PHASE IV.2 - FINAL DESIGN REPORT

APACHE JUNCTION FLOODWATER RETARDING STRUCTURE & FLOODWAY

BUCKHORN - MESA WATERSHED PROTECTION AND FLOOD PREVENTION PROJECT

VOLUME I

Prepared for

THE SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
Phoenix, Arizona

October 1986

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0341T

I. SUMMARY

PHASE IV - FINAL DESIGN REPORT
BUCKHORN - MESA WATERSHED
APACHE JUNCTION FRS AND FLOODWAY
USDA Soil Conservation Service
Phoenix, Arizona

I. SUMMARY

On April 8, 1985, Ebasco Services Incorporated was awarded contract Number 53-9457-5-00475 by the Phoenix, Arizona office of USDA Soil Conservation Service for design of the Bulldog Floodway and Apache Junction Floodway, Floodwater Retarding Structure, and Outlet. The "Notice to Proceed" was issued May 7, 1985. The Contracting Officer for SCS is David O. Lambson, and the Government Representative is Donald E. Paulus.

The features to be designed are a part of the Buckhorn-Mesa Watershed Flood Control Project in Arizona. The Buckhorn-Mesa Watershed is located in eastern Maricopa and northwestern Pinal Counties, about 25 miles due east of Phoenix, and has a total watershed area of approximately 108 square miles. The drainage area of the Apache Junction Floodway and FRS portion is 5.72 square miles.

Ebasco's contract consists of five phases as follows:

a. Phase 1 - Site Characterization and Comparative Design Studies:

Review and evaluate all supporting data furnished by the SCS and assess its suitability for design. Complete design hydrology and review existing hydrology for the works specified. Complete comparative design studies of the project feature alternatives specified. Final project features shall be determined in this phase.

b. Phase 2 - Soil Mechanics Report:

Prepare the required Soil Mechanics Report for the selected project features.

c. Phase 3 - Preliminary Design

Develop a preliminary design for the selected project features.

d. Phase 4 - Final Design:

Make all corrections to the preliminary design work and complete the final design work in accordance with specifications. The final construction drawings and specifications shall be prepared in contract form for use in construction contracts.

e. Phase 5 - Service During Construction:

Make changes in design, drawings and specifications; provide interpretations of the plans and speicifications, review shop drawings; and provide consultation services as requested in writing by the Contracting Officer during construction of the structures designed.

This Design Report covers the work completed under the first four phases.

II. DESCRIPTION OF JOB

II. DESCRIPTION OF JOB

The City of Apache Junction and new development northwest of Apache Trail in Pinal County, Arizona are subject to damage from the flash floods in the local washes (natural drainages) which flow in a southwesterly direction. The entire area is located in the foothills south of the Goldfield Mountains. Apache Junction Floodway, Apache Junction Flood Retarding Structure and Bulldog Floodway, which run in a northwesterly direction from the Apache Trail, are proposed to intercept the floodwater in the local washes and lead it to the Signal Butte Dam.

The Apache Junction Flood Retarding Structure (FRS) will mitigate the flood peak by storing water behind the embankment and releasing it slowly over a period of 10 days or less as required by TR-60. The FRS will release the stored water into the Apache Junction Outlet Channel, which connects directly to the Bulldog Floodway.

From the consideration of height of the embankment, drainage area and the maximum storage, this structure falls in the category of low dams. However, the failure of the embankment could cause loss of human life. The FRS has, therefore, been classified as a Class C structure - NE Manual Section 520.21.

The project is comprised of the following components:

Apache Junction Floodway

The Apache Junction floodway starts at station 12+00 near the west side of the Apache Trail. It will drain the storm water running along the west side of the road and will also intercept two washes.

The floodway is a concrete lined channel with a length of approximately 1540 feet and terminates at station 27+37.5 into an energy dissipator and earth channel behind the FRS. The earth channel is approximately 1250 feet long.

The floodway will have a concrete drop inlet at the beginning, and two side inlets for the washes it intercepts. Local runoff along the length of the channel will be directed to the inlets or to scupper drains which pass through the channel wall.

The concrete lined channel will terminate into a plunge pool type energy dissipator which will be protected by grouted riprap. The earthen portion of the floodway will start from this plunge pool at station 28+70 and end at approximately station 40+90.

Apache Junction Flood-Retarding Structure (FRS)

The Apache Junction Flood-Retarding Structure is an earth embankment with a maximum height of approximately 22 feet above ground. The embankment is approximately 8600 feet long running generally in the northwesterly direction.

The storm water from the Apache Junction floodway and the drainage area above the embankment is temporarily stored behind the embankment and released slowly through the principal spillway. The principal spillway is located near the west end of the embankment.

The embankment has an emergency spillway to safely pass excess storm water without over topping the embankment.

Apache Junction FRS Outlet Structure (Principal Spillway)

The Apache Junction FRS outlet structure (principal spillway) is located at Sta. 100 + 76.99 of the embankment. The structure consists of one baffle riser inlet and a 30-inch diameter reinforced concrete pipe buried in the embankment. The inlet has an ungated opening at the base to provide complete drainage of the reservoir.

Apache Junction FRS Emergency Spillway

A concrete baffle block overflow spillway is provided to allow uncontrolled release of large flood flows which exceed the 100-year flood. The spillway is located near the west end of the embankment, with its centerline at station 97+50.

Idaho and Brown Roads

Idaho and Brown Roads cross the Apache Junction FRS and pass through the storage area. The roads intersect each other a small distance downstream of the center line of the FRS embankment. The roads will be raised to cross the embankment with the maximum elevation at 1812.00 feet, two feet higher than the crest of the FRS, to accommodate burial of utilities without disturbing the dam. A culvert is provided under each road fill to equalize water levels and allow for reservoir drainage.

III. DESIGN

III A DESIGN OBJECTIVES

III. DESIGN

A. DESIGN OBJECTIVES

The design objective is to intercept flood flows in natural channels in the project area, direct them into a constructed floodway, convey them safely and economically to the floodwater retarding structure (FRS), hold the flood water long enough to significantly reduce flood peak flows, release normal flows into a downstream floodway and provide emergency release of extreme floods to prevent overtopping of the FRS. The purpose of this is to reduce flooding damage to irrigated cropland and urban land downstream from the floodway and FRS.

III B BASIS FOR DESIGN

B. BASIS FOR DESIGN

B.1 General Parameters

The following documents and references were used as a basis for design:

1. <u>Hydraulics</u>

   NEH - 5
   TR - 25
   TR - 29
   TR - 39
   TR - 48
   TR - 70
   Computer Program Dams2
   "A Baffled Apron as an Energency Dissipator," T.J. Rhone. U.S. Department of Transportation, Hydraulic Engineering Circular No. 14.

   "Addition of Sideflow from a Broad Crested Wein to Flow in an Open Channel at Superctitical Flow" - SCS Paper.

2. <u>Structure</u>

   NEH - 6
   NEH - 11
   NEH - 14
   TR - 5
   TR - 18
   TR - 30
   TR - 46
   TR - 49
   TR - 50
   TR - 63
   TR - 67
   Eng. Monograph No. 25 (USBR)
   USDA Design Note 21

3. Soils/Layout

ENG - PO - 18

ICES Lease - 11

SMN - 1

SMN - 3

TR - 2

TR - 25

TR - 52

Emillo-2-1902, US Army COE

Sedimentation, 1974 Supplement, Buckhorn Mesa

Soil Test Results

4. Hydrology

NEH - 4

NOAA - Atlas 2

TR - 16

TR - 20

TR - 61

TR - 66

Curve

Hydrology - P04

Hydrology - PO-6 (Rev. 2)

Hydrometeorological Report NO. 49

Number Reduction Factors

5. Other

NEH - 2

NEH - 20

TR - 60

Buckhorn - Mesa Watershed

Catalog of National Engineering Standard Drawings

Design of Small Dams (USOR)

HRD 108

National Engineering Manual

USDA Design Note 22

Workplan w/Supplement
Geological Investigation Report
SCS Drawings and Reports
Engineering Hydraulics - Ed. by H. Rouse
Phase 1 - Feasibility Study (Ebasco)
Phase II - Soil Mechanics Report (Ebasco)

B.2 Design Criteria

Design criteria are included in the Design Criteria Specification which is included on the following pages:

B.3 Detailed Design

Detailed design parameters and calculations are included in subsections as follows:

III C Hydrology
III D Hydraulic Design
III E Foundation and Embankment Design
III F Structural Design

B.2 DESIGN CRITERIA

USDA SOIL CONSERVATION SERVICE

BULLDOG FLOODWAY AND APACHE JUNCTION

FLOOD CONTROL

EBASCO SPECIFICATION

DESIGN CRITERIA

EBASCO SERVICES INCORPORATED

CIVIL DEPARTMENT

Revision	Prepared By	Reviewed By	Approved By	Date
0	S. Goyal	M. S. Temchin	C. J. Montana	7/85
1	S. Goyal	M. S. Temchin	C. J. Montana	9/85

EBASCO SERVICES INCORPORATED

EBASCO SPECIFICATION
DESIGN CRITERIA

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2.4 Apache Junction Flood-Retarding Structure (FRS)
2.5 Apache Junction FRS Outlet Structure (Principal Spillway)
2.6 Apache Junction FRS Outlet Channel
2.7 Bulldog Floodway
2.8 Idaho and Brown Roads

3.0 HYDROLOGIC STUDIES

3.1 General
3.2 Floodways and Channels
3.3 Flood-Retarding Structure
3.4 Idaho and Brown Roads

4.0 SEDIMENTATION

EBASCO SERVICES INCORPORATED

EBASCO SPECIFICATION
DESIGN CRITERIA

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5.0 HYDRAULIC DESIGN

5.1 Floodways and Channels
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6.2 Embankment
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6.4 Principal Spillway
6.5 Channel Inlet Structures
6.6 Emergency Spillway
6.7 Erosion Protection
6.8 Drainage
6.9 Joints
6.10 Miscellaneous

1.0 SCOPE

1.1 This specification covers the design criteria for the various components of the Bulldog Floodway and Apache Junction Flood Control project. Only the basic criteria are stated herein. For detailed design criteria and design procedure the referenced material should be consulted.

2.0 PROJECT DESCRIPTION

2.1 Purpose

2.1.1 The City of Apache Junction and new development northwest of Apache Trail in Pinal County, Arizona are subject to damage from the flash floods in the local washes (natural drainages) which flow in a southwesterly direction. The entire area is located in the foothill south of the Goldfield Mountains. Apache Junction floodway, Apache Junction flood-retarding structure and Bulldog floodway, which run in a northwesterly direction from the Apache Trail, are proposed to intercept the floodwater in the local washes and lead it to the Signal Butte Dam.

2.1.2 The Apache Junction flood-retarding structure (FRS) will mitigate the flood peak by storing water behind the embankment and releasing it slowly over a period of 10 days or less as required by TR-60. The structure is required for flood protection only.

2.1.3 From the considerations of height of the embankment, drainage area and the maximum storage, this structure falls in the category of low dams. However, the failure of the embankment will cause loss of human life. The FRS has, therefore, been classified as Class C structure - NE Manual Section 520.21.

2.2 Layout

2.2.1 The project is comprised of the following components:

a) Apache Junction floodway
b) Apache Junction flood-retarding structure
c) Apache Junction FRS outlet structure
d) Apache Junction FRS outlet channel
e) Bulldog floodway

Each item is briefly described below.

2.3 Apache Junction Floodway

2.3.1 The Apache Junction floodway starts from the west side of the Apache Trail. It will drain the storm water running along the west side of the trail and will also intercept two washes.

2.3.2 The floodway is a concrete lined channel in a length of approximately 1538 feet and terminates into an earth channel behind the FRS. The earth channel is approximately 1508 feet long.

2.3.3 The floodway will have a concrete drop inlet at the beginning, and two side inlets for the washes it intercepts. A number of pipe inlets will be provided in the concrete lined channel to drain the local runoff along the length of the channel.

2.3.4 The concrete lined channel will terminate into a plunge pool type energy dissipator which will be protected by grouted riprap. The earthen portion of the floodway will start from this plunge pool.

2.4 Apache Junction Flood-Retarding Structure (FRS)

2.4.1 The Apache Junction Flood-Retarding Structure is an earth embankment with a maximum height of approximately 22 feet above ground. The embankment is approximately 8600 feet long running generally in the northwesterly direction.

2.4.2 The storm water from the Apache Junction floodway and the drainage area above the embankment is stored behind the embankment and released slowly through the principal spillway. The principal spillway is located near the west end of the embankment.

2.4.3 The embankment has an emergency spillway to safely pass excess storm water without topping the embankment.

2.5 Apache Junction FRS Outlet Structure (Principal Spillway)

2.5.1 The Apache Junction FRS outlet structure (principal spillway) is located at Sta. 100 + 92.50 of the embankment. The structure consists of one baffle riser inlet and a 30-inch diameter reinforced concrete pipe buried in the embankment.

2.6 Apache Junction FRS Outlet Channel

2.6.1 The principal spillway conduit discharges into the Apache Junction FRS outlet channel. This is a concrete lined channel approximately 2826 feet long running in the southwesterly direction before ending into the Bulldog floodway.

2.6.2 The outlet channel intercepts one major wash for which a concrete lined side channel with drop inlet will be provided. A number of pipe inlets will be provided in the channel to drain the local runoff along the length of the channel.

2.7 Bulldog Floodway

2.7.1 The Bulldog Floodway starts from the end of the Apache Junction FRS outlet channel and ends behind the Signal Butte Dam. The floodway is a concrete lined channel for an approximate length of 7324 feet and terminates into an earth channel which is approximately 400 feet long. The earth channel empties into the Signal Butte FRS Borrow Area.

2.7.2 The floodway intercepts a number of small and big washes. For the small washes grouted riprap side inlets will be provided, whereas concrete lined side channels with drop inlets will be provided for the big washes. The wash intercepted by the earth channel will be provided with grouted riprapped side inlet.

2.7.3 At the junction of the concrete lined channel and the earth channel a grouted riprapped plunge pool-type energy dissipator will be provided.

2.8 Idaho and Brown Roads

2.8.1 Idaho and Brown Roads cross the Apache Junction FRS and pass through the storage area. The roads intersect each other a small distance downstream of the center line of the FRS embankment.

3.0 HYDROLOGIC STUDIES

3.1 General

3.1.1 The drainage area for this project is divided into two parts, namely:

a) the northeast area which contributes storm water to the Apache Junction flood-retarding structure;

b) the northwest area which contributes storm water to the Apache Junction FRS outlet channel and the Bulldog Floodway.

3.1.2 The hydrological studies for the northeast area will be performed by Ebasco, whereas the hydrological studies for the northwest area will be performed by Soil Conservation Service, Phoenix, Arizona. The peak discharge data furnished by SCS Phoenix will be used for the design of Apache Junction FRS outlet channel and the Bulldog Floodway.

3.1.3 Ebasco will perform the hydrological studies in accordance with the available up-to-date version of DAMS2. Stream cross-section data and a soil survey map furnished by SCS Phoenix, and the aerial photographs supplied by Landis Aerial Surveys, Phoenix, for delineation of the drainage basin will be utilized for the hydrological studies.

3.2 Floodways and Channels

3.2.1 The floodways and channels will be designed to safely carry the P_{100}-year hydrograph storm flows.

3.2.2 The earth channels will be designed to safely carry the P_{100}-year hydrograph storm without exceeding the permissible velocity in the soil. Tractive stress analysis will be performed when necessary to determine an economical section of the channel. Procedures outlined in TR-25 will be followed.

3.2.3 The P_{100}-year discharge data developed by Ebasco will be used for the design of Apache Junction floodway.

3.2.4 The Apache Junction FRS outlet channel and the Bulldog Floodway will be designed for the FRS principal spillway discharges and the P_{100}-year inflows from the drainage area as furnished by SCS Phoenix.

3.2.5 Due to overlapping drainage sub-areas or uncertainties of runoff paths, the side inlets will be designed for the flow corresponding to the larger sub-area as established in the hydrological studies.

3.2.6 The floodway or the channel will be designed for the cumulative flow at that reach of the channel.

3.3 Flood-Retarding Structure

3.3.1 The principal spillway will be sized for P_{100} hydrograph storm routed through the spillway such that the maximum pool is drained in 10 days or less (at least 85 percent of the maximum storage is drained in 10 days or less - TR 60).

3.3.2 The principal spillway crest will be located at the sediment pool elevation. (TR-60)

3.3.3 The emergency spillway will be sized to safely pass the emergency spillway, P_{100} + .026 (PMP-P_{100}), hydrograph storm with sufficient freeboard for the settled top of the dam. (TR-60)

3.3.4 The freeboard over the maximum water level attained during passage of the emergency spillway hydrograph storm will be adequate for wave action or frost. The freeboard will not be less than 3 feet. (TR-60)

3.3.5 The emergency spillway will have sufficient capacity to pass the freeboard, PMP, hydrograph storm without topping the embankment. (TR-60)

3.3.6 In the flood routing studies increase in the storage capacity due to borrow areas and reduction in the capacity due to the embankment will be accounted for. For this purpose the upstream slope of the embankment will be assumed to be 3 horizontal to 1 vertical. The effect of road embankments on the storage capacity will be neglected because the fill for the embankment will be taken from the storage area.

3.4 Idaho and Brown Roads

3.4.1 The profile of the road embankment will be determined such that the road is not submerged in P_{25}-year hydrograph storm routed through the spillway.

3.4.2 For performing the flood routing studies no obstruction due to the road embankments will be assumed. The culverts under the embankments will be sized to pass the P_{25}-year hydrograph flood with a differential head of 0.25 feet or less across the road embankment.

3.4.3 The profile of the road embankment will be sufficiently low to pass the P_{100} hydrograph storm over the road without causing significant head across the road (for this condition the culvert under the road embankment will be assumed to be blocked by debris, etc.).

3.4.4 Differential head across the road embankments will be accounted for while determining the maximum water level due to the emergency spillway or the freeboard hydrograph storms. The top of the FRS embankment will be fixed for the required freeboard over the maximum water level determined as stated above.

4.0 SEDIMENTATION

4.1 The quantity of sedimentation inside the FRS storage area will be taken as 95 acre feet based upon the report "Sedimentation - 1974 Supplement, Buckhorn - Mesa Watershed".

5.0 HYDRAULIC DESIGN

5.1 Floodways and Channels

5.1.1 All floodways and channels will be designed in accordance with TR-25 and NEH-5. The various assumptions made for the design of the concrete lined channels and the earth channels are discussed below.

5.1.2 For the design of concrete lined channels the following assumptions are made:

a) The coefficient of friction 'n' in the Manning's equation is taken as 0.015. NEH-5 Table 5.4.1 recommends 'n' = .014 to .016. A value of n = .015 is assumed because of infrequent use of the channels.

b) The concrete lined channels will be designed for supercritical flow for economy if the channel alignment permits supercritical slope in the channel.

c) The maximum velocity in concrete will be about 20 feet per second.

5.1.3 For small inflows in the channel the side inlets will be designed in accordance with the study performed by SCS for addition of sideflow from a broad crested weir to a flow in an open channel at supercritical velocities. The same approach will be used for small pipe inlets.

5.1.4 For large inflows concrete lined side channels with drop inlets will be designed in accordance with Figure 5-1 Hydraulic Junction Structures - TR 25.

5.1.5 For stability of supercritical flow and the design of side inlets the Froude No. F, for the flow will be maintained above 1.2.

5.1.6 The flow over the side weir inlets will be computed for a broad crested weir:

$$Q = CL\ H^{3/2} \quad \text{where } c = 3.1$$

5.1.7 The box inlet at the beginning of the channel or for the side channel inlet will be designed as a flat rectangular weir box inlet in accordance with NEH-14, page 2-31.

5.1.8 For the subcritical flow condition a freeboard of 0.1d will be provided for rectangular channels and 0.2d for trapezoidal channels. For the supercritical flow condition a freeboard of 0.2d will be provided for rectangular channels and 0.25d for trapezoidal channels. The minimum freeboard will be 1.0 foot. Additional depth will be provided for unstable flow conditions as required in TR-25.

5.1.9 Superelevation will be provided in the channel at the curves in accordance with the following equation for supercritical flow conditions:

$$S = 1.2\ \frac{V^2 b}{g\ R}$$

where R = Radius of curve.

5.1.10 Pipe inlets, as required, will be provided in the concrete lined channel to drain the flow in the ditch along the channel, if such a ditch cannot be connected to the natural wash. Corrugated metal pipe will be used for these inlets, for which the coefficient of friction 'n' in the Manning's equation will be taken as 0.025 (Table 5.4.1 in NEH-5).

5.1.11 The design of earth channels will be based on the following:

a) the requirements of Engineering Standard 582, Open Channel's

b) the coefficient of friction 'n' in the Manning's equation will be computed using NEH-5, Supplement b

c) the average velocity of flow will not exceed the permissible velocity in accordance with TR-25.

5.2 Principal Spillway

5.2.1 The hydraulic design of the principal spillway will be in accordance with SCS computer program DAMS 2.

The value of 'n' in the Manning's equation equal to 0.013 will be used for the concrete pipe. Table 5.4.1 NEH-5 recommends n = .012 to .017. Design of Small Dams by Bureau of Reclamation recommends n = .014 (maximum). Due to infrequent use of the spillway a value of n = .013 will be assumed.

5.2.2 The concrete pipe will discharge directly into the Apache Junction FRS outlet channel.

5.3 Emergency Spillway

5.3.1 The emergency spillway will either be an earth spillway excavated in the abutment of the FRS embankment at the location shown as Alternate #2 in the SCS drawings, or a concrete spillway. The concrete spillway may be either a baffled block type channel or a drop spillway - Type C.

5.3.2 The earth spillway will be designed in accordance with TR2, TR52 and TR60. Since the channel will be protected by riprap the value of 'n' in the Manning's equation equal to 0.035 will be used. The channel will be straight for a minimum distance of 30 feet upstream of the control section and for a distance of half the base width of the embankment downstream of the control section. This portion of the channel will be horizontal and the same width as the control section.

5.3.3 The exit channel of the emergency earth spillway will have sufficient capacity such that the flow downstream of the control section is supercritical for a discharge greater than 25 percent of the freeboard hydrograph storm outflow - TR52.

5.3.4 Baffle Block Spillway will be designed in accordance with Engineering Monograph No. 25, Bureau of Reclamation. The maximum intensity of flow recommended in the Monograph is 60 cubic feet per second per foot. Higher intensity of flow can be permitted, if required, as recommended by T J Rhone in, "A Baffled Apron as a Spillway Energy Dissipator". However, in the absence of hydraulic model studies, the maximum intensity of flow for the freeboard hydrograph storm will be limited to 100 cfs/foot. The Type C Drop Structure will be designed in accordance with NEH-11.

5.3.5 The hydraulic design of the structural concrete spillway will be based upon 2/3 of the freeboard hydrograph storm outflow. The spillway will, however, be capable of safely passing the freeboard hydrograph storm outflow - TR60.

5.4 Energy Dissipators

5.4.1 Plunge pool type energy dissipator will be provided at the junction of the concrete lined channel and the earth channel. The hydraulic design will be in accordance with Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular No. 14, U.S. Department of Transportation.

6.0 STRUCTURAL DESIGN

6.1 Materials

6.1.1 The following basic materials will be used in the construction of the project:

a) Concrete

b) Reinforcing steel

c) Reinforced concrete pipe

d) Corrugated metal pipe

e) Structural steel

f) Earthfill for the embankment

g) Soil backfill against concrete structures

h) Riprap

i) Bedding for riprap

j) Drainfill in the embankment

6.1.2 Concrete - Concrete having minimum 28-day compressive strength of 4000 psi will be used for all reinforced concrete structures.

6.1.3 Reinforcing Steel - Grade 40 reinforcing steel conforming to ASTM A615 will be used for design. During construction Grade 60 reinforcing steel conforming to ASTM A615 can be substituted for Grade 40 reinforcing steel. However, the substitution will be in accordance with SCS Technical Note 21.

6.1.4 Reinforced Concrete Pipe - The reinforced concrete pipe for the principal spillway will be Steel Cylinder Type Prestressed, meeting Specification AWWA C 301 - TR60.

6.1.5 Corrugated Metal Pipe - Corrugated metal pipes for pipe inlets will conform to AASHO M36, "Zinc Coated (Galvanized) Corrugated Iron or Steel Culverts and Underdrains". Corrosion protection will be provided in accordance with SCS Specification NEH-20 Chapter 2.

6.1.6 Structural Steel - Structural steel, if used, will conform to ASTM A36.

6.1.7 Earthfill for the Embankment - Suitable soil as excavated from the borrow areas after clearing, grubbing and stripping of the top soil, will be used for the construction of the FRS embankment.

6.1.8 Soil Backfill Against Concrete Structures - The backfill against the concrete channel walls and other structures except for the concrete structures in the FRS, will be random fill as available. The backfill against the concrete structures in the FRS will be the same material as used in the FRS.

6.1.9 Riprap - Riprap material as designated on the drawings will be used for protection of soil against erosion in levees or dikes for the emergency spillway, inlet structures and emergency spillway outlet channel. Grouted riprap will be used at the inlets and the plunge pools.

6.1.10 Bedding Material - Bedding material compatible with the riprap size and the soil will be provided under the riprap to avoid movement of soil into the riprap material.

6.1.11 Filter Material - Filter material as designated on the drawings will be used in the embankment for crack control, toe drain, if necessary, and for the seepage control diaphragm around the principal spillway conduit. Material will be designed in accordance with SCS Soil Mechanics Note 1.

6.2 Embankment

6.2.1 The following parameters will be assumed for the FRS embankment:

a) The top width to be a minimum of 14 feet for service road. No public road is assumed on the top of the embankment.

b) The upstream slope of the embankment to be a minimum of 2.5 horizontal to 1 vertical. The slope may be flatter if required by stability analysis.

c) The downstream slope of the embankment to be 2 horizontal to 1 vertical.

d) A seismic coefficient of 0.1g for Zone 2 (Figure 4-1 TR60) will be assumed for the stability analysis of the embankment.

6.2.2 The properties of soil used for the construction of the embankment will be as determined from the geotechnical investigations. The lateral earth pressures will be determined in accordance with "Engineering Design Standards for Far West States".

6.2.3 The embankment section will be analyzed for stability against sliding and sloughing. Settlement of the embankment will also be determined. Since the function of the embankment is flood retardation, and has uncontrolled principal and emergency spillways, water will not be standing against the embankment for any long duration. For the fairly low permeability of the soil to be used for the construction of the embankment no steady state phreatic line is expected to be established. Therefore, the steady state seepage for a reservoir elevation at the principal spillway crest as stated in Table 5-2 TR 60 will not be applicable. The stability of the embankment will be investigated for the following conditions:

Condition	Factor of Safety
1. Reservoir at crest of emergency spillway:	
a) without seismic forces	1.5
b) with seismic forces	1.1
2. Reservoir at freeboard storm elevation	
a) without seismic forces	1.1

The stability of the upstream face of the embankment will be investigated for the rapid drawdown with partial staturation.

6.3 Floodways and Channels

6.3.1 The concrete channels will be designed in accordance with TR 50.

6.3.2 Since the groundwater table is very low no water will be assumed outside the walls for the channel flowing condition, whereas water will be assumed outside the wall for the channel empty condition which may occur immediately after the passage of the storm flows. The water level will be assumed up to the top of weep holes, if provided.

6.4 Principal Spillway

6.4.1 The two-way covered riser inlet for the principal spillway will be located just upstream of the upstream toe of the dam. SCS standard details will be used for detailing the structure.

6.4.2 The reinforced concrete pipe will extend at least 14 feet downstream of the downstream toe of the embankment to provide space for a service road.

6.4.3 The pipe will be supported on a concrete cradle founded directly on caliche. The pipe will be laid horizontal at the inlet riser and will then approximately follow the slope of the caliche. It will exit at the same slope as the FRS outlet channel.

6.4.4 The concrete pipe will be designed in accordance with TR 5. Since the pipe is supported on an unyielding foundation, no computations for pipe joint extensibility will be made.

6.4.5 A piping and seepage control diaphragm will be provided around the conduit in accordance with TR-60.

6.5 Channel Inlet Structures

6.5.1 The channel inlet at the beginning of Apache Junction floodway and at all side channel inlets will be designed in accordance with NEH-6 and TR 67.

6.6 Emergency Spillway

6.6.1 Evaluation of emergency spillway alternatives will consider an earth spillway and a concrete spillway.

6.6.2 For the earth emergency spillway alternative, the excavated slope will be no steeper than 2 horizontal to 1 vertical. Levees, if provided, will have a top width of at least 12 feet and the side slopes of a minimum 3 horizontal to 1 vertical. The stability of slope will be investigated. The Oe/b analysis will be performed for the earth emergency spillway for the freeboard hydrograph flow to provide safety against breaching - TR 52.

6.6.3 A concrete emergency spillway will be designed in accordance with NEH-6 and TR 67.

6.7 Erosion Protection

6.7.1 Erosion protection by riprap and bedding will be provided at the bed of the channel inlets, inlet dikes, plunge pools, levees and emergency spillway outlet channel if required. The size of riprap will be determined in accordance with NEH-11, page 2.6 or USDA Design Note 22 or HRP 108 as applicable. Grouted riprap may be used in high turbulance or high velocity areas. A cutoff will be provided on the upstream end of the riprap. No loose riprap and bedding material will be placed upstream of the grouted riprap.

6.8 Drainage

6.8.1 Drainage provisions for the following areas will be studied, if required:

a) Drainage along the principal spillway conduit

b) Toe drain for the FRS embankment

c) Filter zone and its drainage in the FRS embankment

d) Drainage for the walls of the concrete channels, inlets and spillway

e) Drainage for the bottom slab of concrete channels and spillway floors.

f) Drainage for the AT & T conduit crossing the embankment

6.9 Joints

6.9.1 Expansion and contraction joints will be provided in the channel as recommended in TR 50. The joints will be provided with premolded joint filler.

6.9.2 A half-inch deep by 6-inch beveled offset will be provided in the downstream concrete at each joint to avoid impingment of high velocity flow against the downstream concrete edge.

6.9.3 Expansion and contraction joints will be provided in the concrete spillway structure. The joints will be provided with a key and premolded joint filler. Water stops will be provided where required.

6.10 Miscellaneous

6.10.1 Fencing and Guard Rails - Fencing and guard rails will be provided where required according to SCS standard details.

6.10.2 Culverts Under Idaho and Brown Roads - The culverts under Idaho and Brown Roads Upstream of the FRS will be constructed either of renforced concrete or corrugated metal. If corrugated metal is used, it will be coated only on the outside. The culverts will be designed in accordance with county criteria and SCS criteria, whichever is more stringent.

III C HYDROLOGY

The Apache Junction Floodway and Flood Retention Structure will control a drainage area of 5.72 square miles. The basin is roughly two miles in width from Apache Trail on the east to the Bulldog Floodway Basin on the west, and roughly three miles in length from the Goldfield Mountains in the north to the Floodway and FRS. The slope of the basin increases gradually from Elevation 1790 feet Mean Sea Level (MSL) at the FRS to about El. 2000, and then rises rapidly to mountain peaks ranging from 2307 to 2685 feet MSL. Plant cover is classified as Desert Brush; most of the basin is undeveloped but there is some low-density residential development in the central part of the basin.

The drainage basin is divided into five main flow paths which enter either the FRS or the Floodway. The sub-basins corresponding to each flow path are shown in Figure C.1. The flow paths were determined from aerial photographs, and the topographic divides from the USGS 1:24,000 scale Apache Junction quadrangle sheet. From the photographs, several locations are evident where channels diverge in the downstream direction. These are of minor importance when both routes enter the flood pool, but are more important when one route goes to the pool and the other goes to the floodway, where a design inflow is needed. This is the case with Sub-basin 1A, from which the runoff may pass into either Sub-basin 1B or 1C. For the design of the inlet of 1B to the floodway, it is estimated that it may carry a maximum of 70% of the runoff from Sub-basin 1A.

Sub-basin 3A, a part of the Bulldog Floodway drainage basin with an area of 0.17 square miles, may similarly contribute up to 40% of its runoff to the Apache Junction FRS via Sub-basin 3. Therefore the effective area of Sub-basin 3 is increased by 0.07 square miles, and the total area of the project basin is taken as 5.79 square miles.

Precipitation

The Principal Spillway is to be designed for the 100-year return period, 1- and 10-day rainfall, as required by T.R.60 (Reference 1). Since the FRS is a Class C structure, the emergency spillway is to have the capability to

discharge the Probable Maximum Flood (PMF), which results from the Probable Maximum Precipitation (PMP), without overtopping the dam. The Emergency Spillway Hydrograph (ESH) is also provided, which results from the following precipitation depth, as defined by T.R.60, Table 2-5:

$$P_{esh} = P_{100} + 0.26\ (PMP - P_{100})$$

The PMP is determined using Hydrometerorological Report No. 49 (Reference 2). Two types of storms were developed following the procedure in Chapter 6. For local-type storms with a maximum duration of 6 hours, the PMP depth was found to be 13.7 inches for the site. For a general-type storm, the PMP depth is 15.7 inches for 24 hours, but only 10.1 inches in the most intense 6-hour period. Both types of storm were applied to the site; the critical storm is defined by T.R.60 as that which produces the maximum reservoir stage.

The time distribution of the precipitation was developed according to Reference 2. The sequence for the increments of the 6-hour precipitation is given in Tables 4.7 (HMR No. 5) and 4.8. For the 24-hour PMP, no guidance for time distribution is given in Reference 2. The 24-hour Type II distribution cannot be used because it would give 11.1 inches of rain in the most intense 6-hour period, when Reference 2 gives only 10.1. Consequently a distribution, similar to the 24-hour Type II in that the period of most intense precipitation is centered, was drawn to fit the 6-hour increments determined. The most intense period was preceded by the third most intense, and followed by the second most intense. The least intense 6-hour period was divided in half and placed at the beginning and the end. Both the 6- and 24-hour distributions are shown in Figure C.2.

The 100-year precipitation is determined from NOAA Atlas 2 (Reference 3) for durations up to 24 hours and from TSC Note PO-6 (Reference 4) for durations from 2 to 10 days. An additional case provided is the 25-year return period precipitation, which is used in the design of Idaho and Brown Roads, which cross the flood retention basin. Precipitation depths are summarized in Table C.1.

Times of Concentration

Times of concentration (Tc) for the several different flow paths were determined on the basis of surveyed channel sections and estimated roughness coefficients provided by the SCS in the Signal Butte F.R.S. Design Hydrology book. The Manning Equation was used to calculate flow velocities along three to seven segments characterized by slope, Manning's n, and hydraulic radius. Adjustments to the present condition Tc's were made to reflect future development within the basin. A factor ranging from 92% to 94% for channel modification was determined from T.R.55 Figure 3.4 (Reference 5), based on an assumption of 15% of the channel lengths being improved. An additional factor of 95% for increased imperviousness was determined from T.R.55, Figure 3.5, assuming 10% imperviousness. The resulting times of concentration are given in Table C.1.

Curve Numbers

Curve numbers for determining runoff depths were developed using a soil survey map provided by SCS. Soil Groups B, C, and D were present. From field observations, soil cover was characterized as "desert brush" with a cover density of 15%. The corresponding short duration curve numbers were determined from Figure 10 of Reference 6, and ranged from 83 to 88. Modifications for future development were made according to T.R.55, based on 10% imperviousness. The 6-hour and 24-hour curve numbers were determined from Figure 4 of Reference 7, and 10-day curve numbers from T.R.60, Table 2-3. The results are presented in Table C.1.

Channel Loss Factors

The losses of flood runoff due to absorption into stream beds and overbanks, characteristic of arid areas, were evaluated from Chapter 21 of NEH-4 (Reference 8) and TSC Technical Note PO-4 (Reference 9). The Climatic Index for the Phoenix area was found to be the minimum value of 0.4. Sub-basins 1 and 3 are the only ones over a square mile in area and hence are the only ones having significant channel losses. Since all sub-basins flow directly into the reservoir, it is the sub-basin areas and not the total drainage area that

determines the extent of channel infiltration. The respective channel loss factors from NEH-4 are .8882 and .9038. Adjusting for soil groups according to the equations of PO-4, the final channel loss factors are .943 and .949. These coefficients are applied to the PSH, but not to the ESH and FBH, in accordance with Chapter 21 of NEH-4.

Runoff Depth and Inflow Hydrograph Computations

Inflow hydrographs to the Floodway and the Flood Retention Structure were calculated using the SCS DAMS2 computer program (Reference 10). The program uses the SCS dimensionless unit hydrograph (peak factor 484) to develop runoff hydrographs, and uses the Convex Method for channel routing. There is only one short channel routing involved (through the Floodway). Routings were performed for the Principal Spillway (100-year) Flood, the Emergency Spillway Flood, the Freeboard (Probable Maximum) flood, and the 25-year flood. The 100-year rainfall was also routed using the 24-hour Type II distribution, but the standard 10-day PSH distribution produced greater peak outflow, stage, and draw-down time.

Because of two limitations of the program, it was necessary to convert rainfall depths to runoff and use runoff as input to the program with the "QDIRECT" option for the PSH routing. First, the program will automatically use channel loss factors from Chapter 21 of NEH-4, without adjustment according to Note PO-4, if a climatic index less than one is input. Second, the program computes the 10-day curve number based on the 6-hour CN instead of the 24-hour CN, if a 6-hour value is input. If QDIRECT is used, all curve numbers are assumed to be 100 and the above difficulties are avoided. There is a slight distortion in the hydrograph shape because initial losses are not accounted for (the time distribution of runoff is assumed to be the same as that of rainfall, Figure C.2). However, the effect on peak flow values and storage requirements is expected to be negligible. The runoff depths are those given in Table C.1, as determined from Reference 11.

The 6-hour PMP was found to produce higher reservoir stages in all cases than the 24-hour PMP; the 24-hour case is not considered further. The resulting peak inflows from each sub-basin, times of peaks, and the combined peak

inflows to the FRS are shown in Table C.2. The combined inflow hydrographs from the DAMS2 runs for the various flood events are shown in Figures C.3, 4, 5, 6 and 7.

References - Hydrology

1. Engineering Division, Soil Conservation Service, "Earth Dams and Reservoirs", Technical Release No. 60, U.S. Department of Agriculture, August 1981.

2. National Weather Service, "Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages", Hydrometeorological Report No. 40, U.S. Department of Commerce, September 1977.

3. Miller, J. F., Frederick, R. H., and Tracey, R. J., "Precipitation - Frequency Atlas of the Western United States", Volume VIII, Arizona; NOAA Atlas 2, U.S. Department of Commerce, 1973.

4. Styner, W. R., TSC Technical Note-Hydrology - PO-6 (Rev. 2), SCS Regional Technical Service Center, Portland, OR., October 21, 1975.

5. Soil Conservation Service, "Urban Hydrology for Small Watersheds", Technical Release Number 55, U.S. Department of Agriculture, January 1955.

6. Soil Conservation Service, "Hydrologic Design Manual for Drainage Areas Less Than 25 Square Miles for Arizona", Department of Agrigulture, February 1972.

7. Woodward, D. E., "Runoff Curve Numbers for Semiarid Range and Forest Conditions", American Society of Agricultural Engineers, June 1973.

8. Soil Conservation Service, National Engineering Handbook, Section 4 - Hydrology, U.S. Department of Agriculture.

9. Rallison, R. E., "Estimation of Modified Channel Loss Factor", TSC Technical Note-Hydrology - PO-4, SCS Regional Technical Service Center, Portland, OE., September 15, 1971.

10. Soil Conservation Service, "DAMS2 (Interim Version) Structure Site Analysis Computer Program", Technical Release No. 48, Department of Agriculture, October 1982.

11. Soil Conservation Service, "Rainfall-Runoff Tables for Selected Runoff Curve Numbers", Technical Release No. 16, Department of Agriculture, April 1976.

TABLE C.1. HYDROLOGIC SUMMARY

	Precipitation Depth, Inches	Sub-basins				
		1	1A+1B	1A+1C	2	3
Drainage Area, SQ. mi.		1.86	0.77	0.75	0.67	1.74
Concentration Time, hr.		0.82	0.63	0.65	0.38	0.69
Channel Loss Factor		.943	1	1	1	.949
Short-Duration CN		88	86	85	83	87
Future SDCN		89	87	86	84	88
6-Hour CN		84	81	80	77	82
PMP	13.7					
Runoff, ESH		4.20	3.88	3.78	3.48	3.98
Runoff, FBH		11.66	11.23	11.11	10.67	11.37
24-Hour CN		80	78	77	74	79
100-Year Rainfall	4.1					
Runoff, PSH		2.00	1.97	1.89	1.68	1.94
25-Year Rainfall	3.2					
Runoff		1.32	1.27	1.21	1.04	1.27
PMP	15.7					
Runoff, ESH		4.79	4.58	4.45	4.14	4.68
Runoff, FBH		13.06	12.77	12.61	12.16	12.90
10-Day CN		65	62	61	57	64
100-Year Rainfall	7.3					
Runoff, PSH		3.14	3.02	2.91	2.51	3.07
25-Year Rainfall	5.8					
Runoff		2.07	1.95	1.87	1.55	2.01

TABLE C.2. INFLOWS TO FRS

PEAK INFLOWS, CFS/ TIME, HOURS	PSH	ESH	FBH	25-Year
Sub-Basin 1	1046 120.3	3953 2.77	11501 2.77	689 120.3
Sub-basin 1A + 1B	514 120.0	1796 2.64	5576 2.56	331 120.0
Sub-basin 1A + 1C	476 120.0	1657 2.66	5246 2.58	303 120.0
Sub-basin 2	395 119.6	1847 2.38	6252 2.38	245 119.6
Sub-basin 3	1077 120.1	3978 2.62	12112 2.62	705 120.1
COMBINED PEAK INFLOWS, CFS	2893	12285	37362	1881
TIME OF PEAK, HOURS	120.3	2.68	2.59	120.3

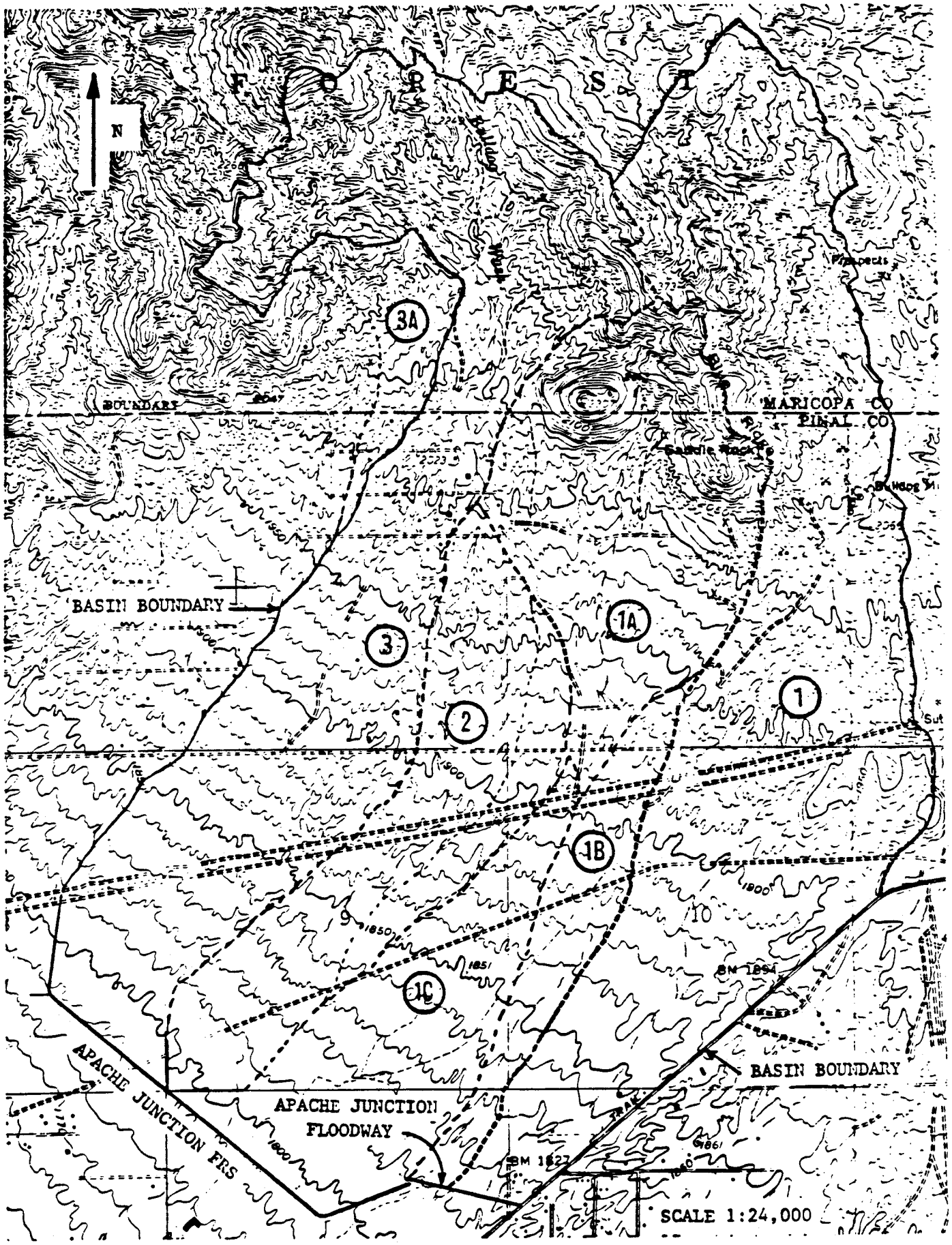

FIGURE C1. BASIN MAP

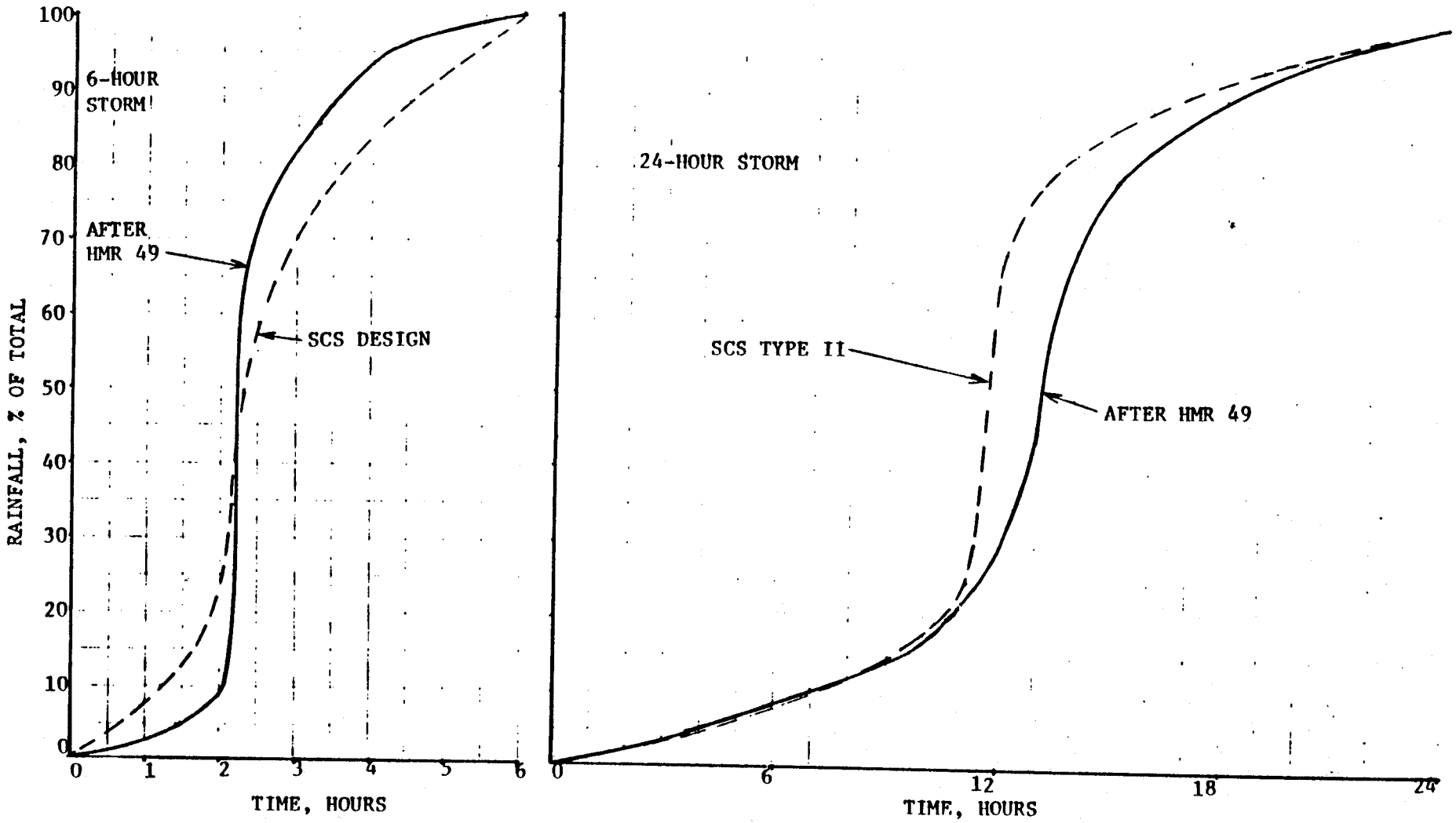

FIGURE C2. PRECIPITATION DISTRIBUTIONS

IIIC.2
Reservoir Volume,
Flow Ratings

EBASCO SERVICES INCORPORATED

BY D.A. DATE 5/28/85 SHEET 1 OF 3

CHKD. BY S DATE 5/28/85 OFS NO. _____ DEPT. NO. _____

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

SUBJECT PLANIMETRY FOR RESERVOIR VOLUMES

Planimeter reading in tenths of cm^2

For 1:4800 scale $1 cm^2 \times \frac{1550 in^2}{cm^2} \times \frac{1 ft^2}{144 in^2} \times (4800)^2 = 24{,}800$ to convert reading to sq.ft.

.5693 to get acres

Elevation	Reading	Area, acres	Cum. Volume acre-ft
1788	1.0, 0.9, .9	0.53	0.
1790			11.0
1792	42.4, 42.7	24.2	45.6
1794			113.3
1796	109.5, 109.7	62.4	219.2
1798			362.3
1800	173.7, 173.3,	98.8	541.8
1802			760.6
1804	248.3, 249.0	141.6	1022.2
1806			1325.8
1808	319.8, 321.2	182.5	1670.3
1810			2056.6
1812	398.1, 397.3	226.4	

Interpolated from curve: 10.4, 43.5, 80.7, 120.0, 162.0, 203.8

Sediment volume = 95 acre-ft.

Dam volume, preliminary = 290,000 cy = 180 acre-ft.

Note: Planimetered from 8/74 drawing, sheet 1 of 1, "Site No. 1 APACHE JUNCTION DAM". Actual volume of reservoir, excluding volume occupied by embankment, was planimetered, but volume to be excavated for spillway was ignored.

561/8-81

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BY DJH DATE 5/29/85 SHEET 2 OF 3

CHKD. BY S DATE 5/28 OFS NO. DEPT. NO.

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

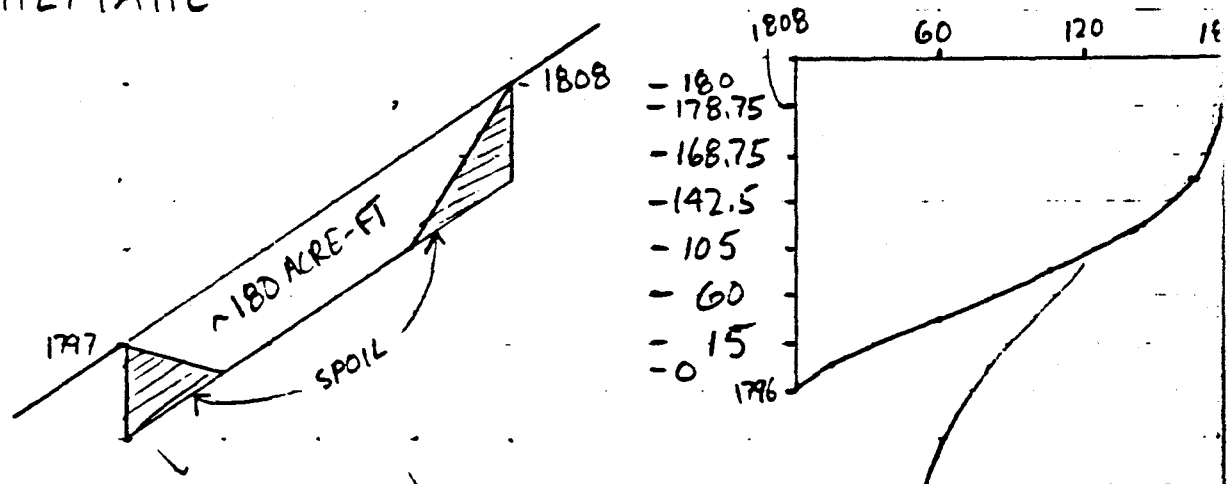
SUBJECT RESERVOIR VOLUME ADJUSTMENTS

BORROW AREA: 900' WIDE, BETWEEN 1797' and 1808' CONTOURS

AVG. 4' DEEP INCLUDING 1' OF STRIPPING

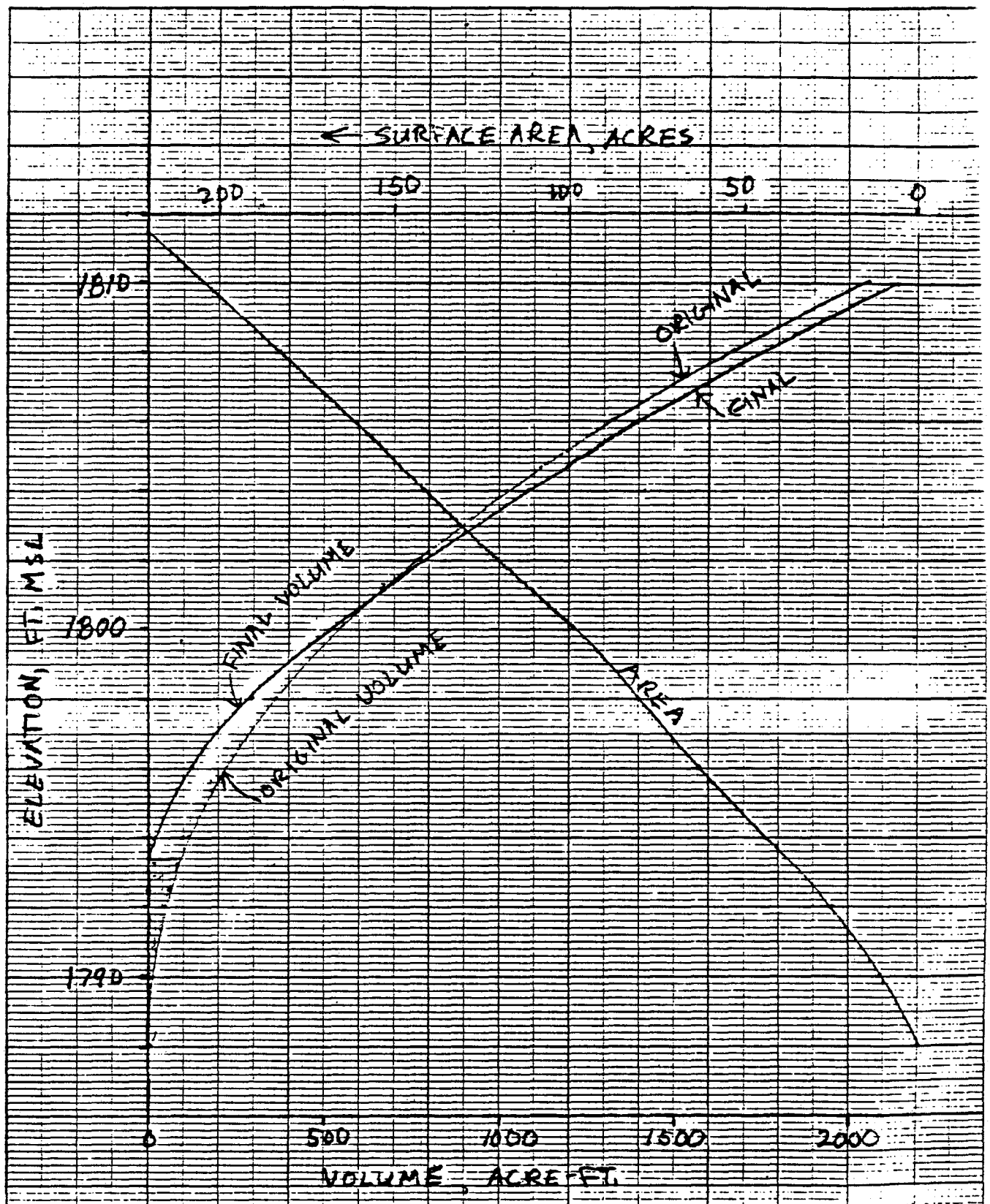
STRIPPING TO BE SPOILED IN BORROW AREA, HALF ALONG EACH EDGE.

SCHEMATIC



El.	ORIG. VOLUME	SEDIMENT	SUM	BORROW	SUM
1788	0	0	0		
1790	11.0	-11	0		
1792	45.6	-45.6	0	1793.4	0
1794	113.3	-95	18.3	1794	18.3
1796	219.2		124.2	0	124.2
1798	362.3		267.3	32	299.3
1800	541.8		446.8	83	529.8
1802	760.6		665.6	126	791.6
1804	1022.2		927.2	158	1085.2
1806	1325.8		1230.8	172	1402.8
1808	1670.3		1575.3	180	1755.3
1810	2056.6		1961.6	180	2141.6

S61/8-81



RESERVOIR AREA, STORAGE CURVES - APACHE JUNCTION FRS

~~DSH~~ 5/29/85 Sheet 3 of 3

46 1242
K+E 20 X 20 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

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CLIENT APACHE JCT. ERS

PROJECT

SUBJECT SPILLWAY RATINGS

$q = 3.1\ B\ H^{3/2}$ for either broad crest of baffle chu

H. for unit width		B 150	200	300 ft.
0.5	1.10	165	220	330
1	3.1	465	620	930
1.5	5.70	855	1140	1710
2	8.77	1315	1754	2631
2.5	12.25	1838	2450	3675
3	16.11	2416	3222	4833
3.5	20.30	3045	4060	6090
4	24.80	3720	4960	7440
4.5	29.54	4438	5918	8877
5	34.66	5199	6932	10398
5.5	39.99	5998	7998	11997
6	45.56	6834	9112	13668
6.5	51.37	7706	10274	15411
7	57.41	8612	11482	17223
7.5	63.67	9550	12733	19102
8	70.14	10522	14028	
8.5	76.82	11523	15364	
9	83.70	12555		
9.5	90.77	13616		
10	98.03	14705		
10.5				
11				

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BY PSM DATE 5/31/85 SHEET ____ OF ____

CHKD. BY S DATE 5/8/85 OFS NO. ____ DEPT. NO. ____

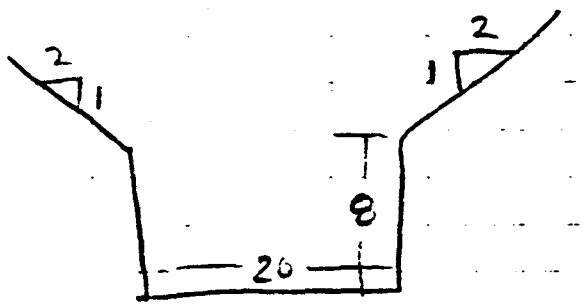
CLIENT USDA/SCS

PROJECT APACHE JCT. FLOODWAY

SUBJECT APACHE FLOODWAY RATING

20' WIDE RECTANGULAR, n=.015 8' DEEP
S=.001

H	A	WP	R	V	Q
1	20	22	.909	2.95	59
2	40	24	1.667	4.42	177
3	60	26	2.31	5.49	329
4	80	28	2.86	6.32	506
5	100	30	3.33	7.01	701
6	120	32	3.75	7.58	909
7	140	34	4.11	8.07	1130
8	160	36	4.44	8.49	1360
9	182	40	4.55	8.63	1570
10	206	44	4.68	8.80	1812



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501/8-81

DBA 4/30/85

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage APACHE JUNCTION FRS Area 6.15 mi² (km²) (prelim.)

Latitude 33° 27', Longitude 111° 31' of basin center

Month July

Step	Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16 12.65 in. (mm)						
2. Reduction for barrier-elevation [fig. 2.18] 80 %						
3. Barrier-elevation reduced PMP [step 1 X step 2] 10.12 in. (mm)						
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	76	90	96	100	111	115 %
5. Convergence PMP for indicated durations [steps 3 X 4]	7.69	9.11	9.72	10.12	11.23	11.64 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5]	7.69	1.42	.61	.40	1.11	.41 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]			100			%
8. Areally reduced PMP [step 6 X step 7]						in. (mm)
9. Drainage average PMP [accumulated values of step 8]	7.69	9.11	9.72	10.12	11.23	11.64 in. (mm)
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d. 4.5 in. (mm) REVISE						
2. Areal reduction [figure 3.20] 100 %						
3. Adjustment for month [one of figs. 3.12 to 3.17] 83 %						
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 3.74 in. (mm)						
5. Durational variation [table 39] ~~3.6~~	36	63	84	100	139	157 %
6. Orographic PMP for given durations [steps 4 X 5]	1.35	2.35	3.13	3.74	5.19	5.86 in. (mm)
C. Total PMP						
1. Add steps A9 and B6	9.0	11.5	12.8	13.9	16.4	17.5 in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

DJA 4/30/85

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage APACHE JUNCTION FRS

Latitude 33°27', Longitude 111°31' of basin center

Area 6.15 mi² (km²) (prelim.)

Month August

Step	Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16	14.0 in. (mm)					
2. Reduction for barrier-elevation [fig. 2.18]	80 %					
3. Barrier-elevation reduced PMP [step 1 X step 2]	11.2 in. (mm)					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	76	90	96	100	111	115 %
5. Convergence PMP for indicated durations [steps 3 X 4]	8.51	10.08	10.75	11.2	12.43	12.88 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5]	8.51	1.57	.67	.45	1.23	.45 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	—	—	100	—	—	— %
8. Areally reduced PMP [step 6 X step 7]	—	—	—	—	—	— in. (mm)
9. Drainage average PMP [accumulated values of step 8]	8.51	10.08	10.75	11.2	12.43	12.88 in. (mm)
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d.	4.5 in. (mm) REVISE					
2. Areal reduction [figure 3.20]	100 %					
3. Adjustment for month [one of figs. 3.12 to 3.17]	100 %					
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	4.5 in. (mm)					
5. Durational variation [table 39] ~~3.6~~	36	63	84	100	139	157 %
6. Orographic PMP for given durations [steps 4 X 5]	1.62	2.84	3.78	4.5	6.26	7.06 in. (mm)
C. Total PMP						
1. Add steps A9 and B6	10.1	12.9	14.5	15.7	18.7	19.9 in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

3
3

Dft 4/30/85

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage APACHE JUNCTION FRS Area 6.15 mi^2 (km^2) (prelim.)

Latitude 33°27', Longitude 111°31' of basin center

Month September

Step	Duration (hrs) 6	12	18	24	48	72	
A. Convergence PMP							
1. Drainage average value from one of figures 2.5 to 2.16	13.9 in. (mm)						August is greater
2. Reduction for barrier-elevation [fig. 2.18]	80 %						
3. Barrier-elevation reduced PMP [step 1 X step 2]	11.0 in. (mm)						
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].							%
5. Convergence PMP for indicated durations [steps 3 X 4]							in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]							in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]							%
8. Areally reduced PMP [step 6 X step 7]							in. (mm)
9. Drainage average PMP [accumulated values of step 8]							in. (mm)
B. Orographic PMP							
1. Drainage average orographic index from figure 3.11a to d.	4.5 in. (mm) REVISE						
2. Areal reduction [figure 3.20]	100 %						
3. Adjustment for month [one of figs. 3.12 to 3.17]	100 %						
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	4.5 in. (mm)						
5. Durational variation [table 39] ~~3.6~~							%
6. Orographic PMP for given durations [steps 4 X 5]							in. (mm)
C. Total PMP							
1. Add steps A9 and B6							in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

DJA 4/30/85

Table 6.3A.—Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required.

Drainage APACHE JUNCTION FRS Area 6.15 (prelim) mi^2 (km^2)
Latitude 33°27' Longitude 111°31' Minimum Elevation 1740 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi^2 (2.6-km^2) PMP for drainage [fig. 4.5]. 11.6 in. (mm)

2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

   b. Multiply step 1 by step 2a. 11.6 in. (mm)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.30

	Duration (hr)								
	1/4	1/2	3/4	1	2	3	4	5	6
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	74	89	95	100	114	121	125	128	130 %
5. 1-mi^2 (2.6-km^2) PMP for indicated durations [step 2b X step 4].	8.59	10.32	11.02	11.60	13.22	14.04	14.5	14.85	15.08 in. (mm)
6. Areal reduction [fig. 4.9].	80	84	86	87	89	90	90	90	91 %
7. Areal reduced PMP [steps 5 X 6].	6.9	8.7	9.5	10.1	11.8	12.6	13.1	13.4	13.7 in. (mm)
8. Incremental PMP [successive subtraction in step 7].				10.1	1.7	0.8	0.5	0.3	0.3 in. (mm)
	6.9	1.8	0.8	0.6	} 15-min. increments				
9. Time sequence of incremental PMP according to:									
Hourly increments [table 4.7].				0.3	0.8	10.1	1.7	0.5	0.3 in. (mm)
Four largest 15-min. increments [table 4.8].	6.9	1.8	0.8	0.6					in. (mm)

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PROJECT APACHE JCT. FRS

SUBJECT 100-year, 25-year PRECIPITATION

24-HOUR PRECIPITATION

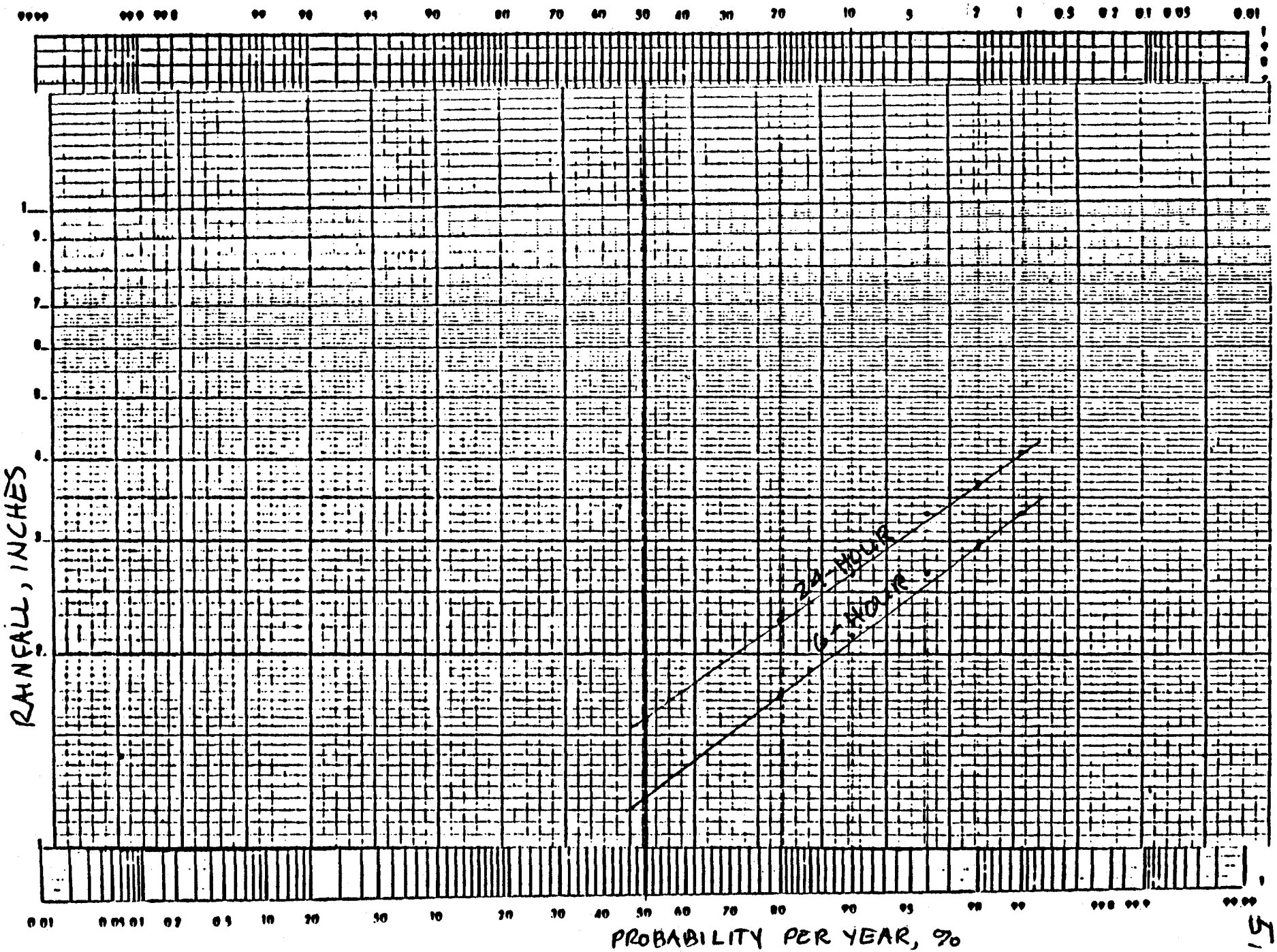
Return Period, yr.	Map Value, in.*	Factor**	Plotted Value, in.	Curve Value, in. (NEXT PAGE)
100	4.10	1	4.10	4.10
50	3.65	1	3.65	3.65
25	3.30	1	3.30	3.20
10	2.70	.99	2.67	2.67
5	2.35	.96	2.26	2.24
2	1.80	.88	1.58	1.58

6-HOUR PRECIPITATION

100	3.30	1	3.30	3.30
50	2.95	1	2.95	2.95
25	2.65	1	2.65	2.55
10	2.15	.99	2.13	2.10
5	1.82	.96	1.75	1.75
2	1.35	.88	1.19	1.20

* SOURCE: NOAA ATLAS 2, VOLUME VIII

** SOURCE: TSC TECHNICAL NOTE PO-6


Probability (Long-axis) by 3 Cycle Log
K+E SEMI-LOGARITHMIC 47 4970
RAINFALL, INCHES
24-HOUR
6-HOUR
PROBABILITY PER YEAR, %

III 0-22

5

6

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BY D. A DATE 5/2/85 SHEET 2 OF 4

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PROJECT APACHE JCT. FRS

SUBJECT 10-day, 25 + 100-yr precipitation

From TSC NOTE PO-6 (Rev. 2)

1. Select 2-yr. 6+24 hr precip. from NOAA Atlas 2

   2-yr 6 hr. = 1.35 in.
   2-yr 24 hr. = 1.8 in.

2. Region 7 from Fig. B-1

3 Estimate 2-yr 1-hr. precip. from Eq. 7 in Table B-1

$$= -.011 + .942\left(\frac{1.35^2}{1.8}\right) = 0.94 \text{ in.}$$

4. 2-yr 10-day from Fig. B-2 = 2.8 in.

5. $\frac{100\text{-yr}}{2\text{-yr}}$ 10-day from Fig. B-3 = 2.62

6. 100-yr 10-day = 2.62 x 2.8 = 7.34 in.

7. 2.8 x 0.88 = 2.46 in. (converted from partial to annual scr.)
   (2 yr 10-day

8 25-yr value from probability plot: 5.8 in.

D.A. <10 sq. mi, no areal adjustment

Precip. by day, in.	25-yr		100-yr	
1	~~3.1~~ 3.2	~~3.1~~ 3.2	4.1	4.1
2	3.6	~~0.5~~ 0.4	4.8	0.7
3	4.0	0.4	5.25	0.45
4	4.4	0.4	5.7	0.45
5	4.7	0.3	6.0	0.3
6	4.95	0.25	6.3	0.3
7	5.2	0.25	6.6	0.3
8	5.4	0.2	6.85	0.25
9	5.6	0.2	7.1	0.25
10	5.8	0.2	7.3	0.2

$E_{24}(6\ h.) = P_{100} \times .25(P_{24}-P_{100})$
$= 3.3 + .26(3.7-3.3)$
$= 6.00$ in

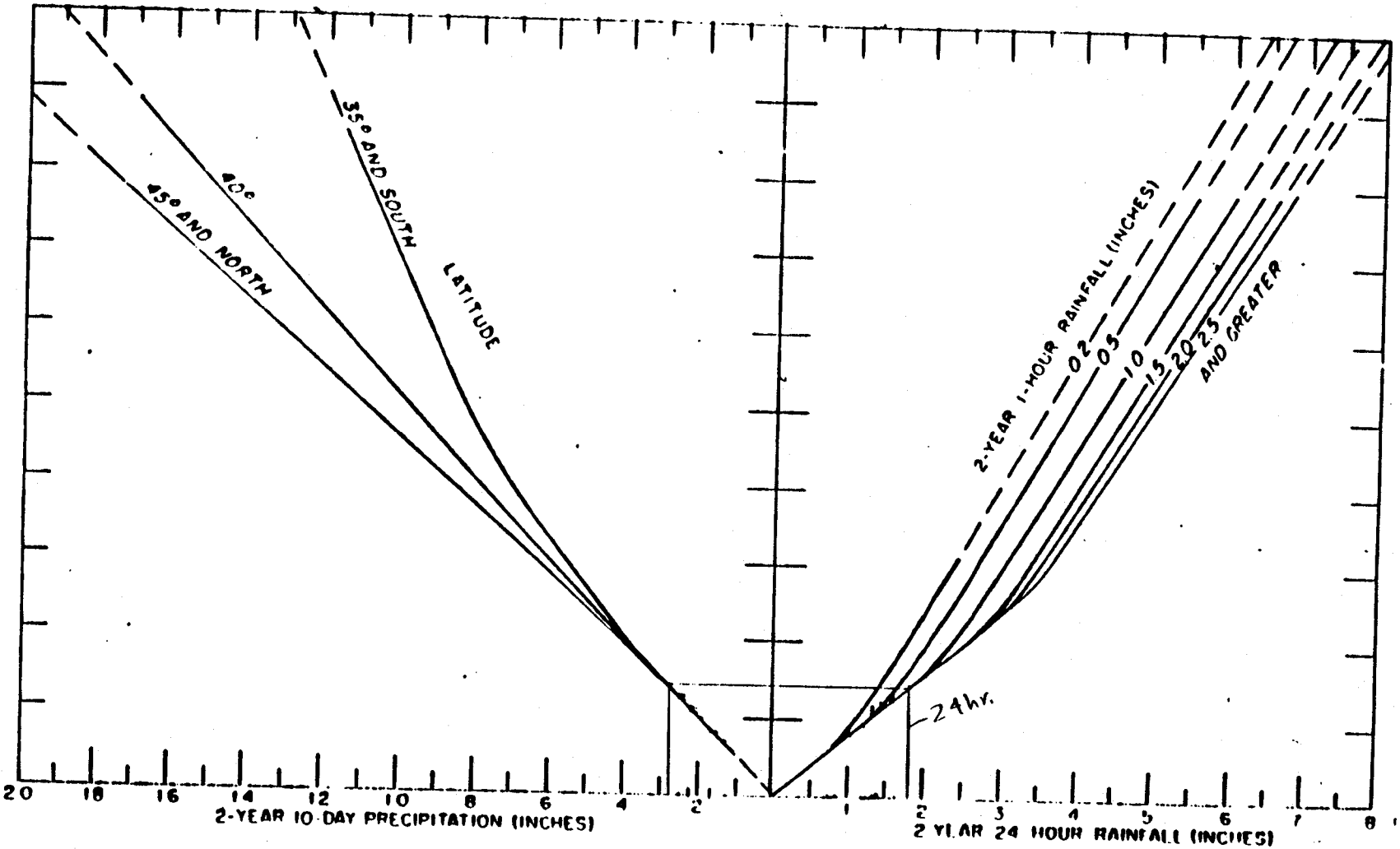


FIGURE B-2 — Relation for estimating 2-year 10-day precipitation from 2-year 1- and 24-hour rainfall and latitude

BH 5/2/85

3/4

8

DH 5/2/85

4/4

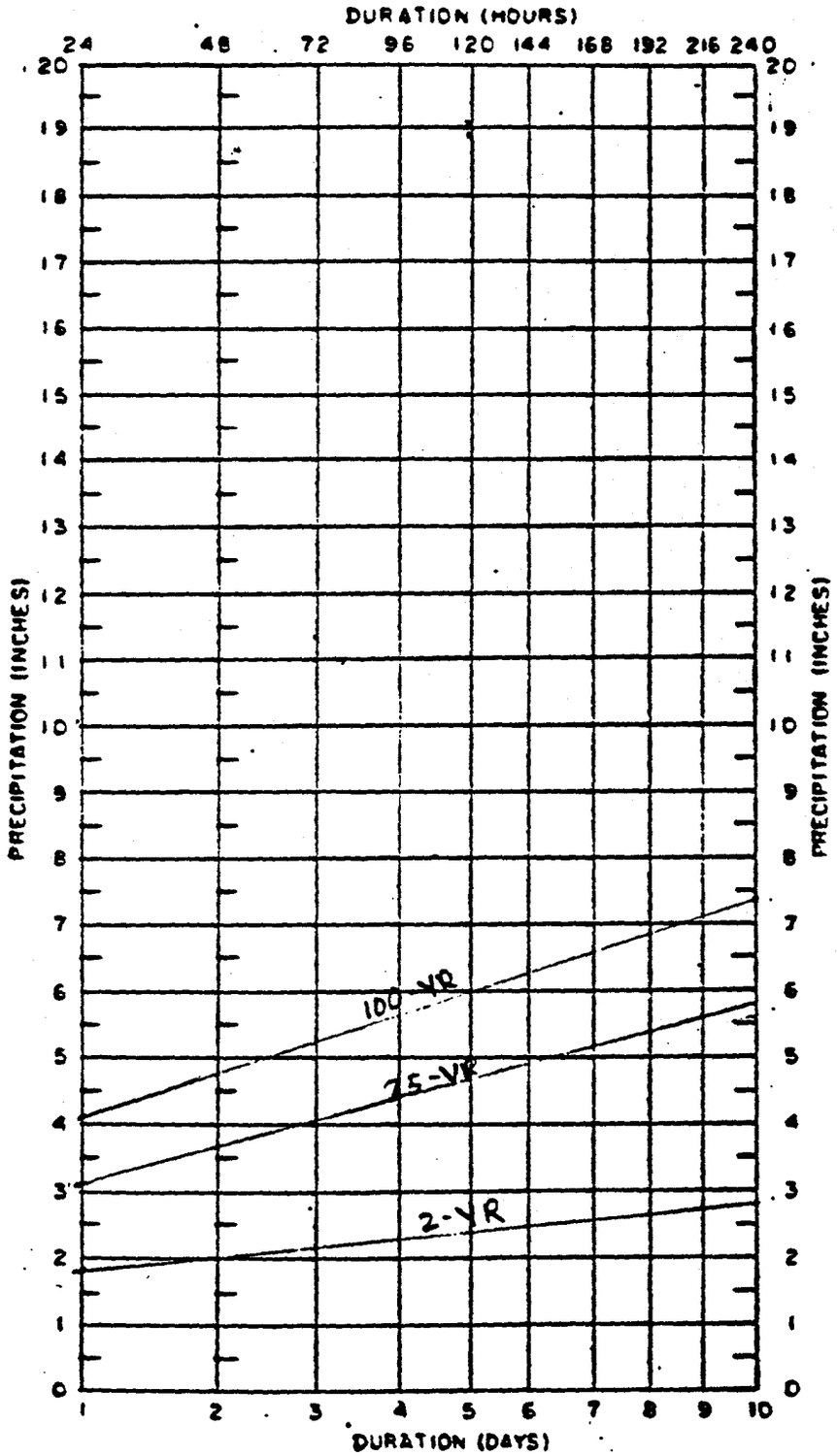
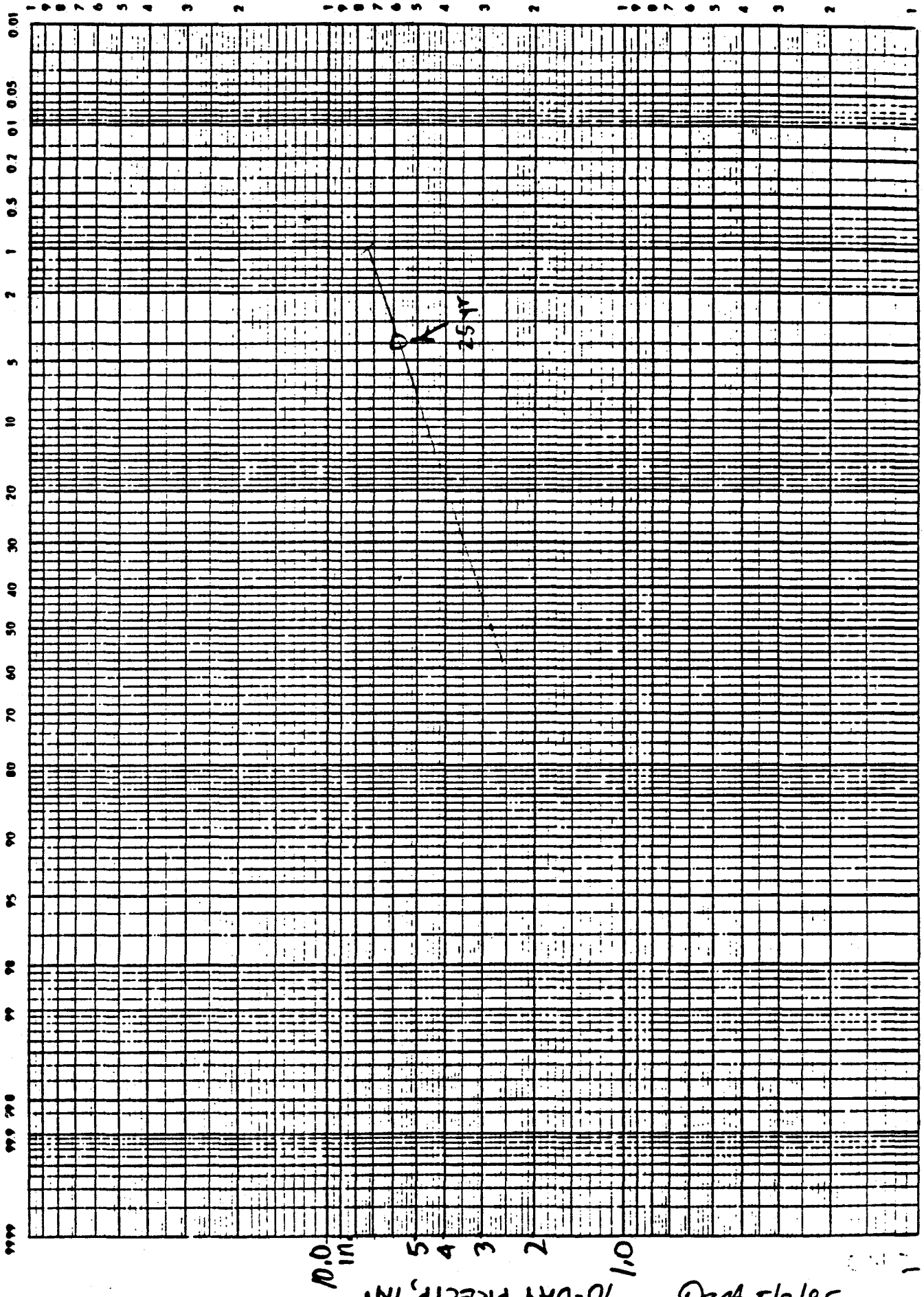


FIGURE B-4 – Duration-interpolation diagram

III C-25

Probability (Long-axis) by 3 Cycle Log



DBA 5/2/85

GRAPH PAPER From Your COPIER—HPBooks

III C-26

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PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASIN AND SUB-BASINS

The drainage basin and sub-basins tributary to the Apache Junction Floodway and FRS were determined using both the USGS Apache Junction quadrangle map and aerial photographs N-23 and N-24 taken on 12/7/83 (N-24) and 3/4/85 (N-23). The photos were used to determine the paths of the dry channels, and the USGS map to locate topographic divides. There are a number of locations where flows coming down may divide into different channels. These are of minor importance when both routes enter the flood pool, but are more important when one route goes to the pool and the other goes to the floodway. This is the case with sub-basin 1A (see map, sheet 4 of). The maximum volume from sub-basin 1A likely to enter the floodway is estimated to be 70% of the total. Drainage areas are planimetered on the USGS map and summarized on sheet 2.

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PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS AND SUBBASINS

SUMMARY

No.	Description	D.A, sq. mi.	~~Tc, hr.~~	~~CN~~
1.	Tributary to Floodway	1.86	~~0.04~~	
1A.	Flow divides at downstream end of basin, up to 70% to Floodway (1B); the rest to FRS (1C).	0.74 (actual) 0.0 (effective)	—	—
1B.	Tributary to Floodway. Receives up to 70% of flow from 1A. (.7 x .74) + .25 = .768	0.25 (actual) 0.77 (effective) ~~0.67~~		
1C.	Tributary to FRS east of Brown Road. Receives an assumed 30% of inflow from 1A. (.3 x .74) + .53 = .752	0.53 (actual) 0.75 (effective) ~~0.70~~		
2.	Tributary to FRS between Idaho Rd + Brown Rd.	0.67 ~~0.41~~		
3.	Tributary to FRS west of Idaho Rd. May receive flow from 3A.	1.67 ~~(actual)~~ ~~1.74 (effective)~~ ~~0.72~~		
3A.	Flow divides at downstream end; up to 40% to FRS (3), the rest to Bulldog Floodway. Area previously included in Bulldog Floodway basin.	0.17 (actual) 0.07 (effective)		
	Total	5.79		

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PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - AREAS

Planimeter Calibration (Map scale 1:24000)

1 square mile reads ~~0.468~~, 0.465, 0.465, 0.465

To convert reading to sq. mi, divide by 0.465

Total drainage basin (not including 3A)

2.661, 2.659 = $\frac{2.660}{.465}$ = 5.720 sq.mi.

Subbasin 1

.861, .860 use $\frac{.860}{.465}$ = 1.849 sq.mi.
adjusted = 1.859

Subbasin 1A

.338, .344, .340 use $\frac{.341}{.465}$ = 0.733 sq.mi.
adj. = .737

Subbasin 1B

.116, $\frac{.116}{.465}$ = 0.249 sq.mi.
adj. = .250

Subbasin 1C

.248, .246 use $\frac{.247}{.465}$ = 0.531 sq.mi.
adj. = .534

Subbasin 2

.310, .312 use $\frac{.311}{.465}$ = 0.669 sq. mi
adj. = .673

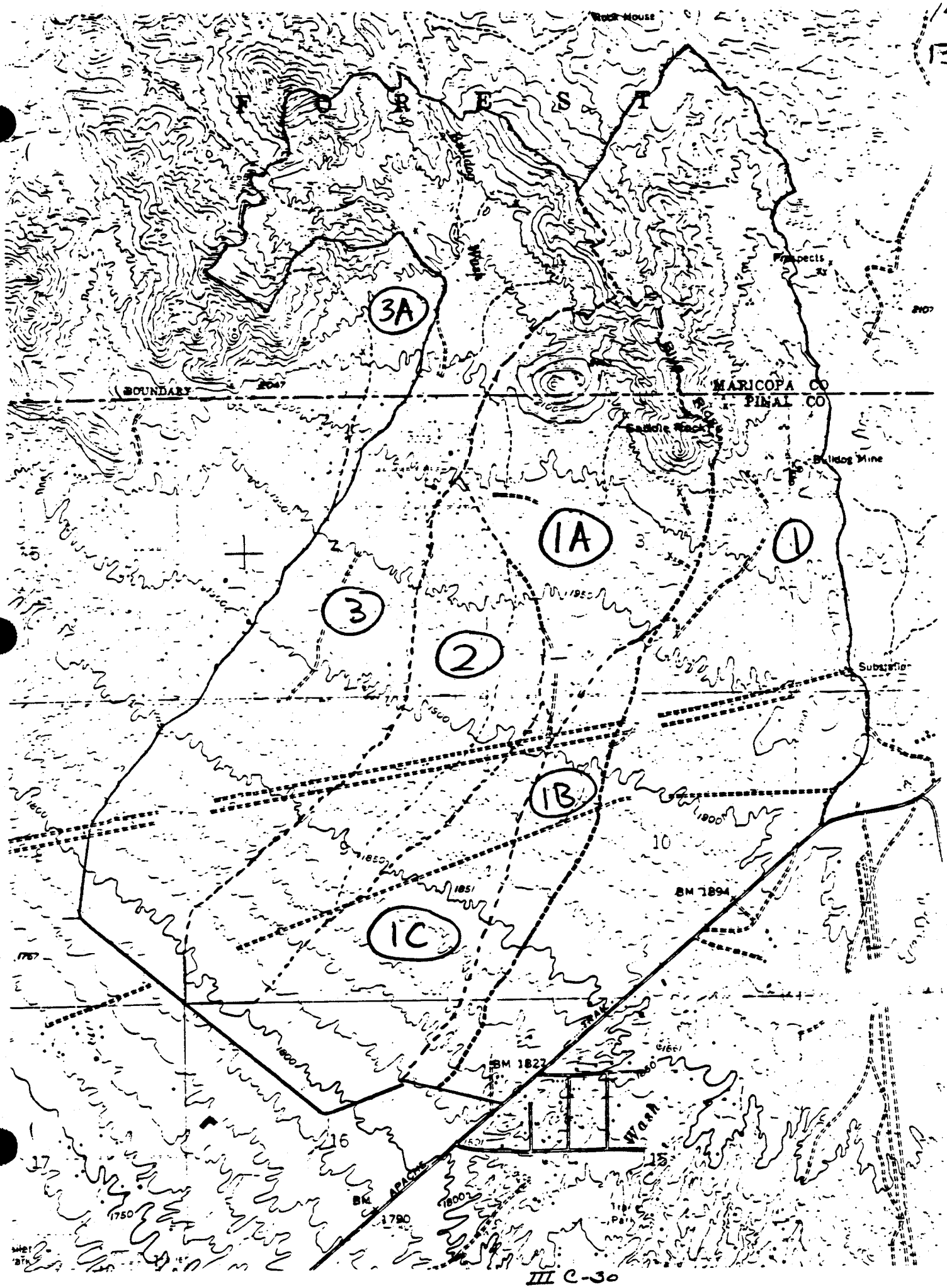
Subbasin 3

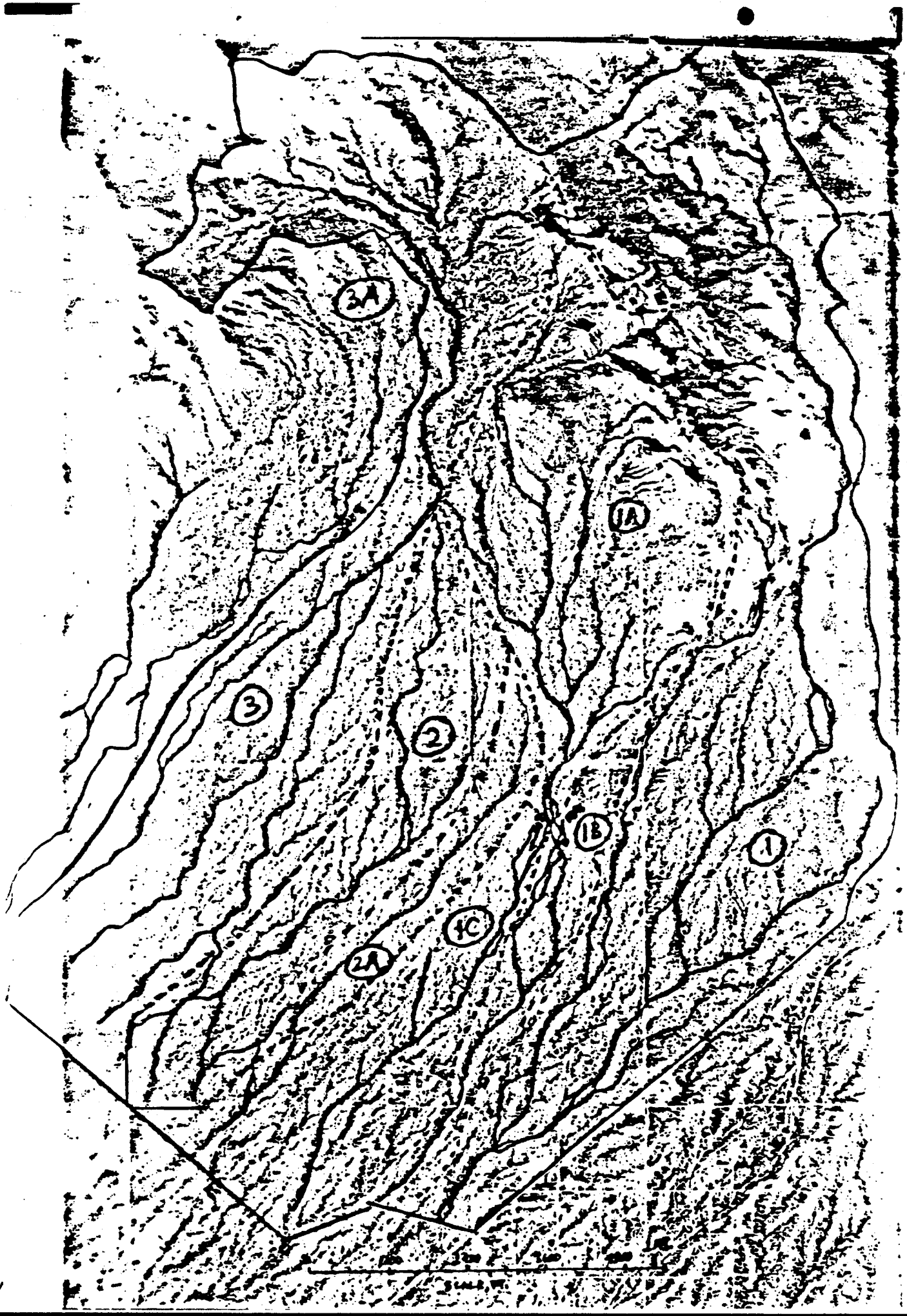
.771, .770 use $\frac{.771}{.465}$ = 1.658 sq.mi.
adj. = 1.667

Total (to check) = 5.689 <1% error
proportion 0.031 sq.mi. to all above (adj.)

Subbasin 3A

.078, .080 use $\frac{.079}{.465}$ = .170 sq.mi.


F O R E S T
Rock House
Bulldog
Wash
Prospects
3A
BOUNDARY
MARICOPA CO
PINAL CO
Saddle Rock
Bulldog Mine
1A
1
3
2
Substation
1B
1C
BM 1894
BM 1823
TRAIL
Wash
APACHE
BM
1790
16
17
15


3A
1A
3
2
1B
1
1C
2A

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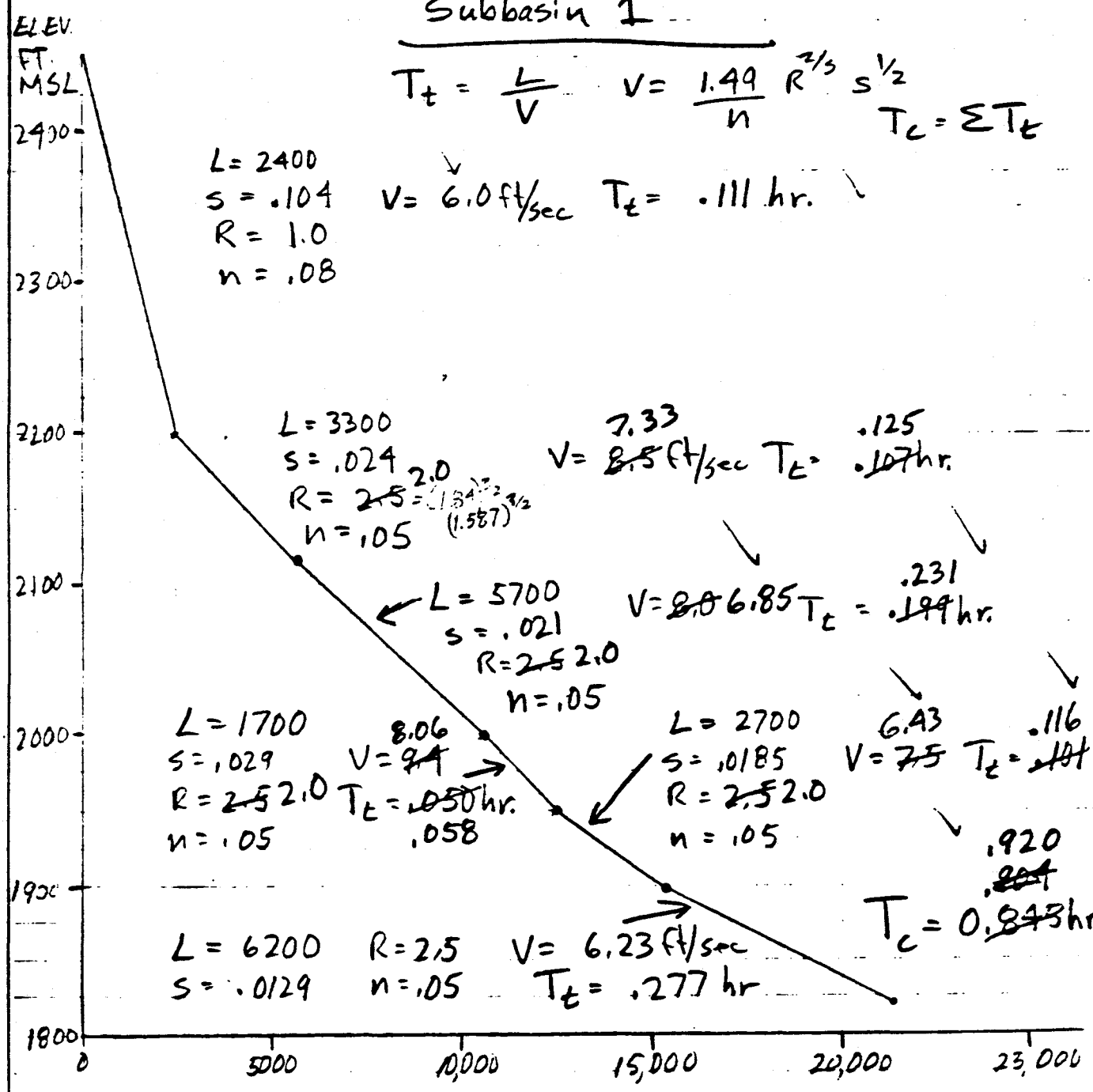
PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - T_c's

Subbasin 1

$T_t = \frac{L}{V}$ $V = \frac{1.49}{n} R^{2/3} s^{1/2}$ $T_c = \Sigma T_t$



$L = 2400$, $s = .104$, $R = 1.0$, $n = .08$ $V = 6.0$ ft/sec $T_t = .111$ hr.

$L = 3300$, $s = .024$, $R = \cancel{2.5}\ 2.0 = (1.54)^{2/3}$ $(1.587)^{3/2}$, $n = .05$ $V = \cancel{8.5}\ 7.33$ ft/sec $T_t = \cancel{.107}\ .125$ hr.

$L = 5700$, $s = .021$, $R = \cancel{2.5}\ 2.0$, $n = .05$ $V = \cancel{8.0}\ 6.85$ $T_t = \cancel{.199}\ .231$ hr.

$L = 1700$, $s = .029$, $R = \cancel{2.5}\ 2.0$, $n = .05$ $V = \cancel{9.4}\ 8.06$ $T_t = \cancel{.050}\ .058$ hr.

$L = 2700$, $s = .0185$, $R = \cancel{2.5}\ 2.0$, $n = .05$ $V = \cancel{7.5}\ 6.43$ $T_t = \cancel{.101}\ .116$

$L = 6200$, $s = .0129$, $R = 2.5$, $n = .05$ $V = 6.23$ ft/sec $T_t = .277$ hr

$T_c = 0.\cancel{843}\ \cancel{.804}\ .920$ hr.

Note: Manning's n's were taken from figure, "Manning's n vs. Slope" in Signal Butte Design Hydrology. R-values were assumed similar depending on slope.

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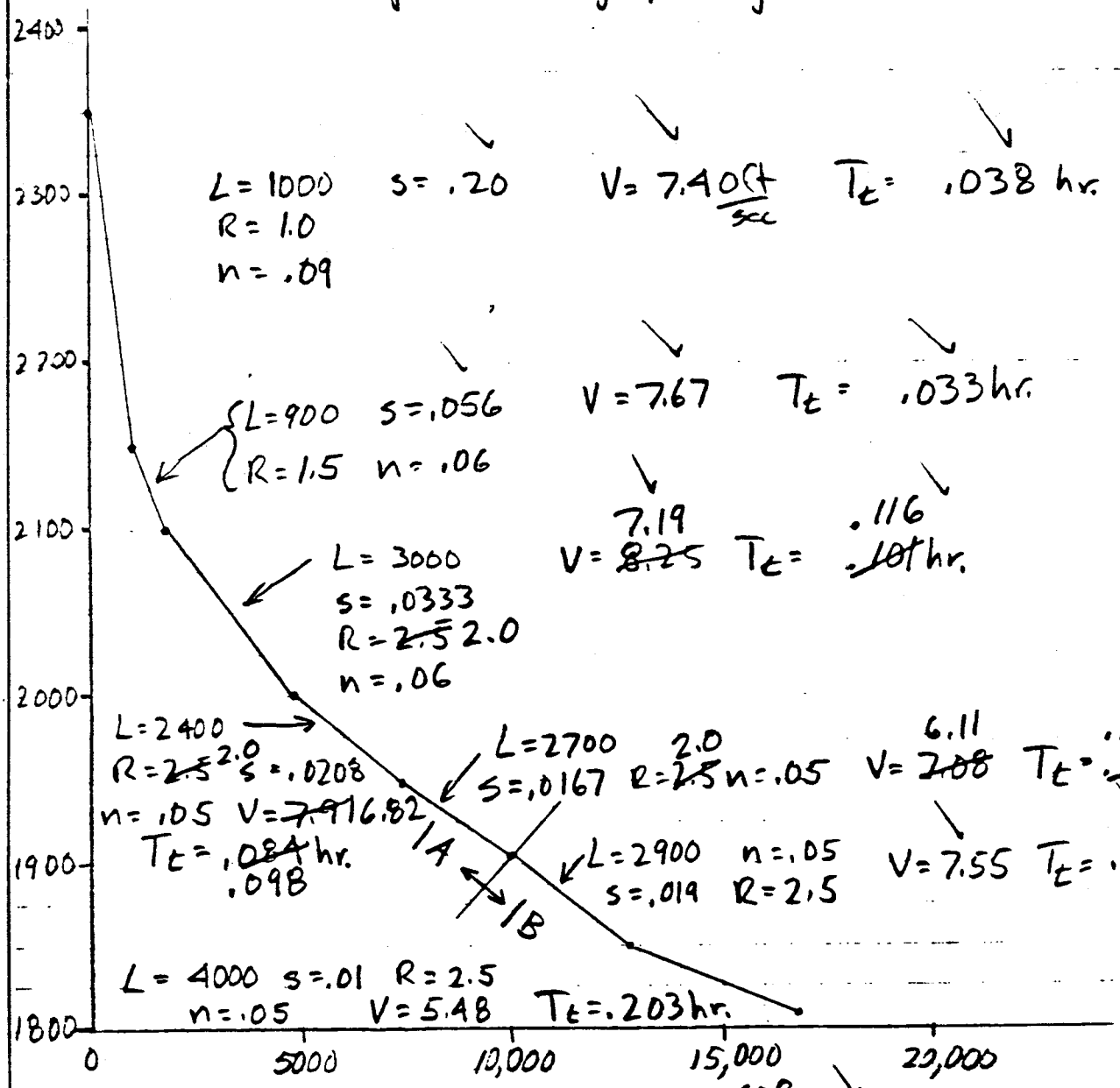
PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - T_c's

Subbasin 1A+1B

(Note: longest drainage path goes west of 2307' peak)



$L = 1000$ $s = .20$ $V = 7.40 \frac{ft}{sec}$ $T_t = .038$ hr.
$R = 1.0$
$n = .09$

$L = 900$ $s = .056$ $V = 7.67$ $T_t = .033$ hr.
$R = 1.5$ $n = .06$

$L = 3000$ $V = \cancel{8.25}\ 7.19$ $T_t = \cancel{.101}\ .116$ hr.
$s = .0333$
$R = \cancel{2.5}\ 2.0$
$n = .06$

$L = 2400$
$R = \cancel{2.5}\ 2.0$ $s = .0208$
$n = .05$ $V = \cancel{7.91}\ 6.82$
$T_t = \cancel{.084}\ .098$ hr.

$L = 2700$ $R = \cancel{2.5}\ 2.0$ $n = .05$ $V = \cancel{7.08}\ 6.11$ $T_t = \cancel{.106}\ .123$ hr
$s = .0167$

$L = 2900$ $n = .05$ $V = 7.55$ $T_t = .107$ hr.
$s = .019$ $R = 2.5$

$L = 4000$ $s = .01$ $R = 2.5$
$n = .05$ $V = 5.48$ $T_t = .203$ hr.

T_t (1A) = $\cancel{.362}$ .408 hr.

T_t (1B) = .310 T_c (1A+1B) = $\cancel{.672}$ .718 hr.

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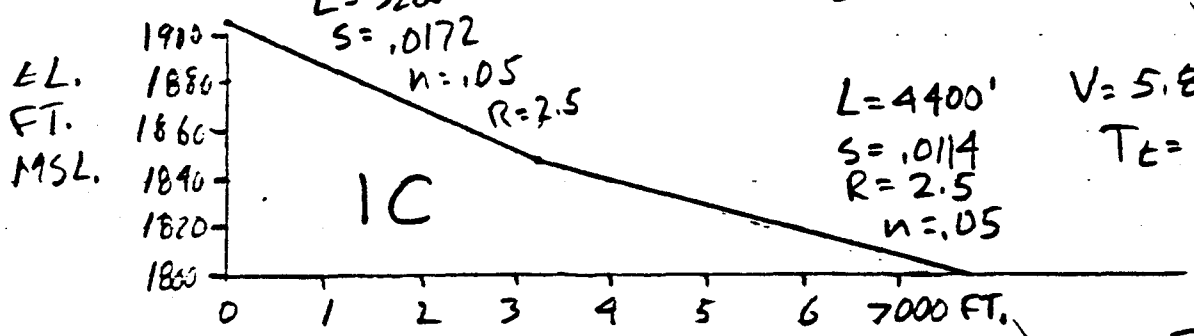
PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - T_c's

Subbasin 1A + 1C

$T_t(1A) = \cancel{.362}$ hr .908

V = 7.19 T_t = .124 hr

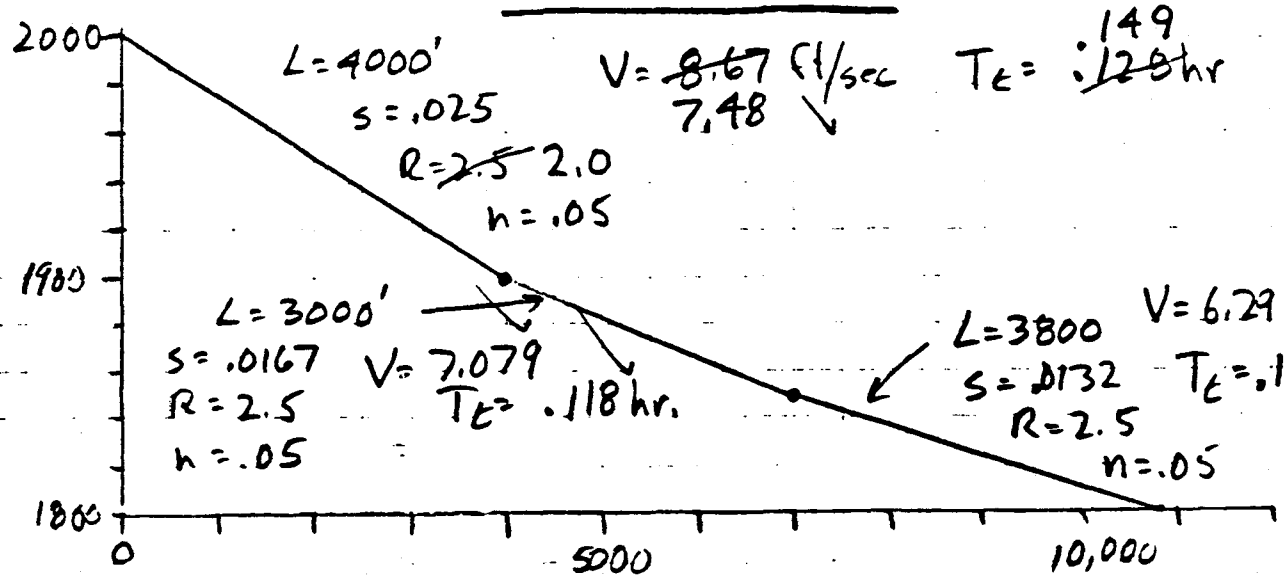


L = 4400'
s = .0114
R = 2.5
n = .05

V = 5.845
T_t = .209 hr

$T_c = T_t(1A) + T_t(1C) = \cancel{.362}\ .908 + .333 = \cancel{.695}\ .741$ hr

Subbasin 2



L = 4000'
s = .025
R = ~~2.5~~ 2.0
n = .05

V = ~~8.67~~ 7.48 ft/sec T_t = ~~.128~~ .149 hr

L = 3000'
s = .0167
R = 2.5
n = .05

V = 7.079
T_t = .118 hr.

L = 3800
s = .0132
R = 2.5
n = .05

V = 6.29
T_t = .168 hr

T_c = 0.~~414~~ .435 hr.

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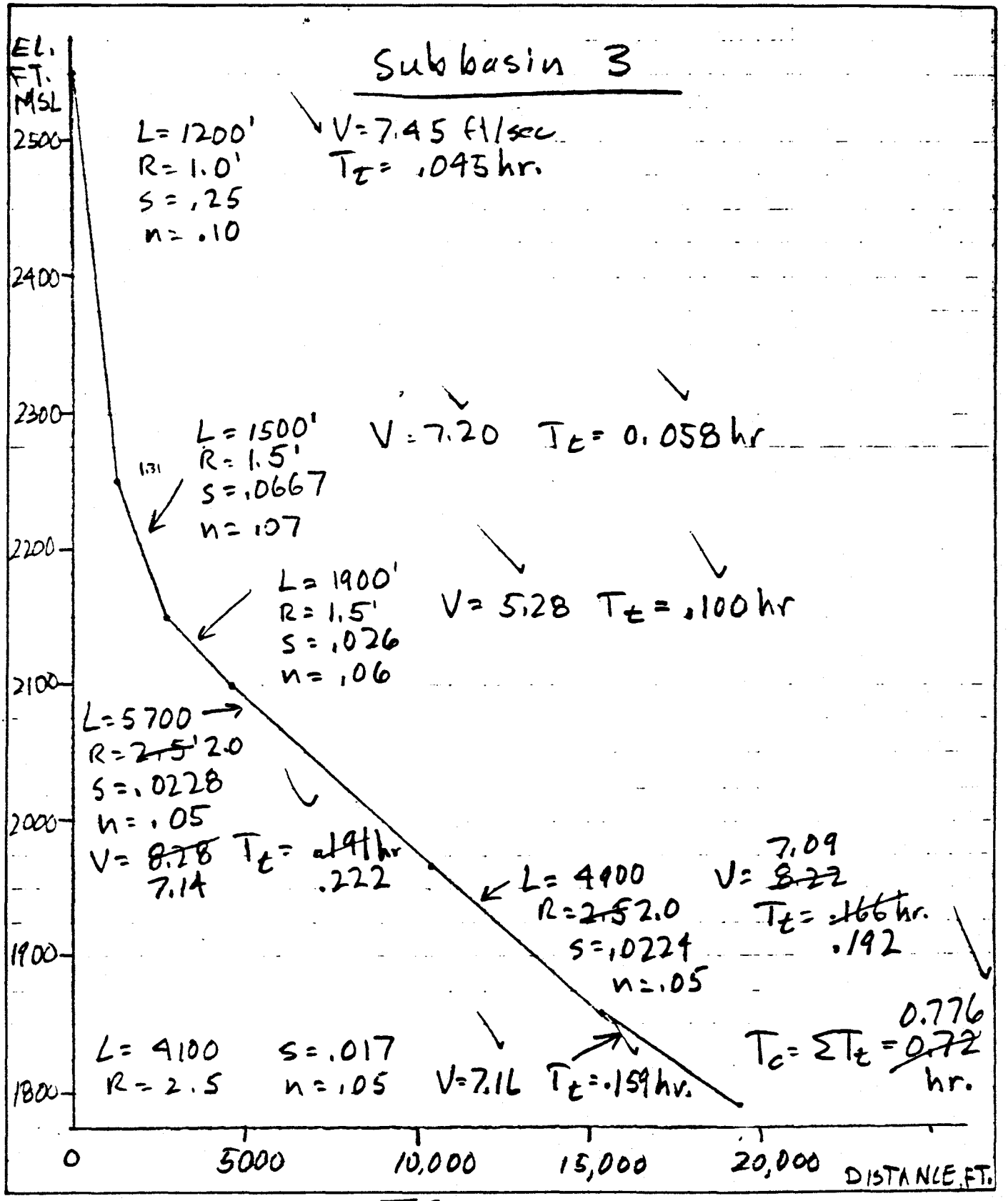
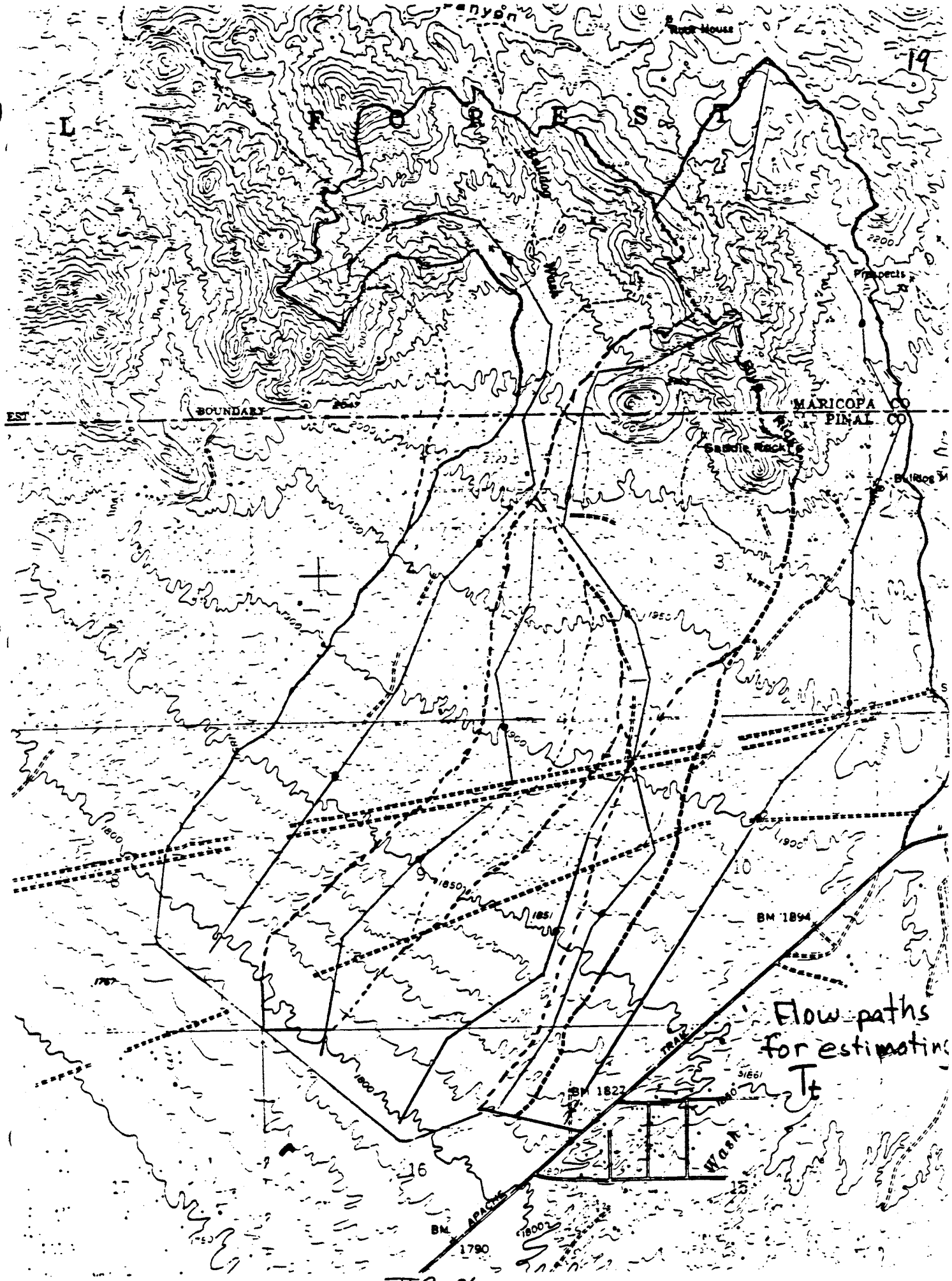
SUBJECT DRAINAGE BASINS- T_c's



581/8-81


19
L F O R E S T
Rock House
Prospects
BOUNDARY
MARICOPA CO
PINAL CO
Saddle Rock
BM 1894
BM 1822
BM 1790
APACHE TRAIL
Wash
Flow paths for estimating T_t

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PROJECT APACHE JCT. FRS
SUBJECT DRAINAGE BASINS – SOIL CLASSIFICATION/SHORT DUR. CN'S

	Name	Class
1E	Antho-Carrizo-Maripo Complex	30% A and 60% B
22	Ebon 0-8%	C
23	Gunsight-Toltec	B-C ? 45-Gst. 40% Toltec call it 65-45
29D	Pinant-Tremant	B-B
29E	Tremant-Gunsight-Rillito Complex	B-B-B
31	Gran-Rock	D
G1	Gran outcrop 10-90%	D
GP	"Gravel pit"	treat as 22-C - not deep

Sub-basin 1

Code	Planimeter	Area	% of Total	Class
29D	.291, .291	.626	34	B
22	.298, .310	.634	34	C
31	.026, .026	.056	3	D
1E	.08, .08	.017	1	B
29E	.01, .01	.022	1	B
~~GP~~ (22)				
G1	—	.504	27	D

(assume all unidentified area is G1)

Short duration Curve Numbers, Desert brush, 15% cover } B: 83, C: 89, D: 92

SDCN for Subbasin 1

$= (.34 + .03)\,83 + .34(89) + .\cancel{29}\,.30\,(92) = 88$

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BY DJM DATE 3/9/85 SHEET 2 OF 4
CHKD. BY [illegible] DATE 5/08 OFS NO. DEPT. NO.
CLIENT USDA/SCS
PROJECT APACHE JCT. FRS
SUBJECT DRAINAGE BASINS - SHORT DURATION CN's

Sub basin 1A - area 0.737 sq. mi. CN: B - 83
C - 89
D - 92

Code	Planimeter	Area	%	Class	
1E	.005, .005	.011	1.5	B	
29D	.098, .100	.215	29%	B	SDCN = 88
22	.098, .100	.215	29%	C	
G1	—	.292	40.5	D	

Subbasin 1B Area = .25 sq. mi.

1E	.08, .08	.017	7	B	SDCN = 83
29D	—	.233	93	B	

Subbasin 1C 1E - B 29D - B SDCN = 83

Subbasin 2

29D - B; 29E - B, 1E - B SDCN = 83

Subbasin 3 Area = 1.667 sq. mi.

29D }	~~.374~~, .390, .392	.841	50%	B	
1E }				B	
22-23	~~.094~~, .092, .093	.20	12%	C	SDCN = 87
G1	—	.626	38%		

(assume all unidentified area is G1

3A - mostly off soil map - assume same as 3: SDCN = 87

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BY D.H. DATE 5/10/85 SHEET 3 OF 1

CHKD. BY [illegible] DATE 5/10/85 OFS NO. 3767.100 DEPT. NO. 930

CLIENT USDA/SCS

PROJECT APACHE JUNCTION FRS

SUBJECT DRAINAGE BASINS- ADJUSTMENTS TO SDCN'S, T_c'S

CURVE NUMBERS

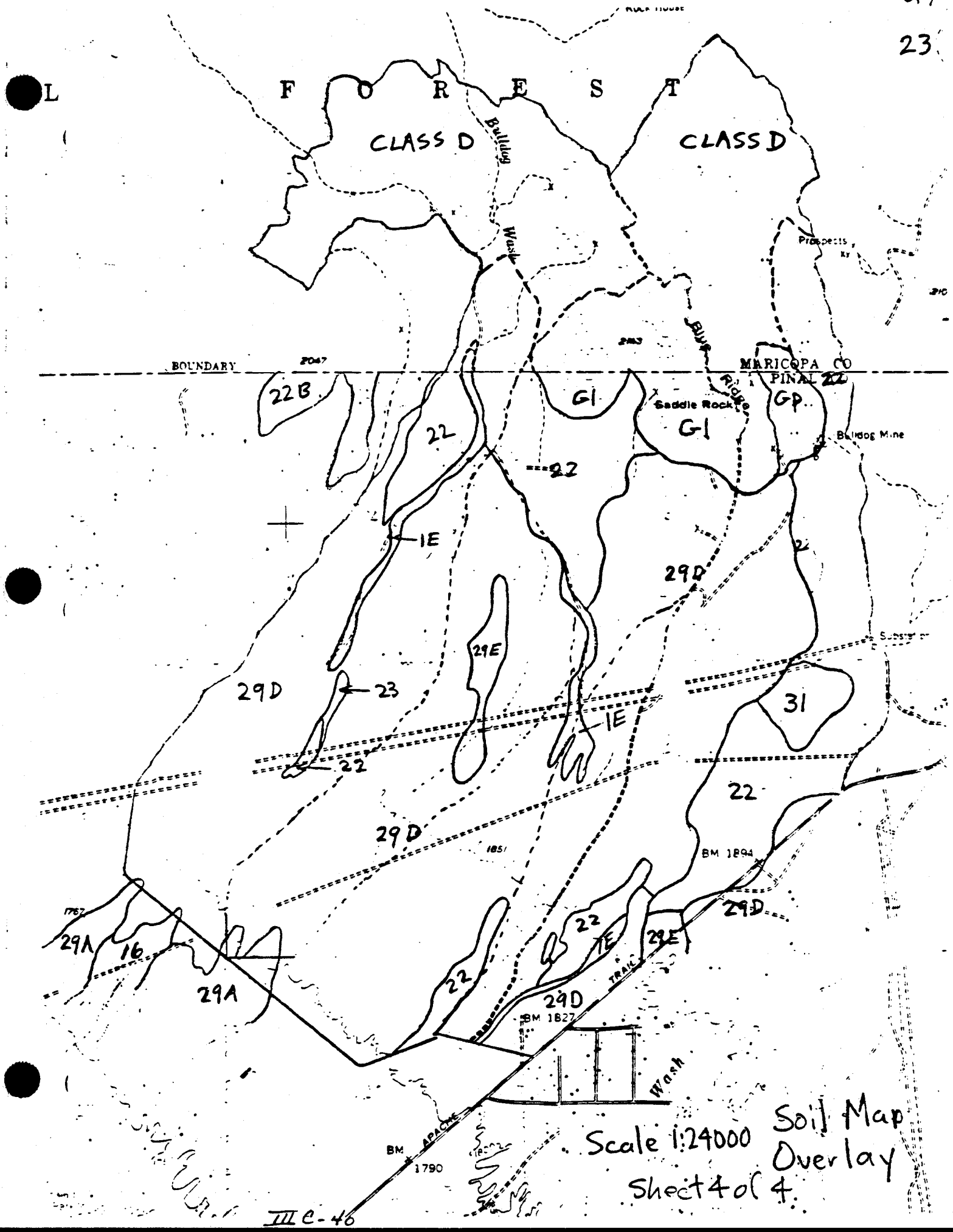
SUB BASIN	SDCN	FUTURE SDCN[1]	6-HR CN[2]	24 HR CN[2]	10-DAY CN[3]
1	88	89	84	80	65
0.7(1A) +1B	86	87	81	78	62
0.3(1A) +1C	85	86	80	77	61
2	83	84	77	74	57
3	87	88	82	79	64
3A	87	88	82	79	64

[1] TR55 FIG. 2-2, DEVELOPMENT OF >1 ACRE PLOTS, 10% IMPERVIOUS
[2] WOODWARD, 1973, FIG. 4
[3] NEH-4, TABLE 21.2 (TR-60 TABLE 2-3)

Concentration Times

SUB-BASIN	PRESENT T_c, HR.	CHANNEL MOD. FACTOR,[4] %	IMPERV.[5] %	FUTURE T_c, HR
1	~~0.84~~ ~~.804~~ .920	94	95	.82 ~~.75~~
0.7(1A)+1B	0.~~67~~ .718	93	95	.63 .59
0.3(1A) +1C	0.~~70~~ .741	93	95	.65 ~~.62~~
2	0.~~41~~ ~~.40~~ .435	92	95	.38 .36
3	0.~~72~~ .776	93	95	.69 .64
~~3A~~				

[4] FROM TR-55, FIG. 3.4, ASSUMING 15% CHANNEL MODIFICATION BASED ON >1 ACRE PLOTS
[5] FROM TR-55, FIG. 3.5, 10% IMPERVIOUS



Scale 1:24000

Soil Map Overlay

Sheet 4 of 4.

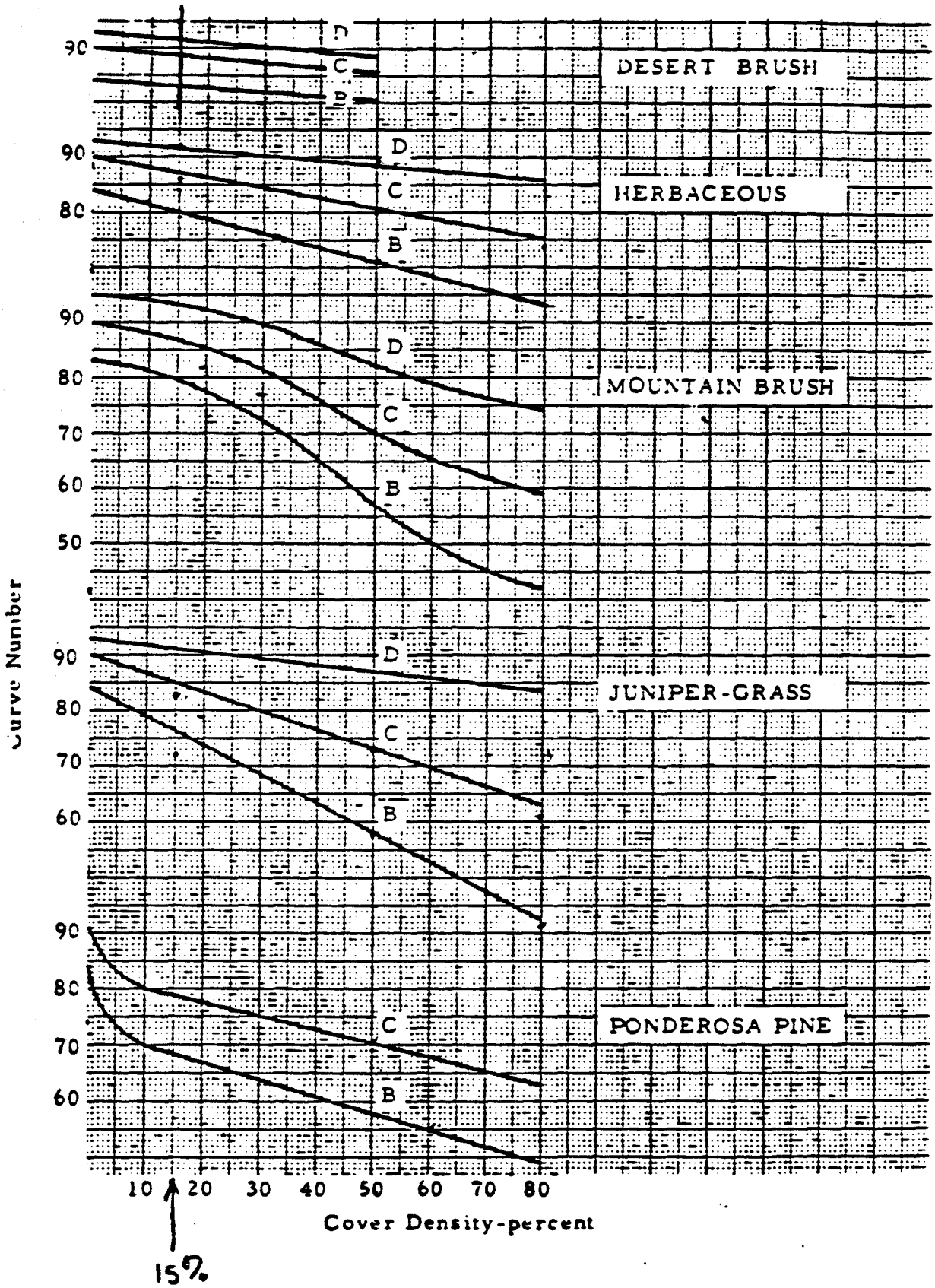


Fig. 10

HYDROLOGIC SOIL - COVER COMPLEXES
AND ASSOCIATED CURVE NUMBERS

Soil Conservation Service

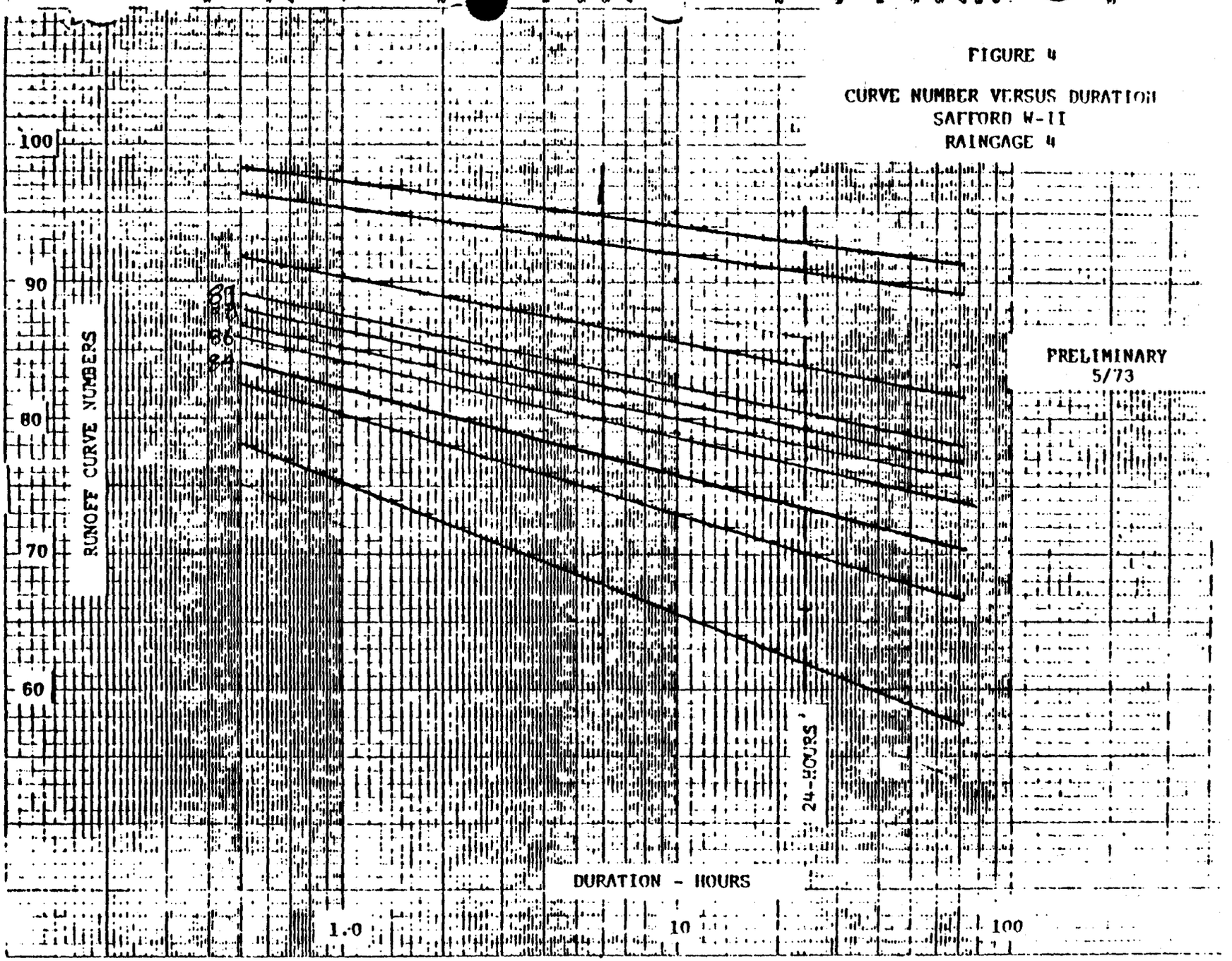


FIGURE 4

CURVE NUMBER VERSUS DURATION
SAFFORD W-II
RAINGAGE 4

III C-42

26

25

EBASCO SERVICES INCORPORATED

BY D.H. DATE 3/24/85 SHEET 1 OF 2

CHKD. BY S DATE 5/85 OFS NO. DEPT. NO.

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

SUBJECT CHANNEL LOSS FACTORS - CLIMATIC INDEX

Climatic Index $CI = \frac{100 P_a}{(T_a)^2}$

From telephone conversation with NWS Phoenix, 5/21/85
602-261-4000

Phoenix, Annual Precipitation 7.11 in.

Annual Temperature 85.1 Daily High
57.3 Daily low

$CI = \frac{100(7.11)}{\left(\frac{85+57}{2}\right)^2} = 0.14$ use 0.4 minimum

581/8-81

EBASCO SERVICES INCORPORATED

BY DeA DATE 5/29/85 SHEET 2 OF 2
CHKD. BY [illegible] DATE 5/30/85 OFS NO. DEPT. NO.
CLIENT USDA/SCS
PROJECT APACHE JCT. FRS
SUBJECT MODIFIED CHANNEL LOSS FACTORS

Climatic Index = 0.4
Subbasin 1 - D.A. = 1.86 - .8882 from NEH-4, Table 21.3

Modification re TSC TECHNICAL NOTE PO-4

Soil Groups: 36% B
34% C from Sheet 1 of 4
30% D

Modified Channel Loss Factor = (.36)(1 - .75(1 - .8882)) = .330 (.916)
+ (.34)(1 - .50(1 - .8882)) = .321 (.944)
+ (.30)(1 - .25(1 - .8882)) = .292 (.972)
.943

Subbasin 3 - D.A. 1.74 - .9038 from NEH4, TABLE 21.3

Soil Groups: 50% B
12% C
38% D

M.C.L.F. = (.5)(1 - .75(1 - .9038)) = .464 (.928)
(.12)(1 - .50(1 - .9038)) = .114 (.952)
(.38)(1 - .25(1 - .9038)) = .371 (.976)
.949

581/8-81

EBASCO SERVICES INCORPORATED

BY D.A. DATE 5/29/85 SHEET ____ OF ____

CHKD. BY S DATE 5/8C OFS NO. ____ DEPT. NO. ____

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

SUBJECT RUNOFF VOLUMES FOR "QDIRECT"

Subbasin	1	1A+1B	1A+1C	2	3
SDCN	88	86	85	83	87
D.A.	1.86	.77	.75	.67	1.74
CHANNEL LOSS FACT.[1]	.943	1	1	1	.949
Rainfall: (inches) PMP	13.7	100-YR, 24 HR		4.1	25-YR ~~3.1~~ 3.2
ESH	6.0	10-DAY		7.3	5.8
6-HR. CN	84	81	80	77	82
RUNOFF[2] (in.)					
PMP	11.66 ~~11.00~~	11.23	11.11	10.67	11.37 ~~10.79~~
ESH	~~3.96~~ 4.20	3.88	3.78	3.48	3.78
24-HR CN	80	78	77	74	79
RUNOFF[2] (in.)					
100-YR	2.00	1.97	1.89	1.68	1.94
25-YR	~~1.25~~ 1.32	~~1.20~~ 1.27	~~1.14~~ 1.21	~~0.97~~ 1.04	~~1.20~~ 1.27
10-DAY CN	65	62	61	57	64
RUNOFF[2] (in.)					
100-YR	3.14	3.02	2.91	2.51	3.07
25-YR	2.07	1.95	1.87	1.55	2.01

[1] MODIFIED LOSS FACTOR FROM PREVIOUS PAGE AND TSC PO-4 APPLIED ONLY TO PSH

[2] FROM TR No. 16 ~~(times Mod. C.L.F. for PSH)~~ (times Modified C.L.F. for 25-yr and PSH)

581/8-81

EBASCO SERVICES INCORPORATED

BY D.M. DATE 5/29/85 SHEET 1 OF 2

CHKD. BY [illegible] DATE 5/[illegible] OFS NO. DEPT. NO.

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

SUBJECT PMP DISTRIBUTIONS

6-HOUR				24 hr (from following page)		
	Hmr-3	in/hr	Dimensionless, cumulative	hour		
1st hr.	0.3	.075	.005	0	0	0
		.075	.011	1	~~.015~~	.012
		.075	.0164	2	~~.03~~	.025
		.075	.0219	3	~~.038~~	.038
2nd	0.8	.2	.036	4	~~.06~~	.053
		.2	.051	5	~~.075~~	.07
		.2	.066	6	.09	.088
		.2	.080	7	~~.105~~	.104
3rd	6.9	6.9	.584	8	~~.125~~	.123
	1.8	1.8	.715	9	.14	.14
	0.8	.8	.774	10	.17	
	0.6	.6	.818	11	.22	
4th	1.7	.425	.848	12	.295	
		.425	.880	13	.44	
		.425	.911	14	.69	
		.425	.942	15	.783	.783
5th	0.5	.125	.951	16	.83	
		.125	.960	17	.865	
		.125	.969	18	.897	
		.125	.978	19	.921	
6th	0.3	.075	.984	20	.944	.944
		.075	.989	21	.962	
		.075	.995	22	.977	
		.075	1.000	23	.989	
				24	1.00	

581/8-81

EBASCO SERVICES INCORPORATED

BY DMA DATE 6/7/85 SHEET 2 OF 2

CHKD. BY SC DATE 5/8/85 OFS NO. DEPT. NO.

CLIENT USDA/SCS

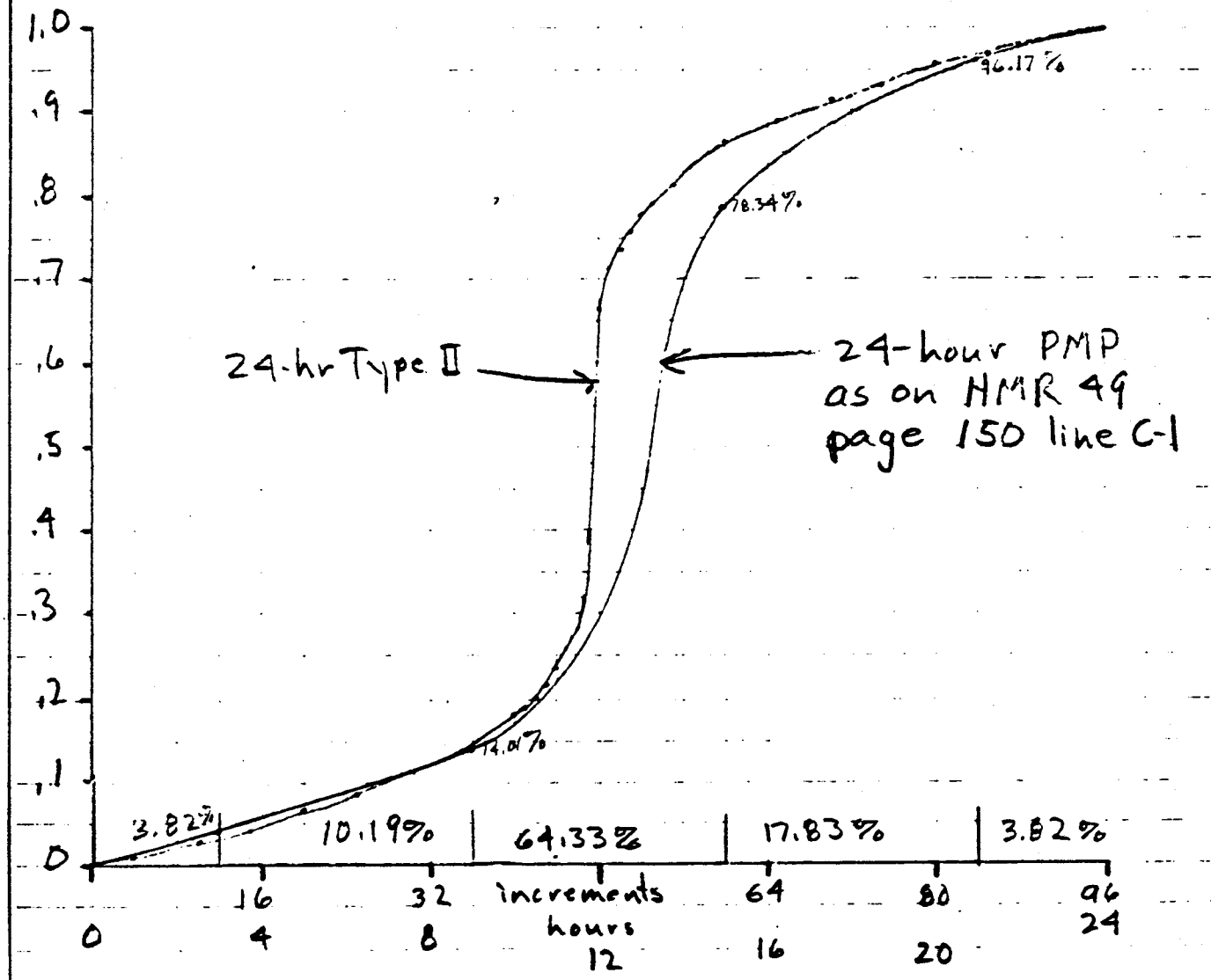
PROJECT APACHE

SUBJECT 24 HR PMP DISTRIBUTION

6-hr accumulations from HMR 49: (See p. 2)

	10.1	12.9	14.5	15.7
incr.	10.1	2.8	1.6	1.2
%	64.33	17.83	10.19	7.64

Most intense 6-hr period of 24-hr. Type II = .856 - .147 = .709 x 15.7 = 11.13 in. Too intense.



Put heaviest 6-hr period in middle, followed by second heaviest 6 hours.

581/8-81

EBASCO SERVICES INCORPORATED

BY DSH DATE 6/3/85 SHEET ____ OF ____

CHKD. BY ____ DATE ____ OFS NO. ____ DEPT. NO. ____

CLIENT APACHE- BULLDOG

PROJECT ____

SUBJECT REPORT OF TELEPHONE CONVERSATION - RUNOFF DISTRIBUTION

To: Wendell Styner, USDA/SCS Portland 503-221-2854
2:15 EDST

From: D. Hunter

At the suggestion of Harry Millsaps, I called Mr. Styner for advice on whether the runoff distribution needs to be different from the rainfall distribution when runoff depths are input to the DAMS2 program with the QDIRECT statement. He advised me that this is not necessary. Although in fact the "initial abstraction" should be taken out of the rising limb of the hydrograph, the resulting error is small and is ignored in practice. Consequently it is acceptable and standard to use the rainfall distribution to represent runoff.

```
DAMS2 XEQ 07/22/85          STRUCTURE SITE ANALYSIS COMPUTER PROGRAM
      REV 12/03/82  SCS TECHNICAL RELEASE 48, DATED OCT.1982 (USER MANUAL)

      ************************** 80-80 LIST OF INPUT DATA ****************************

      DAMS2      12/03/82  APACHE JCT. FRS INFLOW & ROUTING                    00000900
      RAINTABLE  HMR5      6.        6-HR PMP IN 15-MIN. INCREMENTS           00000910
                           0.        .005      .011      .0164     .0219      00000920
                           .036      .051      .066      .08       .584       00000930
                           .715      .774      .818      .848      .88        00000940
                           .911      .942      .951      .96       .969       00000950
                           .978      .984      .989      .995      1.         00000960
      ENDTABLE                                                                00000970
      WSDATA       C  1    84.       1.86      .82                            00001010
      PDIRECT    1                              6.        13.7                 00001015
      QDIRECT              2.        3.14                                     00001020
      GD,DESIGN P          HMR5                                               00001030
      XSECTN     1                                                            00001040
                           1805.8    0.        0.                             00001050
                           1806.8    59.       20.                            00001060
                           1807.8    177.      40.                            00001070
                           1808.8    329.      60.                            00001080
                           1809.8    506.      80.                            00001090
                           1810.8    701.      100.                           00001100
                           1811.8    909.      120.                           00001110
                           1812.8    1130.     140.                           00001120
                           1813.8    1360.     160.                           00001130
                           1814.8    1570.     182.                           00001131
                           1815.8    1812.     206.                           00001132
      ENDTABLE                                                                00001135
      GD,REACH   0     C 1AB1        1200.                                    00001140
      WSDATA       C  1    81.       .77       .63                            00001150
      PDIRECT    1                              6.        13.7                 00001155
      QDIRECT              1.97      3.02                                     00001160
      GD,DESIGN D          HMR5                                               00001170
      GD,ADDHYD  0       1AB                                                  00001180
      WSDATA       C  1    80.       .75       .65                            00001190
      PDIRECT    1                              6.        13.7                 00001195
      QDIRECT              1.89      2.91                                     00001200
      GD,DESIGN            HMR5                                               00001210
      GD,ADDHYD  0       1BC                                                  00001220
      WSDATA       C  1    77.       .67       .38                            00001230
      PDIRECT    1                              6.        13.7                 00001235
      QDIRECT              1.66      2.51                                     00001240
      GD,DESIGN            HMR5                                               00001250
      GD,ADDHYD  2       12                                                   00001260
      STRUCTURE  AJFRS     RESERVOIR ADJUSTED FOR SEDIMENT,BORROW             00001310
                           1792.                                    0.        00001315
                           1794.                                    18.3      00001320
                           1796.                                    124.2     00001325
                           1798.                                    299.3     00001330
                           1800.                                    529.8     00001335
                           1802.                                    791.6     00001340
                           1804.                                    1085.2    00001345

                           1806.                                    1402.8    00001350
                           1808.                                    1755.3    00001355
                           1810.                                    2141.6    00001360
      ENDTABLE                                                                00001370
      WSDATA       C       82.       1.74      .69                            00001372
      PDIRECT    1                              6.        13.7                 00001373
      QDIRECT              1.94      3.07                                     00001374
      POOLDATA   ELEV                1793.5                                   00001380
      CLPROFILE                      APACHE FRS DAM CENTERLINE                00001390
                 0.        1808.     920.      1796.     1110.     1792.      00001400
                 1480.     1788.     5710.     1788.     5910.     1792.      00001410
                 6210.     1790.     7000.     1790.     7450.     1792.      00001420
                 8050.     1800.     8150.     1804.     8480.     1808.      00001430
      ENDTABLE                                                                00001440
      TEMPLATE   14.       2.5       2.                                       00001441
      PSDATA     1         135.      30.                 .013      1786.      00001450
      PSINLET              1.        15.                                      00001460
      ESCREST    ELEV                                                         00001470
      ESDATA     41        500.      .025      2.        .025                00001480
      ESRATING   41        1.        RATING FOR 3.1  B M(3/2)                 00001481
      ESRATING   3.1       8.77      16.11     24.8      34.66     45.56      00001482
      ESRATING   57.41     70.14     83.7      98.03     113.1     126.86     00001483
      BTMWIDTH   FEET      250.      200.      150.      100.                 00001485
      GD,DESIGN L P C E    HMR5                                               00001490
      ENDJOB                                                                  00001500

      ****************************************************************************
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DAMS2 INPUT FOR
BAFFLE CHUTE AND
PRINCIPAL SPILLWAY DESIGN RUNS

```
DAMS2 XEQ 06/26/85          STRUCTURE SITE ANALYSIS COMPUTER PROGRAM
      REV 12/03/82  SCS TECHNICAL RELEASE 48, DATED OCT.1982 (USER MANUAL)

      ************************** 80-80 LIST OF INPUT DATA **************************

      DAMS2      12/03/82  APACHE JCT. FRS INFLOW & ROUTING                    00000900
      RAINTABLE MMR5       6.        6-HR PMP IN 15-MIN. INCREMENTS           00000910
                           0.        .005      .011      .0164     .0219      00000920
                           .036      .051      .066      .08       .584       00000930
                           .715      .774      .818      .848      .88        00000940
                           .911      .942      .951      .96       .969       00000950
                           .978      .984      .989      .995      1.         00000960
                                                                              00000970
      ENDTABLE                                                                00001010
      WSDATA       C  1    84.       1.86      .82                            00001020
      GDIRECT              1.32      2.07                                     00001030
      GD,DESIGN P          MMR5                                               00001040
      XSECTN     1                                                            00001050
                           1805.8    0.        0.                             00001060
                           1806.8    59.       20.                            00001070
                           1807.8    177.      40.                            00001080
                           1808.8    329.      60.                            00001090
                           1809.8    506.      80.                            00001100
                           1810.8    701.      100.                           00001110
                           1811.8    909.      120.                           00001120
                           1812.8    1130.     140.                           00001130
                           1813.8    1360.     160.                           00001131
                           1814.8    1570.     182.                           00001132
                           1815.8    1812.     206.                           00001135
      ENDTABLE                                                                00001140
      GD,REACH  O     C 1AB1         1200.                                    00001150
      WSDATA       C  1    81.       .77       .63                            00001160
      GDIRECT              1.27      1.95                                     00001170
      GD,DESIGN            MMR5                                               00001180
      GD,ADDHYD O       1AB                                                   00001190
      WSDATA       C  1    80.       .75       .65                            00001200
      GDIRECT              1.21      1.87                                     00001210
      GD,DESIGN            MMR5                                               00001220
      GD,ADDHYD O       1BC                                                   00001230
      WSDATA       C  1    77.       .67       .38                            00001240
      GDIRECT              1.04      1.55                                     00001250
      GD,DESIGN            MMR5                                               00001260
      GD,ADDHYD 2        12                                                   00001310
      STRUCTURE AJFRS      RESERVOIR ADJUSTED FOR SEDIMENT,BORROW             00001315
                           1793.5                                   0.        00001320
                           1794.                                    18.3      00001325
                           1796.                                    124.2     00001330
                           1798.                                    299.3     00001335
                           1800.                                    529.8     00001340
                           1802.                                    791.6     00001345
                           1804.                                    1085.2    00001350
                           1806.                                    1402.8    00001355
                           1808.                                    1755.3    00001360
                           1810.                                    2141.6    00001370
      ENDTABLE
```

```
DAMS2 XEQ 06/26/85          STRUCTURE SITE ANALYSIS COMPUTER PROGRAM
      REV 12/03/82  SCS TECHNICAL RELEASE 48, DATED OCT.1982 (USER MANUAL)

      ************************** 80-80 LIST OF INPUT DATA **************************

                                                                              00001372
      WSDATA       C       82.       1.74      .69                            00001374
      GDIRECT              1.27      2.01                                     00001380
      PODLDATA  ELEV                 1793.5                                   00001390
      CLPROFILE                      APACHE FRS DAM CENTERLINE                00001400
                 0.        1808.     920.      1796.     1110.     1792.      00001410
                 1480.     1788.     5710.     1788.     5910.     1792.      00001420
                 6210.     1790.     7000.     1790.     7450.     1792.      00001430
                 8050.     1800.     8150.     1804.     8480.     1808.      00001440
      ENDTABLE                                                                00001441
      TEMPLATE   14.       2.5       2.                                       00001450
      PSDATA     1         135.      30.                  .013      1786.     00001460
      PSINLET              1.        18.                                      00001470
      ESCREST    ELEV                                                         00001480
      ESDATA     41        500.      .025      2.        .025                00001482
      ESRATING   41        1.        RATING FOR 3.1 B H(3/2)                  00001483
      ESRATING   3.1       8.77      16.11     24.8      34.66     45.56      00001484
      ESRATING   57.41     70.14     83.7      98.03     113.1     128.86     00001485
      BTMWIDTH   FEET      100.                                               00001490
      GD,DESIGN L P C E    MMR5                                               00001500
      ENDJOB
      ******************************************************************************
```

DAMS2 INPUT FOR 25-YEAR RAINFALL

```
DAMS2 XEC 06/10/85          STRUCTURE SITE ANALYSIS COMPUTER PROGRAM
      REV 12/03/82  SCS TECHNICAL RELEASE 48, DATED OCT.1982 (USER MANUAL)

      ************************** 80-80 LIST OF INPUT DATA ************************

      DAMS2      12/03/82  APACHE JCT. FRS INFLOW & ROUTING                    00000900
      WSDATA       C  1    84.       1.86      .82                           00001010
      QDIRECT              2.        3.14      4.52      12.32               00001020
      RAINTABLE MR49       24.       24-HOUR PMP IN 1-HOUR INCREMENTS        00001022
                           0.        .012      .025      .038      .053      00001023
                           .069      .086      .103      .121      .14       00001024
                           .17       .22       .295      .44       .69       00001025
                           .783      .83       .865      .897      .921      00001026
                           .944      .962      .977      .989      1.        00001027
                                                                             00001028
      ENDTABLE                                                               00001030
      GD,DESIGN P          MR49                                              00001040
      XSECTN     1                                                           00001050
                           1805.8    0.        0.                            00001060
                           1806.8    59.       20.                           00001070
                           1807.8    177.      40.                           00001080
                           1808.8    329.      60.                           00001090
                           1809.8    506.      80.                           00001100
                           1810.8    701.      100.                          00001110
                           1811.8    909.      120.                          00001120
                           1812.8    1130.     140.                          00001130
                           1813.8    1360.     160.                          00001131
                           1814.8    1570.     182.                          00001132
                           1815.8    1812.     206.                          00001135
      ENDTABLE                                                               00001140
      GD,REACH   0     C 1AB1       1200.                                   00001150
      WSDATA       C  1    81.       .77       .63                           00001160
      QDIRECT              1.97      3.02      4.58      12.77               00001170
      GD,DESIGN            MR49                                              00001180
      GD,ADDHYD 0       1AB                                                  00001190
      WSDATA       C  1    80.       .75       .65                           00001200
      QDIRECT              1.89      2.91      4.45      12.61               00001210
      GD,DESIGN            MR49                                              00001220
      GD,ADDHYD 0       1BC                                                  00001230
      WSDATA       C  1    77.       .67       .38                           00001240
      QDIRECT              1.68      2.51      4.14      12.16               00001250
      GD,DESIGN            MR49                                              00001260
      GD,ADDHYD 2        12                                                  00001310
      STRUCTURE AJFRS      RESERVOIR ADJUSTED FOR SEDIMENT,BORROW            00001315
                           1793.5                                  0.        00001320
                           1794.                                   18.3      00001325
                           1796.                                   124.2     00001330
                           1798.                                   299.3     00001335
                           1800.                                   529.8     00001340
                           1802.                                   791.6     00001345
                           1804.                                   1085.2    00001350
                           1806.                                   1402.8    00001355
                           1808.                                   1755.3    00001360
                           1810.                                   2141.6    00001370
      ENDTABLE


                                                                             00001372
      WSDATA       C       82.       1.74      .69                           00001374
      QDIRECT              1.94      3.07      4.44      12.24               00001380
      PCOLDATA  ELEV                 1793.5                                  00001390
      CLPROFILE                      APACHE FRS DAM CENTERLINE               00001400
                0.         1808.     920.      1796.     1110.     1792.     00001410
                1480.      1788.     5710.     1788.     5910.     1792.     00001420
                6210.      1790.     7000.     1790.     7450.     1792.     00001430
                6050.      1800.     8150.     1804.     8480.     1808.     00001440
      ENDTABLE                                                               00001441
      TEMPLATE  14.        2.5       2.                                      00001450
      PSDATA    1          135.      36.                 .013      1786.     00001460
      PSINLET              1.        16.                                     00001470
      ESCREST   ELEV                                                         00001480
      ESDATA    42         800.      .025      2.        .025                00001482
      ESPROFILE 42         800.      0.        1000.     4.                  00001485
      BTMWIDTH  FEET       300.      275.      250.                          00001490
      GD,DESIGN L P C E    MR49                                              00001500
      ENDJOB
      ****************************************************************************
```

DAMS2 INPUT FOR 24-HOUR PMF (EARTH SPILLWAY)

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH 1 INCH= 500. CFS

0. 500. 1000. 1500. 2000. 2500. 3000. 3

T	I	D	E	VOL	A
0.00	0	0	1793.5	13.7	0.0
1.01	8	1	1793.5	14.0	0.0
2.02	9	2	1793.6	14.6	0.0
3.03	9	4	1793.7	15.1	0.0
4.04	9	5	1793.7	15.5	0.0
5.05	9	6	1793.7	15.8	0.0
6.07	9	7	1793.8	16.1	0.0
7.08	9	7	1793.8	16.3	0.0
8.09	9	8	1793.8	16.4	0.0
9.10	10	8	1793.8	16.6	0.0
10.11	10	8	1793.8	16.7	0.0
11.12	10	8	1793.8	16.8	0.0
12.13	10	9	1793.8	16.9	0.0
13.14	10	9	1793.9	17.0	0.0
14.15	10	9	1793.9	17.1	0.0
15.16	10	9	1793.9	17.2	0.0
16.17	10	9	1793.9	17.2	0.0
17.19	10	9	1793.9	17.3	0.0
18.20	10	9	1793.9	17.4	0.0
19.21	10	10	1793.9	17.4	0.0
20.22	10	10	1793.9	17.5	0.0
21.23	10	10	1793.9	17.5	0.0
22.24	11	10	1793.9	17.6	0.0
23.25	11	10	1793.9	17.6	0.0
24.26	11	10	1793.9	17.7	0.0
25.27	11	10	1793.9	17.8	0.0
26.28	11	10	1793.9	17.8	0.0
27.30	11	10	1794.0	17.9	0.0
28.31	11	10	1794.0	17.9	0.0
29.32	11	11	1794.0	18.0	0.0
30.33	11	11	1794.0	18.0	0.0
31.34	11	11	1794.0	18.1	0.0
32.35	12	11	1794.0	18.1	0.0
33.36	12	11	1794.0	18.2	0.0
34.37	12	11	1794.0	18.2	0.0
35.38	12	11	1794.0	18.3	0.0
36.39	12	11	1794.0	18.4	0.0
37.40	12	11	1794.0	18.4	0.0
38.42	12	12	1794.0	18.5	0.0
39.43	12	12	1794.0	18.5	0.0
40.44	12	12	1794.0	18.6	0.0
41.45	13	12	1794.0	18.7	0.0
42.46	13	12	1794.0	18.7	0.0
43.47	13	12	1794.0	18.8	0.0
44.48	13	12	1794.0	18.9	0.0
45.49	13	12	1794.0	18.9	0.0
46.50	13	12	1794.0	19.0	0.0
47.51	13	13	1794.0	19.1	0.0
48.52	14	13	1794.0	19.1	0.0
49.54	14	13	1794.0	19.2	0.0
50.55	14	13	1794.0	19.3	0.0
51.56	14	13	1794.0	19.4	0.0
52.57	14	13	1794.0	19.5	0.0
53.58	14	13	1794.0	19.5	0.0
54.59	15	14	1794.0	19.6	0.0
55.60	15	14	1794.0	19.7	0.0
56.61	15	14	1794.0	19.8	0.0
57.62	15	14	1794.0	19.9	0.0
58.63	15	14	1794.0	20.0	0.0
59.64	16	14	1794.0	20.1	0.0
60.66	16	15	1794.0	20.2	0.0
61.67	16	15	1794.0	20.3	0.0
62.68	16	15	1794.0	20.4	0.0
63.69	16	15	1794.0	20.5	0.0
64.70	17	15	1794.0	20.6	0.0
65.71	17	16	1794.0	20.7	0.0
66.72	17	16	1794.0	20.9	0.0
67.73	18	16	1794.1	21.0	0.0
68.74	18	16	1794.1	21.1	0.0
69.75	18	17	1794.1	21.2	0.0
70.77	18	17	1794.1	21.4	0.0
71.78	19	17	1794.1	21.5	0.0
72.79	19	17	1794.1	21.7	0.0
73.80	19	18	1794.1	21.8	0.0
74.81	20	18	1794.1	22.0	0.0
75.82	20	18	1794.1	22.1	0.0
76.83	20	18	1794.1	22.3	0.0
77.84	21	19	1794.1	22.5	0.0
78.85	21	19	1794.1	22.6	0.0
79.86	22	19	1794.1	22.8	0.0
80.87	22	20	1794.1	23.0	0.0
81.89	23	20	1794.1	23.2	0.0
82.90	23	20	1794.1	23.4	0.0
83.91	24	21	1794.1	23.7	0.0
84.92	24	21	1794.1	23.9	0.0
85.93	25	22	1794.1	24.1	0.0

FIGURE C.3

PRINCIPAL SPILLWAY
INFLOW HYDROGRAPH (I)
PART A

84.92	24	21	1794.1	23.9	0.0	.
85.93	25	22	1794.1	24.1	0.0	.
86.94	25	22	1794.1	24.4	0.0	.I
87.95	26	23	1794.1	24.6	0.0	.I
88.96	27	23	1794.1	24.9	0.0	.I
89.97	27	23	1794.1	25.3	0.0	.I
90.98	28	24	1794.1	25.6	0.0	.I
91.99	29	24	1794.1	26.0	0.0	.I
93.01	30	25	1794.2	26.4	0.0	.I
94.02	31	25	1794.2	26.8	0.0	.P
95.03	32	26	1794.2	27.3	0.0	.P
96.04	33	26	1794.2	27.8	0.0	.P
97.05	34	27	1794.2	28.4	0.0	.P
98.06	35	28	1794.2	29.0	0.0	.P
99.07	36	28	1794.2	29.6	0.0	.P
100.08	38	29	1794.2	30.3	0.0	.P
101.09	39	30	1794.2	31.0	0.0	.P
102.10	41	31	1794.3	31.9	0.0	.P
103.11	43	32	1794.3	32.8	0.0	.P
104.13	45	33	1794.3	33.7	0.0	.P
105.14	48	34	1794.3	34.8	0.0	.P
106.15	51	36	1794.3	36.0	0.0	.P
107.16	54	37	1794.4	37.3	0.0	.P
108.17	57	39	1794.4	38.7	0.0	.P
109.18	61	41	1794.4	40.3	0.0	.P
110.19	66	43	1794.5	42.1	0.0	.P
111.20	72	46	1794.5	44.2	0.0	.P
112.21	79	49	1794.5	46.5	0.0	.PI
113.22	88	53	1794.6	49.3	0.0	.PI
114.24	100	57	1794.6	52.5	0.0	.PI
115.25	116	63	1794.7	56.5	0.0	.PI
116.26	139	64	1794.8	61.8	0.0	.P I
117.27	177	65	1795.0	69.6	0.0	.P I
118.28	255	66	1795.2	82.2	0.0	.P I
119.29	1192	69	1796.1	137.0	0.0	.P I
120.30	2893	75	1798.0	301.6	0.0	. P
121.31	662	79	1799.3	443.7	0.0	. P I
122.32	272	80	1799.5	476.0	0.0	. P I
123.33	184	81	1799.6	488.3	0.0	. P I
124.34	143	81	1799.7	495.2	0.0	. PI
125.36	116	81	1799.7	499.4	0.0	. P
126.37	102	81	1799.8	501.8	0.0	. P
127.38	90	81	1799.8	503.1	0.0	. P
128.39	80	81	1799.8	503.4	0.0	. X
129.40	73	81	1799.8	503.0	0.0	.IP
130.41	67	81	1799.8	502.1	0.0	.IP
131.42	62	81	1799.7	500.7	0.0	.IP
132.43	58	81	1799.7	499.0	0.0	.IP
133.44	54	81	1799.7	496.9	0.0	.IP
134.45	51	81	1799.7	494.5	0.0	.IP
135.46	48	81	1799.7	491.9	0.0	.IP
136.48	46	81	1799.6	489.0	0.0	.IP
137.49	43	81	1799.6	486.0	0.0	.IP
138.50	41	80	1799.6	482.8	0.0	.IP
139.51	40	80	1799.6	479.5	0.0	.IP
140.52	38	80	1799.5	476.0	0.0	.IP
141.53	36	80	1799.5	472.4	0.0	.IP
142.54	35	80	1799.5	468.7	0.0	.IP
143.55	34	80	1799.4	464.9	0.0	.IP
144.56	33	80	1799.4	461.0	0.0	.IP
145.57	32	80	1799.4	457.1	0.0	.IP
146.59	31	80	1799.3	453.0	0.0	.IP
147.60	30	80	1799.3	448.9	0.0	.IP

FIGURE C.3, PART B

148.61	29	79	1799.3	444.7	0.0	.IP
149.62	28	79	1799.2	440.4	0.0	.IP
150.63	27	79	1799.2	436.1	0.0	.IP
151.64	27	79	1799.1	431.7	0.0	.IP
152.65	26	79	1799.1	427.3	0.0	.IP
153.66	25	79	1799.1	422.9	0.0	.IP
154.67	25	79	1799.0	418.3	0.0	. P
155.68	24	79	1799.0	413.8	0.0	. P
156.69	24	79	1799.0	409.2	0.0	. P
157.71	23	78	1798.9	404.6	0.0	. P
158.72	23	78	1798.9	400.0	0.0	. P
159.73	22	78	1798.8	395.3	0.0	. P
160.74	22	78	1798.8	390.6	0.0	. P
161.75	21	78	1798.8	385.8	0.0	. P
162.76	21	78	1798.7	381.1	0.0	. P
163.77	20	78	1798.7	376.3	0.0	. P
164.78	20	78	1798.6	371.5	0.0	. P
165.79	20	78	1798.6	366.7	0.0	. P
166.80	19	77	1798.5	361.8	0.0	. P
167.81	19	77	1798.5	357.0	0.0	. P
168.83	19	77	1798.5	352.1	0.0	. P
169.84	18	77	1798.4	347.2	0.0	. P
170.85	18	77	1798.4	342.3	0.0	. P
171.86	18	77	1798.3	337.4	0.0	. P
172.87	17	76	1798.3	332.5	0.0	. P
173.88	17	76	1798.2	327.5	0.0	. P
174.89	17	76	1798.2	322.6	0.0	. P
175.90	17	76	1798.2	317.7	0.0	. P
176.91	16	76	1798.1	312.7	0.0	. P
177.92	16	76	1798.1	307.8	0.0	. P
178.93	16	75	1798.0	302.8	0.0	. P
179.95	16	75	1798.0	297.8	0.0	. P
180.96	16	75	1797.9	292.9	0.0	. P
181.97	15	75	1797.9	287.9	0.0	.P
182.98	15	75	1797.8	282.9	0.0	.P
183.99	15	75	1797.8	277.9	0.0	.P
185.00	15	74	1797.7	273.0	0.0	.P
186.01	15	74	1797.6	268.0	0.0	.P
187.02	14	74	1797.6	263.0	0.0	.P
188.03	14	74	1797.5	258.0	0.0	.P
189.04	14	74	1797.5	253.0	0.0	.P
190.06	14	74	1797.4	248.0	0.0	.P
191.07	14	73	1797.4	243.1	0.0	.P
192.08	14	73	1797.3	238.1	0.0	.P
193.09	13	73	1797.2	233.1	0.0	.P
194.10	13	73	1797.2	228.1	0.0	.P
195.11	13	73	1797.1	223.1	0.0	.P
196.12	13	73	1797.1	218.2	0.0	.P
197.13	13	72	1797.0	213.2	0.0	.P
198.14	13	72	1797.0	208.2	0.0	.P
199.15	13	72	1796.9	203.2	0.0	.P
200.16	12	72	1796.8	198.3	0.0	.P
201.18	12	72	1796.8	193.3	0.0	.P
202.19	12	72	1796.7	188.4	0.0	.P
203.20	12	71	1796.7	183.4	0.0	.P
204.21	12	71	1796.6	178.4	0.0	.P
205.22	12	71	1796.6	173.5	0.0	.P
206.23	12	71	1796.5	168.6	0.0	.P
207.24	12	70	1796.5	163.7	0.0	.P
208.25	12	70	1796.4	158.8	0.0	.P
209.26	11	70	1796.3	153.9	0.0	.P
210.27	11	69	1796.3	149.0	0.0	.P
211.28	11	69	1796.2	144.2	0.0	.P
212.30	11	69	1796.2	139.4	0.0	.P
213.31	11	69	1796.1	134.5	0.0	.P
214.32	11	68	1796.1	129.7	0.0	.P
215.33	11	68	1796.0	124.9	0.0	.P
216.34	11	68	1795.9	120.2	0.0	.P
217.35	11	68	1795.8	115.4	0.0	.P
218.36	11	67	1795.7	110.7	0.0	.P
219.37	11	67	1795.7	105.9	0.0	.P
220.38	10	67	1795.6	101.2	0.0	.P
221.39	10	66	1795.5	96.5	0.0	.P
222.40	10	66	1795.4	91.8	0.0	.P
223.42	10	66	1795.3	87.2	0.0	.P
224.43	10	66	1795.2	82.5	0.0	.P
225.44	10	65	1795.1	77.9	0.0	.P
226.45	10	65	1795.0	73.3	0.0	.P
227.46	10	65	1795.0	68.7	0.0	.P
228.47	10	65	1794.9	64.1	0.0	.P
229.48	10	64	1794.8	59.5	0.0	.P
230.49	10	61	1794.7	55.1	0.0	.P
231.50	10	55	1794.6	51.0	0.0	.P
232.51	9	50	1794.5	47.4	0.0	.P
233.53	9	46	1794.5	44.2	0.0	.P
234.54	9	42	1794.4	41.3	0.0	.P
235.55	9	39	1794.4	38.7	0.0	.P
236.56	9	36	1794.3	36.3	0.0	.P
237.57	9	34	1794.3	34.2	0.0	.P
238.58	9	31	1794.3	32.2	0.0	.P
239.59	9	29	1794.2	30.4	0.0	.P
240.60	5	27	1794.2	28.6	0.0	.P
241.61	0	25	1794.2	26.6	0.0	.
T	I	D	E	VDL	A	I

0. 500. 1000. 1500. 2000. 2500. 3000.

FIGURE C3, PART C

[illegible]

[illegible] WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR [illegible]

	PLOT					
0.00	0	0	1793.5	13.7	0.0	.
0.09	0	0	1793.5	13.7	0.0	.
0.17	0	0	1793.5	13.7	0.0	.
0.26	0	0	1793.5	13.7	0.0	.
0.35	0	0	1793.5	13.7	0.0	.
0.43	0	0	1793.5	13.7	0.0	.
0.52	0	0	1793.5	13.7	0.0	.
0.61	0	0	1793.5	13.7	0.0	.
0.69	0	0	1793.5	13.7	0.0	.
0.78	0	0	1793.5	13.7	0.0	.
0.86	0	0	1793.5	13.7	0.0	.
0.95	0	0	1793.5	13.7	0.0	.
1.04	0	0	1793.5	13.7	0.0	.
1.12	0	0	1793.5	13.7	0.0	.
1.21	0	0	1793.5	13.7	0.0	.
1.30	0	0	1793.5	13.7	0.0	.
1.38	0	0	1793.5	13.7	0.0	.
1.47	0	0	1793.5	13.7	0.0	.
1.56	0	0	1793.5	13.7	0.0	.
1.64	0	0	1793.5	13.7	0.0	.
1.73	0	0	1793.5	13.7	0.0	.
1.82	0	0	1793.5	13.7	0.0	.
1.90	0	0	1793.5	13.7	0.0	.
1.99	11	0	1793.5	13.8	0.0	.
2.07	188	2	1793.6	14.5	0.0	.I
2.16	957	12	1794.0	18.5	0.0	.
2.25	2911	31	1794.3	32.2	0.0	.
2.33	5845	65	1794.8	63.1	0.0	.
2.42	8828	89	1795.8	215.9	0.0	.
2.51	11019	72	1796.7	285.4	0.0	.
2.59	12133	35	1797.6	367.4	0.0	.
2.68	12285	77	1798.5	354.3	0.0	.
2.77	11670	79	1799.2	439.3	0.0	.
2.85	10560	118	1799.9	518.0	0.0	.E
2.94	9300	295	1800.4	587.5	0.0	.E
3.03	8109	471	1800.9	646.9	0.0	.E
3.11	7038	606	1801.3	694.4	0.0	.E
3.20	6126	882	1801.6	734.2	0.0	. E
3.28	5353	1052	1801.9	772.3	0.0	. E
3.37	4708	1289	1802.1	800.2	0.0	. E
3.46	4191	1328	1802.2	822.9	0.0	. E
3.54	3788	1430	1802.3	841.6	0.0	. E
3.63	3479	1524	1802.4	857.0	0.0	. E
3.72	3246	1585	1802.5	870.0	0.0	. E I
3.80	3068	1645	1802.6	881.0	0.0	. E I
3.89	2934	1696	1802.7	890.5	0.0	. E I
3.98	2834	1742	1802.7	898.8	0.0	. E I
4.06	2759	1782	1802.8	906.2	0.0	. E I
4.15	2667	1816	1802.8	912.4	0.0	. E I
4.24	2415	1845	1802.9	917.3	0.0	. E I
4.32	2173	1867	1802.9	920.4	0.0	. E I
4.41	1915	1875	1802.9	921.6	0.0	. EI
4.50	1675	1871	1802.9	921.2	0.0	. EI
4.58	1458	1857	1802.9	918.9	0.0	. E
4.67	1279	1834	1802.8	915.3	0.0	. E
4.75	1141	1809	1802.8	911.2	0.0	. E
4.84	1037	1782	1802.8	906.1	0.0	. E
4.93	959	1752	1802.7	900.6	0.0	. E
5.01	882	1728	1802.7	894.9	0.0	. E
5.10	806	1686	1802.7	889.0	0.0	. E
5.19	738	1665	1802.6	883.0	0.0	. E
5.27	762	1622	1802.6	876.9	0.0	. E
5.36	712	1588	1802.5	870.7	0.0	. E
5.45	662	1554	1802.5	864.4	0.0	. E
5.53	606	1549	1802.5	858.0	0.0	. E
5.62	573	1484	1802.4	851.5	0.0	. E
5.71	542	1448	1802.4	845.0	0.0	. E
5.79	520	1413	1802.3	838.6	0.0	. E
5.88	505	1379	1802.3	832.3	0.0	. E
5.96	492	1345	1802.2	826.1	0.0	. E
6.05	486	1312	1802.2	819.9	0.0	. E
6.14	480	1280	1802.2	813.8	0.0	. E
6.22	469	1247	1802.1	808.1	0.0	. E
6.31	451	1214	1802.1	802.0	0.0	.I E
6.40	429	1180	1802.0	795.8	0.0	.I E
6.48	398	1145	1802.0	789.3	0.0	.I E
6.57	377	1109	1801.9	782.7	0.0	.I E
6.66	354	1075	1801.8	776.0	0.0	.I E
6.75	335	1042	1801.8	769.4	0.0	.I E
6.83	325	1000	1801.8	762.7	0.0	. E
6.92	306	964	1801.7	756.2	0.0	. E
7.00	292	928	1801.7	749.7	0.0	. E
7.09	286	895	1801.6	743.4	0.0	. E
7.18	277	857	1801.6	737.3	0.0	. E
7.26	268	820	1801.5	731.2	0.0	. E
7.35	259	824	1801.5	725.4	0.0	. E

FIGURE C.4

6-HOUR EMERGENCY SPILLWAY INFLOW HYDROGRAPH (I)

3.30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.47	0	543	1801.0	663.0	0.0	E
3.56	0	526	1801.0	699.2	0.0	E
3.64	0	510	1801.0	655.5	0.0	E

TYPE	BW	ZMAX	VOL-MAX	QMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	Q/C	Q/C	Q/C	Q/C-25
SCS-FBH	180.0	1809.37	2019.3	0.0	0.60	1515.9	105.7	10460.7	10566.3	0.43	24.41	0.005	0.007

T	I	O	Z	VOL	Q	
0.00	0	0	1793.5	13.7	0.0	
0.09	0	0	1793.5	13.7	0.0	
0.17	0	0	1793.5	13.7	0.0	
0.26	0	0	1793.5	13.7	0.0	
0.35	0	0	1793.5	13.7	0.0	
0.43	0	0	1793.5	13.7	0.0	
0.52	0	0	1793.5	13.7	0.0	
0.61	0	0	1793.5	13.7	0.0	
0.69	0	0	1793.5	13.7	0.0	
0.78	0	0	1793.5	13.7	0.0	
0.86	0	0	1793.5	13.7	0.0	
0.95	0	0	1793.5	13.7	0.0	
1.04	0	0	1793.5	13.7	0.0	
1.12	0	0	1793.5	13.7	0.0	
1.21	1	0	1793.5	13.7	0.0	
1.30	3	0	1793.5	13.7	0.0	
1.38	11	0	1793.5	13.8	0.0	
1.47	30	1	1793.5	13.8	0.0	
1.56	67	2	1793.6	14.3	0.0	
1.64	126	3	1793.6	14.9	0.0	
1.73	206	7	1793.8	16.1	0.0	
1.82	302	10	1794.0	17.8	0.0	
1.90	406	15	1794.0	20.3	0.0	
1.99	561	21	1794.1	23.4	0.0	I
2.07	1496	30	1794.2	30.8	0.0	I
2.16	4768	58	1794.7	52.8	0.0	I
2.25	11768	68	1795.8	111.5	0.0	I
2.33	21084	73	1797.2	228.3	0.0	I
2.42	29621	79	1799.0	408.9	0.0	I
2.51	35179	933	1800.8	636.5	0.0	I
2.59	37362	1694	1802.7	890.0	0.0	E I
2.68	36727	3329	1804.3	1136.7	0.0	E I
2.77	34004	5000	1805.7	1359.6	0.0	E I
2.85	30133	6501	1806.8	1547.7	0.0	E I
2.94	26064	7731	1807.7	1697.6	0.0	E I
3.03	22376	8737	1808.3	1811.8	0.0	E I
3.11	19161	9472	1808.7	1895.1	0.0	E I
3.20	16483	9981	1809.0	1952.9	0.0	E I
3.28	14248	10310	1809.2	1990.2	0.0	E I
3.37	12409	10494	1809.3	2011.1	0.0	E I
3.46	10946	10566	1809.4	2019.3	0.0	E
3.54	9812	10555	1809.4	2018.8	0.0	E
3.63	8943	10483	1809.3	2009.0	0.0	E
3.72	8284	10369	1809.3	1996.9	0.0	I E
3.80	7779	10226	1809.2	1980.7	0.0	I E
3.89	7395	10065	1809.1	1962.5	0.0	I E
3.98	7111	9894	1809.0	1943.3	0.0	I E
4.06	6842	9716	1808.9	1922.8	0.0	I E
4.15	6487	9530	1808.8	1901.6	0.0	I E
4.24	5987	9329	1808.6	1878.8	0.0	I E
4.32	5371	9106	1808.5	1853.6	0.0	I E
4.41	4725	8858	1808.4	1825.5	0.0	I E
4.50	4121	8588	1808.2	1794.8	0.0	I E
4.58	3588	8299	1808.0	1762.0	0.0	I E
4.67	3144	7998	1807.8	1727.8	0.0	I E
4.75	2801	7691	1807.6	1693.0	0.0	I E
4.84	2543	7385	1807.4	1658.2	0.0	I E
4.93	2350	7110	1807.3	1623.9	0.0	I E
5.01	2209	6842	1807.1	1590.4	0.0	I E
5.10	2094	6582	1806.9	1557.8	0.0	I E
5.19	1982	6330	1806.7	1526.2	0.0	I E
5.27	1863	6086	1806.5	1495.6	0.0	I E
5.36	1741	5848	1806.4	1465.9	0.0	I E
5.45	1618	5617	1806.2	1436.9	0.0	I E
5.53	1500	5392	1806.0	1408.7	0.0	I E
5.62	1399	5173	1805.9	1381.3	0.0	I E
5.71	1328	4962	1805.7	1354.9	0.0	I E
5.79	1270	4759	1805.5	1329.4	0.0	I E
5.88	1232	4564	1805.4	1305.0	0.0	I E
5.96	1200	4378	1805.2	1281.8	0.0	I E
6.05	1161	4200	1805.1	1259.6	0.0	I E
6.14	1097	4031	1805.0	1238.2	0.0	I E
6.22	992	3875	1804.8	1217.6	0.0	I E
6.31	853	3736	1804.7	1196.9	0.0	I E
6.40	702	3596	1804.6	1176.2	0.0	I E
6.48	559	3456	1804.4	1155.5	0.0	I E
6.57	431	3317	1804.3	1134.9	0.0	E
6.66	325	3178	1804.2	1114.4	0.0	E
6.75	[illegible]	[illegible]	[illegible]	1094.2	0.0	E
6.83	462	2908	1803.9	1074.5	0.0	E
6.92	936	2779	1803.8	1055.3	0.0	E
7.00	1402	2653	1803.7	1036.7	0.0	E
7.09	1877	2532	1803.5	1018.9	0.0	E
7.17	[illegible]	[illegible]	1803.4	1001.8	0.0	E
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

FIGURE C.5

6-HOUR FREEBOARD

INFLOW HYDROGRAPH (I)

TYPE	BM	EMAX	VOL-MAX	APAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S
SCS-FBM	300.0	1805.11	1261.3	0.0	5.65	793.7	143.7	8720.5	8864.2	2.93	9.73	0.006	

PLOT 1 IN = 2000. CFS

T(HR)	I(CFS)	D	E	VOL	A	0.	2000.	4000.	6000.	8000.	10000.	12000. EXIT
0.00	0	0	1793.5	0.0	0.0	.						
0.27	97	1	1793.5	1.1	0.0	.						
0.53	305	5	1793.6	5.5	0.0	. I						
0.80	450	13	1793.9	13.6	0.0	. I						
1.06	512	26	1794.1	23.8	0.0	. I						
1.33	549	41	1794.3	34.7	0.0	. I						
1.60	577	58	1794.5	46.0	0.0	. I						
1.86	591	77	1794.7	57.4	0.0	. I						
2.13	597	97	1794.9	68.5	0.0	. I						
2.40	600	99	1795.2	79.5	0.0	. I						
2.66	601	100	1795.4	90.6	0.0	.P I						
2.93	601	102	1795.6	101.6	0.0	.P I						
3.19	612	103	1795.8	112.7	0.0	.P I						
3.46	643	104	1796.0	124.2	0.0	.P I						
3.73	671	105	1796.1	136.4	0.0	.P I						
3.99	684	105	1796.3	149.0	0.0	.P I						
4.26	658	106	1796.4	161.8	0.0	.P I						
4.53	717	107	1796.6	175.1	0.0	.P I						
4.79	730	108	1796.7	188.6	0.0	.P I						
5.06	737	108	1796.9	202.4	0.0	.P I						
5.32	750	109	1797.1	216.4	0.0	.P I						
5.59	768	110	1797.2	230.6	0.0	.P I						
5.86	778	111	1797.4	245.2	0.0	.P I						
6.12	783	112	1797.6	260.0	0.0	.P I						
6.39	785	113	1797.7	274.7	0.0	.P I						
6.66	786	113	1797.9	289.5	0.0	.P I						
6.92	786	114	1798.0	304.3	0.0	.P I						
7.19	791	115	1798.2	319.2	0.0	.P I						
7.45	806	115	1798.3	334.2	0.0	.P I						
7.72	820	116	1798.4	349.6	0.0	.P I						
7.99	826	117	1798.6	365.1	0.0	.P I						
8.25	839	117	1798.7	380.9	0.0	.P I						
8.52	855	118	1798.8	397.0	0.0	.P I						
8.79	868	118	1799.0	413.3	0.0	.P I						
9.05	865	119	1799.1	430.0	0.0	.P I						
9.32	1012	120	1799.3	448.2	0.0	.P I						
9.56	1189	126	1799.5	469.8	0.0	.E I						
9.85	1304	186	1799.7	493.8	0.0	.E I						
10.12	1358	248	1799.9	518.7	0.0	.E I						
10.38	1696	320	1800.1	546.5	0.0	. E I						
10.65	2011	408	1800.4	579.3	0.0	. E I						
10.92	2191	576	1800.6	614.7	0.0	. E I						
11.18	2375	814	1800.9	649.6	0.0	. E I						
11.45	2797	1062	1801.2	685.9	0.0	. E I						
11.71	3165	1343	1801.5	725.0	0.0	. E I						
11.96	3363	1751	1801.8	762.6	0.0	. E I						
12.25	3946	2155	1802.1	800.2	0.0	. E I						
12.51	5147	2662	1802.4	847.3	0.0	. E I						
12.78	6027	3358	1802.8	904.0	0.0	. E I						
13.05	6518	4172	1803.1	959.2	0.0	. E I						
13.31	7792	5006	1803.5	1015.6	0.0	. E I						
13.58	9609	6039	1804.0	1085.6	0.0	. E I						
13.84	10732	7194	1804.5	1163.8	0.0	. E I						
14.11	10928	8310	1804.9	1231.5	0.0	. E I						
14.38	8957	8864	1805.1	1261.3	0.0	. E X						
14.64	6564	8490	1805.0	1241.2	0.0	. E X I						
14.91	5239	7635	1804.7	1193.6	0.0	. E I						
15.18	4507	6863	1804.4	1141.3	0.0	. E I						
15.44	3552	6071	1804.0	1087.7	0.0	. E I						
15.71	2790	5260	1803.6	1032.8	0.0	. E I						
15.97	2418	4518	1803.3	982.6	0.0	. E I						
16.24	2189	3899	1803.0	940.7	0.0	. E I						
16.51	1928	3384	1802.8	905.8	0.0	. E I						
16.77	1749	2975	1802.6	876.3	0.0	. E I						
17.04	1667	2706	1802.4	851.4	0.0	. E I						
17.31	1608	2480	1802.3	830.4	0.0	. E I						
17.57	1544	2288	1802.1	812.6	0.0	. E I						
17.84	1506	2126	1802.0	797.6	0.0	. E I						
18.10	1473	1991	1802.0	785.1	0.0	. E I						
18.37	1364	1870	1801.9	773.8	0.0	. E I						
18.64	1234	1749	1801.8	762.6	0.0	. E I						
18.90	1161	1632	1801.7	751.7	0.0	. E I						
19.17	1126	1528	1801.6	742.1	0.0	. E I						
19.44	1099	1440	1801.6	734.0	0.0	. E I						
19.70	1080	1366	1801.5	727.1	0.0	. E I						
19.97	1067	1304	1801.5	721.3	0.0	. E I						
20.23	1031	1268	1801.4	716.1	0.0	. E I						
20.50	948	1229	1801.4	710.4	0.0	. E I						
20.77	883	1185	1801.3	704.0	0.0	. E I						
21.03	850	1141	1801.3	697.5	0.0	. E I						
21.30	809	1097	1801.2	691.1	0.0	. E I						
21.56	754	1053	1801.2	684.6	0.0	. E I						
21.83	719	1009	1801.1	678.2	0.0	. E I						
22.10	697	967	1801.1	672.0	0.0	. E I						
22.36	654	926	1801.0	666.0	0.0	. E I						

FIGURE C.6

24-HOUR PMF INFLOW HYDROGRAPH (I)

DDT TEST , 1794.52 FT 46.1 ACFT 58.2 CFS
CONTROL IS 0.150 DETENTION STORAGE

DRAWDOWN TIME TO DDT TEST Q IS 2.61 DAYS - DRAWDOWN CONTINUING

DRAWDOWN TIME LIMIT = 10.00 DAYS. FLOW WAS 0.00 CFS ELEV = 1793.50 FT

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH 1 INCH= 500. CFS

T(HR)	I(CFS)	D	E	VOL	A	0. I	500. I	1000. I	1500. I	2000. I	2500. I	3000. I
0.00	0	0	1793.5	0.0	0.0	.						
1.01	5	0	1793.5	0.2	0.0	.						
2.02	6	1	1793.5	0.7	0.0	.						
3.03	6	1	1793.5	1.1	0.0	.						
4.04	6	1	1793.5	1.5	0.0	.						
5.05	6	2	1793.6	1.9	0.0	.						
6.07	6	2	1793.6	2.3	0.0	.						
7.08	6	2	1793.6	2.6	0.0	.						
8.09	6	2	1793.6	2.9	0.0	.						
9.10	6	3	1793.6	3.2	0.0	.						
10.11	6	3	1793.6	3.5	0.0	.						
11.12	6	3	1793.6	3.8	0.0	.						
12.13	6	3	1793.6	4.1	0.0	.						
13.14	6	3	1793.6	4.3	0.0	.						
14.15	6	4	1793.6	4.6	0.0	.						
15.16	6	4	1793.6	4.8	0.0	.						
16.17	7	4	1793.6	5.0	0.0	.						
17.19	7	4	1793.6	5.2	0.0	.						
18.20	7	4	1793.6	5.4	0.0	.						
19.21	7	4	1793.7	5.6	0.0	.						
20.22	7	5	1793.7	5.8	0.0	.						
21.23	7	5	1793.7	6.0	0.0	.						
22.24	7	5	1793.7	6.2	0.0	.						
23.25	7	5	1793.7	6.3	0.0	.						
24.26	7	5	1793.7	6.5	0.0	.						
25.27	7	5	1793.7	6.6	0.0	.						
26.28	7	5	1793.7	6.8	0.0	.						
27.30	7	5	1793.7	6.9	0.0	.						
28.31	7	6	1793.7	7.0	0.0	.						
29.32	7	6	1793.7	7.2	0.0	.						
30.33	7	6	1793.7	7.3	0.0	.						
31.34	7	6	1793.7	7.4	0.0	.						
32.35	8	6	1793.7	7.6	0.0	.						
33.36	8	6	1793.7	7.7	0.0	.						
34.37	8	6	1793.7	7.8	0.0	.						
35.38	8	6	1793.7	7.9	0.0	.						
36.39	8	6	1793.7	8.0	0.0	.						
37.40	8	6	1793.7	8.2	0.0	.						
38.42	8	7	1793.7	8.3	0.0	.						
39.43	8	7	1793.7	8.4	0.0	.						
40.44	8	7	1793.7	8.5	0.0	.						
41.45	8	7	1793.7	8.6	0.0	.						
42.46	8	7	1793.7	8.7	0.0	.						
43.47	8	7	1793.7	8.8	0.0	.						
44.48	8	7	1793.7	9.0	0.0	.						
45.49	9	7	1793.7	9.1	0.0	.						
46.50	9	7	1793.8	9.2	0.0	.						
47.51	9	7	1793.8	9.3	0.0	.						
48.52	9	7	1793.8	9.4	0.0	.						
49.54	9	8	1793.8	9.5	0.0	.						
50.55	9	8	1793.8	9.6	0.0	.						
51.56	9	8	1793.8	9.8	0.0	.						
52.57	9	8	1793.8	9.9	0.0	.						
53.58	9	8	1793.8	10.0	0.0	.						
54.59	10	8	1793.8	10.1	0.0	.						
55.60	10	8	1793.8	10.2	0.0	.						
56.61	10	8	1793.8	10.3	0.0	.						
57.62	10	9	1793.8	10.4	0.0	.						
58.63	10	9	1793.8	10.6	0.0	.						
59.64	10	9	1793.8	10.7	0.0	.						
60.66	10	9	1793.8	10.8	0.0	.						
61.67	10	9	1793.8	10.9	0.0	.						
62.68	11	9	1793.8	11.0	0.0	.						
63.69	11	9	1793.8	11.1	0.0	.						
64.70	11	10	1793.8	11.2	0.0	.						
65.71	11	10	1793.8	11.3	0.0	.						
66.72	11	10	1793.8	11.4	0.0	.						
67.73	11	10	1793.8	11.5	0.0	.						
68.74	12	10	1793.8	11.6	0.0	.						
69.75	12	10	1793.8	11.8	0.0	.						
70.77	12	11	1793.8	11.9	0.0	.						
71.78	12	11	1793.8	12.0	0.0	.						
72.79	12	11	1793.8	12.1	0.0	.						
73.80	13	11	1793.8	12.3	0.0	.						
74.81	13	11	1793.8	12.4	0.0	.						
75.82	13	11	1793.8	12.5	0.0	.						
76.83	13	12	1793.8	12.7	0.0	.						
77.84	14	12	1793.8	12.8	0.0	.						
78.85	14	12	1793.9	13.0	0.0	.						
79.86	14	12	1793.9	13.1	0.0	.						
80.87	14	12	1793.9	13.3	0.0	.						
81.89	15	13	1793.9	13.4	0.0	.						
82.90	15	13	1793.9	13.6	0.0	.						
83.91	15	13	1793.9	13.8	0.0	.						
84.92	16	13	1793.9	14.0	0.0	.						
85.93	16	14	1793.9	14.2	0.0	.						

FIGURE C.7
25-YEAR INFLOW HYDROGRAPH (I),
PART A

86.94	16	14	1793.9	14.4	0.0	.
87.95	17	14	1793.9	14.6	0.0	.
88.96	17	15	1793.9	14.8	0.0	.
89.97	18	15	1793.9	15.1	0.0	.
90.98	18	15	1793.9	15.3	0.0	.
91.99	19	16	1793.9	15.6	0.0	.
93.01	19	16	1793.9	15.9	0.0	.
94.02	20	16	1793.9	16.2	0.0	.
95.03	21	17	1794.0	16.5	0.0	.
96.04	21	17	1794.0	16.8	0.0	.
97.05	22	18	1794.0	17.2	0.0	.
98.06	23	18	1794.0	17.5	0.0	.
99.07	24	19	1794.0	17.9	0.0	.
100.08	25	19	1794.0	18.4	0.0	.
101.09	26	20	1794.0	18.8	0.0	.I
102.10	27	21	1794.0	19.3	0.0	.I
103.11	28	21	1794.0	19.9	0.0	.I
104.13	29	22	1794.0	20.4	0.0	.I
105.14	31	23	1794.1	21.1	0.0	.I
106.15	33	24	1794.1	21.8	0.0	.I
107.16	35	25	1794.1	22.6	0.0	.I
108.17	37	26	1794.1	23.5	0.0	.P
109.18	40	27	1794.1	24.5	0.0	.P
110.19	43	29	1794.1	25.6	0.0	.P
111.20	47	30	1794.2	26.8	0.0	.P
112.21	51	32	1794.2	28.3	0.0	.P
113.22	57	35	1794.2	30.1	0.0	.P
114.24	65	37	1794.3	32.2	0.0	.P
115.25	75	41	1794.3	34.8	0.0	.PI
116.26	90	46	1794.4	38.1	0.0	.PI
117.27	115	53	1794.5	42.5	0.0	.PI
118.28	165	63	1794.6	49.4	0.0	.P I
119.29	767	66	1795.2	82.9	0.0	.P I
120.30	1881	72	1796.7	187.9	0.0	.P X
121.31	434	75	1797.8	278.5	0.0	.P I
122.32	177	75	1798.0	297.7	0.0	. P I
123.33	120	76	1798.0	303.8	0.0	. P
124.34	93	76	1798.1	306.4	0.0	. P
125.36	77	76	1798.1	307.2	0.0	. X
126.37	66	76	1798.1	306.9	0.0	.IP
127.38	58	76	1798.1	305.7	0.0	.IP
128.39	52	76	1798.0	304.0	0.0	.IP
129.40	47	75	1798.0	301.9	0.0	.IP
130.41	43	75	1798.0	299.4	0.0	.IP
131.42	40	75	1798.0	296.6	0.0	.IP
132.43	37	75	1797.9	293.6	0.0	.IP
133.44	35	75	1797.9	290.3	0.0	.IP
134.45	33	75	1797.9	286.9	0.0	.P
135.46	31	75	1797.8	283.3	0.0	.P
136.48	30	75	1797.8	279.6	0.0	.P
137.49	28	75	1797.7	275.8	0.0	.P
138.50	27	74	1797.7	271.9	0.0	.P
139.51	26	74	1797.6	267.9	0.0	.P
140.52	25	74	1797.6	263.8	0.0	.P
141.53	24	74	1797.5	259.6	0.0	.P
142.54	23	74	1797.5	255.4	0.0	.P
143.55	22	74	1797.4	251.1	0.0	.P
144.56	21	74	1797.4	246.7	0.0	.P
145.57	21	73	1797.3	242.4	0.0	.P
146.59	20	73	1797.3	237.9	0.0	.P
147.60	19	73	1797.2	233.5	0.0	.P

T, HR. I, CFS

148.61	19	73	1797.2	228.9	0.0	.P
149.62	18	73	1797.1	224.4	0.0	.P
150.63	18	73	1797.1	219.8	0.0	.P
151.64	17	72	1797.0	215.2	0.0	.P
152.65	17	72	1797.0	210.6	0.0	.P
153.66	16	72	1796.9	206.0	0.0	.P
154.67	16	72	1796.9	201.3	0.0	.P
155.68	16	72	1796.8	196.6	0.0	.P
156.69	15	72	1796.8	191.9	0.0	.P
157.71	15	71	1796.7	187.2	0.0	.P
158.72	15	71	1796.7	182.5	0.0	.P
159.73	14	71	1796.6	177.8	0.0	.P
160.74	14	71	1796.6	173.0	0.0	.P
161.75	14	71	1796.5	168.2	0.0	.P
162.76	14	71	1796.4	163.5	0.0	.P
163.77	13	70	1796.4	158.7	0.0	.P
164.78	13	70	1796.3	154.0	0.0	.P
165.79	13	70	1796.3	149.2	0.0	.P
166.80	13	69	1796.2	144.5	0.0	.P
167.81	12	69	1796.2	139.7	0.0	.P
168.83	12	69	1796.1	135.0	0.0	.P
169.84	12	68	1796.1	130.3	0.0	.P
170.85	12	68	1796.0	125.5	0.0	.P
171.86	12	68	1795.9	120.8	0.0	.P
172.87	11	68	1795.8	116.1	0.0	.P
173.88	11	67	1795.8	111.4	0.0	.P
174.89	11	67	1795.7	106.7	0.0	.P
175.90	11	67	1795.6	102.1	0.0	.P
176.91	11	66	1795.5	97.4	0.0	.P
177.92	11	66	1795.4	92.8	0.0	.P
178.93	10	66	1795.3	88.1	0.0	.P
179.95	10	66	1795.2	83.5	0.0	.P
180.96	10	65	1795.1	78.9	0.0	.P

FIGURE C.7, PART B

151.64	17	72	1797.0	215.2	0.0	.P
152.65	17	72	1797.0	210.6	0.0	.P
153.66	16	72	1796.9	206.0	0.0	.P
154.67	16	72	1796.9	201.3	0.0	.P
155.68	16	72	1796.8	196.6	0.0	.P
156.69	15	72	1796.8	191.9	0.0	.P
157.71	15	71	1796.7	187.2	0.0	.P
158.72	15	71	1796.7	182.5	0.0	.P
159.73	14	71	1796.6	177.8	0.0	.P
160.74	14	71	1796.6	173.0	0.0	.P
161.75	14	71	1796.5	168.2	0.0	.P
162.76	14	71	1796.4	163.5	0.0	.P
163.77	13	70	1796.4	158.7	0.0	.P
164.78	13	70	1796.3	154.0	0.0	.P
165.79	13	70	1796.3	149.2	0.0	.P
166.80	13	69	1796.2	144.5	0.0	.P
167.81	12	69	1796.2	139.7	0.0	.P
168.83	12	69	1796.1	135.0	0.0	.P
169.84	12	68	1796.1	130.3	0.0	.P
170.85	12	68	1796.0	125.5	0.0	.P
171.86	12	68	1795.9	120.8	0.0	.P
172.87	11	68	1795.8	116.1	0.0	.P
173.88	11	67	1795.8	111.4	0.0	.P
174.89	11	67	1795.7	106.7	0.0	.P
175.90	11	67	1795.6	102.1	0.0	.P
176.91	11	66	1795.5	97.4	0.0	.P
177.92	11	66	1795.4	92.8	0.0	.P
178.93	10	66	1795.3	88.1	0.0	.P
179.95	10	66	1795.2	83.5	0.0	.P
180.96	10	65	1795.1	78.9	0.0	.P
181.97	10	65	1795.1	74.3	0.0	.P
182.98	10	65	1795.0	69.7	0.0	.P
183.99	10	64	1794.9	65.1	0.0	.P
185.00	10	64	1794.8	60.5	0.0	.P
186.01	10	64	1794.7	56.0	0.0	.P
187.02	9	64	1794.6	51.5	0.0	.P
188.03	9	60	1794.5	47.1	0.0	.P
189.04	9	54	1794.5	43.1	0.0	.P
190.06	9	48	1794.4	39.6	0.0	.P
191.07	9	43	1794.3	36.6	0.0	.P
192.08	9	40	1794.3	33.8	0.0	.P
193.09	9	36	1794.2	31.4	0.0	.P
194.10	9	34	1794.2	29.2	0.0	.P
195.11	9	31	1794.2	27.2	0.0	.P
196.12	8	29	1794.1	25.4	0.0	.P
197.13	8	27	1794.1	23.8	0.0	.P
198.14	8	25	1794.1	22.4	0.0	.
199.15	8	23	1794.1	21.1	0.0	.
200.16	8	21	1794.0	19.9	0.0	.
201.18	8	20	1794.0	18.9	0.0	.
202.19	8	19	1794.0	17.9	0.0	.
203.20	8	18	1794.0	17.1	0.0	.
204.21	8	17	1793.9	16.3	0.0	.
205.22	8	16	1793.9	15.6	0.0	.
206.23	8	15	1793.9	15.0	0.0	.
207.24	8	14	1793.9	14.4	0.0	.
208.25	8	13	1793.9	13.9	0.0	.
209.26	7	13	1793.9	13.5	0.0	.

T, HR. I, CFS

210.27	7	12	1793.9	13.0	0.0	.
211.28	7	12	1793.8	12.7	0.0	.
212.30	7	11	1793.8	12.3	0.0	.
213.31	7	11	1793.8	12.0	0.0	.
214.32	7	10	1793.8	11.7	0.0	.
215.33	7	10	1793.8	11.5	0.0	.
216.34	7	10	1793.8	11.2	0.0	.
217.35	7	9	1793.8	11.0	0.0	.
218.36	7	9	1793.8	10.8	0.0	.
219.37	7	9	1793.8	10.7	0.0	.
220.38	7	9	1793.8	10.5	0.0	.
221.39	7	8	1793.8	10.3	0.0	.
222.40	7	8	1793.8	10.2	0.0	.
223.42	7	8	1793.8	10.1	0.0	.
224.43	7	8	1793.8	10.0	0.0	.
225.44	7	8	1793.8	9.8	0.0	.
226.45	6	8	1793.8	9.7	0.0	.
227.46	6	8	1793.8	9.6	0.0	.
228.47	6	8	1793.8	9.5	0.0	.
229.48	6	8	1793.8	9.4	0.0	.
230.49	6	7	1793.8	9.3	0.0	.
231.50	6	7	1793.8	9.2	0.0	.
232.51	6	7	1793.7	9.1	0.0	.
233.53	6	7	1793.7	9.1	0.0	.
234.54	6	7	1793.7	9.0	0.0	.
235.55	6	7	1793.7	8.9	0.0	.
236.56	6	7	1793.7	8.8	0.0	.
237.57	6	7	1793.7	8.7	0.0	.
238.58	6	7	1793.7	8.6	0.0	.
239.59	6	7	1793.7	8.5	0.0	.
240.60	3	7	1793.7	8.3	0.0	.
241.61	0	6	1793.7	7.9	0.0	.
T	I	D	E	VOL	A	I

0. 500. 1000. 1500. 2000. 2500. 3000.

FIGURE C.7, PART C

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RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR EMG

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DAMS2 [illegible] 07/22/85        STRUCTURE SITE ANALYSIS COMPUTER PROGRAM
      REV 12/03/82  SCS TECHNICAL RELEASE 48, DATED OCT.1982 (USER MANUAL)

      ************************** 80-80 LIST OF INPUT DATA **************************

      DAMS2      12/03/82  APACHE JCT. FRS INFLOW & ROUTING                    00000900
      RAINTABLE HMR5       6.        6-HR PMP IN 15-MIN. INCREMENTS           00000910
                           0.        .005      .011      .0164     .0219      00000920
                           .036      .051      .066      .08       .584       00000930
                           .715      .774      .818      .848      .88        00000940
                           .911      .942      .951      .96       .969       00000950
                           .978      .984      .989      .995      1.         00000960
      ENDTABLE                                                                00000970
      WSDATA       C  1    64.       1.86      .82                            00001010
      PDIRECT    1                            6.        13.7                   00001015
      QDIRECT              2.        3.14                                     00001020
      GO,DESIGN P          HMR5                                               00001030
      XSECTN     1                                                            00001040
                           1805.8    0.        0.                             00001050
                           1806.8    59.       20.                            00001060
                           1807.8    177.      40.                            00001070
                           1808.8    329.      60.                            00001080
                           1809.8    506.      80.                            00001090
                           1810.8    701.      100.                           00001100
                           1811.8    909.      120.                           00001110
                           1812.8    1130.     140.                           00001120
                           1813.8    1360.     160.                           00001130
                           1814.8    1570.     182.                           00001131
                           1815.8    1812.     206.                           00001132
      ENDTABLE                                                                00001135
      GO,REACH   0     C 1AB1         1200.                                   00001140
      WSDATA       C  1    81.       .77       .63                            00001150
      PDIRECT    1                            6.        13.7                   00001155
      QDIRECT              1.97      3.02                                     00001160
      GO,DESIGN D          HMR5                                               00001170
      GO,ADDHYD 0       1AB                                                   00001180
      WSDATA       C  1    80.       .75       .65                            00001190
      PDIRECT    1                            6.        13.7                   00001195
      QDIRECT              1.89      2.91                                     00001200
      GO,DESIGN            HMR5                                               00001210
      GO,ADDHYD 0       1BC                                                   00001220
      WSDATA       C  1    77.       .67       .38                            00001230
      PDIRECT    1                            6.        13.7                   00001235
      QDIRECT              1.66      2.51                                     00001240
      GO,DESIGN            HMR5                                               00001250
      GO,ADDHYD 2        12                                                   00001260
      STRUCTURE AJFRS      RESERVOIR ADJUSTED FOR SEDIMENT,BORROW             00001310
                           1792.                                   0.         00001315
                           1794.                                   18.3       00001320
                           1796.                                   124.2      00001325
                           1798.                                   299.3      00001330
                           1800.                                   529.8      00001335
                           1802.                                   791.6      00001340
                           1804.                                   1085.2     00001345
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DAMS2 XEQ 07/22/85          STRUCTURE SITE ANALYSIS COMPUTER PROGRAM
      REV 12/03/82  SCS TECHNICAL RELEASE 48, DATED OCT.1982 (USER MANUAL)

      ************************* 80-80 LIST OF INPUT DATA *************************

                        1806.                                       1402.8      00001350
                        1808.                                       1755.3      00001355
                        1810.                                       2141.6      00001360
      ENDTABLE                                                                  00001370
      WSDATA       C    82.        1.74       .69                               00001372
      PDIRECT   1                              6.        13.7                    00001373
      QDIRECT           1.94       3.07                                         00001374
      POOLDATA  ELEV               1793.5                                       00001380
      CLPROFILE                    APACHE FRS DAM CENTERLINE                    00001390
                0.      1808.      920.       1796.     1110.      1792.        00001400
                1480.   1788.      5710.      1788.     5910.      1792.        00001410
                6210.   1790.      7000.      1790.     7450.      1792.        00001420
                8050.   1800.      8150.      1804.     8480.      1808.        00001430
      ENDTABLE                                                                  00001440
      TEMPLATE  14.     2.5        2.                                           00001441
      PSDATA    1       135.       30.                  .013       1786.        00001450
      PSINLET           1.         15.                                          00001460
      ESCREST   ELEV                                                            00001470
      ESDATA    41      500.       .025       2.        .025                    00001480
      ESRATING  41      1.         RATING FOR 3.1  B H(3/2)                     00001481
      ESRATING  3.1     8.77       16.11      24.8      34.66      45.56        00001482
      ESRATING  57.41   70.14      83.7       98.03     113.1      128.86       00001483
      BTMWILTH  FEET    250.       200.       150.      100.                    00001485
      GO,DESIGN L P C E HMR5                                                    00001490
      ENDJOB                                                                    00001500

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III C-62

********** BASIC DATA **********

****NOT DEFINED CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION.....6-HR PMP IN 15-MIN. INCREMENTS

Q-PS1 DAY	Q-PS10 DAY	P-ES	P-FB	CN	DA-SM	TC/L	-/H
2.00	3.14	6.00	13.70	84.00	1.86	0.82	0.00

BASEFLOW	INITIAL EL	EXTRA VOL.
0.00	0.00	0.00

REACH ROUTING RESULT - PSH - PEAK = 1045.70 AT 120.30 HRS. LOCATION POINT 1AB
REACH ROUTING RESULT - EMG - PEAK = 3953.41 AT 2.77 HRS. LOCATION POINT 1AB
REACH ROUTING RESULT - FB - PEAK = 11501.29 AT 2.77 HRS. LOCATION POINT 1AB

********** BASIC DATA **********

****NOT DEFINED CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION.....6-HR PMP IN 15-MIN. INCREMENTS

ACCUMULATED DA FOR SYSTEM = 2.63 SQ. MILES

Q-PS1 DAY	Q-PS10 DAY	P-ES	P-FB	CN	DA-SM	TC/L	-/H
1.97	3.02	6.00	13.70	81.00	0.77	0.63	0.00

BASEFLOW	INITIAL EL	EXTRA VOL.
0.00	0.00	0.00

```
INFLOW HYD 1 PSH-PEAK =        514.17 AT  120.00 HRS.  LOCATION POINT  1AB
INFLOW HYD 2 PSH-PEAK =       1045.70 AT  120.30 HRS.  LOCATION POINT  1AB
ADDHYD RESULTS PSH - PEAK =   1438.06 AT  120.30 HRS.  LOCATION POINT  1AB

INFLOW HYD 1 EMG-PEAK =       1795.75 AT    2.64 HRS.  LOCATION POINT  1AB
INFLOW HYD 2 EMG-PEAK =       3953.41 AT    2.77 HRS.  LOCATION POINT  1AB
ADDHYD RESULTS EMG - PEAK =   5535.98 AT    2.68 HRS.  LOCATION POINT  1AB

INFLOW HYD 1 FB -PEAK =       5576.20 AT    2.56 HRS.  LOCATION POINT  1AB
INFLOW HYD 2 FB -PEAK =      11501.29 AT    2.77 HRS.  LOCATION POINT  1AB
ADDHYD RESULTS FB  - PEAK =  16488.77 AT    2.68 HRS.  LOCATION POINT  1AB
```

III C-64

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********** BASIC DATA **********

****NOT DEFINED CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION.....6-HR PMP IN 15-MIN. INCREMENTS

ACCUMULATED DA FOR SYSTEM = 3.38 SQ. MILES

Q-PS1 DAY	Q-PS10 DAY	P-ES	P-FB	CN	DA-SM	TC/L	-/H
1.89	2.91	6.00	13.70	80.00	0.75	0.65	0.00

BASEFLOW	INITIAL EL	EXTRA VOL.
0.00	0.00	0.00

```
INFLOW HYD 1 PSH-PEAK =        476.36 AT  120.03 HRS.  LOCATION POINT  1BC
INFLOW HYD 2 PSH-PEAK =       1438.06 AT  120.30 HRS.  LOCATION POINT  1BC
ADDHYD RESULTS PSH - PEAK =   1813.04 AT  120.30 HRS.  LOCATION POINT  1BC

INFLOW HYD 1 EMG-PEAK =       1656.71 AT    2.66 HRS.  LOCATION POINT  1BC
INFLOW HYD 2 EMG-PEAK =       5535.98 AT    2.68 HRS.  LOCATION POINT  1BC
ADDHYD RESULTS EMG - PEAK =   7171.48 AT    2.68 HRS.  LOCATION POINT  1BC

INFLOW HYD 1 FB -PEAK =       5246.33 AT    2.58 HRS.  LOCATION POINT  1BC
INFLOW HYD 2 FB -PEAK =      16488.77 AT    2.68 HRS.  LOCATION POINT  1BC
ADDHYD RESULTS FB  - PEAK =  21510.83 AT    2.68 HRS.  LOCATION POINT  1BC
```

III C-65

********** BASIC DATA **********

****NOT DEFINED CLIMATE AREA

DESIGN CLASS C

STORM DISTRIBUTION.....6-HR PMP IN 15-MIN. INCREMENTS

ACCUMULATED DA FOR SYSTEM = 4.05 SQ. MILES

Q-PS1 DAY	Q-PS10 DAY	P-ES	P-FB	CN	DA-SM	TC/L	-/H
1.66	2.51	6.00	13.70	77.00	0.67	0.38	0.00

BASEFLOW	INITIAL EL	EXTRA VOL.
0.00	0.00	0.00

INFLOW HYD 1 PSH-PEAK =	394.70	AT	119.60 HRS.	LOCATION POINT	12
INFLOW HYD 2 PSH-PEAK =	1813.04	AT	120.30 HRS.	LOCATION POINT	12
ADDHYD RESULTS PSH - PEAK =	1985.32	AT	120.30 HRS.	LOCATION POINT	12
INFLOW HYD 1 EMG-PEAK =	1847.42	AT	2.45 HRS.	LOCATION POINT	12
INFLOW HYD 2 EMG-PEAK =	7171.48	AT	2.68 HRS.	LOCATION POINT	12
ADDHYD RESULTS EMG - PEAK =	8331.02	AT	2.68 HRS.	LOCATION POINT	12
INFLOW HYD 1 FB -PEAK =	6251.76	AT	2.38 HRS.	LOCATION POINT	12
INFLOW HYD 2 FB -PEAK =	21510.83	AT	2.68 HRS.	LOCATION POINT	12
ADDHYD RESULTS FB - PEAK =	25421.54	AT	2.59 HRS.	LOCATION POINT	12

III C-66

********** BASIC DATA **********

****NOT DEFINED CLIMATE AREA

DESIGN CLASS C

STORM DISTRIBUTION.....6-HR PMP IN 15-MIN. INCREMENTS

ACCUMULATED DA FOR SYSTEM = 5.79 SQ. MILES

Q-PS1 DAY	Q-PS10 DAY	P-ES	P-FB	CN	DA-SM	TC/L	-/H
1.94	3.07	6.00	13.70	82.00	1.74	0.69	0.00
CONDUITS	COND L	D/W	-/H	PS N	KI	WEIR L	TW EL
1.00	135.00	30.00	0.00	0.013	1.00	15.00	1786.00
PERM POOL	CREST PS	FP SED	QRF	2ND STG	DRF H	DRF L	START ES
0.00	1793.50	0.00	0.00	0.00	0.00	0.00	0.00
BASEFLOW	INITIAL EL	EXTRA VOL.					
0.00	0.00	0.00					
ES1	ES2	ES3	ES4	ES5	Z ES	EXIT N	EXIT S
0.00	0.00	0.00	0.00	0.00	2.00	0.025	0.000
ES TYPE	ES L	ES N	BW1	BW2	BW3	BW4	BW5
41	500	0.025	250.00	200.00	150.00	100.00	0.00

****NOTE THIS IS ONLY A PRELIMINARY EMG RATING CURVE OF DISCHARGE/FT OF WIDTH AND DOES NOT INCLUDE SIDESLOPE CORRECTION OR REVISED RATING USING ACTUAL EMG. CONFIGURATION.

ES CODE	INCREMENT			Q1	Q2	Q3	Q4
41	1.000			3.100	8.770	16.110	24.800
Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
34.660	45.560	57.410	70.140	83.700	98.030	113.100	128.860

********** DETAILED LIST OF BASIC DATA **********

WEIR COEF. FOR ORIFICES..... 3.10	RATIO OF IA TO S(CH.10,NEH4).. 0.20	MIN ES BW WHEN MAX V/C GIVEN.. 20.0
WEIR COEF. FOR DROP INLET..... 3.10	TIME INCS TO PEAK OF UNIT HYD. 5.	DELTA BW WHEN MAX V/C GIVEN... 64.0
DISCHARGE COEF. FOR ORIFICES.. 0.60	NO. POINTS FOR DESIGN HYD..... 101	PRECISION OF BW SOLUTION..... 1.0
FILLET SIZE FOR BOX CONDUITS.. 6.00	ES-WSP CALC. DEPTH PRECISION. 0.005	PRECISION OF V/C SOLUTION..... 0.03
GRAVITATIONAL CONSTANT..... 32.16	ES-WSP PERMISSIBLE VEL.CHANGE. 0.05	MIN.ES378 DEPTH EMG TO TOP DAM 2.00
MIN.ES378 DEPTH PS -EMG CREST. 1.00	MINTR60 DEPTH EMG TO TOP DAM.. 3.00	MIN.ES378 DEPTH DESIGN Q- TOD 1.00
EMG. SPILLWAY MIN. CAP. COEFF 237.0		

	TOP WIDTH	UPSTREAM Z	DOWNSTREAM Z	WAVE BERM	STAB. BERM	DH MAX
EMBANKMENT TEMPLATE	14.0	2.5	2.0	0.0	0.0	0.0
RAINFALL EQUATION CONSTANTS CLASS C	K1 PSH	K1 ESH	K1 FBH	K2 PSH	K2 ESH	K2 FBH
	1.00	1.00	1.00	0.00	0.26	1.00

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DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 TIME INC.=0.020 NO. INC. TO PEAK= 5.00 PRODUCT ORD. AND TIME INC. =0.2669787

0.0000	0.0300	0.1000	0.1900	0.3100	0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800	0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470	0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290	0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060	0.0050	0.0040	0.0030	0.0020	0.0010
0.0000									

SCS DESIGN STORM RAINFALL DISTRIBUTION. (CHAPTER 21, NEH4 AND SCS TR-60)

0.000	0.008	0.016	0.025	0.033	0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.127	0.142	0.160	0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684	0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844	0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948	0.957	0.966	0.975	0.983	0.992
1.000									

24 HOUR TYPE II RAINFALL DISTRIBUTION ID NAME IS TYPE2

0.000	0.002	0.005	0.008	0.011	0.014	0.017	0.020	0.023	0.026
0.029	0.032	0.035	0.038	0.041	0.044	0.048	0.052	0.056	0.060
0.064	0.068	0.072	0.076	0.080	0.085	0.090	0.095	0.100	0.105
0.110	0.115	0.120	0.126	0.133	0.140	0.147	0.155	0.163	0.172
0.181	0.191	0.203	0.218	0.236	0.257	0.283	0.387	0.663	0.707
0.735	0.758	0.776	0.791	0.804	0.815	0.825	0.834	0.842	0.849
0.856	0.863	0.869	0.875	0.881	0.887	0.893	0.898	0.903	0.908
0.913	0.918	0.922	0.926	0.930	0.934	0.938	0.942	0.946	0.950
0.953	0.956	0.959	0.962	0.965	0.968	0.971	0.974	0.977	0.980
0.983	0.986	0.989	0.992	0.995	0.998	1.000			

6-HR PMP IN 15-MIN. INCREMENTS ID NAME IS HMR5

0.000	0.005	0.011	0.016	0.022	0.036	0.051	0.066	0.080	0.584
0.715	0.774	0.818	0.848	0.880	0.911	0.942	0.951	0.960	0.969
0.978	0.984	0.989	0.995	1.000					

UNCONTROLLED AREA HYDROGRAPH- FSH - PEAK= 1077.36 AT 120.10 HRS. LOCATION POINT 12

ADDHYD RESULTS PS HYDROGRAPH - PEAK = 2892.55 AT 120.30 HRS. LOCATION POINT 12

CREST PS	1793.50 FT	13.7 ACFT	0.00 AC	0.0 CFS
SED ACCUM	1793.50 FT	13.7 ACFT	0.00 AC	0.0 CFS
STARTING E	1793.50 FT	13.7 ACFT	0.00 AC	0.0 CFS

SCS-PSH RAINFALL 1 DAY =****** IN 10 DAY =****** IN
RUNOFF 1 DAY = 1.94 IN 10 DAY = 3.07 IN

CLIMATIC INDEX = 1.00 CN10D = 0.

ROUTED RESULTS - HYD TYPE	EMAX	VOL-MAX	AMAX	QMAX
SCS-PSH	1799.77 FT	503.4 ACFT	0.00 AC	81.0 CFS

PS STORAGE 489.7 ACFT BETWEEN ES CREST AND SED ACCUM ELEVATIONS

DDT TEST 1795.30 FT 87.2 ACFT 65.9 CFS
CONTROL IS 0.150 DETENTION STORAGE

DRAWDOWN TIME TO DDT TEST Q IS 3.92 DAYS - DRAWDOWN CONTINUING

DRAWDOWN TIME LIMIT = 10.00 DAYS. FLOW WAS 0.00 CFS ELEV = 1793.50 FT

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH 1 INCH= 500. CFS

T	I	O	E	VOL	A	0. 500. 1000. 1500. 2000. 2500. 3000. 3500.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.	0.00
1.01	8	1	1793.5	14.0	0.0	.	0.00
2.02	9	2	1793.6	14.6	0.0	.	0.00
3.03	9	4	1793.7	15.1	0.0	.	0.00
4.04	9	5	1793.7	15.5	0.0	.	0.00
5.05	9	6	1793.7	15.8	0.0	.	0.00
6.07	9	7	1793.8	16.1	0.0	.	0.00
7.08	9	7	1793.8	16.3	0.0	.	0.00
8.09	9	8	1793.8	16.4	0.0	.	0.00
9.10	10	8	1793.8	16.6	0.0	.	0.00
10.11	10	8	1793.8	16.7	0.0	.	0.00
11.12	10	8	1793.8	16.8	0.0	.	0.00
12.13	10	9	1793.8	16.9	0.0	.	0.00
13.14	10	9	1793.9	17.0	0.0	.	0.00
14.15	10	9	1793.9	17.1	0.0	.	0.00
15.16	10	9	1793.9	17.2	0.0	.	0.00
16.17	10	9	1793.9	17.2	0.0	.	0.00
17.19	10	9	1793.9	17.3	0.0	.	0.00
18.20	10	9	1793.9	17.4	0.0	.	0.00
19.21	10	10	1793.9	17.4	0.0	.	0.00
20.22	10	10	1793.9	17.5	0.0	.	0.00
21.23	10	10	1793.9	17.5	0.0	.	0.00
22.24	11	10	1793.9	17.6	0.0	.	0.00
23.25	11	10	1793.9	17.6	0.0	.	0.00
24.26	11	10	1793.9	17.7	0.0	.	0.00

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25.27	11	10	1793.9	17.8	0.0	.	0.00
26.28	11	10	1793.9	17.8	0.0	.	0.00
27.30	11	10	1794.0	17.9	0.0	.	0.00
28.31	11	10	1794.0	17.9	0.0	.	0.00
29.32	11	11	1794.0	18.0	0.0	.	0.00
30.33	11	11	1794.0	18.0	0.0	.	0.00
31.34	11	11	1794.0	18.1	0.0	.	0.00
32.35	12	11	1794.0	18.1	0.0	.	0.00
33.36	12	11	1794.0	18.2	0.0	.	0.00
34.37	12	11	1794.0	18.2	0.0	.	0.00
35.38	12	11	1794.0	18.3	0.0	.	0.00
36.39	12	11	1794.0	18.4	0.0	.	0.00
37.40	12	11	1794.0	18.4	0.0	.	0.00
38.42	12	12	1794.0	18.5	0.0	.	0.00
39.43	12	12	1794.0	18.5	0.0	.	0.00
40.44	12	12	1794.0	18.6	0.0	.	0.00
41.45	13	12	1794.0	18.7	0.0	.	0.00
42.46	13	12	1794.0	18.7	0.0	.	0.00
43.47	13	12	1794.0	18.8	0.0	.	0.00
44.48	13	12	1794.0	18.9	0.0	.	0.00
45.49	13	12	1794.0	18.9	0.0	.	0.00
46.50	13	12	1794.0	19.0	0.0	.	0.00
47.51	13	13	1794.0	19.1	0.0	.	0.00
48.52	14	13	1794.0	19.1	0.0	.	0.00
49.54	14	13	1794.0	19.2	0.0	.	0.00
50.55	14	13	1794.0	19.3	0.0	.	0.00
51.56	14	13	1794.0	19.4	0.0	.	0.00
52.57	14	13	1794.0	19.5	0.0	.	0.00
53.58	14	13	1794.0	19.5	0.0	.	0.00
54.59	15	14	1794.0	19.6	0.0	.	0.00
55.60	15	14	1794.0	19.7	0.0	.	0.00
56.61	15	14	1794.0	19.8	0.0	.	0.00
57.62	15	14	1794.0	19.9	0.0	.	0.00
58.63	15	14	1794.0	20.0	0.0	.	0.00
59.64	16	14	1794.0	20.1	0.0	.	0.00
60.66	16	15	1794.0	20.2	0.0	.	0.00
61.67	16	15	1794.0	20.3	0.0	.	0.00
62.68	16	15	1794.0	20.4	0.0	.	0.00
63.69	16	15	1794.0	20.5	0.0	.	0.00
64.70	17	15	1794.0	20.6	0.0	.	0.00
65.71	17	16	1794.0	20.7	0.0	.	0.00
66.72	17	16	1794.0	20.9	0.0	.	0.00
67.73	18	16	1794.1	21.0	0.0	.	0.00
68.74	18	16	1794.1	21.1	0.0	.	0.00
69.75	18	17	1794.1	21.2	0.0	.	0.00
70.77	18	17	1794.1	21.4	0.0	.	0.00
71.78	19	17	1794.1	21.5	0.0	.	0.00
72.79	19	17	1794.1	21.7	0.0	.	0.00
73.80	19	18	1794.1	21.8	0.0	.	0.00
74.81	20	18	1794.1	22.0	0.0	.	0.00
75.82	20	18	1794.1	22.1	0.0	.	0.00
76.83	20	18	1794.1	22.3	0.0	.	0.00
77.84	21	19	1794.1	22.5	0.0	.	0.00
78.85	21	19	1794.1	22.6	0.0	.	0.00
79.86	22	19	1794.1	22.8	0.0	.	0.00
80.87	22	20	1794.1	23.0	0.0	.	0.00
81.89	23	20	1794.1	23.2	0.0	.	0.00
82.90	23	20	1794.1	23.4	0.0	.	0.00
83.91	24	21	1794.1	23.7	0.0	.	0.00
84.92	24	21	1794.1	23.9	0.0	.	0.00
85.93	25	22	1794.1	24.1	0.0	.	0.00

86.[illegible]	25	22	1794.1	24.4	0.0	.I	0.00
87.95	26	23	1794.1	24.6	0.0	.I	0.00
88.96	27	23	1794.1	24.9	0.0	.I	0.00
89.97	27	23	1794.1	25.3	0.0	.I	0.00
90.98	28	24	1794.1	25.6	0.0	.I	0.00
91.99	29	24	1794.1	26.0	0.0	.I	0.00
93.01	30	25	1794.2	26.4	0.0	.I	0.00
94.02	31	25	1794.2	26.8	0.0	.P	0.00
95.03	32	26	1794.2	27.3	0.0	.P	0.00
96.04	33	26	1794.2	27.8	0.0	.P	0.00
97.05	34	27	1794.2	28.4	0.0	.P	0.00
98.06	35	28	1794.2	29.0	0.0	.P	0.00
99.07	36	28	1794.2	29.6	0.0	.P	0.00
100.08	38	29	1794.2	30.3	0.0	.P	0.00
101.09	39	30	1794.2	31.0	0.0	.P	0.00
102.10	41	31	1794.3	31.9	0.0	.P	0.00
103.11	43	32	1794.3	32.8	0.0	.P	0.00
104.13	45	33	1794.3	33.7	0.0	.P	0.00
105.14	48	34	1794.3	34.8	0.0	.P	0.00
106.15	51	36	1794.3	36.0	0.0	.P	0.00
107.16	54	37	1794.4	37.3	0.0	.P	0.00
108.17	57	39	1794.4	38.7	0.0	.P	0.00
109.18	61	41	1794.4	40.3	0.0	.P	0.00
110.19	66	43	1794.5	42.1	0.0	.P	0.00
111.20	72	46	1794.5	44.2	0.0	.P	0.00
112.21	79	49	1794.5	46.5	0.0	.PI	0.00
113.22	88	53	1794.6	49.3	0.0	.PI	0.00
114.24	100	57	1794.6	52.5	0.0	.PI	0.00
115.25	116	63	1794.7	56.5	0.0	.PI	0.00
116.26	139	64	1794.8	61.8	0.0	.P I	0.00
117.27	177	65	1795.0	69.6	0.0	.P I	0.00
118.28	255	66	1795.2	82.2	0.0	.P I	0.00
119.29	1192	69	1796.1	137.0	0.0	.P I	0.00
120.30	2893	75	1798.0	301.6	0.0	. P X	0.00
121.31	662	79	1799.3	443.7	0.0	. P I	0.00
122.32	272	80	1799.5	476.0	0.0	. P I	0.00
123.33	184	81	1799.6	488.3	0.0	. P I	0.00
124.34	143	81	1799.7	495.2	0.0	. PI	0.00
125.36	118	81	1799.7	499.4	0.0	. P	0.00
126.37	102	81	1799.8	501.8	0.0	. P	0.00
127.38	90	81	1799.8	503.1	0.0	. P	0.00
128.39	80	81	1799.8	503.4	0.0	. X	0.00
129.40	73	81	1799.8	503.0	0.0	.IP	0.00
130.41	67	81	1799.8	502.1	0.0	.IP	0.00
131.42	62	81	1799.7	500.7	0.0	.IP	0.00
132.43	58	81	1799.7	499.0	0.0	.IP	0.00
133.44	54	81	1799.7	496.9	0.0	.IP	0.00
134.45	51	81	1799.7	494.5	0.0	.IP	0.00
135.46	48	81	1799.7	491.9	0.0	.IP	0.00
136.48	46	81	1799.6	489.0	0.0	.IP	0.00
137.49	43	81	1799.6	486.0	0.0	.IP	0.00
138.50	41	80	1799.6	482.8	0.0	.IP	0.00
139.51	40	80	1799.6	479.5	0.0	.IP	0.00
140.52	38	80	1799.5	476.0	0.0	.IP	0.00
141.53	36	80	1799.5	472.4	0.0	.IP	0.00
142.54	35	80	1799.5	468.7	0.0	.IP	0.00
143.55	34	80	1799.4	464.9	0.0	.IP	0.00
144.56	33	80	1799.4	461.0	0.0	.IP	0.00
145.57	32	80	1799.4	457.1	0.0	.IP	0.00
146.59	31	80	1799.3	453.0	0.0	.IP	0.00
147.60	30	80	1799.3	448.9	0.0	.IP	0.00

210.2	11	69	1796.3	149.0	0.0	.P	0.00
211.26	11	69	1796.2	144.2	0.0	.P	0.00
212.30	11	69	1796.2	139.4	0.0	.P	0.00
213.31	11	69	1796.1	134.5	0.0	.P	0.00
214.32	11	68	1796.1	129.7	0.0	.P	0.00
215.33	11	68	1796.0	124.9	0.0	.P	0.00
216.34	11	68	1795.9	120.2	0.0	.P	0.00
217.35	11	68	1795.8	115.4	0.0	.P	0.00
218.36	11	67	1795.7	110.7	0.0	.P	0.00
219.37	11	67	1795.7	105.9	0.0	.P	0.00
220.38	10	67	1795.6	101.2	0.0	.P	0.00
221.39	10	66	1795.5	96.5	0.0	.P	0.00
222.40	10	66	1795.4	91.8	0.0	.P	0.00
223.42	10	66	1795.3	87.2	0.0	.P	0.00
224.43	10	66	1795.2	82.5	0.0	.P	0.00
225.44	10	65	1795.1	77.9	0.0	.P	0.00
226.45	10	65	1795.0	73.3	0.0	.P	0.00
227.46	10	65	1795.0	68.7	0.0	.P	0.00
228.47	10	65	1794.9	64.1	0.0	.P	0.00
229.48	10	64	1794.8	59.5	0.0	.P	0.00
230.49	10	61	1794.7	55.1	0.0	.P	0.00
231.50	10	55	1794.6	51.0	0.0	.P	0.00
232.51	9	50	1794.5	47.4	0.0	.P	0.00
233.53	9	46	1794.5	44.2	0.0	.P	0.00
234.54	9	42	1794.4	41.3	0.0	.P	0.00
235.55	9	39	1794.4	38.7	0.0	.P	0.00
236.56	9	36	1794.3	36.3	0.0	.P	0.00
237.57	9	34	1794.3	34.2	0.0	.P	0.00
238.58	9	31	1794.3	32.2	0.0	.P	0.00
239.59	9	29	1794.2	30.4	0.0	.P	0.00
240.60	5	27	1794.2	28.6	0.0	.P	0.00
241.61	0	25	1794.2	26.6	0.0	.	0.00
T	I	O	E	VOL	A	I	VEL

0. 500. 1000. 1500. 2000. 2500. 3000. 3500. EXIT

****

RATING TABLE DEVELOPED
WITH PS DEVELLPED BY PROGRAM AND ESRATING FOR EMG

RATING TABLE NUMBER 1

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.81	8.03	8.03	16.56	0.00
3	1794.12	22.70	22.70	24.65	0.00
4	1794.43	41.70	41.70	41.07	0.00
5	1794.74	64.21	64.21	57.48	0.00
6	1796.65	71.33	71.33	180.89	0.00
7	1798.56	77.45	77.45	363.26	0.00
8	1800.46	83.13	83.13	590.34	0.00
9	1802.37	88.44	88.44	845.92	0.00
10	1804.28	93.45	93.45	1129.27	0.00
11	1806.19	98.21	98.21	1435.41	0.00
12	1808.09	102.74	102.74	1773.17	0.00
13	1810.00	107.08	107.08	2141.60	0.00

UNCONTROLLED AREA HYDROGRAPH - EMG PEAK = 3978.53 AT 2.62 HRS. LOCATION POINT 12

ADDHYD RESULTS EMERGENCY HYD. - PEAK= 12284.94 AT 2.68 HRS. LOCATION POINT 12

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UNCON[illegible]D AREA HYDROGRAPH - FB  PEAK =  12111.98 AT   2.[illegible]S.  LOCATION POINT   12
ADDHYD RESULTS FREEBOARD HYD. - PEAK=      37362.45 AT   2.59 HRS.  LOCATION POINT   12
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III C-13

ES CREST 1799.77 FT 503.4 ACFT 0.00 AC 81.0 CFS

PS STORAGE 489.7 ACFT BETWEEN ES CREST AND SED ACCUM ELEVATIONS

STARTING E 1793.50 FT 13.7 ACFT 0.00 AC 0.0 CFS

EFFECTIVE HEIGHT(H)= 11.8 FEET, PRODUCT = 5926. (H * STORAGE AT CREST EMG.)

INPUT DESIGN CLASS = C

SCS-ESH D= 6.00 HR P= 6.00 IN Q= 3.99 IN
TC= 0.69 HR CN= 82.00 VOL= 369.9 ACFT
PEAK 12284.9 CFS AT 2.68 HRS

SCS-FBH D= 6.00 HR P= 13.70 IN Q= 11.38 IN
TC= 0.69 HR CN= 82.00 VOL= 1055.3 ACFT
PEAK 37362.4 CFS AT 2.59 HRS

****
RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR EMG

RATING TABLE NUMBER 2

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.81	8.03	8.03	16.56	0.00
3	1794.12	22.70	22.70	24.65	0.00
4	1794.43	41.70	41.70	41.07	0.00
5	1794.74	64.21	64.21	57.48	0.00
6	1795.37	66.91	66.91	90.78	0.00
7	1796.00	69.12	69.12	124.08	0.00
8	1796.63	71.26	71.26	179.06	0.00
9	1797.26	73.33	73.33	234.12	0.00
10	1797.88	75.35	75.35	289.18	0.00
11	1798.51	77.32	77.32	358.45	0.00
12	1799.14	79.24	79.24	430.93	0.00
13	1799.77	81.12	81.12	503.40	0.00
14	1800.28	480.34	82.61	566.77	0.00
15	1800.79	895.98	84.07	633.72	0.00
16	1801.71	2221.13	86.65	754.23	0.00
17	1802.84	4335.14	89.70	914.87	0.00
18	1804.89	9317.85	94.99	1225.82	0.00
19	1807.44	17268.89	101.22	1657.08	0.00
20	1810.00	26866.06	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	250.0	1802.09	805.2	0.0	2.32	301.8	87.7	2804.1	2891.8	1.56	7.10	0.008	0.011	8.5	2.7

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBH Q/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.011

T	I	O	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	0	0	1793.5	13.7	0.0									0.00

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RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR EMG

RATING TABLE NUMBER 5

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.81	8.03	8.03	16.56	0.00
3	1794.12	22.70	22.70	24.65	0.00
4	1794.43	41.70	41.70	41.07	0.00
5	1794.74	64.21	64.21	57.48	0.00
6	1795.37	66.91	66.91	90.78	0.00
7	1796.00	69.12	69.12	124.08	0.00
8	1796.63	71.26	71.26	179.06	0.00
9	1797.26	73.33	73.33	234.12	0.00
10	1797.88	75.35	75.35	289.18	0.00
11	1798.51	77.32	77.32	358.45	0.00
12	1799.14	79.24	79.24	430.93	0.00
13	1799.77	81.12	81.12	503.40	0.00
14	1800.28	242.51	82.61	566.77	0.00
15	1800.79	411.50	84.07	633.72	0.00
16	1801.71	953.67	86.65	754.23	0.00
17	1802.84	1829.08	89.70	914.87	0.00
18	1804.89	3931.62	94.99	1225.82	0.00
19	1807.44	7374.64	101.22	1657.08	0.00
20	1810.00	11643.64	107.08	2141.60	0.00

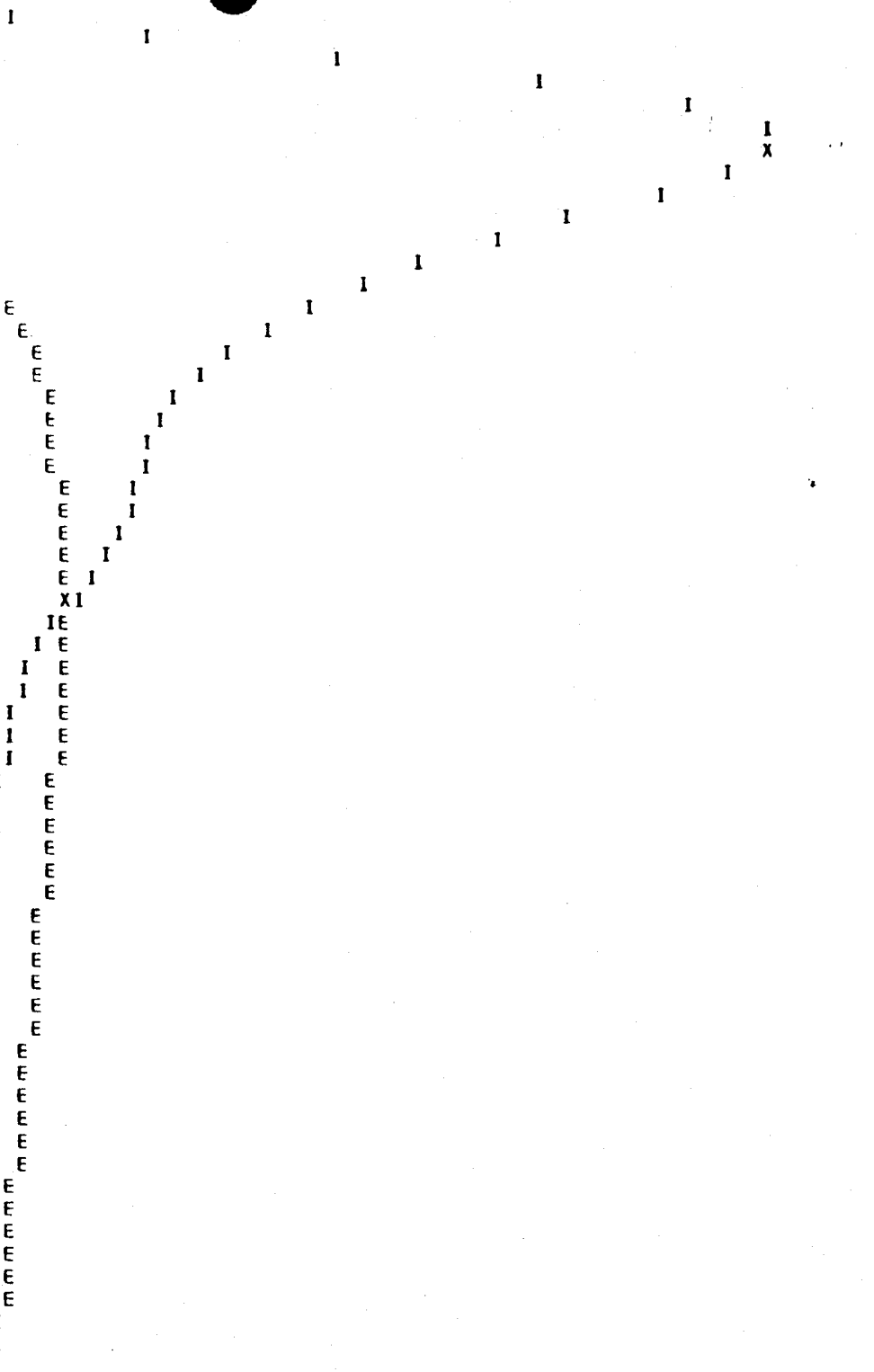
TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	100.0	1802.89	921.6	0.0	3.11	418.2	89.8	1785.1	1874.9	2.08	8.24	0.007	0.010	14.3	6.3

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBH Q/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.010

T	I	O	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	0	0	1793.5	13.7	0.0	.								0.00
0.17	0	0	1793.5	13.7	0.0	.								0.00
0.26	0	0	1793.5	13.7	0.0	.								0.00
0.35	0	0	1793.5	13.7	0.0	.								0.00
0.43	0	0	1793.5	13.7	0.0	.								0.00
0.52	0	0	1793.5	13.7	0.0	.								0.00
0.61	0	0	1793.5	13.7	0.0	.								0.00
0.69	0	0	1793.5	13.7	0.0	.								0.00
0.78	0	0	1793.5	13.7	0.0	.								0.00
0.86	0	0	1793.5	13.7	0.0	.								0.00
0.95	0	0	1793.5	13.7	0.0	.								0.00
1.04	0	0	1793.5	13.7	0.0	.								0.00
1.12	0	0	1793.5	13.7	0.0	.								0.00
1.21	0	0	1793.5	13.7	0.0	.								0.00
1.30	0	0	1793.5	13.7	0.0	.								0.00
1.38	0	0	1793.5	13.7	0.0	.								0.00
1.47	0	0	1793.5	13.7	0.0	.								0.00
1.56	0	0	1793.5	13.7	0.0	.								0.00
1.64	0	0	1793.5	13.7	0.0	.								0.00
1.73	0	0	1793.5	13.7	0.0	.								0.00
1.82	0	0	1793.5	13.7	0.0	.								0.00
1.90	0	0	1793.5	13.7	0.0	.								0.00
1.99	11	0	1793.5	13.8	0.0	.								0.00

2.16	957	12	1794.0	18.5	0.0	.	0.00
2.25	2911	31	1794.3	32.2	0.0	.	0.00
2.33	5845	65	1794.8	65.1	0.0	.	0.00
2.42	8826	69	1795.8	115.0	0.0	.	0.00
2.51	11019	71	1796.7	185.4	0.0	.	0.00
2.59	12133	75	1797.6	267.6	0.0	.	0.00
2.68	12285	77	1798.5	354.3	0.0	.	0.00
2.77	11670	79	1799.2	439.3	0.0	.	0.00
2.85	10560	118	1799.9	518.0	0.0	.	1.95*
2.94	9300	295	1800.4	587.5	0.0	.	3.92*
3.03	8109	471	1800.9	646.9	0.0	.	4.97*
3.11	7038	696	1801.3	696.8	0.0	.	5.93
3.20	6126	882	1801.6	738.2	0.0	.	6.56
3.28	5353	1052	1801.9	772.3	0.0	.	7.12
3.37	4708	1204	1802.1	800.2	0.0	.	7.54
3.46	4191	1328	1802.2	822.9	0.0	.	7.84
3.54	3788	1430	1802.3	841.6	0.0	.	8.07
3.63	3479	1514	1802.4	857.0	0.0	.	8.26
3.72	3246	1585	1802.5	870.0	0.0	.	8.40
3.80	3066	1645	1802.6	881.0	0.0	.	8.52
3.89	2934	1696	1802.7	890.5	0.0	.	8.63
3.98	2834	1742	1802.7	898.8	0.0	.	8.76
4.06	2739	1782	1802.8	906.2	0.0	.	8.85
4.15	2607	1816	1802.8	912.4	0.0	.	8.89
4.24	2415	1845	1802.9	917.3	0.0	.	8.97
4.32	2173	1867	1802.9	920.4	0.0	.	8.99
4.41	1915	1875	1802.9	921.6	0.0	.	9.04
4.50	1673	1871	1802.9	921.1	0.0	.	9.01
4.58	1458	1857	1802.9	918.9	0.0	.	8.98
4.67	1279	1834	1802.8	915.5	0.0	.	8.95
4.75	1141	1809	1802.8	911.2	0.0	.	8.91
4.84	1037	1782	1802.8	906.1	0.0	.	8.84
4.93	959	1752	1802.7	900.6	0.0	.	8.77
5.01	902	1720	1802.7	894.9	0.0	.	8.68
5.10	856	1688	1802.7	889.0	0.0	.	8.64
5.19	810	1655	1802.6	883.0	0.0	.	8.59
5.27	762	1622	1802.6	876.9	0.0	.	8.48
5.36	712	1588	1802.5	870.7	0.0	.	8.43
5.45	662	1554	1802.5	864.4	0.0	.	8.36
5.53	614	1519	1802.5	858.0	0.0	.	8.29
5.62	573	1484	1802.4	851.5	0.0	.	8.16
5.71	542	1448	1802.4	845.0	0.0	.	8.08
5.79	520	1413	1802.3	838.6	0.0	.	8.01
5.88	505	1379	1802.3	832.3	0.0	.	7.93
5.96	492	1345	1802.2	826.1	0.0	.	7.85
6.05	476	1312	1802.2	820.0	0.0	.	7.78
6.14	450	1280	1802.2	814.1	0.0	.	7.71
6.22	407	1247	1802.1	808.1	0.0	.	7.64
6.31	351	1214	1802.1	802.0	0.0	.	7.56
6.40	289	1180	1802.0	795.8	0.0	.	7.46
6.48	230	1145	1802.0	789.3	0.0	.	7.36
6.57	177	1109	1801.9	782.7	0.0	.	7.24
6.66	134	1073	1801.9	776.0	0.0	.	7.17
6.74	101	1036	1801.8	769.4	0.0	.	7.04
6.83	75	1000	1801.8	762.7	0.0	.	6.97
6.92	56	964	1801.7	756.2	0.0	.	6.83
7.00	42	933	1801.7	749.7	0.0	.	6.74
7.09	32	905	1801.6	743.4	0.0	.	6.66
7.17	24	877	1801.6	737.3	0.0	.	6.59
7.26	18	850	1801.5	731.2	0.0	.	6.45
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.	6.38



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7.[illegible]	10	796	1801.5	719.7	0.0	. E	[illegible]
7.52	7	773	1801.4	714.1	0.0	. E	6.18
7.61	5	749	1801.4	708.7	0.0	. E	6.12
7.69	4	725	1801.3	703.5	0.0	. E	6.07
7.78	3	703	1801.3	698.4	0.0	. E	5.95
7.87	2	680	1801.3	693.5	0.0	. E	5.90
7.95	1	659	1801.2	688.7	0.0	. E	5.79
8.04	1	638	1801.2	684.1	0.0	. E	5.68
8.13	1	618	1801.1	679.6	0.0	. E	5.64
8.21	0	598	1801.1	675.3	0.0	. E	5.54
8.30	0	580	1801.1	671.1	0.0	. E	5.44
8.38	0	561	1801.0	667.0	0.0	. E	5.35
8.47	0	543	1801.0	663.0	0.0	. E	5.33
8.56	0	526	1801.0	659.2	0.0	. E	5.24
8.64	0	510	1801.0	655.5	0.0	. E	5.16*
T	I	O	E	VOL	A	I	VEL

0. I 2000. I 4000. I 6000. I 8000. I 10000. I 12000. I 14000. EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	OE/B
SCS-FBH	100.0	1809.37	2019.3	0.0	9.60	1515.9	105.7	10460.7	10566.3	6.43	14.41	0.005	0.007	15.5	28.8

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.007

0. I 10000. I 20000. I 30000. I 40000. I 50000. I 60000. I 70000. EXIT

T	I	O	E	VOL	A		VEL
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	0	0	1793.5	13.7	0.0	.	0.00
0.17	0	0	1793.5	13.7	0.0	.	0.00
0.26	0	0	1793.5	13.7	0.0	.	0.00
0.35	0	0	1793.5	13.7	0.0	.	0.00
0.43	0	0	1793.5	13.7	0.0	.	0.00
0.52	0	0	1793.5	13.7	0.0	.	0.00
0.61	0	0	1793.5	13.7	0.0	.	0.00
0.69	0	0	1793.5	13.7	0.0	.	0.00
0.78	0	0	1793.5	13.7	0.0	.	0.00
0.86	0	0	1793.5	13.7	0.0	.	0.00
0.95	0	0	1793.5	13.7	0.0	.	0.00
1.04	0	0	1793.5	13.7	0.0	.	0.00
1.12	0	0	1793.5	13.7	0.0	.	0.00
1.21	1	0	1793.5	13.7	0.0	.	0.00
1.30	3	0	1793.5	13.7	0.0	.	0.00
1.38	11	0	1793.5	13.8	0.0	.	0.00
1.47	30	1	1793.5	13.9	0.0	.	0.00
1.56	67	2	1793.6	14.3	0.0	.	0.00
1.64	126	3	1793.6	14.9	0.0	.	0.00
1.73	206	7	1793.8	16.1	0.0	.	0.00
1.82	302	10	1794.0	17.8	0.0	.	0.00
1.90	406	15	1794.0	20.3	0.0	.	0.00
1.99	561	21	1794.1	23.6	0.0	.I	0.00
2.07	1496	30	1794.2	30.8	0.0	.I	0.00
2.16	4768	58	1794.7	52.8	0.0	. I	0.00
2.25	11768	68	1795.8	111.5	0.0	. I	0.00
2.33	21084	73	1797.2	228.3	0.0	. I	0.00
2.42	29621	79	1799.0	408.9	0.0	. I	0.00
2.51	35179	433	1800.8	638.5	0.0	. I	4.27*
2.59	37362	1694	1802.7	890.0	0.0	. E X	7.71*
2.68	36727	3329	1804.3	1136.7	0.0	. E I	10.15
2.77	34004	5000	1805.7	1359.6	0.0	. E I	11.87
2.85	30133	6501	1806.8	1547.7	0.0	. E I	13.15
2.94	26064	7731	1807.7	1697.6	0.0	. E I	14.06
3.03	22376	8737	1808.3	1811.8	0.0	. E I	14.71
3.11	19161	9472	1808.7	1895.1	0.0	. E I	15.15

3.20	[illegible]83	9981	1809.0	1952.9	0.0	.	[illegible]
3.28	14248	10310	1809.2	1990.2	0.0	.	15.64
3.37	12409	10494	1809.3	2011.1	0.0	.	15.75
3.46	10946	10566	1809.4	2019.3	0.0	.	15.81
3.54	9812	10555	1809.4	2018.0	0.0	.	15.79
3.63	8943	10483	1809.3	2009.9	0.0	.	15.76
3.72	8284	10369	1809.3	1996.9	0.0	.	15.68
3.80	7779	10226	1809.2	1980.7	0.0	.	15.62
3.89	7399	10065	1809.1	1962.5	0.0	.	15.52
3.98	7111	9894	1809.0	1943.0	0.0	.	15.43
4.06	6842	9716	1808.9	1922.8	0.0	.	15.32
4.15	6487	9530	1808.8	1901.6	0.0	.	15.20
4.24	5987	9329	1808.6	1878.8	0.0	.	15.08
4.32	5371	9106	1808.5	1853.6	0.0	.	14.94
4.41	4725	8858	1808.4	1825.5	0.0	.	14.78
4.50	4121	8588	1808.2	1794.8	0.0	.	14.60
4.58	3588	8299	1808.0	1762.0	0.0	.	14.41
4.67	3144	7998	1807.8	1727.8	0.0	.	14.22
4.75	2801	7691	1807.6	1693.0	0.0	.	14.00
4.84	2543	7385	1807.4	1658.2	0.0	.	13.81
4.93	2350	7110	1807.3	1623.9	0.0	.	13.60
5.01	2209	6842	1807.1	1590.4	0.0	.	13.40
5.10	2094	6582	1806.9	1557.8	0.0	.	13.20
5.19	1982	6330	1806.7	1526.2	0.0	.	13.02
5.27	1863	6086	1806.5	1495.6	0.0	.	12.80
5.36	1741	5848	1806.4	1465.9	0.0	.	12.63
5.45	1618	5617	1806.2	1436.9	0.0	.	12.42
5.53	1500	5392	1806.0	1408.7	0.0	.	12.22
5.62	1399	5173	1805.9	1381.3	0.0	.	12.02
5.71	1323	4962	1805.7	1354.9	0.0	.	11.83
5.79	1270	4759	1805.5	1329.4	0.0	.	11.66
5.88	1232	4564	1805.4	1305.0	0.0	.	11.46
5.96	1200	4378	1805.2	1281.8	0.0	.	11.27
6.05	1161	4201	1805.1	1259.6	0.0	.	11.10
6.14	1097	4031	1805.0	1238.2	0.0	.	10.94
6.22	992	3875	1804.8	1217.5	0.0	.	10.74
6.31	853	3736	1804.7	1196.9	0.0	.	10.59
6.40	702	3596	1804.6	1176.2	0.0	.	10.46
6.48	559	3456	1804.4	1155.5	0.0	.	10.29
6.57	431	3317	1804.3	1134.9	0.0	.	10.10
6.66	325	3178	1804.2	1114.4	0.0	.	9.96
6.74	244	3042	1804.1	1094.2	0.0	.	9.76
6.83	182	2908	1803.9	1074.5	0.0	.	9.61
6.92	136	2779	1803.8	1055.3	0.0	.	9.43
7.00	102	2653	1803.7	1036.7	0.0	.	9.24
7.09	77	2532	1803.5	1018.9	0.0	.	9.11
7.17	57	2416	1803.4	1001.7	0.0	.	8.95*
7.26	43	2304	1803.3	985.2	0.0	.	8.74*
7.35	32	2197	1803.2	969.3	0.0	.	8.60*
7.43	24	2095	1803.1	954.2	0.0	.	8.42*
7.52	18	1997	1803.0	939.7	0.0	.	8.25*
7.61	13	1904	1802.9	925.9	0.0	.	8.09*
7.69	10	1817	1802.8	912.7	0.0	.	7.96*
7.78	7	1746	1802.7	900.0	0.0	.	7.82*
7.87	5	1682	1802.7	887.8	0.0	.	7.69*
7.95	4	1618	1802.6	876.1	0.0	.	7.61*
8.04	2	1556	1802.5	864.8	0.0	.	7.49*
8.13	2	1497	1802.4	853.9	0.0	.	7.33*
8.21	1	1440	1802.4	843.4	0.0	.	7.22*
8.30	1	1385	1802.3	833.3	0.0	.	7.13*
8.38	1	1332	1802.2	823.6	0.0	.	[illegible]

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8.47      0  1281 1802.2   814.3   0.0 .E                                                                                  6.77*
8.56      0  1232 1802.1   805.3   0.0 .E                                                                                  6.65*
8.64      0  1165 1802.0   796.7   0.0 .E
  T       I     O      E     VOL     A  I         I         I         I         I         I         I         I         I   VEL
                                        0.    10000.    20000.    30000.    40000.    50000.    60000.    70000.  EXIT

          VOLUME FILL=  325416. CY,     MAX. HEIGHT=    21.4 FT
          TOP WIDTH=       14.0 FT,     TOP LENGTH=   8480.0 FT
          AREA OF DAM=    18.23 AC,     AREA TO SEED=  18.23 AC (PROJECTED HORIZONTAL AREA)

*****WARNING.....TOP OF DAM EXCEEDS CLPROFILE ENDPOINT - APACHE FRS DAM CENTERLINE
```

III D HYDRAULIC DESIGN

III D. HYDRAULIC DESIGN

1. Apache Junction Floodway

The Apache Junction Floodway starts from the west side of the Apache Trail and terminates behind the Apache Junction Flood Retarding Structure (FRS). The floodway intercepts the storm flows from the drainage Basins 1, and 1A+1B. The floodway consists of a concrete lined channel, an energy dissipator and an earth channel.

The starting point of the Apache Junction Floodway has been changed from Station 11+00 to Station 12+00. This was done because the originally proposed starting point interfered with the planned Tomahawk Road at that point. Grading will be done to direct all flow from west of Apache Trail to the floodway, and future construction of Tomahawk Road should include culverts to maintain essentially the same drainage areas for each inlet to the floodway.

The concrete lined channel is 1537.5 feet long. Since the channel alignment follows a relatively flat grade, a mild (subcritical) slope has been adopted for the hydraulic design of the channel. Weir inlets have been provided for drainage Basins 1 and 1A+1B. The portion of the channel before the inlet for Basin 1 has been designed for 25% of the inflow from Basin 1 to account for any local drainage to the beginning of the channel. Inlet for Basin 1A+1B is towards the end of the channel. The locations of the inlets have been confirmed by field verification.

The major portion of the floodway is designed for a flow of 1046 cfs from Basin 1. Trapezoidal and rectangular cross sections were studied for the channel. Based upon initial construction and future maintenance costs a rectangular cross section shallower than the best hydraulic section has been adopted for the channel. The width of the channel has been increased at the inlets. The Manning's "n" equal to .015 has been adopted for the concrete lining.

Because the flow in the channel is near critical, extra freeboard was provided to handle any instability of the flow.

The concrete lined channel ends at the energy dissipator. The concrete channel and energy dissipator have been located to provide adequate clearance from the FRS. Two types of energy dissipators, baffled block chute and grouted riprap chute with stilling basin were studied. The economics favored the latter which was adopted.

The drop at the end of concrete lined channel is designed in accordance with procedures described in Chapter IV-B of "Hydraulic Design of Energy Dissipators for Culverts and Channels". The approaching rectangular concrete channel is 37.5 feet wide with a depth of water of 3.9 feet for a discharge of 1560 cfs. The trapzoidal earth channel beyond the stilling basin carries the same discharge with 3.7 feet depth of water for the aged condition. The earth channel downstream of the energy dissipator on the Apache Junction Floodway was designed to meet the requirements of Engineering Standard 582, Open Channel. The channel was designed for the 100 year storm flow of 1560 cfs. The concentration of fine sediment was computed using the procedures outlined in Geologic Note Number 2 and the trip report by Neville Curtis dated March 7, 1983 to Verne M. Bathurst. The average annual sediment production rates were obtained from the 1974 Sedimentation Supplement prepared by SCS. Using these procedures the 100 year sediment concentration for the Apache Junction Floodway was found to be 10,000 ppm.

Mannings "n" values were computed for both the "aged" and "as-built" conditions and were found to be 0.027 and 0.024 respectively. The allowable velocity, computed using procedures in TR-25, was found to be 2.92 fps. Since the 10 year discharge (921 cfs) exceeded 50% of the design discharge (780 cfs) it was used in making the "as-built" stability check. The design discharge of 1560 cfs was used to make

the "aged" stability check. The resulting channel has a bottom width of 130 feet, side slopes of 3 horizontal to 1 vertical, and a bottom slope of 0.00056 ft/ft.

A check was make using the tractive stress procedures. Since the d(75) is much less than 0.25 in. it is not the preferable procedure. It should also be noted that the b/d ratio is much greater than the curve values given in Figures 6-12 and 6-13 in TR-25. The check does imply that the velocity approach is conservative.

2. Flood Retarding Structure (FRS)

The FRS is an earth embankment approximately 8600 feet long with a maximum height of approximately 22 feet. The embankment is 14 feet wide at the top with 2.5 horizontal to 1 vertical upstream slope and 2 horizontal to 1 vertical downstream slope. One 30-inch diameter reinforced concrete pipe has been provided through the embankment to serve as a principal spillway. An emergency spillway has also been provided to safely pass the emergency spillway hydrograph (ESH) storm and to have sufficient capacity for passing the freeboard hydrograph (FSH) storm without overtopping the dam.

a) Stage Storage Curve

A stage storage curve was developed for the storage area. Increase in the storage capacity due to the 4-foot deep and 900-foot wide borrow area between contour lines of El. 1797 and 1808, and reduction due to the embankment fill were accounted for in the stage storage curve. The upstream slope of the embankment was taken as 3 horizontal to 1 vertical (conservative assumption, as the final slope is 2.5 horizontal to 1 vertical). The loss of storage due to the Idaho and Brown road embankments was neglected, since the road fill will be taken from the reservoir area.

b) Sedimentation

The quantity of sedimentation inside the FRS storage area over the 100-year life of the project has been taken as 95 acre feet based upon the report "Sedimentation - 1974 Supplement, Buckhorn-Mesa Wastershed".

c) Flood Routing Studies

The crest of the principal spillway has been kept at El. 1793.50 after allowing for the sedimentation in the storage basin. For the design of the principal spillway, flood routings for the PSH, ESH, and FBH storms were performed for 36-inch and 30-inch diameter pipe outlets using the DAMS2 computer program (TR 48). The minimum principal spillway pipe diameter for Class C Dams (TR 60) is 30-inches. A 30-inch diameter pipe outlet will drain the PSH storm storage to 15 percent storage in about 4-days, which is less than the 10-days required by TR 60.

3. Principal Spillway

A comparison of the computer output data for the 36-inch diameter conduit, as proposed in the Work Plan, and a 30 inch diameter pipe indicates that the top of the embankment for the 30-inch outlet is a few inches higher than that required for the 36-inch outlet, and will need approximately 4000 cubic yards of extra fill in the embankment. However, it can also be seen from the computer output that the outflow in the principal spillway outlet conduit has reduced from 120 to 81 cfs for the PSH storm. The flow in the emergency spillway has also been reduced by about 5% for the ESH storm and about 2% for the FBH storm. The saving in cost of principal spillway, outlet channel over a length of approximately 1500 feet up to the first inlet (Basin 4A), Bulldog Floodway and the

Emergency Spillway will be much more than the additional cost of the embankment fill. Therefore, the 30-inch diameter outlet pipe was recommended and adopted.

For the two-way covered riser-height of 10 feet below the spillway crest, the invert of the pipe at the inlet is fixed at El. 1783.5. A baffle riser with an ungated low level outlet has been selected for the inlet to the principal spillway. The principal spillway is located at Sta. 100 + 76.99 of the FRS. Geotechnical investigations along the centerline of the principal spillway indicate that the caliche is only about 3 to 4 feet below ground, approximately at El. 1785 feet. Therefore, the pipe is supported on a concrete cradle founded directly on caliche. The trench in the soil is backfilled with the embankment material compacted in accordance with the applicable specifications. Since the pipe is supported on the firm foundation, no analysis for the settlement of the pipe or joint extensibility is necessary. A piping and seepage control diaphragm is provided in accordance with TR-60 and was designed in accordance with Soil Mechanics Note No. 1. The diaphragm will be outleted into the outlet channel.

The spillway pipe outlet is connected directly with the rectangular Apache Junction outlet channel. No energy dissipator has been provided because the outlet channel is a concrete channel and the exit velocity is less than 20-feet per second.

4. Emergency Spillway

Three different types of emergency spillways were studied for the Apache Junction Flood Retarding structure, namely:

1. Type C Drop Structure

2. Baffle Block Chute, and

3. Earth Channel.

Due to the high walls in the Type C drop structure as compared to the walls in the baffle block chute, the baffle block chute has been determined to be more economical than the Type C drop. The study was made for 150 feet long crest for both structures. The extra height of embankment required for the drop structure spillway due to the head losses in the entrance channel is an additional cost not in favor of the drop structure spillway. The baffle block chute does not have significant entrance channel losses due to its location at Sta. 97+50. The drop structure spillway was proposed at Sta. 112+40, where an entrance channel is required.

Baffle chute spillway has been studied for two crest lengths, 150 feet and 100 feet. The latter has been determined to be more economical than the former. The cost of concrete saved in the 100 feet wide chute is more than the additional cost of fill in the higher FRS embankment and the extra riprap cost in the transition downstream of the chute. A chute with crest length less than 100 feet was not considered due to increase in the intensity of flow and the longer downstream transition required to the 300 feet wide exit channel. The intensity of flow for the 100 foot long crest is 70 cfs per foot for 2/3 FBH storm (the design flow).

An earth channel spillway has been studied for the following cases:

1. Earth channel without any protection

2. Earth channel with bed and side protection by

   - Soil cement or

   - Maccaferri Gabions or riprap

A spillway crest 300 feet wide was used which satisfies the Oe/b requirement: Oe/b = 9.6 <10. For the earth channel the velocity of water is more than 7 feet per second for the ESH storm and higher flows.

This velocity is considered to be high for the soils in the area as well as for the caliche. The strength of caliche varies considerably from poor to medium. Therefore, protection is required for the channel bed and sides.

Surface protection by soil cement is not considered satisfactory because the velocity of water increases to about 10 feet per second, which may be erosive for soil cement. The coefficient of friction used for soil cement is: "n" = .015. A velocity of 10 fps requires a high percentage of cement, and the soil cement lining, being rigid will not allow for movement. This type lining will also require drainage beneath it.

Protection by riprap, either by Maccaferri Gabion or loose riprap, was considered. The value of "n" for Manning's equation is assumed as .035. A slope of 0.026 has been considered for the channel. With these parameters the flow is supercritical for all flows. The spillway channel has been divided into two channels of 150 feet each with a 12 foot wide levee in between because the channel is wider than 200 feet. The cost of protection by Maccaferri Gabions or riprap is very close. The cost of riprap protection is only marginally lower than the gabions because of extra thickness required for loose riprap. The additional cost of riprap for the earth channel spillway with a 350 foot long crest is more than the cost saved in earthfill in the FRS embankment.

Comparative cost study between the baffle block chute spillway (100 feet long crest) and the riprap protected earth channel (300 feet long crest) indicates that the baffle block chute spillway is more economical than the other even after accounting for the higher top of embankment.

On the basis of the comparative cost studies baffle block chute spillway with 100 feet long crest is recommended. The nominal top of embankment will be at El. 1810.0 feet.

The exit channel of the emergency spillway has a natural grade of approximately .012 which gives high velocity in the channel. Therefore, to protect the spillway structure against retrogression in the exit channel it is proposed to provide a control section in a 300 feet wide channel downstream of the spillway. This control structure will maintain adequate depth of water at the toe of the chute to minimize scour.

The geologic investigation indicated that the top of caliche in the area downstream of the structure is approximately at elevation 1779. The control section will therefore be founded on caliche. The channel downstream of the control section will be protected by a loose rock riprap apron (flexible apron) for a distance of approximately 25 feet.

The depth of retrogression in the exit channel will be controlled by the caliche and will be limited to a few feet. The loose rock riprap provided downstream of the control section will flex downward to a stable slope and protect the caliche under the control section.

This arrangement of control section with flexible apron and the existence of caliche at a shallow depth will provide sufficient safeguard against deep scour at the toe to the baffle chute and is recommended. The loose rock riprap apron will require periodic inspection and maintenance. Recommendations are included in the Operation and Maintenance Plan.

The discharge of the emergency spillway has been calculated as 7000 cfs for the design flood and 10,500 cfs for the PMF.

5. Idaho and Brown Roads

The Idaho and Brown Roads traverse the Apache Junction Flood Retarding Structure storage area. These roads will obstruct the

storm flows from the drainage Basins 1, 1A+1B, 1A+1C and 2, to the principal and the emergency spillways. The roads are required to be above the 25 year storm water level in the reservoir.

These roads will therefore need culverts of suitable size to pass the 25 year storm without excessive differential head against the road. Also, the road profile will be low enough to let the PSH, ESH and FBH storms pass over the road without excessive differential heads at the road. The differential head at the roads require raising the top of the FRS embankment. In estimating the size of the culverts it has been assumed that the storm water does not flow along the road from one drainage basin to the other.

The Idaho Road will need a culvert to pass storm flow from drainage Basin 1, 1A+1B, 1A+1C and 2. Though the maximum rate of outflow from the principal spillway for the 25 year storm in only 76 cfs, the peak inflow from these four basins is 1298 cfs.

Since the inflow is much more than the storage capacity of the area northeast of the road, the culverts will be required to pass the storm flows to the storage area on the other side of the road. Conservatively the capacity of the culvert has been estimated to be 200 cfs.

An elliptical corrugated metal pipe culvert, 10 feet high by 7 feet wide, with flow at a differential head of approximately 3 inches will be used under Idaho Road. It will be unlined on the inside as reguested by SCS. The same size culvert will be used under the Brown Road.

Idaho and Brown Roads intersect each other near the center line of the FRS embankment. The portion of the roads from the intersection to the center line of the FRS embankment is planned to be horizontal. Since it is planned that the intersection will have a four-way stop sign, the vertical curves in the road profile were

designed for a 35 mph speed with a maximum 4 percent grade. Thus the road surfaces will drop quickly. This will provide a large area of flow across the road for the flows exceeding the 25 year storm.

A profile with a 35 MPH design speed vertical curve will have only 0.1 feet of differential head across the road for the FBH inflow at the maximum stage of the storage. Assuming the same differential head across Brown Road, water level in the upstream part of the reservior will be 0.2 feet higher than in the downstream portion. This has been handled by increasing the freeboard.

6. Changes in Design and Alternatives Studied

Descrepancies in survey information were corrected during the preliminary design phase with the result that the two major inlets were relocated approximately 100 feet downstream on the floodway. Channel dimensions and slope were not changed.

Possible piping along the spillway conduit will be controlled by including a diaphragm of granular cohesionless material around the portion of the conduit above the concrete embedment. This will connect to the transition zone of the FRS.

A number of alternatives for project features were examined. Many of these were studied in Phase I and described in the "Phase I Feasibility Study". These included:

1. Apache Junction Floodway

    a. Concrete vs earth channel.
    b. Rectangular vs trapezoidal channel section.
    c. Location of energy dissipator.
    d. Grouted riprap chute and stilling basin vs baffled block chute and energy dissipator.

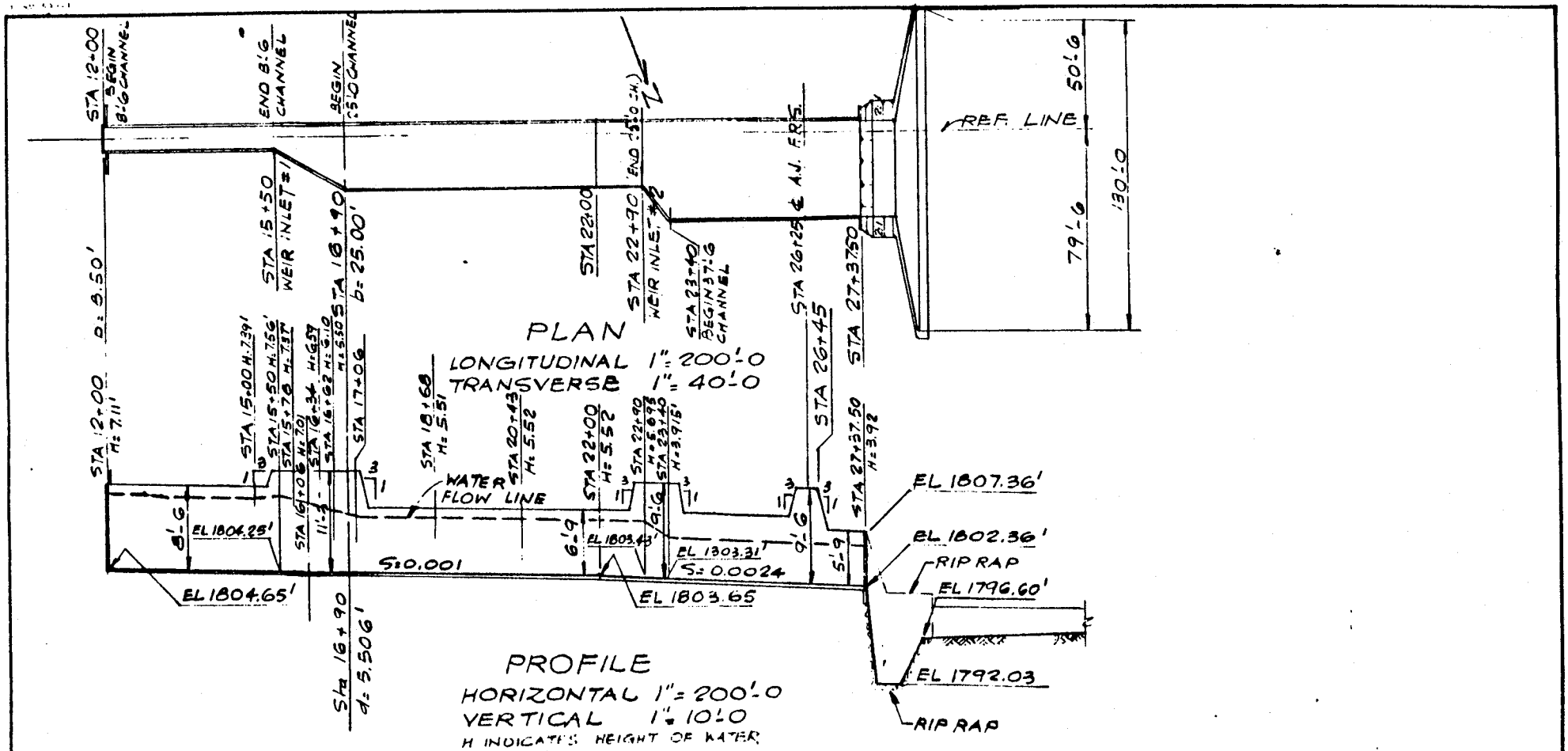
2. Floodwater Retarding Structure

   a. Filter zone vs. membrane to control cracking and internal embankment erosion.
   b. 30 inch diameter vs 36 inch diameter principal spillway pipe.
   c. Baffle block vs earth channel vs. type C emergency spillway type.
   d. Emergency spillway exit channel protection.

3. Idaho and Brown Roads

   a. Present alignment vs relocation.
   b. Profile to remain above 25 year flood.

IIID.2
Flowline Profile



NO.	DATE	REVISION	BY	CH	APPROVED

EBASCO SERVICES INCORPORATED

DIV. CIVIL DR LN
SCALE ____ CH NW
DATE 3-17-80
APPROVED

USDA SCS PHOENIX AZ
APACHE JUNCTION FLOODWAY
FLOW LINE & GEN ARRANGEMENT

SHT 5

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*      FLOW PROFILES             *
*                                *
*       CALCULATION              *
*                                *
*                                *
*                                *
*       VERSION 1985             *
*                                *
*  CONSULTING CIVIL ENGINEERING  *
*    EBASCO SERVICES INC. NY     *
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PROJECT TITLE	APACHE JUNCTION - AGED CONDITION
DEPARTMENT NAME	EBASCO CIVIL CONSULTING
TODAY'S DATE (M-D-Y)	8-19-85
YOUR NAME	C MONTANA

ENGLISH UNIT--- CFS,FT,LB AND G=32.2,C=1.486

TOTAL NUMBER OF CROSS-SECTIONS	1
FLOW ALONG MAIN CHANNEL	1560
COMPUTATION STARTS FROM UPSTREAM	1

PAGE 1

FLOW PROFILES CALCULATION

1	DISTANCE AT THIS SECTION	0
	MANNING ROUGHNESS	.027
	CHANNEL BOTTOM WIDTH	130
	CHANNEL BOTTOM SLOPE	.00056
	CHANNEL SIDE SLOPE	3
	WATER DEPTH AT CONTROL SECTION	3.73
	LATERAL IN/OUT FLOW (+/-)	0
	ENERGY COEFFICIENT ALPHA	1
	MOMENTUM COEFFICIENT BETA	1
	PIER SHAPE CIRCULAR/SQUARE (1/2)	0
	TOTAL PIER WIDTH	0
	HEIGHT OF BOTTOM RISE/DROP (+/-)	0

WATER DEPTH Y =	3.73	NORMAL DEPTH YN =	3.73049
CRITICAL DEPTH YC =	1.62671	FROUDE NUMBER F =	.280796
CHANNEL FLOW Q =	1560	CRITICAL SLOPE SC =	9.19256E-03

PAGE 2

SUMMARY

ITEM	SECTION NO. 1
DISTANCE XL=	0
WATER DEPTH Y =	3.73
ENERGY HEAD EV=	3.86625
NORMAL DEPTH YN=	3.73049
CRITICAL DEPTH YC=	1.62671
FROUDE NUMBER FD=	.280796
MANNING ROUGHNESS N=	.027
BOTTUM SLOPE S0=	.00056
CRITICAL SLOPE SC=	9.19256E-03
FRICTION SLOPE SE=	5.60251E-04
BOTTUM WIDTH B =	130
CHANNEL SIDE SLOPE Z=	3
CHANNEL TOP WIDTH T=	152.38
AREA A =	526.639
HYDRAULIC RADIUS R =	3.42885

VELOCITY = 1560/526.6 = 2.96 fps OK

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*          FLOW PROFILES         *
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*           CALCULATION          *
*                                *
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*                                *
*          VERSION 1985          *
*                                *
*  CONSULTING CIVIL ENGINEERING  *
*    EBASCO SERVICES INC. NY     *
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PROJECT TITLE	APACHE JUNCTION - AS BUILT CONDTION
DEPARTMENT NAME	EBASCO CIVIL CONSULTING
TODAY'S DATE (M-D-Y)	8-19-85
YOUR NAME	C MONTANA

ENGLISH UNIT--- CFS,FT,LB AND G=32.2,C=1.486

TOTAL NUMBER OF CROSS-SECTIONS	1
FLOW ALONG MAIN CHANNEL	921
COMPUTATION STARTS FROM UPSTREAM	1

PAGE 1

FLOW PROFILES CALCULATION

1	DISTANCE AT THIS SECTION	0
	MANNING ROUGHNESS	.023
	CHANNEL BOTTOM WIDTH	130
	CHANNEL BOTTOM SLOPE	.00056
	CHANNEL SIDE SLOPE	3
	WATER DEPTH AT CONTROL SECTION	2.48
	LATERAL IN/OUT FLOW (+/-)	0
	ENERGY COEFFICIENT ALPHA	1
	MOMENTUM COEFFICIENT BETA	1
	PIER SHAPE CIRCULAR/SQUARE (1/2)	0
	TOTAL PIER WIDTH	0
	HEIGHT OF BOTTOM RISE/DROP (+/-)	0

WATER DEPTH Y = 2.48 NORMAL DEPTH YN = 2.4841
CRITICAL DEPTH YC = 1.14914 FROUDE NUMBER F = .310448
CHANNEL FLOW Q = 921 CRITICAL SLOPE SC = 7.45448E-03

PAGE 2

SUMMARY

ITEM	SECTION NO. 1
DISTANCE XL=	0
WATER DEPTH Y =	2.48
ENERGY HEAD EV=	2.59337
NORMAL DEPTH YN=	2.4841
CRITICAL DEPTH YC=	1.14914
FROUDE NUMBER FD=	.310448
MANNING ROUGHNESS N=	.023
BOTTUM SLOPE S0=	.00056
CRITICAL SLOPE SC=	7.45448E-03
FRICTION SLOPE SE=	5.63128E-04
BOTTUM WIDTH B =	130
CHANNEL SIDE SLOPE Z=	3
CHANNEL TOP WIDTH T=	144.88
AREA A =	340.851
HYDRAULIC RADIUS R =	2.33965

VELOCITY = 921/340.85 = 2.70 fps OK

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*      FLOW PROFILES              *
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*       CALCULATION               *
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*                                 *
*       VERSION 1985              *
*                                 *
*  CONSULTING CIVIL ENGINEERING   *
*    EBASCO SERVICES INC. NY      *
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PROJECT TITLE BULLDOG FLOODWAY - AGED CONDITION
DEPARTMENT NAME EBASCO CIVIL CONSULTING
TODAY'S DATE (M-D-Y) 8-19-85
YOUR NAME C MONTANA

ENGLISH UNIT--- CFS,FT,LB AND G=32.2,C=1.486

TOTAL NUMBER OF CROSS-SECTIONS 1
FLOW ALONG MAIN CHANNEL 5466
COMPUTATION STARTS FROM UPSTREAM 1

PAGE 1

FLOW PROFILES CALCULATION

1	DISTANCE AT THIS SECTION	0
	MANNING ROUGHNESS	.027
	CHANNEL BOTTOM WIDTH	100
	CHANNEL BOTTOM SLOPE	.0003
	CHANNEL SIDE SLOPE	3
	WATER DEPTH AT CONTROL SECTION	10.58
	LATERAL IN/OUT FLOW (+/-)	0
	ENERGY COEFFICIENT ALPHA	1
	MOMENTUM COEFFICIENT BETA	1
	PIER SHAPE CIRCULAR/SQUARE (1/2)	0
	TOTAL PIER WIDTH	0
	HEIGHT OF BOTTOM RISE/DROP (+/-)	0

WATER DEPTH Y = 10.58 NORMAL DEPTH YN = 10.577
CRITICAL DEPTH YC = 4.32746 FROUDE NUMBER F = .236684
CHANNEL FLOW Q = 5466 CRITICAL SLOPE SC = 6.86491E-03

PAGE 2

SUMMARY

ITEM	SECTION NO. 1
DISTANCE XL=	0
WATER DEPTH Y =	10.58
ENERGY HEAD EV=	10.8188
NORMAL DEPTH YN=	10.577
CRITICAL DEPTH YC=	4.32746
FROUDE NUMBER FD=	.236684
MANNING ROUGHNESS N=	.027
BOTTUM SLOPE S0=	.0003
CRITICAL SLOPE SC=	6.86491E-03
FRICTION SLOPE SE=	2.99691E-04
BOTTUM WIDTH B =	100
CHANNEL SIDE SLOPE Z=	3
CHANNEL TOP WIDTH T=	163.48
AREA A =	1393.81
HYDRAULIC RADIUS R =	8.35047

VELOCITY = 5466/1394 = 3.92 fps OK

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*          FLOW PROFILES         *
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*           CALCULATION          *
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*                                *
*          VERSION 1985          *
*                                *
*  CONSULTING CIVIL ENGINEERING  *
*    EBASCO SERVICES INC. NY     *
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PROJECT TITLE	BULLDOG FLOODWAY - AS BUILT CONDITION
DEPARTMENT NAME	EBASCO CIVIL CONSULTING
TODAY'S DATE (M-D-Y)	8-19-85
YOUR NAME	C MONTANA

ENGLISH UNIT--- CFS,FT,LB AND G=32.2,C=1.486

TOTAL NUMBER OF CROSS-SECTIONS	1
FLOW ALONG MAIN CHANNEL	2713
COMPUTATION STARTS FROM UPSTREAM	1

PAGE 1

FLOW PROFILES CALCULATION

1	DISTANCE AT THIS SECTION	0
	MANNING ROUGHNESS	.024
	CHANNEL BOTTOM WIDTH	100
	CHANNEL BOTTOM SLOPE	.0003
	CHANNEL SIDE SLOPE	3
	WATER DEPTH AT CONTROL SECTION	6.66
	LATERAL IN/OUT FLOW (+/-)	0
	ENERGY COEFFICIENT ALPHA	1
	MOMENTUM COEFFICIENT BETA	1
	PIER SHAPE CIRCULAR/SQUARE (1/2)	0
	TOTAL PIER WIDTH	0
	HEIGHT OF BOTTOM RISE/DROP (+/-)	0

WATER DEPTH Y	= 6.66	NORMAL DEPTH YN	= 6.66483
CRITICAL DEPTH YC	= 2.7584	FROUDE NUMBER F	= .250408
CHANNEL FLOW Q	= 2713	CRITICAL SLOPE SC	= 6.20081E-03

PAGE 2

SUMMARY

ITEM		SECTION NO. 1
DISTANCE	XL=	0
WATER DEPTH	Y =	6.66
ENERGY HEAD	EV=	6.839
NORMAL DEPTH	YN=	6.66483
CRITICAL DEPTH	YC=	2.7584
FROUDE NUMBER	FD=	.250408
MANNING ROUGHNESS	N=	.024
BOTTUM SLOPE	S0=	.0003
CRITICAL SLOPE	SC=	6.20081E-03
FRICTION SLOPE	SE=	3.0076E-04
BOTTUM WIDTH	B =	100
CHANNEL SIDE SLOPE	Z=	3
CHANNEL TOP WIDTH	T=	139.96
AREA	A =	799.067
HYDRAULIC RADIUS	R =	5.62242

VELOCITY = 2713/799 = 3.40 fps OK

BULLDOG FLOODWAY & APACHE JUNCTION
EARTH CHANNEL DESIGN
8-19-85

APACHE JUNCTION:

Q(100)	= 1560 CFS
50% Q(100)	= 780 CFS
Q(10)	= 921 CFS
SEDIMENT LOAD	= 10000 PPM
ALLOWABLE VELOCITY	= 2.92 FPS

AGED CONDITION:

Q	= 1560 CFS
n	= .027
BW	= 130 FT
CHAN. SLOPE	= .00056 FT/FT
SS	= 3:1
D	= 3.73 FT
ACTUAL VEL.	= 2.96 FPS

AS BUILT CONDITION:

Q	= 921 CFS
n	= .024
BW	= 130 FT
CHAN. SLOPE	= .00056 FT/FT
SS	= 3:1
D	= 2.48 FT
ACTUAL VEL.	= 2.70 FPS

BULLDOG FLOODWAY:

Q(100)	= 5466 CFS
50% Q(100)	= 2713 CFS
Q(10)	= 2444 CFS
SEDIMENT LOAD	= 20000 PPM
ALLOWABLE VELOCITY	= 3.98 FPS

AGED CONDITION:

Q	= 5466 CFS
n	= .027
BW	= 100 FT
CHAN. SLOPE	= .0003 FT/FT
SS	= 3:1
D	= 10.6 FT
ACTUAL VEL.	= 3.92 FPS

AS BUILT CONDITION:

Q	= 2713 CFS
n	= .024
BW	= 100 FT
CHAN. SLOPE	= .0003 FT/FT
SS	= 3:1
D	= 6.7 FPS
ACTUAL VEL.	= 3.4 FPS

EBASCO SERVICES INCORPORATED

BY CJM DATE 8-19-85 SHEET 27 OF

CHKD. BY (W) DATE 9/5/85 OFS NO. DEPT. NO.

CLIENT U.S.D.A. Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Manning's "n" for earth channels

REF: NEH-5 Supplement B
TR-25 Chapter 6

d_{75} = 0.187 inches

BASIC "n":

SINCE d_{75} < 0.25 inches equation from TR-25 Chapter 6 ie:

$$n_t = \frac{(d_{75})^{1/6}}{39}$$

not recommended -

USE NEH 5 Supplement B:

Basic "n" = .020

Only additional modification will be "STEP 2" Surface Irregularity

As-Built "n":

ESTIMATE increase between smooth & minor immediately after construction

Modifying value = .004

∴ n_{AB} = 0.024

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BY cjm DATE 8-19-85 SHEET 27 OF

CHKD. BY DATE OFS NO. DEPT. NO.

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT MANNING'S "n" for earthy channels

Aged "n"

Estimated increase to modifying value due to "erosion & "weathering" that occurs over time. Some additional gullying and deposition.

ie: Modifying value = .007

Aged "n"$_a$ = 0.027

581/8-81

EBASCO SERVICES INCORPORATED

BY Cgm DATE 8/28 SHEET 29 OF

CHKD. BY ✓ DATE 9/5/85 OFS NO. DEPT. NO.

CLIENT USDA SCS

PROJECT Apache Junction - Bulldog Floodway

SUBJECT Apache Junction Channel - Tractive Stress Computation

Aged Condition:

$S_e = 0.00056$ $d_{75} = .187$ in.

$V = 2.96$ fps $d_{65} = .132$ in.

$\eta = 0.027$ $d_{50} = .085$ in. = .0071 ft.

From Fig. 6-11:

Assume Water Temp = 60°

Find: $\nu = 1.22 \times 10^{-5}$

$\rho = 1.938$

$$\therefore \frac{V^3}{g\nu S_e} = \frac{2.96^3}{32.2(1.22\times10^{-5})(.00056)} = 1.18\times10^8$$

$$\frac{V}{(g k_s S_e)^{1/2}} = \frac{2.96}{[(32.2)(.007)(.00056)]^{1/2}} = 260$$

From Fig. 6-9: $V/\sqrt{\tau/\rho} = 19.2$

$$\tau = \frac{(2.96)^2(1.938)}{(19.2)^2} = 0.046$$

$b/d = 130/3.73 = 34.9$

From Figs: 6-12 & 6-13 b/d >>> curve values

METHOD DOES NOT REALLY FIT 10: actual b/d much greater than given in curves: however using $b/d = 8$ $z = 3$

$\tau_s = 0.046\ (1.15) = .053$

$\tau_b = 0.046\ (1.30) = .060$

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BY SM DATE 8/28 SHEET 30 OF
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CLIENT USDA SCS
PROJECT Bulldog Floodway & Apache Junction
SUBJECT Apache Junction - Tractive Stress Computation

Aged Condition (cont.)

Allowable Tractive Stress:

Fine Sediment Content = 10,000 ppm

d_{50} = 2.15 mm

τ_{all} = .1 Fig 6.14

∴ This analysis shows that the actuals are much less than the allowable however since the data is extrapolated to such a great extent and our d_{75} < .25 mm we will stay with the design based on velocity approach.

IE: It is my opinion that The Tractive Stress Approach is not applicable.

SM

581/8-81

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BY cym DATE 8/28/85 SHEET 31 OF

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CLIENT USDA SCS

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Bulldog Floodway - Tractive Stress Computation

Aged Condition

$S_e = .0003$

$V = 3.92$

$\eta = .027$

$z = 3$

From Pg 29 : $\nu = 1.22 \times 10^{-5}$

$e = 1.938$

$$\therefore \frac{V^3}{g \nu S_e} = \frac{3.92^3}{32.2(1.22\times10^{-5})(.0003)} = 5.11\times10^8$$

$$\frac{V}{(g\, k_s\, S_e)^{1/2}} = \frac{3.92}{[32.2(.007)(.0003)]^{1/2}} = 477$$

From Fig 6.9 : $V/\sqrt{T/e} = 21.7$

$$\tau = \frac{(3.92)^2(1.938)}{(21.7)^2} = .0632$$

$b/d = 100/10.6 = 9.4$

$\therefore \tau_s = .0632 \times 1.15 = .073$

$\tau_b = .0632 \times 1.30 = .082$

Allowable = 0.1 SEE previous calc.

Once again this indicates that a smaller section or steeper slope can be built then that obtained by the velocity approach however the velocity approach should govern.

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BY V BOLANO DATE 6/8/85 SHEET 1 OF

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CLIENT USDA-SCS

PROJECT

SUBJECT SOIL PARAMETERS FOR TRACTIVE STRESS ANALYSIS

Tractive Stress Approach

If D_{75} < 1/4 in then use fine grained soil method

Need for Actual Stress Determination:

1) $K_s = D_{65}$ in feet

Need for Allowable Tractive Stress

1) D_{50}

If D_{50} > 5 mm use 5 mm for entering the chart

If D_{50} < 0.1 mm use 0.1 mm for entering the chart and use 0.1 mm as D_{65} for Actual Stress Determination

*NOTE: SINCE D_{75} GIVEN BELOW IS CLOSE TO 1/4" YOU MAY CONSIDER ALSO USING LANE'S METHOD (D_{75} > 1/4") FOR SENSITIVITY ANALYSIS

	* SPILLWAY ALT # 2 (ASSUME SP. MATERIAL)	APACHE JUNCTION FLOODWAY	BULLDOG FLOODWAY
D_{75}	#4 sieve - 4.76 mm (0.187 in)		
D_{65} (use in feet)	#6 sieve - 3.36 mm (0.132 in)		
D_{50}	#8 sieve - 2.36 mm #10 sieve - 2.00 mm		

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BY S GOYAL DATE 1-24-86 SHEET 55 OF

CHKD. BY DATE OFS NO. USDA 3767 300 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

A study of the revised contours for the Apache Junction floodway area need the following changes to the preliminary layout of inlets

1. Inlet #1 should be located from sta 15+50 to 16+90 for the two tributaries of the Arroyo. The increase in length of the weir from 100 feet to 140 feet will reduce the height of weir and as such the height of dikes.

2. Inlet #2 should be located at STA 22+90 and the arroyo near sta 21 be diverted to Sta 22+90 by a dike along the floodway.

3. The small tributary to arroyo at STA 29 I be diverted along the channel to join the main arroyo before meeting the floodway at STA 30 I

The layout and hydraulic design of Apache Junction Floodway is revised to suit the above

CHANNEL FROM STATION 22+90 TO STATION 27+37.50

Bed El STA 22+90 = 1803.65 − (2290 − 2200) × .0024
= 1803.43

Q_1 = 1046 cfs
Q_2 = 514 cfs
Length of weir = 50'

$$Q = C L H_e^{3/2}$$

$$\therefore H_e = \left(\frac{514}{3.1 \times 50}\right)^{2/3} = 2.22 \text{ ft}$$

Incoming velocity at the weir $= \sqrt{2g \frac{H_e}{3}}$
= 6.91 fps

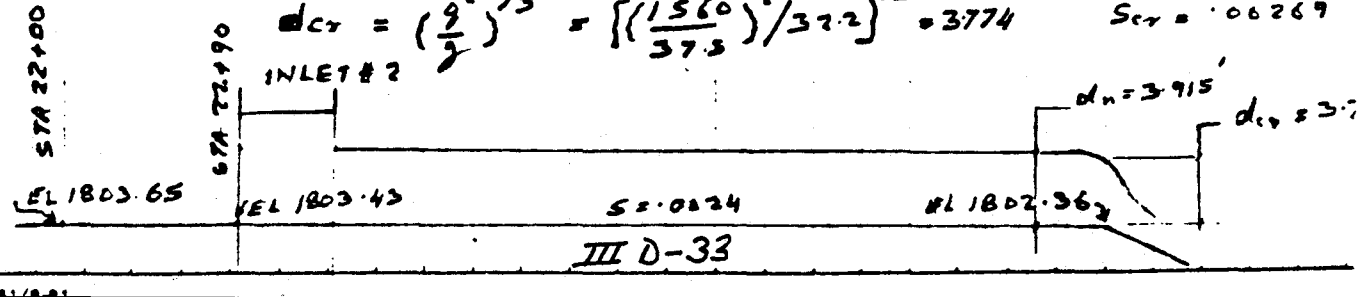
Provide riprap protection u/s of the weir.

The height of dike = 2.22 + 1 (freeboard)
= 3.22 say 3'-3"

Q_3 = 1046 + 514 = 1560 cfs
b_3 = 37.5' S_3 = .0024 n = .015
$\therefore d_3$ = 3.915 R = 3.239
$v_3 = \frac{Q_3}{A_3}$ = 10.626 fps
also $v = \frac{1.486}{n} R^{2/3} S^{1/2}$ = 10.624 o.k.

∴ The depth of flow upstream of STA 27+37.50 is 3.915 and goes through a critical depth at Sta 27+37.50

$$d_{cr} = \left(\frac{q^2}{g}\right)^{1/3} = \left[\left(\frac{1560}{37.5}\right)^2 / 32.2\right]^{1/3} = 3.774 \qquad S_{cr} = .00269$$



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BY S GOYAL DATE 1-24-86 SHEET 57 OF

CHKD. BY DATE OFS NO. USDA 3767.200 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY AND APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

Height of walls d/s Sta 22+40 will need additional free board because $S_b \not< .7 S_c$

$$\therefore \text{Free board} = .1d + .25 d_c \left[1 - 11.1\left(\frac{S}{S_{cr}} - 1\right)^2\right]$$

$$= .1 \times 3.915 + .25 \times 3.774 \left[1 - 11.1\left(\frac{.0024}{.00269} - 1\right)^2\right]$$

$$= 1.0 \text{ Min} + .82$$

$$= 1.82$$

$$\therefore \text{Height of wall} = 3.915 + 1.82$$

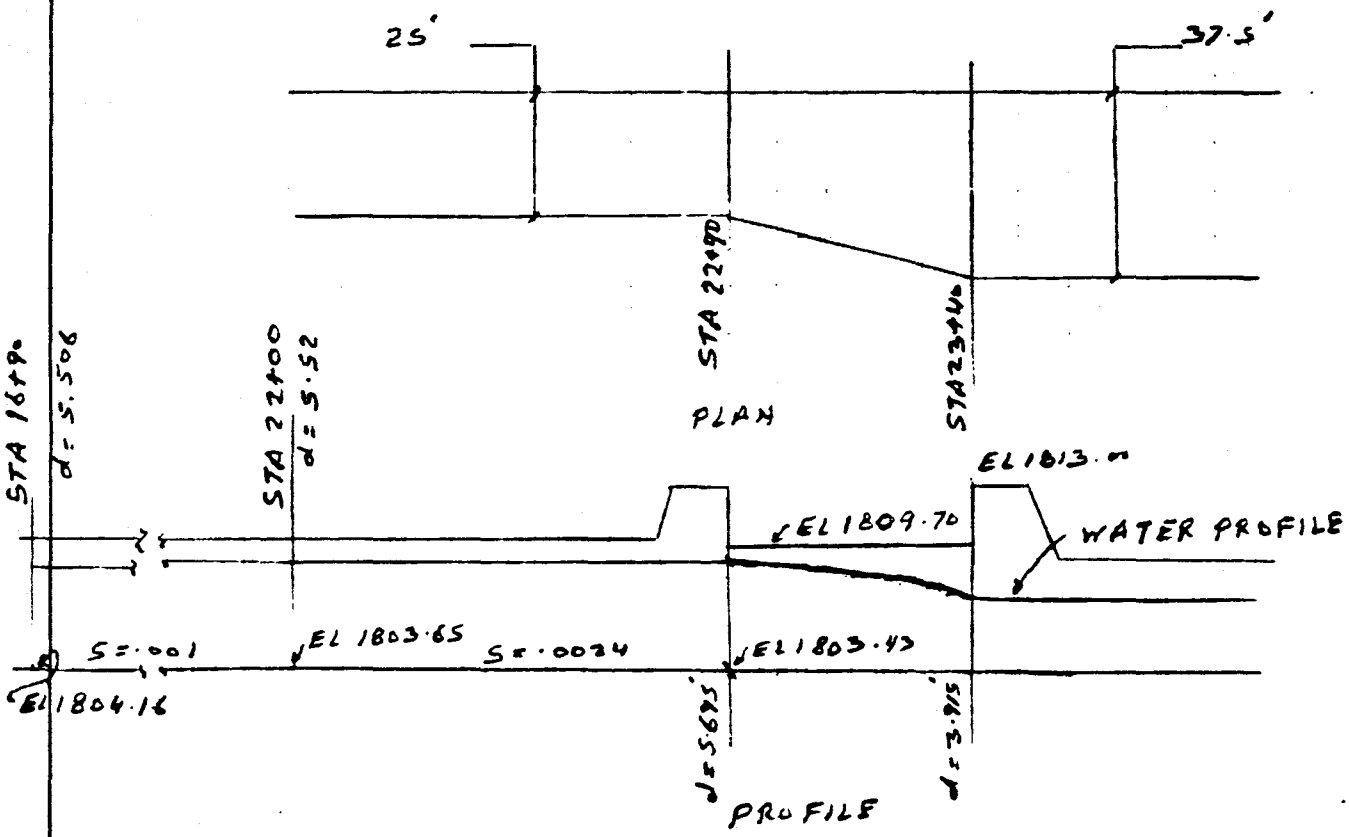
$$= 5.735 \quad \text{say } 5'\text{-}9''$$

The south wall of the channel has to be higher than the top of the FRS dam so that the integrity of the dam is maintained for the freeboard flood.

At the inlet #2 apply momentum equation to determine the depth of flow at Sta 22+90

depth at Sta 23+40 = 3.915'

at Sta 22+90 = 5.695' from page 11 c of SECTION VIII PHASE 2 Report



Invert of weir = 1803.43 + 5.695 + 0.57 (Free board)

= 1809.695 say 1809.70

Top El. of dike = 1809.70 + 3.22

= 1812.92 say 1813.00

CHANNEL FROM STA 16+90 TO STA 22+90

$Q = 1046$ cfs

$b = 25'$

$S = .0024$ STA 22+00 to 22+90

$S = .001$ STA 16+90 to 22+00

Bed El STA 22+00 = 1803.65

STA 16+90 = 1803.65 + (2200 − 1690) · .001

= 1804.16

Depth of flow at sta 16+90 and upto sta 22+90 is computed by backwater curve u/s of sta 22+90 with depth of flow at sta 22+90 equal to 5.695'

At STA 22+90 $d = 5.695'$

$v = \frac{Q}{bd} = 7.347$ $\quad He_1 = 6.533$

$P = d + 2b$

$A = bd$

$R = \frac{A}{P} = \frac{bd}{b+2d} = 3.912$

$S = \left[\frac{vn}{1.486\, R^{2/3}}\right]^2$

$\Delta H_f = S_{av} \times l$

$\Delta Z = S_b \times l$

$He_1 = d_1 + \frac{v_1^2}{2g}$

$He_2 = He_1 + \Delta H_f - \Delta Z$

$= He_1 + S_{av}\, l - S_b\, l$

$= He_1 + (S_{av} - S_b)\, l \quad$ or $l = \frac{He_2 - He_1}{S_{av} - S_b}$

$= d_2 + \frac{v_2^2}{2g}$

BY S GOYAL DATE 1-24-86 SHEET 60 OF

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CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

H_{c_1}	d Assumed	V	R	S_1	S_{av}	S_b	l	STA
6.5331	5.695	7.347	3.912	.000892				22+90
					.000902	.0024	-21	
6.3015	5.65	7.405	3.891	.000913				22+61
					.000925	.0024	-23	
6.4668	5.6	7.471	3.867	.000931				22+38
					.000962	.0024	-47	
6.3986	5.5	7.607	3.819	.000988				21+91

By interpolation depth of flow at STA 22+00 will be approx. equal to $5.5 + \frac{.1}{47} \times 9 = 5.52$

Proceeding the same way

6.4121	5.52	7.5797	3.829	.000977				22+00
					.000983	.001	-776	
6.3986	5.5	7.607	3.819	.000988				14+24
6.4121	5.52	7.5797	3.829	.000977				22+00
					.0009784	.001	-157	
6.4087	5.515	7.587	3.827	.0009798				20+43
					.0009811	.001	-175	
6.4054	5.51	7.593	3.824	.0009824				18+68
					.0009829	.001	-82	
6.4040	5.508	7.596	3.823	.000983				17+86
					.0009838	.001	-80	
6.4027	5.506	7.5989	3.822	.0009845				17+06
					.0009848	.001	-47	
6.40198	5.505	7.600	3.8219	.0009850				16+59

By interpolation the depth of flow at station 16+90 $= 5.506 - \frac{.001}{47} \times 16$
$= 5.5056$

Assume depth of flow at station 16+90 = 5.506

Height of walls u/s STA 22+90

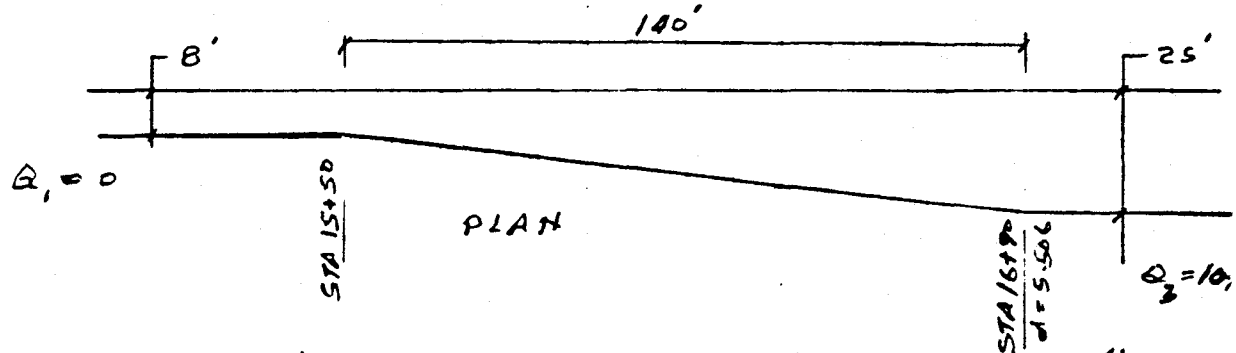
$Q = 1046$ $b = 85'$ $d_{cr} = 3.788$
$S_{cr} = .002996$

$S = .001 < .7\, S_c$

∴ Free board $= .1\, d = .1 \times 5.695 = .57$ use 1'

∴ Height of wall $= 5.695 + 1 = 6.695$ use 6'-9"

CHANNEL FROM STA 15+50 TO STA 16+90



To be conservative assume the flow to be all from the inlet i.e. $Q_1 = 0$

$Q_2 = 1046 + Q_3$

∴ Momentum equation becomes

$$\frac{w}{g}\left(\frac{Q_3^2}{B_3 D_3} - \frac{Q_1^2}{B_1 D_1}\right) = \frac{w}{2}\left(B_1 D_1^2 - B_3 D_3^2\right) + \frac{w}{8}(B_3 - B_1)(D_1 + D_3)$$

$$+ W \sin\theta - F_f$$

$$W = W\left(\frac{D_3 + B_1}{8}\right)\left(\frac{D_1 + D_3}{2}\right) \times l \qquad \sin\theta \approx .001$$

$$F_f = W\left(\frac{S_3 + S_1}{2}\right) \qquad S_3 = .000985 \simeq .001$$

$$S_1 = 0$$

$Q_1 = 0$ $\qquad l = 140'$

$Q_3 = 1046$ $\qquad B_1 = 8'$

$d_3 = 5.505'$ $\qquad B_3 = 25'$

Applying the momentum equation in one step

$$\frac{w}{32.2}\left(\frac{1046^2}{25 \times 5.505} - 0\right) = \frac{w}{2}\left(8 D_1^2 - 25 \times 5.505^2\right) + \frac{w}{8}(25 - 8)(D_1 + 5.505)$$

$$+ \frac{w}{4}(25 + 8)(D_1 + 5.505) \times 140\left[.001 - \frac{.001 + 0}{2}\right]$$

or $246.85 = 4 D_1^2 - 378.8 + 2.125 D_1^2 + 23.4 D_1 + 64.4 + .58 D_1 + 3$

or $D_1^2 + 3.9 D_1 - 91.1 = 0$

or $D_1 = 7.78'$

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BY S GOYAL DATE 1-27-86 SHEET 62 OF

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CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

Apply the momentum equation in 5 steps

$\Delta L = \frac{140}{5} = 28'$ $\Delta Q = \frac{1046}{5} = 209.2$

$\Delta B = \frac{25.8}{5} = 3.4'$

Momentum equation between two sections is

$$\underbrace{\frac{1}{32.2}\left(\frac{Q_3^2}{B_3 D_3} - \frac{D_1^2}{B_1 D_1}\right)}_{A} - \underbrace{\frac{1}{2}(B_1 D_1^2 - B_3 D_3^2)}_{B} - \underbrace{\frac{1}{6}(B_3 - B_1)(D_1 + D_3)^2}_{C}$$

$$- \underbrace{\frac{B_3 + B_1}{2} \times \frac{D_1 + D_3}{2} \Delta l}_{D} \left[S_b - \frac{S_3 + S_1}{2}\right] = 0 \quad E$$

$Q_1 = Q_3 - \Delta Q$

$B_1 = B_3 - \Delta B$

$S = \left[\frac{Vn}{1.486 R^{2/3}}\right]^2 = \left[\frac{Q}{BD} \times \frac{.015}{1.486 R^{2/3}}\right]^2$

Q_3	Q_1	B_3	B_1	D_3	S_3	D_1	S_1
1046	836.8	25	21.6	5.506	.000985	6.105	.000668
836.8	627.6	21.6	18.2	6.105	.000668	6.59	.000467
627.6	418.4	18.2	14.8	6.59	.000467	7.01	.000300
418.4	209.2	14.8	11.4	7.01	.000300	7.37	.000133
209.2	0	11.4	8.0	7.37	.000133		0

	D_1	S_1	A	B	C	D	E	
I	5.97	.000712	+78.25	-6.11	-55.96	-.688	+15.49	
	6.0	.000702	+79.097	-9.987	-56.255	-.713	+12.14	
	6.1	.000670	+81.848	-23.055	-57.273	-.793	+0.727	
	6.11	.000667	+82.118	-24.374	-57.336	-.801	-0.39	
	6.105	.000668	+81.983	-23.714	-57.287	-.797	+.185	o.k.
II	6.6	.000469	+63.076	+6.131	-68.602	-1.863	-1.258	
	6.55	.000475	+62.299	+12.114	-68.063	-1.835	+4.515	
	6.59	.000467	+62.921	+7.33	-68.494	-1.858	-0.10	o.k
III	7.0	.000302	+49.512	+32.595	-78.492	-2.347	+1.268	
	7.01	.000300	+49.587	+31.559	-78.608	-2.351	+.187	o.k
IV	7.3	.000137	+36.070	+51.864	-87.030	-2.491	+6.433	
	7.36	.000134	+36.203	+54.870	-87.761	-2.506	+.806	
	7.37	.000133	+36.225	+54.030	-87.883	-2.509	-.137	o.k
V	7.37	0	+16.177	+80.287	-94.862	-2.300	-.598	
	7.56	0	+16.177	+80.992	-94.735	-2.298	+.136	o.k

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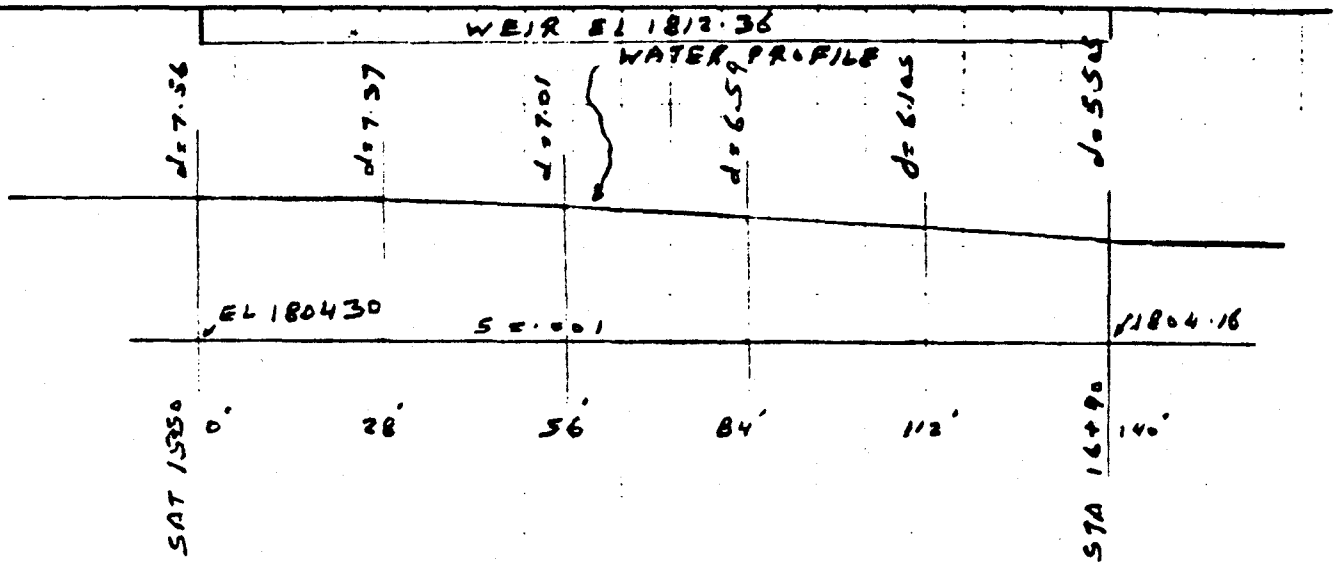
BY S GOYAL DATE 1-27-86 SHEET 63 OF

CHKD. BY DATE OFS NO. USDA 3767.700 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY



If part of catchbasin 1 flow is coming in the channel u/s of STA 15+50 the depth of flow at STA 15+50 will be less than 7.56'

Bed EL at STA 15+50 = 1804.16 + (1690 - 1550).001
= 1804.30

Provide weir at EL = 1804.30 + 7.56 + .5
= 1812.36'

Height of weir u/s STA 15+50
= 7.56 + 1.00
= 8.56 say 8'-6"

Length of weir = 140'
Q = $CLH^{3/2}$ = 1046 c = 3.10
∴ H = 1.8'
∴ Top of dike = 1812.36 + 1.8 + 1
= 1815.16

Depth of water u/s of station 15+50 will be slightly less than that at STA 15+50. Provide the same height of weir 8'-6"

Bed EL At STA 12+00 = 1804.30 + (1550 - 1200) x .001 = 1804.6

ENERGY DISSIPATOR WATER PROFILE

INCOMING FLOW

$Q = 1560$ CFS

$b = 37.5$ ft

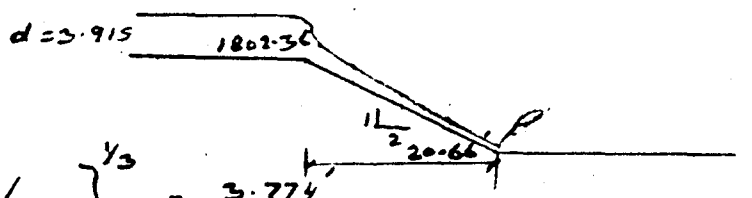
$S = .0024$

$n = .015$

$d = 3.915$ $v = 10.63$

$H_e = d + \frac{v^2}{2g} = 5.67$

Bed El = 1802.36



$$D_{cr} = \left[\left(\frac{1560}{37.5}\right)^2 / 32.2\right]^{1/3} = 3.774'$$

Immediately after the rectangular section assume that the water is spread into the trapezoidal section. Neglect expansion loss

∴ Assume $d = 2.55$ 2.6

$v = 14.36$ 14.05

$H_e = 5.75$ 5.67 ok

sudden expansion loss $= k_e\left(\frac{v_2^2}{2g} - \frac{v_1^2}{2g}\right)$

where $k_e = 1$

d	3.0	3.01	
v	11.95	11.909	
H_{e_2}	5.22	5.212	
ΔH_{exp}	.463	.448	
H_{e_1}	5.683	5.66	ok

$d = 3.01$ $A = 130.995$ $P = 50.961$ $R = 2.570$

$S = \left[\frac{vn}{1.486 R^{2/3}}\right]^2$ for $n = .02$

$= \left[\frac{11.909 \times .02}{1.486 \times 2.570^{2/3}}\right]^2$

$= .0073$

Neglecting the effect of slope on normal and vertical depths of flow and applying Bernoulli's Equation

$S_b = .5$,

Assume	$d =$	3.01	2.5	2.0	1.5	1.4
	$A =$	130.995	106.25	83	60.75	56.42
	$P =$	50.961	48.68	46.444	44.208	43.761
	$R =$	2.570	2.183	1.787	1.374	1.289
	$v =$	11.909	14.682	18.795	25.679	27.649
	$S =$	.0073	.0138	.0295	.0782	.0987
	$S_{av} =$		.0105	.02165	.0538	.0884
$v^2/2g + d$	$He =$	5.212	5.847	7.485	11.739	13.271
$\frac{He_2 - He_1}{S_b - S_{av}}$	$l =$	0	1.297'	3.42	9.535	3.722
	$\Sigma l =$	0	1.297	4.717	14.252	17.974

$d =$	1.36	1.34
$A =$	54.699	53.841
$P =$	43.582	43.493
$R =$	1.255	1.238
$v =$	28.520	28.974
$S =$	.1088	.1144
$S_{av} =$	.1038	.1116
$He =$	13.990	14.376
$l =$	1.815	.994
$\Sigma l =$	19.789	20.78'

∴ The velocity at the base of the slope will be approximately 29 fps which compares very well with 30.7 fps as computed without losses in the short reach (20.66') of the slope (PHASE I REPORT)

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BY S Goyal DATE 9-20-85 SHEET 1 OF 2

CHKD. BY Y.C. YAN DATE 9-24-85 OFS NO. USDA 3767.308 DEPT. NO. 350

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY - INLET STA ~~11+00~~ 12+00

Assume the inflow in the inlet from the Apache Trail road side ditch to be only 5% of the total flow from Basin 1. The area between the road and the adjoining drainage ridge is a very percentage of the area of Basin 1.

$\therefore \quad Q = 0.05 \times 1046$

$= 52.3$ cfs

For flat Rectangular weir

$Q = 3.1 \, W \, H_e^{3/2}$ Engineering Handbook EH-14 pp 234

$\therefore \quad H_e = \left[\frac{52.3}{3.1 \times 8.5}\right]^{2/3}$

$= 1.58$ feet

Provide upstream projections of 2.0 (box inlet)

$\therefore \quad 52.3 = 3.1 (2 \times 2.0 + 8.5) \, H_e^{3/2}$

or $H_e = 1.22$ say 1.25

$0.49 W = .49 \times 8.5 = 4.165 > H_e$

$5.5 \, W^{5/2} = 5.5 \times 8.5^{5/2} = 1158 > 52.3$ O.K.

Provide weir crest at EL $1804.75 + (7.11 + 0.5)$

$= 1804.75 + 7.61$

$= 1812.36$ say 1812.50 ft

Provide a freeboard of 1 foot to top of headwall

$= 1812.5 + 1.25 + 1.0$

$= 1814.75$

provide approach channel 15' wide

11.7.85 **EBASCO SERVICES INCORPORATED**

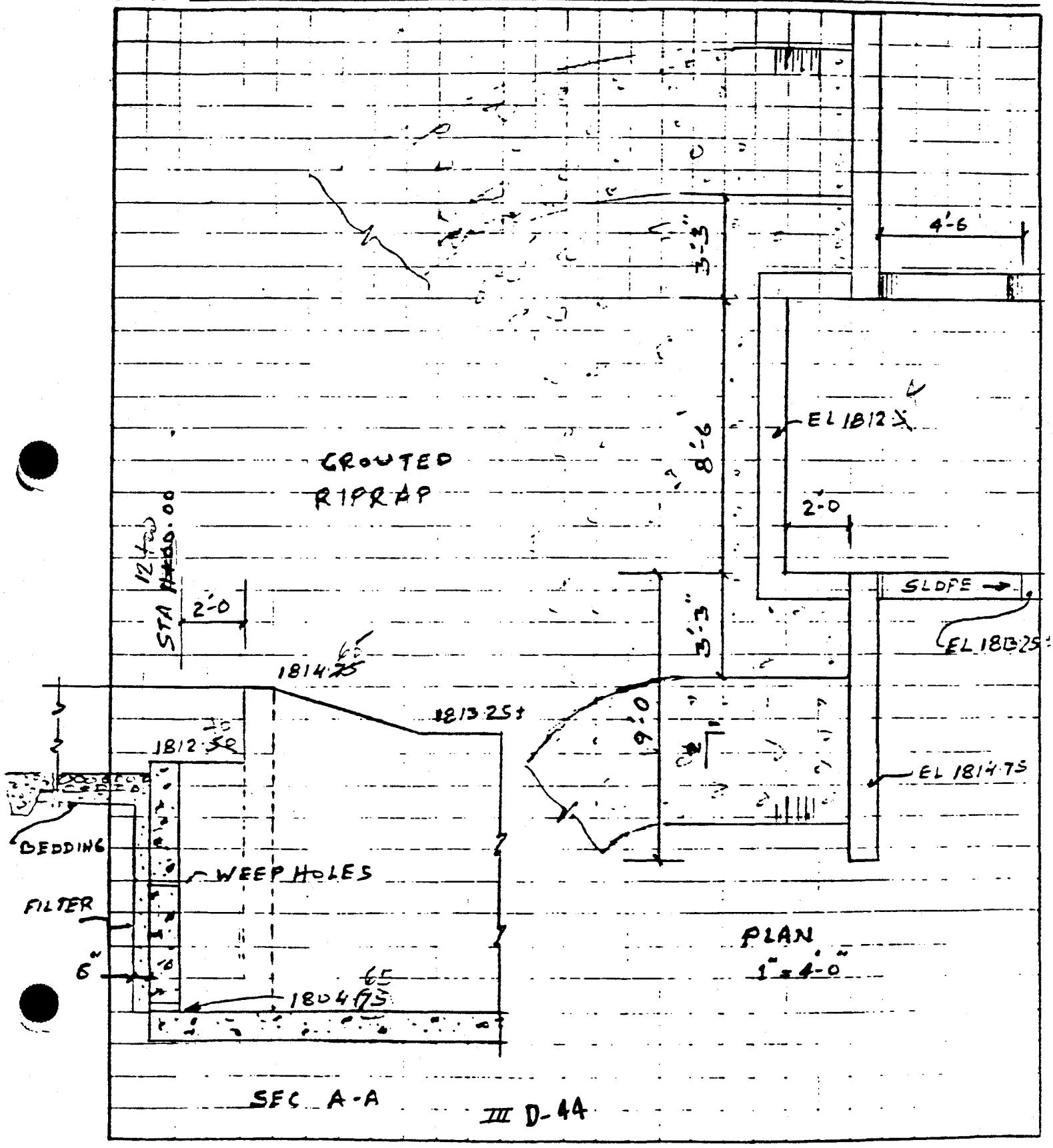
BY S GOYAL DATE 9-20-85 SHEET 2 OF 2

CHKD. BY Y.C YANG DATE 9-24-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY - INLET STA ~~11+00~~ 12+00



III D-44

B1/2-81

EBASCO SERVICES INCORPORATED

BY S GUVAL DATE 6-22-85 SHEET 1 OF 5
CHKD. BY C. Zee DATE 7/2/85 OFS NO. USDA 3767-180 DEPT. NO. 550
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTR.
SUBJECT APACHE JUNCTION FLOODWAY

The Apache Junction floodway starts from the west side of the Apache Trail. There is no inflow to the floodway across the trail. The starting station of the floodway is STA 11+00 12+00 Rev

The first drainage from Basin 1 meets the floodway between STA. 16+00 and 17+00.

Q PSH for Basin 1 = 1046

Assume that about 25% of the basin 1 flow may enter the floodway upstream of the drainage inlet #1 in the reach STA 11+00 to 16+00. Therefore design this portion of the floodway for

Q PSH ≈ .25 x 1046
= 260 cfs

The general ground slope along the centerline of the floodway from STA 11+00 to 27+00 is mild - a drop of about 3.5 feet (.0022 only). Therefor to avoid deep excavations and curved side inlets for Basin 1 and 1A + 1B the channel has been provided with mild slopes upto the inlet for 1A + 1B.

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-22-85 SHEET 2 OF 15

CHKD. BY C. Zoe DATE 7/2/85 OPS NO. USDA 3767.1 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTR

SUBJECT APACHE JUNCTION FLOODWAY

Reach	11+00 to 16+00	17+00 to 22+00
Q	260	1046
b	8.5	25
d	5.48	5.48
$V = \frac{Q}{bd}$	5.58	7.64
n	.015	.015
$A = bd$	46.58	137
$P = b+2d$	19.46	35.96
$R = \frac{A}{P}$	2.39	3.81
$S = \left[\frac{Vn}{1.486 R^{2/3}}\right]^2$	.00099	.000999
	any .001	any .001
$d_c = \left(\frac{q^2}{g}\right)^{1/3}$	3.07	5.78
S_c	.0047	.003

Q inlet #1 = 1046

For broad crested weir

$Q = CLH^{3/2}$

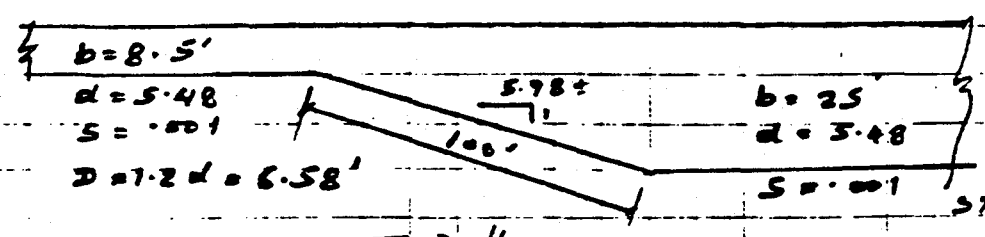
$C = 3.1$

$\therefore LH^{3/2} = 337.42$

L	H	V
50	3.57	5.86
100	2.25	4.65
150	1.72	4.05

— will inundate about 300' length of inlet

Provide grouted riprap at the inlet and use 100' long weir.



EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-22-85 SHEET 3 OF 15

CHKD. BY C Zee DATE 7/3/85 OFS NO. USDA 3767-10C DEPT. NO. 556

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

Increase the slope of the channel to .0024 less than so after STA 22400 to follow the ground profile

$Q = 1046$

$b = 25$

$S = .0024$

for $d = 4.07$

bd $A = 101.75$

$b+2d$ $P = 33.14$

A/P $R = 3.07$

$n = .015$

$\frac{1.486}{n} R^{2/3} S^{1/2}$ $V = 10.25$

Q/bV $d = 4.08$ o.k

Inlet 1A + 1B STA 25475 TO 26+25 (Subject to Field verification)

$Q_2 = 514$ cfs

$\therefore Q_3 = 1046 + 514 = 1560$ cfs

For inlet $CLH^{3/2} = 514$

$\therefore LH^{3/2} = \frac{514}{3.1} = 165.8$

$L = 50'$ $H = 2.22$

For channel $Q = 1560$

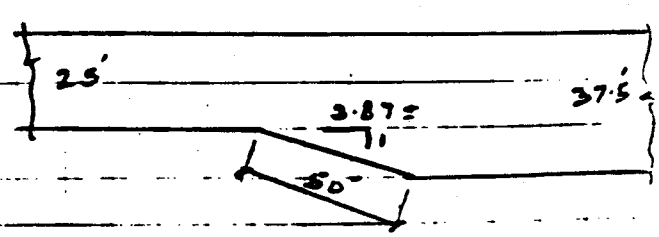
use concrete rectangular channel

$Q = 1560$

$b = 37.5$

$S = .0024$

for $d = 3.92$



bd $A = 147$

$b+2d$ $P = 45.34$

A/P $R = 3.242$

$n = .015$

$\frac{1.486}{n} R^{2/3} S^{1/2}$ $V = 10.63$

Q/bV $d = 3.91$ o.k

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-23-85 SHEET 4 OF 15

CHKD. BY L. Jee DATE 7/5/85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

STA 17+00

Bed El = 1813.25 - 6.58 = 1806.67

$v^2/2g = \frac{5.58^2}{2 \times 32.2}$ = 0.48

d = 5.48

STA 16+00

Bed El = 1806.67 - .001 x 500 = 1806.17

$v^2/2g$ .48

d 5.48

1812.13

STA 17+00

Bed El = $1806.17 + \frac{v_1^2}{2g} - \frac{v_2^2}{2g} + d_1 - d_2 - SL$

$= 1806.17 + .48 - \frac{7.64^2}{2 \times 32.2} + 5.48 - 5.48 - .001 \times 100$

$= 1806.17 + .48 - .91 - .1 = 1805.64$

$\frac{v^2}{2g} = \frac{7.64^2}{2 \times 32.2}$ .91

d 5.48

STA 22+00

Bed El = 1805.64 - .001 x 500 = 1805.14

$v^2/2g$ = .91

d = 5.48

STA 25+00

Bed El = 1805.14 - .0024 x 300 = 1804.42

$v^2/2g = \frac{10.25^2}{2 \times 32.2}$ = 1.63

d = 4.08

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-23-85 7-1-85 SHEET 5 OF 15

CHKD. BY C. Zee DATE 7/2/85 OFS NO. USDA 3767.10 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

STA 25+25

Bed El = 1804.42 - .0024 x 75 = 1804.24

$v^2/2g$ = 1.63

d = 4.08

STA 26+25

Bed El = $1804.24 + \frac{v_1^2}{2g} - \frac{v_2^2}{2g} + d_1 - d_2 - SL$

$= 1804.24 + 1.63 - \frac{10.63^2}{2 \times 32.2} + 4.08 - 3.92 - .0024 \times 50$

$= 1804.24 + 1.63 - 1.75 + 4.08 - 3.92 - .12$

$= 1804.24 - 0.08$ = 1804.16

Provid. the same slope .0024 in the reach STA 25+75 to 26+25 and continue to STA 27+00

STA 26+25

Bed El = 1804.24 - .0024 x 50 = 1804.12

$v^2/2g = \frac{10.63^2}{2 \times 32.2}$ = 1.75

d = 3.91

STA 27+00

Bed El = 1804.12 - .0024 x 75 = 1803.94

$v^2/2g$ = 1.75

d = 3.91

Continue the same slope to STA 27+45 start of the

Bed El = 1803.94 - .0024 x 45 = 1803.83

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-24-85 7-1-85 SHEET 6 OF 15

CHKD. BY L. Zu DATE 7/2/85 OFS NO. USDA 3767.100 DEPT. NO. 5.2

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

SUPERSEDED

Energy dissipator

$Q_{PSH} = 1560$ cfs

For $D_{75} = 4.76$ mm > 0.4 mm

Allowable velocity for unprotected channel (TR 25 Fig 6-2) silt laden flow

$V_{all.} = V_b \times D \times A \times B$

$= 4 \times 1.1 \times 1 \times .83$ [3:1 side slope DKS]

$= 3.65$

$A = \frac{Q}{V} = \frac{1560}{3.65} = 427.4$ sq ft

Assume $b = 80'$

for 3:1 side slopes

$d = 4.60'$

$A = 431.48$

$P = 80 + 2\sqrt{10} \times 4.6$

$= 109.09$

$R = 3.955$

$V = 3.62$

$S = \left[\frac{V n}{1.486 R^{2/3}}\right]^2$ $n = .0$

$= .0006$

SUPERSEDED

The excavation from the channel can be used for the embankment

if $b = 100'$

$d = 4.2$ 2:1 side slo

$A = 455.28$ $4.2 \times 100 + 2 \times 4.2$

$P = 118.78$ $100 + 2\sqrt{5} \times 4$

$R = 3.83$

$V = \frac{1560}{455.28} = 3.43$

$S = .00056$

EBASCO SERVICES INCORPORATED

BY S Goyal DATE 6-27-85 SHEET 7 OF 15

CHKD. BY C. Zee DATE 7/2/85 OPS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

SUPERSEDED

Reservoir water level for ESL
For 100' wide channel
∴ bed level = 1795.52
End of channel STA 39+50
∴ stilling basin STA 28+52
Bed slope = .00056
∴ Bed EL at STA 28+52 = 1795.52 + .00056 × 109
= 1796.13'
Water EL = 1796.13 + 4.2 = 1800.33

SUPERSEDED

Ref Hydraulic Design of Energy Dissipators for Culverts and channel US DOT Page [illegible]

$Q = 1560 \qquad W_B = W_o = 37.5'$

$Y_o = Y_c = \left[\left(\frac{1560}{37.5}\right)^2 / 32.2\right]^{1/3} = 3.77' \qquad Y_c = \sqrt[3]{\frac{q^2}{g}}$

$V_o = 1560/(37.5 \times 3.77) = 11.03$

Bed EL = 1803.83

$Q = Y_1 W_B \left[2g\{(Z_o - Z_1) + (Y_o - Y_1)\} + V_o^2\right]^{1/2}$

$1560 = 37.5\, Y_1 \left[64.4(Z_o - Z_1) + 64.4 \times 3.77 - 64.4\, Y_1 + 11.03^2\right]^{1/2}$

$= 37.5\, Y_1 \left[64.4(Z_o - Z_1) + 364.45 - 64.4\, Y_1\right]^{1/2}$

For $Z_o - Z_1$ =	12	12.2
Bed EL =	1791.83	1791.63
Y_1 =	1.28	1.273
Q =	1559	1560
V_1 =	32.5	32.68
$F_r = \frac{V}{\sqrt{gY}}$ =	5.06	5.10
$Y_2 = \frac{1}{2} Y_1 \left[\sqrt{1 + 8F_r^2} - 1\right]$ =	8.55	8.57

For free jump $\frac{TW}{Y_2} = 1.0$ or $TW = 8.55$ 8.57

Bed of stilling basin = 1800.33 − 8.55 = 1791.78 < 1791.83
(For $Z_o - Z_1$ = 12.2) → = 1791.76 > 1791.63

Length of jump (for $F_r = 5.06$) = 6 × Y_2

= 6 × 8.55	6 × 8.57
= 51.3'	51.42
	Use 52'

Provide transition in 31.25' length to 100' wide channel at 45°

III D-51

EBASCO SERVICES INCORPORATED

BY S Goyal DATE 6-27-85 / 9-16-85 SHEET 7A OF 15
CHKD. BY C. Zee DATE 7/2/85 Y.C YANG 9-17-85 OFS NO. USDA 3767-100 DEPT. NO. 550
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT APACHE JUNCTION FLOODWAY

Reservoir water level for ESH = 1799.72
For 130' wide channel d = 3.73 See separate calc.
∴ bed level = 1795.99
End of channel STA 39+50
" " stilling basin STA 28+53.5
Bed slope = .00056
∴ Bed EL at STA 28+52 = 1795.99 + .00056 × 1096.5
= 1796.60'
Water EL " = 1796.60 + 3.73 = 1800.33
Ref Hydraulic Design of Energy Dissipators for Culverts and channel US DOT Page IV B-8

$Q = 1560 \qquad W_B = W_0 = 37.5'$

$Y_0 = Y_c = \left[\left(\frac{1560}{37.5}\right)^2 / 32.2\right]^{1/3} = 3.77' \qquad Y_c = \sqrt[3]{\frac{q^2}{g}}$

$V_0 = 1560/(37.5 \times 3.77) = 11.03$

Bed EL = 1802.36

$Q = Y_1 W_B \left[2g\{(Z_0 - Z_1) + (Y_0 - Y_1)\} + V_0^2\right]^{1/2}$

or $1560 = 37.5\, Y_1 \left[64.4(Z_0 - Z_1) + 64.4 \times 3.77 - 64.4\, Y_1 + 11.03^2\right]^{1/2}$

$= 37.5\, Y_1 \left[64.4(Z_0 - Z_1) + 364.45 - 64.4\, Y_1\right]^{1/2}$

For $Z_0 - Z_1 = 10.33$

Bed EL = 1792.03

$Y_1 = 1.355$

$Q = 1559.9$

$V_1 = 30.70$

$F_r = \frac{V}{\sqrt{gY}} = 4.65$

$Y_2 = \frac{1}{2} Y_1 \left[\sqrt{1 + 8F_r^2} - 1\right]$

$= 8.25$

For free jump $\frac{TW}{Y_2} = 1.0$ or $TW = 8.25$

Bed of stilling basin = 1800.33 − 8.25 = 1792.08 < 1792.03 o.k

Length of Jump (for $F_r = 4.65$) = $5.9 \times Y_2$

$= 5.9 \times 8.25$

$= 48.7'$ use 49'±

Provide Transition in 46.25' length to 130' wide channel at 45°

EBASCO SERVICES INCORPORATED

BY S Goyal DATE 9-10-85 SHEET 7B OF 15

CHKD. BY YCYOUNG DATE 9-17-85 OFS NO. USDA 3767.10 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

Check energy dissipator for lower flows in the floodway

Q	921	390
$W_B = W_0 = 37.5'$		
$Y_0 = Y_c = \left[\left(\frac{Q}{W}\right)^2/g\right]^{1/3}$	2.66	1.5
$V_0 = Q/(W \times Y_c)$	9.23	6.93
Bed El = 1792.00		
$Z_0 - Z_1 = 1802.33 - 1792 = 10.33$		
$Q = Y_1 W_B [2g\{(Z_0 - Z_1) + (Y_0 - Y_1)\} + V_0^2]^{1/2}$		
$= Y_1\, 37.5 [64.4 \{10.33 + (Y_0 - Y_1)\} + V_0^2]^{1/2}$		
For $Y_1 =$	.834	.371
$Q =$	921.4	390.0
$V_1 = Q/(37.5 \times Y_1)$	29.45	28.03
$Fr_1 = V_1/\sqrt{gY_1}$	5.68	8.11
$Y_2 = \frac{1}{2} Y_1 [\sqrt{1 + 8 Fr_1^2} - 1]$	6.30	4.07
T.W req $= 1792.33 + Y_2$	1798.33	1796.10
T.W Avail $= 1796.60 + D$		1796.6
D	2.48	
T.W. Avail	1799.08	
	0.4	0.4

The pool is alright for lower flows.

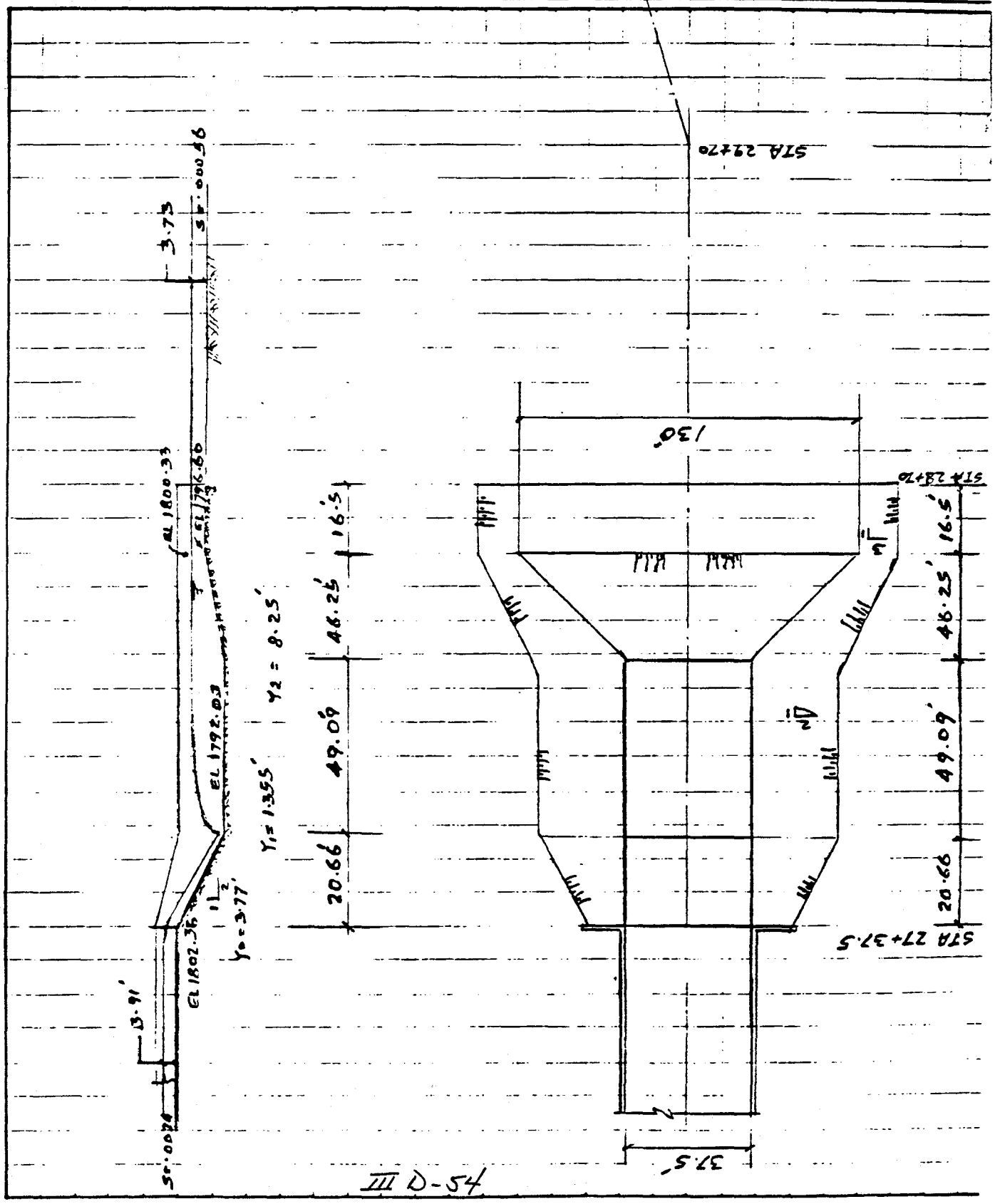
EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-27-85 / 9-17-85 SHEET 8 OF 15
6-28-85 Y.C. YANG 9-17-85
CHKD. BY C. Zee DATE 9/2/85 OFS NO. USDA 3767-100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY



881/8-81

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-25-85 SHEET 9 OF 15

CHKD. BY L.Zu DATE 7/2/85 OPS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT

A major portion of the Apache Junction floodway has a slope of 0.001

Q = 1046 cfs

For the best rectangular channel for the same area of flow 25 x 5.48 = 137 sq ft

b = 2d = 16.5'

d = 8.25 D = 1.2 x 8.25 = 9.9'

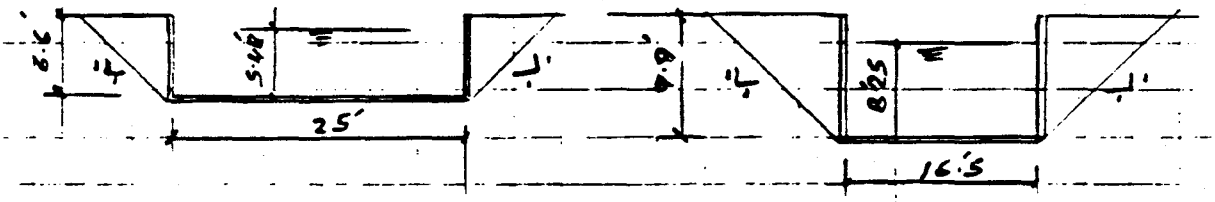
A = 136.1

P = 33

R = 4.125

V = 7.68

D = 1.2 x 5.48 = 6.6' S = .00091 ok



Adopted Alternate

EXCAVATION	209 CFT/FT		261
length of walls & floor	38.2 FT		36.3 FT
Concrete	25.5 CFT/FT (8" wall)		30.25 CFT/FT (10" walls)

Therefore the section assumed is less expensive both in excavation, concrete and form work.

EBASCO SERVICES INCORPORATED

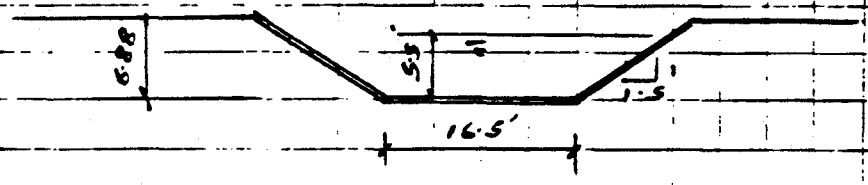
BY S GOYAL DATE 6-25-85 SHEET 10 OF 15

CHKD. BY L Zee DATE 7/2/85 OFS NO. USDA 3767-10 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT



D = 1.25 x 5.5 = 6.88

Excavation = (16.5 + 1.5 x 6.88) 6.88 = 184.5 CFT/FT

Length of lining = 16.5 + 2 x 6.88 x $\sqrt{2.25}$ = 41.3

Concrete = 41.3 x 5 6" lining chan channel

= 20.7 CFT/FT

Filter 10" = 41.3 x .8

= 33 CFT/FT

	Section adopted	Trapezoidal
Exc.	$\frac{209}{27}$ @ 2.5 = 19.35	$\frac{184.5}{27}$ @ 2.5 = 17.08
Conc.	$\frac{25.5}{27}$ @ 200 = 188.89	$\frac{20.7}{27}$ @ 200 = 153.33
Filter	-	$\frac{33}{27}$ @ 40 = 48.89
	208.24	219.30

Besides this trapezoidal lined channel will have more maintenance cost than the reinforced concrete rectangular channel.

881/8-81

EBASCO SERVICES INCORPORATED

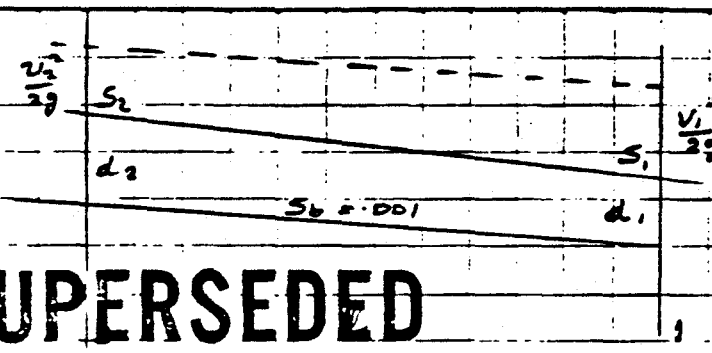
BY B Goyal DATE 7-8-85 SHEET 11 OF 15

CHKD. BY L. Jan DATE 7/9/85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY WATER PROFILE



SUPERSEDED

$$Z_1 + d_1 + \frac{v_1^2}{2g} = Z_2 + d_2 + \frac{v_2^2}{2g} - \Delta h$$

$$= Z_1 + S_b l + d_2 + \frac{v_2^2}{2g} - \frac{S_1 + S_2}{2} l$$

or $$\left[\frac{S_1+S_2}{2} - S_b\right] l = d_2 + \frac{v_2^2}{2g} - d_1 - \frac{v_1^2}{2g}$$

$$v_2 = \frac{1.486}{n} R_2^{2/3} S_2^{1/2}$$

$$\Delta S\, l = \Delta E$$

$$= \frac{Q}{b d_2}$$

$$l = \Delta E / \Delta S$$

or $$d_2 R_2^{2/3} = \frac{1.46 \times .001}{25 \times 1.486} = .4223 / S_2$$

S_1	S_2	S_b	ΔS	d_1	$\frac{v_1^2}{2g}$	d_2	$\frac{v_2^2}{2g}$	ΔE	l	Σl
.0024	.0020	.001	.0012	4.08	1.63	4.333	1.448	.0708	59	59
.0020	.0016	.001	.0008	4.333	1.448	4.67	1.246	.135	169	228
.0016	.0014	.001	.0005	4.67	1.246	4.885	1.139	.108	216	442
.0014	.0013	.001	.00035	4.885	1.139	5.0	1.087	.063	180	622

STA	d_1
25+75	4.08
22+50	4.08
21+41	4.33
19+72	4.67
17+56	4.885
15+76	5

SUPERSEDED

Total energy at STA 17+00 = 1805.64 + 5 + 1.087 = 1811.727

" 16+00 = 1811.727 + .0013 x 100 + .4(1.087 - .41) Transition loss

= 1812.1

∴ = 1812.13 See sheet 4

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-13-85 SHEET 11A OF 15

CHKD. BY S Goyal DATE 9-16-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT. FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

@ STA 26+25 :

$Q = 1560$ CFS ; $S_b = 0.0024$

$B = 37.50'$; $n = 0.015$

$$Q = \frac{1.486}{n} S_b^{1/2} A R^{2/3} = \frac{1.486}{n} S^{1/2} \frac{A^{5/3}}{P^{2/3}}$$

$$= \frac{1.486}{n} S^{1/2} \frac{(BD_n)^{5/3}}{(B+2D_n)^{2/3}}$$

OR $$\frac{(BD)^{5/3}}{(B+2D)^{2/3}} = \frac{Qn}{1.486 S^{1/2}} = \frac{1560(0.015)}{1.486(0.0024)^{1/2}}$$

$$\frac{(BD_n)^{5/3}}{(B+2D_n)^{2/3}} = 321.4337$$

BY TRIAL : $D_n = \underline{3.9154}$

$$\frac{(BD_n)^{5/3}}{(B+2D_n)^{2/3}} = 321.4278 \quad \text{(O.K)}$$

581/8-81

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-13-85 SHEET 11B OF 15

CHKD. BY S Goyal DATE 9-16-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT. PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

STA 26+25 TO STA 25+75 :

APPLY MOMENTUM EQUATION TO FIND DEPTH

$$\frac{W}{g}(Q_1V_1 - Q_2V_2) = P_2 - P_1 + \bar{P} + W\sin\theta - F_f \quad (1)$$

$$P_1 = \frac{1}{2}WB_1D_1^2 \; ; \qquad V_1 = \frac{Q_1}{B_1D_1}$$

$$P_2 = \frac{1}{2}W\cdot B_2D_2^2 \; ; \qquad V_2 = \frac{Q_2}{B_2D_2}$$

$$\bar{P} = \frac{W}{2}(B_1 - B_2)\left(\frac{D_1+D_2}{2}\right)^2$$

$$= \frac{W}{8}(B_1 - B_2)(D_1+D_2)^2$$

$$F_f = W h_f'$$

$$W\sin\theta \doteq W\tan\theta = WS_b$$

ASSUME $h_f' = S_b$

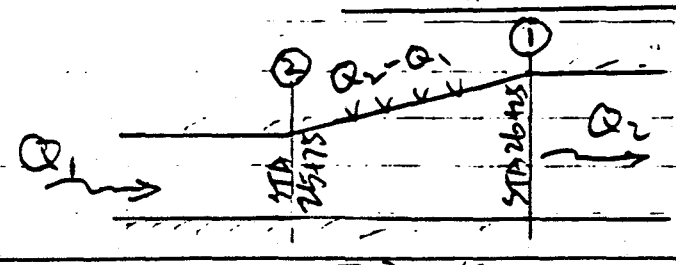
THEN $W\sin\theta = F_f$.

Eq. (1) BECOMES

$$\frac{W}{g}\left(\frac{Q_1^2}{B_1D_1} - \frac{Q_2^2}{B_2D_2}\right) = \frac{W}{2}\left(B_2D_2^2 - B_1D_1^2\right) + \frac{W}{8}(B_1-B_2)(D_1+D_2)^2$$

OR

$$\frac{1}{g}\left(\frac{Q_2^2}{B_2D_2}\right) + \frac{1}{2}\left(B_2D_2^2\right) + \frac{1}{8}(B_1-B_2)(D_1+D_2)^2 = \frac{1}{g}\left(\frac{Q_1^2}{B_1D_1}\right) + \frac{1}{2}\left(B_1D_1^2\right) \quad (2)$$



EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-13-85 SHEET 11C OF 15

CHKD. BY S Goyal DATE 9-16-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

FROM STA. 26+25 TO STA 25+75:

$$\frac{1}{g}\left(\frac{Q_2^2}{B_2 D_2}\right)+\frac{1}{2}\left(B_2 D_2^2\right)+\frac{1}{8}\left(B_1-B_2\right)\left(D_1+D_2\right)^2=C_2$$

$$\frac{1}{g}\left(\frac{Q_1^2}{B_1 D_1}\right)+\frac{1}{2}\left(B_1 D_1^2\right)=C_1$$

STA	B	Q	D	C_1	C_2
26+25	37.50	1560.00	3.9154	802.182	
26+18.75	35.9375	1495.75	4.422	788.578	802.182
26+12.5	34.375	1431.50	4.684	772.337	788.532
26+06.25	32.8125	1367.25	4.899	754.474	772.391
26+00	31.25	1303.00	5.077	735.084	754.502
25+93.75	29.6875	1238.75	5.244	714.305	735.109
25+87.5	28.125	1174.50	5.401	692.237	714.369
25+81.25	26.5625	1110.25	5.550	668.767	692.190
25+75	25.00	1046.00	5.695		668.769

EBASCO SERVICES INCORPORATED

CLIENT: USDA SCS PHOENIX ARIZONA
PROJECT: BULLDOG FLOODWAY & APACHE FLOOD PROTECTION
SUBJECT: APACHE JUNCTION FLOODWAY - WATER PROFILE

OFS NO.: DEPT. NO.:
BY: Y.C. YANG DATE: 9-13-85
CHECKED BY: S Goyal DATE: 9-16-85

$E_1 = D_1 + Z_1 + \frac{V_1^2}{2g}$; $E_2 = D_2 + Z_2 + \frac{V_2^2}{2g} + H_f$ $\quad \Sigma E_1 = \Sigma E_2$ $\quad S_f = \left(\frac{0.015}{1.486}\frac{V}{R^{2/3}}\right)^2$

	(1) STA	(2) EU	(3) ΔL	(4) Sb	(5) Sw/L	(6) B	(7) A	(8) R^2/3	(9) Q	(10) V	(11) = Σ(5) Z	(12) D	(13) V²/2g	(14) ΣE₁	(15) Sf	(16) Sf AVE	(17) Hf	(18) ΣE₂
	25+75				0	250	142.375	2.483	1016	7.347	0	5.695	0.838	6.533	0.00089			
	25+50		25	0.0024	0.06	"	141.0	2.472	"	7.418	0.06	5.640	0.855	6.555	0.00092	0.00090	0.023	6.556
	25+00		50	0.0024	0.12	"	138.375	2.451	"	7.559	0.18	5.535	0.887	6.602	0.00097	0.00095	0.042	6.602
	24+50		50	0.0024	0.12	"	135.75	2.429	"	7.705	0.30	5.430	0.922	6.652	0.00103	0.00100	0.050	6.652
4.07735	24+00		50	"	0.12	"	133.125	2.407	"	7.857	0.42	5.325	0.959	6.704	0.00109	0.00106	0.053	6.705
	23+00		100	"	0.24	"	128.125	2.364	"	8.164	0.66	5.125	1.035	6.820	0.00122	0.00115	0.115	6.819
1	22+00		100	"	0.24	"	123.375	2.322	"	8.478	0.90	4.935	1.116	6.951	0.00136	0.00129	0.129	6.949
5.477	21+00		100	0.0010	0.10	"	124.875	2.335	"	8.376	1.00	4.995	1.089	7.084	0.00131	0.00134	0.134	7.084
	20+00		100	"	0.10	"	126.125	2.346	"	8.293	1.10	5.045	1.068	7.213	0.00127	0.00129	0.129	7.213
	19+00		100	"	0.10	"	127.105	2.356	"	8.222	1.20	5.089	1.050	7.339	0.00124	0.00126	0.126	7.339
	18+00		100	"	0.10	"	128.20	2.365	"	8.159	1.30	5.128	1.034	7.462	0.00121	0.00123	0.123	7.462
	17+00		100	"	0.10	"	129.05	2.372	"	8.104	1.40	5.162	1.020	7.582	0.00119	0.00120	0.120	7.582
	FROM STA 17+00 TO STA 16+00 COMPUTATION SEE NEXT PAGE																	
	16+00			0.0010		8.5	62.807	1.938	460	4.140	0	7.389	0.266	7.655	0.00046			
	15+50		50	"	0.05	"	62.56	1.936	"	4.156	0.05	7.360	0.268	7.628	0.00047	0.00023	0.023	7.628
	15+00		50	"	0.05	"	62.356	1.935	"	4.170	0.10	7.336	0.270	7.606	0.00047	0.00024	0.024	7.608
	14+00		100	"	0.10	"	61.88	1.931	"	4.202	0.20	7.280	0.274	7.754	0.00048	0.00048	0.048	7.754
	13+00		100	"	0.10	"	61.404	1.927	"	4.234	0.30	7.224	0.278	7.802	0.00047	0.00048	0.048	7.803
	12+00		100	"	0.10	"	60.928	1.924	"	4.267	0.40	7.168	0.283	7.851	0.00050	0.00495	0.050	7.852
	11+00		100	"	0.10	"	60.469	1.920	"	4.300	0.50	7.114	0.287	7.901	0.00051	0.00505	0.051	7.902

19-Q III

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-13-85 SHEET 11F OF 15

CHKD. BY S Goyal DATE 9-16-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

FROM STA 17+00 TO STA 16+00 :-

$$\frac{1}{g}\left(\frac{Q_2^2}{B_2 D_2}\right)+\frac{1}{2}\left(B_2 D_2^2\right)+\frac{1}{8}\left(B_1 D_1^2 - B_2 D_2^2\right) = C_2$$

$$\frac{1}{g}\left(\frac{Q_1^2}{B_1 D_1}\right)+\frac{1}{2}\left(B_1 D_1^2\right) = C_1$$

STA	B	Q	D	C_1	C_2
17+00	25.00	1046.0	5.162	596.377	
16+87.5	22.9375	947.75	5.489	567.104	596.350
16+75	20.875	849.50	5.778	534.356	567.084
16+62.5	18.8125	751.25	6.050	498.289	534.357
16+50	16.75	653.0	6.311	458.839	498.231
16+37.5	14.6875	554.75	6.570	416.036	458.812
16+25	12.625	456.5	6.833	369.751	416.064
16+12.5	10.5625	358.25	7.104	319.647	369.724
16+00	8.50	260.0	7.389		319.618

III D-62

501/8-81

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-25-85 SHEET 12 OF 15

CHKD. BY S Goyal DATE 9-13-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY – BAFFLE CHUTE

$Q_{max} = 1560$ CFS $W = 37.50'$ $S = \frac{1}{2}$

$q = \frac{Q}{W} = \frac{1,560}{37.5} = 41.6$ CFS/FT.

$D_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{41.6^2}{32.2}} = 3.77'$

$V_c = \sqrt[3]{qg} = \sqrt[3]{(41.6 \times 32.2)} = 11.02$ '/sec

TOTAL LENGTH OF CHUTE (MIN)

$L = (1803.58 - 1796.97)\sqrt{1^2+2^2} = 14.78$ (SLOPE)

$L_{HORIZ} = (1803.58 - 1796.97)\,2 = 13.22$

BAFFLE PIER HEIGHT:-

$H = 0.8 D_c = 0.8 \times 3.77 = 3.02'$ USE 3'-0

BAFFLE PIER WIDTH & SPACING

$B = 3/2 H = 3/2 \times 3.02 = 4.53'$ USE 4.5'

SLOPE DISTANCE BETWEEN BAFFLE PIERS:-

$D = 2H = 2 \times 3.00 = 6.00$

NO. OF BAFFLE PIERS PER ROW:-

$37.5 / 2 \times 4.5 = 4.17$

NO OF ROWS

$14.78 \div 6.0 - 1 = 1.45$ USE 4 ROWS (MIN)

LENGTH OF CHUTE:

$(4.0 + 1.) \times 6 = 30'$ III D-63

EBASCO SERVICES INCORPORATED

BY E.C. YANG DATE 6-25-85 SHEET 12 A OF 15

CHKD. BY S Goyal DATE 9-13-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY — BAFFLE CHUTE

$L_{HORIZ} = 30.0 \times 2 / \sqrt{5} = 26.83'$

$F = 30.0 / \sqrt{5} = 13.42'$

TOP OF STILLING POOL EL

$1803.58 - 13.42 = 1790.16'$

HEIGHT OF TRAINING WALL

$H = 3 \times 3 = 9'$

EBASCO SERVICES INCORPORATED

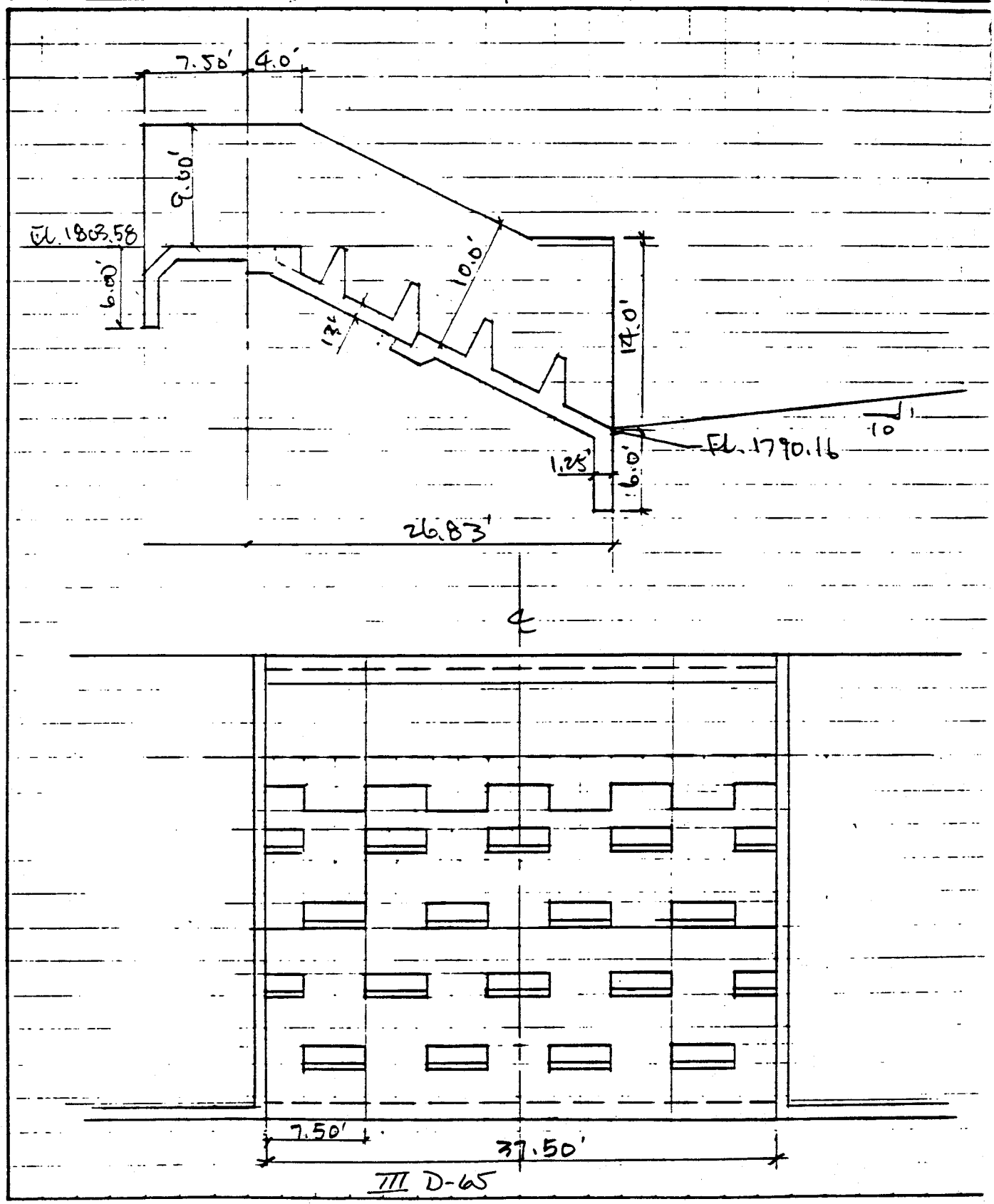
BY Y.C. YANG DATE 6-25-85 SHEET 12B OF 15

CHKD. BY S GOYAL DATE 9-16-85 OPS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE FLOODWAY — BATTLE CHUTE



EBASCO SERVICES INCORPORATED

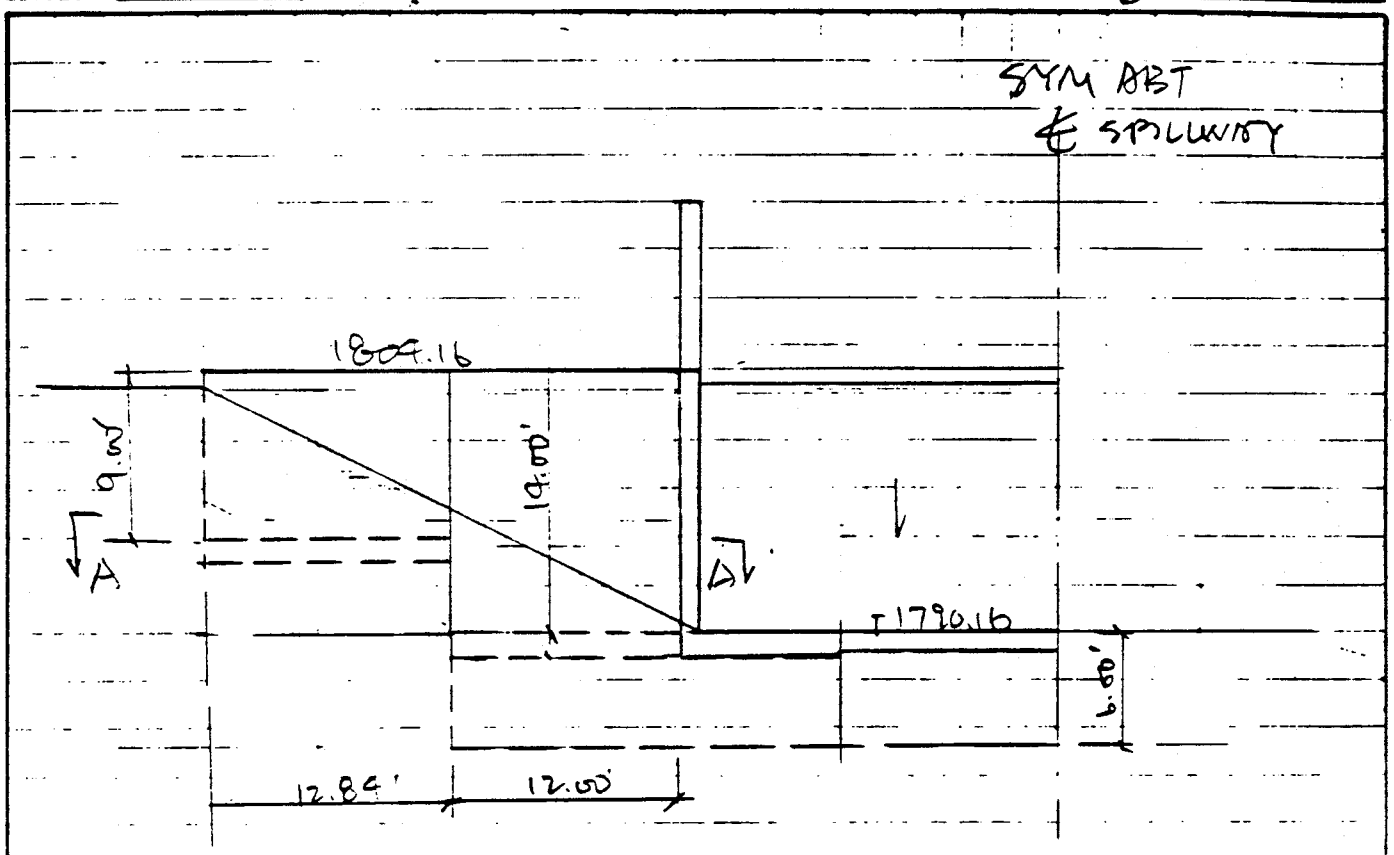
BY Y.C. YANG DATE 6-25-85 SHEET 12C OF 15

CHKD. BY S Goyal DATE 9-18-85 OFS NO. 3767.100 DEPT. NO. 650

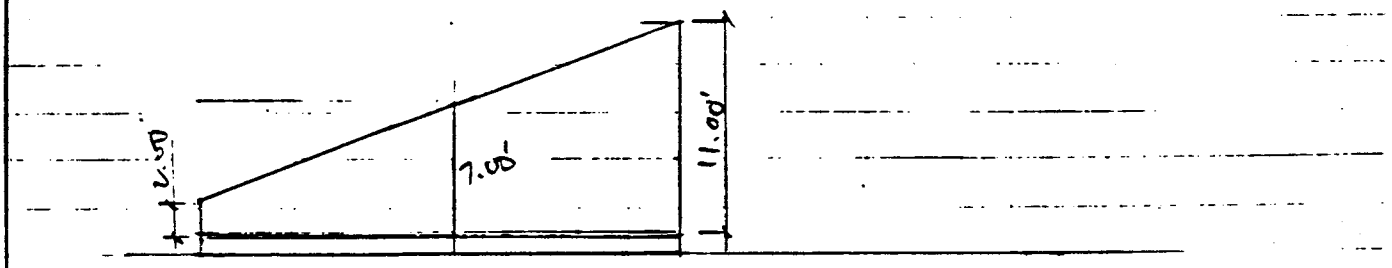
CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY – BAFFLE CHUTE



FRONT ELEVATION
(WING-WALL)



SECT A-A

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-25-85 SHEET 12D OF 15

CHKD. BY S Goyal DATE 9-18-85 OPS NO. 3767.100 DEPT. NO. 65

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY - BAFFLE CHUTE

QUANTITIES:

SLAB: (t = 16"):

1.33 × 8.50 × 2 × 30.0 = 678.30 CF

SLAB: (t = 13"):

13/12 × 22.50 × 30.0 = 731.25 CF

SLAB @ CREST: (t = 12")

1.0 × (7.50 + 6.00) × 39.50 = 533.25 CF

C.O. WALL (t = 15"):

15/12 × 6.0 × 39.50 = 296.25 CF

BAFFLES:

(0.6 + 2.1) 3.0/2 × 4.5 × 14 = 255.15 CF

(0.6 + 2.1) 3.0/2 × 3.0 × 4 = 98.60 CF

4.0 × 1 × 4.5 × 4 = 72.00 CF

2.0 × 1.0/2 × (3 × 4.5 + 2 × 3.0) = 19.50

1.0 × 3.0 × 37.5 = 112.50

SIDE WALL: (AVE t = 11")

2 × 11/12 × (7.50 + 4.0) × 9.0 = 189.75

2 × 11/12 × (26.83 − 4.0 − 6.0) 10√5/2 = 399.97

2 × 11/12 × (14.0 + 10√5/2) 6.0/2 = 138.49

3420.01

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-25-85 SHEET 12 E OF 15

CHKD. BY S.G. yo DATE 9-16-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTIO

SUBJECT APACHE JUNCTION FLOODWAY – BAFFLE CHUTE

RETAINING WALL: (t = 12" & 15")

WALL: $2 \times 15/12 \times 14.0 \times 12.0 = 420.00$ C.F.

$2 \times 12/12 \times 9.0 \times 12.84 = 231.12$

SLAB: $2 \times 15/12 \times (12.25 + 8.25)\, 12.0/2 = 307.50$

$2 \times 12/12 \times (3.0 + 8.0)\, 12.84/2 = 141.24$

$\Sigma V = 4519.87$ C.F.

$= \underline{167.5}$ C.Y.

EBASCO SERVICES INCORPORATED

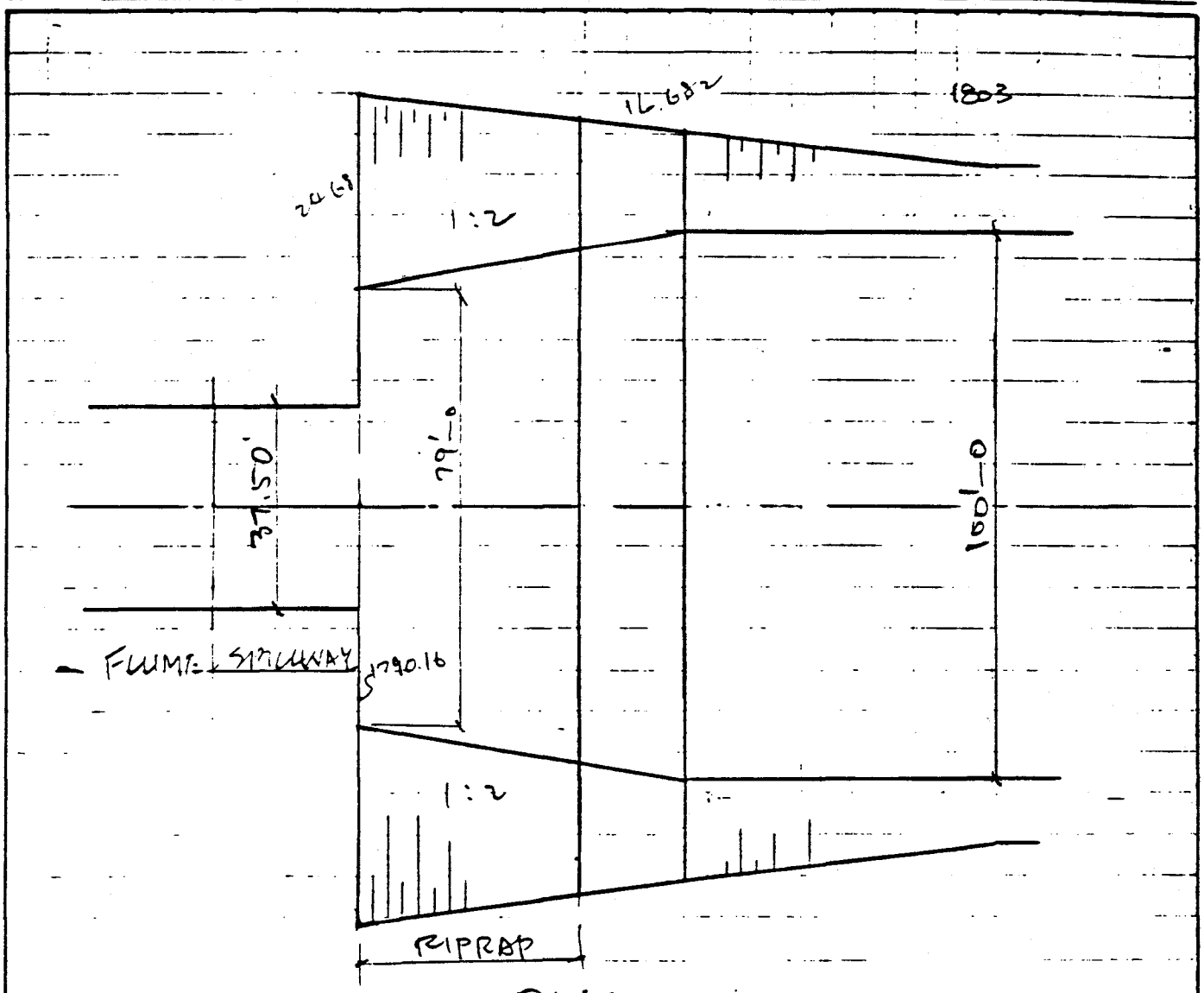
BY Y. C. YANG DATE 6-26-85 SHEET 12 E OF 15

CHKD. BY S. Goyal DATE 9-16-85 OFS NO. 3267.100 DEPT. NO. 650

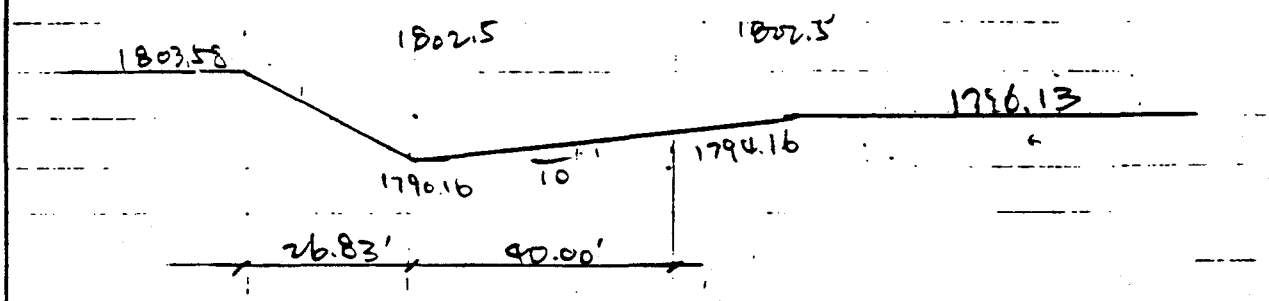
CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — BAFFLE CHUTE



PLAN



PROFILE

1" = 30'-0

III D-69

EBASCO SERVICES INCORPORATED

BY Y.C. Yang DATE 6-26-85 SHEET 12 G OF 15

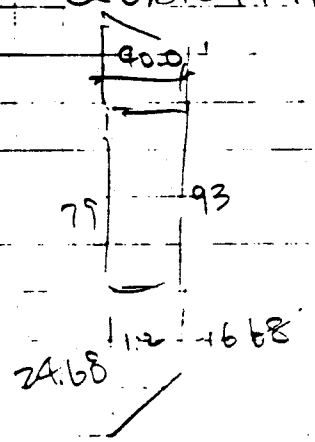
CHKD. BY S Goyal DATE 9-16-85 OFS NO. 3767.101 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY - BAFFLE CHUTE

QUANTITIES (t = 2.6')



$A_1 = 40.0\,(79 + 93)\frac{1}{2} \times \frac{\sqrt{101}}{10} \doteq 3457\ \square'$

$A_2 = 2(24.68 + 16.68)\frac{\sqrt{5}}{2} \times \frac{40.0}{2} \times \frac{\sqrt{101}}{10} = 1859\ \square'$

$\Sigma A = 5{,}316\ \square'$

$\bar{V} = 5{,}316 \times 2.5 = 13{,}290\ CF$

$= 492\ CY$

EBASCO SERVICES INCORPORATED

BY S Goyal DATE 7-2-85 SHEET 12 OF 15

CHKD. BY Y C Yang DATE 9-17-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY - ENERGY DISSIPATOR

RIPRAP

$37.5 \times 24.14 \frac{\sqrt{5}}{2} \times 2.5 = 2530$

$37.5 \times 51.61 \times 2.5 = 4838$

$2 \times (10 + 25.5) \frac{1}{2} \frac{\sqrt{5}}{2} \times 24.14 \times \frac{\sqrt{5}}{2} \times 2.5 = 2678$

$2 \times 25.5 \frac{\sqrt{5}}{2} \times 51.61 \times 2.5 = 7357$

$2 \times \left(\frac{25.5 + 8.37}{2}\right) \frac{\sqrt{5}}{2} \times 31.25 \times 1.5 = 1775$

$(37.5 + 100) \frac{1}{2} \times 31.25 \times 1.5 = 3223$

$2 \times 8.37 \times \frac{\sqrt{5}}{2} \times 18 \times 1.5 = 505$

$18 \times 100 \times 1.5 = 2700$

25606 cft

or 948 cyd.

Baffle chute CONC = 167 @ 300 = $ 50100

RIPRAP = 492 cyd @ 30 = $ 14760

$ 64860

Riprap basin RIPRAP = 948 cyd @ 30 = $ 28440

∴ RIPRAP BASIN IS ECONOMICAL AND WILL BE USED.

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-28-85 SHEET 1 OF 17

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA 3767.100 DEPT. NO. 55

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL

Earth emergency spillway

From computer output

Length of crest (Ft)	OF/b	TOP OF Embankment (Feet)	Quantity of Fill (CYD)
400	7.3	1807.03	260092
350	8.3	1807.34	268269
300	9.6	1807.69	278038
275	10.5	1807.89	283335

The minimum width which satisfies OF/b criteria to be less than 10 is 300 feet. Design study is done for 300 wide crest and thereafter 350 wide crest will be considered if it is more economical than the 300 wide crest

For 300 wide crest

$Q_{ESH} = 2329.8$ cfs

$Q_{FBH} = 16084.9$ cfs

For earth channel assume $n = .025$

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

Approximate ground slope in the exit channel is 0.015.

$$\therefore V = \frac{1.486}{.025}(.015)^{1/2} R^{2/3} = 7.28 R^{2/3}$$

$$R = \frac{A}{P} = \frac{(300+2d)d}{300+2\sqrt{5}\,d}$$

$$Q = AV = (300+2d)d\,V$$

$$q = \frac{Q}{(300+2d)}$$

$$d_c = \sqrt[3]{q^2/g}$$

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EBASCO SERVICES INCORPORATED

BY S GUYAL DATE 6-28-85 SHEET 2 OF 17

CHKD. BY V.C.YANG DATE 7-9-85 OPS NO. USDA-SCS-PHOENIX DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL

d	R	V	Q	q	d_c	$d_c > d$
1.0	.99	7.24	2187	7.24	1.18	✓
1.5	1.48	9.46	4301	14.19	1.84	✓
2.0	1.97	11.43	6951	22.87	2.53	✓
2.5	2.45	13.23	10089	33.08	3.24	✓
3.0	2.93	14.90	13681	44.71	3.96	✓
3.5	3.40	16.47	17701	57.66	4.69	✓

$Q_{ESH} = 2329.8$

The flow is supercritical for all flows. The control is at the crest. However the velocity for Q_{ESH} is about 7.25 fps which is high for the soils and also for caliche which is considered to be a poor strength material. Protection by riprap or other material will be necessary.

For soil cement assume 'n' = .015 same as for concrete

$$\therefore \quad V = \frac{1.486}{.015}(.015)^{1/2} R^{2/3} = 12.13\, R^{2/3}$$

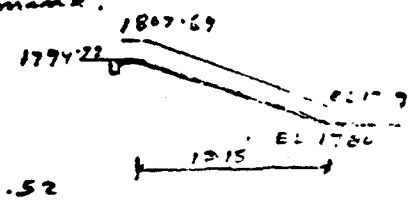
assume $d \simeq R$

$$\text{For } Q_{ESH} = 2329.8 = VA$$
$$= 12.13\, R^{2/3}\, 300 \times d$$
$$= 3639\, R^{5/3}$$

$d \simeq R = .765$ for 2/3 FBH $Q = 10723$, $d \simeq 1.9$, $V \simeq 18.6$

$V = 10.15$ fps

This velocity is considered to be high for soil cement without performing tests on the soil cement.



$$F = \frac{18.6}{\sqrt{32.2 \times 1.9}} = 2.38$$

conjugate depth $d_2 = 1.9 \times \frac{1}{2}\left(\sqrt{8F^2+1} - 1\right) = 5.52$

soil cement quantity $= 14000 \times (300 + 2\sqrt{3} \times 8) = 4700000$ sq ft

EBASCO SERVICES INCORPORATED

BY S GUPTA DATE 6-28-85 SHEET 3 OF 17

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAYS APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL WITH RIPRAP

For riprap or wire mat use n = .035

Provide bed slope of 0.0175 as shown in SCS work plan

$$V = \frac{1.486}{.035} R^{2/3} (.0175)^{1/2} = 5.617 R^{2/3}$$

d	R	V	Q	q	d_c	$d_c > d$
1.0	.99	5.59	1687	5.59	.99	approx.
1.5	1.48	7.30	3318	10.95	1.53	✓
2.0	1.97	8.82	5363	17.64	2.13	✓
2.5	2.45	10.21	7784	25.53	2.72	✓
3.0	2.93	11.50	10556	34.5	3.33	✓
3.5	3.40	12.71	13657	44.48	3.95	✓

Flow is supercritical for 25% of Q_{FBH} or greater

For $2/3\ Q_{FBH}$ $Q = 10723 = VA = 5.617 R^{2/3}(30 + 2d)d$

$d = 3.04$

$v = 11.6$

$F = 1.16$

$d_2 = 3.04 \times \frac{1}{2}\left(\sqrt{8 \times 1.16^2 + 1} - 1\right)$

$= 3.71$

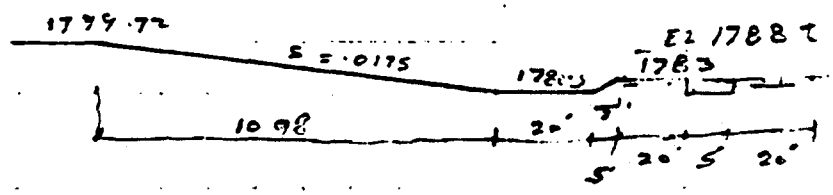
$Q_{ESH} = 2329 = 5.617 R^{2/3}(30 + 2d)d$

$d = 1.28$ $Q = 2350$

$v = 6.37$

$F = \frac{v}{\sqrt{gd}} = 1.016$

$d_2 \simeq d_1$



Too long a channel Provide S = .026

Total length ≈ = 739 + 70 = 809 ft

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-2-85 SHEET 4 OF 17

CHKD. BY Y.C YANG DATE 7-9-85 OFS NO. USDA 3767.01 DEPT. NO. 5

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL WITH RIPRAP

$$V = \frac{1.486}{.035} R^{2/3} S^{1/2}$$

$$= \frac{1.486}{.035} R^{2/3} (.026)^{1/2} = 6.846 R^{2/3}$$

For Q_{FBH} (16084.9) $d = 3.43$ $Q = 16093$ o.k.

$V = 15.29$

$2/3\ Q_{FBH}$ (10723) $d = 2.7$ $Q = 10789$ o.k.

$V = 13$

$F = 1.39$

$d_2 = 2.7 \times \frac{1}{2} \left[\sqrt{8 \times 1.39^2 + 1} - 1\right]$

$= 4.13$

$L = 4 \times 4.13 = 16.52$ ~> 20'

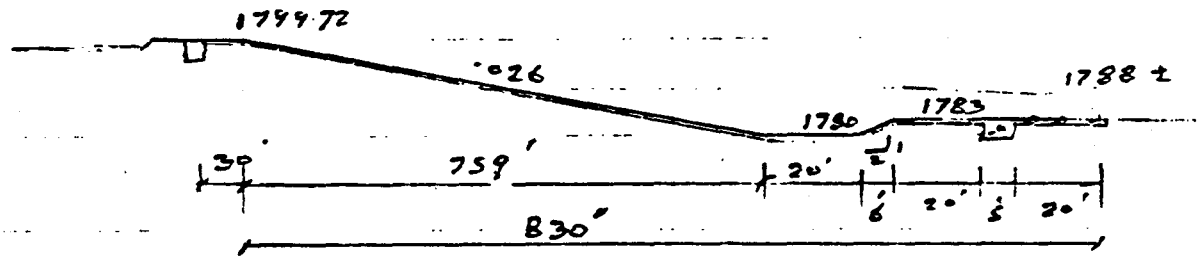
Q_{ESH} (2329) $d = 1.08$ $Q = 2337$ o.k.

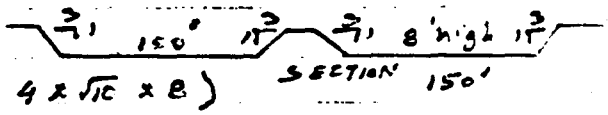
$V = 7.16$

$F = 1.21$

$d_2 = \frac{1.08}{2} \left[\sqrt{8 \times 1.21^2 + 1} - 1\right]$

$= 1.39$





Riprap $= 860 (150 \times 2 + 4 \times \sqrt{16} \times 8)$

$= 345,026$ sq ft. $= 38336$ sq yd

add for 1' thick Gabions and fabric @ 21 = 8,556

For 2 thick riprap

quantity $= 345026 \times \frac{2}{27} = 25557$ cy

@ \$30/yd $= \$766,724$

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-2-85 SHEET 5 OF 17

CHKD. BY Y.C.YANG DATE 7-9-85 OFS NO. USDA 3767.00 DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMENGENCY SPILLWAY - EARTH CHANNEL WITH RIPRAP

For 350' crest

Extra riprap cost = $860 \times 50 \times \frac{2}{27} \times 30$ = $95,555

Saving in fill = $(278 - 38 - 268269) \times 1.2$ = $11,723

∴ The cost of extra riprap is much more than the saving in the embankment height. Consider using 300 feet wide crest

ES CREST 1799.72 FT 498.1 ACFT 0.00 AC 80.8 CFS

PS STORAGE 484.4 ACFT BETWEEN ES CREST AND SED ACCUM ELEVATIONS

STARTING E 1793.50 FT 13.7 ACFT 0.00 AC 0.0 CFS

EFFECTIVE HEIGHT(H)= 11.7 FEET, PRODUCT = 5840. (H * STORAGE AT CREST ENG.)

INPUT DESIGN CLASS = C

SCS-ESH D= 6.00 HR P= 6.00 IN Q= 3.99 IN
TC= 0.69 HR CN= 82.00 VOL= 369.9 ACFT
PEAK 12284.9 CFS AT 2.68 HRS

SCS-FBH D= 6.00 HR P= 13.70 IN Q= 11.38 IN
TC= 0.69 HR CN= 82.00 VOL= 1055.3 ACFT
PEAK 37362.4 CFS AT 2.59 HRS

30" PS OUTLET
EARTH SPILLWAY
6/28/85

****

RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND ENG SPILLWAYS

RATING TABLE NUMBER 2

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	276.10	82.48	561.05	0.00
15	1800.75	493.46	83.96	628.30	0.00
16	1801.68	1588.69	86.55	749.35	0.00
17	1802.81	3763.45	89.61	910.14	0.00
18	1804.86	9708.88	94.93	1222.16	0.00
19	1807.43	20136.55	101.19	1655.06	0.00
20	1810.00	33348.42	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	400.0	1802.28	833.1	0.0	2.56	335.0	88.2	2633.3	2721.5	1.10	5.95	0.009	0.012	11.7	1.6

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBH Q/4 CRITICAL SLOPE.

EXIT SLOPE = 0.012

PLOT 1 IN = 2000. CFS

T	I	O	E	VOL	A	0.	2000.	4000.	6000.	8000.	10000.	12000.	14000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	0	0	1793.5	13.7	0.0	.								0.00

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5.45	662	1518	1801.6	741.5	0.0	. I E	5.15
5.53	614	1463	1801.6	735.4	0.0	. I E	5.08
5.62	573	1408	1801.5	729.4	0.0	. I E	5.01
5.71	542	1355	1801.5	723.5	0.0	. I E	4.94
5.79	520	1303	1801.4	717.8	0.0	. I E	4.88
5.88	505	1254	1801.4	712.3	0.0	. I E	4.73
5.96	492	1207	1801.4	707.1	0.0	. I E	4.67
6.05	476	1161	1801.3	702.1	0.0	. I E	4.63
6.14	450	1116	1801.3	697.3	0.0	. I E	4.49
6.22	407	1074	1801.2	692.5	0.0	. I E	4.45
6.31	351	1031	1801.2	687.7	0.0	. I E	4.40
6.40	289	986	1801.2	682.8	0.0	.I E	4.35
6.48	230	941	1801.1	677.7	0.0	.I E	4.18
6.57	177	895	1801.1	672.6	0.0	.I E	4.10
6.66	134	848	1801.1	667.5	0.0	.I E	4.01
6.74	101	803	1801.0	662.5	0.0	.I E	3.92
6.83	75	758	1801.0	657.5	0.0	. E	3.83
6.92	56	715	1800.9	652.7	0.0	. E	3.74*
7.00	42	673	1800.9	648.1	0.0	. E	3.65*
7.09	32	633	1800.9	643.7	0.0	. E	3.57*
7.17	24	595	1800.8	639.5	0.0	. E	3.50*
7.26	18	559	1800.8	635.6	0.0	. E	3.32*
7.35	13	525	1800.8	631.8	0.0	. E	3.26*
7.43	10	493	1800.8	628.2	0.0	. E	3.21*
[illegible]	7	482	1800.7	624.8	0.0	. E	3.11*
[illegible]	5	471	1800.7	621.5	0.0	. E	3.13*
	4	461	1800.7	618.2	0.0	. E	3.03*
	3	450	1800.7	614.9	0.0	. E	3.05*
	2	440	1800.6	611.8	0.0	. E	2.95*
	1	430	1800.6	608.7	0.0	. E	2.97*
	1	420	1800.6	605.7	0.0	. E	2.87*
	1	411	1800.6	602.7	0.0	. E	2.90*
	0	401	1800.5	599.8	0.0	. E	2.93*
	0	392	1800.5	597.0	0.0	. E	2.83*
	0	383	1800.5	594.2	0.0	. E	2.86*
	0	374	1800.5	591.5	0.0	. E	2.77*
	0	366	1800.5	588.8	0.0	. E	2.80*
	0	358	1800.4	586.3	0.0	. E	2.71*
I	I	D	E	VOL	A	I I I I I I I I I VEL	
						0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. EXIT	

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	400.0	1807.03	1584.2	0.0	7.30	1086.1	100.2	18330.0	18430.2	3.97	11.32	0.006	0.008	9.7	7.3

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.008

I	I	D	E	VOL	A	0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT VEL
0.00	0	0	1793.5	13.7	0.0	. 0.00
0.09	0	0	1793.5	13.7	0.0	. 0.00
0.17	0	0	1793.5	13.7	0.0	. 0.00
0.26	0	0	1793.5	13.7	0.0	. 0.00
0.35	0	0	1793.5	13.7	0.0	. 0.00
0.43	0	0	1793.5	13.7	0.0	. 0.00
0.52	0	0	1793.5	13.7	0.0	. 0.00
0.61	0	0	1793.5	13.7	0.0	. 0.00
0.69	0	0	1793.5	13.7	0.0	. 0.00
0.78	0	0	1793.5	13.7	0.0	. 0.00
0.86	0	0	1793.5	13.7	0.0	. 0.00
0.95	0	0	1793.5	13.7	0.0	. 0.00
1.04	0	0	1793.5	13.7	0.0	. 0.00
1.12	0	0	1793.5	13.7	0.0	. 0.00

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6.48	559	1849	1801.8	768.6	0.0	.IE	4.91*
6.57	431	1725	1801.8	759.4	0.0	. E	4.77*
6.66	325	1600	1801.7	750.2	0.0	. E	4.61*
6.74	244	1514	1801.6	741.1	0.0	. E	4.52*
6.83	182	1433	1801.5	732.1	0.0	.E	4.43*
6.92	136	1353	1801.5	723.3	0.0	.E	4.34*
7.00	102	1276	1801.4	714.8	0.0	.E	4.25*
7.09	77	1201	1801.4	706.6	0.0	.E	4.09*
7.17	57	1130	1801.3	698.7	0.0	.E	4.01*
7.26	43	1063	1801.2	691.2	0.0	.E	3.94*
7.35	32	999	1801.2	684.1	0.0	.E	3.80*
7.43	24	938	1801.1	677.4	0.0	.E	3.75*
7.52	18	880	1801.1	671.1	0.0	.E	3.62*
7.61	13	826	1801.0	665.1	0.0	.E	3.49*
7.69	10	775	1801.0	659.4	0.0	.E	3.38*
7.78	7	727	1800.9	654.1	0.0	.E	3.28*
7.87	5	682	1800.9	649.1	0.0	.E	3.18*
7.95	4	640	1800.9	644.5	0.0	.E	3.09*
8.04	2	600	1800.8	640.1	0.0	.E	3.01*
8.13	2	562	1800.8	635.9	0.0	.E	2.94*
8.21	1	527	1800.8	632.0	0.0	.E	2.88*
8.30	1	494	1800.8	628.4	0.0	.	2.83*
8.38	1	482	1800.7	624.9	0.0	.	2.79*
8.47	0	471	1800.7	621.5	0.0	.	2.75*
8.56	0	461	1800.7	618.2	0.0	.	2.66*
8.64	0	450	1800.7	614.9	0.0	.	2.68*
T	I	O	E	VOL	A		VEL

```
                                   I         I         I         I         I         I         I         I
                                  0.     10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT
```

VOLUME FILL= 260092. CY, MAX. HEIGHT= 19.0 FT
TOP WIDTH= 14.0 FT, TOP LENGTH= 8325.5 FT
AREA OF DAM= 16.14 AC, AREA TO SEED= 16.14 AC (PROJECTED HORIZONTAL AREA)

****

RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

RATING TABLE NUMBER 3

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.27	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	251.92	82.48	561.05	0.00
15	1800.75	442.35	83.96	628.30	0.00
16	1801.68	1401.63	86.55	749.35	0.00
17	1802.81	3307.35	89.61	910.14	0.00
18	1804.86	8522.54	94.93	1222.16	0.00
19	1807.43	17683.81	101.19	1655.06	0.00

20 1810.00 29311.81 107.08 2141.60 0.00

TYPE	BW	EMAX	VOL-PAR	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	350.0	1802.39	648.9	0.0	2.67	350.8	88.5	2493.3	2581.8	1.15	6.15	0.009	0.012	12.5	1.8

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBW Q/4 CRITICAL SLOPE.

PLOT — 1 IN = 2000. CFS — EXIT SLOPE = 0.012

T	I	O	E	VOL	A	0. / 2000. / 4000. / 6000. / 8000. / 10000. / 12000. / 14000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	0	0	1793.5	13.7	0.0		0.00
1.30	0	0	1793.5	13.7	0.0		0.00
1.38	0	0	1793.5	13.7	0.0		0.00
1.47	0	0	1793.5	13.7	0.0		0.00
1.56	0	0	1793.5	13.7	0.0		0.00
1.64	0	0	1793.5	13.7	0.0		0.00
1.73	0	0	1793.5	13.7	0.0		0.00
1.82	0	0	1793.5	13.7	0.0		0.00
1.90	0	0	1793.5	13.7	0.0		0.00
1.99	11	0	1793.5	13.8	0.0		0.00
2.07	168	2	1793.6	14.5	0.0		0.00
2.16	957	15	1794.0	18.5	0.0		0.00
2.25	2911	37	1794.3	32.1	0.0		0.00
2.33	5845	69	1794.8	63.0	0.0		0.00
2.42	8828	69	1795.8	115.0	0.0		0.00
2.51	11019	71	1796.7	185.4	0.0		0.00
2.59	12133	75	1797.6	267.5	0.0		0.00
2.68	12285	77	1798.5	354.2	0.0		0.00
2.77	11670	79	1799.2	439.2	0.0		0.00
2.85	10560	135	1799.9	517.9	0.0		1.64*
2.94	9300	326	1800.4	587.2	0.0		2.72*
3.03	8109	583	1800.9	646.1	0.0		3.60*
3.11	7038	966	1801.3	694.7	0.0		4.43
3.20	6126	1277	1801.6	733.7	0.0		5.06
3.28	5353	1561	1801.8	764.5	0.0		5.49
3.37	4708	1861	1802.0	788.1	0.0		5.87
3.46	4191	2071	1802.1	805.8	0.0		6.15
3.54	3788	2227	1802.2	819.0	0.0		6.34
3.63	3479	2341	1802.3	828.6	0.0		6.45
3.72	3246	2424	1802.3	835.6	0.0		6.51
3.80	3068	2484	1802.3	840.7	0.0		6.64
3.89	2934	2526	1802.4	844.2	0.0		6.69
3.98	2834	2555	1802.4	846.7	0.0		6.66
4.06	2734	2574	1802.4	848.2	0.0		6.72
4.15	2607	2582	1802.4	848.9	0.0		6.75
4.24	2415	2576	1802.4	848.4	0.0		6.73
4.32	2173	2553	1802.4	846.5	0.0		6.66

6.66

4.41	1915	2512	1802.4	843.0	0.0	.	6.66
4.50	1673	2453	1802.3	838.1	0.0	.	6.61
4.58	1458	2381	1802.3	832.0	0.0	.	6.51
4.67	1279	2299	1802.2	825.1	0.0	.	6.38
4.75	1141	2211	1802.2	817.6	0.0	.	6.28
4.84	1037	2120	1802.1	809.9	0.0	.	6.18
4.93	959	2026	1802.1	802.2	0.0	.	6.06
5.01	902	1939	1802.0	794.7	0.0	.	5.95
5.10	856	1853	1802.0	787.4	0.0	.	5.84
5.19	810	1770	1801.9	780.5	0.0	.	5.74
5.27	762	1690	1801.9	773.7	0.0	.	5.64
5.36	712	1613	1801.8	767.2	0.0	.	5.55
5.45	662	1538	1801.8	760.8	0.0	.	5.46
5.53	614	1465	1801.7	754.7	0.0	.	5.29
5.62	573	1396	1801.7	748.7	0.0	.	5.22
5.71	542	1350	1801.6	742.9	0.0	.	5.17
5.79	520	1305	1801.6	737.2	0.0	.	5.03
5.88	505	1261	1801.5	731.7	0.0	.	4.98
5.96	492	1219	1801.5	726.4	0.0	.	4.94
6.05	476	1179	1801.5	721.2	0.0	.	4.81
6.14	450	1139	1801.4	716.3	0.0	.	4.78
6.22	407	1100	1801.4	711.3	0.0	.	4.74
6.31	351	1061	1801.3	706.3	0.0	.	4.61
6.40	289	1020	1801.3	701.2	0.0	.	4.55
6.48	230	978	1801.3	695.9	0.0	.	4.49
6.57	177	935	1801.2	690.5	0.0	.	4.42
6.66	134	892	1801.2	685.1	0.0	.	4.34
6.74	101	850	1801.1	679.7	0.0	.	4.25
6.83	75	808	1801.1	674.4	0.0	.	4.17
6.92	56	767	1801.1	669.3	0.0	.	4.08
7.00	42	727	1801.0	664.3	0.0	.	3.90
7.09	32	689	1801.0	659.5	0.0	.	3.82*
7.17	24	653	1801.0	654.9	0.0	.	3.75*
7.26	18	618	1800.9	650.5	0.0	.	3.68*
7.35	13	585	1800.9	646.3	0.0	.	3.62*
7.43	10	553	1800.9	642.3	0.0	.	3.45*
7.52	7	523	1800.8	638.5	0.0	.	3.40*
7.61	5	495	1800.8	634.9	0.0	.	3.37*
7.69	4	468	1800.8	631.5	0.0	.	3.22*
7.78	3	442	1800.8	628.3	0.0	.	3.19*
7.87	2	434	1800.7	625.2	0.0	.	3.10*
7.95	1	425	1800.7	622.1	0.0	.	3.13*
8.04	1	416	1800.7	619.1	0.0	.	3.04*
8.13	1	408	1800.7	616.2	0.0	.	3.07*
8.21	0	400	1800.6	613.3	0.0	.	2.98*
8.30	0	392	1800.6	610.5	0.0	.	3.01*
8.38	0	384	1800.6	607.7	0.0	.	2.92*
8.47	0	376	1800.6	605.0	0.0	.	2.96*
8.56	0	369	1800.6	602.4	0.0	.	2.87*
8.64	0	361	1800.5	599.7	0.0	.	2.91*
T	I	D	E	VOL	A		VEL

0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	350.0	1807.34	1638.2	0.0	7.61	1140.0	101.0	17225.1	17326.1	4.15	11.58	0.006	0.008	10.4	8.3

PLOT I IN = 10000. CFS EXIT SLOPE = 0.008

0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT

T	I	D	E	VOL	A		VEL
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	0	0	1793.5	13.7	0.0	.	0.00

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5.45  1618  3803 1803.0   939.8   0.0 . I E                                                  6.96*
5.53  1500  3550 1802.9   924.7   0.0 . I E                                                  6.72*
5.62  1399  3314 1802.8   910.5   0.0 .I E                                                   6.55*
5.71  1323  3153 1802.7   897.1   0.0 .I E                                                   6.45*
5.79  1270  3002 1802.6   884.4   0.0 .I E                                                   6.30*
5.88  1232  2860 1802.6   872.4   0.0 .I E                                                   6.16*
5.96  1200  2727 1802.5   861.1   0.0 .I E                                                   6.05*
6.05  1161  2601 1802.4   850.5   0.0 .I E                                                   5.94*
6.14  1097  2481 1802.3   840.5   0.0 .IE                                                    5.85*
6.22   992  2365 1802.3   830.6   0.0 .IE                                                    5.69*
6.31   853  2248 1802.2   820.7   0.0 .IE                                                    5.59*
6.40   702  2128 1802.1   810.6   0.0 .IE                                                    5.47*
6.48   559  2006 1802.1   800.4   0.0 .IE                                                    5.33*
6.57   431  1884 1802.0   790.0   0.0 . E                                                    5.19*
6.66   325  1761 1801.9   779.7   0.0 . E                                                    5.09*
6.74   244  1641 1801.8   769.6   0.0 . E                                                    4.93*
6.83   182  1525 1801.8   759.8   0.0 . E                                                    4.76*
6.92   136  1414 1801.7   750.4   0.0 .E                                                     4.60*
7.00   102  1339 1801.6   741.4   0.0 .E                                                     4.50*
7.09    77  1270 1801.6   732.8   0.0 .E                                                     4.43*
7.17    57  1204 1801.5   724.4   0.0 .E                                                     4.28*
7.26    43  1140 1801.4   716.4   0.0 .E                                                     4.21*
7.35    32  1080 1801.4   708.7   0.0 .E                                                     4.16*
7.43    24  1022 1801.3   701.4   0.0 .E                                                     4.02*
7.52    18   967 1801.3   694.5   0.0 .E                                                     3.90*
7.61    13   914 1801.2   687.9   0.0 .E                                                     3.86*
7.69    10   865 1801.2   681.6   0.0 .E                                                     3.75*
7.78     7   817 1801.1   675.6   0.0 .E                                                     3.64*
7.87     5   773 1801.1   670.0   0.0 .E                                                     3.55*
7.95     4   730 1801.0   664.7   0.0 .E                                                     3.46*
8.04     2   690 1801.0   659.6   0.0 .E                                                     3.37*
8.13     2   653 1801.0   654.8   0.0 .E                                                     3.30*
8.21     1   617 1800.9   650.3   0.0 .E                                                     3.23*
8.30     1   583 1800.9   646.0   0.0 .E                                                     3.17*
8.38     1   551 1800.9   642.0   0.0 .E                                                     3.02*
8.47     0   520 1800.8   638.2   0.0 .E                                                     2.98*
8.56     0   492 1800.8   634.5   0.0 .                                                      2.94*
8.64     0   465 1800.8   631.1   0.0 .                                                      2.81*
  T      I     O     E     VOL     A  I         I         I         I         I         I         I         I   VEL
                                     0.    10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT
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VOLUME FILL= 268269. CY. MAX. HEIGHT= 19.3 FT
TOP WIDTH= 14.0 FT. TOP LENGTH= 8374.2 FT
AREA OF DAM= 16.42 AC. AREA TO SEED= 16.42 AC (PROJECTED HORIZONTAL AREA)

****

RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

RATING TABLE NUMBER 4

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00

8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	227.74	82.48	561.05	0.00
15	1800.75	391.25	83.96	628.30	0.00
16	1801.68	1214.57	86.55	749.35	0.00
17	1802.81	2851.25	89.61	910.14	0.00
18	1804.86	7336.20	94.93	1222.16	0.00
19	1807.43	15231.07	101.19	1655.06	0.00
20	1810.00	25275.20	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/D
SCS-ESH	300.0	1802.52	867.6	0.0	2.79	369.5	88.8	2329.8	2418.6	1.22	6.31	0.008	0.012	13.6	2.1

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBW Q/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.012

T	I	O	E	VOL	A	0. 2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	0	0	1793.5	13.7	0.0		0.00
1.30	0	0	1793.5	13.7	0.0		0.00
1.38	0	0	1793.5	13.7	0.0		0.00
1.47	0	0	1793.5	13.7	0.0		0.00
1.56	0	0	1793.5	13.7	0.0		0.00
1.64	0	0	1793.5	13.7	0.0		0.00
1.73	0	0	1793.5	13.7	0.0		0.00
1.82	0	0	1793.5	13.7	0.0		0.00
1.90	0	0	1793.5	13.7	0.0		0.00
1.99	11	0	1793.5	13.8	0.0		0.00
2.07	106	2	1793.6	14.5	0.0		0.00
2.16	957	15	1794.0	18.5	0.0		0.00
2.25	2911	37	1794.3	32.1	0.0		0.00
2.33	5645	65	1794.8	63.0	0.0		0.00
2.42	8828	69	1795.8	115.0	0.0		0.00
2.51	11019	71	1796.7	185.4	0.0		0.00
2.59	12133	75	1797.6	267.5	0.0		0.00
2.68	12285	77	1798.5	354.2	0.0		0.00
2.77	11670	79	1799.2	439.2	0.0		0.00
2.85	10560	127	1799.9	517.9	0.0		1.64*
2.94	9300	292	1800.4	587.3	0.0		2.71*
3.03	8109	516	1800.9	646.6	0.0		3.51*
3.11	7038	851	1801.3	695.9	0.0		4.47
3.20	6126	1123	1801.6	735.8	0.0		5.04
3.28	5353	1402	1801.8	767.8	0.0		5.55
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		5.91

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T	I	O	E	VOL	A	VEL
8.64	0	361	1800.7	61[illegible].8	0.0	3.04*

0.	2000.	4000.	6000.	8000.	10000.	12000.	14000.	EXIT

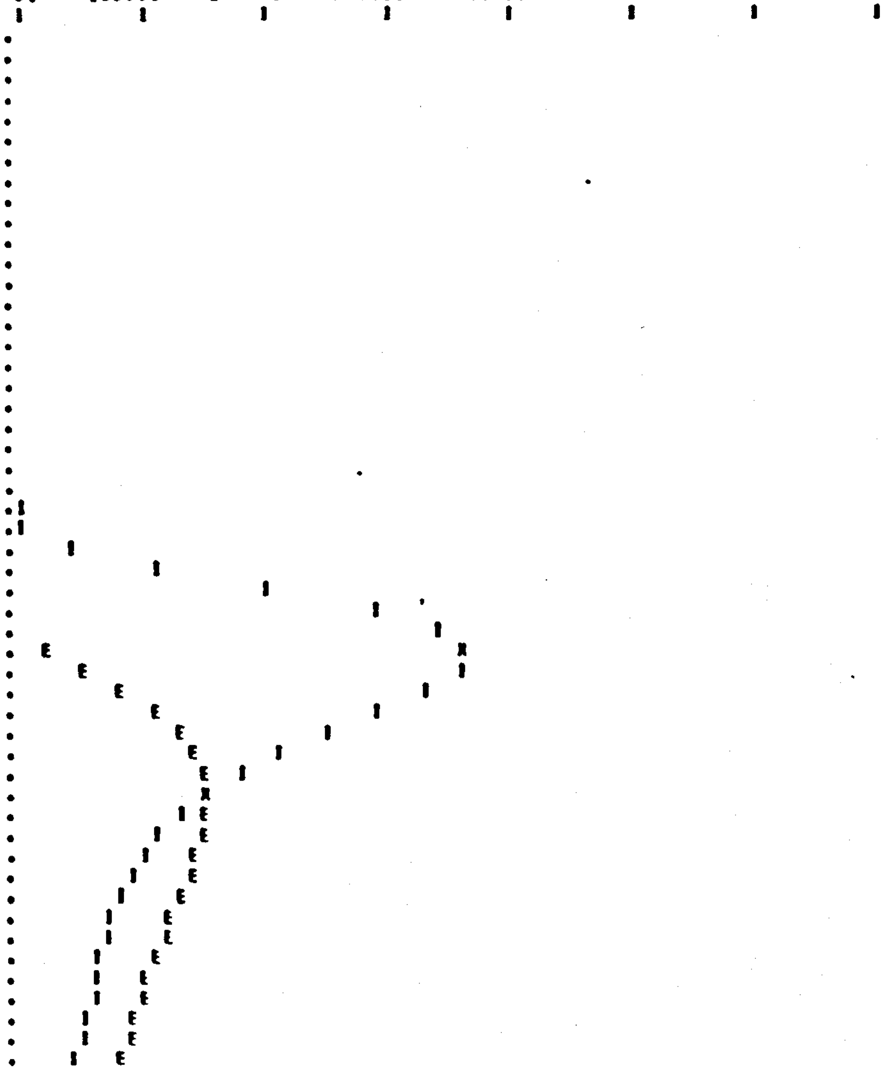
TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBW	300.0	1807.69	1701.3	0.0	7.97	1203.2	101.8	16084.9	16186.7	4.38	11.89	0.006	0.008	11.4	9.6

PLOT

1 IN = 10000. CFS

EXIT SLOPE = 0.008

0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT



T	I	O	E	VOL	A	VEL
0.00	0	0	1793.5	13.7	0.0	0.00
0.09	0	0	1793.5	13.7	0.0	0.00
0.17	0	0	1793.5	13.7	0.0	0.00
0.26	0	0	1793.5	13.7	0.0	0.00
0.35	0	0	1793.5	13.7	0.0	0.00
0.43	0	0	1793.5	13.7	0.0	0.00
0.52	0	0	1793.5	13.7	0.0	0.00
0.61	0	0	1793.5	13.7	0.0	0.00
0.69	0	0	1793.5	13.7	0.0	0.00
0.78	0	0	1793.5	13.7	0.0	0.00
0.86	0	0	1793.5	13.7	0.0	0.00
0.95	0	0	1793.5	13.7	0.0	0.00
1.04	0	0	1793.5	13.7	0.0	0.00
1.12	0	0	1793.5	13.7	0.0	0.00
1.21	1	0	1793.5	13.7	0.0	0.00
1.30	3	0	1793.5	13.7	0.0	0.00
1.38	11	0	1793.5	13.8	0.0	0.00
1.47	30	1	1793.5	13.9	0.0	0.00
1.56	67	2	1793.6	14.3	0.0	0.00
1.64	126	4	1793.6	14.9	0.0	0.00
1.73	206	8	1793.8	16.1	0.0	0.00
1.82	302	13	1793.9	17.8	0.0	0.00
1.90	406	21	1794.0	20.2	0.0	0.00
1.99	561	26	1794.1	23.5	0.0	0.00
2.07	1496	35	1794.2	30.6	0.0	0.00
2.16	4768	64	1794.6	52.7	0.0	0.00
2.25	11768	68	1795.8	111.3	0.0	0.00
2.33	21084	73	1797.2	228.1	0.0	0.00
2.42	29621	79	1798.9	408.7	0.0	0.00
2.51	35179	459	1800.8	638.2	0.0	2.96*
2.59	37362	2609	1802.6	886.4	0.0	6.27*
2.68	36727	5878	1804.2	1120.7	0.0	8.74
2.77	34004	9117	1805.5	1319.8	0.0	10.37
2.85	30133	11924	1806.4	1473.7	0.0	11.56
2.94	26064	13903	1807.0	1582.2	0.0	12.29
3.03	22376	15165	1807.4	1651.4	0.0	12.70
3.11	19161	15926	1807.6	1688.7	0.0	12.98
3.20	16483	16187	1807.7	1701.3	0.0	13.05
3.28	14248	16074	1807.7	1695.9	0.0	13.01
3.37	12409	15697	1807.6	1677.6	0.0	12.90
3.46	10946	15154	1807.4	1650.8	0.0	12.73
3.54	9812	14570	1807.2	1618.8	0.0	12.50
3.63	8943	13935	1807.0	1584.0	0.0	12.29
3.72	8284	13284	1806.8	1548.3	0.0	12.05
3.80	7779	12641	1806.6	1512.1	0.0	11.83
3.89	7399	12023	1806.4	1479.2	0.0	11.60
3.98	7111	11440	1806.3	1447.2	0.0	11.38
4.06	6842	10694	1806.1	1417.3	0.0	11.16
4.15	6487	10377	1805.9	1386.9	0.0	10.96
4.24	5987	9870	1805.7	1361.1	0.0	10.72
4.32	5371	9358	1805.6	1333.0	0.0	10.49

10.27

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4.41	4725	8831	1805.4	1304.[illegible]		10.27
4.50	4121	8292	1805.2	1274.5	[illegible]	10.02
4.58	3568	7749	1805.0	1244.8	0.0	9.73
4.67	3149	7238	1804.8	1215.3	0.0	9.47
4.75	2601	6821	1804.6	1186.3	0.0	9.25
4.84	2543	6416	1804.5	1158.1	0.0	9.03
4.93	2350	6028	1804.3	1131.2	0.0	8.82
5.01	2209	5662	1804.1	1105.7	0.0	8.59
5.10	2094	5319	1804.0	1081.8	0.0	8.38
5.19	1982	4999	1803.8	1059.5	0.0	8.19
5.27	1863	4698	1803.7	1038.6	0.0	7.98
5.36	1741	4415	1803.5	1019.0	0.0	7.79
5.45	1618	4148	1803.4	1000.4	0.0	7.56
5.53	1500	3895	1803.3	982.8	0.0	7.41*
5.62	1399	3656	1803.2	966.2	0.0	7.21*
5.71	1323	3432	1803.1	950.6	0.0	7.04*
5.79	1270	3224	1803.0	938.0	0.0	6.84*
5.88	1232	3031	1802.9	922.6	0.0	6.66*
5.96	1200	2854	1802.8	910.3	0.0	6.51*
6.05	1161	2736	1802.7	898.8	0.0	6.40*
6.14	1097	2623	1802.7	887.7	0.0	6.31*
6.22	992	2512	1802.6	876.8	0.0	6.21*
6.31	853	2401	1802.5	865.9	0.0	6.05*
6.40	702	2287	1802.4	854.7	0.0	5.92*
6.48	559	2170	1802.4	843.3	0.0	5.85*
6.57	431	2053	1802.3	831.7	0.0	5.70*
6.66	325	1935	1802.2	820.2	0.0	5.54*
6.74	244	1820	1802.1	808.8	0.0	5.44*
6.83	182	1707	1802.0	797.7	0.0	5.27*
6.92	136	1598	1802.0	787.0	0.0	5.10*
7.00	102	1494	1801.9	776.8	0.0	5.01*
7.09	77	1396	1801.8	767.2	0.0	4.86*
7.17	57	1303	1801.7	758.0	0.0	4.73*
7.26	43	1215	1801.7	749.4	0.0	4.60*
7.35	32	1159	1801.6	741.2	0.0	4.47*
7.43	24	1105	1801.6	733.3	0.0	4.42*
7.52	18	1054	1801.5	725.7	0.0	4.31*
7.61	13	1004	1801.4	718.5	0.0	4.19*
7.69	10	957	1801.4	711.5	0.0	4.16*
7.78	7	912	1801.3	704.9	0.0	4.06*
7.87	5	869	1801.3	698.6	0.0	3.97*
7.95	4	828	1801.2	692.6	0.0	3.88*
8.04	2	789	1801.2	686.8	0.0	3.80*
8.13	2	752	1801.2	681.3	0.0	3.72*
8.21	1	716	1801.1	676.1	0.0	3.65*
8.30	1	682	1801.1	671.1	0.0	3.58*
8.38	1	650	1801.0	666.3	0.0	3.52*
8.47	0	619	1801.0	661.8	0.0	3.38*
8.56	0	590	1801.0	657.5	0.0	3.33*
8.64	0	562	1800.9	653.4	0.0	3.29*
I	I	O	E	VOL	A	VEL

0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT

VOLUME FILL= 278038. CY. MAX. HEIGHT= 19.7 FT
TOP WIDTH= 14.0 FT. TOP LENGTH= 8431.3 FT
AREA OF DAM= 16.75 AC. AREA TO SEED= 16.75 AC (PROJECTED HORIZONTAL AREA)

****
RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

III D-85

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RATING TABLE NUMBER 5

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.86	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	261.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.29	215.65	82.48	561.05	0.00
15	1800.75	365.69	83.96	628.30	0.00
16	1801.68	1121.04	86.55	749.35	0.00
17	1802.81	2623.20	89.61	910.14	0.00
18	1804.86	6743.03	94.93	1222.16	0.00
19	1807.43	14004.70	101.19	1655.06	0.00
20	1810.00	23256.89	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	275.0	1802.59	878.1	0.0	2.86	380.0	89.0	2235.1	2324.2	1.26	6.39	0.008	0.011	14.2	2.3

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBH Q/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.011

T	I	D	E	VOL	A	0. 2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	0	0	1793.5	13.7	0.0		0.00
1.30	0	0	1793.5	13.7	0.0		0.00
1.38	0	0	1793.5	13.7	0.0		0.00
1.47	0	0	1793.5	13.7	0.0		0.00
1.56	0	0	1793.5	13.7	0.0		0.00
1.64	0	0	1793.5	13.7	0.0		0.00
1.73	0	0	1793.5	13.7	0.0		0.00
1.82	0	0	1793.5	13.7	0.0		0.00
1.90	0	0	1793.5	13.7	0.0		0.00
1.99	11	0	1793.5	13.8	0.0		0.00
2.07	188	2	1793.6	14.5	0.0	.I	0.00
2.16	957	15	1794.0	18.5	0.0	I	0.00
2.25	2911	37	1794.3	32.1	0.0	I	0.00
						I	0.00

III D-86

7.61	5	589	1801.0	664.0	0.0	. E	3.96*
7.69	4	563	1801.0	659.9	0.0	. E	3.82*
7.78	3	539	1801.0	656.0	0.0	. E	3.79*
7.87	2	515	1800.9	652.3	0.0	. E	3.66*
7.95	1	493	1800.9	648.7	0.0	. E	3.64*
8.04	1	472	1800.9	645.3	0.0	. E	3.52*
8.13	1	451	1800.9	642.0	0.0	. E	3.40*
8.21	0	431	1800.8	638.8	0.0	. E	3.40*
8.30	0	413	1800.8	635.8	0.0	. E	3.29*
8.38	0	395	1800.8	632.9	0.0	. E	3.19*
8.47	0	377	1800.8	630.2	0.0	. E	3.20*
8.56	0	364	1800.7	627.5	0.0	. E	3.15*
8.64	0	358	1800.7	624.9	0.0	. E	3.07*

```
T     I     O     E     VOL     A  I         I         I         I         I         I         I         I   VEL
                                   0.      2000.     4000.     6000.     8000.    10000.    12000.    14000. EXIT
```

TYPE	PW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBM	275.0	1807.89	1735.1	0.0	6.16	1237.0	102.3	15424.0	15526.2	4.50	12.07	0.006	0.007	12.0	10.5

```
          PLOT                          1 IN =  10000. CFS                                    EXIT SLOPE = 0.007
                                        0.    10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT
T     I     O     E     VOL     A  I         I         I         I         I         I         I         I   VEL
```

0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	0	0	1793.5	13.7	0.0	.	0.00
0.17	0	0	1793.5	13.7	0.0	.	0.00
0.26	0	0	1793.5	13.7	0.0	.	0.00
0.35	0	0	1793.5	13.7	0.0	.	0.00
0.43	0	0	1793.5	13.7	0.0	.	0.00
0.52	0	0	1793.5	13.7	0.0	.	0.00
0.61	0	0	1793.5	13.7	0.0	.	0.00
0.69	0	0	1793.5	13.7	0.0	.	0.00
0.78	0	0	1793.5	13.7	0.0	.	0.00
0.86	0	0	1793.5	13.7	0.0	.	0.00
0.95	0	0	1793.5	13.7	0.0	.	0.00
1.04	0	0	1793.5	13.7	0.0	.	0.00
1.12	0	0	1793.5	13.7	0.0	.	0.00
1.21	1	0	1793.5	13.7	0.0	.	0.00
1.30	3	0	1793.5	13.7	0.0	.	0.00
1.38	11	0	1793.5	13.8	0.0	.	0.00
1.47	30	1	1793.5	13.9	0.0	.	0.00
1.56	67	2	1793.6	14.3	0.0	.	0.00
1.64	126	4	1793.6	14.9	0.0	.	0.00
1.73	206	8	1793.8	16.1	0.0	.	0.00
1.82	302	13	1793.9	17.8	0.0	.	0.00
1.90	406	21	1794.0	20.2	0.0	.	0.00
1.99	561	26	1794.1	23.5	0.0	.I	0.00
2.07	1496	35	1794.2	30.6	0.0	.I	0.00
2.16	4768	64	1794.6	52.7	0.0	. I	0.00
2.25	11768	68	1795.8	111.3	0.0	. I	0.00
2.33	21084	73	1797.2	228.1	0.0	. I	0.00
2.42	29621	79	1798.9	400.7	0.0	. I	0.00
2.51	35179	428	1800.8	638.3	0.0	. I	2.96*
2.59	37362	2910	1802.7	887.3	0.0	. E X	6.28*
2.68	36727	5446	1804.2	1123.9	0.0	. E I	8.71
2.77	34004	8497	1805.5	1326.6	0.0	. E I	10.43
2.85	30133	11162	1806.5	1485.6	0.0	. E I	11.62
2.94	26064	13077	1807.1	1599.8	0.0	. E I	12.37
3.03	22376	14379	1807.5	1674.7	0.0	. E I	12.84
3.11	19161	15192	1807.8	1717.5	0.0	. E I	13.11
3.20	16483	15526	1807.9	1735.1	0.0	. X	13.24
3.28	14248	15506	1807.9	1734.0	0.0	. I E	13.22
						I E	13.11
							12.97

Fig. 8-87

16 of 17

118

```
 8.64     0   615 1801.1   668.2   0.0 .L                                                                    3.52*
  T       I     D      E      VOL      A  I         I         I         I         I         I         I         I   VEL
                                           0.     10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT

          VOLUME FILL=  283335. CY.      MAX. HEIGHT=     19.9 FT
          TOP WIDTH=       14.0 FT.      TOP LENGTH=    8461.7 FT
          AREA OF DAM=    16.92 AC.      AREA TO SEED=  16.92 AC (PROJECTED HORIZONTAL AREA)

*****************************************************************************
RATING TABLE DEVELOPED
 BY PROGRAM FOR PS AND EMG SPILLWAYS
```

RATING TABLE NUMBER 6

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	261.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	203.56	82.48	561.05	0.00
15	1800.75	340.14	83.96	628.30	0.00
16	1801.68	1027.51	86.55	749.35	0.00
17	1802.81	2395.15	89.61	910.14	0.00
18	1804.86	6149.86	94.93	1222.16	0.00
19	1807.43	12778.33	101.19	1655.06	0.00
20	1810.00	21238.59	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	250.0	1802.67	889.8	0.0	2.94	391.7	89.2	2133.0	2222.2	1.30	6.50	0.008	0.011	15.0	2.5

```
********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBW Q/4 CRITICAL SLOPE.

          PLOT                                  1 IN =   2000. CFS                                   EXIT SLOPE = 0.011
                                                 0.     2000.     4000.     6000.     8000.    10000.    12000.    14000. EXIT
   T       I     D      E      VOL      A  I         I         I         I         I         I         I         I   VEL
 0.00      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.09      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.17      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.26      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.35      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.43      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.52      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.61      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.69      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.78      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.86      0     0 1793.5     13.7    0.0 .                                                                            0.00
 0.95      0     0 1793.5     13.7    0.0 .                                                                            0.00
 1.04      0     0 1793.5     13.7    0.0 .                                                                            0.00
 1.12      0     0 1793.5     13.7    0.0 .                                                                            0.00
 1.21      0     0 1793.5     13.7    0.0 .                                                                            0.00


                                                                                                                       0.00
```

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-13-85 SHEET 1 OF 23

CHKD. BY S. G. Yan DATE 7-9-85 OFS NO. 3767.1070 DEPT. NO. 1050

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BAFFLE CHUTE DESIGN - TOP OF DAM EL 1808.27

$Q_{max} = 13,162.7$ C.F.S. $W = 150$ FT. $S = 1/2$

FOR DESIGN BAFFLE CHUTE USE $2/3\ Q_{max}$

$\therefore\ Q = 2/3\ Q_{max} = 2/3 \times 13,162.7 = 8775.13$ CFS.

$$q = \frac{Q}{W} = \frac{8775.13}{150.0} = 58.5 \text{ CFS/FT.}$$

$$\therefore\ D_c = \sqrt[3]{\frac{q^2}{g}} = \left(\frac{58.5^2}{32.2}\right)^{1/3} = 4.74 \text{ FT.}$$

$$V_c = \sqrt[3]{gq} = (32.2 \times 58.5)^{1/3} = 12.35 \text{ '/sec.}$$

TOTAL LENGTH OF CHUTE:- (MIN.)

$L = (1808.27 - 1788 + 7/2)\sqrt{1^2+2^2} = 53.15'$ USE $L = 56.0'$

BAFFLE PIER HEIGHT:-

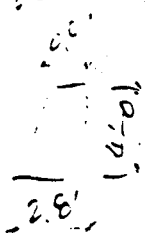
$H = 0.8 D_c = 0.8 \times 4.74 = 3.79'$ USE 4'-0

BAFFLE PIER WIDTH & SPACING:-

$B = 3/2 H = 3/2 \times 4.0 = 6.0'$

SLOPE DISTANCE BETWEEN BAFFLE PIERS:-

$D = 2H = 8.0'$



NO. OF BAFFLE PIERS PER ROW:-

$150/2 \times 6.0 = 12.50$

NO. OF ROWS:

$(56.0/8.00) - 1 = 6$ ROWS

HEIGHT OF WALL $= 3.5 \times 4 = 14'-0$

III D-89

EBASCO SERVICES INCORPORATED

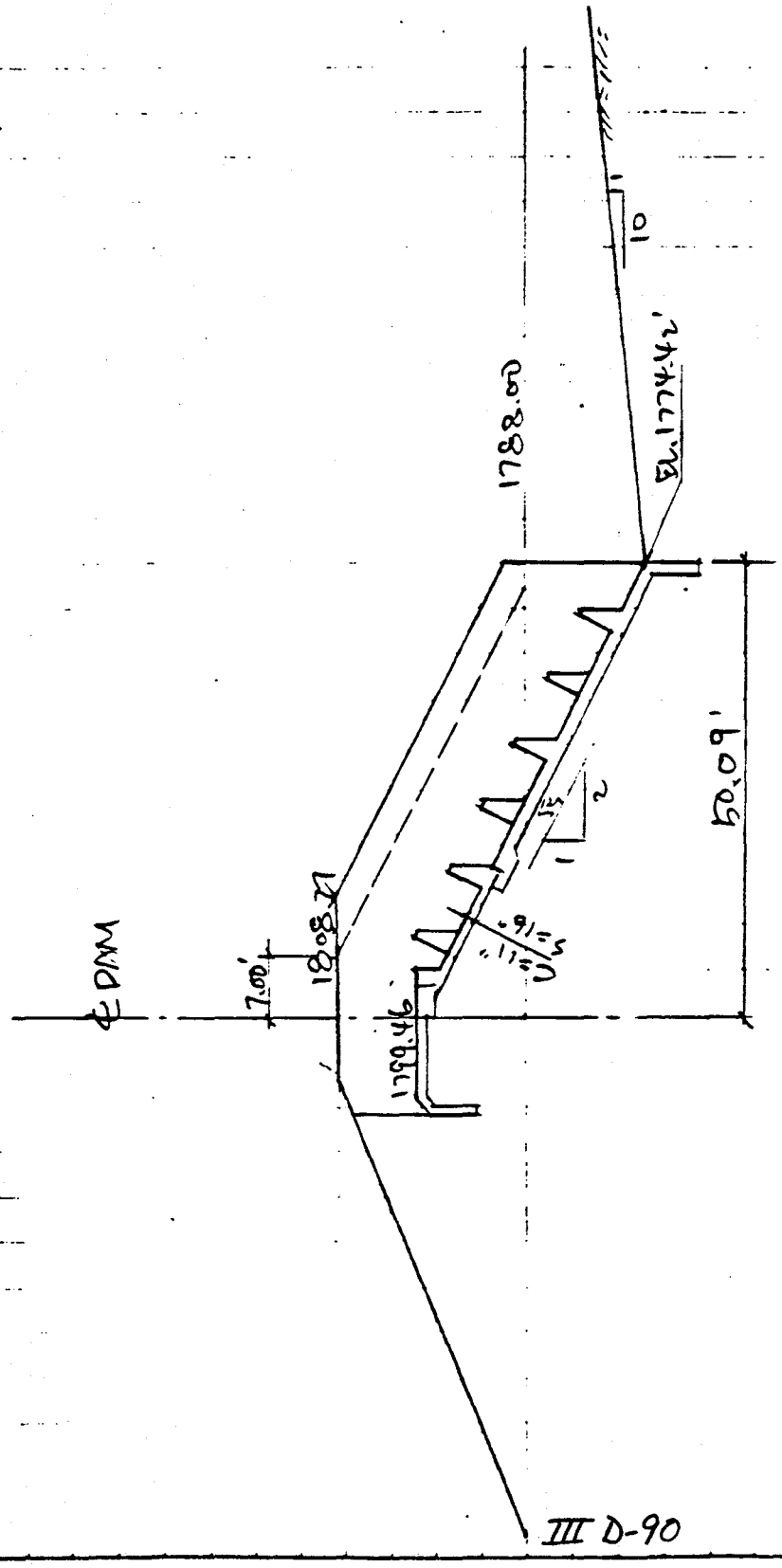
BY Y. C YANG DATE 6-13-83 SHEET 2 OF 23

CHKD. BY S Goyal DATE 7-9-83 OFS NO. 3762.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY – BAFFLE DROP CHUTE DESIGN (150' WI



1" = 20'-0

III D-90

EBASCO SERVICES INCORPORATED

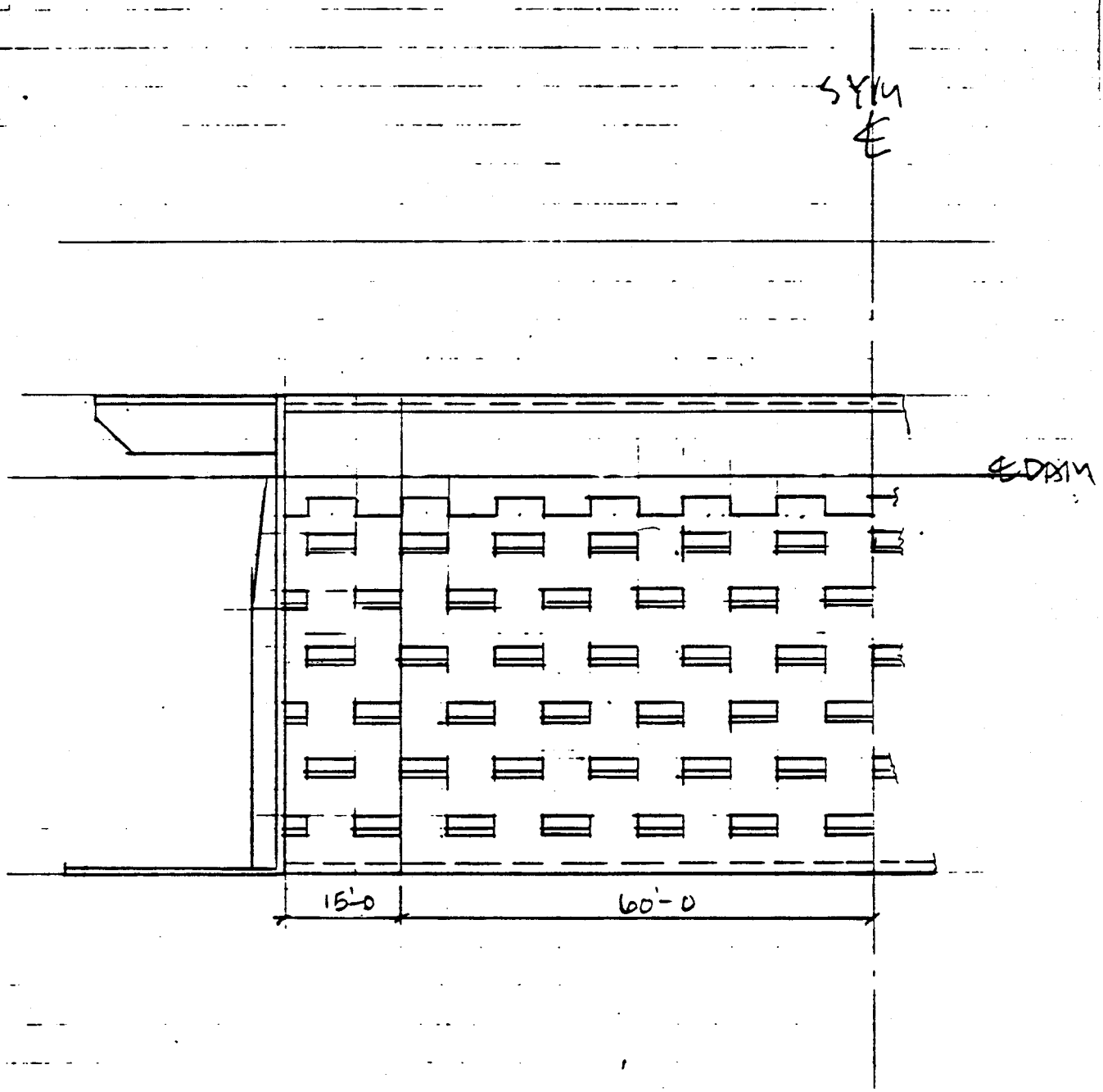
BY Y.C. YANG DATE 6-13-85 SHEET 3 OF 23

CHKD. BY S.G. Yo DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY - BAFFLE CHUTE W=150.0'



1" = 20'-0

581/6-81

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-13-85 SHEET 4 OF 23

CHKD. BY S.G. Yo DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT QUANTITIES (FOR 150' W CHUTE)

SLAB :

CENTER SLAB : $120.0 \times 56.0 \times 11/12 = 6,160$ C.F.

SIDE SLAB : $30.0 \times 56.0 \times 16/12 = 2,240$

U/S SLAB : $150(8.5+\sqrt{8}) \times 12/12 = 1699$

$150 \times 4.0 \times 18/12 = 900$

D/S CUTOFF : $150 \times 6.0 \times 15/12 = 1,125$

12,124 C.F.

BAFFLES :-

PIERS $(0.8+2.8)\frac{4.0}{2} \times 6.0 \times 12.5 \times 6 = 3,240$ CF

U/S WEIR $2.50 \times 1.25/2 \times 150$

$+ (1.25+2.50) 250/2 \times 6.0 \times 12.5 = 586.$

3,826 CF

SIDE WALL :

WALL : $2[14.0 \times 56.0 - (5.19 \times 2 \times 5.19)] 11/12 = 1339.$ CF

U/S WALL : $2 \times 8.81 \times 10.5 \times 14/12 = 170$

SLAB : $(2+4.)\frac{18.8}{2} \times 16/12 \times 2 = 150$

$37.2 \times 4.0 \times 16/12 \times 2 = 397$

2,056 C.F.

HEAD WALL :-

WALL : $(27.5 \times 15.0 - 8.5 \times 5.0) \times 12/12 \times 2 = 740$ CF

SLAB : $[27.5 \times 7.25 - (5.25 \times 7.5)/2] 12/12 \times 2 = 359$

1099 CF

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-13-85 SHEET 5 OF 23

CHKD. BY S.G. YE DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 1650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT QUANTITIES (FOR 150W CHUTE)

WING WALL:

WALL: $(31.0 \times 14.0 - 4.0 \times 4.0/2)\ 11/12 \times 2 = 781$

$(18.0 \times 4.5 - 4.5 \times 4.5/2)\ 18/12 \times 2 = 213$

SLAB: $(24.0 \times 14.0 - 11.0 \times 5.5/2)\ 18/12 \times 2 = 917$

1911

TOTAL CONC = 21,016 C.F.

= 778.5 C.Y.

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-18-85 SHEET 6 OF 23

CHKD. BY S Goyal DATE 7-8-85 OFS NO. 3767.100 DEPT. NO.

CLIENT USDA

PROJECT

SUBJECT DROP SPILLWAY DESIGN

CREST @ EL. 1799.46 W = 150.0'

$Q = 2/3\ Q_{max} = 2/3 \times 13162.7 = 8775.13$ CFS.

CRITICAL DEPTH @ OUTLET:

$$d_c = \sqrt[3]{\frac{(Q/W)^2}{g}} = \sqrt[3]{\frac{8775.13^2}{150^2 \times 32.2}} = 4.74'$$

MIN. DEPTH OF TAILWATER FROM TOP OF THE TRANSVERSE SILL:

$$t = 1.75\, d_c = 1.75 \times 4.74 = 8.30'$$

LENGTH OF STILLING BASIN APRON L_B

$$F_{min.} = 1799.46 - 1788.0 + 8.3 = 19.76'$$

$$h = 1.5\, d_c = 1.5 \times 4.74 = 7.11'$$

$$\frac{h}{F} = \frac{7.11}{19.76} = 0.36; \quad \frac{h}{t} = \frac{7.11}{8.30} = 0.86$$

FROM DIAG: ES-111 SH 5 OF 6:

$$\frac{L_B}{F} = 1.7; \quad L_B = 1.7 \times 19.76 = 33.59'$$

USE $L_B = 33.5'$

LOCATION OF FLOOR BLOCKS L_f:

FOR $\frac{h}{F} = 0.36$, $\frac{h}{t} = 0.86$

FROM DIAG: ES-111 SH 6 OF 6:

$$\frac{L_f}{F} = 1.3; \quad L_f = 1.3 \times 19.76 = 25.69'$$

HEIGHT OF FLOOR BLOCKS:

$$H_f = 0.8\, d_c = 0.8 \times 4.74 = 3.79'$$ USE 3'-9"

EBASCO SERVICES INCORPORATED

BY Y. C YANG DATE 6-18-85 SHEET 7 OF 23

CHKD. BY S.G.Y.I DATE 7-8-85 OPS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT

SUBJECT DROP SPILLWAY DESIGN

FLOOR BLOCK WIDTH & LENGTH :-

$0.9 \times d_c = 0.9 \times 4.74 = 1.90'$ USE $2.00'$

FLOOR BLOCK SPACING :-

$2.0 \times 2/3 = 1.33' = 1'-4$

TRANSVERSE SILL HEIGHT

$0.9 d_c = 0.9 \times 4.74 = 1.90$

SIDEWALL HEIGHT

$t + 0.85 d_c = 8.30 + 0.85 \times 4.74 = 12.33'$

EBASCO SERVICES INCORPORATED

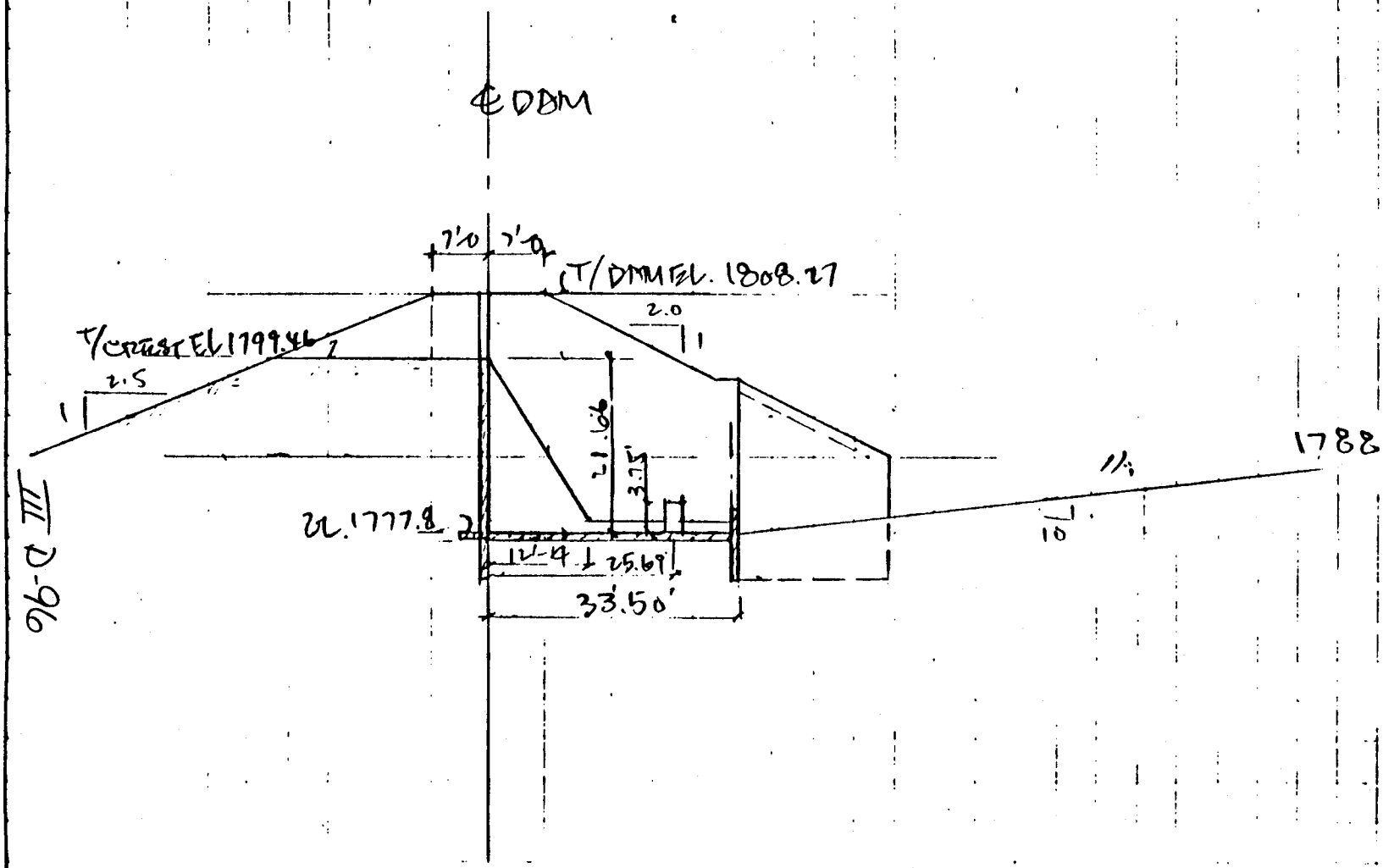
BY Y.C. YIANG DATE 6-18-85 SHEET 8 OF 23

CHKD. BY S. GUYO DATE 7-8-85 OFS NO. 3260.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT



ELEVATION THRU ℄ SPILLWAY

1" = 20'-0

III D-96

EBASCO SERVICES INCORPORATED

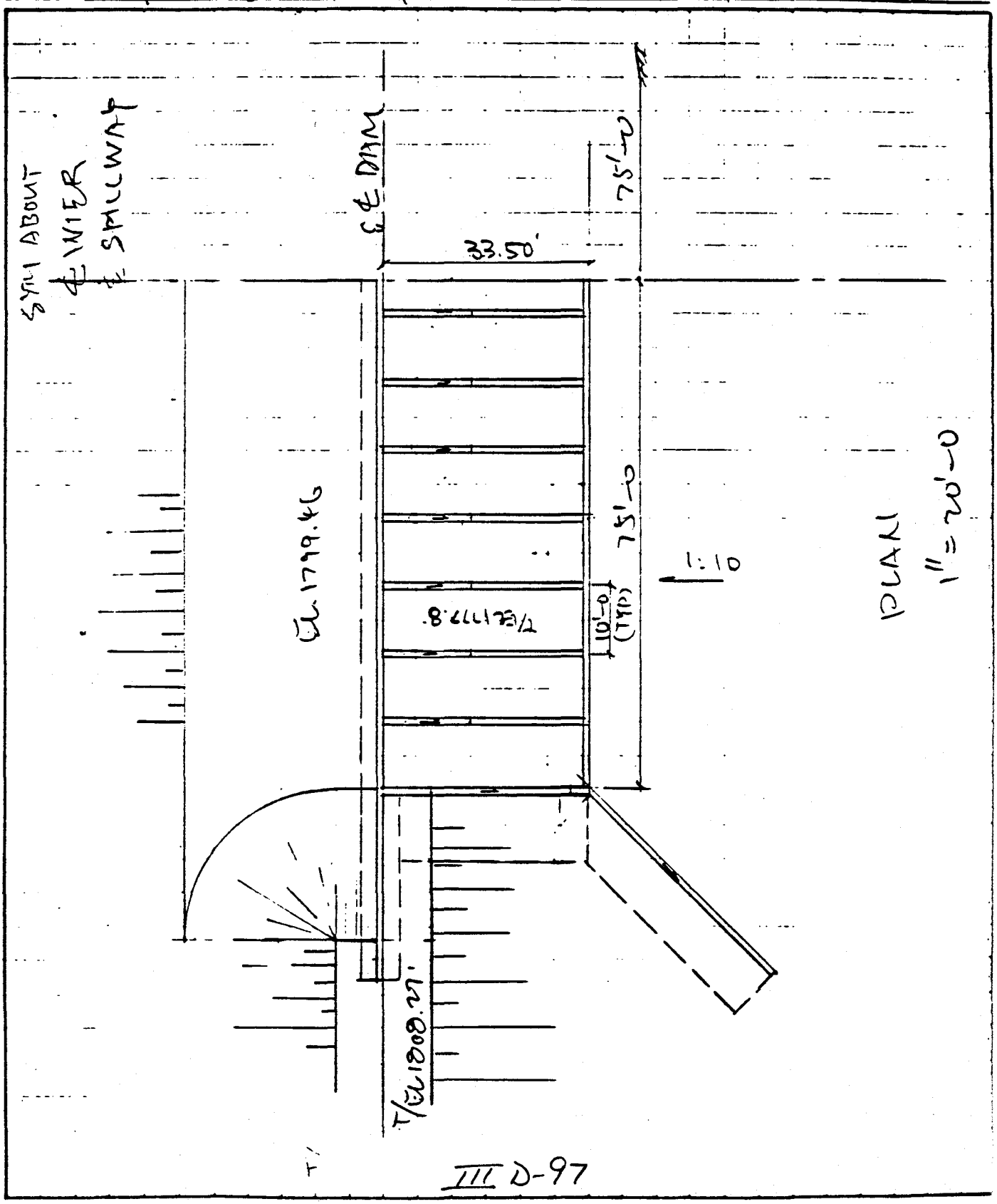
BY Y.C. YANG DATE 6-18-85 SHEET 9 OF 23

CHKD. BY S. Gowri DATE 7-8-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



201/8-81

EBASCO SERVICES INCORPORATED

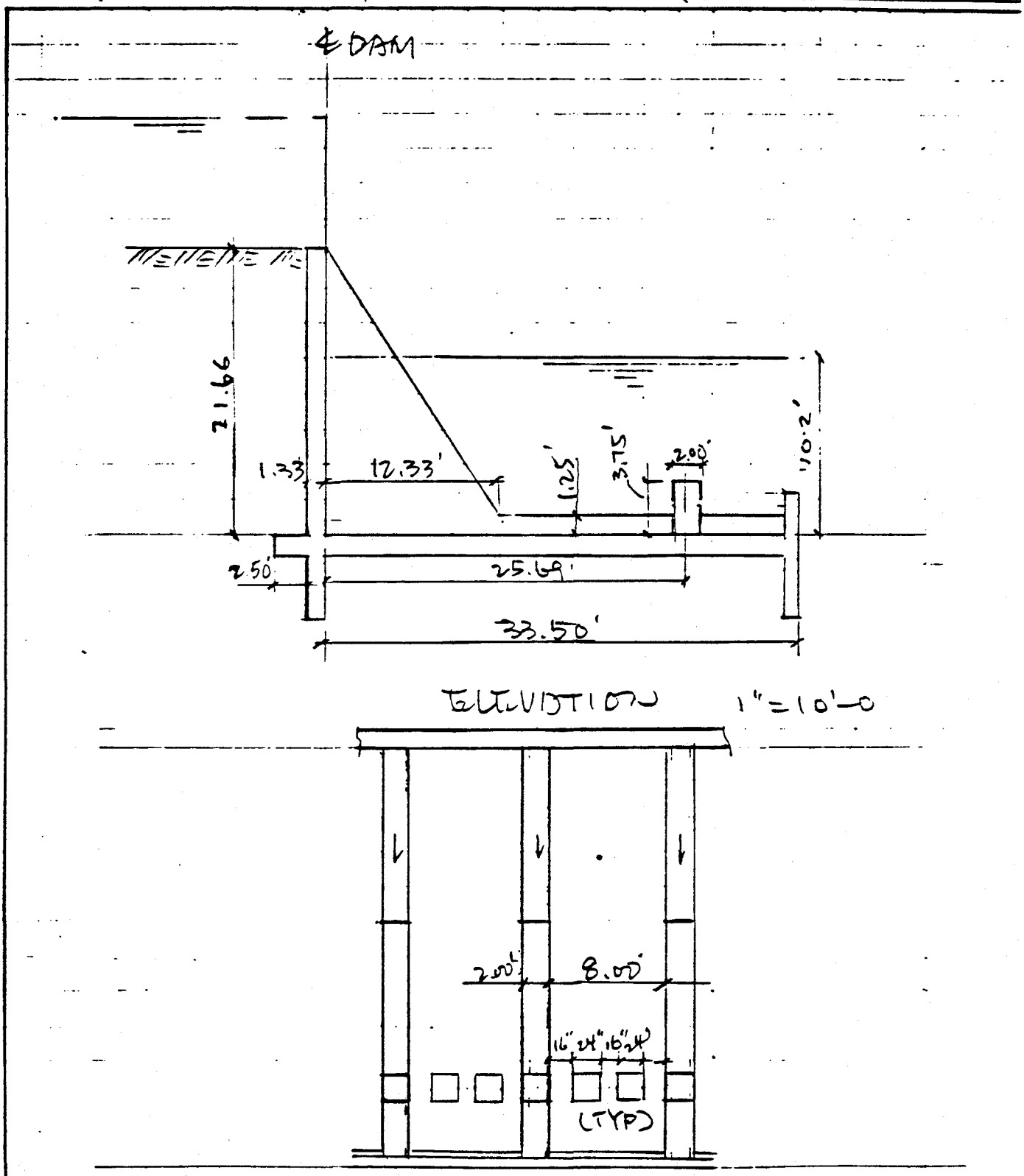
BY Y.C. YANG DATE 6-18-85 SHEET 10 OF 23

CHKD. BY S Goyal DATE 7-8-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



III D-98 DLDN 1"=10'-0

EBASCO SERVICES INCORPORATED

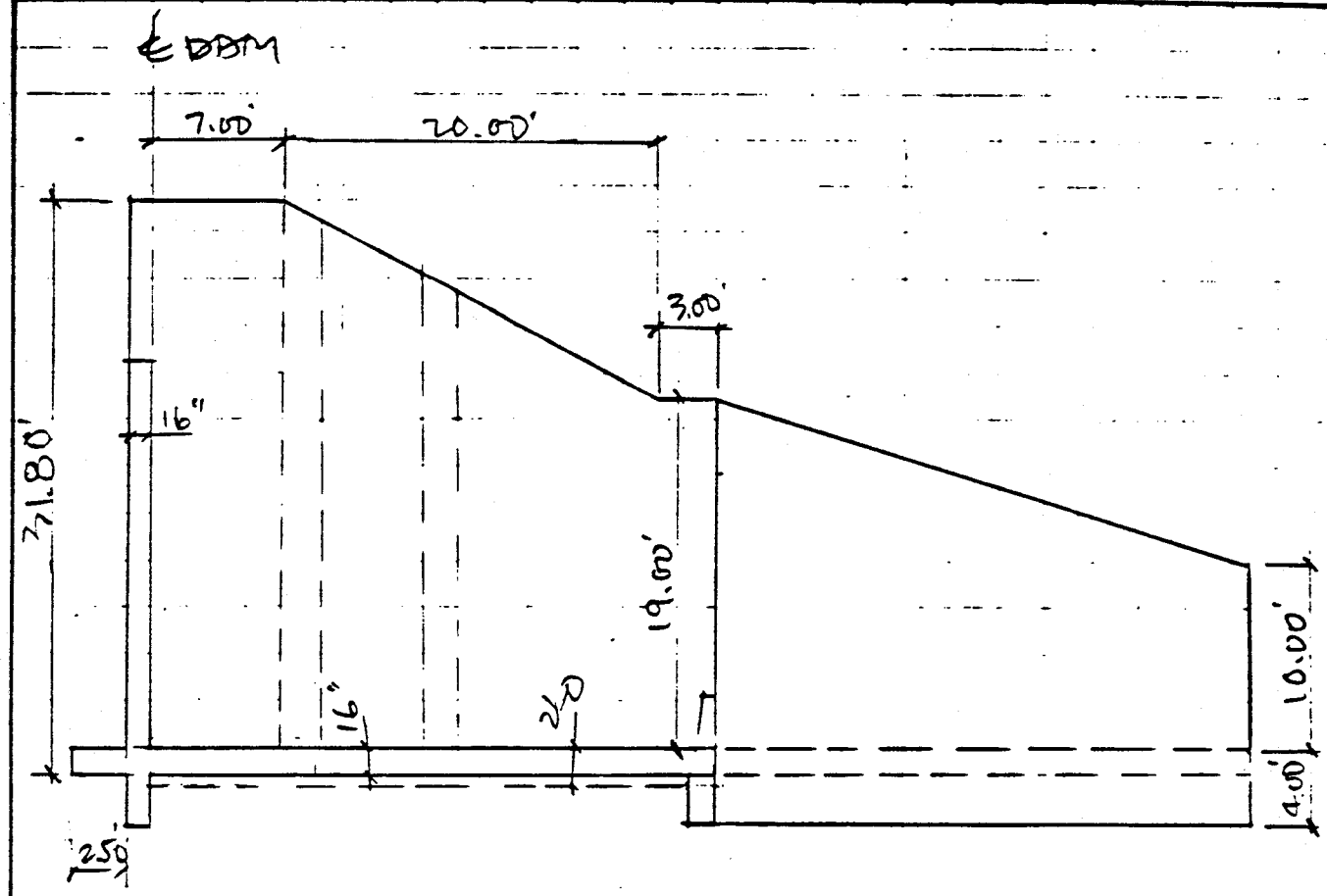
BY Y.C. YANG DATE 6-26-85 SHEET 11 OF 23

CHKD. BY S.G.Y. DATE 7-8-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



1" = 10'-0

EBASCO SERVICES INCORPORATED

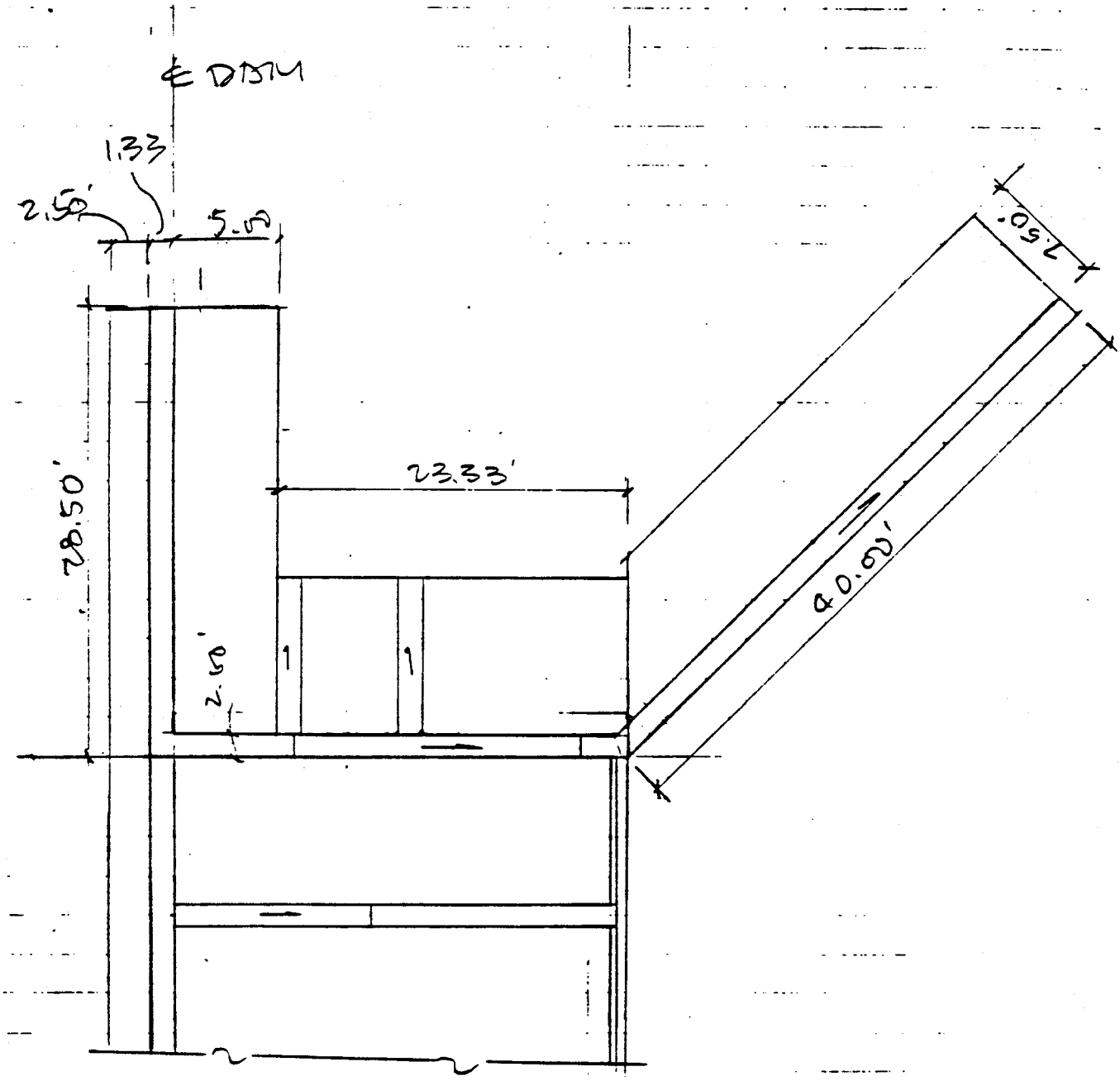
BY Y.C. YANG DATE 6-21-85 SHEET 12 OF 23

CHKD. BY S Gay DATE 7-8-85 OFS NO. 3767.150 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



III D-100

EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 6-26-85 SHEET 13 OF 23

CHKD. BY S.G.Y. DATE 7-8-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN

QUANTITIES:

SLABS: (t = 1.33')

16/12 × 33.50 × 150 = 6700.0 CF.

LONG. SILL: (t = 2.00')

24/12 × (33.50 − 0.75) × 1.25 × 14 = 1,146 CY.

BUTTRESS: (t = 2.00')

24/12 × 19.38 × 12.33 × 14 = 6,691 CF.

END SILLS: (t = 9" ~ 12")

10.5/12 × 150 × 3.0 = 393.75 CF.

HEAD WALL: (t = 1.33')

16/12 × 150 × 22.99 = 4598 CF.

C.O. WALL: (t = 1.33)

16/12 × (150.0 + 28.5 × 2) × 4.0 = 1104.00

SIDE WALL (t = 2'-0)

WALL 2.0 × [31.80 × 7.0 + (31.80 + 21.80) 20.0/2 + 21.80 × 3.0] × 2
= 3296.00 CF

SLAB 2 × 2.0 × 10.0 × 23.33 = 933.20 CF.

BUTTRESS = 2.0(30.47 × 10.0/2 + 25.5 × 10.0/2) = 559.70 CF

BY Y. C YANG DATE _____ SHEET 14 OF 23

CHKD. BY S. G. Y. DATE 7. 8. 85 OFS NO. _____ DEPT. NO. _____

CLIENT USDA

PROJECT

SUBJECT DROP SPILLWAY

RETAINING WALL (t = 1.33')

U/S : 2 x 16/12 x 28.5 x 30.7 = 2338.52 C.F.

2 x 16/12 x 28.5 x 5.00 = 671.08 C.F.

D/S : (t = 1.50')

WALL : 2 x 18/12 x (23.0 + 14) x 40.0/2 = 2520 C.F.

SLAB : 2 x 18/12 (40.0 + 32.5) 7.5/2 = 815.63 C.F.

Σ = 31,766.88 C.F.

= 1,177 C.Y.

PS STORAGE 454.1 ACFT BETWEEN ES CREST AN ACCUM ELEVATIONS

STARTING E 1793.50 FT 13.7 ACFT 0.00 . 0.0 CFS

EFFECTIVE HEIGHT(H)= 11.5 FEET, PRODUCT = 5362. (H * STORAGE AT CREST ENG.)

INPUT DESIGN CLASS = C

6-11-85

SCS-ESH D= 6.00 HR P= 3.78 IN Q= 3.78 IN
TC= 0.69 HR CN= 82.00 VOL= 350.6 ACFT
PEAK 12387.9 CFS AT 2.59 HRS

SCS-FBH D= 6.00 HR P= 10.79 IN Q= 10.79 IN
TC= 0.69 HR CN= 82.00 VOL= 1000.8 ACFT
PEAK 35614.4 CFS AT 2.59 HRS

NO ENTRANCE LOSSES

36" OUTLET

****
RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR ENG

RATING TABLE NUMBER 2

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.86	12.18	12.18	17.04	0.00
3	1794.22	34.45	34.45	30.21	0.00
4	1794.59	63.28	63.28	49.41	0.00
5	1794.95	97.43	97.43	68.60	0.00
6	1795.51	101.37	101.37	98.47	0.00
7	1796.08	104.33	104.33	131.03	0.00
8	1796.64	107.21	107.21	180.41	0.00
9	1797.21	110.02	110.02	229.78	0.00
10	1797.77	112.75	112.75	279.16	0.00
11	1798.33	115.42	115.42	337.79	0.00
12	1798.90	118.03	118.03	402.79	0.00
13	1799.46	120.59	120.59	467.79	0.00
14	1799.99	532.69	122.92	528.52	0.00
15	1800.52	981.33	125.22	597.32	0.00
16	1801.46	2349.35	129.24	721.47	0.00
17	1802.62	4586.42	134.00	883.11	0.00
18	1804.73	9805.59	142.24	1201.28	0.00
19	1807.37	18108.31	151.91	1643.47	0.00
20	1810.00	28191.87	161.01	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	250.0	1801.89	777.8	0.0	2.43	310.0	131.0	2998.3	3129.3	1.63	7.26	0.008	0.011	7.4	2.5

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBH Q/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.011

T	I	O	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	5	0	1793.5	13.7	0.0	.								0.00
0.17	19	0	1793.5	13.8	0.0	.								0.00
0.26	46	1	1793.5	14.0	0.0	.								0.00
0.35	81	3	1793.6	14.5	0.0	.								0.00
0.43	122	5	1793.7	15.2	0.0	.I								0.00
0.52	162	9	1793.8	16.1	0.0	.I								0.00
0.61	199	13	1793.9	17.4	0.0	.I								0.00
0.69	230	15	1794.0	18.8	0.0	.I								0.00
0.78	253	18	1794.0	20.4	0.0	.I								0.00

III-D-03

Sc-D-51

134

[illegible]		1356	.0	3		I	5.61
[illegible]	429	1287	1800.7	625.0	0.0	. I E	5.46
5.62	400	1221	1800.7	619.0	0.0	. I E	5.39
5.71	378	1158	1800.6	613.3	0.0	. I E	5.25
5.79	363	1098	1800.6	607.9	0.0	. I E	5.12
5.88	351	1042	1800.6	602.8	0.0	. I E	5.00
5.96	342	989	1800.5	598.0	0.0	. I E	4.90
6.05	331	956	1800.5	593.5	0.0	. I E	4.84
6.14	313	928	1800.5	589.1	0.0	. I E	4.72
6.22	284	899	1800.4	584.7	0.0	.I E	4.69
6.31	244	870	1800.4	580.2	0.0	.I E	4.65
6.40	202	841	1800.4	575.7	0.0	.I E	4.51*
6.48	161	811	1800.3	571.1	0.0	.I E	4.46*
6.57	124	780	1800.3	566.5	0.0	.I E	4.40*
6.66	94	750	1800.2	561.8	0.0	. E	4.33*
6.74	70	719	1800.2	557.1	0.0	. E	4.26*
6.83	53	689	1800.2	552.5	0.0	. E	4.09*
6.92	39	660	1800.1	548.0	0.0	. E	4.02*
7.00	29	631	1800.1	543.7	0.0	. E	3.95*
7.09	22	604	1800.1	539.4	0.0	. E	3.88*
7.17	17	577	1800.0	535.4	0.0	. E	3.82*
7.26	12	552	1800.0	531.4	0.0	. E	3.76*
7.35	9	527	1800.0	527.7	0.0	. E	3.60*
7.43	7	502	1799.9	524.0	0.0	. E	3.54*
7.52	5	479	1799.9	520.6	0.0	. E	3.48*
7.61	4	456	1799.9	517.3	0.0	. E	3.32*
7.69	3	435	1799.9	514.1	0.0	. E	3.27*
7.78	2	414	1799.8	511.1	0.0	. E	3.24*
7.87	1	395	1799.8	508.2	0.0	. E	3.09*
7.95	1	376	1799.8	505.5	0.0	. E	3.06*
8.04	1	358	1799.8	502.8	0.0	. E	2.92*
8.13	1	342	1799.7	500.4	0.0	. E	2.90*
8.21	0	325	1799.7	498.0	0.0	. E	2.77*
8.30	0	310	1799.7	495.7	0.0	. E	2.77*
8.38	0	295	1799.7	493.5	0.0	.E	2.64*
8.47	0	281	1799.7	491.5	0.0	.E	2.51*
8.56	0	268	1799.7	489.5	0.0	.E	2.39*
8.64	0	255	1799.6	487.7	0.0	.E	2.40*
T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	250.0	1807.09	1594.3	0.0	7.62	1126.5	150.9	17034.7	17185.6	5.10	12.84	0.005	0.007	0.1	11.3

PLOT

I IN = 10000. CFS

EXIT SLOPE = 0.007

T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	14	0	1793.5	13.8	0.0	.	0.00
0.17	56	1	1793.5	14.0	0.0	.	0.00
0.26	133	3	1793.6	14.7	0.0	.	0.00
0.35	237	8	1793.7	16.0	0.0	.	0.00
0.43	353	14	1794.0	18.0	0.0	.	0.00
0.52	469	19	1794.0	20.8	0.0	.	0.00
0.61	576	25	1794.1	24.4	0.0	.I	0.00
0.69	663	32	1794.2	28.6	0.0	.I	0.00
0.78	728	39	1794.3	33.3	0.0	.I	0.00
0.86	775	47	1794.4	38.4	0.0	.I	0.00
0.95	808	55	1794.5	43.7	0.0	.I	0.00
1.04	838	63	1794.6	49.1	0.0	.I	0.00
1.12	895	73	1794.7	54.8	0.0	.I	0.00
1.21	1006	84	1794.8	61.1	0.0	.I	0.00
1.30	1170	97	1794.9	68.2	0.0	.I	0.00
1.38	1364	98	1795.1	76.6	0.0	.I	0.00
1.47	1561	100	1795.3	86.3	0.0	. I	0.00

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0.04	2	641	1800.1	545.2	0.0	.E	3.0[illegible]
0.13	1	612	1800.1	540.7	0.0	.E	3.45*
0.21	1	584	1800.1	536.4	0.0	.E	3.38*
0.30	1	558	1800.0	532.4	0.0	.E	3.32*
0.38	0	532	1800.0	528.5	0.0	.E	3.26*
0.47	0	507	1800.0	524.8	0.0	.E	3.20*
0.56	0	483	1799.9	521.2	0.0	.	3.06*
0.64	0	460	1799.9	517.8	0.0	.	3.01*

```
T      I     O      E      VOL      A  I         I         I         I         I         I         I         I   VEL
                                      0.     10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT
```

VOLUME FILL= 261613. CY. MAX. HEIGHT= 19.1 FT
TOP WIDTH= 14.0 FT. TOP LENGTH= 8334.6 FT
AREA OF DAM= 16.19 AC. AREA TO SEED= 16.19 AC (PROJECTED HORIZONTAL AREA)

****

RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR ENG

RATING TABLE NUMBER 3

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.86	12.18	12.18	17.04	0.00
3	1794.22	34.45	34.45	30.21	0.00
4	1794.59	63.28	63.28	49.41	0.00
5	1794.95	97.43	97.43	68.60	0.00
6	1795.51	101.37	101.37	98.47	0.00
7	1796.08	104.33	104.33	131.03	0.00
8	1796.64	107.21	107.21	180.41	0.00
9	1797.21	110.02	110.02	229.78	0.00
10	1797.77	112.75	112.75	279.16	0.00
11	1798.33	115.42	115.42	337.79	0.00
12	1798.90	118.03	118.03	402.79	0.00
13	1799.46	120.59	120.59	467.79	0.00
14	1799.99	451.03	122.92	528.52	0.00
15	1800.52	811.07	125.22	597.32	0.00
16	1801.46	1910.03	129.24	721.47	0.00
17	1802.62	3710.79	134.00	883.11	0.00
18	1804.73	7925.98	142.24	1201.28	0.00
19	1807.37	14662.73	151.91	1643.47	0.00
20	1810.00	22884.98	161.01	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	200.0	1802.06	799.7	0.0	2.59	331.9	131.7	2649.9	2781.6	1.74	7.48	0.008	0.010	8.3	3.1

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBW 0/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.010

```
                                      0.     2000.     4000.     6000.     8000.    10000.    12000.    14000. EXIT
T      I     O      E      VOL      A  I         I         I         I         I         I         I         I   VEL
0.00   0     0 1793.5     13.7    0.0 .                                                                        0.00
0.09   5     0 1793.5     13.7    0.0 .                                                                        0.00
0.17  19     0 1793.5     13.8    0.0 .                                                                        0.00
0.26  46     1 1793.5     14.0    0.0 .                                                                        0.00
0.35  81     3 1793.6     14.5    0.0 .                                                                        0.00
0.43 122     5 1793.7     15.2    0.0 .I                                                                       0.00
0.52 162     9 1793.8     16.1    0.0 .I                                                                       0.00
0.61 199    13 1793.9     17.4    0.0 .I                                                                       0.00
0.69 230    15 1794.0     18.8    0.0 .I                                                                       0.00
0.78 253    18 1794.0     20.4    0.0 .I                                                                       0.00
0.86 269    21 1794.1     22.1    0.0 .I                                                                       0.00
0.95 281    24 1794.1     23.9    0.0 .I                                                                       0.00
```

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6.96	342	1097	1800.8	629.7	0.0	. I E	5.56
6.05	331	1051	1800.7	624.4	0.0	. I E	5.46
6.14	313	1006	1800.7	619.4	0.0	. I E	5.37
6.22	284	963	1800.6	614.5	0.0	.I E	5.21
6.31	244	920	1800.6	609.6	0.0	.I E	5.12
6.40	202	877	1800.6	604.8	0.0	.I E	5.03
6.48	161	835	1800.5	600.0	0.0	.I E	4.93
6.57	124	800	1800.5	595.1	0.0	.I E	4.80
6.66	99	774	1800.5	590.3	0.0	. E	4.75
6.74	70	749	1800.4	585.4	0.0	. E	4.69*
6.83	53	724	1800.4	580.6	0.0	. E	4.55*
6.92	39	699	1800.4	575.9	0.0	. E	4.49*
7.00	29	674	1800.3	571.2	0.0	. E	4.44*
7.09	22	651	1800.3	566.7	0.0	. E	4.38*
7.17	17	627	1800.2	562.2	0.0	. E	4.33*
7.26	12	605	1800.2	557.9	0.0	. E	4.19*
7.35	9	583	1800.2	553.8	0.0	. E	4.14*
7.43	7	562	1800.2	549.7	0.0	. E	4.10*
7.52	5	542	1800.1	545.8	0.0	. E	3.96*
7.61	4	522	1800.1	542.1	0.0	. E	3.93*
7.69	3	503	1800.1	538.4	0.0	. E	3.80*
7.78	2	485	1800.0	534.9	0.0	. E	3.77*
7.87	1	467	1800.0	531.5	0.0	. E	3.74*
7.95	1	450	1800.0	528.3	0.0	. E	3.62*
8.04	1	433	1800.0	525.1	0.0	. E	3.60*
8.13	1	416	1799.9	522.1	0.0	. E	3.47*
8.21	0	400	1799.9	519.2	0.0	. E	3.35*
8.30	0	385	1799.9	516.4	0.0	. E	3.34*
8.38	0	370	1799.9	513.7	0.0	. E	3.22*
8.47	0	356	1799.8	511.1	0.0	. E	3.22*
8.56	0	343	1799.8	508.6	0.0	. E	3.11*
8.64	0	330	1799.8	506.2	0.0	. E	3.00*
T	I	D	E	VOL	A	I I I I I I I I	VEL
						0. 2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	Q-ES	QE/B
SCS-FBH	200.0	1807.62	1688.0	0.0	8.16	1220.2	152.8	15245.0	15397.8	5.45	13.26	0.005	0.007	9.2	14.0

PLOT I IN = 10000. CFS EXIT SLOPE = 0.007

T	I	D	E	VOL	A	I I I I I I I I	VEL
						0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	14	0	1793.5	13.8	0.0	.	0.00
0.17	56	1	1793.5	14.0	0.0	.	0.00
0.26	133	3	1793.6	14.7	0.0	.	0.00
0.35	237	8	1793.7	16.0	0.0	.	0.00
0.43	353	14	1794.0	18.0	0.0	.	0.00
0.52	469	19	1794.0	20.8	0.0	.	0.00
0.61	576	25	1794.1	24.4	0.0	.I	0.00
0.69	663	32	1794.2	28.6	0.0	.I	0.00
0.78	728	39	1794.3	33.3	0.0	.I	0.00
0.86	775	47	1794.4	38.4	0.0	.I	0.00
0.95	808	55	1794.5	43.7	0.0	.I	0.00
1.04	838	63	1794.6	49.1	0.0	.I	0.00
1.12	895	73	1794.7	54.8	0.0	.I	0.00
1.21	1006	84	1794.8	61.1	0.0	.I	0.00
1.30	1170	97	1794.9	68.2	0.0	.I	0.00
1.38	1364	98	1795.1	76.6	0.0	.I	0.00
1.47	1561	100	1795.3	86.3	0.0	. I	0.00
1.56	1747	101	1795.5	97.4	0.0	. I	0.00
1.64	1910	102	1795.7	109.7	0.0	. I	0.00
1.73	2042	104	1796.0	123.1	0.0	. I	0.00
1.82	2142	105	1796.1	137.3	0.0	. I	0.00
1.90	2213	106	1796.3	152.1	0.0	. I	0.00
1.99	2251	106	1796.5	167.5	0.0	. I	0.00

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T	I	O	E	VOL	A		VEL
[illegible]	[illegible]	887	[illegible]	[illegible]	[illegible]		4.50*
7.78	6	835	1800.5	600.0	0.0	.E	4.40*
7.87	4	795	1800.5	594.2	0.0	.E	4.24*
7.95	3	766	1800.4	588.7	0.0	.E	4.17*
8.04	2	738	1800.4	583.3	0.0	.E	4.10*
8.13	1	711	1800.4	578.2	0.0	.E	4.03*
8.21	1	685	1800.3	573.2	0.0	.E	3.97*
8.30	1	660	1800.3	568.4	0.0	.E	3.91*
8.38	0	636	1800.3	563.8	0.0	.E	3.85*
8.47	0	612	1800.2	559.3	0.0	.E	3.80*
8.56	0	590	1800.2	555.0	0.0	.E	3.67*
8.64	0	568	1800.2	550.9	0.0	.E	3.63*

0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT

VOLUME FILL= 275950. CY. MAX. HEIGHT= 19.6 FT
TOP WIDTH= 14.0 FT. TOP LENGTH= 8419.2 FT
AREA OF DAM= 16.68 AC. AREA TO SEED= 16.68 AC (PROJECTED HORIZONTAL AREA)

****
RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR EMG

RATING TABLE NUMBER 4

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.86	12.18	12.18	17.04	0.00
3	1794.22	34.45	34.45	30.21	0.00
4	1794.59	63.28	63.28	49.41	0.00
5	1794.95	97.43	97.43	68.60	0.00
6	1795.51	101.37	101.37	98.47	0.00
7	1796.08	104.33	104.33	131.03	0.00
8	1796.64	107.21	107.21	180.41	0.00
9	1797.21	110.02	110.02	229.78	0.00
10	1797.77	112.75	112.75	279.16	0.00
11	1798.33	115.42	115.42	337.79	0.00
12	1798.90	118.03	118.03	402.79	0.00
13	1799.46	120.59	120.59	467.79	0.00
14	1799.99	369.36	122.92	528.52	0.00
15	1800.52	640.82	125.22	597.32	0.00
16	1801.46	1470.72	129.24	721.47	0.00
17	1802.62	2835.16	134.00	883.11	0.00
18	1804.73	6046.38	142.24	1201.28	0.00
19	1807.37	11217.15	151.91	1643.47	0.00
20	1810.00	17578.09	161.01	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	150.0	1802.25	828.9	0.0	2.79	361.2	132.5	2245.5	2378.0	1.87	7.81	0.007	0.010	9.7	4.8

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FOR 0/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.010

T	I	O	E	VOL	A		VEL
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	5	0	1793.5	13.7	0.0	.	0.00
0.17	19	0	1793.5	13.8	0.0	.	0.00
0.26	46	1	1793.5	14.0	0.0	.	0.00
0.35	81	3	1793.6	14.5	0.0	.	0.00
0.43	122	5	1793.7	15.2	0.0	.I	0.00
0.52	162	9	1793.8	16.1	0.0	.I	0.00
0.61	199	13	1793.9	17.4	0.0	.I	0.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		0.00

0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. EXIT

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6.05	331	1137	1801.1	671.9	0.0	. I	6.21
6.14	313	1099	1801.0	665.8	0.0	. I E	6.13
6.22	284	1061	1801.0	660.2	0.0	.I E	6.05
6.31	244	1024	1801.0	654.7	0.0	.I E	5.97
6.40	202	987	1800.9	649.1	0.0	.I E	5.89
6.48	161	949	1800.9	643.4	0.0	.I E	5.80
6.57	124	912	1800.8	637.8	0.0	.I E	5.62
6.66	94	874	1800.8	632.2	0.0	. E	5.52
6.74	70	837	1800.7	626.7	0.0	. E	5.41
6.83	53	801	1800.7	621.3	0.0	. E	5.30
6.92	39	766	1800.7	616.0	0.0	. E	5.19
7.00	29	732	1800.6	610.9	0.0	. E	5.09
7.09	22	699	1800.6	606.0	0.0	. E	4.99
7.17	17	667	1800.5	601.2	0.0	. E	4.90*
7.26	12	638	1800.5	596.7	0.0	. E	4.83*
7.35	9	621	1800.5	592.3	0.0	. E	4.71*
7.43	7	604	1800.4	587.9	0.0	. E	4.68*
7.52	5	587	1800.4	583.7	0.0	. E	4.57*
7.61	4	571	1800.4	579.6	0.0	. E	4.55*
7.69	3	555	1800.4	575.6	0.0	. E	4.44*
7.78	2	540	1800.3	571.7	0.0	. E	4.43*
7.87	1	525	1800.3	567.9	0.0	. E	4.32*
7.95	1	510	1800.3	564.3	0.0	. E	4.31*
8.04	1	496	1800.2	560.7	0.0	. E	4.21*
8.13	1	482	1800.2	557.2	0.0	. E	4.20*
8.21	0	469	1800.2	553.8	0.0	. E	4.11*
8.30	0	456	1800.2	550.5	0.0	. E	4.01*
8.38	0	443	1800.1	547.3	0.0	. E	4.01*
8.47	0	431	1800.1	544.1	0.0	. E	3.92*
8.56	0	419	1800.1	541.1	0.0	. E	3.83*
8.64	0	407	1800.1	538.2	0.0	. E	3.84*

T	I	D	E	VOL	A	I 0.	I 2000.	I 4000.	I 6000.	I 8000.	I 10000.	I 12000.	I 14000.	VEL EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	Q-ES	DE/B
SCS-FBN	150.0	1808.27	1808.0	0.0	8.81	1340.2	155.1	13162.7	13317.8	5.90	13.79	0.005	0.007	11.2	10.6

PLOT

I IN = 10000. CFS

EXIT SLOPE = 0.007

T	I	D	E	VOL	A	I 0.	I 10000.	I 20000.	I 30000.	I 40000.	I 50000.	I 60000.	I 70000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	14	0	1793.5	13.8	0.0	.								0.00
0.17	56	1	1793.5	14.0	0.0	.								0.00
0.26	133	3	1793.6	14.7	0.0	.								0.00
0.35	237	8	1793.7	16.0	0.0	.								0.00
0.43	353	14	1794.0	18.0	0.0	.								0.00
0.52	469	19	1794.0	20.8	0.0	.								0.00
0.61	576	25	1794.1	24.4	0.0	.I								0.00
0.69	663	32	1794.2	28.6	0.0	.I								0.00
0.78	728	39	1794.3	33.3	0.0	.I								0.00
0.86	775	47	1794.4	38.4	0.0	.I								0.00
0.95	808	55	1794.5	43.7	0.0	.I								0.00
1.04	838	63	1794.6	49.1	0.0	.I								0.00
1.12	895	73	1794.7	54.8	0.0	.I								0.00
1.21	1006	84	1794.8	61.1	0.0	.I								0.00
1.30	1170	97	1794.9	68.2	0.0	.I								0.00
1.38	1364	98	1795.1	76.6	0.0	.I								0.00
1.47	1561	100	1795.3	86.3	0.0	. I								0.00
1.56	1747	101	1795.5	97.4	0.0	. I								0.00
1.64	1910	102	1795.7	109.7	0.0	. I								0.00
1.73	2042	104	1796.0	123.1	0.0	. I								0.00
1.82	2142	105	1796.1	137.3	0.0	. I								0.00
1.90	2213	106	1796.3	152.1	0.0	. I								0.00
1.99	2321	106	1796.5	167.5	0.0	. I								0.00
2.07	3370	108	1796.7	187.1	0.0	. I								0.00

```
 .69       0   1193 1801.1   679.9   0.0 .E                                                                                  5.720
 .78       6   1137 1801.1   671.6   0.0 .E                                                                                  5.550
7.87       4   1085 1801.0   663.7   0.0 .E                                                                                  5.440
7.95       3   1034 1801.0   656.2   0.0 .E                                                                                  5.340
8.04       2    986 1800.9   649.0   0.0 .E                                                                                  5.250
8.13       1    940 1800.9   642.1   0.0 .E                                                                                  5.100
8.21       1    896 1800.8   635.5   0.0 .E                                                                                  5.030
8.30       1    855 1800.8   629.3   0.0 .E                                                                                  4.900
8.38       0    815 1800.7   623.3   0.0 .E                                                                                  4.780
8.47       0    777 1800.7   617.6   0.0 .E                                                                                  4.660
8.56       0    741 1800.6   612.2   0.0 .E                                                                                  4.620
8.64       0    706 1800.6   607.1   0.0 .E                                                                                  4.520
  T        I      O      E     VOL      A I         I         I          I          I          I          I          I  VEL
                                         0.     10000.    20000.     30000.     40000.     50000.     60000.     70000. EXIT

            VOLUME FILL=  294086. CY.      MAX. HEIGHT=     20.3 FT
            TOP WIDTH=       14.0 FT,      TOP LENGTH=    8480.0 FT
            AREA OF DAM=    17.27 AC.      AREA TO SEED=  17.27 AC (PROJECTED HORIZONTAL AREA)

*****WARNING.....TOP OF DAM EXCEEDS CLPROFILE ENDPOINT - APACHE FRS DAM CENTERLINE

*******************************************************************************
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RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR EMG

RATING TABLE NUMBER 5

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.86	12.18	12.18	17.04	0.00
3	1794.22	34.45	34.45	30.21	0.00
4	1794.59	63.28	63.28	49.41	0.00
5	1794.95	97.43	97.43	68.60	0.00
6	1795.51	101.37	101.37	98.47	0.00
7	1796.08	104.33	104.33	131.03	0.00
8	1796.64	107.21	107.21	180.41	0.00
9	1797.21	110.02	110.02	229.78	0.00
10	1797.77	112.75	112.75	279.16	0.00
11	1798.33	115.42	115.42	337.79	0.00
12	1798.90	118.03	118.03	402.79	0.00
13	1799.46	120.59	120.59	467.79	0.00
14	1799.99	287.69	122.92	528.52	0.00
15	1800.52	470.57	125.22	597.32	0.00
16	1801.46	1031.40	129.24	721.47	0.00
17	1802.62	1959.53	134.00	883.11	0.00
18	1804.73	4166.77	142.24	1201.28	0.00
19	1807.37	7771.57	151.91	1643.47	0.00
20	1810.00	12271.20	161.01	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESW	100.0	1802.56	873.4	0.0	3.10	405.6	133.7	1770.1	1903.9	2.07	8.21	0.007	0.010	12.1	5.9

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBW 0/4 CRITICAL SLOPE.

```
          PLOT                                  I IN =   2000. CFS                                         EXIT SLOPE = 0.010
                                                 0.    2000.    4000.     6000.     8000.    10000.    12000.    14000. EXIT
   T        I       O      E       VOL      A    I        I        I         I         I         I         I         I  VEL
 0.00       0       0 1793.5      13.7    0.0 .                                                                         0.00
 0.09       5       0 1793.5      13.7    0.0 .                                                                         0.00
 0.17      19       0 1793.5      13.8    0.0 .                                                                         0.00
 0.26      46       1 1793.5      14.0    0.0 .                                                                         0.00
 0.35      81       3 1793.6      14.5    0.0 .                                                                         0.00
```

	463	1426	1802.0	790.1	0.0	. I E	7.96
	429	1386	1801.9	783.3	0.0	. I E	7.84
.62	400	1347	1801.9	776.5	0.0	. I E	7.78
5.71	370	1309	1801.8	769.8	0.0	. I E	7.67
5.79	363	1271	1801.8	763.2	0.0	. I E	7.55
5.88	351	1234	1801.7	756.8	0.0	. I E	7.50
5.96	342	1199	1801.7	750.6	0.0	. I E	7.39
6.05	331	1164	1801.6	744.5	0.0	. I E	7.28
6.14	313	1130	1801.6	738.6	0.0	. I E	7.18
6.22	284	1097	1801.6	732.8	0.0	.I E	7.08
6.31	244	1063	1801.5	727.0	0.0	.I E	7.04
6.40	202	1030	1801.5	721.1	0.0	.I E	6.92
6.48	161	1003	1801.4	715.1	0.0	.I E	6.80
6.57	124	976	1801.4	709.1	0.0	.I E	6.74
6.66	94	948	1801.3	703.0	0.0	. E	6.67
6.74	70	921	1801.3	696.9	0.0	. E	6.60
6.83	53	893	1801.2	690.9	0.0	. E	6.46
6.92	39	866	1801.2	684.9	0.0	. E	6.39
7.00	29	840	1801.1	679.1	0.0	. E	6.31
7.09	22	814	1801.1	673.3	0.0	. E	6.24
7.17	17	789	1801.1	667.8	0.0	. E	6.10
7.26	12	764	1801.0	662.3	0.0	. E	6.04
7.35	9	740	1801.0	657.0	0.0	. E	5.97
7.43	7	717	1800.9	651.9	0.0	. E	5.84
7.52	5	694	1800.9	646.9	0.0	. E	5.79
7.61	4	673	1800.9	642.0	0.0	. E	5.66
7.69	3	651	1800.8	637.3	0.0	. E	5.62
7.78	2	631	1800.8	632.8	0.0	. E	5.50
7.87	1	611	1800.8	628.3	0.0	. E	5.46
7.95	1	591	1800.7	624.1	0.0	. E	5.35
8.04	1	573	1800.7	619.9	0.0	. E	5.24
8.13	1	554	1800.7	615.9	0.0	. E	5.140
8.21	0	537	1800.6	612.0	0.0	. E	5.110
8.30	0	520	1800.6	608.2	0.0	. E	5.020
8.38	0	503	1800.6	604.6	0.0	. E	4.920
8.47	0	487	1800.5	601.0	0.0	. E	4.830
8.56	0	472	1800.5	597.6	0.0	. E	4.740
8.64	0	462	1800.5	594.3	0.0	. E	4.670

T I O E VOL A I I I I I I I I VEL
0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. EXIT

TYPE	DW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	100.0	1809.12	1972.6	0.0	9.66	1509.0	158.0	10586.5	10744.6	6.48	14.46	0.005	0.007	14.6	27.5

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.007
0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT

T	I	O	E	VOL	A		VEL
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	14	0	1793.5	13.8	0.0	.	0.00
0.17	56	1	1793.5	14.0	0.0	.	0.00
0.26	133	3	1793.6	14.7	0.0	.	0.00
0.35	237	8	1793.7	16.0	0.0	.	0.00
0.43	353	14	1794.0	18.0	0.0	.	0.00
0.52	469	19	1794.0	20.8	0.0	.	0.00
0.61	576	25	1794.1	24.4	0.0	.I	0.00
0.69	663	32	1794.2	28.6	0.0	.I	0.00
0.78	728	39	1794.3	33.3	0.0	.I	0.00
0.86	775	47	1794.4	38.4	0.0	.I	0.00
0.95	808	55	1794.5	43.7	0.0	.I	0.00
1.04	838	63	1794.6	49.1	0.0	.I	0.00
1.12	895	73	1794.7	54.8	0.0	.I	0.00
1.21	1006	84	1794.8	61.1	0.0	.I	0.00
1.30	1170	97	1794.9	68.2	0.0	.I	0.00
1.38	1364	98	1795.1	76.6	0.0	.I	0.00
1.47	[illegible]	100	[illegible]	[illegible]	0.0	. I	0.00

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.62	1144	4688	1803.[illegible]	12[illegible]	0.[illegible]	.	E	
.71	1082	4485	1805.0	1240.4	0.0	.I	E	11.33
5.79	1038	4291	1804.8	1216.6	0.0	.I	E	11.15
5.88	1007	4115	1804.7	1193.9	0.0	.I	E	10.98
5.96	981	3964	1804.5	1172.1	0.0	.I	E	10.80
6.05	949	3819	1804.4	1151.2	0.0	.I	E	10.62
6.14	897	3679	1804.3	1131.0	0.0	.I	E	10.46
6.22	811	3543	1804.2	1111.3	0.0	.I	E	10.34
6.31	698	3408	1804.0	1091.9	0.0	.I	E	10.18
6.40	574	3274	1803.9	1072.5	0.0	.I	E	10.01
6.48	457	3140	1803.8	1053.3	0.0	.	E	9.84
6.57	352	3008	1803.7	1034.2	0.0	.	E	9.65
6.66	266	2877	1803.5	1015.4	0.0	.	E	9.51
6.74	199	2750	1803.4	997.0	0.0	.	E	9.32
6.83	149	2625	1803.3	979.0	0.0	.	E	9.14
6.92	111	2504	1803.2	961.6	0.0	.	E	9.00*
7.00	83	2388	1803.0	944.9	0.0	.	E	8.83*
7.09	63	2276	1802.9	928.7	0.0	.	E	8.62*
7.17	47	2168	1802.8	913.2	0.0	.	E	8.47*
7.26	35	2066	1802.7	898.4	0.0	.	E	8.32*
7.35	26	1967	1802.6	884.2	0.0	.	E	8.14*
7.43	20	1888	1802.5	870.6	0.0	.	E	8.00*
7.52	15	1813	1802.4	857.5	0.0	.	E	7.88*
7.61	11	1740	1802.4	844.9	0.0	.	E	7.72*
7.69	8	1671	1802.3	832.8	0.0	.	E	7.61*
7.78	6	1604	1802.2	821.2	0.0	.	E	7.46*
7.87	4	1540	1802.1	810.0	0.0	.	E	7.32*
7.95	3	1478	1802.1	799.2	0.0	.E		7.24*
8.04	2	1418	1802.0	788.9	0.0	.E		7.11*
8.13	1	1362	1801.9	779.0	0.0	.E		6.94*
8.21	1	1307	1801.8	769.4	0.0	.E		6.83*
8.30	1	1254	1801.8	760.3	0.0	.E		6.73*
8.38	0	1204	1801.7	751.5	0.0	.E		6.58*
8.47	0	1156	1801.6	743.1	0.0	.E		6.50*
8.56	0	1109	1801.6	735.0	0.0	.E		6.36*
8.64	0	1065	1801.5	727.2	0.0	.E		6.24*
T	I	O	E	VOL	A	I	I	VEL

0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT

VOLUME FILL= 318344. CY. MAX. HEIGHT= 21.1 FT
TOP WIDTH= 14.0 FT. TOP LENGTH= 8480.0 FT
AREA OF DAM= 18.02 AC. AREA TO SEED= 18.02 AC (PROJECTED HORIZONTAL AREA)

*****WARNING.....TOP OF DAM EXCEEDS CLPROFILE ENDPOINT - APACHE FRS DAM CENTERLINE

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EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 7-3-85 SHEET 1 OF 13

CHKD. BY S.G.Y. DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 656

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOODPROOFING

SUBJECT BAFFLE CHUTE DESIGN — 100' WIDE

$Q_{max} = 10{,}505$ CFS.; $W = 100$ FT. $S = 1/2$

TOP OF DDM EL. @ EL 1809.35

FOR DESIGN BAFFLE CHUTE :

$Q = 2/3\, Q_{max} = 2/3 \times 10{,}505 = 7003.33$ CFS

$q = \frac{Q}{W} = \frac{7003.33}{100} = 70.03$ CFS/FT.

$\therefore D_c = \sqrt[3]{\frac{q^2}{g}} = \left(\frac{70.03^2}{32.2}\right)^{1/3} = 5.34'$

$V_c = \sqrt[3]{qg} = (70.03 \times 32.2)^{1/3} = 13.11$ '/sec.

TOTAL LENGTH OF CHUTE (MIN.)

$L = (1809.35 - 1788 + 7.0/2)\sqrt{5} = 55.57'$

USE $L = 59.50'$

BAFFLE PIER HEIGHT :-

$H = 0.8 D_c = 0.8 \times 5.34 = 4.27'$ USE $H = 4.25'$

BAFFLE PIER WIDTH & SPACING :-

$B = 3/2\, H = 3/2 \times 4.25 = 6.38'$ USE $B = 6'-4$

SLOPE DISTANCE BETWEEN BAFFLE PIERS :-

$D = 2H = 2(4.25) = 8.50'$

NO. OF BAFFLE PIERS PER ROW :-

$100/2 \times 6.33 = 7.90$

NO OF ROWS :- $(59.5/8.5) - 1 = 6$ ROWS

HEIGHT OF WALL : $3.3 \times 4.25 = 14.025'$ USE $14'-3$

EBASCO SERVICES INCORPORATED

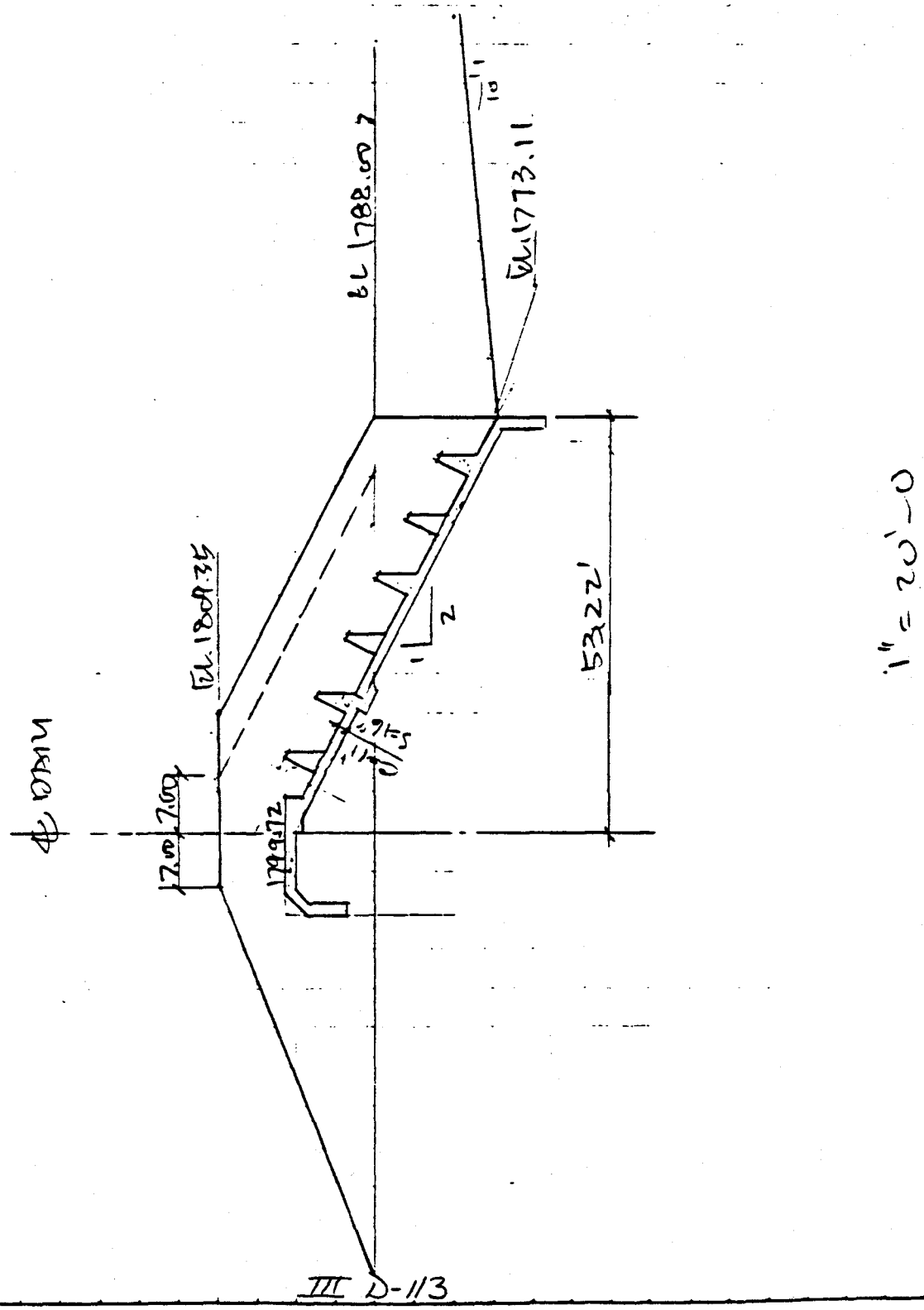
BY Y.C. YANG DATE 7-3-85 SHEET 2 OF

CHKD. BY S. Goyal DATE 7-9-85 OFS NO. 3767.100 DEPT. NO.

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT ~~BULLDOG FLOODWAY~~ - BAFFLE CHUTE SPILLWAY - 100



S01/8-81

EBASCO SERVICES INCORPORATED

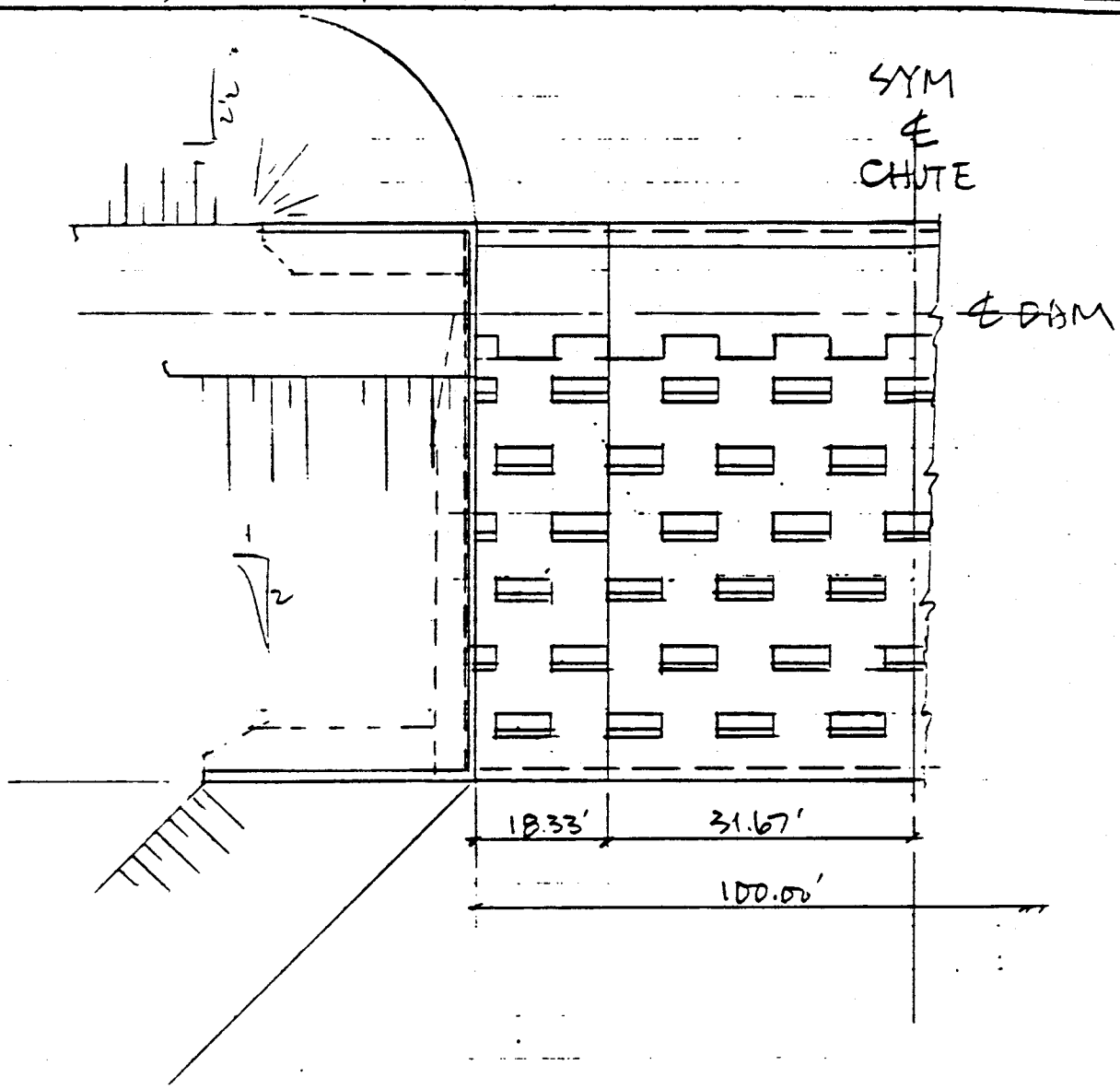
BY Y.C. YONG DATE 7-3-85 SHEET 3 OF 13

CHKD. BY S. Goyal DATE 7-9-85 OFS NO. 3767.100 DEPT. NO.

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT ~~BULLDOG FLOODWAY~~ - BAFFLE CHUTE SPILLWAY - 100' WIDE



1" = 20'-0

581/8-81

EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 7-3-85 SHEET 4 OF 13

CHKD. BY S Gupta DATE 7-9-85 OFS NO. 2767 100 DEPT. NO.

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BAFFLE CHUTE SPILLWAY — 100 WIDE

QUANTITIES:

SLAB:

CENTER SLAB: 31.67 x 2 x 59.5 x 11/12 = 3,455 C.Y.

SIDE SLAB: 18.33 x 2 x 59.5 x 16/12 = 2908

U/S SLAB: 100 (8.5 + √8) x 12/12 = 1,133

U/S CUTOFF W. 100 x 4.0 x 18/12 = 600

D/S C.O. WALL 100 x 6.0 x 15/12 = 750

8,846 C.Y.

BAFFLES:

PIER: (0.85 + 3.0) 4.25 x 6.33 x 7.9 x 6 = 2,455 C.Y.

U/S WTHR: 2.5 x 1.25/2 x 100 + (1.25 + 2.50) 2.5/2 x 6.33 x 7.9 = 391

2,846 C.Y.

SIDE WALL:

WALL: 2 [14.25 x 59.5 - 4.62 x 2 x 4.62] 12/12 = 1,476 C.Y.

U/S WALL: 2 x 9.63 x 10.5 x 11/12 = 185

SLAB = (2+4) 18.8/2 x 16/12 x 2 = 150

37.2 x 4.0 x 16/12 x 2 = 397

2,208 C.Y.

HEAD WALL:

WALL, (27.5 x 15.0 - 8.5 x 5.0) x 12/12 x 2 = 740 C.Y.

SLAB: [27.5 x 7.25 - (5.25 x 7.5)/2] 12/12 x 2 = 359

1099 C.Y.

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EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 7-3-85 SHEET 5 OF

CHKD. BY S. G. Yo DATE 7-9-85 OFS NO. 3767.100 DEPT. NO.

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION PROTECTION

SUBJECT ~~BULLDOG~~ BAFFLE CHUTE SPILLWAY — 100 WIDE

WING WALL:

WALL: $(31.0 \times 14.25 - 4.0 \times 4.0/2)\, 11/12 \times 2 = 795$ CF

$(18.0 \times 4.5 - 4.5 \times 4.5/2)\, 18/12 \times 2 = 213$

SLAB: $(24.0 \times 14.0 - 11.0 \times 5.5/2)\, 18/12 \times 2 = 917$

1925 CF

TOTAL CONC. = 16,924 CF

= 627 C.Y.

S81/8-81

EBASCO SERVICES INCORPORATED

BY Y.C YANG DATE 7-3-85 SHEET 1 OF 13

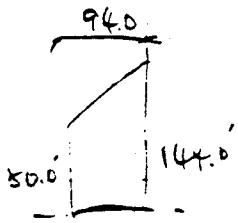
CHKD. BY S.G.Yo DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 6

CLIENT USDA

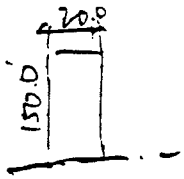
PROJECT

SUBJECT QUANTITIES - 100 W/ BAFFLE SPILLWAY

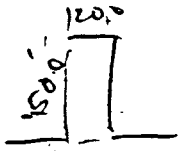
RIP-RAP QUANTITIES (½) 2' THICK



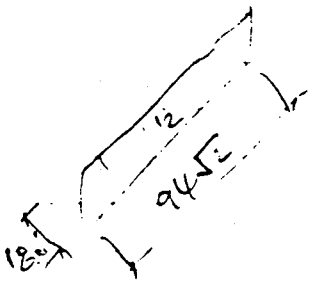
$2.0 \times (50.0 + 144.0)/2 \times 94.0 = 18{,}236$ CF



$2.0 \times 150.0 \times 20.0 = 6{,}000$ CF

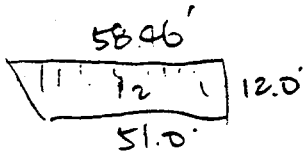


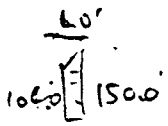
$2.0 \times 150.0 \times 20.0 = 6{,}000$ CF



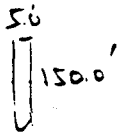
$2.0 \times 94.0\sqrt{2} \times 18.0 \times \sqrt{5}/2 = 5{,}351$ CF

$2.0 \times (58.46 + 51.0)/2 \times 12\frac{\sqrt{5}}{2} = 1{,}469$ CF





$2.0(144.0 + 150.0)/2 \times 6.0\frac{\sqrt{5}}{2} = 1972$ CF



$5.0\,(5.0 \times 150.0) = 3750$ CF

$\Sigma = 42{,}778$ CF

$2 \times \Sigma = 85{,}556$ CF $= \underline{3{,}169\ CY}$

SB1/8-81

EBASCO SERVICES INCORPORATED

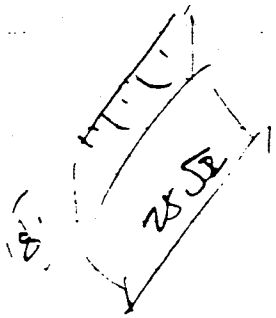
BY Y.C. YANG DATE 7-3-85 SHEET 7 OF 17

CHKD. BY S Gowd DATE 7-9-85 OFS NO. 2767 150 DEPT. NO.

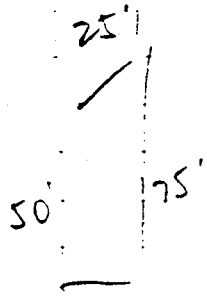
CLIENT

PROJECT

SUBJECT BOFFLE SPILLWAY — 150 WIDTH



$2.0 \times 25\sqrt{2} \times 18.0 \times \frac{\sqrt{5}}{2} = 1423$ CF



$2.0 \times (50.0 + 75.0)/2 \times 25 = 3125$ CF

$\Sigma = 4548$ CF

$2 \times \Sigma = 9096$ CF $= 337$ CY

TOTAL $= 3{,}169 - 337 = 2{,}832$ CY

581/8-81

8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	353.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	499.11	0.00
14	1800.24	322.74	82.48	561.05	0.00
15	1800.75	576.84	83.96	629.30	0.00
16	1801.68	1383.76	86.55	749.35	0.00
17	1802.81	2683.15	89.41	913.14	0.00
18	1804.86	5767.42	94.93	1222.16	0.00
19	1807.43	10746.07	101.19	1655.06	0.00
20	1810.00	16837.68	107.08	2141.60	0.00

30" FS OUTLET
CONC. S FILLWAY

7/2/85

TYPE	DW	EMAX	VOL-MAX	AMAX	NP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/D
SCS-ESN	150.0	1802.51	866.8	0.0	2.79	369.7	89.8	2244.4	2333.3	1.87	7.81	0.007	0.010	11.2	4.4

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FOR 0/4 CRITICAL SLOPE.

PLOT — 1 IN = 2000. CFS — EXIT SLOPE = 0.010

T	I	O	E	VOL	A	0. / 2000. / 4000. / 6000. / 8000. / 10000. / 12000. / 14000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	0	0	1793.5	13.7	0.0		0.00
1.30	0	0	1793.5	13.7	0.0		0.00
1.38	0	0	1793.5	13.7	0.0		0.00
1.47	0	0	1793.5	13.7	0.0		0.00
1.56	0	0	1793.5	13.7	0.0		0.00
1.64	0	0	1793.5	13.7	0.0		0.00
1.73	0	0	1793.5	13.7	0.0		0.00
1.82	0	0	1793.5	13.7	0.0		0.00
1.90	0	0	1793.5	13.7	0.0		0.00
1.99	11	0	1793.5	13.8	0.0		0.00
2.07	188	2	1793.6	14.5	0.0		0.00
2.16	957	15	1794.0	18.5	0.0		0.00
2.25	2911	37	1794.3	32.1	0.0		0.00
2.33	5845	65	1794.8	63.0	0.0		0.00
2.42	8828	69	1795.8	115.0	0.0		0.00
2.51	11019	71	1796.7	185.4	0.0		0.00
2.59	12133	75	1797.6	267.5	0.0		0.00
2.68	12285	77	1798.5	354.2	0.0		0.00
2.77	11670	79	1799.2	439.2	0.0		0.00
2.85	10563	157	1799.9	517.8	0.0		2.32*
2.94	9300	420	1800.4	586.7	0.0		4.07*
3.03	8109	687	1800.9	644.9	0.0		5.14
3.11	7038	1008	1801.2	692.9	0.0		6.03
3.20	6126	1267	1801.5	731.8	0.0		6.62
3.28	5353	1494	1801.8	763.0	0.0		7.09

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 0.64    0   435 1800.5   590.7   0.0 . E                                                                  4.11*
  T      I     0       E     VOL     A I         I         I         I         I         I         I         I  VEL
                                       0.      2000.     4000.     6000.     8000.    10000.    12000.    14000. EXIT

  TYPE        BW     EMAX  VOL-MAX   AMAX     HP   VOL-ES    Q-PS    Q-ES   Q-TOT   D/C    V/C   S/C   S/C.25   Q-ES   QE/Q
BCS-FBNI     150.0  1808.48  1847.2    0.0   8.79  1349.1   103.6  13048.4  13152.1  5.87  13.74  0.005  0.007   11.5   19.4

          PLOT                                  1 IN = 17000. CFS                                   EXIT SLOPE = 0.007
                                                0.     10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT
  T      I     0       E     VOL     A I         I         I         I         I         I         I         I         I  VEL
 0.00    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.09    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.17    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.26    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.35    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.43    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.52    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.61    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.69    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.78    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.86    0     0 1793.5    13.7   0.0 .                                                                          0.00
 0.95    0     0 1793.5    13.7   0.0 .                                                                          0.00
 1.04    0     0 1793.5    13.7   0.0 .                                                                          0.00
 1.12    0     0 1793.5    13.7   0.0 .                                                                          0.00
 1.21    1     0 1793.5    13.7   0.0 .                                                                          0.00
 1.30    3     0 1793.5    13.7   0.0 .                                                                          0.00
 1.38   11     0 1793.5    13.8   0.0 .                                                                          0.00
 1.47   30     1 1793.5    13.9   0.0 .                                                                          0.00
 1.56   67     2 1793.6    14.3   0.0 .                                                                          0.00
 1.64  126     4 1793.6    14.9   0.0 .                                                                          0.00
 1.73  206     8 1793.8    16.1   0.0 .                                                                          0.00
 1.82  302    13 1793.9    17.8   0.0 .                                                                          0.00
 1.90  406    21 1794.0    20.2   0.0 .                                                                          0.00
 1.99  561    26 1794.1    23.5   0.0 .I                                                                         0.00
 2.07 1496    35 1794.2    30.6   0.0 .I                                                                         0.00
 2.16 4768    64 1794.6    52.7   0.0 .    I                                                                     0.00
 2.25 11768   68 1795.8   111.3   0.0 .            I                                                             0.00
 2.33 21084   73 1797.2   228.1   0.0 .                    I                                                     0.00
 2.42 29621   79 1798.9   408.7   0.0 .                            I                                             0.00
 2.51 35179  639 1800.8   637.6   0.0 .E                                   I                                     4.42*
 2.59 37362 2494 1802.6   885.5   0.0 . E                                      X                                  7.80*
 2.68 36727 4799 1804.2  1124.2   0.0 .   E                                    I                               10.19
 2.77 34004 7059 1805.6  1334.5   0.0 .     E                                  I                               11.86
 2.85 30135 9033 1806.6  1506.1   0.0 .      E                                 I                               13.07
 2.94 26064 10537 1807.3 1636.9   0.0 .          E                   I                                          13.94
 3.03 22376 11691 1807.9 1730.5   0.0 .           E                     I                                        14.42
 3.11 19161 12468 1808.2 1792.6   0.0 .            E                      I                                      14.78
 3.20 16483 12927 1808.4 1829.2   0.0 .             E  I                                                         14.99
 3.28 14248 13136 1808.5 1845.9   0.0 .              EI                                                          15.08
 3.37 12409 13152 1808.5 1847.2   0.0 .              IX                                                          15.07
 3.46 10946 13026 1808.4 1837.1   0.0 .             I E                                                          15.03
 3.54  9812 12799 1808.3 1819.0   0.0 .            I  E                                                          14.95
 3.63  8943 12506 1808.2 1795.6   0.0 .           I   E                                                          14.80
 3.72  8284 12173 1808.1 1769.0   0.0 .          I    E                                                          14.65
 3.80  7779 11818 1807.9 1740.7   0.0 .          I    E                                                          14.47
 3.89  7399 11456 1807.8 1711.8   0.0 .         I     E                                                          14.30
 3.98  7111 11097 1807.6 1685.1   0.0 .         I     E                                                          14.13
 4.06  6842 10744 1807.4 1654.9   0.0 .         I     E                                                          13.96
 4.15  6487 10422 1807.3 1626.9   0.0 .        I      E                                                          13.80
 4.24  5987 10092 1807.1 1598.2   0.0 .        I      E                                                          13.61
 4.32  5371  9744 1806.9 1567.9   0.0 .       I       E                                                          13.42
```

T	I	O	E	VOL	A	VEL EXIT
4.41	4725	9373	1806.8	1535.7	0.0	13.22
4.50	4121	8992	1806.6	1501.7	0.0	13.01
4.58	3588	8578	1806.4	1466.5	0.0	12.90
4.67	3144	8166	1806.2	1430.8	0.0	12.56
4.75	2801	7756	1806.0	1395.1	0.0	12.36
4.84	2543	7355	1805.7	1360.2	0.0	12.04
4.93	2350	6968	1805.5	1326.5	0.0	11.79
5.01	2209	6598	1805.3	1294.4	0.0	11.55
5.10	2094	6247	1805.1	1263.9	0.0	11.30
5.19	1982	5915	1804.9	1235.0	0.0	11.07
5.27	1863	5622	1804.8	1207.5	0.0	10.93
5.36	1741	5362	1804.6	1181.1	0.0	10.65
5.45	1618	5111	1804.4	1155.7	0.0	10.44
5.53	1500	4868	1804.3	1131.2	0.0	10.24
5.62	1399	4635	1804.1	1107.6	0.0	10.05
5.71	1323	4412	1804.0	1085.0	0.0	9.84
5.79	1270	4199	1803.9	1063.5	0.0	9.67
5.88	1232	3998	1803.7	1043.2	0.0	9.49
5.96	1200	3809	1803.6	1024.0	0.0	9.28
6.05	1161	3629	1803.5	1005.9	0.0	9.14
6.14	1097	3459	1803.3	988.6	0.0	8.96
6.22	992	3294	1803.2	971.9	0.0	8.75
6.31	853	3132	1803.1	955.6	0.0	8.58*
6.40	702	2972	1803.0	939.3	0.0	8.40*
6.48	559	2812	1802.9	923.2	0.0	8.21*
.57	431	2659	1802.8	907.2	0.0	8.03*
[illegible]	325	2531	1802.7	891.3	0.0	7.89*
[illegible]	244	2405	1802.6	875.7	0.0	7.74*
[illegible]	182	2292	1802.5	860.5	0.0	7.54*
[illegible]	136	2163	1802.4	845.8	0.0	7.39*
[illegible]	102	2048	1802.3	831.6	0.0	7.25*
[illegible]	77	1938	1802.2	818.0	0.0	7.07*
[illegible]	57	1833	1802.1	805.0	0.0	6.90*
[illegible]	43	1733	1802.0	792.6	0.0	6.74*
7.35	32	1638	1801.9	780.8	0.0	6.59*
7.43	24	1548	1801.8	769.6	0.0	6.46*
7.52	18	1462	1801.8	759.0	0.0	6.28*
7.61	13	1381	1801.7	749.0	0.0	6.17*
7.69	10	1318	1801.6	739.4	0.0	6.03*
7.78	7	1257	1801.5	730.3	0.0	5.91*
7.87	5	1199	1801.5	721.6	0.0	5.79*
7.95	4	1143	1801.4	713.2	0.0	5.68*
8.04	2	1090	1801.3	705.3	0.0	5.57*
8.13	2	1039	1801.3	697.7	0.0	5.48*
8.21	1	991	1801.2	690.5	0.0	5.34*
8.30	1	945	1801.2	683.5	0.0	5.26*
8.38	1	901	1801.1	677.0	0.0	5.13*
8.47	0	859	1801.1	670.7	0.0	5.00*
8.56	0	819	1801.0	664.7	0.0	4.95*
8.64	0	781	1801.0	659.0	0.0	4.85*

0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.

VOLUME FILL= 299776. CY, MAX. HEIGHT= 20.5 FT
TOP WIDTH= 14.0 FT, TOP LENGTH= 4680.0 FT
AREA OF DAM= 17.45 AC, AREA TO SEED= 17.45 AC (PROJECTED HORIZONTAL AREA)

*****WARNING.....TOP OF DAM EXCEEDS CLPROFILE ENDPOINT - APACHE FRS DAM CENTERLINE

****

III D-121

10 of 13

RATING TABLE DEVELOPED
WITH PS DEVELOPED BY PROGRAM AND ESRATING FOR ENG

RATING TABLE NUMBER 5

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	13.72	0.00
3	1794.04	22.45	22.45	23.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.49	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	353.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	499.11	0.00
14	1800.24	243.11	82.49	561.05	0.00
15	1800.75	414.05	83.96	629.30	0.00
16	1801.68	958.74	86.55	749.35	0.00
17	1802.81	1841.80	89.61	913.16	0.00
18	1804.86	3959.48	94.93	1222.16	0.00
19	1807.43	7426.04	101.19	1655.06	0.00
20	1810.00	11728.97	107.09	2141.60	0.00

30" ϕ

11 rcf

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	Q/C	V/C	S/C	S/C.25	Q-ES	QE/Q
SCS-ESH	100.0	1802.86	918.4	0.0	3.14	420.3	89.8	1907.8	1897.6	2.10	8.26	0.007	0.010	14.2	6.3

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FOR 0/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.010

T	I	Q	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	0	0	1793.5	13.7	0.0	.								0.00
0.17	0	0	1793.5	13.7	0.0	.								0.00
0.26	0	0	1793.5	13.7	0.0	.								0.00
0.35	0	0	1793.5	13.7	0.0	.								0.00
0.43	0	0	1793.5	13.7	0.0	.								0.00
0.52	0	0	1793.5	13.7	0.0	.								0.00
0.61	0	0	1793.5	13.7	0.0	.								0.00
0.69	0	0	1793.5	13.7	0.0	.								0.00
0.78	0	0	1793.5	13.7	0.0	.								0.00
0.86	0	0	1793.5	13.7	0.0	.								0.00
0.95	0	0	1793.5	13.7	0.0	.								0.00
1.04	0	0	1793.5	13.7	0.0	.								0.00
1.12	0	0	1793.5	13.7	0.0	.								0.00
1.21	0	0	1793.5	13.7	0.0	.								0.00
1.30	0	0	1793.5	13.7	0.0	.								0.00
1.38	0	0	1793.5	13.7	0.0	.								0.00
1.47	0	0	1793.5	13.7	0.0	.								0.00
1.56	0	0	1793.5	13.7	0.0	.								0.00
1.64	0	0	1793.5	13.7	0.0	.								0.00
1.73	0	0	1793.5	13.7	0.0	.								0.00
1.82	0	0	1793.5	13.7	0.0	.								0.00
1.90	0	0	1793.5	13.7	0.0	.								0.00
1.99	11	0	1793.5	13.8	0.0	.								0.00
2.07	188	2	1793.6	14.5	0.0	.I								0.00

T	I	O	E	VOL	A		VEL
7.43	10	800	1801.4	714.2	0.0	E	6.33
7.52	7	775	1801.4	708.6	0.0	E	6.26
7.61	5	751	1801.3	703.2	0.0	E	6.14
7.69	4	727	1801.3	697.9	0.0	E	6.02
7.78	3	704	1801.2	692.8	0.0	E	5.97
7.87	2	682	1801.2	687.9	0.0	E	5.85
7.95	1	661	1801.2	683.1	0.0	E	5.81
8.04	1	640	1801.1	678.5	0.0	E	5.70
8.13	1	620	1801.1	674.0	0.0	E	5.56
8.21	0	600	1801.1	669.6	0.0	E	5.56
8.30	0	581	1801.0	665.4	0.0	E	5.46
8.38	0	563	1801.0	661.3	0.0	E	5.37
8.47	0	545	1801.0	657.4	0.0	E	5.27
8.56	0	528	1800.9	653.6	0.0	E	5.26
8.64	0	511	1800.9	649.8	0.0	E	5.18*

0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	Q/C	V/C	S/C	S/C.25	Q-ES	QE/Q
SCS-FDN	100.0	1809.35	2015.2	0.0	9.62	1517.1	105.6	10505.8	10611.4	6.45	14.43	0.005	0.007	15.4	28.9

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.007

0. 10000. 20000. 30000. 40000. 50000. 60000. 70000. EXIT

T	I	O	E	VOL	A		VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	1	0	1793.5	13.7	0.0		0.00
1.30	3	0	1793.5	13.7	0.0		0.00
1.38	11	0	1793.5	13.8	0.0		0.00
1.47	30	1	1793.5	13.9	0.0		0.00
1.56	67	2	1793.6	14.3	0.0		0.00
1.64	126	4	1793.6	14.9	0.0		0.00
1.73	206	8	1793.8	16.1	0.0		0.00
1.82	302	13	1793.9	17.8	0.0		0.00
1.90	406	21	1794.0	20.2	0.0		0.00
1.99	561	26	1794.1	23.5	0.0	I	0.00
2.07	1496	35	1794.2	30.6	0.0	I	0.00
2.16	4768	64	1794.6	52.7	0.0	I	0.00
2.25	11768	68	1795.8	111.3	0.0	I	0.00
2.33	21084	73	1797.2	228.1	0.0	I	0.00
2.42	29621	79	1798.9	408.7	0.0	I	0.00
2.51	35179	459	1800.8	638.2	0.0	I	4.35*
2.59	37362	1729	1802.7	889.5	0.0	E I	7.81*
2.68	36727	3374	1804.3	1136.0	0.0	E I	10.19
2.77	34004	5051	1805.7	1358.5	0.0	E I	11.94
2.85	30133	6556	1806.8	1546.2	0.0	E I	13.17
2.94	26064	7785	1807.7	1695.7	0.0	E I	14.07
3.03	22376	8792	1808.3	1809.5	0.0	E I	14.75
3.11	19161	9525	1808.7	1892.4	0.0	E I	15.19

```
8.47     J  1277 1802.1   807.3   0.0 .E                                                                  6.87*
8.56     O  1228 1802.0   798.3   0.0 .E                                                                  6.74*
8.64     U  1180 1802.0   789.7   0.0 .E                                                                  6.67*
  T      I     O      E     VOL     A  I        I        I        I        I        I        I        I    VEL
                                       0.    10000.   20000.   30000.   40000.   50000.   60000.   70000. EXIT.

          VOLUME FILL=  324795. CY,     MAX. HEIGHT=    21.3 FT
          TOP WIDTH=       14.0 FT,     TOP LENGTH=   4680.0 FT
          AREA OF DAM=    18.21 AC,     AREA TO SEED=  18.21 AC (PROJECTED HORIZONTAL AREA)

******WARNING.....TOP OF DAM EXCEEDS CLPROFILE ENDPOINT - APACHE FRS DAM CENTERLINE
```

III D-124

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-3-85 SHEET 1 OF 2

CHKD. BY Y.C YOUNG DATE 7-9-85 OFS NO. USDA 2-... DEPT. NO. S.T.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EXIT CHANNEL

Q_{ESH} = 2244 for L = 120 conc. spillway

Q_{ESH} = 2329 for L = 300' earth spillway

Assume Q = 2300 cfs for the channel design

Natural ground slope is .012

For stable channel condition

Allowable velocity = 2.5 × .9 × 1.0 × .86 (for D_{75} = ... 3:1 side slope)

= 1.935

Assume V = 2

$A = \frac{2300}{2} = 1150$ sq ft

d = R

$V = \frac{1.486}{.025} R^{2/3} (.012)^{1/2} = 2$

or $R^{2/3} = \frac{2 \times .025}{1.486 \times (.012)^{1/2}} = .31$

R = .17

This will need very wide channel about 6755'

∴ provide a weir in the channel to provide adequate depth of water d/s of the spillway & avoid scouring at that location.

Protect the weir by flexible apron of riprap

For 300' wide channel

$q = \frac{2300}{300} = 7.66$ cfs

d = 1.22

$V_c = \frac{7.66}{1.22} = 6.27$ fps

$L = d\sqrt{10} = 3.16\,d$

Provide 2 ft thick riprap for 3.16 d length

501/8-81

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-3-85 SHEET 2 OF

CHKD. BY Y.C.YANG DATE 7-9-85 OFS NO. USDA 3760.100 DEPT. NO. S

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EXIT CHANNEL

For $V = 2$ fps

$d = \frac{2300}{300 \times 2} = 3.83$ $R = \frac{(300 + 2 \times 3.83)\, 3.83}{300 + 2\sqrt{5} \times 3.83}$

$= \frac{1178}{317} = 3.71$

$S = \left[\frac{V n}{1.486\, R^{2/3}}\right]^2$

$= .000196$

Provide a slope of .0002

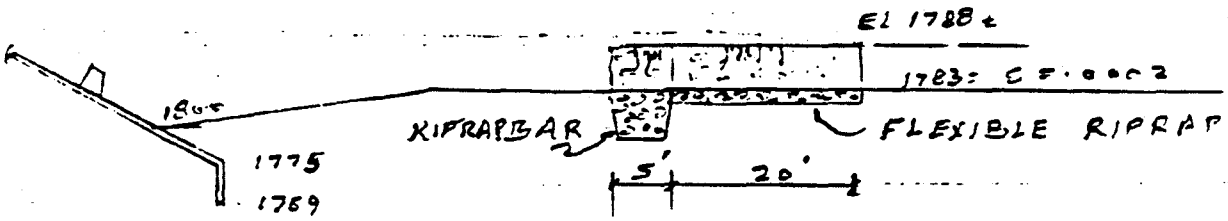
Provide a channel 300 feet wide 5 feet deep at the weir with a slope of .0002

Length of channel = 400'

Provide weir protection for another 5' depth of scour d/s of the weir.

Length of flexible riprap = 3.16 x 5

= 15.8 say 20' long



EBASCO SERVICES INCORPORATED

BY S Goyal DATE 9-10-85 SHEET 2A OF 2

CHKD. BY Y C Yang DATE 9-17-85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EXIT CHANNEL

The geological investigations (TP 201, 202, E 205) indicate existence of caliche at about EL 1779. The control section in the 300' wide channel will be extended from EL 1783 down to caliche. This caliche formation will minimize downstream degradation in the exit channel below the top of caliche. To further protect the caliche foundation at the control section and thereby to protect the control section a flexible apron (loose riprap) will be provided downstream of the control section in a length of 25 feet. This loose riprap will settle down in a manner as the degradation starts downstream of the control section and will protect the caliche. This riprap may need maintenance depending upon the extent & frequency of operation of the spillway.

From Engineering Monograph No. 25, "Hydraulic Design of Stilling Basins and Energy Dissipators" Bureau of Reclamation, Section 9, the scour downstream of the baffle chute is expected to be less than 10' (extrapolated for 70 cfs/ft design discharge). Therefore the chute is extended to EL 1773 ± (1783 - 10) and an additional 5 feet deep cut off is provided for additional safety against undermining of the chute.

As the caliche exists at about EL 1779 the area between the chute and the control section will be excavated to caliche and provided with riprap protection (Top EL 1779). This will form a pool of about 6.5' deep for the design flow and give better energy dissipation downstream of the chute.

The arrangement as discussed above should provide the required protection.

EBASCO SERVICES INCORPORATED

BY Y C. YANG DATE 7-8-85 SHEET 1 OF

CHKD. BY S. Goyal DATE 7. 9. 85 OFS NO. 3767.100 DEPT. NO. 652

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT EMERGENCY SPILLWAY - RIPRAP SIZE

D/S RIPRAP SIZE :-

$Q = 2400$ CFS ; $b = 300.00$; $Z = 3.0$; $S = 0.02$

$$q^* = \frac{Q}{b + 2(1+Z^2)^{1/2}} = \frac{2400}{300 + 2(1+3^2)^{1/2}} = 7.835$$

1. $$R/k = \frac{0.064}{S(S^2+1)^{1/2}}\left(1 - \frac{S}{0.58}\right) + 0.2$$

$$= \frac{0.064}{0.026\sqrt{0.026^2+1}}\left(1 - \frac{0.026}{0.58}\right) + 0.2$$

$$= 2.5504$$

2. $$\frac{V}{\sqrt{R}} = 32.63\left(1 - \frac{k}{6R}\right)^{1/2} \log\left(6\frac{R}{k}\right)\sqrt{S}$$

$$= 32.63\left(1 - \frac{1}{6 \times 2.5504}\right)^{1/2} \log(6 \times 2.5504)\sqrt{0.026}$$

$$= 6.026$$

3. $$R = \left(\frac{q^*}{V/\sqrt{R}}\right)^{2/3} = \left(\frac{7.835}{6.026}\right)^{2/3} = 1.192$$

4. $$k = \frac{R}{(R/k)} = \frac{1.192}{2.5504} = 0.467$$

5. $$V = \frac{q^*}{R} = \frac{7.835}{1.192} = 6.572 \text{ '/sec}$$

6. $$A = \frac{Q}{V} = \frac{2400}{6.572} = 365.18 \text{ □'}$$

7. $$\tau_{AV} = 62.5RS = 62.5 \times 1.192 \times 0.026 = 1.937$$

8. $$y = (b^2 + 4AZ)^{1/2} - b/2Z$$

$$= [(300^2 + 4 \times 365.18 \times 3)^{1/2} - 300]/2 \times 3 = 1.203'$$

EBASCO SERVICES INCORPORATED

BY Y.C YANG DATE 7-8-85 SHEET 2 OF 2

CHKD. BY S.C. YOU DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 64

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT D/S RIPRAP

9. $b/y = 300/1.203 = 249.4$

FROM FIG B-1 $C_{\tau s} = 1.13$

FROM FIG B-2: $C_{\tau b} = 1.3$

FROM FIG B-4: $K = 0.87$

$$K_s = \frac{C_{\tau s}}{K} k = 1.13 \times \frac{0.467}{0.87} = 0.606'\phi$$

$$K_b = C_{\tau b}\, k = 1.3 \times 0.467 = 0.607'\phi$$

SAY 8"ϕ

THICKNESS OF RIPRAP LAYER:

$$t = 3 \times d_{50} = 3 \times 8'' = 24''$$

EBASCO SERVICES INCORPORATED

BY S GOVAL DATE 7-3-85 SHEET 1 OF 2

CHKD. BY Y.C. YIANG DATE 7-9-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY, COMPARATIVE STUDY

The quantity of concrete in Type 6 drop structure for 150' wide crest = 1183 cyd

The quantity of concrete in the Baffle block structure for 150' wide crest = 778 cyd.

Due to high walls in the drop structure the quantity of concrete is 40% more than that in the baffle block chute channel.

The saving in conc = 1183 - 778 = 405 cyd
Extra riprap which is necessary d/s of baffle chute = 1132 cyd

cost of conc. @ 300 = $121500 plus
" " Riprap @ 30 = 33,960 minus

For drop structure spillway located in the vicinity of STA 112+00 the embankment will be higher than that for baffle block chute at STA 97+50 due to head losses in the entrance channel. This will further increase the cost of drop structure proposal.

Further studies are done for baffle block chute and earth channel spillway.

For 150' and 100' baffled chute
extra fill in embankment = 324795 - 299776 = 5019 cyd
@ $1.2 = $6023
Saving in conc. = 50 x 59.5 x 11/12 = 2727 cft = 101 cyd
@ $300 = $30300
∴ 100' crest baffle block chute is more economical.

EBASCO SERVICES INCORPORATED

BY S Gryal DATE 7-3-85 SHEET 2 OF 2

CHKD. BY Y.C. Yang DATE 7-9-85 OFS NO. USDA 3707.100 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - COMPARATIVE STUDY

Earth spillway with riprap protection 300' crest

Top of embankment El 1807.69

Riprap = 25557 cyd @ 30 = $ 766710

Baffled block chute spillway 100' crest

Top of embankment El 1809.35

Concrete 627 cyd @ 300 = $188,100
(incl. Reinf element)

Riprap 5725 cyd @ 30 = $ 171,750

Extra fill in embankment
(324795 - 278038)
= 46757 cyd @ 1.2 = $ 56,108

415,958

$ 415,958

∴ Baffle block chute spillway 100' long crest is more economical than the earth channel spillway with riprap protection.

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 1 OF

CHKD. BY [illegible] DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930

CLIENT U.S.D.A. Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yield for Channel Stability Calculations

ESTIMATE OF SEDIMENT CONTENT IN APACHE JUNCTION AND BULLDOG FLOODWAY FLOWS FOR THE 100 YEAR STORM EVENT.

APPROACH:

* USE PROCEDURES SUPPLIED BY SCS INCLUDING GEOLOGIC NOTE 2, TRIP REPORT BY NEVILLE CURTIS DATED MARCH 7, 1983, AND 1974 SEDIMENTATION SUPPLEMENT.

* FOR APACHE JUNCTION FLOODWAY: COMPUTE SEDIMENT PRODUCTION FROM SUBWATERSHEDS 1 AND 1A+1B.

* ASSUME THAT NO SEDIMENT IS ADDED TO THE FLOWS IN BULLDOG FLOODWAY FROM THE DRAINAGE AREAS BEHIND THE APACHE JUNCTION FRS. (IE:ONLY CLEAR WATER FLOWS OUT OF THE APACHE JUNCTION FRS DURING THE 100 YEAR STORM FOR WHICH THE MAXIMUM DISCHARGE IS APPROXIMATELY 100 CFS)

* DESIGN BULLDOG FLOODWAY FOR ONLY THAT SEDIMENT PRODUCED FROM THOSE DRAINAGE AREAS CONTRIBUTING FLOW TO THE APACHE JUNCTION OUTLET CHANNEL AND BULLDOG FLOODWAY ITSELF.

* SINCE THE PERCENTAGES OF THE VARIOUS UNITS CONTRIBUTING SEDIMENT TO BULLDOG FLOODWAY ARE FAIRLY UNIFORM AND THE RATES DO NOT VARY EXCESSIVELY, TREAT THE ENTIRE WATERSHED AS ONE AREA.

* DENSITY OF SEDIMENT = 1960 TONS/AF

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 2 OF
CHKD. BY D DATE 9/4/85 OFS NO. 3767.100 DEPT. NO. 930
CLIENT U.S.D.A. SCS
PROJECT Bulldog Floodway & Apache Junction
SUBJECT Sediment Volumes - Channel DESIGN

I. Apache Junction Floodway

D.A. # 1 : D.A. = 1.86 SM

Unit	Sed. Yield Rate	Percent Of W/S
7	.12 AF/SM/YR.	50
12	.20 AF/SM/YR.	40
7	.40 AF/SM/YR.	10

Average Annual Sediment Production

.50 x .12 x 1.86 = 0.11
.40 x .20 x 1.86 = 0.15
.10 x .40 x 1.86 = 0.07
0.33 AF/YR.

Using Relation Provided By SCS
ie. 65% Fines
35% Coarse

Fines = .65 (.33) = 0.21 AF/YR
Coarse = .35 (.33) = 0.12 AF/YR

581/8-81

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 3 OF
CHKD. BY DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930
CLIENT U.S.D.A. Soil Conservation Service
PROJECT Bulldog Floodway & Apache Junction
SUBJECT Sediment Vol. (CONT.)

I Apache Junction (CONT.)

D.A. 1A + 1B : D.A. = 0.77 SM

UNIT	SED YIELD Rate	Percent OF W/S
7	0.12	50
12	0.20	20
1	0.40	30

AVERAGE Annual Sediment Production

.50 × .12 × .77 = 0.05
.20 × .20 × .77 = 0.03
.30 × .40 × .77 = 0.09
0.17 AF/YR

USING SAME RATE AS PREVIOUS PAGE (.65 & .35)

Fine = .65(.17) = 0.11 AF/YR
Coarse = .35(.17) = 0.06 AF/YR

TOTAL FINES TO Apache Junction Early Channel = 0.32 AF/YR

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EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 4 OF

CHKD. BY [illegible] DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930

CLIENT U.S.D.A Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yd (CONT)

II. Bulldog Floodway

Drainage Area excluding all area above Apache Junction FRS

D.A. = 5.72 SM

A review of the data provided shows that the contributory area is made up of Units 1, 5, and 12. Units 5 and 12 have the same Sediment Yield Rate of .2 AF/SM/YR

Due to the accuracy of the map and overall level of accuracy needed for this determination a overall percentage will be used for the two sediment yield rates for the entire watershed.

Therefore:

Unit	Sediment Yield Rate	Percent Of W/S
5 & 12	0.2 AF/SM/YR	80
1	0.4 AF/SM/YR.	20

Average Annual Sediment Production:

.80 x .20 x 5.72 = 0.92 AF
.20 x .40 x 5.72 = 0.46 AF
1.38 AF

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BY CJM DATE 8/85 SHEET 5 OF

CHKD. BY D DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION

SUBJECT Sediment Yield

ONCE AGAIN USING RELATION
PROVIDED BY SCS, IE:

65 % Fines
35 % Coarse

AVERAGE ANNUAL SEDIMENT LOAD
IN BULLDOG FLOODWAY

FINES = 0.65 x 1.38 = 0.90 AF/YR

COARSE = 0.35 x 1.38 = 0.48 AF/YR

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BY CJM DATE 8/85 SHEET 6 OF
CHKD. BY R DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930
CLIENT U.S.D.A Soil Conservation Service
PROJECT Bulldog Floodway & Apache Junction
SUBJECT Sediment Yield for 100 yr storm event

Ref. Geologic Note # 2

III. Apache Junction Floodway

a. 100 yr. storm values

Vol. of runoff = $Q_{100\,AF}$

W/S	D A (SM)	Runoff (IN.)	Runoff A.F.
1	1.86	2.00	198
1A+1B	0.77	1.97	81

$Q_{100\,AF}$ = 279 Ac. Ft.

Peak Discharge = q_{100}

q_{100} = 1438 CFS (Prev. Calcs.)

$$C_{100_{AF}} = 95\,(Q_{100} \times q_p)^{0.56}$$

$$= 95\,(279 \times 1438)^{0.56}$$

$$C_{100_{AF}} = 130499$$

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EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 7 OF

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CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment yield for 100 yr. storm event

III (CONT.)

b. 2 YR. STORM VALUES

Vol. of RUNOFF = $Q_{2_{AF}}$

W/S	DA (SM)	Runoff (in)	Runoff (AF)
1	1.86	.32	32
1A+1B	0.77	.27	11

$\therefore Q_{2_{AF}} = 43$ Ac. Ft.

Peak Discharge = $q_{2_{AF}}$

$q_{2_{AF}} = 390$ CFS

$C_{2_{AF}} = 95(43 \times 390)^{0.56}$

$C_{2_{AF}} = 22052$

c. RATIO: Apache Junction Floodway

$C_{100_{AF}} / C_{2_{AF}} = 130499/22052 = 6$

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BY CJM DATE 8/85 SHEET 8 OF

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CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yield - 100 yr. storm

d. Apache Junction Sediment Load (100 yr.)

Sediment Vol. = .32 x 6 = 1.9 A.F.

Sediment Density = 1960 TONS/AF

(From SCS Geologist 8/14/85 TELEPHONE)

WT. OF SEDIMENT = 1.9(1960)

= 3724 TONS

WT OF WATER = 279 AC.FT. x 624 x 21.78

= 379181 TONS

SEDIMENT Content = $\bar{S}$

$$\bar{S}_{AF} = \frac{3724}{3724 + 379181} \times 1{,}000{,}000$$

$$\bar{S}_{AF} = 9726 \text{ ppm}$$

Apache Junction Floodway

SAY 10,000 ppm

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BY CJM DATE 8/85 SHEET 9 OF

CHKD. BY DATE OFS NO. 3767 DEPT. NO. 960

CLIENT U.S.D.A. Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yield For 100 yr storm

IV Bulldog Floodway

a. 2 & 100 YR RUNOFF AMOUNTS [1]

SWS	D.A. (Sm)	q_2 (IN.)	q_{100} IN	q_2 (AF)	q_{100} (AF)
1	.47	.21	1.92	5	48
2	.62	.21	1.93	7	64
3	.15	.29	2.16	2	17
4	.06	.15	1.68	0.5	5
5	.33	.26	2.08	5	37
6	.05	.15	1.69	0.4	5
7	.69	.26	2.08	10	77
8	.03	.15	1.68	0.2	3
9	2.00	.35	2.33	37	248
10	.17	.15	1.70	1	15
11	.03	.15	1.68	0.2	3
12	.32	.24	2.00	4	34
13	.11	.15	1.69	1	10
14	.71	.26	2.08	10	79
				83.3	645

b. 2 & 100 yr Peak Discharges

$Q_{2_{BF}}$ = 653 CFS

$Q_{100_{BF}}$ = 5427 CFS

1/ Do not include volume of runoff and vol. of sediment from those areas behind Apache Junction FRS.

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BY C.J.M. DATE 8/85 SHEET 10 OF

CHKD. BY [illegible] DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yield For 100 yr. storm event

C. RATION C_{100BF} / C_{2BF}

$$C_{100BF} = 95(645 \times 5427)^{0.56}$$

$$C_{100BF} = 438{,}966$$

$$C_{2BF} = 95(83.3 \times 653)^{0.56}$$

$$C_{2BF} = 42{,}622$$

$$C_{100BF}/C_{2BF} = 10.3$$

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BY CJM DATE 8/85 SHEET 11 OF

CHKD. BY [illegible] DATE 9/5/85 OFS NO. DEPT. NO.

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT 100 year Sediment Yield

d. Bulldog Floodway Sediment Load

100 yr Sediment Load = 0.9 x 10.3 = 9.3 AF

WT. OF 100 yr Sed. = 1960 x 9.3

= 18228 Tons

WT. OF WATER = 645 x 62.4 x 21.78

= 876,601 Tons

Sediment Content = $\bar{S}_{BF}$

$$\bar{S}_{BF} = \frac{18228}{18228 + 876,601} \times 1,000,000$$

= 20,370 ppm

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BY cym DATE 8/16/85 SHEET 12 OF

CHKD. BY D DATE 9/5/85 OFS NO. DEPT. NO.

CLIENT U.S.D.A. Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Apache Junction Floodway EARTH CHANNEL

e. Apache Junction Discharges:

Q_{100} = 1560 CFS (At end of earth)

50% Q_{100} = 780 CFS

Computation of TEN YEAR PEAK = Q_{10}

W/S	D.A. (SM)	CN	Tc (hrs)	CLF
1	1.86	80	.82	.943
1A+1B	.77	78	.63	1

RAINFALL = 2.58 IN.

W/S	R.O. (IN.)	C.L.F.	PEAK FACTOR TR-55	D.A (SM)	Q_{10} (CFS)
1	.96	.943	375	1.86	631
1A+1B	.86	1	440	0.77	291

Assume Peaks Add Q_{10} = 921 CFS

Q_{10} = 921 CFS

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BY CJM DATE 8/16/85 SHEET 13 OF

CHKD. BY D DATE 9/5/85 OFS NO. 3767 DEPT. NO. 930

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Bulldog Floodway Discharge & Allowable Velocities For Apache Junction & Bulldog Floodway

f. Bulldog Floodway Discharge:

Q_{100} = 5466 CFS

50% Q_{100} = 2733 CFS

Q_{10} = 2444 CFS

g. Allowable Velocities TR

d_{75} = 4.76 mm

a. Bulldog Floodway Sediment Load 20,000 ppm

ALLOW. VEL. = $V_b \times D \times A \times B$ SS = 3:1

= 4 x 1.2 x 1 x .83

ALLOW. VEL. = 3.98 fps

b. Apache Junction Sediment Load 10,000 ppm

ALLOW. VEL. = 3.2 x 1.1 x 1 x .83

ALLOW. VEL. = 2.92 fps

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BY [illegible] DATE 10/31/85 SHEET 13A OF

CHKD. BY DATE OFS NO. DEPT. NO.

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Allowable Velocities For Other Than 100 year flow

g. (CONT.)

c. Bulldog Floodway

Curve Radius = Straight
Design Q = 2713 cfs
Depth = 6.7 feet (See pg. 26)

$V_{ALL} = 4 \times 1.18 \times 1 \times .83$

$= 3.92$ fps

$V_{ACT} = 3.4$ fps OK (Pg 26)

D. Apache Junction Floodway

Curve Radius = 480 Ft.
Design Q = 921 CFS
Depth = 2.48'

$V_{ALL.} = V_b \times D \times A \times B$
$= 3.2 \times .97 \times 1 \times .83$

$= 2.6$

$V_{ACT} = 2.7$ fps (OK) (Pg 26)

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-26-85 SHEET 1 OF 7
CHKD. BY DSA DATE 7-1-85 OFS NO. USDA 3767.1 DEPT. NO. 550
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT IDAHO & BROWN ROAD CULVERTS

Reservoir storage east of Idaho road is approximately

$\frac{3300}{5600} = .589$ of the total storage

STORAGE	Total	East of Idaho
EL 1793.5	0	0
1794	18.3	17
1796	124.2	73
1798	299.3	176
1800	529.8	312
1802	791.6	466

Inflow 25 year

Total peaks from drainage basins

1	689
1A + 1B	321
1A + 1C	303
2	245
	1568

Assuming all peaks together the inflow is $\frac{1568}{1568+705} = .69$ of the total inflow

The peak inflow = 1881 x .69 = 1298 cfs

Assuming that the reservoir is level at El 1794.0

Inflow after hr 104.13

Interval	Time	cfs	Acft(x)	Sum .69x	Int	Time	cfs	Acft(x)	Sum .69
2.02 hr	105.14	31	5.0	3.5	1.01	118.28	165	14	10
2.02	107.16	35	6.0	4.0	1.01	119.29	767	64	44
2.02	109.18	40	7.0	5.0	1.01	120.30	1881	157	108
2.02	111.20	47	8.0	5.5	1.01	121.31	434	36	25
2.02	113.22	57	9.5	6.5	1.01	122.32	177	15	10.5
2.03	115.25	75	12.5	8.5	1.01	123.33	120	10	7.
1.01	117.27	113	9.5	6.5	1.01	124.34	93	8	5.5

EBASCO SERVICES INCORPORATED

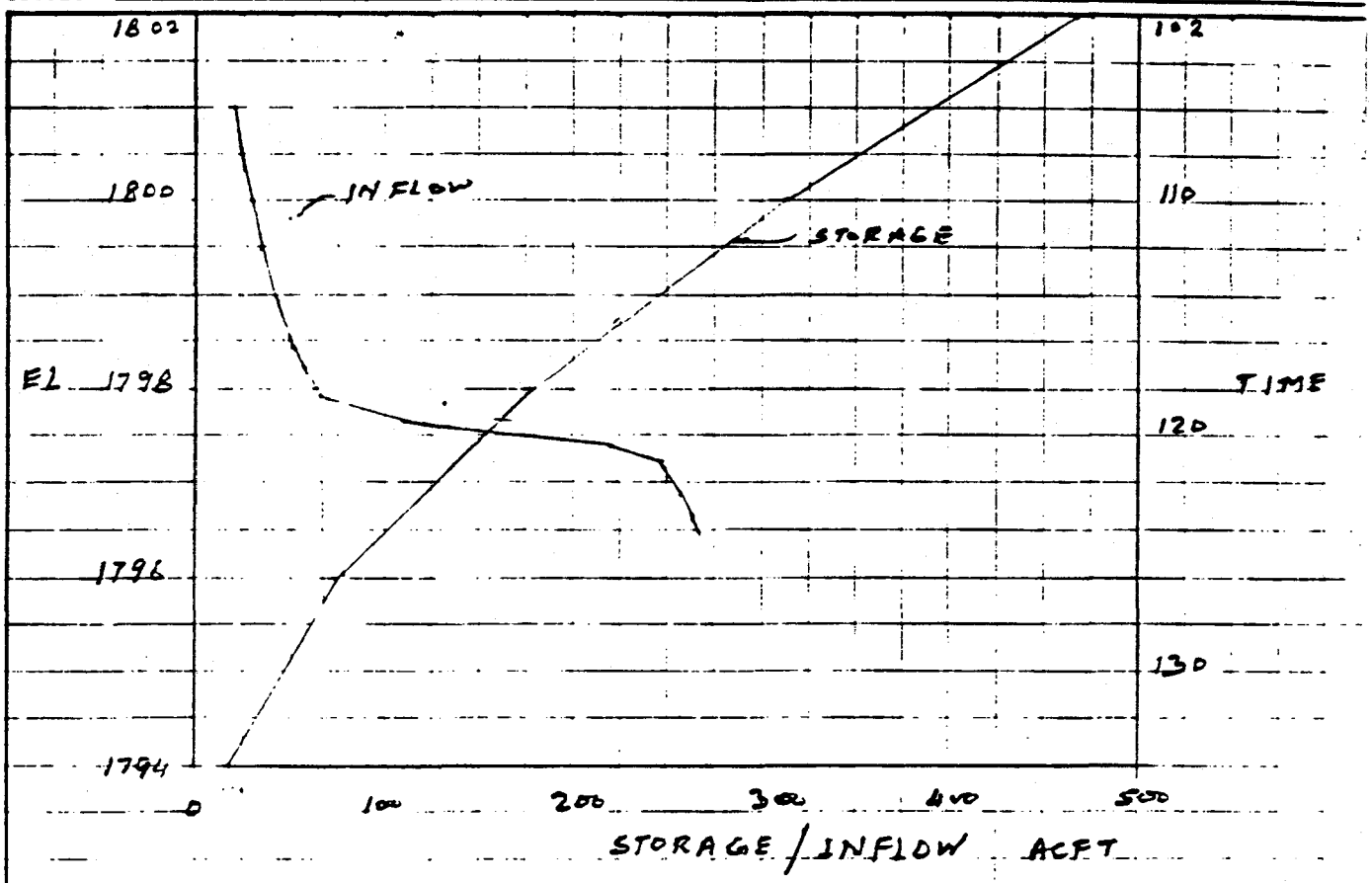
BY S GOYAL DATE 6-26-85 SHEET 2 OF 7

CHKD. BY DM DATE 7-1-85 7/3/85 OPS NO. USDA 3267.1 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT IDAHO & BROWN ROAD CULVERTS



Inflow (Additional)

UP TO Time	Acft	cumulative inflow in storage	If no flow is assumed through
106.15	3.5	+17 20.5	the culvert from time 104 to 118 hrs,
108.17	4	24.5	the storm is stored to EL 1795.1
110.19	5	29.5	with storage of 66.5 Acft
112.21	5.5	35	Assume .25' differential head
114.24	6.5	41.5	Road level = 1798.1 + .25 = 4.5 free board
116.26	8.5	50	= 1798.85
117.27	6.5	56.5	Storage at EL 1798.1 + .25
118.28	10	66.5	level 1798.35 is ≈ 200 Acft
119.29	44	110.5	∴ Outflow required up to 120 hrs
120.30	108.5	219	in two hours
121.31	25	244	= [219 − 200] = 19 Acft i.e. 9.5/h
122.32	10.5	254.5	in three hours upto 121 hrs
122.33	7	261.5	= 244 − 200 = 44, i.e. 14.7
124.34	5.5	267	

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-9-86 SHEET 1 OF

CHKD. BY Y.C. YANG DATE 9-29-81 OFS NO. USDA 3767.400 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT APACHE JUNCTION FRS

SUBJECT IDAHO ROAD CROSSING

a. Culvert size 10' x 9.08 ELLIPSE INVERT EL 1787

Length from DWG 1-35 = 275' Revised

Area of pipe $= \frac{\pi}{4} 10 \times 9.08 = 71.3$

Perimeter $= \pi \sqrt{\frac{1}{2}(10^2 + 9.08^2)} = 30$

$R = \frac{A}{P} = 2.376$

Losses in the culvert $= .5 \frac{v^2}{2g} + \frac{v^2}{2g} + \left\{ \frac{v \times .025}{1.486 \times 2.376^{2/3}} \right\}$

Entrance Exit pipe

$= .0478\, v^2$

Reservoir storage east of Idaho road $= \frac{3300}{5600}$

$= .589$ of the total

Q PSH Assume all peaks at the same time

basin 1	1046
1A + 1B	514
1A + 1C	476
2	395
	2431 cfs

Ratio of total inflow $= \frac{2431}{2431 + 1077} = .69$

∴ Inflow from east of Idaho road = .69 of total

From principal spillway hydrograph routing at interval 117.27 to 118.28 hrs (Feasibility Report)

Inflow $= .69 \times \left(\frac{177 + 255}{2}\right) \times \frac{3600}{43560} = 12.32$

Storage $= .589 (82.2 - 69.6) = 7.42$

Excess volume to pass thru culvert = 4.9 Acft

∴ Average flow $= \frac{4.9 \times 43560}{(118.28 - 117.27) \times 3600} = 58.7$ cfs

∴ $v = \frac{58.7}{60} = .99$ fps $\Delta H = .0478 v^2 = .047'$ negligible

Allowing for partially full

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BY S GOYAL DATE 7-9-86 SHEET 2 OF

CHKD. BY Y.C. YANG DATE 9-29-86 OFS NO. USDA 370.400 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT APACHE JUNCTION FRS

SUBJECT IDAHO ROAD CROSSING

Interval 118:28 to 119:29 hrs = 1.01 hrs

Inflow $= .69\left(\frac{1192+255}{2}\right)\frac{3600}{43560} = 41.26$

Storage $= .589(137-82.2) = 32.28$

Excess $= 8.98$ Acft

flow $= \frac{8.98 \times 43560}{1.01 \times 3600} = 107.6$ cfs

$\therefore v = \frac{107.6}{67} = 1.6$ $\Delta H = .0478 v^2 = .122$

Allowing for partially full very small

The water level $= 1796.1 + .122$

$1796.2 < 1799.1$

Road is not submerged

Interval 119.29 to 120.30 = 1.01 hrs

Inflow $= .69\left(\frac{2893+1192}{2}\right)\frac{3600}{43560} = 116.47$

Storag $= .589(301.6-137) = 96.60$

Excess $= 19.87$

flow $= \frac{19.87 \times 43560}{1.01 \times 3600} = 238$ cfs

$v = \frac{238}{71.3} = 3.34$ $\Delta H = .0478 v^2 = .53'$

Water level $= 1798 + .53$

$= 1798.53$ lower than the road

Interval 120:30 to 121.31 = 1.01 hrs

Inflow $= .69\left(\frac{662+2893}{2}\right)\frac{3600}{43560} = 101.36$

Storage $= .589(443.7-301.6) = 83.70$

Excess $= 17.66$

flow $= \frac{17.66 \times 43560}{1.01 \times 3600} = 211.6$ cfs

$v = \frac{211.6}{71.3} = 2.97$ $\Delta H = .0478 v^2 = .42'$

Water level $= 1799.3 + .42 = 1799.63$

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The water level is higher than the top of the road and as soon as water level on the west of road reaches (1799.1 − .42) i.e 1798.68 the water will start spilling over the road and reduce the differential head ΔH.

For $\Delta H = .1'$

W.L. West = 1799.3

East = 1799.3 + .1

= 1799.4

flow over the road $= L d \sqrt{2g \Delta H}$

$= 250 \times (1799.3 - 1799.1)\sqrt{2g \times .1}$

= 127 cfs

For culvert $\Delta H = .0478 v^2$

$\therefore v = \sqrt{\frac{.1}{.0478}} = 1.446$

$Q_c = 1.446 \times 71.3 = 103$

Total flow = 127 + 103 = 230 > 211.6

$\therefore$ ΔH will be lower than .1 and the velocity over the top of road will be less than $\sqrt{2g \Delta H} = 2.5$ fps

Before the road is submerged the velocity of flow on the d/s face of the roadway can be as high as $\sqrt{2g \times .42} = 5.2$ fps neglecting losses Provide riprap on the d/s face from EL 1800 EL 1794

At 121.31 hrs flow = .69 × 662 = 456.8 cfs

for $\Delta H = .4$ flow over road = 253.8 $250 \times .2 \times \sqrt{2g \times .4}$

thru culvert = 206.3

460.1 > 456.8

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BY S GOYAL DATE 7-9-86 SHEET 4 OF

CHKD. BY Y.C YANG DATE 9-29-86 OFS NO. USDA 3767.1 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT APACHE JUNCTION FRS

SUBJECT IDAHO ROAD CROSSING

Velocity over the road for $\Delta H = .4$ will be max $\sqrt{2g \times .4} = 5$ fps neglecting losses

For subsequent intervals the depth of flow over the road will increase because of higher water level west of the road and also that the rate of inflow is decreasing

Provide riprap w/s and d/s of the road from EL 1800 to 1794.

Maximum velocity on the road top will be about 5 fps when the depth of flow is only about 3 inches. As depth of flow increases to about 8 inches (max on top of road) the velocity will reduce to about .5 fps.

The actual length of culvert pipe in the final drawing is less than 275 feet. Therefore the head loss through the culvert will reduce and the differential head across the road will reduce which will mean lower velocity of flow over the top of the road. The design is conservative.

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EBASCO SERVICES INCORPORATED

BY Mel. Chalco DATE 8/27/86 SHEET 1 OF 3

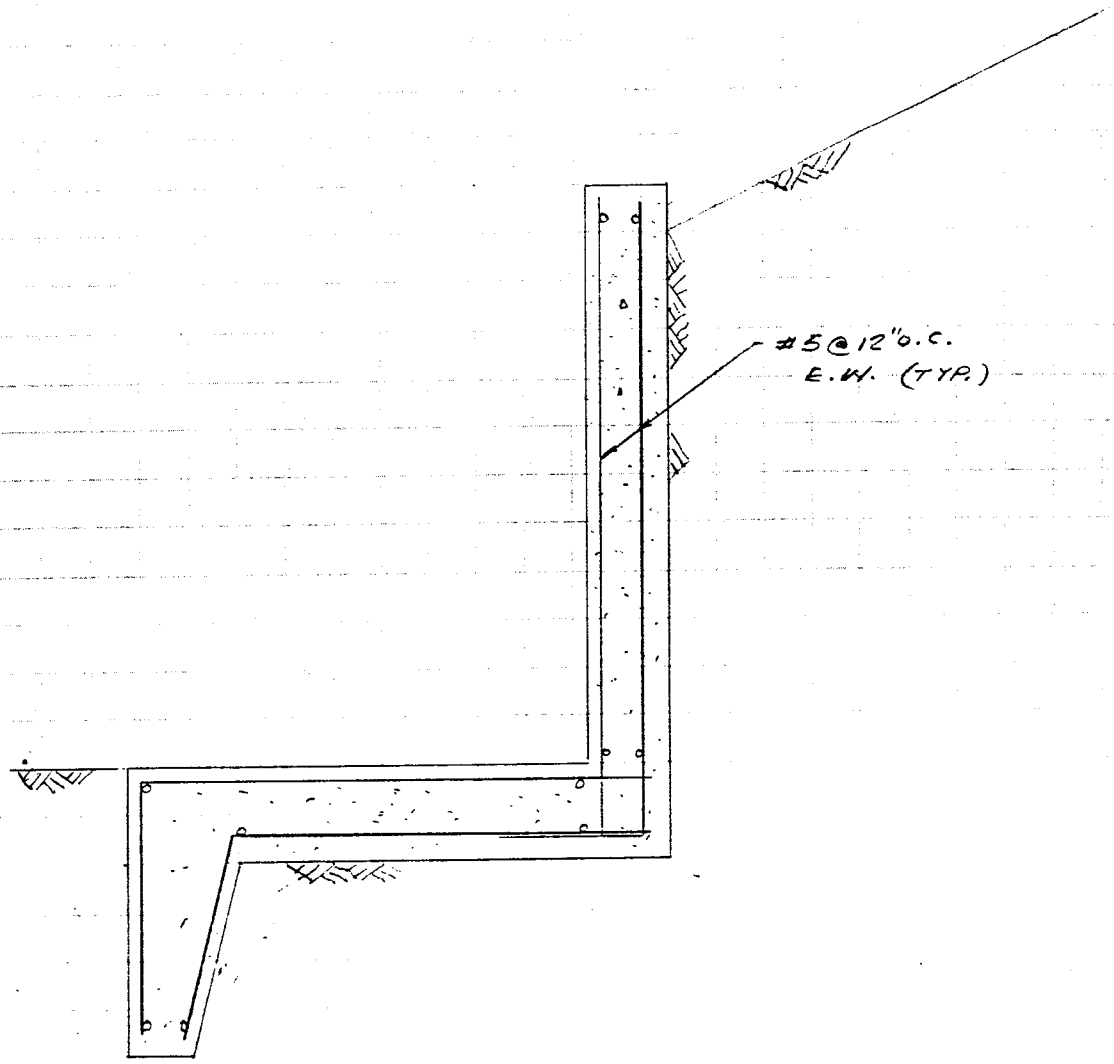
CHKD. BY N. H DATE 8/27/86 OFS NO. FCDM 4452 001 DEPT. NO. 521

CLIENT FCDMC

PROJECT ROAD RAMPS

SUBJECT LAYOUT OF CMP HEADWALL

TYPICAL WALLS & SLAB REINFORCEMENT



SECTION C

IID-152

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EBASCO SERVICES INCORPORATED

BY Mel. Chalco DATE 8/27/86 SHEET 2 OF 3

CHKD. BY N. Id DATE 8/27/86 OFS NO. FCDM4452 .001 DEPT. NO. 521

CLIENT FCDMC

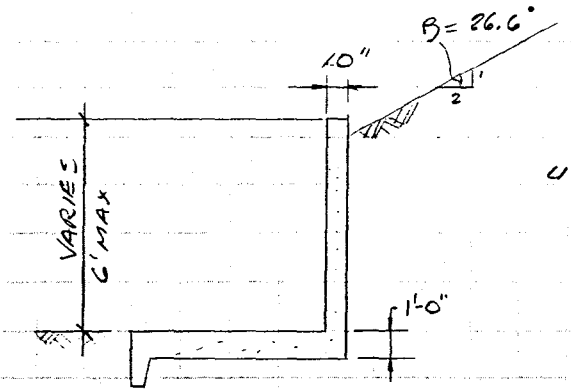
PROJECT ROAD RAMPS

SUBJECT LAYOUT OF CMP HEADWALL

RETAINING WALL DESIGN

LOADS:

LATERAL PRESSURE = 100 PCF + 2' OF SOIL SURCHARGE.



USE H = 5.0' TO DESIGN RETAINING WALL

FIND LATERAL FORCE (P_{a_1}) DUE TO LATERAL PRESSURE

$P_{a_1} = (100\ \#/ft^3 \times 5'^2 \times 1/2)\ 1'$
$= 1250^{\#}$

FIND LATERAL FORCE (P_{a_2}) DUE TO SURCHARGE LOAD

$P_{a_2} = (100\ \#/ft^3 \times 2')(5')(1')$
$= 1000^{\#}$

CONSERVATIVELY, DESIGN WALL AS A CANTILIVER WALL

$M_b = 1250^{\#} \times 5'/3 + 1000^{\#} \times 5' \times 1/2$

$\approx 5.0'^{k}$ (MOMENT @ BASE OF WALL)

5R1/R-R1

EBASCO SERVICES INCORPORATED

BY Mel. Chalco DATE 8/27/86 SHEET 3 OF 3

CHKD. BY N.G. DATE 8/30/86 OFS NO. ECDM 4459.001 DEPT. NO. 521

CLIENT ECDMC

PROJECT ROAD RAMPS

SUBJECT LAYOUT OF CMP HEADWALL

RETAINING WALL DESIGN CONT'D.

- FIND WALL REINFORCEMENT

$M_u = (5.0^{1k})1.7 = 8.5^{1k}$

$d = 10'' - 3\frac{5}{8}'' = 6.375'', \quad b = 12'' \quad f_c' = 3.0KSF$

$F = \frac{12'' \times 6.375''^2}{12,000} = 0.041, \quad K_u = \frac{8.5^{1k}}{0.041} = 207, \quad a_u = 4.29$

$A_s = \frac{8.5^{1k}}{4.29 \times 6.375''} = 0.31 \text{ in}^2/', \quad \therefore$ #5 @ 12" O.C. $A_s = 0.31 \text{ in}^2/'$

- FIND SLAB REINFORCEMENT (12" THICK)

BY INSPECTION, USE MINIMUM REINFORCEMENT.

$A_{s_{MIN}} = 0.0018 \times 12'' \times 12''$

$= 0.26 \text{ in}^2 \quad \therefore$ USE #5 @ 12" O.C. $A_s = 0.31 \text{ in}^2$

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EBASCO SERVICES INCORPORATED

BY Mel. Chalco DATE 9/2/86 SHEET ____ OF ____

CHKD. BY N. Hu DATE 9/2/86 OFS NO. FCDM 4452.001 DEPT. NO. 521

CLIENT FCDMC

PROJECT ROAD RAMPS

SUBJECT LAYOUT OF CMP HEADWALL

VOLUME OF CONCRETE

$V_1 = (10''/12)[(23.56' \times 5')/2 + (2' \times 23.56')] = 88\ ft^3$

$V_2 = (10''/12)[(4' \times 5')/2 + (2' \times 4')] = 15\ ft^3$

$V_3 = 10''/12\ [(11' \times 7') - (\pi \times \bar{3}^2) \times 1/4 \times 1/2] = 56\ ft^3$

APPROXIMATE

} 10" WALLS

$V_4 = 1'\ [(4' + 11'/\sqrt{2})(28.2' - 11'/\sqrt{2})]/2 = 120\ ft^3$

$V_5 = 1'\ [(4' \times 11'/\sqrt{2}) + (11'/\sqrt{2})^2 \times 1/2] = 61\ ft^3$

} 1'-0" SLAB

$V_6 = (8''/12)(2')(28.2') + (6''/12)(2')(28.2')/2 = 52\ ft^3$ } GRADE BEAM

$V_T = (88\ ft^3 + \overset{159}{15\ ft^3} + 56\ ft^3) + (\overset{181}{120\ ft^3 + 61\ ft^3}) + 52\ ft^3$

$= 392\ ft^3 \approx 15\ yd^3.$

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EBASCO SERVICES INCORPORATED

BY DG DATE 9.3.86 SHEET ____ OF ____

CHKD. BY ____ DATE ____ OFS NO. ____ DEPT. NO. ____

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BORROW AREA DRAINAGE DITCH & CULVERT LENGTHS

CRITERIA

1. Est. Depth of Borrow is 5'-0.
2. Apache Floodway Earth Channel Outlet = EL. 1795 (Sh 1-5
3. Invert EL. P.S. Inlet = EL. 1783.50 (Sh 1-20
4. Scaled Length of Dr. Ditch = 5,300 (Sh 1-2.

· Bottom of U/s Borrow Area 1795 − 5. = EL 1790.
· Start Ditch at Surface EL 1790.00

Ave Slope = 1790 − 1783.50 / 5,300 = .00122'/1 or 1.22'/1000'
Use .001'/1 for setting culvert el's.

LOST DUTCHMAN "L"

Scale Dist to Lost D. Culvert = 2200 + 2300 = 2500'

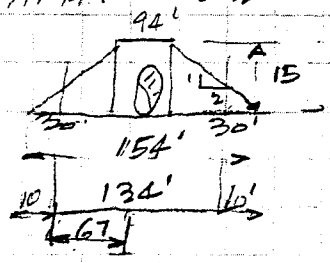
D.E. = 2500 × .001 = 2.5. Scaled Ht 14' + Use 15'

[1] Culv U/s Inv EL = 1790 − 2.5 = EL 1787.5

℄ Rd Sta. of Culvert = STA (−) 4+80 L

D/s Inv. 1787.5 − 134' × .003 = EL 1787.1

2×4 = D/s 0.8' longer than U/s ∴ U/s 66.6' D/s 67.4'



IDAHO "K"

Scale dist. of connecting ditch = 470; D.E. = 470 × .001 = .47'

[2] Culv U/s Inv = 1787.1 − .47 = EL 1786.63

Remaining Dist = 2,100' @ .001 D.E = 2.1'

℄ Rd Sta of Culvert = STA (−) 4+20 K

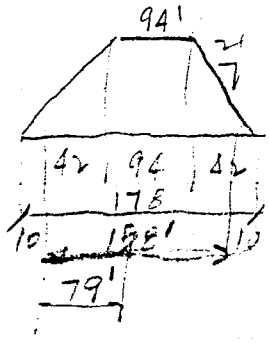
D/s Inv EL 1786.63 − (158 × .003) = EL 1786.15

2×48 D/s 0.96' longer than U/s 78.5, D/s 79.5'

Slope to P.S. Inlet = (1786.15 − 1783.50) / 2,100 = .0013'/1

ok

Scale Ht = 20' Use 21'



581/8-81

EBASCO SERVICES INCORPORATED

BY DG DATE 4/21/86 SHEET 1 OF

CHKD. BY DATE OFS NO. DEPT. NO.

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT Vertical Curves at Road Crossing

Min. L = 3 x V_{max} = 3 x 35 = 105'

40 mph stopping speed sight Dist S' = 275'

SUMMIT S<L ; $S = 3.82\sqrt{L/A}$ ∴ $L = S^2A/3.82^2$

$= 275^2 \cdot .04/3.82^2 = 205'$

S>L $S = 7.28/A + L/2$ ∴ $L = 2(S - 7.28/A)$

$L = 2(275 - 7.28/.04) = 186'$

USE 200' V.C

SAG S<L $L = AS^2/500 + 3.5S =$

$4 \cdot 275^2/500 + 3.5 \cdot 275 =$ 206.8

S>L $L = 2S - (500 + 3.5S)/A =$

$2 \cdot 275 - 1462.5/4 =$ 184.4

USE 200 V.C

IIID-157

581/8-81

III E FOUNDATIONS & EMBANKMENT DESIGN

E. FOUNDATIONS AND EMBANKMENT DESIGN

1. General

As noted in the Geological Investigation Report prepared by the Soil Conservation Service (SCS), the project is situated within the Sonoran Desert section of the Basin and Range physiographic province near the eastern edge of the Phoenix Basin. This basin is subdivided into a series of lesser structural and topographic basins by a number of fault block mountains.

The project is located on a pediment of primarily unconsolidated alluvial fan deposits of Quarternary-Tertiary ages. Features of the project intersect numerous ephemeral washes which have their origin mainly in the Goldfield Mountains. Loose alluvial deposits of recent age are in the washes. Caliche is intermittently exposed throughout the project area, especially in the smaller washes, and generally is present at shallow dpeths eleswhere. Depth to groundwater is unknown, but it is at least several hundred feet deep.

Borings and test pits located along the center line of the Apache Junction FRS show the subsurface materials to consist mainly of silty sands (SM) and clayey sands (SC), with various degrees of cementation and presence of calcium carbonate ($CaCO_3$), underlayed by caliche. Along the few visible washes which cut across the dam, the soils are poorly graded sands (SP) generally extending to a depth of two to four feet. Generally caliche is found at shallow depths ner the west abutment and fluctuates to maximum depths of 24 feet near the east abutment. The caliche varies from fairly soft to hard and ranges from poorly to moderately cemented. Standard Penetration tests show that the overburden soils are loose to medium dense extending from ground surface to a depth of approximately three feet. From this depth to the top of caliche, the subsurface soils appear to be dense to very dense as indicated by the blow counts recorded. However, five in-situ density tests performed at depths ranging from five to nine feet indicate that the soils are loose to medium dense with the dry inplace densities being only 76

to 92 percent of the maximum densities obtained from Standard Proctor compaction tests. The caliche is very dense and breaks down to a gravelly, silty, fine to coarse sand when augered.

Stability analysis of the FRS embankment with a homogeneous section and a filter zone supports the selection of 2.5:1 and 2.0:1 slopes on the upstream and downstream sides, respectively.

A foundation trench will be excavated to a depth of five feet or to caliche, whichever is less. This will remove the most permeable material, reducing seepage potential. For much of the embankment length the trench will extend to caliche. Where washes with permeable material are encountered at the five foot depth, additional excavation will be done to remove that material.

Two concerns were discussed at length in the earlier phases of the project design, the potential for cracking of the embankment, either from dessication or settlement, and the potential for settlement as a result of collapsible soils in the foundation.

The embankment cracking will be assumed to occur and will be handled by constructing a transition zone in the embankment of granular, cohesionless material which will maintain a filter zone capable of preventing the migration of embankment material.

It has been acknowledged that soil testing performed has not defined the potential for collapsibility of soils underlying the embankment or structures. Moreover, an effective sampling and testing program to define this condition would be impractical. SCS has estimated that the embankment transition zone can accommodate as much as approximately two feet of settlement in the twenty feet high embankment. This, combined with the limited depth of the soil layer between the underlying calich and the embankment, had led to a decision to make no provisions other than to apply extra compaction

effort to the foundation material under the embankment. No provision of embankment camber to allow for settlement has been made or considered necessary.

The principal spillway conduit will be surrounded by a transition zone and a drainfill zone connected to the embankment transition zone and drained to the downstream toe.

The principal spillway conduit will rest on caliche and therefore will not experience any settlement or extension.

No instrumentation is included in the design. Surveys will be made to measure settlement of the embankment.

The emergency spillway will discharge into a 300 feet wide exit channel. The energy dissipation and spreading basin will be protected by a 100 foot long loose riprap channel ending at a control section of grouted riprap founded upon caliche near the downstream end. Downstream of the control section a 25 feet long loose riprap section will adjust to any degradation at the downstream end.

The energy dissipator at the end of the Apache Floodway concrete channel is connected to a grouted riprap chute and stilling basin, a total of 132.5 feet to the beginning of the unlined earth channel. A downstream control section of loose rock riprap, 25 ft long, is provided downstream of the stilling basin.

The floodway earth channel has a bottom width of 130 feet and side slopes of 3:1. No special treatment will be required to withstand maximum velocities of about 3.0 fps.

Grouted riprap will be provided upstream from each of the weir inlets to the floodway in the region to protect against scour and erosion from possible high velocities.

2. FRS Design

An analysis of slope stability using Bishop's Simplified Method was conducted for a critical cross-section of the Apache Junction FRS utilizing the SLOPE-II computer program. After performing an overall evaluation of the stability using the SLOPE-II program, Ebasco's in house Slip Circle computer program (also based on Bishop's Simplified Method) was used to determine the stability of a few selected cases. In addition, an infinite slope stabiiity analysis was performed.

The analysis focuses on the more critical downstream slope since: (1) it is steeper than the upstream (2H to 1V versus 2.5H to 1V), and (2) the upstream slope will be submerged for most of the cases analyzed and therefore its stability will be increased by the water impounded against the slope. Still a few runs were made for the upstreams slope for all conditions considered.

The stability of the embankment was investigated for the following conditions using both the slip circle and infinite slope stability analysis to meet the requirements of Technical Release No. 60 (TRS-60) and Ebasco's Phase I Design Criteria.

1. End of construction without seismic forces.

2. Reservoir at freeboard storm elevation (EL +1809.4 ft) without seismic forces.

3.a Reservoir at crest of emergency spillway (EL + 1799.7 ft) and steady state seepage without seismic forces.

3.b Reservoir at crest of emergency spillway (EL + 1799.7 ft) and steady state seepage with a horizontal ground acceleration of 0.10g (pseudostatic condition).

4. Complete sudden drawdown condition with reservoir initially at crest of emergency spillway (EL +1799.7 ft).

The table on page III E-6 presents the minimum factors of safety obtained for the slip circle and infinite slope stability analysis performed for the Apache Junction FRS and, in parentheses, the required safety factors as per TR-60.

The slip circle analysis conducted indicates that shallow failure circles within the saturated embankment zones of both the upstream and downsteam slopes may occur for the steady state seepage condition with seismic forces. Shallow sloughs may also occur at the upsteam slope in a sudden drawdown condition.

It is Ebasco's opinion that the steady state seepage and rapid drawdown conditions (loading conditions 1 and 2) are not applicable in the analysis of the stability of the Apache Junction FRS under the current operating criteria which states that the "FRS will mitigate the flood peak by storing water behind the embankment over a period of 10 days or less".

Table X, page III E-10, presents the duration of water impoundment behind the FRS, at various elevations, for the freeboard hydrograph (FBH). It can be observed that during the FBH, the duration of water impoundment above elevation +1799 feet will be under 10 hours. Under normal operating conditions the impoundment of water behind the FRS above elevation +1795 feet will be under five days (116.2 hrs). Therefore, given the unsaturated conditions of the embankment, the penetration of water into the fill material above elevation +1799 feet will only be a few inches. During the freeboard hydrograph the penetration of water into the embankment soils, will at maximum, be a few feet.

The short impoundment durations, coupled with a relatively impervious and unstrated embankment will prevent the development of steady state seepage along the cross-section of the FRS and thus the

APPACHE JUNCTION FRS EMBANKMENT SLOPE STABILITY

Loading Condition	Slip Circle Analysis		Infinite Slope Analaysis	
	W/O Seismic	W/Seismic	W/O Seismic	W/Seismic
1. End of Construction (DS slope)	1.65 (1.4)	Not Applicable	1.51 (1.1)	Not Applicable
2. Reservoir at freeboard storm elevation (DS slope)	1.65 (Not Req'd)	1.32 (Not Req'd)	Not Required	Not Required
3. Reservoir at crest of emergency spillway and steady state seepage (DS slope)	1.24 (1.5)	0.97 (1.1)	0.78 (1.1)	0.62 (1.1)
4. Sudden drawndown (US slope)	0.87 (1.3)	Not Applicable	0.83 (1.1)	Not Applicable

Note: Failure modes for loading conditions 1 and 2 are shallow circles. Figures 1, 2 and 3 present the critical failure circles.

possible occurrence of a rapid drawdown condition along a considerable portion of the upstream slope.

It must be note that if cracks develop in the upsteam face and some water penetrates through the embankment, the water flow will be terminated at the filter and the zone of penetration will be restricted to the localized crack area. Therefore, neither steady state seepage or saturation of the embankment will occur.

The seepage analysis performed indicates that if the riser were to plug with the reservoir at the highest possible elevation (1799.7 ft) it would take nearly seventeen months for a steady state seepage condition to be established and then only the lower four feet of material in the downstream slope near the toe becomes saturated. Assuming that the riser were to be plugged for this large period of time and neglecting other factors such as evaporation and bank storage, it is expected that the reservoir level will be significantly lowered since calculations show that water flow through the natural soils beneath the foundation cut-off trench will occur after a relatively short period of three months. The loss of water through the natural soils underneath the foundation will decrease the elevation of the impoundment, unless the reservoir is continuously replenished, and will further decrease the probability of the development of steady state seepage. Therefore, it is doubtful that a steady state seepage condition will ever be established in the embankment soils.

Even though it is theoretically possible that the upstream face of the embankment may become saturated at very shallow depths, it is not foreseen that near surface sloughs will occur. The soils used for construction of the embankment will contain at least 15 percent to 20 percent fines (passing No. 200 sieve) and will be compacted at or near optimum moisture content. Thus the soils will exhibit some cohesion after compaction which will increase as the material become dessicated and cemented. In addition, even if it is assumed that

the soils are cohesionless and a drawdown condition does occur at the upstream face, it is expected that the water retained in the voids would be held by capillary forces and the pore water pressures developed in the fill would be negative thereby making the embankment temporarily more stable than it was at the outset. The triaxial shear strength test results conducted on the compacted borrow area soils indicate that negative pore water pressures do indeed develop in these soils and thus the total strength parameters have a significant temporary cohesion component.

Based on the discussions presented above, it is believed that: (1) the conventional steady state and rapid drawdown conditions are extremely unlikely to occur at the Apache Junction FRS, (2) the infinite slope stability analysis for cohesionless soils in not totally representative of actual field conditions, and (3) sloughs of the near surface materils will be prevented by the limited cohesion properties of the soils and the temporary development negative pore water pressures upon the possible occurence of a drawdown conditions.

In an case as shown on Figures 2 and 3, if steady state seepage or sudden drawdown conditions were to occur, the only damagt to the FRS would be surface sloughs or shallow failure circles of the saturated zones in either slope. This unlikely occurrence can be easily rectified through maintenance rather than drastically decreasing the slopes at the time of construction to satisfy the stability safety factors required by TR-60. The slopes mandated by the safety factor criteria established in TR-60 are approximately 4.5H to 1V downstream and 3.5H to 1V upstream.

For the embankment slopes considered, surface erosion due to rainfall runoff may occur as gullies are formed, In order to minimize this damage, it is possible to provide either a riprap cover along the entire dam or some type of protective vegetative cover. Section IX, "Operation and Maintenance" suggests that a maintenance program be established to periodically inspect and repair erosion damage in the embankment.

Information in depth regarding geology and design is contained in following documents found under separate cover.

1. Phase II - Soil Mechanic Report by Ebasco Services.

2. Buckhorn-Mesa Watershed, Geological Investigation Report, by the Soil Conservation Service.

TABLE X

SCS - APACHE JUNCTION AND BULLDOG PROJECT

FREEBOARD HYDROGRAPH (FBH)

DURATION OF FLOOD STAGES ABOVE VARIOUS ELEVATIONS

Elevation (feet)	Duration (hrs)
1809	0.9
1808	1.7
1807	2.3
1806	2.9
1805	3.5
1804	4.2
1803	5.0
1802	6.0
1801	7.2 (estimated)
1800	8.4 (estimated)
1799	41.4 (estimated)
1798	65.7 (estimated)
1797	83.8 (estimated)
1796	102.0 (estimated)
1795	116.2 (estimated)
1794	218.0 (estimated)

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SHEET ____ OF ____

CLIENT USDA-SCS

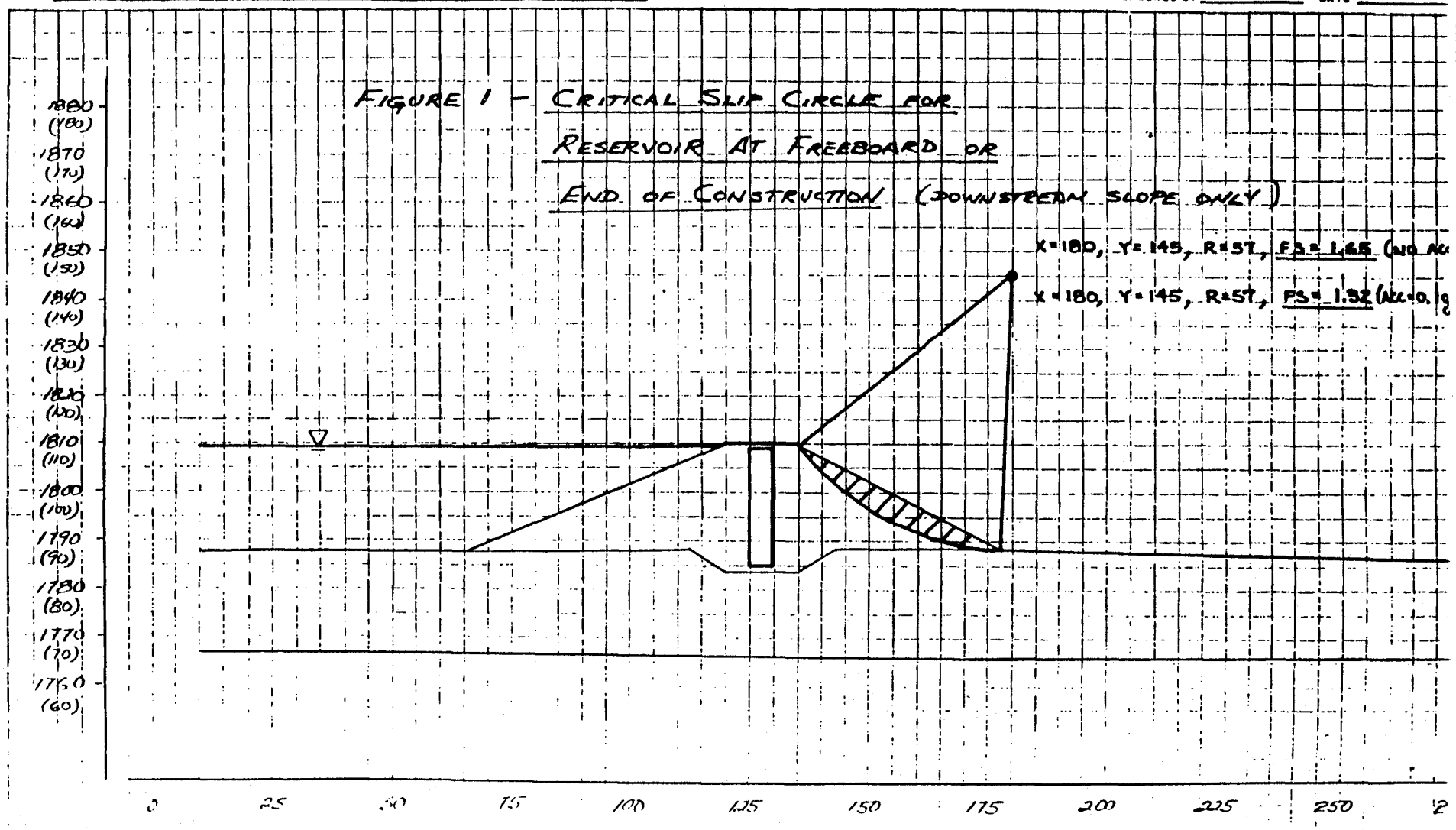
PROJECT APACHE JUNCTION FRS

SUBJECT STABILITY ANALYSIS - RESERVOIR AT FREEBOARD

OPS NO. ____ DEPT. NO. ____

BY Y BOLANO DATE 11/7/85

CHECKED BY ____ DATE ____



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SHEET ____ OF ____

CLIENT USDA-SCS

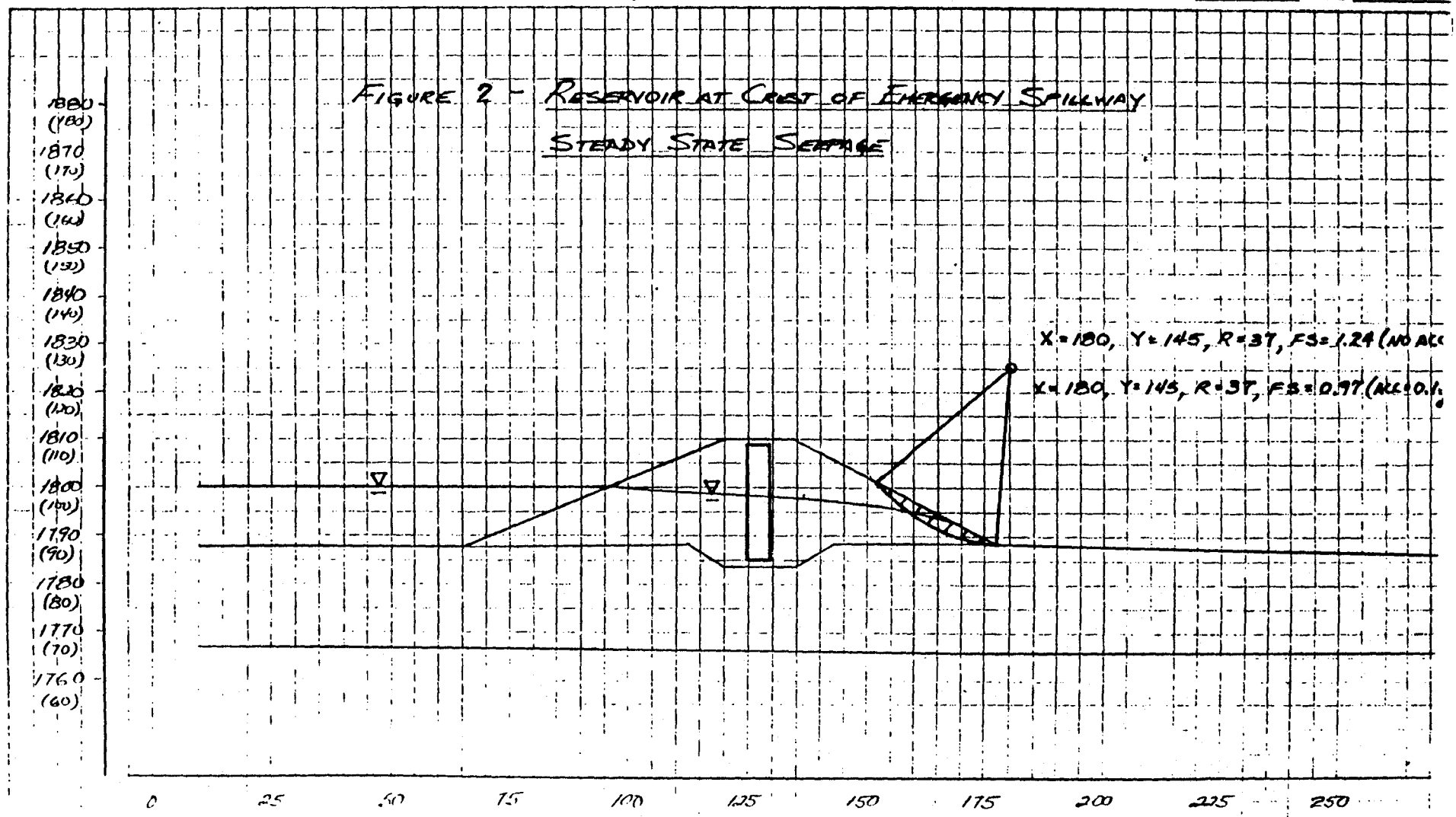
PROJECT APACHE JUNCTION FRS

SUBJECT STABILITY ANALYSIS - RESERVOIR AT CREST OF EMERGENCY SPILLWAY

OPS NO. ____ DEPT. NO. ____

BY Y BOLANO DATE 11/7/85

CHECKED BY ____ DATE ____



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SHEET ____ OF ____

CLIENT USDA-SCS

PROJECT APACHE JUNCTION ERS

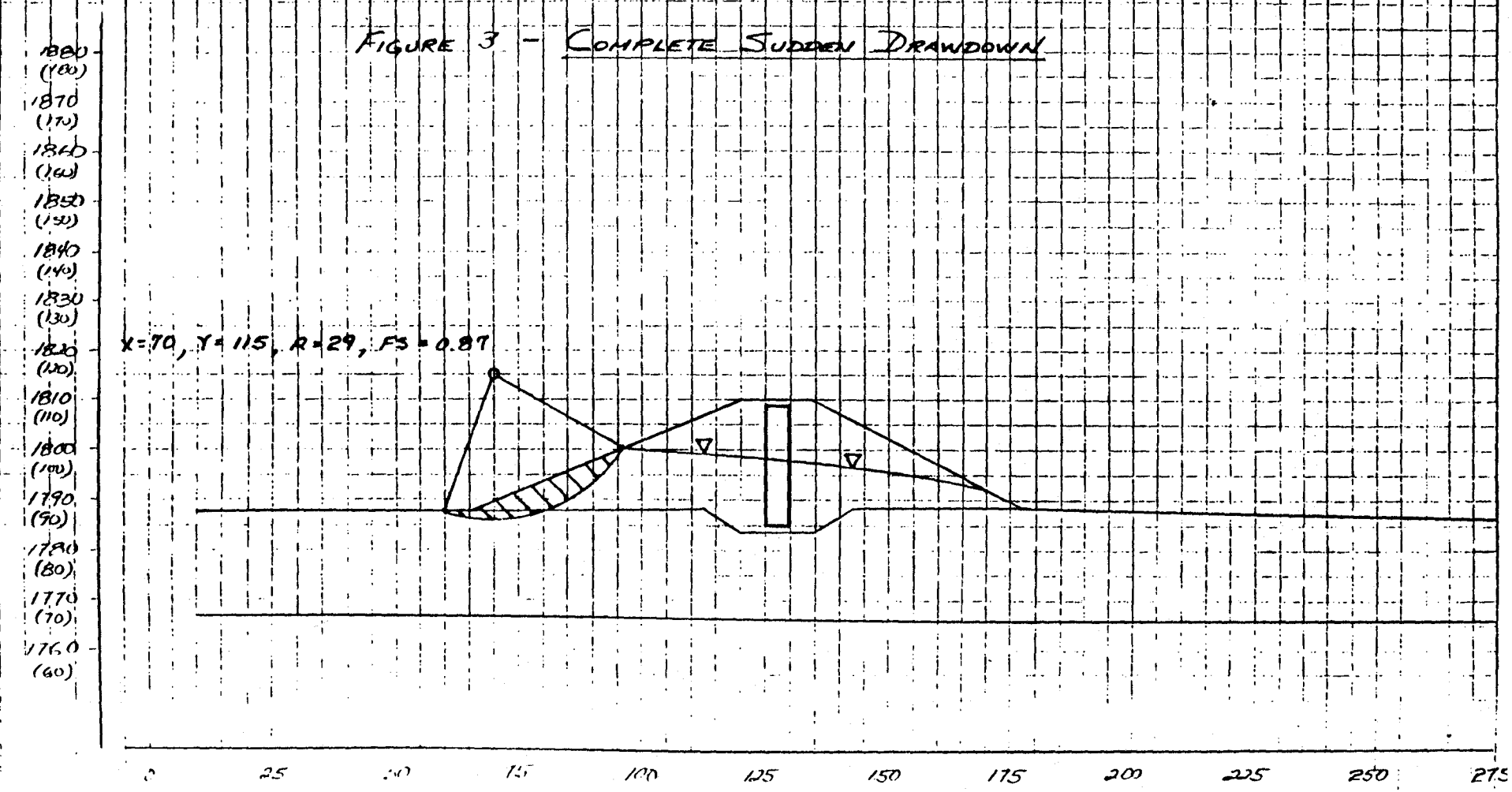
SUBJECT STABILITY ANALYSIS - COMPLETE SUDDEN DRAWDOWN

OFS NO. ____ DEPT. NO. ____

BY V BOLANO DATE 11/7/85

CHECKED BY ____ DATE ____

FIGURE 3 - COMPLETE SUDDEN DRAWDOWN



As per TR-60 (Aug '81 REV), a separate diaphragm will not be required if the material to be used in the transition zone meet the minimum size and location limits.

Determine the location limits (or required area) necessary to calculate the water infiltration quantities into the diaphragm.

As stated in TR-60:

1- Thickness = 5 feet (3 ft min as per TR-60)

2- Height of diaphragm above top of conduit surface

$H = 3D_0 = 3 \times 2\frac{1}{2}\,ft = 7\frac{1}{2}\,ft$ (90 in)

3- Depth of diaphragm

a) If $\Sigma < 0.7$ then 1.5 D or (1.5)(30") = 45" below bottom of conduit surface

b) If $\Sigma > 0.7$ then extend diaphragm 2 feet below bottom of conduit surface

4- Design the diaphragm to extend in all directions a minimum of 2 times the outside diameter from the surface of the conduit.

EBASCO SERVICES INCORPORATED

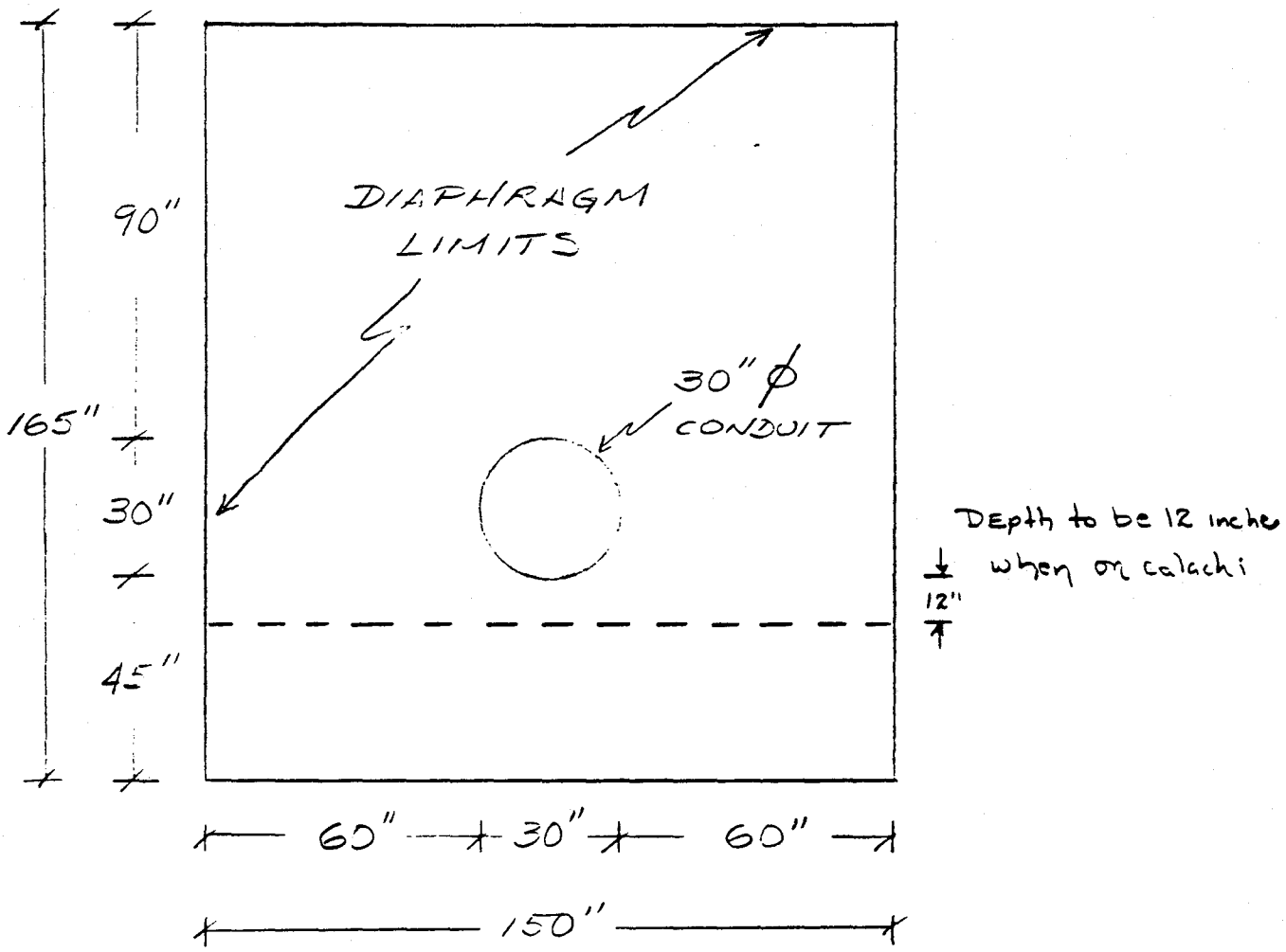
BY V BOLANO DATE 12/9/85 SHEET 2 OF 21

CHKD. BY [illegible] DATE 12/20/85 OFS NO. _____ DEPT. NO. _____

CLIENT USDA

PROJECT APACHE JCT FRS

SUBJECT DIAPHRAGM DESIGN



$$\text{Inflow area} = (150'' \times 165'' \times 1\,ft^2/144\,in^2) - \left[\pi\,(30\,in)^2\,(1\,ft/12\,in)^2\,(1/4)\right]$$

$$\text{Inflow area} = 171.9\,ft^2 - 4.9\,ft^2 = 167\,ft^2$$

581/8-81

$$\phi = K_1 \Delta h A / L \quad \text{where}$$

$$K_1 = (100)(K_{base}) = (100) \times (1 \times 10^{-4} \text{ cm/sec}) = 1 \times 10^{-2} \text{ cm/sec}$$

$$\Delta h = 12 \text{ ft} \; (EL + 1800 - EL + 1788)$$

$$L = 60 \text{ feet (from upstream toe to diaphragm face)}$$

$$\phi = (1 \times 10^{-2} \text{ cm/sec})\left(\frac{1 \text{ in}}{2.54 \text{ cm}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)(12 \text{ ft})(167 \text{ ft}^2) / (60 \text{ ft})$$

$$\phi = 1.10 \times 10^{-2} \text{ ft}^3/\text{sec}$$

$$\phi = (1.10 \times 10^{-2} \text{ ft}^3/\text{sec})(7.5 \text{ gallons/ft}^3)(60 \text{ sec/min}) = 4.95 \text{ gallons/minute}$$

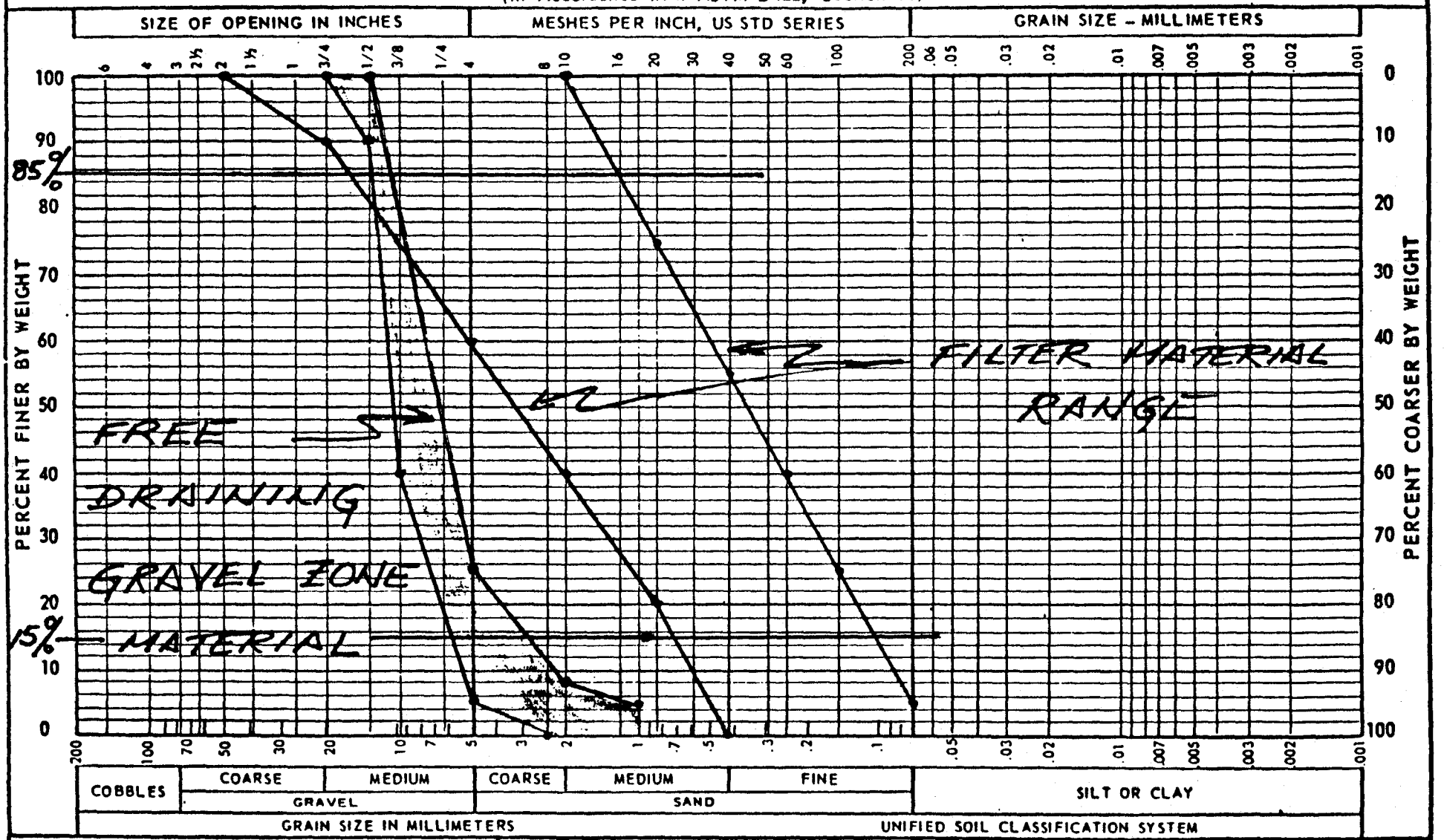
Design the conduit drainage to be composed of a free draining gravel zone (such as a gravel size No 78 - ASTM Designation D448) surrounded by a fine to coarse sand which will serve as filter material between the embankment soils and the free draining gravel.

It is proposed that the fine to coarse sand previously specified for the diaphragm be used as the filter material

FORM #14

MECHANICAL ANALYSIS GRAPH OF GRANULAR MATERIALS

(In Accordance With ASTM D422, Section 16)



TEST NO.	SAMPLE DESCRIPTION	EBASCO SERVICES INCORPORATED
SAMPLE NO.		USDA - APACHE JCT FRS PROJECT
SAMPLE LOCATION		DRAWN BY / CHECKED BY / DATE
SAMPLE ELEVATION		

III E-17

SHEET 4 of 21

FORM #14

Check the compatability of the fine and coarse limits of gravel size No 78 with allowable gradation range of filter material (base soil)

As per Soil Mechanics Note No 1

Category of filter material (base soil): 4 (<15% finer than #200 sieve)

Criteria #1

D_{15} of drain $\leq 4 \times d_{85}$ of base

d_{85} max = 18 mm

d_{85} min ≈ 1.20

D_{15} of drain $\leq 4 \times 1.20\text{mm} = 4.8\text{ mm}$

D_{15} of drain ranges between 3.0 and 6.0 mm

In order to meet the first criteria the minimum d_{85} of the base soil must be greater than

$$d_{85\ min} \geq \frac{6.0\text{mm}}{4} = 1.5\text{ mm}$$

Given the range of soils available at the site and the wide gradation range allowed for the filter material, it is determined that it will not be necessary to adjust the gradation in order

to meet criteria #1. (See attached allowable gradation range for filter material, Sheet)

Criteria #2

D_{15} of drain $\geq 4 \times d_{15}$ of base

d_{15} max = 0.7 mm

d_{15} min = 0.1 mm

D_{15} of drain $\geq 4 \times 0.7$ mm = 2.8 mm

Since D_{15} of drain ranges between 3.0 mm and 6.0 mm this criteria is satisfied

∴ Gravel size No 78 is compatible with filter material which is in turn compatible with embankment soils (Phase II report)

Determine the permeability of the gravel material and calculate the area required to remove the Q inflowing into the diaphragm (4.95 gallons/minute, Sheet 3).

The permeability of the gravel material will be estimated and the required area computed. The values obtained will be checked to assure that the design criteria presented in SMN #9 Figure 2 is satisfied.

From NAVFAC-DM 7, Fig 8-5, Sheet 7-8-10, attached as Sheet , it is observed that the minimum permeability of the free draining gravel is approx 2.0 ft/min (CURVE #6)

$\therefore K = 2$ ft/min

$$Q = K \Delta h A / L$$

$$\therefore A = QL / K \Delta h \quad \text{where}$$

$Q = 4.95$ gallons/minute

$L = 48$ ft (distance from downstream face of diaphragm to downstream toe)

$K = 2$ ft/min (estimated as minimum value)

$\Delta h = 4\frac{1}{2}$ ft (assumes 12" cover below and above conduit: 12" + 30" + 12" = 4½ ft)

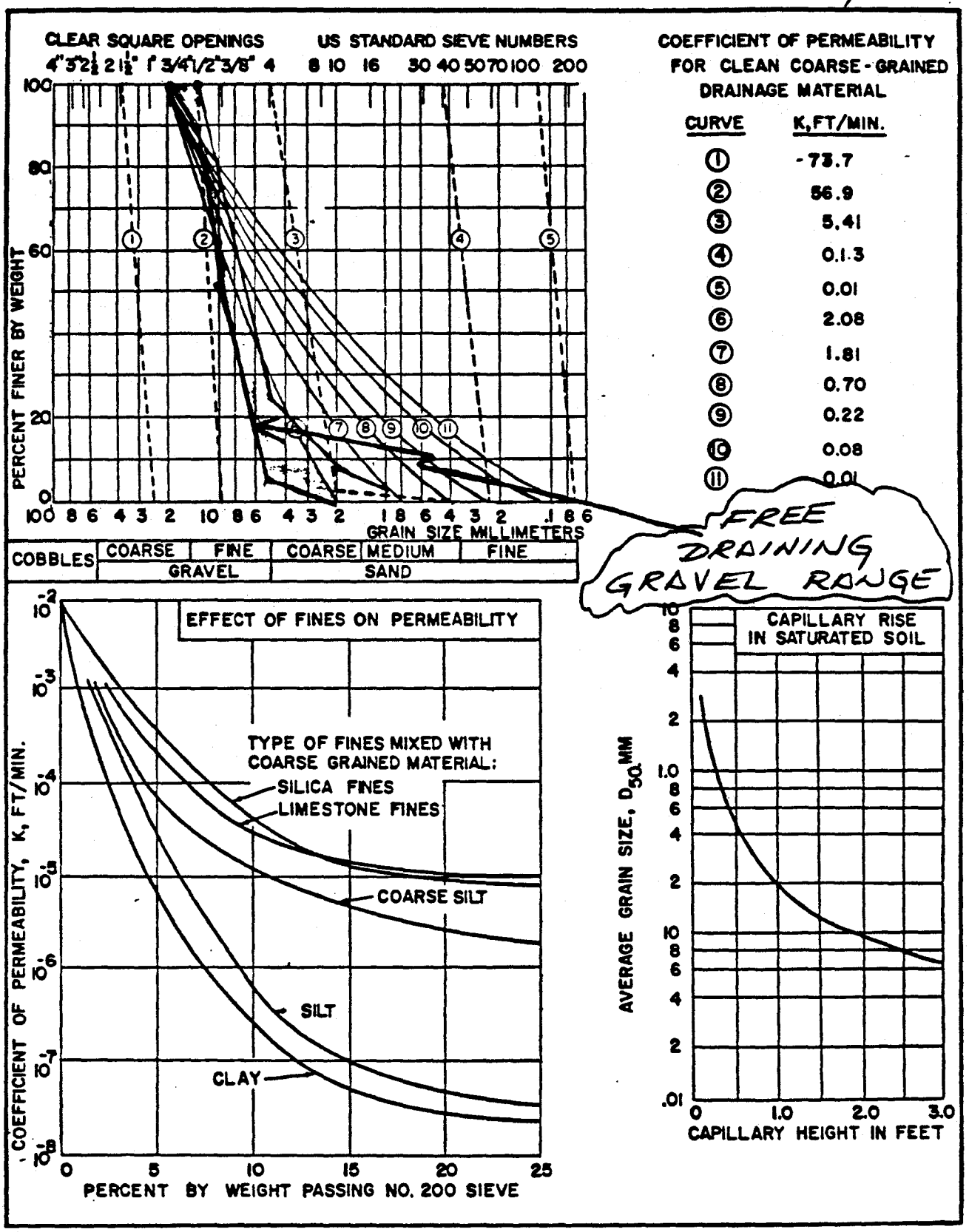


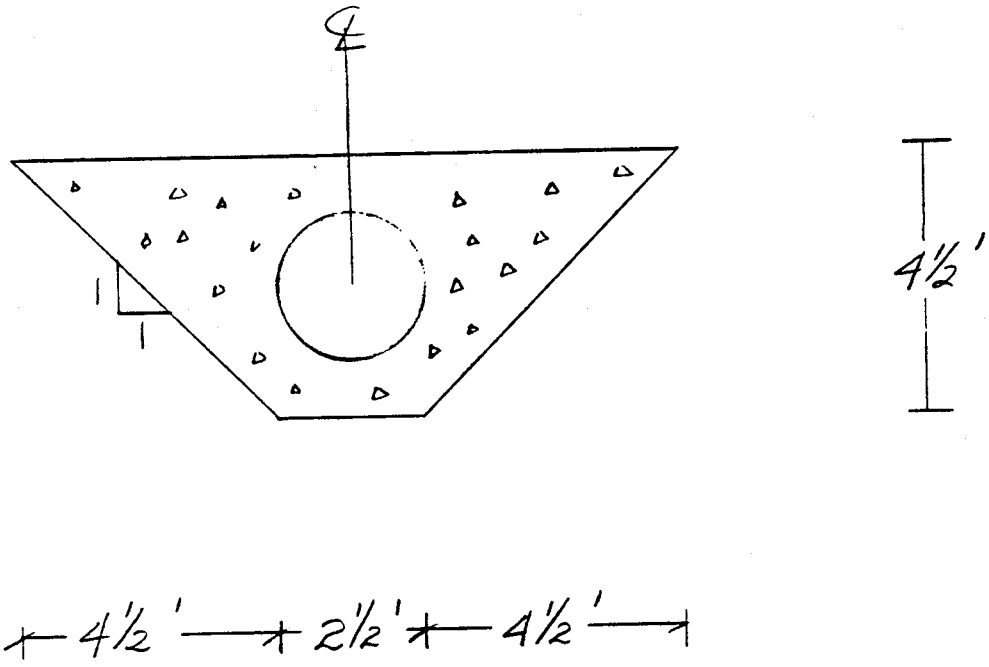
FIGURE 8-5
Permeability and Capillarity of Drainage Materials

7-8-10

Source NAVFAC DM 7

$$A = (4.95 \text{ gallons/minute})\left(\frac{1 \text{ ft}^3}{7.5 \text{ gallons}}\right)(48 \text{ ft}) / (2 \text{ ft/min})(4.5 \text{ ft})$$

$$A = 3.5 \text{ ft}^2$$

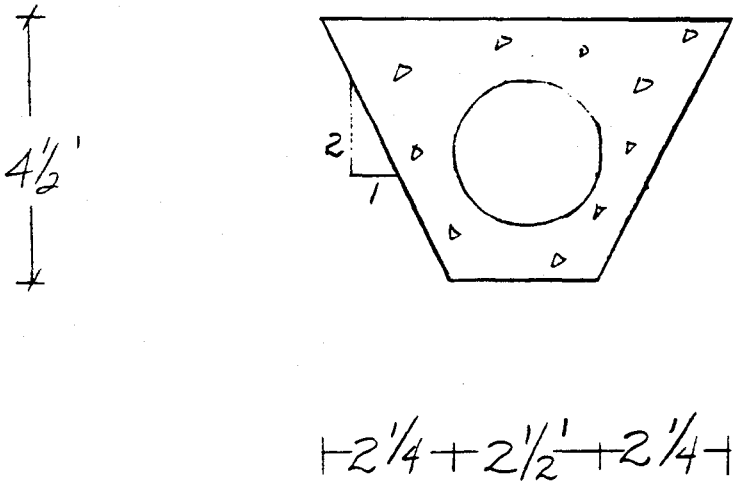


$$A = (4\tfrac{1}{2} \text{ ft} \times 4\tfrac{1}{2} \text{ ft}) + (2\tfrac{1}{2} \text{ ft} \times 4\tfrac{1}{2} \text{ ft}) - (\pi)(2\tfrac{1}{2} \text{ ft})^2/4$$

$$A = 20.3 \text{ ft}^2 + 11.3 \text{ ft}^2 - 4.9 \text{ ft}^2$$

$$A = 26.7 \text{ ft}^2 \gg 3.5 \text{ ft}^2 \quad \therefore \text{ OK}$$

If constructability is not a concern the slopes of the gravel side can be increased thereby reducing the area and amount of required material.



$$\text{Area} = (2\tfrac{1}{4}\,ft \times 2\tfrac{1}{4}\,ft) + (2\tfrac{1}{2}\,ft \times 4\tfrac{1}{2}\,ft) - 4.9\,ft^2$$

$$= 5.1\,ft^2 + 11.3\,ft^2 - 4.9\,ft^2$$

$$= 11.5\,ft^2 > 3.5\,ft^2 \quad \therefore \text{OK}$$

Check the above design against Fig 2, SMN #9

$$Q = (4.95\,\text{gallons/min})\left(1\,ft^3/7.5\,\text{gallons}\right)\left(\frac{60\,min}{hr}\right)\left(\frac{24\,hr}{day}\right)$$

$$Q = 950.4\,ft^3/day$$

$$A = 11.5\,ft^2$$

$$\Delta h = 4\tfrac{1}{2}\,ft$$

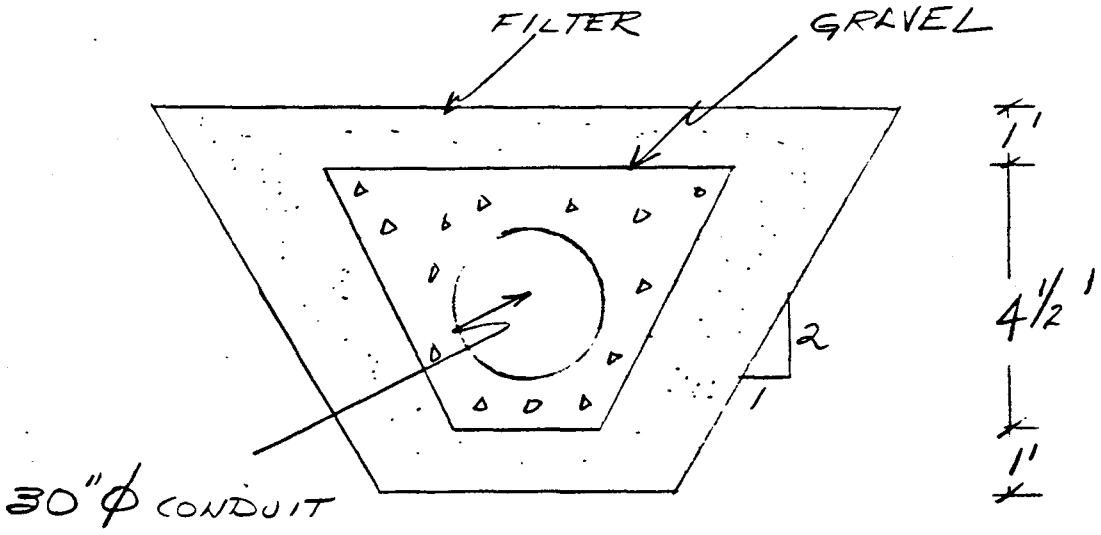
$$L = 48\,ft$$

$$Q/A = \frac{950.4\ ft^3/day}{11.5\ ft^2} = 82.6\ ft/day$$

$$\Delta h/L = 4.5\ ft / 48\ ft = 0.09$$

From Figure 2, Sheet 12, the gravel size specified is adequate to permit complete drainage of diaphragm zone.

Surround the gravel with filter material (soil) approximately as follows to provide compatibility with embankment soils



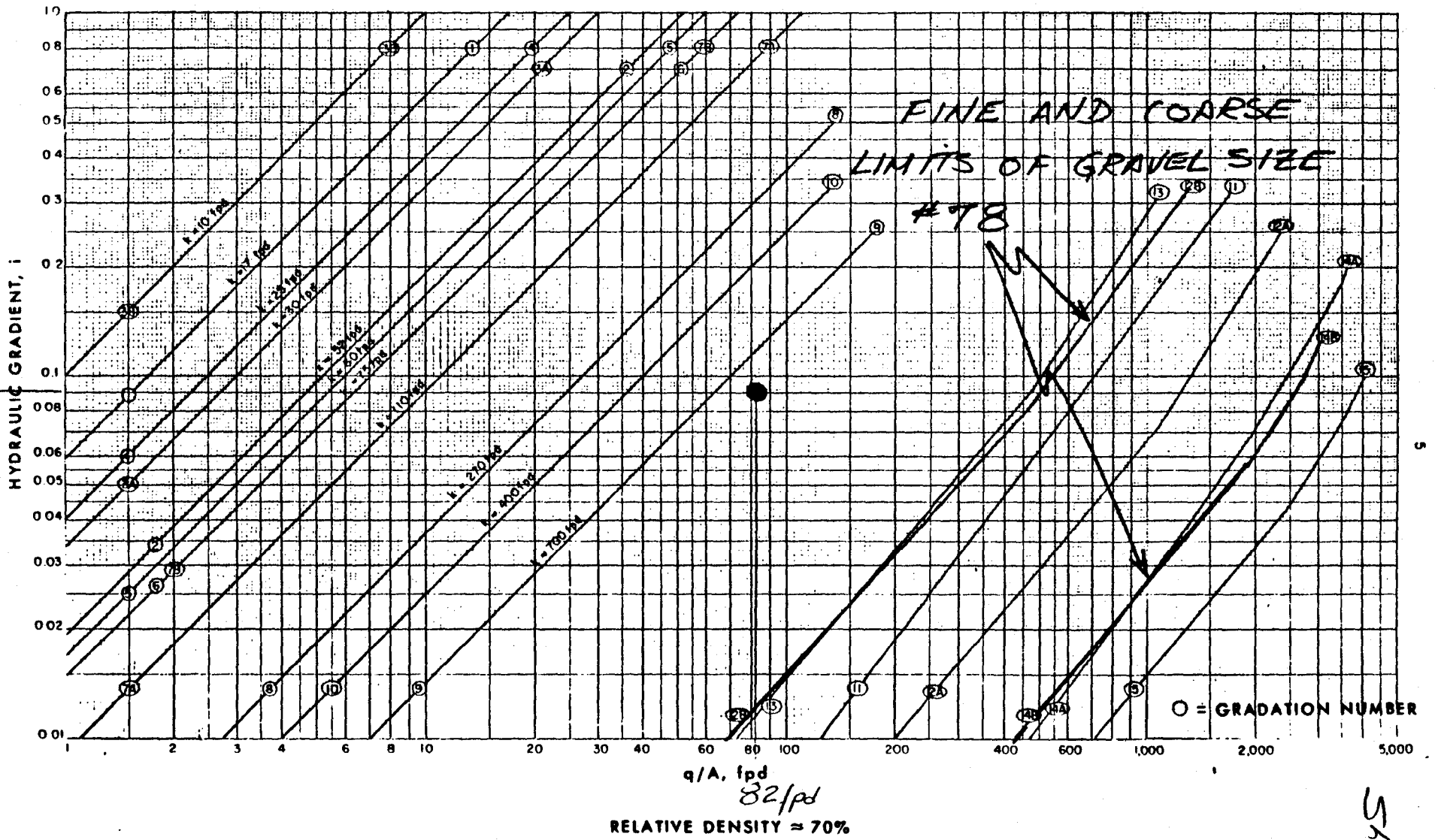
1½' 2½' 1½'

THESE DIMENSIONS ARE APPROX AND MAY BE DECREASED HOWEVER IN NO CASE SHALL THE DIMENSION OF THE FILTER ZONE BE LESS THAN ONE FOOT!

Source SH 9

0.09

III E-25



RELATIVE DENSITY ≈ 70%

Figure 2. RELATIONSHIP BETWEEN i AND q/A FOR 15 GRADATIONS OF CLEAN SANDS AND GRAVELS

Sheet 12 of 21

Form SCS 130
5-65

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

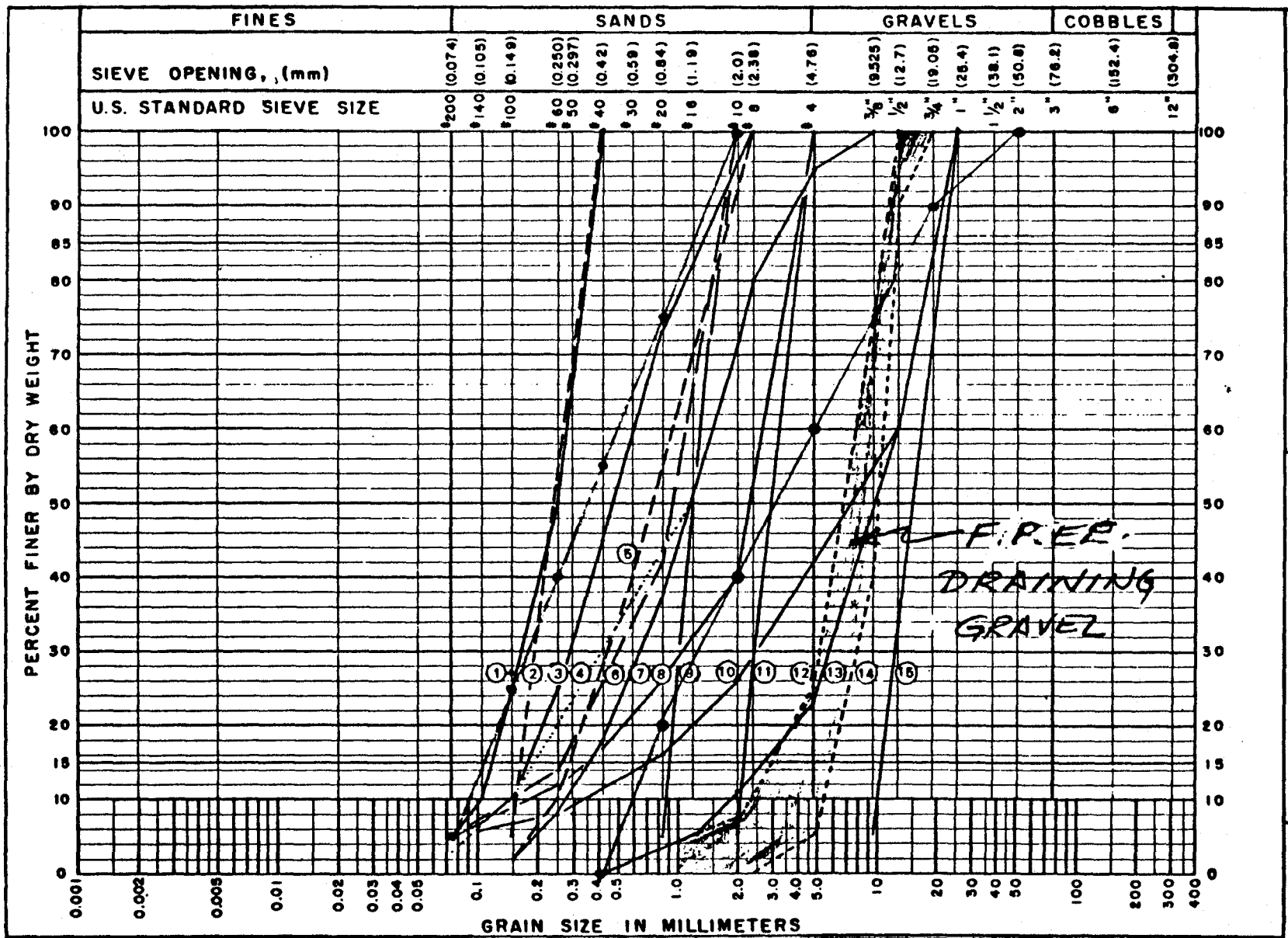
DRAIN MATERIALS

PROJECT and STATE: Project Study No. 101

DESIGNED AT | BY: SML | DATE

Source: SMP

Sheet 13 of 21



REMARKS 1. Gradations No. 3 and 7 represent the fine and coarse limits of fine aggregate sand (ASTM Designation C33).

2. Gradations No. 12 and 14 represent the fine and coarse limits of gravel size No. 78 (ASTM Designation D448).

Figure 1. Gradations of sands and gravels tested

From AT&T Drawing WR 52932, the conduit is a 4"ϕ RGC pipe encased in a 1'-4" x 1'-4" concrete section. Use dimensions of concrete section to determine area of diaphragm

$$A = \pi D^2/4 \quad \therefore \quad D = \left(4A/\pi\right)^{1/2} = \left[(4)(1\tfrac{1}{3}ft)^2/\pi\right]^{1/2}$$

$$D = 1.5\,ft$$

$\therefore$ Convert the 1'-4" x 1'-4" square concrete section to a 1.5 ft ϕ section

According to TR-60:

1- Height of diaphragm above top of conduit surface

$$H = 3D_o = (3)(1.5ft) = 4.5\,ft$$

2- Depth of diaphragm

a) If $\delta < 0.7$ then $1.5D$ or $(1.5)(1.5ft) = 2\tfrac{1}{4}ft$

b) If $\delta > 0.7$ then 2 ft

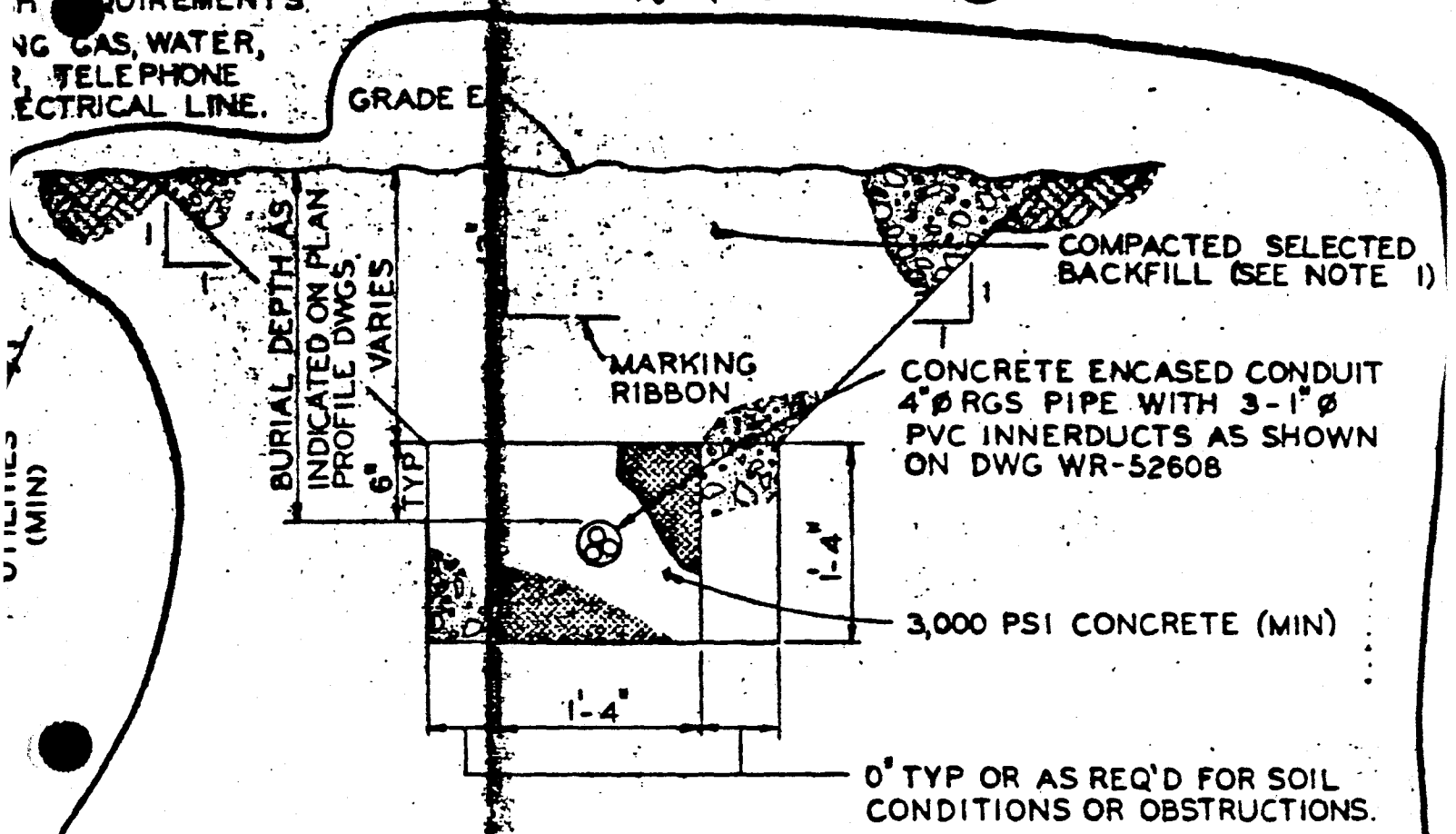
Use $2\tfrac{1}{4}$ ft as a conservative value

3- Design the diaphragm to extend in all directions a minimum of 2 times the outside diameter from the surface of the conduit

$$2D = (2)(1.5ft) = 3\,ft.$$

ECTIONS 1&2
DWG FOR
H QUIREMENTS.
NG GAS, WATER,
, TELEPHONE
ECTRICAL LINE.

AT&T DRAWING
WR 52932



SECTION 4
TYPICAL CONCRETE ENCASED CONDUIT
APACHE JUNCTION FLOOD DAM

NO SCALE
(SEE DWG WR-52608)

NOTES:

1. SEE CONSTRUCTION SPECIFICATION WR 90120, SECTION 21 FOR BACKFILL REQUIREMENTS EXCEPT AS MODIFIED BY THE FOLLOWING. THE EARTHFILL PLACEMENT REQUIREMENTS WILL BE CLASS A COMPACTION TO AT LEAST 95 PERCENT OF THE MAXIMUM DENSITY OBTAINED FROM COMPACTION TESTS PERFORMED BY METHOD C, ASTM DESIGNATION D698. THE MOISTURE CONTENT SHALL BE WITHIN 2 PERCENT OF OPTIMUM. THE MATERIAL SHALL HAVE A MAXIMUM PARTICLE SIZE OF 1 INCH WITH A MINIMUM OF 75 PERCENT PASSING TH NUMBER 4 SEIVE.
2. SEE CONSTRUCTION SPECIFICATION WR 90120 SECTION 2 FOR BACKFILL REQUIREMENTS.

EBASCO SERVICES INCORPORATED

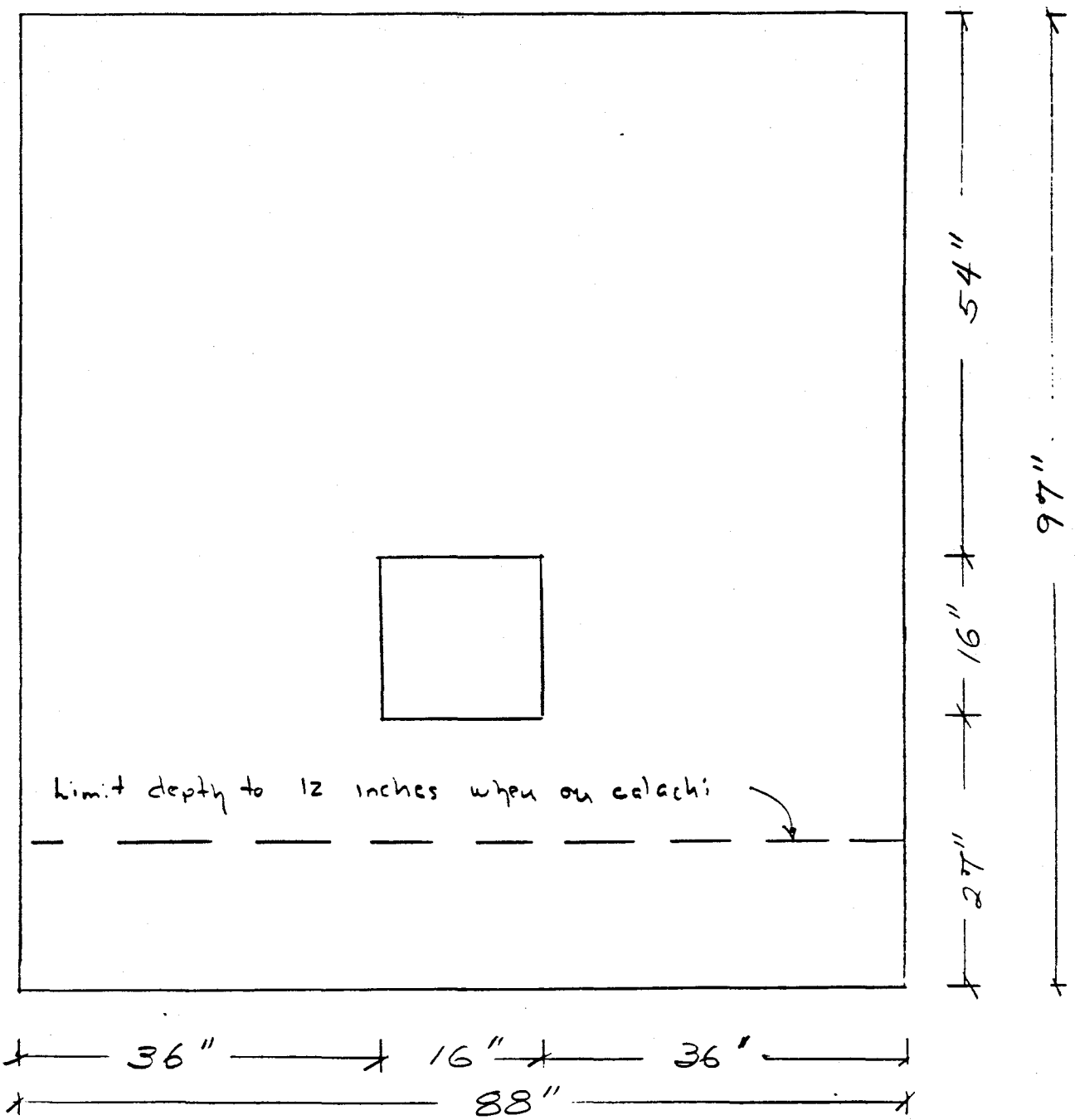
BY V BOLANO DATE 12/10/85 SHEET 15 OF 21

CHKD. BY D DATE 12/20/85 OFS NO. _____ DEPT. NO. _____

CLIENT UCDA

PROJECT APACHE JCT FRS

SUBJECT DIAPHRAGM DESIGN FOR AT&T CABLE CROSSING



Area of diaphragm = $[(88'' \times 97'') - (16'' \times 16'')](1 ft^2/144 in^2)$

Area of diaphragm = $57.5 ft^2$

$Q = K_1 \Delta h A / L$ where

$K_1 = (100)(K_{base}) = 1 \times 10^{-2}$ cm/sec (sheet 3)

$\Delta h = 12$ ft (EL + 1800 to EL + 1788)

$L = 60$ ft (from upstream toe to downstream toe)

$A = 57.5$ ft^2

$$Q = (1 \times 10^{-2} \text{ cm/sec})\left(\frac{1 \text{ in}}{2.54 \text{ cm}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)(12 \text{ ft})(57.5 \text{ ft}^2)/(60 \text{ ft})$$

$$Q = 3.77 \times 10^{-3} \text{ ft}^3/\text{sec}$$

$$Q = (3.77 \times 10^{-3} \text{ ft}^3/\text{sec})(7.5 \text{ gal/ft}^3)(60 \text{ sec/min}) = 1.7 \text{ gpm}$$

As per SM #1 (July '85, p. 4, item 10) filters adjacent to perforated pipe shall have a D_{85} size equal to or larger than the perforation diameter

Perforation diameter: 1/4" ± 1/16" (as per ASTM)

$$D_{85} \geq 1/4" + 1/16" = 5/16"$$

As shown on Sheet 4 of this calculation package a free draining gravel zone (size No 78 - ASTM Designation D448) will meet the requirements of SM #1. In order to assure compatibility with the embankment soils, a filter material (fine to coarse sand meeting the gradation requirements shown on sheet 4) must be provided to separate the free draining gravel and the embankment soils

As shown on D Gruner's sketch dated 11/21/85 the weep holes along the channel walls will be protected using a #4 mesh.

In order to meet the requirements of SHN #1 the D_{85} of soil adjacent to the mesh must be greater than the mesh perforations

$$\therefore D_{85} > \#4$$

This requirement can be satisfied using a free draining gravel such as the one shown on Sheet 4 (size No 78 - ASTM Designation D448)

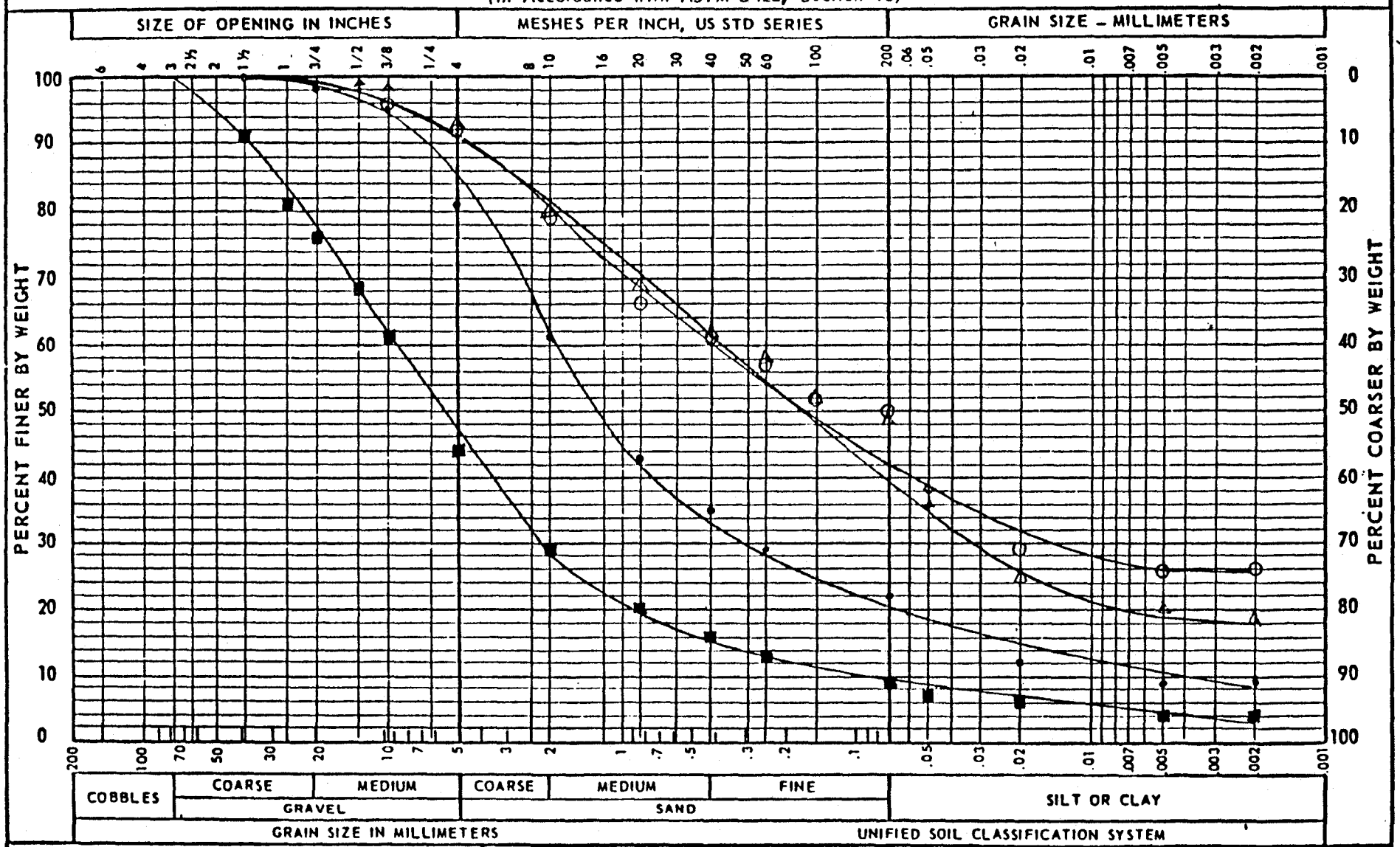
However, if this free-draining gravel is used, a filter material must be also used (fine to coarse sand meeting the gradation requirements shown on sheet 4) to assure compatibility with existing soils.

Gradation range of existing soils is the same as for the borrow area soils (Phase II - Soil Mechanics Report, Sh 34) and a copy of this figure is shown on the following Sheet 19.

FORM #14

MECHANICAL ANALYSIS GRAPH OF GRANULAR MATERIALS

(In Accordance With ASTM D422, Section 16)



TEST NO.	
SAMPLE NO.	
SAMPLE LOCATION	
SAMPLE ELEVATION	

SAMPLE DESCRIPTION

- ● LAB # 2928
- ○ LAB # 2932
- △ LAB # 2941
- ■ LAB # 2940

EBASCO SERVICES INCORPORATED

APACHE JCT FRS

PROJECT

DRAWN BY	CHECKED BY	DATE
V BOLAND	SG	77-8

GRADATION RANGE OF BORROW RIVER SOILS

SH 19

III F-33

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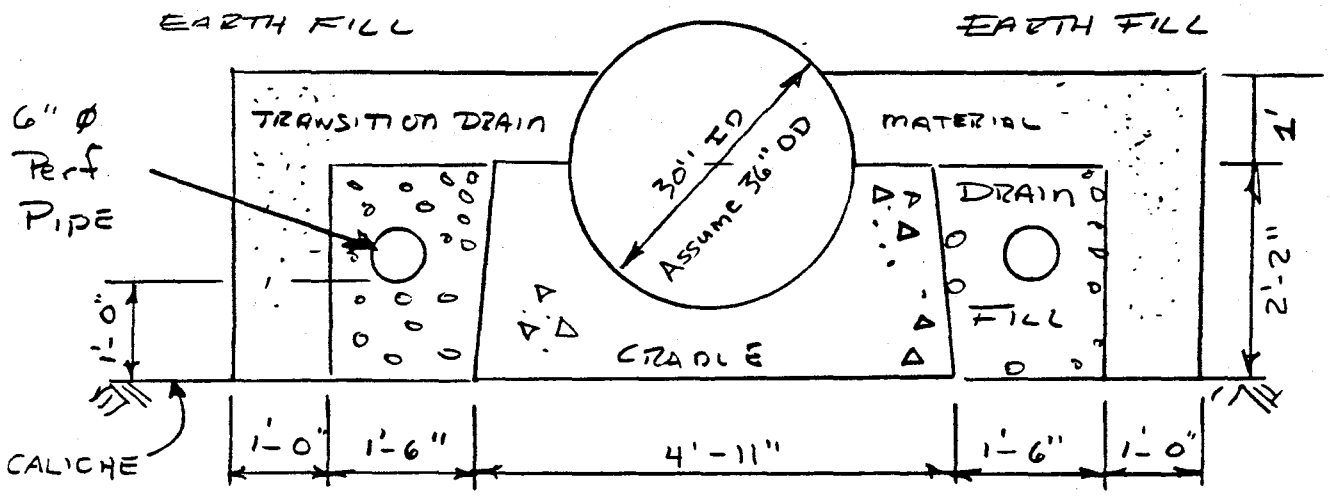
BY [illegible] DATE 12/17/85 SHEET 20 OF 21

CHKD. BY [illegible] DATE 12/20/85 OFS NO. _____ DEPT. NO. _____

CLIENT USDA SCS

PROJECT Apache Junction FRS

SUBJECT Diaphram Outlet Along P.S. Conduit



Req'd Area Of Coarse Drain Fill = 3.5 Ft.

Cradle Bedded On Caliche

Provide Coarse Fill Surrounded By Transition Material - Outlet Thru 6" ϕ Perf. Pipe into Apache Junction Outlet Channel

Area Of Drain Fill Provided:

$2[1.5 \times 2.2] = 6.6$ SF > 3.5 OK

∴ Perforated Pipe To Outlet Into Conc. Channel

Pay For Transition & Drain Fill By Next Line

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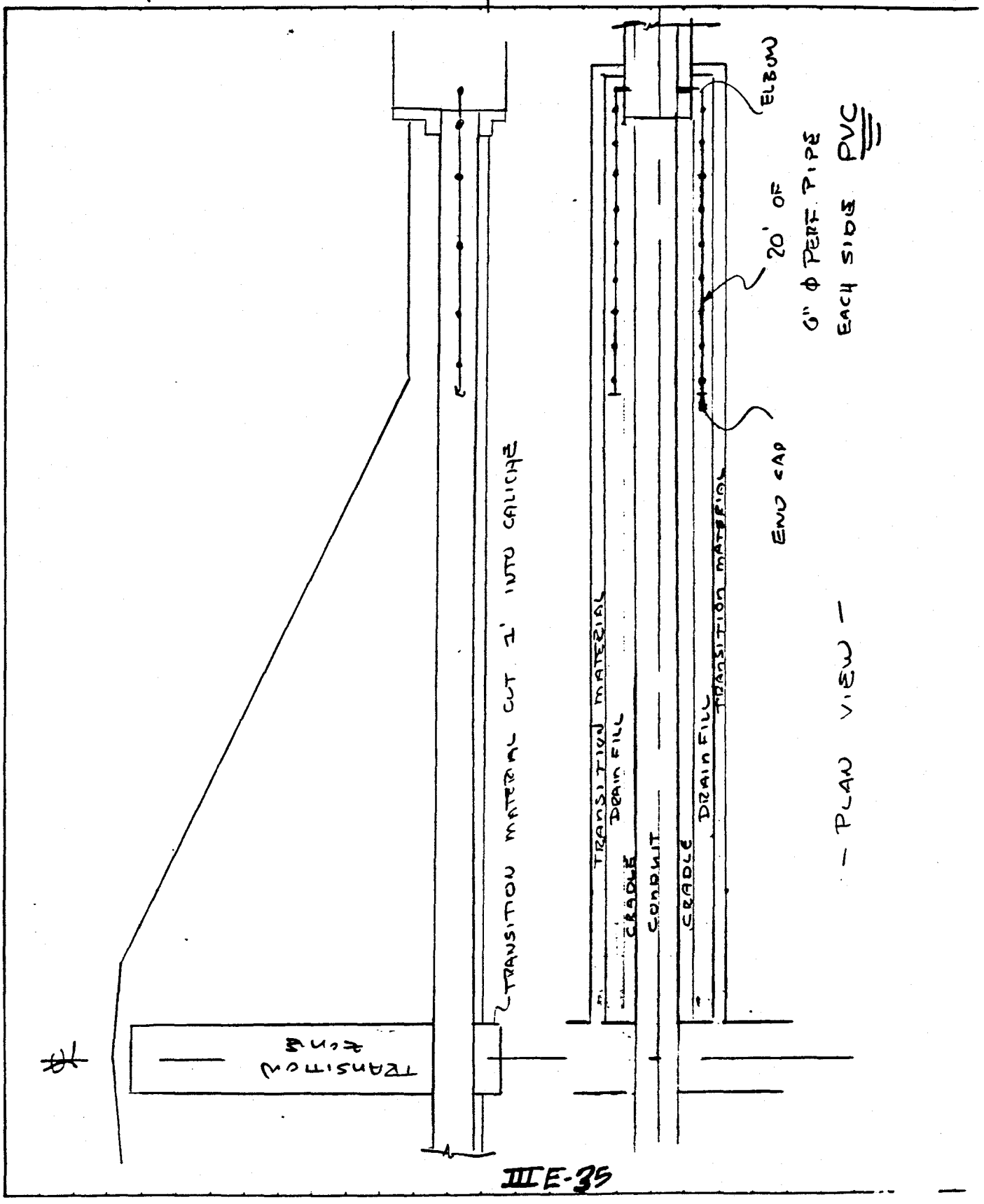
BY SM DATE 12/17/85 SHEET 21 OF 21

CHKD. BY [illegible] DATE 12/20/85 OFS NO. _____ E. NO. _____

CLIENT USDA SCS

PROJECT Apache Junction FRS

SUBJECT Diaphram Outlet Along PS. Conduit



III E-35

581/8-81

III F STRUCTURAL DESIGN

F. STRUCTURAL DESIGN

Structural design of floodway concrete walls and floor was based upon the following parameters:

Moist Unit Soil Weight	130 lb/ft^3
At-Rest Lateral Earth Pressure Coeff.	0.60
Surcharge from Wheel Loads	equivalent to 2 feet of additional fill
Drainage	3 in. diameter weep holes @ 8 ft. backed by longitudinally continuous filter zone.

The drainage provision will reduce lateral pressure against the floodway walls and insure that uplift against the floodway slab is negligible.

Minimum wall thickness has been established as ten inches. A one inch wearing allowance is provided on the bottom slab of the channel. Keyed joints are provided between the slab and the walls.

Rubber-gasketed, prestressed steel cylinder reinforced concrete pipe is specified for the principal spillway conduit. This will adequately handle the loads imposed by the maximum fill height of 25 feet plus service vehicles operating on the embankment crest.

Alternatives examined in the study and design phases, in addition to minor changes in some of those items described above, were as follows:

1. The start of the Apache Junction Floodway was moved to avoid conflict with the future Tomahawk road.

2. A low level outlet in the base of the principal spillway riser was provided to eliminate frequent periods of ponding.

3. Inlets locations were relocated to correspond to the revised topography received after the project design had started.

4. Weep holes and drainage behind concrete floodway walls were included to reduce wall loads and possible uplift on bottom slab.

5. Floodway channel walls were established at a constant thickness from bottom to top with a minimum of 10 inches, to facilitate construction.

6. Continuously reinforced U-shaped sections were chosen as compared with structurally independent retaining walls with a slab between the two walls based upon lower or equal costs.

7. Decisions were made to fill behind all channel walls up to within six inches of the top and to use colored concrete for all structures.

8. Washes will be filled behind inlets and adequately graded to eliminate ponding.

Utilities known at this time which will be affected by the project are an overhead power line along Idaho Road, a buried telephone line along Idaho road, a temporary water line from Brown Road extending north along Idaho Road and a newly-laid buried AT&T cable along Brown Road.

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 9/19/85 SHEET 1 OF

CHKD. BY [illegible] DATE 9/20/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE BULLDOG FLOOD CONTROL PROJECT

SUBJECT RECTANGULAR CHANNEL DESIGN

REFERENCES:

(1) DESIGN OF RECTANGULAR STRUCTURAL CHANNEL (USDA TR-50)

(2) DESIGN OF SMALL CANAL STRUCTURES (USDI, BUREAU OF RECLAMATION)

(3) ENGINEERING HANDBOOK SECT. 14 CHUTE SPILLWAYS (USDA, UCS).

(4) SAMPLE CALCULATIONS OF DETERMINING THICKNESS OF GROUTED ROCK DROP STRUCTURES, LETTER BY JACK STEVENSON DATED JUNE 27, 1983.

(5) DESIGN OF OPEN CHANNELS (USDA. UCS TR 25)

(6) BEAM ON ELASTIC FOUNDATION (BY M. HETENYI)

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BY N. Hung DATE 9/18/85 SHEET 2 OF

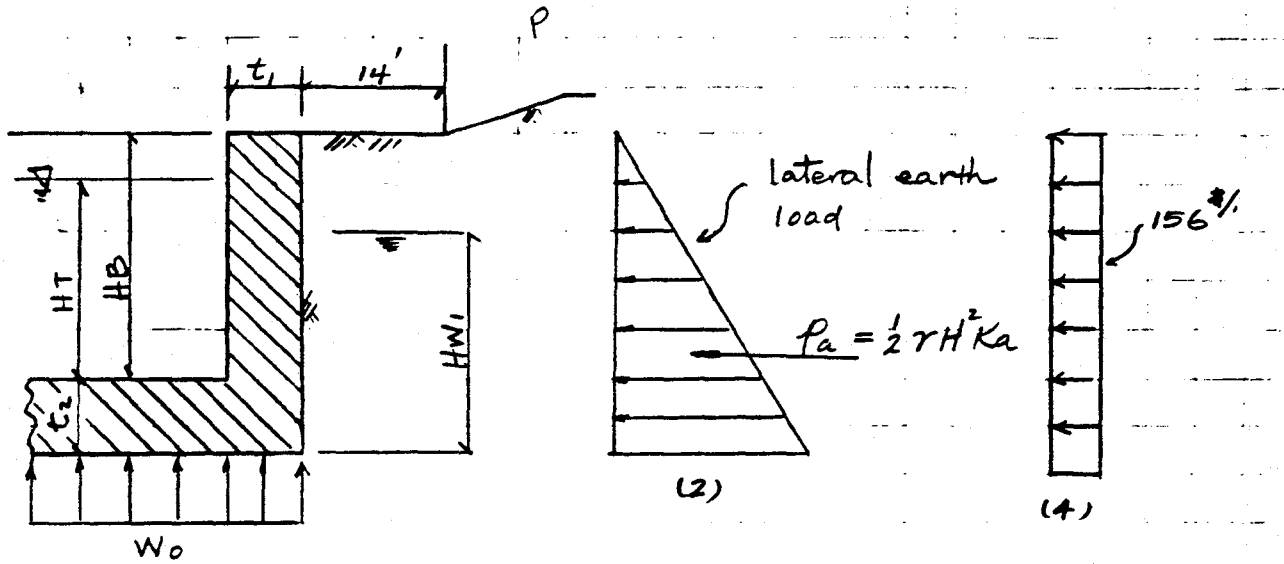
CHKD. BY P. Nelson DATE 9/20/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT Assumptions for rectangular channel design

I) : Cond. I : External load with floodway empty



(1): wt. of backfill $\gamma = 130$ pcf

(2) lateral earth pressure coefficient $K_a = 0.6$
Equivalent fluid pressure
* $\gamma K_a = 130 \times 0.6 = 78$ psf/ft (CONSERVATIVE)

(3) $HW_1 = 0$ $W_o = 0$

(4) ADDITIONAL LATERAL LOAD EQUIVALENT TO 2' OF EARTH SURCHARGE : 78 #/ × 2 = 156 #/

(5) $t_1 \geq 10$, $t_2 \geq 11''$.
allow. soil bearing pressure 4000 psf
Coefficient of friction. soil to concrete 0.35 } (TR 50 P.7)
" soil to soil .55

(6) $f_s = 40$ KSI . $f_c = 4$ KSI

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BY N. Hung DATE 9/18/85 SHEET 3 OF

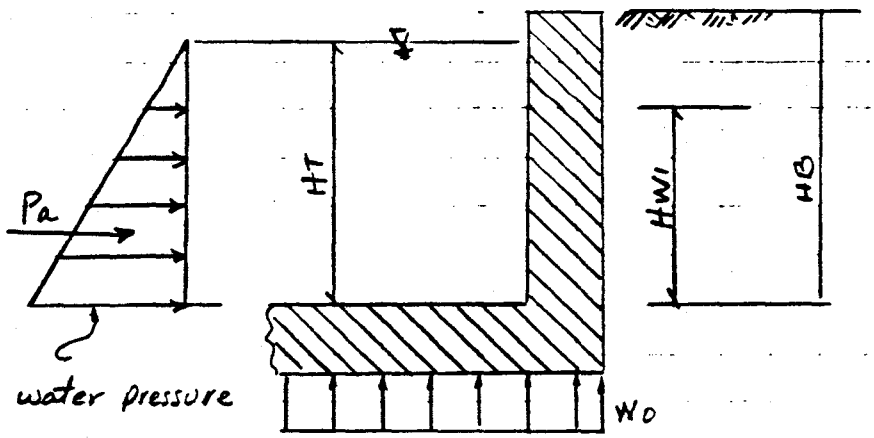
CHKD. BY P. Brooks DATE 9/20/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT Assumption for rectangular channel design

II): Cond. II : Internal load : water level max. with no backfill in place



(1): fluid pressure: 62.4 psf/ft.

$P_a = \frac{1}{2}(62.4)\,H_T^2$. (H_T = DESIGN WATER HT.)

(2) $HW_1 = 0$. $W_O = 0$

(3) No surcharge Load

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- Rec'd 10/7/85

SHEET 4 OF ____

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JTN FLOODWAY — CHANNEL PROPERTIES

OPE NO. 3767.200 DEPT. NO. 650

BY Y.C. YANG DATE 9-20-85

CHECKED BY S Goyal DATE 9-26-85

STATION	BED ELEV.	BED SLOPE S_b	BED WIDTH (FT)	WATER DEPTH (FT)	DISCHARGE (CFS)	CRITICAL DEPTH D_{cr}	CRITICAL SLOPE S_{cr}	CONDITION	$\left[1-1.1\left(\frac{S_b}{S_{cr}}-1\right)\right]R_n$	MIN FREEBOARD (FT)	HEIGHT OF WALL (FT)	REMARK
11+00	1804.75			7.11								
		0.0010	8.50		260	3.074	0.0097	$S_b < 0.7 S_{cr}$	-	1.00	8.50	
15+90	1804.26			7.38								
		0.0010	8.50		260	3.074	0.0097		-	1.00	11.25	[illegible]
16+00	1804.25			7.39								
		0.0010	TRANSITION		↓	-	-		-	-	11.25	
17+00	1804.15			5.16								
		0.0010	25.00		1046	3.788	0.0030	$S_b < 0.7 S_{cr}$	-	1.00	11.25	
17+20	1804.13			5.15								
		0.0024	25.00		1046	3.788	0.0030	$0.7 S_{cr} < S_b < 1.3 S_{cr}$	0.527	1.53	6.75	
22+00	1803.65			4.94								
		0.0024	25.00		1046	3.788	0.0030		0.527	1.53	6.75	
23+50	1803.29			5.03								
		0.0024	25.00		1046	3.788	0.0030		0.527	1.53	6.75	EXTRA FREEBOARD NOT REQ'D; SURFACE CURV. MUCH FLATTER THAN S_{cr}
25+65	1802.77			5.67								
		0.0024	25.00		1046	3.788	0.0030		0.527	1.53	9.50	
25+75	1802.75			5.70								
		0.0024	TRANSITION		↓	-	-				9.50	
26+25	1802.63			3.92								
		0.0024	37.50		1560	3.774	0.0027		0.525	1.53	9.50	
26+95	1802.58			3.91								
		0.0024	37.50		1560	3.774	0.0027	$0.7 S_{cr} < S_b < 1.3 S_{cr}$	0.525	1.53	5.50	
27+37.5	1802.36			3.77								
		0.5000	37.50		1560							Z = 2.0
27+58.16	1792.03			-								
		0.0000	37.50		1560							Z = 2.0
27+07.25	1792.03			-								
		-0.0893	TRANSITION		1560							TRANSITION
28+53.5	1796.60											
		0.0056	130.00		1560							Z = 3.0
END												

III F-6

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BY N. Hung DATE 2/27/86 SHEET 5 OF

CHKD. BY P. Brown DATE 2/28/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY WATER PROFILE

STATION NO	WATER HT.	CHANNEL SLOPE
11+00	7.11	
15+00	7.39	
15+50	7.56	
15+78	7.37	
16+06	7.01	
16+34	6.59	.001
16+62	6.10	
16+90	5.50	
17+06	5.50	
18+68	5.51	
20+43	5.52	
22+00	5.52	
22+38	5.60	
22+90	5.70	
23+40	3.92	.0024
27+37.5	3.92	
27+37.5	3.77	

581/8-81

EBASCO SERVICES INCORPORATED

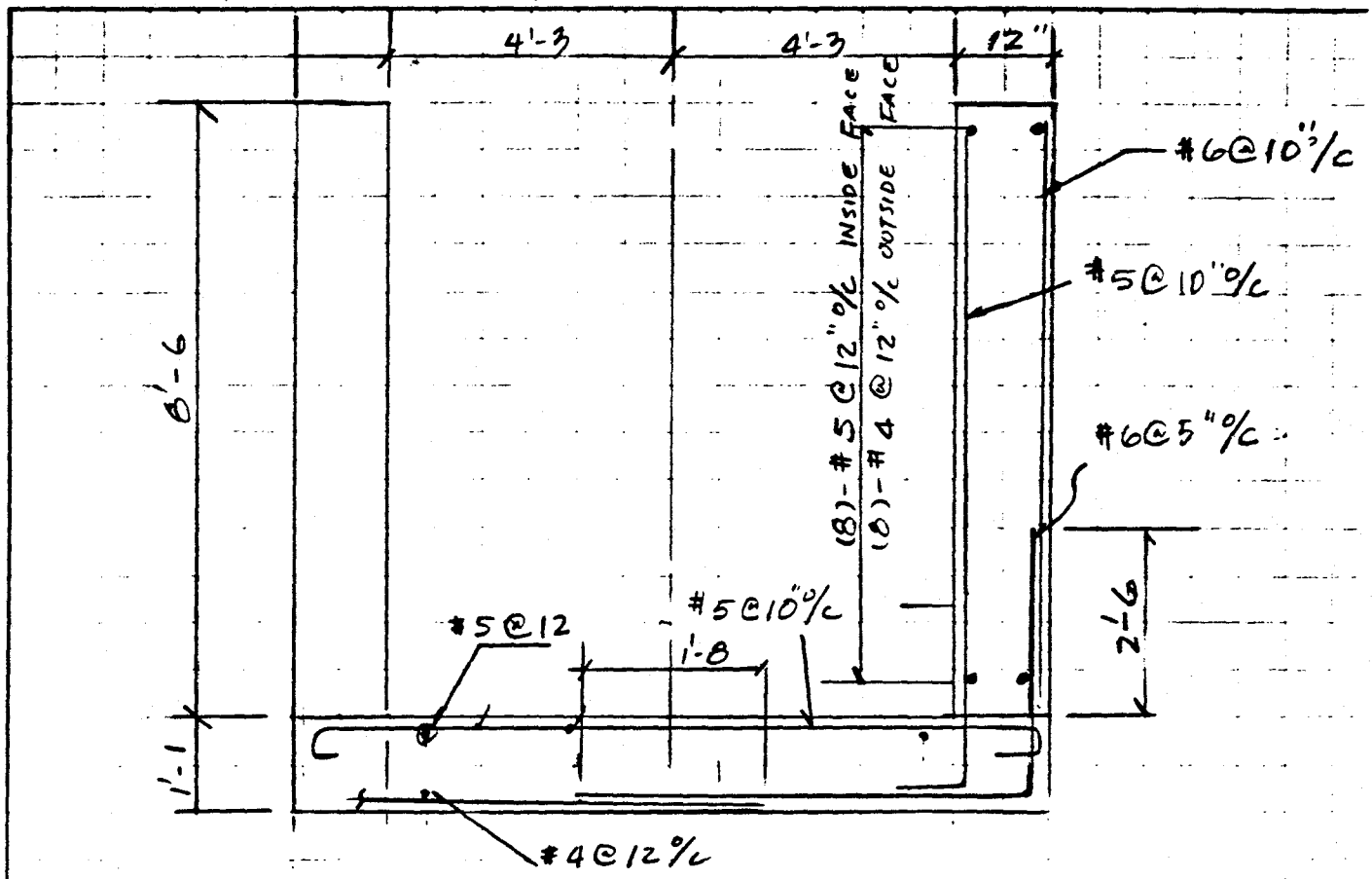
BY N Hung DATE 10/2/85 SHEET 6 OF

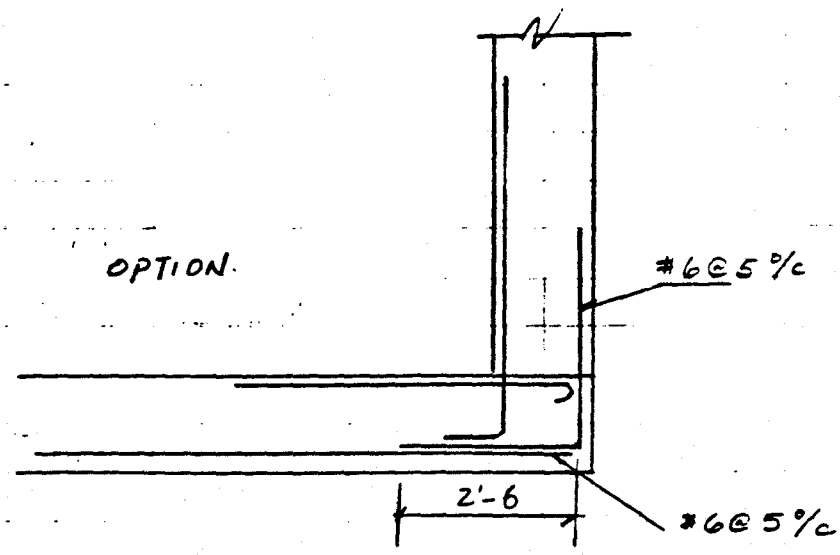
CHKD. BY P. Bach DATE 10/3/85 OFS NO. 3767300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY RECTANGULAR CHANNEL (8'-6 x 8'-6)





581/8-81

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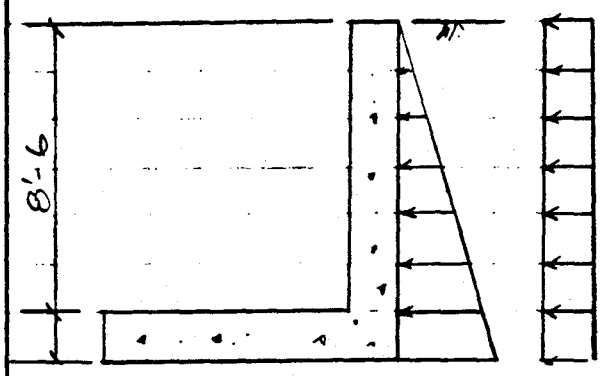
BY N. Hung DATE 10/2/85 SHEET 7 OF

CHKD. BY P. Baran DATE 10/3/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY RECTANGULAR CHANNEL



EQUIVALENT FLUID RESSURE
= 78 pcf

ADDITIONAL SURCHARGE LOAD
= 156 psf

WALL DESIGN

UNEXPOSED FACE

$M = \frac{1}{6} \times 78 \times 8.5^3 + \frac{1}{2} \times 156 \times 8.5^2$

$= 7984 + 5636 = 13620$ '#/'

$= 13.6$ 'K/'

$P_h = \frac{1}{2} \times 78 \times 8.5^2 + 156 \times 8.5$

$= 2818 + 1326 = 4144$ '#

$M_u = 1.8M = 1.8 \times 13.6 = 24.48$ 'K/' $V_u = 1.8P_h = 7459$ #/'

$t = 12''$ $d = 9''$ $F = .081$

$K_u = M_u/F = 24.48/.081 = 302$ $\rho = .00885$

$A_s = .00885 \times 12 \times 9 = .96$ □"/'

#6 @ 5" o/c

FOR $H = 6'-0$

$M = \frac{1}{6} \times 78 \times 6.0^3 + \frac{1}{2} \times 156 \times 6.0^2 = 2808 + 2808 = 5616$ '#/'

$M_u = 1.8M = 10.10$ 'K/'

$K_u = 8.14/.081 = 125$ $1.33 K_u = 167$

$\rho = .00475$

$A_s = .00475 \times 9 \times 12 = .513$ □"/'

#6 @ 10" o/c.

$V_u = 7459$ # $v_u = 7459/12 \times 9 = 69$ #/□" $< 2\phi\sqrt{f_c'} = 107$ #/□"

$A_s = .48$ □"/'

HORIZONTAL BARS $A_s = .0020 \times 12 \times 11 = 0.264$ □"/'

$A_s = .0010 \times 12 \times 11 = 0.132$ □"/'

EXPOSED FACE : 7.39' HEIGHT OF WATER

$M = \frac{1}{2} \times 62.4 \times 7.39^3 = 4197'\#/' = 4.2'^K/'$

$M_u = 1.8M = 7.56'^K/'$

$F = .081 \quad K_u = 7.56/.081 = 93.4$

$1.33 K_u = 124 \quad \rho = .0035$

$A_s = .0035 \times 12 \times 9 = 0.378 \square''/'$

TRY $t = 9.5' \quad F = .9025$

$K_u = 7.56/.09025 = 84. \quad \rho = .00237$

$A_s = .00237 \times 1.33 \times 12 \times 9.5 = 0.36 \square''/'$ — #5@10"o/c

FOUNDATION: OR #5@10"o/c

TRANS. TOP BARS: #6@12"o/c $A_s = .44 \square''/' > 0.38 \square''$

LONG. " #5@12"o/c

TRANS BOTTOM BAR #6@5" o/c $A_s =$

LONG. " $A_{s\,min} = .001 \times 12 \times 13 = .16 \square''/'$ #4@12"o/c

RECHECK REINF. AT BOTTOM

$13'' - 3 - 1 - 0.5 = 8.5'' \quad F = .07225$

$K_u = 24.48/.07225 = 339 \quad \rho = .01$

$A_s = .01 \times 12 \times 8.5 = 1.02 \square''/' < 1.06 \square''/'$

#6@5"o/c

EBASCO SERVICES INCORPORATED

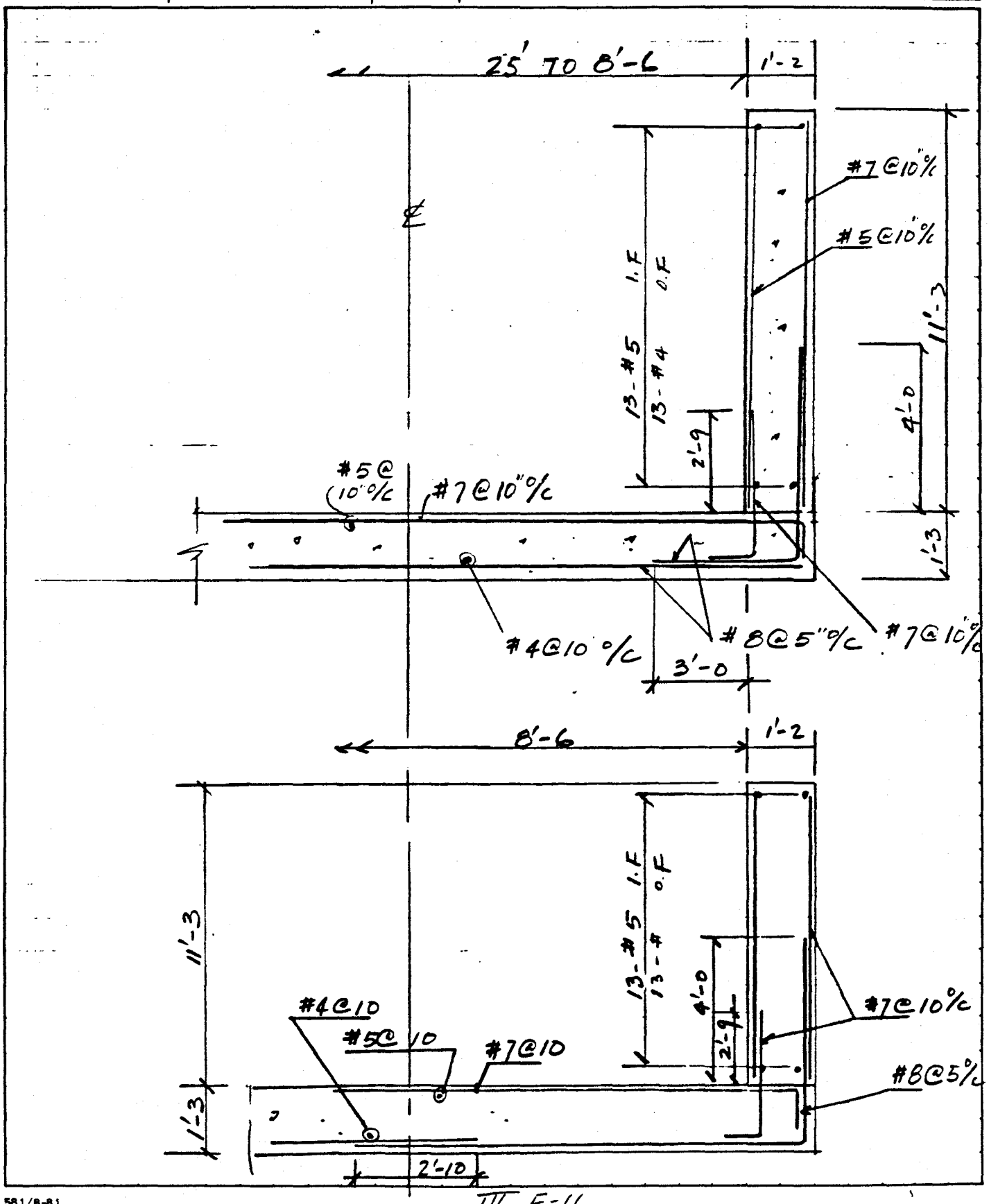
BY N. Chang DATE 2/5/86 SHEET 9 OF

CHKD. BY P. Bodnal DATE 2/6/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY 11'-3 HT. CHANNEL.



581/8-81

EBASCO SERVICES INCORPORATED

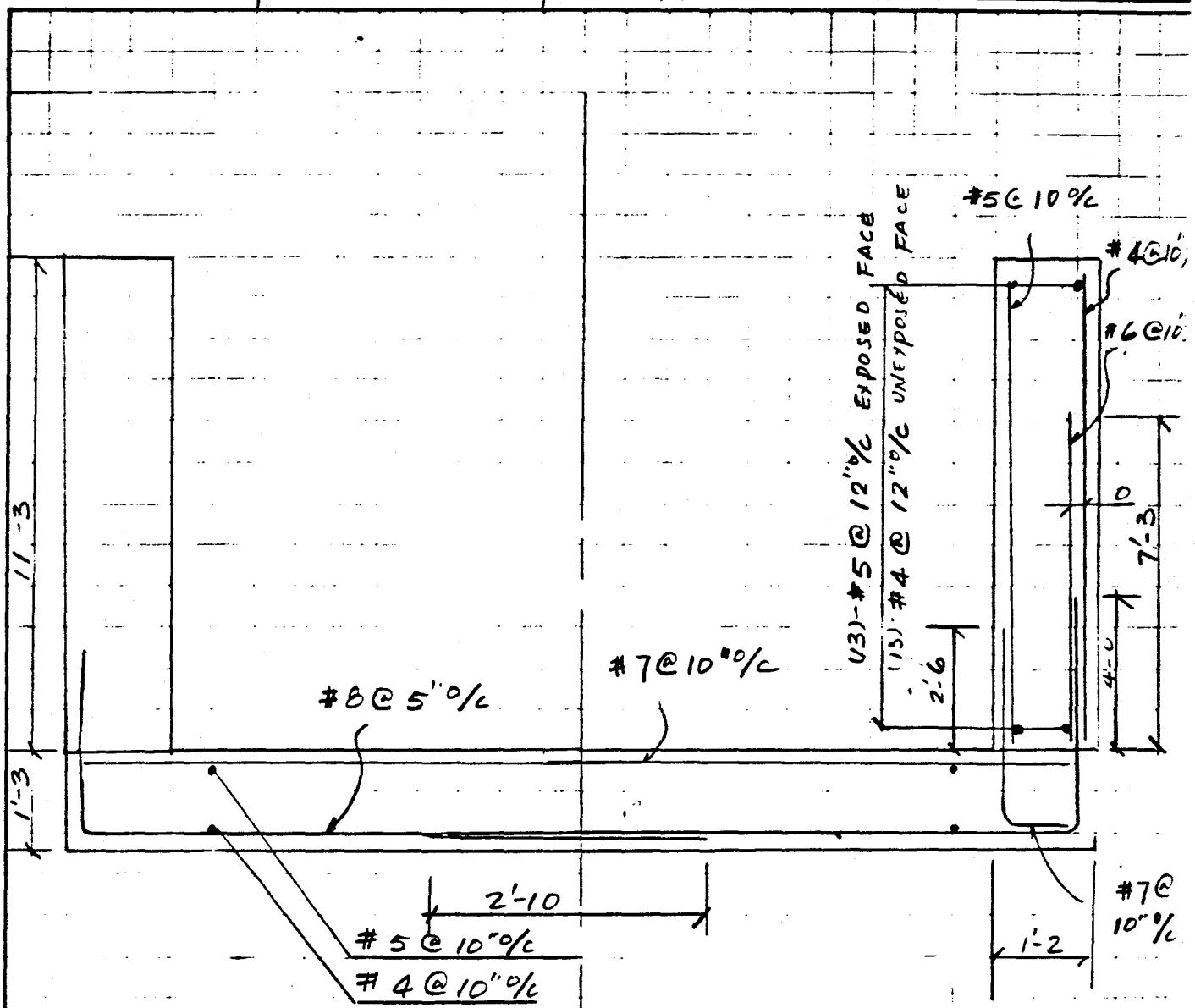
BY N. Hung DATE 10/3/85 SHEET 10 OF

CHKD. BY [illegible] DATE 10/4/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY RECTANGULAR CHANNEL



EBASCO SERVICES INCORPORATED

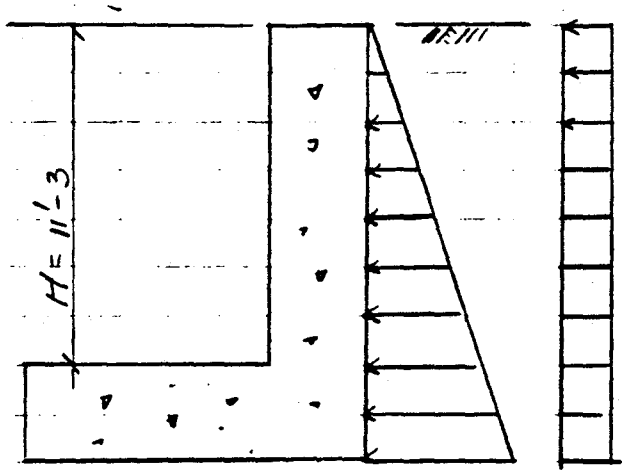
BY N Hung DATE 10/3/85 SHEET 11 OF

CHKD. BY P. BARON DATE 10/4/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY RECTANGULAR CHANNEL



EQUIVALENT FLUID PRESSURE = 78 PCF

ADDITIONAL SURCHARGE LOAD = 156 PSF

A): WALL DESIGN ($t = 14''$)

(I) UNEXPOSED FACE: // $H = 11'-3''$

$M = \frac{1}{6} \times 78 \times 11.25^3 + \frac{1}{2} \times 156 \times 11.25^2$

$= 18500 + 9870 = 28370$ '#/'

$P_h = \frac{1}{2} \times 78 \times 11.25^2 + 156 \times 11.25$

$= 4935 + 1765 = 6700$ #/'

$M_u = 1.8M = 1.8 \times 28370 = 51066$ '#/'

$= 51.1$ 'K/'

$V_u = 1.8 P_h = 1.8 \times 6700 = 12060$ #/'

$d = 14'' - 3'' = 11''$ $F = .121$

$K_u = M_u / F = 51.1 / .121 = 422$

$\rho = .0127$ $A_s = .0127 \times 12 \times 11 = 1.68$ □"/'

$v_u = V_u / bd = 12060 / 12 \times 11 = 91.4$ #/□" $< 2\phi\sqrt{f_c'} = 107.$ #/□"

#8 @ 5" o/c

2. $H = 7.25$

$M = \frac{1}{6} \times 7.25^3 \times 78 + \frac{1}{2} \times 156 \times 7.25^2 = 4954 + 4099 = 9053$ '#/'

$M_u = 1.8 \times 9053 = 16.3$ 'K/'

$F = .121$

$K_u = 16.3 / .121 = 134.7$ $1.33 K_u = 179. > 175$

$\rho = .0050$ $A_s = .0050 \times 12 \times 11 = 0.66$ □"/'

USE #6 @ 10" o/c + #4 @ 10" o/c

OR #7 @ 10" o/c $A_s = .72$ □"/'

B: FOUNDATION:

TOP BARS: TRANS. BAR. #7 @ 11"/c. MIN.
LONG. BARS $A_s = .002 \times 12 \times 15 = 0.36$ #5 @ 10"/c

BOTTOM BARS: TRANS. BARS. #8 @ 5½"/c (MIN.)
LONGU. BARS $A_s = .001 \times 12 \times 15 = 0.18$ #4 @ 12"/c

TRANSV. BARS: $M_o = 51.5$ 'K/'

$F = 0.11025$

$K_u = 51.1/.11025 = 463$ $\rho = .014$

$A_s = .014 \times 12 \times 10.5 = 1.76$ □"/' — #8 @ 5"/c

3. $H = 4'-0$

$M = \frac{1}{6} \times 78 \times 4^3 + \frac{1}{2} \times 156 \times 4^2 = 832 + 1248 = 2080^{1\#}$

$M_u = 1.8M = 1.8 \times 2080 = 3744^{1\#}/' = 3.74^{1K}/'$

$K_u = 3.74/.121 = 31.$ $1.33 K_u = 41$

$\rho_{min.} = .001$

$A_s = .001 \times 12 \times 14 = .168^{\square''}/'$ #4 @ 12"o/c

(II) EXPOSED FACE:

1). $H = 7'-6''$ (WATER HEIGHT = 7-6")

$M = \frac{1}{6} \times 62.4 \times 7.5^3 = 4387^{1\#}/' = 4.4^{1K}/'$

$M_u = 1.8M = 7.92^{1K}/'$

$K_u = M_u/F = 7.92/.121 = 65.4$ $1.33 K_u = 87$

$\rho = .0025$ $A_s = .0025 \times 12 \times 11. = 0.33^{\square''}/'$

#5 @ 11"o/c

2) $H = 10'-3$

$M = \frac{1}{6} \times 62.4 \times 10.25^3 = 11200^{1\#}/' = 11.2^{1K}/'$

$M_u = 1.8M = 20.16$ $F = 1.21$

$K_u = 20.16/1.21 = 166$ $1.33 K_u > 175$ $\rho = .005$

$A_s = .005 \times 12 \times 11 = 0.66$ #7 @ 10"o/c

(III): HORIZONTAL BARS

EXPOSED FACE : $.002 \times 12 \times 14 = 0.336^{\square''}/'$ #5 @ 11 o/c

UNEXPOSED " $.001 \times 12 \times 14 = 0.168^{\square''}/'$ #4 @ 12 o/c

EBASCO SERVICES INCORPORATED

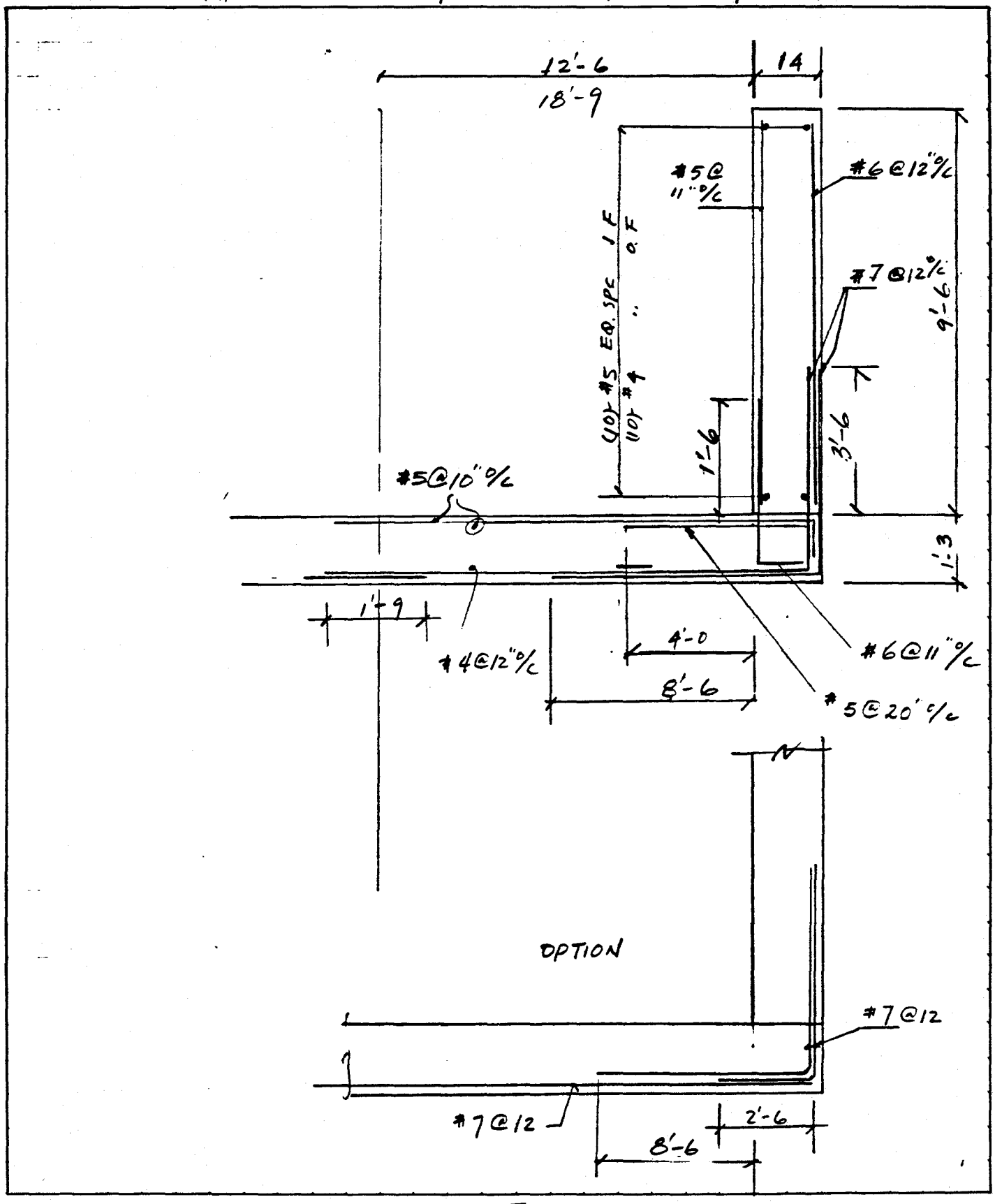
BY N. Hung DATE 10/2/85 SHEET 14 OF

CHKD. BY P. Bratton DATE 10/3/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY 25' x 9'-6 OR 37'-6 x 9'-6 CHANNEL



581/8-81

EBASCO SERVICES INCORPORATED

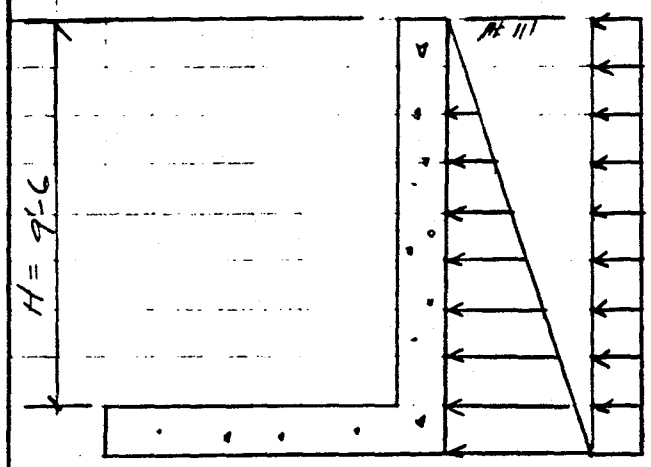
BY N. Chung DATE 10/2/85 SHEET 15 OF

CHKD. BY J. Bodhal DATE 10/8/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY RECTANGULAR CHANNEL



EQUIVALENT FLUID PRESSURE = 78 pcf

ADDITIONAL SURCHARGE LOAD = 156 psf

WALL DESIGN : UNEXPOSED FACE

$H = 9.5'$

$M = \frac{1}{6} \times 78 \times 9.5^3 + \frac{1}{2} \times 156 \times 9.5^2$

$= 11145 + 7039 = 18184 \; '\#/' = 18.2 \; '^K/'$

$P_h = \frac{1}{2} \times 78 \times 9.5^2 + 156 \times 9.5$

$= 3520 + 1482 = 5000 \; \#/'$

$M_u = 1.8M = 1.8 \times 18.2 = 32.76 \; '^K/'$

$V_u = 1.8 P_h = 1.8 \times 5000 = 9000$

$v_u = V_u / bd = \frac{9000}{12 \times 11} = 83 < 2\phi\sqrt{f_c} = 107 \; \#/\square''$

$d = 14 - 3 = 11''$ $F = .121$

$K_u = M/F = 32.76/.121 = 270$

$\rho = .0122$ $A_s = .008 \times 12 \times 11 = 1.06 \; \square''/'$

$H = 6'-0$ #7 @ 6½" o/c

$M = \frac{1}{6} \times 78 \times 6^3 + \frac{1}{2} \times 156 \times 6^2 = 2808 + 2808 = 5616 \; '\#/'$

$M_u = 1.8M = 10.1 \; '^K/'$ $F = .121$

$K_u = 10.1/.121 = 83.5$ $1.33 K_u = 111$ $\rho = .00315$

$A_s = .00315 \times 12 \times 11 = 10.42 \; \square''/'$ #6 @ 12" o/c

EXPOSED WALL :

WATER HT. = 8.5'

$M = \frac{1}{6} \times 62.4 \times 8.5^3 = 6386 \; '\#/' = 6.4 \; '^K/'$

$M_u = 1.8M = 11.5 \; '^K/'$

$K_u = M_u/F = 11.5/.121 = 95$ $1.33 K_u = 126$

$\rho = .00355$

$A_s = .00355 \times 12 \times 11 = 0.47^{\square''}/'$ #6 @ 11" o/c

REF. TO WALL HT. = 11'-3

FOR WATER HT = 7'-6 #5 @ 10" o/c

$A_{s\,min} = .002 \times 12 \times 14 = 0.336^{\square''}/'$

CHECK MOMENT CAPACITY OF #5 @ 10" o/c

$A_s = .31 \times 12/10 = .372$

$\rho = .372/12 \times 11.5 = .00270$ $F = \frac{11.5^2}{10.0} = .132$

$K_u = 95.0$

$M_u' = 95.0 \times .132 = 12.54^{'K}/'$

$M_u = M_u'/1.33 = 9.4^{'K}/'$

FOUNDATION:

$L = 25'$ $\lambda = .1308$ $\lambda L = 3.27$

$$M = \frac{M_o}{\sinh\lambda L + \sin\lambda L}\left(\sinh\lambda x \cos\lambda x' + \cosh\lambda x \sin\lambda x' + \sinh\lambda x' \cos\lambda x + \cosh\lambda x' \sin\lambda x\right)$$

$\sinh\lambda L = 13.137$ $\sin\lambda L = -.128$

$$M = \frac{M_o}{13.137 - .128} A = .07667\, M_o A$$

FOR $x = 8'$ $x' = 17'$ $\lambda x = 1.0464$, $\lambda x' = 2.2236$

$A = 1.2481 \times (-.6074) + 1.60 \times 0.794 + 4.566 \times 0.50 + 4.674 \times .866$

$= -.76 + 1.27 + 2.28 + 4.05 = 6.84$

$M = 0.526\, M_o$

$x = 4'$ $x' = 21'$ $\lambda x = .523$ $\lambda x' = 2.7468$

$A = .547 \times (-.92) + 1.14 \times 0.38 + 7.764 \times .866 + 7.828 \times .50$

$= -.50 + .43 + 6.72 + 3.91 = 10.56$

$M = 0.812\, M_o$

BOTTOM BARS TRANSVERSE BARS

MAX. MOMENT AT FOUNDATION

$M_u = 32.76^{'K}/'$

$t = 15" - 3 - \frac{1}{2} - 1 = 10.5"$ $F = .110$

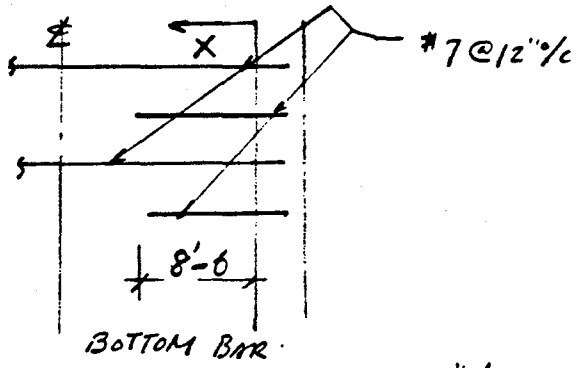
$K_u = 32.72/.110 = 298 < 175$ $\rho = .00873$

$A_s = .00873 \times 12 \times 10.5 = 1.10^{\square"}/'$ #7 @ 6" o/c

For $x = 8'-0$ $M = 0.526 M_u = 17.21^{'K}/'$

$K_u = 17.21/.110 = 156 < 175$ $\rho = .0050$

$A_s = .0050 \times 12 \times 10.5 = 0.63^{\square"}/'$ #7 @ 12" o/c O.K.



LONG. BARS $A_{s\,min} = .001 \times 12 \times 14 = 0.17^{\square"}/'$ — #4 @ 12" o/c

TOP BARS

TRANVERSE BARS: $M = 11.5^{'K}/'$

$X = 4'-0$ $M = .812 \times 11.5^{'K}/' = 9.33^{'K}/'$

#5 @ 10" o/c O.K.

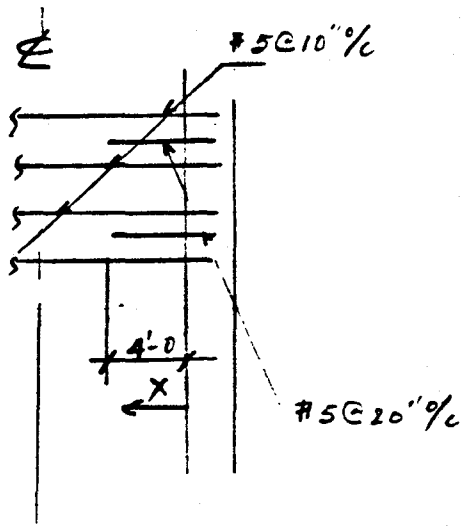
$X = 0$ $M = 11.5$

$A_s = 0.47^{\square"}/'$: #5@10" o/c + #5@20" o/c

$A_s = .31\left(\frac{12}{10} + \frac{12}{20}\right)$

$= .56^{\square"}/'$

LONG. BARS #5@10" o/c.



FOUNDATION FOR 37'-6" x 9'-6 CHANNEL

$L = 37.5 \quad \lambda = .1308 \quad \lambda L = 4.905$

$\sinh \lambda L = 67.48 \quad \sin \lambda L = -.98$

$$M = \frac{M_0}{67.48 - .98} A = .015038 M_0 A$$

FOR $x = 8' \quad \lambda x = 1.0464, \quad \lambda x' = 3.8586 \quad x' = 29.5'$

$A = 1.2481 \times (-.754) + 1.60 \times (-.657) + (23.69) \times 0.50 + (23.71) \times .866$

$= -.94 - 1.05 + 11.85 + 20.53 = 30.40$

$M = .015038 \times 30.4 M_0 = 0.457 M_0$

$x = 10' \quad \lambda x = 1.308 \quad x' = 27.5' \quad \lambda x' = 3.597$

$A = 1.7142 \times (-.898) + 1.984 \times (-.44) + 18.23 \times .260 + 18.25 \times 0.97$

$= -1.54 - .87 + 4.74 + 17.70 = 20.03$

$M = .015038 \times 20.03 = 0.30 M_0$

BOTTOM BARS: $M_0 = 32.72$

$x = 8' \quad M = .457 M_0 = 14.95$ 'K/' #7@12"o/c

SAME AS 25' x 9'-6 CHANNEL

TOP BARS: SAME AS 25' x 9'-6 CHANNEL

EBASCO SERVICES INCORPORATED

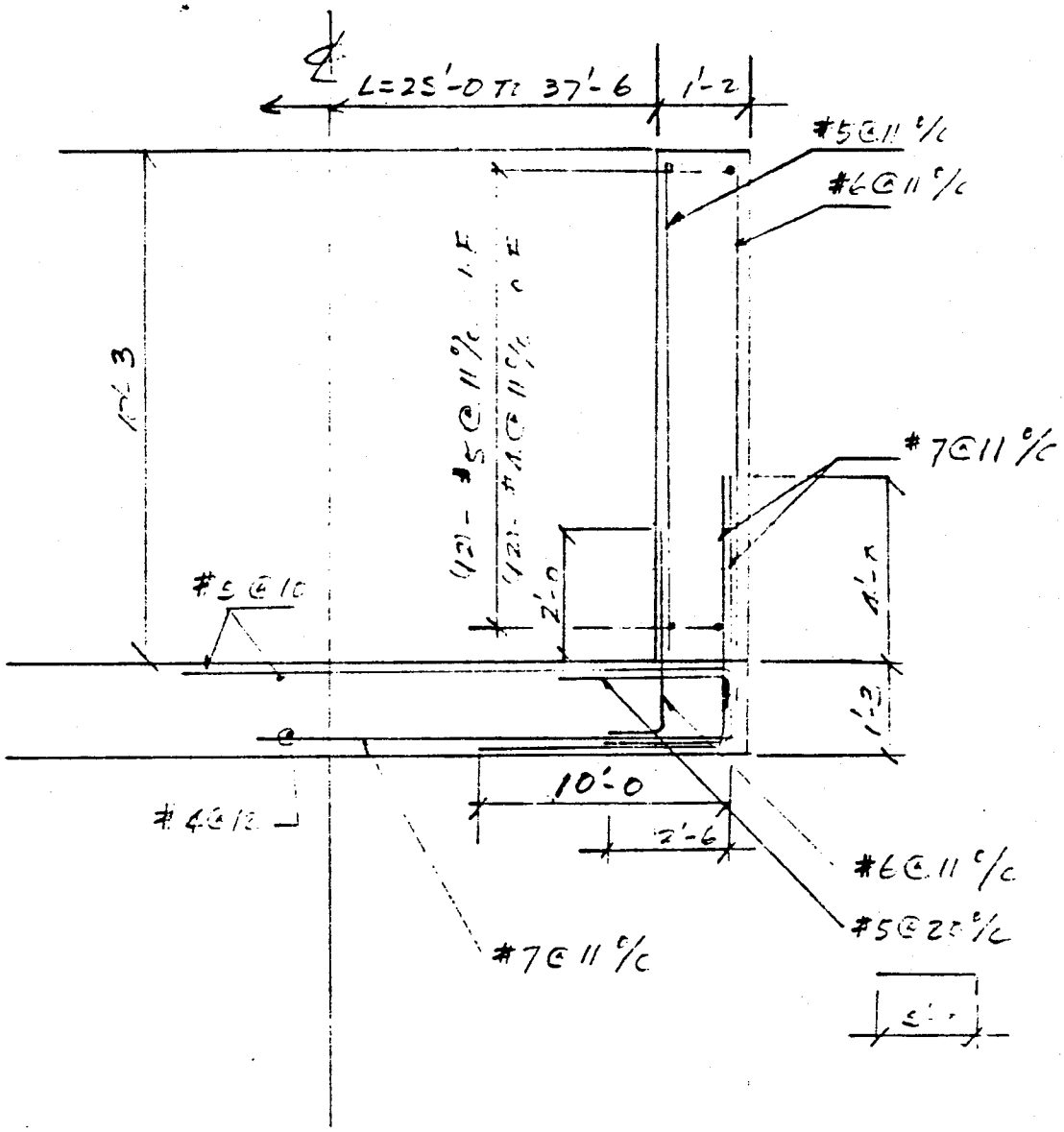
BY N. Young DATE 10/12/85 SHEET 19 OF

CHKD. BY [illegible] DATE 10/12/85 OFS NO. 3747-31T DEPT. NO. [illegible]

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY RECTANGULAR CHANNEL 10'-3 FT WIDE



SB1/8-81

$H = 10'-3$ WALL

UNEXPOSED FACE VERT. BARS

$M = \frac{1}{6} \times 78 \times 10.25^3 + \frac{1}{2} \times 156 \times 10.25^2$

$= 14{,}000 + 8{,}194 = 22194$ '#/' $= 22.2$ 'K/'

$M_u = 1.8M = 40.0$ 'K/' $F = 11^2/1000 = .121$

$K_u = 40./.121 = 331$ $a_u = 2.82$

$A_s = 40.0/2.82 \times 11 = 1.29$ □"/' #7 @ 5½" o/c

FOR $H = 6'-3$

$M = \frac{1}{6} \times 78 \times 6.25^3 + \frac{1}{2} \times 156 \times 6.25^2 = 3174 + 3046 = 6220$ '#/'

$= 6.22$ 'K/' $M_u = 1.8M = 11.2$ 'K/'

$K_u = 11.2/.121 = 93.$ $a_u = 2.95$

$A_s = 1.33 \times \frac{11.2}{2.95 \times 11} = 0.46$ □"/' #6 @ 11" o/c

$A_s = 0.46$ □"/'

HORIZ BARS: $.002 \times 12 \times 14 = 0.336$ □"/' #5 @ 11" o/c I.F

$.001 \times$ " $= 0.17$ □"/' #4 @ 11" o/c O.F

EXPOSED FACE SEE 9'-6 HT. WALL

WATER HT. = 6'-6 (MAX.)

FOUNDATION: $M_c = 40.0$ 'K/'

$x = c$ $M = 40.0$ 'K/' $t = 10.5$" $F = 0.11$

$K_u = M/F = 40/0.11 = 364$ $a_u = 2.81$

$A_s = 40/2.81 \times 10.5 = 1.36$ □"/' $= 1.31$ □"/' #7 @ 5½" o/c

FOR $L = 25'$ $x = 9'-0$

$M = 0.471M = 18.84$ (SEE P.20-1 FOR COEF.)

$K_u = 18.84/0.11 = 172$ $A_s = 18.84/2.91 \times 10.5 = 0.62$ □"/'

#7 @ 11" o/c

FOR $L = 37'-6$ $x = 9'-0$

$M = 0.38 M_o = 15.2'^K/'$

(SEE P. 18 FOR COEF.)

$K_u = M/F = 15.2/.11 = 139 < 175$

$A_s = .005 \times 12 \times 10.5 = 0.63^{\square''}/'$ #7 @ 11" o/c

LONG. BARS:

TOP BARS $.002 \times 12 \times 15 = 0.36^{\square''}/'$ #5 @ 10" o/c

BOTTOM BARS $.001 \times 12 \times 15 = .18^{\square''}/'$ #4 @ 12" o/c

$x = 9'-0$. $x' = 16$ $\lambda x = 1.177$, $\lambda x' = 2.0926$

$A = 1.466 \times (-.50) + 1.776 \times .866 + 4.0 \times .384 + 4.116 \times .923$

$= -.734 + 1.53 + 1.536 + 3.80 = 6.132$

$M = 0.471 M_o$

EBASCO SERVICES INCORPORATED

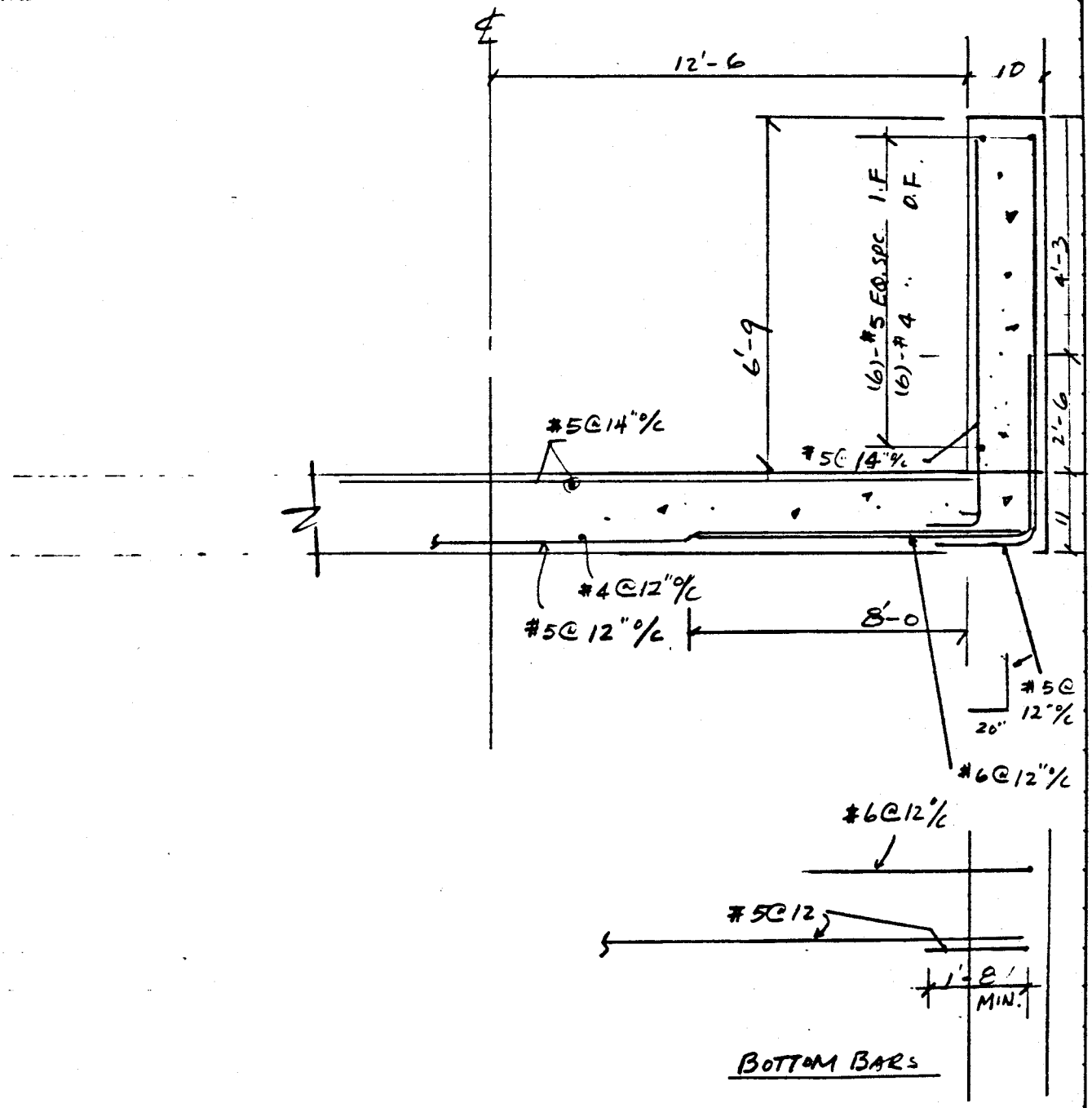
BY N. Hung DATE 1/27/86 SHEET 21 OF

CHKD. BY F. Brown DATE 1/28/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY 25' x 6'-9 CHANNEL



E81/8-81

A): WALL DESIGN: UNEXPOSED FACE

$M = \frac{1}{6} \times 78 \times 6.75^3 + \frac{1}{2} \times 156 \times 6.75^2 = 3998 + 3554 = 7552$ '#/'

$M_u = 1.8M = 13.6$ 'K/'

$P_h = \frac{1}{2} \times 78 \times 6.75^2 + 156 \times 6.75 = 1777 + 1054 = 2830$ #/'

$V_u = 1.8 P_h = 5094$

$F = .049$. $K_u = M_u/F = 13.6/.049 = 278$. $\rho = .0081$

$A_s = .0081 \times 12 \times 7 = 0.68$ □"/' — #6 @ 12"o/c + #5 @ 12" o/c.

$v_u = V_u/bd = 5094/12 \times 7 = 60.6$ #/□"

$< 2\phi\sqrt{f_c'} = 108$ #/□"

.44 + .31 = 0.75 □"/'

H = 4.25

$M_u = \frac{1}{6} \times 78 \times 4.25^3 + \frac{1}{2} \times 156 \times 4.25^2 = 998 + 1408 = 2407$ '#/'

$M_u = 1.8M = 4332$ '#/' $= 4.4$ 'K/'

$K_u = 4.4/.049 = 90$ $1.33 K_u = 120$ $\rho = .0035$

$A_s = .0035 \times 12 \times 7 = 0.294$ □"/' #5 @ 12"o/c

EXPOSED FACE: $A_{s\,min} = .002 \times 12 \times 10 = 0.24$ □"/' #5 @ 14 "o/c (MIN.)

B: FOUNDATION: (COEFFICIENT SEE NEXT PAGE)

BOTTOM BARS: $M_o = 13.6$ 'K/'

x = 6'-0 $M = 0.491 M_o = 6.7$ 'K/' — #5 @ 12"o/c + #6 @ 12"o/c

x = 8'-0 $M = .302 M_o = 4.1$ 'K/' — #5 @ 12 "o/c

CAPACITY OF #5 @ 12"o/c $A_s = .31$, $F = .04225$

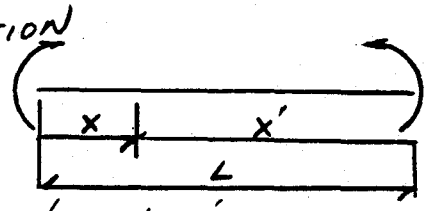
$\rho = .31/12 \times 6.5 = .00397$ $K_u = 141$

$M_u' = K_u \cdot F = 141 \times .04225 = 5.96$ 'K

$M_u = M_u'/1.33 = 4.48$ 'K/'

FOUNDATION BEAM ON ELASTIC FOUNDATION

$L = 25'$



$\lambda = .16506 \qquad \lambda L = 4.1265 > \pi$

$$M = \frac{M_0}{\sinh\lambda L + \sin\lambda L}\left(\sinh\lambda x \cos\lambda x' + \cosh\lambda x \sin\lambda x' + \sinh\lambda x' \cos\lambda x + \cosh\lambda x' \sin\lambda x\right)$$

$\sinh\lambda L = 30.97 \qquad \sin\lambda L = -.8332$

$$M = \frac{M_0 \quad A}{30.97 - .8332} = .033182\, M_0 A$$

FOR $x = 6' \qquad x' = 19 \qquad \lambda x = .99036, \quad \lambda x' = 3.13614$

$A = 1.160 \times -1.0 + 1.5318 \times .00545 + 11.4857 \times .5484 + 11.53 \times .836$

$= -1.16 + 0 + 6.30 + 9.64 = 14.78$

$M = 0.491\, M_0$

FOR $x = 8' \qquad x' = 17' \qquad \lambda x = 1.3205, \quad \lambda x' = 2.806$

$A = 1.739 \times (-0.944) + 2.006 \times 0.33 + 8.242 \times 0.2477 + 8.30 \times 0.97$

$= -1.64 + 0.66 + 2.04 + 8.05 = 9.11$

$M = 0.302\, M_0$

FOR $x = L/2 \qquad \lambda L/2 = 2.063$

$$M = 2M_0 \frac{\sinh\frac{\lambda L}{2}\cos\frac{\lambda L}{2} + \cosh\frac{\lambda L}{2}\sin\frac{\lambda L}{2}}{\sinh\lambda L + \sin\lambda L}$$

$$= 2M_0 \frac{3.811 \times -.4726 + 4.0 \times .881}{30.97 - .8332} = \frac{2(-1.83 + 3.52)M_0}{30.97 - .8332} = .112\, M_0$$

EBASCO SERVICES INCORPORATED

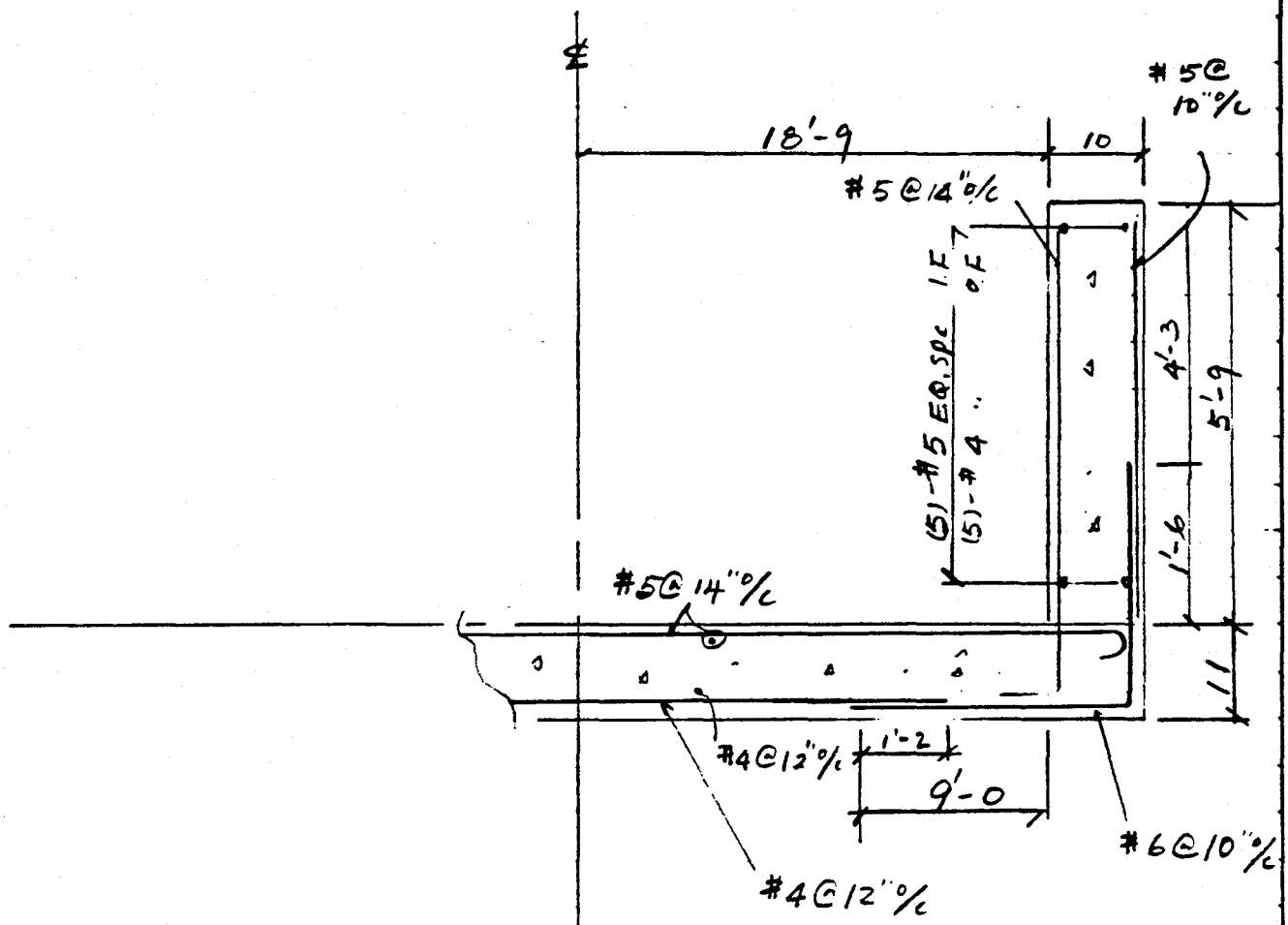
BY N. Hung DATE 1/27/86 SHEET 24 OF

CHKD. BY [illegible] DATE 1/28/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY 37'-6 x 5'-9 CHANNEL



581/8-81

WALL DESIGN: UNEXPOSED FACE:

$H = 5'-9$. $M = \frac{1}{6} \times 78 \times 5.75^3 + \frac{1}{2} \times 156 \times 5.75^2 = 2472 + 2579 = 5051$ '#/'

$M_u = 1.8M = 9.1$ 'K/'

$K_u = 9.1/.049 = 186$ $\rho = .00534$

$A_s = .00534 \times 12 \times 7 = 0.448$ □"/' #6@12"o/c

$H = 4-3$. #5@12"o/c

EXPOSED FACE:

$A_{s\,min} = .002 \times 12 \times 10 = 0.24$ □"/' #5@15½"o/c

FOUNDATION: (SEE NEXT PAGE FOR COEF.)

BOTTOM BARS: $M_o = 9.1$ 'K/'

$x = 6'-0$ $M = 0.511 \times 9.1 = 4.65$ 'K/' #6@10"o/c

$x = 8'-0$ $M = 0.318 \times 9.1 = 2.9$ 'K/' #4@12"o/c

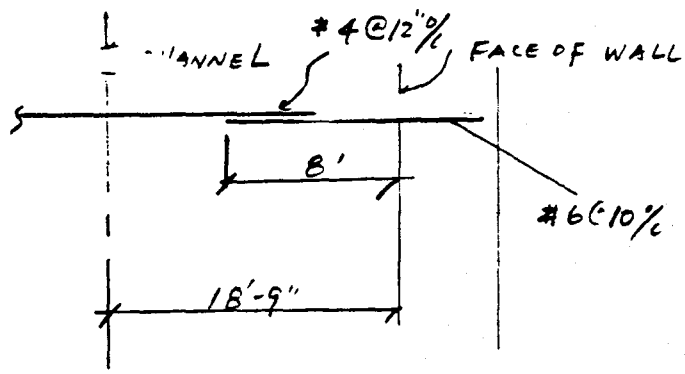
FOR $t = 6.5''$ $F = .04225$

$M_u/F = 9.1/.04225 = 215$.

$\rho = .00625$

$A_s = .00625 \times 12 \times 6.5 = 0.49$ □"/'

#6@10"o/c



TOP BARS: $A_{s\,min.} = .002 \times 12 \times 11 = .264$ #5@14"o/c E.W.

[MOMENT CAPACITY OF #4@12"o/c

$\rho = .02/12 \times 6.5 = .00256$ $K_u = 89$ $F = .04225$

$M_u' = 89 \times .04225 = 3.76$ 'K/'

$M_u = 3.76/1.33 = 2.83$ 'K/']

FOUNDATION

$\lambda = .16506 \qquad \lambda L = .16506 \times 37.5' = 6.18978$

$$M = \frac{M_o}{\sinh\lambda L + \sin\lambda L}\left(\sinh\lambda x \cos\lambda x' + \cosh\lambda x \sin\lambda x' + \sinh\lambda x' \cos\lambda x + \cosh\lambda x' \sin\lambda x\right)$$

$\sinh\lambda L = 243.868 \qquad \sin\lambda L = -.0932$

$$M = \frac{M_o}{243.868 - .093} A = M_o \times .004102 A$$

FOR $x = 2' \qquad \lambda x = 0.33012 \qquad x' = 35.5' \qquad \lambda x' = 5.85963$

$A = .33615 \times .91163 + 1.055 \times -.411 + 175.296 \times .946 + 175.30 \times .3242$
$= 0.31 + (-.43) + 165.83 + 56.83 = 222.54$

$M = .9129\, M_o$

FOR $x = 6' \qquad \lambda x = .99036, \quad x' = 31.5' \qquad \lambda x' = 5.19939$

$A = 1.161 \times .468 + 1.5318 \times -.8837 + 90.579 \times .5484 + 90.583 \times .8362$
$= 0.543 - 1.354 + 49.67 + 75.74 = 124.60$

$M = 0.5111\, M_o$

FOR $x = 8' \qquad \lambda x = 1.3205, \quad x' = 29.5 \qquad \lambda x' = 4.869$

$A = (1.7391 \times 0.15597 + 2.006 \times -.9877 + 65.09 \times .2477 + 65.10 \times .969$
$= 0.27 + (-1.98) + 16.12 + 63.08 = 77.49.$

$M = 0.3179\, M_o$

FOR $x = 12' \qquad \lambda x = 1.98072 \qquad x' = 25.5' \qquad \lambda x' = 4.209$

$A = 3.555 \times -0.482 + 3.692 \times -.876 + 33.64 \times -.3986 + 33.65 \times .9171$
$= -1.72 + (-3.23) - 13.41 + 30.86 = 12.50$

$M_0 = .0513 M_0$

For $x = 16'$ $\lambda x = 2.568$ $x' = 21.5'$ $\lambda x' = 3.54879$

$A = 6.9777 \times -.9182 + 7.049 \times -.396 + 17.37 \times -.8773 + 17.40 \times .480$

$= -6.407 - 2.792 + -15.23 + 8.35 = -16.08$

$M_0 = -.066 M_0$

FOR $x = 18.75$ $\lambda L/2 = 3.095$

$$M = 2M_0 \frac{\sinh\frac{\lambda L}{2}\cos\frac{\lambda L}{2} + \cosh\frac{\lambda L}{2}\sin\frac{\lambda L}{2}}{\sinh\lambda L + \sin\lambda L}$$

$$= 2M_0 \frac{11.02 \times -.998 + 11.07 \times .0466}{243.868 - .093} = -.086 M_0$$

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 10/21/85 SHEET 28 OF

CHKD. BY P. Brett DATE 10/21/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT DROP #1 APACHE FLOODWAY

THICKNESS OF GROUTED ROCK DROP (t)

WATER VELOCITY = 30.70 fps $y_1 = 1.35$

$y_2 = 8.25$

TRY $t = 2'$

$$* \text{ UPLIFT} = \frac{\left(\frac{V^2}{2g} - T\right)(62.4)(T)^2}{2}$$

$$= \frac{\left(\frac{30.7^2}{2\times 32.2} - 2\right)(62.4)\,4}{2} = 1576 \uparrow$$

$$* \text{ WEIGHT} = (T^3)(150) + (T^2)(62.4)$$

$$= 8\times 150 + 4\times 62.4 = 1450 \downarrow$$

$$F.S = \frac{\text{WEIGHT}}{\text{UPLIFT}} = \frac{1450}{1576} = 0.92 < 1.0$$

TRY $t = 2'\text{-}6$

$$\text{UPLIFT} = \frac{\left(\frac{30.7^2}{2\times 32.2} - 2.5\right)(62.4)(2.5)^2}{2} = 2366 \uparrow$$

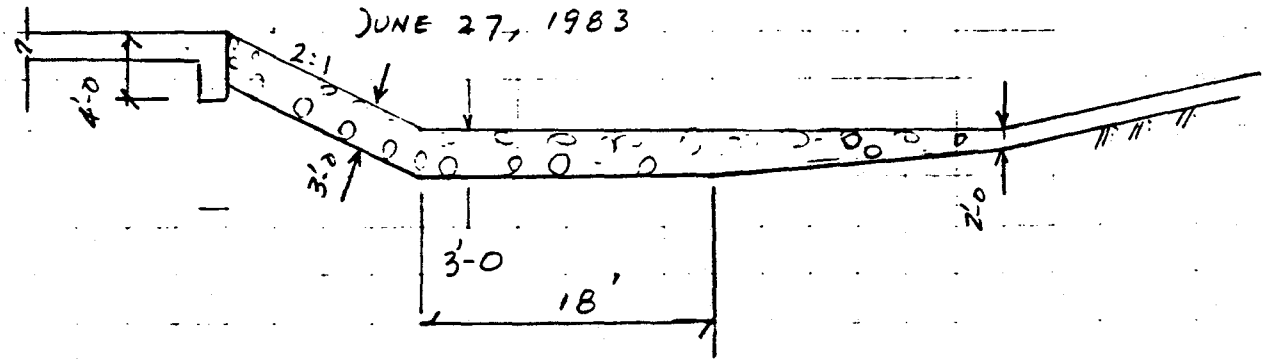
$$\text{WEIGHT} = 2.5^3 \times 150 + 2.5^2 (62.4)$$

$$= 2343 + 390 = 2733$$

$$F.S = 2733/2366 = 1.16 > 1.0 \quad \text{O.K.}$$

USE $t = 3'\text{-}0$

* SAMPLE CALCULATION OF DETERMING THICKNESS OF GROUTED ROCK DROP STRUCTURES, LETTER BY JACK STEVENSON DATED JUNE 27, 1983



561/8-81

EBASCO SERVICES INCORPORATED

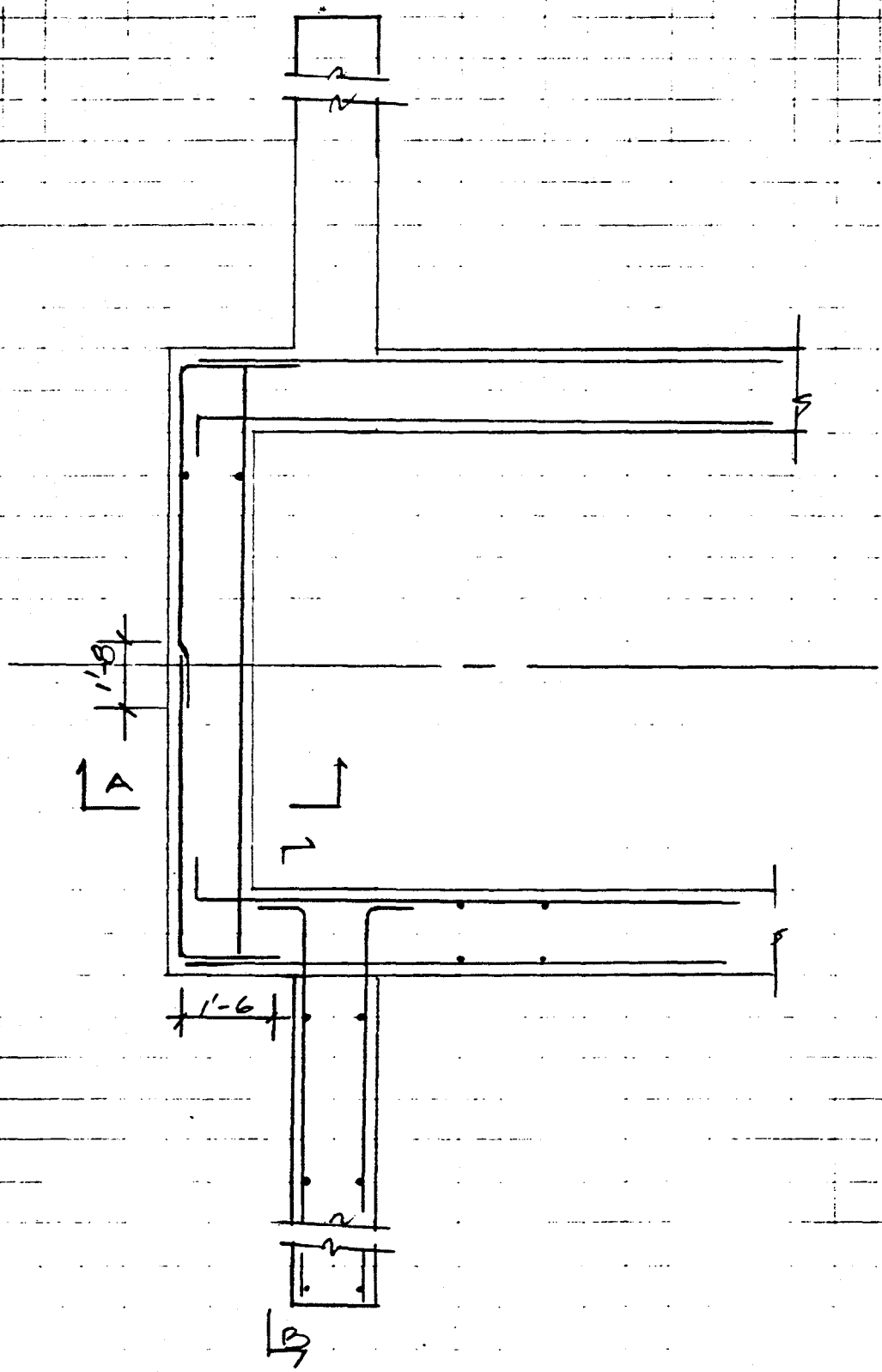
BY N. Hung DATE 10/24/85 SHEET 27 OF

CHKD. BY [illegible] DATE 10/24/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY DROP INLET #1 DWG 1-7



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EBASCO SERVICES INCORPORATED

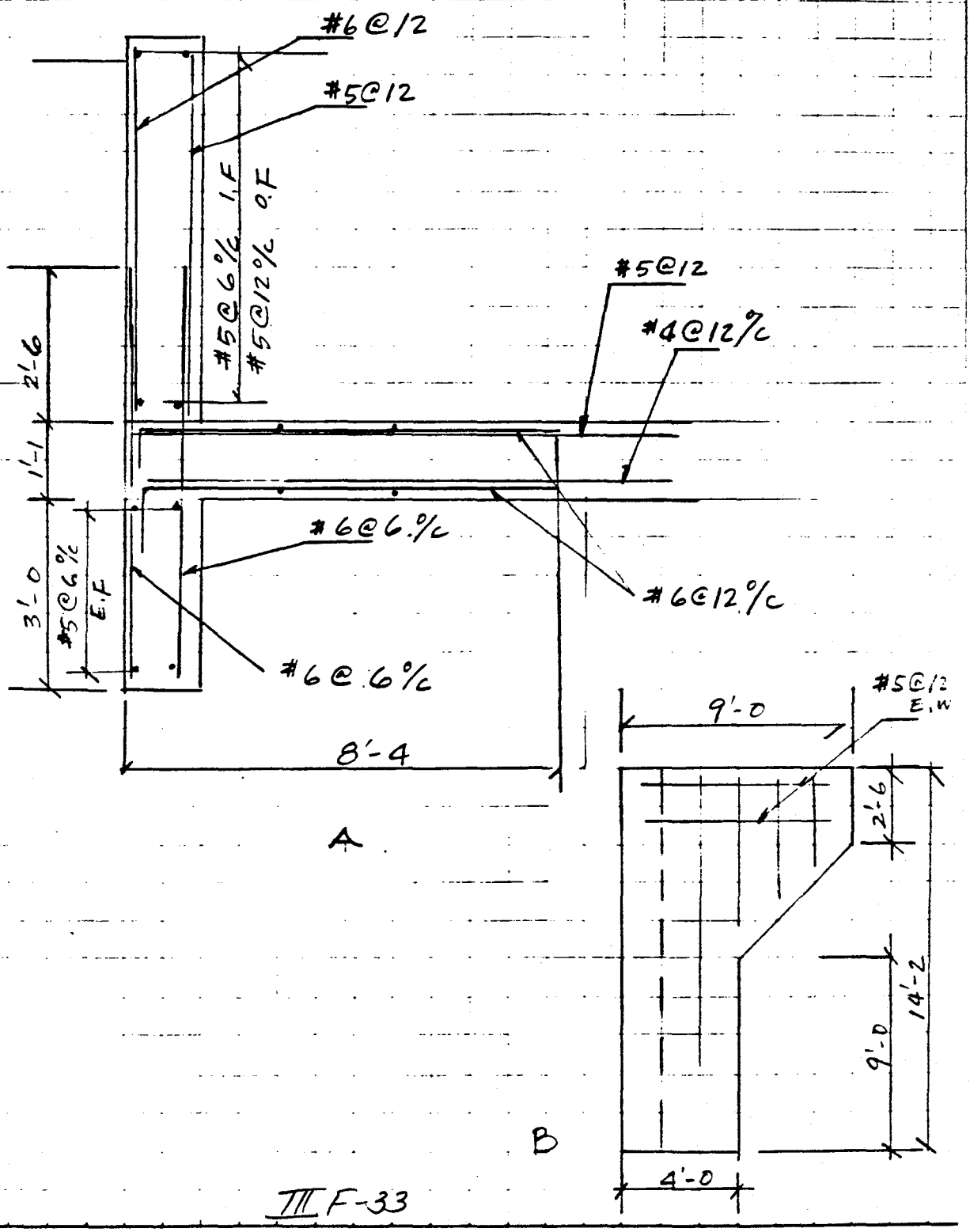
BY N. Hung DATE 10/25/86 SHEET 30 OF

CHKD. BY P. Parar DATE 10/25/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY DROP INLET #1 DWG 1-7



III F-33

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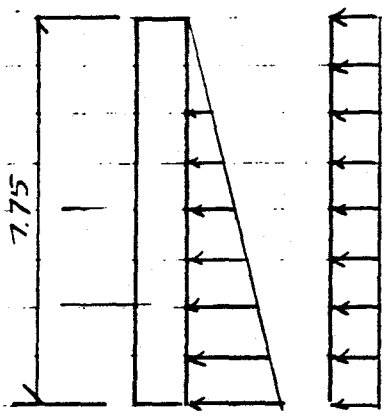


EXPOSED FACE : 1. HORIZ. BARS

$w = 78 \times \left(\frac{7.75 + 3.875}{2}\right) + 156$

$= 78 \times 5.81 + 156 = 609\ \#/'$

$w_u = 609 \times 1.8 = 1100\ \#/' = 1.1\ K/'$

$M_u = \frac{1}{8} \times 1100 \times 9.0^2 = 11.1\ 'K/'$

$V_u = 1.1\ 'K/' \times 8/2 = 4.4\ K/'$

$v_u = 4.4/12 \times 7 = .052\ K/\square'' = 52\ \#/\square'' < 2\phi\sqrt{f_c}$

$F = .049 \quad K_u = 11.1/.049 = 226$

$\rho = .0065 \quad A_s = .0065 \times 12 \times 7 = .0546\ \square''/'$

#5 @ 6" o/c

2. VERT. BARS.

$A_s = .002 \times 12 \times 10 = .24\ \square''/'$

#5 @ 12" o/c

UNEXPOSED FACE

1. HORIZ. BARS
2. VERT. "

} #5 @ 12" o/c

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 3/24/86 SHEET ____ OF ____

CHKD. BY ____ DATE ____ OFS NO. 3767-300 DEPT. NO. 323

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

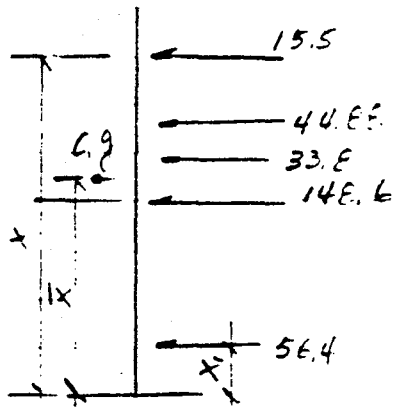
SUBJECT APACHE FLOODWAY - PRINCIPAL SPILLWAY DWG 1-20

STABILITY OF INLET STRUCTURE

TOTAL WEIGHT

$$150 \times \left[\frac{8}{12}(14.16 \times 9.1) + \frac{10}{12} \times 2 \times (14.1 \times 1.91 + \frac{14.1 + 6.16}{2} \times 2' + 9' \times 9.1) + 1 \times 6.16 \times 9.16 \right]$$

$$= 150 [15.5 + 44.88 + 33.8 + 148.6 + 56.4] = 150 \times 298.78 = 44817^{\#}$$



C G OF INLET

$X_1 = 14'-4$

$X_2 = 13'-0$

$X_3 = 11'-0$

$X_4 = 5'-6$

$X_5 = 0'-6$

$$\bar{X} = \frac{15.5 \times 14.3 + 44.88 \times 13 + 11 \times 33.8 + 5.5 \times 148.6 + 56.4 \times .5}{298.78}$$

$$= 6.77'$$

STABILITY OF STRUCTURE

(1) LATERAL FORCE: SAY 10% OF DEAD WT (SEISMIC LOAD)

ACT MOMENT $= 4482^{\#} \times 6.77 = 30.300^{1\#}$

RESIST " $= 44820 \times \frac{6.16}{2} = 138045^{1\#}$

$S.F = 138045 / 30300 = 4.56 > 1.5$

OR 30#/□' WIND LOAD

$9.16 \times 13.6 \times 30 \times \frac{13.6}{2} = 25143^{\#1}$

$S.F = 138045 / 25143 = 5.43 > 1.5$

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BY N. H. - J DATE 3/24/86 SHEET ____ OF ____

CHKD. BY ____ DATE ____ OFS NO. 3767-300 DEPT. NO. 523

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT LITTLE BUFFALO WATER CONTROL STRUCTURE

SUBJECT APACHE FLOODWAY - PRINCIPAL SPILLWAY

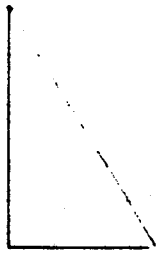
Q: SOIL PRESSURE

HORIZ. FORCE (SLIDING FORCE)

$$7E \times \frac{7.5^2}{2} \times 4' = 8775^{\#}$$

$$7E \times \frac{4^2}{2} \times 2.5' = 1560^{\#}$$

$$10{,}335^{\#}$$



FRICTION FORCE

$$0.35 \times 44617 = 15686^{\#}$$

$$S.F = 15686/10335 = 1.517 > 1.5 \quad \text{O.K}$$

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EBASCO SERVICES INCORPORATED

BY CJM DATE 12/2/85 SHEET 1 OF 21

CHKD. BY [illegible] DATE 12/4/85 OFS NO. 3767.300 DEPT. NO. 930

CLIENT USDA Soil Conservation Service - Pheonix Az

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Design Of Grouted Rock Gradation For Energy Diss.

At End Of Apache Junction Floodway

A. From Previous Calculations The Required Rock Thickness = 3 FEET

T = 3 FEET

B. Reference Letter From Jack Stevenson To Ralph Arrington dtd. June 27, 1983

" D_{50} sized such that $D_{100} = T$ "

C. Guide Gradation Criteria: TR-59, Pg 16

$$\left[\frac{D_{85}}{D_{50}} + \frac{D_{50}}{D_{15}}\right] \leq 5.5$$

D. Guideline Dn Ratios:

$D_{15} = 0.5\ D_{50}$

$D_{50} = 1.0\ D_{50}$

$D_{85} = 1.25\ D_{50}$

$D_{100} = 1.50\ D_{50}$

SUPERSEDED

NOTE: THE DESIGN OF THE ROCK FOR THE ENERGY DISSIPATORS HAS BEE MODIFIED BASED ON DECISIONS MADE AT THE PREL. DESIGN MTG 1/8,9,/86 SEE SHEET 9 : III-F.37

581/8-81

E. Gradation : 36 inch Rock Riprap

$D_{15} = 1.0' = 12''$

$D_{50} = 2.0' = 24''$

$D_{85} = 2.5' = 30''$

$D_{100} = 3.0' = 36''$

F. Criteria Check

$$\left[\frac{D_{85}}{D_{50}} + \frac{D_{50}}{D_{15}}\right] \leq 5.5$$

$$\left[\frac{2.5}{1} + \frac{2}{1}\right] = 4.5 \quad \underline{\text{OK}}$$

∴ 36 inch Rock Riprap

The riprap shall be well graded from 6 inches to 36 inches in diameter with:

- a minimum of 50% by weight greater than 24 inches in diameter
- a minimum of 15 % by weight greater than 30 inches in diameter
- a maximum of 15 % by weight less than 12 inches in diameter

EBASCO SERVICES INCORPORATED

BY cjm DATE 12/2/85 SHEET 3 OF

CHKD. BY (y) DATE 12/4/85 OFS NO. 3767.300 DEPT. NO. 930

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Design Of Grouted Rock Gradation Based On Past Specs

F. Design Based On Previous SCS Specs

The following ratios are from SCS Design For Pass Mountain:

% Passing By wt.	Part. Size (Pass mt.) (in.)	Ratio D/D50	Computed Apache Jt. (in)
100	42	2.1	36
60 - 100	30	1.5	27
30 - 60	20	1	18
5 - 30	12	0.6	11
0 - 5	9	0.45	8

∴ Design Gradation (Adjusted)

% Passing By wt.	Particle Size (Inches)
100	36
60 - 100	27
30 - 60	18
5 - 30	12
0 - 5	9

USE DESCRIPTION ON PAGE 2 PARA. F.

CK: USING MID. RANGE

$$\left[\frac{27}{18} + \frac{18}{12}\right] = 1.5 + 1.5 = 3 < 5.5 \text{ OK}$$

G (cont.)

The Specification As Previously written by SCS For Pass Mountain will allow the largest rock to be smaller than 27". In discussions with the Project Engineer on December 10, 1985 this experience was that the largest rock size was about 24 inches even when the design called for a 42 inch rock and the spec. was still met.

I recommend that we use the description on page 2 paragraph F.

H. On "NON IMPACT AREAS" DECREASE MAXIMUM ROCK SIZE TO 24 inches:

D_{15}	=	8	(USE 9)
D_{50}	=	16	(USE 15)
D_{85}	=	20	
D_{100}	=	24	

∴ <u>24 inch Rock Riprap</u>

The riprap shall be well graded from 3 inches to 24 inches in diameter with:

- a minimum of 50% by weight > 15 in. in dia.
- a minimum of 15% by weight > 20 in. in dia
- a maximum of 15% by weight < 9 in. in dia

A From Previous Calculations The Req'd Rock Thickness = 4 Feet

T = 4 Feet

B Using Same Relationships As On Pg. 1

			(USE)
D_{15}	=	16"	(15)
D_{50}	=	32"	(30)
D_{85}	=	40"	(36)
D_{100}	=	48"	(48)

G.I = 3.2 OK

- 48 inch Rock Riprap

The riprap shall be well graded from 9 inches to 48 inches in diameter with:

- a minimum of 50% by weight > 30 in. in dia.
- a minimum of 15% by weight > 36 in. in dia.
- a maximum of 15% by weight < 15 in. in dia

C. For "NON IMPACT AREAS" USE "24 inch Rip Rap As Graded On Page 4.

EBASCO SERVICES INCORPORATED

BY EJM DATE 12/10/85 SHEET 6 OF

CHKD. BY [illegible] DATE 12/9/85 OFS NO. 3763.30 DEPT. NO. 231

CLIENT USDA SCS

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Grouted Rock Gradations For Weir And Side Channel Inlets

A. From Previous Calculations

a. Max Head Over Weir Inlets < 2.5 Ft.

b. Max Velocity in entrance sections to side channel inlets < 3 fps

B Design Approach Design for these 2 conditions and, if rock size approx the same use larger throughout for ease of construction.

C. For condition A. a.

Given Max. Head < 2.5

From NEH 4 Pg 2 6

D_{50} = 5 inchs

D For condition 1. b.

Given max velocity = 3 fps

From various references including H.R. Report 101 Ishbash, ASCE Proceedings

D_{50} = 1 to 2 inches

(NOTE: It is close to not being needed)

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EBASCO SERVICES INCORPORATED

BY CJM DATE 12/12/85 SHEET 7 OF

CHKD. BY [illegible] DATE 12/4/85 OFS NO. 3767300 DEPT. NO. 930

CLIENT LISDA SCS

PROJECT Bullds Floodway & Apache Junction

SUBJECT Grouted Rock Gradations For Weir & Side Channel Inlets

E DESIGN :

Provide Grouted Rock Riprap[1] of the following gradation at all weir and side channel inlets :

D_{15} = 3 inch
D_{50} = 6 inch
D_{85} = 9 inch
D_{100} = 12 inch

[1] Rock does not have to be grouted if properly designed bedding is provided. Based on SCS Previous Experience - rock will be grouted with no bedding provided, however the thickness should be at least 2 x D_{100}

- 12 inch Rock Riprap

The riprap shall be well graded from 1 inches to 12 inches in diameter with :

- a minimum of 50% by weight > 6 in. in dia.
- a minimum of 15% by weight > 9 in. in dia.
- a maximum of 15% by weight < 3 in. in dia

THICKNESS = 24 inches (NO BEDDING, BUT GROUTED.)

58 1/8-R1

Design Concept:

- No bedding or fabric will be placed under riprap to be placed at weir and side channel inlets:
  - NO FLOW IS EXPECTED TO BE MOVING FROM THE BASE SOIL THRU THE ROCK RIPRAP
  - THE RIPRAP IS GROUTED WITH LITTLE CHANCE OF MOVEMENT AND CRACKING
  - VELOCITIES OVER THE GROUTED ROCK ARE LOW; < 3 fps
  - THE ROCK HAS BEEN PLACED AT T = 24 inches which is 2 x D_{100}.

- Some form of protection is required under the grouted rock in the energy dissipators:
  - Velocities are high
  - Saturation can occur behind the grouted rock and cause movement of the soil (or drawdown) into the voids in the rock riprap. - Note the riprap is of a large size with potential for large voids even w/ grouting
  - Movement can be expected w/ cracking

BY CJM DATE 1/23/86 SHEET 9 OF
CHKD. BY [illegible] DATE 12/4/85 OFS NO. DEPT. NO.
CLIENT USDA Soil Conservation Service
PROJECT Bulldog Floodway & Apache Junction
SUBJECT Design OF Grouted Rock For Energy Dissipators

At the "Preliminary Design Meeting held in Portland, Oregon on January 8, 9, 1986 it was agreed that the energy dissipators would be re-designed using higher roughness values and that the D_{100} size of the rock could be reduced to approximately 2/3 the thickness computed. See "Minutes Of Preliminary Design Review Meeting, January 8 and 9, 1986, Paragraph 9".

The following calculations reflect these changes:

ENERGY DISSIPATOR

Incoming flow

$Q = 4674$

$b = 50'$

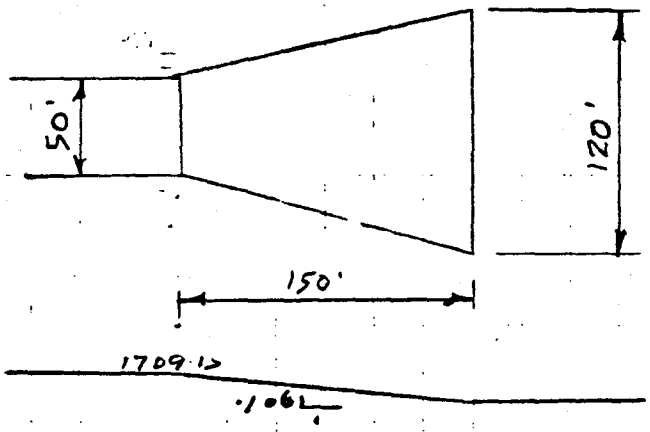
$S = .0051$

$n = .015$

$d = 5.063$ $\quad v = 18.46$

$H_e = d + \frac{v^2}{2g} = 10.354$

Bed EL = 1709.15



Immediately after the rectangular section assume that the water spreads into the trapezoidal section.

Sudden expansion loss $= K_e \left(\frac{v_2^2}{2g} - \frac{v_1^2}{2g} \right)$

$K_e = 1$

d	4	4.2	4.15	4.16	4.17
v	20.147	19.055	19.318	19.265	19.213
H_{e_2}	10.30	9.839	9.945	9.923	9.902
ΔH_{exp}	1.01	.347	.503	.472	.440
H_{e_1}	11.31	10.186	10.448	10.395	10.342 ok

$\therefore d = 4.17 \quad A = 243.278 \quad P = 68.649 \quad R = 3.544$

for $n = .02 \quad S = .01238 \quad H_e = 10.354 - .44 = 9.914$

ENERGY DISSIPATOR

INCOMING FLOW

$Q = 1560$ CFS

$b = 37.5$ ft

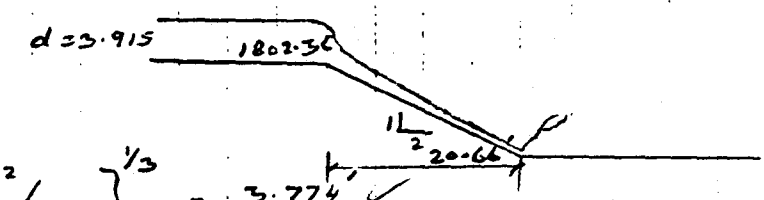
$S = .0024$

$n = .015$

$d = 3.915$ $\quad v = 10.63$

$He = d + \frac{v^2}{2g} = 5.67$

Bed El = 1802.36



$$D_{cr} = \left[\left(\frac{1560}{37.5}\right)^2 / 32.2\right]^{1/3} = 3.774'$$

Immediately after the rectangular section assume that the water is spread into the trapezoidal section. Negl. expansion loss

∴ Assume

$d =$	2.55	2.6
$v =$	14.36	14.05
$He =$	5.75	5.67 ok

sudden expansion loss $= k_e \left(\frac{v_2^2}{2g} - \frac{v_1^2}{2g}\right)$

where $k_e = 1$

d	3.0	3.01
v	11.95	11.909
He_2	5.22	5.212
ΔH_{exp}	.463	.448
He_1	5.683	5.66 ok

$d = 3.01$ $\quad A = 130.995$ $\quad P = 50.961$ $\quad R = 2.570$

$$S = \left[\frac{v\,n}{1.486\,R^{2/3}}\right]^2 \quad \text{for } n = .02$$

$$= \left[\frac{11.909 \times .02}{1.486 \times 2.570^{2/3}}\right]^2$$

$$= .0073$$

Neglecting the effect of slope on normal and vertical depths of flow and applying Bernoulli's Equation

$S_b = .5$

Assume	d =	3.01	2.5	2.0	1.5	1.4
	A =	130.995	106.25	83	60.75	56.42
	P =	50.961	48.68	46.444	44.208	43.761
	R =	2.570	2.183	1.787	1.374	1.289
	v =	11.909	14.682	18.795	25.679	27.647
	S =	.0073	.0138	.0295	.0782	.0987
	Sw =		.0105	.02165	.0538	.0884
$v^2/2g + d$	He =	5.212	5.847	7.485	11.739	13.271
$\frac{He_2 - He_1}{S_b - Sw}$	l =	0	1.297	3.42	9.535	3.722
	Σl =	0	1.297	4.717	14.252	17.974

d =	1.36	1.34
A =	54.699	53.841
P =	43.582	43.493
R =	1.255	1.238
v =	28.520	28.974
S =	.1088	.1144
Sw =	.1038	.1116
He =	13.990	14.376
l =	1.815	.994
Σl =	19.789	20.78'

∴ The velocity at the base of the slope will be approximately 29 fps which compares very well with 30.7 fps as computed without losses in the short reach (20.66') of the slope (PHASE I REPORT)

BY S GOYAL DATE 1-22-86 SHEET 13 OF

CHKD. BY [illegible] DATE 2/2/[illegible] OFS NO. USDA 3767.300 DEPT. NO. 500

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY

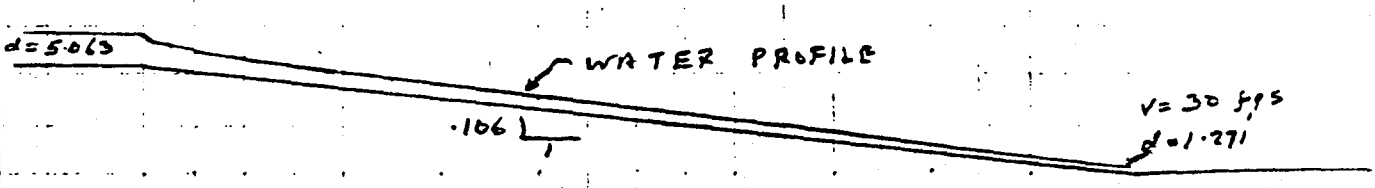
Neglecting the effect of slope on normal and vertical depths of flow

$S_b = .106$ $n = .02$ $Q = 4674$

$S = \left[\frac{Vn}{1.486 R^{2/3}}\right]^2$; $H_e = H_{e_1} - S_{av} L + \Delta Z$; $H_e' = \frac{v^2}{2g} + d$

L	b	d (Assumed)	A	V	R	S_o	S_{av}	$S_{av} L$	ΔZ	H_e	$\frac{v^2}{2g}$	H_e'
0	50	4.17	243.28	19.21	3.54	.01238		-	-	9.91	5.73	9.90
7.5	53.5	3.64	221.24	21.13	3.17	.01236	.0149	.11	.795	10.595	6.93	10.57
15	57	3.24	205.68	22.73	2.877	.02286	.0261	.15	.795	11.24	8.02	11.26
30	64	2.69	186.63	25.04	2.454	.03431	.0286	.43	1.59	12.40	9.74	12.43
45	71	2.32	175.48	26.63	2.156	.0461	.04402	.60	1.59	13.39	11.02	13.34
60	78	2.03	166.58	28.06	1.913	.060	.0531	.80	1.59	14.18	12.22	14.25
75	85	1.825	161.79	28.89	1.737	.072	.0662	.10	1.59	14.78	12.96	14.74
90	92	1.66	158.23	29.54	1.59	.085	.0785	1.18	1.59	15.19	13.55	15.21
105	99	1.53	156.15	29.93	1.475	.0966	.0908	1.36	1.59	15.42	13.91	15.44
120	106	1.427	155.33	30.09	1.38	.1065	.1016	1.523	1.59	15.486	14.06	15.486
135	113	1.343	155.366	30.08	1.3055	.1149	.1107	1.66	1.59	15.416	14.05	15.396
150	120	1.271	155.75	30.01	1.239	.12256	.1187	1.78	1.59	15.22	13.98	15.25

The maximum velocity in the chute will be 30 FPS. The design of energy dissipator will be kept the same as before neglecting losses in the energy dissipator chute.



EBASCO SERVICES INCORPORATED

BY N Hung DATE 10/21/85 SHEET 14 OF

CHKD. BY DATE OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT DROP #1 APACHE FLOODWAY

THICKNESS OF GROUTED ROCK DROP. (t)

WATER VELOCITY = 30.70 fps $y_1 = 1.35$

$y_2 = 8.25$

TRY $t = 2'$

$$* \text{ UPLIFT} = \frac{\left(\frac{V^2}{2g} - T\right)(62.4)(T)^2}{2}$$

$$= \frac{\left(\frac{30.7^2}{2\times 32.2} - 2\right)(62.4)4}{2} = 1576 \text{ ✗}$$

$$* \text{ WEIGHT} = (T^3)(150) + (T^2)(62.4)$$

$$= 8\times 150 + 4\times 62.4 = 1450 \text{ ✓}$$

$$F.S = \frac{\text{WEIGHT}}{\text{UPLIFT}} = \frac{1450}{1576} = 0.92 < 1.0$$

TRY $t = 2'\text{-}6$

$$\text{UPLIFT} = \frac{\left(\frac{30.7^2}{2\times 32.2} - 2.5\right)(62.4)(2.5)^2}{2} = 2366 \text{ ✗}$$

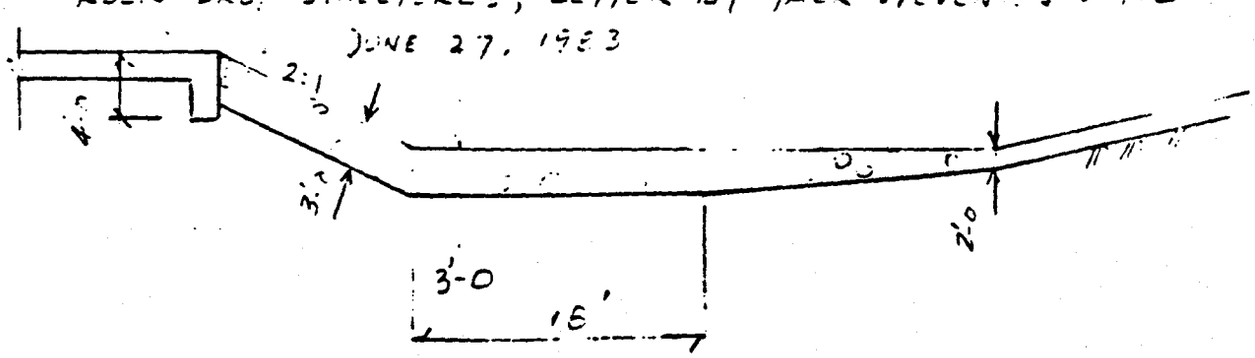
$$\text{WEIGHT} = 2.5^2 \times 150 + 2.5^2(62.4)$$

$$= 2343 + 390 = 2733$$

$$F.S = 2733/2366 = 1.16 > 1.0 \text{ OK}$$

USE $t = 3'\text{-}0$

* SAMPLE CALCULATION OF DETERMINING THICKNESS OF GROUTED ROCK DROP STRUCTURES, LETTER BY JACK STEVENS DATED JUNE 27, 1983



III F-50

Summary Of Computed Velocities:

Apache Junction	29 fps	(Sheet 12)
Bulldog Floodway	30 fps	(Sheet 13)

From Previous Calculations: (Sheet 14)

For $V = 30.7$ fps

$T = 3.0$ Ft.

$\therefore D_{100} = 2/3\ T$

$D_{100} = 24$ inches

$\therefore$ For Both Energy Dissipators

$$\boxed{\begin{aligned} D_{100} &= 24 \text{ inches} \\ T &= 36 \text{ inches} \end{aligned}}$$

EBASCO SERVICES INCORPORATED

BY CJM DATE 1/24/86 SHEET 16 OF

CHKD. BY DATE OFS NO. DEPT. NO.

CLIENT USDA SCS

PROJECT Bulldog Floodway & Apache Junction

SUBJECT

GRADATION FROM PREVIOUS CALCS. SHEET 4 :

D_{15} = 9 IN.

D_{50} = 15 IN.

D_{85} = 20 IN.

D_{100} = 24 IN.

MINIMUM SIZE = 6 IN. FOR GROUTING

NOTE : SAME MATERIAL TO BE USED ON ALL AREAS :

IE : DO NOT DECREASE SIZE ON "NON-IMPACT" AREAS :

BEDDING (DRAINAGE) IS REQ'D

∴

THE ROCK SHALL BE WELL GRADED FROM 6 INCHES TO 24 INCHES IN DIAMETER WITH :

- a minimum of 50 % by weight > 15 in. in dia.
- a minimum of 15 % by weight > 20 in. in dia.
- a maximum of 15 % by weight < 9 in. in dia.

581/8-81

Criteria For Bedding And Filter Fabric Design

Bedding:

$$D_{85}\ \text{BASE} > \frac{D_{15}(RR)}{5}$$

$$D_{15}\ \text{BASE} < \frac{D_{15}(RR)}{5}$$

$$D_{15}\ \text{BASE} > \frac{D_{15}(RR)}{40}$$

$$D_{50}\ \text{BASE} > \frac{D_{50}(RR)}{40}$$

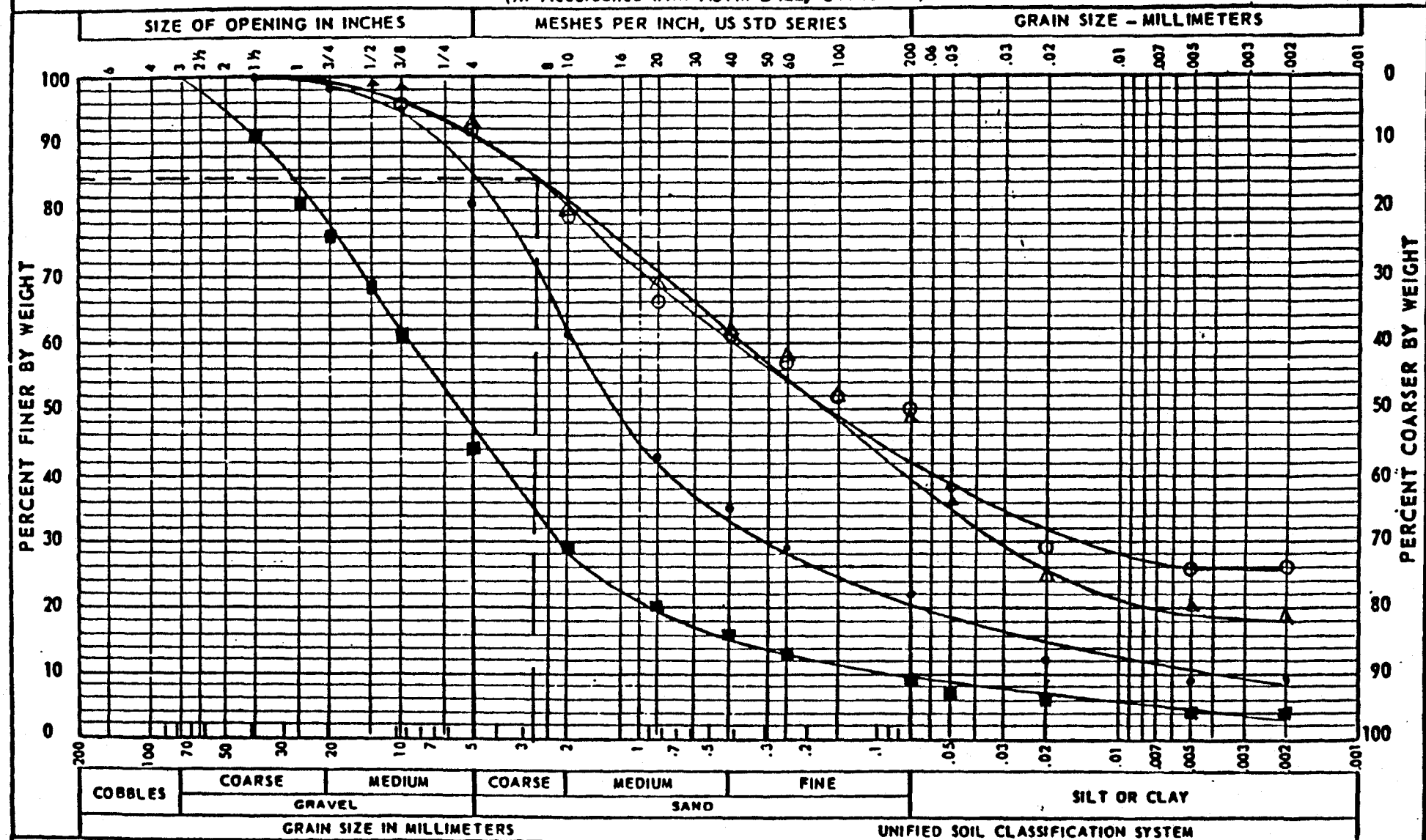
Fabric:

$$EOS \geq \frac{D_{85}}{1.2}$$

FORM #1

MECHANICAL ANALYSIS GRAPH OF GRANULAR MATERIALS

(In Accordance With ASTM D422, Section 16)



TEST NO.	
SAMPLE NO.	
SAMPLE LOCATION	
SAMPLE ELEVATION	

SAMPLE DESCRIPTION

- ● LAB # 2928
- ○ LAB # 2932
- △ LAB # 2941
- ■ LAB # 2940

EBASCO SERVICES INCORPORATED

APACHE JCT FRS
PROJECT

DRAWN BY	CHECKED BY	DATE
V BOLAND	SG	11-8-85

GRADATION RANGE OF BORROW AREA SOILS

SHEET 18

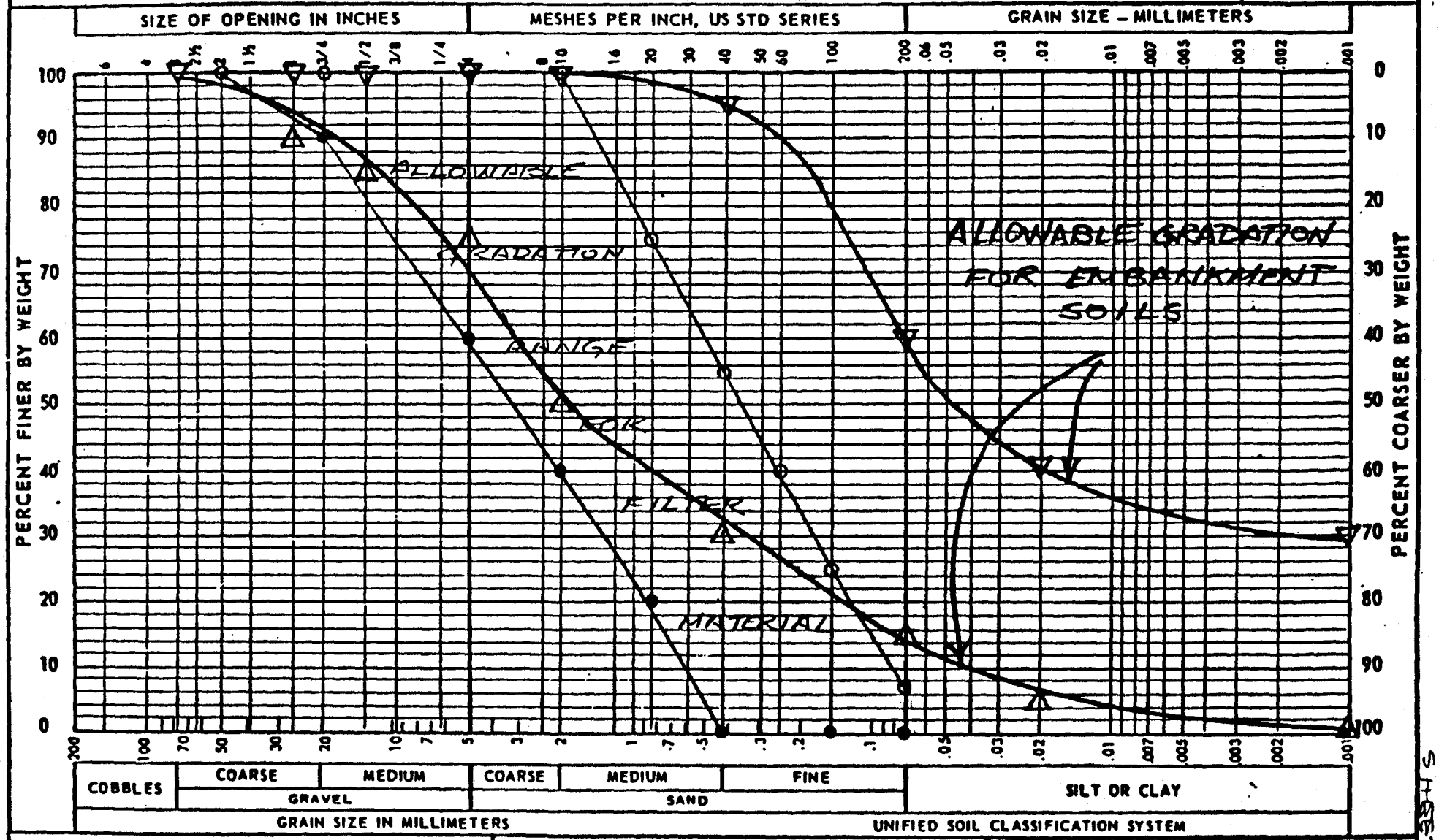
FORM #14

III F-54

FORM #1

MECHANICAL ANALYSIS GRA... OF GRANULAR MATERIALS

(In Accordance With ASTM D422, Section 16)



TEST NO.	
SAMPLE NO.	
SAMPLE LOCATION	
SAMPLE ELEVATION	

SAMPLE DESCRIPTION

Allowable gradation range for filter material & embankment fill

EBASCO SERVICES INCORPORATED

APACHE JCT FRS
PROJECT

DRAWN BY	CHECKED BY	DATE
	SG	11-8-85

III F-55

SHEET 19

FORM #14

EBASCO SERVICES INCORPORATED

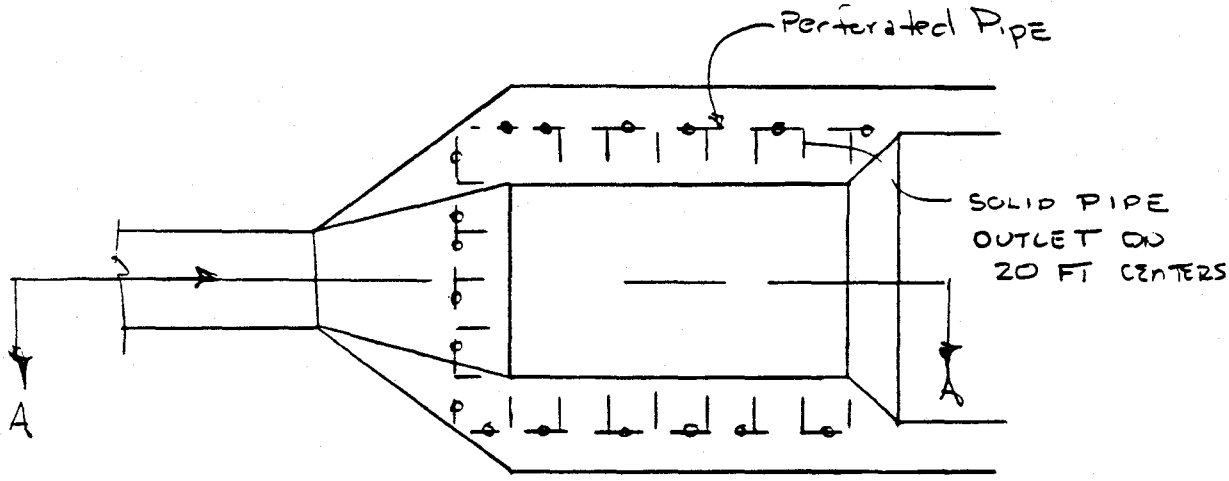
BY Cyn DATE 12/13/85 SHEET 20 OF 22

CHKD. BY _____ DATE _____ OFS NO. 3767.800 DEPT. NO. 930

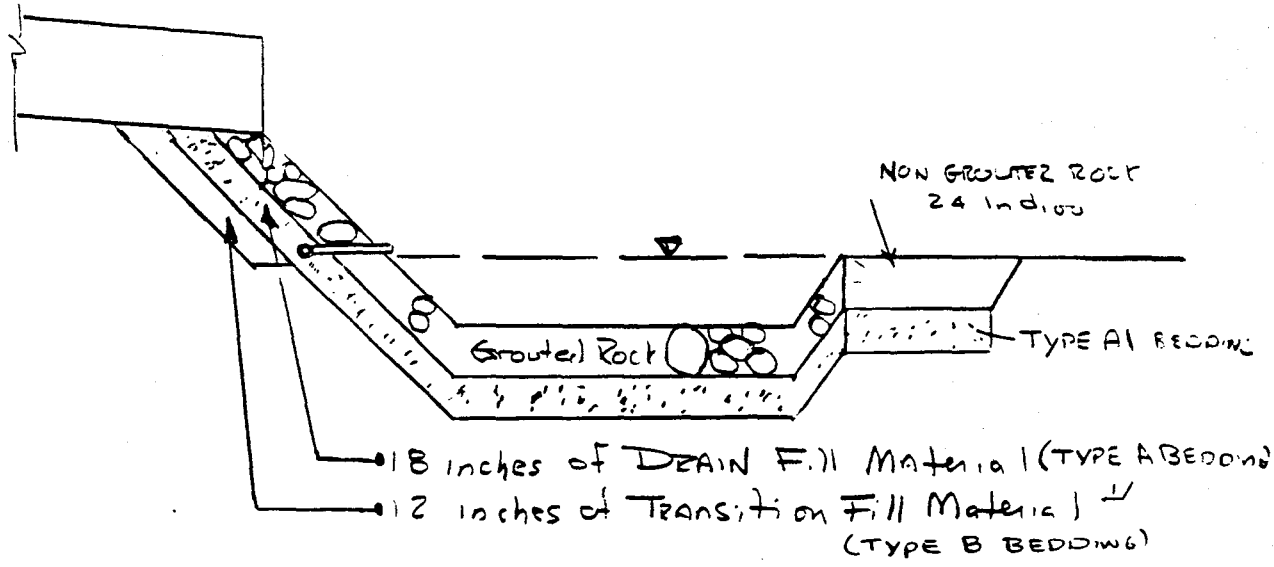
CLIENT USDA SCS

PROJECT Bullfrog Floodway & Apache Junction

SUBJECT Design Of Bedding Under Rock In Energy Dissipator



ALL GROUTED ROCK D_{100} = 24 inches
THICKNESS OF GROUTED ROCK = 36 inches



SECT A-A

1/ TRANSITION FILL MATERIAL ONLY REQ'D IN AREAS ABOVE THE WATERLINE

CLIENT USDA SCS PHOENIX ARIZONA

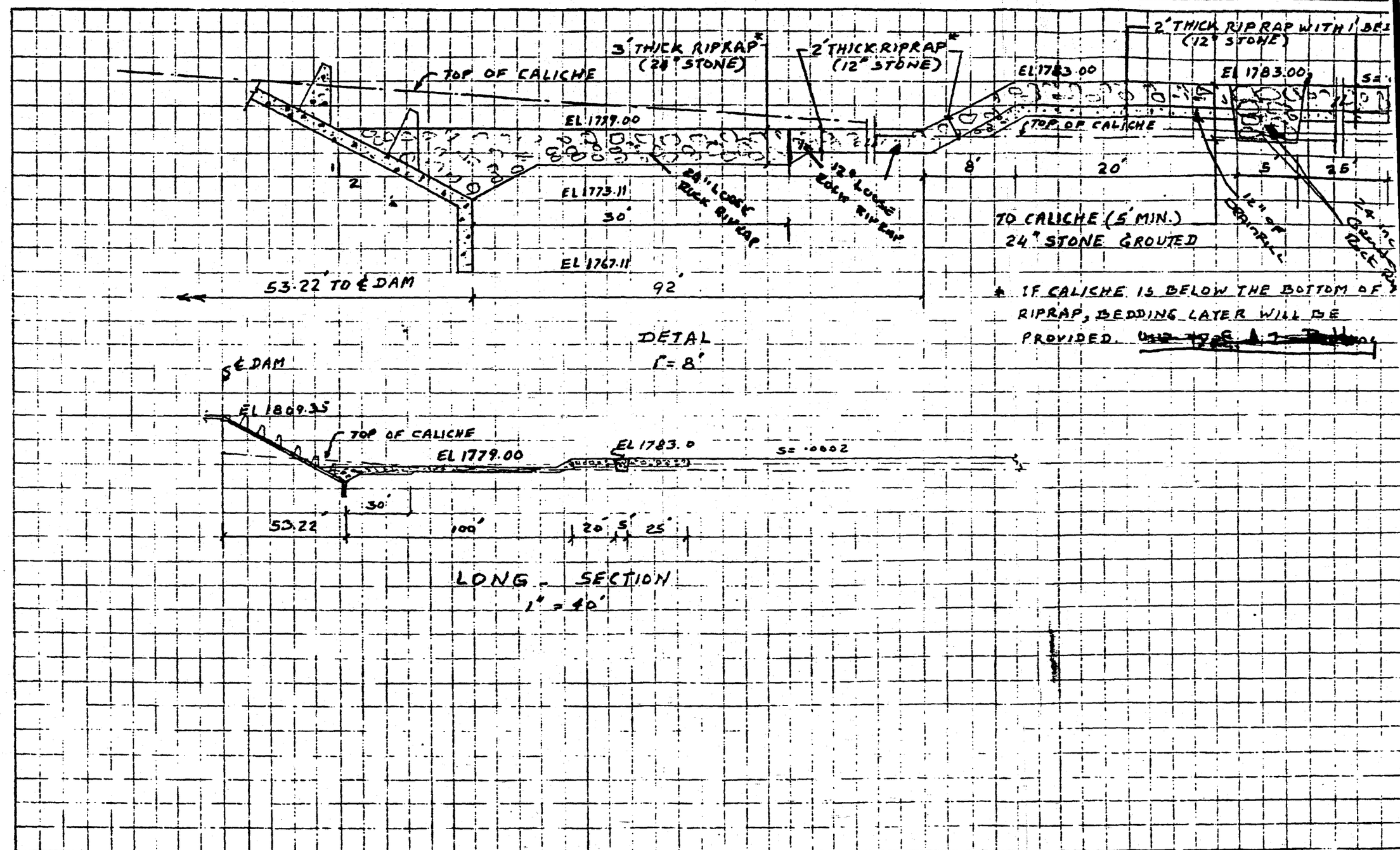
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS - EMERGENCY SPILLWAY

OPS NO. USDA 3767.300 DEPT. NO. 55

BY S GOYAL DATE 1-31-86

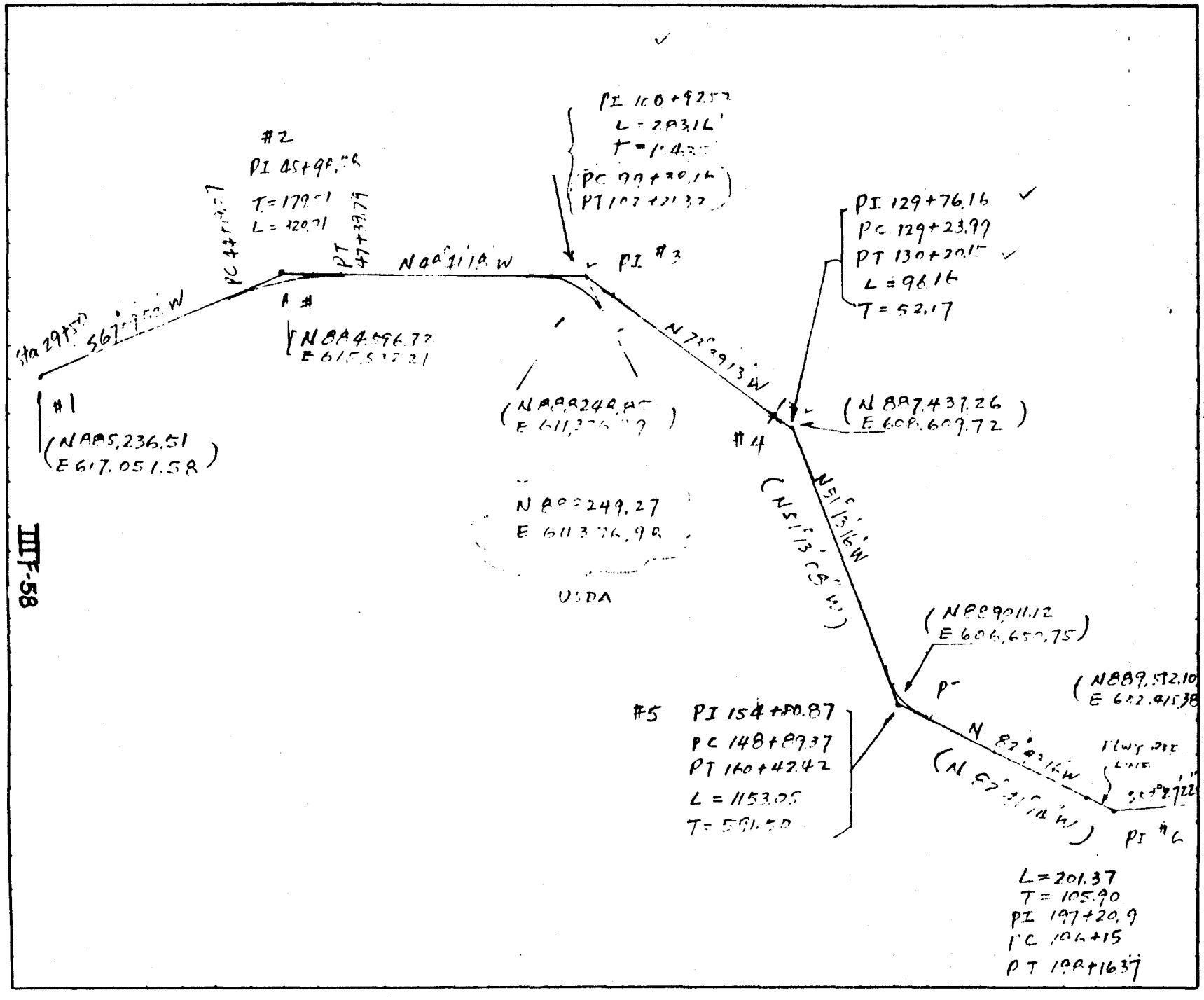
CHECKED BY _____ DATE _____



8810/5-74

EBASCO SERVICES INCORPORATED

BY N. Id DATE 12/12/85
CHKD. BY [illegible] DATE 12/19/85
CLIENT USDA SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY COORDINATE
SHEET 1 OF 19
OFS NO. 3767-300
DEPT. NO. 242



EBASCO SERVICES INCORPORATED

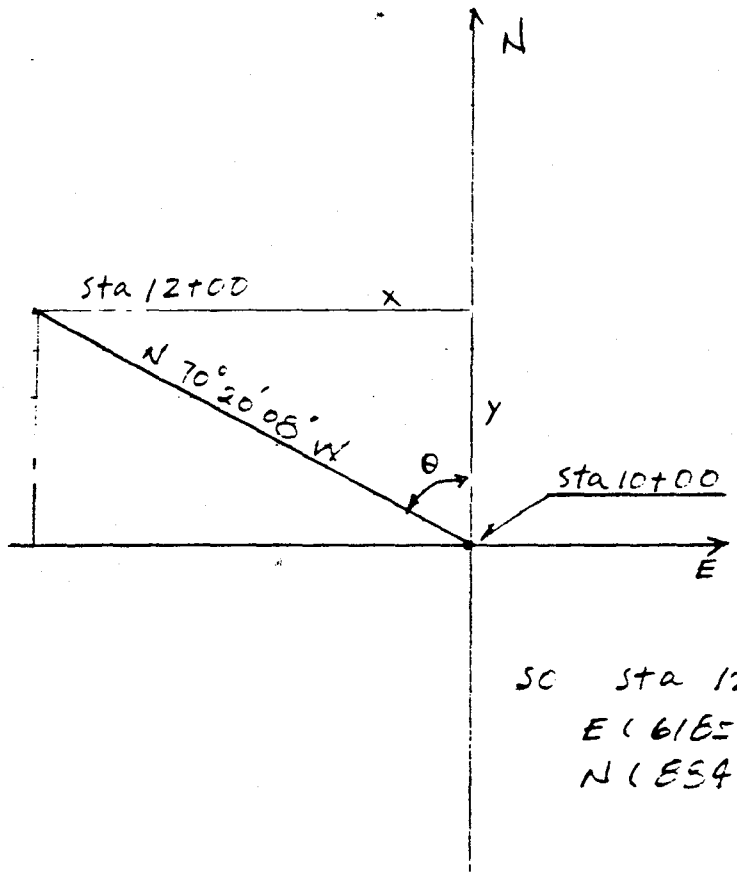
BY N. H. DATE 12/12/85 SHEET 2 OF 19

CHKD. BY R. B. DATE 12/19/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

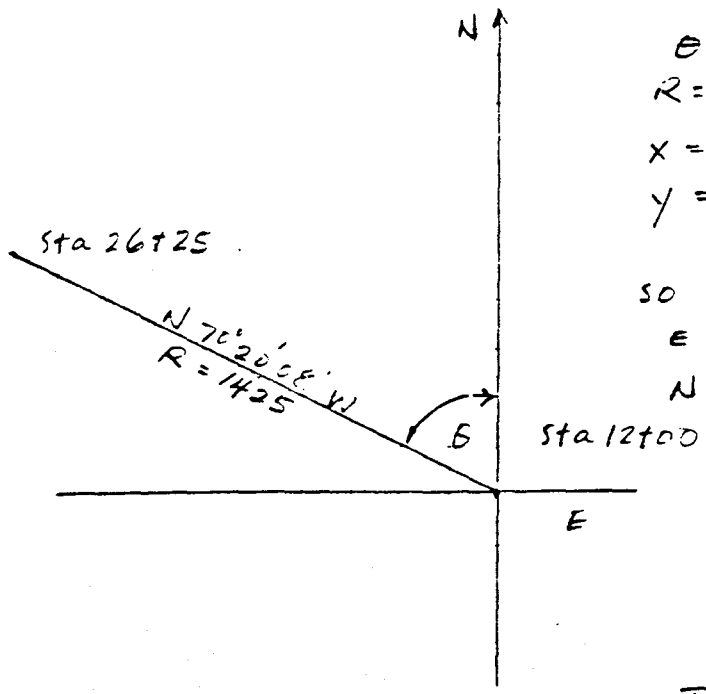
SUBJECT APACHE + BULLDOG FLOODWAY COORDINATE



Sta 10+00
N 884689.68
E 618581.81

$\theta = 70°20'08''$
$= 70.3355555°$
$R = 1200 - 1000 = 200'$
$x = 200 \sin\theta$
$= 188.34'$
$y = 200 \cos\theta$
$= 67.30'$

so Sta 1200:
E (618581.81 - 188.34) = E 618393.47
N (884689.68 + 67.30) = N 884756.98



$\theta = 70.335555°$
$R = 2625 - 1200 = 1425'$
$x = 1425 \sin\theta = 1341.89'$
$y = \cdot\cdot \cos\theta = 479.53'$

so Sta 26+25:
E (618393.47 - 1341.89) = E 617051.58
N (884756.98 + 479.53) = N 885236.51

581/8-81

EBASCO SERVICES INCORPORATED

BY N. H. J. DATE 12/12/85 SHEET 9 OF 19

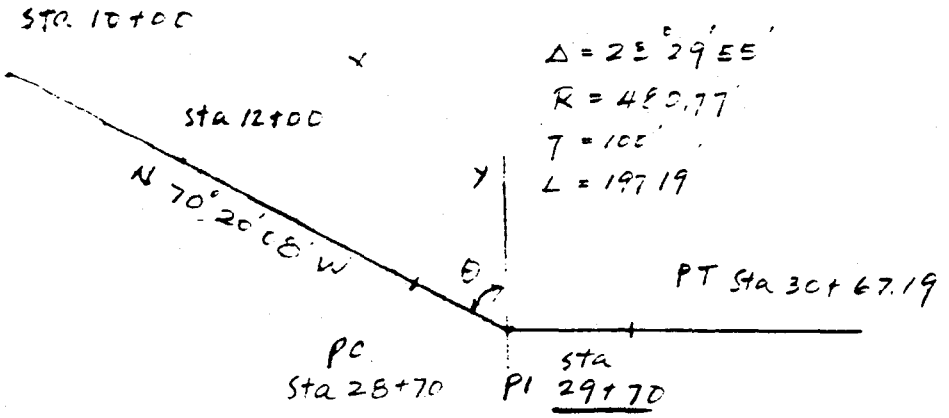
CHKD. BY D. BRIAN DATE 12/19/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE FLOODWAY COORDINATE

N 884,659.68
E 616,581.81



$\Delta = 23°29'55"$
$R = 480.77'$
$T = 100'$
$L = 197.19$

$R = 2970 - 1200 = 1770'$
$\theta = 70.335555°$
$x = R \sin\theta = 1770'(.9416795) = 1666.77$
$y = R \cos\theta = 595.62'$

Sta 29+70
E (616393.47 - 1666.77) = E 616,726.70
N (884756.98 + 595.62) = N 885,352.60

501/8-81

EBASCO SERVICES INCORPORATED

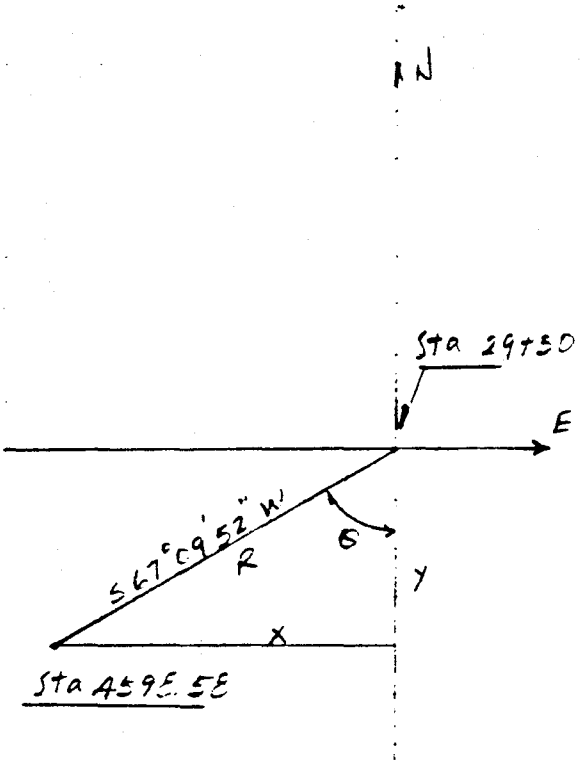
BY 12/12/85 DATE 12/12/85 SHEET 4 OF 19

CHKD. BY [illegible] DATE 12/19/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY COORDINATE



$\theta = 67°09'52'' = 67.164444°$

$R = (4419.07 - 2950) + 179.51 = 1648.58'$

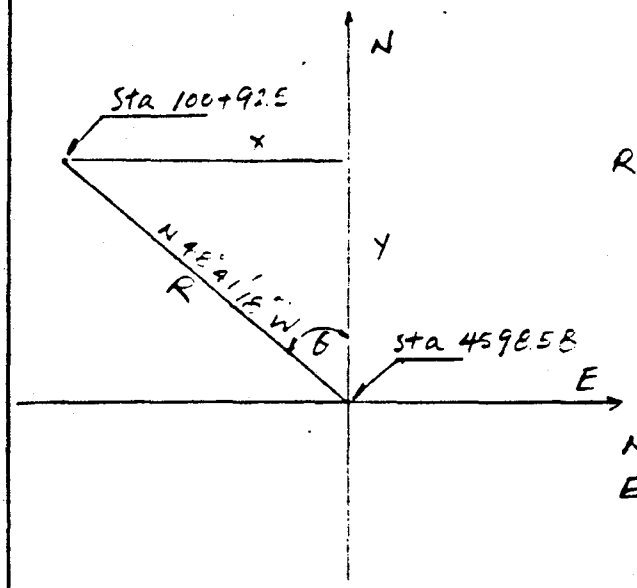
$x = R \sin\theta = 1519.37'$

$y = R \cos\theta = 639.79'$

Sta. 4598.58

N (885,236.51 - 639.79) = 884,596.72

E (617,051.58 - 1519.37) = 615,532.21



$\theta = 48°41'18'' = 48.685333$

$R = (9938.16 - 4739.79) + (179.51 + 1542.5)$

$= 5532.23'$

$x = R \sin\theta = 4155.42$

$y = R \cos\theta = 3652.13$

Sta 100+92.5

N (884,596.72 + 3652.13) = N 888,248.85

E (615,532.21 - 4155.42) = E 611376.79

501/8-81

EBASCO SERVICES INCORPORATED

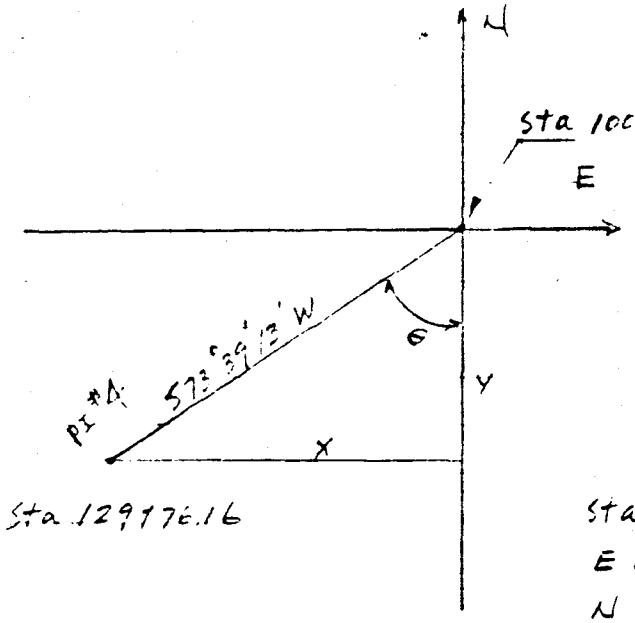
BY N. Hung DATE 12/12/85 SHEET 5 OF 19

CHKD. BY [illegible] DATE 12/19/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY



$\theta = 73°39'13'' = 73.653611°$

$R = (12923.99 - 10092.52) + 52.17$
$= 2883.64$

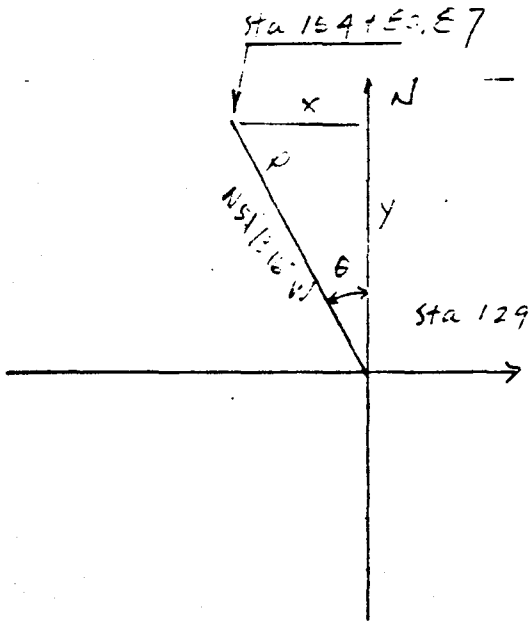
$X = R \sin\theta = 2767.07$

$Y = R \cos\theta = 811.59$

Sta 129+76.16

$E\ (611376.79 - 2767.07) = E\ 608609.72$

$N\ (888248.85 - 811.59) = N\ 887437.26$



$\theta = 51°13'16'' = 51.221111°$

$R = (14889.37 - 13020.15) + 52.17 + 591.50 = 2512.89$

$X = R \sin\theta = 1958.97$

$Y = R \cos\theta = 1573.86$

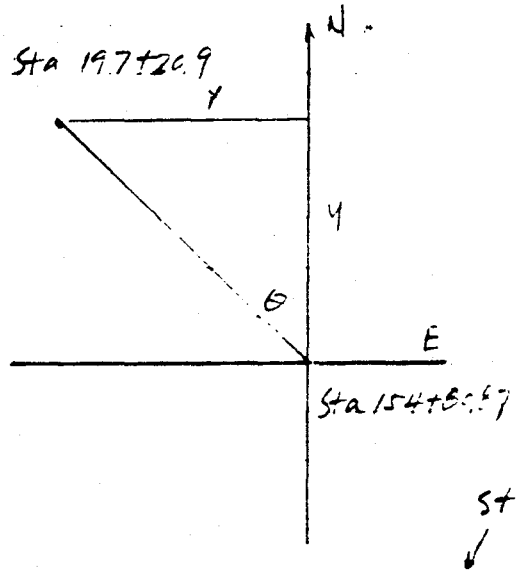
Sta 154+50.57

$E\ (608609.72 - 1958.97 = E\ 606650.$

$N\ (887437.26 + 1573.86 = N\ 889011.12$

III F-62

881/8-81



$\theta = 82°43'16'' W = 82.721111°$

$R = (197+20.7) - (160+42.42) + 591.50$
$= 4269.78$

$R \sin\theta = 4235.37 = x$
$R \cos\theta = 540.98 = y$

Sta 197+20.9

E $606,650.75 - 4235.37 = 602,415.35$ ←

N $889011.12 + 540.98 = 889,552.10$ ←

$\theta = 82.721111$

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 12/12/85 SHEET 7 OF 19

CHKD. BY [illegible] DATE 12/19/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY COORDINATE

FOR $\theta = 51°13'08" = 51.2189°$

$R = 2512$ ft

$x = 1958.91 = R \sin\theta$

$y = 1573.94 = R \cos\theta$

Sta 154+80.87

$E\ (608609.72 - 1958.91) = 606650.81$

$N\ (887437.26 + 1573.94) = 889011.20$

EBASCO SERVICES INCORPORATED

BY N. H. DATE 12/12/85 SHEET 8 OF 19

CHKD. BY [illegible] DATE 12/19/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

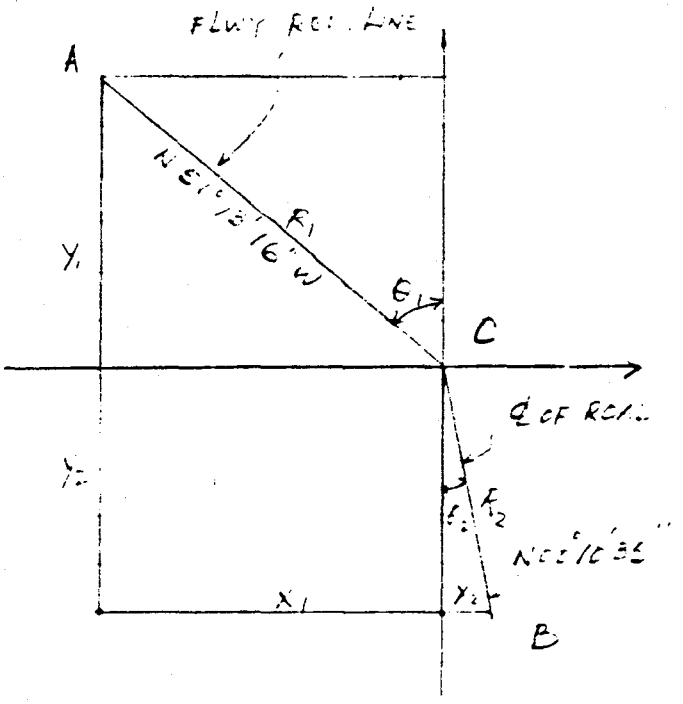
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT APACHE + BULLDOG FLOODWAY COORDINATE

STA No	N	E	
10+00	N 884,689.66	E 616,581.81	
12+00	N 884,756.95	E 615,393.47	
26+25 (29+50)	N 885,236.51	E 617,051.58	
29+70	N 885,352.60	E 616,726.70	
45+95.55	N 884,596.72	E 615,532.21	
100+92.50	N 885,248.85	E 611,376.79	
129+76.16	N 887,437.26	E 608,609.72	
154+50.57	N 889011.12	E 606,650.75	
197+20.9	N 889,552.10	E 602,415.35	

581/8-81

I) INTERSECTION OF ℄ ROAD & FLWY REFERENCE LINE



A: N 889,011.12
E 606,650.75

$\theta_1 = 51°13'16" = 51.22111$

B: N 886,591.62
E 607,874.56

$\theta_2 = 00°10'35" = 0.1763888$

$Y_1 + Y_2 = 889011.12 - 886591.62$
$= 2419.50'$

$X_1 + X_2 = 607874.56 - 606650.75$
$= 1223.81'$

$\tan\theta_1 = 1.244668$
$\tan\theta_2 = .0030785$

$X_1 = Y_1 \tan\theta_1 = (2419.50 - Y_2)\tan\theta_1$
$X_2 = Y_2 \tan\theta_2$

$X_1 + X_2 = (2419.50 - Y_2)\tan\theta_1 + Y_2 \tan\theta_2 = 1223.81$

$2419.50 \times 1.244668 - Y_2 \times 1.244668 + .0030785\, Y_2 = 1223.81$

$1787.71 = 1.2416095\, Y_2, \quad Y_2 = 1439.83'$

$X_2 = Y_2 \tan\theta_2 = 1439.83\,(.0030785) = 4.43'$

$X_1 = 1223.81 - 4.43 = 1219.38'$

$Y_1 = 2419.50 - 1439.83 = 979.67'$

COORDINATION C: N (889011.12 - 979.67) = N 888,031.45
E (606650.75 + 1219.38) = ~~E 608,870.13~~
606,650.75 E 607,870.13

$R_1 = (X_1^2 + Y_1^2)^{\frac{1}{2}} = (1219.38^2 + 979.67^2)^{\frac{1}{2}} = 1564.17'$

$R_2 = (X_2^2 + Y_2^2)^{\frac{1}{2}} = (4.43^2 + 1439.83^2)^{\frac{1}{2}} = 1439.84'$

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 12/16/85 SHEET 10 OF 19

CHKD. BY [illegible] DATE 12/19/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT IRONWOOD DRIVE BRIDGE LOCATION

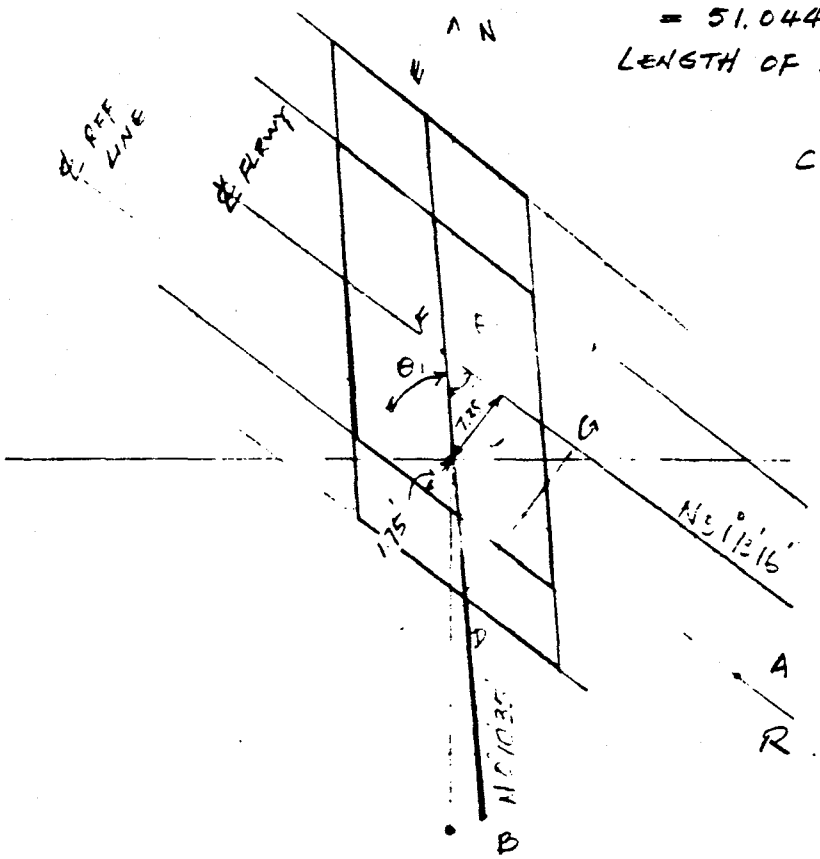
FLWY sta C 148E9.37 + 591.50 − 1564.17 = 13916.70

ROADWAY sta C 1439.84

(II) LOCATION OF BRIDGE : $\theta_1 = 51°13'16'' - 0°10'35'' = 51°2'41''$

$= 51.044722°$

LENGTH OF BRIDGE : 26.573'



$CE = 1.75 / \sin 51°2'41''$

$FD = 26.573/2 = 13.2865'$

$DG = FD \cdot \sin\theta_1$

$= 10.332073$

$CD = (DG - 7.25)/\sin\theta_1$

$= 3.082073 / 0.7776369$

$= 3.96'$

R. sta D :

$14 + (39.84 - 3.96)$

$= 14 + 35.88$

R. sta E.

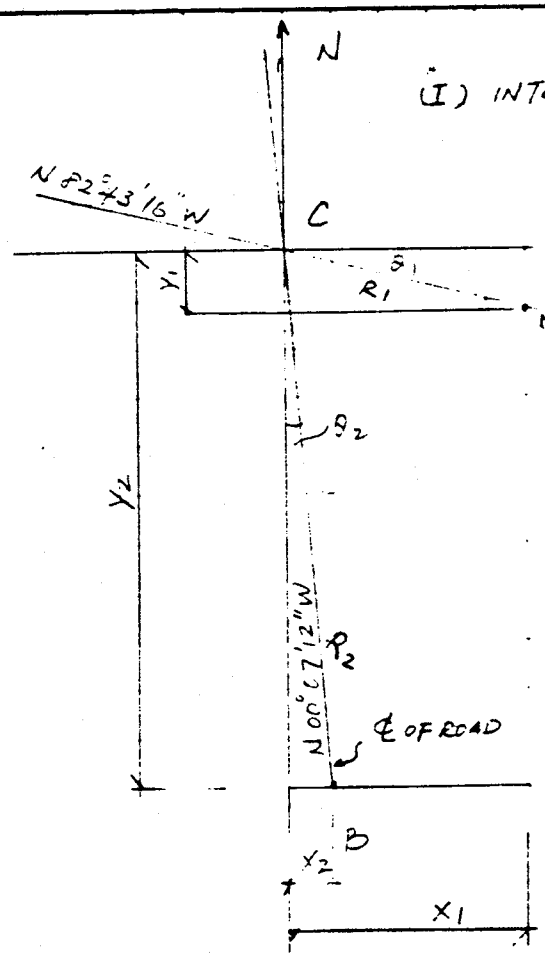
$14 + (35.88 + 26.57)$

$= 14 + 62.45$

$13916.70 - 23.5 = 13893.20$

$1744.5 - (13893.2 - 13841) \times .0052 = 1744.23$

$1744.23 + 4.34 + 1 = 1749.57$



(I) INTERSECTION OF ℄ MERIDIAN ROAD & FLWY REF. LINE

A: N 889,011.12
E 606,650.75

$\theta_1 = 90° - (82°43'16") = 7°16'44"$
$= 7.2788889$

B: N 886,563.54
E 602,616.89

$\theta_2 = 00°07'12" = 0.12°$

$\tan\theta_1 = 0.1277284$, $\tan\theta_2 = .0020943$

$X_1 - X_2 = 606,650.75 - 602616.89$
$= 4033.86$

$Y_2 - Y_1 = 889,011.12 - 886,563.54$
$= 2447.58$

$X_2 = Y_2 \tan\theta_2$, $X_1 = Y_1/\tan\theta_1$

$X_1 - X_2 = Y_1/\tan\theta_1 - Y_2\tan\theta_2 = 4033.86$

$Y_1/\tan\theta_1 - (2447.58 + Y_1)\tan\theta_2 = 4033.86$

$7.8291124Y_1 - 5.125967 - .0020943Y_1 = 4033.86$

$7.8270181Y_1 = 4038.986$ $Y_1 = 516.03$

$X_1 = Y_1/\tan\theta_1 = 4040.07$, $X_2 = 621$
$Y_2 = 2963.61$

COORDINATION C N 889,011.12 + 516.03 = N 889,527.15
E 606,650.75 - 4040.07 = E 602610.68

$R_1 = (X_1^2 + Y_1^2)^{1/2} = (4040.07^2 + 516.03^2)^{1/2} = 4072.87$

$R_2 = (X_2^2 + Y_2^2)^{1/2} = (6.21^2 + 2963.61)^{1/2} = 2963.62$

EBASCO SERVICES INCORPORATED

BY H. Huang DATE 11/18/85 SHEET 12 OF 19

CHKD. BY PAL DATE 11/20/85 OFS NO. 3767-300 DEPT. NO. 273

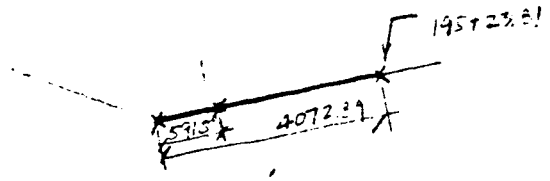
CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT MERIDIAN ROAD BRIDGE LOCATION

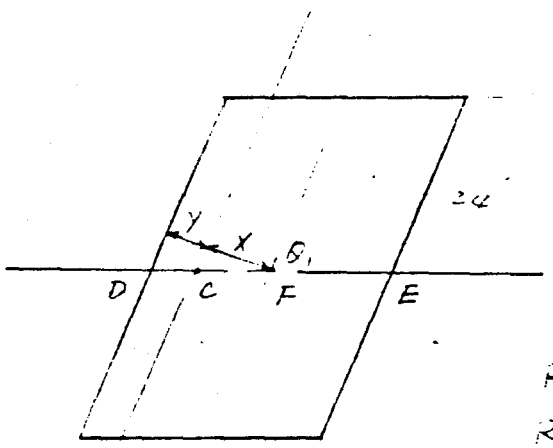
F sta C : F sta 16042.42 + 4072.89 − 591.50 = 195+23.81

R sta C R sta 00+00 + (2963.62) = R sta 29+63.62



LOCATION OF BRIDGE

(II)



LENGTH OF BRIDGE = 53.12

$X = 25 - 1.75' = 23.25$

$\theta_1 = 82°43'16 - 00°07'12 = 82°36'04$

$= 82.6011°$

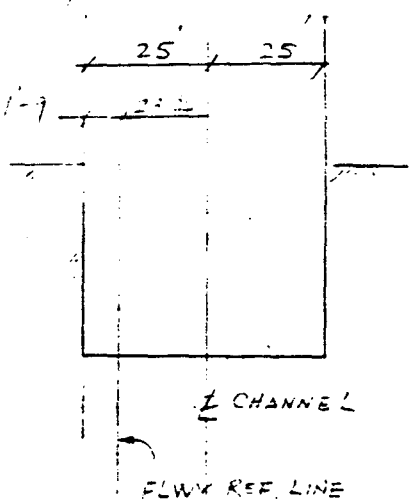
$DF = 53.12/2 = 26.56'$

$CF = X/\sin\theta_1 = 23.25/.9916736 = 23.45$

$DC = 26.56 - 23.45 = 3.11'$

R sta D sta 29+63.62 − (3.11) = sta 29+60.51

R sta E sta 29+(60.51)+(53.12) = sta 30+13.63



581/8-81

EBASCO SERVICES INCORPORATED

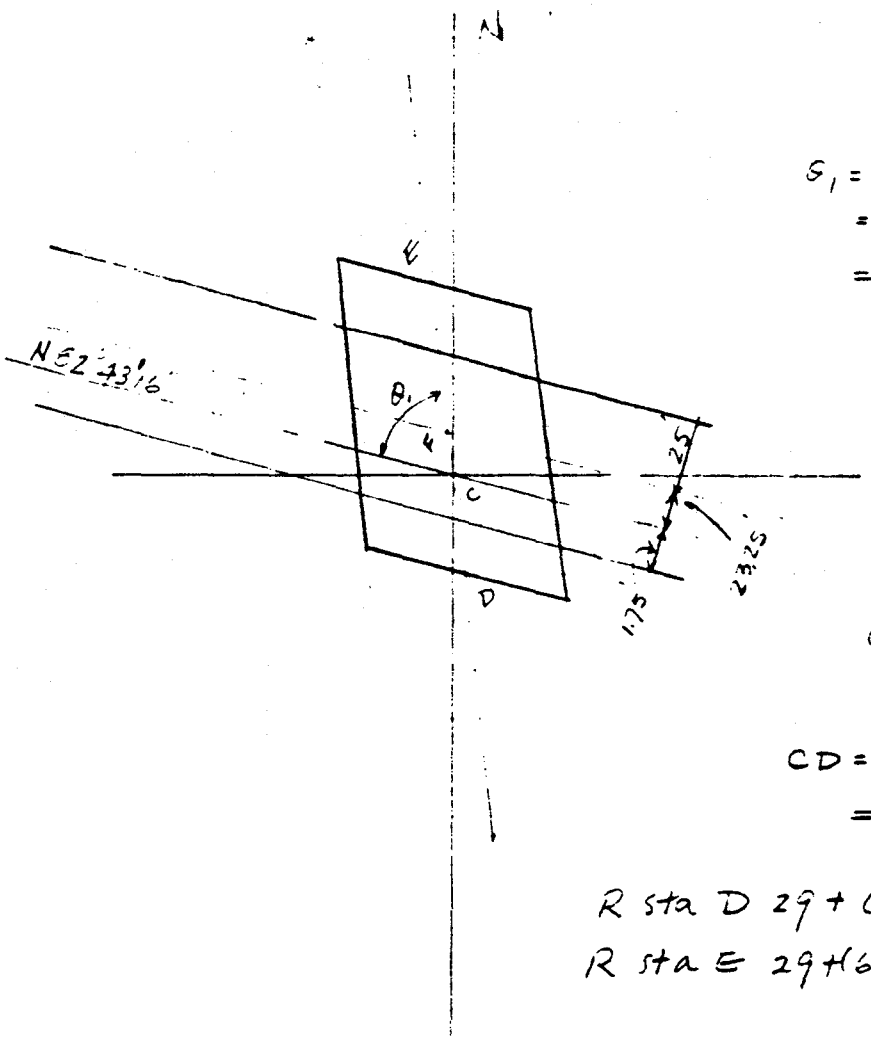
BY N. Young DATE 12/16/85 SHEET 13 OF 19

CHKD. BY P. Patel DATE 3/19/85 OFS NO. 3767-300 DEPT. NO. 343

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT MERIDIAN ROAD BRIDGE LOCATION



$\theta_1 = 82°43'16'' - 0°7'12''$
$= 82°36'4''$
$= 82.601111$

$FD = 53.12/2 = 26.56'$

$CF = 23.25/\sin\theta_1$
$= 23.4452'$

$CD = 26.56 - 23.45$
$= 3.11'$

R sta D $29 + (63.62 - 3.11) = 29+60.51$

R sta E $29+(60.51+53.12) = 30+13.63$

HT. OF WT. = 5.1

ELEV. @ 195+00 = 1709.66 - (20200-19500) x .0051 = 1713.23

ELEV. OF WATER: 1713.23 + 5.1 = 1718.33 + 1 = 1719.33

℄ 195+00

581/8-81

FOR BEARING OF FLWY REF. LINE (N 82°41'14")

$\theta_1 = 90° - (82°41'14") = 7°18'46" = 7.3127778°$

$\tan\theta_1 = 0.1283296 \qquad \tan\theta_2 = .0020943$

A: N 839,011.57 . E 606,650.81 .

B: N 836,563.54 E 602,616.89

$X_1 - X_2 = 4033.92 \qquad Y_2 - Y_1 = 2448.03$

$Y_1/\tan\theta_1 - (2448.03 + Y_1)\tan\theta_2 = 4033.92$

$7.7924345\,Y_1 - 5.1269092 - .0020943\,Y_1 = 4033.92$

$7.7903402\,Y_1 = 4039.0469$

$Y_1 = 518.46862$

$X_1 = Y_1/\tan\theta_1 = 4040.13, \qquad X_2 = 6.21$

$Y_2 = 2966.50$

COORDINATION C N 839,011.57 + 518.47 = N 839,530.04

E 606,650.81 − 4040.13 = E 602610.68

R = 2966.51

N 839,530.03

E 602610.78

2966.63

EBASCO SERVICES INCORPORATED

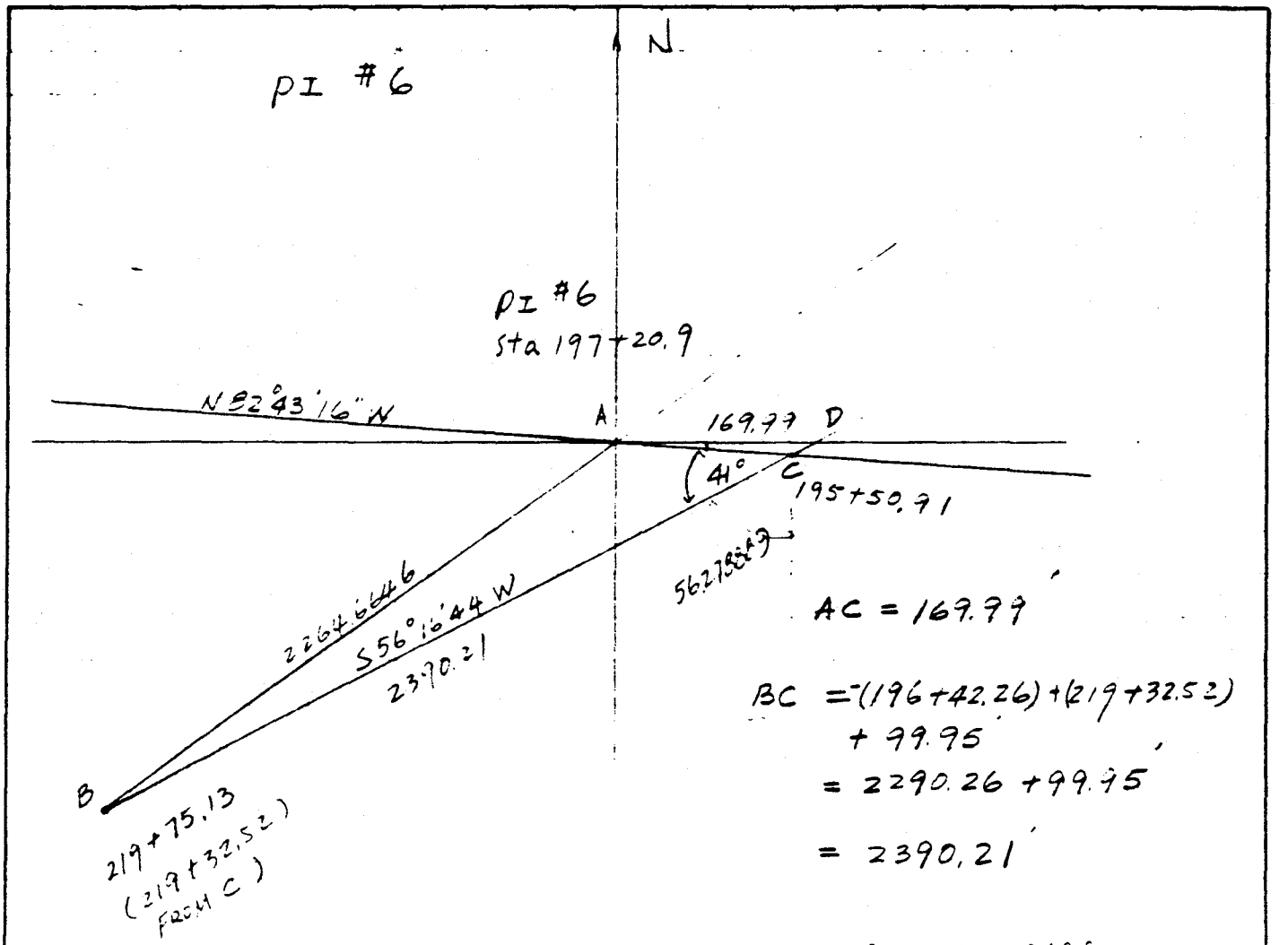
BY N. Hung DATE 1/12/86 SHEET 15 OF 19

CHKD. BY _____ DATE _____ OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY COORDINATE



$AC = 169.99'$

$BC = -(196+42.26) + (219+32.52) + 99.95$

$= 2290.26 + 99.95$

$= 2390.21'$

$\angle ADC = 90 - 56.278889$

$= 33.721111°$

$\angle DAC = 90 - 82.721111$

$= 7.2788889$

$\angle ACB = 33.721111 + 7.2788889$

$= 41.°$

$\overline{AB}^2 = AC^2 + \overline{BC}^2 - 2(AC)(BC)\cos\angle ACB$

$\overline{AB}^2 = 28896.6 + 5713103.3 - 2(169.99)(2390.21)\cos\angle ACB$ (0.7547095)

$= 5742000.4 \quad - 613294.81 \quad -$

$AB = 2264.66$

$\frac{\overline{BC}}{\sin A} = \frac{AB}{\sin 41°}$

$\sin A = \frac{\overline{BC} \cdot \sin 41°}{AB} = .6924391$

$A = 43.822785 = 136.17772$

III F-72

581/8-81

EBASCO SERVICES INCORPORATED

BY N. H. J DATE 1/12/86 SHEET 16 OF 19

CHKD. BY _____ DATE _____ OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

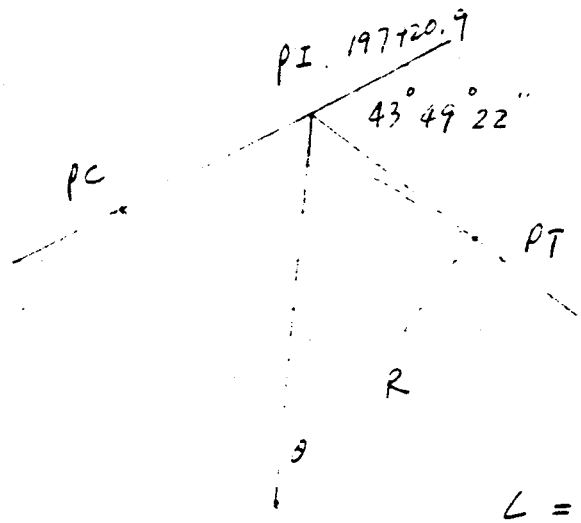
SUBJECT BULLDOG FLOODWAY COORDINATE

BEARING OF AB = 136.17722 + 7.278539 - 90°

= 53.456109°

= 53° 27' 22" ←

S 53° 27' 22" W



PC STA 196+15

T = 105.9

θ = 43.822755/2 = 21.911393°

R = T/tan θ

= 105.9 / 0.4022284 = 263.28

$$L = \frac{2\pi(263.28325)}{360} \times 43.822755$$

= 201.37'

PT Sta (196+15) + 201.37 = 198+16.37

STA NO. AT A :

(193+16.37) + (2264.6646 - 105.9)

= 21975.13 ←

$$D = \frac{5729.58}{R} = 21.762038 = 21° 45' 43"$$

PI. #6

PC STA 196+15 , PI STA 197+20.7

PT STA 198+16.37

Δ = 43° 49' 22" D = 21° 45' 43

R = 263.28' , L = 201.37'

III F-73

581/8-81

EBASCO SERVICES INCORPORATED

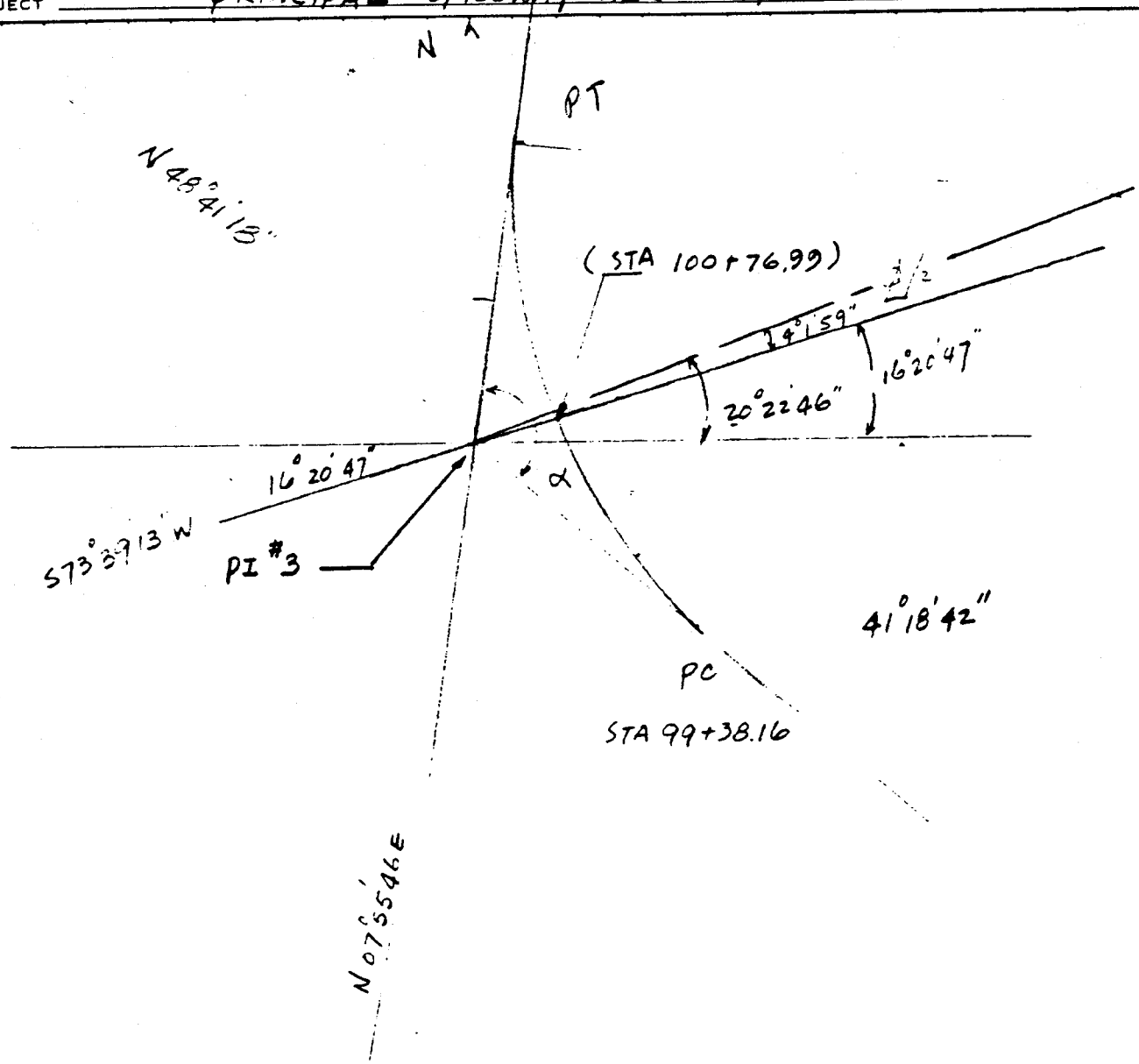
BY N. Hung DATE 1/15/86 SHEET 17 OF 19

CHKD. BY _____ DATE _____ OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SC'L CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT PRINCIPAL SPILLWAY ALIGNMENT



$\alpha = 180° - (48°41'18" + 7°55'46") = 180 - 56°37'4" = 123°22'56"$

$\alpha/2 = 61°41'28"$

$61°41'28" - 41°18'42" = 20°22'46"$

$20°22'46" - 16°20'47" = 4°1'59"$

581/8-81

EBASCO SERVICES INCORPORATED

BY N Hung DATE 1/15/86 SHEET 18 OF 19

CHKD. BY _____ DATE _____ OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

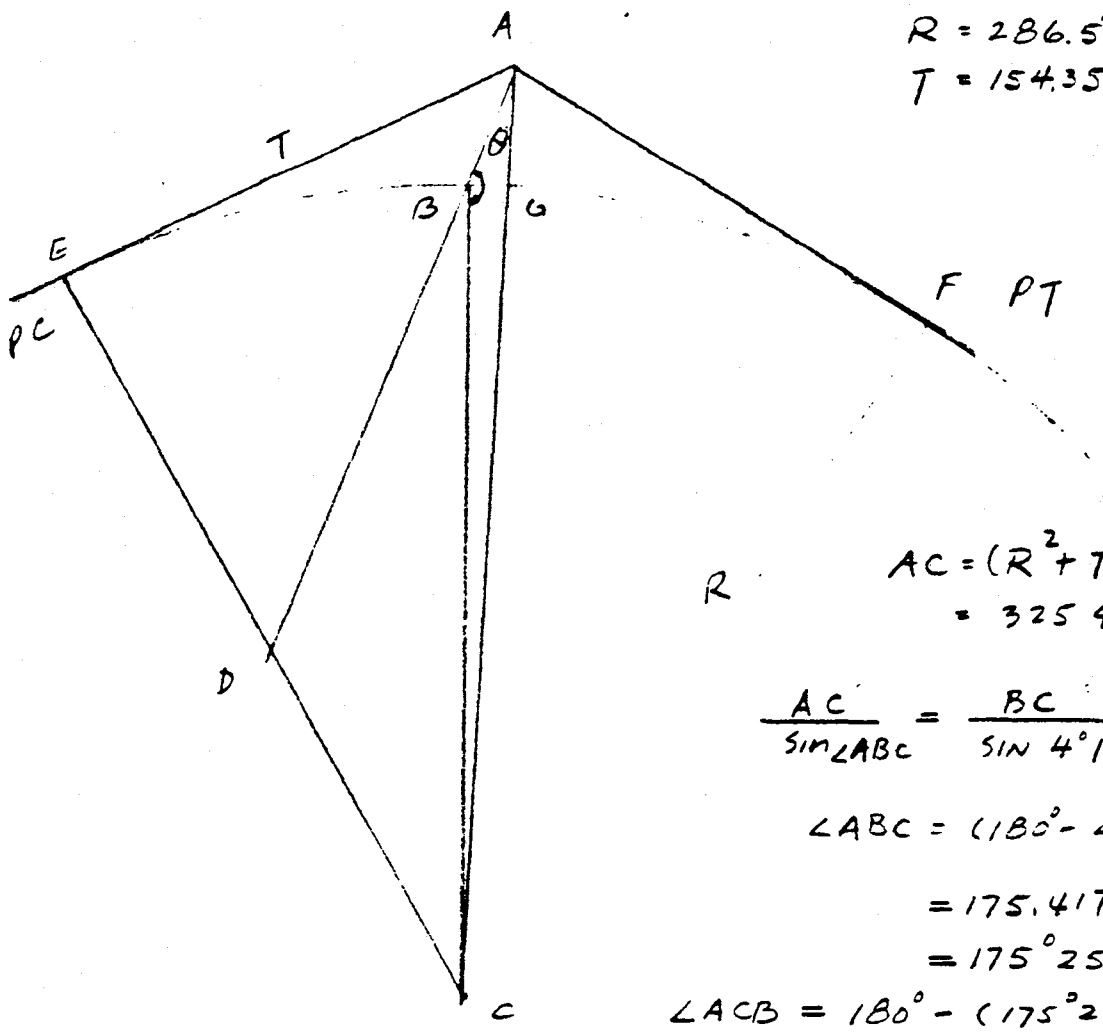
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT PRINCIPAL SPILLWAY ALIGNMENT

$\theta = 4^\circ 1' 59''$

$R = 286.55'$

$T = 154.35'$



$AC = (R^2 + T^2)^{1/2}$

$= 325.4763'$

$$\frac{AC}{\sin \angle ABC} = \frac{BC}{\sin 4^\circ 1' 59''}$$

$\angle ABC = (180^\circ - 4.5820253)$

$= 175.41797$

$= 175^\circ 25' 5''$

$\angle ACB = 180^\circ - (175^\circ 25' 5'' + 4^\circ 1' 59'')$

$= 180^\circ - (179^\circ 27' 4'')$

$= 0^\circ . 32' 56''$

$$\overset{\frown}{BG} = \frac{2\pi (286.55)}{360} \times 0^\circ 32' 56'' = 2.75'$$

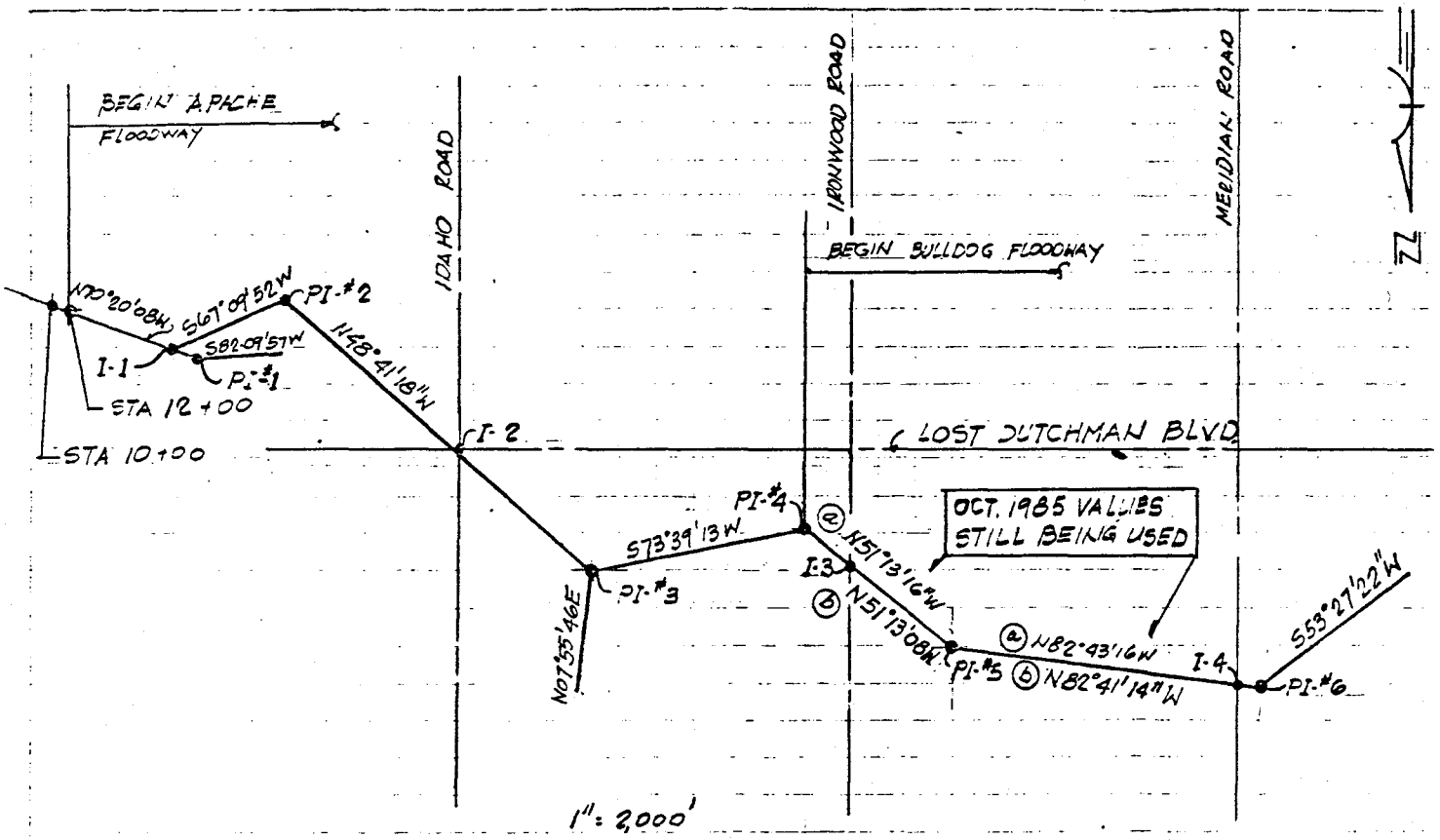
$$\overline{AB} = \frac{AC}{\sin \angle ABC} \times \sin \angle ACB \qquad \overline{AB} = \frac{325.4763}{.0798862} \times .0095797 = 39.03'$$

STA NO. OF B : $(99+38.16) + \left(\frac{283.16}{2}\right) - (2.75)$

$= 10076.99$

III F-75

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT ALIGNMENT SCHEMATIC



EBASCO SERVICES INCORPORATED

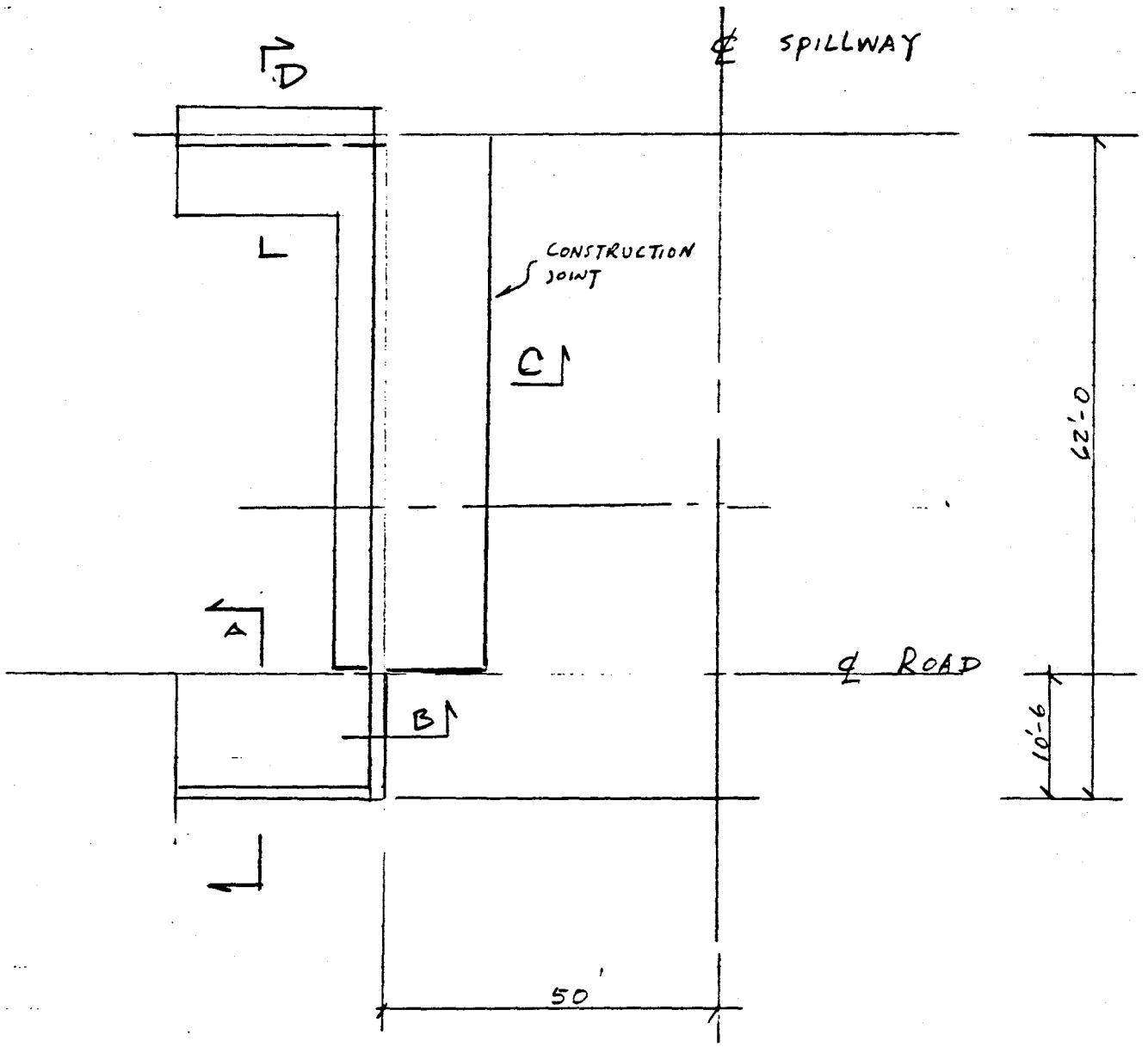
BY N. Hung DATE 2/19/86 SHEET 1 OF

CHKD. BY P. Baran DATE 2/24/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY



581/8-81

EBASCO SERVICES INCORPORATED

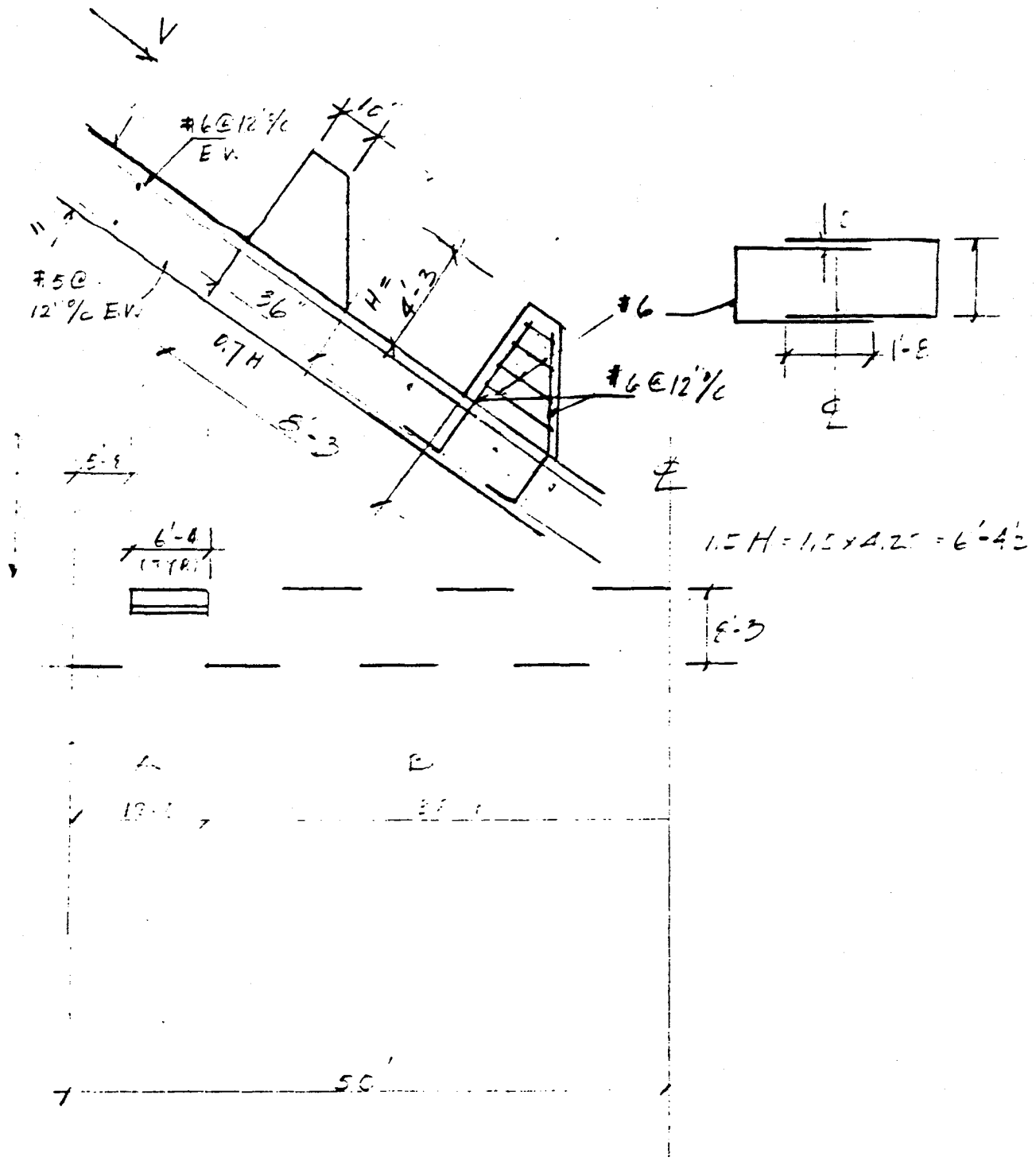
BY N. Huang DATE 2/17/84 SHEET 1 OF

CHKD. BY P. Eaton DATE 2/21/84 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY WALL



EBASCO SERVICES INCORPORATED

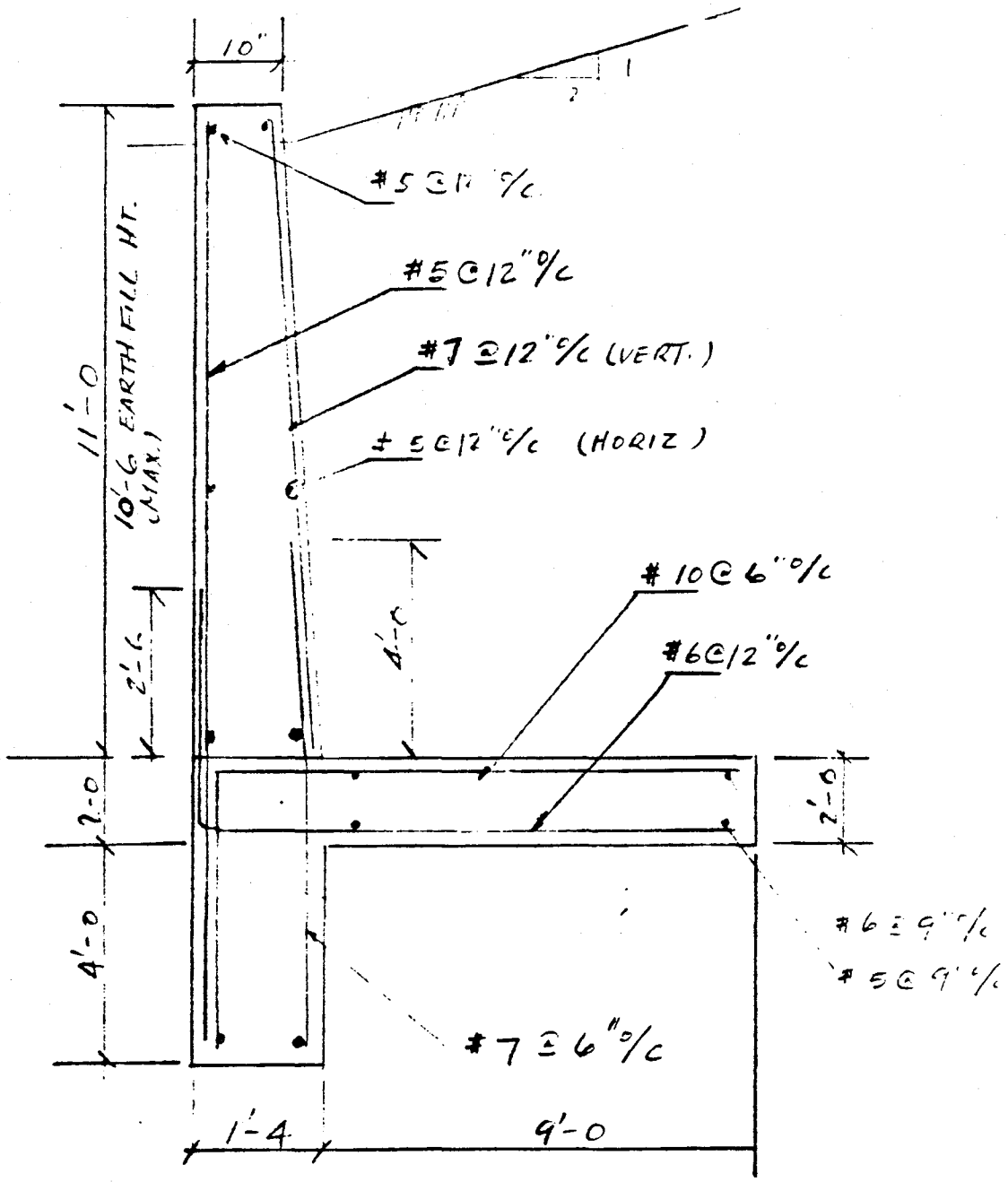
BY N. H. J. DATE 2/17/86 SHEET 3 OF

CHKD. BY P. BARN DATE 2/24/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY WALL



(A)

III F-79

56'/8-61

EBASCO SERVICES INCORPORATED

BY P. BORAN DATE 1.16.86 SHEET 4 OF

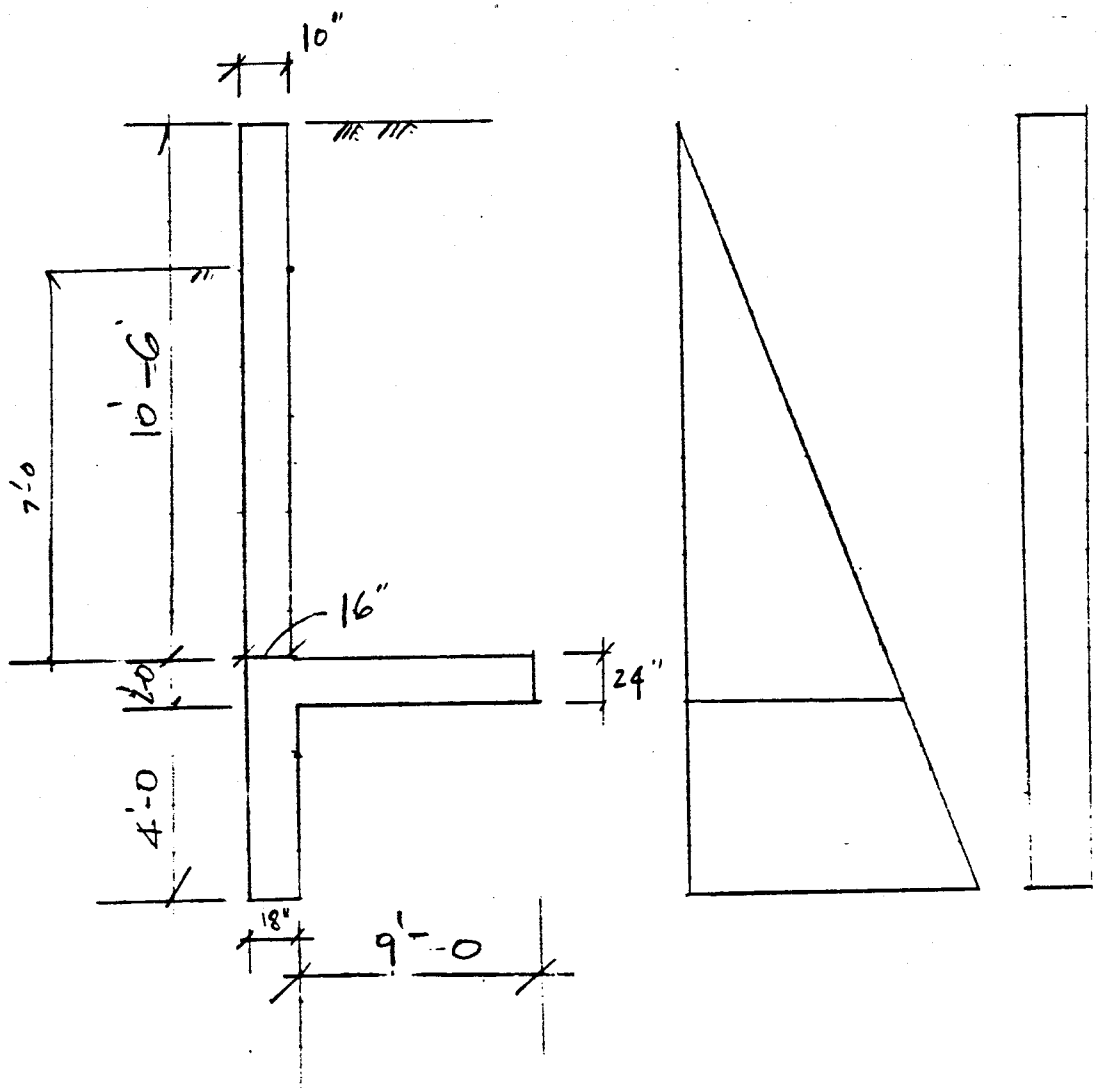
CHKD. BY N. 16 DATE 2-18-86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT

PROJECT USDA-SOIL CONSERVATION SERVICE
APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY WALL

EMERGENCY SPILLWAY - PLAN SECTIONS.



SOIL COULD BE ON EITHER OF THE WALL

EQUIVALENT FLUID PRESSURE = 78 PCF
ADDITIONAL SURCHARGE LOAD = 156 PSF

581/8-81

EBASCO SERVICES INCORPORATED

BY P. BARAN DATE 1/16/86 SHEET 5 OF

CHKD. BY N.10 DATE 2/18/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY

EMERGENCY SPILLWAY DESIGN

WALL DESIGN : OUTSIDE FACE

HEIGHT 7'-0 (MAX. SOIL HT AT OUTSIDE FACE)

$M = \frac{1}{6} \times 7^3 \times 78 + \frac{1}{2} \times 156 \times 7^2 = 4460 + 3822 = 8282^{\#}$

$M_u = 1.8 \times 8.3 = 14.94^{'k}$ $d = 12 - 3 = 9$

$F = \frac{bd^2}{12{,}000} = \frac{12 \times 13^2}{12{,}0000} = .169$

$K = M_u/F = 14.94/.169 = 88.4$ $a_u = 2.955$

$A_s = \frac{14.94}{2.955 \times 13} = 0.39$ $1.33 A_s = 0.52^{\square''}/'$

#5@12"/c + #6@12"/c

HEIGHT 4'-6

$M = \frac{1}{6} \times 4.5^3 \times 78 + \frac{1}{2} \times 156 \times 4.5^2 = 1185 + 1580 = 2765^{'\#}/'$

$M_u = 1.8M = 5.0^{'k}/'$ $t = 10'' + 6 \times \frac{8}{10.5} = 14.57''$ SAY 14"

$F = .121$ $K = 5.0/.121 = 41.3$ $a_u = 2.96$

$A_s = 5.0/2.96 \times 11 = 0.153^{\square''}/'$ $1.33 A_s = 0.20^{\square''}/'$ — #5@12"/c

HORIZ. BARS: $.002 \times 12 \times 13'' = .31^{\square''}/'$ #5@12"/c
(AVE.)

INSIDE FACE :

$H = 10'-6$

$M = \frac{1}{6} \times 10.5^3 \times 78 + \frac{1}{2} \times 156 \times 10.5^2 = 15{,}049^{'\#} + 8600^{'\#} =$
$= \underline{23{,}649^{'\#}}$

$M_u = 1.8 \times 23{,}649 = 42.568^{'\#} \cong \underline{43^{'k}}$

581/8-81

EBASCO SERVICES INCORPORATED

BY P. BARAN DATE 1/16/86 SHEET 0 OF

CHKD. BY N.10 DATE 2/18/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY

EMERGENCY SPILLWAY DESIGN

$F = \frac{bd^2}{12{,}000} = \frac{12 \times 13^2}{12{,}000} = .169$

$f'_c = 4000$
$f_y = 40{,}000$

$K = \frac{M_u}{F} = \frac{43}{.169} = 254 \rightarrow a_u = 2.87$

$A_s = \frac{M_u}{a_u d} = \frac{43}{2.87 \times 13} = 1.15 \text{ in}^2$ USE #7 @ 6"o/c ($A_s = 1.20 \text{ in}^2$)

CHECK SHEAR

$V = 78 \times 10.5 \times 10.5/2 + 156 \times 10.5 = 4300 + 1638 = 5938^{\#}$

$V_u = 1.8 \times 5938 = 10{,}688^{\#}$

$v_u = \frac{10{,}688}{12 \times 13} = 68.5 \text{ psi} < 108 \text{ psi}$

$H = 6'-6$

$M = \frac{1}{6} \times 78 \times 6.5^3 + \frac{1}{2} \times 156 \times 6.5^2 = 3570 + 3296 = 6866^{1\#/'}$

$M_u = 1.8M = 12.36^{1K/'}$ $t = 10 + 6" \times \frac{6.5}{10.5} = 13.7"$

SAY $t = 13"$ $d = 10"$ $F = 0.1$

$K_u = M_u/F = 12.36/0.1 = 124.$ $a_u = 2.94$

$A_s = 1.33 \times \frac{12.36}{2.94 \times 10} = 0.56^{\square"/'}$ — #7 @ 12"o/c

581/8-81

FOUNDATION:

$$M_o = 48 \times \frac{12.0^2}{2} \times \frac{1}{3} \times 12 + 48 \times 2 \times 12.0 \times 6 = 22{,}464 + 11{,}232 = 33{,}696^{\#}$$

$$M_R = 10.5 \times 1.25 \times 1.25/2 \times .15 + 6 \times 1.5 \times 1.5/2 \times .15 + 9 \times 2 \times 6 \times .15 + 9 \times 10 \times 6 \times .13 = 1.23 + 1.01 + 16.2 + 70.2 = 88.64$$

$$\text{VERTICAL LOAD} = 10.5 \times 1.25 \times .15 + 6 \times 1.5 \times .15 + 9 \times 2 \times .15 + 10 \times 9 \times .13 = 1.97 + 1.35 + 2.7 + 11.7 = 17.72$$

$$e' = \frac{M_R - M_o}{\text{VERT. LOAD}} = \frac{88.64 - 33.696}{17.72} = 3.1'$$

$$e = \frac{10.5}{2} - 3.1 = 2.15' > \frac{b}{6} = \frac{10.5}{6} = 1.75$$

$$SF = \frac{\overset{M_R}{88.64}}{\underset{M_o}{33\,696}} = 2.63 > 1.5$$

$$\text{DRIVING FORCE} = 12^2 \times 48 \times 1/2 + 156 \times 12.0 = 5616 + 1872 = 7{,}488^{\#}$$

$$\text{RESISTING FORCE} = (9 \times 10 \times .13 + 1.25 \times 10.5 \times .15 + 9 \times 2 \times .15 + 6 \times 1.5 \times .15) \times .35 + 6^2 \times .130 \times 3 \times 1/2 = \underbrace{(11.7 + 1.97 + 2.7 + 1.35) \cdot .35}_{6.19} + 4.02 = 13.22^{k}$$

EBASCO SERVICES INCORPORATED

BY P. Brown DATE 1/16/86 SHEET 8 OF

CHKD. BY N. 10 DATE 2/18/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT

PROJECT USDA-SOIL CONSERVATION SERVICE

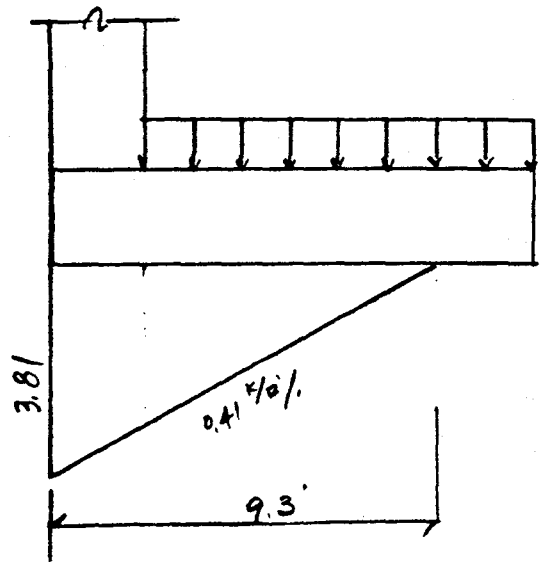
SUBJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

EMERGENCY SPILLWAY DESIGN.

SAFETY FACTOR = $\frac{13.22}{7.5} = 1.76 > 1.5$ O.K.

$\sigma_{max} = \frac{2 \times 14.42}{3 \times 3.1} = 3.81 KSF < 4.0 KSF$ O.K.

FOUNDATION DESIGN.



TOP BARS:

$W = 10 \times .13 = 1.3 K/'$

$M_{u_1} = 1.3 \times 1.8 \times 9^2/2 = 95 K'$

$M_{u_2} = 2 \times .15 \times 1.8 \times 9^2/2 = 21.84$

$116.87^{'K}$

$F = \frac{bd^2}{12,000} = 12 \times 14.5^2 / 12,000 = .210$

$K = \frac{M}{F} = 114/.38 = 308 \longrightarrow a_u = 2.84$

$A_s = \frac{M_u}{a_u d} = \frac{114}{2.84 \times 19.5} = 2.11 in^2$ USE #10 @ 6

SHEAR

$V_u = 1.6 \times 1.8 \times 9 = 26^K$ (S.F.)

$v_u = \frac{26}{12 \times 19.5} = 110 \simeq 108$ is o.k.

EBASCO SERVICES INCORPORATED

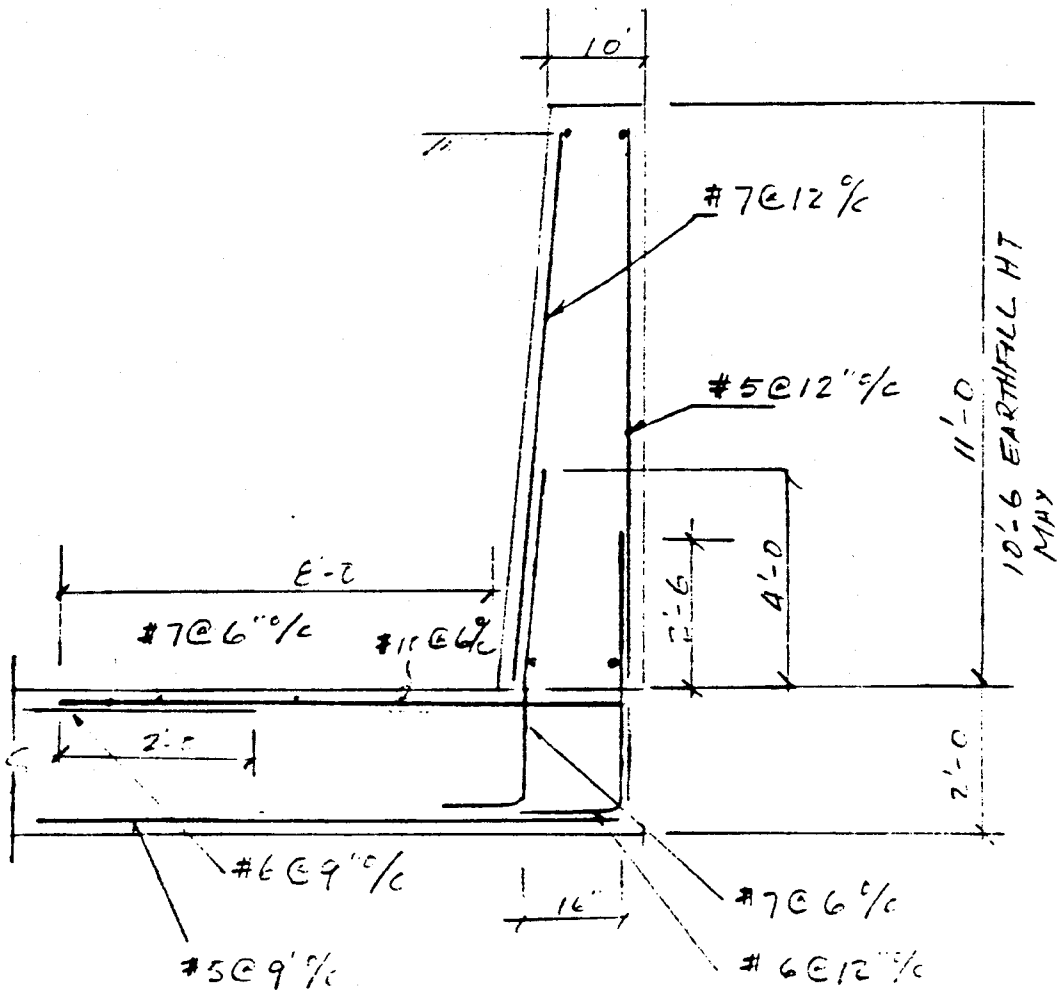
BY N. Hung DATE 2/3/86 SHEET 9 OF

CHKD. BY P. Parks DATE 2/4/86 OFS NO. 3767 300 DEPT. NO. 223

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT



B

EBASCO SERVICES INCORPORATED

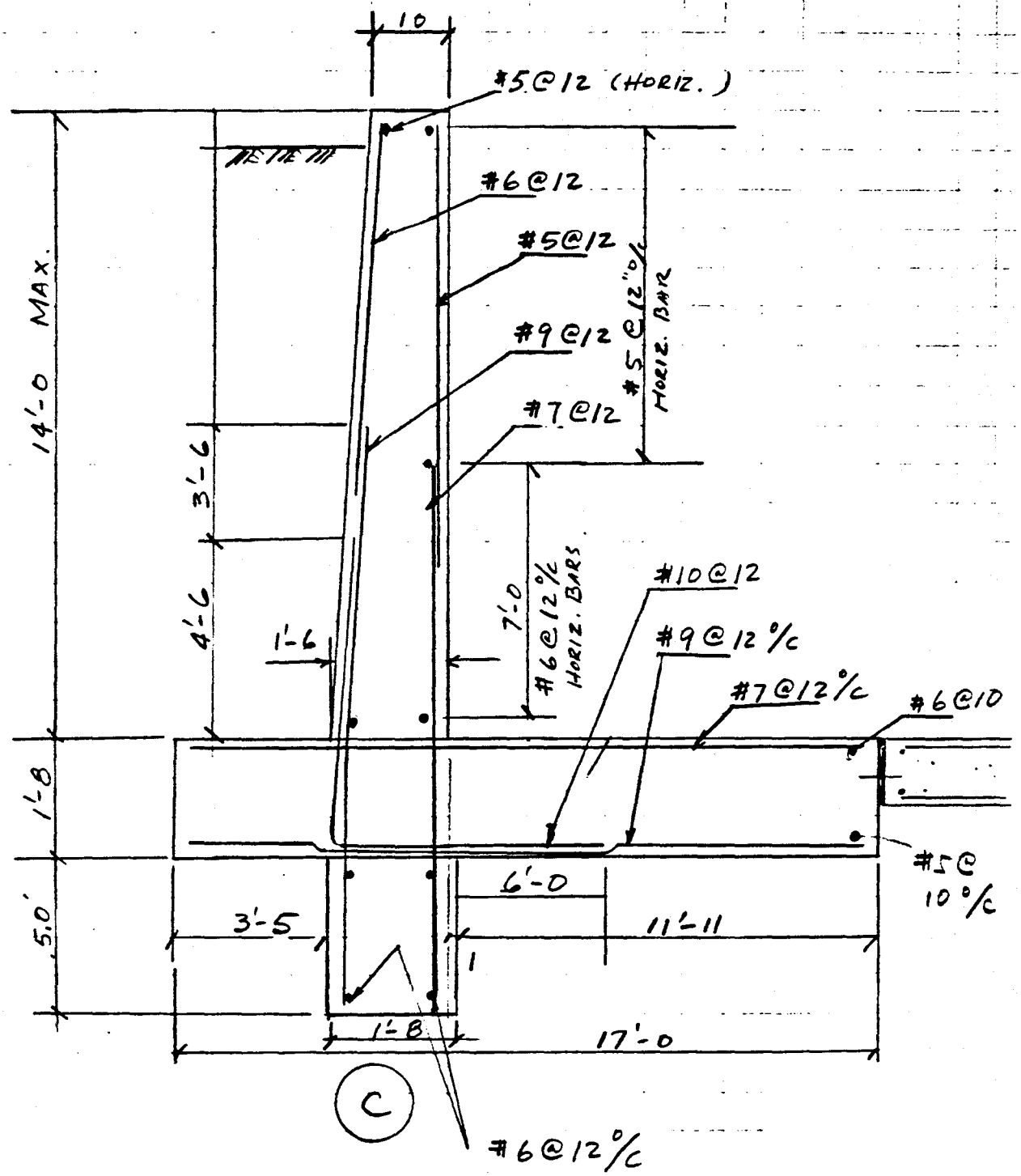
BY N. Hung DATE 7/3/86 SHEET 10 OF

CHKD. BY P. Baran DATE 2/24/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERENCY SPILLWAY WALL



III F-86

581/8-81

WALL DESIGN: UNEXPOSED FACE VERT. BARS

$H = 13'-6$

$M = \frac{1}{6} \times 78 \times 13.5^3 + \frac{1}{2} \times 78 \times 13.5^2 \times 2$

$= 31984 + 14215 = 46200'\#/' = 46.2'^K/'$

$M_u = 1.8M = 83.2'^K/'$

$t = 15''$ $F = .225$ $K_u = M_u/F = 83.2/.225 = 370$

$a_u = 2.81$ $A_s = 83.2/(15 \times 2.81) = 1.97\ \square''/'$ — #9 @ 6" o/c

(#9 @ 12" o/c + #10 @ 12" o/c)

$P_h = \frac{1}{2} \times 78 \times 13.5^2 + 156 \times 13.5$

$= 7107 + 2106 = 9213\ \#/'$

$V_u = 1.8 P_h = 16584\ \#/'$

$v_u = \frac{V_u}{bd} = 16584/(12 \times 15) = 92.1\ \#/\square'' < 2\phi\sqrt{f_c'}$

$H = 9'-6$

$M = \frac{1}{6} \times 78 \times 9.5^3 + \frac{1}{2} \times 78 \times 2 \times 9.5^2$

$= 11146 + 7039 = 18184'\#/' = 18.2'^K/'$

$M_u = 1.8M = 32.7'^K/'$

$18 - 8 \times \frac{4}{14} = 15.7$ SAY 15" $t = 12''$

$F = .144$ $K_u = M_u/F = 32.7/.144 = 227$

$a_u = 2.885$ $A_s = M_u/a_u d = 32.7/(2.885 \times 12) = 0.95\ \square''/'$

#9 @ 12" o/c

$H = 5'-6$

$M = \frac{1}{6} \times 78 \times 5.5^3 + \frac{1}{2} \times 78 \times 2 \times 5.5^2 = 2162 + 2360 = 4523'\#/'$

$M_u = 1.8M = 8.2'^K/'$

$18 - 8 \times \frac{8}{14} = 13.4''$ SAY 13" $F = .10$

$K_u = 8.2/0.1 = 82$ $a_u = 2.955$

$$A_s = \frac{M_u}{a_u d} = \frac{8.2}{10 \times 2.955} = 0.28 \text{ in}^2/'$$

$$1.33 A_s = 0.37 \text{ in}^2/' \quad \text{— \#6@12"o/c}$$

HORIZ. BARS: $.001 \times \frac{10+18}{2} \times 12 = 0.17 \text{ in}^2/'$ #4@12"o/c.

EXPOSED FACE:

VERT. BAR & HORIZ. BARS.

0'~7' FROM TOP OF FTG. $A_{s_{min}} = 18 \times 12 \times .002 = 0.43 \text{ in}^2/'$ #6@12"o/c

7'-0 TO 14' FROM TOP OF FTG. $A_{s_{min}} = 12" \times \frac{10+14}{2} \times .002 = 0.29$ #5@12"o/c

FOUNDATION DESIGN:

RESISTING MOMENT:

$.120 \times 13.5 \times 3.5 = 5.67 \times (\frac{3.5}{2} + 13.5) = 86.46$

$.15 \times \frac{14}{12} \times 14 = 2.45 \times (.58 + 12) = 30.82$

$.15 \times \frac{20}{12} \times 17 = 4.25 \times 17/2 = 36.10$

$12.37^{K/'}$ $153.39^{K/'}$

ACTING MOMENT:

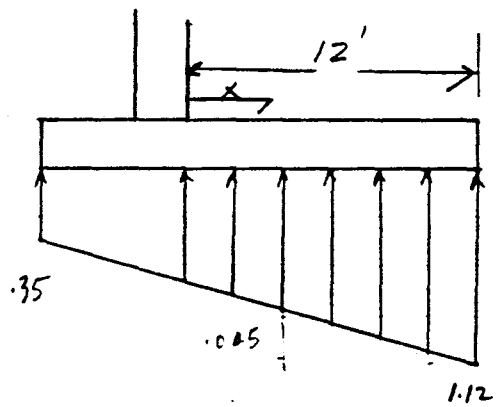
$M = 67.15^{'K/'}$ (SEE P.)

S.F. AGAINST OTM $= \frac{153.38}{67.15} = 2.28 > 1.5$

$e' = \frac{153.38 - 67.15}{12.37} = 6.97$, $e = \frac{17}{2} - 6.97 = 1.53 < \frac{17}{6}$

SOIL PRESSURE $= \frac{12.37}{17}(1 \pm \frac{6 \times 1.53}{17})$

$= .728(1 \pm 0.54) = 1.12^{K/\square'}$ OR $0.35^{K/\square'}$



BOTTOM BARS: $x = 0$

$M = (1.12 - .15 \times \frac{20}{12}) \times \frac{12^2}{2} - \frac{1}{6} \times .045 \times 12^3$

$= 62.64 - 12.96 = 49.68^{'K/'}$

$M_u = 1.8M = 89.42^{'K/'}$

$d = 20 - 4 = 16''$ $F = .256$

$K_u = M_u/F = 89.42/.256 = 349$

$a_u = 2.815$

$A_s = M/a_u d = 89.42/2.815 \times 16 = 1.98^{\square''/'}$

#9 @ 6"o/c

$x = 4'-0$ $M = (1.12 - .15 \times \frac{20}{12}) \times \frac{8^2}{2} - \frac{1}{6} \times .045 \times 8^3$ (#9 @ 12"o/c + #10 @ 12"o/c)

$= 27.84 - 3.84 = 24.0^{'K}$

$M_u = 1.8M = 43.2^{'K/'}$ $K_u = 43.2/.256 = 169$ $a_u = 2.91$

$A_s = 43.2/2.91 \times 16 = .93^{\square''/'}$ — #9 @ 12"o/c

$x = 6'-6''$

$$M = (1.12 - .15 \times \frac{20}{12}) \times \frac{5.5^2}{2} - \frac{1}{6} \times .045 \times 5.5^3$$

$$= 13.16 - 1.24 = 11.92 \ ^{'k}/_{'}$$

$M_u = 1.8M = 21.45 \ ^{'k}/_{'}$ $\quad K_u = 21.45/.256 = 84$

$a_u = 2.955$

$$A_s = 1.33 \times \frac{21.45}{16 \times 2.955} = 0.60 \ ^{\square''}/_{'} \qquad \#7 @ 12''\ o/c$$

CHECK SHEAR $\quad V_u = 1.8\left[(1.12 - .15 \times \frac{20}{12}) \times 12 - .045 \times \frac{12^2}{2}\right] = 1.8(10.44 - 3.24)$

$= 12.96 \ ^{k}/_{'}$

$$v_c = \frac{12.96 \times 1000}{12 \times 17} = 64 \ ^{\#/\square''}$$

TOP BARS

$$A_{s_{min}} = .0020 \times 12 \times 20 = 0.48 \ ^{\square''}/_{'}$$

$\#6 @ 10''\ o/c$ OR

$\#7 @ 12''\ o/c$

TRANSVERSE TOP BARS

$$M = .13 \times 13.5 \times \frac{1}{2} \times 3.5^2 = 10.74$$

$M_u = 1.8 \times 10.74 = 19.4 < 21.45 \ ^{'k}$ $\quad \#7 @ 12\ o/c$

SLIDING:

ACT. FORCE $= 9213 \ ^{\#}/_{'} = 9.2 \ ^{k}/_{'}$

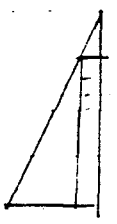
RESIST. " $= (12.37 + .15 \times 4.5 \times 1.6) \times .35 = 4.71$ — D. WT. OF KEY

$\frac{1}{2} \times .30 \times 6.0^2 = 5.40$

10.11

WITHOUT SURCHARGE ACT. FORCE $P_a = 7.1$

S.F. AGAINST SLIDING $= 10.11/7.1 = 1.42 \doteq 1.5$ O.K



$$M = \frac{1}{6} \times .30 \times 5^3 + .3 \times \frac{1}{2} \times 5^2 = 6.25 + 3.75 = 10.0 \ ^{'k}/_{'}$$

$M_u = 1.8 \times 10.0 = 18 \ ^{'k}$ $\quad F = .289$

$M_u/F = 18/.289 = 62.2$

$$A_s = 1.33 \times 18/2.96 \times 17 = 0.48 \ ^{\square''}/_{'} \qquad \#7 @ 12''\ o/c$$

EBASCO SERVICES INCORPORATED

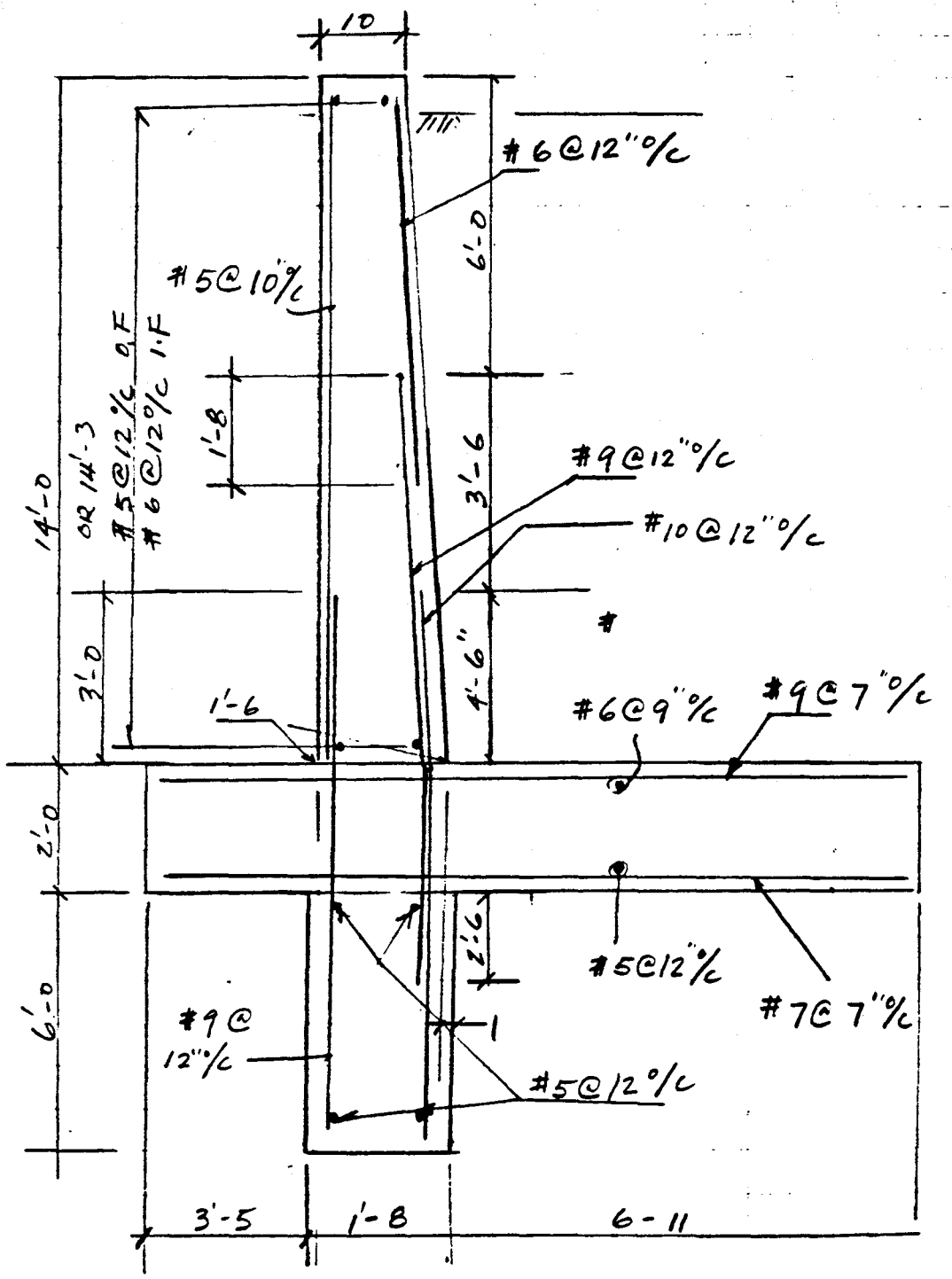
BY N. H. DATE 2/14/86 SHEET 15 OF

CHKD. BY P. DATE 2/26/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY WALL



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EBASCO SERVICES INCORPORATED

BY N. Hy DATE 2/14/86 SHEET 16 OF

CHKD. BY P. Brown DATE 2/26/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT EMERGENCY SPILLWAY WALL

FOUNDATION DESIGN:

RESISTING MOMENT:

$.15 \times 1.5 \times 14 = 3.15 \times (3.5 + \frac{1.5}{2}) = 13.39$

$.12 \times 7 \times 13.5 = 11.34 \times (7 + 1.5) = 96.39$

$.15 \times 2 \times 12.5 = 3.60 \times 6 = 21.6$

$.15 \times 1.5 \times 6 = 1.35 \times (3.5 + \frac{1.5}{2}) = 5.74$

19.44 137.12

ACTING MOMENT:

$M = \frac{1}{6} \times 78 \times 15.5^3 + \frac{1}{2} \times 156 \times 15.5^2$

$= 48410 + 18740 = 67150'^{\#}/' = 67.15$

S.F. AGAINST OTM $= \frac{137.12}{67.15} = 2.04 > 1.5$

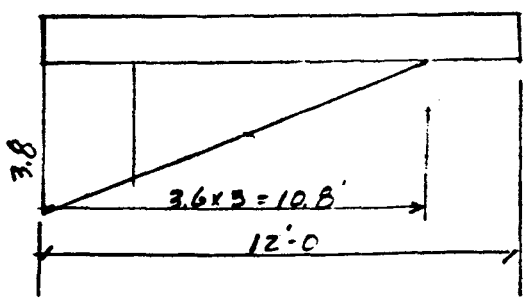
$e' = \frac{137.12 - 67.12}{19.44} = 3.6 \qquad \frac{12}{2} - 3.6 = 2.4 > \frac{12}{6}$

SOIL PRESSURE $f_b = \frac{19.44}{\frac{1}{2} \times 1 \times 3.6 \times 3} = 3.6^{K/\square'} < 4.0^{K/\square'}$

DRIVING FORCE:

$P_a = \frac{1}{2} \times 78 \times 15.5^2 + 156 \times 15.5$

$= 9369 + 2418 = 11790^{\#} = 11.8^{K}$



RESIST FORCE

FRICITION FORCE $.35 \times 19.44 = 6.8^{K}$

PASSIVE SOIL PRESSURE: $.30 \times \frac{1}{2} \times 8^2 = 9.6^{K}$

16.4^{K}

S.F. AGAINST SLIDING

$= 16.4/11.8 = 1.40$ O.K.

WITHOUT SURCHARGE LOAD: $16.4/9.4 = 1.74$

TOP BAR DESIGN

$M = (.15 \times 2 + .13 \times 13.5) \times \frac{7^2}{2} = 2.055 \times \frac{7^2}{2} = 50.3^{'k/'}$

$M_u = 50.3 \times 1.8 = 90.6^{'k/'}$

$24 - 3 - 1 = 20''$ $F = 0.4$

$K_u = 90.6/0.4 = 227$. $a_u = 2.885$

$A_s = \frac{M_u}{a_u d} = 90.6/2.885 \times 20 = 1.57^{\square''/'}$ — #9 @ 7"o/c

$P_h = 2.055 \times 7 = 14.4^{k/'}$, $V_u = 14.4 \times 1.8 = 25.92$

$v = 25.92/12 \times 20 = 108^{\#/\square''} = 2\phi\sqrt{f_c'} = 108^{\#/\square''}$.

BOTTOM BARS

$M = \frac{1}{2} \times 3.8 \times 3.5^2 = 23.2^{'k/'}$

$M_u = 1.8M = 41.9^{'k/'}$ $K_u = 41.9/0.4 = 105$

$a_u = 2.95$ $A_s = \frac{41.9}{2.95 \times 20} = 0.71^{\square''/'}$ — #7 @ 7"o/c

$1.33 A_s = 0.71 \times 1.33 = 0.94^{\square''/'}$

KEY DESIGN

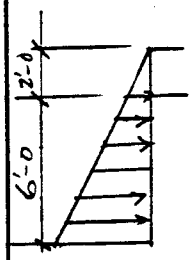
$.60 \times \frac{6^2}{2} + .30 \times \frac{6^3}{6} = 10.8^{K} + 10.8 = 21.6^{K}/'$

$F = 14.5^2/1000 = .210 \qquad M_u = 1.8M = 38.9^{K}/'$

$K = M_u/F = 38.9/.210 = 186$

$a_u = 2.90$

$A_s = 38.9/14.5 \times 2.9 = 0.93^{\square''}/' \quad$ — #9@12"o/c



$P_a = \frac{1}{2} \times .30 \times 6^2 + .60 \times 6 = 5.4^{K} + .36 = 9.0^{K}$

$V_u = 1.8 P_a = 16.2^{K}$

$v_u = 16.2 \times 10^3 / 12 \times 14.5 = 93.1^{\#/\square''} < 2\phi\sqrt{f_c'} = 108^{\#/\square''}$

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-5-85 SHEET 1 OF 3

CHKD. BY S Goyal DATE 9-26-85 OFS NO. USDA 3767.300 DEPT. NO. 650

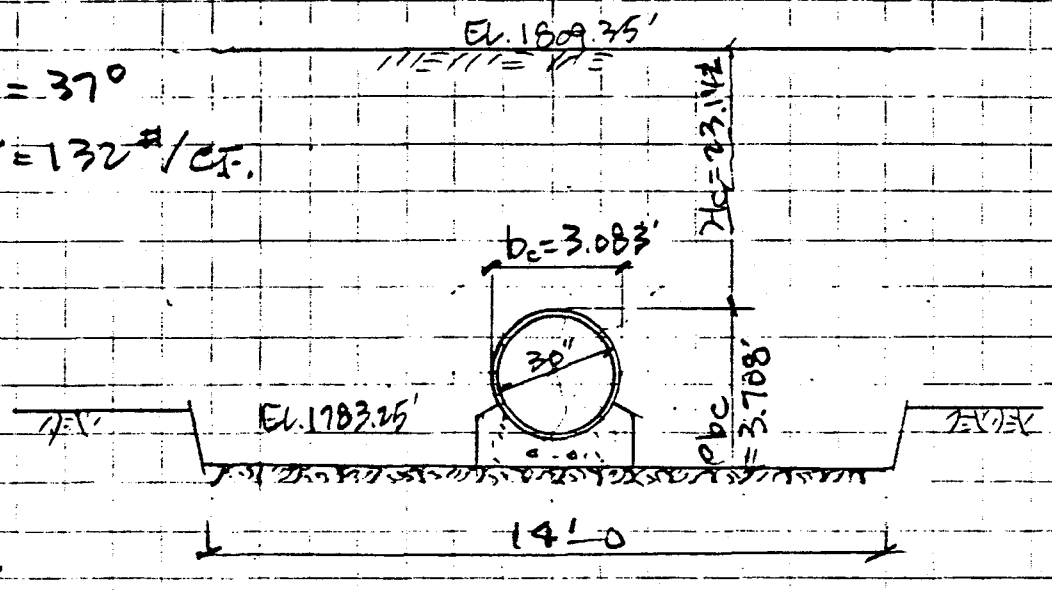
CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FRS PRINCIPAL SPILLWAY

$\phi = 37°$

$\gamma = 132\#/cf.$



FROM ES-119: FOR EXTRA STRENGTH R.C. CULVERT

30"ϕ PIPE: $b_c = 3.083'$;

FROM ES-114 $\phi = 37°$, $K = 0.25$, $K_\mu = 0.19$

& FOR R.C. PIPE $S = 1.0$

$$\rho = \frac{P_{bc}}{b_c} = \frac{3.708}{3.083} = 1.203$$

FROM ES-115, SH. 1 OF 4 : $\delta = 1.0$

$\therefore \delta\rho = 1.0 \times 1.203 = 1.203$

$b_d = \infty$; $\therefore \frac{b_d}{b_c} > \frac{b_d'}{b_c}$ (POSITIVE)

$$\frac{H_c}{b_c} = \frac{23.142}{3.083} = 7.506$$

FROM ES-117, SH. 1 OF 2: FOR $K_\mu = 0.19$; $\delta\rho = 1.203$

$\frac{H_e}{b_c} = 2.18$; $\frac{H_c}{b_c} > \frac{H_e}{b_c}$

THE CONDUIT IS CLASSED THE INCOMPLETE CONDITION.

581/8-81

FOR $2K_\mu S_p = 2 \times 0.19 \times 1.203 = 0.457$

$$2K_\mu \frac{H_c}{b_c} = 2 \times 0.19 \times 7.506 = 2.85$$

FROM ES-118, SH 3 OF 3: $2K_\mu C_p = 5.90$

$$C_p = \frac{5.90}{2 \times 0.19} = 15.526$$

FROM ES-120, SH 3 OF 5:

$X_p = 0.65$ (TYPE B1)

FROM ES-120, SH. 5 OF 5:

FOR $\rho = 1.0$; $X_a = 0.64$

$$\Sigma T = \rho X_a \left[\frac{H_c}{b_c} + \frac{\rho}{2}\right]$$

$$= 1.0 \times 0.64 \left[7.506 + \frac{1}{2}\right] = 5.124$$

$$F_{sr} = C_p X_p - KT$$

$$= 15.526 \times 0.65 - 0.25 \times 5.124 = 8.811$$

FOR 0.001" CRACK: (FACTOR OF SAFETY $S_1 = 1.0$)

$$R_{eb}(S_1) = \frac{S_1 \gamma F_{sr} b_c^2}{1.431} = \frac{1.0 \times 132 \times 8.811 \times 3.083^2}{1.431} = 7725\ \#/'$$

FOR 0.01 CRACK.. (FACTOR OF SAFETY $S_2 = 1.33$)

$$R_{eb}(S_2) = 7725 \times 1.33 = 10{,}275\ \#/'$$

581/8-81

EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 9-5-85 SHEET 3 OF 3

CHKD. BY S Goyal DATE 9-25-85 OFS NO. USDA 3767.300 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FRS PRINCIPAL SPILLWAY

STRENGTH REQUIREMENTS :-

INSIDE DIAMETER OF PIPE :	30"
HYDROSTATIC PRESSURE :	30 FT. HEAD OF WATER
MIN 3 EDGE BEARING STRENGTH IN #/' OF PIPE (APPLICABLE STANDARD SPECIFICATION — AWWA C-301) :	7,725 #/' (LOAD TO PRODUCE 0.001" CRACK ON FOOT LONG)

THE OUTSIDE DIAMETER OF PIPE ASSUMED IN DESIGN IS 37 INCHES. WHERE THE PIPE FURNISHED HAS AN OUTSIDE DIAMETER GREATER THAN ASSUMED IN DESIGN, THE THREE-EDGE BEARING STRENGTH OF THE PIPE FURNISHED MUST BE LESS THAN THE SPECIFIED THREE-EDGE BEARING STRENGTH MULTIPLIED BY THE RATIO OF THE OUTSIDE DIAMETER OF THE PIPE FURNISHED TO THE OUTSIDE DIAMETER ASSUMED IN DESIGN.

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EBASCO SERVICES INCORPORATED

BY N. Hung DATE 9/25/86 SHEET 1 OF 2

CHKD. BY LNO DATE 11.06.86 OFS NO. 3767-300 DEPT. NO. 807

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT RISER WITH CONDUIT OPENINGS IN BOTH ENDWALLS APACHE

REVIEW THE REQUIRED CONCRETE THICKNESS & STEEL IN THE RISER SIDE WALL DUE TO OPENINGS IN BOTH ENDWALLS

(REFERENCES: TR 30, TR 37)

EL. OF INLET = 1783.5', EL. OF CREST = 1793.5'

$h_x = 1793.5' - 1783.5' = 10'$

DESIGN WATER PRESSURE

$q' = 62.4 \times 10' = 624\ \#/\square'$

$q = 1.7 \times 624 = 1061\ \#/\square' = 1.06\ ^k/\square'$

1) VERT BARS @ OUTSIDE FACE OF END WALL

$t = 10'', \quad D = 30''$

$t/D = 10''/30'' = 0.33$

$K_y = 1.954 - (1.954 - 1.453) \times \frac{0.17}{0.25}$ (TR37 P 2)

$= 1.954 - 0.34 = 1.614$

$\beta^4 = 1/4K_yD^4 = \frac{1}{4 \times 1.614 \times 2.54} = \frac{1}{252.19} = .003965$

$\beta^2 = .063 \quad \beta = 0.251$

$M_u = \frac{q}{2\beta^2}\left(1 - \frac{0.1074}{q\beta}\right) = \frac{1.06}{2 \times .063}\left(1 - \frac{0.1074}{1.06 \times .251}\right)$

$= 8.41(1 - 0.40) = 5.05\ ^k/'$ (TR 30, P2-20)

$V_u = \frac{q}{\beta}\left(1 - \frac{.1074}{2 \times q\beta}\right) = \frac{1.06}{.251}\left(1 - \frac{.1074}{2 \times 1.06 \times .251}\right)$

$= 4.22\ (1 - .20) = 3.4\ ^k/'$

$v_u = 3400\#/12 \times 7.5 = 38.0\ \#/\square'' < 2\phi\sqrt{f_c'} = 108\ \#/\square''$

$F = bd^2/12000 = 12 \times 7.5^2/12000 = .056$

III F-98

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EBASCO SERVICES INCORPORATED

BY N. Hung DATE 9/25/86 SHEET 2 OF 2

CHKD. BY LN DATE 11-06-86 OFS NO. 3767-300 DEPT. NO. 807

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT RISER WITH CONDUIT OPENINGS IN BOTH ENDWALLS

$K = M_u/F = 5.05/.056 = 90 \qquad a_u = 2.94$

$A_s = 5.05^{'K}/2.95 \times 7.5 = 0.23 \, \square''/'$

$1.33 A_s = 0.31 \, \square''/'$ — #5 @ 12"/c REQ'D

#7 @ 12"/c PROVIDED

VERT. BARS @ INSIDE FACE OF END WALL

$A_s = .002 \times 12 \times 10 = 0.24 \, \square''/'$ #5 @ 15"/c

HORIZONTAL BARS @ OUTSIDE FACE

$t/D = 10/30 = 0.33$

$M_R = m_i q D^2$ (TR 30 TABLE 2-6)

$m_i = 0.75 + (.94 - .75) \times \frac{.08}{.25} = .81$

$M_R = 0.81 \times 1.06 \times 2.5^2 = 5.4 \, ^{'K}/'$

$A_s = 5.4/2.94 \times 7.5 = 0.244 \, \square''/'$

$1.33 A_s = 0.244 \times 1.33 = 0.33 \, \square''/'$ #5 @ 11"/c REQ'D

#5 @ 9"/c PROVIDED

HORIZONTAL BARS @ INSIDE FACE

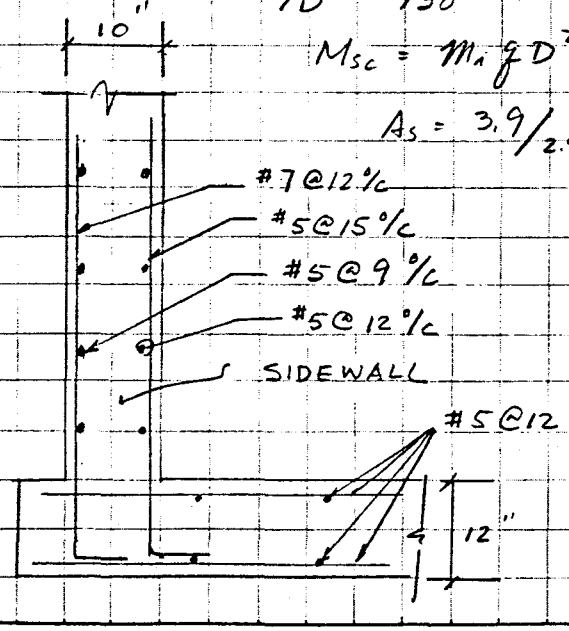
$t/D = 10/30 = 0.33 \qquad m_i = 0.58$

$M_{sc} = m_i q D^2 = .58 \times 1.06 \times 2.5^2 = 3.9 \, ^{'K}/'$

$A_s = 3.9/2.94 \times 7.5 = 0.18 \, \square''/'$

$1.33 A_s = 0.24 \, \square''/'$ #5 @ 15½"/c REQ'D

#5 @ 12"/c PROVIDED



III F-99

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IV CONSTRUCTION DRAWINGS

IV. CONSTRUCTION DRAWINGS

Thirty-nine drawings were prepared for the Project tender documents. The drawing list is attached.

Principal spillway, fence and identification sign drawings are based upon SCS standard drawings.

10/22/86

USDA-SOIL CONSERVATION SERVICE

APACHE-BULLDOG FLOOD CONTROL PROJECT

LIST OF DRAWINGS

Ebasco Sh. No.	Drawing Title
	Apache Junction Flood Retarding Structure and Floodway
1-1	Drawing Index and Project Location Map
1-2	Project Plan and Right-of-Way
1-3	Plan - Clearing and Grubbing, Borrow Area, Underground Utilities
1-4	Floodway - Plan and Profile - Sta 12 + 00 to Sta 25 + 00
1-5	Floodway - Plan and Profile - Sta 25 + 00 to Sta 42 + 45
1-6	Floodway - Section & Details
1-7	Floodway - Drop Inlet No. 1 Details
1-8	Floodway - Weir Inlet No. 1 Details
1-9	Floodway - Weir Inlet No. 2 Details
1-10	Floodway - Bar Bending Schedule - Sh. 1
1-11	Floodway - Bar Bending Schedule - Sh. 2
1-12	Floodway - Energy Dissipator No. 1 Details
1-13	FRS - Plan and Profile - Sta 29 + 50 to Sta 45 + 00
1-14	FRS - Plan and Profile - Sta 45 + 00 to Sta 60 + 00
1-15	FRS - Plan and Profile - Sta 60 + 00 to Sta 75 + 00
1-16	FRS - Plan and Profile - Sta 75 + 00 to Sta 90 + 00
1-17	FRS - Plan and Profile - Sta 90 + 00 to Sta 105 + 00
1-18	FRS - Plan and Profile - Sta 105 + 00 to Sta 117 + 10
1-19	FRS - Cross - Sections
1-20	FRS - Principal Spillway - Plan & Profile

10/22/86

LIST OF DRAWINGS

(Continued)

Ebasco Sh. No.	Drawing Title
1-21	FRS - Principal Spillway - Riser - Reinf. Schedule
1-22	FRS - Principal Spillway - Reinf. - Sh. 1
1-23	FRS - Principal Spillway - Reinf. - Sh. 2
1-24	FRS - Principal Spillway - Reinf. - Sh. 3
1-25	FRS - Principal Spillway - R/C Pipe
1-26	FRS - Principal Spillway - Trashrack Dets
1-27	FRS - Emergency Spillway - Plan & Profile
1-28	FRS - Emergency Spillway - Cross Sections & Details
1-29	FRS - Emergency Spillway - Reinf. Details - Sh. 1
1-30	FRS - Emergency Spillway - Reinf. Details - Sh. 2
1-31	FRS - Emergency Spillway - Reinf. Details - Sh. 3
1-32	FRS - Emergency Spillway - Bar Bending Schedule - Sh. 3
1-33	Apache Junction Floodway - Details Sta. 17 + 20 to Sta. 22 + 60; Sta. 23 + 80 to Sta. 27 + 37.50
1-34	Apache Junction Floodway - Bar Bending Schedule - Sh. 4
1-35	Idaho Rd. & Lost Dutchman Blvd - Plan
1-36	Idaho Rd. & Lost Dutchman Blvd - Profiles
1-37	Protective Barrier
1-38	Fence Details
1-39	Identification Sign