	1615	196	2144.	*	1	2230	271	1121.
1	0350	47	599.	*	1	1005	122	1615.	*	1	1620	197	2129.	*	1	2235	272	1107.
1	0355	48	613.	*	1	1010	123	1629.	*	1	1625	198	2114.	*	1	2240	273	1093.
1	0400	49	626.	*	1	1015	124	1644.	*	1	1630	199	2099.	*	1	2245	274	1080.
1	0405	50	640.	*	1	1020	125	1659.	*	1	1635	200	2084.	*	1	2250	275	1066.
1	0410	51	653.	*	1	1025	126	1673.	*	1	1640	201	2069.	*	1	2255	276	1054.
1	0415	52	666.	*	1	1030	127	1687.	*	1	1645	202	2054.	*	1	2300	277	1042.
1	0420	53	680.	*	1	1035	128	1702.	*	1	1650	203	2040.	*	1	2305	278	1030.
1	0425	54	693.	*	1	1040	129	1716.	*	1	1655	204	2026.	*	1	2310	279	1017.
1	0430	55	706.	*	1	1045	130	1731.	*	1	1700	205	2013.	*	1	2315	280	1004.
1	0435	56	720.	*	1	1050	131	1747.	*	1	1705	206	2000.	*	1	2320	281	990.
1	0440	57	733.	*	1	1055	132	1763.	*	1	1710	207	1986.	*	1	2325	282	976.
1	0445	58	747.	*	1	1100	133	1779.	*	1	1715	208	1971.	*	1	2330	283	962.
1	0450	59	760.	*	1	1105	134	1796.	*	1	1720	209	1958.	*	1	2335	284	948.
1	0455	60	773.	*	1	1110	135	1814.	*	1	1725	210	1944.	*	1	2340	285	936.
1	0500	61	787.	*	1	1115	136	1831.	*	1	1730	211	1931.	*	1	2345	286	923.
1	0505	62	800.	*	1	1120	137	1848.	*	1	1735	212	1918.	*	1	2350	287	911.
1	0510	63	813.	*	1	1125	138	1866.	*	1	1740	213	1905.	*	1	2355	288	899.
1	0515	64	827.	*	1	1130	139	1883.	*	1	1745	214	1891.	*	2	0000	289	885.
1	0520	65	840.	*	1	1135	140	1901.	*	1	1750	215	1877.	*	2	0005	290	871.

1	0525	66	854.	*	1	1140	141	1922.	*	1	1755	216	1864.	*	2	0010	291	856.
1	0530	67	867.	*	1	1145	142	1948.	*	1	1800	217	1851.	*	2	0015	292	840.
1	0535	68	880.	*	1	1150	143	1985.	*	1	1805	218	1838.	*	2	0020	293	824.
1	0540	69	894.	*	1	1155	144	2038.	*	1	1810	219	1825.	*	2	0025	294	808.
1	0545	70	907.	*	1	1200	145	2111.	*	1	1815	220	1811.	*	2	0030	295	792.
1	0550	71	920.	*	1	1205	146	2202.	*	1	1820	221	1797.	*	2	0035	296	776.
1	0555	72	934.	*	1	1210	147	2306.	*	1	1825	222	1784.	*	2	0040	297	761.
1	0600	73	947.	*	1	1215	148	2415.	*	1	1830	223	1772.	*	2	0045	298	746.
1	0605	74	960.	*	1	1220	149	2514.	*	1	1835	224	1758.	*	2	0050	299	732.
1	0610	75	974.	*	1	1225	150	2588.	*	1	1840	225	1744.	*	2	0055	300	718.
				*					*					*				

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.92-HR
2653.	12.58	(CFS)	2271.	1413.	1363.	1363.
		(INCHES)	26.065	64.888	64.977	64.977
		(AC-FT)	1126.	2803.	2807.	2807.

CUMULATIVE AREA = .81 SQ MI

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          **************
          *            *
 57 KK    *    RBUSH2  *
          *            *
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ROUT HYDROGRAPH FROM BUSH HWY TO SEDIMENT BASIN

59 KO OUTPUT CONTROL VARIABLES

IPRNT	2	PRINT CONTROL
IPLOT	2	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

60 RK KINEMATIC WAVE STREAM ROUTING

L	623.	CHANNEL LENGTH
S	.0198	SLOPE
N	.030	CHANNEL ROUGHNESS COEFFICIENT
CA	.00	CONTRIBUTING AREA
SHAPE	TRAP	CHANNEL SHAPE
WD	40.00	BOTTOM WIDTH OR DIAMETER
Z	.00	SIDE SLOPE

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KINEMATIC STREAM ROUTING USED FOR THIS REACH

COMPUTED KINEMATIC PARAMETERS

ALPHA	M	DT (MIN)	DX (FT)
.5978	1.667	2.50	311.50

HYDROGRAPH AT STATION RBUSH2

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	1.	1		0615	76	986.	1		1230	151	2630.	1		1845	226	1730.
1		0005	2	1.	1		0620	77	999.	1		1235	152	2651.	1		1850	227	1714.
1		0010	3	1.	1		0625	78	1012.	1		1240	153	2649.	1		1855	228	1698.
1		0015	4	3.	1		0630	79	1026.	1		1245	154	2629.	1		1900	229	1683.
1		0020	5	10.	1		0635	80	1039.	1		1250	155	2596.	1		1905	230	1669.
1		0025	6	27.	1		0640	81	1052.	1		1255	156	2555.	1		1910	231	1656.
1		0030	7	47.	1		0645	82	1066.	1		1300	157	2512.	1		1915	232	1643.
1		0035	8	65.	1		0650	83	1079.	1		1305	158	2474.	1		1920	233	1631.
1		0040	9	82.	1		0655	84	1093.	1		1310	159	2444.	1		1925	234	1618.
1		0045	10	98.	1		0700	85	1106.	1		1315	160	2421.	1		1930	235	1606.
1		0050	11	113.	1		0705	86	1119.	1		1320	161	2402.	1		1935	236	1594.
1		0055	12	128.	1		0710	87	1133.	1		1325	162	2386.	1		1940	237	1582.
1		0100	13	142.	1		0715	88	1146.	1		1330	163	2373.	1		1945	238	1570.
1		0105	14	156.	1		0720	89	1160.	1		1335	164	2363.	1		1950	239	1558.
1		0110	15	170.	1		0725	90	1173.	1		1340	165	2356.	1		1955	240	1544.
1		0115	16	184.	1		0730	91	1187.	1		1345	166	2351.	1		2000	241	1529.
1		0120	17	198.	1		0735	92	1200.	1		1350	167	2349.	1		2005	242	1513.
1		0125	18	212.	1		0740	93	1214.	1		1355	168	2349.	1		2010	243	1498.
1		0130	19	226.	1		0745	94	1227.	1		1400	169	2351.	1		2015	244	1483.
1		0135	20	239.	1		0750	95	1241.	1		1405	170	2355.	1		2020	245	1469.
1		0140	21	253.	1		0755	96	1255.	1		1410	171	2360.	1		2025	246	1456.
1		0145	22	267.	1		0800	97	1268.	1		1415	172	2367.	1		2030	247	1443.
1		0150	23	280.	1		0805	98	1282.	1		1420	173	2376.	1		2035	248	1431.
1		0155	24	294.	1		0810	99	1295.	1		1425	174	2385.	1		2040	249	1418.
1		0200	25	308.	1		0815	100	1309.	1		1430	175	2395.	1		2045	250	1404.
1		0205	26	321.	1		0820	101	1323.	1		1435	176	2405.	1		2050	251	1390.
1		0210	27	335.	1		0825	102	1336.	1		1440	177	2414.	1		2055	252	1376.
1		0215	28	348.	1		0830	103	1350.	1		1445	178	2413.	1		2100	253	1361.
1		0220	29	362.	1		0835	104	1364.	1		1450	179	2400.	1		2105	254	1348.
1		0225	30	375.	1		0840	105	1377.	1		1455	180	2385.	1		2110	255	1335.
1		0230	31	389.	1		0845	106	1391.	1		1500	181	2371.	1		2115	256	1323.
1		0235	32	403.	1		0850	107	1404.	1		1505	182	2356.	1		2120	257	1310.
1		0240	33	416.	1		0855	108	1418.	1		1510	183	2341.	1		2125	258	1298.
1		0245	34	429.	1		0900	109	1432.	1		1515	184	2325.	1		2130	259	1284.
1		0250	35	443.	1		0905	110	1446.	1		1520	185	2309.	1		2135	260	1270.
1		0255	36	456.	1		0910	111	1460.	1		1525	186	2292.	1		2140	261	1255.
1		0300	37	470.	1		0915	112	1474.	1		1530	187	2275.	1		2145	262	1239.
1		0305	38	483.	1		0920	113	1488.	1		1535	188	2258.	1		2150	263	1223.
1		0310	39	497.	1		0925	114	1502.	1		1540	189	2242.	1		2155	264	1208.
1		0315	40	510.	1		0930	115	1515.	1		1545	190	2228.	1		2200	265	1194.
1		0320	41	518.	1		0935	116	1529.	1		1550	191	2214.	1		2205	266	1180.
1		0325	42	531.	1		0940	117	1542.	1		1555	192	2201.	1		2210	267	1168.
1		0330	43	544.	1		0945	118	1556.	1		1600	193	2187.	1		2215	268	1158.
1		0335	44	557.	1		0950	119	1570.	1		1605	194	2174.	1		2220	269	1147.
1		0340	45	571.	1		0955	120	1585.	1		1610	195	2159.	1		2225	270	1135.
1		0345	46	584.	1		1000	121	1599.	1		1615	196	2145.	1		2230	271	1122.
1		0350	47	598.	1		1005	122	1614.	1		1620	197	2130.	1		2235	272	1108.
1		0355	48	611.	1		1010	123	1628.	1		1625	198	2115.	1		2240	273	1095.
1		0400	49	624.	1		1015	124	1643.	1		1630	199	2100.	1		2245	274	1081.
1		0405	50	638.	1		1020	125	1657.	1		1635	200	2085.	1		2250	275	1068.
1		0410	51	651.	1		1025	126	1672.	1		1640	201	2070.	1		2255	276	1055.

1	0415	52	665.	*	1	1030	127	1686.	*	1	1645	202	2056.	*	1	2300	277	1043.
1	0420	53	678.	*	1	1035	128	1701.	*	1	1650	203	2041.	*	1	2305	278	1031.
1	0425	54	691.	*	1	1040	129	1715.	*	1	1655	204	2027.	*	1	2310	279	1019.
1	0430	55	705.	*	1	1045	130	1730.	*	1	1700	205	2014.	*	1	2315	280	1005.
1	0435	56	718.	*	1	1050	131	1745.	*	1	1705	206	2001.	*	1	2320	281	991.
1	0440	57	732.	*	1	1055	132	1761.	*	1	1710	207	1987.	*	1	2325	282	977.
1	0445	58	745.	*	1	1100	133	1778.	*	1	1715	208	1973.	*	1	2330	283	963.
1	0450	59	758.	*	1	1105	134	1795.	*	1	1720	209	1959.	*	1	2335	284	950.
1	0455	60	772.	*	1	1110	135	1812.	*	1	1725	210	1945.	*	1	2340	285	937.
1	0500	61	785.	*	1	1115	136	1829.	*	1	1730	211	1933.	*	1	2345	286	925.
1	0505	62	799.	*	1	1120	137	1847.	*	1	1735	212	1919.	*	1	2350	287	913.
1	0510	63	812.	*	1	1125	138	1864.	*	1	1740	213	1906.	*	1	2355	288	900.
1	0515	64	825.	*	1	1130	139	1881.	*	1	1745	214	1892.	*	2	0000	289	887.
1	0520	65	839.	*	1	1135	140	1899.	*	1	1750	215	1878.	*	2	0005	290	872.
1	0525	66	852.	*	1	1140	141	1920.	*	1	1755	216	1865.	*	2	0010	291	857.
1	0530	67	865.	*	1	1145	142	1946.	*	1	1800	217	1852.	*	2	0015	292	842.
1	0535	68	879.	*	1	1150	143	1982.	*	1	1805	218	1839.	*	2	0020	293	826.
1	0540	69	892.	*	1	1155	144	2034.	*	1	1810	219	1826.	*	2	0025	294	810.
1	0545	70	906.	*	1	1200	145	2105.	*	1	1815	220	1812.	*	2	0030	295	794.
1	0550	71	919.	*	1	1205	146	2195.	*	1	1820	221	1798.	*	2	0035	296	778.
1	0555	72	932.	*	1	1210	147	2298.	*	1	1825	222	1785.	*	2	0040	297	763.
1	0600	73	946.	*	1	1215	148	2406.	*	1	1830	223	1773.	*	2	0045	298	748.
1	0605	74	959.	*	1	1220	149	2506.	*	1	1835	224	1759.	*	2	0050	299	734.
1	0610	75	972.	*	1	1225	150	2582.	*	1	1840	225	1745.	*	2	0055	300	720.
				*					*					*				

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PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.92-HR
2651.	12.58	(CFS)	2271.	1413.	1363.	1363.
		(INCHES)	26.065	64.873	64.955	64.955
		(AC-FT)	1126.	2803.	2806.	2806.

CUMULATIVE AREA = .81 SQ MI

STATION RBUSH2

(I) INFLOW, (O) OUTFLOW

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                0.      400.     800.    1200.    1600.    2000.    2400.    2800.       0.       0.       0.       0.       0.
DAHRMN PER
10000   1I---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.
10005   2I         .         .         .         .         .         .         .         .         .         .         .         .
10010   3I         .         .         .         .         .         .         .         .         .         .         .         .
10015   4I         .         .         .         .         .         .         .         .         .         .         .         .
10020   5I         .         .         .         .         .         .         .         .         .         .         .         .
10025   6.I        .         .         .         .         .         .         .         .         .         .         .         .
10030   7.I        .         .         .         .         .         .         .         .         .         .         .         .
10035   8. I       .         .         .         .         .         .         .         .         .         .         .         .
10040   9. I       .         .         .         .         .         .         .         .         .         .         .         .
10045   10. OI     .         .         .         .         .         .         .         .         .         .         .         .
10050   11. .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10055   12.  I     .         .         .         .         .         .         .         .         .         .         .         .
10100   13.   I    .         .         .         .         .         .         .         .         .         .         .         .
10105   14.   I    .         .         .         .         .         .         .         .         .         .         .         .
10110   15.   I    .         .         .         .         .         .         .         .         .         .         .         .
10115   16.    I   .         .         .         .         .         .         .         .         .         .         .         .
10120   17.    I   .         .         .         .         .         .         .         .         .         .         .         .
10125   18.    I   .         .         .         .         .         .         .         .         .         .         .         .
10130   19.     I  .         .         .         .         .         .         .         .         .         .         .         .
10135   20.     I  .         .         .         .         .         .         .         .         .         .         .         .
10140   21. . . I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10145   22.      I .         .         .         .         .         .         .         .         .         .         .         .
10150   23.      I .         .         .         .         .         .         .         .         .         .         .         .
10155   24.      I .         .         .         .         .         .         .         .         .         .         .         .
10200   25.       I .        .         .         .         .         .         .         .         .         .         .         .
10205   26.       I .        .         .         .         .         .         .         .         .         .         .         .
10210   27.       I .        .         .         .         .         .         .         .         .         .         .         .
10215   28.        I.        .         .         .         .         .         .         .         .         .         .         .
10220   29.        I.        .         .         .         .         .         .         .         .         .         .         .
10225   30.        I.        .         .         .         .         .         .         .         .         .         .         .
10230   31. . . . . I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10235   32.         I        .         .         .         .         .         .         .         .         .         .         .
10240   33.         I        .         .         .         .         .         .         .         .         .         .         .
10245   34.         .I       .         .         .         .         .         .         .         .         .         .         .
10250   35.         .I       .         .         .         .         .         .         .         .         .         .         .
10255   36.         .I       .         .         .         .         .         .         .         .         .         .         .
10300   37.         . I      .         .         .         .         .         .         .         .         .         .         .
10305   38.         . I      .         .         .         .         .         .         .         .         .         .         .
10310   39.         . I      .         .         .         .         .         .         .         .         .         .         .
10315   40.         .  I     .         .         .         .         .         .         .         .         .         .         .
10320   41. . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10325   42.         .  I     .         .         .         .         .         .         .         .         .         .         .
10330   43.         .   I    .         .         .         .         .         .         .         .         .         .         .
10335   44.         .   I    .         .         .         .         .         .         .         .         .         .         .
10340   45.         .   I    .         .         .         .         .         .         .         .         .         .         .
10345   46.         .    I   .         .         .         .         .         .         .         .         .         .         .
10350   47.         .    I   .         .         .         .         .         .         .         .         .         .         .
10355   48.         .    I   .         .         .         .         .         .         .         .         .         .         .
10400   49.         .     I  .         .         .         .         .         .         .         .         .         .         .
10405   50.         .     I  .         .         .         .         .         .         .         .         .         .         .
10410   51. . . . . . . . I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10415   52.         .      I .         .         .         .         .         .         .         .         .         .         .
10420   53.         .      I .         .         .         .         .         .         .         .         .         .         .
10425   54.         .      I .         .         .         .         .         .         .         .         .         .         .
10430   55.         .       I .        .         .         .         .         .         .         .         .         .         .
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10435  56.          .       I .         .         .         .         .         .         .         .         .         .
10440  57.          .       I .         .         .         .         .         .         .         .         .         .
10445  58.          .        I.         .         .         .         .         .         .         .         .         .
10450  59.          .        I.         .         .         .         .         .         .         .         .         .
10455  60.          .        I.         .         .         .         .         .         .         .         .         .
10500  61.  . . . . . . . . . I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10505  62.          .         I         .         .         .         .         .         .         .         .         .         .
10510  63.          .         I         .         .         .         .         .         .         .         .         .         .
10515  64.          .         .I        .         .         .         .         .         .         .         .         .
10520  65.          .         .I        .         .         .         .         .         .         .         .         .
10525  66.          .         .I        .         .         .         .         .         .         .         .         .
10530  67.          .         . I       .         .         .         .         .         .         .         .         .
10535  68.          .         . I       .         .         .         .         .         .         .         .         .
10540  69.          .         . I       .         .         .         .         .         .         .         .         .
10545  70.          .         .  I      .         .         .         .         .         .         .         .         .
10550  71.  . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10555  72.          .         .  I      .         .         .         .         .         .         .         .         .
10600  73.          .         .   I     .         .         .         .         .         .         .         .         .
10605  74.          .         .   I     .         .         .         .         .         .         .         .         .
10610  75.          .         .   I     .         .         .         .         .         .         .         .         .
10615  76.          .         .    I    .         .         .         .         .         .         .         .         .
10620  77.          .         .    I    .         .         .         .         .         .         .         .         .
10625  78.          .         .    I    .         .         .         .         .         .         .         .         .
10630  79.          .         .     I   .         .         .         .         .         .         .         .         .
10635  80.          .         .     I   .         .         .         .         .         .         .         .         .
10640  81.  . . . . . . . . . . . . I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10645  82.          .         .      I  .         .         .         .         .         .         .         .         .
10650  83.          .         .      I  .         .         .         .         .         .         .         .         .
10655  84.          .         .      I  .         .         .         .         .         .         .         .         .
10700  85.          .         .       I .         .         .         .         .         .         .         .         .
10705  86.          .         .       I .         .         .         .         .         .         .         .         .
10710  87.          .         .       I .         .         .         .         .         .         .         .         .
10715  88.          .         .        I.         .         .         .         .         .         .         .         .
10720  89.          .         .        I.         .         .         .         .         .         .         .         .
10725  90.          .         .        I.         .         .         .         .         .         .         .         .
10730  91.  . . . . . . . . . . . . . . I . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10735  92.          .         .         I         .         .         .         .         .         .         .         .         .
10740  93.          .         .         I         .         .         .         .         .         .         .         .         .
10745  94.          .         .         .I        .         .         .         .         .         .         .         .
10750  95.          .         .         .I        .         .         .         .         .         .         .         .
10755  96.          .         .         .I        .         .         .         .         .         .         .         .
10800  97.          .         .         . I       .         .         .         .         .         .         .         .
10805  98.          .         .         . I       .         .         .         .         .         .         .         .
10810  99.          .         .         . I       .         .         .         .         .         .         .         .
10815 100.          .         .         .  I      .         .         .         .         .         .         .         .
10820 101.  . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10825 102.          .         .         .  I      .         .         .         .         .         .         .         .
10830 103.          .         .         .   I     .         .         .         .         .         .         .         .
10835 104.          .         .         .   I     .         .         .         .         .         .         .         .
10840 105.          .         .         .   I     .         .         .         .         .         .         .         .
10845 106.          .         .         .    I    .         .         .         .         .         .         .         .
10850 107.          .         .         .    I    .         .         .         .         .         .         .         .
10855 108.          .         .         .    I    .         .         .         .         .         .         .         .
10900 109.          .         .         .     I   .         .         .         .         .         .         .         .
10905 110.          .         .         .     I   .         .         .         .         .         .         .         .
10910 111.  . . . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
10915 112.          .         .         .      I  .         .         .         .         .         .         .         .
10920 113.          .         .         .      I  .         .         .         .         .         .         .         .
10925 114.          .         .         .       I .         .         .         .         .         .         .         .
10930 115.          .         .         .       I .         .         .         .         .         .         .         .
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10935 116.          .         .         .       I .         .         .         .         .         .         .         .         .
10940 117.          .         .         .        I.         .         .         .         .         .         .         .         .
10945 118.          .         .         .        I.         .         .         .         .         .         .         .         .
10950 119.          .         .         .        I.         .         .         .         .         .         .         .         .
10955 120.          .         .         .         I         .         .         .         .         .         .         .         .
11000 121. . . . . . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11005 122.          .         .         .         I         .         .         .         .         .         .         .         .
11010 123.          .         .         .         .I        .         .         .         .         .         .         .         .
11015 124.          .         .         .         .I        .         .         .         .         .         .         .         .
11020 125.          .         .         .         .I        .         .         .         .         .         .         .         .
11025 126.          .         .         .         . I       .         .         .         .         .         .         .         .
11030 127.          .         .         .         . I       .         .         .         .         .         .         .         .
11035 128.          .         .         .         .  I      .         .         .         .         .         .         .         .
11040 129.          .         .         .         .  I      .         .         .         .         .         .         .         .
11045 130.          .         .         .         .  I      .         .         .         .         .         .         .         .
11050 131. . . . . . . . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11055 132.          .         .         .         .   I     .         .         .         .         .         .         .         .
11100 133.          .         .         .         .   I     .         .         .         .         .         .         .         .
11105 134.          .         .         .         .    I    .         .         .         .         .         .         .         .
11110 135.          .         .         .         .    I    .         .         .         .         .         .         .         .
11115 136.          .         .         .         .     I   .         .         .         .         .         .         .         .
11120 137.          .         .         .         .     I   .         .         .         .         .         .         .         .
11125 138.          .         .         .         .      I  .         .         .         .         .         .         .         .
11130 139.          .         .         .         .      I  .         .         .         .         .         .         .         .
11135 140.          .         .         .         .      OI .         .         .         .         .         .         .         .
11140 141. . . . . . . . . . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11145 142.          .         .         .         .        I.         .         .         .         .         .         .         .
11150 143.          .         .         .         .         I         .         .         .         .         .         .         .
11155 144.          .         .         .         .         .I        .         .         .         .         .         .         .
11200 145.          .         .         .         .         .  I      .         .         .         .         .         .         .
11205 146.          .         .         .         .         .    I    .         .         .         .         .         .         .
11210 147.          .         .         .         .         .      OI .         .         .         .         .         .         .
11215 148.          .         .         .         .         .         I         .         .         .         .         .         .
11220 149.          .         .         .         .         .         .  I      .         .         .         .         .         .
11225 150.          .         .         .         .         .         .    I    .         .         .         .         .         .
11230 151. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . .
11235 152.          .         .         .         .         .         .     I   .         .         .         .         .         .
11240 153.          .         .         .         .         .         .     I   .         .         .         .         .         .
11245 154.          .         .         .         .         .         .     I   .         .         .         .         .         .
11250 155.          .         .         .         .         .         .    I    .         .         .         .         .         .
11255 156.          .         .         .         .         .         .   I     .         .         .         .         .         .
11300 157.          .         .         .         .         .         .  I      .         .         .         .         .         .
11305 158.          .         .         .         .         .         . I       .         .         .         .         .         .
11310 159.          .         .         .         .         .         .I        .         .         .         .         .         .
11315 160.          .         .         .         .         .         IO        .         .         .         .         .         .
11320 161. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11325 162.          .         .         .         .         .         I         .         .         .         .         .         .
11330 163.          .         .         .         .         .        I.         .         .         .         .         .         .
11335 164.          .         .         .         .         .        I.         .         .         .         .         .         .
11340 165.          .         .         .         .         .        I.         .         .         .         .         .         .
11345 166.          .         .         .         .         .        I.         .         .         .         .         .         .
11350 167.          .         .         .         .         .        I.         .         .         .         .         .         .
11355 168.          .         .         .         .         .        I.         .         .         .         .         .         .
11400 169.          .         .         .         .         .        I.         .         .         .         .         .         .
11405 170.          .         .         .         .         .        I.         .         .         .         .         .         .
11410 171. . . . . . . . . . . . . . . . . . . . . . . . . . . . . .I. . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11415 172.          .         .         .         .         .        I.         .         .         .         .         .         .
11420 173.          .         .         .         .         .        I.         .         .         .         .         .         .
11425 174.          .         .         .         .         .         I         .         .         .         .         .         .
11430 175.          .         .         .         .         .         I         .         .         .         .         .         .
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11435 176.          .         .         .         .         .         I         .         .         .         .         .         .
11440 177.          .         .         .         .         .         I         .         .         .         .         .         .
11445 178.          .         .         .         .         .         I         .         .         .         .         .         .
11450 179.          .         .         .         .         .         I         .         .         .         .         .         .
11455 180.          .         .         .         .         .         I         .         .         .         .         .         .
11500 181. ..........................................................I.............................................................
11505 182.          .         .         .         .         .        I.         .         .         .         .         .         .
11510 183.          .         .         .         .         .       IO.         .         .         .         .         .         .
11515 184.          .         .         .         .         .       I .         .         .         .         .         .         .
11520 185.          .         .         .         .         .       I .         .         .         .         .         .         .
11525 186.          .         .         .         .         .      I  .         .         .         .         .         .         .
11530 187.          .         .         .         .         .      I  .         .         .         .         .         .         .
11535 188.          .         .         .         .         .     I   .         .         .         .         .         .         .
11540 189.          .         .         .         .         .     I   .         .         .         .         .         .         .
11545 190.          .         .         .         .         .     I   .         .         .         .         .         .         .
11550 191. ......................................................I.................................................................
11555 192.          .         .         .         .         .    I    .         .         .         .         .         .         .
11600 193.          .         .         .         .         .    I    .         .         .         .         .         .         .
11605 194.          .         .         .         .         .   I     .         .         .         .         .         .         .
11610 195.          .         .         .         .         .   I     .         .         .         .         .         .         .
11615 196.          .         .         .         .         .   I     .         .         .         .         .         .         .
11620 197.          .         .         .         .         .  I      .         .         .         .         .         .         .
11625 198.          .         .         .         .         .  I      .         .         .         .         .         .         .
11630 199.          .         .         .         .         . IO      .         .         .         .         .         .         .
11635 200.          .         .         .         .         . I       .         .         .         .         .         .         .
11640 201. ...................................................I....................................................................
11645 202.          .         .         .         .         .I        .         .         .         .         .         .         .
11650 203.          .         .         .         .         .I        .         .         .         .         .         .         .
11655 204.          .         .         .         .         .I        .         .         .         .         .         .         .
11700 205.          .         .         .         .         I         .         .         .         .         .         .         .
11705 206.          .         .         .         .         I         .         .         .         .         .         .         .
11710 207.          .         .         .         .         I         .         .         .         .         .         .         .
11715 208.          .         .         .         .        I.         .         .         .         .         .         .         .
11720 209.          .         .         .         .        I.         .         .         .         .         .         .         .
11725 210.          .         .         .         .        I.         .         .         .         .         .         .         .
11730 211. ...............................................I........................................................................
11735 212.          .         .         .         .       I .         .         .         .         .         .         .         .
11740 213.          .         .         .         .       I .         .         .         .         .         .         .         .
11745 214.          .         .         .         .      I  .         .         .         .         .         .         .         .
11750 215.          .         .         .         .      I  .         .         .         .         .         .         .         .
11755 216.          .         .         .         .      I  .         .         .         .         .         .         .         .
11800 217.          .         .         .         .     I   .         .         .         .         .         .         .         .
11805 218.          .         .         .         .     I   .         .         .         .         .         .         .         .
11810 219.          .         .         .         .     I   .         .         .         .         .         .         .         .
11815 220.          .         .         .         .    I    .         .         .         .         .         .         .         .
11820 221. ............................................I...........................................................................
11825 222.          .         .         .         .    I    .         .         .         .         .         .         .         .
11830 223.          .         .         .         .   I     .         .         .         .         .         .         .         .
11835 224.          .         .         .         .   I     .         .         .         .         .         .         .         .
11840 225.          .         .         .         .   I     .         .         .         .         .         .         .         .
11845 226.          .         .         .         .  I      .         .         .         .         .         .         .         .
11850 227.          .         .         .         .  I      .         .         .         .         .         .         .         .
11855 228.          .         .         .         . I       .         .         .         .         .         .         .         .
11900 229.          .         .         .         . I       .         .         .         .         .         .         .         .
11905 230.          .         .         .         . I       .         .         .         .         .         .         .         .
11910 231. ........................................I...............................................................................
11915 232.          .         .         .         .I        .         .         .         .         .         .         .         .
11920 233.          .         .         .         .I        .         .         .         .         .         .         .         .
11925 234.          .         .         .         I         .         .         .         .         .         .         .         .
11930 235.          .         .         .         I         .         .         .         .         .         .         .         .
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11935 236.          .         .         .         I         .         .         .         .         .         .         .         .
11940 237.          .         .         .         I         .         .         .         .         .         .         .         .
11945 238.          .         .         .        I.         .         .         .         .         .         .         .         .
11950 239.          .         .         .        I.         .         .         .         .         .         .         .         .
11955 240.          .         .         .        I.         .         .         .         .         .         .         .         .
12000 241. .....................................I..................................................................................
12005 242.          .         .         .       I .         .         .         .         .         .         .         .         .
12010 243.          .         .         .      I  .         .         .         .         .         .         .         .         .
12015 244.          .         .         .      I  .         .         .         .         .         .         .         .         .
12020 245.          .         .         .      I  .         .         .         .         .         .         .         .         .
12025 246.          .         .         .     I   .         .         .         .         .         .         .         .         .
12030 247.          .         .         .     I   .         .         .         .         .         .         .         .         .
12035 248.          .         .         .     I   .         .         .         .         .         .         .         .         .
12040 249.          .         .         .    I    .         .         .         .         .         .         .         .         .
12045 250.          .         .         .    I    .         .         .         .         .         .         .         .         .
12050 251. ..................................I.....................................................................................
12055 252.          .         .         .   I     .         .         .         .         .         .         .         .         .
12100 253.          .         .         .   I     .         .         .         .         .         .         .         .         .
12105 254.          .         .         .   I     .         .         .         .         .         .         .         .         .
12110 255.          .         .         .  I      .         .         .         .         .         .         .         .         .
12115 256.          .         .         .  I      .         .         .         .         .         .         .         .         .
12120 257.          .         .         .  I      .         .         .         .         .         .         .         .         .
12125 258.          .         .         . I       .         .         .         .         .         .         .         .         .
12130 259.          .         .         . I       .         .         .         .         .         .         .         .         .
12135 260.          .         .         . I       .         .         .         .         .         .         .         .         .
12140 261. ..............................I.........................................................................................
12145 262.          .         .         .I        .         .         .         .         .         .         .         .         .
12150 263.          .         .         .I        .         .         .         .         .         .         .         .         .
12155 264.          .         .         I         .         .         .         .         .         .         .         .         .
12200 265.          .         .         I         .         .         .         .         .         .         .         .         .
12205 266.          .         .        IO         .         .         .         .         .         .         .         .         .
12210 267.          .         .        I.         .         .         .         .         .         .         .         .         .
12215 268.          .         .        I.         .         .         .         .         .         .         .         .         .
12220 269.          .         .        I.         .         .         .         .         .         .         .         .         .
12225 270.          .         .       I .         .         .         .         .         .         .         .         .         .
12230 271. ...........................I............................................................................................
12235 272.          .         .       I .         .         .         .         .         .         .         .         .         .
12240 273.          .         .      I  .         .         .         .         .         .         .         .         .         .
12245 274.          .         .      I  .         .         .         .         .         .         .         .         .         .
12250 275.          .         .      I  .         .         .         .         .         .         .         .         .         .
12255 276.          .         .     I   .         .         .         .         .         .         .         .         .         .
12300 277.          .         .     I   .         .         .         .         .         .         .         .         .         .
12305 278.          .         .     I   .         .         .         .         .         .         .         .         .         .
12310 279.          .         .    I    .         .         .         .         .         .         .         .         .         .
12315 280.          .         .    I    .         .         .         .         .         .         .         .         .         .
12320 281. ........................I...............................................................................................
12325 282.          .         .   I     .         .         .         .         .         .         .         .         .         .
12330 283.          .         .   I     .         .         .         .         .         .         .         .         .         .
12335 284.          .         .   I     .         .         .         .         .         .         .         .         .         .
12340 285.          .         .  I      .         .         .         .         .         .         .         .         .         .
12345 286.          .         .  I      .         .         .         .         .         .         .         .         .         .
12350 287.          .         .  I      .         .         .         .         .         .         .         .         .         .
12355 288.          .         . IO      .         .         .         .         .         .         .         .         .         .
20000 289.          .         . I       .         .         .         .         .         .         .         .         .         .
20005 290.          .         . I       .         .         .         .         .         .         .         .         .         .
20010 291. ....................I...................................................................................................
20015 292.          .         .I        .         .         .         .         .         .         .         .         .         .
20020 293.          .         .I        .         .         .         .         .         .         .         .         .         .
20025 294.          .         I         .         .         .         .         .         .         .         .         .         .
20030 295.          .         I         .         .         .         .         .         .         .         .         .         .
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20035 296.         .        I.         .         .         .         .         .         .         .         .         .         .
20040 297.         .        I.         .         .         .         .         .         .         .         .         .         .
20045 298.         .        I.         .         .         .         .         .         .         .         .         .         .
20050 299.         .       I .         .         .         .         .         .         .         .         .         .         .
20055 300.---------.-------I-.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.
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          *            *
61 KK     *     BASIN  *
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SEDIMENT BASIN CAPACITY
BASIN CARACTERISTICS: W=100, L=650, Z=2:1

HYDROGRAPH ROUTING DATA

64 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	1316.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

65 SV	STORAGE	.0	1.6	3.2	4.9	6.7	8.5	10.4	12.3	14.3
66 SE	ELEVATION	1316.00	1317.00	1318.00	1319.00	1320.00	1321.00	1322.00	1323.00	1324.00

67 SS SPILLWAY

CREL	1318.00	SPILLWAY CREST ELEVATION
SPWID	150.00	SPILLWAY WIDTH
COQW	1.85	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	.00	.00	.70	5.60	18.87	44.75	87.43	151.04	239.84	358.05
ELEVATION	1316.00	1318.00	1318.02	1318.07	1318.17	1318.30	1318.46	1318.67	1318.91	1319.19
OUTFLOW	509.80	699.29	930.78	1208.39	1536.40	1918.93	2360.15	2864.37	3435.69	4078.40
ELEVATION	1319.50	1319.85	1320.24	1320.67	1321.13	1321.63	1322.17	1322.74	1323.35	1324.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	1.58	3.22	3.25	3.35	3.51	3.73	4.01	4.36	4.77
OUTFLOW	.00	.00	.00	.70	5.60	18.87	44.75	87.43	151.04	239.84
ELEVATION	1316.00	1317.00	1318.00	1318.02	1318.07	1318.17	1318.30	1318.46	1318.67	1318.91
STORAGE	4.92	5.25	5.80	6.42	6.68	7.12	7.90	8.51	8.75	9.69
OUTFLOW	277.50	358.05	509.80	699.29	784.89	930.78	1208.39	1441.93	1536.40	1918.93
ELEVATION	1319.00	1319.19	1319.50	1319.85	1320.00	1320.24	1320.67	1321.00	1321.13	1321.63
STORAGE	10.39	10.71	11.82	12.33	13.03	14.32				
OUTFLOW	2220.00	2360.15	2864.37	3102.54	3435.69	4078.40				
ELEVATION	1322.00	1322.17	1322.74	1323.00	1323.35	1324.00				

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 510. TO 4078.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.

THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

****

HYDROGRAPH AT STATION BASIN

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	.0	1316.0	*	1		0820	101	1317.	8.2	1320.8	*	1		1640	201	2075.	10.1	1321.8
1		0005	2	0.	.0	1316.0	*	1		0825	102	1331.	8.2	1320.8	*	1		1645	202	2060.	10.0	1321.8
1		0010	3	0.	.0	1316.0	*	1		0830	103	1345.	8.3	1320.9	*	1		1650	203	2046.	10.0	1321.8
1		0015	4	0.	.0	1316.0	*	1		0835	104	1358.	8.3	1320.9	*	1		1655	204	2032.	10.0	1321.8
1		0020	5	0.	.1	1316.0	*	1		0840	105	1372.	8.3	1320.9	*	1		1700	205	2019.	9.9	1321.8
1		0025	6	0.	.2	1316.1	*	1		0845	106	1385.	8.4	1320.9	*	1		1705	206	2005.	9.9	1321.7
1		0030	7	0.	.5	1316.3	*	1		0850	107	1399.	8.4	1320.9	*	1		1710	207	1991.	9.9	1321.7
1		0035	8	0.	.8	1316.5	*	1		0855	108	1413.	8.4	1321.0	*	1		1715	208	1977.	9.8	1321.7
1		0040	9	0.	1.4	1316.9	*	1		0900	109	1427.	8.5	1321.0	*	1		1720	209	1963.	9.8	1321.7
1		0045	10	0.	2.0	1317.2	*	1		0905	110	1441.	8.5	1321.0	*	1		1725	210	1950.	9.8	1321.7
1		0050	11	0.	2.7	1317.7	*	1		0910	111	1455.	8.5	1321.0	*	1		1730	211	1937.	9.7	1321.7
1		0055	12	16.	3.5	1318.1	*	1		0915	112	1469.	8.6	1321.0	*	1		1735	212	1924.	9.7	1321.6
1		0100	13	91.	4.0	1318.5	*	1		0920	113	1483.	8.6	1321.1	*	1		1740	213	1911.	9.7	1321.6
1		0105	14	136.	4.3	1318.6	*	1		0925	114	1497.	8.6	1321.1	*	1		1745	214	1897.	9.6	1321.6
1		0110	15	158.	4.4	1318.7	*	1		0930	115	1510.	8.7	1321.1	*	1		1750	215	1883.	9.6	1321.6
1		0115	16	174.	4.5	1318.7	*	1		0935	116	1524.	8.7	1321.1	*	1		1755	216	1870.	9.6	1321.6
1		0120	17	189.	4.5	1318.8	*	1		0940	117	1537.	8.8	1321.1	*	1		1800	217	1857.	9.5	1321.5
1		0125	18	203.	4.6	1318.8	*	1		0945	118	1551.	8.8	1321.1	*	1		1805	218	1844.	9.5	1321.5
1		0130	19	216.	4.7	1318.8	*	1		0950	119	1565.	8.8	1321.2	*	1		1810	219	1831.	9.5	1321.5
1		0135	20	230.	4.7	1318.9	*	1		0955	120	1579.	8.9	1321.2	*	1		1815	220	1817.	9.4	1321.5
1		0140	21	244.	4.8	1318.9	*	1		1000	121	1594.	8.9	1321.2	*	1		1820	221	1803.	9.4	1321.5
1		0145	22	258.	4.8	1319.0	*	1		1005	122	1608.	8.9	1321.2	*	1		1825	222	1790.	9.4	1321.5
1		0150	23	272.	4.9	1319.0	*	1		1010	123	1623.	9.0	1321.2	*	1		1830	223	1777.	9.3	1321.4
1		0155	24	286.	5.0	1319.0	*	1		1015	124	1638.	9.0	1321.3	*	1		1835	224	1764.	9.3	1321.4
1		0200	25	300.	5.0	1319.1	*	1		1020	125	1652.	9.0	1321.3	*	1		1840	225	1750.	9.3	1321.4
1		0205	26	313.	5.1	1319.1	*	1		1025	126	1667.	9.1	1321.3	*	1		1845	226	1735.	9.2	1321.4
1		0210	27	327.	5.1	1319.1	*	1		1030	127	1681.	9.1	1321.3	*	1		1850	227	1720.	9.2	1321.4
1		0215	28	340.	5.2	1319.1	*	1		1035	128	1695.	9.1	1321.3	*	1		1855	228	1704.	9.2	1321.3
1		0220	29	354.	5.2	1319.2	*	1		1040	129	1710.	9.2	1321.4	*	1		1900	229	1689.	9.1	1321.3
1		0225	30	368.	5.3	1319.2	*	1		1045	130	1725.	9.2	1321.4	*	1		1905	230	1674.	9.1	1321.3
1		0230	31	382.	5.3	1319.2	*	1		1050	131	1740.	9.2	1321.4	*	1		1910	231	1661.	9.1	1321.3
1		0235	32	395.	5.4	1319.3	*	1		1055	132	1756.	9.3	1321.4	*	1		1915	232	1648.	9.0	1321.3
1		0240	33	409.	5.4	1319.3	*	1		1100	133	1772.	9.3	1321.4	*	1		1920	233	1635.	9.0	1321.3
1		0245	34	422.	5.5	1319.3	*	1		1105	134	1789.	9.4	1321.5	*	1		1925	234	1623.	9.0	1321.2
1		0250	35	436.	5.5	1319.3	*	1		1110	135	1806.	9.4	1321.5	*	1		1930	235	1611.	8.9	1321.2
1		0255	36	449.	5.6	1319.4	*	1		1115	136	1823.	9.5	1321.5	*	1		1935	236	1598.	8.9	1321.2
1		0300	37	463.	5.6	1319.4	*	1		1120	137	1841.	9.5	1321.5	*	1		1940	237	1586.	8.9	1321.2
1		0305	38	476.	5.7	1319.4	*	1		1125	138	1858.	9.5	1321.5	*	1		1945	238	1574.	8.8	1321.2
1		0310	39	490.	5.7	1319.5	*	1		1130	139	1875.	9.6	1321.6	*	1		1950	239	1562.	8.8	1321.2
1		0315	40	503.	5.8	1319.5	*	1		1135	140	1893.	9.6	1321.6	*	1		1955	240	1549.	8.8	1321.1
1		0320	41	514.	5.8	1319.5	*	1		1140	141	1913.	9.7	1321.6	*	1		2000	241	1534.	8.7	1321.1
1		0325	42	525.	5.9	1319.5	*	1		1145	142	1937.	9.7	1321.7	*	1		2005	242	1519.	8.7	1321.1
1		0330	43	538.	5.9	1319.6	*	1		1150	143	1969.	9.8	1321.7	*	1		2010	243	1504.	8.7	1321.1
1		0335	44	551.	5.9	1319.6	*	1		1155	144	2015.	9.9	1321.7	*	1		2015	244	1489.	8.6	1321.1
1		0340	45	564.	6.0	1319.6	*	1		1200	145	2080.	10.1	1321.8	*	1		2020	245	1475.	8.6	1321.0
1		0345	46	578.	6.0	1319.6	*	1		1205	146	2164.	10.3	1321.9	*	1		2025	246	1461.	8.6	1321.0
1		0350	47	591.	6.1	1319.7	*	1		1210	147	2262.	10.5	1322.1	*	1		2030	247	1448.	8.5	1321.0
1		0355	48	605.	6.1	1319.7	*	1		1215	148	2370.	10.7	1322.2	*	1		2035	248	1436.	8.5	1321.0
1		0400	49	618.	6.2	1319.7	*	1		1220	149	2475.	11.0	1322.3	*	1		2040	249	1423.	8.5	1321.0
1		0405	50	631.	6.2	1319.7	*	1		1225	150	2559.	11.1	1322.4	*	1		2045	250	1410.	8.4	1321.0

1	0410	51	645.	6.2	1319.8	*	1	1230	151	2617.	11.3	1322.5	*	1	2050	251	1395.	8.4	1320.9
1	0415	52	658.	6.3	1319.8	*	1	1235	152	2646.	11.3	1322.5	*	1	2055	252	1381.	8.3	1320.9
1	0420	53	672.	6.3	1319.8	*	1	1240	153	2651.	11.4	1322.5	*	1	2100	253	1367.	8.3	1320.9
1	0425	54	685.	6.4	1319.8	*	1	1245	154	2636.	11.3	1322.5	*	1	2105	254	1353.	8.3	1320.9
1	0430	55	698.	6.4	1319.9	*	1	1250	155	2607.	11.3	1322.4	*	1	2110	255	1340.	8.2	1320.9
1	0435	56	712.	6.5	1319.9	*	1	1255	156	2569.	11.2	1322.4	*	1	2115	256	1327.	8.2	1320.8
1	0440	57	726.	6.5	1319.9	*	1	1300	157	2526.	11.1	1322.4	*	1	2120	257	1315.	8.2	1320.8
1	0445	58	739.	6.5	1319.9	*	1	1305	158	2486.	11.0	1322.3	*	1	2125	258	1303.	8.1	1320.8
1	0450	59	752.	6.6	1319.9	*	1	1310	159	2453.	10.9	1322.3	*	1	2130	259	1289.	8.1	1320.8
1	0455	60	766.	6.6	1320.0	*	1	1315	160	2428.	10.9	1322.2	*	1	2135	260	1275.	8.1	1320.8
1	0500	61	779.	6.7	1320.0	*	1	1320	161	2408.	10.8	1322.2	*	1	2140	261	1260.	8.0	1320.7
1	0505	62	793.	6.7	1320.0	*	1	1325	162	2391.	10.8	1322.2	*	1	2145	262	1245.	8.0	1320.7
1	0510	63	806.	6.7	1320.0	*	1	1330	163	2377.	10.7	1322.2	*	1	2150	263	1229.	8.0	1320.7
1	0515	64	819.	6.8	1320.1	*	1	1335	164	2366.	10.7	1322.2	*	1	2155	264	1214.	7.9	1320.7
1	0520	65	833.	6.8	1320.1	*	1	1340	165	2358.	10.7	1322.2	*	1	2200	265	1199.	7.9	1320.7
1	0525	66	846.	6.9	1320.1	*	1	1345	166	2353.	10.7	1322.2	*	1	2205	266	1186.	7.8	1320.6
1	0530	67	860.	6.9	1320.1	*	1	1350	167	2350.	10.7	1322.2	*	1	2210	267	1173.	7.8	1320.6
1	0535	68	873.	6.9	1320.1	*	1	1355	168	2349.	10.7	1322.2	*	1	2215	268	1162.	7.8	1320.6
1	0540	69	886.	7.0	1320.2	*	1	1400	169	2350.	10.7	1322.2	*	1	2220	269	1151.	7.7	1320.6
1	0545	70	900.	7.0	1320.2	*	1	1405	170	2353.	10.7	1322.2	*	1	2225	270	1140.	7.7	1320.6
1	0550	71	913.	7.1	1320.2	*	1	1410	171	2358.	10.7	1322.2	*	1	2230	271	1127.	7.7	1320.5
1	0555	72	926.	7.1	1320.2	*	1	1415	172	2365.	10.7	1322.2	*	1	2235	272	1114.	7.6	1320.5
1	0600	73	940.	7.1	1320.3	*	1	1420	173	2373.	10.7	1322.2	*	1	2240	273	1100.	7.6	1320.5
1	0605	74	954.	7.2	1320.3	*	1	1425	174	2382.	10.8	1322.2	*	1	2245	274	1086.	7.6	1320.5
1	0610	75	967.	7.2	1320.3	*	1	1430	175	2391.	10.8	1322.2	*	1	2250	275	1073.	7.5	1320.5
1	0615	76	980.	7.3	1320.3	*	1	1435	176	2402.	10.8	1322.2	*	1	2255	276	1060.	7.5	1320.4
1	0620	77	994.	7.3	1320.3	*	1	1440	177	2411.	10.8	1322.2	*	1	2300	277	1048.	7.5	1320.4
1	0625	78	1007.	7.3	1320.4	*	1	1445	178	2414.	10.8	1322.2	*	1	2305	278	1036.	7.4	1320.4
1	0630	79	1020.	7.4	1320.4	*	1	1450	179	2405.	10.8	1322.2	*	1	2310	279	1024.	7.4	1320.4
1	0635	80	1034.	7.4	1320.4	*	1	1455	180	2390.	10.8	1322.2	*	1	2315	280	1011.	7.3	1320.4
1	0640	81	1047.	7.4	1320.4	*	1	1500	181	2375.	10.7	1322.2	*	1	2320	281	997.	7.3	1320.3
1	0645	82	1060.	7.5	1320.4	*	1	1505	182	2361.	10.7	1322.2	*	1	2325	282	983.	7.3	1320.3
1	0650	83	1074.	7.5	1320.5	*	1	1510	183	2346.	10.7	1322.2	*	1	2330	283	969.	7.2	1320.3
1	0655	84	1087.	7.6	1320.5	*	1	1515	184	2331.	10.6	1322.1	*	1	2335	284	955.	7.2	1320.3
1	0700	85	1101.	7.6	1320.5	*	1	1520	185	2315.	10.6	1322.1	*	1	2340	285	942.	7.2	1320.3
1	0705	86	1114.	7.6	1320.5	*	1	1525	186	2298.	10.6	1322.1	*	1	2345	286	930.	7.1	1320.2
1	0710	87	1127.	7.7	1320.5	*	1	1530	187	2281.	10.5	1322.1	*	1	2350	287	918.	7.1	1320.2
1	0715	88	1141.	7.7	1320.6	*	1	1535	188	2264.	10.5	1322.1	*	1	2355	288	906.	7.0	1320.2
1	0720	89	1154.	7.7	1320.6	*	1	1540	189	2248.	10.4	1322.0	*	2	0000	289	893.	7.0	1320.2
1	0725	90	1168.	7.8	1320.6	*	1	1545	190	2233.	10.4	1322.0	*	2	0005	290	879.	7.0	1320.2
1	0730	91	1181.	7.8	1320.6	*	1	1550	191	2219.	10.4	1322.0	*	2	0010	291	864.	6.9	1320.1
1	0735	92	1195.	7.9	1320.6	*	1	1555	192	2205.	10.4	1322.0	*	2	0015	292	849.	6.9	1320.1
1	0740	93	1208.	7.9	1320.7	*	1	1600	193	2192.	10.3	1322.0	*	2	0020	293	833.	6.8	1320.1
1	0745	94	1222.	7.9	1320.7	*	1	1605	194	2178.	10.3	1321.9	*	2	0025	294	817.	6.8	1320.1
1	0750	95	1236.	8.0	1320.7	*	1	1610	195	2164.	10.3	1321.9	*	2	0030	295	801.	6.7	1320.0
1	0755	96	1250.	8.0	1320.7	*	1	1615	196	2150.	10.2	1321.9	*	2	0035	296	785.	6.7	1320.0
1	0800	97	1263.	8.0	1320.7	*	1	1620	197	2135.	10.2	1321.9	*	2	0040	297	770.	6.6	1320.0
1	0805	98	1277.	8.1	1320.8	*	1	1625	198	2120.	10.2	1321.9	*	2	0045	298	755.	6.6	1319.9
1	0810	99	1290.	8.1	1320.8	*	1	1630	199	2105.	10.1	1321.9	*	2	0050	299	740.	6.5	1319.9
1	0815	100	1304.	8.1	1320.8	*	1	1635	200	2090.	10.1	1321.8	*	2	0055	300	726.	6.5	1319.9
						*							*						

****

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.92-HR
2651.	12.67	(CFS)	2271.	1411.	1360.	1360.
		(INCHES)	26.065	64.803	64.804	64.804
		(AC-FT)	1126.	2799.	2800.	2800.

PEAK STORAGE TIME MAXIMUM AVERAGE STORAGE

(AC-FT)	(HR)	6-HR	24-HR	72-HR	24.92-HR
11.	12.67	10.	8.	8.	8.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	24.92-HR
1322.50	12.67	1322.06	1320.87	1320.71	1320.71

CUMULATIVE AREA = .81 SQ MI

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	SPK	2336.	14.67	2100.	1361.	1314.	.00		
ROUTED TO	ROUT	2332.	14.67	2100.	1360.	1312.	.00		
HYDROGRAPH AT	A	653.	12.58	172.	53.	52.	.81		
2 COMBINED AT	BUSH	2653.	12.58	2271.	1413.	1363.	.81		
ROUTED TO	RBUSH	2653.	12.58	2271.	1413.	1363.	.81		
ROUTED TO	RBUSH2	2651.	12.58	2271.	1413.	1363.	.81		
ROUTED TO	BASIN	2651.	12.67	2271.	1411.	1360.	.81	1322.50	12.67

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

APPENDIX B

B.7

HEC-2 MODEL SEDIMENT BASIN OUTLET

```
*-----------------------------------*
|              S U M P O            |
|                                   |
|   Interactive Summary Printout    |
|   for MS/PC-DOS micro computers   |
|              May 1991             |
*-----------------------------------*
```

NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

EXISTING CONDITION

Summary Printout

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	ARE
10.00	2650.00	19.22	17.00	19.25	1.47	5.42	1927.7
50.00	2650.00	19.63	17.52	19.67	1.67	4.03	1723.4
100.00	2650.00	20.16	18.43	20.22	2.00	4.16	1410.8
150.00	2650.00	20.69	18.87	20.77	2.30	4.39	1189.0
200.00	2650.00	21.14	19.16	21.26	2.80	3.94	964.7
300.00	2650.00	21.68	19.47	21.86	3.52	4.18	760.9
360.00	2650.00	22.50	20.11	22.71	3.71	4.50	714.6

Summary of Errors and Special Notes

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    29JUL92    TIME   09:50:42 *
*******************************************
```

```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X       X     X            X     X
X     X  X       X                        X
XXXXXXX  XXXX    X          XXXXX    XXXXX
X     X  X       X                  X
X     X  X       X     X            X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

SPKOUT3

THIS RUN EXECUTED 29JUL92 09:50:42

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************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************
```

T1 SPOOKHILL SEDIMENT BASIN OUTLET BKH 6/92
T2 FROM SPOOKHILL SEDIMENT BASIN OUTLET TO SALT RIVER
T3 EXISTING CONDITION

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	0	.0075	0	0	2650	18.3	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1	0	0	0	0	0	-1	0	0	0

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

110 115 110

QT	1	2650								
NC	.175	.175	.175	.06	.08					
X1	10	29	9728	10293	0	0	0			
GR	24.1	9615	20.6	9621	20.9	9630	20.3	9640	24.2	9645
GR	23.9	9655	22.0	9677	19.1	9695	18.8	9710	13.8	9720
GR	19.2	9728	18.0	9770	17.0	9810	16.0	9860	16.5	9955
GR	16.0	10000	16.0	10050	15.6	10130	15.5	10220	16.0	10260
GR	17.0	10263	18.0	10270	18.3	10293	18.0	10312	17.9	10425
GR	17.9	10472	17.9	10490	17.9	10510	23.0	10511		
X1	050	28	9780	10215	85	55	50			
X3				9755	24					
GR	21.8	9710	22.0	9715	21.8	9720	19.0	9727	17.9	9738
GR	18.0	9745	23.1	9755	19.0	9780	18.0	9810	17.0	9845
GR	16.6	9967	16.5	10000	16.4	10025	16.0	10080	15.6	10147
GR	16.0	10200	17.0	10207	18.0	10215	18.2	10250	18.0	10275
GR	17.9	10305	17.9	10340	17.9	10400	17.9	10405	17.9	10413
GR	17.9	10425	17.9	10455	23.0	10456				
X1	100	23	9855	10178	70	60	50			
X3				9835	24					
GR	21.5	9763	21.7	9770	21.4	9780	17.3	9785	16.8	9808
GR	17.5	9822	22.4	9830	23.4	9835	20.0	9845	18.5	9855
GR	18.0	9865	17.0	9990	16.6	10000	16.2	10045	16.0	10070
GR	16.0	10090	17.0	10103	18.0	10130	18.2	10178	18.0	10213
GR	17.9	10270	17.9	10378	23.0	10379				

NC	.125	.125	.125							
X1	150	25	9905	10154	70	57	50			
X3				9887	24					
GR	21.4	9815	19.0	9825	18.0	9830	17.0	9840	16.3	9853
GR	17.0	9878	18.0	9882	19.0	9887	19.0	9905	18.0	9915
GR	17.0	10000	16.4	10010	17.0	10020	18.0	10024	18.3	10032
GR	18.0	10040	17.5	10067	18.0	10117	18.0	10154	17.9	10200
GR	17.9	10223	17.9	10230	17.9	10260	17.9	10300	23.0	10303
X1	200	30	9950	10117	70	55	50			
X3	10							24		
GR	21.5	9875	19.0	9878	18.0	9883	17.0	9890	16.0	9903
GR	15.5	9914	16.0	9925	17.0	9937	18.0	9939	19.0	9943
GR	19.3	9950	19.0	9960	18.0	9965	17.2	9975	17.2	9980
GR	17.2	10000	17.2	10030	17.2	10038	17.2	10045	17.2	10053
GR	17.2	10057	18.0	10062	18.0	10080	18.0	10108	18.0	10117
GR	17.9	10150	17.9	10162	17.9	10185	17.9	10235	23.0	10236
X1	300	11	9915	10065	125	50	50			
GR	21.5	9915	19.0	9920	18.0	9923	17.5	9928	17.5	9943
GR	17.5	10000	17.5	10055	17.5	10065	17.9	10066	17.9	10105
GR	23.0	10106								
X1	360	5	9915	10085	60	62	60			
GR	23.0	9915	18.0	9925	18.0	10000	18.0	10075	23.0	10085

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .060 CEHV= .080

*SECNO 10.000

10.000	5.42	19.22	17.00	18.30	19.25	.03	.00	.00	19.20
2650.0	69.5	2341.6	238.9	55.1	1596.1	276.6	.0	.0	18.30
.00	1.26	1.47	.86	.175	.175	.175	.000	13.80	9694.25
.007480	0.	0.	0.	0	14	5	.00	816.01	10510.26

*SECNO 50.000

3470 ENCROACHMENT STATIONS= 9755.0 10456.0 TYPE= 1 TARGET= -9755.000
ELENCL= 24.00 ELENCR= 100000.00

50.000	4.03	19.63	17.52	.00	19.67	.04	.41	.00	19.00
2650.0	.4	2200.1	449.4	1.2	1320.9	401.3	2.2	.9	18.00
.01	.36	1.67	1.12	.175	.175	.175	.000	15.60	9776.17
.008755	85.	50.	55.	2	19	0	.00	679.16	10455.34

*SECNO 100.000

3470 ENCROACHMENT STATIONS= 9835.0 10379.0 TYPE= 1 TARGET= -9835.000
ELENCL= 24.00 ELENCR= 100000.00

100.000	4.16	20.16	18.43	.00	20.22	.06	.55	.00	18.50
2650.0	8.3	1913.7	728.0	9.2	958.4	443.3	4.1	1.6	18.20
.02	.90	2.00	1.64	.175	.175	.175	.000	16.00	9844.52
.012974	70.	50.	60.	2	14	0	.00	533.92	10378.44

*SECNO 150.000

3470 ENCROACHMENT STATIONS= 9887.0 10303.0 TYPE= 1 TARGET= -9887.000
ELENCL= 24.00 ELENCR= 100000.00

150.000	4.39	20.69	18.87	.00	20.77	.08	.55	.00	19.00
2650.0	44.6	1725.2	880.2	30.4	751.7	407.0	5.6	2.2	18.00
.02	1.47	2.30	2.16	.125	.125	.125	.000	16.30	9887.00
.008553	70.	50.	57.	2	14	0	.00	414.64	10301.64

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 200.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 24.00 ELREA= 18.00

200.000	3.94	21.14	19.16	.00	21.26	.12	.49	.00	19.30
2650.0	.0	1633.6	1016.4	.0	582.6	382.1	6.9	2.6	18.00
.03	.00	2.80	2.66	.000	.125	.125	.000	17.20	9950.00
.010531	70.	50.	55.	2	18	0	.00	285.64	10235.64

*SECNO 300.000

3280 CROSS SECTION 300.00 EXTENDED .18 FEET

300.000	4.18	21.68	19.47	.00	21.86	.19	.60	.01	21.50
2650.0	.0	2139.9	510.1	.0	608.3	152.6	7.9	2.9	17.50
.03	.00	3.52	3.34	.000	.125	.125	.000	17.50	9915.00
.013655	125.	50.	50.	2	8	0	.00	190.74	10105.74

*SECNO 360.000

360.000	4.50	22.50	20.11	.00	22.71	.21	.84	.00	23.00
2650.0	.0	2650.0	.0	.0	714.7	.0	8.9	3.2	23.00
.04	.00	3.71	.00	.000	.125	.000	.000	18.00	9916.01
.014350	60.	60.	62.	2	8	0	.00	167.98	10083.99

PROFILE FOR STREAM EXISTING CONDITION

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

```
ELEVATION   14.       15.       16.       17.       18.       19.       20.       21.       22.       23.
   SECNO   CUMDIS

  10.00     0.  I         .         .         . C       .    R    .   E    .         .         .         . M       .
            5.  . I       .         .         .  C      .    R    .   LE   .         .         .         . M       .
           10.  .  I      .         .         .  C      .   R     .   LE   .         .         .         . M       .
           15.  .   I     .         .         .   C     .   R     . L WE   .         .         .         . M       .
           20.  .     I   .         .         .   C     .   R     . L  E   .         .         .         . M       .
           25.  .       I.          .         .    C    .  R      . L  WE  .         .         .         . M       .
           30.  .        .I         .         .    C    .  R      . L   E  .         .         .         . M       .
           35.  .         . I       .         .     C   .  R      . L   E  .         .         .         . M       .
           40.  .         .  I      .         .     C   .  R      . L    WE .         .         .         . M       .
           45.  .         .   I     .         .      C  . R       . L     E .         .         .         . M       .
  50.00    50.  .         .     I   .         .      C  . R       . L     WE.         .         .         . M       .
           55.  .         .     I   .         .       C . R       .L      E.         .         .         . M       .
           60.  .         .      I. .         .        C. R       .L      WE         .         .         . M       .
           65.  .         .      I. .         .         C  R      L        E         .         .         . M       .
           70.  .         .       I .         .        .C R      L        WE         .         .         . M       .
           75.  .         .       I .         .         . CR     L.        .E         .         .         . M       .
           80.  .         .       I .         .         .  C     L.        .WE        .         .         . M       .
           85.  .         .      .I .         .         .  RC   L .        . WE       .         .         . M       .
           90.  .         .      .I .         .         .   C   L .        .  E       .         .         . M       .
           95.  .         .      . I .         .         .  RC L  .        .  WE      .         .         . M       .
  100.00   100.  .         .      . I .         .         .  R CL  .        .   E      .         .         . M       .
           105.  .         .      . I .         .         .  R  C  .        .   WE     .         .         . M       .
           110.  .         .      .  I .         .         .  R  CL .        .    E     .         .         . M       .
           115.  .         .      .  I .         .         . R    C .        .    WE    .         .         . M       .
           120.  .         .      .  I .         .         . R    CL.        .     E    .         .         . M       .
           125.  .         .      .  I .         .         . R     C.        .     WE   .         .         . M       .
           130.  .         .      .   I .         .         . R     CL        .      E   .         .         . M       .
           135.  .         .      .   I .         .         . R     CL        .      WE  .         .         . M       .
           140.  .         .      .   I .         .         . R      CL       .       WE.         .         . M       .
           145.  .         .      .    I .         .         . R      CL       .       WE.         .         . M       .
  150.00   150.  .         .      .    I .         .         . R      .CL      .        WE         .         . M       .
           155.  .         .      .     I .         .         . R      .CL      .        WE         .         M         .
           160.  .         .      .      I .         .         . R      .C L     .         WE        .         M.        .
           165.  .         .      .       I .         .         . R      . CL     .         WE        .       M .         .
           170.  .         .      .        I.         .         . R      . CL     .         .WE       .      M  .         .
           175.  .         .      .        I.         .         . R      . CL     .         .WE       .    M     .         .
           180.  .         .      .         I         .         . R      . C L    .         . WE      .  M      .         .
           185.  .         .      .         .I        .         . R      .  CL    .         . WE     .M         .         .
           190.  .         .      .         . I       .         . R      .  CL    .         . W E    M          .         .
           195.  .         .      .         .  I      .         . R      .  C L   .         .  WE   M .         .         .
  200.00   200.  .         .      .         .   I     .         . R      .   CL   .         .  W E M  .         .         .
           205.  .         .      .         .   I     .         .R       .   C  L .         .   WE M  .         .         .
           210.  .         .      .         .    I    .         .R       .   C    L.        .   W EM  .         .         .
           215.  .         .      .         .    I    R         .    C   . L     .         .   WEM   .         .         .
           220.  .         .      .         .    I    R         .    C   .   L   .         .    WE   .         .         .
           225.  .         .      .         .     I  R.         .    C   .     L .         .    WME  .         .         .
           230.  .         .      .         .     I  R.         .    C   .       L.         .     WE  .         .         .
           235.  .         .      .         .     I R .         .     C  .        L         .     W E.         .         .
```

```
        240.  .         .         .         .    I R .         .    C   .         .  L   MWE.         .         .
        245.  .         .         .         .     I  .         .    C   .         .    L MW E         .         .
300.00  250.  .         .         .         .     I  .         .     C  .         .      L W.E        .         .
        255.  .         .         .         .     I  . R       .     C  .         .       LW.E        .         .
        260.  .         .         .         .      I .     R   .      C .         .        LW E       .         .
        265.  .         .         .         .      I .        .R      C .         .         .W E      .         .
        270.  .         .         .         .       I.         .   R  C.         .         .WLE      .         .
        275.  .         .         .         .       I.         .      CR         .         . WLE      .         .
        280.  .         .         .         .       I.         .       C   R     .         .  WLE     .         .
        285.  .         .         .         .        I         .       C        R.         .   W E    .         .
        290.  .         .         .         .        I         .      .C        .   R     .   W EL   .         .
        295.  .         .         .         .        .I        .       . C      .       R .    W EL .         .
        300.  .         .         .         .        .I        .       . C      .         .  R W EL.         .
        305.  .         .         .         .        . I       .       .  C     .         .     WRE .L       .
360.00  310.  .         .         .         .        . I       .       .  C     .         .      W E. L      .
```

THIS RUN EXECUTED 29JUL92 09:50:45

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

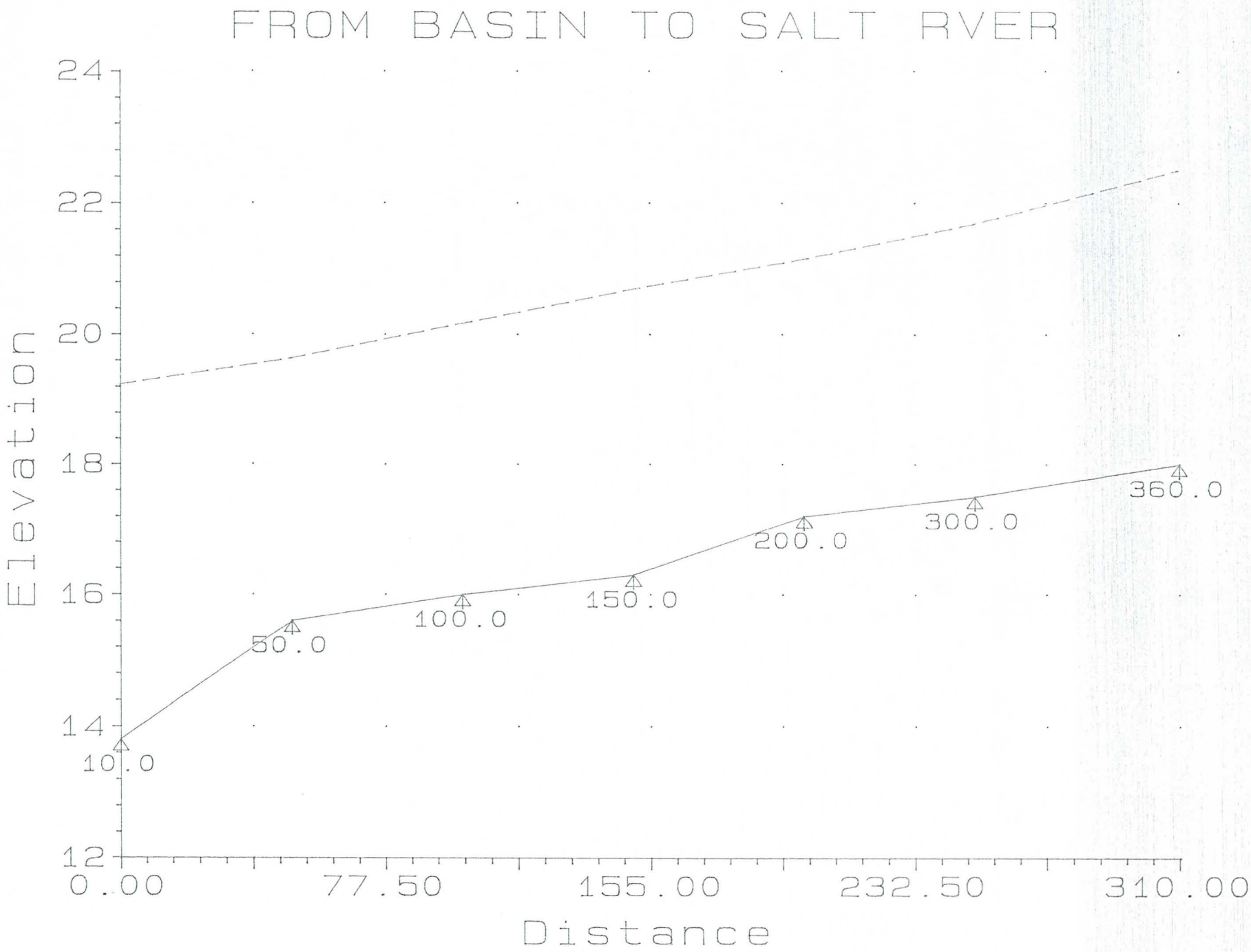
NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

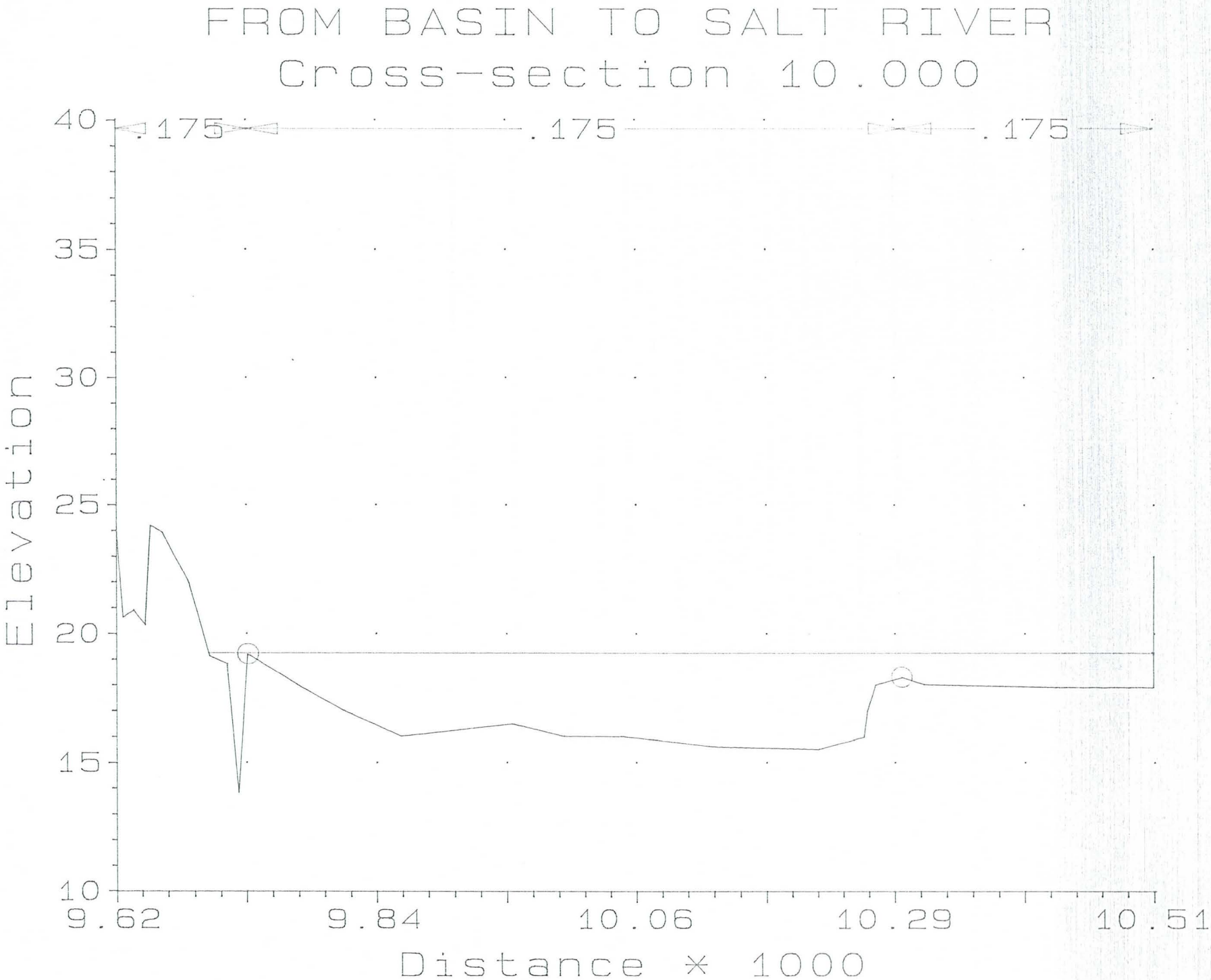
EXISTING CONDITION

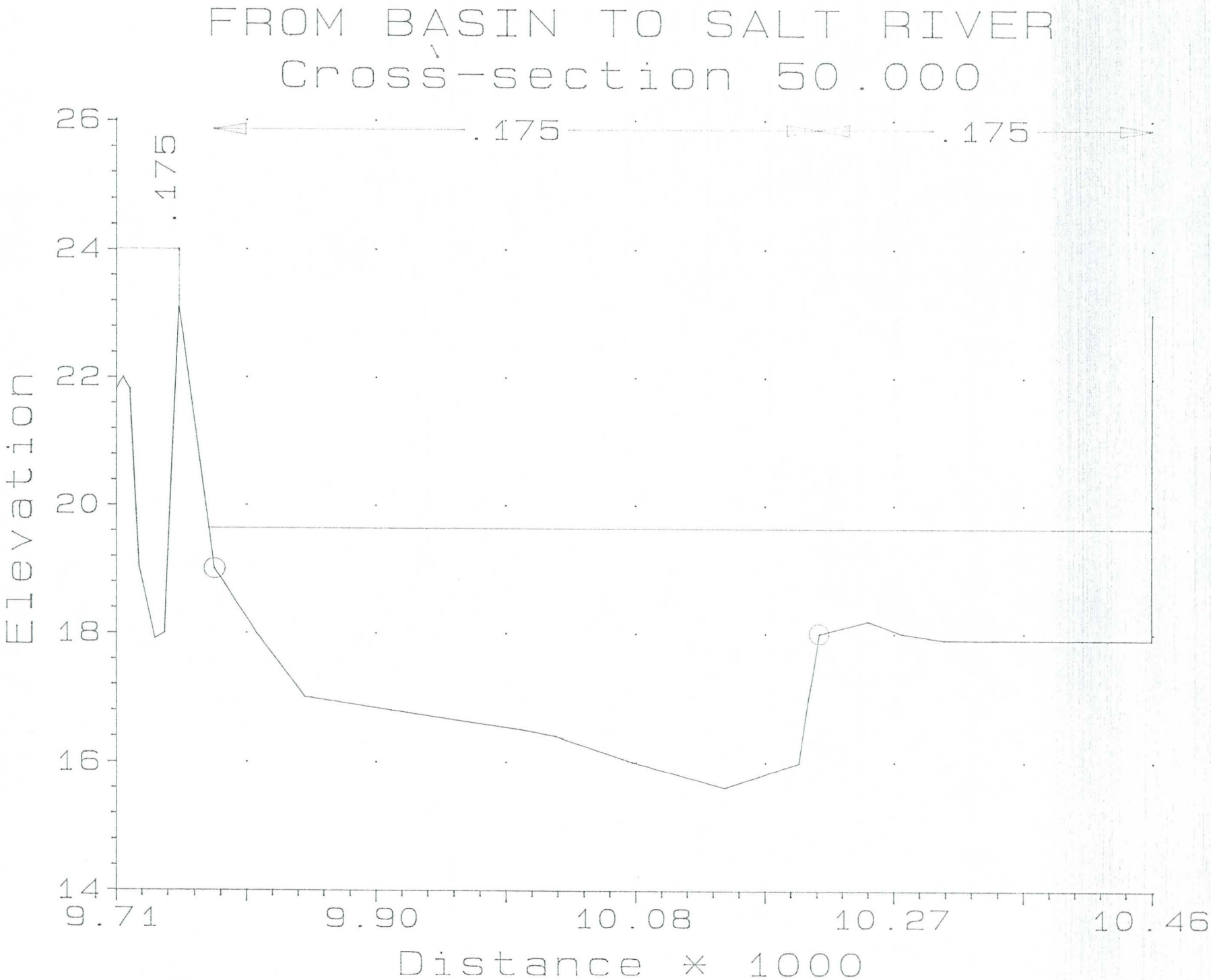
SUMMARY PRINTOUT TABLE 110

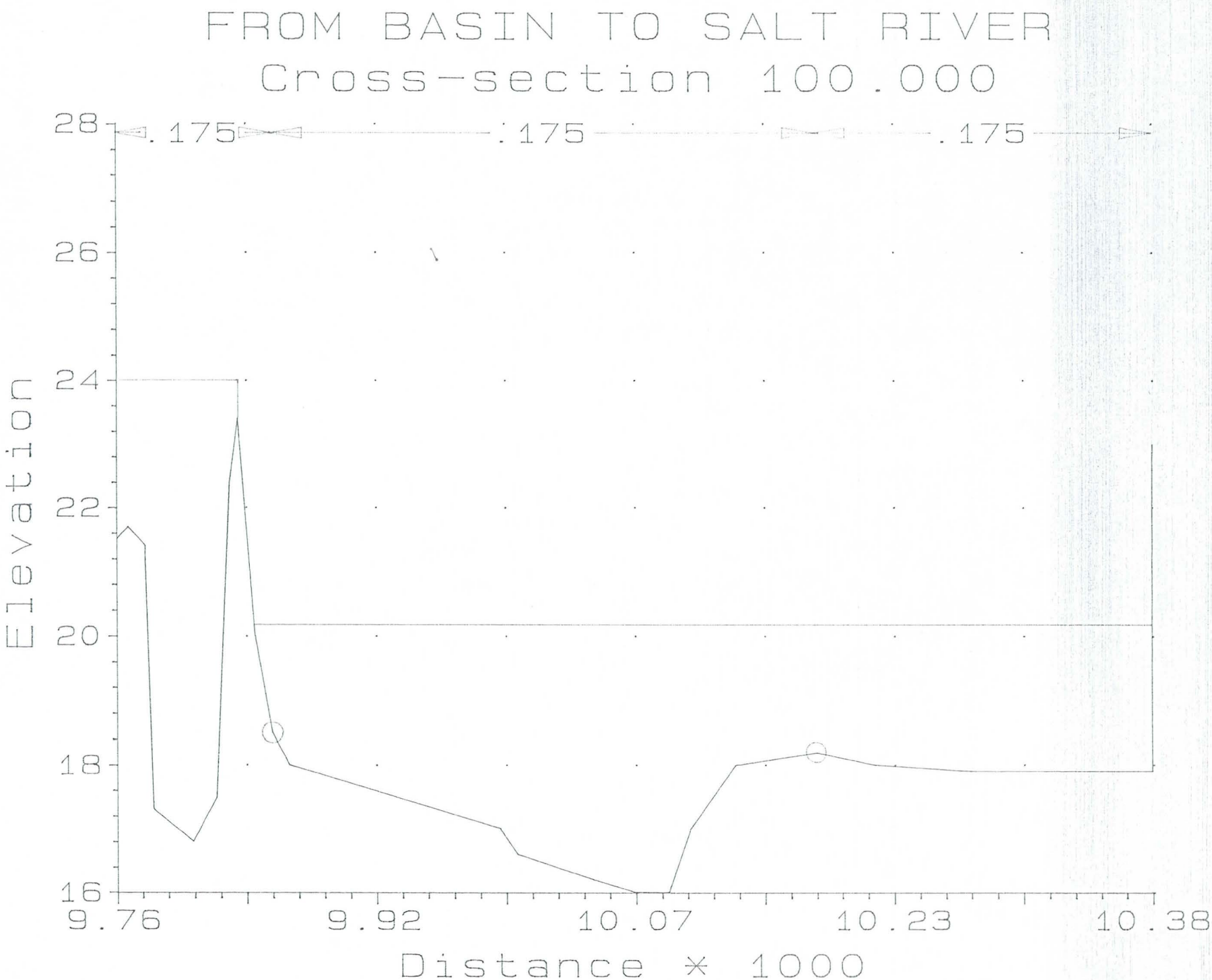
SECNO	CWSEL	DIFKWS	EG	TOPWID	QLOB	QCH	QROB	PERENC	STENCL	STCHL	STCHR	STENCR
10.000	19.22	.92	19.25	816.01	69.47	2341.62	238.91	.00	.00	9728.00	10293.00	.00
50.000	19.63	.00	19.67	679.16	.44	2200.14	449.42	-9755.00	9755.00	9780.00	10215.00	10456.00
100.000	20.16	.00	20.22	533.92	8.25	1913.70	728.04	-9835.00	9835.00	9855.00	10178.00	10379.00
150.000	20.69	.00	20.77	414.64	44.61	1725.15	880.24	-9887.00	9887.00	9905.00	10154.00	10303.00
200.000	21.14	.00	21.26	285.64	.00	1633.55	1016.45	.00	.00	9950.00	10117.00	.00
300.000	21.68	.00	21.86	190.74	.00	2139.90	510.10	.00	.00	9915.00	10065.00	.00
360.000	22.50	.00	22.71	167.98	.00	2650.00	.00	.00	.00	9915.00	10085.00	.00

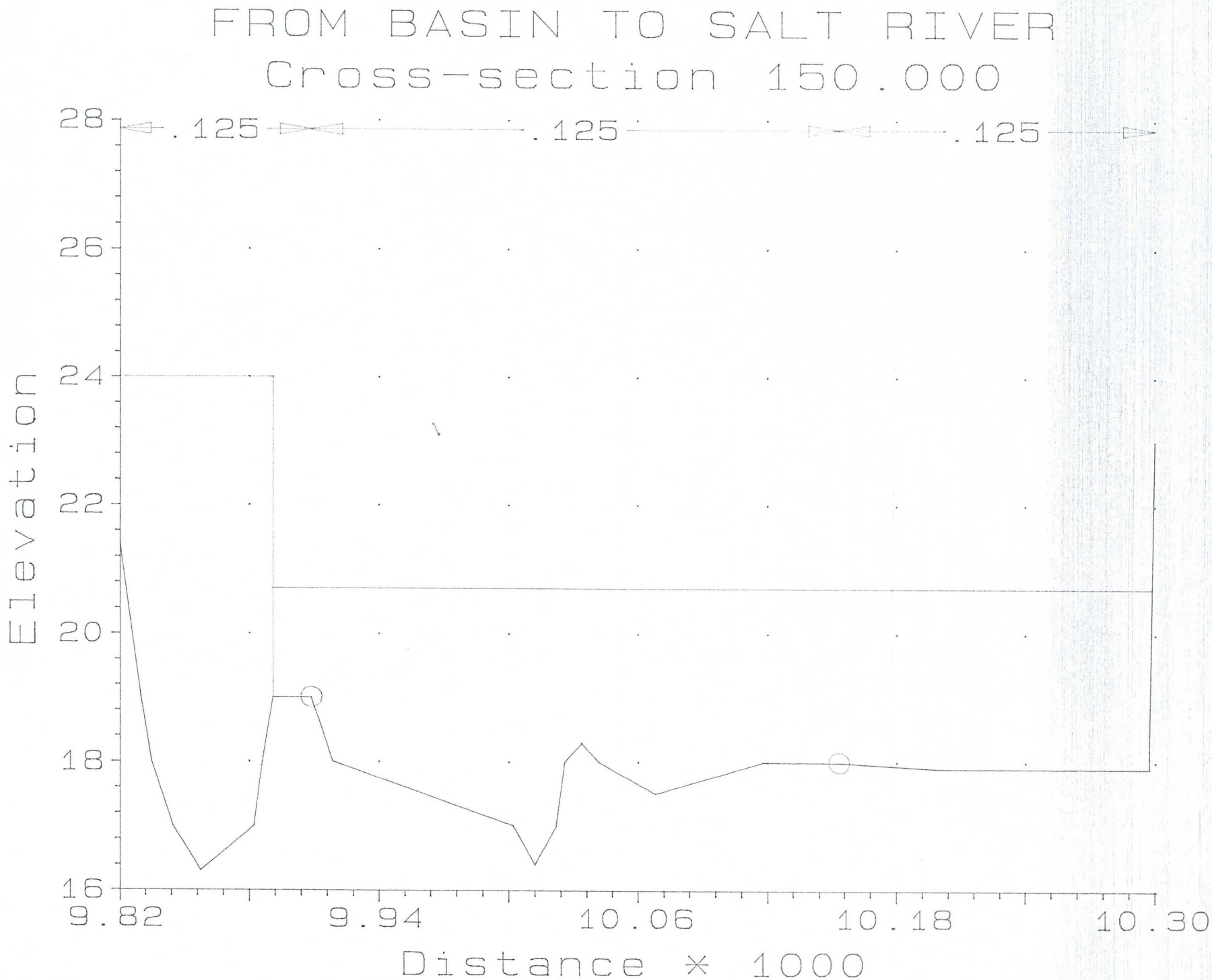
SUMMARY OF ERRORS AND SPECIAL NOTES

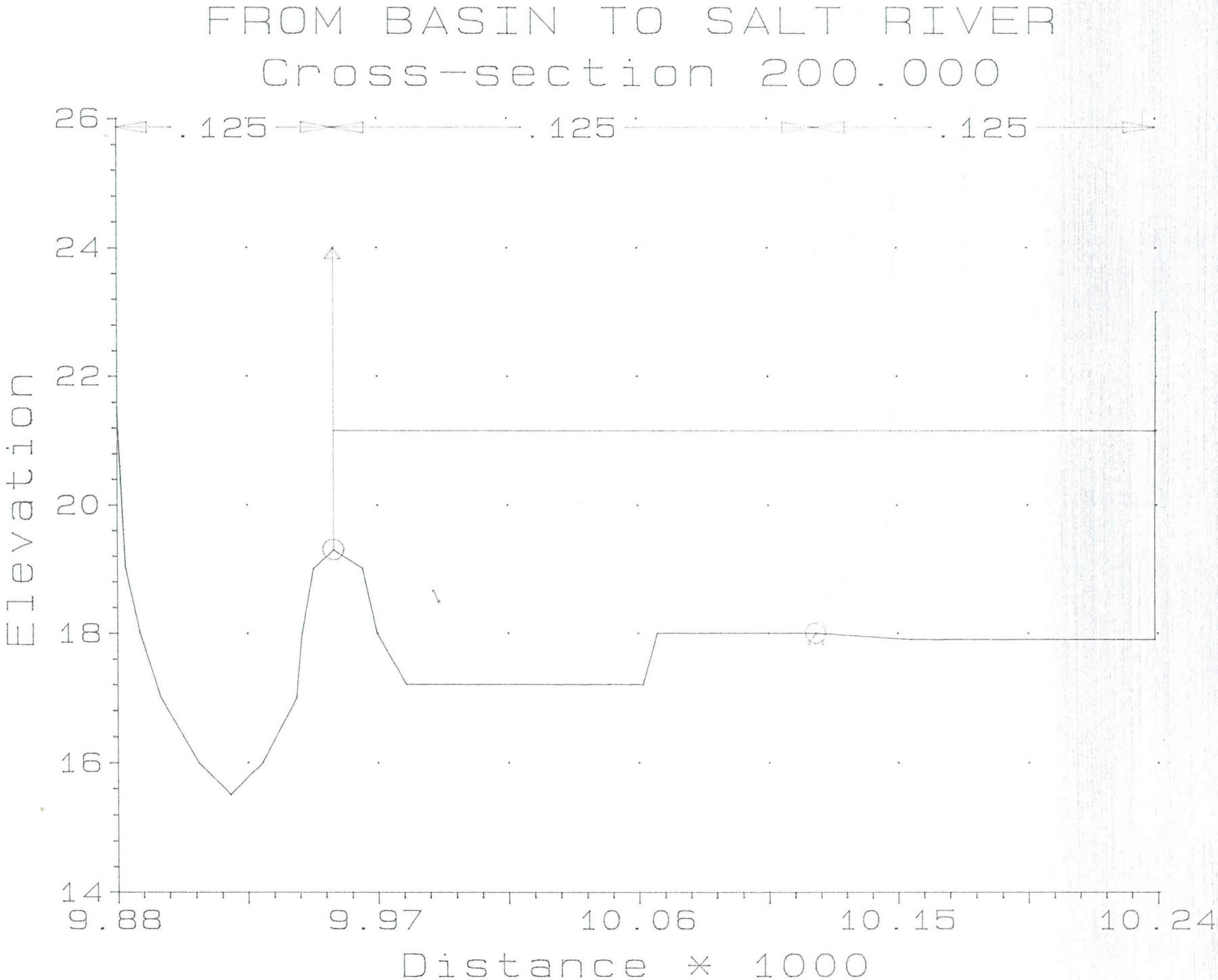

FROM BASIN TO SALT RVER
Elevation
24
22
20
18
16
14
12
0.00
77.50
155.00
232.50
310.00
Distance
10.0
50.0
100.0
150.0
200.0
300.0
360.0


FROM BASIN TO SALT RIVER
Cross-section 10.000
.175
.175
.175
40
35
30
25
20
15
10
Elevation
9.62
9.84
10.06
10.29
10.51
Distance * 1000


FROM BASIN TO SALT RIVER
Cross-section 50.000
.175
.175
.175
26
24
22
20
18
16
14
Elevation
9.71
9.90
10.08
10.27
10.46
Distance * 1000

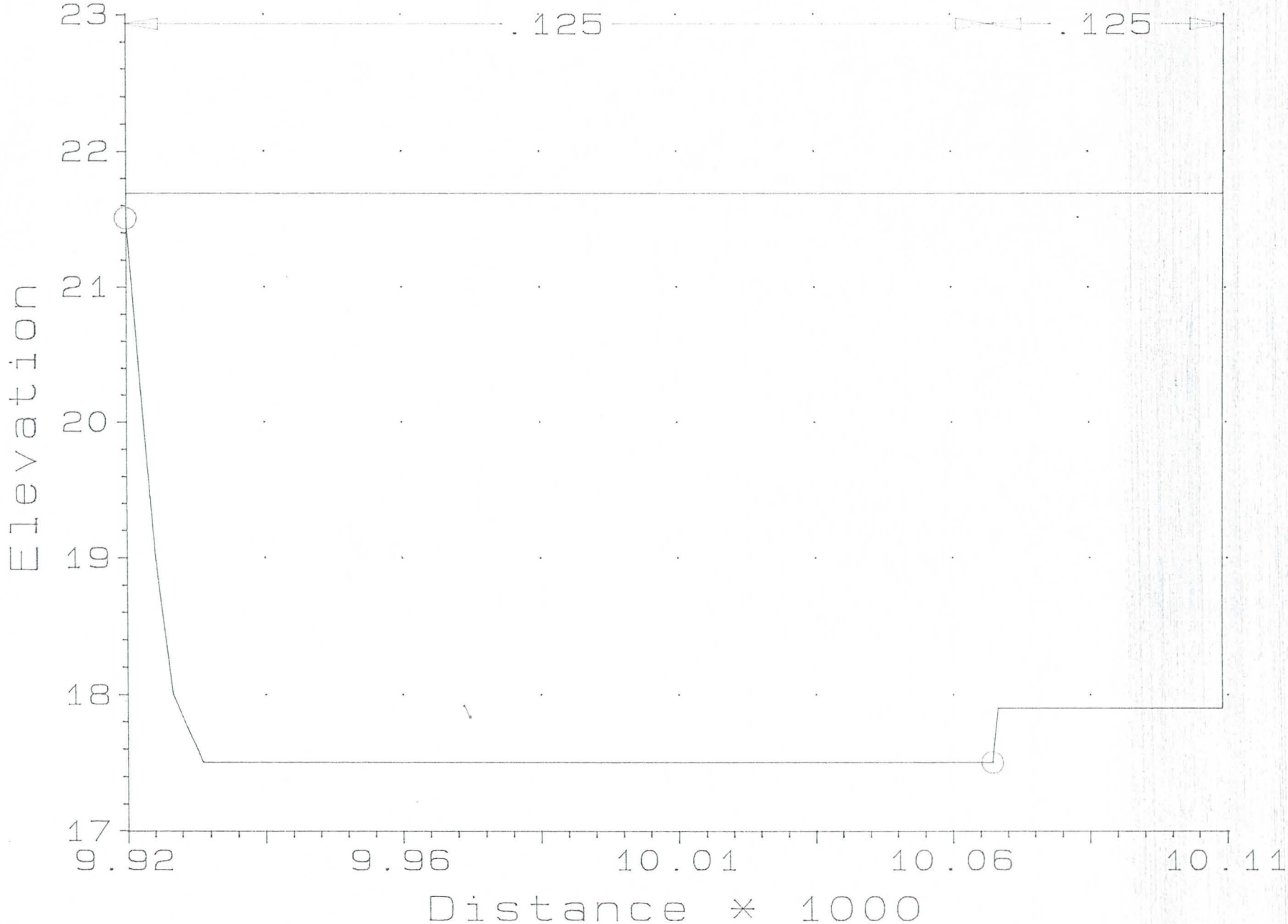

FROM BASIN TO SALT RIVER
Cross-section 100.000
.175
.175
.175
28
26
24
22
20
18
16
Elevation
9.76
9.92
10.07
10.23
10.38
Distance * 1000


FROM BASIN TO SALT RIVER
Cross-section 150.000
.125
.125
.125
28
26
24
22
20
18
16
Elevation
9.82
9.94
10.06
10.18
10.30
Distance * 1000


FROM BASIN TO SALT RIVER
Cross-section 200.000
.125
.125
.125
26
24
22
20
18
16
14
Elevation
9.88
9.97
10.06
10.15
10.24
Distance * 1000

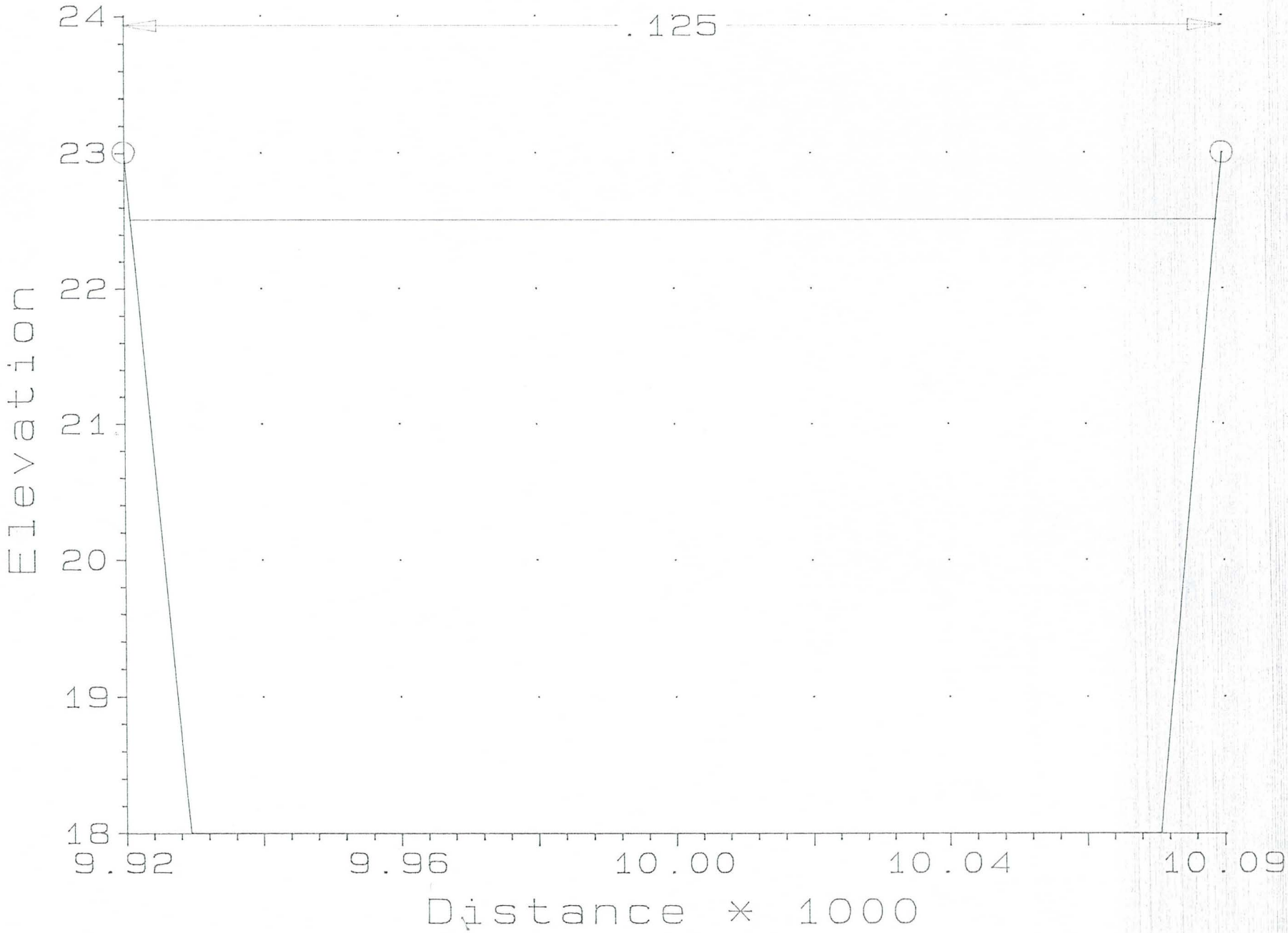
FROM BASIN TO SALT RIVER

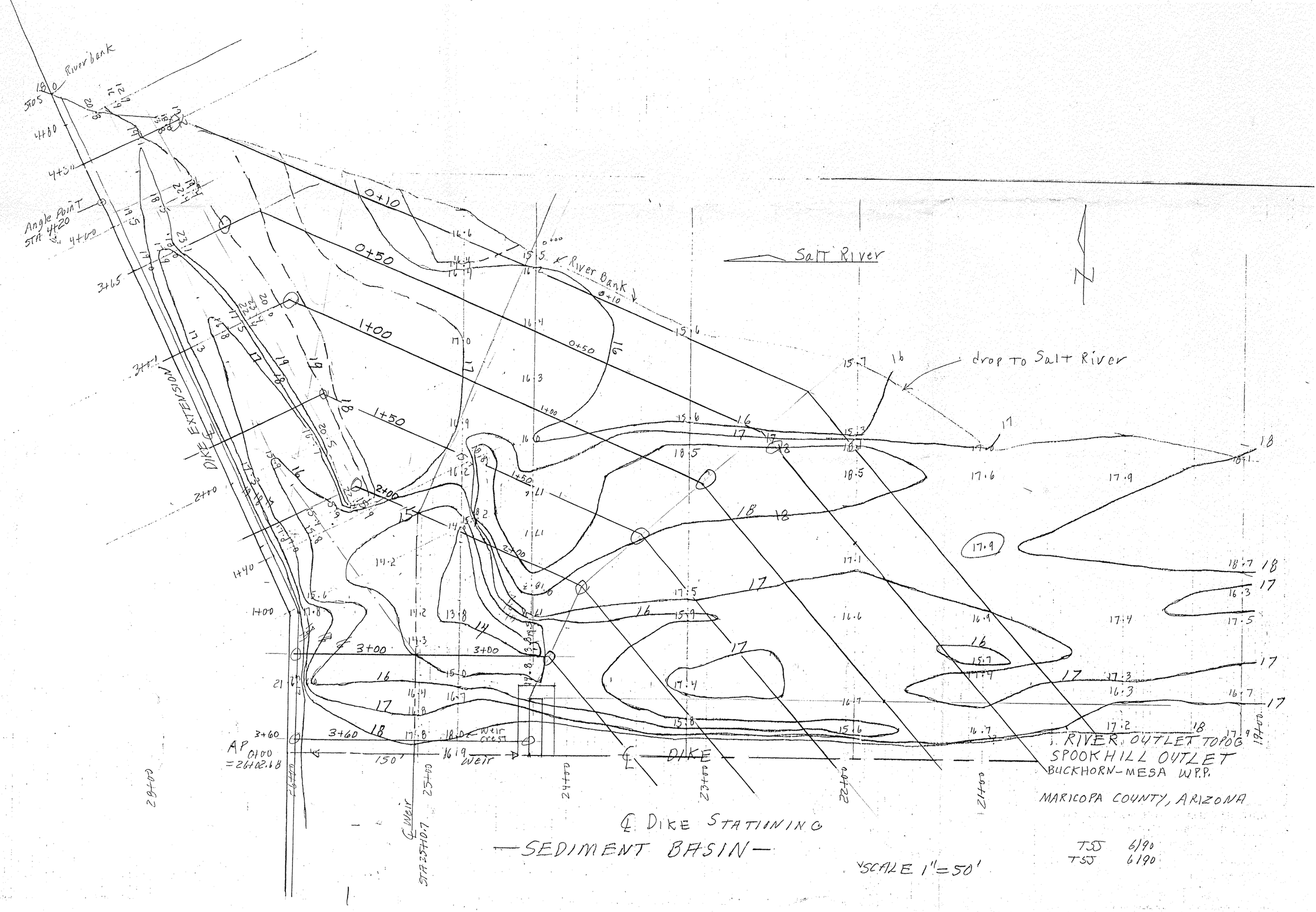
Cross-section 300.000



FROM BASIN TO SALT RIVER

Cross-section 360.000




Riverbank
Angle Point
STA 4+20
DIKE EXTENSION
Salt River
River Bank
drop to Salt River
Weir crest
Weir
℄ DIKE
AP
=26+02.68
150'
℄ Weir
STA 25+10.7
℄ DIKE STATIONING
—SEDIMENT BASIN—
SCALE 1"=50'
RIVER OUTLET TO FOG
SPOOKHILL OUTLET
BUCKHORN-MESA W.P.P.
MARICOPA COUNTY, ARIZONA
TJJ 6/90
TJJ 6/90

APPENDIX B

B.8

HEC-2 MODEL FINAL DESIGN

5.8

SPKHL2F

HEC-2 SUMMARY TABLE

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
319.00	2653.00	41.97	41.97	44.56	12.92	5.17	205.33	40.00	.00	36.80
400.00	2653.00	38.13	39.66	43.39	18.40	3.64	144.15	40.00	81.00	34.49
500.00	2653.00	35.14	36.43	39.74	17.22	3.85	154.10	40.00	100.00	31.29
650.00	2653.00	30.08	31.63	35.42	18.55	3.58	143.04	40.00	150.00	26.50
722.33	2653.00	29.21	30.22	33.20	16.02	4.13	165.56	40.00	72.33	25.08
850.00	2653.00	26.80	27.72	30.64	15.73	4.22	168.67	40.00	127.67	22.58
979.98	2653.00	24.22	25.17	28.13	15.85	4.18	167.36	40.00	129.98	20.04
1100.00	2653.00	21.87	22.82	25.77	15.86	4.18	167.25	40.00	120.02	17.69
1237.60	2653.00	19.19	20.13	23.08	15.83	4.19	167.62	40.00	137.62	15.00

5.8

SPKHL3F

```
*****************************************
*  HEC-2 WATER SURFACE PROFILES          *
*                                        *
*  Version   4.6.2;  May 1991            *
*                                        *
*  RUN DATE    17AUG92    TIME   11:15:53 *
*****************************************
```

```
***************************************
*  U.S. ARMY CORPS OF ENGINEERS       *
*  HYDROLOGIC ENGINEERING CENTER      *
*  609 SECOND STREET, SUITE D         *
*  DAVIS, CALIFORNIA 95616-4687       *
*          (916) 756-1104             *
***************************************
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X       X     X           X     X
X     X  X       X                       X
XXXXXXX  XXXX    X         XXXXX   XXXXX
X     X  X       X                 X
X     X  X       X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

THIS RUN EXECUTED 17AUG92 11:15:53

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************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************


THIS IS AN ARCHIVAL RUN ALL DATA AND RESULTS ARE SAVED ON UNIT   96

AC
AC AERIAL MAPPING: FLOOD CONTROL DISTRICT OF MARICOPA COUNTY   4-13-92
AC                 2801 W. DURANGO  PHX. AZ. 85009
AC                 PHONE (602) 501-1501
AC
AC SURVEY CONTROL: SOIL CONSERVATION SERVISE  DATE: 7-24-90
AC                 201 E. INDIANOLA AVE., SUITE 200
AC                 PHOENIX. ARIZONA 85012   TEL: (602) 640-5143
AC
AC   ************************************************************
AC   *                                                          *
AC   *  SPOOKHILL OUTLET DESIGN  SUPPER CRITICAL CONDITION      *
AC   *                                                          *
AC   ************************************************************
AC
AC   OUTLET CHANNEL WIDTH ..................................... 40 FEET
AC   OUTLET CHANNEL DEPTH  ..................................... 5 FEET
AC   DISCHARGE FOR THE 100-YEAR BY FCD ....................  2653 CFS
AC   CULVERT INFORMATION OUT LET ELEVATION (FCD MAPS) .....  1334.49
AC   BY FCD PROPOSED CONDITION MAPS
AC   THERE ARE 4-10x10 CULVERTS
AC   THE MANNING N FOR THE CULVERT .........................     0.015
AC   THE MANNING N FOR THE CONCRET RETAINING ..............     0.030
AC   WALLS FOR SIDES AND GROUTED ROCK BOTTOM
AC
AC
AC
AC
T1 SPOOKHILL OUTLET DESIGN FOR THE SOIL CONSERVATION SERVICE
T2 FCD 6C300S  100 YEAR FLOW - PROPOSED CONDITION
T3 DATE: 8-10-92

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

      0        0        0        1        0        0        0     2653    44.60      0

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

      1        0       -1        0        0        0       -1        0        0        15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT
```

38 43 1 2 3 26 25 8 4 39

```
   150
J1      0         0         0         1         0         0         0      2653     44.60         0
J1  ICHECK    INQ      NINV      IDIR      STRT     METRIC    HVINS     Q        WSEL      FQ

      0         0         0         1         0         0         0      2653     44.60         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN       ALLDC     IBW      CHNIM     ITRACE

      1         0        -1         0         0         0        -1         0         0        15

     38        43         1         2         3        26        25         8         4        39
   150

NC    .065      .065      .015       .3        .5
X1     319        28     76.58   123.42        81        81        81
X3      10                                                            49.00     46.80
GR   43.80     67.75     36.80     74.75     36.80     75.75     43.80     75.75     43.80     76.58
GR   37.63     76.58     36.80     77.42     36.80     85.75     37.63     86.58     43.80     86.58
GR   43.80     88.75     37.63     88.75     36.80     89.58     36.80     97.92     37.63     98.75
GR   43.80     98.75     43.80    101.25     36.80    101.25     36.80    111.25     43.80    111.25
GR   43.80    113.42     36.80    113.42     36.80    123.42     43.80    123.42     43.80    124.25
GR   36.80    124.25     36.80    125.25     43.80    131.25

NC   0.065      .065      .030       0.1        .3
X1     400        28     76.58   123.42       100       100       100
X3      10                                                            49.00     46.80
GR   41.49     67.75     34.49     74.75     34.49     75.75     41.49     75.75     41.49     76.58
GR   35.32     76.58     34.49     77.42     34.49     85.75     35.32     86.58     41.49     86.58
GR   41.49     88.75     35.32     88.75     34.49     89.58     34.49     97.92     35.32     98.75
GR   41.49     98.75     41.49    101.25     34.49    101.25     34.49    111.25     41.49    111.25
GR   41.49    113.42     34.49    113.42     34.49    123.42     41.49    123.42     41.49    124.25
GR   34.49    124.25     34.49    125.25     41.49    131.25

X1     500         4        80       120       150       150       150
GR      37        80     31.29        80     31.29       120        37       120

X1     650         4        80       120     72.33     72.33     72.33
GR      32        80     26.50        80     26.50       120        32       120

X1  722.33         4        80       120    121.06    134.28    127.67
GR      31        80     25.08        80     25.08       120        31       120

X1     850         4        80       120    123.25    136.71    129.98
GR      28        80     22.59        80     22.58       120        28       120
```

X1	979.98	4	80	120	113.80	126.24	120.02	
GR	26	80	20.04	80	20.04	120	26	120
X1	1100	4	80	120	130.47	144.73	137.62	
GR	24	80	17.69	80	17.69	120	24	120
X1	1237.6	4	80	120	0	0	0	
GR	21	80	15.00	80	15.00	120	24	120

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .300 CEHV= .500
*SECNO 319.000

3265 DIVIDED FLOW

3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

319.000	5.17	41.97	41.97	44.60	44.56	2.59	.00	.00	43.80
2653.0	.0	2653.0	.0	.0	205.3	.0	.0	.0	43.80
.00	.00	12.92	.00	.000	.015	.000	.000	36.80	76.58
.004792	0.	0.	0.	0	13	0	.00	40.00	123.42

FLOW DISTRIBUTION FOR SECNO= 319.00 CWSEL= 41.97

STA= 77. 123.
PER Q= 100.0
AREA= 205.3
VEL= 12.9
DEPTH= 5.1

CCHV= .100 CEHV= .300
*SECNO 400.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.23

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
400.000	3.64	38.13	39.66	.00	43.39	5.26	.90	.27	41.49
2653.0	.0	2653.0	.0	.0	144.2	.0	.3	.1	41.49
.00	.00	18.40	.00	.000	.030	.000	.000	34.49	76.58
.049855	81.	81.	81.	6	5	0	.00	40.00	123.42

FLOW DISTRIBUTION FOR SECNO= 400.00 CWSEL= 38.13

STA= 77. 123.
PER Q= 100.0
AREA= 144.2
VEL= 18.4
DEPTH= 3.6

*SECNO 500.000

3301 HV CHANGED MORE THAN HVINS

500.000	3.85	35.14	36.43	.00	39.74	4.60	3.45	.20	37.00
2653.0	.0	2653.0	.0	.0	154.1	.0	.7	.2	37.00
.00	.00	17.22	.00	.000	.030	.000	.000	31.29	80.00
.025294	100.	100.	100.	5	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 500.00 CWSEL= 35.14

STA= 80. 120.
PER Q= 100.0
AREA= 154.1
VEL= 17.2
DEPTH= 3.9

*SECNO 650.000

3301 HV CHANGED MORE THAN HVINS

650.000	3.58	30.08	31.63	.00	35.42	5.34	4.25	.07	32.00
2653.0	.0	2653.0	.0	.0	143.0	.0	1.2	.3	32.00
.01	.00	18.55	.00	.000	.030	.000	.000	26.50	80.00
.031924	150.	150.	150.	6	11	0	.00	40.00	120.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 650.00 CWSEL= 30.08

STA= 80. 120.
PER Q= 100.0
AREA= 143.0
VEL= 18.5
DEPTH= 3.6

*SECNO 722.330

3301 HV CHANGED MORE THAN HVINS

722.330	4.13	29.21	30.22	.00	33.20	3.99	1.81	.41	31.00
2653.0	.0	2653.0	.0	.0	165.6	.0	1.4	.4	31.00
.01	.00	16.02	.00	.000	.030	.000	.000	25.08	80.00
.020236	72.	72.	72.	6	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 722.33 CWSEL= 29.21

STA= 80. 120.
PER Q= 100.0
AREA= 165.6
VEL= 16.0
DEPTH= 4.1

*SECNO 850.000

850.000	4.22	26.80	27.72	.00	30.64	3.84	2.51	.04	28.00
2653.0	.0	2653.0	.0	.0	168.7	.0	1.9	.5	28.00
.01	.00	15.73	.00	.000	.030	.000	.000	22.58	80.00
.019099	121.	128.	134.	7	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 850.00 CWSEL= 26.80

STA= 80. 120.
PER Q= 100.0
AREA= 168.7
VEL= 15.7
DEPTH= 4.2

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 979.980

979.980	4.18	24.22	25.17	.00	28.13	3.90	2.51	.01	26.00
2653.0	.0	2653.0	.0	.0	167.4	.0	2.4	.6	26.00
.01	.00	15.85	.00	.000	.030	.000	.000	20.04	80.00
.019567	123.	130.	137.	9	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 979.98 CWSEL= 24.22

STA= 80. 120.
PER Q= 100.0
AREA= 167.4
VEL= 15.9
DEPTH= 4.2

*SECNO 1100.000

1100.000	4.18	21.87	22.82	.00	25.77	3.91	2.35	.00	24.00
2653.0	.0	2653.0	.0	.0	167.2	.0	2.9	.7	24.00
.01	.00	15.86	.00	.000	.030	.000	.000	17.69	80.00
.019609	114.	120.	126.	8	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1100.00 CWSEL= 21.87

STA= 80. 120.
PER Q= 100.0
AREA= 167.2
VEL= 15.9
DEPTH= 4.2

*SECNO 1237.600

1237.600	4.19	19.19	20.13	.00	23.08	3.89	2.69	.01	21.00
2653.0	.0	2653.0	.0	.0	167.6	.0	3.4	.8	24.00
.02	.00	15.83	.00	.000	.030	.000	.000	15.00	80.00
.019474	130.	138.	145.	8	11	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1237.60 CWSEL= 19.19

STA= 80. 120.
PER Q= 100.0
AREA= 167.6
VEL= 15.8
DEPTH= 4.2

T1 SPOOKHILL OUTLET DESIGN FOR THE SOIL CONSERVATION SERVICE
T2 FCD 6C300S LOW FLOW DESIGN FOR SCOUR ANALYSIS
T3 DATE: 8-10-92

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	0	0	1	0	0	0	100	37.41	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	15	0	-1	0	0	0	-1	0	0	15

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 2

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .300 CEHV= .500
*SECNO 319.000

3265 DIVIDED FLOW

3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

319.000	.60	37.40	37.40	37.41	37.70	.30	.00	.00	43.80
100.0	.0	100.0	.0	.0	22.9	.0	.0	.0	43.80
.00	.00	4.37	.00	.000	.015	.000	.000	36.80	76.81
.004448	0.	0.	0.	0	4	0	.00	39.09	123.42

FLOW DISTRIBUTION FOR SECNO= 319.00 CWSEL= 37.40

STA= 77. 123.
PER Q= 100.0
AREA= 22.9
VEL= 4.4
DEPTH= .6

CCHV= .100 CEHV= .300
*SECNO 400.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 8.03

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 49.00 ELREA= 46.80

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
400.000	.25	34.74	35.10	.00	36.42	1.68	1.14	.14	41.49
100.0	.0	100.0	.0	.0	9.6	.0	.0	.1	41.49
.00	.00	10.40	.00	.000	.030	.000	.000	34.49	77.16
.286647	81.	81.	81.	6	5	0	.00	37.71	123.42

FLOW DISTRIBUTION FOR SECNO= 400.00 CWSEL= 34.74

STA= 77. 123.
PER Q= 100.0
AREA= 9.6
VEL= 10.4
DEPTH= .3

*SECNO 500.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

500.000	.58	31.87	31.87	.00	32.16	.29	4.31	2.83	37.00
100.0	.0	100.0	.0	.0	23.1	.0	.1	.2	37.00
.01	.00	4.33	.00	.000	.030	.000	.000	31.29	80.00
.016560	100.	100.	100.	20	17	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 500.00 CWSEL= 31.87

STA= 80. 120.
PER Q= 100.0
AREA= 23.1
VEL= 4.3
DEPTH= .6

*SECNO 650.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.09

650.000	.36	26.86	27.08	.00	27.57	.71	4.54	.04	32.00
100.0	.0	100.0	.0	.0	14.8	.0	.1	.3	32.00
.01	.00	6.77	.00	.000	.030	.000	.000	26.50	80.00
.072265	150.	150.	150.	5	5	0	.00	40.00	120.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 650.00 CWSEL= 26.86

STA= 80. 120.
PER Q= 100.0
AREA= 14.8
VEL= 6.8
DEPTH= .4

*SECNO 722.330
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

722.330	.58	25.66	25.66	.00	25.95	.29	2.19	1.22	31.00
100.0	.0	100.0	.0	.0	23.1	.0	.2	.4	31.00
.02	.00	4.33	.00	.000	.030	.000	.000	25.08	80.00
.016558	72.	72.	72.	20	14	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 722.33 CWSEL= 25.66

STA= 80. 120.
PER Q= 100.0
AREA= 23.1
VEL= 4.3
DEPTH= .6

*SECNO 850.000

850.000	.53	23.11	23.16	.00	23.47	.36	2.48	.01	28.00
100.0	.0	100.0	.0	.0	20.9	.0	.2	.5	28.00
.03	.00	4.79	.00	.000	.030	.000	.000	22.58	80.00
.023013	121.	128.	134.	3	5	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 850.00 CWSEL= 23.11

STA= 80. 120.
PER Q= 100.0
AREA= 20.9
VEL= 4.8
DEPTH= .5

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 979.980

979.980	.57	20.61	20.62	.00	20.91	.29	2.54	.02	26.00
100.0	.0	100.0	.0	.0	23.0	.0	.3	.6	26.00
.04	.00	4.35	.00	.000	.030	.000	.000	20.04	80.00
.016803	123.	130.	137.	2	8	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 979.98 CWSEL= 20.61

STA= 80. 120.
PER Q= 100.0
AREA= 23.0
VEL= 4.4
DEPTH= .6

*SECNO 1100.000

1100.000	.53	18.22	18.27	.00	18.57	.35	2.33	.01	24.00
100.0	.0	100.0	.0	.0	21.0	.0	.4	.7	24.00
.04	.00	4.77	.00	.000	.030	.000	.000	17.69	80.00
.022717	114.	120.	126.	3	5	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1100.00 CWSEL= 18.22

STA= 80. 120.
PER Q= 100.0
AREA= 21.0
VEL= 4.8
DEPTH= .5

*SECNO 1237.600

1237.600	.57	15.57	15.58	.00	15.87	.30	2.68	.02	21.00
100.0	.0	100.0	.0	.0	22.9	.0	.4	.8	24.00
.05	.00	4.36	.00	.000	.030	.000	.000	15.00	80.00
.016934	130.	138.	145.	2	8	0	.00	40.00	120.00

FLOW DISTRIBUTION FOR SECNO= 1237.60 CWSEL= 15.57

STA= 80. 120.
PER Q= 100.0
AREA= 22.9
VEL= 4.4
DEPTH= .6

THIS RUN EXECUTED 17AUG92 11:15:58

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

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

8-10-92

SUMMARY PRINTOUT

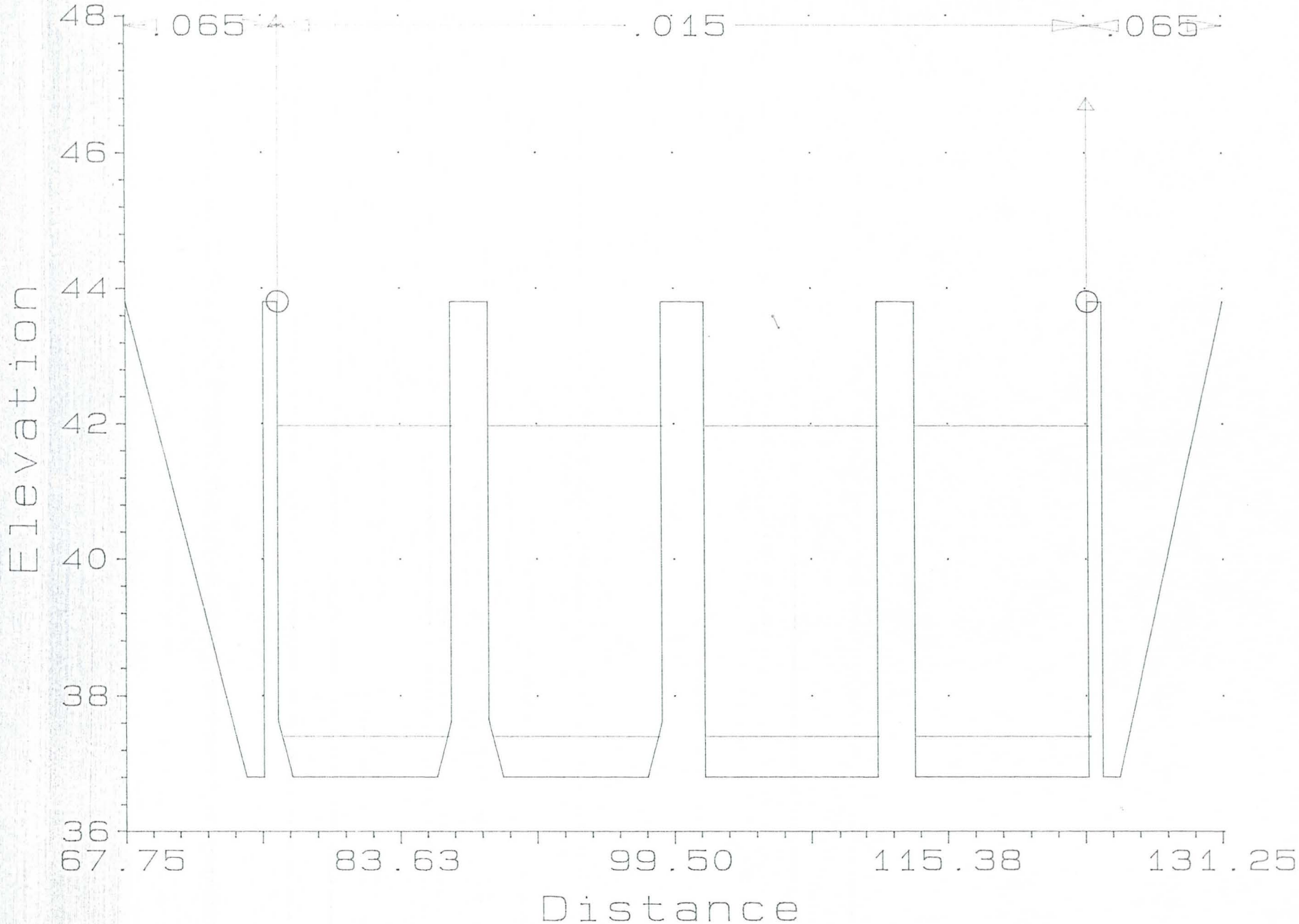
	SECNO	Q	CWSEL	CRIWS	EG	VCH	AREA	DEPTH	TOPWID	XLCH
*	319.000	2653.00	41.97	41.97	44.56	12.92	205.33	5.17	40.00	.00
*	319.000	100.00	37.40	37.40	37.70	4.37	22.88	.60	39.09	.00
*	400.000	2653.00	38.13	39.66	43.39	18.40	144.15	3.64	40.00	81.00
*	400.000	100.00	34.74	35.10	36.42	10.40	9.62	.25	37.71	81.00
	500.000	2653.00	35.14	36.43	39.74	17.22	154.10	3.85	40.00	100.00
*	500.000	100.00	31.87	31.87	32.16	4.33	23.07	.58	40.00	100.00
	650.000	2653.00	30.08	31.63	35.42	18.55	143.04	3.58	40.00	150.00
*	650.000	100.00	26.86	27.08	27.57	6.77	14.77	.36	40.00	150.00
	722.330	2653.00	29.21	30.22	33.20	16.02	165.56	4.13	40.00	72.33
*	722.330	100.00	25.66	25.66	25.95	4.33	23.07	.58	40.00	72.33
	850.000	2653.00	26.80	27.72	30.64	15.73	168.67	4.22	40.00	127.67
	850.000	100.00	23.11	23.16	23.47	4.79	20.88	.53	40.00	127.67
	979.980	2653.00	24.22	25.17	28.13	15.85	167.36	4.18	40.00	129.98
	979.980	100.00	20.61	20.62	20.91	4.35	22.97	.57	40.00	129.98
	1100.000	2653.00	21.87	22.82	25.77	15.86	167.25	4.18	40.00	120.02
	1100.000	100.00	18.22	18.27	18.57	4.77	20.96	.53	40.00	120.02
	1237.600	2653.00	19.19	20.13	23.08	15.83	167.62	4.19	40.00	137.62
	1237.600	100.00	15.57	15.58	15.87	4.36	22.92	.57	40.00	137.62

8-10-92

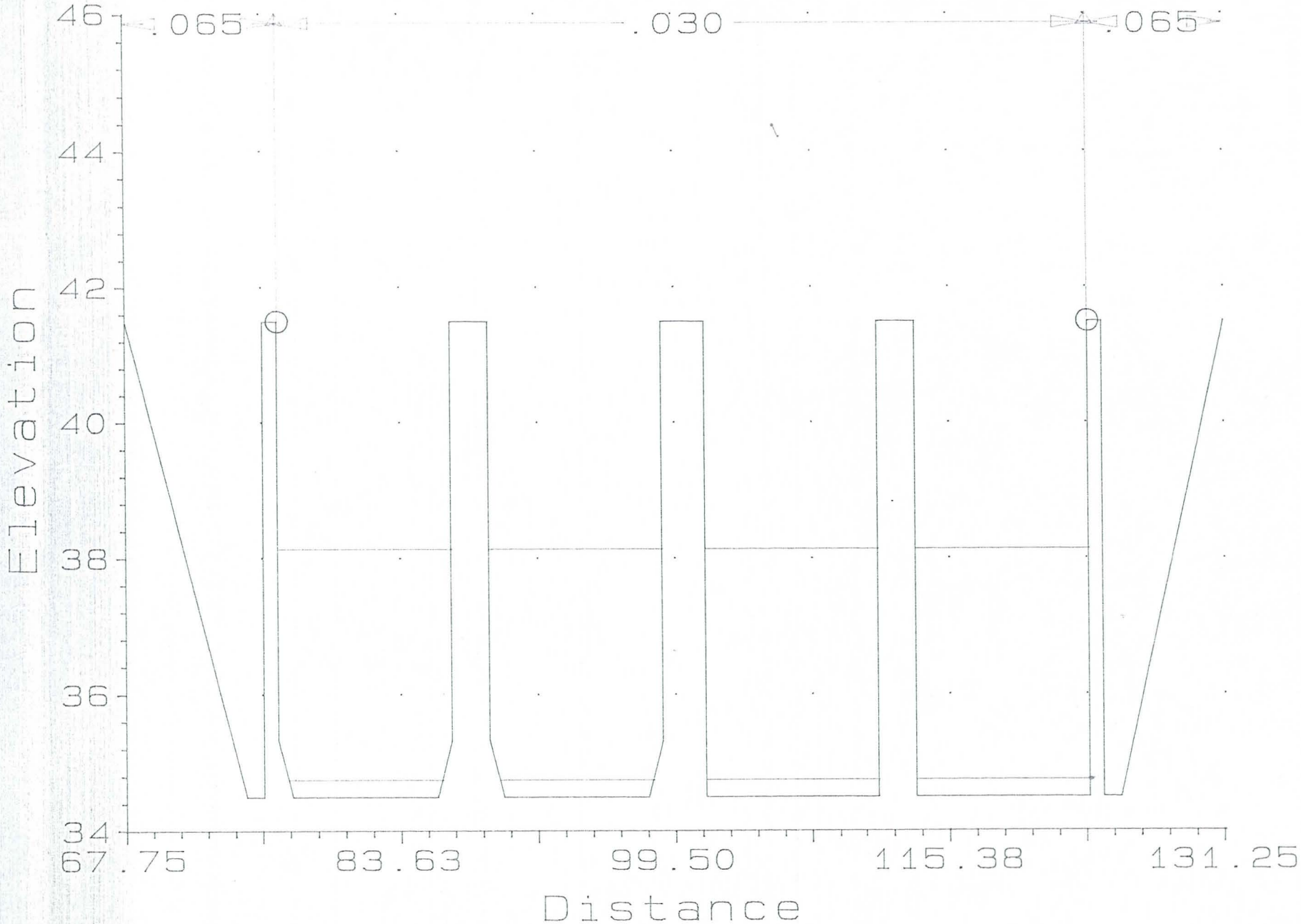
SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	EG	VCH	AREA	DEPTH	TOPWID	XLCH
*	319.000	2653.00	41.97	41.97	44.56	12.92	205.33	5.17	40.00	.00
*	319.000	100.00	37.40	37.40	37.70	4.37	22.88	.60	39.09	.00
*	400.000	2653.00	38.13	39.66	43.39	18.40	144.15	3.64	40.00	81.00
*	400.000	100.00	34.74	35.10	36.42	10.40	9.62	.25	37.71	81.00
	500.000	2653.00	35.14	36.43	39.74	17.22	154.10	3.85	40.00	100.00
*	500.000	100.00	31.87	31.87	32.16	4.33	23.07	.58	40.00	100.00
	650.000	2653.00	30.08	31.63	35.42	18.55	143.04	3.58	40.00	150.00
*	650.000	100.00	26.86	27.08	27.57	6.77	14.77	.36	40.00	150.00
	722.330	2653.00	29.21	30.22	33.20	16.02	165.56	4.13	40.00	72.33
*	722.330	100.00	25.66	25.66	25.95	4.33	23.07	.58	40.00	72.33
	850.000	2653.00	26.80	27.72	30.64	15.73	168.67	4.22	40.00	127.67
	850.000	100.00	23.11	23.16	23.47	4.79	20.88	.53	40.00	127.67
	979.980	2653.00	24.22	25.17	28.13	15.85	167.36	4.18	40.00	129.98
	979.980	100.00	20.61	20.62	20.91	4.35	22.97	.57	40.00	129.98
	1100.000	2653.00	21.87	22.82	25.77	15.86	167.25	4.18	40.00	120.02
	1100.000	100.00	18.22	18.27	18.57	4.77	20.96	.53	40.00	120.02
	1237.600	2653.00	19.19	20.13	23.08	15.83	167.62	4.19	40.00	137.62
	1237.600	100.00	15.57	15.58	15.87	4.36	22.92	.57	40.00	137.62

SPOOKHILL OUTLET CHANNEL
Cross-section 319.000

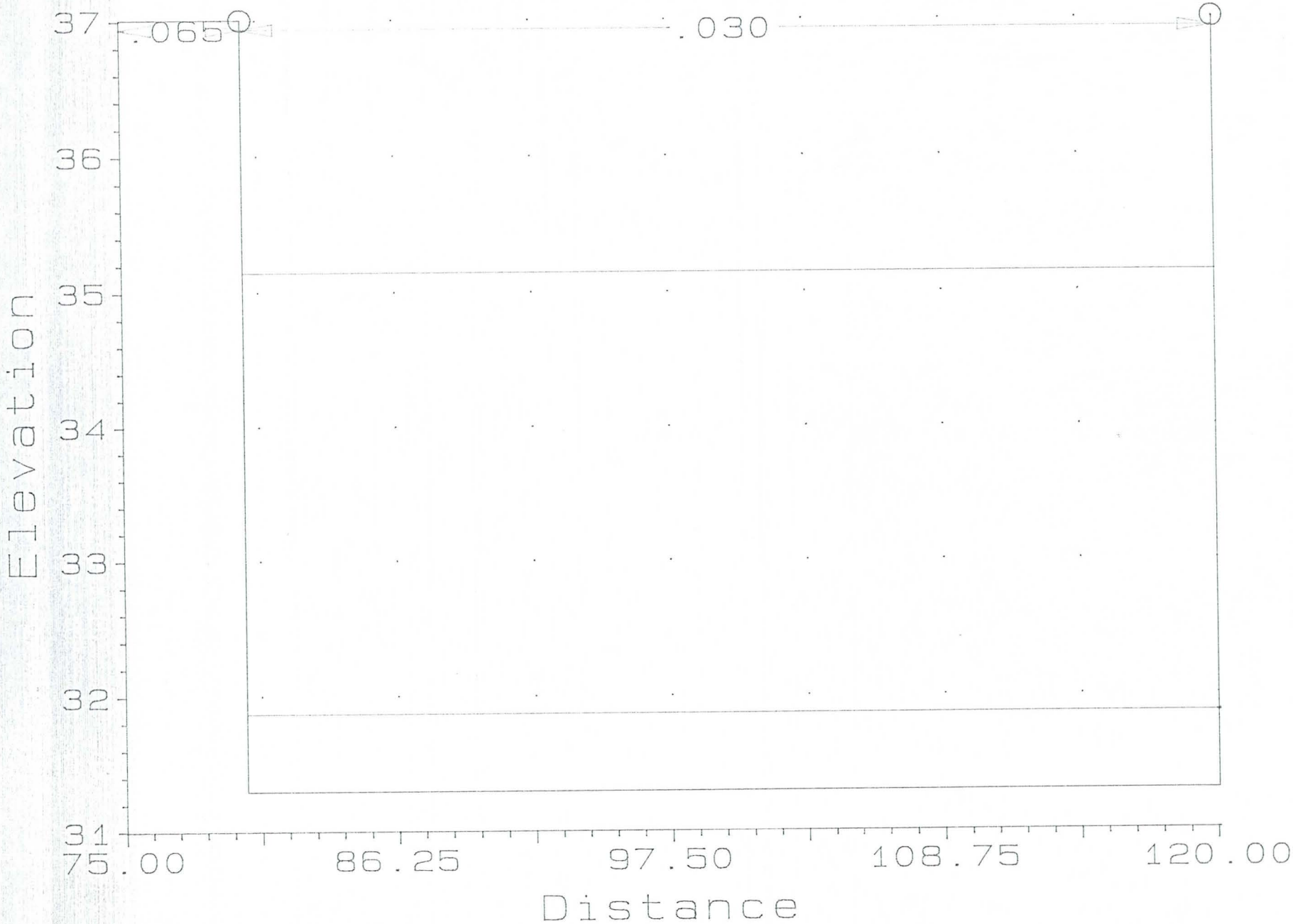


SPOOKHILL OUTLET CHANNEL
Cross-section 400.000

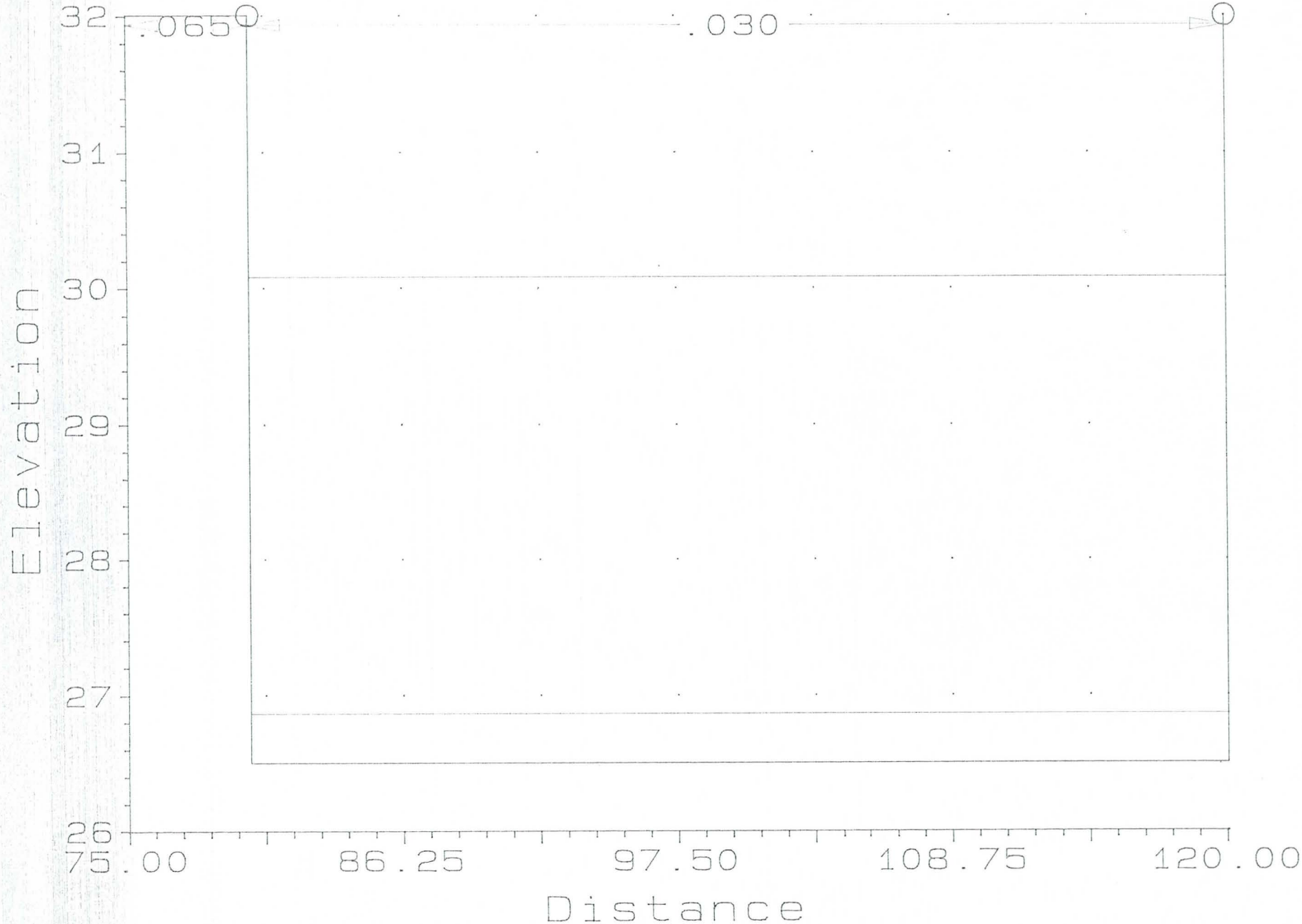


SPOOKHILL OUTLET CHANNEL

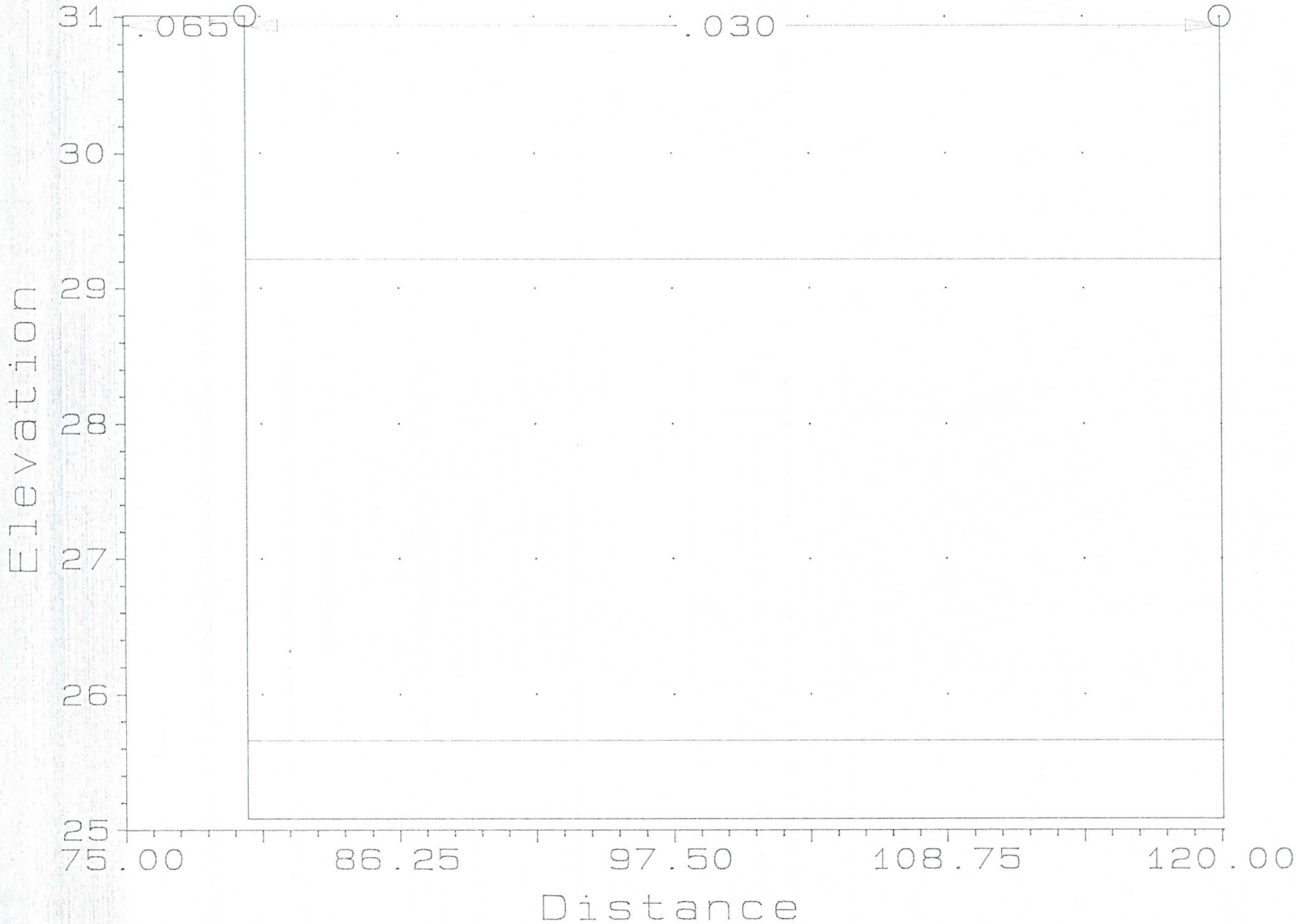
Cross-section 500.000



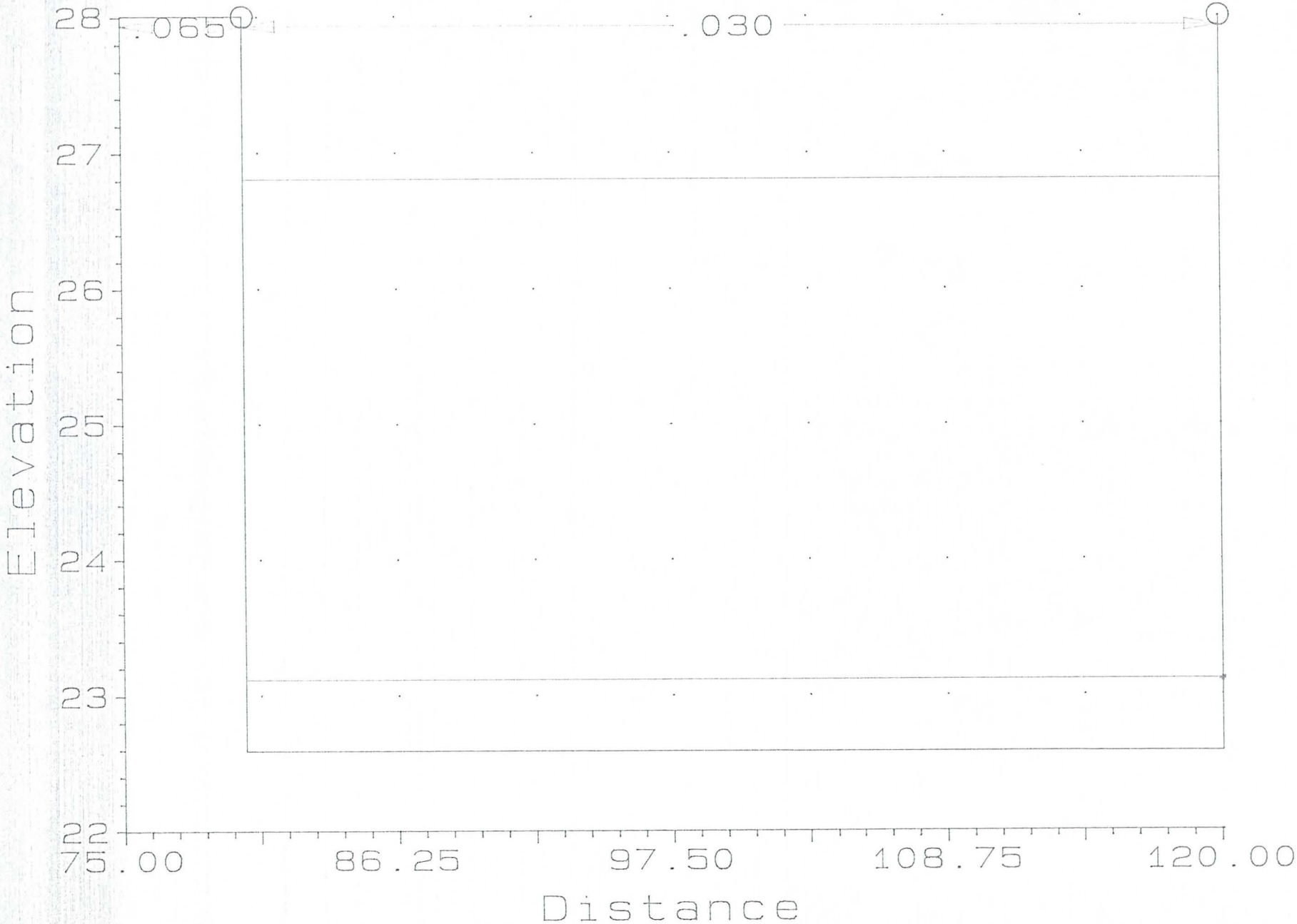
SPOOKHILL OUTLET CHANNEL
Cross-section 650.000



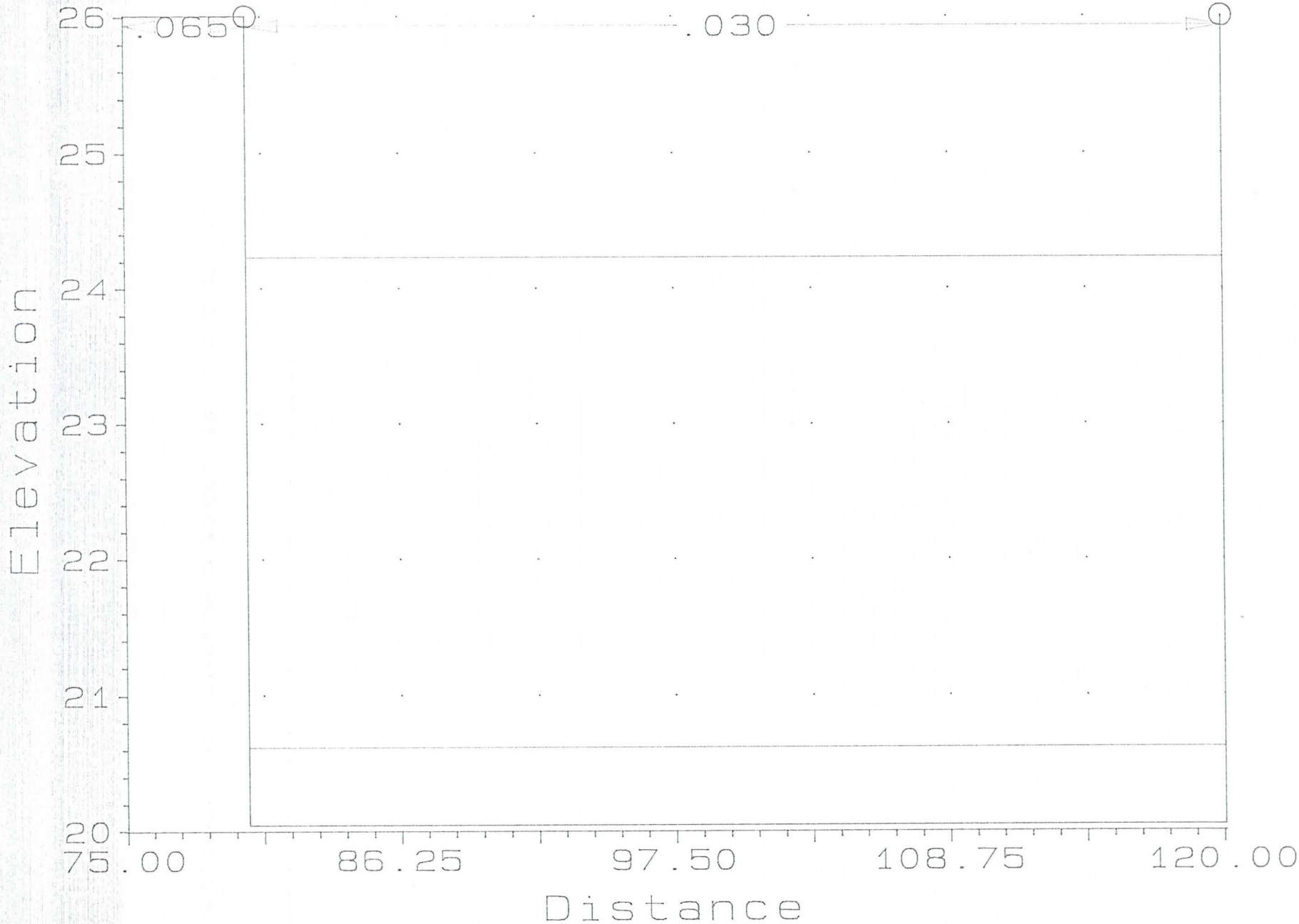
SPOOKHILL OUTLET CHANNEL
Cross-section 722.330



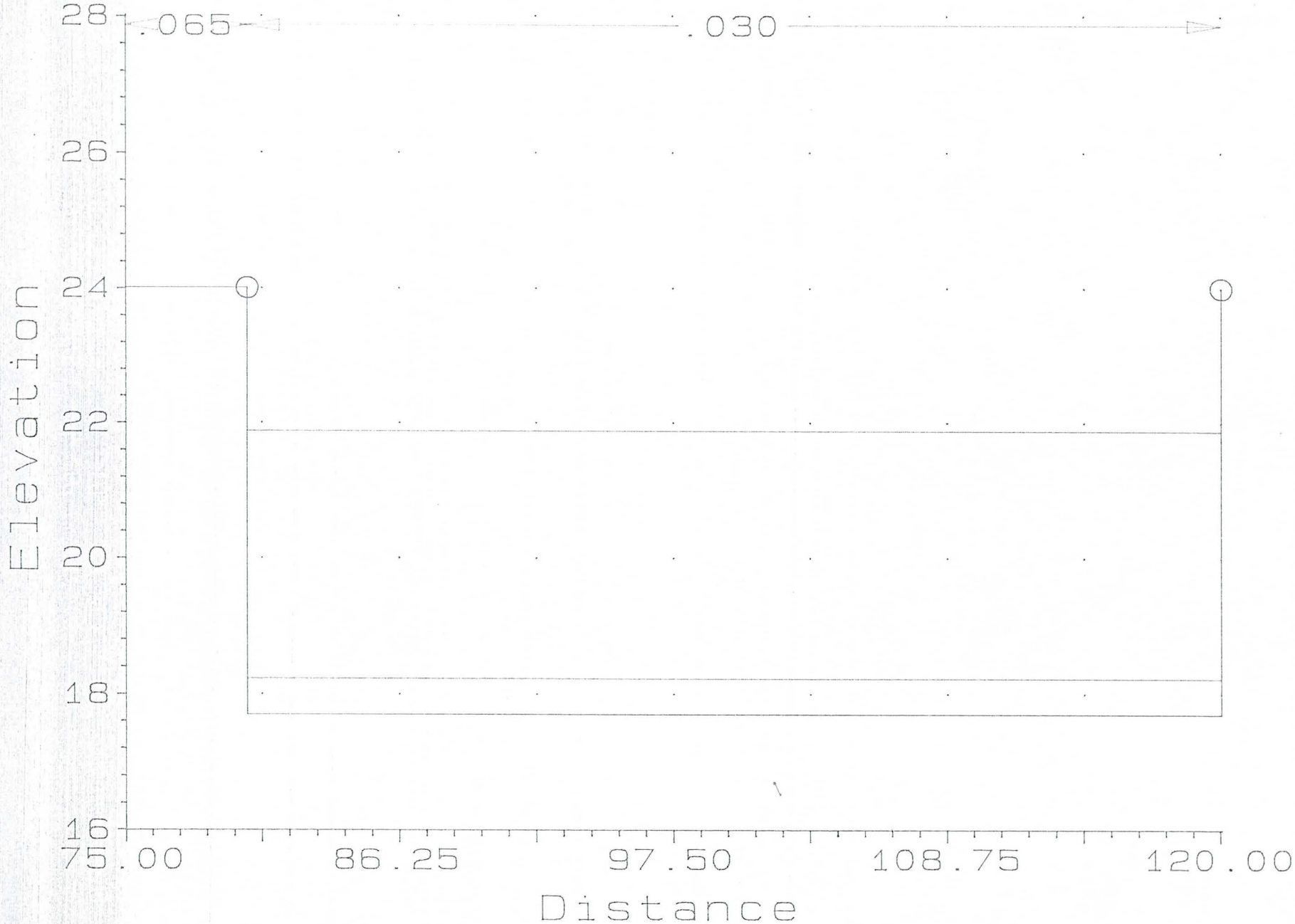
SPOOKHILL OUTLET CHANNEL
Cross-section 850.000



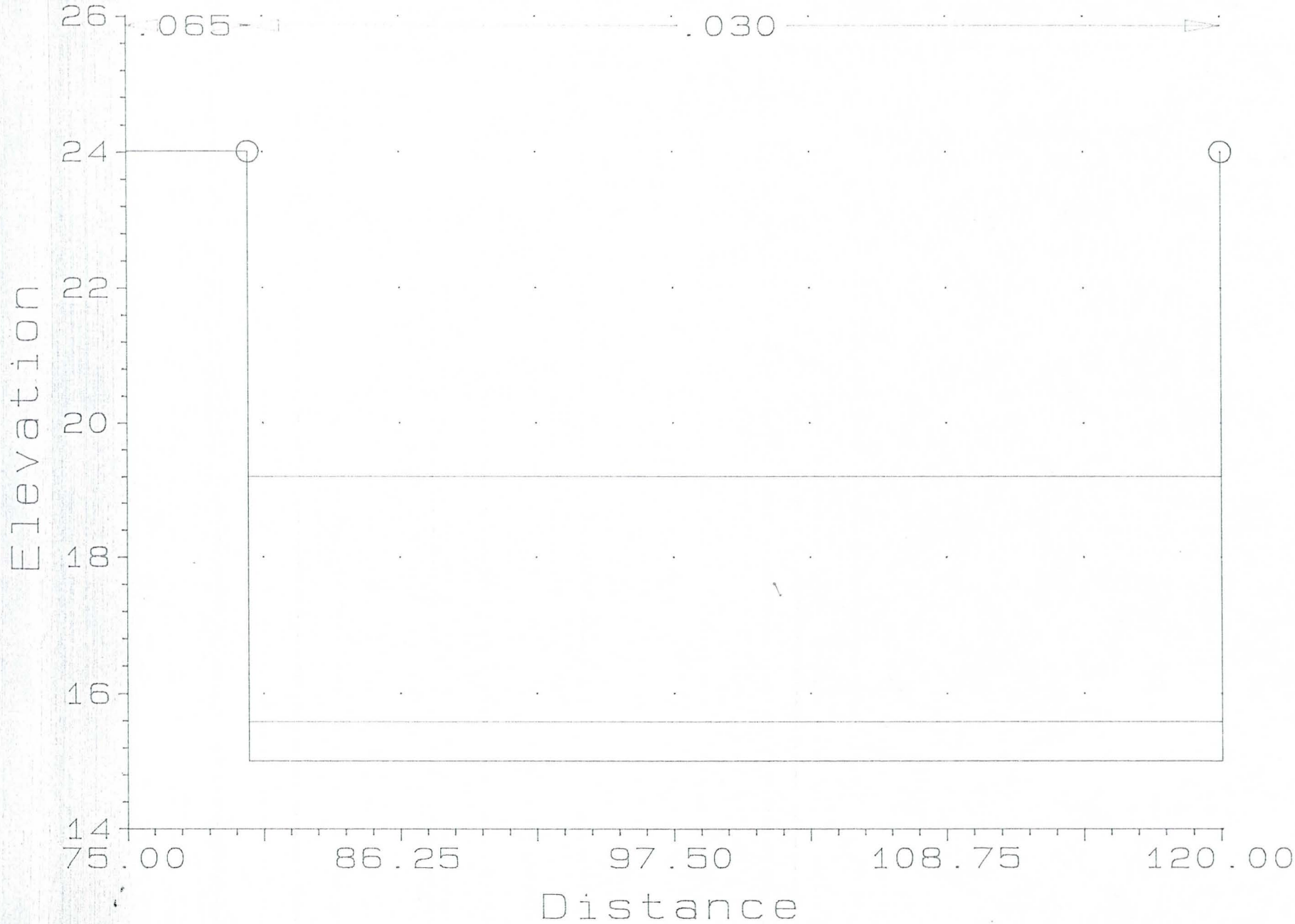
SPOOKHILL OUTLET CHANNEL
Cross-section 979.980



SPOOKHILL OUTLET CHANNEL
Cross-section 1100.000



SPOOKHILL OUTLET CHANNEL
Cross-section 1237.600



APPENDIX 5.8

FLOOD CONTROL DISTRICT of MARICOPA COUNTY

FLOOD CO NTY

PROJECT Spoo F 2

DETAIL Hydra E 8/92

E

Copied from the originals 9/3/93

CULVERT CA

Since the flow is sup trol;

Culvers = 4 - 1

$Q \approx 2650$ c

$q = \frac{2650}{4} \approx$

$\frac{q}{B} = \frac{663}{10} =$

$\frac{HW}{D} = 0.78$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF 2

DETAIL Hydraulic Culvert COMPUTED BKH DATE 8/92

CHECKED BY DATE

CULVERT CALCULATION:

Since the flow is supercritical, the culvert is inlet control;

Culvers = 4 - 10'x10'

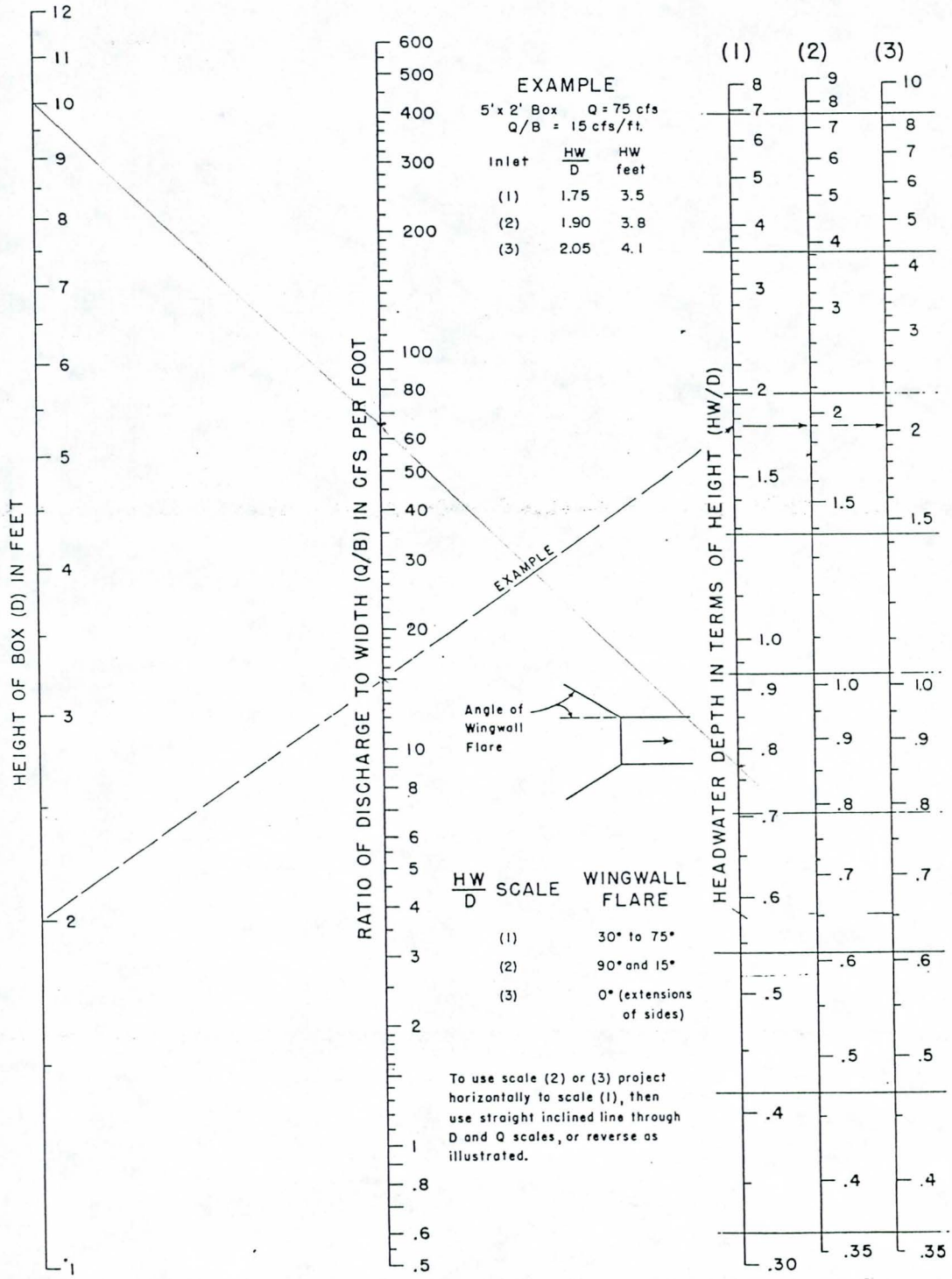
$Q \approx 2650$ cfs

$$q = \frac{2650}{4} \approx 663 \text{ cfs}$$

$$\frac{q}{B} = \frac{663}{10} = 66.30$$

$$\frac{HW}{D} = 0.78 \longrightarrow HW = 7.8'$$

CHART I



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF 2

DETAIL Hydraulic Jump COMPUTED BKH DATE 8-5-92

CHECKED BY DATE

METHOD #1 (Using Hydralic Jump Graph):

$V_1 = 16.09$

$d_1 = 4.12$

$$F_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{16.09}{\sqrt{32.2 \times 4.12}} = 1.3969$$

$$\frac{Y_2}{Y_1} = 1.55 \Rightarrow Y_2 = 1.55(4.12) = \underline{\underline{6.39'}}$$

$$\frac{L}{Y_2} = 3.8 \rightarrow L \approx 24'$$

METHOD #2 (Using Hydralic Jump Formulas):

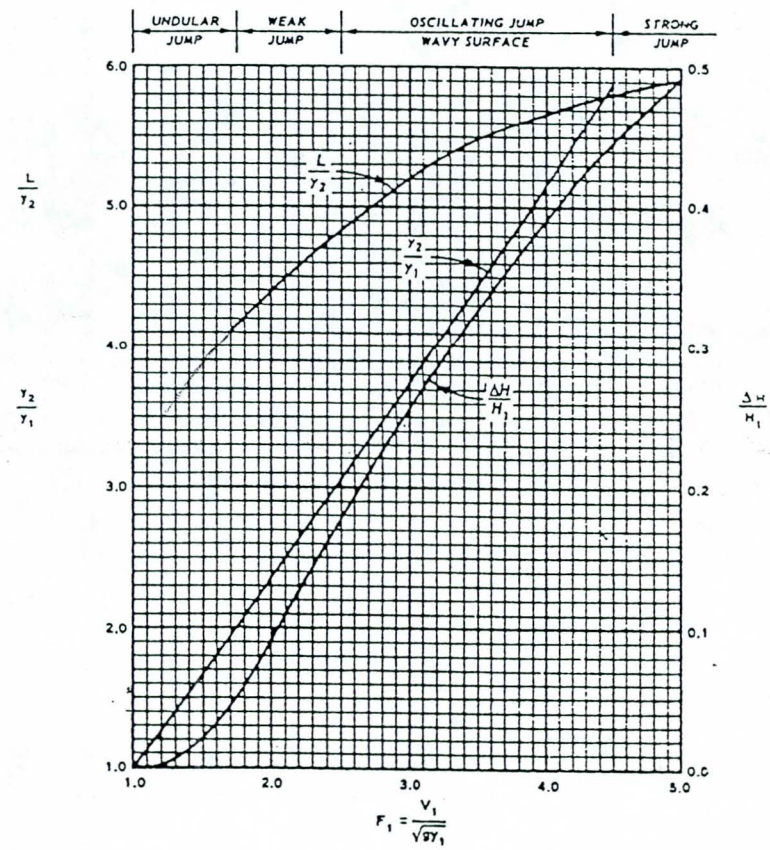
5.52

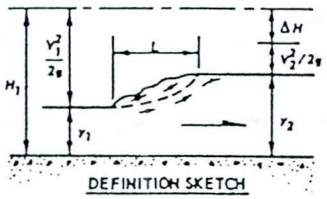
$$d_2 = -\tfrac{1}{2} d_1 + \sqrt{\frac{2V_1^2 d_1}{g} + \frac{d_1^2}{4}}$$

P.E. P5-21

$$= -\frac{4.12}{2} + \sqrt{\frac{2 \times 16.09^2 \times 4.12}{32.2} + \frac{4.12^2}{4}} = \underline{\underline{6.34'}}$$

2 of 2





DEFINITION SKETCH

L = JUMP LENGTH
ΔH = ENERGY LOSS
H_1 = TOTAL HEAD
y = SEQUENT DEPTHS

HYDRAULIC JUMP CHARACTERISTICS
RECTANGULAR CHANNEL

SEE TEXT PAGE 54

Plate 46

HYDRAULIC DESIGN OF FLOOD CONTROL CHANNELS

APP 5.8 SPKHL2F.OUT

Page 1

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*-----------------------------------*
ñ            S U M P O            ñ
ñ                                 ñ
ñ   Interactive Summary Printout  ñ
ñ   for MS/PC-DOS micro computers ñ
ñ             May 1991            ñ
*-----------------------------------*
```

NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

8-10-92

Summary Printout

	SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S
*	319.00	2653.00	41.97	41.97	44.56	12.92	5.17	205.33	40.00	.00	36.80	47.92
*	400.00	2653.00	38.13	39.66	43.39	18.40	3.64	144.15	40.00	81.00	34.49	498.55
	500.00	2653.00	35.14	36.43	39.74	17.22	3.85	154.10	40.00	100.00	31.29	252.94
	650.00	2653.00	30.08	31.63	35.42	18.55	3.58	143.04	40.00	150.00	26.50	319.24
	722.33	2653.00	29.21	30.22	33.20	16.02	4.13	165.56	40.00	72.33	25.08	202.36
	850.00	2653.00	26.80	27.72	30.64	15.73	4.22	168.67	40.00	127.67	22.58	190.99
	979.98	2653.00	24.22	25.17	28.13	15.85	4.18	167.36	40.00	129.98	20.04	195.67
	1100.00	2653.00	21.87	22.82	25.77	15.86	4.18	167.25	40.00	120.02	17.69	196.09
	1237.60	2653.00	19.19	20.13	23.08	15.83	4.19	167.62	40.00	137.62	15.00	194.74

eng-spookhil-app5.81

SUMMARY OF CALCULATION FOR THE RETAINING WALL HEIGHT

STA.	FLOW DEPTH FT	FB FT	SUP ELEV FT	CH DEPTH FT	CH DEPTH IN FT-INCH	CH DEPTH OUT FT-INCH	REQUIRED ELEV IN FT	REQUIRED ELEV OUT FT	RECOMMENDED ELEV IN FT	RECOMMENDED ELEV OUT FT
319	5.17	1.94	n/a	7.11	6'-0"	6'-0"	40.49	40.49	40.49	40.49
400	3.64	2.22	n/a	5.87	6'-0"	6'-0"	40.49	40.49	40.49	40.49
500	3.85	2.11	n/a	5.96	6'-0"	6'-0"	37.29	37.29	37.29	37.29
650	3.58	2.23	n/a	5.81	6'-0"	6'-0"	32.50	32.50	32.50	32.50
PC 722.33	4.13	2.03	0.00	6.16	6'-2"	6'-2"	31.25	31.25	31.25	31.25
850	4.22	2.02	0.50	6.74	6'-3"	6'-9"	28.83	29.33	28.83	29.33
PI 979.98	4.18	2.02	1.00	7.20	6'-3"	6'-3"	26.29	27.29	26.29	27.29
1096.94									24.00	
1100	4.18	2.02	0.53	6.73	6'-3"	6'-3"	23.94	24.44	24.00	24.44
1118.98									24.00	24.00
PT1237.60	4.19	2.02	0.00	6.21	6'-3"	6'-3"	21.25	21.25	24.00	24.00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 2A OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY DATE

WALL Depth

STA	Channel Invert	Channel Wall Elev. Inside	Channel Wall Elev. Outside	Depth of Wall Inside	Depth of Wall Outside
319					
400	34.49	40.49	40.49	6'-0"	6'-00"
650	26.50	32.50	32.50	6'-0"	6'-00"
722.33 PC	25.08	31.25	31.25	6'-2"	6'-2"
850	22.59	28.83	29.33	6'-3"	6'-8.88"
979.98 PI	20.04	26.29	27.29	6'-3"	7'-3"
1097.11	17.75	24.00	24.55	6'-3"	6'-9.6"
1100	17.69	24.00	24.44	6'-3.72"	6'-9"
1118.98	17.32	24.00	24.00	6'-8.16"	6'-8.16"
1237.60 PT	15.00	24.00	24.00	9'-0"	9'-00

3.196%

-.9570%

STA	Inv. el.	Lt Wall Depth	Lt Wall Elev.	RT Wall Depth	RT Wall Elev.
650	26.50	6'-0"	32.50G	6'-0"	32.50 G
660	26.30	6'-3"	32.55G	6'-4"	32.72 G
760	24.35	"	30.60	6'-5"	30.76 G
770	24.15	"	30.40	6'-10"	30.98G
870	22.19	"	28.44	6'-10"	29.03G
880	22.00	"	28.25	7'-3"	29.25 G
1097.11	17.75	"	24.00	"	25.00
1148.27	16.75	6'-3"	24.00G	7'-3"	24.00 G
1000	19.65		25.90		26.90

BKH 12-9-92

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 2B OF

DETAIL COMPUTED BKH DATE 11-92

CHECKED BY DATE 12-11-92

Final Wall depth

Sta.	Invert Elev.	Channel Depth	Wall Elev.		
650	26.50	6'-0"	32.50		
660	26.30	7'-2"	33.47		
850	22.59	7'-2"	29.76		
860	22.39	8'-4"	30.72		
1050	18.67	8'-4"	27.00		
1060	18.48	9'-6"	27.98		
1237.61	15.00	9'-6"	24.50		
1257.61	15.00	9'-0"	24.00		

3

SUPERELEVATION CALCULATION

Avrage velocity (V):	15.86	fps
Bottom width (b):	40	feet
Maximum height above depth (S):	1	feet
Gravity acceleration (G):	32.2	fps2
Radius of curve (R):	374.9658	feet

SECT: 979.98

FREEBOARD CALCULATION

Avrage Velocity (V):	15.86	fps
Depth of flow (Y):	4.18	feet
Freeboard required (FB)	2.021473	feet
Channel Depth (D):	6.201473	feet

SECT: 979.98

11-Aug-92 10:50 AM CAPS

F16: 12.92 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	12.92	fps
Depth of flow (Y):	5.17	feet
Freeboard required (FB)	1.940506	feet
Channel Depth (D):	7.110506	feet

319

11-Aug-92 10:54 AM NUM CAPS

F16: 18.4 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	18.4	fps
Depth of flow (Y):	3.64	feet
Freeboard required (FB)	2.224285	feet

400

4

F23: 18.4 READY

A B C D E F G H

15
16
17
18
19
20
21
22 FREEBOARD CALCULATION
23 Avrage Velocity (V): 18.4 feet
24 Depth of flow (Y): 3.64 feet
25 Freeboard required (FB) 2.224285 feet
26 Channel Depth (D): 5.864285
27
28
29
30
31
32
33
34

400

11-Aug-92 11:33 AM NUM

G25: 'feet READY

A B C D E F G H

15
16
17
18
19
20
21
22 FREEBOARD CALCULATION
23 Avrage Velocity (V): 17.22 feet
24 Depth of flow (Y): 3.85 feet
25 Freeboard required (FB) 2.113619 feet
26 Channel Depth (D): 5.963619 feet
27
28
29
30
31
32
33
34

500

11-Aug-92 11:33 AM NUM

F25: 0.25*(F24+(F23^2/64.4)) READY

A B C D E F G H

15
16
17

5

19 ~~Channel Depth (D): 5.084285 feet~~ 400

11-Aug-92 10:55 AM NUM CAPS

F16: 18.55 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	18.55	fps
Depth of flow (Y):	3.58	feet
Freeboard required (FB)	2.230801	feet
Channel Depth (D):	5.810801	feet

650

11-Aug-92 10:55 AM NUM CAPS

F16: 16.02 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	16.02	fps
Depth of flow (Y):	4.13	feet
Freeboard required (FB)	2.028774	feet
Channel Depth (D):	6.158774	feet

722.33

6

27
28
29
11-Aug-92 10:56 AM NUM CAPS

F. 15.73 READY

A B C D E F G H
10
11
12
13
14 FREEBOARD CALCULATION
15
16 Avrage Velocity (V): 15.73 fps
17 Depth of flow (Y): 4.22 feet
18 Freeboard required (FB) 2.015531 feet
19 Channel Depth (D): 6.235531 feet
20
21
22
23
24
25
26
27
28
29
1 g-92 10:58 AM NUM CAPS

F16: 15.85 READY

850

A B C D E F G H
10
11
12
13
14 FREEBOARD CALCULATION
15
16 Avrage Velocity (V): 15.85 fps
17 Depth of flow (Y): 4.18 feet
18 Freeboard required (FB) 2.020242 feet
19 Channel Depth (D): 6.200242 feet
20
21
22
23
24
25
26
27
28
29
1 g-92 10:58 AM NUM CAPS

F16: 15.86 READY

979.98

7

	A	B	C	D	E	F	G	H
10								
11								
12								
13								
14		FREEBOARD CALCULATION						
15								
16		Avrage Velocity (V):				15.86 fps		
17		Depth of flow (Y):				4.18 feet		
18		Freeboard required (FB)				2.021473 feet		
19		Channel Depth (D):				6.201473 feet		
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

1100

11-Aug-92 10:59 AM NUM CAPS

F16: 15.83 READY

	A	B	C	D	E	F	G	H
10								
11								
12								
13								
14		FREEBOARD CALCULATION						
15								
16		Avrage Velocity (V):				15.83 fps		
17		Depth of flow (Y):				4.19 feet		
18		Freeboard required (FB)				2.020282 feet		
19		Channel Depth (D):				6.210282 feet		
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

1237

11-Aug-92 10:59 AM NUM CAPS

F25: READY

	A	B	C	D	E	F	G	H
20								
21								
22								
23								
24								
25								
26								

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook hill Outlet PAGE 8 OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY DATE

EXISTING CONDITION ELEVATIONS: @ ℄

4+23	33	P
4+35	32	
+45	31	
+84	30	
5+19	29	
+44	28	
+99	27	
6+85	26	
7+34	25	
8+05	24	
+70	23	
9+35	22	
+89	21	
10+66	20	
+90	20	
11+18	19	
11+98	18	
12+80	17	

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 9 OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY DATE

PROPOSED CONDITION

		℄	slope	Distance Lt	Rt	℄
	3+19	36.80	2.8519%	"	"	81
	4+00	34.49		"	"	100
	5+00	31.29	3.1960%	"	"	150
	6+50	26.50		"	"	72.33
PC	7+22.33	25.08		121.06	134.28	127.67
	8+50	22.59	1.9570%	123.25	136.71	129.98
PI	9+79.98	20.04		113.80	126.24	120.02
	11+00	17.69		130.47	144.73	137.60
	12+37.60	15.00		"	"	0

Table 3.--*Values of Manning's n for flood plains*

[Modified from Chow, 1959]

Description	Minimum	Normal	Maximum
Pasture, no brush:			
Short grass	0.025	0.030	0.035
High grass	.030	.035	.050
Cultivated areas:			
No crop	.020	.030	.040
Mature row crops	.025	.035	.045
Mature field crops	.030	.040	.050
Brush:			
Scattered brush, heavy weeds	.035	.050	.070
Light brush and trees, in winter	.035	.050	.060
Light brush and trees, in summer	.040	.060	.080
Medium to dense brush, in winter	.045	.070	.110
Medium to dense brush, in summer	.070	.100	.160
Trees:			
Dense willows, summer, straight	.110	.150	.200
Cleared land with tree stumps, no sprouts	.030	.040	.050
Same as above, but heavy growth off sprouts	.050	.060	.080
Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	.080	.100	.120
Same as above, but with flood stage reaching branches	.100	.120	.160

from: "DESIGN of RIPRAP REVETMENT", HEC-11, FHWA-IP-89-016, March 89

Page 101 COMPUTED : BKH DATE: 11-92

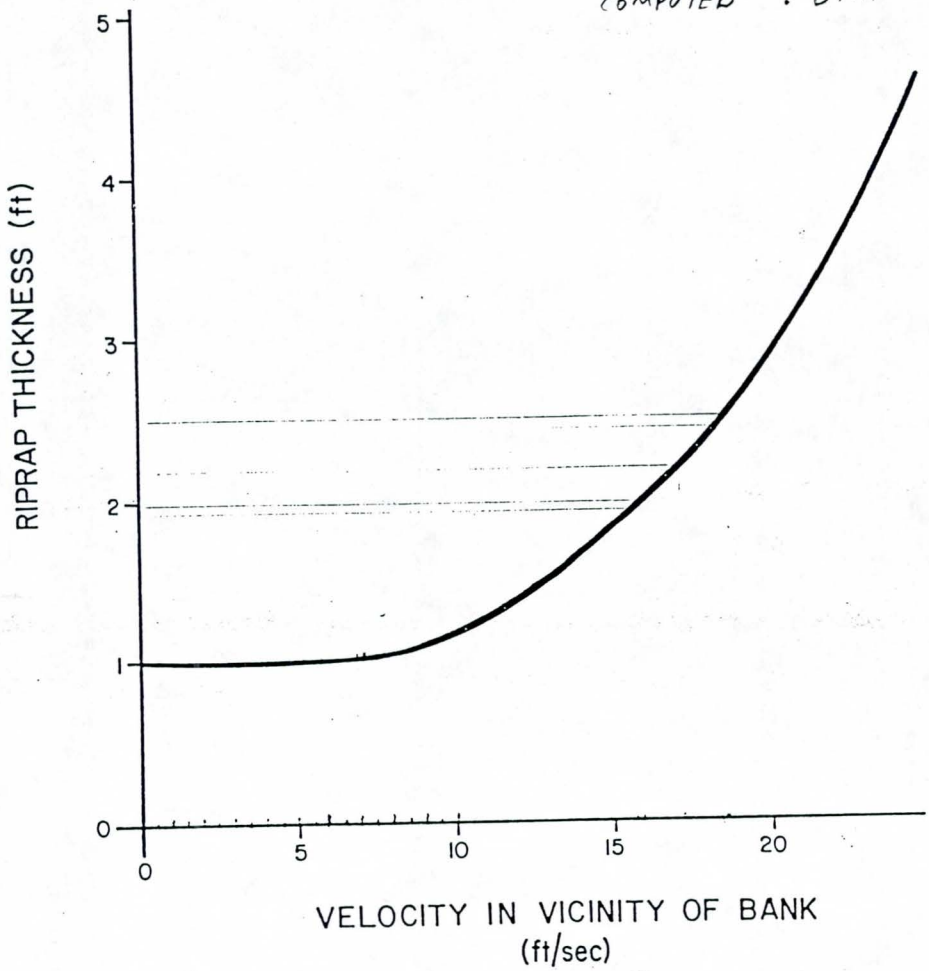


Figure 57. Required blanket thickness as a function of flow velocity.

STA.	VELOCTY	RIPRAP THICKNESS (ft)	
400	18.40	2.40	
500	17.22	2.20	USE 2.50'
650	18.55	2.52	
722.33	16.02	2.00	
850	15.73	1.94	
979.98	15.85	1.97	USE 2.00'
1100	15.86	1.97	
1237	15.83	1.96	

GROUTED ROCK

HEC-11

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF 2

DETAIL Hydraulic Culvert COMPUTED BKH DATE 8/92

CHECKED BY SHF DATE 8/92

CULVERT CALCULATION:

Since the flow is supercritical, the culvert is inlet control;

Culvers = 4 - 10'x10'

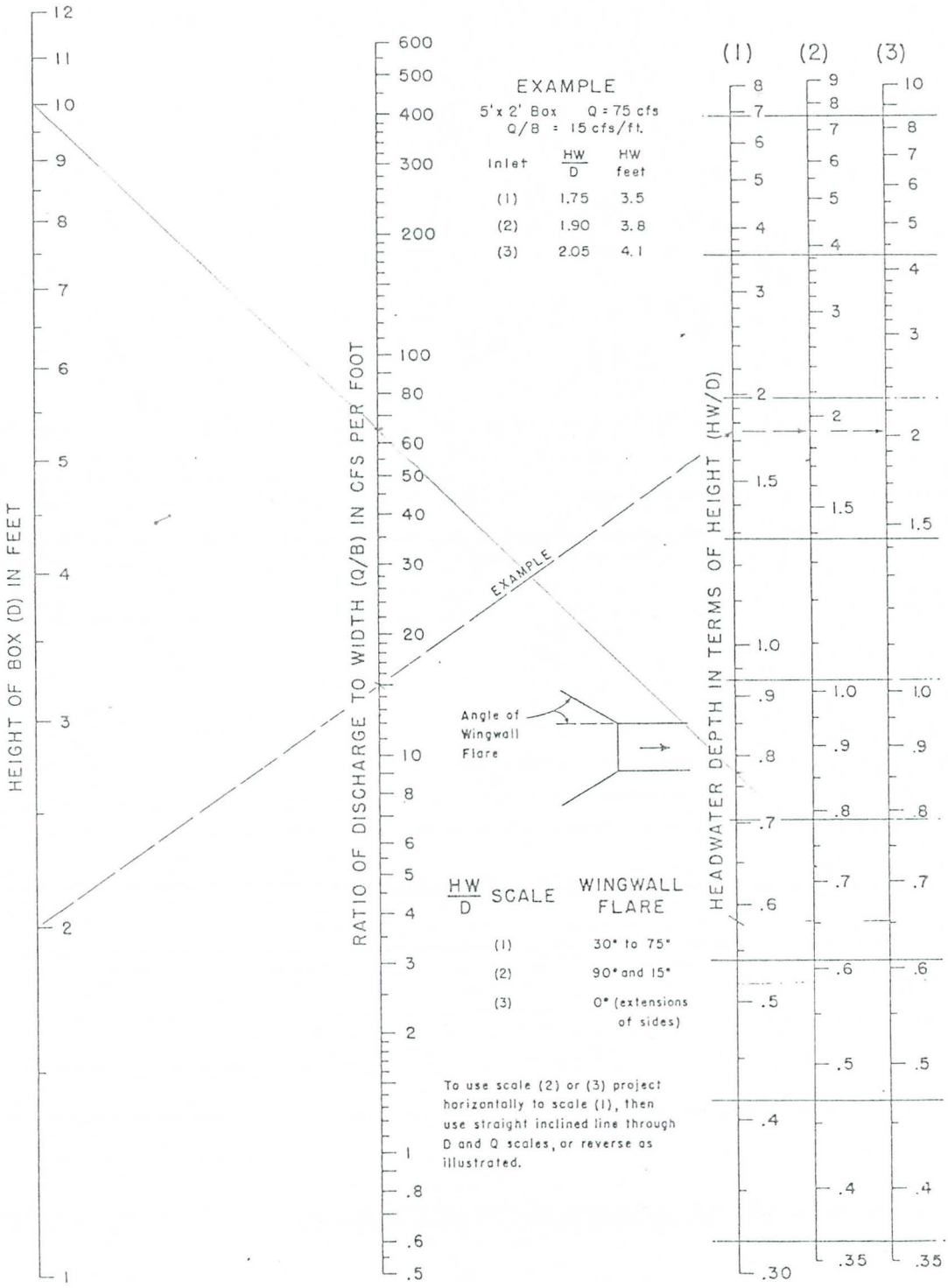
$Q \approx 2650$ cfs

$q = \frac{2650}{4} \approx 663$ cfs

$\frac{Q}{B} = \frac{663}{10} = 66.30$

$\frac{HW}{D} = 0.78 \longrightarrow HW = 7.8'$

CHART I



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF 2

DETAIL Hydraulic Jump COMPUTED BKH DATE 8-5-92

CHECKED BY SH DATE 8/92

METHOD #1 (Using Hydralic Jump Graph):

$V_1 = 16.09$ $\quad F_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{16.09}{\sqrt{32.2 \times 4.12}} = 1.3969$

$d_1 = 4.12$

$$\frac{Y_2}{Y_1} = 1.55 \Rightarrow Y_2 = 1.55(4.12) = \underline{6.39'}$$

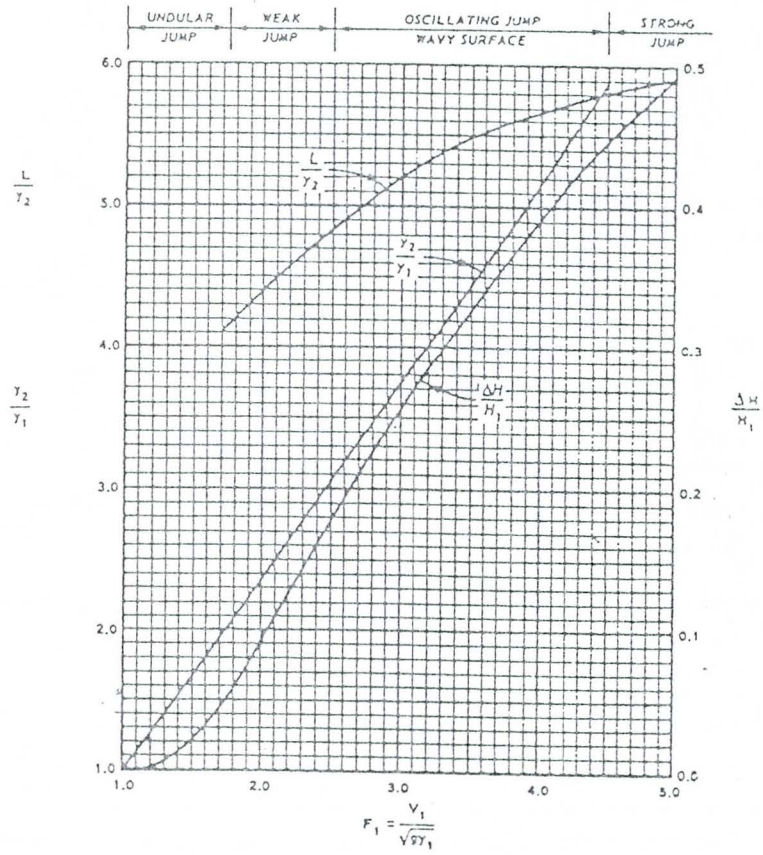
METHOD #2 (Using Hydralic Jump Formulas):

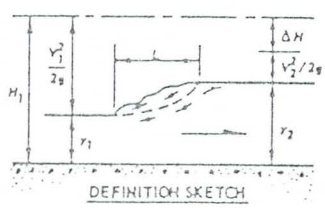
5.52 $\quad d_2 = -\frac{1}{2} d_1 + \sqrt{\frac{2V_1^2 d_1}{g} + \frac{d_1^2}{4}}$

P.E. P5-21

$$= -\frac{4.12}{2} + \sqrt{\frac{2 \times 16.09^2 \times 4.12}{32.2} + \frac{4.12^2}{4}} = \underline{6.34'}$$

2 of 2





DEFINITION SKETCH

L = JUMP LENGTH
ΔH = ENERGY LOSS
H_1 = TOTAL HEAD
Y = SEQUENT DEPTHS

HYDRAULIC JUMP CHARACTERISTICS
RECTANGULAR CHANNEL

SEE TEXT PAGE 54

Plate 46

HYDRAULIC DESIGN OF FLOOD CONTROL CHANNELS

APP 5.8 SPKHL2F.001

Page 1

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*-----------------------------------*
ñ            S U M P O              ñ
ñ                                   ñ
ñ   Interactive Summary Printout    ñ
ñ   for MS/PC-DOS micro computers   ñ
ñ             May 1991              ñ
*-----------------------------------*
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NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

8-10-92

Summary Printout

	SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S
*	319.00	2653.00	41.97	41.97	44.56	12.92	5.17	205.33	40.00	.00	36.80	47.92
*	400.00	2653.00	38.13	39.66	43.39	18.40	3.64	144.15	40.00	81.00	34.49	498.55
	500.00	2653.00	35.14	36.43	39.74	17.22	3.85	154.10	40.00	100.00	31.29	252.94
	650.00	2653.00	30.08	31.63	35.42	18.55	3.58	143.04	40.00	150.00	26.50	319.24
	722.33	2653.00	29.21	30.22	33.20	16.02	4.13	165.56	40.00	72.33	25.08	202.36
	850.00	2653.00	26.80	27.72	30.64	15.73	4.22	168.67	40.00	127.67	22.58	190.99
	979.98	2653.00	24.22	25.17	28.13	15.85	4.18	167.36	40.00	129.98	20.04	195.67
	1100.00	2653.00	21.87	22.82	25.77	15.86	4.18	167.25	40.00	120.02	17.69	196.09
	1237.60	2653.00	19.19	20.13	23.08	15.83	4.19	167.62	40.00	137.62	15.00	194.74

eng-spookhil-app5.81

SUMMARY OF CALCULATION FOR THE RETAINING WALL HEIGHT

STA.	FLOW DEPTH	FB	SUP ELEV	CH DEPTH	CH DEPTH FT IN	CH DEPTH FT OUT	REQUIRED ELEV FT IN	REQUIRED ELEV FT OUT	RECOMMENDED ELEV FT IN	RECOMMENDED ELEV FT OUT
	FT	FT	FT	FT	FT-INCH		FT		FT	
319	5.17	1.94	n/a	7.11	6'-0"	6'-0"	40.49	40.49	40.49	40.49
400	3.64	2.22	n/a	5.87	6'-0"	6'-0"	40.49	40.49	40.49	40.49
500	3.85	2.11	n/a	5.96	6'-0"	6'-0"	37.29	37.29	37.29	37.29
650	3.58	2.23	n/a	5.81	6'-0"	6'-0"	32.50	32.50	32.50	32.50
PC 722.33	4.13	2.03	0.00	6.16	6'-2"	6'-2"	31.25	31.25	31.25	31.25
850	4.22	2.02	0.50	6.74	6'-3"	6'-9"	28.83	29.33	28.83	29.33
PI 979.98	4.18	2.02	1.00	7.20	6'-3"	6'-3"	26.29	27.29	26.29	27.29
1096.94									24.00	
1100	4.18	2.02	0.53	6.73	6'-3"	6'-3"	23.94	24.44	24.00	24.44
1118.98									24.00	24.00
PT1237.60	4.19	2.02	0.00	6.21	6'-3"	6'-3"	21.25	21.25	24.00	24.00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 2 OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY STF DATE 9-92

WALL Depth

STA	Channel Invert	Channel Wall Elev. Inside	Channel Wall Elev. Outside	Depth of the Wall Inside	Depth of the Wall Outside
319					
400	34.49	40.49	40.49	6'-0"	6'-00"
650	26.50	32.50	32.50	6'-0"	6'-00"
722.33 PC	25.08	31.25	31.25	6'-2"	6'-2"
850	22.59	28.83	29.33	6'-3"	6'-8.88"
979.98 PI	20.04	26.29	27.29	6'-3"	7'-3"
1096.94	17.75	24.00	24.55	6'-3"	6'-9.6"
1100	17.69	24.00	24.44	6'-3.72"	6'-9"
1118.98	17.32	24.00	24.00	6'-8.16"	6'-8.16"
1237.60	15.00	24.00	24.00	9'-0"	9'-00

3.96% .9570%

121, Fig 1.7

SUPERELEVATION CALCULATION

Avrage velocity (V):	15.86 fps
Bottom width (b):	40 feet
Maximum height above depth (S):	1 feet
Gravity acceleration (G):	32.2 fps2
Radius of curve (R):	374.9658 feet

SECT: 979.98

FREEBOARD CALCULATION

Avrage Velocity (V):	15.86 fps
Depth of flow (Y):	4.18 feet
Freeboard required (FB)	2.021473 feet
Channel Depth (D):	6.201473 feet

SECT: 979.98

11-Aug-92 10:50 AM CAPS

F16: 12.92 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	12.92 fps
Depth of flow (Y):	5.17 feet
Freeboard required (FB)	1.940506 feet
Channel Depth (D):	7.110506 feet

319

11-Aug-92 10:54 AM NUM CAPS

F16: 18.4 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	18.4 fps
Depth of flow (Y):	3.64 feet
Freeboard required (FB)	2.224285 feet

400

4

F23: 18.4 READY

	A	B	C	D	E	F	G	H
15								
16								
17								
18								
19								
20								
21								
22		FREEBOARD CALCULATION						
23		Avrage Velocity (V):				18.4 feet		
24		Depth of flow (Y):				3.64 feet		
25		Freeboard required (FB)				2.224285 feet		
26		Channel Depth (D):				5.864285		
27								
28								
29								
30								
31								
32								
33								
34								

400

11-Aug-92 11:33 AM NUM

G25: 'feet READY

	A	B	C	D	E	F	G	H
15								
16								
17								
18								
19								
20								
21								
22		FREEBOARD CALCULATION						
23		Avrage Velocity (V):				17.22 feet		
24		Depth of flow (Y):				3.85 feet		
25		Freeboard required (FB)				2.113619 feet		
26		Channel Depth (D):				5.963619 feet		
27								
28								
29								
30								
31								
32								
33								
34								

500

11-Aug-92 11:33 AM NUM

F25: 0.25*(F24+(F23^2/64.4)) READY

	A	B	C	D	E	F	G	H
15								
16								
17								

19 ~~Channel Depth (D): 5.864285 feet~~ 400

11-Aug-92 10:55 AM NUM CAPS

F16: 18.55 READY

A B C D E F G H

14 FREEBOARD CALCULATION

16 Avrage Velocity (V): 18.55 fps
17 Depth of flow (Y): 3.58 feet
18 Freeboard required (FB) 2.230801 feet
19 Channel Depth (D): 5.810801 feet

650

11-Aug-92 10:55 AM NUM CAPS

F16: 16.02 READY

A B C D E F G H

14 FREEBOARD CALCULATION

16 Avrage Velocity (V): 16.02 fps
17 Depth of flow (Y): 4.13 feet
18 Freeboard required (FB) 2.028774 feet
19 Channel Depth (D): 6.158774 feet

722.33

6

11-Aug-92 10:56 AM NUM CAPS

F16: 15.73 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	15.73 fps
Depth of flow (Y):	4.22 feet
Freeboard required (FB)	2.015531 feet
Channel Depth (D):	6.235531 feet

850

11-Aug-92 10:58 AM NUM CAPS

F16: 15.85 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	15.85 fps
Depth of flow (Y):	4.18 feet
Freeboard required (FB)	2.020242 feet
Channel Depth (D):	6.200242 feet

979.98

11-Aug-92 10:58 AM NUM CAPS

F16: 15.86 READY

7

	A	B	C	D	E	F	G	H
10								
11								
12								
13								
14		FREEBOARD CALCULATION						
15								
16		Avrage Velocity (V):				15.86 fps		
17		Depth of flow (Y):				4.18 feet		
18		Freeboard required (FB)				2.021473 feet		
19		Channel Depth (D):				6.201473 feet		
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

1100

11-Aug-92 10:59 AM NUM CAPS

F16: 15.83 READY

	A	B	C	D	E	F	G	H
10								
11								
12								
13								
14		FREEBOARD CALCULATION						
15								
16		Avrage Velocity (V):				15.83 fps		
17		Depth of flow (Y):				4.19 feet		
18		Freeboard required (FB)				2.020282 feet		
19		Channel Depth (D):				6.210282 feet		
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

1237

11-Aug-92 10:59 AM NUM CAPS

F25: READY

	A	B	C	D	E	F	G	H
20								
21								
22								
23								
24								
25								
26								

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook hill Outlet PAGE 8 OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY DATE

EXISTING CONDITION ELEVATIONS: @ ℄

4+23	33	P
4+35	32	
+45	31	
+84	30	
5+19	29	
+44	28	
+99	27	
6+85	26	
7+34	25	
8+05	24	
+70	23	
9+35	22	
+89	21	
10+66	20	
+90	20	
11+18	19	
11+98	18	
12+80	17	

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 9 OF

DETAIL COMPUTED BKH DATE 8-92

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PROPOSED CONDITION

			slope	Distance Lt	Rt	℄
	3+19	36.80		"	"	81
	4+00	34.49	2.8519%	"	"	100
	5+00	31.29	3.1960%	"	"	150
	6+50	26.50		"	"	72.33
PC	7+22.33	25.08		121.06	134.28	127.67
	8+50	22.59	1.9570%	123.25	136.71	129.98
PI	9+79.98	20.04		113.80	126.24	120.02
	11+00	17.69		130.47	144.73	137.60
	12+37.60	15.00		"	"	0

Table 3.--*Values of Manning's n for flood plains*

[Modified from Chow, 1959]

Description	Minimum	Normal	Maximum
Pasture, no brush:			
Short grass	0.025	0.030	0.035
High grass	.030	.035	.050
Cultivated areas:			
No crop	.020	.030	.040
Mature row crops	.025	.035	.045
Mature field crops	.030	.040	.050
Brush:			
Scattered brush, heavy weeds	.035	.050	.070
Light brush and trees, in winter	.035	.050	.060
Light brush and trees, in summer	.040	.060	.080
Medium to dense brush, in winter	.045	.070	.110
Medium to dense brush, in summer	.070	.100	.160
Trees:			
Dense willows, summer, straight	.110	.150	.200
Cleared land with tree stumps, no sprouts	.030	.040	.050
Same as above, but heavy growth off sprouts	.050	.060	.080
Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	.080	.100	.120
Same as above, but with flood stage reaching branches	.100	.120	.160

Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona

APPENDIX 5.8

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF

DETAIL CUT-OFF WALL COMPUTED BKH DATE 8-92

CHECKED BY SH DATE 9/92

Using "Designe of Open Channel, TR-25" Method:

PI = 12.3 from Fig. 6.2

V_B = 3.85 fps

For Q = 100 cfs

V_m = 4.36 FPS

Y = .57 ft depth

d_s = depth of Scour

$$d_s = Y\left(\frac{V_m}{V_B} - 1\right)$$

$$d_s = 0.56\left(\frac{4.36}{3.85} - 1\right) = 0.07 \text{ ft}$$

For a more Conservative Way, We assume a Sediment Free Flow Condition

V_B = 2.35

$$d_s = 0.56\left(\frac{4.36}{2.35} - 1\right) = 0.30'$$

Use 1.5 for Safety factor

$0.30' \times 1.5 = 0.45'$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 2 OF

DETAIL Cut-off Wall COMPUTED BKH DATE 8-92

CHECKED BY SH DATE 9/92

Using Tractive Force Method of analysis:

$\tau = \gamma R S$

τ = Tractive force lb/ft²

γ = Unit weight of water 62.4 lb/ft³

S = Gradient Energy

R = Hydraulic Radius $\frac{A}{P_w}$

Problem:

$R = 0.56$

$S = 0.019$ ft/ft.

$d_5 = 0.005$ ft.

$V = 5$ ft/sec

$\tau_{actual} = \gamma R S$

$\tau_A = 62.4 \times 0.56 \times 0.019 = 1.$

$\tau_A = 0.66$ lb/ft²

Use 1.5 as S.F.

$\tau_A = 0.66 \times 1.5 = 0.99$ lb/ft²

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 3 OF

DETAIL Cut-Off Wall COMPUTED BKH DATE 8-92

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From Fig. 4, Pg 11 of "Computing Degradation and Local Scour" by Ernest L. Pemberton & Joseph M. Lara, Technical Guideline for Bureau of Reclamation

τ_c = Critical Tractive force

$\tau_c = 0.048$ lb/ft²

$$d_s = R\left(\sqrt{\frac{\tau_o}{\tau_c}} - 1\right)$$

$$d_s = 0.56\left[\sqrt{\frac{0.99}{0.048}} - 1\right] = 1.97'$$

$d_s \approx 2'$

Use 5' to get to the rock.

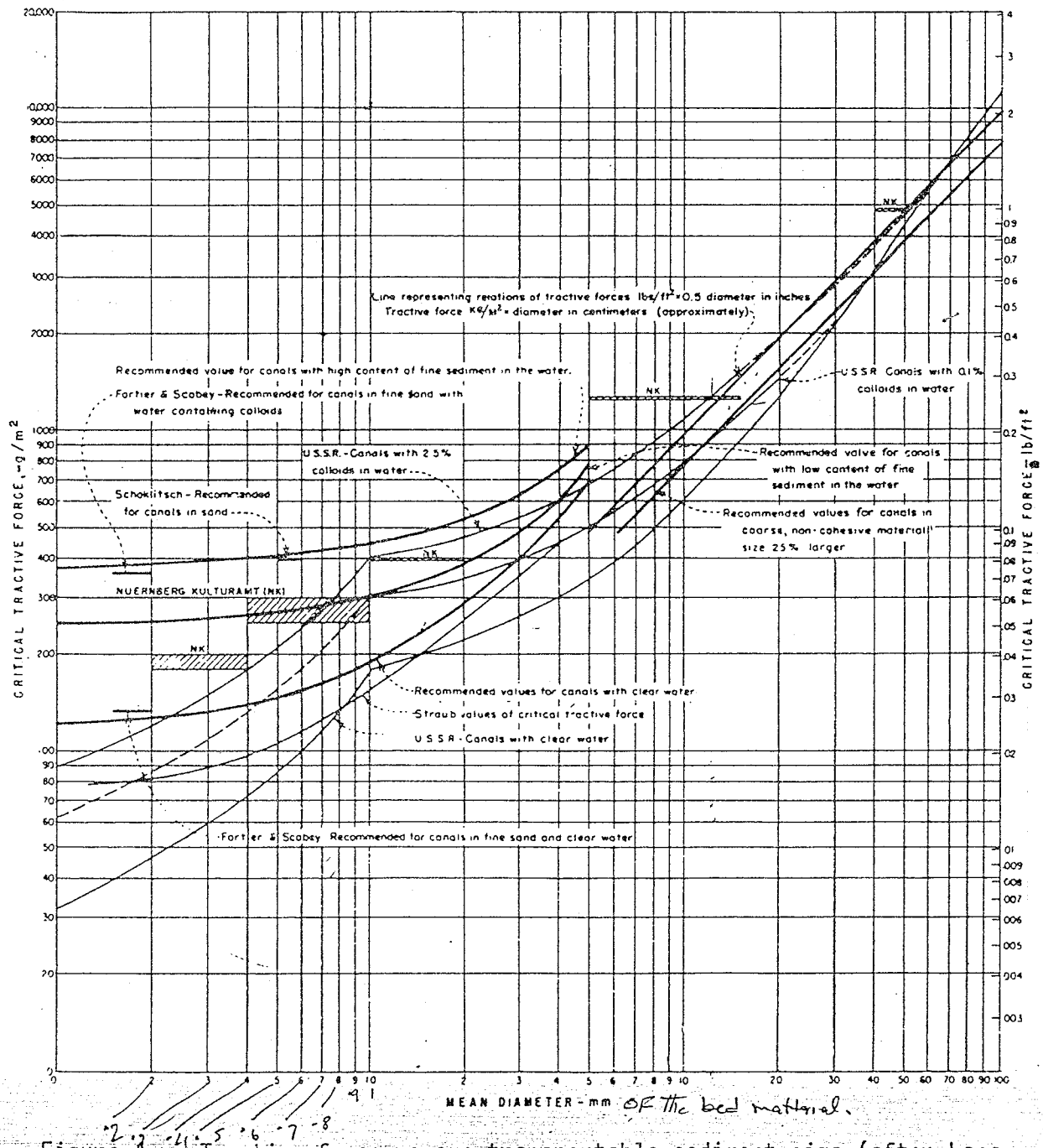

Figure 4. - Tractive force versus transportable sediment size (after Lane, 1952).

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 5 OF

DETAIL Cut-Off Wall COMPUTED BKH DATE 8-92

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D50 Calculation

$\tau_A = \gamma K S = 62.4 \times 0.56 \times 0.019 = 0.66'$

Use 1.5 for S.F.

$\tau_A = 0.66 \times 1.5 \approx 1$ lb/ft²

$\tau_c = 0.04 (\gamma_s - \gamma_w) d_{50}$

$\tau_A = \tau_c$

$1 = 0.04 (165 - 62.4) d_{50}$

$d_{50} = 0.24' \approx 3''$

Use nearest $d_{50} = 6''$

APPENDIX C

CHANNEL RETAINING WALL

TYPICAL SECTION

STRUCTURAL DESIGN:

Channel walls are basically designed as cantilever retaining walls of varying heights, with grouted riprap section between the channel walls. AASHTO standard specifications for highway bridges with applicable live loads is used for design.

Concrete used is Class AA, compressive strength 4000 psi.Reinforcing steel shall conform to ASTM specifications A615 Grade 60.

Existing wing walls, footings, apron and cutoff walls to be removed before the new channel construction. Dowels from existing box to remain in place and to be doweled into the new wing wall.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 1 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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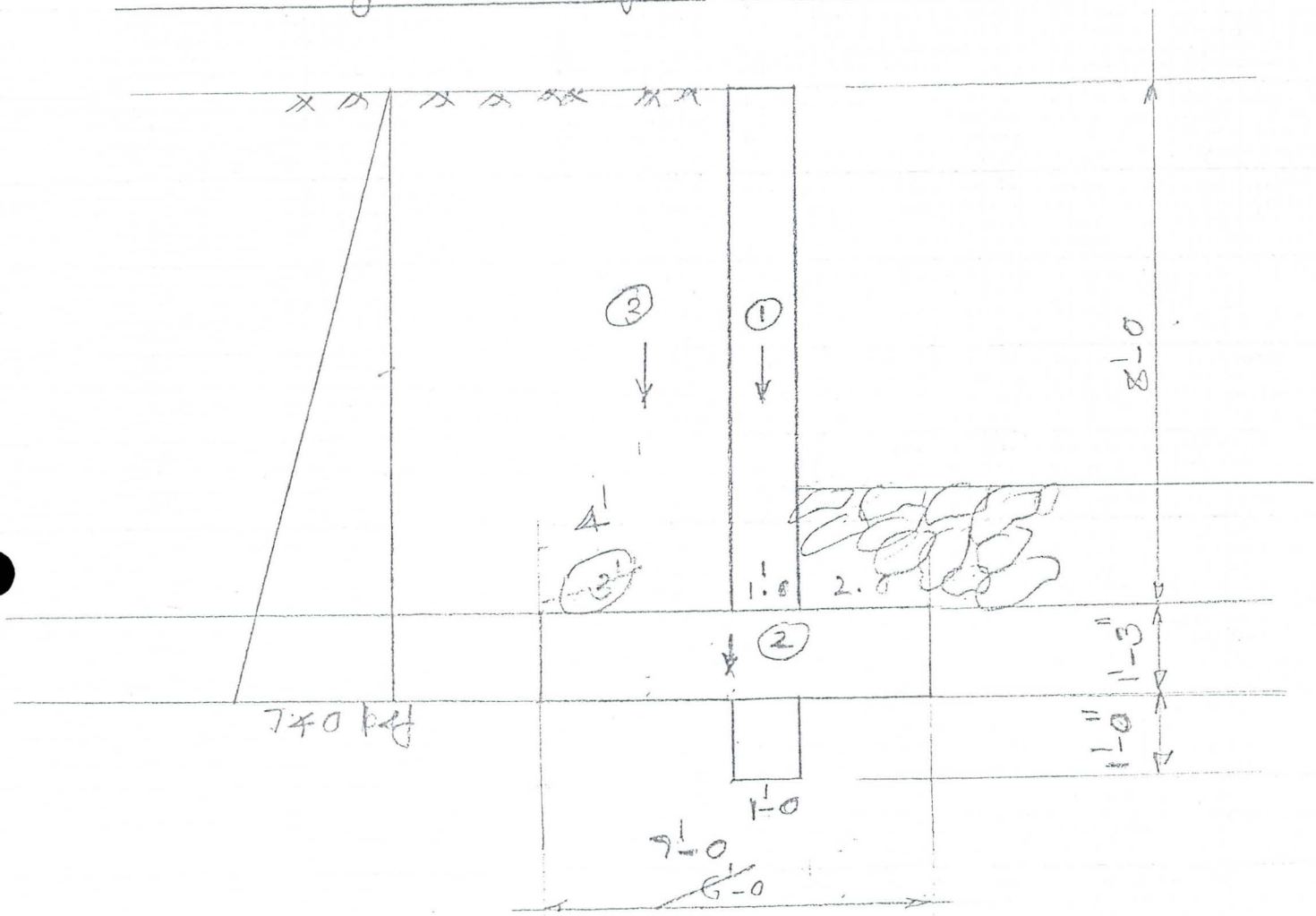
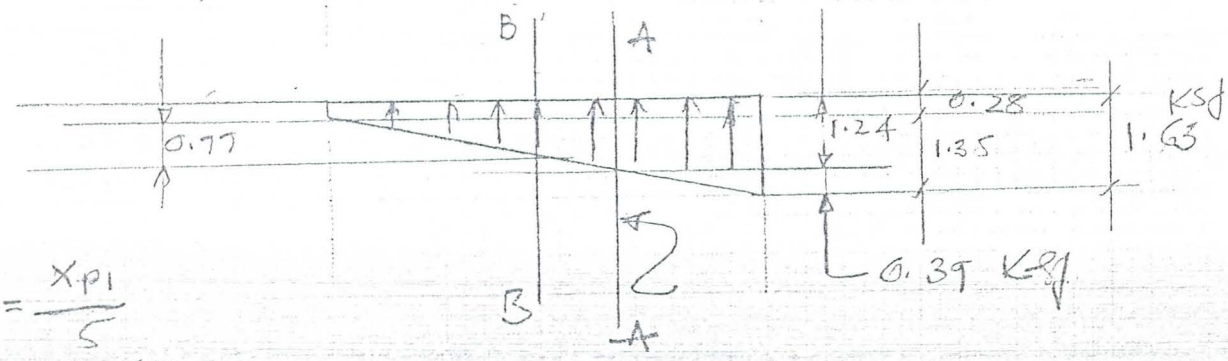
Case 1

Submerged Backfill





$\frac{1.35}{7.0} = \frac{X_{p1}}{5}$

$X_{p1} = 0.96$ Ksf

$(0.96 + 0.28) = 1.24$ Ksf

$(1.63 - 1.24) = 0.39$

$\frac{X_{p2}}{4.0} = \frac{1.35}{7.0}$, $X_{p2} = 0.77$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 2 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/9

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1) Using Submerged Condition:

Wt of wet soil = 130 pcf

Wt. of Water = 62.4

Wt. of Submerged Soil = 67.6

Using K = 0.33

$P_r = wKh = (67.6 \times 0.33 \times h) = 22.3$ pcf

water pr = 62.4

84.7

use 80 to 85 pcf.

$P_r = (80 \times 9.25) = 740$ pcf

$P = (\frac{740}{2} \times 9.25) = 3.43^K$

$M_{O.T} = 3.43 \times 9.25/3 = 10.6$ kft

Stabilizing Moment

$W_1 = (8.0 \times 1.0 \times 0.15) = 1.20^K$

$W_2 = (6.0 \times 1.25 \times 0.15) = 1.13$

W_3 (Soil) $= (3.0 \times 8.0 \times 0.13) = 3.12$

5.45 K

$M_{stb} = (1.2 \times 2.5) + (1.13 \times 3.0) + (3.12 \times 4.5) = 20.43$

$F.S = (\frac{20.43}{10.6}) = 1.93$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 3 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

CHECKED BY DATE

Check Sliding:

Sliding force = P = 3.43 K

Frictional force = μN = 0.4 x 5.45 = 2.18 K

< 3.43 K

∴ use a Key &
Increase Heel to 4'-0 to
get some additional wt.

Try Footing width = 7'-0

Stabilizing Moment:

W_1 = 1.20 K

W_2 = (7.0 x 1.25 x 0.15) = 1.31

W_3 = (4.0 x 8.0 x 0.13) = 4.16

6.67 K

M_{STB} = (1.2 x 2.5) + (1.31 x 7.0/2) + (4.16 x 5.0)

= 28.4 K'

F.S = (28.4 / 10.6) = 2.7

Sliding Check:

Frictional Force = μN = 0.4 x 6.67 = 2.7 K

Sliding Force P = 3.43 > 2.7 K

Still need a Key for the Base Slab

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 4 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

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Footing pressure: 7' wide

$M_{STB} = 28.4^{kft}$, $N = 6.67^{k}$

$M_{OT} = 10.6$,

X_R = Dist. of Resultant $= \frac{(28.4 - 10.6)}{6.67}$

$= 2.67'$

$b/3 = \frac{7.0}{3} = 2.33$, within Mid Third

$e = (b/2 - X_R) = (3.5 - 2.67) = 0.83'$

$< \frac{b}{6} = 1.17'$

$P_r = \frac{6.67}{7 \times 1}\left(1 \pm \frac{6 \times 0.83}{7}\right)$

$= 0.953\,(1 \pm 0.71)$

$P_r(max) = 1.63\ ksf$ $P_r(Min) = 0.28$

Toe Design:

a) UDL : $(1.24 \times 2) = 2.48^{k}$

b) Triangular: $\left(\frac{0.39}{2} \times 2.0\right) = 0.39^{k}$

Neglecting the footing wt.

$M_{AA} = \left(2.48 \times \frac{2}{2}\right) + \left(0.39 \times \frac{2}{3} \times 2\right) = 3.0^{kft}$

$M_u = (3.0 \times 1.3) = 3.9^{kft}$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 5 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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Toe Steel:

$M_u = 3.9^{k'}$

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{3.9 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.011$$

from Table 9-2, Read $\omega = 0.012$

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.012 \times 3.0}{60} = 0.0006$$

$\rho_{req} = 0.001$

$A_s = 0.001 \times 12 \times 11.5 = 0.14 \text{ in}^2$

$\rho_{min} = 200/f_y = 200/60000 = 0.0033$

(Grade 60) $A_s = (0.0033 \times 12 \times 11.5) = 0.46 \text{ in}^2$

Reqd Reinf: $1.33(0.14) = 0.19 \text{ in}^2$

use #4 @ 9", $A_s = 0.27$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sprook Hill outlet PAGE 6 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

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Heel Design

unif: $(0.28 \times 4.0) = 1.12^{K}$

Triangular: $\left(\frac{0.77}{2} \times 4.0\right) = 1.54^{K}$

Soil wt: $(8 \times 1)\,0.13 = 1.04\ K/ft$

Conc. wt: $(1.25 \times 0.15) = 0.19\ K/ft$

$$M_{BB} = \left(1.04 \times 4 \times \frac{4}{2}\right) + \left(0.19 \times 4 \times \frac{4}{2}\right) - \left(1.12 \times \frac{4}{2}\right) - \left(1.54 \times \frac{1}{3} \times 4\right)$$

$$= 5.55\ ^{K'}$$

$$M_u = 1.3(5.55) = 7.22\ ^{K'}$$

$$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{7.22 \times 12}{0.9 \times 3.0 \times 12 \times 12.5^2}\right) = 0.017$$

$d = (15 - 2 - 0.5)$
$= 12.5''$

from Table 9-2, $\omega = 0.018$

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.018 \times 3.0}{60}\right) = 0.001$$

$$A_s = 0.001 \times 12 \times 12.5 = 0.15\ in^2$$

$$\rho_{min} = \frac{200}{f_y} = 0.0033,$$

$$A_s = 0.0033 \times 12 \times 12.5 = 0.5\ in^2$$

or $1.33\,A_s = 1.33 \times 0.15 = 0.2\ in^2$

Use #5 @ 9", $A_s = 0.41$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Retaining Wall COMPUTED KVH DATE 8/92

CHECKED BY DATE

Stem Design:

$P_r = wKh = (80 \times 8) = 640$ lbs

$M_{stem} = \left(\frac{0.64}{2} \times 8.0\right)\frac{8}{3} = 6.83$ kft

$M_u = (6.83 \times 1.3) = 8.9$ kft

$d = (12 - 2 - 0.5) = 9.5''$

$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{8.9 \times 12}{0.9 \times 3.0 \times 12 \times 9.5^2}\right) = 0.037$

from Table 9-2, $\omega = 0.038$

$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.038 \times 3.0}{60}\right) = 0.0019$

$A_s = (0.0019 \times 12 \times 9.5) = 0.21$ in^2

$A_{s\,min} = (0.0033 \times 12 \times 9.5) = 0.38$ in^2

#5 @ 8", $A_s = 0.47$

or $1.33\, A_s = 1.33 \times 0.21 = 0.28$

use #5 @ 8", $A_s = 0.47$

For 9' wall #5 @ 6", $A_s = 0.62$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 8 OF

DETAIL COMPUTED KVH DATE 8/92

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Stem Design:

Check using 10" wall thickness:

$M_u = (6.83 \times 1.3) = 8.9$ kft

$d = (10 - 2 - 0.5) = 7.5''$

$\frac{M_u}{\phi f'_c b d^2} = \frac{(8.9 \times 12)}{0.9 \times 3.0 \times 12 \times 7.5^2} = 0.059$

Read $\omega = 0.061$ from Table 9-2

$\rho = \frac{\omega f'_c}{f_y} = \frac{(0.061 \times 3.0)}{60} = 0.0031$

$\rho_{min} = (0.0033 \times 12 \times 7.5) = 0.30 \text{ in}^2$

$\rho = (0.0031 \times 12 \times 7.5) = 0.28 \text{ in}^2$

#5 @ 12" used before is still ok

10" Stem wall is ok, but

Better to use 12" wall to have some

Factor of Safety against overturning

and Sliding.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill out Lot PAGE 9 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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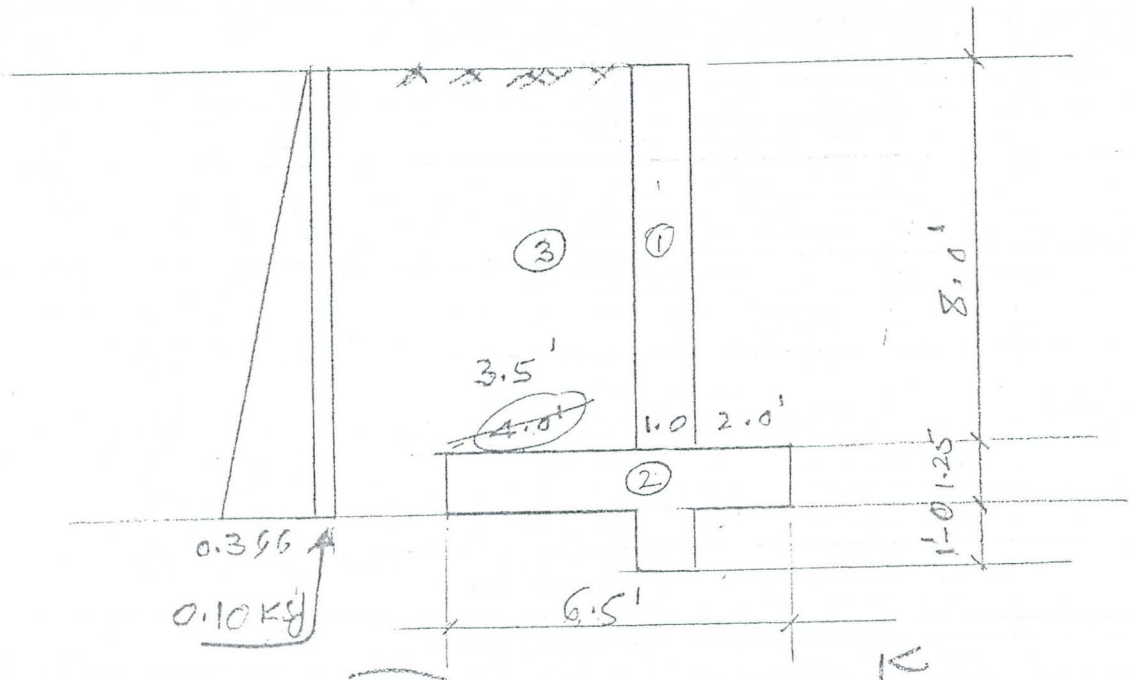
Case 2

Dry Backfill & 2' Surcharge

$P_{H_1} = wKh = (0.12 \times 0.33 \times 9.25) = 0.366$ ksf

Assuming Surcharge = 2'

$P_{H_2} = (0.12 \times 0.33 \times 2) = 0.079$ ksf, say 0.1 ksf



$P_1 = \left(\frac{0.366}{2} \times 9.25\right) = 1.7^{K}$

$P_2 = (0.1 \times 9.25) = 0.93$

$M_{OT} = \left(1.7 \times \frac{9.25}{3}\right) + \left(0.93 \times \frac{9.25}{2}\right) = 9.54$ k-ft

M_{STB}:

$W_1 = (1.0 \times 8.0 \times 0.15) = 1.20^{K}$

$W_2 = (6.5 \times 1.25 \times 0.15) = 1.22$

$W_3 = (3.5 \times 8.0 \times 0.12) = 3.36$

5.78

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sponk Hill outlet PAGE 10(A) OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

8'-0 High Sect^n CHECKED BY DATE

$M_{STB} = (1.20 \times 2.5) + (1.22 \times \frac{6.5}{2}) + (3.06 \times 4.75)$

$= 22.93$ k/ft

$F.S = (22.93 / 9.54) = 2.4$

Sliding Check:

Frictional Force $= \mu N = 0.4 \times 5.78 = 2.3^K$

Sliding Force $= (1.7 + 0.93) = 2.63^K$

> 2.3 ∴ Use a Base Slab Key

Check Stem Moment:

$P_{r_1} = (0.12 \times 0.33 \times 8) = 0.317$ Kgf

$P_{r_2} = 0.1$ Kgf

$P_1 = (\frac{0.317}{2} \times 8) = 1.27^K$

$P_2 = (0.10 \times 8) = 0.8^K$

$M_{Stem} = (1.27 \times \frac{8}{3}) + (0.8 \times \frac{8}{2}) = 6.59$ kft

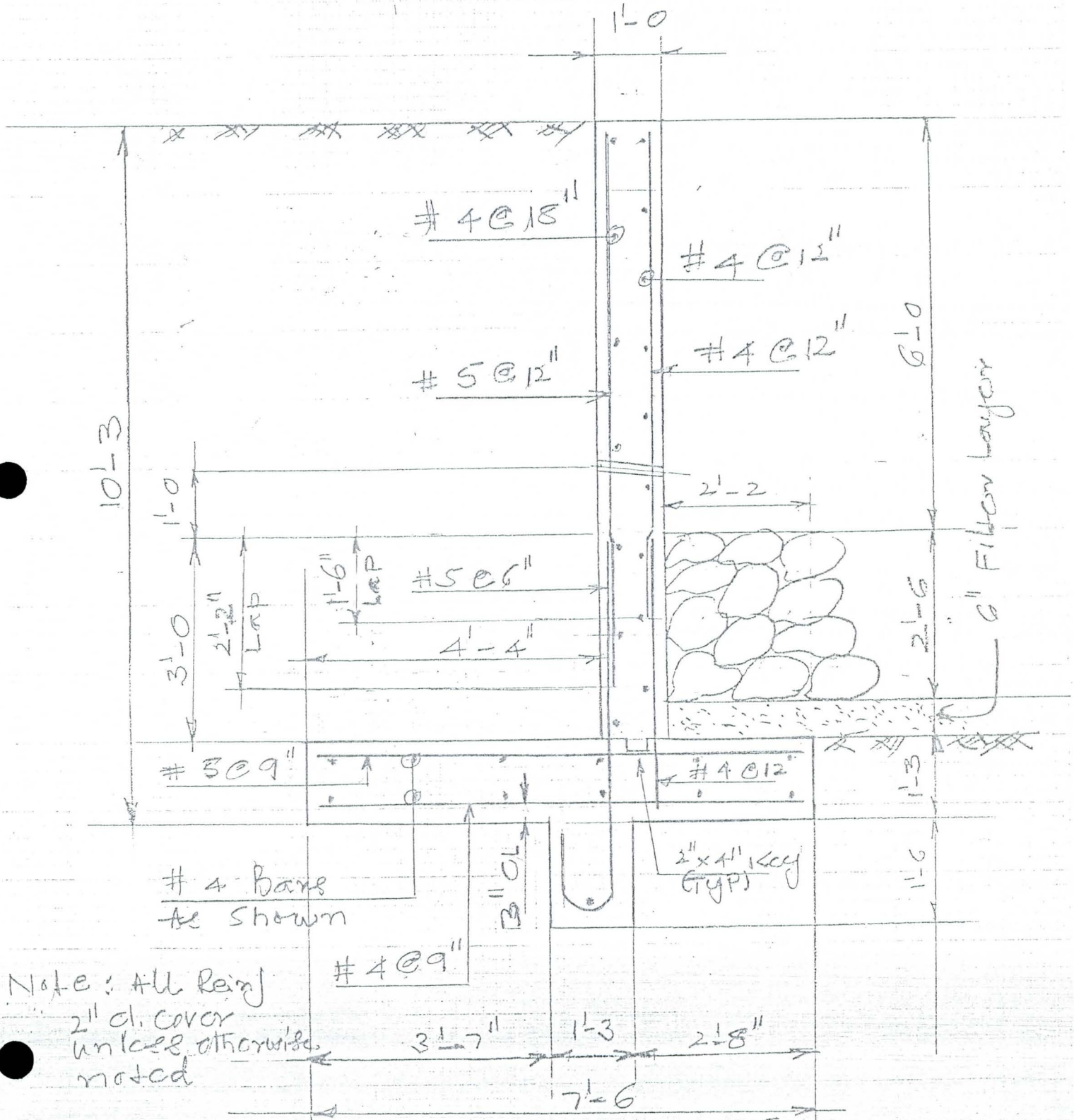
< 6.83 kft (Used for Design under Submerged Cond.)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 10(B) OF

DETAIL 6' Wall Section COMPUTED KJH DATE 8/72

Type 1 Wall CHECKED BY DATE



Note: All Reinf 2" cl. cover unless otherwise noted

Type 1 Wall Section

1/2" = 1'-0

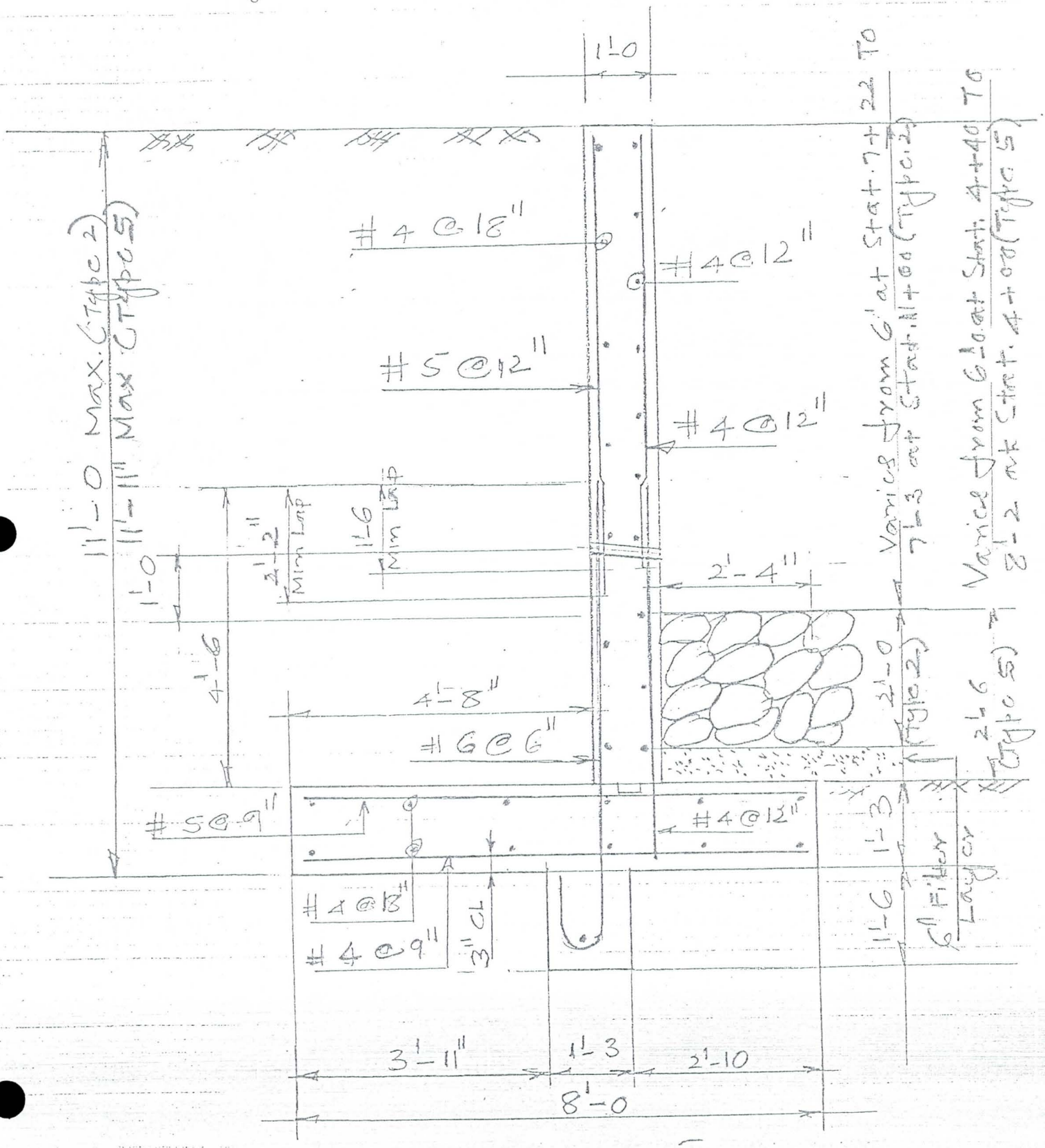
Stat. 440 to 722.3

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 10(c) OF

DETAIL 7'-3 Wall Section COMPUTED KVH DATE 8/92

Type 2 Wall CHECKED BY DATE



TYPE-2 AND TYPE-5 WALL SECTION

Scale 1/2" = 1'-0

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PROJECT Spook Hill outlet PAGE 11 OF

DETAIL @ Transition COMPUTED KVH DATE 7/92

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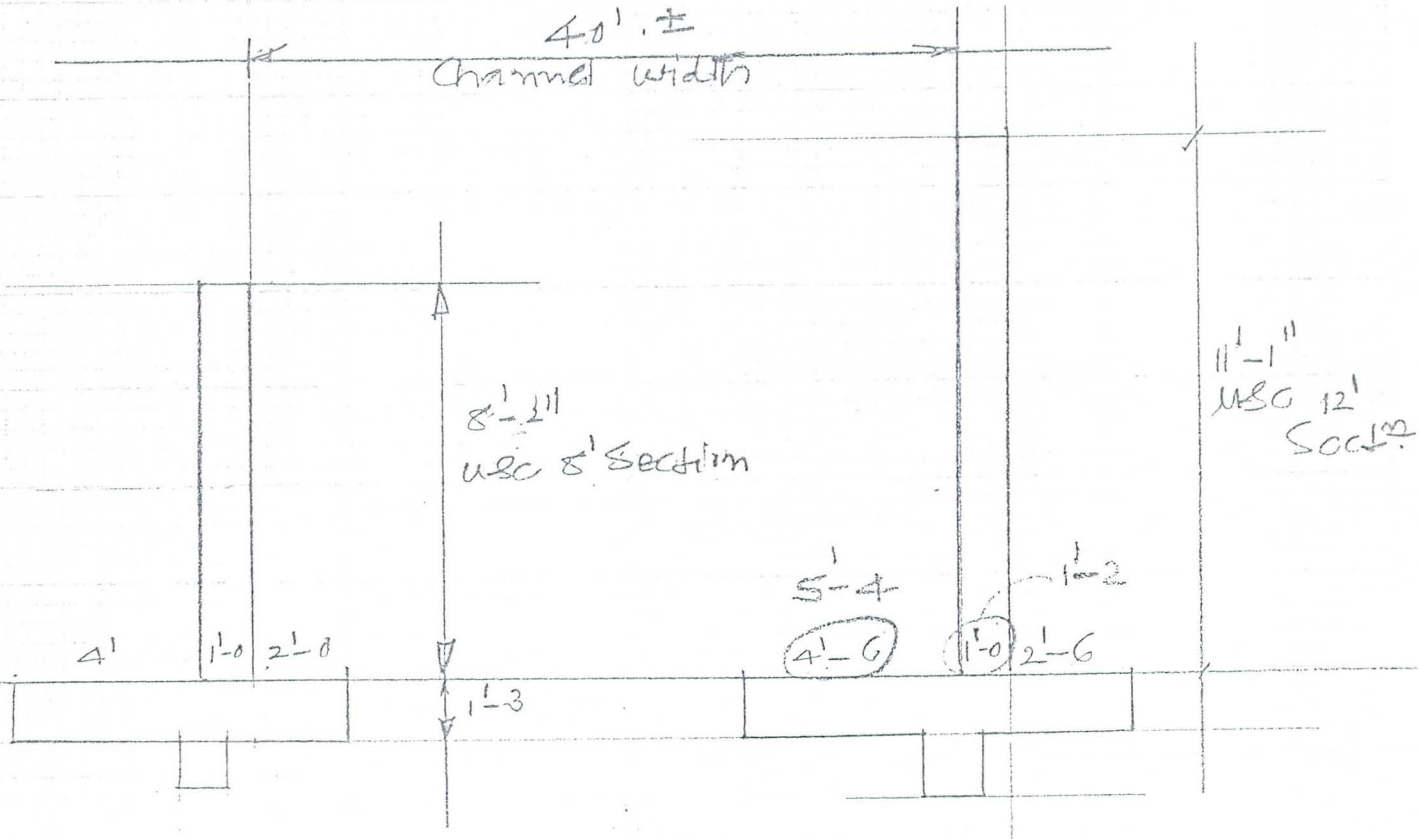
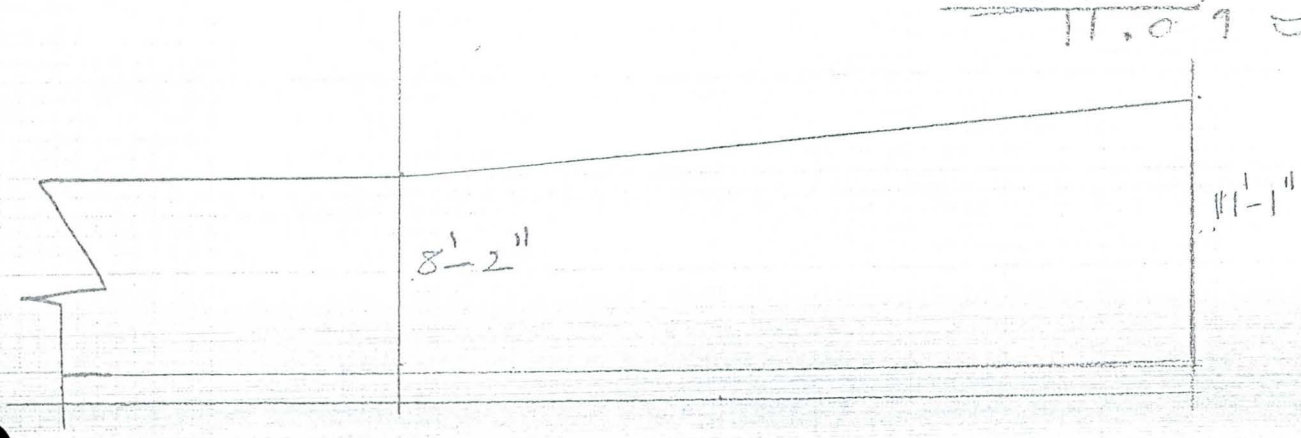


Section at outlet

1/4" = 1'-0

1342.10
1333.91
18.19 ≅ 8'-2

1345.58
1334.49
11.09 ≅ 11'-1



Elevation View
Transition from High Wall to Regular Sec

1/8" = 1'-0

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PROJECT Stock Hill outlet PAGE 12 OF

DETAIL 12' High Wall COMPUTED KVH DATE 7/92

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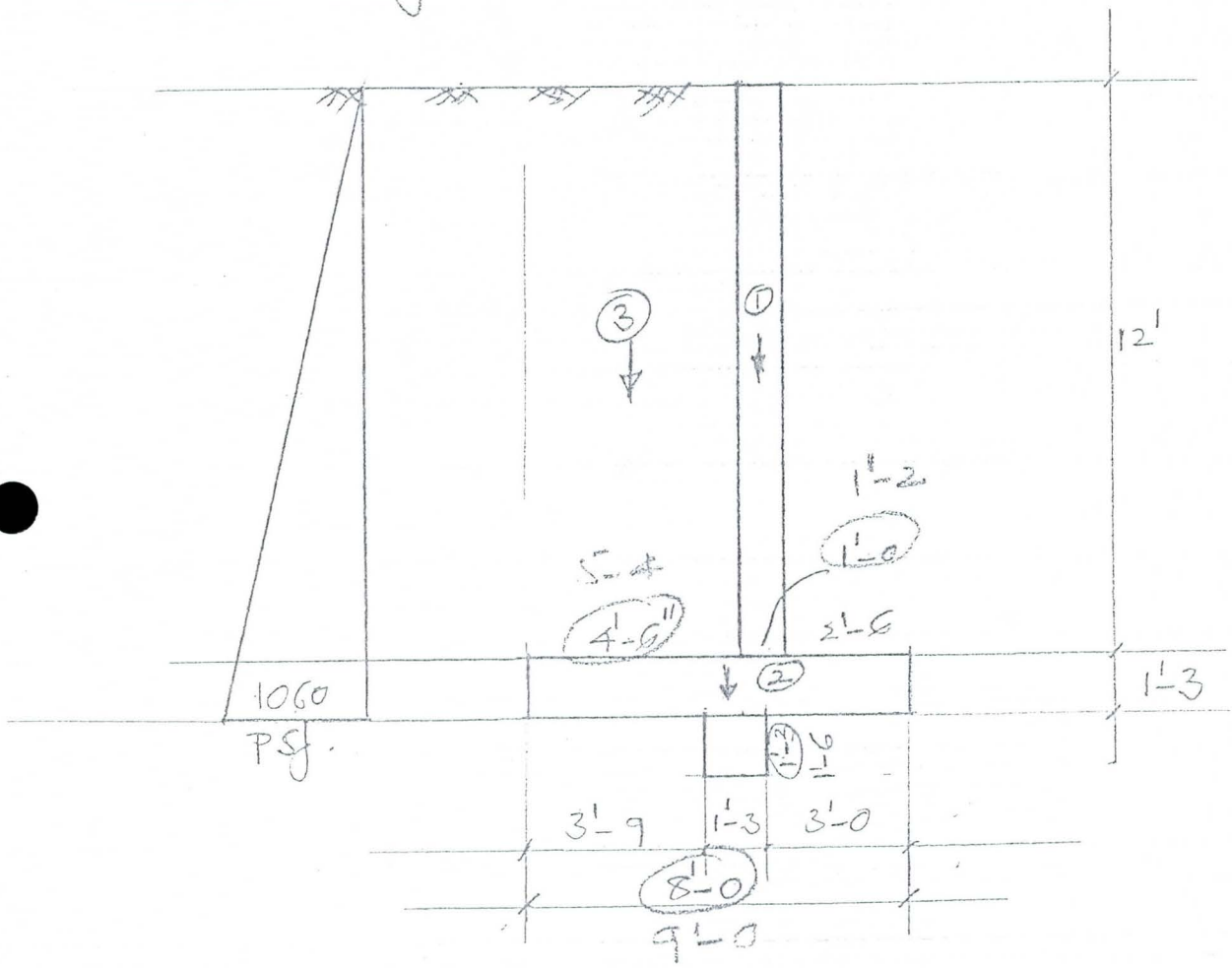
Case 1

Submerged Condition



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 13 OF

DETAIL 12' High Wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

Check for Submerged Condition

Footing width = 8'

Using Equivalent fluid pr. of 80 pcf

$pr = wkh = (80 \times 13.25) = 1060$ psf

$P = \left(\frac{1060}{2} \times 13.25\right) = 7.03^K$

$M_{OT} = \left(7.03 \times \frac{13.25}{3}\right) = 31.1^{K'}$

Stabilizing Moment:

$w_1 = (12.0 \times 1.0 \times 0.15) = 1.8^K$

$w_2 = (8.0 \times 1.25 \times 0.15) = 1.5$

$w_3 = (4.5 \times 12 \times 0.13) = 7.02$

10.32^K

$M_{STB} = (1.8 \times 3) + (1.5 \times 4.0) + (7.02 \times 5.75) = 51.8^{K'}$

$FS = \left(\frac{51.8}{31.1}\right) = 1.7$

Sliding Check:

Frictional Force $= \mu N = 0.4 \times 10.32 = 4.13^K$

Sliding Force $= 7.03^K > 4.13^K$

Use a Key for Base Slab.

However Sliding force of 7.03^K is very high since 80 pcf Equiv. fluid pr is used. wall will not slide because of Grouted Riprap on the inside of the channel wall. Also use weep holes to keep the water pr. to a minimum

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DETAIL 12' Retaining wall COMPUTED KVH DATE 9/92

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Check Footing Pressure: (8' footing width)

$M_{STB} = 51.8$ K'ft, $M_{OT} = 31.1$ K'ft, $N = 10.32$ K

x_R = Dist. of Resultant $= (51.8 - 31.1)/10.32 = 2.01'$

$b/3 = 8.0/3 = 2.67'$

$e = (b/2 - x_R) = (4.0 - 2.01) = 1.99'$

$b/6 = 1.33$ $\quad e > \frac{b}{6}$ ∴ Resultant outside the middle third.

$\frac{L'}{3} = (\frac{L}{2} - e)$

$L' = 3.(\frac{L}{2} - e) = 3(4 - 1.99) = 6.03$

$q_{max} = \frac{2P}{BL'} = \left(\frac{2 \times 10.32}{1 \times 6.03}\right) = 3.43$ KSF

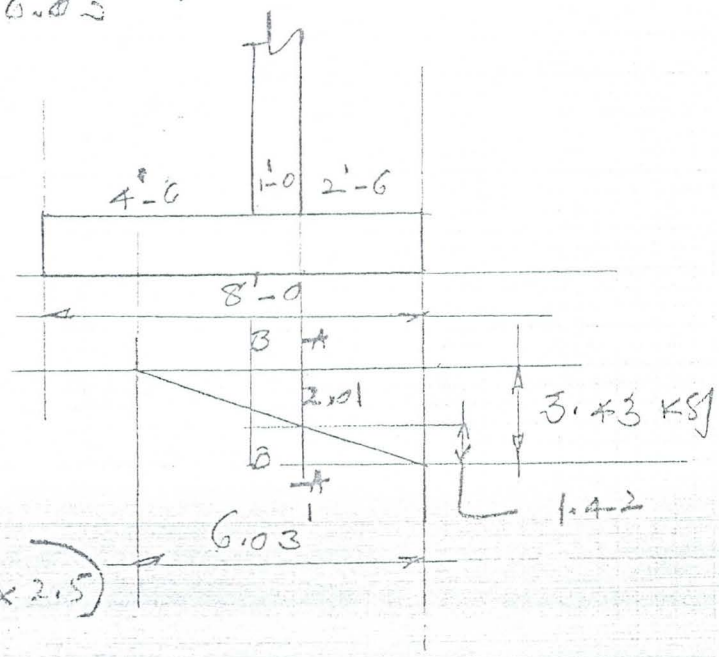
Toe Design

$\frac{3.43}{6.03} = \frac{q_1}{3.53}$

$q_1 = 2.01$ KSF

$P_1 = (2.01 \times 2.5) = 5.03$ K

$P_2 = (\frac{1.42}{2} \times 2.5) = 1.78$ K



Neglecting footing wt:

$M_{AA} = (5.03 \times \frac{2.5}{2}) + (1.78 \times \frac{2}{3} \times 2.5)$

$= 9.3$ K'ft

$M_u = 1.3(9.3) = 12.1$ K'ft

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL 12.1 Retaining Wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

Toe Design (Cont'd) (8' Footing width)

$M_u = 12.1$

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{12.1 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.034$$

Read $\omega = 0.035$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{(0.034 \times 3.0)}{60} = 0.0017$$

$$\rho_{min} = \frac{200}{f_y} = \frac{200}{60\,000} = 0.0033$$

$A_s = (0.0017 \times 12 \times 11.5) = 0.24\ in^2$

$A_s(min) = (0.0033 \times 12 \times 11.5) = 0.46$

or $1.33\ A_s = (1.33 \times 0.24) = 0.32$

Since wall th. varies, use #6 @ 9", $A_s = 0.59$

Heel Design:

Neglecting upward Soil pr. on the Heel:

Soil wt $= (12 \times 0.13) = 1.56$ k/ft

Conc. Ftg $= (1.25 \times 0.15) = 0.19$

$M_{13B} = \left(1.56 \times \frac{4.5^2}{2}\right) + \left(0.19 \times \frac{4.5^2}{2}\right) = 17.72$ k-ft

$M_u = 1.3\,(17.72) = 23.04$ k-ft

$d = (15 - 2 - 0.5) = 12.5''$ or

$d = (15 - 3 - 0.5) = 11.5''$ with 1" clearance to Standard Ke

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 16 OF

DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

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8' Footing width

$$\frac{M_u}{\phi f'_c b d^2} = \frac{23.04 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.065$$

Read $\omega = 0.068$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.068 \times 3.0}{60.0} = 0.0034$$

$$\rho_{min} = \frac{200}{f_y} = 0.0033$$

$$A_s = (0.0034 \times 12 \times 11.5) = 0.47 \text{ in}^2$$

#6 @ 9", $A_s = 0.59$ OR

#7 @ 9" $A_s = 0.80$

Try 9'-0 Footing width to have a little more F.S. in sliding & reduce soil. pr a little

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL 12' High wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

Try Footing width = 9'-0

Using Equiv. Fluid pr = 80 pcf

$P_r = wKh = (80 \times 13.25) = 1060$ psf

$P = \left(\frac{1060}{2} \times 13.25\right) = 7.03^K$

$M_{OT} = \left(7.03 \times \frac{13.25}{3}\right) = 31.1$ KFt

Stabilizing Mom:

$W_1 = (1.0 \times 12.0 \times 0.15) = 1.80^K$

$W_2 = (9.0 \times 1.25 \times 0.15) = 1.69$

$W_3 = (5.5 \times 12.0 \times 0.13) = 8.58$

12.07^K

$M_{STB} = (1.8 \times 3.0) + (1.69 \times 4.5) + 8.58\left(3.5 + \frac{5.5}{2}\right)$

$= 66.63$ KFt

$F.S = \frac{66.63}{31.10} = 2.14$

Sliding Check

Frictional force $= \mu N = 0.4 \times 12.07 = 4.8^K$

with $\mu = 0.5$, $\therefore 0.5 \times 12.07 = 6.1^K$

Sliding force $= 7.03^K > 6.1^K$

use a Base Slab Key (1'-3) x (1'-6)

Actually Sliding force will not be as high as 7.03K, because of water pr on Channel side, under submerged condition

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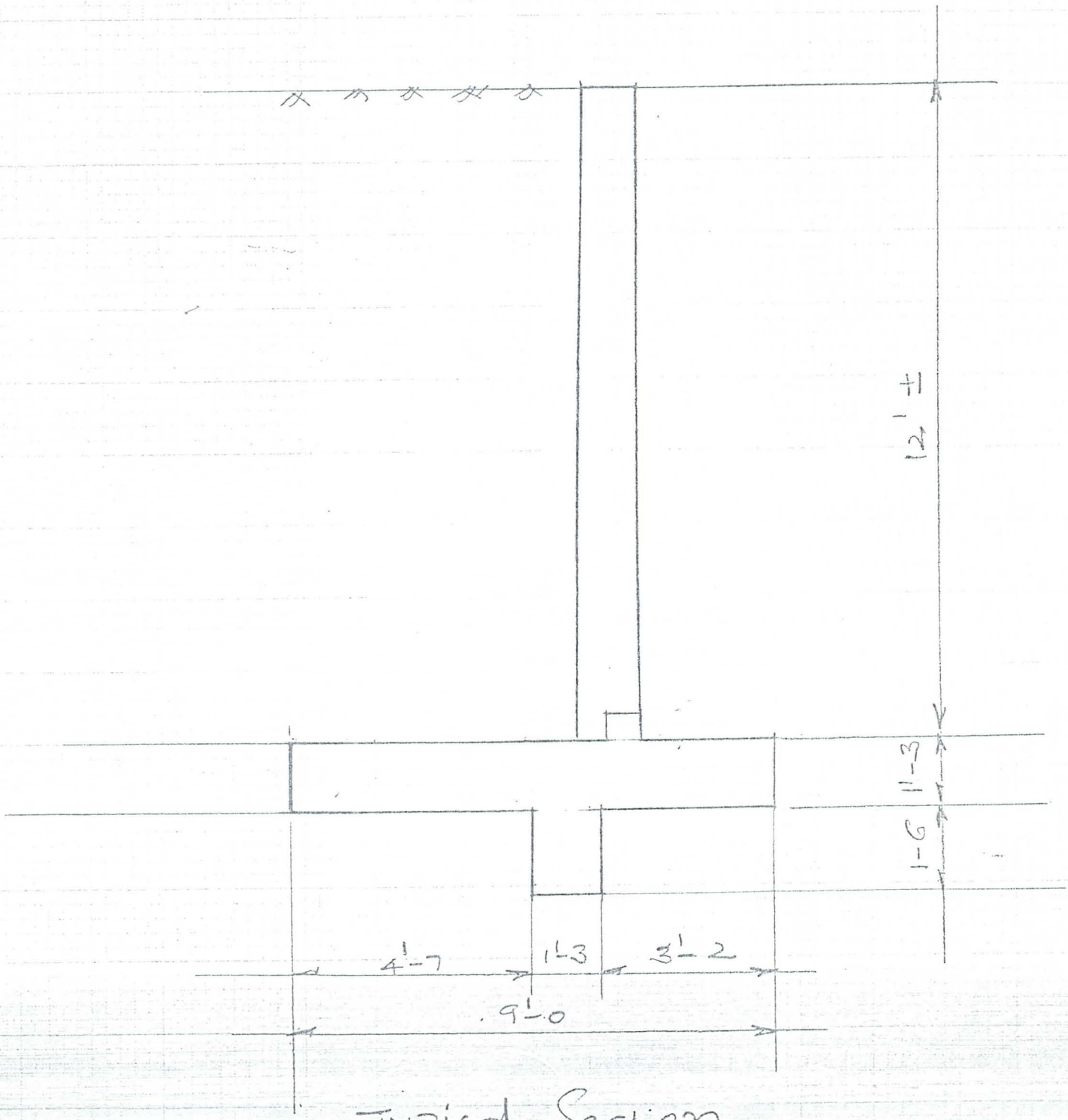
DETAIL 12' High wall COMPUTED KVH DATE 7/92

CHECKED BY DATE



Typical Section

Scale 1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL 12' High wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

Checking Footing pr (9'-0 footing width)

$M_{STB} = 66.63$, $M_{OT} = 31.1$, $N = 12.07^K$

$x_R = (66.63 - 31.1)/12.07 = 2.94'$

$e = (4.5 - 2.94) = 1.56$,

$b/6 = \frac{9.0}{6} = 1.5$ $e > b/6$ ∴ ok

$P_{r\,max} = \frac{12.07}{9 \times 1}\left(1 \pm \frac{6 \times 1.56}{9}\right)$

$= 1.34\,(1 \pm 1.04)$

$p_r(max) = 2.74$ ksf, $p_r(min) = -0.05$ ksf

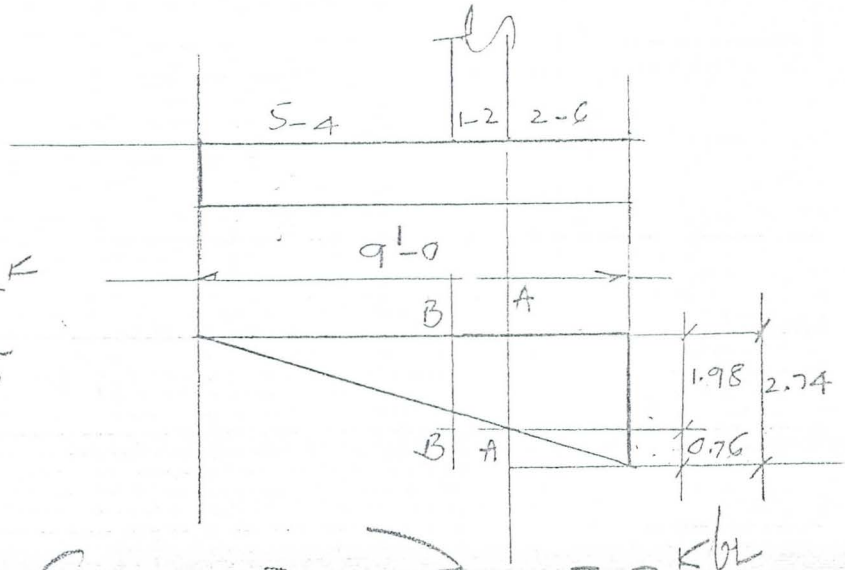
Toe Design:

$\frac{2.74}{9} = \frac{p_{r_1}}{6.5}$

$p_{r_1} = 1.98$ ksf

$P_1 = (1.98 \times 2.5) = 4.95^K$

$P_2 = \left(\frac{0.76}{2} \times 2.5\right) = 0.95$



Neglecting ftg wt:

$M_{AA} = \left(4.95 \times \frac{2.5}{2}\right) + \left(0.95 \times \frac{2}{3} \times 2.5\right) = 7.8^{K'}$

$M_u = (7.8 \times 1.3) = 10.14^{K'}$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

9' Footing width (Contd)

$M_u = 10.14$, $d = (15-3-0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{10.14 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.029$$

Read $\omega = 0.03$ from Table 9-2

f_{min} Controlling, use #6 @ 9''

Heel Design:

$$\frac{2.74}{9} = \frac{p_v}{5.33} \qquad p_v = 1.62 \text{ ksf}$$

$$P = \left(\frac{1.62}{2} \times 5.33\right) = 4.32^{K}$$

Soil wt $= (12.0 \times 0.13) = 1.56$ K/ft

Conc. ftg $= (1.25 \times 0.15) = 0.19$

$$M_{BB} = \left(1.56 \times \frac{5.33^2}{2}\right) + \left(0.19 \times \frac{5.33^2}{2}\right) - 4.32 \times \frac{5.33}{3}$$

$= 17.2$ kft

$M_u = 1.3(17.2) = 22.4$ kft

$d = (15-3-0.5) = 11.5$ with 1'' Cl to Standard Key

$$\frac{M_u}{\phi f'_c b d^2} = \frac{22.4 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.063$$

Read $\omega = 0.066$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.066 \times 3.0}{60} = 0.033$$

$A_s = (0.033 \times 12 \times 11.5) = 0.46 \text{ in}^2$

#6 @ 9'', $A_s = 0.59$, #7 @ 9'', $A_s = 0.80$

As the wall ht. varies use #7 @ 9''

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 21(A) OF

DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

Stem Design

$P_r = wKh = (80 \times 12) = 960$ psf

$Mom = \left(\frac{0.96}{2} \times 12\right) \frac{12}{3} = 23.04$ kft

$M_u = (23.04 \times 1.3) = 29.95$ kft

$d = (14 - 2 - 0.5) = 11.5''$

$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{29.95 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2}\right) = 0.084$

from Table 9-2, $w = 0.089$

$\rho = \frac{w f'_c}{f_y} = \left(\frac{0.089 \times 3.0}{60}\right) = 0.0045$

$A_s = (0.0045 \times 12 \times 11.5) = 0.62 in^2$

6 @ 6" $A_s = 0.88$

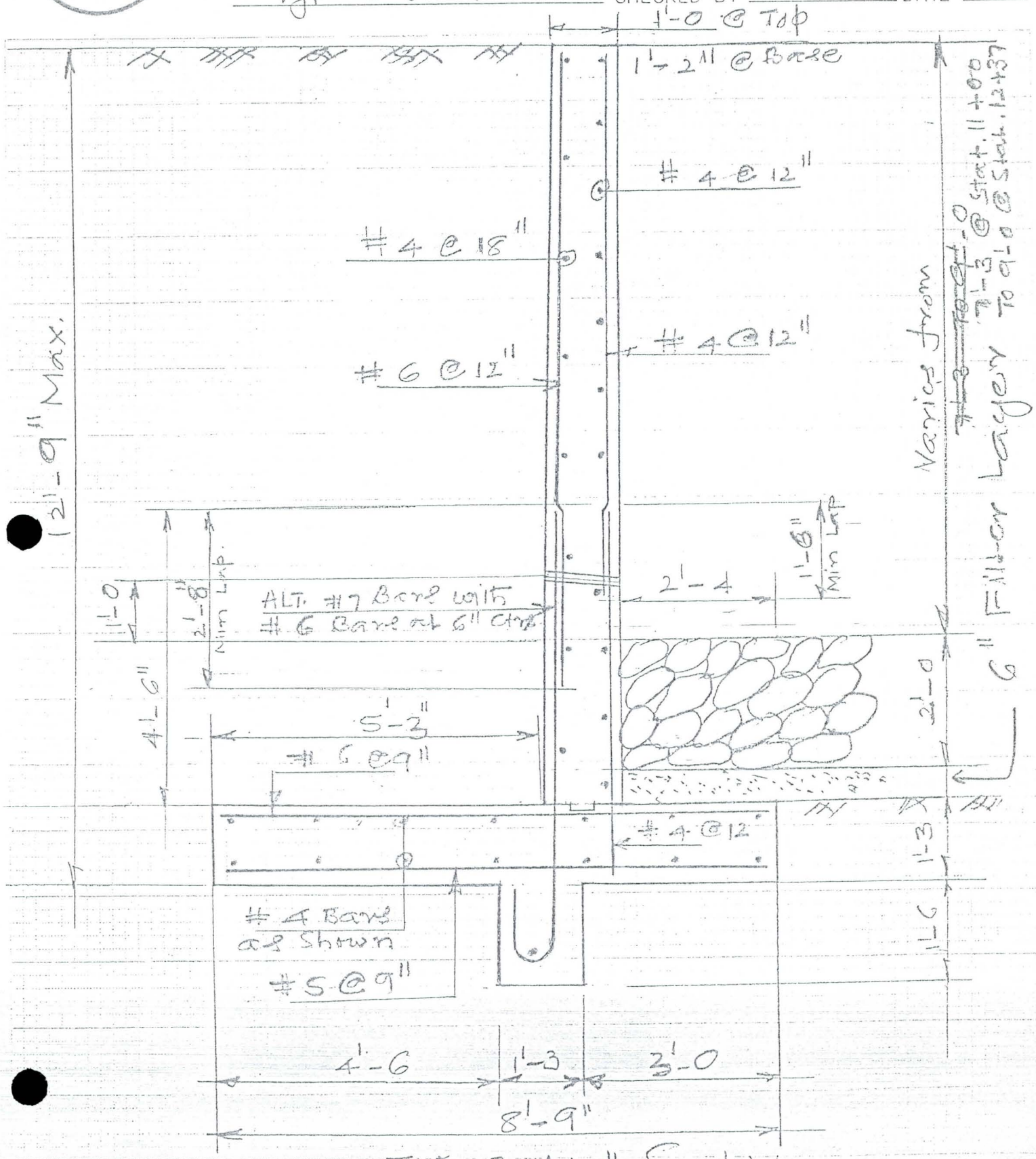
As the wall ht. varies use # 7 @ 6", $A_s = 1.20$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 21(B) OF

DETAIL 9'-0 Wall Sect. COMPUTED KVH DATE 8/92

Type 3 Wall CHECKED BY DATE



Type 3 Wall Section

Stat. 1100 To 1237.6

1/2" = 1'-0

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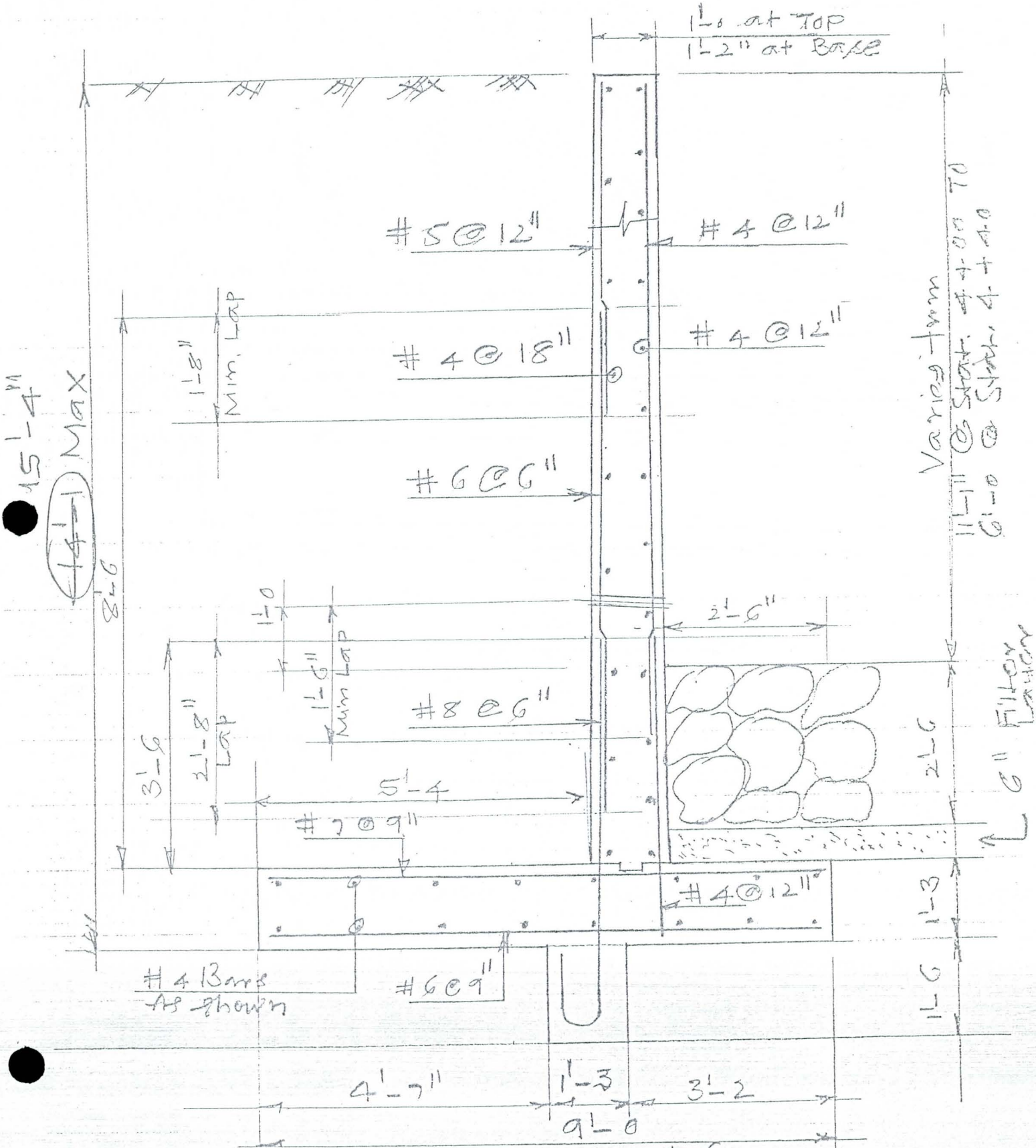
PROJECT Spook Hill PAGE 21(C) OF

DETAIL Type 4 wall COMPUTED KVH DATE 8/92

CHECKED BY DATE



Type 4 Wall Section

1/2" = 1'-0 Stat. 4+00 To 4+40

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DETAIL Type 1 wall COMPUTED KVH DATE 8/92

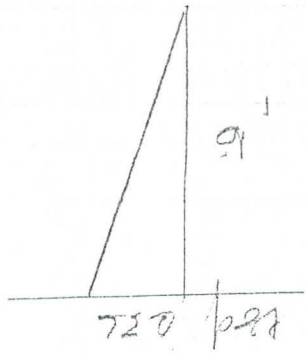
Reinf Check CHECKED BY DATE

Type 1 wall:

$Ht = (6+3) = 9'$

pr @ 80 pcf Saturated pr.

$(80 \times 9) = 720$ pcf



$P = \left(\frac{0.720}{2} \times 9\right) = 3.24^k$

$M = 3.24 \left(\frac{9}{3}\right) = 9.72$

$d = (12 - 2 - 0.5) = 9.5$ $\quad As = \frac{9.72 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.58$

Use #5 @ 6", As = 0.62

Bar Cut off @ (6'-2) - 1' = 1'-1" say 1' from Bott

$pr = (80 \times 8) = 640$

$P = \left(\frac{640}{2} \times 8\right) = 2.56^k$

$M = \left(2.56 \times \frac{8}{3}\right) = 6.83$, $\quad As = \frac{6.83 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.41 \text{ in}^2$

Bars Continued to cutoff at 2-2' from Bottom for #5 @ 12"

Bar Extension, $12 d_b = 12 \times 5/8 = 7.5"$

$d_{eff} = 9.5"$

Min 12" $= 12"$

Try Bar Cut off at 3'-0 from Base

Check Min. at (3-1) = 1.0 = 2.0' from Base

Check Reinf @ (9-2) = 7' Height

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sbook Hill Outlet PAGE 23 OF

DETAIL Typ. 1. wall COMPUTED KVH DATE 8/92

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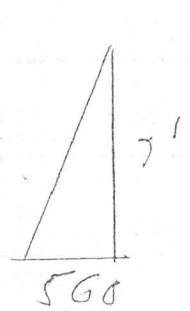
Ht = 7'

$p_v = (80 \times 7) = 560$

$P = \left(\frac{0.560}{2} \times 7.0\right) = 1.96$

$M = 1.96 \times 7/3 = 4.6^{k'}$



$A_s = \frac{4.6 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.28$

#5 @ 12" Bar Cutoff at 3' from Base is ok

Shear Check:

$V = 2.56^k$

$b = 12, \; d = 9.5$

$v = \frac{2.56 \times 1000}{12 \times 9.5} = 22 \text{ psi}$

$\therefore$ ok

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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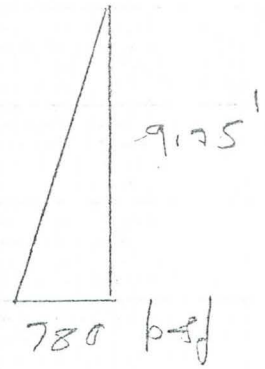
DETAIL Type 2 wall COMPUTED KVH DATE 8/92

CHECKED BY DATE

Type 2 wall



Ht = 9'-9

$pr = (80 \times 9.75) = 780$

$P = \left(\frac{0.780}{2} \times 9.75\right) = 3.80^K$

$M = \left(3.80 \times \frac{9.75}{3}\right) = 12.4^{kft}$

$As = \left(\frac{12.4 \times 12}{24 \times 0.88 \times 7.5}\right)$

$= 0.74$

use #6 @ 6", As = 0.88

Try Bar Cut off at 3' from Base

Check Mom at $(9.75 - 2.0) = 7.75'$

$Pr = (80 \times 7.75) = 620$

$P = \left(\frac{0.620}{2} \times 7.75\right) = 2.4^K$

$M = \left(2.4 \times \frac{9.75}{3}\right) = 7.8^{kft}$, $As = \frac{7.8 \times 12}{24 \times 0.88 \times 9.5}$

$\doteq 0.47 \text{ in}^2$

Try Bar Cut off at 3'-6 from Base

$Pr = (80 \times 7.25) = 580$

$P = \frac{0.580}{2} \times 7.25 = 2.10^K$

$M = \left(2.10 \times \frac{7.25}{3}\right) = 5.08$

$As = \frac{5.08 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.30$

∴ Use #5 @ 12" at 3'-6 from Base

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DETAIL Type 3 wall COMPUTED KNH DATE 8/92

CHECKED BY DATE

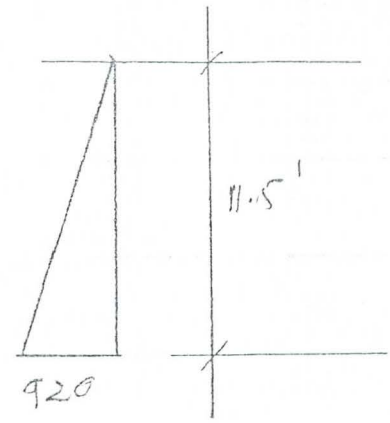
Type 3 wall

Ht = 11'-6"

$p_r = 80(11.5) = 920$

$P = \left(\frac{0.920}{2} \times 11.5\right) = 5.29^K$

$M = \left(5.29 \times \frac{11.5}{3}\right) = 20.3^{K'}$



$d_{eff} = (14 - 2.5) = 11.5"$

Alt Bars #7 & #6

#7 @ 12 = 1.20
#6 @ 12 = 0.88 } 1.04

$A_s = \left(\frac{20.3 \times 12}{24 \times 0.88 \times 11.5}\right) = 1.0$

Alt #7 Bars with #6 Bars

$A_s = 1.04$

Bar Cut off

$12 d_b = 12 \times 7/8 = 10.5"$

$d_{eff} = 11.5$

Min 12" = 12"

Use 12" Min beyond the actual Bar Cutoff

Try at (4-0) - 1' = 3'-0"

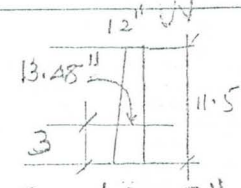
Ht = (11.5 - 3.0) = 8.5'

$p_r = (8.5 \times 80 \text{ psf}) = 680 \text{ psf}$

$P = \left(\frac{0.68}{2} \times 8.5\right) = 2.89^K$

$M = 2.89 \times \frac{8.5}{3} = 8.2^{K'}$

$\left(12 + \frac{8.5}{11.5} \times 2'\right)$
= 13.48"
d_{eff} = 13.48 - 2.5 = 10.98"



$A_s = \frac{8.2 \times 12}{24 \times 0.88 \times 10.98}$

= 0.42

#6 @ 12, A_s = 0.44

Use Bar Cut off at 4'-6 & use #6 @ 12 at top

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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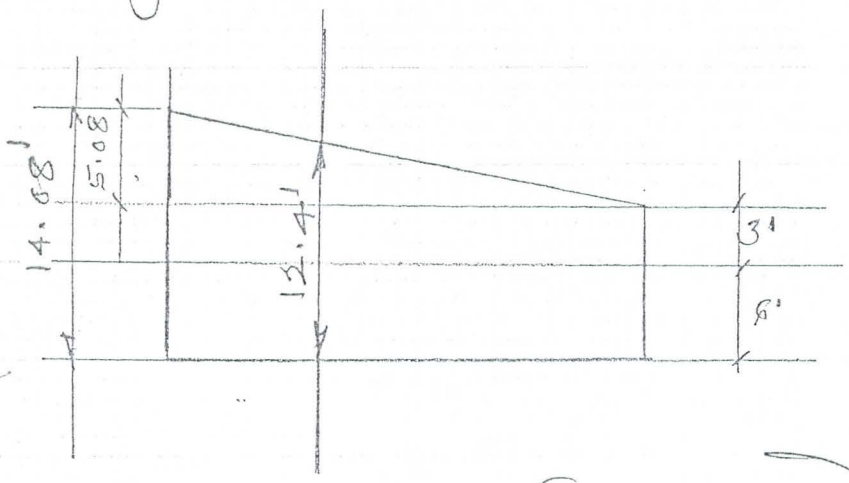
DETAIL Type 4 wall COMPUTED KVH DATE 8/92

CHECKED BY DATE

Type 4 wall



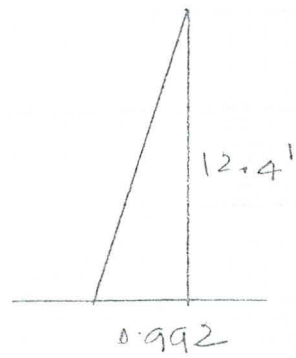
$Ht @ C.G_r = (6 + \frac{2}{3} \times 5.08) = 12.4'$

Design $Ht = 12.4'$

$P_r = (50 \times 12.4) = 992$

$P = \frac{0.992}{2} \times 12.4 = 6.15^K$

$M = 6.15 \times \frac{12.4}{3} = 25.4$ K/ft



$d_{eff} = (14 - 2.5) = 11.5''$

$A_s = \frac{25.4 \times 12}{24 \times 0.88 \times 11.5} = 1.25$

use #8 @ 6", $A_s = 1.58$

Shear Check:

$V_{max} = 6.15^K$

$v = \frac{6.15}{12 \times 11.5}$

$= 44.6$ psi

Allow $S_h = 0.95\sqrt{4000} = 60$ psi ∴ OK

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 29 OF

DETAIL Type 4 wall COMPUTED RVH DATE 9/92

CHECKED BY DATE

b) Check Bar Cut off @ 4'-0

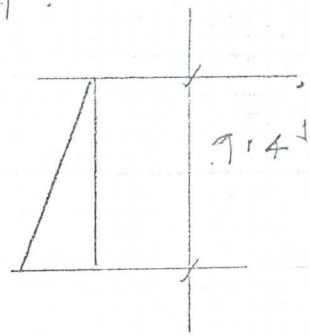
Check at (4 - 1.0) = 3' from Batt.

Ht = (12.4 - 3.0) = 9.4'

pr = (80 × 9.4) = 752 psf

P = (0.752/2 × 9.4) = 3.53 K

M = (3.53 × 9.4/3) = 11.1 K'



deff = (14 - 2 - 0.5 - 0.5) = 11.0

As = (11.1 × 12) / (24 × 0.88 × 11) = 0.57

Use #6 @ 6" & Bar Cutoff at 3'-6

c) Check Bar Cutoff at 7'-0

Check at (7 - 1.0) = 6' from Bottom

Ht = (12.4 - 6.0) = 6.4'

pr = 80 × 6.4 = 512

P = 0.512/2 × 6.4 = 1.64 K

M = 1.64 × 6.4/3 = 3.5 K'

As = (3.5 × 12) / (24 × 0.88 × 10.5) = 0.19

Use min #5 @ 12

deff = (14 - 2.0 - 0.5 - 1.0)

= 10.5

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

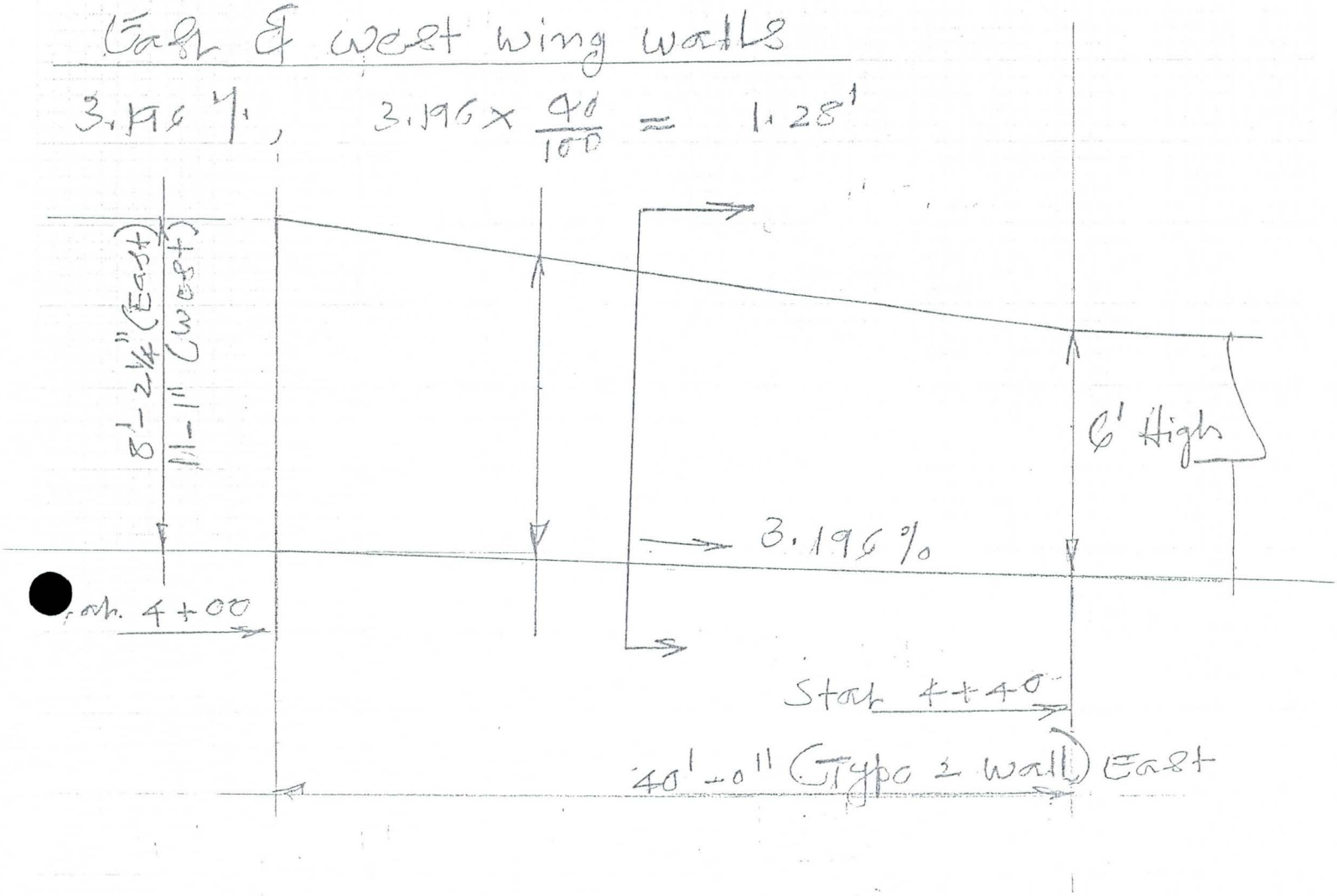
PROJECT Spook Hill outlet PAGE 28 OF

DETAIL East wing wall COMPUTED KVH DATE Aug 92

CHECKED BY DATE

East & west wing walls

3.196 %, $3.196 \times \frac{40}{100} = 1.28'$



East (8'-2) - 6 = 2'-2

Design Ht = 6' + 2/3 (2.17) = 7'-6"

∴ Use Type 2 Wall Detail - East wing

West (11'-1) - 6 = 5.08', Design Ht = 6 + 2/3 (5.08) = 9.4'

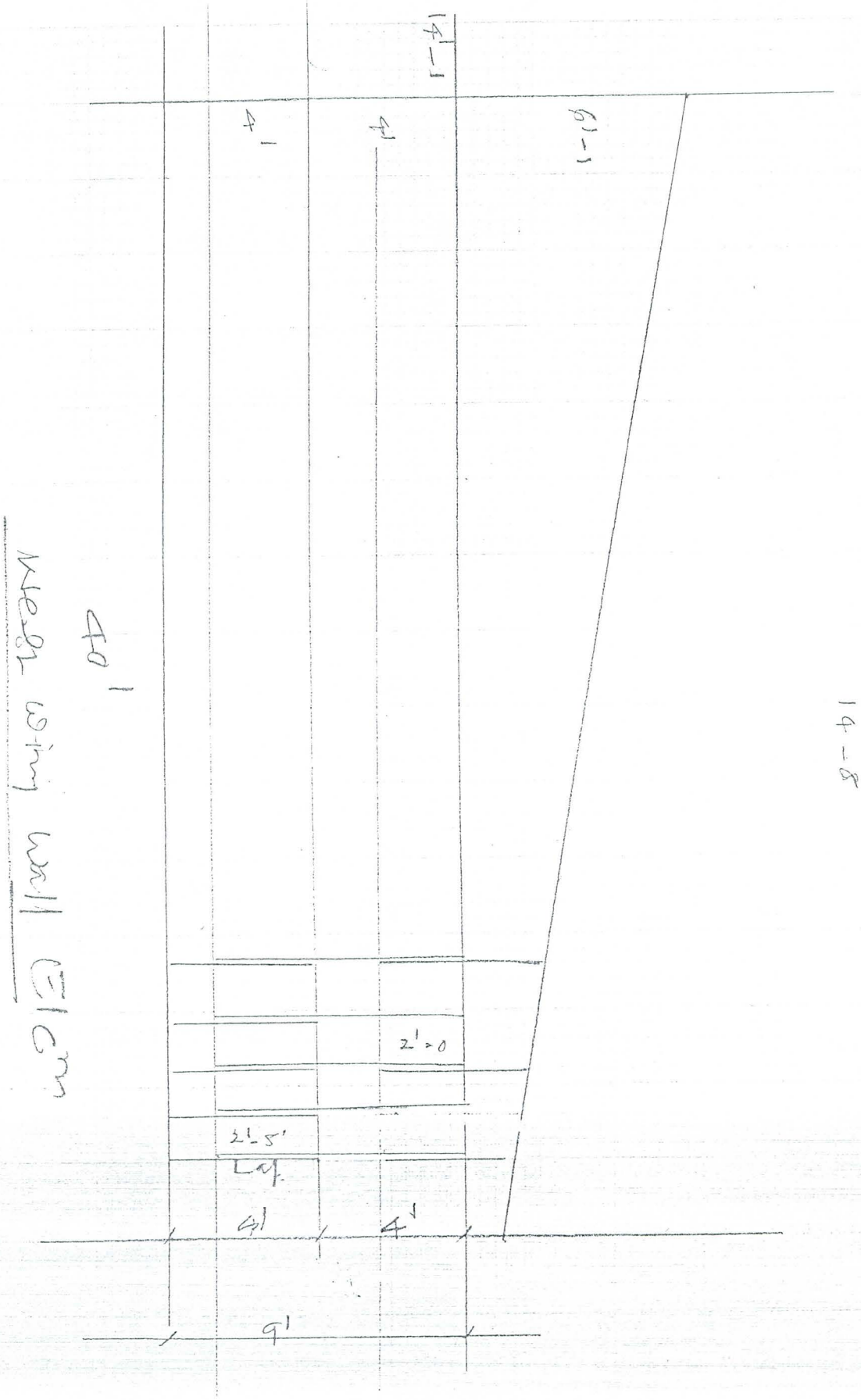
use Type 4 wall Detail with 9'-0 Footing width

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 29 OF

DETAIL West Wingwall COMPUTED KVH DATE 9/92

CHECKED BY DATE

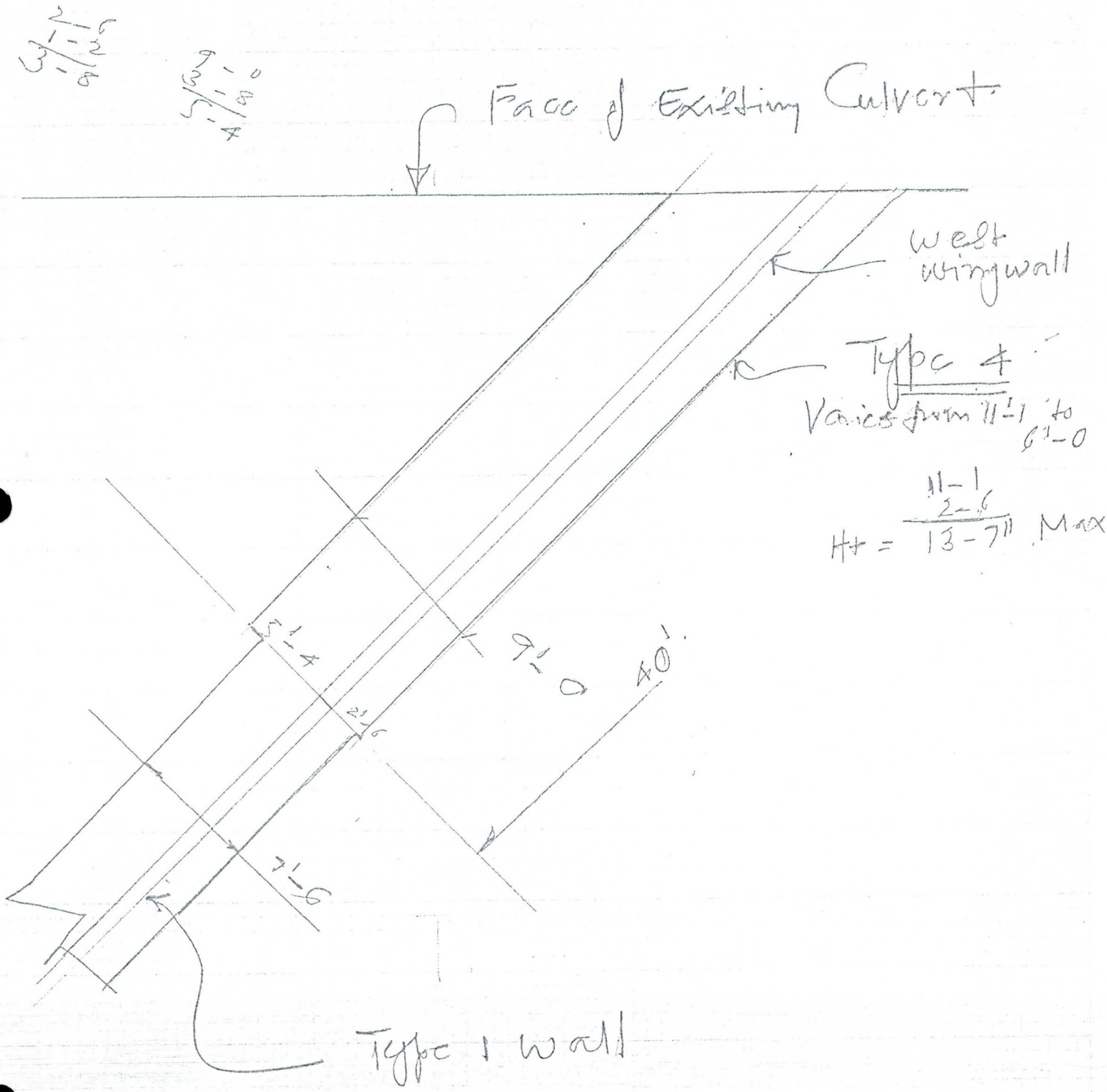


FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 30 OF

DETAIL Plan West wing COMPUTED KVH DATE 8/92

CHECKED BY DATE



Plan West wing wall

CONSTRUCTION SPECIFICATION

2. CLEARING AND GRUBBING

1. SCOPE

The work shall consist of the clearing and grubbing of designated areas by removal and disposal of trees, snags, logs, stumps, shrubs and rubbish.

2. MARKING

The limits of the areas to be cleared and grubbed will be marked by means of stakes, flags, tree markings or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

3. REMOVAL

All trees not marked for preservation and all snags, logs, brush, stumps, shrubs and rubbish shall be removed from within the limits of the marked areas. Unless otherwise specified, all stumps, roots and root clusters having a diameter of one inch or larger shall be grubbed out to a depth of at least two feet below subgrade elevation for concrete structures and one foot below the ground surface at embankment sites and other designated areas.

4. DISPOSAL

All materials removed from the cleared and grubbed areas shall be burned or buried at location shown on the drawings or as specified in Section 6 of this specification.

5. MEASUREMENT AND PAYMENT

Method 1 For items of work for which specific unit prices are established in the contract, the cleared and grubbed area will be measured to the nearest 0.1 acre. Payment for clearing and grubbing will be made for the total area within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools and all other items necessary and incidental to the completion of the work.

Method 2 For items of work for which specific unit prices are established in the contract, the length of the cleared and grubbed area will be measured to the nearest full station (100 feet) along the line designated on the drawings or in the specifications. Payment for clearing and grubbing will be made for the total length

within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to completion of the work.

Method 3 For items of work for which specific unit prices are established in the contract, each tree, stump and snag having a diameter of 4 inches or greater and each log having a diameter of 4 inches or greater and a length of 10 feet will be measured prior to removal. The size of each tree and snag will be determined by measuring its trunk at breast height above the natural ground surface. The size of each log will be determined by measuring the butt and by measuring its length from butt to tip. The size of each stump will be measured at the top. Diameter shall be determined by dividing the measured circumference by 3.14.

Payment for clearing and disposal of each tree, stump and snag having a diameter of 4 inches or greater and each log having a diameter of 4 inches or greater and a length of 10 feet or greater will be made at the contract unit price for its size designation as determined by the following schedule:

Measured Diameter	Size Designation
4 inches to 8 inches	6-inch size
Over 8 inches to 12 inches	10-inch size
Over 12 inches to 24 inches	18-inch size
Over 24 inches to 36 inches	30-inch size
Over 36 inches to 60 inches	48-inch size
Over 60 inches	60-inch size

The sum of such payments shall constitute full compensation for all labor, equipment, tools and all other items necessary and incidental to the work of completely clearing and grubbing the designated areas, including clearing, grubbing and disposal of smaller trees, stumps, snags and logs and brush, shrubs, roots and rubbish.

Method 4 For items of work for which specific lump sum prices are established in the contract, payment for clearing and grubbing will be made at the contract lump sum price. Such payment shall constitute full compensation for all labor, equipment, tools and all other items necessary and incidental to completion of the work.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

CONSTRUCTION SPECIFICATION

3. STRUCTURE REMOVAL

1. SCOPE

The work shall consist of the removal, salvage and disposal of structures (including fences) from the designated areas.

2. MARKING

Method 1 Each structure unit to be removed will be marked by means of stakes, flags, painted markers or other suitable methods.

Method 2 The limits of the areas from which structures must be removed will be marked by means of stakes, flags or other suitable methods. Structures to be preserved in place or salvaged will be designated by special markings.

3. REMOVAL

Method 1 All structures designated in the contract for removal shall be removed to the specified extent and depth.

Method 2 Within the areas so marked all visible structures and attachments and all buried structures located and identified by survey stakes shall be removed to the specified extent and depth.

4. SALVAGE

Structures that are designated to be salvaged shall be carefully removed and neatly placed in the specified storage areas. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly match marked with paint prior to disassembly. All pins, nuts, bolts, washers, plates and other loose parts shall be marked or tagged to indicate their proper locations in the structure and shall be fastened to the appropriate structural member or packed in suitable containers. Materials from fences designated to be salvaged shall be placed outside the work area on the property from which they were removed. Wire shall be rolled into uniform rolls of convenient size. Posts and rails shall be neatly piled.

5. DISPOSAL OF REFUSE MATERIALS

Refuse materials resulting from structure removal shall be burned or buried at locations shown on the drawings or as specified in Section 7 of the specification.

6. MEASUREMENT AND PAYMENT

Method 1 For items of work for which specific unit prices are established in the contract, payment for the removal of each structure unit, except fences, will be made at the contract unit price. Fences removed or removed and salvaged will be measured to the nearest linear foot. Payment for fence removal or removal and salvage will be made at the contract unit prices appropriate to each type and size of fence.

Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 2 For items of work for which specific lump sum prices are established in the contract, payment for structure removal will be made at the contract lump sum price.

Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item. Structure Removal

(1) This item consists of:

Sawcutting and removal of the existing concrete headwalls and concrete slab at the north side of Bush Highway Box Culvert, as shown on the drawings.

(2) Section 5, DISPOSAL OF REFUSE MATERIALS, the lean concrete base designated for removal may be placed in the required earthfill of the existing channel between the proposed channnel and fence line. The top of the concrete rubble shall be at least 18 inches below the existing ground elevation at the fence line.

(3) No separate payment will be made for this item. Compensation for the work will be included in the payment for Bid Item 4, Concrete.

CONSTRUCTION SPECIFICATION

5. POLLUTION CONTROL

1. SCOPE

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air during construction operations in accordance with these specifications.

2. MATERIALS

All materials furnished shall meet the requirements of the Material Specifications listed in Section 8 of this specification.

3. EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

The work and measures shall include but not be limited to the following, as shown on the drawings or as specified in Section 8 of this specification.

Staging of Earthwork Activities - The excavation and moving of soil materials shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.

Seeding - Seedings to protect disturbed areas shall be done as specified on the drawings or in Section 8 of this specification.

Mulching - Mulching shall be used to provide temporary protection to soil surfaces from erosion.

Diversions - Diversions shall be used to divert water away from work areas and/or to collect runoff from work areas for treatment and safe disposition.

Stream Crossings - Culverts or bridges shall be used where equipment must cross streams.

Sediment Basins - Sediment basins shall be used to settle and filter out sediment from eroding areas to protect properties and streams below the construction site.

Straw Bale Filters - Straw bale filters shall be used to trap sediment from areas of limited runoff. Bales are temporary and shall be removed when permanent measures are installed.

Waterways - Waterways shall be used for the safe disposal of runoff from fields, diversions and other structures or measures.

4. CHEMICAL POLLUTION

The Contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to be used to dispose of chemical pollutants (such as drained lubricating or transmission oils, greases, soaps, asphalt, etc.) produced as a by-product of the project's work. At the completion of the construction work, sumps shall be voided without causing pollution as specified in Section 8 of this specification.

Sanitary facilities such as pit toilets, chemical toilets, or septic tanks shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources. At the completion of construction work, facilities shall be disposed of without causing pollution as specified in Section 8 of this specification

5. AIR POLLUTION

Local and state regulations concerning the burning of brush or slash or disposal of other materials shall be adhered to.

Fire prevention measures shall be taken to prevent the start or the spreading of fires which result from project work. Fire breaks or guards shall be constructed at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated to fully suppress dust.

6. MAINTENANCE, REMOVAL, AND RESTORATION

All pollution control measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. All temporary measures shall be removed and the site restored to as nearly original conditions as practicable.

7. MEASUREMENT AND PAYMENT

Method 1 For items of work for which specific unit prices are established in the contract each item will be measured to the nearest unit applicable. Payment for each item will be made at the contract unit price for that item. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 2 For items of work for which specific lump sum prices are established in the contract, payment for pollution control will be made at the contract lump sum price. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Pollution Control

(1) This item consists of all work and materials required to control or reduce pollution of air, water and soil.

(2) This specification shall apply to all construction activities.

(3) The Contractor is required to adhere to all applicable local, State and Federal laws and regulations pertaining to the control of pollution as may result from construction of this project. These laws and regulations include but are not limited to:

(a) The "Policy on construction and related activities in water" adopted April 13, 1977, by the Water Quality Control Council of Arizona.

(b) The Clean Air Act (42 U.S.C. 1857 et seq. as amended by Pub. L. 91-604) Section 114, and Section 308 of the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq., as amended by Pub. L. 90-500) relating to inspection, monitoring, entry, reports, and information as well as the other requirements of these section.

(4) The Contractor is responsible for maintaining air, water, and vegetative quality within the work area. Methods include:

(a) Establishing turn areas, haul roads, work site access roads, temporary building sites, equipment yards, etc., in approved locations, and staging earthwork activities to prevent contamination of air and water, to minimize destruction of existing vegetation, and to minimize erosion.

(b) Operating mechanized equipment at the job site in a manner that will avoid destruction or removal of trees and shrubs other than as necessary for construction of the measure.

(5) Under Section 2, Materials, there are no material specifications required.

(6) In Section 4, Chemical Pollution, prior to the completion of the job the Contractor shall provide a plan, for approval by the Contracting Officer, to void sump areas and dispose of sanitary facilities as applicable.

(7) No separate payment will be made for this item. Compensation for this work will be included in the payment for Bid Item 3, Earthfill; Bid Item 6, Gravel Road Surfacing.

7. CONSTRUCTION SURVEYS FOR LAYOUT, CONTROL AND MEASUREMENT

1. SCOPE

The work shall consist of performing all surveys, measurements and computations required by this specification.

2. EQUIPMENT AND MATERIAL

Equipment for construction surveys shall be of a quality and condition to provide the required accuracy. The equipment shall be maintained in good working order and in proper adjustment at all times. Records of calibration tests, accuracy checks and adjustments shall be maintained and be available for inspection by the Contracting Officer.

Material includes all the necessary field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and all other items necessary to perform the work specified.

3 QUALITY OF WORK

All work shall follow recognized professional practice and the standards of the industry unless otherwise specified in Section 9 of this specification. The work shall be performed to the accuracy and detail appropriate for the type of job. Notes, sketches, and other data shall be complete, recorded neatly, legible, reproducible and organized in a manner that will allow reproduction of copies for job documentation.

All computations shall be mathematically correct. Computations shall include information to identify the bid item, date, and who performed, checked and approved the computations. Computations shall be legible, complete and clearly document the source of all information used including assumptions and measurements made.

If a computer program is used to perform the computations the Contractor shall provide the Contracting Officer with the software identification, venders name, version number, and other pertinent data, prior to beginning survey work. Computer generated computations shall show all input data including values assigned and assumptions made.

The elevations of permanent and temporary bench marks shall be determined and recorded to the nearest 0.01 foot. Differential leveling and transit traverses shall be of such precision that the error of vertical closure in feet shall not exceed plus or minus 0.1 times the square root of the traverse distance in miles. Linear measurements shall be accurate to within 1.0 foot in 5000 feet, unless otherwise specified in Section 9 of this specification. The angular error of closure for transit traverses shall not exceed 1.0 minute times the square root of the number of angles turned.

Slope stakes shall be placed, as a minimum; at 100 foot stations, breaks in the original ground surface and at any other intermediate stations necessary to insure accurate location for construction layout and measurement. Slope stakes and cross sections shall be perpendicular to the centerline. Significant breaks in grade shall be determined for cross sections. Distances shall be measured horizontally and recorded to the nearest 0.1 foot. Side shots for interim construction stakes may be taken with a hand level.

Unless otherwise specified in Section 9 of this specification, measurements for stationing and establishing the location of structures shall be made to the nearest 0.1 of a foot.

Elevations for concrete work, pipes and mechanical equipment shall be determined and recorded to the nearest 0.01 foot. Elevations for earth work shall be determined and recorded to the nearest 0.1 foot.

4. PRIMARY CONTROL

The baselines and bench marks for primary control, necessary to establish lines and grades needed for construction, are shown on the drawings and have been located on the job site.

These baselines and bench marks shall be used as the origin of all surveys, layouts and measurements to establish construction lines and grades. The Contractor shall take all necessary precautions to prevent the loss or damage of primary control points.

5. CONSTRUCTION SURVEYS

Prior to commencement of work requiring contractor performed surveys, the Contractor shall submit in writing to the Contracting Officer for approval the name, qualifications and experience of the individuals to be assigned to the survey tasks.

Method 1 Contractor performed surveys shall include: (1) checking and any supplemental or interim staking, (2) performing quantity surveys, measurements and computations for progress payment, (3) other surveys as described in Section 9 of this specification.

Method 2 Contractor performed surveys shall consist of all work necessary for: (1) establishing line and grade for all work, (2) setting slope stakes for all work, (3) checking and any supplemental or interim staking, (4) establishing final grade stakes, (5) performing quantity surveys, measurements and computations for progress payment and (6) others surveys as described in Section 9 of this specification.

Method 3 Contractor performed surveys shall consist of all work necessary for: (1) establishing line and grade for all work, (2) setting slope stakes for all work, (3) checking and any supplemental or interim staking, (4) establishing final grade stakes, (5) performing quantity surveys, measurements and computations for progress payments, (6) performing original (initial) and final surveys for final quantity determinations, and (7) other surveys as described in Section 9 of this specification.

6. STAKING

Prior to the commencement of work on any item the construction staking required for that item shall be completed. Construction staking shall be completed as follows, or as otherwise specified in Section 9 of this specification:

a. Clearing and grubbing - The boundary of the clearing and grubbing areas shall be staked or flagged at 200 foot intervals, or closer if needed, to clearly mark the limits of work.

b. Excavation and fill - Slope stakes shall be placed at the intersection of the specified slopes and ground line. Slope stakes or the reference stakes for slopes shall be marked with the stationing, required cut or fill, slope ratio and horizontal distance. Offset reference stakes and hubs shall be placed, as a minimum, at 100 foot stations, and shall be placed on at least one side of specified excavations and on both sides of specified fills.

c. Structures - Centerline and offset reference line stakes for location, alignment and elevation shall be placed for all structures.

7. RECORDS

All survey data shall be recorded in fully identified, standard hard-bound engineering survey field notebooks with consecutively numbered pages. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, weather data, sketches and the personnel who performed and checked the work. Electronically generated survey data and computations shall be bound, page numbered and cross referenced in a bound field notebook containing the index for all survey data.

The construction survey records shall be available at all times during the progress of the work for examination and use by the Contracting Officer and copies shall be made available to the Contracting Officer upon request. The original field notebooks and other records shall be turned over to and become the property of the Contracting Officer prior to final acceptance of the work.

Complete documentation of computations and supporting data for progress payments shall be submitted to the Contracting Officer with each invoice for payment as specified in Section 9 of this specification.

8. PAYMENT

For items of work for which lump sum prices are established in the contract, payment will be made as the work proceeds, after presentation of invoices by the Contractor showing related costs and evidence of the charges of suppliers, subcontractors, and others for supplies furnished and work performed. If the total of such payments is less than the lump sum contract price for this item, the unpaid balance will be included in final contract payment. Payment of the lump sum contract price will constitute full compensation for completion of the work.

Payment will not be made under this item for the purchase cost of materials and equipment having a residual value.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the item to which they are made subsidiary are identified in Section 9 of this specification.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 2, Surveys

(1) This item consists of furnishing personnel, equipment, materials and performing surveys required to construct the Spookhill Outlet Channel and Sediment Basin (see Section 5).

(2) In Section 5, CONSTRUCTION SURVEYS, Method 3 shall apply, "other surveys" shall include those required for preparation of as-built drawings.

(3) All surveys shall be certified by a licensed land surveyor registered in the State of Arizona, and surveyor will be proficient in construction surveys.

(4) The Contractor shall provide the Contracting Officer with copies of all relevant computations and supporting data with each invoice for progress payment and final payment.

(5) Any primary control monuments damaged or destroyed by the Contractors due to negligence will be replaced by the Government at the Contractor's expense. The actual cost to the Government for replacing the primary control monuments will be deducted from payments due the Contractor or as determined by the contracting officer.

(6) All entries shall be consistent with Soil Conservation Service TR-62, "Engineering Layout, Notes, Staking and Calculations". TR-62 will be furnished to the contractor upon request. As-builts will be recorded on 24x36 sheets with same scale as contract plans.

(7) A staking plan shall be submitted to the Contracting Officer for approval prior to performing the work.

(8) In Section 3, Quality of Work, third paragraph, it is not necessary to submit the software etc., prior to beginning survey work.

8. MOBILIZATION AND DEMOBILIZATION

1. SCOPE

The work shall consist of the mobilization and demobilization of the Contractor's forces and equipment necessary for performing the work required under the contract.

This work shall not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract.

Mobilization will not be considered as work in fulfilling the contract requirement for commencement of work.

2. EQUIPMENT AND MATERIALS

Mobilization shall include all activities and costs for transportation of personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary facilities for the Contractor's operations at the site; premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable; and other items specified in Section 4.

Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not included in the contract from the site; including the disassembly, removal and site clean up, of offices, buildings, and other facilities assembled on the site for this contract.

This work includes mobilization and demoblization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted,or added items of work for which the Contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

3. PAYMENT

Payment will be made as the work proceeds, after presentation of invoices by the Contractor showing specific mobilization and demoblization costs and evidence of the charges of suppliers, subcontractors, and others. If the total of such payments is less than the lump sum contract price, the unpaid balance will be included in the final contract payment. Payment of the lump sum contract price for mobilization and demoblization will constitute full compensation for completion of the work.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

4. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 1, Mobilization and Demobilization

(1) This item consists of mobilization and demobilization of the Contractor's equipment and forces for performing the work required under the contract.

CONSTRUCTION SPECIFICATION

10. WATER FOR CONSTRUCTION

1. SCOPE

The work shall consist of furnishing, transporting, and using water for construction purposes in accord with the applicable specifications.

2. FACILITIES AND EQUIPMENT

The Contractor shall build and maintain such access and haul roads as are needed, and shall furnish, operate, and maintain all pumps, piping, tanks, and other facilities needed to load, transport, and use the water as specified.

These facilities shall be equipped with meters, tanks, or other devices by which the volume of water supplied can be measured.

3. DUST ABATEMENT AND HAUL ROAD MAINTENANCE

Water for dust abatement and haul road maintenance shall be applied to haul roads and other dust-producing areas as needed to prevent excessive dust and to maintain the roads in good condition for efficient operation while they are in use.

4. EARTHFILL, DRAINFILL, ROCKFILL

Water for earthfill, drainfill, or rockfill shall be used in the fill materials as specified in the applicable construction specifications.

5. CONCRETE, MORTAR, GROUT

Water used in mixing or curing concrete, pneumatically applied mortar, or other portland cement mortar or grout shall meet the requirements of the applicable construction specifications and shall be used in conformance with those specifications. Payment for water used in these items is covered by the applicable concrete, mortar, or grout specification.

6. MEASUREMENT AND PAYMENT

For water items for which specific unit prices are established in the contract, the volume of water furnished and used in accordance with the specifications will be measured to the nearest 1000 gallons.

Except as otherwise specified, the measurement for payment will include all water needed at the construction site, except as noted in Section 5, to perform the work required under the contract in accordance with the specifications but will not include water wasted or used in excess of the amount needed. It will not include water used in concrete which is mixed elsewhere and transported to the site.

Payment for water will be made at the contract unit price. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to furnishing, transporting, and using the water.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Water

(1) This consists of furnishing and applying all water necessary for performance of the work described in this contract.

(2) In Section 6. MEASUREMENT AND PAYMENT, no separate payment will be made for this item. Compensation for water will be included in the payment for Bid Item 3, Earthfill; and Bid Item 6, Gravel Road Surfacing.

CONSTRUCTION SPECIFICATION

11. REMOVAL OF WATER

1. SCOPE

The work shall consist of the removal of surface water and ground water as needed to perform the required construction in accordance with the specifications. It shall include (1) building and maintaining all necessary temporary impounding works, channels, and diversions, (2) furnishing, installing and operating all necessary pumps, piping and other facilities and equipment, and (3) removing all such temporary works and equipment after they have served their purposes.

2. DIVERTING SURFACE WATER

The Contractor shall build, maintain and operate all cofferdams, channels, flumes, sumps, and other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site and away from the construction work while construction is in progress. Unless otherwise specified, a diversion must discharge into the same natural drainageway in which its headworks are located.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer in writing, his plan for diverting surface water before beginning the construction work for which the diversion is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

3. DEWATERING THE CONSTRUCTION SITE

Foundations, cutoff trenches and other parts of the construction site shall be dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction work. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps, casings, wellpoints, and other equipment needed to perform the dewatering as specified. Dewatering methods that cause a loss of fines from foundation areas will not be permitted.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, his plan for dewatering before beginning the construction work for which the dewatering is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

4. DEWATERING BORROW AREAS

Unless otherwise specified in Section 8, the Contractor shall maintain the borrow areas in drainable condition or otherwise provide for timely and effective removal of surface and ground waters that accumulate within the borrow areas from any source. Borrow material shall be processed as necessary to achieve proper and uniform moisture content for placement.

If pumping to dewater borrow areas is included as an item of work in the bid schedule, each pump used for this purpose shall be equipped with a water meter in the discharge line. Accuracy of the meters shall be such that the measured quantity of water is within 3 percent, plus or minus, of the true quantity. Means shall be provided by the Contractor to check the accuracy of the water meters when requested by the Contracting Officer.

5. EROSION AND POLLUTION CONTROL

Removal of water from the construction site, including the borrow areas shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized.

6. REMOVAL OF TEMPORARY WORKS

After the temporary works have served their purposes, the Contractor shall remove them or level and grade them to the extent required to present a sightly appearance and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.

Except as otherwise specified, pipes and casings shall be removed from temporary wells and the wells shall be filled to ground level with gravel or other suitable material approved by the Contracting Officer.

7. MEASUREMENT AND PAYMENT

Method 1 Items of work listed in the bid schedule for removal of water, diverting surface water, dewatering construction sites, and dewatering borrow areas will be paid for at the contract lump sum prices. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 2 Items of work listed in the bid schedule for removal of water, diverting surface water, dewatering construction sites, and dewatering borrow areas will be paid for at the contract lump sum prices. Such payment will constitute full compensation for furnishing, installing, operating, and maintaining the necessary trenches, drains, sumps, pumps, and piping, and for all labor,

equipment, tools, and all other items necessary and incidental to the completion of the work, except that additional payment for pumping to dewater borrow areas will be made as described in the following paragraph.

If pumping to dewater borrow areas is listed as an item of work in the bid schedule, payment will be made at the contract unit price which shall be the price per 1,000 gallons shown in the bid schedule. Such payment will constitute full compensation for pumping only. Compensation for equipment and preparation and for other costs associated with pumping will be included in the lump sum payment for removal of water or the lump sum payment for dewatering borrow areas. Payment will be made only for pumping that is necessary to dewater borrow areas that cannot be effectively drained by gravity or that must have the water table lowered to be usable. Pumping for other purposes will not be included for payment in this item.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Removal of Water

(1) This item consists of the removal or diversion of surface water from the construction area shown on the drawings.

(2) Section 2, DIVERTING SURFACE WATER no plan for diverting water is required. The contractor shall be responsible for passing flows through or around the work areas.

(3) In Section 2, DIVERTING SURFACE WATER, this project is located in an active watershed consisting of a series of floodways and flood retarding structures which collect and discharge flows into the East Maricopa Floodway through uncontrolled outlets. In the event of significant rain storms there may be water flowing in Spookhill outlet Channel and Sediment Basin for extended periods of time. Work in the channel bottom may be impractical during periods of flow and subsequent dry-outs.

(4) No separate payment will be made for Removal of Water. Compensation for Removal of Water will be included in the payment for Bid Item 3, Earthfill; and Bid Item 4, Concrete.

CONSTRUCTION SPECIFICATION

21. EXCAVATION

1. SCOPE

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials.

2. CLASSIFICATION

Excavation will be classified as common excavation or rock excavation in accordance with the following definitions or will be designated as unclassified.

Common excavation shall be defined as the excavation of all materials that can be excavated, transported, and unloaded by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded onto hauling equipment by means of excavators having a rated capacity of one cubic yard and equipped with attachments (such as shovel, bucket, backhoe, dragline or clam shell) appropriate to the character of the materials and the site conditions.

Rock excavation shall be defined as the excavation of all hard, compacted or cemented materials the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than one cubic yard in volume encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation.

Excavation will be classified according to the above definitions by the Engineer, based on his judgment of the character of the materials and the site conditions.

The presence of isolated boulders or rock fragments larger than one cubic yard in size will not in itself be sufficient cause to change the classification of the surrounding material.

For the purpose of this classification, the following definitions shall apply:

Heavy ripping equipment shall be defined as a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a tractor having a power rating of 200-300 net horsepower (at the flywheel).

Wheel tractor-scraper shall be defined as a self-loading (not elevating) and unloading scraper having a struck bowl capacity of 12-20 yards.

Pusher tractor shall be defined as a track type tractor having a power rating of 200-300 net horsepower (at the flywheel) equipped with appropriate attachments.

3. UNCLASSIFIED EXCAVATION

Items designated as "Unclassified Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed. When excavation is unclassified, none of the definitions or classifications stated in Section 2 of this specification shall apply.

4. BLASTING

The transportation, handling, storage, and use of dynamite and other explosives shall be directed and supervised by a person of proven experience and ability in blasting operations.

Blasting shall be done in such a way as to prevent damage to the work or unnecessary fracturing of the foundation and shall conform to any special requirements in Section 12 of this specification.

5. USE OF EXCAVATED MATERIALS

Method 1 To the extent they are needed, all suitable materials from the specified excavations shall be used in the construction of required permanent earthfill or rockfill. The suitability of materials for specific purposes will be determined by the Engineer. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

Method 2 Suitable materials from the specified excavations may be used in the construction of required earthfill or rockfill. The suitability of materials for specific purposes will be determined by the Engineer.

6. DISPOSAL OF WASTE MATERIALS

Method 1 All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of at the locations shown on the drawings.

Method 2 All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of by the Contractor at sites of his own choosing away from the site of the work.

7. BRACING AND SHORING

Excavated surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workmen, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. The Contractor shall furnish, place and subsequently remove such supporting installations.

8. STRUCTURE AND TRENCH EXCAVATION

Structure or trench excavation shall be completed to the specified elevations and to sufficient length and width to include allowance for forms, bracing and supports, as necessary, before any concrete or earthfill is placed or any piles are driven within the limits of the excavation.

9. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fills, additional materials shall be obtained from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas shall be as directed by the Engineer.

Borrow pits shall be excavated and finally dressed in a manner to eliminate steep or unstable side slopes or other hazardous or unsightly conditions.

10. OVEREXCAVATION

Excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete made of materials and mix proportions approved by the Engineer. Concrete that will be exposed to the atmosphere when construction is completed shall contain not less than 6 sacks of cement per cubic yard of concrete. Concrete that will be permanently covered shall contain not less than 4-1/2 sacks of cement per cubic yard. The concrete shall be placed and cured as specified by the Engineer.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved compacted earthfill, except that, if the earth is to become the subgrade for riprap, rockfill, sand or gravel bedding, or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding or drainfill.

11. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Regardless of quantities excavated, the measurement for payment will be made to the specified pay limits, except that excavation outside the specified lines and grades directed by the Engineer to remove unsuitable material will be included. Excavation required because unsuitable conditions result from the Contractor's improper construction operations, as determined by the Contracting Officer will not be included for measurement and payment.

Method 1 The pay limits shall be as designated on the drawings.

Method 2 The pay limits shall be defined as follows:

a. The upper limit shall be the original ground surface as it existed prior to the start of construction operations except that where excavation is performed within areas designated for previous excavation or fill the upper limit shall be the modified ground surface resulting from the specified previous excavation or fill.

b. The lower and lateral limits shall be the neat lines and grades shown on the drawings.

Method 3 The pay limits shall be defined as follows:

a. The upper limit shall be the original ground surface as it existed prior to the start of construction operations except that where excavation is performed within areas designated for previous excavation or fill the upper limit shall be the modified ground surface resulting from the specified previous excavation or fill.

b. The lower and lateral limits shall be the true surface of the completed excavation as directed by the Engineer.

Method 4 The pay limits shall be defined as follows:

a. The upper limit shall be the original ground surface as it existed prior to the start of construction operations except that where excavation is performed within areas designated for previous excavation or fill the upper limit shall be the modified ground surface resulting from the specified previous excavation or fill.

b. The lower limit shall be at the bottom surface of the proposed structure.

c. The lateral limits shall be 18 inches outside of the outside surfaces of the proposed structure or shall be vertical planes 18 inches outside of and parallel to the footings, whichever gives the larger pay quantity, except as provided in d, below.

d. For trapezoidal channel linings or similar structures that are to be supported upon the sides of the excavation without intervening forms, the lateral limits shall be at the under side of the proposed lining or structure.

e. For the purposes of the definitions in b, c, and d, above, any specified bedding or drainfill directly beneath or beside the structure will be considered to be a part of the structure.

All Methods The following provisions apply to all methods of measurement and payment.

Payment for each type and class of excavation will be made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to the performance of the work, except that extra payment for backfilling overexcavation will be made in accordance with the following provisions:

Payment for backfilling overexcavation, as specified in Section 10 of this specification, will be made only if the excavation outside specified lines and grades is directed by the Engineer to remove unsuitable material and if the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 12 of this specification.

12. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Structure Excavation

(1) This item consists of all excavation required to construct the concrete channel and berms as shown on the drawings.

(2) Suitable channel excavation and berm excavated material shall be utilized to reconstruct the channel subgrade and O&M roads adjacent to the sides of the channel, as approved by the Engineer.

(3) No separate payment will be made for structure excavation. Compensation for this item will be included in payment for Bid Item 4, Concrete.

b. Subsidiary Item, Borrow Excavation

(1) This item consists of all common excavation required to obtain fill material not available from the required excavations to complete the construction of the permanent works.

(2) The borrow material shall be obtained from the areas shown on the drawings. A license shall be obtained from the Flood Control District of Maricopa County to utilize the borrow source. (Contact-Ken Johnson 506-1501)

(3) No separate payment will be made for borrow excavation. Compensation for this item will be included in the payment for Bid Item 3, Earthfill.

CONSTRUCTION SPECIFICATION

23. EARTHFILL

1. SCOPE

The work shall consist of the construction of earth embankments and other earthfills required by the drawings and specifications.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing and disposition of materials in the various fills shall be subject to approval by the Engineer.

Fill materials shall contain no sod, brush, roots or other perishable materials. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to compaction of the fill.

The types of materials used in the various fills shall be as listed and described in the specifications and drawings.

3. FOUNDATION PREPARATION

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable materials or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earthfill, and the surface materials of the foundation shall be compacted and bonded with the first layer of earthfill as specified for subsequent layers of earthfill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of two inches in depth normal to the slope and shall be at such a moisture content that the earthfill can be compacted against them to effect a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose materials by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock

outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Foundation and abutment surfaces shall be not steeper than 1 horizontal to 1 vertical unless otherwise specified. Test pits or other cavities shall be filled with compacted earthfill conforming to the specifications for the earthfill to be placed upon the foundation.

4. PLACEMENT

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Engineer. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exceed the maximum thickness specified. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of fill compacted by manually directed power tampers.

Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earthfill in dams, levees and other structures designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

a. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

b. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

c. The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of approximately 2 percent shall be maintained to insure effective drainage, and except as otherwise specified for drainfill or sectional zones.

d. Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of stream flow during construction are specifically authorized in the contract.

e. Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in place shall be stripped of all material not meeting the requirements of this specification, and shall be scarified, moistened and recompacted when the new fill is placed against it as needed to insure a good bond with the new fill and to obtain the specified moisture content and density at the contact of the in place and new fills.

5. CONTROL OF MOISTURE CONTENT

During placement and compaction of fill, the moisture content of the materials being placed shall be maintained within the specified range:

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary. Uniform moisture distribution shall be obtained by disking.

Material that is too wet when deposited on the fill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacted fill or a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

6. COMPACTION

Earthfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction. Each layer of fill shall be compacted as necessary to make the density of the fill matrix not less than the minimum density specified. The fill matrix is defined as the portion of the fill material finer than the maximum particle size used in the compaction test method specified.

Class B compaction. Each layer of fill shall be compacted to a mass density not less than the minimum density specified.

Class C compaction. Each layer of fill shall be compacted by the specified number of passes of the type and weight of roller or other equipment specified, or by an approved equivalent method. Each pass shall consist of at least one passage of the roller wheel or drum over the entire surface of the layer.

Fill adjacent to structures shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping or manually directed power tampers or plate vibrators. Unless otherwise specified, heavy equipment including backhoe mounted powertampers, or vibrating compactors and manually directed vibrating rollers, shall not be operated within 2 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist will not be permitted.

The passage of heavy equipment will not be allowed: (1) over cast-in-place conduits prior to 14 days after placement of the concrete; (2) over cradled or bedded precast conduits prior to 7 days after placement of the concrete cradle or bedding; or (3) over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 2 feet, whichever is greater.

Compacting of fill adjacent to structures shall not be started until the concrete has attained the strength specified in Section 10 for this purpose. The strength will be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determining when a structure may be put into service.

When the required strength of the concrete is not specified as described above, compaction of fill adjacent to structures shall not be started until the following time intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and spillway risers, cast-in-place (with inside forms in place)	7 days
Conduits and spillway risers, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Cantilever outlet bents (backfilled) both sides simultaneously)	3 days

7. REWORKING OR REMOVAL AND REPLACEMENT OF DEFECTIVE FILL

Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

8. TESTING

During the course of the work, the Engineer will perform such tests as are required to identify materials, to determine compaction characteristics, to determine moisture content, and to determine density of fill in place. These tests performed by the Engineer will be used to verify that the fills conform to the requirements of the specifications. Such tests are not intended to provide the Contractor with the information required by him for the proper execution of the work and their performance shall not relieve the Contractor of the necessity to perform tests for that purpose.

Densities of fill requiring Class A compaction will be determined by the Engineer in accordance with ASTM Method D 1556, D 2167, D 2922 or D 2937 except that the volume and moist weight of included rock particles larger than those used in the compaction test method specified for the type of fill will be determined and deducted from the volume and moist weight of the total sample prior to computation of density or if using the nuclear gauge, added to the specified density to bring it to the measure of equivalent composition for comparison. The density so computed will be used to determine the percent compaction of the fill matrix. Unless otherwise specified, moisture content will be determined by one of the following methods: ASTM Method D 2216 or D 3017.

9. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill within the specified zone boundaries and pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified, no deduction in volume will be made for embedded conduits and appurtenances.

The pay limits shall be as defined below, with the further provision that earthfill required to fill voids resulting from overexcavation of the foundation, outside the specified lines and grades, will be included in the measurement for payment only where such overexcavation is directed by the Engineer to remove unsuitable material and where the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Method 1 The pay limits shall be as designated on the drawings.

Method 2 The pay limits shall be the measured surface of the foundation when approved for placement of the fill and the specified neat lines of the fill surface.

Method 3 The pay limits shall be the measured surface of the foundation when approved for placement of the fill and the measured surface of the completed fill.

Method 4 The pay limits shall be the specified pay limits for excavation and the specified neat lines of the fill surface.

Method 5 The pay limits shall be the specified pay limits for excavation and the measured surface of the completed fill.

Method 6 Payment for each type and compaction class of earthfill will be made at the contract unit price for that type and compaction class of fill. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work.

Method 7 Payment for each type and compaction class of earthfill will be made at the contract unit price for that type and compaction class of fill. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work, except furnishing, transporting, and applying water to the foundation and fill materials. Water applied to the foundation and fill materials will be measured and payment will be made as specified in Construction Specification 10.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 10 of this specification.

10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 3, Earthfill

(1) This item consists of placing and compacting all earthfill for the left O&M road and ditch as shown on the drawings.

(2) Borrow for earthfill shall be obtained from the area shown on the drawings.

(3) The maximum size of rock placed in the fill shall be six (6) inches.

(4) The maximum thickness of a layer prior to compaction shall be nine (9) inches.

(5) The fill material shall contain sufficient moisture that when a small portion is taken in the hand and squeezed, it remains intact when released and does not leave free water on the palm of the hand, and it will not ribbon or plastically deform under hand pressure.

(6) Section 6, COMPACTION, Class C shall apply. Each layer of fill shall be compacted with a minimum of four (4) passes over the entire surface by rubber tired equipment having a minimum weight of 25,000 pounds or approved equivalent method.

(7) Section 9, MEASUREMENT AND PAYMENT, will include compensation for Subsidiary Items Water, Pollution Control, Removal of Water, Borrow Excavation and Structure Backfill.

b. Subsidiary Item, Structure Backfill

(1) This item consists of all fill adjacent to the new channel concrete walls as shown on the drawings.

(2) Borrow for structure backfill shall be obtained from the area shown on the drawings.

(3) The maximum size of rock placed in the backfill shall be four (4) inches.

(4) The maximum thickness of a layer prior to compaction shall be six (6) inches.

(5) The backfill material shall contain sufficient moisture such that when a small portion is taken in the hand and squeezed, it remains intact when released and does not leave free water on the palm of the hand.

(6) Section 6, COMPACTION, Class C shall apply. Each layer of fill shall be compacted with a minimum of three (3) complete passes over the entire surface area using manually directed power tampers or plate vibrators having a minimum rated capacity of 3400 pounds per blow.

(7) Section 9, MEASUREMENT AND PAYMENT, the work will not be measured, no separate payment will be made for this item. Compensation for this work will be included in Bid Item 3, Earthfill.

CONSTRUCTION SPECIFICATION

24. DRAINFILL

1. SCOPE

The work shall consist of furnishing, placing and compacting drainfill required in the construction of structure drainage systems.

2. MATERIALS

Method 1 Drainfill materials shall conform to the requirements of Material Specification 521. At least 30 days prior to delivery of the materials to the site the Contractor shall inform the Contracting Officer in writing of the source from which he intends to obtain them. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing.

Method 2 Drainfill materials shall be sand, gravel, or crushed stone or mixtures thereof obtained from the specified sources. They shall be selected as necessary to avoid the inclusion of organic matter, clay balls, excessive fine particles or other substances that would interfere with their free-draining properties.

3. BASE PREPARATION

Foundation surfaces and trenches shall be clean and free of organic matter, loose soil, foreign substance, and standing water when the drainfill is placed. Earth surfaces upon or against which drainfill will be placed shall not be scarified.

4. PLACEMENT

Drainfill shall not be placed until the subgrade has been inspected and approved by the Engineer. Drainfill shall not be placed over or around pipe or drain tile until the installation of the pipe or tile has been inspected and approved.

Drainfill shall be placed uniformly in layers not more than 12 inches deep before compaction. When compaction is accomplished by manually controlled equipment, the layers shall be not more than 8 inches deep. the material shall be placed in a manner to avoid segregation of particle sizes and to insure the continuity and integrity of all zones. No foreign materials shall be allowed to become intermixed with or otherwise contaminate the drainfill.

Traffic shall not be allowed to cross over drains at random. Equipment crossovers shall be maintained, and the number and

location of such crossovers shall be established and approved prior to the beginning of drainfill placement. Each crossover shall be cleaned of all contaminating materials and shall be inspected and approved by the Engineer before additional drainfill is placed.

Any damage to the foundation surface or the sides or bottoms of trenches occurring during placement of drainfill shall be repaired before drainfill placement is continued.

The upper surface of drainfill constructed concurrently with adjacent zones of earthfill shall be maintained at an elevation at least one foot above the upper surface of the adjacent fill.

Drainfill over or around pipe or drain tile shall be placed in a manner to avoid any displacement in line or grade of the pipe or tile.

Drainfill shall not be placed adjacent to structures until the concrete has attained the strength specified in Section 9 of this specification. The strength shall be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determining when a structure may be put in service.

When the required strength of the concrete is not specified as described above, placement of drainfill adjacent to structures shall not be started until the following item intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and galleries, cast-in-place (with inside forms in place)	7 days
Conduits and galleries, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Cantilever outlet bents backfilled on both sides simultaneously	3 days

5. CONTROL OF MOISTURE

The moisture content of drainfill materials shall be controlled as specified in Section 9. When the addition of water is required, it shall be applied in such a way as to avoid excessive wetting to adjacent earth fill. Except as specified in Section 9, control of moisture content will not be required.

6. COMPACTION

Drainfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction. Each layer of drainfill shall be compacted to a relative density of not less than 70 percent as determined by ASTM Method D 4254.

Class I compaction. Each layer of drainfill shall be compacted by at least 2 passes, over the entire surface, of a steel-drum vibrating roller weighing not less than 5 tons and exerting a vertical vibrating force of not less than 20,000 pounds at least 1200 times per minute, or by an approved equivalent method.

Class II compaction. Each layer of drainfill shall be compacted by one of the following methods or by an approved equivalent method:

a. At least 2 passes, over the entire surface, of a pneumatic-tired roller exerting a pressure of not less than 75 pounds per square inch. A pass is defined as at least one complete coverage of the roller wheel, tire or drum over the entire surface of the layer.

b. At least 4 passes, over the entire surface, of the track of a crawler-type tractor weighing not less than 20 tons.

c. Controlled movement of the hauling equipment so that the entire surface is traversed by not less than one tread track of the loaded equipment.

Class III compaction. No compaction will be required beyond that resulting from the placing and spreading operations.

When compaction other than Class III compaction is specified materials placed in trenches or other locations inaccessible to heavy equipment shall be compacted by means of manually controlled pneumatic or vibrating tampers or by approved equivalent methods.

Heavy equipment shall not be operated within 2 feet of any structure. Vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from cranes or hoists will not be permitted.

7. TESTING

The Engineer will perform such tests as are required to verify that the drainfill materials and the drainfill in place meet the requirements of the specifications. These tests are not intented to provide the Contractor with information he needs to assure that the materials and workmanship meet the requirements of the specifications, and their performance will not relieve the Contractor of the responsibility of performing his own tests for that purpose.

8. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of drainfill within the neat lines shown on the drawings will be measured and computed to the nearest cubic yard. Where the Engineer directs placement of drainfill outside the neat lines to replace unsuitable foundation material, the volume of such drainfill will be included, but only to the extent that the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Payment for drainfill will be made at the contract unit price for each type of drainfill, complete in place. Except as otherwise specified in Section 9, such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 9 of this specification.

CONSTRUCTION SPECIFICATION

31. CONCRETE

1. SCOPE

The work shall consist of furnishing, forming, placing, finishing and curing portland cement concrete as required to build the structures designated in Section 26 of this specification.

2. MATERIALS

Portland cement shall conform to the requirements of Material Specification 531 for the specified type. One brand only of any type of cement shall be used in any single structure as defined in Section 26.

Aggregates shall conform to the requirements of Material Specification 522 unless otherwise specified. The grading of coarse aggregates shall be as specified in Section 26.

Water used in mixing or curing concrete shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter or other deleterious substances.

Air entraining admixtures shall conform to the requirements of Material Specification 532. If air-entraining cement is used, any additional air-entraining admixture shall be of the same type as that in the cement.

Pozzolan shall conform to ASTM C618, Class F, except the loss of ignition shall not exceed 3.0 percent.

Water-reducing, set-retarding admixture shall conform to the requirements of Material Specification 533.

Shear plates shall conform to the requirements of Material Specification 581 for structural quality or commercial or merchant quality steel. Structural quality shall be used if specifically designated in the drawings or specifications.

Preformed expansion joint filler shall conform to the requirements of Material Specification 535.

Waterstops shall conform to the requirements of Material Specifications 537 and 538 for the specified kinds.

Curing compound shall conform to the requirements of Material Specification 534.

3. CLASSES OF CONCRETE

Method 1 Concrete shall be classified according to the required compressive strength. The strength of the concrete at 28 days shall equal or exceed the Minimum Compressive Strength at 28 days tabulated below for the class of concrete specified.

Class of Concrete	Minimum Compressive Strength at 28 days (psi)
5000	5000
4000	4000
3000	3000
2500	2500

Method 2 Concrete shall be classified as follows:

Class of Concrete	Water Content (gallons/bag)	Cement Content (bag/cu. yd.)
5000X	5	7
4000X	6	6
3000X	7	5
2500X	8	4-1/2

4. AIR CONTENT AND CONSISTENCY

Unless otherwise specified the air content (by volume) of the concrete at the time of placement shall be:

Maximum Size Aggregate	Air Content (%)
3/8 inch to 1/2 inch	6 to 9
Over 1/2 inch to 1 inch	5 to 8
Over 1 inch to 2-1/2 inches	4 to 7

The consistency of the concrete shall be such as to allow it to be worked into place without segregation or excessive laitance. Unless otherwise specified, the slump shall be :

Type of Structure	Slump (inches)
Massive sections, pavements, footings	2 ± 1/2
Heavy beams, thick slabs, thick walls (over 12 in.)	3 ± 1/2
Columns, light beams, thin slabs, thin walls (12 in. or less)	4 ± 1

5. DESIGN OF THE CONCRETE MIX

Method 1 The Contractor will be responsible for the design of the concrete mixtures. At least 5 days prior to any placement of concrete he shall furnish the Contracting Officer a statement of the materials and mix proportion (including admixtures, if any) he intends to use for each specified class of concrete. The statement shall include evidence satisfactory to the Contracting Officer that the materials and proportions selected will produce concrete of the quality, consistency and strength specified.

The materials and proportions so stated shall constitute the "job mix". After a job mix has been designated, neither the source, character or grading of the aggregates nor the type or brand or quantity of cement or admixture shall be changed without prior notice to the Contracting Officer and establishment of a new job mix supported by evidence, as required for the initial job mix, that the proposed new materials and mix proportions will produce concrete of the quality, consistency, and strength specified.

When specified, a water-reducing, set-retarding admixture shall be used. When conditions are such that the temperature of the concrete at the time of placement is consistently above 75°F, a water-reducing, set-retarding admixture may be used, at the option of the Contractor. The cement content shall be the same as that required in the mix without the admixture.

The use of calcium chloride or other accelerators or antifreeze compounds will not be allowed.

Before placing concrete containing a water-reducing, set-retarding admixture, the Contractor shall furnish test results satisfactory to the Contracting Officer showing that its performance in the job mix meets the requirements of Material Specifications 533, Section 4.

When specified, mixes that include fly ash as a partial substitution for portland cement shall be based on absolute volume with a maximum substitution of 20 percent.

Method 2 At least 35 days prior to any placement of concrete the Contractor shall inform the Contracting Officer in writing of the source and grading of aggregates and the brand and type of cement and the brand and type of admixture, if any, he proposes to use for each class of concrete, and shall furnish test results or other evidence satisfactory to the contracting officer that the proposed materials meet the requirements of the specifications.

When acceptable sources, types and gradings of aggregates are designated in the contract, test results or other data to verify that the aggregates meet the specification will not be required. Grading will be tested at the site.

Job mix proportions and batch weights will be determined by the Engineer. During the course of the work, the Engineer will adjust the job mix proportions and batch weights whenever necessary.

After the job mix has been designated, neither the source, character or grading of the aggregates nor the type or brand of cement or admixture shall be changed without prior notice to the Engineer.

If such changes are necessary, no concrete containing such new or altered materials shall be placed until the Engineer has designated a revised job mix.

When specified, a water-reducing, set-retarding admixture shall be used. When conditions are such that the temperature of the concrete at the time of placement is consistently above 75°F, a water-reducing, set-retarding admixture may be used, at the option of the Contractor. The cement content shall be the same as that required in the mix without the admixture.

The use of calcium chloride or other accelerators or antifreeze compounds will not be allowed.

When it is anticipated that a water-reducing, set-retarding admixture will be used, the Contractor shall furnish to the Engineer a sample of the admixture he proposes to use sufficient for the tests required by Material Specification 533, Section 4. Concrete containing the admixture shall not be placed until test results have been obtained showing that its performance in the job mix meets the requirements of Material Specification 533, Section 4.

6. INSPECTING AND TESTING

During the course of the work, the Engineer will perform such tests as are required to assure the concrete meets the contract requirements. Tests performed by the Engineer are not for the purpose of providing the Contractor with the information required for proper work execution and performance and shall not relieve the Contractor of the necessity to perform tests for that purpose.

The following tests will be performed by the methods indicated:

Test	Method (ASTM Designation)
Sampling	C 172 1/
Slump Test	C 143 1/
Air Content	C 231 1/ or C 173 1/
Compression Test Specimens	C 31 1/, C 42 or C 684 2/
Compressive Strength	C 39 2/ or C 42
Unit Weight	C 138

1/ Test of a portion of a batch may be made on samples representative of that portion for any of the following purposes:

(1) Determining uniformity of the batch.

(2) Checking compliance with requirements for slump and air content when the batch is discharged over an extended period of time.

(3) Checking compliance of the concrete with the specifications when the whole amount being placed in a small structure, or a distinct portion of a larger structure, is less than full batch.

2/ For each strength test of specimens made according to ASTM Designation C 39 or C 684, three (3) standard test specimens shall be made. The test result shall be the average of the strength of the three (3) specimens, except that if one (1) specimen in the test shows manifest evidence of improper sampling, molding or testing, it shall be discarded and the strengths of the remaining two (2) specimens shall be averaged. Should more than one (1) specimen representing a test show such defects, the entire test shall be discarded.

The Engineer shall have free entry to the plant and equipment furnishing concrete under the contract. Proper facilities shall be provided for the Engineer to inspect materials, equipment and processes, to obtain samples of the concrete. All tests and inspections will be conducted so as not to interfere unnecessarily with the manufacture and delivery of the concrete.

7. HANDLING AND MEASUREMENT OF MATERIALS

Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size will be avoided and that various sizes will not become intermixed before proportioning. Methods of handling and transporting aggregates shall be such as to avoid contamination, excessive breakage, segregation or degradation, or intermingling of various sizes.

Scales for weighing aggregates and cement shall be beam type or springless dial type. They shall be accurate within 1 percent under operating conditions. All exposed fulcrums, clevises and similar working parts of scales shall be kept clean.

The quantities of cement and aggregates in each batch of concrete, as indicated by the scales, shall be within the following percentage of the required batch weights:

Cement	plus or minus 1.0 percent
Aggregates	plus or minus 2.0 percent

Measuring tanks for mixing water shall be of adequate capacity to furnish the maximum amount of mixing water required per batch and shall be equipped with outside taps and valves to provide for checking their calibration unless other means are provided for readily and accurately determining the amount of water in the tank.

Except as otherwise provided in Section 8, cement and aggregates shall be measured as follows:

Cement shall be measured by weight or in bags of 94 lbs. each. When cement is measured by weight, it shall be weighed on a scale separate from that used for other materials, and in a hopper entirely free and independent of the hopper used for weighing the aggregates. When cement is measured in bags, no fraction of a bag shall be used unless weighed.

Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight corrected by the weight of surface moisture it contains.

Mixing water shall consist of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates and water introduced in the form of admixtures. The added water shall be measured by weight or volume to an accuracy of 1 percent of the required total mixing water. Added ice shall be measured by weight. Wash water shall not be used as a portion of the mixing water for succeeding batches.

Dry admixtures shall be measured by weight, and paste or liquid admixtures by weight or volume, within a limit of accuracy of 3 percent.

8. MIXERS AND MIXING

Mixers and mixing shall be in accordance with recommended standards set forth in ACI 304, some specific interpretations of which are stated below.

Concrete may be furnished by batch mixing at the site of the work or by ready-mix methods.

Mixers shall be capable of thoroughly mixing the concrete ingredients into a uniform mass within the specified mixing time and of discharging the mix without segregation. Each mixer or agitator shall bear a manufacturer's rating plate indicating the rated capacity and recommended speeds of rotation, and shall be operated in accordance with these recommendations.

Concrete shall be uniform and thoroughly mixed when delivered to the forms. Variations in slump of more than 1 inch within a batch will be considered evidence of inadequate mixing and shall be corrected by changing batching procedures, increasing mixing time, changing mixers or other means. Mixing time shall be within the limits specified below unless the Contractor demonstrates by mixer performance tests that adequate uniformity is obtained by different times of mixing.

No mixing water in excess of the amount called for by the job mix shall be added to the concrete during mixing or hauling or after arrival at the delivery point. If less water than the design maximum water-cement ratio has been incorporated in the batch, water to compensate for up to a one (1) inch loss in slump may be added, up to the design maximum water cement ratio. Withholding some of the mixing water until the concrete arrives on the job, then adding the remaining water and turning the mixer 30 revolutions at mixing speed may overcome transporting conditions. When loss of slump or workability cannot be offset by these measures, complete mixing shall be performed on the job using centrally dry batched materials, or by on site batching and mixing.

Batch mixing at the site. For concrete mixed at the site of the work with paving mixers or stationary construction mixers, the time of mixing after all cement and aggregates are in the mixer drum shall be not less than 1-1/2 minutes. The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates and all mixing water shall be introduced into the drum before one-fourth of the mixing time has elapsed.

Controls shall be provided to insure that the batch cannot be discharged until the required time has elapsed.

If truck mixers are used, the requirements below for truck mixers and truck-mixed concrete shall apply.

Volumetric batching and continuous mixing at the site. Unless otherwise specified, volumetric batching and continuous mixing at the construction site will be permitted. The batching and mixing equipment shall conform to the requirements of ASTM Specification C 685 and shall be demonstrated prior to placement of concrete, by tests with the job mix, to produce concrete meeting the specified proportioning and uniformity requirements. Concrete made by this method shall be produced, inspected, and documented in conformance with Sections 6, 7, 8, 13, and 14 of ASTM Specification C 685.

Ready-mixed concrete. Ready-mixed concrete shall be mixed and delivered to the site of the work by one of the following methods:

a. Truck-mixed concrete--Mixed completely in a truck mixer.

b. Shrink-mixed concrete--Mixed partially in a stationary mixer, and the mixing completed in a truck mixer.

c. Central-mixed concrete--completely in a stationary mixer and the mixed concrete transported to the point of delivery in a truck agitatior or in a truck mixer operating at agitating speed or in nonagitating equipment.

Truck mixers and agitators shall be equipped with revolution counters by which the number of revolutions of the drum or blades may be readily verified.

When ready mixed concrete is furnished, the Contractor shall furnish the Engineer a statement-of-delivery ticket showing the time of loading, the revolution counter reading at the time of loading and the quantities of materials used for each load of concrete.

Truck-mixed concrete. When concrete is mixed in a truck mixer loaded to its maximum capacity, the number of revolutions of the drum or blades at mixing speed shall be not less than 70 nor more than 100. If the batch is at least 1/2 cubic yard less than maximum capacity, the number of revolutions at mixing speed may be reduced to not less than 50. Mixing in excess of 100 revolutions shall be at the speed designated by the manufacturer of the equipment as agitating speed. The mixing operation shall begin within 30 minutes after the cement has been added to the aggregates and the water shall be added during mixing. When mixing is begun during or immediately after charging, a portion of the mixing water shall be added ahead of, or with, the other ingredients.

Shrinked-mixed concrete. When concrete is partially mixed at a central plant and the mixing is completed in a truck mixer, the mixing time in the central plant mixer shall be the minimum required to intermingle the ingredients and shall be not less than 30 seconds. The mixing shall be completed in a truck mixer and the number of revolutions of the drum or blades at mixing speed shall be not less than 50 nor more than 100. Mixing in excess of 100 revolutions shall be at the speed designated by the manufacturer of the equipment as agitating speed.

Central-mixed concrete. For central-mixed concrete, mixing in the stationary mixer shall meet the same requirements as batch mixing at the site.

When an agitator, or truck mixer used as an agitator, transports concrete that has been completely mixed in a stationary mixer, mixing during transportation shall be at the speed designated by the manufacturer of the equipment as agitating speed.

The use of nonagitating equipment to transport concrete to the site of the work will be permitted only if the consistency and uniformity of the concrete as discharged at the point of delivery meet the requirements of this specification. Bodies of nonagitating hauling equipment shall be so constructed that leakage of the concrete mix, or any part thereof will not occur. Concrete hauled in open-top vehicles shall be protected from rain, and from more than 20 minutes exposure to the sun when the air temperature is above 75°F.

9. FORMS

Forms shall be of wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags or other irregularities. Forms shall be coated with a nonstaining form oil before being set into place.

Metal ties or anchorages within the forms shall be equipped with cones, she-bolts or other devices that permit their removal to a depth of at least one inch without injury to the concrete. Ties designed to break off below the surface of the concrete shall not be used without cones.

All edges that will be exposed shall be chamfered, unless finished with molding tools as specified in Section 20.

10. PREPARATION OF FORMS AND SUBGRADE

Prior to placement of concrete the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. Any form release agent on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed.

Rock surfaces shall be cleaned by air-water cutting, wet sandblasting or wire brush scrubbing, as necessary, and shall be wetted immediately prior to placement of concrete. Earth surfaces shall be firm and damp. Placement of concrete on mud, dried earth, uncompacted fill or frozen subgrade will not be permitted. All ice, snow and frost shall be removed and the temperature of all surfaces to be in contact with the new concrete shall be no colder than 40°F.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Weepholes in walls or slabs shall be formed with nonferrous materials.

11. CONVEYING

Concrete shall be delivered to the site and discharged into the forms within 1-1/2 hours after the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85°F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

The Engineer may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the forms as rapidly as practicable, by methods that will prevent segregation of the aggregates or loss of mortar.

12. PLACING

Concrete shall not be placed until the subgrade, forms and steel reinforcement have been inspected and approved.

The Contractor shall have all equipment and materials required for curing available at the site ready for use before placement of concrete begins.

No concrete shall be placed except in the presence of the Engineer. The Contractor shall give reasonable notice to the Engineer each time he intends to place concrete. Such notice shall be far enough in advance to give the Engineer adequate time to inspect the subgrade, forms, steel reinforcement and other preparations for compliance with specifications. Other preparations include but are not limited to the concrete batching plant, mixing and delivery equipment and system, placing and finishing equipment and system, schedule of work, work force and heating or cooling facilities as applicable. All deficiencies are to be corrected before concrete is delivered for placing.

The concrete shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The depositing of concrete shall be regulated so that the concrete can be consolidated with a minimum of lateral movement.

Concrete shall not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation.

13. LAYERS

Unless otherwise specified, slab concrete shall be placed to design thickness in one continuous layer. Formed concrete shall be placed

in horizontal layers not more than 20 inches thick. Hoppers and chutes, pipes or "elephant trucks" shall be used as necessary to prevent splashing of mortar on the forms and reinforcing steel above the layer being placed.

Successive layers shall be placed at a fast enough rate to prevent the formation of "cold joints". If the surface of a layer of concrete in place sets to the degree that it will not flow and merge with the succeeding layer when vibrated, the Contractor shall discontinue placing concrete and shall make a construction joint according to the procedure specified in Section 15.

If placing is discontinued when an incomplete layer is in place, the unfinished end of the layer shall be formed by a vertical bulkhead.

14. CONSOLIDATING

Unless otherwise specified, concrete shall be consolidated with internal type mechanical vibrators capable of transmitting vibration to the concrete at frequencies not less than 6000 impulses per minute.

The location, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface.

The Contractor shall provide a sufficient number of vibrators to properly consolidate the concrete immediately after it is placed in the work. Vibration shall be applied to the freshly deposited concrete by slowly inserting and removing the vibrator at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. The vibrator shall extend into the previously placed layer of fresh concrete, at all points, to insure effective bond between layers.

Vibration shall not be applied directly to the reinforcement steel or the forms nor to concrete that has hardened to the degree that it does not become plastic when vibrated.

The use of vibrators to transport concrete in the forms or conveying equipment will not be permitted.

Vibration shall be supplemented by spading and hand tamping as necessary to insure smooth and dense concrete along form surfaces, in corners and around embedded items.

15. CONSTRUCTION JOINTS

Construction joints shall be made at the locations shown on the drawings. If construction joints are needed which are not shown on the drawings, they shall be placed in locations approved by the Engineer.

Where a feather edge would be produced at a construction joint, as in the top surface of a sloping wall, an insert form shall be used so that the resulting edge thickness on either side of the joint is not less than 6 inches.

In walls and columns as each lift is completed, the top surfaces shall be immediately and carefully protected from any condition that might adversely affect the hardening of the concrete.

Steel tying and form construction adjacent to concrete in place shall not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms shall be retightened. New concrete shall not be placed until the hardened concrete has cured at least 12 hours.

Method 1 Surfaces of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, stains or debris by either sandblasting after the concrete has gained sufficient strength to resist excessive cutting, or air-water cutting as soon as the concrete has hardened sufficiently to prevent the jet from displacing the coarse aggregates, or both. The surface of the concrete in place shall be cut to expose clean, sound aggregate but not so deep as to undercut the edges of larger particles of the aggregate. After cutting, the surface shall be thoroughly washed to remove all loose material. If the surface is congested by reinforcing steel, is relatively inaccessible, or it is considered undesirable to disturb the concrete before it is hardened, cleaning of the joint by air-waterjets will not be permitted and the wet sandblasting method will be required after the concrete has hardened.

The surfaces shall be kept moist for at least one hour prior to placement of new concrete. The new concrete shall be placed directly on the cleaned and washed surface.

Method 2 Surfaces of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, stains, or debris by washing and scrubbing with a wire brush or wire broom or by other means approved by the Engineer. The surfaces shall be kept moist for at least one hour prior to placement of new concrete. The new concrete shall be placed directly on the cleaned and washed surface.

16. EXPANSION AND CONTRACTION JOINTS

Expansion and contraction joints shall be made only at locations shown on the drawings.

Exposed concrete edges at expansion and contraction joints shall be carefully tooled or chamfered, and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

When open joints or weakened plane "dummy" joints are specified, the joints shall be constructed by the insertion and subsequent removal of a wood strip, metal plate or other suitable template in such a manner that the corners of the concrete will not be chipped or broken. The edges of the concrete at the joints shall be finished with an edging tool prior to removal of the joint strips.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

17. WATERSTOPS

Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in metal waterstops shall be brazed or welded. Joints in rubber or plastic waterstops shall be cemented, welded or vulcanized as recommended by the manufacturer.

18. REMOVAL OF FORMS

Forms shall be removed only when the Engineer is present and has given approval. Forms shall be removed in such a way as to prevent damage to the concrete. Supports shall be removed in a manner that will permit the concrete to take the stresses due to its own weight uniformly and gradually.

Method 1 Forms shall not be removed sooner than the following minimum times after the concrete is placed. These periods represent cumulative number of days and fractions of days, not necessarily consecutive, during which the temperature of the air adjacent to the concrete is above 50°F.

Element	Time
Beams, arches - supporting forms and shoring	14 days
Conduits, deck slabs - supporting (inside) forms and shoring	7 days
Conduits (outside forms), sides of beams, small structures	24 hours
Columns, walls, spillway risers - with side or vertical load	7 days
Columns, walls, spillway riser - with no side or vertical load:	
Concrete supporting more than 30 feet of wall in place above it	7 days
Concrete supporting 20 to 30 feet of wall in place above it [1/]	3 days
Concrete supporting not more than 20 feet of wall in place above it [1/]	24 hours

[1/] Age of stripped concrete shall be at least 7 days before any load is applied other than the weight of the column or wall, forms and scaffolds for succeeding lifts.

Method 2 Forms, supports and housings shall not be removed until the concrete has attained the strength specified in Section 26 for this purpose. The strength will be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determining form removal time.

19. FINISHING FORMED SURFACES

All concrete surfaces shall be true and even, and shall be free from open or rough spaces, depressions or projections.

Immediately after the removal of forms:

All bulges, fins, form marks or other irregularities which in the judgment of the Engineer will adversely affect the appearance or the function of the structure shall be removed. All form bolts and ties shall be removed to a depth at least 1 inch below the surface of the concrete. The cavities produced by form ties and all other holes of similar size and depth shall be thoroughly cleaned and, after the interior surfaces have been kept continuously wet for at least 3

hours, shall be carefully packed with a dry patching mortar mixed not richer than 1 part cement to 3 parts sand. Patching mortar shall be mixed in advance and allowed to stand without addition of water until it has reached the stiffest consistency that will permit placing. Manipulation of the mortar with a trowel during this period shall be performed as required to insure the proper consistency.

Holes left by form bolts or straps which pass through the wall shall be filled solid with mortar.

Patching mortar shall be thoroughly compacted into place to form a dense, well-bonded unit, and the in-place mortar shall be sound and free from shrinkage cracks.

All repaired areas shall be cured as specified in Section 21.

20. FINISHING UNFORMED SURFACES

All exposed surfaces of the concrete shall be accurately screeded to grade and then float finished, unless specified otherwise.

After placing and consolidating the concrete, all exposed surfaces shall be accurately struck off to grade. Following strike-off, the surfaces shall be immediately smoothed by darbying or bull floating before any free water has bled to the surface. The concrete will then be allowed to rest until the bleed water and water sheen has left the surface and the concrete has stiffened to where it will sustain foot pressure with only about 1/4 inch (6mm) indentation. At this time all joints and edges that will be exposed to view that are not chamfered shall be finished with edging and/or molding tools. After edging and hand-jointing is complete, all exposed surfaces shall be floated with wood or magnesium floats. The floating should work the concrete no more than necessary to remove screed, edger and jointer marks and produce a compact surface, uniform in texture.

Joints and edges on unformed surfaces shall be chamfered or finished with molding tools.

21. CURING

Concrete shall be cured in accordance with the recommended practice of ACI 308, of which some specific interpretations are set forth below.

Concrete shall be prevented from drying for a period of at least 7 days after it is placed. Exposed surfaces and concrete formed in absorptive wood forms shall be kept continually wet during the entire curing period or until the forms have been removed. After forms have been removed, the exposed surface shall be kept continuously wet until patching and repair are complete and until the curing period is completed or until a curing compound is applied.

Moisture can be maintained by sprinkling, flooding or fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand or and approved material. Water and/or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

Except as otherwise specified in Section 26, curing compound may be used for exposed surfaces or formed surfaces after patching and repair have been completed. Unless otherwise specified, the curing compound shall be white pigmented and conform to ASTM C 309 Type 2, Class A or B. If surface coatings are to be applied to concrete where curing compound is use, Type 2, Class B shall be used and allowed to age a minimum of 30 days prior to the application of the coating. Clear curing compound (Type 1) or clear with fugitive dye (Type 1-D) may be used only when specified in Section 26.

Curing compound shall be thoroughly mixed before applying and agitated during application. It shall be applied using a continuously agitating pressure sprayer at a uniform rate of not less than one gallon per 150 square feet of surface. It shall form a uniform continuous, adherent film that shall not check, crack or peel and shall be free from pinholes or other imperfections.

All surfaces covered with curing compound shall be continuously protected from damage to the protective film during the required curing period.

Surfaces subjected to heavy rainfall or running water within 3 hours after the compound has been applied, or surfaces damaged by subsequent construction operations during the curing period shall be resprayed in the same manner as for the original application.

Unless otherwise specified in Section 26, curing compound shall not be applied to construction joints or other areas that are to receive additional concrete, paint or other material that require a positive bond.

Water for curing shall be clean and free from any substances that will cause discoloration of the concrete.

22. REMOVAL, REPLACEMENT, OR REPAIR

When concrete is honeycombed, damaged or otherwise defective, the Contractor shall remove and replace the structure or structural member containing the defective concrete, or correct or repair the defective parts. The Contracting Officer will determine the required extent of removal, replacement or repair and advise the Contractor, in writing, of this determination.

Prior to starting repair work the Contractor shall obtain the Contracting Officer's approval of his plan for making the repair. The appropriate methods described in Chapter VII of the Concrete

Manual, Bureau of Reclamation, U.S. Department of the Interior, shall be used as the primary reference for repairs. If approved in writing by the Contracting Officer, proprietary compounds for adhesion or as patching ingredients may be used. Such compounds shall be used in accordance with the manufacturer's recommendations.

Approval of the Contractor's repair plan shall not be considered a waiver of the Contracting Officer's right to require complete removal of defective work if the completed repair does not produce concrete of the required quality and appearance.

Repair work shall be performed only when the Engineer is present.

Repair of formed surfaces shall be started within 24 hours after removal of the forms.

Curing as specified in Section 21 shall be applied to repaired areas immediately after the repairs are completed.

23. CONCRETING IN COLD WEATHER

Concreting in cold weather shall be performed in accordance with ACI 306 Recommended Practice for Cold Weather Concreting, of which some specific interpretations are set forth below.

When the atmospheric temperature may be expected to drop below 40°F at the time concrete is delivered to the work site, during placement, or at any time during the curing period, the following provisions also shall apply:

a. The temperature of the concrete at time of placing shall not be less than 50°F nor more than 90°F. The temperature of neither aggregates nor mixing water shall be more than 140°F just prior to mixing with the cement.

b. When the minimum daily atmospheric temperature is less than 40°F, concrete structures shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the concrete shall be maintained at not less than 50°F nor more than 90°F for the duration of the curing period.

c. Methods of insulating, housing and heating the structure shall conform to "Recommended Practice for Cold Weather Concreting," ACI Standard 306.

d. When dry heat is used to protect concrete, means of maintaining an ambient humidity of at least 40 percent shall be provided unless the concrete has been coated with curing compound as specified in Section 21 or is covered tightly with an approved impervious material.

24. CONCRETING IN HOT WEATHER

Concreting in Hot Weather shall be in accordance with the recommended practice of ACI 305, of which some specific interpretations are set forth below.

For the purpose of the specification hot weather is defined as any combination of high temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

When climatic or other conditions are such that the temperature of the concrete may reasonably be expected to exceed 90°F at the time of delivery at the work site, during placement, or during the first 24 hours after placement, the following provisions shall apply;

a. The Contractor shall maintain the temperature of the concrete below 90°F during mixing, conveying, and placing.

b. The concrete shall be placed in the work immediately after mixing. Truck mixing shall be delayed only until time enough remains to accomplish it before the concrete is placed.

c. Exposed concrete surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or other means to maintain adequate moisture during the time between placement and finishing, and after finishing.

d. Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay.

e. Formed surfaces shall be kept completely and continuously wet for the duration of curing period (prior to, during and after form removal) or until curing compound is applied as specified in subsection g, below.

f. Concrete surfaces, especially flat work placed with large areas of surface, shall be covered as soon as the concrete has sufficiently hardened and shall be kept continuously wet for at least 24 hours of the curing period. This protective method may be continued for the required curing period or until curing compound as specified in (g) below is applied:

g. Moist curing may be discontinued before the end of the curing period if white pigmented curing compound is applied immediately, following the procedures specified in Section 21.

h. In extreme conditions it may be necessary to (1) restrict placement to late afternoon or evening (2) restrict the depth of layers to assure coverage of the previous layer while it

will still respond readily to vibration, (3) suspend placement until conditions improve, and (4) remove forms, repair, patch and reapply wet curing by small areas at a time.

25. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, concrete will be measured to the neat lines or pay limits shown on the drawings, and the volume of concrete will be computed to the nearest 0.1 cubic yard. No deduction in volume will be made for chamfers, rounded or beveled edges, or for any void or embedded item that is less than five cubic feet in volume. Where concrete is placed against the sides or bottom of an excavation without intervening forms, drainfill, or bedding, the volume of concrete required to fill voids resulting from overexcavation outside the neat lines or pay limits will be included in the measurement for payment where such overexcavation is directed by the Engineer to remove unsuitable foundation material; but only to the extent that the unsuitable condition is not a result of the Contractor's improper construction operations, as determined by the Contracting Officer.

Method 1 Payment for each item of concrete will be made at the contract unit price for that item. The payment for concrete will constitute full compensation for all labor, materials, equipment, transportation, tools, forms, falsework, bracing and all other items necessary and incidental to completion of the concrete work, such as joint fillers, waterstops, dowels or dowel assemblies and shear plates, but not including reinforcing steel or other items listed for payment elsewhere in the contract.

Measurement and payment for furnishing and placing reinforcing steel will be made as specified in Construction Specification 34.

Method 2 Payment for each item of concrete will be made at the contract unit price for that item. The payment for concrete will constitute full compensation for all labor, materials, equipment, transportation, tools, forms, falsework, bracing and all other items necessary and incidental to completion of the concrete work, such as joint fillers, waterstops, dowels or other assemblies, and shear plates, but not including furnishing and placing reinforcing steel or furnishing and handling cement or other items listed for payment elsewhere in the contract.

Measurement and payment for furnishing and placing reinforcing steel will be made as specified in Construction Specification 34.

Cement will be measured by dividing the volume of concrete accepted for payment by the yield of the applicable job mix. The yield will be determined by the procedure specified in ASTM Designation C 138.

If the amount of cement actually used per batch exceeds the amount in the job mix specified by the Engineer, the measurement will be based on the latter. One barrel of cement will be considered equal to 4 bags or 376 pounds. Payment for each type of cement will be made at the contract unit price for furnishing and handling that type of cement and such payment will constitute full compensation for all materials, labor, equipment, storage, transportation and all other items necessary and incidental to furnishing and handling the cement.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is make subsidiary. Such items and the items to which they are made subsidiary are identified in Section 26 of this specification.

26. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 3, Concrete Channel Lining

(1) This item consists of furnishing, forming and placing all concrete to construct the outlet channel and headwalls as shown on the drawings.

(2) In Section 2, MATERIALS, the materials shall be as follows:

(a) Portland Cement shall be Type II or IIA.

(b) The joint sealing compound shall be Type S. Grade NS, use T or NT, low modules silicone conforming to the requirements of ASTM C 920 and shall tolerate submergence by intermittent flood flows. The sealant shall have the capability to withstand without failure an increase of 50 percent and decrease of 50 percent of the joint width as measured at the time of application when tested in accordance with ASTM C 719. The elongation shall be a minimum of 800 percent without failure when tested in accordance with ASTM D 412, and 500 percent without adhesion failure when tested in accordance with ASTM D 3583 (modified).

The sealant material shall show no evidence of failure from accelerated weathering per ASTM C 793 after 5000 hours.

(c) Backer rod shall be closed cell, non-gassing, expanded polyethylene polyurethane or polyvinyl chloride polypropylene flexible foam compatible with the sealant. The rod shall be sized to fit tightly, installed in accordance with the manufacturer's recommendations, and as shown on the drawing.

(3) Section 3, CLASSES OF CONCRETE, Method 1 shall apply and the concrete shall be Class 4000.

(4) Coarse aggregate shall be size No. 57 in accordance with ASTM C 33.

(5) In Section 18, REMOVAL OF FORMS, Method 1 shall apply.

(6) Pozzolan shall be used as a partial substitute for portland cement.

(7) In Section 15, CONSTRUCTION JOINTS, Method 1 shall apply.

(8) Sealant installation and cleaning shall be in accordance with Construction Specification 400, Section 3, JOINT SEALANT FOR CONCRETE LINED FLOODWAYS.

(9) All plant roots will be removed from joints and a soil sterilant equal or equivalent to Pramitol shall be applied per manufacturers recommendation.

(10) In Section 25, MEASUREMENT AND PAYMENT, payment will include compensation for Subsidiary Items: Water; Removal of Water; Channel Excavation; Borrow Excavation, Common; Earthfill; and Surveys.

CONSTRUCTION SPECIFICATION

34. STEEL REINFORCEMENT

1. SCOPE

The work shall consist of furnishing and placing steel reinforcement for reinforced concrete or pneumatically applied mortar.

2. MATERIALS

Steel reinforcement shall conform to the requirements of Material Specification 539. Before reinforcement is placed, the surfaces of the bars and fabric and any metal supports shall be cleaned to remove any loose, flaky rust, mill scale, oil, grease or other coatings or foreign substances. After placement, the reinforcement shall be maintained in a clean condition until it is completely embedded in the concrete.

3. BAR SCHEDULE, LISTS AND DIAGRAMS

Any supplemental bar schedules, bar lists or bar-bending diagrams required to accomplish the fabrication and placement of reinforcement shall be provided by the Contractor. Prior to placement of reinforcement, the Contractor shall furnish four prints or copies of any such lists or diagrams to the Contracting Officer. Acceptance of the reinforcement will not be based on approval of these lists or diagrams but will be based on inspection of the reinforcement after it has been placed.

4. BENDING

Reinforcement shall be cut and bent in compliance with the requirements of the American Concrete Institute Standard 315. Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks, cracks or improper bends will be rejected.

5. SPLICING BAR REINFORCEMENT

Method 1 Splices of reinforcement shall be made only at locations shown on the drawings and provided by the steel schedule. Placement of bars at the lap splice locations shown, when not in contact, shall not be farther apart than one-fifth the shown lap length and in any case no greater than 6 inches.

Method 2 Splices of reinforcement shall be limited to those locations shown on the drawings. Splice lengths shall be determined prior to fabrication and meet the requirements of ACI Standard 318

"Building Code Requirements for Reinforced Concrete" based upon design information contained in Section 10 of this specification. Bar placement drawings and schedules shall be provided for approval prior to fabrication. The drawings shall show all splice locations, layouts, and lap distances.

6. SPLICING WELDED WIRE FABRIC

Unless otherwise specified, welded wire fabric shall be spliced in the following manner:

a. Adjacent sections shall be spliced end to end (longitudinal lap) by overlapping a minimum of one full mesh plus 2 inches plus the length of the two end overhangs. The splice length is measured from the end of the longitudinal wires in one piece of fabric to the end of the longitudinal wires in the lapped piece of fabric.

b. Adjacent sections shall be spliced side to side (transverse lap) a minimum of one full mesh plus 2 inches. The splice length shall be measured from the centerline of the first longitudinal wire in one piece of fabric to the centerline of the first longitudinal wire in the lapped piece of fabric.

7. PLACING

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. Tack welding of bars will not be permitted. Metal chairs, metal hangers, metal spacers and concrete chairs may be used to support the reinforcement. Metal hangers, spacers and ties shall be placed in such a manner that they will not be exposed in the finished concrete surface. The legs of metal chairs or side form spacers that may be exposed on any face of slabs, walls, beams or other concrete surfaces shall have a protective coating or finish by means of hot dip galvanizing, epoxy coating, plastic coating, or be stainless steel. Metal chairs and spacers not fully covered by a protective coating or finish shall have a minimum cover of 3/4 inch of concrete over the unprotected metal portion except for those with plastic coatings may have a minimum cover of 1/2 inch of concrete over the unprotected metal portion. Precast concrete chairs shall be manufactured of the same class of concrete as that specified for the structure and shall have tie wires securely anchored in the chair or a V-shaped groove at least 3/4 inch in depth molded into the upper surface to receive the steel bar at the point of support. Precast concrete chairs shall be moist at the time concrete is placed.

High density or structural plastic rebar accessories, designed to insure maximum concrete bond, may be substituted for metal or concrete accessories in spacer applications as approved by the

Contracting Officer. Exposure of plastic rebair accessories at the finished concrete surface shall be kept to a minimum. Plastic rebar accessories, if used, shall be staggered along adjacent parallel bars and shall be placed at intervals no closer than 12 inches. Plastic rebar accessories shall not be used in concrete sections 6 inches or less in thickness.

Reinforcement shall not be placed until the prepared site has been inspected and approved by the Engineer. After placement of the reinforcement, concrete shall not be placed until the reinforcement has been inspected and approved by the Engineer.

8. STORAGE

Steel reinforcement stored at the work site shall be placed above the ground surface on platforms, skids or other supports and protected from mechanical damage or corrosion.

9. MEASUREMENT AND PAYMENT

Method 1 For items of work for which specific unit prices are established in the contract, the weight of reinforcement placed in the concrete in accordance with the drawings will be determined to the nearest pound by computation from the placing drawings. Measurement of hooks and bends will be based on the requirements of ACI Standard 315. Computation of weights of reinforcement will be based on the unit weights established in Tables 34-1 and 34-2. Computation of weights for welded wire fabric not shown in Table 34-2 shall be based on ACI Standard 315. The area of welded wire fabric reinforcement placed in the concrete in accordance with the drawings will be determined to the nearest square foot by computation from the placing drawings with no allowance for laps. The weight of steel reinforcing in extra splices or extra length splices approved for the convenience of the Contractor or the weight of supports and ties will not be included in the measurement for payment.

Payment for furnishing and placing reinforcing steel will be made at the contract unit price. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the completion of the work including preparing and furnishing bar schedules, lists or diagrams; furnishing and attaching ties and supports; and furnishing, transporting, storing, cutting, bending, cleaning and securing all reinforcements.

Method 2 For items of work for which specific unit prices are established in the contract, the weight of bar reinforcement placed in the concrete in accordance with the drawings will be determined to the nearest pound by computation from the placing drawings.

Measurement of hooks and bends will be based on the requirements of ACI Standard 315. Computation of weights of bar reinforcement will be based on the unit weights established in Table 34-1. The weight of steel reinforcing in extra splices or extra length splices approved for the convenience of the Contractor or the weight of supports and ties will not be included in the measurement for payment.

The area of welded wire fabric reinforcement placed in the concrete in accordance with the drawings will be determined to the nearest square foot by computation from the placing drawings with no allowance for laps.

Payment for furnishing and placing bar reinforcing steel will be made at the contract unit price for bar reinforcement. Payment for furnishing and placing welded wire fabric reinforcing steel will be made at the contract unit price for welded wire fabric reinforcement. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the completion of the work including preparing and

furnishing bar schedules, lists or diagrams; furnishing and attaching ties and supports; and furnishing, transporting, cutting, bending, cleaning, and securing all reinforcement.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items to which they are made subsidiary are identified in Section 10 of this specification.

TABLE 34-1. STANDARD REINFORCING BARS

Bar Size No.	Wt. (lb./ft.)
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.670
9	3.400
10	4.303
11	5.313
14	7.65
18	13.60

TABLE 34-2. RECTANGULAR WELDED WIRE FABRIC [1]

Style Designation By Steel Wire Gauge	Style Designation By W-Number	Weight, lb. Per 100 Sq. Ft.
6 x 6 - 10 x 10	6 x 6 - W1.4 x W1.4	21
6 x 6 - 8 x 8	6 x 6 - W2.1 x W2.1	30
6 x 6 - 6 x 6	6 x 6 - W2.9 x W2.9	42
6 x 6 - 4 x 4	6 x 6 - W4.0 x W4.0	58
4 x 4 - 10 x 10	4 x 4 - W1.4 x W1.4	31
4 x 4 - 8 x 8	4 x 4 - W2.1 x W2.1	44
4 x 4 - 6 x 6	4 x 4 - W2.9 x W2.9	62
4 x 4 - 4 x 4	4 x 4 - W4.0 x W4.0	85
4 x 12 - 8 x 12	4 x 12 - W2.1 x W0.9 [2]	25
4 x 12 - 7 x 11	4 x 12 - W2.5 x W1.1 [2]	31

1/ Style designation is defined in ACI Standard 315 of the American Concrete Institute.

2/ Welded smooth wire fabric with wires smaller than Size W1.4 is manufactured from galvanized wire.

10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Steel Reinforcement

(1) This item consists of furnishing and installing all steel reinforcement to construct the concrete channel lining as shown on the drawings.

(2) Section 5, SPLICING BAR REINFORCEMENT, minimum splice length shall be 15 inches.

(3) No separate payment will be made for steel reinforcement. Compensation for this item will be included in Bid Item 4, Concrete.

CONSTRUCTION SPECIFICATION

62. GROUTED ROCK RIPRAP

1. SCOPE

The work shall consist of furnishing, transporting, and placing rock and concrete grout in the construction of grouted rock riprap sections.

2. MATERIALS

Rock for grouted rock riprap shall conform to the requirements of Material Specification 523, or if so specified shall be obtained from designated sources. It shall be free from dirt, clay, sand, rock fines, and other materials not meeting the required gradation limits.

At least 30 days prior to delivery of rock from other than designated sources, the Contractor shall designate, in writing, the source from which he intends to obtain the rock and information satisfactory to the Contracting Office that the material meets the requirements of the contract. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock shall be as specified in Section 13 of this specification.

Rock from designated sources shall be excavated, selected and processed as necessary to meet the quality and grading requirements in Section 13 of this specification. The rock shall conform to the specified grading limits when installed in the riprap.

Filter or bedding materials when required, shall unless otherwise specified, conform to the requirements of Material Specification 521.

Portland cement shall conform to the requirements of Material Specification 531 for the specified type.

Pozzolan. Unless otherwise specified in Section 13 of this specification, pozzolans conforming to Specification ASTM C-618 class F in amounts not to exceed 20 percent, based on absolute volume, may be substituted for an equivalent amount of portland cement in the grout mixture.

Aggregates shall conform to the requirements of Material Specification 522, except that the grading for coarse aggregate shall be as specified in the construction details.

Water shall be clean and free from injurious amounts of oils, acid, alkali, organic matter or other deleterious substances.

Air-entraining admixtures shall conform to the requirements of Material Specification 532.

Curing compound shall conform to the requirements of Material Specification 534.

Other admixtures, when required, shall be as specified in the construction details.

3. SUBGRADE PREPARATION

Riprap or filter shall not be placed until the subgrade surfaces have been inspected and approved by the Engineer.

4. FILTER LAYERS OR BEDDING

When filter layers or bedding beneath the riprap is specified, the material shall be spread uniformly on the prepared subgrade surfaces to the depth shown on the drawings. Compaction of the material will not be required but the surfaces of such layers shall be finished reasonably free of mounds, dips, or windrows.

5. PLACING ROCK

The rock shall be placed on the surfaces and to the depths specified in such a manner as to avoid displacement of the underlying materials. The rock may be equipment or hand placed as necessary to produce a surface in which the tops of the individual rocks do not vary more than the specified deviation from the neat lines shown on the drawings. Double decking of thin, flat rocks to bring the surface up to the required grade will not be permitted.

6. DESIGN OF THE GROUT MIX

The mix proportions for the grout mix shall be as specified in the construction details. During the course of the work the Engineer will require adjustment of the mix proportions whenever necessary. After the mix has been designated, it shall not be changed without the approval of the Engineer.

7. HANDLING AND MEASUREMENT OF MATERIAL

Materials shall be stockpiled and batched by methods that will prevent segregation or contamination of aggregates and insure accurate proportioning of the ingredients of the mix.

Except as otherwise provided in Section 11, cement and aggregates shall be measured as follows:

Cement shall be measured by weight or in bags of 94 pounds each. When cement is measured in bags, no fraction of a bag shall be used unless weighed.

Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight plus the weight of surface moisture it contains.

Water shall be measured, by volume or by weight, to an accuracy within one percent of the total quantity of water required for the batch.

Admixtures shall be measured within a limit of accuracy of ±3 percent.

8. MIXERS AND MIXING

The mixer, when loaded to capacity, shall be capable of combining the ingredients of the grout mix into a thoroughly mixed and uniform mass and of discharging it with a satisfactory degree of uniformity.

Mixer shall be operated within the limits of the manufacturer's guaranteed capacity and speed of rotation.

The time of mixing after all cement and aggregates are in the mixer drum shall be not less than one minute for mixers having a capacity of one cubic yard or less. For mixers of larger capacities, the minimum time shall be increased fifteen seconds for each cubic yard or fraction thereof of additional capacity. The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate, and all mixing water shall be introduced into the drum before one-fourth of the mixing time has elapsed.

When ready-mixed grout mix is furnished, the Contractor shall furnish to the Engineer a delivery ticket showing the time of loading and the quantities of materials used for each load of grout mix.

No mixing water in excess of the amount called for by the job mix shall be added to the grout mix during mixing or hauling or after arrival at the delivery point.

9. CONVEYING AND PLACING

The grout mix shall be delivered to the site and placed within 1-1/2 hours after the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. The Engineer may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the final placement as rapidly as practicable by methods that will prevent segregation of the aggregates or loss of mortar.

Grout mix shall not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation.

The grout mix shall not be placed until the rock riprap has been inspected and approved by the Engineer.

Rock to be grouted shall be kept wet for at least 2 hours immediately prior to grouting.

The rock riprap shall be flushed with water to remove the fines from the rock prior to placing the grout. The rock shall be kept moist just ahead of the actual placing, but the grout shall not be placed in standing or flowing water. Grout placed on inverts or other nearly level areas may be placed in one course. On slopes, the grout shall be placed in two (2) courses in successive lateral strips approximately ten (10) feet in width starting at the toe of the slope and progressing to the top. The grout shall be delivered to the place of final deposit by approved means and discharged directly on the surface of the rock, using a splash plate of metal or wood to prevent displacement of the rock directly under the discharge. The flow of grout shall be directed with brooms, spades or baffles to prevent it from flowing excessively along the same path and to assure that all intermittent spaces are filled. Sufficient barring shall be done to loosen tight pockets of rock and otherwise aid the penetration of grout so that all voids shall be filled and the grout fully penetrates the rock blanket. All brooming on slopes shall be uphill and after the grout has stiffened, the entire surface shall be rebroomed to eliminate runs and to fill voids caused by sloughing.

After completion of any strip or panel, no workman or other load shall be permitted on the grouted surface for a period of twenty-four (24) hours. The grouted surface shall be protected from injurious action by the sun, rain, flowing water and mechanical injury.

10. CURING AND PROTECTION

The surface of treatment materials shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied as specified below. Moisture shall be maintained by sprinkling, flooding or fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand or other approved material. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

The grouted rock may be coated with an approved curing compound in lieu of continued application of moisture. The compound shall be sprayed on the moist concrete surfaces as soon as free water has disappeared, but shall not be applied to any surface until finishing of that surface is completed. The compound shall be applied at a

uniform rate of not less than one gallon per 150 square feet of surface and shall form a continuous adherent membrane over the entire surface. Curing compound shall not be applied to surfaces requiring bond to subsequently placed concrete. If the membrane is damaged during the curing period, the damaged area shall be resprayed at the rate of application specified above.

Grout mix shall not be placed when the daily minimum temperature is less than 40°F unless facilities are provided to insure that the temperature of the materials is maintained at not less than 50°F nor more than 90°F during placement and the curing period. Grout mix shall not be placed on frozen surfaces. When freezing conditions prevail, rock to be grouted must be covered and heated to a range of 50°F to 90°F for at least 24 hours prior to placing treatment materials.

11. INSPECTING AND TESTING FRESH GROUT

The Engineer will inspect and test grout during the course of the work. Sampling of fresh grout will be done by the methods prescribed in ASTM Designation C 172. The volume of each batch will be determined by the methods prescribed in ASTM Designation C 138.

The Engineer shall have free entry to all parts of the Contractor's plant and equipment which concern mixing and placing the grout while work on the contract is being performed. Proper facilities shall be provided for the Engineer to inspect materials and processes used in mixing and placing the grout as well as for securing samples of the grout mix. All tests and inspections shall be so conducted as not to interfere unnecessarily with the mixing and placing of the grout.

When ready-mixed grout is furnished, the Contractor shall furnish to the Engineer a statement-of-delivery ticket for each batch delivered to the job site. The ticket shall show the total weights in pounds of cement, water, and fine and coarse aggregates, amount of air-entraining agent, time of loading, and the revolution counter reading at the time of batching.

12. MEASUREMENT AND PAYMENT

Method 1 For items of work for which specific unit prices are established in the contract, the volume of grouted rock riprap, including filter layers or bedding, will be determined from the specified thickness shown on the drawings and the area on which acceptable placement has been made. Payment for grouted rock riprap will be made at the contract unit price. Such payment will be considered full compensation for all labor, materials, equipment and all other items necessary and incidental to the completion of the grouted rock riprap and filter layers or bedding.

Method 2 For items of work for which specific unit prices are established in the contract, the volume of riprap and the volume of filter layers or bedding will be determined from the specified

thickness shown on the drawings and the area on which acceptable placement has been made. The volume of grout will be determined from the calculated batch volume and the number of mixed batches delivered to the site and acceptably placed in the work. Payment for riprap; filter or bedding material; and the concrete grout will be made at the contract unit price for each item. Such payment will be considered full compensation for all labor, materials, equipment, and all other items necessary and incidental to the completion of the work.

All Methods The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 13 of this specification.

13. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 7, Grouted Riprap Channel Lining

(1) This consists of furnishing and placing all riprap necessary to construct the channel lining as shown on the drawings.

(2) The bed for the riprap shall be shaped and trimmed to provide even surfaces.

(3) Riprap shall be placed as specified and grouted with portland cement mortar for 100 percent of its depth.

(4) In Section 12, MEASUREMENT AND PAYMENT, payment will indicate compensation for Subsidiary Items: Water; Removal of Water; Channel Excavation; and Borrow Excavation.

CONSTRUCTION SPECIFICATION

94. CONTRACTOR QUALITY CONTROL

1. SCOPE

The work shall consist of developing, implementing, and maintaining a quality control system to ensure that the specified quality is achieved for all materials and work performed. The work shall include all equipment, materials, labor and services necessary to implement and maintain the quality control system throughout the duration of the work.

2. EQUIPMENT AND MATERIALS

Equipment and materials for quality control shall be of the quality and condition required to meet the test specifications cited in the contract references. Testing equipment shall be properly adjusted and calibrated at the start of operations and the calibration maintained at the frequency specified. Records of equipment calibration tests shall be available to the contracting officer at all times. Where specific requirements exist, equipment shall be operated and maintained by qualified operators. All equipment and materials used in performing quality control testing shall be as prescribed by the test standards referenced in the contract.

Equipment and materials shall be handled and operated in a safe and proper manner complying with all applicable state and federal regulations pertaining to their use, operation, handling and transportation.

3. QUALITY CONTROL SYSTEM

Method 1 The contractor shall develop, implement and maintain a system adequate to achieve the specified quality of all work performed, material incorporated and equipment furnished. The system established shall be documented in a written plan developed by the contractor and approved by the contracting officer. The system activities shall include the material testing and inspection work needed to verify the adequacy of completed work and procedures to be followed when corrective action is required. Daily records to substantiate the conduct of the system shall be maintained by the contractor. The quality control plan shall cover all aspects of quality control and shall address, as a minimum, any specified testing and inspection requirements. The system provided shall be consistent with the planned performance in the contractor's approved construction schedule. The system

shall identify the contractor's on-site quality control manager and provide an organizational listing of all quality control personnel and their specific duties. The system shall be submitted to the contracting officer within 15 calendar days after notice of award.

Method 2 The contractor shall develop a system of quality control to provide the specified basic material testing and verification of material quality prior to use. The system activities shall include procedures to verify adequacy of completed work, initiate corrective action to be taken and document the final results. A written plan for the system will not be required other than the identification of the quality control personnel and their duties. This identification shall be submitted to the contracting officer within 15 calendar days after notice of award.

4. QUALITY CONTROL PERSONNEL

Method 1 Quality control activities shall be accomplished by qualified personnel such as licensed engineers, or inspection technicians certified by the American Concrete Institute; and by qualified facilities such as testing laboratories certified by the U.S. Army Corps of Engineers. The contractor's written quality control plan shall identify the name, qualification, training, experience and availability of all personnel who will perform the quality control activities. The quality control manager's primary responsibility shall be in quality control activities.

Method 2 Quality control activities shall be accomplished by qualified personnel. The contractor shall identify and furnish to the contracting officer, for approval, the names, qualifications, experience and availability of all personnel who will perform the quality control activities.

5. POST-AWARD CONFERENCE

Method 1 The contractor shall meet with the contracting officer prior to beginning any work and discuss the contractor's written quality control plan. The contracting officer and the contractor shall develop a mutual understanding regarding the quality control plan. The finalized plan will be approved by the contracting officer.

Method 2 The contractor shall meet with the contracting officer prior to the beginning of any work and discuss the contractor's quality control system. The contracting officer and the contractor shall develop a mutual understanding regarding the quality control system. The

understanding reached will be documented by the contracting officer by correspondence to the contractor.

6. RECORDS

The contractor's quality control records shall be kept daily and shall document both acceptable and deficient features of the work. All records shall be on forms approved by the contracting officer and shall be legible.

Records shall include but are not limited to the following:

a. The material or item tested, or inspection performed.

b. Date and time of tests or inspections.

c. Type and number of quality control activities and tests involved.

d. The location and extent of work inspected or tested.

e. Test results and description of conditions observed during the quality control activities.

f. Method of testing used (e.g. citation of reference specification).

g. Nature of defects, specifications not met, etc.

h. Proposed corrective action, and reason for corrective action.

i. Corrective actions taken and supporting quality control recertification testing.

j. Signature of authorized testing or inspecting official with appropriate checkers verification.

k. Manufacture's recommendations and certifications if any.

l. Documentation of material delivered including; quantity, location stored, and results of examinations citing applicable construction, material and reference specifications.

m. Documentation of shop drawings including; date submitted to and date approval by the contracting officer, and results of examinations citing applicable construction, material and reference specifications and construction drawings.

n. Date of the records creation.

7. REPORTING RESULTS

The results of contractor quality control inspections and tests shall be communicated to the contracting officer's representative immediately upon completion of the inspection or test.

8. Submittal of Records

Method 1 An original plus one copy of all records shall be submitted to the contracting officer's representative within one working day of the completion of the inspection or test.

Method 2 The original plus one copy of records of inspections, tests preformed and material testing reports shall be submitted to the contracting officer's representative weekly. The original plus one copy of documentation of materials delivered shall be submitted to the contracting officer's representative prior to the use of the material.

9. ACCESS

The contracting officer and the contracting officer's representatives shall be given free access to all testing equipment, facilities, sites, and related records.

10. MEASUREMENT AND PAYMENT

For items of work for which lump sum prices are established in the contract, payment will be made as the work proceeds, after presentation of invoices by the contractor showing their costs. If the total of such payments is less than the contract lump sum for this item, the unpaid balance will be included in final contract payment. Total payment will be the lump sum contract price for this item, regardless of actual cost to the contractor.

Payment will not be made under this item for the purchase cost of materials and equipment having a residual value.

Payment of the lump sum contract price for contractor quality control will constitute full compensation for all labor, materials, equipment, transportation, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 11.

11. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 5, Contractor Quality Control

(1) This item consists of furnishing the personnel, equipment and material required to perform the testing and inspection of construction activities that will ensue the specific quality is achieved for the required works of improvement.

(2) In Section 2, EQUIPMENT AND MATERIALS, all equipment used for testing shall have been calibrated within 3 months of the beginning of construction and at the specified frequency given in the appropriate materials testing standards. Records of the calibration shall be furnished to the Engineer prior to using the equipment and within 3 days after each calibration.

(3) In Section 3, QUALITY CONTROL SYSTEM, the following items shall also apply:

(a) The field inspector's duties shall primarily include continuous field monitoring of all the construction activities, direction of the Contractor's testing and inspection as specified herein, and preparation of daily diaries of quality control observations and actions. It is the responsibility of the inspector, in conjunction with the Contractor's quality control manager, to identify deficiencies and to take corrective actions to keep all work in compliance with the contract specifications.

(b) The following tests/inspections shall be required: tests/inspections shall be conducted in accordance with the drawings and construction specifications "as requires" to maintain contract requirements w\except that a minimum testing/inspection frequency is shown.

ITEM	TEST	REFERENCE SPECIFICATION	MINIMUM TEST/INSPECTION FREQUENCY
Concrete	Temperature	ASTM C1064 & 31	Each truckload
	Slump	ASTM C143 & 31	Each truckload
	Air content	ASTM C231 & 31	Each day
Pozzolan		ASTM C618	
Portland Cement		531 & 31	
Air Entrainment		532 & 31	
Curing Compunnd		534 & 31	
Gravel	Gradation	ASTM C136 & 200	Each 1500 tons
	Atterburg Limits	200	
Earthfill		23	The process will be verified on a continuous basis
Reinforcing Steel		539 34	Each delivery to site; placement shall be certified by contractor QC prior to each concrete placement
Riprap		62	Each 1500 tons

(3) The Contractor shall designate an experienced quality control manager. THe quality control manager shall be on site as each construction activity is mobilized to establish that the methods and procedures will achieve the minimum specified quality.

(4) The quality control manager shall attend all weekly progress meetings to provide a weekly review of all quality control activities including testing, construction methods, problems and their resolution, and quality control activities for the next week.

(5) The frequency of testing and or site quality control guidance shall be increased immediately upon discovery by contractor quality control or government inspections of material or areas of work that do not meet the minimum squality specified by the contract. Quality control actions at such time include but are not limited to stopping construction activities to correct procedures, methods, and /or material being installe; increasing test frequency at the site and/or source of materials; replacing workers, Foreman or other contractor employees who refuse or are unable to comply with providing the minimum quality of construction specified by the Contract.

CONSTRUCTION SPECIFICATION

200. GRAVEL ROAD SURFACING

1. SCOPE

The work shall consist of furnishing, transporting, and placing mineral aggregates for road surfacing.

2. MATERIALS

Aggregate shall conform to the applicable requirements of ASTM D 1241 or, if so specified, shall be obtained from designated sources. The aggregate material shall be free from vegetable matter and other deleterious substances. After the contractor has determined that the aggregate meets the specification and at least 20 days prior to delivery to the site, the contractor shall notify the contracting officer in writing of the source of the material. Test data and other certification information for the aggregate shall be furnished 20 days prior to use of the material.

3. BASE PREPARATION

The areas to be surfaced shall be compacted as specified to the lines and grades shown on the drawings. The surface shall be inspected and approved by the Engineer before any aggregate surfacing material is placed.

4. PLACEMENT

The aggregate shall be deposited, spread, processed, and compacted on the prepared subgrade to the required thickness as shown on the drawings. In the event segregation occurs, the material shall be bladed until the various sizes of aggregate are uniformly and satisfactorily blended. After being spread, the material shall be watered, mixed, shaped to the required section, and compacted as specified in Section 6. The completed course shall be smooth, true to grade and cross-section, and free from ruts, humps, depressions, and irregularities.

5. MEASUREMENT AND PAYMENT

Compensation for any items of work described in the contract, but not listed in the Bid Schedule, will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 6 of this specification.

6. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 6, Gravel Road Surfacing

(1) This item consists of furnishing and placing gravel road surfacing on the proposed O&M roads and maintenance ramps around the sediment basin, as shown on the drawings.

(2) Gravel road surfacing shall be placed at a rate of 21 tons per 1000 square feet of surface area.

(3) The gravel road surfacing shall be graded per Section 702.2.2 of the MAG specification as follows:

Sieve Size	Percent Passing (by dry weight)
1 1/8"	100
# 4	38-65
# 8	25-60
# 30	10-40
# 200	3-12

(4) In Section 2, MATERIALS, gravel road surfacing shall meet the following requirements:

(a) Percentage of Wear: When tested in accordance with ASTM C 131, the percentage of wear shall not exceed 40 percent after 500 revolutions.

(b) Plasticity Index: When tested in accordance with ASTM D 4318, the placticity index shall not be more than five (5).

(c) Liquid Limit: When tested in accordance with ASTM D 4318, the liquid limit shall not be more than 25 percent.

(5) Where the plans require gravel road surfacing, the Contractor shall install the surfacing before using that road as a haul road for project purposes. The cover shall be compacted and maintained in good, level condition during project use and shall be left to the thickness and neat line and grade indicated on the plans.

(6) In Section 3, BASE PREPARATION, rills and jug holes in the O&M road areas to be surfaced shall be filled with Gravel Road Surfacing.

(7) In Section 4, PLACEMENT, compaction of gravel road surfacing is required. Compaction shall be accomplished with a minimum of two (2) complete passes over the entire surface area by rubber tired equipment having a minimum empty weight of 25,000 pounds or approved equivalent method.

(8) In Section 5, MEASUREMENT AND PAYMENT, the quantity of gravel road surfacing placed within the specified limits will be measured to the nearest ton by actual weight. For each load of gravel placed as specified, the Contractor shall furnish to the Engineer a statement of delivery ticket showing the weight, to the nearest 0.1 ton, of gravel in the load.

Payment for gravel road surfacing will be made at the contract unit price. Such payment will be considered full compensation for all labor, materials, equipment and all other items necessary and incidental to the completion of the gravel road surfacing.

Measurement and payment for gravel road surfacing will include compensation for subsidiary items: Pollution Control and Water for Construction.

MATERIAL SPECIFICATION

522. AGGREGATE FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of fine aggregate and coarse aggregate for use in the manufacture of portland cement concrete.

2. QUALITY

Aggregate shall conform to the requirements of ASTM Specification C-33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when: (1) the specified alternate conditions of acceptance can be proved prior to the use of the aggregates on the job and within a period of time such that no work under the contract will be delayed by the requirements of such proof; or, (2) the specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

3. REACTIVITY WITH ALKALIES

The potential reactivity of aggregates with the alkalies in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM Designation C 289, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM Specification C 33, Appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used, except under one of the following conditions:

a. Applicable test results of mortar bar tests, made according to ASTM Method C 227, are available which indicate an expansion of less than 0.10 percent at six months in mortar bars made with cement containing not less than 0.8 percent alkalies expressed as sodium oxide; or

b. Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with "low alkali" cement, containing less than 0.60 percent alkalies expressed as sodium oxide.

4. STORING AND HANDLING

Aggregate of each class and size shall be stored and handled by methods that prevent segregation of particles sizes or contamination by intermixing with other materials.

MATERIAL SPECIFICATION

523. ROCK FOR RIPRAP

1. SCOPE

This specification covers the quality of rock to be used in the construction of rock riprap.

2. QUALITY

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Except as provided below, the rock shall have the following properties:

a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5.

b. Absorption not more than 2 percent.

c. Soundness: Weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

The bulk specific gravity and absorption shall be determined by ASTM Method C 127. The test for soundness shall be performed by ASTM Method C 88 for coarse aggregate modified as follows:

The test sample shall not be separated into fractions. It shall consist of 5000 ± 300 grams of rock fragments, reasonably uniform in size and shape and weighing approximately 100 grams each, obtained by breaking the rock and selecting fragments of the required size.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more pieces.

The report shall show the percentage loss of weight and the results of the qualitative examination.

Rock that fails to meet the requirements stated in a, b, and c above, may be accepted only if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

3. GRADING

The rock shall conform to the specified grading limits after it has been placed in the riprap.

MATERIAL SPECIFICATION

531. PORTLAND CEMENT

1. SCOPE

This specification covers the quality of portland cements.

2. QUALITY

Portland cement shall conform to the requirements of ASTM Specification C 150 for the specified types of cement, except that, when Type I portland cement is specified, Type IS portland blast-furnace slag cement or Type IP portland-pozzolan cement conforming to the requirements of ASTM Specification C 595 may be used unless prohibited in the specifications.

If air-entraining cement is to be used, the Contractor shall furnish the manufacturer's written statement giving the source, amount and brand name of the air-entraining addition.

3. STORAGE AT THE CONSTRUCTION SITE

Cement shall be stored in such a manner as to be protected from weather, dampness or other destructive agencies. Cement that is partially hydrated or otherwise damaged will be rejected.

MATERIAL SPECIFICATION

532. AIR-ENTRAINING ADMIXTURES (FOR CONCRETE)

1. SCOPE

This specification covers the quality of air-entraining admixtures for concrete.

2. QUALITY

Air-entraining admixtures shall conform to the requirements of ASTM Specification C 260, except that the relative durability factor in the freezing and thawing test shall be not less than 95.

MATERIAL SPECIFICATION

533. WATER-REDUCING AND SET-RETARDING ADMIXTURES FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of water-reducing and set-retarding admixtures for portland cement concrete.

2. QUALITY

Water-reducing and set-retarding admixtures shall conform to the requirements of ASTM Specification C 494, except that resistance to freezing and thawing shall be determined in all cases, and the minimum relative durability factor shall be 95.

3. TYPES

Admixtures shall be Type A, Water-Reducing or Type D, Water-Reducing and Retarding, as defined in ASTM Specification C 494.

4. PERFORMANCE IN THE JOB MIX

When added in the manner and amount recommended by the manufacturer to the concrete used on the job, with no change in the cement content or proportions of the aggregates, admixtures shall have the following effects:

Type A or Type D: The water content at the required slump shall be at least 5 percent less with the admixture than without. The air content shall remain within the range specified, but shall not exceed 8 percent in any case.

Type D: The time of initial setting, determined as prescribed in ASTM C 494, shall be from 1 to 3 hours longer with the admixture than without.

MATERIAL SPECIFICATION

534. CURING COMPOUND (FOR CONCRETE)

1. SCOPE

This specification covers the quality of liquid membrane-forming compounds suitable for spraying on concrete surfaces to retard the loss of water during the curing process.

2. QUALITY

The curing compound shall meet the requirements of ASTM Specification C 309.

Unless otherwise specified the compound shall be Type 2.

3. DELIVERY AND STORAGE

All curing compound shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner to prevent damage to the containers and to protect water-emulsion types from freezing.

MATERIAL SPECIFICATION

535. PREFORMED EXPANSION JOINT FILLER

1. SCOPE

This specification covers the quality of preformed expansion joint fillers for concrete.

2. QUALITY

Preformed expansion joint filler shall conform to the requirements of ASTM Specification D 1752, Type I, Type II or Type III, unless bituminous type is specified. Bituminous type preformed expansion joint filler shall conform to the requirements of ASTM Specification D 994, or D 1751.

MATERIAL SPECIFICATION

536. SEALING COMPOUND FOR JOINTS IN CONCRETE AND CONCRETE PIPE

1. SCOPE

This specification covers the quality of sealing compound for filling joints in concrete pipe and concrete structures.

2. TYPE

The compound shall be a cold-application mastic, single component or multiple component type.

The single component type shall be a ready-mixed nondrying compound furnished in troweling consistency or in preformed rope or strip form.

The multiple component type shall be composed of two or more substances that are to be mixed prior to application.

3. QUALITY

Sealing compound shall conform to the requirements of one of the following specifications:

ASTM Specification D 1850; Concrete Joint Sealer, Cold-Application Type. Penetration, determined as specified in ASTM D 1850, shall be not greater than 120.

Federal Specification SS-S-210A; Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

ASTM Specification D-1190 concrete joint sealer, hot poured elastic type.

Federal Specification TT-S-227; Sealing Compound: Elastomeric Type Multi-Component (for Caulking, Sealing, and Glazing in Buildings and other Structures), Type II.

The compound shall be capable of being applied at a temperature of 70°F and shall be of such nature that it will adhere to dry, dust free concrete when applied either directly or over a suitable primer. After curing it shall be a resilient, adhesive material that is capable of filling joints and firm enough to prevent the entry of subsequently placed concrete or of earth during the bedding, cradling, or backfilling operations.

4. COMPOSITION AND PROPERTIES

The compound, if used for pipe having rubber gaskets, shall have a composition such that it will not cause deterioration of the rubber gaskets.

MATERIAL SPECIFICATION

537. NON-METALLIC WATERSTOPS

1. SCOPE

This specification covers non-metallic waterstops for use in joints of concrete structures.

2. CLASSIFICATION

a. Classes. Non-metallic waterstops shall be of the following classes, as specified:

Class I shall be made of either natural or synthetic rubber.

Class II shall be made of vinyl chloride polymer or copolymer.

b. Types. Non-metallic waterstops may be either split or solid and shall conform to the following types, as specified (see Figure 1):

Type A shall have ribbed anchor flanges and a smooth web. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type B shall have ribbed anchor flanges and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to at least one-half the web thickness and (2) the inside diameter (D) specified in the contract. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type C shall have a single, circular, bulb-type anchor flange at each edge and a smooth web.

Type D shall have a single, circular, bulb-type anchor flange at each edge and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to at least one-half the thickness of the web and (2) the inside diameter (D) specified in the contract.

Type E shall have ribbed anchor flanges and a web molded or extruded in the form of a round or U-shaped bulb of the dimensions specified in the contract. The web bulb shall be connected at the open end of the "U" by a thin membrane (having a thickness of not less than 1/64-inch or more than 1/5 the web thickness) designed to: (1) prevent infiltration of wet concrete into the bulb and (2) tear when expansion of the joint occurs. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges. Auxiliary positioning or nailing flanges may be provided so long as they do not interfere with the functioning of the web bulb.

Type F shall have ribbed anchor flanges with at least two extra heavy ribs (designed to resist displacement of the waterstop during placement of concrete) on each flange and a smooth web having a positioning or nailing flange attached at the center.

Type G shall be of special design conforming to the details shown on the drawings.

c. Sizes. Waterstops of Types A through F shall be of the sizes listed herein, as specified (see Table 1). Type G waterstops shall have the dimensions shown on the drawings.

3. PHYSICAL REQUIREMENTS

The extruded or molded materials shall exhibit the properties specified herein when tested by the methods specified in Section 4 of this specification.

a. Class I Waterstops

(1) The hardness (Shore A durometer) shall be not less than 60.

(2) The specific gravity shall be not more than 1.2.

(3) The tensile strength shall be not less than 2500 pounds per square inch.

(4) The ultimate elongation shall be not less than 450 percent.

(5) The compression set shall be not more than 30 percent.

(6) The water absorption (by weight) shall be not more than 5 percent.

(7) The decrease in tensile strength and ultimate elongation after aging shall be not more than 20 percent.

(8) There shall be no sign of failure due to brittleness at a temperature of minus 35°F.

b. Class II Waterstops

(1) The hardness (Shore A durometer) shall be not less than 60.

(2) The specific gravity shall be not more than 1.4.

(3) The tensile strength shall be not less than 1400 pounds per square inch.

(4) The ultimate elongation of the web shall be not less than 280 percent and that of the flanges shall be not less than 200 percent.

(5) There shall be no sign of failure due to flange brittleness at a temperature of 0°F nor of web brittleness at a temperature of minus 35°F.

(6) The decrease in either tensile strength or ultimate elongation after accelerated extraction shall be not greater than 15 percent.

(7) As a result of the effects of alkalies:

(a) After immersion for 7 days, the sample shall exhibit no loss of weight and not more than 0.25 percent increase in weight, and the hardness (Shore A) of the treated sample shall differ from that of the untreated sample by not more than plus 5 points or minus 5 points.

(b) After immersion for 30 days, the sample shall exhibit no loss of weight and not more than 0.40 percent increase in weight, and the dimensions of the treated sample shall not differ from those of the untreated sample by more than one percent.

4. TEST METHODS

Testing shall be done by the methods cited herein. All cited test methods are included in Federal Test Method Standard No. 601.

a. Hardness shall be determined by Method 3021.

b. Specific gravity shall be determined by Method 14011.

c. Tensile strength shall be determined by Method 4111.

d. Ultimate elongation shall be determined by Method 4121.

e. Compression set shall be determined by Method 3311.

f. Water absorption shall be determined by Method 6631.

g. Tensile strength and ultimate elongation after aging shall be determined by Method 7111.

h. Brittleness shall be determined by Method 5311-1.

i. Accelerated extraction shall be accomplished by Method 6111 under the following conditions:

(1) Samples shall be not less than 1/16-inch nor more than 1/8-inch in thickness;

(2) The immersion medium shall be a solution made by dissolving 5 grams of chemically pure sodium hydroxide and 5 grams of chemically pure potassium hydroxide in one liter of distilled water;

(3) The samples shall be immersed in the medium for 14 days at a temperature of 145° ± 5°F;

(4) During the immersion period, air shall be gently bubbled through the medium from a 1/4-inch glass tube at a rate of about one bubble per second;

(5) Fresh medium shall be substituted every day;

(6) Samples need not be dipped in acetone.

j. The effects of alkalies shall be determined by Method 6251 under the following conditions:

(1) Sample shall be not more than 1/4-inch in thickness;

(2) The immersion medium shall be as described in (i), above;

(3) Fresh medium shall be substituted every 7 days.

(4) The samples shall be immersed in the medium for a period of 30 days;

(5) Samples need not be dipped in acetone.

5. CONDITION

Waterstops shall be extruded or molded in such a manner that the material is dense and homogeneous throughout and free from voids, tears, thins, indentations, or other imperfections. Unless otherwise specified, waterstops shall be symmetrical in shape and uniform in dimensions and shall be furnished in continuous strips at least 50 feet long. Factory splices shall have a tensile strength equal to at least one-half that of the unspliced section.

6. PACKAGING AND STORING

Waterstops shall be packaged and stored by methods that will protect them from prolonged exposure to direct sunlight or excessive heat.

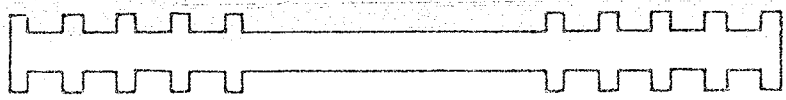
TABLE 1. SIZES OF WATERSTOPS

Size Designation	Web Thickness (T) (Inches)	Width (W) (Inches)
1	1/16	5 1/4
2	3/32	3 3/4
3	3/32	4
4	3/32	5 1/4
5	3/32	6
6	1/8	4
7	1/8	5 1/4
8	1/8	6
9	5/32	4
10	5/32	4 1/2
11	5/32	9
12	3/16	4
13	3/16	5
14	3/16	6
15	3/16	9
16	1/4	6
17	1/4	9
18	3/8	5
19	3/8	6
20	3/8	9
21	1/2	6
22	1/2	9
23	1/2	12

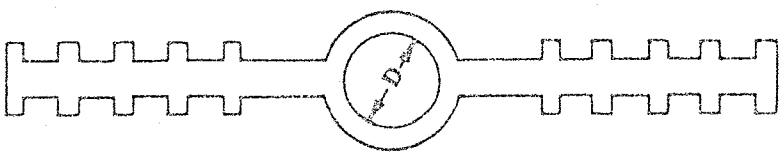
FIGURE 1

TYPES OF NON-METALLIC WATERSTOPS

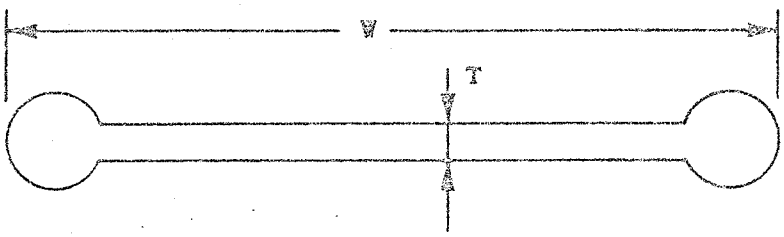
TYPE A



TYPE B

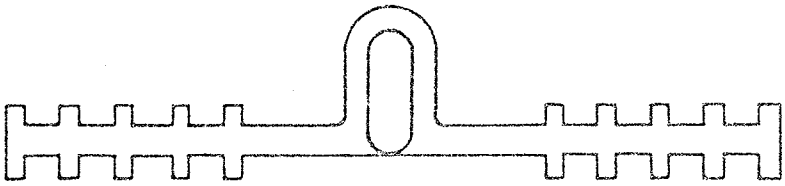


TYPE C

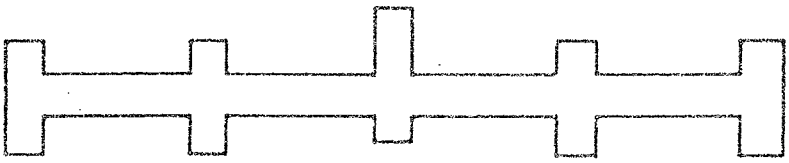


TYPE D

TYPE E



TYPE F



MATERIAL SPECIFICATION

539. STEEL REINFORCEMENT (FOR CONCRETE)

1. SCOPE

This specification covers the quality of steel reinforcement for reinforced concrete.

2. QUALITY

All reinforcement shall be free from rust, oil grease, paint or other deleterious matter.

Steel bars for concrete reinforcement requiring bends shall be deformed billet-steel bars conforming to ASTM Specification A 615, Grade 40 or Grade 60.

Straight steel bars shall be deformed bars conforming to one of the following specifications:

Deformed Billet-Steel Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 615.

Rail-Steel Deformed Bars for Concrete Reinforcement (Grade 50 or Grade 60) - ASTM Designation A 616.

Axle-Steel Deformed Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 617.

Fabricated steel bar mats shall conform to the requirements of ASTM Specification A 184.

Welded steel wire fabric reinforcement shall conform to the requirements of ASTM Specification A 185.

Welded deformed steel wire fabric for concrete reinforcement shall conform to the requirements of ASTM Specification A 497.

Cold-drawn steel wire reinforcement shall conform to the requirements of ASTM Specification A 82.

Deformed steel wire for concrete reinforcement shall conform to the requirements of ASTM Specification A 496.

3. DIMENSIONS OF WELDED WIRE FABRIC

Gauges, spacing and arrangement of wires in welded steel wire fabric shall be as defined in ACI Standard 315 of the American Concrete Institute for the specified style designations.

4. STORAGE

Steel reinforcement stored at the site of the work shall be stored above the ground surface on platforms, skids or other supports and shall be protected from mechanical injury and corrosion.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 2

CLEARING AND GRUBBING

1. Applicability

Construction Specification 2 is applicable to the clearing and grubbing of construction sites.

2. Material Specifications.

There are no material specifications complementary to Construction Specification 2.

3. Items to be Included in Contract Specifications and Drawings.

a. When the areas to be cleared and grubbed are definable on the site plan, their limits must be shown and clearly defined.

b. When the areas to be cleared are not definable on the site plan (such as for many channel improvement jobs), the extent of clearing and grubbing required must be described by notes and designation of right-of-way boundaries and station limits.

c. When payment is to be made under Method 2, Section 5, the survey line along which the length of cleared area is to be measured must be designated, as well as the lateral extent and station limits of the areas to be cleared.

d. Areas in which disposal of refuse material will not be allowed or areas to which disposal will be restricted should be shown if such restrictions are necessary.

e. Special requirements for depth of grubbing when appropriate.

f. Required depth of cover over buried material, if applicable.

g. Required surface grading over buried material, if applicable.

h. Restrictions on blasting, if any.

i. Special requirements for control of erosion, water pollution, and air pollution, if applicable.

j. Methods of measurement and payment, if the standard specification includes more than one method.

4. Discussion of Methods

Section 5, Measurement and Payment

(1) Method 1 is intended for use when the areas to be cleared and grubbed are extensive and can be defined in units of area on the ground and on the drawings. A reservoir area is a typical example of this type of site.

(2) Method 2 is intended for use when the areas to be cleared and grubbed are long and narrow. A channel right-of-way is a typical example of this type of site.

(3) Method 3 is intended for use when the areas to be cleared and grubbed are extensive but the vegetation consists mainly of scattered trees, stumps, snags, etc., that can be measured individually.

(4) Method 4 is intended for use when the areas to be cleared and grubbed cannot be measured practically and when it is reasonable to expect that variations in the quantity of clearing and grubbing to be done will not occur after the contract is awarded.

(5) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 3

STRUCTURE REMOVAL

1. Applicability.

Construction Specification 3 is applicable to the removal of all types of structures, including fencing, from construction sites.

2. Material Specifications.

There are no material specifications complementary to Construction Specification 3.

3. Items to be Included in Contract Specifications and Drawings.

a. The location and type of each structure or fence to be removed or the limits of the areas from within which structures are to be removed must be shown on the plan and profiles of the site. If structure removal is designated by area limits, the location and type of all buried structures to be removed must be shown in addition to the area limits. All known information regarding the structures must be shown on the drawings.

b. The location and types of structures or fences to be preserved in place or to be salvaged must be shown on the plan and profiles of the site.

c. The required extent and depth of removal.

d. The locations of storage areas for salvaged structural materials must be shown on the plan or indicated by appropriate notations.

e. Areas in which disposal of refuse material will not be allowed or areas to which disposal will be restricted, if known. If refuse materials must be disposed of off the right-of-way, make appropriate notations.

f. Structures, including fences, to be removed by others.

g. Required depth of cover over buried material, if applicable.

h. Required surface grading over buried material, if applicable.

i. Restrictions on blasting, if any.

j. Special requirements for control of erosion, water pollution, and air pollution, if applicable.

k. Note that a separate bid item for salvage may be needed because of cost sharing arrangements. (See Chapter 1.)

4. Discussions of Methods.

a. Section 2, Marking

(1) Method 1 is intended for use when the structures to be removed are of significant size or when several widely separated structures must be removed. Whenever possible this method should be used in preference to Method 2.

(2) Method 2 may be used when many small structures, such as irrigation turnouts, check structures and lined ditches, are located within the limits of the construction site.

b. Section 3, Removal

(1) Method 1 is compatible with Method 1, Marking, and must be used in specifications where Method 1, Marking, is selected.

(2) Method 2 is compatible with Method 2, Marking, and must be used in specifications where Method 2, Marking, is selected.

c. Section 6, Measurement and Payment

(1) Method 1 is for measurement and payment on a unit basis.

(2) Method 2 is for payment on a lump sum basis.

(3) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment," and left justify the remaining text.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 5

POLLUTION CONTROL

1. Applicability.

This construction specification is applicable to the control or reduction of pollution from any and all construction activity (including dams, channel reorientation, or any other operations involving any earthmoving or disturbance of tree or vegetative cover) during the construction period.

2. Material Specifications.

There are no material specifications complementary to this specification. Any material specifications shall be specified in Section 8.

3. Items to be Included in Contract Specifications and Drawings.

a. When the area to be controlled can be defined, the limits to be treated shall be shown or described.

b. When the areas to be treated are not definable on the site map (such as on many channel jobs), the extent of treatment shall be described by notes or designations by station or right-of-way limits.

c. Any restrictions or requirements limiting the methods of control or treatment.

d. Special requirements designating the sequence of time of control of construction operations. (These requirements might require temporary or prolonged shutdown periods of construction operations.)

e. Alternate methods of control, if applicable.

f. Any restrictions on amount of area disturbed before treatment is started.

g. Any restrictions on timing and period of time to install, operate, or remove any of the controls or treatments.

h. Special requirements, such as sectional excavation or placement of materials, burning operations, blasting, clearing, dredging, or any other unique construction procedure or operation.

i. Any other special requirement pertaining to this specification, including reference to applicable state laws and regulations.

j. Method of measurement and payment. When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

Construction Methods to be Used in Contracts to Control Pollution

The following list does not include all possible erosion and pollution control methods. All personnel concerned with planning, design, and construction should study the needs of the site carefully and specify whatever is required to control erosion.

A. Structures

1. Limit clearing or clearing and grubbing prior to actual need.

2. Install terraces or diversions, including stable outlets.

   a. Above and below borrow areas.
   b. Above emergency spillway area.
   c. Above storage areas.

3. Control access and haul roads.

   a. Contour roads.
   b. Dust control.
   c. Erosion control - turnouts, pipe culverts.
   d. Vegetate disturbed areas.

4. Shape and control borrow areas. Reduce area and duration of exposed areas.

5. Install debris basins, brush dams.

6. Locate, shape, size and protect by-pass channel.

   a. Use coffer dams.
   b. Pump excess water across construction site.

7. Sectional construction.

8. Timely installation of mechanical structures.

9. Control work sequence.

10. Complete as you go.

11. Winter or seasonal shutdowns to insure pollution control.

12. Clean and sanitary conditions at the work site at all times.

13. Seeding - temporary and permanent.

14. Prevent fires.

15. Prevent pollution by chemicals and oil.

16. Mulch unprotected areas.

B. Channels

1. Leave blocks.

2. Construction in new cut - leaving old channel to carry flow.

3. Do not open new channel to flow until vegetated. -- Work sequence.

4. Seed slopes immediately after construction.

5. Mulch slopes.

6. Spray mulch, seed, fertilizer, and asphalt or polyvinyl resin, etc.

7. Excavate downstream.

8. Temporary grade control structures.

9. Limit clearing, snagging.

10. Limit disturbing channel banks on one side. Delay and complete other side after first side is vegetated.

11. Construction on channels should be performed in segments, completing each segment before moving to next segment.

12. Control water inlets into channel.

13. Install pipe inlets, grade control structures, etc., at the time of construction.

14. Install sediment traps in channel, and provide for their cleanout and maintenance.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 7

CONSTRUCTION SURVEYS FOR LAYOUT, CONTROL AND MEASUREMENT

1. Applicability

Construction Specification 7 is applicable to construction contracts containing clauses requiring the Contractor to provide construction surveys, layout and measurement from government established baselines and bench marks; to provide quantity surveys, measurements and computations for progress payment estimates; and when Method 3, Section 5, is authorized, provide original and final surveys for final quantity determinations.

2. Material Specifications

There are no material specifications complementary to this specification. Any material requirements are to be specified in Section 9.

3. Items to be Included in Contract Specifications and Drawings

a. Baselines and bench marks to be provided by the government are to be indicated on the drawings.

b. Number of copies, format and timing of the submittal of survey data,notes, computations, etc., to be provided to the Contracting Officer by the Contractor.

c. Special requirements for advance notification of surveys to be performed by the Contractor.

d. Quality of any material, as applicable.

e. Qualifications of construction survey personnel such as qualified; construction personnel, certified or licensed land surveyors, or registered engineers.

f. Special requirements for staking, such as offset reference stakes and hubs for excavation and fill.

g. Requirements other than the standards of the industry such as being consistent with SCS TR-62 or higher levels of accuracy than those specified.

h. Any special surveys, etc., to be performed by either the Contractor or the government, that are not listed in Section 5.

Discussion of Methods, Section 5. Construction Surveys

a. Method 1 is for use where the government provides basic staking that includes alignment, grade and slope stakes. Other construction staking shall be performed by the Contractor. Other special surveying requirements such as establishing final grade stakes (blue tops, etc.) must be designated in Section 9.

b. Method 2 is for use where the Contractor performs all surveys required for the layout and control of construction work and all surveys necessary for progress payment quantities. This does not include original (initial) and final surveys for final quantity determinations.

c. Method 3 is the same as Method 2 except the Contractor is required to perform the original (initial) and final surveys for final quantity determinations. Note: the use of Method 3 requires a variance to SCS policy for Field Surveys, Paragraph 540.05, National Engineering Manual, and approval to use FAR Clause 52.236-16, Quantity Surveys, Alternate I.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 8

MOBILIZATION AND DEMOBILIZATION

1. Applicability

Construction Specification 8 is applicable to any construction contract that contains a bid item for general mobilization and demobilization of the Contractor's personnel and equipment. It is not intended to cover mobilization and demobilization of special equipment for specific items of work, such as grouting equipment, for which payment for mobilization and demobilization is provided elsewhere in the contract.

2. Material Specification

There are no material specifications complementary to Construction Specification 8.

3. Items to be included in Contract Specifications and Drawings

a. Special requirements pertaining to mobilization and demobilization, if any.

b. Any particular work for which payment will or will not be made under the mobilization item if not adequately described by the specification.

4. Discussion of Methods No methods are included.

INSTRUCTIONS FOR USE FOR CONSTRUCTION SPECIFICATION 10

WATER FOR CONSTRUCTION

1. Applicability.

Construction Specification 10 is applicable to all water used at the construction site except for water used for mixing or curing grout and concrete covered by construction specifications 14, 31, 32, 33, 62, and 63. It is to be used when a pay item for water is provided in the contract. A pay item for water should be provided when the cost of water is expected to be a significant part of the total cost of the items of work in which it is to be used.

If the water is to be furnished free to the Contractor at some designated source the pay item should cover the remaining costs of transporting it and using it as specified. More than one pay item may be used if the cost of water is expected to be different for various purposes.

2. Material Specifications.

There are no material specifications complementary to Construction Specification 10.

3. Items to be Included in Contract.

a. Pay item for water in units of 1,000 gallons and estimated quantity.

ignore

b. ~~Designated source of water, and details of ownership and water rights, if applicable.~~

ignore

c. ~~Cost to the Contractor of water at the designated source, if applicable. Note: It may be advantageous for SCS to contract separately with the owner of the water and furnish it to the Contractor free at the source. This should be done only if the net cost to the SCS would be less than if bid by the contractor.~~

ignore

d. ~~Special requirements pertaining to furnishing and using water, including water quality requirements if quality may be a problem.~~

e. Details of what water will be included in the pay item if exceptions are to be made to the provisions of Section 6.

f. Details on metering, accuracy, gauge certification, or other requirements imposed by state or local agencies for measuring water use.

4. Discussion of Methods.

No methods are included.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 11

REMOVAL OF WATER

1. Applicability.

Construction Specification 11 is applicable to the temporary diversion of surface water and dewatering of the construction site and borrow areas during the construction period.

2. Material Specifications.

There are no material specifications complementary to Construction Specification 11.

3. Items to be Included in Contract Specifications and Drawings.

a. Special requirements or restrictions applicable to the diversion works or to the method of diverting surface water.

b. Special requirements for dewatering the construction site (such as a requirement that the water table be lowered before excavation is begun, or that it be maintained at a certain level below the bottom of the excavation during construction operations).

c. Special requirements for dewatering borrow areas such as removal of surface water and subsurface drainage to keep the borrow material at a workable moisture content during borrowing operations. A bid item for dewatering borrow areas should be used if it is expected to require a substantial amount of work, or if pumping to dewater borrow areas is to be paid for on a unit price basis.

d. Information regarding alternate borrow areas that may be used in lieu of dewatering the primary borrow area if applicable.

e. Special requirements for control of erosion and water pollution if applicable.

f. Waiver of the requirement that the Contractor furnish a plan for diverting surface water or dewatering the construction site, if a plan in writing is not wanted.

g. Items of work may be separated in whatever manner is deemed most expedient for the particular contract. Usually, diverting surface water and dewatering should be established as separate bid items. Dewatering can be broken down into several items (such as, "Dewatering, Core-Trench," or "Dewatering, Borrow Area 6") if better administrative control will likely result.

h. Provisions for payment for pumping to dewater borrow areas and construction sites as follows if payment is to be made on a unit price basis:

(1) Pay item for pumping to dewater borrow areas or construction sites and estimated quantity--in the Bid Schedule.

(2) At least one lump sum item as described in Section 6 (Method 2) to include compensation for the work and cost of preparation for pumping.

4. Discussion of Methods.

a. Section 7, Measurement and Payment

(1) Method 1 is intended for use when removal of water is to be covered by one or more lump sum items of work.

(2) Method 2 is intended for use when pumping to dewater borrow areas is to be measured and paid for as a unit price item of work.

(3) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 21

EXCAVATION

1. Applicability.

Construction Specification 21 is applicable to all types of excavation. The specification defines classes of excavation and includes special requirements for certain types of excavation but does not establish and define all types of excavation. It is intended that the types of excavation be established on a job or project basis as needed.

The "class" of excavation defines the kind of material to be excavated. The "type" of excavation defines the functional purpose of the excavation. Established types of excavation may include (but are not restricted to):

a. Foundation Excavation (or Stripping);

b. Cutoff Trench Excavation;

c. Channel Excavation;

d. Structure Excavation;

e. Emergency Spillway Excavation;

f. Abutment Shaping Excavation.

Any of the established types may include excavation of materials in either class or may be unclassified. However, the excavation of a given class of material may be more difficult in one type of excavation than in another. These factors must be carefully considered as a basis for establishing types of excavation to be designated on the drawings and listed in the bid schedule.

For projects involving considerable quantities of excavation of different classes of material under conditions that vary in different parts of the works, bids must be asked, and payments made, on the basis of both type and class of excavation. For such projects it is necessary that the bid schedule be set up in terms of both type and class of excavation (for example: Channel Excavation, Common; Channel Excavation, Rock).

For projects involving only one type of excavation and for projects involving small quantities of excavation it may be sufficient to include only the classes of excavation in the bid schedule.

2. Material Specifications.

There are no material specifications complementary to Construction Specification 21.

3. Items to be Included in Contract Specifications and Drawings.

a. The horizontal and vertical extent of each type of excavation. Indicate the vertical extent as approximate where the exact depth required is not known.

b. Designation and definition of types of excavation.

c. Excavation pay limits when Method 1, Section 11, is used.

d. Surface finish requirements, such as grading tolerances. (This may be especially important at the crest of a spillway.)

e. The location and limits of all borrow areas.

f. The location and limits of all waste areas.

g. Boring logs or test pit logs pertinent to all areas to be excavated. In addition to descriptions of materials, logs must also include water table elevations and dates of observation. For purposes of the construction drawings, no indications of correlation of materials between logs shall be shown.

h. Existing access and haul roads.

i. Special requirements for dewatering and keeping the excavation dry, with cross reference to Construction Specification 11 where applicable.

j. Special requirements for control of blasting if applicable.

k. Special requirements for control of erosion, water pollution and air pollution if applicable.

l. Requirements for control of the size gradation of excavated rock where necessary in order to obtain material of a particular gradation for rock fill or riprap.

m. Methods of measurement and payment, if the standard specification includes more than one method.

n. Requirements for concrete to fill voids from overexcavation (refer to Specification 31 or 32) if requirements in Section 10 are not adequate.

4. Discussion of Methods.

a. Section 5, Use of Excavated Materials

(1) Method 1 is intended for use when the quality, condition and relative location of significant quantities of the materials to be excavated are known to be suited to the economic construction of the required fill, and particularly where alternate sources of material are less desirable or do not exist.

(2) Method 2 is intended for use when the known data indicate that the use of alternate sources of fill materials may result in more economical construction of the required fill.

b. Section 6, Disposal of Waste Materials

(1) Method 1 is intended for use when areas for wasting fill are available at the site, when the waste fill will beneficially supplement the function of the permanent works or when there is no known market for the sale of such waste materials as may be produced.

(2) Method 2 is intended for use when areas for wasting fill are not readily available at the site or when there is a known market for the sale of such waste materials as may be produced.

c. Section 11, Measurement and Payment

(1) Method 1 is intended for excavations where the pay limits can best be defined on the drawings.

(2) Method 2 is intended for excavations bounded by simple plane surfaces and constant or gradually varying cross Section throughout.

(3) Method 3 is intended for excavations whose lower limits are determinable only by examination of the materials encountered and where the lower limits have been designated on the drawings as approximate or "to be determined by the Engineer during construction".

(4) Method 4 is intended for structure excavation bounded by fairly simple plane surfaces where pay limits are not shown on the drawings.

(5) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 23

EARTHFILL

1. Applicability

Construction Specification 23 is applicable to all types of earthfill including fill constructed of rocky soils and fill constructed of soft or friable rock which is expected to break down during compaction.

2. Material Specifications

There are no material specifications complementary to Construction Specification 23.

3. Items to be Included in the Contract Specifications and Drawings

a. Complete plans and cross sections of the required fills.

b. Pay limits where applicable.

c. Borrow areas or other sources of material.

d. Designation and description of the types of materials required in the various parts of the work.

e. Maximum allowable size of rock particles.

f. Special requirements for foundation preparation.

g. Maximum layer thickness before compaction. (Table A-23 may be used as a guide. Table A-23 gives upper limits for the general classes of material listed. The specified maximum layer thickness may have to be substantially less than the tabulated value to obtain adequate compaction.)

h. Maximum layer thickness for fill compacted by manually directed power tampers. (The maximum thickness that can be adequately compacted depends upon the tampers and upon the soil being placed, varying from about 4 inches for plastic clays to about 8 inches for coarse grained material of low plasticity.)

i. Special instructions for sectional or phase construction where applicable.

j. Allowable range of moisture content for each item. For example:

(1) "The moisture content of the fill matrix at the time of compaction shall be neither less than 2 percent below optimum moisture content nor more than 2 percent above optimum moisture content."

(2) "The moisture content of the fill material shall be maintained within the limits required to: (a) prevent bulking or dilatance of the material under the action of the hauling or compacting equipment; (b) prevent the adherence of the fill material to the treads and tracks of the equipment; and (c) insure the crushing and blending of the soil clods and aggregations into a reasonably homogeneous mass."

k. Compaction class for each item. (Table A-23 may be used as a guide.)

l. For Class A compaction: Compaction test method and required percent of maximum density. Typical compaction test results if applicable.

m. For Class B compaction: Minimum mass density.

n. For Class C compaction: Type of roller; minimum weight or contact pressure of roller; minimum vibrating force and frequency for vibrating roller; minimum number of passes.

o. Special rapid methods for moisture control, (quick, dry, speedy, alcohol), if used. These methods are only to be used when they prove to be an approximate equivalent in results to ASTM D 2216 with sufficient accuracy for the soil being tested. When rapid methods are used, a reference to the procedure to be followed should be included.

p. Special requirements for backfilling and compacting adjacent to structures if applicable, including instructions regarding forms or other supports which must be left in place until the concrete attains its specified 28-day strength.

q. Required minimum strength of concrete, determined according to Section 6, for starting compaction of backfill adjacent to structures, if applicable.

r. Methods of measurement and payment if the standard specification includes more than one method.

s. Embedded structures whose volume will be excluded from the earthfill volume for payment. (In general, the embedded volume of conduits over 48 inches in inside diameter and other structures of comparable size should be deducted.)

t. Special requirements pertaining to furnishing and applying water, including designated source and details of ownership and water rights if applicable, and including water quality requirements if quality may be a problem.

u. Special requirements for control of erosion, water pollution, and air pollution, if applicable.

4. Discussion of Methods.

Section 9, Measurement and Payment.

(1) Method 1 is intended for structure backfill and other cases where pay limits can best be shown on the drawings.

(2) The selected methods for pay limits must be compatible with those selected for use in Construction Specification 21.

(3) Method 6 or 7 must be used with any or all Methods 1 through 5.

(4) Method 6 is intended for use when no separate payment is to be made for water.

(5) Method 7 is intended for use with Construction Specification 10 when the Contractor is to be paid under a separate item for the water needed to bring the fill materials to the specified moisture content.

(6) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

TABLE A-23

	Grading Characteristics of Fill Material		Appropriate Compaction Classes	Maximum Layer Thickness* (Before Compaction)			
	% > No. 4	% Fines		Tamping Roller	Pneum. Roller	Vibrating Roller	40000 lb. Tractor
SOILS	0 - 35	Over 5	A	9"	9"	24"	---
		Under 5	A	9"	12"	24"	---
			B, C	--	18"	30"	12"
	35 - 65	25 - 50	A	9"	12"	24"	---
			B, C	9"	18"	24"	---
		5 - 25	A	--	12"	24"	---
			B, C	--	18"	24"	---
		Under 5	B, C	--	24"	36"	18"
	Over 65	Over 5	B, C	--	18"	24"	---
		Under 5	B, C	--	24"	36"	18"
WEATHERED OR WEAKLY INDURATED ROCK MATERIALS	Materials such as shales, schists, disintegrated granite, soft sandstone, siltstone.		Depends upon the degree of breakdown under the action of the excavating and compacting equipment.	Must be determined on the basis of special laboratory tests or field compaction tests or both. Test fills may be needed.			

*NOTE: Tabulated values are upper limits. Actual maximum layer thickness for uniform compaction of a given material may be substantially lower. Maximum size of rock fragments should not exceed 2/3 of the layer thickness.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 24

DRAINFILL

1. Applicability.

Construction Specification 24 is applicable to the placing of drainfill in all types of structure drainage systems such as:

a. Drainage systems installed beneath concrete structures, linings or pavements;

b. Wall drains for concrete structures;

c. Embankment drainage systems;

d. Interceptor drains installed adjacent to structures;

e. Foundation drains.

2. Material Specifications.

Material Specification 521 is complementary to Construction Specification 24.

3. Items to be Included in Contract Specifications and Drawings.

a. The location, extent, and dimensions of each drain.

b. The grading limits of each type of drainfill.

c. The allowable percentage of material (nonplastic) passing No. 200 Sieve.

d. The source of drainfill materials, when applicable.

e. Specifications for control of moisture if required. If water is to be added and is to be included in a separate pay item for water, add the statement: "Water applied to the fill material will be measured and payment will be made as specified in Construction Specification 10".

f. Class of compaction. Also specify the weight and number of passes of the compacting equipment required, if more than the minimum amounts specified in Section 6. (Class A provides for control of compaction by relative density of the fill. Classes I, II and III specify the method of compaction. Relative density tests during construction usually should be made in connection with the method specifications to evaluate the compaction being accomplished. Class I is intended for use

where highest densities are required, Class II is intermediate, and Class III may be used for wall drains in uncompacted backfill or for other applications where strength is not important.)

g. Special requirements for placing drainfill adjacent to new concrete as set forth in Section 4.

4. Discussion of Methods.

Section 2, Materials.

(1) Method 1 is intended for use in specifications for drainage systems in areas where commercial aggregate is available in sufficient quantity to meet project needs.

(2) Method 2 is intended to be used in specifications for drainage systems in areas where the Contractor will have to process the material from designated sources.

INSTRUCTIONS FOR THE USE OF CONSTRUCTION SPECIFICATION 31

CONCRETE

1. Applicability.

Construction Specification 31 is applicable to the usual types of concrete construction entailed in SCS operations. Supplementary specifications will be required for works of a special nature, such as:

a. Placing concrete under water.

b. Concrete exposed to sea water.

c. Concrete exposed to alkali soils or alkaline water.

d. Special finishes.

Good examples of such specifications are contained in Standard Specifications for Highway Bridges, AASHTO.

2. Material Specifications

The following specifications are complementary to Construction Specifications 31:

a. Cement. Specification 531

b. Aggregates. Specification 522

c. Curing Compounds. Specification 534

d. Preformed Joint Filler. Specification 535

e. Metal Waterstops. Specification 538

f. Metal. Specification 581

g. Water-Reducing, Set-Retarding Admixtures. Specification 533

h. Air-Entraining Admixtures. Specification 532

i. Non-Metallic Waterstops. Specification 537

3. Items to be Included in Contract Specifications and Drawings.

a. Complete engineering and structural detail drawings of the structure. (See Section 6, National Engineering Handbook.)

b. Type, size and quality of joint filler, waterstops and shear plates.

c. Notation of the type and quality of concrete, including:

(1) Class of concrete.

(2) Type of cement.

(3) Nominal size of coarse aggregate; or specification for aggregate if Material Specification 522 does not apply.

(4) Types of admixtures, if any.

(5) When to be permitted, authorization for a design mix that includes pozzolan as a partial substitute for cement.

(6) Deviations, if any, from the air content and slump specified in Section 4. (The air content specified in Section 4 may not be reduced for structures where the average annual minimum air temperature is below 20°F.)

d. Notation of which procedure is to be used when ASTM Designation C 684 is used for strength tests.

e. If volumetric batching and continuous mixing will not be permitted, include a statement to that effect.

f. Deviations, if any, from specifications requiring:

(1) Placement of slab concrete in a single layer.

(2) Consolidation of concrete with vibrators.

g. Required minimum strength of concrete when forms are removed if Method 2 is used in Section 18.

h. Finish requirements for unformed surfaces if other than float finish is required.

i. Notation calling for carborundum rubbing or similar abrasive treatment of formed surfaces exposed to view, if desired. (The following statement may be added in Section 26, Items of Work and Construction Details:

"Surfaces for which a rubbed finish is specified shall be rubbed with a medium coarse carborundum stone, using water for lubrication and cleaning. The rubbing shall be started as soon as possible after the forms are removed, patching is finished, and the patching mortar has set thoroughly.

Rubbing shall be continued until all form marks, projections and irregularities have been removed and a uniform surface has

been obtained. After rubbing is completed the surface shall be washed to remove loose powder and shall be left free from unsound patches, paste, powder, and objectionable marks."

4. Discussion of Methods.

a. Section 3, Classes of Concrete

(1) Method 1 is intended for use when strength is to be used as one of the criteria for acceptance of the concrete and the Contractor is to be made responsible for the mix.

When substitution of fly ash for cement is permitted, an adjustment must be included for the time at which the strength test is made or for the strength to be attained at 28 days because of the slower rate of strength increase.

(2) Method 2 is intended for use when the concrete mix is to be prescribed by the Engineer and strength will not govern acceptance from the Contractor.

b. Section 5, Design of the Concrete Mix

(1) Method 1 is required with Method 1 in Section 3.

(2) Method 2 is required with Method 2 in Section 3.

c. Section 15, Construction Joints

(1) Method 1 is intended for use in circumstances where maximum bond between old and new concrete is desired. When such joint treatment is specified it is permissible to design horizontal construction joints as flat plane surfaces without shear keys or shear plates. Method 1 is preferred for all structures that are continuously or intermittently exposed to water. Where the joint will be subject to differential water pressure, a shear plate is recommended.

(2) Method 2 is intended for use in circumstances where bond between old and new concrete is not a critical element. When such joint treatment is specified, the design of horizontal construction joints must incorporate shear plates if differential water pressure can possibly exist across the joint.

d. Section 18, Removal of Forms

(1) Method 1 is intended for use when operations are not controlled on the basis of results of tests on job-cured test cylinders.

(2) Method 2 is intended for use when operations are controlled on the basis of results of tests on job-cured test cylinders.

e. Section 25, Measurement and Payment

(1) Method 1 is intended for use when the design and control of the concrete mix is the responsibility of the Contractor (that is, when the compressive strength of the concrete is one of the criteria determining acceptability).

(2) Method 2 is intended for use when the job mix is designed and controlled by the Engineer.

(3) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 34

STEEL REINFORCEMENT

1. Applicability.

Construction Specification 34 is applicable to the placement of steel bar reinforcement and steel welded wire fabric reinforcement for reinforced concrete or pneumatically applied mortar.

2. Material Specifications.

Steel Reinforcement. Specification 539 is complementary to Construction Specification 34.

3. Items to be Included in Contract Specifications and Drawings.

a. Complete placing drawings. (Detail drawings as specified in Section 6, National Engineering Handbook.)

b. Steel schedule and bar list and bending diagram if needed to facilitate the placement drawings. These are usually needed for all except very simple structures.

c. Type and grade of steel if it is necessary to restrict the Contractor's choice from the list in Material Specification 539.

d. Method used to specify bar splice lengths. There is an option to use one of three methods in specifying lap lengths at bar splices. The required information will vary depending upon the method used.

(1) Method 1 show splice locations along with lengths of bars in a schedule that is adequate to meet the design requirements and criteria.

(2) Method 2 include the following:

(a) Locations where splices are and are not permitted.

(b) Type of splices at locations permitted - contact, noncontact or butt.

(c) Splice layout at locations permitted - staggered or coincident and alternating or repeated in Section 10:

(d) Splice class for each respective location and mat.

(e) Concrete design compressive strength, f'c.

(f) Bar stress condition - tension or compression.

(g) Designation of "top bars" and "others".

(h) Steel reinforcement design yield strength.

e. Method of measurement and payment.

4. Discussion of Methods.

a. Section 5, Splicing Bar Reinforcement

(1) Method 1 is intended for use when construction drawings for reinforced concrete structures show bar placement details and steel schedules listing bar lengths and fabricated shaped. Splice locations and bar laps have been determined during design and fully detailed on the drawings. This method generally applies when National Standard detail drawings are used.

(2) Method 2 is intended for use when construction drawings do not contain complete bar placement diagrams and bar schedules. This method should only be specified under limited conditions. Complete bar placement - drawings and schedules should normally be included in all construction drawings. However, in such cases when engineering drawings are prepared by a project sponsor or an A-E and complete bar placement drawings and schedules are not provided, they may be prepared by the steel fabricator based on engineering drawings as shown in ACI 315.

b. Section ~~8~~ 9, Measurement and Payment.

(1) Method 1 is intended for use when all reinforcement is measured by weight.

(2) Method 2 is intended for use when bar reinforcement is measured by weight and welded wire fabric reinforcement is measured by area.

(3) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

INSTRUCTIONS FOR USE OF CONSTRUCTION SPECIFICATION 62

GROUTED ROCK RIPRAP

1. Applicability.

   Construction Specification 62 is applicable to the placement of grouted rock riprap on channel slopes and other designated areas.

2. Material Specifications.

   Material Specifications 521, 522, 523, 531, 532, and 534, and Construction Specification 31 are complementary to Construction Specification 62.

3. Items to be Included in Contract Specifications or on the Drawings

   a. Complete plans and cross sections of the required riprap.

   b. Pay limits, where applicable.

   c. Gradation of rock riprap.

   d. Gradation of filter or bedding materials, if used.

   e. Location of weepholes and pipe material for weepholes, if used.

   f. Placement tolerances.

   g. Design of grout mix, slump, air content.

   h. Type of cement.

   i. Type of admixtures, if any.

   j. Gradation of coarse aggregate.

   k. Method of measurement and payment.

4. Discussion of Methods.

   a. Section ~~8~~ 12, Measurement and Payment

      (1) Method 1 is intended for use when the volume of riprap and grout, and filter or bedding material, if used, is computed as one quantity and paid for at the contract unit price for grouted rock riprap.

      (2) Method 2 is intended for use when the volume of riprap, the volume of filter or bedding material, and the volume of concrete grout are computed and paid for separately.

(3) When all but one method are deleted for use in a contract specification, delete from the last paragraph "All Methods The following provisions apply to all methods of measurement and payment" and left justify the remaining text.

INSTRUCTION FOR USE OF CONSTRUCTION SPECIFICATION 94

CONTRACTOR QUALITY CONTROL

1. Applicability

Construction Specification 94 is applicable to contracts that contain clauses requiring the contractor to provide quality control, material testing and verification of material quality prior to use.

2. Material Specifications

There are no material specifications complementary to Construction Specification 94. Any material requirements are to be specified in Section 11 (see 3.b. below).

3. Items to be included in the Items of Work and Construction Details regardless of the method chosen

a. Specific requirements for the quality control testing that the contractor is to provide. Establish, as appropriate for the method selected, the types of material the contractor will be required to test, types of representative tests required, frequency of tests and other site specific related details.

b. Details on the required intensity of contractor's quality control inspection efforts with emphasis on the site specific aspects of the work, equipment and materials to be used. Specify, as appropriate for the method selected, the documentation required for: verification of foundations and cutoff trench excavations, subgrade for fills, placement of reinforcement and forming prior to ordering concrete, equipment operational tests and available equipment backups, safety measures specified, etc. Prescribe specific requirements regarding:

(1) Reliance on contractor for initial or benchmark testing, production testing and testing to adjust to changes in materials or methods.

(2) Standards to be used as reference for quality control testing and field inspections of materials, methods and procedures.

(3) Special testing or inspection procedures that need to be included in the quality control system.

c. Required approvals by the contracting officer, not covered in the basic specification for items such as; personnel qualifications, equipment condition, format of record keeping and documentation, etc.

4. Discussion of Methods

Method 1 is for use with large or complex work where the contractor is required to have qualified quality control testing and inspection personnel on their staff or will subcontract for these services and provide SCS with a written quality control plan and regularly submit quality control documentation.

Method 2 is for use with the smaller or less complex work where the contractor's staff is expected to understand and be qualified to perform routine quality control. The contractor must develop an effective quality control system. The contractor and contracting officer will meet and reach agreement on the system. The contracting officer will document by correspondence to the contractor the understanding reached concerning the quality control system.

Selection of either method 1 or method 2 must be uniformly made within the specification for each contract.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF

DETAIL Performance Time COMPUTED BKH DATE 9/92

CHECKED BY STF DATE 9-92

1. Mobilization

Use 20 Working days

2. Excavation

· Assume 2,500 CY/day

12,992 / 2,500 ≈ 5 days

3. Channel Wall

· Assume 2 Crews working

· 75 LF/day

2 sides

[(1237 - 400) + 20] x 2 = 1714 LF.

1714 / 75 ≈ 23 days

4. Earthfill & Backfill

· Assume 1500 CY/day

6124 / 1500 ≈ 4 days

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 2 OF

DETAIL Performance Time COMPUTED BKH DATE 9/92

CHECKED BY SH DATE 9-92

5. Grouded Rip-rap

Grouded Rip-rap = 3,339 C.Y.

3,339 X 1.35 (Ton of Rock/cy) = 4,507.65 Tons

- 12 Tons / Truck rock (Using 4 Trucks)
- Assume 45 min/round Trip for Trucks

$$\frac{8 \text{ hr day}}{45/60} \times \frac{50}{60} \approx 9 \text{ Trips / day - Truck}$$

12 X 9 = 108 Tons

108 X 4 (Trucks) = 432 Tons/day

4507.65 / 432 ≈ 11 days

6. Gravel Road Surfacing

$$\text{Yardage} = \frac{1200}{1.7 \frac{\text{Ton}}{\text{C.Y.}}} \approx 706 \text{ C.Y.}$$

- Assume 45 min/round Trip for Trucks

$$\frac{8 \text{ hr day}}{\frac{45}{60}} \times \frac{50}{60} \approx 9 \text{ Trips / day - Truck}$$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 3 OF

DETAIL Performance Time COMPUTED BKH DATE 9/92

CHECKED BY STF DATE 9-92

Using 13.5 Cy./load = 9 (13.5) = 121.5 Cy./day - Truck

Assume 4 Trucks used

121.5 (4) = 486 Cy./day

706 / 486 ≈ 2 days

7. Weather Days

From state Climate, Data for Chandler Heights Gauging Station for 32 years of record thru 1986:

Month	Inches	Rain Days			
Jan	0.94	1	July	0.71	1
Feb	0.80	1	Aug	1.27	1
Mar	1.06	1	Sept	0.76	1
Apr.	0.24		Oct	0.75	1
May	0.15		Nov	0.63	1
June	0.09		Dec	0.97	1

• Assume Construction will be done Mar. thru Aug.

No of rain day 3

allow 3 dry days/rain day 9

12 days

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 4 OF

DETAIL Performance Time COMPUTED BKH DATE 9/92

CHECKED BY STF DATE 9-92

Holidays = 5 days

Total working days = 20 + 5 + 23 + 4 + 11 + 9 + 2 + 12 + 5 = 91

Calendar days = $\frac{7}{5}(91)$ = 127.40 days = 4.25 Mo

Use total of 5 Month for Performance Time

SPOOKHILL OUTLET CHANNEL AND SEDIMENT BASIN

COST ESTIMATE

Item No.	Work or Material	Spec. No.	Quantity	Unit	Unit Price	Amount
1	Mobilization	8	1	L.S.	15,000.00	15,000.00
2	Survey	7	1	L.S.	15,000.00	15,000.00
3	Earthfill	23	6,124	C.Y.	~~4.00~~ 2.00	24,496.00
4	Concrete	31	1,453	C.Y.	~~100.00~~ 150	145,300.00
5	Quality Control	94	1	L.S.	25,000.00	25,000.00
6	Gravel Road Surfacing 21Ton/1000SF	200	1,200	Ton	8.00	9,600.00
7	Grouted Rip-rap	62	3,339	C.Y.	95.00	137,205.00
8	Filter Material	62	620	C.Y.	11.00	6,820.00
9	Basin Improvement	23, 62	1	L.S.	50,000.00	50,000.00
					TOTAL	$608,421.00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE ___ OF ___

DETAIL Engineering Cost Est COMPUTED BKH DATE 9/92

CHECKED BY ___ DATE ___

Item 1. Mobilization

3% Estimated cost = 0.03(500,000) 15,000

Item 2. Survey

3% Estimated cost = 0.03(500,000) 15,000

Item 3. Earth fill – 6,124 C.Y.

4.00/cy ⇒ 6124 (4) = 24,496

Item 4. Concrete – 1453 C.Y.

estimate 100.00/C.Y. ⇒ 1453(100) = 145,300

Item 5. Inspection

estimate 5% = 0.05(500,000) 25,000

Item 6. Gravel Road Surfacing 1,200 Ton

Use 8.00/Ton → 1200 X 8 = 9,600

Item 7. Grouted Rip-rap 3339 C.Y.

Use 95.00/C.Y. → 3339 X 95 = 317,205

Item 8. Filter Material 620 C.Y.

Use 11.00/C.Y → 620 X 11 = 6,820

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

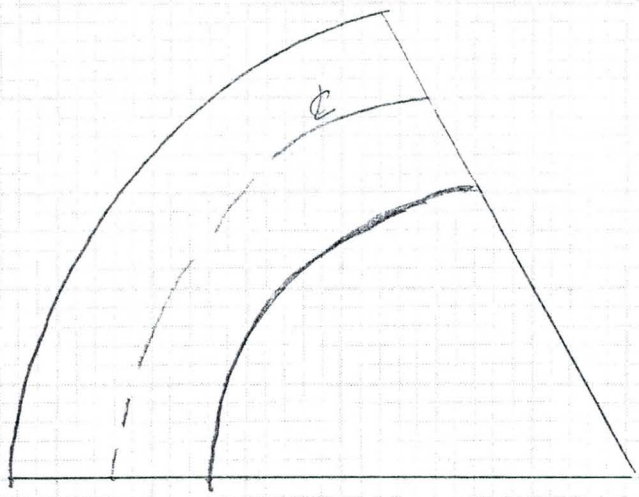
PROJECT Spookhill Outlet PAGE 1 OF

DETAIL Conc. Est. COMPUTED BKH DATE 9/92

CHECKED BY DATE

CONCRETE

R =



7 $R = 386.00$ $P = 2R\pi = 2 \times 386 \times \pi = 2425.31'$ $\alpha = \frac{2425.31}{360} = 6.737$

1 $R_R = 386 + 20 + \frac{1.17}{2} = 406.58$ $P = 2 \times 406.58 \times \pi = 2554.64'$ $\alpha_R = \frac{2554.64}{360} = 7.0962$

4 $R_L = 386 - 20 - \frac{1.17}{2} = 365.42$ $P = 2295.98'$ $\alpha_L = 6.3777$ %

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ___ OF ___

DETAIL _____ COMPUTED _____ DATE _____

_____ CHECKED BY _____ DATE _____

Item 9. Basin Improvement

10% Estimated → .10 (500,000) 50,000

Total $ 608,421.00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 2 OF

DETAIL Conc. Est. COMPUTED BKH DATE 9/72

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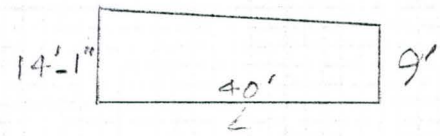
WALL

From Sta. 400 to 440 (R&L)

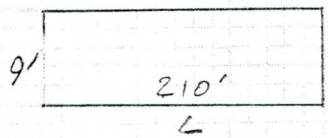


Wall Thickness = 1.17'

$\frac{14.08+9}{2} \times 40 \times 1.17 = 540.07$ CF

2 Sides $540.07 \times 2 \approx$ 1080 CF

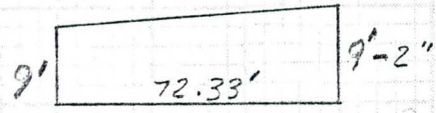
440 to 650 (R&L)



$9 \times (650-440) \times 1.17 = 2211.30$ CF

2 Sides $2211.30 \times 2 \approx$ 4423 CF

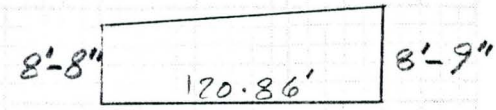
650 to 722.33 (R&L)



$\left(\frac{9+9.17}{2}\right) \times (722.33-650) \times 1.17 = 768.83$ CF

2 Sides → $768.83 \times 2 \approx$ 1538 CF

722.33 to 850 (L)



$850 - 722.33 = 127.67'$

from Page 1: $L = \frac{127.67}{6.737} \times 6.3777 = 120.86'$

$\left(\frac{8.67+8.75}{2}\right) \times 120.86 \times 1.17 \approx$ 1231 CF

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 3 OF

DETAIL Conc. Est. COMPUTED BKH DATE 1/92

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850 to 1096.94 (L)

1096.94 − 850 = 246.94'

$L = \frac{246.94}{6.737} \times 6.3777 = 233.77'$

$8.75 \times 233.77 \times 1.17 \approx$ 2393 CF

8'-9" | 233.77' | 8'-9"

1096.94 to 1237.60 (L)

1237.60 − 1096.94 = 140.66'

$L = \frac{140.66}{6.737} \times 6.3777 = 133.16'$

$\left(\frac{8.75+11.5}{2}\right) \times 133.16 \times 1.17 \approx$ 1577 CF

8'-9" | 133.16' | 11'-6"

722.33 to 979.98 (R)

979.98 − 722.33 = 257.65'

$L = \frac{257.65}{6.737} \times 7.0962 = 271.39$

$\left(\frac{8.67+9.75}{2}\right) \times 271.39 \times 1.17 \approx$ 2924 CF

8'-8" | 271.39' | 9'-9"

979.98 to 1118.98 (R)

1118.98 − 979.98 = 139.0

$L = \frac{139.0}{6.737} \times 7.0962 = 146.41$

$\left(\frac{9.75+9.18}{2}\right) \times 146.41 \times 1.17 \approx$ 1621 CF

9'-9" | 146.41' | 9'-2.16

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sunkhill Outlot PAGE 4 OF

DETAIL Conc. Ft. COMPUTED BKH DATE 9/92

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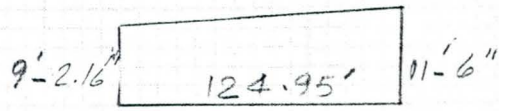
1118.98 to 1237.60 (R)

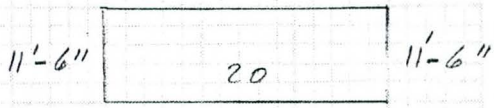


$1237.60 - 1118.98 = 118.62'$

$L = \frac{118.62}{6.737} \times 7.0962 = 124.95'$

$\left(\frac{9.18 + 11.5}{2}\right) \times 124.94 \times 1.17 \approx$ 1511 CF

W. Wall (R & L)



$11.5 \times 20 \times 1.17 = 269.10$ CF

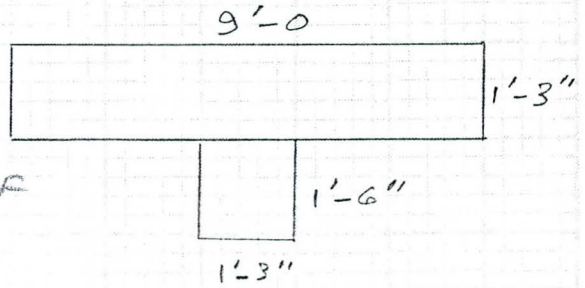
2 Sides $269.10 \times 2 \approx$ 538 CF

WALL = 1080 + 4423 + 1538 + 1231 + 2393 + 1577 + 2924 + 1621 + 1511 + 538 = 18836 CF

≈ 698 CY

FOOTING

377.08 to 440 (L)



$(9 \times 1.25) + (1.25 \times 1.5) = 13.125$ SF

$13.125 \times (440 - 377.08) \approx$ 825 CF

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Speakhill Outlet PAGE 5 OF

DETAIL Conc. Est. COMPUTED BKH DATE 9/92

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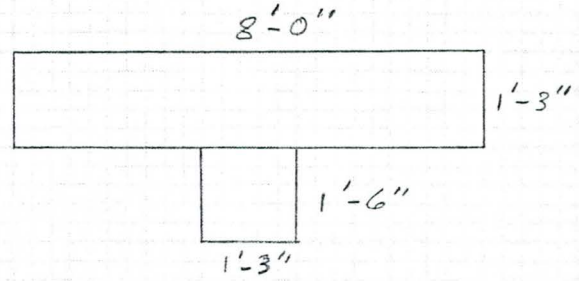
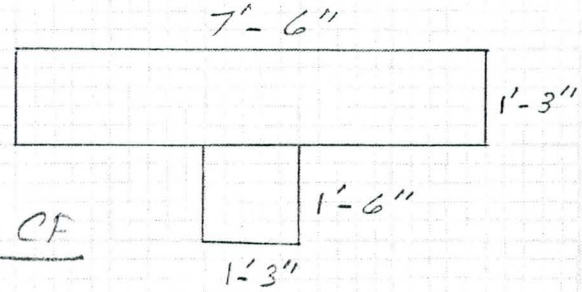
422.92 to 440 (R)



$(8 \times 1.25) + (1.25 \times 1.5) = 11.88$ S.F.

$11.88 \times (440 - 422.92) \approx$ 203 CF

440 to 722.33 (R & L)

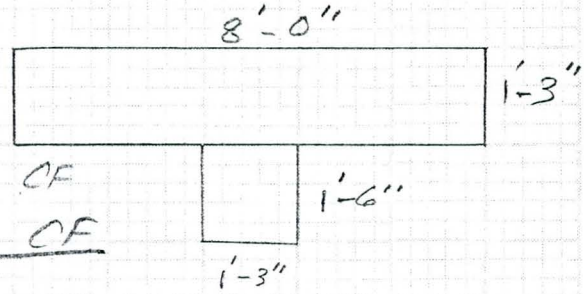


$(7.5 \times 1.25) + (1.25 \times 1.5) = 11.25$ SF

$11.25 \times (722.33 - 440) = 3176.21$ CF

2 Sides → $3176.21 \times 2 \approx$ 6352 CF

722.33 to 11+00 (R & L)

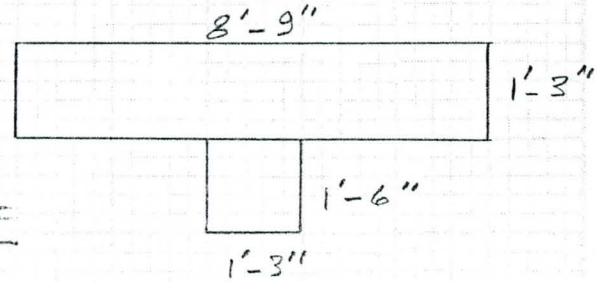


$(8 \times 1.25) + (1.25 \times 1.5) = 11.88$ S.F.

$11.88 \times (1100 - 722.33) = 4484.83$ CF

2 Sides → $4484.83 \times 2 \approx$ 8970 CF

11+00 to 12+37.60 (R & L)



$(8.75 \times 1.25) + (1.25 \times 1.5) = 12.81$ SF

$12.81 \times (1237.60 - 1100) = 1763$ CF

2 Sides → $1763 \times 2 =$ 3526 CF

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 6 OF

DETAIL Conc. Est. COMPUTED BKH DATE 9/92

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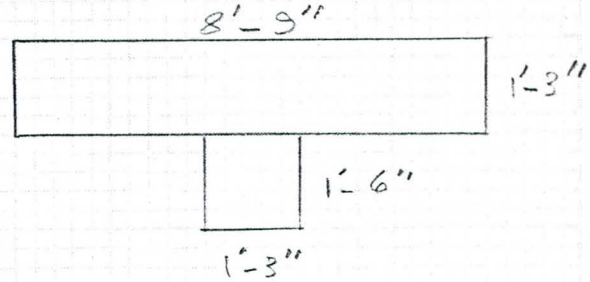
Cutoff Wall (R&L)

$(8.75 \times 1.25) + (1.25 \times 1.5) = 12.81$ SF

$12.81 \times 20 \times 2 \approx 513$ CF



Footing: $826 + 203 + 6352 + 3970 + 3526 + 513 = 20{,}390$ CF

≈ 755 CY

Total Conc. $\Rightarrow 698 + 755 = \underline{\underline{1453 \text{ CY}}}$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 327 OF

DETAIL Grout COMPUTED KVH DATE 9/92

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Grouted Rip-Rap

a) L = (282 + 40) = 322'

Qty = (3.10 × 40 × 322)/27 = 1431 CY

2) L = (378 + 137) = 515'

Qty = (2.15 × 40 × 515)/27 = 1908 CY

3339 CY

3) Filter Material

$\frac{6}{12}$ × 40 × (322 + 515)/27 = 620 CY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ~~33~~ 8 OF

DETAIL Retg. Reinf. St COMPUTED KVH DATE 9/92

CHECKED BY DATE

Reinf Steel

Type 1. wall, L = 282'

1) Dowels #5 @ 6" (1.0)

No. = $\frac{282 \times 12}{6}$ = 564

L = (564 × 6.5) = 3666

Wt = (3666 × 1.043) = 3824 lbs

2) Back face #5 @ 12, L = (9 − 2" − 10") = 8'

No. $282 \times \frac{12}{12}$ = 282

L = (282 × 8) = 2256

Wt = (2256 × 1.043) = 2353

3) a) Front face #4 @ 12, L = 3 + (1'-0") = 4'

Wt = (282 × 4) 0.668 = 754

b) t. face #4 @ 12, L = 7.33'

Wt = (282 × 7.33) 0.668 = 1381

4) Long. Steel, No. = 16 #4

L = 282, Splices 10 × 1.5 = 15'

Total L = (282 + 15) = 297

Wt = (297 × 16) 0.668 = 3174

5) Footing Steel:

a) Top: #5 @ 9", No. $\frac{282 \times 12}{9"}$ = 376

Wt = (376 × 7.17) 1.043 = 2812

b) Bott: #4 @ 9"

Wt = (376 × 7.17) 0.668 = 1801

c) Longit. Bars: No. = 13, L = 297

Wt = (297 × 13) 0.668 = 2579

18678 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ~~34~~ 9 OF
DETAIL Qty's Steel COMPUTED KWH DATE 9/92
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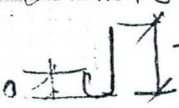
Type 2 wall
L = 378'

1) Dowels #6 @ 6" L = (7+1) = 8.0



Nos = $\frac{378 \times 12}{6}$ = 756

wt = (756 x 8.0) 1.502 = 9084 lbs

2) Back face #5 @ 12, Av. L = $\frac{(6+7.25)}{2}$ = 6.625

Nos = $\frac{378 \times 12}{12}$ = 378

wt = (378 x 6.625) 1.043 = 2612

3) a) Ft face #4 @ 12, L = 5.5

wt = (378 x 5.5) 0.668 = 1389

b) ft. face (Top) Av. L = 6.625

wt = (378 x 6.625) 0.668 = 1673

4) Longit Bars, L = 378 + (13 x 1.5) = 398'
spliced

Nos = 17, wt = (17 x 398) 0.668 = 4520

5) Footings: a) Top #5 @ 9", L = 7.67

Nos = $\frac{378 \times 12}{9}$ = 504,

wt = 504 x 7.67 x 1.043 = 4032

b) Bott. Steel #4 @ 9"

wt = (504 x 7.67 x 0.668) = 2,582

c) Longi Steel: #4 @ 18" Nos = 12

L = (398 x 12 x 0.668) = 3190

29082

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 35 OF 10

DETAIL Qty's - Steel COMPUTED KVH DATE 9/92

CHECKED BY _____ DATE _____

Reinf. Steel

Type 3 Wall L = 137'

1) Dowels #6 @ 12 & #7 @ 12" Ht. 6" Stg

1.0 L = 8.0, $\frac{137 \times 12}{12} = 137$ — lbs

Wt #6 Bars: (137 × 8.0 × 1.502) = 1646

Wt #7: (137 × 8.0 × 2.044) = 2240

2) Back face #5 @ 12", Av. L = $\frac{7.75 + 9.5}{2}$ = 8.625'

Nos = 137

Wt = (137 × 8.625) 1.043 = 1232

3) Front face: #4 @ 12" L = 5.5'

Wt = (137 × 5.5) 0.668 = 503

front of (Top): Av. L = $\frac{(6.58 + 8.33)}{2}$ = 7.5'

Wt = (137 × 7.5) 0.668 = 686

4) Longit Bars: L = 137 + (5 × 1.5) = 145' (5 splices)

Nos = 19, (145 × 19) 0.668 = 1840

5) a) Footing #6 @ 9" Top Nos = $\frac{137 \times 12}{9}$ = 183

Wt = (183 × 8.42) 1.502 = 2314

b) Ftg - Bottom #5 @ 9"

Wt = (183 × 8.42) 1.043 = 1609

c) Longit Steel #4 Bars = 15

Wt = (145 × 15) 0.668 = 1453

13521 lb

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

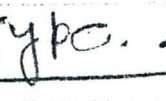
PROJECT Spook Hill PAGE 3-611 OF

DETAIL Qty's - Steel COMPUTED KVH DATE 9/92

CHECKED BY DATE

Typ. 4 wall

1) L = 40' Dowels # 8 @ 6" L = 7.0'



No = $\frac{40 \times 12}{6}$ = 80

wt = (80 × 7.0 × 2.67) = 1495 lbs

2) a) Back face # 6 @ 6, L = 7.67

wt = (80 × 7.67 × 1.502) = 922

b) Back face # 5 @ 12, L = $\left(\frac{11.08}{2} + 1.5\right)$ = 7.21

No = $\frac{40 \times 12}{12}$ = 40

wt = (40 × 7.21 × 1.043) = 301

3) a) Front f. # 4 @ 12, L = 4.0

wt = 40 × 4 × 0.668 = 107

b) front f (Tab) AV. L = $\left(\frac{6 + 11.08}{2}\right) + 1.5$ = 10.04

wt = 40 × 10.04 × 0.668 = 268

4) Long. Steel: No = 22 + 4 = 26, L = 40

wt = 26 × 40 × 0.668 = 695

5) a) Footing # 7 @ 9", L = 8.67, No = $\frac{40 \times 12}{9}$ = 54

wt = 54 × 8.67 × 2.044 = 959

b) # 6 @ 9", wt = 54 × 8.67 × 1.502 = 703

c) Long. Steel # 4 Bars = 17

wt = 17 × 40 × 0.668 = 454

5902 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ~~39~~ 12 OF

DETAIL Bridge - Steel COMPUTED KVH DATE 9/92

CHECKED BY DATE

TCJPC 5 wall

1) L = 40', Double #6@6, L = 8.

No = 40×12/6 = 80

1.0 7.0 Wt = 80×8×1.502 = 961

2). Backface #5 @ 12, Avg L = $\left(\frac{4.5+6.69}{2}\right)$ + 2.19 = 7.8'

Wt = 7.8 × 40 × 1.043 = 325

3) Frface a) #4 @ 12, L = 5.5

Wt = 5.5 × 40 × 0.668 = 149

b) Avg L = $\left(\frac{4.5+6.69}{2}\right)$ + 1.5 = 7.1

Wt = 7.1 × 40 × 0.668 = 190

4) Long. Bars: No = 17, L = 40

Wt = 17 × 40 × 0.668 = 454

5) a) Footing #5 @ 9", No = $\frac{40 \times 12}{9}$ = 54

L = 7.67, Wt = 7.67 × 54 × 1.043 = 432

b) #4 @ 9, Wt = 7.67 × 54 × 0.668 = 277

c) Long. Bars No = 13, L = 40

Wt = 13 × 40 × 0.668 = 347

3133

Total Reinf:

(8678 + 29082 + 13521) 2

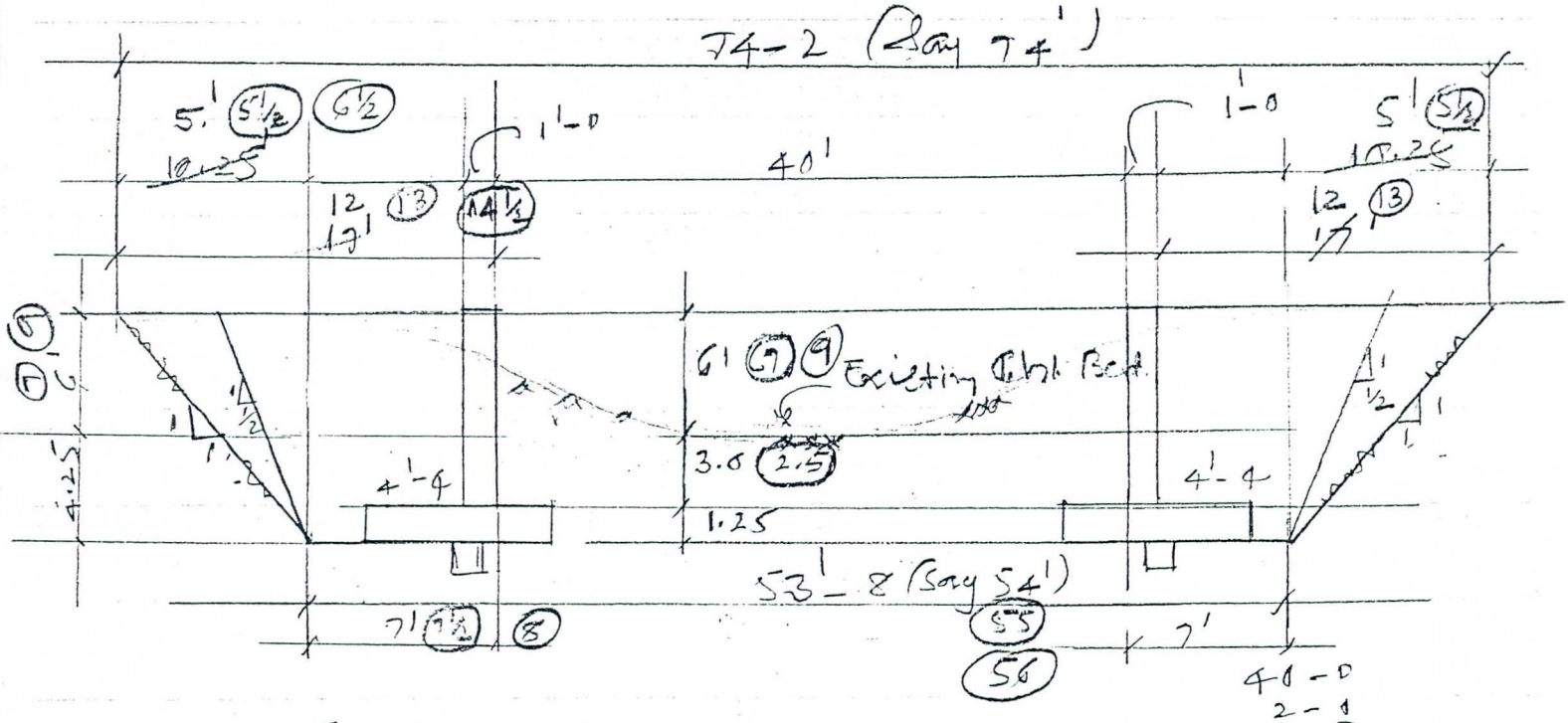
+ (5902 + 3133) = 131597 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 34 13 OF

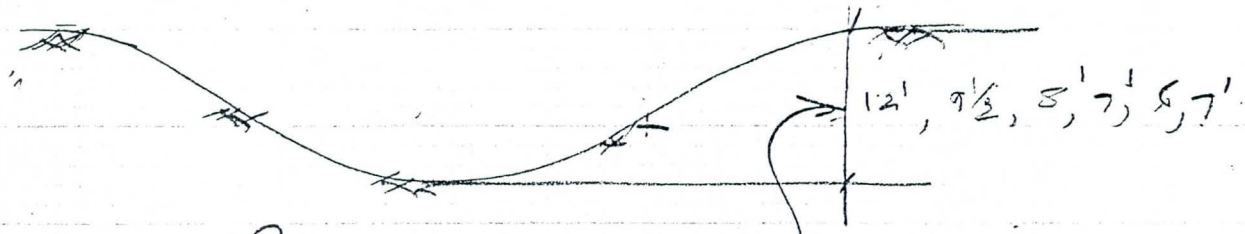
DETAIL Quantities COMPUTED KVH DATE 9/92

CHECKED BY DATE



Stat. 4+40 To 7+22

40-0
2-1
8-8
3-1
53-8
20-6
74'-2



From Stream Bed to Top of Bank (From Topo Sheet)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ~~40~~ 14 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

Excavation CHECKED BY DATE

I Excavation (Sta 4+40 To 7+22)

1) Between Chl. walls: L = 282

(40 x 4.25 x 282)/27 = 1776 cy

2) wall & Footings

A = ½ (7 + 12) 10.25 = 97.4

Qty = (97.4 x 282)/27 = 1017 (2) = 2034

Both Sides

3). Key Trench: (1.25 x 1.5) 282/27 = 20 (2) = 40

II Sta. 7+22 To 11+00 L = 378'

Same as previous Cross Section

Except Ht = 7'

1) Between Chl. walls

(40 x 3.75 x 378)/27 = 2100 2100

2) Wall & Footings

A = ½ (7.5 + 13) 11.25 = 115.3

Qty = (115.3 x 378)/27 = 1614 (2) 3228

2 Sides

3) Key Trench: 1.25 x 1.5 x 378/27 = 26 (2) 52

III Sta 11+00 To 12+37 L = 137'

1) Bot^n Channel walls

(40 x 3.75 x 137)/27 = 761

2) wall & Footings

A = ½ (8 + 14.5) 12.75 = 143.4

Qty = (143.4 x 137)/27 = 727 x 2 = 1454

3) Key Trench: 1.25 x 1.5 x 137/27 = 10 (2) = 20

11465 cy

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ~~41~~ 15 OF

DETAIL Quantities COMPUTED KNH DATE 9/92

Excavation CHECKED BY DATE

IV East wing:		11465 CY
By proportioning for 40' & using Quantities of I		
1) $(1776 \times \frac{40}{282})$	=	252
6.0, 8.17; 4.25, 4.25; 10.25, 12.42 — 2) $(2034 \times \frac{40}{282})\frac{(12.42)}{10.25}$	=	350
3) $40 \times \frac{40}{282}$	=	6
V West wing:		
By proportioning for 40' & using Quantities of III		
1) $761 \times \frac{40}{137}$	=	222
6.0, 11.00; 3.75, 3.75; 12.75, 14.75 — 2) $(1454 \times \frac{40}{137})\frac{14.75}{12.75}$	=	491
3) $(20 \times \frac{40}{137})$	=	6
Total Exc^n		12792 CY

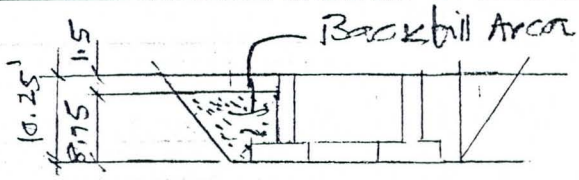
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE ~~42~~ 16 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

Backfill CHECKED BY DATE

Backfill.



I) Stat 4+40 To 7+22, L = 282

A = ½ (7+12) 8.75 = 83.1

wall = (1.0 x 9) = 9
ftg = 4.33 x 1.25 = 5.4 } 14.4

Net Area = 68.7

Qty = [(68.7 x 282)/27] 2 (both sides) = 1435 CY

II) Stat. 7+22 To 11+00, L = 378

A = ½ (7.5+13) 9.75 = 99.9

wall = 1.0 x 10 = 10
ftg = 4.67 x 1.25 = 5.8 } = 15.8

Net 84.1

Qty = [(84.1 x 378)/27] 2 = 2354 CY

III) Stat. 11+00 to 12+37, L = 137

A = ½ (8+14.5) 11.25 = 126.6

wall = (1.08 x 11.5) = 12.4
Ftg = 5.25 x 1.25 = 6.6 } = 19.0

Net = 107.6

Qty = [107.6 x 137/27] 2 = 1092

IV) East wing: By prop'n. Qtys of I, L = 40

[1435 x 40/282] 8.75/10.92 = 163

V) West wing: By prop'n Qtys of III L = 40

[1092 x 40/137] 11.25/13.25 = 270

Total Back Fill 5314 CY

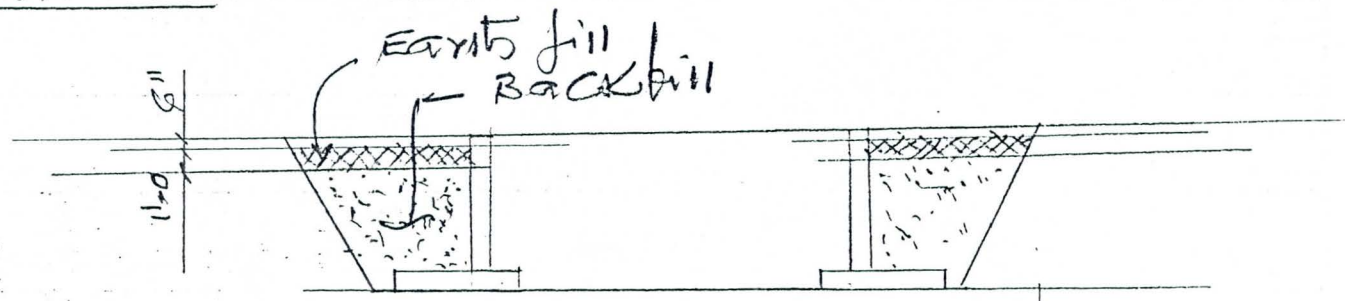
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ~~43~~ 17 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

Earth Fill CHECKED BY DATE

Earth Fill



1) Stat 4+40 To 7+22, L = 282
Fill width = 12 ±
Qty = $\left(\frac{12 \times 1.0 \times 282}{27}\right) 2$ (2 Sides) = 251 CY

2) L = 378 Fill width = 13 ±
Qty = $\left(\frac{13 \times 1.0 \times 378}{27}\right) 2$ = 364

3) L = 137, width = 14.5 ±
Qty = $\left(\frac{14.5 \times 1.0 \times 137}{27}\right) 2$ = 147

5) East & West Approaches
width = 16.0 (Average) L = 40
Qty = $\left(\frac{16 \times 1.0 \times 40}{27}\right) 2$ = 48

Total Earth Fill 810 CY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sugarhill Outlet PAGE 18 OF

DETAIL Road Surfacing COMPUTED BKH DATE

CHECKED BY DATE

Road Surfacing

1950 + 100 = 2050'

2050 X 14 = 28,700 SF

2 sides 28700 X 2 = 57,400 SF

Using 21 Ton per 1000 SF of Road.

$\frac{57400}{1000} \times 21 \approx 1200$ Tons

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ~~38~~ 19 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

CHECKED BY DATE

Summary of Qtys:

1) Concrete	~~1402~~ 1453 CY
2) Reinf. Steel	131597 lbs
3) Grouted Rip rap	3339 CY
4) Filter Material	620 CY
5) Excavation	12992 CY
6) Backfill	5314 CY
7) Earth Fill	810 CY

OPERATION AND MAINTENANCE PLAN

SPOOKHILL OUTLET CHANNEL AND SEDIMENT BASIN

The operation and maintenance plans for Spookhill Outlet Channel and Sediment Basin is hereby amended by adding the following maintenance items which resulted from the construction of the concrete channel and new improved gravel road surfacing. The limits of the work are from the Bush Highway concrete box culvert north to the sediment basin.

MAINTENANCE

Channel Outlet

Channel is built with concrete retaining walls on the sides and the grouted riprap on the bottom. The channel should be checked periodically and after heavy storm to determine if storm damage has occurred. Concrete cracks should be sealed as required.

Gravel Road Surfacing

Gravel Road Surfacing covers the maintenance roads and ramps. The gravel road surfacing should be checked periodically and after heavy storm to determine if storm damage has occurred. Holes, ruts and other rough areas should be filled with gravel road surfacing and graded.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF 2

DETAIL Hydraulic Jump COMPUTED BKH DATE 8-5-92

CHECKED BY EAR-JHK DATE 12-92

METHOD #1 (Using Hydralic Jump Graph):

$Y_1 = 16.09$

$d_1 = 4.12$

$$F_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{16.09}{\sqrt{32.2 \times 4.12}} = 1.3969$$

$$\frac{Y_2}{Y_1} = 1.55 \Rightarrow Y_2 = 1.55(4.12) = \underline{\underline{6.39'}}$$

$$\frac{L}{Y_2} = 3.8 \rightarrow L \approx 24'$$

METHOD #2 (Using Hydralic Jump Formulas):

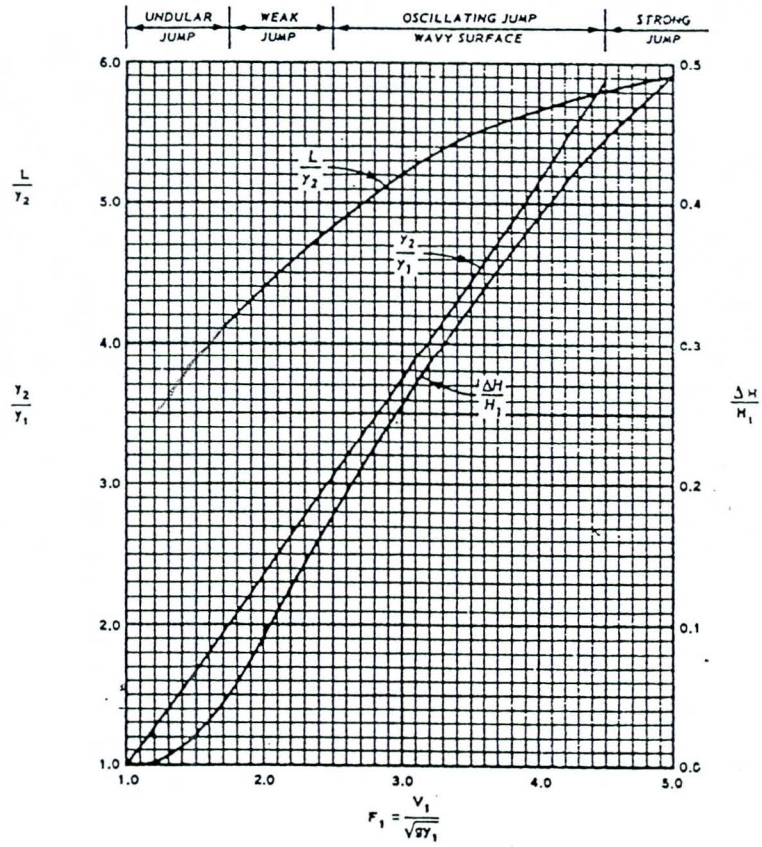
5.52

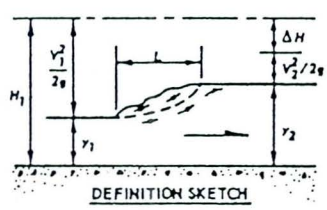
$$d_2 = -\tfrac{1}{2} d_1 + \sqrt{\frac{2V_1^2 d_1}{g} + \frac{d_1^2}{4}}$$

P.E. P5-21

$$= -\frac{4.12}{2} + \sqrt{\frac{2 \times 16.09^2 \times 4.12}{32.2} + \frac{4.12^2}{4}} = \underline{\underline{6.34'}}$$

2 of 2





DEFINITION SKETCH

L = JUMP LENGTH
ΔH = ENERGY LOSS
H_1 = TOTAL HEAD
y = SEQUENT DEPTHS

HYDRAULIC JUMP CHARACTERISTICS
RECTANGULAR CHANNEL

SEE TEXT PAGE 54

Plate 46

HYDRAULIC DESIGN OF FLOOD CONTROL CHANNELS

APP 5.8 SPKHL2F.OUT

Page 1

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*-----------------------------------*
ñ            S U M P O            ñ
ñ                                 ñ
ñ   Interactive Summary Printout  ñ
ñ   for MS/PC-DOS micro computers ñ
ñ             May 1991            ñ
*-----------------------------------*
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CHECKED BY: JHK 12-92

NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

8-10-92

Summary Printout

	SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S
*	319.00	2653.00	41.97	41.97	44.56	12.92	5.17	205.33	40.00	.00	36.80	47.92
*	400.00	2653.00	38.13	39.66	43.39	18.40	3.64	144.15	40.00	81.00	34.49	498.55
	500.00	2653.00	35.14	36.43	39.74	17.22	3.85	154.10	40.00	100.00	31.29	252.94
	650.00	2653.00	30.08	31.63	35.42	18.55	3.58	143.04	40.00	150.00	26.50	319.24
	722.33	2653.00	29.21	30.22	33.20	16.02	4.13	165.56	40.00	72.33	25.08	202.36
	850.00	2653.00	26.80	27.72	30.64	15.73	4.22	168.67	40.00	127.67	22.58	190.99
	979.98	2653.00	24.22	25.17	28.13	15.85	4.18	167.36	40.00	129.98	20.04	195.67
	1100.00	2653.00	21.87	22.82	25.77	15.86	4.18	167.25	40.00	120.02	17.69	196.09
	1237.60	2653.00	19.19	20.13	23.08	15.83	4.19	167.62	40.00	137.62	15.00	194.74

eng-spookhil-app5.81

SUMMARY OF CALCULATION FOR THE RETAINING WALL HEIGHT

STA.	FLOW DEPTH	FB	SUP ELEV	CH DEPTH	CH DEPTH FT IN	CH DEPTH FT OUT	REQUIRED ELEV FT IN	REQUIRED ELEV FT OUT	RECOMMENDED ELEV FT IN	RECOMMENDED ELEV FT OUT
	FT	FT	FT	FT	FT-INCH		FT		FT	
319	5.17	1.94	n/a	7.11	6'-0"	6'-0"	40.49	40.49	40.49	40.49
400	3.64	2.22	n/a	5.87	6'-0"	6'-0"	40.49	40.49	40.49	40.49
500	3.85	2.11	n/a	5.96	6'-0"	6'-0"	37.29	37.29	37.29	37.29
650	3.58	2.23	n/a	5.81	6'-0"	6'-0"	32.50	32.50	32.50	32.50
PC 722.33	4.13	2.03	0.00	6.16	6'-2"	6'-2"	31.25	31.25	31.25	31.25
850	4.22	2.02	0.50	6.74	6'-3"	6'-9"	28.83	29.33	28.83	29.33
PI 979.98	4.18	2.02	1.00	7.20	6'-3"	6'-3"	26.29	27.29	26.29	27.29
1096.94									24.00	
1100	4.18	2.02	0.53	6.73	6'-3"	6'-3"	23.94	24.44	24.00	24.44
1118.98									24.00	24.00
PT1237.60	4.19	2.02	0.00	6.21	6'-3"	6'-3"	21.25	21.25	24.00	24.00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 2A OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY STF DATE 9-92

11-92

WALL Depth

STA	Channel Invert	Channel Wall Elev. Inside	Wall Elev. Outside	Depth of Wall Inside	Depth of Wall Outside
319	[illegible]				
400	34.49	40.49	40.49	6'-0"	6'-00"
650	26.50	32.50	32.50	6'-0"	6'-00"
722.33 PC	25.08	31.25	31.25	6'-2"	6'-2"
850	22.59	28.83	29.33	6'-3"	6'-8.88"
979.98 PI	20.04	26.29	27.29	6'-3"	7'-3"
1097.11	17.75	24.00	24.55	6'-3"	6'-9.6"
1100	17.69	24.00	24.44	6'-3.72"	6'-9"
1118.98	17.32	24.00	24.00	6'-8.16"	6'-8.16"
1237.60 PT	15.00	24.00	24.00	9'-0"	9'-00

3.9470%

-.9570%

STA	Inv. el.	Lt Wall Depth	Lt Wall Elev.	RT Wall Depth	RT Wall Elev.
650	26.50	6'-0"	32.50G	6'-0"	32.50 G
660	26.30	6'-3"	32.55G	6'-4"	32.72 G
760	24.35	"	30.60	6'-5"	30.76 G
770	24.15	"	30.40	6'-10"	30.98G
870	22.19	"	28.44	6'-10"	29.03G
880	22.00	"	28.25	7'-3"	29.25 G
1097.11	17.75	"	24.00	"	25.00
1148.27	16.75	6'-3"	24.00G	7'-3"	24.00 G
1000	19.65		25.90		26.90

BKH 12-92

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 2B OF

DETAIL COMPUTED BKH DATE 11-92

CHECKED BY JMH - TSJ DATE 11-92 ~~12-11-92~~

Final Wall depth

Sta.	Invert Elev.	Channel Wall Depth	Channel Wall Elev.		
650	26.50	6'-0"	32.50		
660	26.30	7'-2"	33.47		
850	22.59	7'-2"	29.76		
860	22.39	8'-4"	30.72		
1050	18.67	8'-4"	27.00		
1060	18.48	9'-6"	27.98		
1237.61	15.00	9'-6"	24.50		
1257.61	15.00	9'-0"	24.00		

3

SUPERELEVATION CALCULATION

Avrage velocity (V):	15.86	fps
Bottom width (b):	40	feet
Maximum height above depth (S):	1	feet
Gravity acceleration (G):	32.2	fps2
Radius of curve (R):	374.9658	feet

SECT: 979.98

FREEBOARD CALCULATION

Avrage Velocity (V):	15.86	fps
Depth of flow (Y):	4.18	feet
Freeboard required (FB)	2.021473	feet
Channel Depth (D):	6.201473	feet

SECT: 979.98

11-Aug-92 10:50 AM CAPS

F16: 12.92 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	12.92	fps
Depth of flow (Y):	5.17	feet
Freeboard required (FB)	1.940506	feet
Channel Depth (D):	7.110506	feet

319

11-Aug-92 10:54 AM NUM CAPS

F16: 18.4 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	18.4	fps
Depth of flow (Y):	3.64	feet
Freeboard required (FB)	2.224285	feet

400

4

F23: 18.4 READY

	A	B	C	D	E	F	G	H
15								
16								
17								
18								
19								
20								
21								
22		FREEBOARD CALCULATION						
23		Avrage Velocity (V):				18.4 feet		
24		Depth of flow (Y):				3.64 feet		
25		Freeboard required (FB)				2.224285 feet		
26		Channel Depth (D):				5.864285		
27								
28								
29								
30								
31								
32								
33								
34								

400

11-Aug-92 11:33 AM NUM

G25: 'feet READY

	A	B	C	D	E	F	G	H
15								
16								
17								
18								
19								
20								
21								
22		FREEBOARD CALCULATION						
23		Avrage Velocity (V):				17.22 feet		
24		Depth of flow (Y):				3.85 feet		
25		Freeboard required (FB)				2.113619 feet		
26		Channel Depth (D):				5.963619 feet		
27								
28								
29								
30								
31								
32								
33								
34								

500

11-Aug-92 11:33 AM NUM

F25: 0.25*(F24+(F23^2/64.4)) READY

	A	B	C	D	E	F	G	H
15								
16								
17								

5

~~Channel Depth (D): 5.984285 feet~~ 4.00

11-Aug-92 10:55 AM NUM CAPS

F16: 18.55 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	18.55	fps
Depth of flow (Y):	3.58	feet
Freeboard required (FB)	2.230801	feet
Channel Depth (D):	5.810801	feet

650

11-Aug-92 10:55 AM NUM CAPS

F16: 16.02 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	16.02	fps
Depth of flow (Y):	4.13	feet
Freeboard required (FB)	2.028774	feet
Channel Depth (D):	6.158774	feet

722.33

6

11-Aug-92 10:56 AM NUM CAPS

F. 15.73 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	15.73 fps
Depth of flow (Y):	4.22 feet
Freeboard required (FB)	2.015531 feet
Channel Depth (D):	6.235531 feet

850

1 g-92 10:58 AM NUM CAPS

F16: 15.85 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	15.85 fps
Depth of flow (Y):	4.18 feet
Freeboard required (FB)	2.020242 feet
Channel Depth (D):	6.200242 feet

979.98

1 g-92 10:58 AM NUM CAPS

F16: 15.86 READY

7

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	15.86	fps
Depth of flow (Y):	4.18	feet
Freeboard required (FB)	2.021473	feet
Channel Depth (D):	6.201473	feet

1100

11-Aug-92 10:59 AM NUM CAPS

F16: 15.83 READY

A B C D E F G H

FREEBOARD CALCULATION

Avrage Velocity (V):	15.83	fps
Depth of flow (Y):	4.19	feet
Freeboard required (FB)	2.020282	feet
Channel Depth (D):	6.210282	feet

1237

11-Aug-92 10:59 AM NUM CAPS

F25: READY

A B C D E F G H

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook hill Outlet PAGE 8 OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY DATE

EXISTING CONDITION ELEVATIONS: @ ℄

4+23	33	P
4+35	32	
+45	31	
+84	30	
5+19	29	
+44	28	
+99	27	
6+85	26	
7+34	25	
8+05	24	
+70	23	
9+35	22	
+89	21	
10+66	20	
+90	20	
11+18	19	
11+98	18	
12+80	17	

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PROPOSED CONDITION

		℄	slope	Distance Lt	Rt	℄
	3+19	36.80	2.8519%	"	"	81
	4+00	34.49		"	"	100
	5+00	31.29	3.1960%	"	"	150
	6+50	26.50		"	"	72.33
PC	7+22.33	25.08		121.06	134.28	127.67
	8+50	22.59	1.9570%	123.25	136.71	129.98
PI	9+79.98	20.04		113.80	126.24	120.02
	11+00	17.69		130.47	144.73	137.60
	12+37.60	15.00		"	"	0

Table 3.--*Values of Manning's n for flood plains*

[Modified from Chow, 1959]

Description	Minimum	Normal	Maximum
Pasture, no brush:			
Short grass	0.025	0.030	0.035
High grass	.030	.035	.050
Cultivated areas:			
No crop	.020	.030	.040
Mature row crops	.025	.035	.045
Mature field crops	.030	.040	.050
Brush:			
Scattered brush, heavy weeds	.035	.050	.070
Light brush and trees, in winter	.035	.050	.060
Light brush and trees, in summer	.040	.060	.080
Medium to dense brush, in winter	.045	.070	.110
Medium to dense brush, in summer	.070	.100	.160
Trees:			
Dense willows, summer, straight	.110	.150	.200
Cleared land with tree stumps, no sprouts	.030	.040	.050
Same as above, but heavy growth off sprouts	.050	.060	.080
Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	.080	.100	.120
Same as above, but with flood stage reaching branches	.100	.120	.160

Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona

APPENDIX 5.8

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL CUT-OFF WALL COMPUTED BKH DATE 8-92

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Using "Designe of open channel, TR-25" Method:

PI = 12.3 from Fig. 6.2

V_B = 3.85 fps

For Q = 100 cfs.

V_m = 4.36 FPS

Y = .57 ft depth

ds = depth of Scoure

$$d_s = y\left(\frac{V_m}{V_B} - 1\right)$$

$$d_s = 0.56\left(\frac{4.36}{3.85} - 1\right) = 0.07 \text{ ft}$$

For a more Conservative way, We assume a Sediment Free flow Condition

V_B = 2.35

$$d_s = 0.56\left(\frac{4.36}{2.35} - 1\right) = 0.30'$$

Use 1.5 for Safety factor;

$0.30' \times 1.5 = 0.45'$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Cut-off Wall COMPUTED BKH DATE 8-92

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Using Tractive Force Method of analysis:

$\tau = \gamma R S$

τ = Tractive force lb/ft²

γ = Unit weight of water 62.4 lb/ft³

S = Gradient Energy

R = Hydraulic Radius $\frac{A}{P_w}$

Problem:

$R = 0.56$

$S = 0.019$ ft/ft.

$d_5 = 0.005$ ft.

$V \approx 5$ ft/sec

$\tau_{Actual} = \gamma R S$

$\tau_A = 62.4 \times 0.56 \times 0.019' = 1.$

$\tau_A = 0.66$ lb/ft²

Use 1.5 as S.F.

$\tau_A = 0.66 \times 1.5 = 0.99$ lb/ft²

6900-018 5-89

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Cut-Off Wall COMPUTED BKH DATE 8-92

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From Fig. 4, Pag 11 of "Computing Degradation and Local Scour" by Ernest L. Pemberton & Joseph M. Lara, Technical Guideline for Bureau of Reclamation

τ_c = Critical Tractive force

$\tau_c = 0.048 \ lb/ft^2$

$$d_s = R\left(\sqrt{\frac{\tau_A}{\tau_c}} - 1\right]$$

$$d_s = 0.56\left[\sqrt{\frac{0.99}{0.048}} - 1\right] = 1.97'$$

$$d_s \simeq 2'$$

Use 3' depth to get to the Rock.

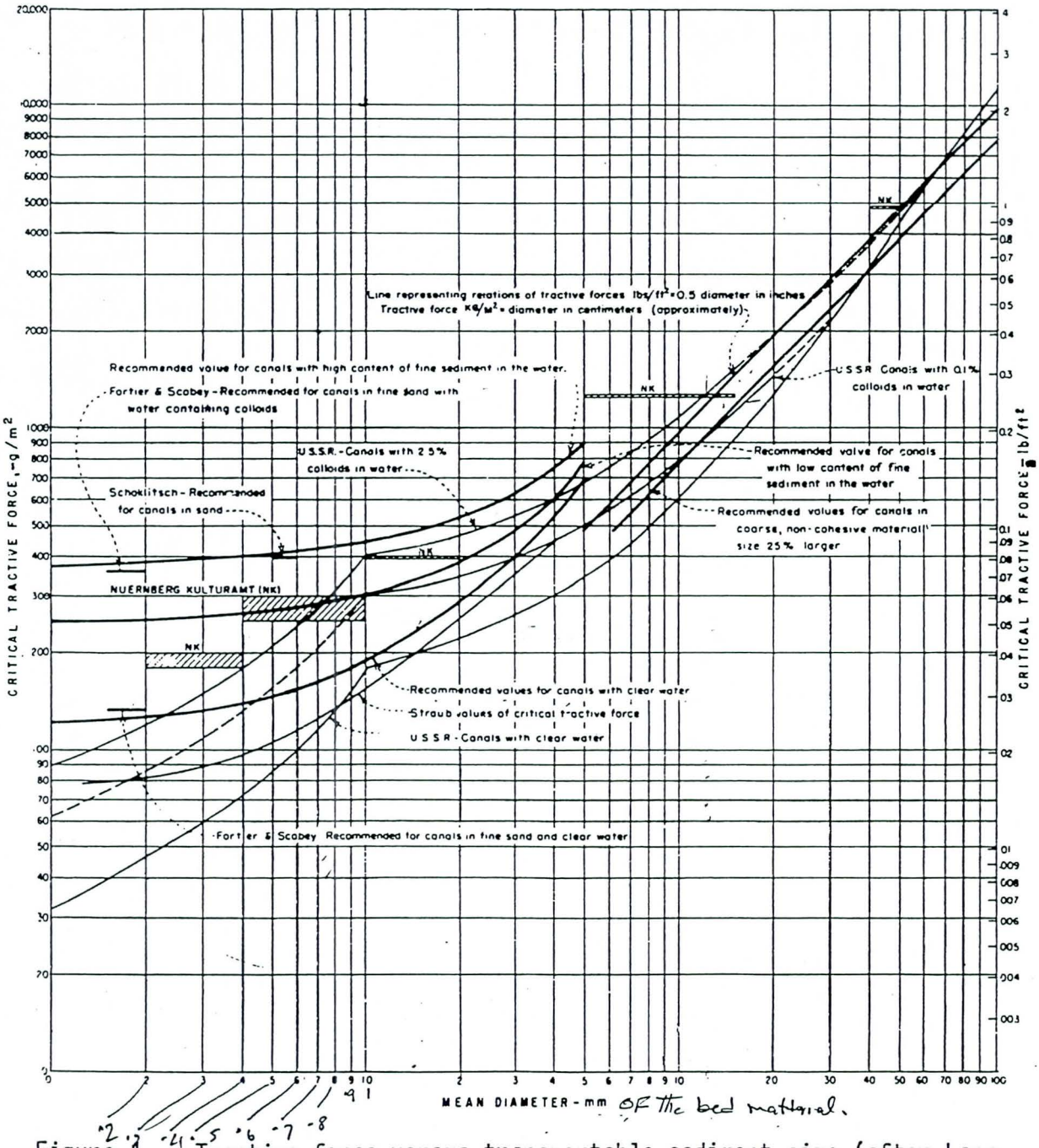

Figure 4. - Tractive force versus transportable sediment size (after Lane, 1952).

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Cut-Off Wall COMPUTED BKH DATE 8-92

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D_{50} Calculation

$\tau_A = \gamma R S = 62.4 \times 0.56 \times 0.019 = 0.66'$

Use 1.5 for S.F.

$\tau_A = 0.66 \times 1.5 \approx 1$ lb/ft2

$\tau_c = 0.04 (\gamma_s - \gamma_w) d_{50}$

$\tau_A = \tau_c$

$1 = 0.04 (165 - 62.4) d_{50}$

$d_{50} = 0.24' \approx 3''$

Recommended $d_{50} = 6''$

from: "DESIGN of RIPRAP REVETMENT", HEC-11, FHWAA-IP-89-016, March 89

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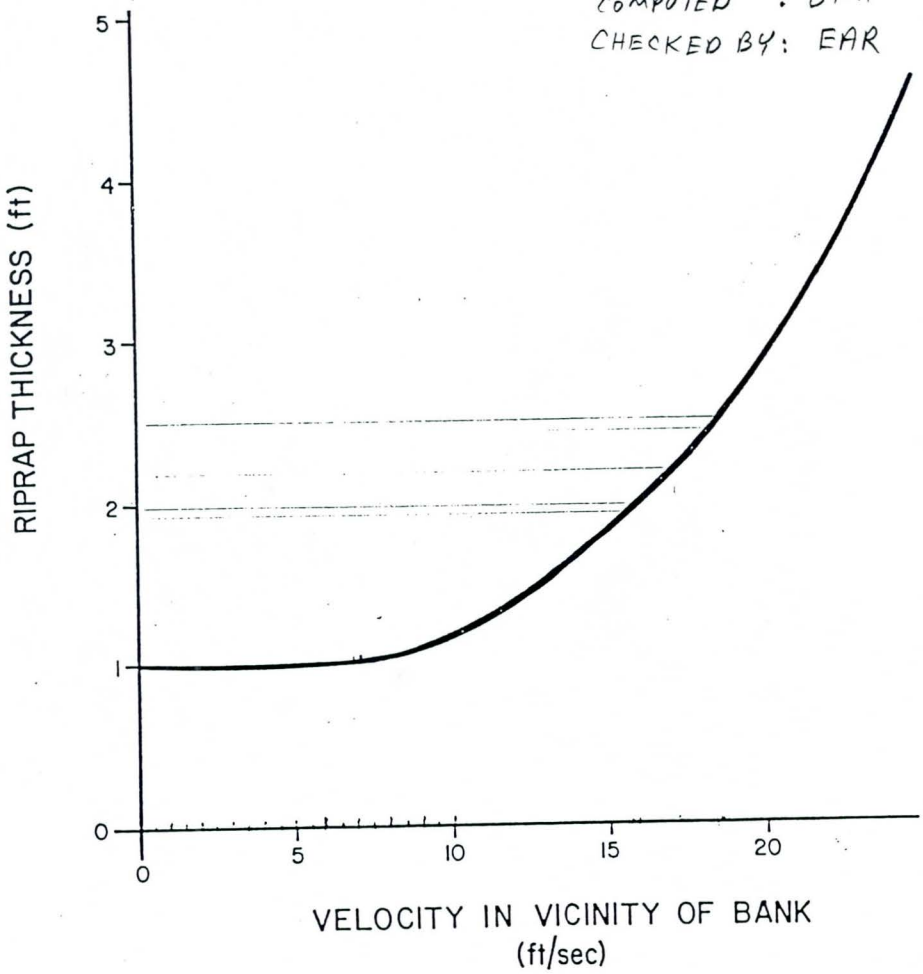

Figure 57. Required blanket thickness as a function of flow velocity.

STA.	VELOCTY	RIPRAP THICKNESS (ft)	
400	18.40	2.40	
500	17.22	2.20	USE 2.50'
650	18.55	2.52	
722.33	16.02	2.00	
850	15.73	1.94	
979.98	15.85	1.97	USE 2.00'
1100	15.86	1.97	
1237	15.83	1.96	

GROUTED ROCK 99

HEC-11

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Ch. PAGE 1 OF 1

DETAIL Filter Design COMPUTED BKH DATE 10-29-92

CHECKED BY _____ DATE _____

Filters are required under grouted riprap revetment to provide a zone of high permeability to carry off seepage water and prevent damage to the overlying structure from uplift pressures. However, in Spookhill channel outlet the top soil has a high permeability. However, If uplift happens, what would be the pressure?

$P = \rho h_p$

$\rho = 62.30 \ lb/ft^3$ @ 70° F. (3-54)

$P = 62.30 \ lb/ft^3 \times 3.5 \ ft \approx 218 \ lb/ft^2$

pressure from the Channel:

$W = 2 \times 150 \ lb/ft^3 \approx 300 \ lb/ft^2$

Since $218 < 300$, therefore, the uplift will not happen and there will be no need for Filter Layer for this project.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 1 OF

DETAIL Performance Time COMPUTED BKH DATE 9/92

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1. Mobilization

Use 20 working days

2. Excavation

· Assume 2,500 CY/day

12,992 / 2,500 ≈ 5 days

3. Channel Wall

· Assume 2 Crews working

· 75 LF/day

2 sides

[(1237 - 400) + 20] x 2 = 1714 LF.

1714 / 75 ≈ 23 days

4. Earthfill & Backfill

· Assume 1500 CY/day

6124 / 1500 ≈ 4 days

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 2 OF

DETAIL Performance Time COMPUTED BRH DATE 9/92

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5. Grouded Rip-rap

Grouded Rip-rap = 3,339 C.Y.

3,339 X 1.35 (Ton of Rock/cy) = 4,507.65 Tons

- 12 Tons / Truck rock & Using 4 Trucks
- Assume 45 min/round Trip for Trucks

$$\frac{8 \text{ hr day}}{45/60} \times \frac{50}{60} \approx 9 \text{ Trips / day - Truck}$$

12 X 9 = 108 Tons

108 x 4 (Trucks) = 432 Tons/day

4507.65 / 432 ≈ 11 days

6. Gravel Road Surfacing

$$\text{Yardage} = \frac{1200}{1.7 \frac{\text{Ton}}{\text{C.Y.}}} \approx 706 \text{ C.Y.}$$

- Assume 45 min/round Trip for Trucks

$$\frac{8 \text{ hr day}}{\frac{45}{60}} \times \frac{50}{60} \approx 9 \text{ Trips / day - Truck}$$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 3 OF

DETAIL Performance Time COMPUTED BKH DATE 9/92

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Using 13.5 Cy./load = 9 (13.5) = 121.5 Cy./day-Truck

Assume 4 Trucks used

121.5 (4) = 486 Cy./day

706 / 486 ≈ 2 days

7. Weather Days

From state Climate, Data for Chandler Heights Gauging Station for 32 years of record thru 1986:

Month	Inches	Rain Days			
Jan	0.94	1	July	0.71	1
Feb	0.80	1	Aug	1.27	1
Mar	1.06	1	Sept	0.76	1
Apr.	0.24		Oct	0.75	1
May	0.15		Nov	0.63	1
June	0.09		Dec	0.97	1

• Assume Construction will be done Mar. thru Aug.

No of rain day 3

Allow 3 dry days/rain day 9

12 days

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet PAGE 4 OF

DETAIL Performance Time COMPUTED BKH DATE 9/92

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Holidays = 5 days

Total working days = 20 + 5 + 23 + 4 + 11 + 9 + 2 + 12 + 5 = 91

Calendar days = $\frac{7}{5}(91)$ = 127.40 days = 4.25 Mo

Use total of 5 Month for Performance Time

From RMC
3/31/93

1. DESCRIPTION OF JOB

The Spookhill Outlet Channel and Sediment Basin project is l
Maricopa County area. It is part of the Buckhorn-Mesa Water
Buckhorn-Mesa structures control a watershed area of approxi
miles north of the study area and are designed for a 100-year event.

The Spookhill Outlet structure is constructed to convey flows from the Spookhill Dam into the Salt River. The existing outlet is an earth channel. The outlet intercepts Bush Highway through a concrete box culvert which recently was improved (from 2 boxes to 4 boxes) to carry the required capacity flow. The conveyed flow deposits its sediments into an existing basin at the end of the channel prior to reaching the Salt River in the vicinity of the Granite Reef Dam.

The design limits for this project start at the north end of the Bush Highway Concrete Box Culvert and end at the outlet of the sediment basin to the Salt River, Project.

2. DESIGN OBJECTIVE

The objective of this project is to design a new channel from Bush Highway, northwest to the existing sediment basin and into the Salt River, upstream of the Granite Reef Dam.

3. BASIS FOR DESIGN

1. The SCS collected material handbook.
2. Engineering Design Standards, Far West States, June 1979.
3. Design of Open Channels, TR-25, October 1977.
4. HEC-2, Water Surface Profiles, September 1990.
5. HEC-1, Flood Hydrology Package, September 1981.
6. Drainage Design Manual for Maricopa County, Volume II, Hydraulics, 1991.
7. Hydraulic Carts for the Selection of Highway Culverts, HEC-5, December 1965.

1. DESCRIPTION OF JOB

The Spookhill Outlet Channel and Sediment Basin project is located in the East Maricopa County area. It is part of the Buckhorn-Mesa Watershed project. The Buckhorn-Mesa structures control a watershed area of approximately 42 square miles north of the study area and are designed for a 100-year event.

The Spookhill Outlet structure is constructed to convey flows from the Spookhill Dam into the Salt River. The existing outlet is an earth channel. The outlet intercepts Bush Highway through a concrete box culvert which recently was improved (from 2 boxes to 4 boxes) to carry the required capacity flow. The conveyed flow deposits its sediments into an existing basin at the end of the channel prior to reaching the Salt River in the vicinity of the Granite Reef Dam.

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4. DISCUSSION

4.1- Hydrology

The hydrology for Spookhill Outlet was completed by the Soil Conservation Service (SCS) in 1975 and used to design the Spookhill Floodway. Since the hydrology has been approved, there have been minor changes in SCS's hydrologic procedures. The first known change in the hydrology procedures is a change to the Att-Kin versus the Improved Coefficient method of routing in the TR-20 program. The second change is the time increment for the type II, 24-hour storm from 0.50 hours to 0.25 hours. These changes might tend to increase the peaks to some extent, but they should not be significant. There was no need to re-evaluate the hydrology for the outlet design. SCS recommended that the 1975 hydrology be used to design the floodway outlet. The discharges could be increased about 10% to account for a possible increase in the computed peak flows.

In the July 24, 1990, meeting between the Flood Control District of Maricopa County (FCD) and SCS representatives, the above decision was agreed to and the proposed flow discharge for Bush Highway Culvert was set for 2650 cfs. In this study, the 2650 cfs was used to design the proposed outlet channel.

(what decision - to increase the flow by 10% or to ignore the 10% increase? (Just take this out if it is not necessary))

4.2- Survey

The proposed channel plan and profile design is based on the field survey information which was conducted by the SCS personnel during 1990. The 1990 survey covers the topo information from ~~the~~ ~~old~~ Bush Highway, ~~all the way~~ north along the existing dike to the Salt River. The survey topo uses the centerline of the channel dike as the survey centerline and provides cross section stationing and topographic profiles ~~for~~ at approximately ~~each~~ every 100 feet. The SCS field survey information was used to develop a topographic one foot contour map for the site. The topographic map was used to do the hydraulic and hydrology design of the channel outlet and sediment basin. **Appendix A provides a copy of the topographic map developed for the study.**

4.3- Location and Layout

The location and layout are along the existing channel and sediment basin, in accordance with the as-built survey drawings and the Spookhill Floodway 1977 design by the U.S. Department of Agriculture Soil Conservation Service.

4.4- Geologic Evaluation (by: SCS):

A geologic investigation was undertaken in order to evaluate geologic conditions along the proposed alignment of the outlet channel and sediment basin. Four test pits were excavated upstream from Bush Highway and eight test pits were excavated downstream from the highway. Logs of the test pits are attached to this report.

FINDINGS

Weathered granite is either exposed at the surface or is present at shallow depths upstream from Bush Highway. For a distance of at least 150 feet downstream from Bush Highway, weathered granite is present at a depth of no more than 13.5 feet. Immediately downstream from the bridge, the granite is locally exposed at the surface. Proceeding downstream from the bridge, the weathered granite is buried progressively deeper by fine to coarse, slightly silty, gravelly sand (SP-SM) with a few cobbles. Excavation to a depth of 16 feet in the vicinity of station 7+50 failed to reach bedrock. Further downslope, toward the Salt River, soil materials become more varied and stratified. Sporadically, surficial material is clayey silty (ML-CL) or silt (ML) to depths up to about three feet. These materials represent recent deposits of the Salt River. At the surface and beneath the silts are fine to coarse, slightly silty to silty sands (SM-SP and SM) to depths of about four feet. Some lenticular deposits of clayey, sandy gravel (GC) are present in the silty sand stratum. Cobbles with sand, gravel and silt are present at depths of four feet or less in this portion of the channel and sediment basin. Moisture conditions encountered generally ranged from dry to moist, except at one location. In the vicinity of station 10+50, the silt filling the interstices between cobbles was wet.

CONCLUSIONS

Geologic conditions for the proposed work~~s~~ is generally favorable. Foundation conditions should not pose any major problems. Some difficulty may be experienced in excavating and maintaining neat lines due to the presence of cobbles and ravelling sands. There is a slight possibility that ripping may be required to excavate a small quantity of weathered granite in the vicinity of Bush Highway.

A copy of the SCS's October report and soils test analysis is available in Appendix A.

5. HYDRAULICS AND SEDIMENT TRANSPORT ANALYSIS

5.1- Channel Design:

5.1.1- Engineering Methods:

Standard hydraulic methods were used to determine different alternative solutions for the proposed channel. Cross-sections for the water surface profiles were selected from the survey by SCS. Using the SCS survey information, FCD developed a topographic map with **1' contour intervals**, which is used for a base map and plan profile map.

Locations of selected cross-sections used in the hydraulic analysis are shown in Appendix B. Station 400 is located at the Bush Highway Box Culvert outlet and HEC-2 stationing increases, going north along the proposed channel centerline.

Water surface elevations for the 2650 cfs flow discharge were computed through the use of the COE HEC-2 step water surface profile computer program.

HEC-2 supercritical flow condition was selected to design the channel. Under supercritical conditions, the culvert is said to be inlet-controlled. The Hydraulic Charts for the Selection of Highway Culverts (by: U.S. Department of Commerce, Bureau of Public Roads) is used to determine the starting water surface elevation. A copy of the calculations is available in Appendix B.

A steep slope on the north side of the Bush Highway Box Culvert causes high velocity and develops a super critical hydraulic condition. Due to the high velocity along the channel, the earth type of channel will be unstable and, therefore, it is not recommended. In order to stabilize the channel, different types of structures were examined.

The proposed the channel maximum design curve is designed to limit superelevation to one foot above calculated water surface elevation or 10% of water surface width, whichever is the least. The following formula is used to calculate superelevation depth for the curve:

$$S=1.2(V^2 \times b)/gR$$

The required freeboard was computed using the following formula from the Flood Control District Drainage Design Manual:

$$FB = 0.25\ (y+(V^2/2g))$$ y=Depth of flow

V=Average velocity
g=Gravity acceleration

The Spookhill Channel Outlet slope changes sharply at the intersection of the proposed channel and basin. In peak flow conditions, when the water is introduced at a high velocity in the channel, the velocity will be reduced through a hydraulic jump at the sediment basin.

5.1.2- Channel Alternatives:

Using the above criteria and engineering methodologies, for a 40 foot width rectangular channel, in **Alternative No. 1**, a reinforced concrete channel was tested. The results are as follows:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 1

SENCO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80
400.00	2653.00	37.24	39.67	46.50	24.42	2.75	108.64	40.00	86.00	34.49
500.00	2653.00	34.04	36.56	44.01	25.34	2.62	104.71	40.00	100.00	31.42
660.00	2653.00	28.98	31.64	40.16	26.83	2.48	98.88	40.00	160.00	26.50
800.00	2653.00	26.60	29.11	36.52	25.27	2.62	104.97	40.00	140.00	23.98
900.00	2653.00	24.88	27.33	34.35	24.70	2.69	107.43	40.00	100.00	22.19

SECNO= Cross section station identification
Q= Discharge runoff, cfs.
CWSEL= Water surface elevation, ft.
CRIWS= Critical water surface elevation, ft.
EG= Energy line elevation, ft.
VCH= Velocity, fps.
DEPTH= Depth of water, ft.
AREA= Wetted area, ft.
TOPWID= Top width of the channel, ft.
XLCH= Distance between the cross section stations, ft.
ELMIN= Channel invert flow line elevation, ft.

Alternative No. 2, modeled ~~tried~~ concrete retaining walls for the sides and grouted rock bottom. The profile starts with a steep slope (3.0731%) and changes to a flatter grade (1.9818%) to match the existing elevation. The following table is the results of HEC-2 model:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 2

SENCO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49
500.00	2653.00	35.27	36.55	36.87	17.21	3.85	154.18	40.00	100.00	31.42
660.00	2653.00	30.11	31.63	35.35	18.35	3.61	144.54	40.00	160.00	26.50
800.00	2653.00	28.08	28.87	31.69	15.24	4.35	174.07	40.00	140.00	23.73
1020.00	2653.00	23.48	24.51	27.50	16.09	4.12	164.87	40.00	220.14	19.36
1240.00	2653.00	19.20	20.13	23.07	15.80	4.20	167.93	40.00	220.14	15.00

Alternative No. 3. Looking at the water surface profile of Alternative No. 2, there is a small hydraulic jump between stations 660 and 800. This jump is caused by the extensive change between the channel profile grades. To eliminate the jump and to have a more uniform flow condition ~~a similar channel material~~ the same channel cross-section ~~for~~ used in Alternative No. 2, was used for Alternative No. 3 with ~~more comparable~~ lower grades in and variances (2.6885% and 2.0651%) ~~was used to have smaller variances between the grades and therefore a more uniform hydraulic flow condition.~~ The following table is the results of this attempt:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 3

SENCO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
81 ~~314.00~~	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49
500.00	2653.00	35.81	36.93	40.06	16.54	4.01	160.36	40.00	100.00	31.80
660.00	2653.00	31.28	32.63	36.08	17.58	3.78	150.87	40.00	160.00	27.50
800.00	2653.00	28.85	29.75	32.65	15.65	4.24	169.53	40.00	140.00	24.61
1032.60	2653.00	23.88	24.93	27.98	16.26	4.08	163.18	40.00	232.65	19.80
1265.30	2653.00	19.14	20.13	23.13	16.04	4.14	165.42	40.00	232.65	15.00

Alternative No. 4. Alternative No. 3 resulted in a more uniform hydraulic condition for the water surface profile. It also showed that the attempt ~~for~~ to eliminate the hydraulic jump ~~is in the right direction.~~ was a more desirable design alternative. Alternative No. 4 ~~goes~~ went a step further to eliminate ~~this problem.~~ the jump. ~~We used~~ were used Concrete retaining walls for the sides and grouted rock for the bottom with the ~~flattest~~ minimum allowable slopes of 2.3038% and 2.1418% ~~for~~ which resulted in a more uniform flow pattern in the channel (see the water surface profile figure), as ~~follows:~~ indicated in the table below:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 4

SENCO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
81 ~~314.00~~	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49
500.00	2653.00	36.38	37.32	40.27	15.82	4.19	167.75	40.00	100.00	32.19
660.00	2653.00	32.45	33.63	36.82	16.77	3.95	158.18	40.00	160.00	28.50
800.00	2653.00	29.61	30.63	33.65	16.13	4.11	164.44	40.00	140.00	25.50
1045.10	2653.00	24.30	25.38	28.46	16.37	4.05	162.11	40.00	245.16	20.25
1290.30	2653.00	19.07	20.13	23.19	16.29	4.07	162.90	40.00	245.16	15.00

The following table summarizes the results of the above alternatives:

	H	Hc	Rc	Lc	L
Alternative #1			910	1138	
Alternative #2	6.33	7.25	386	483	883
Alternative #3	6.25	7.17	394	493	893
Alternative #4	6.25	7.17	399	500	900

H= depth of channel, ft.
Hc= depth of channel at curve, ft.
Rc= radius of curve, ft.
Lc= length of curve, ft.
L= total length of channel, ft.

The final results of the above tables indicate that Alternative No. 1 needs to have a very large radius for the curve area, due to the high flow velocity (approximately 26 fps), and the proposed channel alignment will be outside the existing channel. It will be the longest channel and more earthwork and concrete materials will be needed to construct the channel. Alternatives 2, 3 and 4 appear to have similar hydraulic characteristics. However, in Alternative No. 2, which is the preferred alternative, the proposed channel alignment fits within the existing channel and the profile of the proposed channel matches the existing channel profile. Therefore, much less earthwork is needed and the shortest channel length will be required. Alternative No. 2 will be the least expensive method and perhaps the most suitable alternative to use.

A concrete retaining wall and grouted rock bottom, using Alternative No. 2 profile, is recommended.

5.1.3- Final Design:

The SCS 30 percent review of the Spookhill Outlet channel plans and design analysis indicates that SCS agrees with FCD that Alternative No. 2 should be finalized as the preferred alternative.

The channel alignment was adjusted to match the centerline of the sediment basin. This prevents channel runoff from being directed at the north side sediment basin dike and, therefore, it eliminates erosion to the north side dike. The centerline adjustment reduced the channel length. The channel profile was revised based on the above adjustment. The profile starts with a steep slope which matches the existing channel profile, and changes to a flatter grade to match the existing elevation of 1315.00 where it enters the sediment basin. The following table is a summery of the HEC-2 results:

HEC-2 SUMMARY TABLE FOR FINAL DESIGN

SENCO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
319.00	2653.00	41.97	41.97	44.56	12.92	5.17	205.33	40.00	.00	36.80
400.00	2653.00	38.13	39.66	43.39	18.40	3.64	144.14	40.00	81.00	34.49
500.00	2653.00	35.14	36.43	39.74	17.22	3.85	154.10	40.00	100.00	31.29
650.00	2653.00	30.08	31.63	35.42	18.55	3.58	143.04	40.00	150.00	26.50
722.33	2653.00	29.21	30.22	33.20	16.02	4.13	165.56	40.00	72.33	25.08
850.00	2653.00	26.80	27.72	30.64	15.73	4.22	168.67	40.00	127.67	22.58
979.98	2653.00	24.22	25.17	28.13	15.85	4.18	167.36	40.00	129.98	20.04
1100.00	2653.00	21.87	22.82	25.77	15.86	4.18	167.25	40.00	120.02	17.69
1237.60	2653.00	19.19	20.13	23.08	15.83	4.19	167.62	40.00	137.62	15.00

Stability and scour analysis where the channel enters the sediment basin:

At this location of the proposed channel, the flow velocity will be at a super-critical flow condition. However, there is no scour along the channel and sediment basin at the existing condition. ~~This is because,~~ No scour occurs here, since during the storm event while the runoff in the channel is increasing to reach the peak flow condition, the basin water surface elevation is also increasing to reach the maximum storage capacity. The sediment basin water surface elevation will reach the basin weir outlet invert elevation within an hour after the start of the storm. By that time, the runoff flow will have reached its peak and the basin water surface depth will have increased more than 7 feet (22.50-15.00=7.50) in depth.

To insure that the channel peak flow runoff will not overtop the channel and basin where the hydraulic jump occurred, the height of the hydraulic jump is calculated. The height of the jump is approximately 7 feet and the length is approximately 24 feet. The jump is estimated to be downstream of channel station 10+84, where the invert elevation is about 1318 (the sediment basin weir outlet invert elevation). The channel wall depth is selected to be 9'-6" in this area, and there is no overtopping flow problem with the channel at this location.

As the water surface elevation increases in the sediment basin, so does the buffering, which provides protection for the basin and the channel entrance to the basin. The existing basin condition indicates that the basin water storage should be adequate to prevent any scour at the channel entrance.

SEDIMENT BASIN STAGE STORAGE DATA

TIME Hr.	IN-FLOW CFS	OUT-FLOW CFS	BASIN WATER SURFACE ELEVATION Ft
0.25	3	0	1316.0
0.33	10	0	1316.0
0.42	27	0	1316.1
0.50	47	0	1316.3
0.58	65	0	1316.5
0.67	82	0	1316.9
0.75	98	0	1317.2
0.83	113	0	1317.7
0.91	128	16	1318.1
1.00	142	91	1318.5
1.08	156	136	1318.6
1.17	170	158	1318.7
1.25	184	174	1318.7
1.33	198	189	1318.8

NOTE: This statement is contradicted in the 1st paragraph of the previous page

The most severe scour occurs when the basin is empty and runoff is increasing. The channel is expected to have a scour problem where it enters the sediment basin. The major scour develops during the first hour of storm runoff (prior to the basin water surface reaching the weir outlet invert elevation). During the first hour, the sediment basin is empty or has less than 3 feet of water. Runoff within the first hour will reach approximately 140 cfs (see the "Sediment Basin In-flow & Out-flow Condition" table). At that time, the basin water surface elevation will be about 3 feet. However, since the major scour occurs when the basin is empty (when runoff is much smaller than 140 cfs), it is conservative enough to use 100 cfs for calculating the scour depth. The maximum velocity is approximately 4 fps for 100 cfs discharge. Scour depth at the channel entrance is calculated for approximately 2 feet. Soil tests in the vicinity of the sediment basin indicates the existence of ~~rock~~ self-armoring layer at an approximate~~ly 6 feet~~ depth of 6 feet below the ~~basin~~ basin floor existing ~~elevation~~. The existing elevation at the channel intersection with the sediment basin is approximately 1.5 feet above the proposed channel invert elevation. Therefore, it is recommended that a 5 foot deep cutoff wall be used where the channel enters the basin to provide sufficient protection for the channel (5+1.5=6.5'> 6' ~~rock~~ Self-armoring layer depth). move this circled stuff to the end of the sentence.

NOTE: Has the cobble layer been checked for self-armoring capability?

The engineering methods of calculations described in Section 5.1.1 are used to determine the channel required freeboard and superelevation depths. The following table displays the results of ~~this effort~~: these calculations:

SUMMERY OF Minimum Height Requirements CALCULATION FOR THE PROPOSED CHANNEL WALLS

STA. No.	Water Depth ft.	Freeboard ft.	Super Elev. ft.	Min. Required Channel Depth Left	Right
319.00	5.17	1.94	N/A	6'-0"	6'-0"
400.00	3.64	2.22	N/A	6'-0"	6'-0"
500.00	3.85	2.11	N/A	6'-0"	6'-0"
650.00	3.58	2.23	N/A	6'-0"	6'-0"
722.33	4.13	2.03	0.00	6'-2"	6'-2"
850.00	4.22	2.02	0.50	6'-3"	6'-9"
979.98	4.18	2.02	1.00	6'-3"	7'-3"
1100.00	4.18	2.02	0.53	6'-3"	6'-9"
1237.60	4.19	2.02	0.00	6'-3"	6'-3"

Sedimentation Removal: The channel flow is ~~in~~ supercritical occurring. ~~condition,~~ and ~~it~~ is expected to be self-cleaning with no sediment deposition. However, should substantial sediment deposition occur, The Flood Control District Operation and Maintenance Division will be able to remove the sediment deposition by using a front end loader (compatible to the 624E John Deere loader) without damaging the ~~rock.~~ cobble armoring layer.

5.2- Sediment Basin Outlet Analysis:

5.2.1- Sediment Analysis:

Most of the sediment will be dropped at the lower 10-12 feet of the Spookhill Reservoir pool by the time the flow reaches the principal spillway outlet. Don Clark (SCS Geologist) has estimated that 95 percent of the sediment will remain in the Spookhill Reservoir. Suspended sediment contributed to this project from the reservoir is estimated to be 0.14 ac-ft of suspended load. Mr. Clark estimated that the average erosion rate for the natural channel is approximately 0.25 ac-ft/sq.mi-yr. Half of the sediment from the watershed area is suspended load, of which 90 percent is estimated to be transported to the basin. The other half is bed load, ~~and~~ with 70 percent ~~of that~~ estimated to be transported to the basin.

Other contributing areas downstream from the reservoir are subareas 23, 24, 25 and 26 (from TR-20 hydrology study dated 3/75 by SCS). Areas 23, 24 and 25 contribute 0.05 ac-ft of suspended load and 0.04 ac-ft of bed load. Area 26 contributes approximately 0.29 ac-ft of suspended load and 0.18 ac-ft of bed load. Total sediment transported to the basin is estimated to be 0.70 ac-ft/yr. The Flood Control District currently cleans out the basin once every two years. The maximum sediment volumes in the basin should not increase by more than 1.40 ac-ft (2-year X 0.70 ac-ft/yr = 1.40 ac-ft/yr). The proposed basin ~~capacity will be well above the requirement.~~ has a design capacity which will accomodate this predicted increase in sediment deposition.

The 100-year storm sediment is calculated to be approximately 0.94 ac-ft. Based on the SCS Geologist's recommendation, the 100 percent of the annual bed load and 100 percent of the annual suspended load is used to calculate the 100-year storm sediment. It is conservatively assumed that the 100-year storm sediment occurs while the basin contains the two year sediment. The combined sediment is estimated to be 2.34 ac-ft. However, the basin volume is approximately 5 (Ave. length=685, Ave. width=106, and Ave. depth=3) ac-ft. Therefore, the basin will accommodate the 100-year storm sediment accumulation, assuming that the FCD will continue to remove sediment approximately once every two years. Appendix B provides backup documentation for the sediment study by SCS personnel.

move this here

5.2.2- Hydraulic Analysis:

The sediment basin ~~is built~~ was designed to capture sediment in the flow~~s~~ ~~prior to entering into~~ before it encounters Granite Reef Dam. ~~Through the years of cleaning and reconstruction of the sediment basin dikes, some of the features like driveway ramp entrances and drop structure at the end of channel, which were part of the original design, have disappeared. The existing basin has no driveway entrance and drop structure.~~ Hydraulic analysis indicates a need for increasing the dike's profile elevations around the sediment basin in order to insure that only the flow will ~~only~~ exit through the sediment basin outlet.

if this is pertinent info, I think it should be moved to another sub-heading. Under this topic, the info is not relavent. (or make another paragraph with this info.)

The FCD had previously developed a HEC-1 model to compute the outlet flow from ~~the~~ Spookhill Dam. This model~~, which was~~ developed by FCD watershed branch ~~simulates~~ generated the outlet hydrograph from the dam and routes flows ~~it~~ through the existing outlet channel, then computes the runoff hydrograph from the downstream side of the dam~~, and combines~~. The two hydrographs were combined to ~~determine~~ predict the peak discharge at Bush Highway.

At the suggestion of SCS personnel, The FCD HEC-1 model was revised to ~~account for~~ include the ~~10%~~ 10% additional discharge expected from the watershed. ~~This was suggested by SCS personnel~~ (see the hydrology section of this report). ~~The hydrology model was improved by routing the combined hydrograph at the Bush Highway Culvert through the new four-barrel culvert, the proposed (Alternative No. 2) channel, and then into the sediment basin structure. It was assumed~~ For the hydrograph generation, the assumption was made that the basin ~~has~~ will have a maximum of one foot of sediment deposits (see the sediment basin calculation section of this report)

replace with: The HEC-1 model was also modified to reflect the recent expansion of the Bush Highway crossing from 2 to 4 box culverts, as well as to reflect the improvements described in ~~Alternate~~ design alternate number 2 and the proposed improvements to the sediment basin.

during the time of peak discharge ~~hydrograph routing~~. The basin will have two feet of storage depth prior to activating and conveying the outlet flow. The weir outlet elevation ~~sits at~~ is 1318 and the bottom width of the trapezoidal weir is 150 feet.

Using the stage storage method of calculations for routing through the basin, the HEC-1 model ~~resolutes~~ predicted that, at the maximum stage, the water surface profile will reach ~~1322.50.~~ (This water surface elevation ~~is calculated~~ estimated was also using the final HEC-2 model water surface computation (see last paragraph of page 16 of 20).) ~~(?? I don't know if this is true.)~~ (okay, stated on next sheet)

Stage Storage Data

Volume, acre-feet	0	1.582	3.223	4.924	6.685	8.506	10.386
Elevation, feet	1316	1317	1318	1319	1320	1321	1322

(where is this elevation in this ~~table~~ ??) ?

and why state this twice?? take this out here (entire sentence)

~~Based on the HEC-1 computation, the water surface elevation will reach 1322.50. It is recommended that the~~ the dikes around the sediment basin be raised to 1324.00 feet. ~~to allow for adequate freeboard requirements~~ should

~~(To allow for adequate freeboard requirements, the dikes around the basin should be raised to 1324.00 feet.)~~

(NOTE: According to pg S-19 of FCD HDM, Fb = 2' min for supercritical (insert) ~~To allow for a minimum of one foot of freeboard,~~ we have 1.5' here - was originally will this be important to change??) (OK - ~~Basin~~ has this on the next page)

5.3- Sediment Basin Analysis

An existing trapezoidal sediment basin outlet ~~is~~ designed to direct runoff~~s~~ from the basin into the Salt River. The area between ~~the~~ this basin outlet and the Salt River is a wetland area~~. This area~~ and is covered with vegetation and trees. ~~The runoff should~~ channel flow should go through this area and ~~find its way out~~ then in to the Salt River. Using SCS's survey information, an HEC-2 model was developed to compute the water surface elevation for the sediment basin outlet. The model ~~runs~~ ran under a subcritical flow condition ~~and~~ with ~~the stationing starts from~~ station 0+00 at the Salt River and ~~runs~~ running southeasterly along the sediment basin outlet centerline being ~~located~~ located to approximately station 3+60 at the weir outlet.

~~The~~ Field reconnaissance ~~during and prior to the monsoon session rior to that,~~ season, indicated that a higher Manning's "n" value for the wetland area should be considered to reflect the effect of dense brush and trees. For the final design, Table 3 page 11 of "Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona" ~~is~~ was used. This document ~~is~~ was prepared by the U.S. Geological Survey for Flood Control District of Maricopa County. A copy of Table 3 is presented in Appendix B. The HEC-2 model for the sediment basin outlet was revised ~~due~~ to reflect the higher "n" value.

Appendix B provides a copy of the HEC-2 model, ~~HEC-2~~ and the model which ~~and~~ shows map ~~and~~ cross-section locations, water surface profile, and HEC-2 cross-section profiles. The following table provides a summary of the results for the HEC-2 sediment basin model:

HEC-2 SUMMARY TABLE FOR THE SEDIMENT BASIN OUTLET

SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA
10.00	2650.00	19.22	17.00	19.25	1.47	5.42	1927.7
50.00	2650.00	19.63	17.52	19.67	1.67	4.03	1723.4
100.00	2650.00	20.16	18.43	20.22	2.00	4.16	1410.8
150.00	2650.00	20.69	18.87	20.77	2.30	4.39	1189.0
200.00	2650.00	21.14	19.16	21.26	2.80	3.94	964.7
300.00	2650.00	21.68	19.47	21.86	3.52	4.18	760.9
360.00	2650.00	22.50	20.11	22.71	3.71	4.50	714.6

According to the HEC-2 results, the water surface elevation at the sediment outlet will be approximately 1322.50. Increasing the sediment basin levee top to 1324 feet will provide more than one foot of freeboard at the weir outlet.

5. HYDRAULICS AND SEDIMENT TRANSPORT ANALYSIS

5.1- Channel Design:

5.1.1- Engineering Methods:

Standard hydraulic methods were used to determine the different alternative solutions for the proposed channel. Cross-sections for the water surface profiles were selected from the survey by SCS. Using the SCS survey information, ~~the~~ FCD developed a topographic map with **1' contour intervals**, which was ~~is~~ used ~~for a~~ to generate a base map and plan/profile map.

Locations of ~~the~~ selected cross-sections used in hydraulic analysis are shown in Appendix B. ~~A~~ Station 400 is located at the Bush Highway Box Culvert outlet and the HEC-2 stationing increases, ~~going~~ proceeding north along the proposed channel centerline.

The ~~W~~water surface elevations for the 2650 cfs flow discharge were computed ~~through~~ by use~~d~~ ~~of~~ the COE HEC-2 step water surface profile computer program.

An HEC-2 supercritical flow condition was selected to design the channel. Under supercritical conditions, the culvert is said to be inlet-controlled. The Hydraulic Charts for the Selection of Highway Culverts (by: U.S. Department of Commerce, Bureau of Public Roads) was ~~is~~ used to determine the starting water surface elevation. A copy of the calculations is available in Appendix B.

The ~~A~~ steep slope on the north side of the Bush Highway ~~Box~~ b ~~Culvert~~ k causes high velocity and the flow develops a super critical hydraulic condition. Due to the high velocity along the channel, ~~the~~ an earth ~~type of~~ lined channel ~~will~~ would be unstable and, therefore, ~~it~~ is not recommended. In order to stabilize the channel, different types of structure~~s~~al were examined.

The curved section of the proposed channel ~~The proposed channel curve~~ ~~is~~ was designed to limit the superelevation of the water to one foot above the calculated water surface elevation or 10% of water surface width, whichever ~~is~~ was the least. The following formula ~~is~~ was used to calculate the superelevation depth ~~for~~ of the curve:

the maximum

$$S=1.2(V^2 \times b)/gR$$

where is the reference for this eqn?

The required freeboard was computed using the following formula from the Flood Control District Drainage Design Manual (pg 5-19):

$$FB = 0.25\ (y+(V^2/2g))$$

y=Depth of flow

V=Average velocity

move this here

6. STRUCTURAL DESIGN

the Channel ~~walls are basically~~ was designed ~~as~~ channel bottom (to have) cantilever retaining walls ~~of~~ with varying heights, ~~with~~ and a grouted riprap ~~section between the channel walls~~. ~~AASHTO standard specifications for highway bridges with applicable live loads is used for design~~. The structural design criterion were based on AASHTO Standard Specification for Highway Bridges (need a year here). Class AA Concrete, compressive strength 4000 psi ~~is used~~ specified. Reinforcing steel shall conform to ASTM ~~specifications~~ A615 Grade 60 steel. ALL

Part of the existing wing walls are to be sawcut~~ted~~ and removed before the new channel construction begins. The new channel construction will match the existing walls, footings, apron and cutoff walls.

All walls shall have construction joints spaced at intervals of 30 feet minimum and 50 feet maximum. Expansion joints shall be provided at intervals not ~~exceeding~~ exceed 90'-0" and as per details shown on ~~drawings~~ the construction plans. Appendix "C" provides the design calculations for the retaining walls.

PROPOSED ~~DESIGNED~~ CHANNEL WALL ~~DEPTH~~ HEIGHTS

Station	Channel Invert	Channel Wall Depth Height	Channel Wall Top Elev.
4+40		6'-0"	
6+50	1326.50	6'-0"	1332.50
6+60	1326.30	7'-2"	1333.47
8+50	1322.59	7'-2"	1329.76
8+60	1322.39	8'-4"	1330.72
10+50	1318.67	8'-4"	1327.00
10+60	1318.48	9'-6"	1327.98
12+37.61	1315.00	9'-6"	1324.50
12+57.61	1315.00	9'-0"	1324.00

7. Operation & Maintenance ~~O&M~~ ROAD DESIGN

~~The~~ An O&M road will be built on both sides of the channel. ~~The~~ This portion of the project consists of ~~of protecting the maintenance road from erosion by applying~~ installing a gravel ~~cover.~~ road surface with a minimum ~~Gravel road surfacing will be~~ compacted ~~to approximately~~ thickness of 4 inches. ~~thick~~. The gradation for the gravel road surfacing was based on the Maricopa Association of Governments (MAG) specification for aggregated base.

In addition, there will be a 10 foot wide O&M road along the centerline of the channel. The channel centerline O&M road ~~is~~ will be covered by grouted rock rip rap and ~~is to~~ will be used for to access the channel cleaning and maintenance ~~of the channel.~~ purposes.

8. ENVIRONMENTAL CONSIDERATIONS

The gravel road surfacing on the maintenance roads will reduce dust produced by vehicles. The gravel road surfacing will have a positive impact on the visual aspects of the channel.

Water will be used to abate dust generated ~~by~~ during the construction phase. No negative impact on the conservation of biological or water resources is ~~anticipated by~~ expected due to the construction of the proposed channel and sediment basin improvements.

(Check first!! With Basin) The existing wetland area shall be preserved in its existing condition and no construction operations shall be allowed in this area.

9. CONSTRUCTION DRAWINGS

~~The Computer Aid Drafting Design~~ Auto-CAD Software (Version 11) was used to produce and store the construction drawings; ~~using Auto-CAD Software, Version 11~~.

10. SPECIFICATIONS

this is only the specs for one specific topic... what about the structural specs, construction specs... etc...

NEH Section 20 Standard Specifications ~~have been~~ were used for this project, and no special written specifications were required.

what aspect of this project??

11. COST ESTIMATE

There are no unusual materials or construction methods involved in this project. ~~Most of the~~ The work ~~involves the use of earthfill, drainfill, concrete, steel reinforcement, loose rock riprap, grouted riprap, chain link fence, and gravel road.~~ consists of earthwork, drainable backfill placement, reinforced concrete construction, loose and grouted riprap placement, chainlink fence installation and gravel roadway construction.

12. CONSTRUCTION SCHEDULE

The construction schedule was based on an average sized contractor company doing the work. Total construction time is approximately five months.

13. OPERATION AND MAINTENANCE

The proposed improvements will reduce the maintenance requirements ~~in~~ of the channel, sediment basin, and maintenance roads. A regular maintenance program should be initiated to check for broken grouted riprap and concrete and these areas should be immediately repaired to prevent plant growth. After each major storm, the channel and basin should be checked to assure that it is still functioning properly, that debris and sediment is removed, and that no damage has occurred. The sediment basin should be scheduled to be cleaned a minimum of once every two years.

14. CONSTRUCTION REVIEW

All of the channel retaining walls, grouted riprap, and maintenance roads should be inspected regularly during the construction process.

this should be more "defined" (ie, daily, etc...)

A preconstruction conference will be held, at which time questions ~~about the repair or design~~ regarding ~~this~~ project can be discussed.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WEST NATIONAL TECHNICAL CENTER
Engineering Staff
Portland, Oregon
November 20, 1992

DESIGN REVIEW REPORT

Project: Buckhorn Mesa Watershed
Job: Spook Hill Floodway Outlet
Location: Maricopa County, AZ
Authority: PL566
Stage: Preliminary Design

Summary:

Description of Job:

This job consists of the upgrading of the temporary outlet works for the Spook Hill Floodway to the capability of passing the 100 year frequency storm and attendant sediment. The works has approximately 550 feet of composite reinforced concrete and grouted rock riprap channel from Bush Highway to the existing sediment basin. The sediment basin dikes will be raised to pass the increased flow and to accommodate the backwater in the outlet channel.

Purpose of Review:

The purpose of this review is to determine compliance with SCS standards and criteria, and sound engineering practices.

Scope of Review:

The following material was reviewed:

1. Preliminary design calculations.
   a. Narrative.
   b. Hydraulic and Sediment Transport Analysis.
   c. Structural Design.
   d. Miscellaneous.
2. Preliminary construction drawings.
3. Specifications.

Basis for Review:

The following references were used in review of the job:

1. TR 25 Design of Open Channels
2. Handbook of Hydraulics, King & Brater, 5th ed.
3. Engineering Design Standards - Far West States.
4. NEH Section 5, Hydraulics.
5. Hydraulic Charts for the Selection of Highway Culverts, Hydraulic Engineering Circular No. 5, BPR (USDI).
6. Capacity Charts for the Hydraulic Design of Highway Culverts, Hydraulic Engineering Circular No. 10, BPR (USDI).
7. NEH Section 6 Structural Design.

replacement costs during the life of the project as well as initial cost.

e. Minor comments, suggestions, and editorial comments are redlined on the preliminary design calculations.

4. Structural Design.

a. Narrative. The retaining walls are designed in accordance with AASHTO requirements for live loads. It is recommended that SCS requirements be used where exceeding AASHTO requirements.

b. Narrative. Because expansion joints are on 90 foot intervals the longitudinal steel should meet temperature steel requirements of 0.03 sq in for exposed face and 0.02 sq in for unexposed face.

c. No Soils Mechanics test information is available giving the unit weights, shear strengths and other pertinent structural values for the design of the retaining wall. Values used are based on AASHTO recommendations for typical highway wall design. The specifications do not identify the backfill material by type nor do the drawings show the borrow area. A saturated unit weight of 130 pcf is assumed and a coefficient of lateral pressure of .33. The coefficient corresponds to that of clean sand or gravel. A likely material in the borrow area appears to be SM or SC. At best this material can be expected to be classified as soil type 2 in figure 46 of TR 74. The moist unit weight for this material is expected to be about 100 pcf. This would lead to a minimum value of around .4 for the coefficient or an increase of about 20 percent in the lateral pressure of the soil although something less in the total pressures. Recommend the following actions:

(1) Identify the borrow material and verify their availability.
(2) Correlate unit weights, shear values and other pertinent information for this material with similar material from Spook Hill Dam or other jobs in the vicinity.
(3) Use the correlated values in design or check of the proposed design.

d. Design does not meet provisions of TR 67 as follows:
(1) 60 ksi used for design of Service Hydraulic Structure instead of 40 ksi.
(2) Rho less than rho shy.
(3) Minimum steel less than 0.002bd in the exposed faces and less than 0.001bd in the greater thickness in the unexposed faces..
(4) Load factor of 1.3 used instead of 1.8.

e. NEH Section 11 not met for factor of safety in sliding. Used 1.0 instead of 1.5.

Preliminary Construction Drawings.

1. No comments yet

8. NEH Section 11 Drop Structures.
9. National Engineering Manual.

Review Comments:

Preliminary Design Calculations.

1. HYDRAULICS AND SEDIMENT TRANSPORT ANALYSIS

a. At low water surface in the sediment basin and design flow in the channel a jump will form well into the sediment basin. It is recommended that the stability of the sediment basin under the above condition be addressed. It is suggested a grouted rock riprap hydraulic jump energy dissipator basin or plunge pool be designed for the end of the channel. Examples of design of these type of dissipators are available in the SCS Arizona projects. Pass Mountain Floodway drop structures were designed as jump basins and the outlet of the Signal Butte Floodway was designed as a plunge pool.

The explanation given in the narrative appears acceptable. Any hydraulic jump that can occur will be during high flows at which time the basin will be full and the jump will form in the channel. At low basin water surface flows should be around critical or less and scour will depend upon velocities. A cutoff wall is acceptable at or near the depth proposed be the anticipation of rock in that location to tie it into appears unrrealistic and is not supported by the Geology. The drawings show existing ground about 1.5 feet above the proposed invert and TH 2403 shows no rock at it's limit of 6.0 feet.

c. It appears that the wall height at the end of the channel is sufficient to include the effects of backwater from the sediment basin. It is recommended that documentation of the adequacy of the wall height be included.

Page 11 of 19 of the narrative provides a summary table for the hydraulic properties of the channel. The properties appear to be based on unimpeded flow and does not reflect the location of the sequent depth of the jump formed at maximum discharge. It is suggested that this location be documented to show that the sequent depth will occur in the channel and not in the sediment basin.

d. It does not appear to be documented that the basin will accommodate the 100 year frequency sediment accumulation. It is recommended that the narrative include reasoning for assuming that sufficient capacity is available to accommodate the 100 year frequency sediment amount.

e. No cost comparisons were included in the documentation supporting the statement in the narrative that Alternative number 2 is the least cost. It is recommended that this support be included in the documentation and that it include maintenance and