

BUCKHORN - MESA WATERSHED
PROTECTION AND FLOOD PREVENTION PROJECT
MARICOPA AND PINAL COUNTIES, ARIZONA

SPECIFICATIONS AND DESIGN REPORT
FOR THE CONSTRUCTION OF

SPOOKHILL OUTLET CHANNEL
AND SEDIMENT BASIN

A300.504

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PHOENIX, ARIZONA

August 1993

FINAL DESIGN REPORT

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JOB: Spookhill Outlet Channel and Sediment Basin
CLASS: Class VII
WATERSHED: Buckhorn Mesa Watershed
LOCATION: Maricopa County, Arizona
AUTHORITY: PL 566
PHASE: Final Design

Summary: The plans and specifications for this project were prepared by the Flood Control District of Maricopa County through an agreement between FCD and SCS. The Spookhill Outlet Design report prepared by the FCD (final revision, June 1993) is attached and made a part of this Final Design Report. The design was reviewed by the WNTC and the Arizona design section during April 1993. SCS brought the design responsibility back into the Arizona design section for final corrections and contract preparation. Numerous changes have been made to the drawings and specifications.

Description of Job: The job consists of a grouted rock lined chute with reinforced concrete side walls beginning at the Bush Highway box culvert and proceeding downstream a distance of approximately 900 feet where it discharges into an existing sediment basin. Portions of the sediment basin side slopes and outlet weir are being rebuilt. Out-flow from the sediment basin discharges into the Salt River. The chute is designed for discharge of 2650 cfs which exceeds Arizona's engineering approval authority of 300 cfs for Standard Practice 587, Structures for Water Control. The job class for this project is class VII.

Authority:

John M Harrington

Submitted by: State Design Engineer

9-1-93

Date

Samuel J. DeKle

Approved by: State Conservation Engineer

9-1-93

Date

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

SPOOKHILL OUTLET DESIGN

REVISED: 6-17-92

REVISED: SEPTEMBER 1992

REVISED: DECEMBER 1992

REVISED: JUNE 1993

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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.

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 into the Salt River.

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 ^hCharts for the Selection of Highway Culverts, HEC-5, December 1965.

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 possible increase in computed peak flows.

In the July 24, 1990, meeting between the Flood Control District of Maricopa County (FCD) and SCS representatives, 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.

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 Bush Highway, 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 at approximately 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 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 was used to generate 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 the HEC-2 stationing increases, proceeding north along the proposed channel centerline.

Water surface elevations for the 2650 cfs flow discharge were computed by using 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 used to determine the starting water surface elevation. A copy of the calculations is available in Appendix B.

The steep slope on the north side of the Bush Highway Box Culvert causes high velocity and the flow develops a super critical hydraulic condition. Due to the high velocity along the channel, an earth-lined channel would be unstable and, therefore, is not recommended. In order to stabilize the channel, different types of structural configurations were examined.

The curved section of the proposed channel was designed to limit the superelevation of the water to one foot above the maximum calculated design water surface elevation or 10% of water surface width, whichever was the least. The following formula was used to calculate the superelevation depth of 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:

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

V=Average velocity

y=Depth of flow

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	CRWS	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

SENCO= Cross section station identification

Q= Discharge runoff, cfs.

CWSEL= Water surface elevation, ft.

CRWS= 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 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

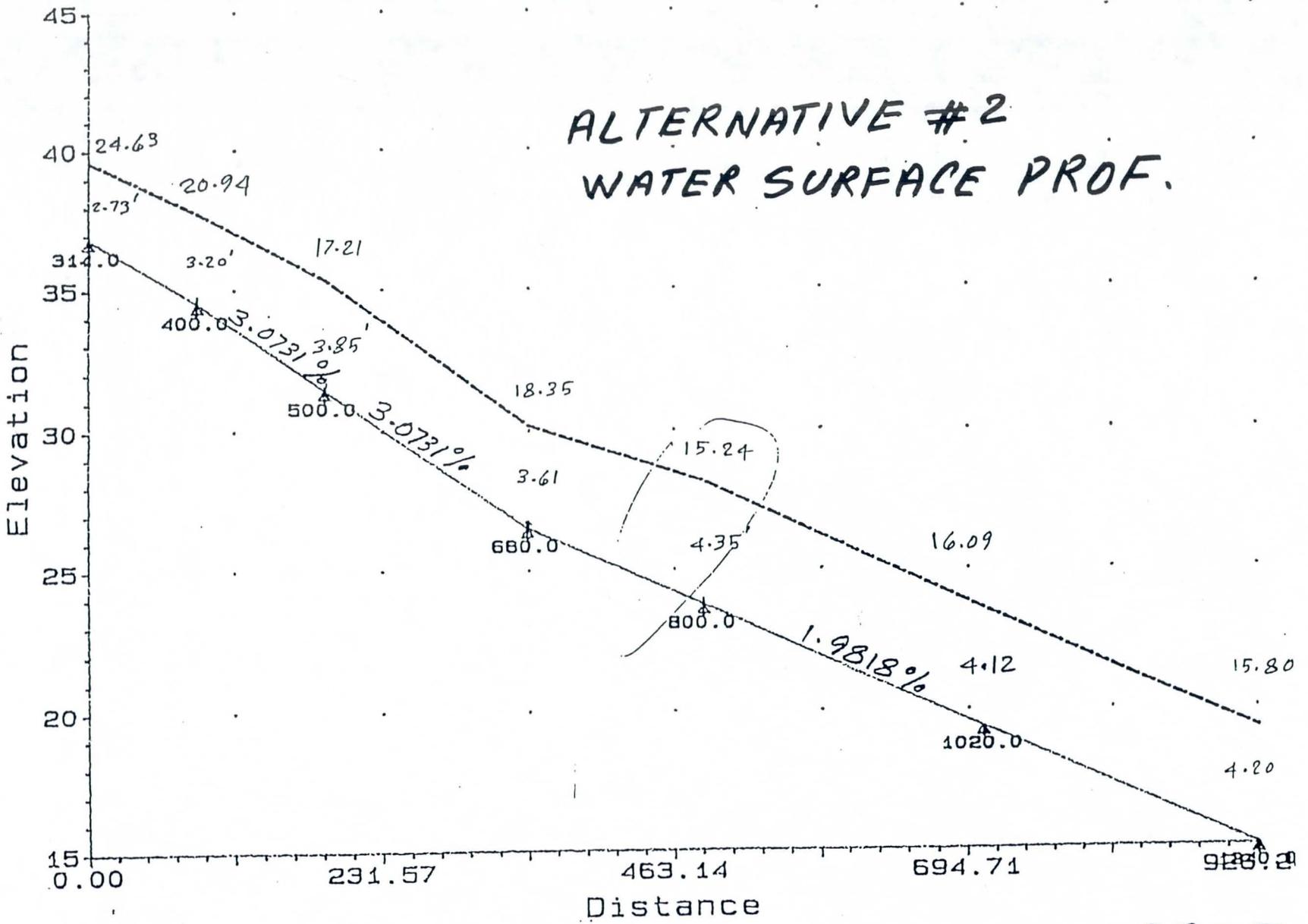
SENCO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49
500.00	2653.00	35.27	36.55	36.87	17.21	3.85	154.18	40.00	100.00	31.42
660.00	2653.00	30.11	31.63	35.35	18.35	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

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Spookhill outlet channel and sediment basin

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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, the channel cross-section used in Alternative No. 2, with lower grades and variances (2.6885% and 2.0651%), was used for Alternative No. 3. 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
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 to eliminate the hydraulic jump was a more desirable design alternative. Alternative No. 4 went a step further to eliminate the jump. Concrete retaining walls were used for the sides and grouted rock for the bottom with the minimum allowable bottom slopes 2.3038% and 2.1418% which resulted in a more uniform flow pattern in the channel (see the water surface profile figure), as indicated in the table below:

HEC-2 SUMMARY TABLE FOR ALTERNATIVE No. 4

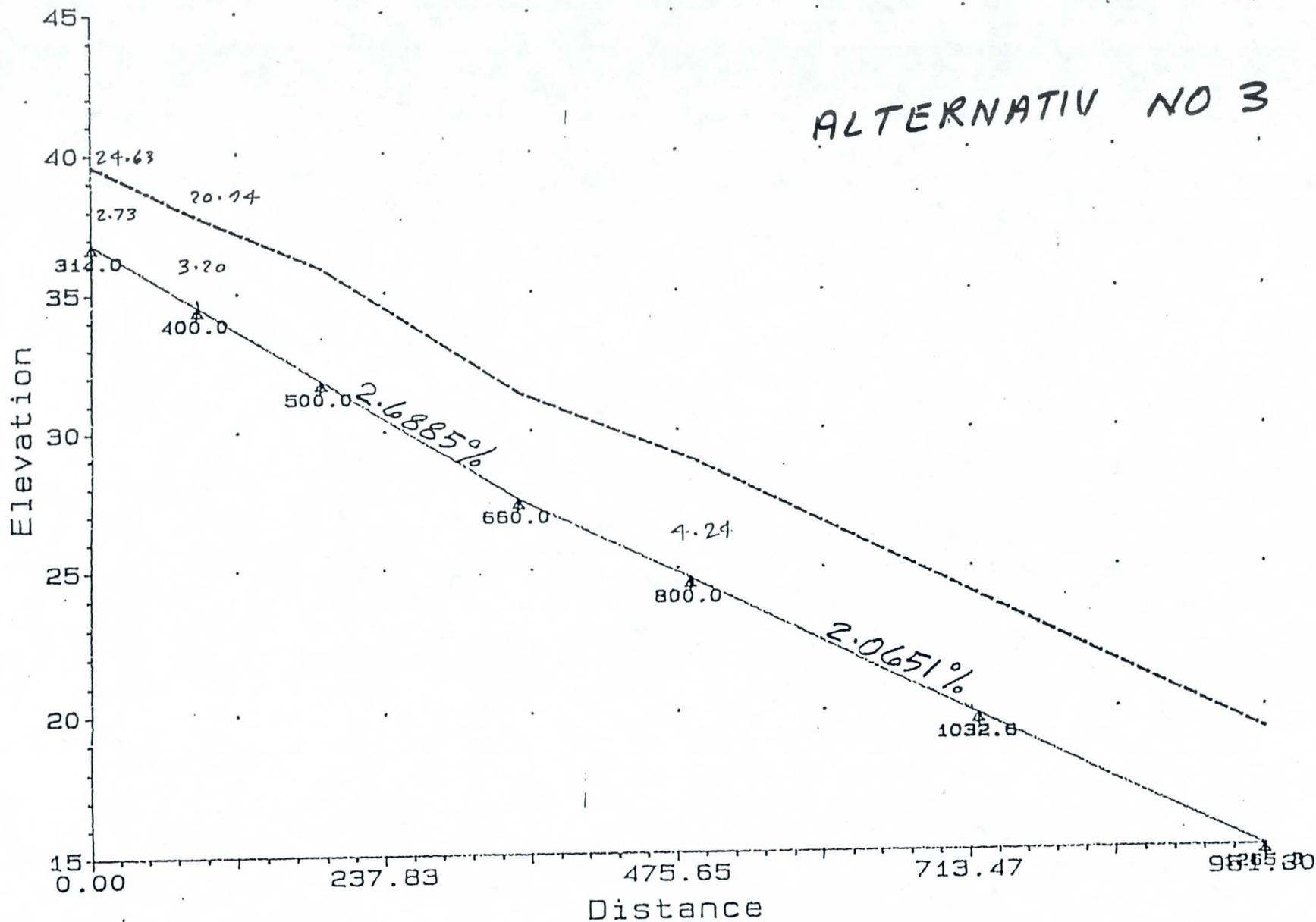
SENCO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN
314.00	2653.00	39.53	41.97	48.95	24.63	2.73	107.71	40.00	.00	36.80
400.00	2653.00	37.69	39.67	44.50	20.94	3.20	126.70	40.00	86.00	34.49
500.00	2653.00	36.38	37.32	40.27	15.82	4.19	167.75	40.00	100.00	32.19
660.00	2653.00	32.45	33.63	36.82	16.77	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

ALTERNATIV NO 3

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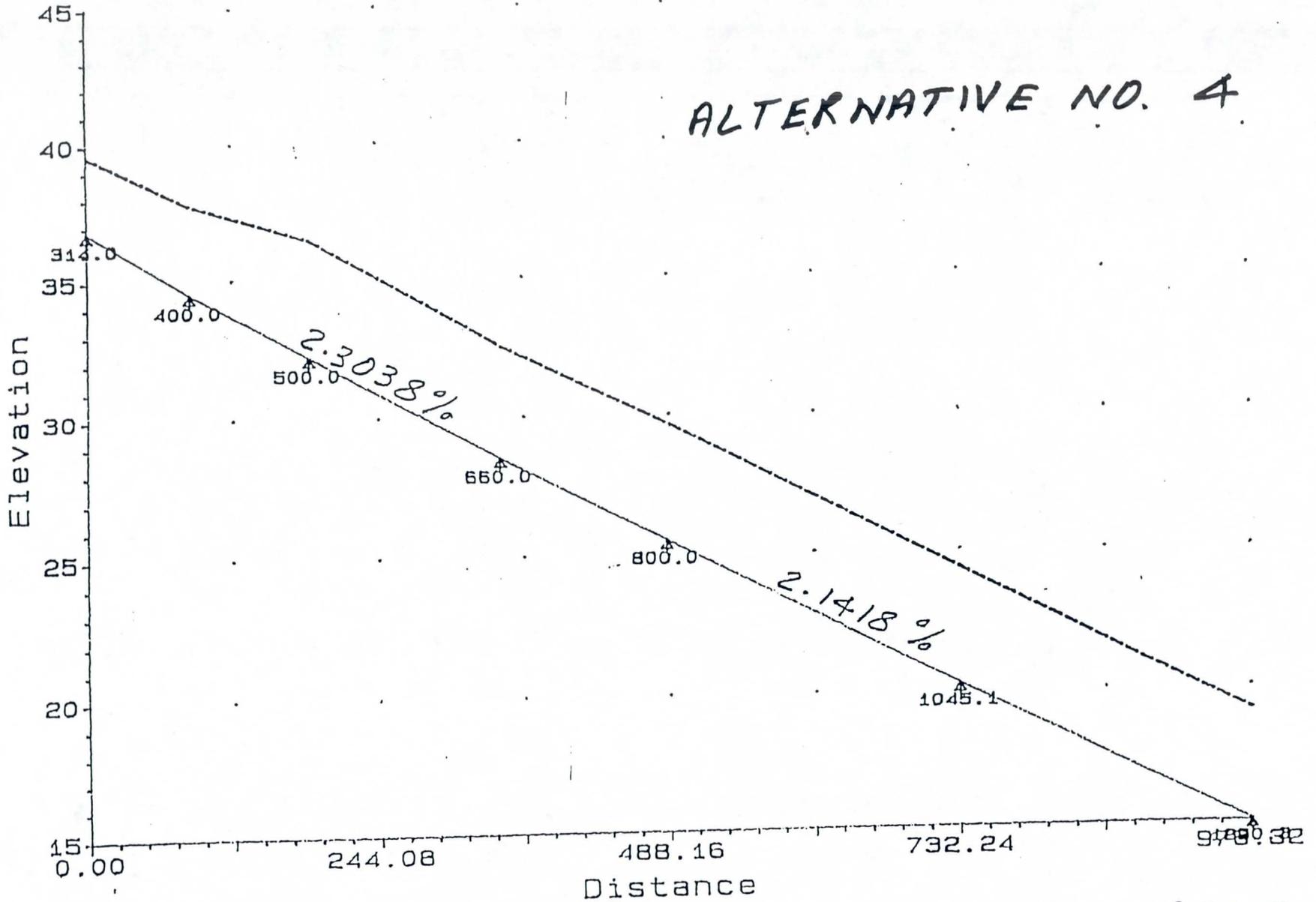
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ALTERNATIVE NO. 4



Spookhill Outlet Channel and Sediment Basin

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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 summary 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. 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

<u>TIME</u> <u>Hr.</u>	<u>IN-FLOW</u> <u>CFS</u>	<u>OUT-FLOW</u> <u>CFS</u>	<u>BASIN WATER SURFACE ELEVATION</u> <u>Ft</u>
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

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 indicate the existence of a cobble self-armoring layer at an approximate depth of 6 feet below the existing basin floor. 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 to provide sufficient protection for the channel where the channel enters the basin ($5+1.5=6.5' > 6'$ self-armoring layer depth).

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 these calculations:

SUMMARY 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 supercritical and is expected to be self-cleaning with no sediment deposition occurring. 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 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, with 70 percent 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 more than 1.40 ac-ft (2-year X 0.70 ac-ft/yr = 1.40 ac-ft/yr). The proposed basin has a design capacity which will accommodate 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, 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 ac-ft (Ave. length=685, Ave. width=106, and Ave. depth=3). Therefore, the basin will accommodate the 100-year storm sediment accumulation, assuming that FCD will continue to remove sediment approximately once every two years. Appendix B provides backup documentation for the sediment study by SCS personnel.

5.2.2- Hydraulic Analysis:

The sediment basin was designed to capture sediment in the flows 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 exit through the sediment basin outlet.

FCD previously developed a HEC-1 model to compute the outlet flow from Spookhill Dam. This model, developed by the FCD watershed branch, generated the outlet hydrograph from the dam and routed flows through the existing outlet channel, then computed the runoff hydrograph from the downstream side of the dam. The two hydrographs were combined to predict the peak discharge at Bush Highway.

At the suggestion of SCS personnel, the FCD HEC-1 model was revised to include the additional 10% discharge expected from the watershed (see the hydrology section of this report). 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 design Alternative No. 2 and

the proposed improvements to the sediment basin. For the hydrograph generation, the assumption was made that the basin will have a maximum of one foot of sediment deposits (see the sediment basin calculation section of this report) during the time of peak discharge. The basin will have two feet of storage depth prior to activating and conveying the outlet flow. The weir outlet elevation is 1318 and the bottom width of the trapezoidal weir is 150 feet.

Using the stage storage method of calculation for routing through the basin, the HEC-1 model predicted that, at the maximum stage, the water surface profile will reach 1322.50. (This water surface elevation is estimated using the final HEC-2 model water surface computation [see last paragraph of page 16 of 20]).

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

The dikes around the sediment basin should be raised to 1324.00 feet.

5.3- Sediment Basin Analysis

An existing trapezoidal sediment basin outlet was originally designed to direct runoff from the basin into the Salt River. The area between this basin outlet and the Salt River is a wetland area and is covered with vegetation and trees. Channel flow should go through this area and then into 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 ran under a subcritical flow condition with station 0+00 being at the Salt River and running southeasterly along the sediment basin outlet centerline to approximately station 3+60 at the weir outlet.

Field reconnaissance 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" was used. This document 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 to reflect the higher "n" value.

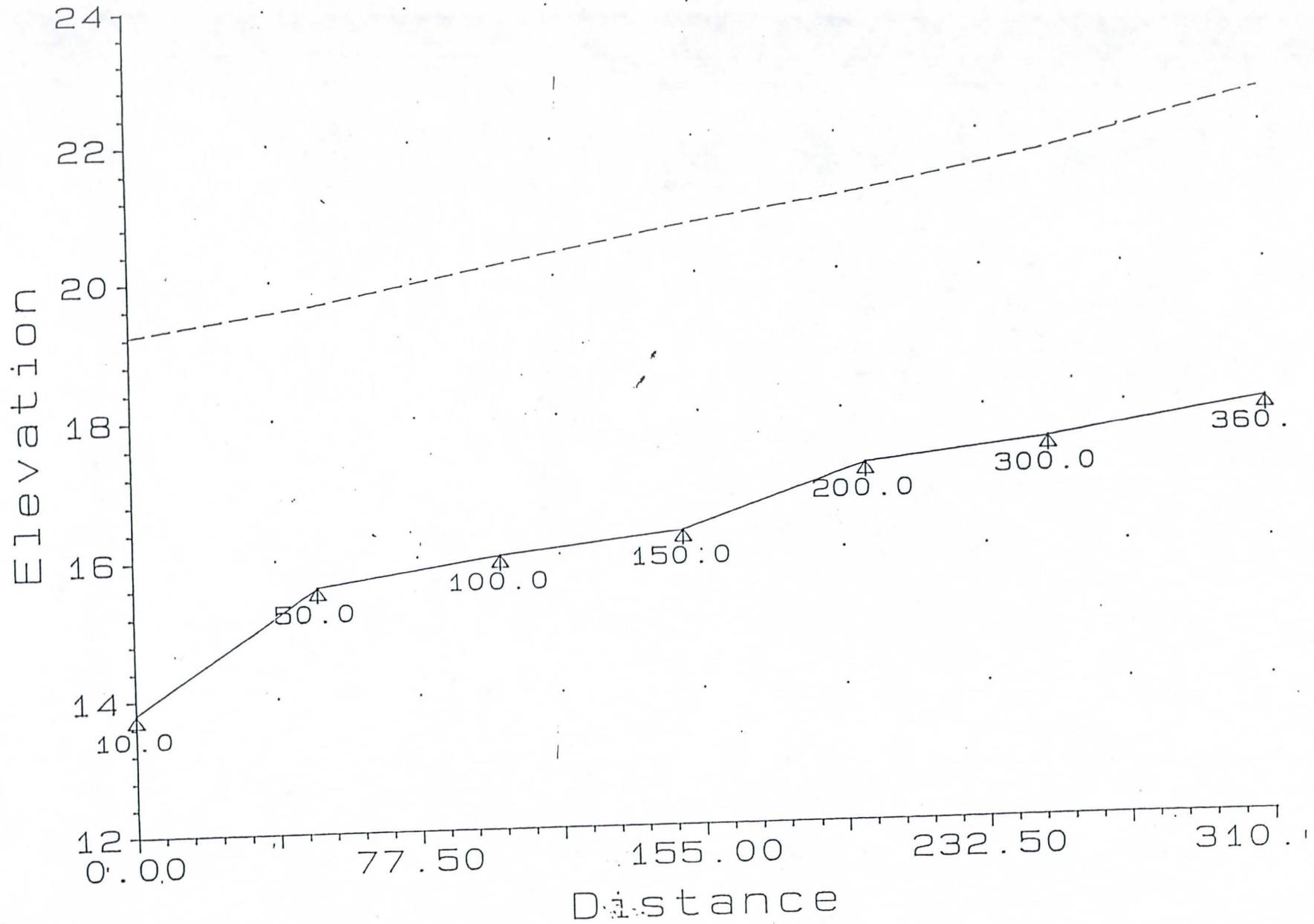
Appendix B provides a copy of the HEC-2 model and the model map which shows cross-section locations, water surface profile, and HEC-2 cross-section profiles. The following table provides a summary of the results for the HEC-2 sediment basin model:

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.

FROM BASIN TO SALT RVER



6. STRUCTURAL DESIGN

The channel was designed to have cantilever retaining walls with varying heights and a grouted riprap channel bottom. The structural design criterion was based on AASHTO Standard Specifications for Highway Bridges, 19 .

NEH-6 (Spull)

Class AA concrete with a minimum compressive strength of 4000 psi is specified. All reinforcing steel shall conform to ASTM specifications for A615 Grade 60 steel.

Part of the existing wing walls are to be sawcut 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 to exceed 90'-0" and as per details shown on the construction plans. Appendix "C" provides the design calculations for the retaining walls.

PROPOSED CHANNEL WALL HEIGHTS

Station	Channel Invert	Channel Wall	
		Heights	Top Elev.
4+40		6'-0"	
6+50	1326.50	6'-0"	1332.50
6+60	1326.31	7'-2"	1333.48
8+50	1322.60	7'-2"	1329.77
8+60	1322.41	8'-4"	1330.74
10+50	1318.70	8'-4"	1327.03
10+60	1318.51	9'-6"	1328.01
12+39.91	1315.00	9'-6"	1324.50
12+59.91	1315.00	9'-0"	1324.00

7. OPERATIONS & MAINTENANCE ROAD DESIGN

An O&M road will be built on both sides of the channel. This portion of the project consists of installing a gravel road surface with a minimum compacted thickness of 4 inches. 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 will be covered by grouted rock rip rap and will be used to access the channel for cleaning and maintenance purposes.

Change to 45'
See calc's in File.
design Spull 8-93

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 during the construction phase. No negative impact on the conservation of biological or water resources is expected due to construction of the proposed channel and sediment basin improvements.

The construction activities will disturb ^{more} less than 5 acres, therefore the National Pollution Discharge Elimination System permit is ~~not~~ required. *JMH 8-93*

- Color has been ~~added~~ ^{specified} for concrete walls and grouted rock riprap.
- Colored PVC Fence has also been specified.

9. CONSTRUCTION DRAWINGS

Auto-CAD Software (Version 11) was used to produce and store the construction drawings.

10. SPECIFICATIONS

NEH Section 20 Standard Specifications were used for this project, and no special written specifications were required.

11. COST ESTIMATE

There are no unusual materials or construction methods involved in this project. The majority of the work consists of earthwork, drainable backfill placement, reinforced concrete construction, loose and grouted riprap placement, chain-link fence installation and gravel roadway construction.

12. CONSTRUCTION SCHEDULE

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

13. OPERATION AND MAINTENANCE

The proposed improvements will reduce the maintenance requirements 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.

A preconstruction conference will be held, at which time questions regarding this project can be discussed.

AUTHORITY

Submitted by *Besir Phull* 8/25/93
Civil Design Engineer Date

Submitted by *K. Hanumaniah* 8/25/93
Structural Design Engineer Date



CONSTRUCTION SPECIFICATION

2. CLEARING AND GRUBBING

1. SCOPE

The work shall consist of the clearing and grubbing of designated areas by the removal and disposal of trees, 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 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

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 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. Subsidiary Item, Clearing and Grubbing

- (1) This item shall consist of clearing and grubbing of all areas shown on the drawings and staked in the field.
- (2) All materials removed from the cleared and grubbed areas shall be disposed of at the waste site between Stations 10+50 and 11+50.
- (3) If materials removed from the cleared and grubbed area are to be burned, burning shall be carried out in accordance with Maricopa County Health Department regulations.
- (4) In Section 5, Measurements and Payment, no separate payment will be made for this item. Compensation for the work will be included in the payment for Bid Item 10, Channel Excavation, Common.

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

Each structure unit to be removed will be marked by means of stakes, flags, painted markers or other suitable methods.

3. REMOVAL

All structures designated in the contract for removal 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 this Specification.

6. 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 wing walls, footings and grouted rock riprap at the north side of Bush Highway Box Culvert and the removal of existing fencing, as shown on the drawings. The structures to be removed will be marked by the Engineer.
- (2) Section 5, DISPOSAL OF REFUSE MATERIALS, the concrete and grouted rock riprap material designated for removal shall be placed in the required earthfill a minimum of 2' outside the right channel wall between stations 10+50 and 11+50. All refuse material shall be placed a minimum of 2' below the finished elevation. Disposal of fencing materials shall be the responsibility of the contractor and shall be disposed of away from the job site.
- (3) Refuse materials are to be no larger than 2'-0" in width or diameter and no longer than 2'-0".
- (4) No separate payment will be made for this item. Compensation for the work will be included in the payment for Bid Item 5, 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

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) Under Section 2, Materials, there are no material specifications required.
- (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.
- (4) In Section 3, EROSION AND SEDIMENT CONTROL, MEASURES AND WORK, methods include 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.
- (5) In Section 4, Chemical Pollution, prior to the start of construction, the Contractor shall provide a plan, for approval by the Contracting Officer, to void sump areas and dispose of sanitary facilities as applicable.
- (6) No separate payment will be made for this item. Compensation for this work will be included in the payment for Bid Item 3, Earthfill.

CONSTRUCTION SPECIFICATION

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, vendors 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 channel 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 of a 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.

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 10 foot stations, and shall be placed on at least one side of the 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 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 of work to which it is 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.
- (2) In Section 5, CONSTRUCTION SURVEYS, "other surveys" shall include those required for preparation of as-built drawings. As-built drawings shall include complete cross-sections of all earthwork at 100 foot intervals. As-builts will be recorded on 24x36 sheets with an appropriate scale within 30 days after completion of the construction.
- (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 Contractor 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) A staking plan shall be submitted to the Contracting Officer for approval prior to performing the work.

CONSTRUCTION SPECIFICATION

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 of this specification.

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 demobilization 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 demobilization 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 demobilization will constitute full compensation for the 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 supplies 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 specifications.

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 item 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 11, 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 Contractors 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

Compensation of 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 3, DEWATERING THE CONSTRUCTION SITE, no plan for dewatering is required. This will not relieve the Contractor of responsibility for completing the work as specified.
- (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 5, Concrete.

CONSTRUCTION SPECIFICATION

21. EXCAVATIONS

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-scrappers 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 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 judgement 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

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.

6. DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of at the locations shown on the drawings.

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.

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.

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. Bid Item 10, Channel Excavation Common

- (1) This item consists of excavation required to construct the outlet channel and sediment basin as shown on the drawings.
- (2) In Section 11, MEASUREMENT AND PAYMENT, payment will include compensation for subsidiary items, Structure Excavation, Common, and Clearing and Grubbing.

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 area shown on the drawings.
- (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.

c. Subsidiary Item, Structure Excavation, Common

- (1) This item consists of excavation required to construct concrete cutoff wall and 24 inch drain pipe, as shown on the drawings.
- (2) Section 11, MEASUREMENT AND PAYMENT shall not apply. The work will not be measured. No separate payment will be made for structure excavation. Compensation for this item will be included in payment for Bid Item 10, Channel Excavation, Common.

CONSTRUCTION SPECIFICATION

23. EARTHFILL

1. SCOPE

The work shall consist of the construction of earth embankments and other earthfills required by 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 two 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 two 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 to 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 surface 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 diskings.

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 of 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 tamers 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.

<u>Structure</u>	<u>Time Interval</u>
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 form 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 on 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.

The pay limits shall be as designated on the drawings.

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 O&M roads, ditches, and channel subgrades as shown on the drawings.
- (2) Borrow, if needed, 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, except in designated refuse area defined in Construction Specification 3, STRUCTURE REMOVAL.
- (4) The maximum thickness of a layer prior to compaction shall be nine (9) inches.
- (5) 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.
- (6) In addition to the time limitations in Section 6, Compaction, earthfill and backfill of the channel concrete walls will not be allowed until after the adjacent grouted rock riprap invert has been completed and cured for a minimum of 3 days.
- (7) In Section 8, TESTING, moisture testing will not be required. 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.
- (8) Section 9, MEASUREMENT AND PAYMENT, will include compensation for Subsidiary Items Water for Construction, Pollution Control, Removal of Water, and Borrow Excavation and Structure Backfill.

b. Bid Item 4, Structure Backfill

- (1) This item consists of all fill adjacent to the new channel concrete walls and the maintenance road drain 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) 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.
- (6) In Section 8, TESTING, moisture testing will not be required. 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.
- (7) In Section 9, MEASUREMENT AND PAYMENT, payment will include compensation for subsidiary item, Drainfill.

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

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.

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 ins placed.

Any damage to the foundation surface or the sides or bottoms of trenches occurring during placement 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.

<u>Structure</u>	<u>Time Interval</u>
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 earthfill. 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 tract 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 rare required to verify that the drainfill materials and the drainfill in place meet the requirements of the specifications. These tests are not intended 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.

9. 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, Drainfill

- (1) This item consists of furnishing and installing the Drainfill material, including burlap, necessary to construct the Drainfill portion of the structure drain at locations shown on the drawings.
- (2) The Drainfill material shall be well graded within the following limits:

<u>U.S. Sieve Size</u>	<u>Percent Passing (by Dry Wt.)</u>
3"	100
3/4"	76-100
#4	52- 80
#16	28- 56
#40	8- 38
#200	0- 3

The fines shall be non-plastic as determined by ASTM D 4318.

- (3) The drainfill material shall contain sufficient moisture to permit placing without segregation.
- (4) Section 6, COMPACTION, shall be Class III.
- (5) Section 8, 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 4, Structure Backfill.

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 course 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 C 618, 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.

Performed 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.

<u>Class of Concrete</u>	<u>Minimum Compressive Strength at 28 days (psi)</u>
5000	5000
4000	4000
3000	3000
2500	2500

Method 2. Concrete shall be classified as follows

<u>Class of Concrete</u>	<u>Water Content (gallons/bag)</u>	<u>Cement Content (bag/cu. yd.)</u>
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:

<u>Maximum Size Aggregate</u>	<u>Air Content (%)</u>
3/8 inch to 1/2 inch	6 to 9
Over 1/2 inch to 1 inch	5 to 8
Over 1 inch to 2-1/3 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:

<u>Type of Structure</u>	<u>Slump (inches)</u>
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°, 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 the results satisfactory to the Contracting Officer showing that its performance in the job mix meets the requirements of Material Specification 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 specifications 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:

<u>Test</u>	<u>Method</u> <u>(ASTM Designation)</u>
Sampling	C 172 <u>1/</u>
Slump Test	C 143 <u>1/</u>
Air Content	C 231 <u>1/</u> or C 173 <u>1/</u>
Compression Test Specimens	C 31 <u>1/</u> , C 42 or C 684 <u>2/</u>
Compressive Strength	C 39 <u>2/</u> or C 42
Unit Weight	C 138

1/ Test of 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 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 aggregate 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
Aggregate	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 is 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 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 requirement of ASTM Specification C 685 and shall be demonstrated prior to placement of concrete, by test 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.
- c. Central-mixed concrete. Completely in a stationary mixer and the mixed concrete transported to the point of delivery in a truck agitator 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.

Shrink-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 reinforcements 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 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 location 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 well, 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.

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.

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 shall not be removed without his 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.

<u>Element</u>	<u>Time</u>
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 risers - 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 <u>1/</u>	3 days
Concrete supporting not more than 20 feet of wall in place above it <u>1/</u>	24 hours
<u>1/</u> 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 housing 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 SURFACE

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 surface 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 uniformed 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 any 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 used, 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 recommendation.

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. CONCRETE 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 the 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.

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.

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 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 5, Concrete 4000

(1) This item consists of furnishing, forming and placing all concrete to construct the outlet channel, headwalls, maintenance road drain and cutoff walls, 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 modulus 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 material compatible with the sealant.

(d) Pre-formed expansion joint filler shall conform to ASTM D-1752 and shall be Type I.

- (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 may be used as a partial substitute for portland cement, not to exceed a maximum of substitution of 15 percent based on absolute volume. Pozzolanic material to be used in concrete shall conform to the requirements of ASTM C-618 for Class N or Class F. The contractor shall obtain and deliver to the Engineer a certificate of compliance signed by the Pozzolan supplier identifying the Pozzolan and stating the Pozzolan delivered to the batching site complies with applicable specifications.
- 7) Concrete for Bid Item 5 shall be integrally colored. The cured concrete color shall blend with the natural earth tones at the site and may be produced using Davis Colors' Miami Buff additive produced by pigment #5447, at a rate of 1-lb per sack of cement or similar quality products produced by Colorful Admixtures or L.M. Scofield. The Contractor shall provide a cured trial test sample on an unexposed footing or slab to verify the color.

Color matching of concrete patching materials shall also be established by the Contractor in a trial sample. The color tone of the finished concrete and patching materials shall be provided by the Contractor prior to full production.

- (8) Curing compound shall contain a fugitive dye conforming to Material Specification 534, and ASTM C-309, Type I-D, Class B.
- (9) In Section 25, MEASUREMENT AND PAYMENT, payment will include compensation for Subsidiary Items: Removal of Water; Structure Removal; Metal Work; and Pozzolan testing and certification.

b. Subsidiary Item, Concrete, Class 2500

- (1) This item consists of furnishing, forming and placing all concrete to construct the post anchors for the farm field fence.
- (2) Section 3, Class of Concrete, Method 1 shall apply and concrete shall be Class 2,500.
- (3) Cement shall be Type II or Type II A.
- (4) Coarse aggregate shall be size No. 57 or 67 in accordance with ASTM C 33.
- (5) In Section 5, Design of the Concrete Mix, Method 1 shall apply.
- (6) Section 18, Removal of Forms, does not apply.
- (7) Pozzolan may be used as a partial substitute for Portland cement not to exceed a maximum substitution of 20 percent based on absolute volume.
- (8) Section 25, Measurement and Payment, no separate payment will be made for concrete, Class 2500. Compensation for this item will be included in Bid Item 13, Farm Field Fence.

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

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.

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) 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 rebar 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

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 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; furnishings and attaching ties and supports; and furnishing, transporting, storing, cutting, bending, cleaning and securing all reinforcements.

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	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. Bid Item 6, Steel Reinforcement

- (1) This item consists of furnishing and installing all steel reinforcement to construct the outlet channel, the maintenance road drain and the cutoff walls, as shown on the drawings.
- (2) Reinforcing steel shall conform to ASTM Specification A615 Grade 60.

CONSTRUCTION SPECIFICATION

51. CORRUGATED METAL PIPE CONDUITS

1. SCOPE

The work shall consist of furnishing and placing circular, arched or elliptical corrugated metal pipes and the necessary fittings.

2. MATERIALS

Pipe fittings shall conform to the requirements of Material Specification 551 or Material Specification 552, whichever is specified.

Unless otherwise specified in Section 11 of this specification, perforated pipe furnished shall meet the requirements for Class I perforations as described in ASTM A 760 or A 762.

3. COUPLING BANDS AND HARDWARE

Pipe joint coupling bands shall be provided meeting the requirements specified in Section 11.

Hardware consisting of coupling bands and band fastening devices such as connecting bolts, rods, lugs and angles used in conjunction with zinc-coated iron or steel pipe shall be galvanized by the hot-dip method. Hardware used in conjunction with aluminum pipe and aluminum or aluminum-zinc alloy-coated iron and steel pipe shall be of the same material as the pipe except that hot-dip galvanized or cadmium plated fasteners may be used. The surface of all band fastening devices for pipe specified with bituminous or polymer coating shall be coated with asphalt mastic materials meeting the requirements of ASTM A 849. The coupling band shall be coated similar to that specified for the pipe unless otherwise specified in Section 11.

Coupling bands shall be installed to provide straight alignment of the connecting pipe ends. Unless otherwise specified in Section 11, the band width shall be as specified in ASTM A 760 and A 762. The bands shall be positioned to overlap adjacent pipe ends equally. The coupling bands shall be corrugated to match the corrugations of the connecting pipe ends.

4. FABRICATION

Fabrication of appurtenant sections shall be done as shown on the drawings and described in Section 11 of this specification. The items may consist of inlet sections, outlet sections, and sections, elbows, skew or beveled headwalls. Fabrication of these appurtenant sections shall be made from metallic-coated materials identical to those from which the attached pipe is fabricated. Fabrication shall be of a quality and finished workmanship equal to that required for the pipe.

5. HANDLING THE PIPE

The Contractor shall furnish equipment as necessary to place the pipe without damaging the pipe or coatings. The pipe shall be transported and handled in a manner to prevent damage to the pipe or coating.

6. LAYING AND BEDDING THE PIPE

Unless otherwise specified, the pipe shall be installed in accordance with the manufacturer's recommendations. The pipe shall be laid with the outside laps of circumferential joints pointing upstream and with longitudinal laps at the sides at about the vertical mid-height of the pipe.

Field welding of corrugated galvanized iron or steel pipe will not be permitted. The pipe sections shall be joined with fabricator-supplied coupling bands meeting the specified joint requirements. The coupling shall be made as recommended by the fabricator.

The pipe shall be firmly and uniformly bedded throughout its entire length to the depth and in the manner specified on the drawings.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about a vertical center line. Perforations shall be clear of any obstructions at the time the pipe is laid.

The pipe shall be loaded sufficiently during backfilling around the sides to prevent its being lifted from the bedding.

7. STRUTTING

When required, struts or horizontal ties shall be installed in the manner specified on the drawings. Struts and ties shall remain in place until the backfill has been placed above the top of the pipe to a height of 5 feet or the pipe diameter, whichever is the greater, or has been completed if the finished height is less than 5 feet above the top of the pipe; at which time struts or ties used shall be removed by the Contractor.

8. EMBEDMENT IN CONCRETE

Special treatment shall be provided to pipe embedded in or attached to concrete when the pipe is aluminum or aluminum-coated and aluminum-zinc alloy-coated. Potential contact surfaces shall be insulated. All aluminum, aluminum-coated, and aluminum-zinc alloy-coated pipe surfaces in contact with concrete and masonry surfaces shall be coated with two coats of a bituminous paint of the cut-back type. Placement of the pipe shall be such that direct metal-to-metal contact with other metallic materials, such as embedded steel reinforcement or water control gates, is prevented.

9. REPAIR OF DAMAGED COATINGS

Any damage to the metallic coating shall be repaired by cleaning the damaged surface area by sand blasting, power disk sanding or wire brushing. All loose and cracked coating, dirt, and any products of corrosion shall be removed prior to application of two (2) coats of paint. Oil and grease materials shall be removed by use of a solvent. The surface shall be clean and dry during the painting period and until the coating has dried.

Painting shall be by use of one of the following options based upon installed exposure of the pipe as determined by the Engineer:

Normal exterior or interior atmospheric exposure:

- (a) Zinc dust - zinc oxide primer, Federal Specification TT-P-641, Type I or Type II, or
- (b) Single package, moisture cured urethane primer in silver metallic color, or
- (c) Zinc-rich cold galvanizing compound, brush, or aerosol application.

Submergence in water exposure:

- (a) Zinc dust-zinc oxide primer, Federal Specification TT-P-641, Type III, or
- (b) Zinc dust paint, Military Specification MIL-P-21035, or
- (c) Zinc dust chlorinated rubber, Federal Specification TT-P-1046a, or
- (d) Epoxy-Polyamid, Department of Defense Specification DOD-P-151.

If the metallic coating is damaged in any individual area larger than 12 square inches, or if more than 0.2 percent of a total surface area of a length of pipe is damaged, the length will be rejected.

Breaks or scuffs in bituminous coatings that are less than 36 square inches in area shall be repaired by the application of two coats of hot asphaltic paint or a coating of cold-applied bituminous mastic. The repair coating shall be at least 0.05 inches thick after hardening and shall bond securely and permanently to the pipe. The material shall meet the physical requirements for bituminous coatings contained in ASTM A 849 and A 885. Whenever individual breaks exceed 36 square inches in area or when the total area of breaks exceeds 0.5 percent of the total surface area of a length of pipe, the pipe length will be rejected.

Bituminous coating damaged by welding of coated pipe or pipe fittings shall be repaired as specified in this Section for breaks or scuffs in bituminous coatings.

Breaks or scuffs in polymer coatings that are less than 36 square inches in area shall be repaired by the application of two coats of a polymer material similar to and compatible with the durability, adhesion and appearance of the original polymer coating, not as described in ASTM A 762, paragraph 11.5.1. The repair coating shall be a minimum thickness of 0.010 inches (10 mils) after drying. Whenever individual breaks exceed 36 square inches in area or when the total area of breaks exceeds 0.5 percent of the total surface area of a length of pipe, the pipe length will be rejected.

10. MEASUREMENT AND PAYMENT

For items of work for which specific lump sum prices are established in the contract, payment for corrugated metal pipe structures will be made at the contract lump sum prices. Such payment will constitute full compensation for furnishing, fabricating, transporting, and installing the pipe, fittings, and appurtenances, and all other items necessary and incidental to completion of the work, including, except as otherwise specified, required excavation, dewatering and backfilling.

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 of this Specification.

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 7, Maintenance Road Drain

- (1) This item consists of furnishing and installing the Maintenance Road Drain which includes the CMP pipe, the CMP drop shaft, connecting bands, and fabricated handrails, as shown on the drawings.
- (2) Material Specification 551 shall apply. Coupling bands shall be water-tight.
- (3) The CMP pipe shall be 18 inch diameter, 14 gauge, Class I or Class II, Shape 1, Series A or B and Bituminous coating A, in accordance with Federal Specification WW-P-405.
- (4) The CMP drop shaft shall be 24-inch diameter, 14 gauge, Class I or Class II, Shape 1, Series A or B and Bituminous coating A, in accordance with Federal Specification WW-P-405 with a 2 foot, 18 inch diameter shop welded stub, in accordance with 11.a (3) above, as shown on the drawings.
- (5) Excavation and backfilling for the maintenance road drain will not be included in Section 10, MEASUREMENT AND PAYMENT.
- (6) In Section 10, MEASUREMENT AND PAYMENT, backfilling for the maintenance road drain will not be included for payment. Payment will include compensation for Subsidiary Items; Metal Fabrication and Cleaning and Painting Metalwork.

CONSTRUCTION SPECIFICATION

61. LOOSE ROCK RIPRAP

1. SCOPE

The work shall consist of the construction of loose rock riprap revetments and blankets, including filter layers or bedding where specified.

2. MATERIALS

Rock for loose 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 Officer that the material meets the requirements of the contract. The Contractor shall provide the Engineer free access to the source for the propose of obtaining samples for testing. The size and grading of the rock shall be as specified in Section 9 of this Specification.

Rock from designated sources shall be excavated, selected and processed as necessary to meet the quality and grading requirements in Section 9 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.

3. SUBGRADE PREPARATION

The subgrade surfaces on which the riprap or bedding course is to be placed shall be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall conform to the requirements of the specified class of fill.

Riprap shall not be placed until the foundation preparation is completed and the subgrade surfaces have been inspected and approved by the Engineer.

4. EQUIPMENT-PLACED ROCK RIPRAP

The rock shall be placed by equipment on the surfaces and to the depths specified. The riprap shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. The rock shall be delivered and placed in a manner that will insure that the riprap in place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks.

Riprap shall be placed in a manner to prevent damage to structures. Hand placing will be required to the extent necessary to prevent damage to the permanent works.

5. HAND-PLACED RIPRAP

The rock shall be placed by hand on the surfaces and to the depths specified. It shall be securely bedded with the larger rocks firmly in contact one to another. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rock. Flat slab rock shall be laid on edge.

6. FILTER LAYERS OR BEDDING

When the drawings specify filter layers or bedding beneath riprap, the filter or bedding material shall be spread uniformly on the prepared subgrade surfaces to the depth specified. Compaction of filter layers or bedding will not be required, but the surface of such layers shall be finished reasonably free of mounds, dips or windows.

7. TESTING

The Engineer will perform such tests as are required to verify that the riprap, filter, and bedding materials and the completed work meet the requirements of the specifications. These tests are not intended to provide the Contractor with the 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 quantity of each type of riprap placed within the specified limits will be measured to the nearest ton by actual weight, and the volume of each type of filter layer or bedding will be measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas. For each load of rock 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 rock in the load.

Payment for each type of riprap will be made at the contract unit price for that type of riprap. Payment for each type of filter or bedding will be made at the contract unit price for that type of filter or bedding. Such payment will be considered full compensation for all labor, materials, equipment and all other items necessary and incidental to the completion of the riprap, filter layers and bedding.

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.

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 8, Loose Rock Riprap

- (1) This item consists of the furnishing and placing of loose rock as shown on the drawings and as staked in the field.
- (2) The rock shall be graded as follows:

<u>Particle Size (inch)</u>	<u>Percent Passing (Dry Wt.)</u>
15	100
12	70-100
9	40- 80
6	10- 50
3	0- 5

- (3) Rock shall be either hand or equipment placed.
- (4) In Section 6, FILTER LAYERS OR BEDDING, no filter layer or bedding is required.

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 Officer 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 substitutes 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 this, 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 aggregates 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 after 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 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

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.

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 9, Grouted Rock Riprap

- (1) This consists of furnishing and placing all grouted rock riprap as shown on the drawings.
- (2) The rock shall be measured and visually graded to the following approximate limitations:

50% or more of the rock shall be between 15 and 21 inches diameter.

50% or less of the rock may be between 9 and 15 inches diameter.

5% or less of the rock shall be smaller than 9 inches diameter.
- (3) In Section 6, Design of the Grout Mix, the Contractor shall be responsible for proportioning the mix. The grout shall consist of portland cement, fine and coarse aggregate, water, and an air entraining agent. The minimum cement content shall be 5½ bags per cubic yard of grout. The maximum nominal size of coarse aggregate shall be 3/8 inch. The slump shall be within the range of 6 to 10 inches. The air content (by volume) of the grout mixture at the time of placement shall be five (5) to seven (7) percent. At least five (5) days prior to placement of grout, the Contractor shall furnish the Engineer with a statement of the mix proportions for approval.
- (4) Cement shall be type II or IIA.
- (5) Rock against concrete footings and walls shall be hand placed to two (2) feet away from the concrete.

CONSTRUCTION SPECIFICATION

81. METAL FABRICATION AND INSTALLATION

1. SCOPE

The work shall consist of furnishing, fabricating and erecting metalwork, including the metal parts of composite structures.

2. MATERIALS

Unless otherwise specified, materials shall conform to the requirements of Material Specification 581. Steel shall be structural quality unless otherwise specified. Castings shall be thoroughly cleaned and subjected to careful inspection before installation. Finished surfaces shall be smooth and true to assure proper fit. Galvanizing shall conform to the requirements of Material Specification 582.

3. FABRICATION

Fabrication of structural steel shall conform to the requirements of Section 1.23 of the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Riveted, Bolted and Arc-Welded Construction)," American Institute of Steel Construction.

Fabrication of structural aluminum shall conform to the requirements in the Aluminum Construction Manual, "Specifications for Aluminum Structures," Section 6 and Section 7, The Aluminum Association, November 1976.

4. ERECTION

The frame of metal structures shall be carried up true and plumb. Temporary bracing shall be placed wherever necessary to resist all loads to which the structure may be subjected, including those applied by the installation and operation of equipment. Such bracing shall be left in place as long as may be necessary for safety.

As erection progresses, the work shall be securely bolted up, or welded, to resist all dead load, wind and erection stresses. The Contractor shall furnish such fitting up bolts, nuts and washers as may be required.

No riveting or welding shall be done until as much of the structure as will be stiffened thereby has been properly aligned.

Rivets driven in the field shall be heated and driven with the same care as those driven in the shop.

All field welding shall be done in conformance to the requirements for shop fabrication, except those that expressly apply to shop conditions only.

Galvanized items shall not be cut, welded or drilled after the zinc coating is applied.

5. PROTECTIVE COATINGS

Items specified to be galvanized shall be completely fabricated for field assembly before the application of the zinc coatings.

Items specified to be painted shall be painted in conformance to the requirements of Construction Specification 82 for the specified paint systems.

6. 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, Metal Work

- (1) This item shall consist of fabricating and installing the pipe inlet handrails and screen wire mesh for 3" drain pipes.
- (2) Pipe inlet handrails shall be fabricated of standard weight steel pipe conforming to the requirements ASTM A 53.
- (3) The handrails shall be painted in the manner specified in Construction Specification 82.
- (4) All anchor bolts, nuts and washers shall be galvanized.
- (5) Screen wire mesh for 3" drain pipe shall be commercial bronze, 16 gauge minimum (16x16 per lin. in., wire Dia. = .018 in.).
- (6) No separate payment will be made for this item. Compensation for the work will be included in the payment for Bid Item 7, Maintenance Road Drain, and Bid Item 5, Concrete.

CONSTRUCTION SPECIFICATION

82. CLEANING AND PAINTING METALWORK

1. SCOPE

The work shall consist of cleaning metal surfaces and applying paints and protective coatings.

2. PAINTS

For the purpose of this specification, paints and coatings shall be designated by types as defined below.

Materials for systems requiring two or more coats shall be supplied by the same manufacturer.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, their plan for painting metalwork and a list of materials including name of manufacturer, pertinent product identification names and numbers and product data sheets. Data shall reflect the requirements set forth in this section.

Type 1 Alkyd Primer. Alkyd based, rust inhibitive primer. Primer shall be lead and chromate free. Primer shall have a minimum of 54 percent solids by volume. Color availability shall be red, gray and white. Primer shall be able to be applied at 2.0 to 3.0 mils. dry film thickness in one coat.

Type 2 Alkyd Enamel (gloss). Alkyd based enamel shall be lead free. Alkyd enamel shall have a minimum of 49 percent solids by volume. Alkyd enamel shall be able to be applied at 2.0 to 3.0 mils. dry film thickness in one coat. Finish shall be gloss.

Type 3 Alkyd Enamel (semi-gloss). Alkyd based enamel shall be lead free. Alkyd enamel shall have a minimum of 55 percent solids by volume. Alkyd enamel shall be able to be applied at 2.0 to 3.0 mils. dry film thickness in one coat. Finish shall be semi-gloss.

Type 4 Epoxy Polyamide Primer. Epoxy polyamide primer shall be lead and chromate free. Epoxy primer shall have a minimum of 56 percent solids by volume. Epoxy primer shall be able to be applied at 4.0 to 6.0 mils. dry film thickness in one coat. Color availability shall be red, gray and white. Epoxy primer shall conform to AWWA Standard C 210 and AWWA Standard D 102.

Type 5 Epoxy Polyamide (intermediate or finish). Epoxy polyamide shall be lead free. Epoxy shall have a minimum of 56 percent solids by volume. Epoxy shall be able to be applied at 4.0 to 6.0 mils. dry film thickness in one coat. Finish shall be semi-gloss. Epoxy finish shall conform to AWWA Standard C 210 and AWWA Standard D 102.

Type 6 Acrylic Polyurethane (gloss). Acrylic polyurethane shall be lead free. Acrylic polyurethane shall have a minimum of 74 percent solids by volume. Polyurethane shall be able to be applied at 3.0 to 5.0 mils. dry film thickness in one coat. Finish shall be gloss.

Type 7 Acrylic Polyurethane (semi-gloss). Acrylic polyurethane shall be lead free. Acrylic polyurethane shall have a minimum of 58 percent solids by volume. Polyurethane shall be able to be applied at 3.0 to 5.0 mils. dry film thickness in one coat. Finish shall be semi-gloss.

Type 8 Vinyl Acid Wash Treatment. Pretreatment primer for galvanized and non-ferrous metal. Pretreatment primer shall have a minimum of 8 percent solids by volume. The applied dry film thickness of pretreatment primer shall not exceed 0.5 mil. Steel primed with pretreatment primer shall be topcoated within six to eight hours in humid conditions.

Type 9 Single Package Moisture Cured Urethane Primer. Urethane primer shall have a minimum of 50 percent solids by volume. Primer shall be able to be applied at 2.0 to 3.0 mils. dry film thickness in one coat. Color shall be metallic aluminum.

Type 10 Coal Tar Epoxy. Coal tar epoxy shall have a minimum of 75 percent solids by volume and conform to the requirements of SCS Material Specification 583 (Steel Structures Paint Council PS No. 16, Type I). Coal tar epoxy shall be able to be applied at 8.0 to 15.0 mils. dry film thickness in one coat.

3. TINTING

Tinting shall not be performed in the field unless otherwise specified.

4. SURFACE PREPARATION

Surfaces to be painted shall be thoroughly cleaned prior to the application of paint or coatings. Surface preparation

required by this specification are as designated by SSPC (Steel Structures Paint Council) and are summarized below.

Method 1 Near White Blast (SSPC-SP10). All surfaces to be coated shall be prepared by removing all grease and oil using steam cleaning or solvent cleaning methods per Method 5. After degreasing is completed, sand or grit blasting shall be performed to remove all dirt, rust, mill scale or other foreign material or residue. The cleaned, finished surface shall be at least 95 percent free of all visible foreign material or residue.

Method 2 Commercial Blast (SSPC-SP6). All surfaces to be coated shall be prepared by removing all grease and oil using steam cleaning or solvent cleaning methods per Method 5. After degreasing is completed, sand or grit blasting shall be performed to remove all dirt, rust, mill scale or other foreign material or residue. The cleaned, finished surface shall be at least 67 percent free of all visible foreign material or residue.

Method 3 Brush-off Blast Cleaning (SSPC-SP7). All surfaces to be coated shall be prepared by removing all grease and oil using steam cleaning or solvent cleaning methods per Method 5. After degreasing is completed, sand or grit blasting shall be performed to remove dirt, rust, mill scale or other foreign material or residue. Tightly adherent mill scale, rust and paint may remain on the surface. Mill scale, rust and paint are considered tightly adherent if they cannot be removed by lifting with a dull putty knife.

Method 4 Hand Tool Cleaning (SSPC-SP2). All surfaces to be coated shall be prepared by removing all oil or grease using steam cleaning or solvent cleaning methods per Method 5. After degreasing is completed, non-power hand tools shall be used to remove loose, detrimental foreign material. Adherent mill scale, rust and paint need not be removed.

Method 5 Solvent Cleaning (SSPC-SP1). Surfaces to be coated shall be prepared by removing all visible oil, grease, soil, drawing and cutting compounds and other soluble contaminants from surfaces with solvents or commercial cleaners using various methods of cleaning such as wiping, dipping, steam cleaning or vapor degreasing.

5. PAINT SYSTEMS

For the purposes of this specification, systems of painting and coating metalwork will be designated as defined below.

Paint System A shall consist of the application of one primer coat of Type 1 and two or more coats of Type 2 (gloss) or Type 3 (semi-gloss) to provide a minimum dry film thickness of 6.0 mils.

Paint System B shall consist of the application of one primer coat of Type 9 and two or more coats of Type 2 (gloss) or Type 3 (semi-gloss) to provide a minimum dry film thickness of 6.0 mils.

Paint System C shall consist of the application of one coat of Type 4 and one or more coats of Type 5 to provide a minimum dry film thickness of 8.0 mils.

Paint System D shall consist of the application of one coat of Type 4 primer, one coat of Type 5 and one coat of Type 6 (gloss) or Type 7 (semi-gloss) to provide a minimum dry film thickness of 11.0 mils.

Paint System E shall consist of the application of one coat of Type 9 and one coat of Type 6 (gloss) or Type 7 (semi-gloss) to provide a minimum dry film thickness of 5.0 mils.

Paint System F shall consist of the application of two coats of Type 10 at a dry film thickness of 8.0 mils. per coat. Total system shall provide a minimum dry film thickness of 16.0 mils.

Paint System G shall consist of the application of two coats of Type 4 and two coats of Type 9 paint. Total system shall provide a minimum dry film thickness of 14.0 mils.

6. APPLICATION OF PAINT

Surfaces shall be painted immediately after preparation or within the same day as prepared with at least one coat of type of primer specified. Surfaces not required to be painted shall be protected against contamination and damage during the cleaning and painting operation.

Paints shall be thoroughly mixed at the time of application.

After erection or installation of the metal work, all damage to shop applied coatings shall be repaired and all bolts, nuts, welds and field rivet heads shall be cleaned and painted with one coat of the specified priming paint.

Except on surfaces accessible only to spray equipment, initial priming coats shall be applied by brush. All other coats may be applied by brush, or spray. Each coat shall be applied in such a manner as to produce a paint film of uniform thickness with a rate of coverage within the limits recommended by the paint manufacturer.

The drying time between coats shall be as prescribed by the paint manufacturer, but not less than that required for the paint film to dry through. The elapsed time between coats in Paint System F shall not exceed 24 hours. If for any reason the critical recoat time is exceeded, the coated surfaces shall be treated with the manufacturer's recommended tackifier solvent or brush blasted to roughen the surface.

The finished surface of each coat shall be free from runs, drops, ridges, laps or excessive brushmarks and shall present no variation in color, texture and finish.

The surface of each dried coat shall be cleaned as necessary before application of the next coat.

7. ATMOSPHERIC CONDITIONS

Paint shall not be applied when the temperature of the item to be painted or the surrounding air is less than 50°F. Painting shall be done only when the humidity and temperature of the surrounding air and the temperature of the metal surfaces are such that evaporation rather than condensation will result during the period of time required for application and drying. The surface shall be dry and at least 5°F above the dew point. Surfaces protected from adverse atmospheric conditions by special cover, heating or ventilation shall remain so protected until the paint is dry.

8. TESTS

Dry film thickness on ferrous metal shall be determined by the use of a non-destructive magnetic instrument such as an Elcometer or Mikrotest gage. Instruments shall have been calibrated within one month of use. Film thickness on non-ferrous metal shall be determined with wet film gauges during the application process. Systems with film thickness less than specified shall be brought into conformance by the application of one or more additional coats of the specified material.

9. 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 prices for this item, the unpaid balance will be included in the next appropriate contract payment. Payment of the lump sum contract price will constitute full compensation for 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 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. Subsidiary Item, Cleaning and Painting Metal Work

- (1) This item shall consist of cleaning and painting the designated metal items in Bid Item 7, Maintenance Road Drain
- (2) In Section 3, Surface Preparation, Method 2 shall apply.
- (3) In Section 5, Paint Systems, Paint System E shall be used. The color shall be tan and the finish shall be gloss.
- (4) In Section 2, Paints, a written plan for painting metalwork is not required.
- (5) No separate payment will be made for cleaning and painting metal work. Compensation for this work will be included in the payment for Bid Item 7, Maintenance Road Drain,

CONSTRUCTION SPECIFICATIONS

91. CHAIN-LINK FENCE

1. SCOPE

The work shall consist of furnishing and installing chain link fencing complete with all posts, braces, gates and all other appurtenances.

2. MATERIALS

Chain-link fence fabric, fence posts, top rails, braces, gates and accessories shall conform to the requirements of Federal Specification RR-F-191. Types, classes, and materials shall be as follows except as otherwise specified.

Fabric: Type I. 2-inch mesh, 9-gage, minimum weight of zinc coating - 1.8 ounces per square foot.

Barbed Wire: Zinc-coated steel

Posts: Type I, Class 1, zinc-coated

Top Rails: Type II, Class 1, zinc-coated

Braces: Zinc-coated steel

Gates: Type I, zinc-coated steel

3. INSTALLING FENCE POSTS

Unless otherwise specified, line posts shall be placed at intervals of 10 feet measured from center to center of adjacent post. In determining the post spacing, measurement will be made parallel with the ground surface.

Posts will be set in concrete backfill in the manner shown on the drawings.

Posts set in the tops of concrete walls shall be grouted into preformed holes to a depth of 12 inches.

All corner posts, end posts, gate posts, and pull posts shall be embedded, braced and trussed as shown on the drawing.

4. INSTALLING WIRE FABRIC

Fencing fabric shall not be stretched until at least 4 days after the posts are grouted into walls or 14 days after the posts are set in the concrete backfill.

Fencing shall be installed on the side of the posts designated on the drawings.

The fabric shall be stretched taut and securely fastened, by means of tie clips, to the posts at intervals not exceeding 15 inches and to the top rails or tension wires at intervals not exceeding 2 feet. Care shall be taken to equalize the tension on each side of each post.

Barbed wire shall be installed as shown on the drawings and shall be pulled taut and fastened to each post with tie wires or metal tie clips.

5. MEASUREMENT AND PAYMENT

The length of fence will be measured to the nearest 0.1 foot along the fence, including gates. Payment will be made at the contract unit price for the specified height of fence. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the 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 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 12, Chain Link Fence

- (1) This item consists of furnishing and installing the chain link fence, as shown on the drawings.
- (2) The fence shall be chain link, 9 gauge, Class 1, Grade A, with a nominal height of 6 feet. Chain link fence shall be PVC coated, tan or brown in color.
- (3) In Section 2, MATERIALS, the weight of galvinizing for PVC coated chain link fabric does not apply. Weight of galvenized coating and the PVC coating shall be in conformance with ASTM F668, class 2a or 2b.

PVC coating for posts and top rails shall be in accordance with ASTM F1234.

PVC coating for other fittings shall be in accordance with ASTM F626.

- (4) In Section 3, INSTALLING FENCE POSTS, posts shall be welded to sleeves set in concrete as shown on the drawings.

CONSTRUCTION SPECIFICATION

92. FARM FIELD FENCES

1. SCOPE

The work shall consist of furnishing and installing farm field fences, including gates and fittings.

2. MATERIALS

Materials for farm field fences shall conform to the requirements of Material Specification 591. All wooden posts shall be of the same species.

3. SETTINGS POSTS

Concrete or wood posts shall be set in holes and backfilled with earth except where otherwise specified. Steel posts shall be driven unless otherwise specified.

Post holes shall be at least 6 inches larger than the diameter or side dimension of the posts.

Earth backfill around posts shall be thoroughly tamped in layers not thicker than 4 inches and shall completely fill the post hole up to the ground surface. Concrete backfill around posts shall be rodded into place in layers not thicker than 12 inches and shall completely fill the post hole up to the ground surface. Backfill, either earth or concrete, shall be crowned up around posts at the ground surface.

No stress shall be applied to posts set in concrete until at least 24 hours after the concrete has set.

4. CORNER ASSEMBLY

Unless otherwise specified, corner assemblies shall be installed at all points where the fence alignment changes 15 degrees or more.

5. END PANELS

End panels shall be built at gates and fence ends.

6. PULL POST ASSEMBLY

Pull post assemblies shall be installed at the following locations

- a. In straight fence sections, at intervals of no more than 660 feet.
- b. At any point where the vertical angle described by two adjacent reaches of wire is upward and exceeds 10 degrees (except as provided in Section 9 of this Specification).
- c. At the beginning and end of each curve.

7. ATTACHING FENCING TO POSTS

The fencing shall be stretched and attached to posts as follows:

- a. The fencing shall be placed on the side of the pose opposite the areas being protected, except on curves.
- b. The fencing shall be placed on the outside of curves.
- c. The fencing shall be fastened to each end post, corner post and pull post by wrapping each horizontal strand around the post and tying it back on itself with not less than three tightly wound wraps.
- d. The fencing shall be fastened to wooden line posts by means of staples. Woven wire fencing shall be attached at alternate horizontal strands. Each strand of barbed wire shall be attached to each post. Staples shall be driven diagonally with the grain of the wood and at a slight downward angle and shall not be driven so tightly as to bind the wire against the post.
- e. The fencing shall be fastened to steel or concrete line posts with either two turns of 14 gauge galvanized steel or iron wire or the post manufacturer's special wire fasteners.
- f. Wire shall be spliced by means of a Western Union splice or by suitable splice sleeves applied with a tool designed for the purpose. The Western Union splice shall have not less than 8 wraps of each end about the other. All wraps shall be tightly wound and

closely spaced. Splices made with splice sleeves shall have a tensile strength no less than 80 percent of the strength of the wire.

8. STAYS

Stays shall be attached to the fencing in a manner to insure maintenance of the proper spacing of the fence wire strands.

9. CROSSINGS AT DEPRESSIONS AND WATERCOURSES

Where fencing is installed parallel to the ground surface, the line posts subject to upward pull shall be anchored by means of extra embedment or by special anchors as detailed on the drawings.

- a. If the fence wire is installed parallel to the ground surface, the line posts subject to upward pull shall be anchored by means of extra embedment or by special anchors as detailed on the drawings.
- b. If the wire fence is installed with the top wire straight and parallel to the ground surface on either side of the depression, extra length posts shall be used to allow normal post embedment. Unless otherwise specified, excess space between the bottom of the fence and the ground shall be closed with extra strands of barbed wire.

10. MEASUREMENT AND PAYMENT

The length of each type and kind of fence will be measured to the nearest foot along the profile of the fence, including gate openings. Payment for each type and kind of fence will be made at the contract unit price for that type and kind of fence. Such payment will constitute full compensation for completion of the work, including fabricating and installing gates.

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 of this Specification.

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 13, Farm Field Fence

- (1) This item shall consist of furnishing and installing the smooth wire fence, including gates, post anchors and appurtenances as shown on the drawings and staked in the field.
- (2) The wire shall be Type I, with two strands of 12 1/2 gauge line wires in accordance with Material Specification 591 and Federal Specification RR-F-221. The zinc coating on the wire shall be a minimum weight of 0.3 oz. per square foot.
- (3) Gates, corners, pull and end post assemblies shall be as shown on the drawings. Line posts shall be Type 1, Style 1, painted in accordance with Material Specification 591 and Federal Specification RR-F-221.
- (4) Chains shall be welded, case hardened straight link pattern of 5/16 inch stock diameter, 18 inches long. Padlocks will be furnished by the Flood Control District of Maricopa County.
- (5) Payment will include compensation for Subsidiary Item, Concrete, Class 2500.

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.

2. EQUIPMENT AND MATERIALS

Equipment and materials used for quality control shall be of the quality and condition required to meet the test specifications cited in the contract. 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. Equipment shall be operated and maintained by qualified operators, as prescribed in the manufacturers operating instructions, the references specified and as specified in Section 10. All equipment and materials used in performing quality control testing shall be as prescribed by the test standards referenced in the contract or in Section 10.

All equipment and materials shall be handled and operated in a safe and proper manner and shall comply 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 of quality control to provide the specified 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. The identification of the quality control personnel and their duties and authorities shall be submitted to the Contracting Officer within 15 calendar days after notice of award.

Method 2 The contractor shall develop, implement and maintain a system adequate to achieve the specified quality of all work performed, material incorporated and equipment furnished prior to use. 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 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, all specified testing and inspection requirements. The plan provided shall be consistent with the planned performance in the Contractor's approved construction schedule. The plan 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 written plan shall be submitted to the Contracting Officer within 15 calendar days after notice of award. The Contractor shall not proceed with any construction activity which requires inspection until written plan is approved by the Contracting Officer.

4. QUALITY CONTROL PERSONNEL

Method 1 Quality control activities shall be accomplished by competent personnel. A competent person is: one who is experienced and capable of identifying, evaluating, and documenting that materials and processes being used will result in work that complies with the contract; and, who has authorization to take prompt action to remove, replace, or correct such work or products not in compliance. Off-site testing laboratories shall be certified or inspected by a nationally recognized entity. The Contractor shall submit to the Contracting Officer, for approval, the names, qualifications, authorities, certifications, and availability of the competent personnel who will perform the quality control activities.

Method 2 Quality control activities shall be accomplished by competent personnel who are separate and apart from line supervision and who report directly to management. A competent person is: one who is experienced and capable of identifying, evaluating, and documenting that materials and processes being used will result in work that complies with the contract; and, who has authorization to take prompt action to remove, replace, or correct such work or products not in compliance. Off-site testing laboratories shall be certified or inspected by a nationally recognized entity. The Contractor shall submit to the Contracting Officer, for approval, the names, qualifications, authorities, certifications, and availability of the competent personnel who will perform the quality control activities.

5. POST-AWARD CONFERENCE

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.

6. RECORDS

The Contractor's quality control records shall document both acceptable and deficient features of the work and corrective actions taken. All records shall be: on forms approved by the Contracting Officer; legible; and dated and signed by the competent person creating the record.

Unless otherwise specified in Section 10, records shall include:

- a. Documentation of shop drawings including date submitted to and date approved by the Contracting Officer, results of examinations, any need for changes or modifications, manufacturer's recommendations and certifications, if any, and signature of the authorized examiner.
- b. Documentation of material delivered including quantity, storage location, and results of quality control examinations and tests.
- c. Type, number, date and time of quality control activities performed.
- d. The material or item inspected and tested, the location and extent of such material or item, and a description of conditions observed and test results obtained during the quality control activity.
- e. The determination that the material or item met the contract provisions and documentation that the Contracting Officer's representative was notified.
- f. For deficient work the nature of the defects, specifications not met, etc., corrective action taken and results of quality control activities on the corrected material or item.

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. Unless otherwise specified in Section 10, the original plus one copy of all records, inspections, tests performed and material testing reports shall be submitted to the Contracting Officer's Representative within one working day of completion. 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.

8. ACCESS

The Contracting Officer and the Contracting Officer's Representatives shall be given free access to all testing equipment, facilities, sites, and related records.

9. 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 items to which they are made subsidiary are identified in Section 10 of this specification.

1. 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 14, Quality Control

- (1) This item consists of furnishing the personnel, equipment and material to perform the testing and inspection that is necessary to implement a quality control system that will ensure the specified quality is being maintained for:
 - a. Construction Surveys
 - b. Excavation
 - c. Earthfill
 - d. Concrete
 - e. Steel Reinforcement
 - f. Pollution Control (Dust)
 - g. Grouted Rock Riprap
 - h. Joint Sealant
 - i. Fence Installation
- (2) In Section 2, EQUIPMENT AND MATERIALS, equipment and materials needed for materials testing shall be calibrated at the specified frequency given in the appropriate materials testing standards. Records of all calibration shall be submitted to the Engineer within seven (7) days prior to using equipment.
- (3) In Section 3, QUALITY CONTROL SYSTEM, the Contractor's Quality Control System shall provide the degree of inspection and testing necessary to ensure that the specified quality is maintained on all work performed.

The Quality Control System shall include inspections and materials testing as follows:

- (a) Inspection of construction staking to ensure its accuracy.
- (b) Inspection of all excavation to ensure that it is constructed to the lines and grades shown on the drawings.
- (c) The earthfill shall be monitored by visually observing that compaction operations and moisture application and distribution are according to the contract plans and specifications.

- (d) The quality control for concrete will involve testing for strength, slump, temperature, and air entrainment. The test frequency shall be one set of tests for each 100 cubic yards, or one test per day, whichever occurs first. Slump and temperature tests will be taken for each truck load of concrete.
 - (e) The placing of steel reinforcement shall be inspected by quality control personnel a minimum of eight (8) working hours prior to delivery of concrete. A certification that all bars are the correct size and positioned as specified shall be given to the contracting officer's representative.
 - (f) The quality control for grouted rock riprap shall include verification of rock gradation and placement control of grouted mix, grouting operations, and verification of 100% penetration of the grout into the rock voids to the specified and placed depth of rock.
 - (g) The quality control for joint sealant will involve monitoring by quality control personnel for the proper joint size, surface cleanliness, installation of performed joint material, bond breaker, and joint sealant all according to drawings, specifications, and manufacturers recommendations.
- (4) The Contractor shall designate an experienced quality control manager and inspection staff whose primary responsibility will be implementing the inspection system. The manager or his/her representative shall be on site during major construction activities and will not be involved in directing production oriented activities unless it pertains to achieving the specified quality for the work being performed. The quality control manager shall be employed by and answerable to the Contractor. The manager's duties cannot be delegated to a subcontractor or others.

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

For items of work for which specific unit prices are established in the contract, the volume of aggregate will be measured to the nearest cubic yard within the neat lines shown on the drawings. Payment for the quantity of

aggregate will be made at the contract unit price for each type of aggregate, complete in place. Such payment will be full compensation for furnishing delivery, placing and compacting the aggregate, and for 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 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 11, Gravel Road Surfacing

- (1) This item consists of furnishing and placing gravel road surfacing on the 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:

<u>Sieve Size</u>	<u>Percent Passing (by dry weight)</u>
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 plasticity 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) 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.

- (6) Section 5, MEASUREMENT AND PAYMENT, shall not apply. 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.

Payment will include compensation for subsidiary Item, Water.