PHASE IV.1 - FINAL DESIGN REPORT

BULLDOG FLOODWAY AND APACHE JUNCTION OUTLET

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

EBASCO

EBASCO SERVICES INCORPORATED

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I SUMMARY

PHASE IV - FINAL DESIGN REPORT
BUCKHORN - MESA WATERSHED
BULLDOG FLOODWAY AND APACHE JUNCTION OUTLET

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 Bulldog Floodway and Apache Junction Outlet 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.

The project is comprised of the following components:

Apache Junction FRS Outlet Channel

The FRS principal spillway conduit discharges into the Apache Junction FRS outlet channel. This is a concrete lined channel extending from station 101+50 approximately 2,830 feet in the southwesterly direction before ending into the Bulldog floodway at station 129+76.16. The 30 inch diameter spillway conduit discharges directly into the 3.5 feet wide rectangular channel.

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.

Bulldog Floodway

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 7,320 feet from station 129+76.16 to station 203+00 feet. A grouted riprap plunge pool-type energy dissipator will be provided at the end of the concrete lined channel. It will be 300 feet long and empty into an earth channel at station 206+00. The earth channel is 400 feet long, extending from the station 206+00 to station 210+00. The exact end of the earth channel will depend upon the excavation in the borrow area of the Signal Butte FRS.

The floodway intercepts a number of small and big washes. For the small washes, nine weir inlets will be provided, whereas seven concrete lined side channel inlets will be provided for the big washes.

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. Hydraulics

   NEH - 5
   TR - 25
   TR - 29
   TR - 39
   TR - 48
   TR - 70

   Addition of Sideflow from a Broad Crested Weir to Flow in an Open Channel at Supercritical flow" - SCS Paper

   Department of Transportation, Hydraulic Engineering Circular No. 14.

2. Structure

   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

Sedimentation, 1974 Supplement, Buckhorn Mesa

Soil Test Results

4. Hydrology

NEH - 4

NOAA - Atlas 2

TR - 16

TR - 20

TR - 61

TR - 66

Curve Number Reduction Factors

Hydrometeorological Report NO. 49

Hydrology - PO-6 (Rev. 2)

5. Other

NEH - 2

NEH - 20

TR - 60

Catalog of National Engineering Standard Drawings

Design of Small Dams (USBR)

USDA Design Note 22

HRD 108

National Engineering Manual

Buckhorn - Mesa Watershed 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)
Phase III - Preliminary Design 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

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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- 3.4 Idaho and Brown Roads

4.0 SEDIMENTATION

EBASCO SERVICES INCORPORATED

EBASCO SPECIFICATION
DESIGN CRITERIA

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6.9 Joints
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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

C. HYDROLOGY

C.1 General

The hydrology associated with the 5.72 square mile basin controlled by the Project was developed by SCS. Inflow quantities at each inlet location were provided to Ebasco.

C.2 Runoff Calculations

The drainage area, its sub-basins, precipitation and inflow calculations, including computer printouts start on the next page.

BULLDOG

Ariz

Buckhorn Mesa WLS

Hem' 4.12.3/85

Bulldog Wash - Peak Discharge Summary

USING ESTI. "NORMAL" Drainage Areas for each Inlet.

Subarea or "U" X-Section (No.)	2-YEAR 24-Hour (CFS)	10-YEAR 24-Hour (CFS)	100-YEAR 24-Hour (CFS)
4A	30	163	397
①	135	265	496
4B	39	215	525
②	173	480	1019
4C	17	69	155
③	188	542	1160
4D	5	29	71
④	188	543	1162
4E	32	143	327
⑤	216	670	1459
4F	4	23	56
⑥	216	672	1465
4G	58	265	611
⑦	273	932	2066
4H	3	15	37
⑧	273	932	2067
5A	310	1109	2348
⑨	552	1963	4272
5B	8	61	157
⑩	556	1998	4387
5C	2	15	36
⑪	555	1997	4384
6A	32	149	345
⑫	582	2124	4688
6B	8	51	126
⑬	580	2125	4692
6C	75	331	753
⑭	658	2444	5427

4A - Subarea No. and Discharges are for individual subareas and can be used for Inlet Design

① - X-Section No. and Flow Shows Accumulative Discharges along the

AR12 Buckhorn Mesa WTP
Hem 4/17/85
Subdrainage Areas, Building Wash F/Way 1 2

Subarea No.	D.A. M.i.²	Remarks
4A	0.15	Min. D.A to Inlet 4A
X	0.58	
Y	0.16	
✓ 4A+.5X+.2Y	0.47	Normal D.A. to Inlet 4A
4A+X+Y	0.89	Max. D.A. to Inlet 4A
4B	0.25	Min. D.A to Inlet 4B
✓ 4E+.5X+.5Y	0.62	Normal D.A to Inlet 4E
4B+X+Y	0.99	Max. D.A. to Inlet 4E
4C	0.07	Min D.A. to Inlet 4C
✓ 4C+0.2[(.65X4E)+Y]	0.15	Normal D.A to Inlet 4C
4C+(.65X4E)+Y	0.45	Max D.A to Inlet 4C
✓ 4D	0.06	Tot. D.A. to Inlet 4D
4E	0.34	
✓ (.35)4E+0.8[(.65X4E)+.34)]	0.33	Normal D.A. to Inlet 4E

AR12 Buckhorn Mesa W/S
Hem 4/22/85
TIME OF Conc Summary
Building W.S. Floodway (FOR NORMAL D.A.'S)

Subarea No	Pres Condi. Tc	Future Shed Dw CN	Adj for ch[1] Length and	Adj for [2] Imperv	Future Tc
4A	0.61	85	.93	.95	0.54
4E	0.62	85	.93	.95	0.56
4C	0.53	88	.94	.95	0.47
4D	0.11	83	.92	.95	0.10
4E	0.52	87	.93	.95	0.47
4F	0.15	83	.92	.95	0.13
4G	0.65	87	.93	.95	0.58
4H	0.02	83	.92	.95	0.07
5A	0.45	90	.95	.95	0.41
5B	0.38	83	.92	.95	0.33
5C	0.11	83	.92	.95	0.10
6A	0.38	86	.93	.95	0.34
6B	0.14	83	.92	.95	0.12
6C	0.52	87	.93	.95	0.46

dates Jan 1975

[1] Fig 3.4, TR-55 Assuming 15% chan Modification based on development of S. Rim Trails

[2] Fig 3.5, TR-55 Assuming 10% Imperviousness based on Table 2.2, TR-55 III C-4

Ariz Buckhorn Mesa W/S

Hem 4/22/85

Curve Numbers by Duration

Bulldog Wash Floodway

1 2

Drainage Area No.	Short (1-hr) Duration RCN	6-Hr RCN	24-Hr RCN	10 Day RCN Table 2-3 TR-60	
4A	83	79	75	58	Min D.A. to Inlet 4A
X	85	81	78	62	
Y	90	86	83	69	
4A+.5X+.5Y	85	81	78 ✓	62	Normal D.A. to Inlet 4A
4A+X+Y	86	82	79	64	Max D.A. to Inlet 4A
4B	84	80	77	61	Min D.A. to Inlet 4B
4B+.5X+.5Y	85	81	78 ✓	62	Normal D.A. to Inlet 4B
4B+X+Y	86	82	79	64	Max D.A. to Inlet 4B
4C	87	83	80	65	Min D.A. to Inlet 4C
$4C+.2[(.65)(4E)^{.044}+Y^{.22}]$	88	84	81 ✓	66	Normal D.A. to Inlet 4C
4C+.65(4E)+Y	88	84	81	66	Max D.A. to Inlet 4C
4D	83	79	75 ✓	58	Tot. D.A. to Inlet 4D
4E	87	83	80	65	
$(.35)(4E)^{.12}+.8[(.65)(4E)^{.118}+.37Y^{.04}]$	87	83	80 ✓	65	Normal D.A. to Inlet 4E

AR12 Buckhorn Mesa W/S

~~Hem~~ 4/22/85

CURVE NUMBERS by Duration

Building Walk Floodway

2 2

Drainage Area No.	Short (1-hr) Duration RCN	6-Hr RCN	24-Hr RCN	10-Day RCN Table 2-3 TR-60	
4E+y	88	84	81	66	MAX D.A. to Inlet 4E
4F	83	79	75 ✓	58	Tot. D.A. to Inlet 4F
4G	85	81	78	62	MIN. D.A. to Inlet 4G
Z	91	87	84	71	
4G+0.4Z	87	83	80 ✓	65	Normal D.A. to Inlet 4G
4G+Z	88	84	81	66	MAX D.A. to Inlet 4G
4H	83	79	75 ✓	58	Tot. D.A. to Inlet 4H
5A	90	85	82	69	MIN D.A. to Inlet 5A
5A+0.4Z	90	85	82 ✓	69	Normal DA to Inlet 5A
5A+Z	90	86	82	69	MAX D.A. to Inlet 5A
5B	83	79	75 ✓	58	Tot. DA to Inlet 5B
5C	83	79	75 ✓	58	Tot. DA to Inlet 5C
6A	86	82	79 ✓	64	Tot. DA to Inlet 6A
6B	83	79	75 ✓	58	Total D.A. to Inlet 6B
6C	87	83	80 ✓	65	Tot. D.A. to Inlet 6C

ARIZONA

BUCKHORN-MESA WATERSHED

E. McArthur 7/30/79 Hum 11/19/80

PRECIPITATION-FREQUENCY RELATIONSHIP

SOURCE: NOAA ATLAS 2 "PRECIPITATION-FREQUENCY ATLAS OF WESTERN U.S. VOL. VIII ARIZONA

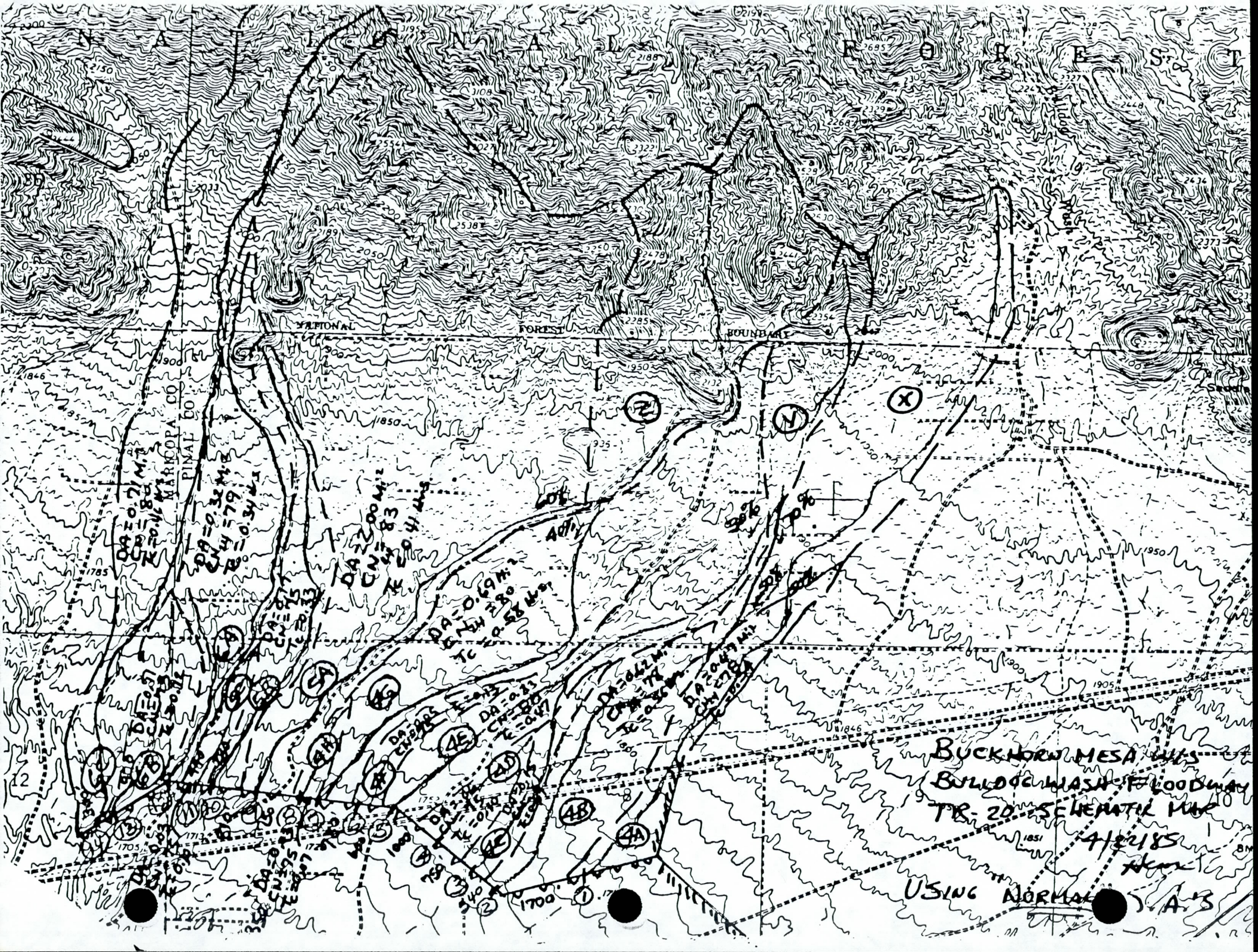
Note: [illegible] 12/20/83

6 HR DURATION POINT PRECIP

FREQUENCY (Yrs)	MEAN MAP VALUE (In)	FACTOR	PLOTTED ANNUAL SERIES VALUE (In)	ANNUAL SERIES VALUE USED (In)
100	3.28	1.00	3.28	3.28
50	2.89	1.00	2.89	2.89
25	2.56	1.00	2.56	2.50
10	2.08	0.99	2.06	2.04
5	1.76	0.96	1.69	1.67
2	1.27	0.88	1.12	1.13

24 HR DURATION POINT PRECIP

FREQUENCY (Yrs)	MEAN MAP VALUE (In.)	FACTOR	PLOTTED ANNUAL SERIES VALUE (In)	ANNUAL SERIES VALUE USED (In)
100	4.00	1.00	4.00	4.05
50	3.58	1.00	3.58	3.58
25	3.18	1.00	3.18	3.15
10	2.59	0.99	2.56	2.58
5	2.23	0.96	2.15 (2.14)	2.10
2	1.63	0.88	1.43	1.45


NATIONAL FOREST BOUNDARY
MARICOPA CO
PINAL CO
BUCKHORN MESA WLS
BULLDOG WASH FLOODWAY
TR-20 SCHEMATIC MAP
4/22/85
USING NORMAL I.A.'S

BULLDOG WASH, DESIGN HYDROLOGY 04/23/85

TR-20 HYDROLOGY

USING "MAXIMUM" DRAINAGE AREAS TO INLETS 4A, 4B, 4C, 4E & 4G & 5A.

BUCKHORN MESA W/S
BULLDOG WASH FLOODWAY
INLET DESIGN HYDROLOGY

2-YEAR, 24-HOUR
10-YEAR, 24-HOUR
100-YEAR, 24-HOUR

(DES/TR20. ADWH)
4/24/85

III C-9

NOTES!!

1.) 105 CFS. Base Flow (P. Spy Flow) From Apache Junction FRS was Added to Each Storm based on Work Plan Supplement dated June 1976

Imp!!. 2) This Run should be Used Only to Estimate MAXIMUM Discharges for Inlets to Sub Areas 4A, 4B, 4C, 4E, 4G, & 5A. Do "Not" Use This Run to Estimate Peak flows Along the Floodway since the Accumulation D.A.'S are in Error due to overlapping D.A.'S

EXECUTIVE CONTROL CARD 33 OPERATION LIST

LISTING OF DATA IN CORE

0 BULLDOG WASH,DESIGN HYDROLOGY

VELOCITY INCREMENT

1 CTABLE .2000

8	.0000	.0900	.1800	.2500	.3200
8	.3700	.4100	.4500	.4900	.5100
8	.5400	.5700	.5900	.6100	.6300
8	.6500	.6600	.6700	.6900	.7000
8	.7100	.7200	.7300	.7400	.7500
8	.7600	.7700	.7700	.7800	.7900
8	.7900	.8000	.8100	.8100	.8200
8	.8200	.8300	.8300	.8400	.8400
9	.8400	.8500	.8500	.8600	.8600
8	.8600	.8600	.8700	.8700	.8700
8	.8800	.8800	.8800	.8900	.8900
8	.8900	.8900	.8900	.8900	.9000
8	.9000	.9000	.9000	.9000	.9100
8	.9100	.9100	.9100	.9100	.9100
8	.9200	.9200	.9200	.9200	.9200
8	.9200	.9200	.9200	.9300	.9300

9 ENDTBL

TIME INCREMENT

4 DIMHYD

8	.0000	.0300	.1000	.1900	.3100
8	.4700	.6600	.8200	.9300	.9900
8	1.0000	.9900	.9300	.8600	.7900
8	.6800	.5600	.4600	.3900	.3300
8	.2800	.2410	.2070	.1740	.1470
8	.1260	.1070	.0910	.0770	.0660
8	.0550	.0470	.0400	.0340	.0290
8	.0250	.0210	.0180	.0150	.0130
8	.0110	.0090	.0080	.0070	.0060
8	.0050	.0040	.0030	.0020	.0010
8	.0000	.0000	.0000	.0000	.0000

9 ENDTBL

COMPUTED PEAK K FACTOR = 484.00

TIME INCREMENT

```
8          .0000     .0080     .0170     .0260     .0350
8          .0450     .0550     .0650     .0760     .0870
8          .0990     .1120     .1250     .1400     .1560
8          .1740     .1940     .2190     .2540     .3030
8          .5150     .5830     .6240     .6540     .6820
8          .7050     .7270     .7480     .7670     .7840
8          .8060     .8160     .8300     .8440     .8570
8          .8700     .8820     .8930     .9050     .9160
8          .9260     .9360     .9460     .9550     .9650
8          .9740     .9830     .9920    1.0000    1.0000
9 ENDTBL
```

```
                TIME INCREMENT
5 RAINFL 2                .5000
8          .0000     .0050     .0110     .0160     .0220
8          .0280     .0350     .0410     .0480     .0560
8          .0630     .0710     .0800     .0890     .0980
8          .1090     .1200     .1330     .1470     .1630
8          .1810     .2040     .2350     .2830     .6630
8          .7350     .7720     .7990     .8200     .8380
8          .8540     .8680     .8800     .8910     .9020
8          .9120     .9210     .9290     .9370     .9450
8          .9520     .9590     .9650     .9720     .9780
8          .9840     .9890     .9950    1.0000    1.0000
9 ENDTBL
```

```
                TIME INCREMENT
5 RAINFL 3                .0200
8          .0000     .0080     .0162     .0246     .0333
8          .0425     .0524     .0630     .0743     .0863
8          .0990     .1124     .1265     .1420     .1600
8          .1800     .2050     .2550     .3450     .4370
8          .5300     .6030     .6330     .6600     .6840
8          .7050     .7240     .7420     .7590     .7750
8          .7900     .8043     .8180     .8312     .8439
8          .8561     .8678     .8790     .8898     .9002
8          .9103     .9201     .9297     .9391     .9483
8          .9573     .9661     .9747     .9832     .9916
8         1.0000    1.0000    1.0000    1.0000    1.0000
9 ENDTBL
```

STANDARD CONTROL INSTRUCTIONS

24 inch

```
6 RUNOFF 1   1       6        .8900      79.0000      .54001 0 0 1 0 1
6 REACH  3   2   6   5     1700.0000       .8600      .00001 0 0 1 0 1
6 RUNOFF 1   2       6        .9900      79.0000      .56001 0 0 1 0 1
6 ADDHYD 4   2   5 6 7                                    1 0 0 1 0 1
6 REACH  3   3   7   5      540.0000       .8600      .00000 0 0 0 0 0
6 RUNOFF 1   3       6        .4500      81.0000      .47001 0 0 1 0 1
6 ADDHYD 4   3   5 6 7                                    1 0 0 1 0 1
6 REACH  3   4   7   5     1000.0000       .8700      .00000 0 0 0 0 0
6 RUNOFF 1   4       6        .0600      75.0000      .19001 0 0 1 0 1
6 ADDHYD 4   4   5 6 7                                    1 0 0 1 0 1
6 REACH  3   5   7   5     1030.0000       .8700      .00000 0 0 0 0 0
6 RUNOFF 1   5       6        .5000      81.0000      .47001 0 0 1 0 1
6 ADDHYD 4   5   5 6 7                                    1 0 0 1 0 1
6 REACH  3   6   7   5      600.0000       .8800      .00000 0 0 0 0 0
6 RUNOFF 1   6       6        .0500      75.0000      .13001 0 0 1 0 1
6 ADDHYD 4   6   5 6 7                                    1 0 0 1 0 1
6 REACH  3   7   7   5      720.0000       .8800      .00000 0 0 0 0 0
6 RUNOFF 1   7       6       1.0400      81.0000      .58001 0 0 1 0 1
6 ADDHYD 4   7   5 6 7                                    1 0 0 1 0 1
6 REACH  3   8   7   5      350.0000       .9000      .00000 0 0 0 0 0
6 RUNOFF 1   8       6        .0300      75.0000      .07001 0 0 1 0 1
6 ADDHYD 4   8   5 6 7                                    1 0 0 1 0 1
6 REACH  3   9   7   5      750.0000       .9000      .00000 0 0 0 0 0
6 RUNOFF 1   9       6       2.2400      83.0000      .41001 0 0 1 0 1
6 ADDHYD 4   9   5 6 7                                    1 0 0 1 0 1
6 REACH  3  10   7   5      810.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF 1  10       6        .1700      75.0000      .33001 0 0 1 0 1
6 ADDHYD 4  10   5 6 7                                    1 0 0 1 0 1
6 REACH  3  11   7   5      280.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF 1  11       6        .0300      75.0000      .10001 0 0 1 0 1
6 ADDHYD 4  11   5 6 7                                    1 1 0 1 0 1
6 REACH  3  12   7   5      440.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF 1  12       6        .3200      79.0000      .34001 0 0 1 0 1
6 ADDHYD 4  12   5 6 7                                    1 0 0 1 0 1
6 REACH  3  13   7   5      970.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF 1  13       6        .1100      75.0000      .12001 0 0 1 0 1
6 ADDHYD 4  13   5 6 7                                    1 0 0 1 0 1
6 REACH  3  14   7   5        .0000     340.0000      .91000 0 0 0 0 0
6 RUNOFF 1  14       6        .7100      80.0000      .40001 0 0 1 0 1
6 ADDHYD 4  14   5 6 7                                    1 1 0 1 0 1
  ENDATA
```

END OF LISTING

III C -12

PASS= 1

EXECUTIVE CONTROL CARD 34 OPERATION BASFLO, NEW BASE FLOW= 105.00
EXECUTIVE CONTROL CARD ******** OPERATION
EXECUTIVE CONTROL CARD 35 OPERATION INCREM, RAIN TIME INCREMENT= .10
EXECUTIVE CONTROL CARD 36 OPERATION COMPUT, FROM XSECTN/STRUCT 1/ 0 TO XSECTN/STRUCT 14/ 0
STARTING TIME= .00 RAIN DEPTH= 1.45 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 SOIL CONDITION= 2
ALTERNATE NO.= 1 STORM NO.= 1

SUBROUTINE RUNOFF CROSS SECTION 1
AREA= .89 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .54

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.27	66.964	(RUNOFF)
16.96	7.266	(RUNOFF)
19.47	5.569	(RUNOFF)
21.62	4.877	(RUNOFF)
23.62	4.267	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2355 CFS-HRS= 135.28 ACRE-FT= 11.18

SUBROUTINE REACH CROSS SECTION 2
LENGTH= 1700.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .39

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.32	171.007	(NULL)
19.49	110.566	(NULL)
21.66	109.866	(NULL)
23.66	109.256	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.7014 CFS-HRS= 3274.78 ACRE-FT= 270.63

SUBROUTINE RUNOFF CROSS SECTION 2
AREA= .99 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .56

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.27	73.663	(RUNOFF)
16.97	8.087	(RUNOFF)
19.48	6.195	(RUNOFF)
21.63	5.427	(RUNOFF)
23.63	4.732	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2354 CFS-HRS= 150.40 ACRE-FT= 12.43

SUBROUTINE ADDHYD CROSS SECTION 2
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.29	244.226	(NULL)
16.96	120.352	(NULL)
19.48	116.761	(NULL)

23.64	113.985	(NULL)			

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.8230 CFS-HRS= 3425.18 ACRE-FT= 283.06

SUBROUTINE REACH CROSS SECTION 3
LENGTH= 540.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 3
AREA= .45 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	50.622	(RUNOFF)
16.98	4.198	(RUNOFF)
19.47	3.197	(RUNOFF)
21.58	2.805	(RUNOFF)
23.58	2.444	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2886 CFS-HRS= 83.81 ACRE-FT= 6.93

SUBROUTINE ADDHYD CROSS SECTION 3
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.28	288.911	(NULL)
16.96	124.550	(NULL)
19.48	119.956	(NULL)
21.64	118.076	(NULL)
23.64	116.409	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.3336 CFS-HRS= 3508.99 ACRE-FT= 289.98

SUBROUTINE REACH CROSS SECTION 4
LENGTH= 1000.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .21

SUBROUTINE RUNOFF CROSS SECTION 4
AREA= .06 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTPATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.00	4.902	(RUNOFF)
12.46	1.616	(RUNOFF)
12.96	.932	(RUNOFF)
13.46	.730	(RUNOFF)
13.96	.595	(RUNOFF)
14.46	.530	(RUNOFF)
14.96	.488	(RUNOFF)
15.45	.440	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1476 CFS-HRS= 5.72 ACRE-FT= .47

SUBROUTINE ADDHYD CROSS SECTION 4
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.30	288.531	(NULL)
16.95	124.916	(NULL)
19.48	120.237	(NULL)
21.65	118.284	(NULL)
23.65	116.588	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.2787 CFS-HRS= 3514.72 ACRE-FT= 290.46

SUBROUTINE REACH CROSS SECTION 5
LENGTH= 1030.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .22

SUBROUTINE RUNOFF CROSS SECTION 5
AREA= .50 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	55.580	(RUNOFF)
16.98	4.665	(RUNOFF)
19.47	3.552	(RUNOFF)
21.58	3.117	(RUNOFF)
23.58	2.716	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2886 CFS-HRS= 93.12 ACRE-FT= 7.70

SUBROUTINE ADDHYD CROSS SECTION 5
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.30	335.954	(NULL)
16.95	129.581	(NULL)
19.48	123.784	(NULL)
21.65	121.364	(NULL)
23.65	119.267	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.9344 CFS-HRS= 3607.86 ACRE-FT= 298.15

SUBROUTINE REACH CROSS SECTION 6
LENGTH= 600.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .12

SUBROU RUNOFF CROSS SECTION 6
AREA= INPUT RUNOFF CURVE= 75.0 TIME CONCENTRATION= .13

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.02	3.548	(RUNOFF)
12.47	1.318	(RUNOFF)
12.96	.768	(RUNOFF)
13.46	.604	(RUNOFF)
13.96	.493	(RUNOFF)
14.46	.440	(RUNOFF)
14.96	.405	(RUNOFF)
15.46	.365	(RUNOFF)
15.96	.319	(RUNOFF)
16.96	.305	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1484 CFS-HRS= 4.79 ACRE-FT= .40

SUBROUTINE ADDHYD CROSS SECTION 6
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.31	335.749	(NULL)
19.48	124.018	(NULL)
21.66	121.544	(NULL)
23.66	119.422	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.9040 CFS-HRS= 3612.65 ACRE-FT= 298.55

SUBROUTINE REACH CROSS SECTION 7
LENGTH= 720.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 7
AREA= 1.04 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .58

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.27	100.871	(RUNOFF)
19.47	7.378	(RUNOFF)
21.64	6.408	(RUNOFF)
23.63	5.572	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2887 CFS-HRS= 193.76 ACRE-FT= 16.01

SUBROUTINE ADDHYD CROSS SECTION 7
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.31	434.006	(NULL)
19.48	131.392	(NULL)
21.66	127.935	(NULL)
23.66	124.976	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.4819 CFS-HRS= 3806.41 ACRE-FT= 314.56

SUBROUTINE REACH CROSS SECTION 8
LENGTH= 350.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 8
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .07

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.99	2.701	(RUNOFF)
12.46	.825	(RUNOFF)
12.96	.471	(RUNOFF)
13.46	.369	(RUNOFF)
13.96	.299	(RUNOFF)
14.46	.266	(RUNOFF)
14.96	.245	(RUNOFF)
15.45	.221	(RUNOFF)
15.96	.193	(RUNOFF)
16.95	.184	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1479 CFS-HRS= 2.86 ACRE-FT= .24

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SUBROUTINE ADDHYD CROSS SECTION 8
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.31	433.681	(NULL)
19.48	131.534	(NULL)
21.67	128.039	(NULL)
23.66	125.064	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.4719 CFS-HRS= 3809.28 ACRE-FT= 314.80

SUBROUTINE REACH CROSS SECTION 9
LENGTH= 750.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 9
AREA= 2.24 INPUT RUNOFF CURVE= 83.0 TIME OF CONCENTRATION= .41

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	347.535	(RUNOFF)
16.97	23.642	(RUNOFF)
19.46	17.881	(RUNOFF)
21.55	15.718	(RUNOFF)
23.55	13.667	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .3499 CFS-HRS= 505.76 ACRE-FT= 41.80

SUBROUTI ADDHYD CROSS SECTION 9

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	734.059	(NULL)
16.96	163.430	(NULL)
19.47	149.408	(NULL)
21.61	143.617	(NULL)
23.61	138.596	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.0698 CFS-HRS= 4315.05 ACRE-FT= 356.60

SUBROUTINE REACH CROSS SECTION 10
LENGTH= 810.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 10
AREA= .17 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .33

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.15	7.934	(RUNOFF)
16.99	1.025	(RUNOFF)
19.46	.803	(RUNOFF)
20.46	.719	(RUNOFF)
21.53	.726	(RUNOFF)
22.45	.640	(RUNOFF)
23.51	.640	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1489 CFS-HRS= 16.34 ACRE-FT= 1.35

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SUBROUTINE ADDHYD CROSS SECTION 10
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.23	736.663	(NULL)
16.95	164.453	(NULL)
19.47	150.203	(NULL)
21.62	144.301	(NULL)
23.61	139.194	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.0454 CFS-HRS= 4331.36 ACRE-FT= 357.94

SUBROUTINE REACH CROSS SECTION 11
LENGTH= 280.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .04

SUBROUTINE RUNOFF CROSS SECTION 11
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.00	2.401	(RUNOFF)
12.46	.208	(RUNOFF)

13.46	.365	(RUNOFF)
13.96	.297	(RUNOFF)
14.46	.265	(RUNOFF)
14.96	.244	(RUNOFF)
15.45	.220	(RUNOFF)
15.96	.192	(RUNOFF)
16.95	.183	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1476 CFS-HRS= 2.86 ACRE-FT= .24

SUBROUTINE ADDHYD CROSS SECTION 11
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.23	735.453	(NULL)
16.95	164.637	(NULL)
19.47	150.344	(NULL)
21.62	144.403	(NULL)
23.62	139.281	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 6.45

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
8.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
9.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
10.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
11.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.13	108.85	134.52	201.58	325.63
12.00	DISCHG	495.76	654.68	730.75	713.81	647.55	576.13	513.75	457.72	407.14	365.42
13.00	DISCHG	333.96	310.63	291.42	274.81	261.51	251.73	243.98	236.56	229.09	222.52
14.00	DISCHG	217.52	213.54	209.76	206.00	202.69	200.19	198.12	195.99	193.73	191.66
15.00	DISCHG	190.08	188.62	186.86	184.79	182.81	181.23	179.74	177.89	175.72	173.66
16.00	DISCHG	172.01	170.63	169.29	167.94	166.76	165.85	165.24	164.87	164.68	164.61
17.00	DISCHG	164.62	164.46	163.94	163.11	162.22	161.48	160.75	159.82	158.69	157.61
18.00	DISCHG	156.73	155.90	154.89	153.71	152.58	151.68	151.04	150.62	150.37	150.24
19.00	DISCHG	150.19	150.18	150.20	150.24	150.29	150.34	150.17	149.60	148.69	147.71
20.00	DISCHG	146.90	146.29	145.90	145.66	145.52	145.44	145.18	144.53	143.56	142.55
21.00	DISCHG	141.72	141.32	141.54	142.27	143.17	143.99	144.39	144.21	143.52	142.68
22.00	DISCHG	141.93	141.37	140.99	140.75	140.61	140.52	140.24	139.58	138.57	137.51
23.00	DISCHG	136.65	136.24	136.45	137.18	138.09	138.88	139.27	139.07	138.37	137.50
24.00	DISCHG	136.63	134.84	131.07	125.70	120.09	115.38	111.83	109.39	107.77	106.75
25.00	DISCHG	106.10	105.69	105.43	105.26	105.15	105.09	105.05	105.03	105.01	105.00
26.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.0412 CFS-HRS= 4334.21 ACRE-FT= 358.18

LENGTH= 440.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 12
AREA= .32 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .34

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.13	31.848	(RUNOFF)
16.98	2.616	(RUNOFF)
19.46	2.009	(RUNOFF)
20.45	1.788	(RUNOFF)
21.52	1.791	(RUNOFF)
22.45	1.577	(RUNOFF)
23.52	1.570	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2353 CFS-HRS= 48.60 ACRE-FT= 4.02

SUBROUTINE ADDHYD CROSS SECTION 12
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.23	759.670	(NULL)
16.95	167.252	(NULL)
19.47	152.349	(NULL)
21.62	146.155	(NULL)
23.61	140.813	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.0031 CFS-HRS= 4382.80 ACRE-FT= 362.19

SUBROUTINE REACH CROSS SECTION 13
LENGTH= 970.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 13
AREA= .11 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .12

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.01	8.097	(RUNOFF)
12.46	2.914	(RUNOFF)
12.96	1.698	(RUNOFF)
13.46	1.332	(RUNOFF)
13.96	1.087	(RUNOFF)
14.46	.969	(RUNOFF)
14.96	.892	(RUNOFF)
15.46	.804	(RUNOFF)
15.96	.703	(RUNOFF)
16.96	.671	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1482 CFS-HRS= 10.52 ACRE-FT= .87

SUBROUTINE ADDHYD CROSS SECTION 13
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.25	756.045	(NULL)
19.47	152.864	(NULL)
21.63	146.540	(NULL)
23.62	141.142	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9895 CFS-HRS= 4393.31 ACRE-FT= 363.06

SUBROUTINE REACH CROSS SECTION 14
LENGTH= .00 INPUT COEFFICIENT=340.0000 INPUT ROUTINGS= .91

AVERAGE WATER VELOCITY= .000 AVERAGE ROUTING COEFF= .0000 NUMBER OF ROUTINGS= .00

SUBROUTINE RUNOFF CROSS SECTION 14
AREA= .71 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .40

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	74.832	(RUNOFF)
16.98	6.207	(RUNOFF)
19.46	4.745	(RUNOFF)
20.45	4.224	(RUNOFF)
21.56	4.202	(RUNOFF)
23.55	3.672	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2611 CFS-HRS= 119.64 ACRE-FT= 9.89

SUBROUTINE ADDHYD CROSS SECTION 14
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.23	826.170	(NULL)
16.95	174.129	(NULL)
19.47	157.609	(NULL)
21.62	150.720	(NULL)
23.61	144.792	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 7.59

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
8.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
9.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
10.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
11.00	DISCHG	105.00	105.00	105.00	105.00	.00	105.10	108.20	131.81	201.73	342.8
12.00	DISCHG	543.39	729.53	820.14	881.95	.46	647.75	576.68	512.16	453.75	405.4

14.00	DISCHG	235.13	230.53	226.15	221.81	218.00	215.15	212.75	210.28	207.67	205.30
15.00	DISCHG	203.50	201.80	199.74	197.35	195.08	193.28	191.54	189.39	186.87	184.49
16.00	DISCHG	182.61	181.02	179.46	177.90	176.54	175.51	174.81	174.39	174.17	174.10
17.00	DISCHG	174.11	173.91	173.30	172.33	171.31	170.47	169.62	168.53	167.23	165.98
18.00	DISCHG	164.98	164.01	162.83	161.45	160.15	159.12	158.39	157.91	157.63	157.48
19.00	DISCHG	157.41	157.41	157.43	157.48	157.54	157.60	157.39	156.71	155.66	154.53
20.00	DISCHG	153.60	152.91	152.45	152.17	152.02	151.93	151.61	150.85	149.72	148.55
21.00	DISCHG	147.59	147.16	147.45	148.30	149.34	150.26	150.71	150.47	149.68	148.71
22.00	DISCHG	147.86	147.22	146.78	146.50	146.34	146.24	145.90	145.11	143.94	142.71
23.00	DISCHG	141.73	141.28	141.55	142.40	143.45	144.36	144.79	144.53	143.71	142.71
24.00	DISCHG	141.74	139.55	135.10	128.82	122.34	116.95	112.89	110.07	108.20	107.01
25.00	DISCHG	106.26	105.78	105.48	105.29	105.18	105.10	105.06	105.03	105.01	105.00
26.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9213 CFS-HPS= 4512.95 ACRE-FT= 372.95

ENDCMP

PASS= 2

EXECUTIVE CONTROL CARD 37A OPERATION BASFLO, NEW BASE FLOW= 105.00
EXECUTIVE CONTROL CARD ******** OPERATION
EXECUTIVE CONTROL CARD 38 OPERATION COMPUT, FROM XSECTN/STRUCT 1/ 0 TO XSECTN/STRUCT 14/ 0
STARTING TIME= .00 RAIN DEPTH= 2.58 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 SOIL CONDITION= 2
ALTERNATE NO.= 1 STORM NO.= 1

SUBROUTINE RUNOFF CROSS SECTION 1
AREA= .89 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .54

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	332.335	(RUNOFF)
19.45	15.579	(RUNOFF)
21.61	13.420	(RUNOFF)
23.62	11.600	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .8900 CFS-HRS= 511.18 ACRE-FT= 42.24

SUBROUTINE REACH CROSS SECTION 2
LENGTH= 1700.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .39

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	431.202	(NULL)
19.46	120.575	(NULL)
21.65	118.390	(NULL)
23.66	116.571	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 6.3559 CFS-HRS= 3650.68 ACRE-FT= 301.69

SUBROUTINE RUNOFF CROSS SECTION 2
AREA= .99 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .56

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	369.561	(RUNOFF)
19.46	17.332	(RUNOFF)
21.63	14.933	(RUNOFF)
23.62	12.865	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .8906 CFS-HRS= 569.03 ACRE-FT= 47.02

SUBROUTINE ADDHYD CROSS SECTION 2
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	799.329	(NULL)
19.46	137.907	(NULL)
21.64	133.318	(NULL)
23.64	129.428	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 7.2779 CFS-HRS= 4219.71 ACRE-FT= 348.72

SUBROUTINE REACH CROSS SECTION 3
LENGTH= 540.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 3
AREA= .45 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	207.658	(RUNOFF)
19.46	8.407	(RUNOFF)
21.58	7.277	(RUNOFF)
23.58	6.275	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9975 CFS-HRS= 289.68 ACRE-FT= 23.94

SUBROUTINE ADDHYD CROSS SECTION 3
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	992.025	(NULL)
19.46	146.312	(NULL)
21.63	140.543	(NULL)
23.63	135.652	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9989 CFS-HRS= 4509.41 ACRE-FT= 372.66

SUBROUTINE REACH CROSS SECTION 4
LENGTH= 1000.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .21

SUBROUTINE RUNOFF CROSS SECTION 4
AREA= .06 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	29.217	(RUNOFF)
12.45	6.830	(RUNOFF)
12.95	3.646	(RUNOFF)
13.45	2.740	(RUNOFF)
13.95	2.168	(RUNOFF)
14.45	1.889	(RUNOFF)
14.95	1.709	(RUNOFF)
15.45	1.518	(RUNOFF)
15.95	1.308	(RUNOFF)
16.95	1.223	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .4898 CFS-HRS= 26.71 ACRE-FT= 2.21

SUBROUTINE ADDHYD CROSS SECTION 4

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.23	987.304	(NULL)
19.46	147.228	(NULL)
21.65	141.199	(NULL)
23.65	136.211	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9409 CFS-HRS= 4536.14 ACRE-FT= 374.87

SUBROUTINE REACH CROSS SECTION 5
LENGTH= 1030.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .22

SUBROUTINE RUNOFF CROSS SECTION 5
AREA= .50 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	230.731	(RUNOFF)
19.46	9.341	(RUNOFF)
21.58	8.085	(RUNOFF)
23.58	6.973	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9975 CFS-HRS= 321.87 ACRE-FT= 26.60

SUBROUTINE ADDHYD CROSS SECTION 5
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.23	1191.809	(NULL)
19.46	156.561	(NULL)
21.65	149.196	(NULL)
23.65	143.089	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.6047 CFS-HRS= 4858.11 ACRE-FT= 401.47

SUBROUTINE REACH CROSS SECTION 6
LENGTH= 600.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 6
AREA= .05 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .13

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.98	22.935	(RUNOFF)
12.46	5.607	(RUNOFF)
12.95	3.914	(RUNOFF)
13.45	2.970	(RUNOFF)
13.95	1.800	(RUNOFF)
14.45	1.569	(RUNOFF)
14.95	1.419	(RUNOFF)

15.95	1.088	(RUNOFF)
16.95	1.017	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6939 CFS-HRS= 22.39 ACRE-FT= 1.85

SUBROUTINE ADDHYD CROSS SECTION 6
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	1189.751	(NULL)
19.46	157.323	(NULL)
21.65	149.769	(NULL)
23.65	143.575	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.5722 CFS-HRS= 4880.54 ACRE-FT= 403.33

SUBROUTINE REACH CROSS SECTION 7
LENGTH= 720.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 7
AREA= 1.04 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .58

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	427.359	(RUNOFF)
19.45	19.420	(RUNOFF)
21.63	16.627	(RUNOFF)
23.63	14.309	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9979 CFS-HRS= 669.80 ACRE-FT= 55.35

SUBROUTINE ADDHYD CROSS SECTION 7
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	1606.096	(NULL)
19.46	176.736	(NULL)
21.66	166.352	(NULL)
23.66	157.839	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.1609 CFS-HRS= 5550.40 ACRE-FT= 458.68

SUBROUTINE REACH CROSS SECTION 8
LENGTH= 350.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .06

SUBROUTI JNOFF CROSS SECTION 8
AREA= .23 INPUT RUNOFF CURVE= 75.0 TIME (ONCENTRATION= .07

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	15.422	(RUNOFF)
12.45	3.462	(RUNOFF)
12.95	1.837	(RUNOFF)
13.45	1.380	(RUNOFF)
13.95	1.089	(RUNOFF)
14.45	.947	(RUNOFF)
14.95	.857	(RUNOFF)
15.45	.761	(RUNOFF)
15.95	.656	(RUNOFF)
16.95	.613	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6903 CFS-HRS= 13.36 ACRE-FT= 1.10

SUBROUTINE ADDHYD CROSS SECTION 8
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	1604.073	(NULL)
19.46	177.196	(NULL)
21.66	166.683	(NULL)
23.66	158.116	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.1499 CFS-HRS= 5563.78 ACRE-FT= 459.79

SUBROUTINE REACH CROSS SECTION 9
LENGTH= 750.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 9
AREA= 2.24 INPUT RUNOFF CURVE= 83.0 TIME OF CONCENTRATION= .41

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.10	1242.440	(RUNOFF)
16.95	59.906	(RUNOFF)
19.43	44.399	(RUNOFF)
21.55	38.607	(RUNOFF)
23.55	33.273	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.1146 CFS-HRS= 1611.28 ACRE-FT= 133.16

SUBROUTINE ADDHYD CROSS SECTION 9
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.17	2714.087	(NULL)
19.45	221.621	(NULL)
21.61	204.949	(NULL)
23.61	191.358	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.7789 CFS-HRS= 7175.13 ACRE-FT= 592.95

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SUBROUTINE REACH CROSS SECTION 10
LENGTH= 810.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 10
AREA= .17 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .33

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.09	60.586	(RUNOFF)
16.96	3.430	(RUNOFF)
19.45	2.586	(RUNOFF)
20.45	2.288	(RUNOFF)
21.51	2.283	(RUNOFF)
22.45	1.999	(RUNOFF)
23.51	1.983	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6970 CFS-HRS= 76.47 ACRE-FT= 6.32

SUBROUTINE ADDHYD CROSS SECTION 10
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.18	2749.709	(NULL)
19.45	224.195	(NULL)
21.61	207.123	(NULL)
23.61	192.931	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.7502 CFS-HRS= 7251.55 ACRE-FT= 599.27

SUBROUTINE REACH CROSS SECTION 11
LENGTH= 280.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .04

SUBROUTINE RUNOFF CROSS SECTION 11
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	14.608	(RUNOFF)
12.45	3.415	(RUNOFF)
12.95	1.823	(RUNOFF)
13.45	1.370	(RUNOFF)
13.95	1.084	(RUNOFF)
14.45	.945	(RUNOFF)
14.95	.855	(RUNOFF)
15.45	.759	(RUNOFF)
15.95	.654	(RUNOFF)
16.95	.612	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6997 CFS-HRS= 13.35 ACRE-FT= 1.10

SUBROUTINE ADDHYD CROSS SECTION 11
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.19	2746.968	(NULL)
19.45	224.653	(NULL)
21.62	207.452	(NULL)
23.61	193.207	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 6.45

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
8.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.70	106.44	107.37
9.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.05	105.25	105.70	106.44	107.37
10.00	DISCHG	108.41	109.64	111.24	113.30	115.70	118.37	121.61	126.07	131.72	138.05
11.00	DISCHG	144.79	153.11	165.53	181.95	200.52	224.91	307.23	561.32	1005.27	1577.77
12.00	DISCHG	2194.10	2630.08	2743.90	2542.06	2194.40	1849.57	1558.40	1315.07	1111.93	951.74
13.00	DISCHG	832.79	745.22	675.63	617.95	572.53	538.88	512.20	487.66	464.00	443.48
14.00	DISCHG	427.74	415.00	403.15	391.61	381.46	373.61	366.97	360.32	353.42	347.11
15.00	DISCHG	342.17	337.54	332.16	326.05	320.20	315.45	310.89	305.46	299.25	293.33
16.00	DISCHG	288.52	284.43	280.49	276.59	273.15	270.46	268.55	267.32	266.58	266.19
17.00	DISCHG	266.00	265.36	263.80	261.40	258.87	256.72	254.57	251.92	248.78	245.76
18.00	DISCHG	243.29	240.90	238.08	234.83	231.72	229.22	227.40	226.16	225.39	224.93
19.00	DISCHG	224.68	224.56	224.52	224.53	224.57	224.59	224.06	222.48	220.03	217.41
20.00	DISCHG	215.19	213.52	212.39	211.67	211.23	210.93	210.17	208.43	205.87	203.19
21.00	DISCHG	200.95	199.87	200.36	202.15	204.40	206.45	207.43	206.92	205.14	202.92
22.00	DISCHG	200.93	199.42	198.36	197.68	197.27	196.98	196.19	194.44	191.83	189.08
23.00	DISCHG	186.81	185.73	186.20	187.99	190.25	192.23	193.19	192.66	190.87	188.62
24.00	DISCHG	186.37	181.64	172.01	158.37	144.09	132.00	122.82	116.48	112.28	109.60
25.00	DISCHG	107.89	106.81	106.12	105.69	105.42	105.25	105.14	105.08	105.03	105.01
26.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.7453 CFS-HRS= 7264.90 ACRE-FT= 600.37

SUBROUTINE REACH CROSS SECTION 12
LENGTH= 440.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 12
AREA= .32 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .34

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.09	140.117	(RUNOFF)

19.45	5.612	(RUNOFF)
20.45	4.955	(RUNOFF)
21.52	4.925	(RUNOFF)
22.45	4.311	(RUNOFF)
23.52	4.266	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .8896 CFS-HRS= 183.72 ACRE-FT= 15.18

SUBROUTINE ADDHYD CROSS SECTION 12
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.18	2965.226	(NULL)
19.45	230.259	(NULL)
21.61	212.275	(NULL)
23.61	197.375	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.7048 CFS-HRS= 7448.61 ACRE-FT= 615.55

SUBROUTINE REACH CROSS SECTION 13
LENGTH= 970.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 13
AREA= .11 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .12

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.98	51.232	(RUNOFF)
12.46	12.369	(RUNOFF)
12.96	6.654	(RUNOFF)
13.45	5.003	(RUNOFF)
13.95	3.963	(RUNOFF)
14.45	3.456	(RUNOFF)
14.95	3.125	(RUNOFF)
15.45	2.774	(RUNOFF)
15.95	2.395	(RUNOFF)
16.95	2.238	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6927 CFS-HRS= 49.17 ACRE-FT= 4.06

SUBROUTINE ADDHYD CROSS SECTION 13
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	2858.891	(NULL)
19.45	231.934	(NULL)
21.62	213.514	(NULL)
23.62	198.420	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6886 CFS-HRS= 7497.77 ACRE-FT= 619.62

SUBROUTINE REACH CROSS SECTION 14
LENGTH= .00 INPUT COEFFICIENT=340.0000 INPUT ROUTINGS= .91

AVERAGE WATER VELOCITY= .000 AVERAGE ROUTING COEFF= .0000 NUMBER OF ROUTINGS= .00

SUBROUTINE RUNOFF CROSS SECTION 14
AREA= .71 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .40

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.11	330.999	(RUNOFF)
16.96	17.235	(RUNOFF)
19.45	12.854	(RUNOFF)
21.55	11.217	(RUNOFF)
23.55	9.694	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9429 CFS-HRS= 432.07 ACRE-FT= 35.71

SUBROUTINE ADDHYD CROSS SECTION 14
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.18	3168.233	(NULL)
19.45	244.788	(NULL)
21.61	224.678	(NULL)
23.61	208.059	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 7.59

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
8.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
9.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.04	105.21	105.61	106.29	107.18
10.00	DISCHG	108.20	109.38	110.91	112.87	115.23	117.95	121.35	126.09	132.32	139.53
11.00	DISCHG	147.35	156.86	170.80	189.37	210.71	238.13	333.89	629.34	1148.00	1819.35
12.00	DISCHG	2534.31	3041.90	3163.13	2919.96	2516.83	2126.19	1792.12	1509.88	1273.49	1086.95
13.00	DISCHG	949.98	848.40	767.61	700.68	648.31	609.76	578.90	550.35	522.90	499.17
14.00	DISCHG	481.05	466.26	452.37	438.93	427.17	418.18	410.45	402.62	394.58	387.32
15.00	DISCHG	381.64	376.20	369.85	362.70	355.95	350.51	345.15	338.73	331.45	324.58
16.00	DISCHG	319.07	314.32	309.71	305.16	301.17	298.09	295.91	294.50	293.66	293.21
17.00	DISCHG	292.99	292.19	290.30	287.50	284.57	282.11	279.58	276.43	272.76	269.26
18.00	DISCHG	266.43	263.62	260.27	256.47	252.88	250.01	247.92	246.50	245.61	245.08
19.00	DISCHG	244.79	244.65	244.61	244.63	244.68	244.71	244.01	242.11	239.24	236.20
20.00	DISCHG	233.66	231.75	230.44	229.61	229.10	228.77	227.81	225.71	222.69	219.58
21.00	DISCHG	217.02	215.86	216.53	218.66	221.28	223.61	224.67	223.97	221.87	219.31
22.00	DISCHG	217.03	215.30	214.08	213.30	212.81	212.49	211.50	209.38	206.30	203.11
23.00	DISCHG	200.51	199.35	200.00	202.12	204.75	207.03	208.05	207.33	205.21	202.61
24.00	DISCHG	200.09	194.21	182.63	166.52	[illegible].92	136.07	125.58	118.26	113.40	110.29
25.00	DISCHG	108.31	107.66	106.28	105.78	.47	105.28	105.16	105.09	105.04	105.[illegible]
[illegible]	DISCHG	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].00	105.00	105.00	105.00	105.00	105.0[illegible]

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28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6189 CFS-HRS= 7929.84 ACRE-FT= 655.32

ENDCMP

PASS= 3

EXECUTIVE CONTROL CARD 39A OPERATION BASFLO, NEW BASE FLOW= 105.00
EXECUTIVE CONTROL CARD ******** OPERATION
EXECUTIVE CONTROL CARD 40 OPERATION COMPUT, FROM XSECTN/STRUCT 1/ 0 TO XSECTN/STRUCT 14/ 0
STARTING TIME= .00 RAIN DEPTH= 4.05 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 SOIL CONDITION= 2
ALTERNATE NO.= 1 STORM NO.= 3

SUBROUTINE RUNOFF CROSS SECTION 1
AREA= .89 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .54

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.17	785.110	(RUNOFF)
19.37	29.677	(RUNOFF)
21.61	25.396	(RUNOFF)
23.62	21.828	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0004 CFS-HRS= 1148.96 ACRE-FT= 94.95

SUBROUTINE REACH CROSS SECTION 2
LENGTH= 1700.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .39

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	877.603	(NULL)
19.36	134.675	(NULL)
21.65	130.329	(NULL)
23.66	126.773	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 7.4663 CFS-HRS= 4288.48 ACRE-FT= 354.40

SUBROUTINE RUNOFF CROSS SECTION 2
AREA= .99 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .56

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.18	874.316	(RUNOFF)
19.45	33.027	(RUNOFF)
21.62	28.248	(RUNOFF)
23.62	24.208	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0027 CFS-HRS= 1279.55 ACRE-FT= 105.74

SUBROUTINE ADDHYD CROSS SECTION 2
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.19	1749.124	(NULL)
19.37	167.689	(NULL)
21.64	158.569	(NULL)
23.64	150.965	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.5892 CFS-HRS= 5568.03 ACRE-FT= 460.14

SUBROUTINE REACH CROSS SECTION 3
LENGTH= 540.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 3
AREA= .45 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.12	463.993	(RUNOFF)
19.45	15.589	(RUNOFF)
21.58	13.409	(RUNOFF)
23.58	11.510	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.1584 CFS-HRS= 626.82 ACRE-FT= 51.80

SUBROUTINE ADDHYD CROSS SECTION 3
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.19	2181.963	(NULL)
19.39	183.262	(NULL)
21.63	171.882	(NULL)
23.63	162.380	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.1197 CFS-HRS= 6194.88 ACRE-FT= 511.95

SUBROUTINE REACH CROSS SECTION 4
LENGTH= 1000.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .21

SUBROUTINE RUNOFF CROSS SECTION 4
AREA= .06 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.96	71.040	(RUNOFF)
12.45	15.108	(RUNOFF)
12.95	7.981	(RUNOFF)
13.45	5.842	(RUNOFF)
13.95	4.578	(RUNOFF)
14.45	3.959	(RUNOFF)
14.95	3.558	(RUNOFF)
15.45	3.143	(RUNOFF)
15.95	2.697	(RUNOFF)
16.95	2.502	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6823 CFS-HRS= 65.14 ACRE-FT= 5.38

SUBROUTINE ADDHYD CROSS SECTION 4

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	2174.551	(NULL)
19.45	185.150	(NULL)
21.65	173.202	(NULL)
23.65	163.481	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.0586 CFS-HRS= 6260.09 ACRE-FT= 517.33

SUBROUTINE REACH CROSS SECTION 5
LENGTH= 1030.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .22

SUBROUTINE RUNOFF CROSS SECTION 5
AREA= .50 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.12	515.548	(RUNOFF)
19.45	17.321	(RUNOFF)
21.58	14.899	(RUNOFF)
23.58	12.788	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.1584 CFS-HRS= 696.47 ACRE-FT= 57.56

SUBROUTINE ADDHYD CROSS SECTION 5
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	2636.145	(NULL)
19.45	202.460	(NULL)
21.64	187.939	(NULL)
23.65	176.111	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.7300 CFS-HRS= 6956.87 ACRE-FT= 574.92

SUBROUTINE REACH CROSS SECTION 6
LENGTH= 600.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 6
AREA= .05 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .13

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	56.379	(RUNOFF)
12.45	12.427	(RUNOFF)
12.95	6.519	(RUNOFF)
13.45	4.841	(RUNOFF)
13.95	3.801	(RUNOFF)
14.45	3.288	(RUNOFF)
14.95	2.955	(RUNOFF)

15.95	2.243	(RUNOFF)
16.95	2.080	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6936 CFS-HRS= 54.65 ACRE-FT= 4.52

SUBROUTINE ADDHYD CROSS SECTION 6
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	2634.432	(NULL)
19.45	204.003	(NULL)
21.65	189.090	(NULL)
23.65	177.082	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.6954 CFS-HRS= 7011.63 ACRE-FT= 579.44

SUBROUTINE REACH CROSS SECTION 7
LENGTH= 720.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 7
AREA= 1.04 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .58

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.19	959.673	(RUNOFF)
21.63	30.642	(RUNOFF)
23.63	26.247	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.1595 CFS-HRS= 1449.43 ACRE-FT= 119.78

SUBROUTINE ADDHYD CROSS SECTION 7
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	3571.900	(NULL)
21.65	219.650	(NULL)
23.65	203.246	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.2941 CFS-HRS= 8461.22 ACRE-FT= 699.23

SUBROUTINE REACH CROSS SECTION 8
LENGTH= 350.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 8
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .07

PEAK ELEVATIONS

12.45	7.643	(RUNOFF)
12.95	3.967	(RUNOFF)
13.45	2.941	(RUNOFF)
13.95	2.298	(RUNOFF)
14.45	1.985	(RUNOFF)
14.95	1.785	(RUNOFF)
15.45	1.576	(RUNOFF)
15.95	1.351	(RUNOFF)
16.95	1.254	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6789 CFS-HRS= 32.51 ACRE-FT= 2.69

SUBROUTINE ADDHYD CROSS SECTION 8
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	3568.238	(NULL)
21.66	220.315	(NULL)
23.66	203.800	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.2821 CFS-HRS= 8493.77 ACRE-FT= 701.93

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SUBROUTINE REACH CROSS SECTION 9
LENGTH= 750.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 9
AREA= 2.24 INPUT RUNOFF CURVE= 83.0 TIME OF CONCENTRATION= .41

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.09	2629.256	(RUNOFF)
19.39	80.238	(RUNOFF)
21.55	69.391	(RUNOFF)
23.55	59.563	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.3253 CFS-HRS= 3361.50 ACRE-FT= 277.79

SUBROUTINE ADDHYD CROSS SECTION 9
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.15	5942.866	(NULL)
19.37	321.119	(NULL)
21.61	289.097	(NULL)
23.61	262.769	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9392 CFS-HRS= 11855.49 ACRE-FT= 979.74

SUBROUT REACH CROSS SECTION 10
LENGTH= 810.00 INPUT COEFFICIENT= .9100 PUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 10
AREA= .17 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .33

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.07	157.086	(RUNOFF)
16.95	7.025	(RUNOFF)
19.45	5.221	(RUNOFF)
21.51	4.570	(RUNOFF)
23.51	3.943	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.7022 CFS-HRS= 186.76 ACRE-FT= 15.43

SUBROUTINE ADDHYD CROSS SECTION 10
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	6042.931	(NULL)
19.36	326.331	(NULL)
21.61	293.463	(NULL)
23.61	266.507	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9065 CFS-HRS= 12042.23 ACRE-FT= 995.17

SUBROUTINE REACH CROSS SECTION 11
LENGTH= 280.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .04

SUBROUTINE RUNOFF CROSS SECTION 11
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.96	35.520	(RUNOFF)
12.45	7.554	(RUNOFF)
12.95	3.940	(RUNOFF)
13.45	2.921	(RUNOFF)
13.95	2.289	(RUNOFF)
14.45	1.979	(RUNOFF)
14.95	1.779	(RUNOFF)
15.45	1.571	(RUNOFF)
15.95	1.348	(RUNOFF)
16.95	1.251	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6823 CFS-HRS= 32.57 ACRE-FT= 2.69

SUBROUTINE ADDHYD CROSS SECTION 11
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK DISCHARGES PEAK ELEVATIONS

19.36	327.252	(NULL)
21.61	294.127	(NULL)
23.61	267.061	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 6.45

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.01	105.08	105.36	105.90	106.65	107.56	108.53	109.54
8.00	DISCHG	110.62	111.89	113.56	115.63	117.93	120.33	122.86	125.65	128.75	132.06
9.00	DISCHG	135.50	139.30	143.80	148.94	154.31	159.59	165.02	171.17	178.08	185.21
10.00	DISCHG	192.19	200.00	210.14	222.57	235.68	248.27	262.29	280.68	303.19	326.80
11.00	DISCHG	349.51	376.59	415.93	466.45	520.26	587.06	828.35	1489.60	2559.92	3834.09
12.00	DISCHG	5079.37	5900.16	5999.86	5453.69	4628.99	3830.50	3163.66	2617.68	2172.42	1826.43
13.00	DISCHG	1570.96	1383.51	1236.35	1116.18	1022.17	952.39	897.09	847.02	799.53	758.58
14.00	DISCHG	727.07	701.45	677.76	654.90	634.79	619.13	605.77	592.49	578.87	566.41
15.00	DISCHG	556.54	547.26	536.65	524.71	513.32	504.00	494.99	484.41	472.44	461.05
16.00	DISCHG	451.71	443.72	436.07	428.52	421.85	416.59	412.81	410.30	408.73	407.82
17.00	DISCHG	407.29	405.92	402.83	398.22	393.36	389.20	385.02	379.92	373.95	368.20
18.00	DISCHG	363.47	358.87	353.50	347.35	341.47	336.72	333.22	330.81	329.28	328.34
19.00	DISCHG	327.78	327.47	327.31	327.25	327.25	327.21	326.12	323.14	318.55	313.64
20.00	DISCHG	309.47	306.30	304.13	302.72	301.84	301.22	299.73	296.45	291.69	286.72
21.00	DISCHG	282.53	280.48	281.32	284.55	288.62	292.34	294.10	293.12	289.82	285.72
22.00	DISCHG	282.01	279.17	277.17	275.87	275.05	274.48	272.97	269.71	264.89	259.82
23.00	DISCHG	255.62	253.60	254.40	257.62	261.72	265.31	267.04	266.05	262.77	258.64
24.00	DISCHG	254.48	245.69	228.03	203.12	177.01	154.84	137.95	126.24	118.49	113.52
25.00	DISCHG	110.36	108.36	107.09	106.28	105.78	105.46	105.26	105.14	105.06	105.02
26.00	DISCHG	105.01	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9008 CFS-HRS= 12074.79 ACRE-FT= 997.86

SUBROUTINE REACH CROSS SECTION 12
LENGTH= 440.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 12
AREA= .32 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .34

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.06	344.800	(RUNOFF)
16.95	14.456	(RUNOFF)
19.45	10.686	(RUNOFF)
21.51	9.315	(RUNOFF)
23.52	8.025	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0000 CFS-HRS= 413.04 ACRE-FT= 34.13

SUBROUTINE ADDHYD CROSS SECTION 12
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	6317.976	(NULL)
19.36	337.924	(NULL)
21.61	303.254	(NULL)
23.61	274.907	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.8582 CFS-HRS= 12487.85 ACRE-FT= 1032.00

SUBROUTINE REACH CROSS SECTION 13
LENGTH= 970.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 13
AREA= .11 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .12

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	125.874	(RUNOFF)
12.45	27.398	(RUNOFF)
12.95	14.389	(RUNOFF)
13.45	10.671	(RUNOFF)
13.95	8.371	(RUNOFF)
14.45	7.243	(RUNOFF)
14.95	6.506	(RUNOFF)
15.45	5.744	(RUNOFF)
15.95	4.937	(RUNOFF)
16.95	4.579	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6903 CFS-HRS= 120.00 ACRE-FT= 9.92

SUBROUTINE ADDHYD CROSS SECTION 13
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.17	6311.389	(NULL)
21.62	305.752	(NULL)
23.62	277.004	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.8395 CFS-HRS= 12607.87 ACRE-FT= 1041.91

SUBROUTINE REACH CROSS SECTION 14
LENGTH= .00 INPUT COEFFICIENT=340.0000 INPUT ROUTINGS= .91

AVERAGE WATER VELOCITY= .000 AVERAGE ROUTING COEFF= .0000 NUMBER OF ROUTINGS= .00

SUBROUT RUNOFF CROSS SECTION 14
AREA= .71 INPUT RUNOFF CURVE= 90.0 TIME CONCENTRATION= .40

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.09	752.894	(RUNOFF)
16.95	32.735	(RUNOFF)
19.41	24.131	(RUNOFF)
21.55	20.936	(RUNOFF)
23.55	18.004	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0794 CFS-HRS= 952.80 ACRE-FT= 78.74

SUBROUTINE ADDHYD CROSS SECTION 14
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	7018.701	(NULL)
19.37	365.430	(NULL)
21.61	326.594	(NULL)
23.61	294.910	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 7.59

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.01	105.07	105.30	105.79	106.50	107.37	108.33	109.33
8.00	DISCHG	110.39	111.63	113.22	115.24	117.63	120.23	123.07	126.25	129.82	133.68
9.00	DISCHG	137.71	142.10	147.24	153.12	159.30	165.42	171.69	178.81	186.79	195.05
10.00	DISCHG	203.17	212.25	223.96	238.27	253.42	268.01	284.35	305.69	331.77	359.16
11.00	DISCHG	385.45	417.28	463.19	521.92	584.35	659.66	955.75	1744.25	3006.93	4502.68
12.00	DISCHG	5965.10	6882.64	6961.17	6298.63	5336.47	4428.60	3662.11	3027.66	2508.44	2104.90
13.00	DISCHG	1810.41	1592.86	1421.81	1282.16	1173.66	1093.72	1029.68	971.24	915.93	868.45
14.00	DISCHG	832.12	802.28	774.42	747.69	724.34	706.38	690.77	675.10	659.15	644.76
15.00	DISCHG	633.40	622.46	609.85	595.84	582.64	571.94	561.32	548.76	534.65	521.38
16.00	DISCHG	510.68	501.38	492.38	483.55	475.80	469.78	465.45	462.57	460.76	459.72
17.00	DISCHG	459.11	457.37	453.63	448.19	442.55	437.79	432.83	426.75	419.74	413.05
18.00	DISCHG	407.63	402.20	395.80	388.58	381.77	376.29	372.28	369.52	367.75	366.66
19.00	DISCHG	366.02	365.66	365.48	365.42	365.43	365.39	363.97	360.33	354.92	349.21
20.00	DISCHG	344.42	340.79	338.29	336.66	335.64	334.95	333.06	329.09	323.45	317.64
21.00	DISCHG	312.84	310.67	311.87	315.72	320.48	324.71	326.58	325.23	321.30	316.56
22.00	DISCHG	312.30	309.05	306.74	305.23	304.28	303.63	301.73	297.75	292.05	286.14
23.00	DISCHG	281.32	279.17	280.34	284.18	288.95	293.10	294.90	293.53	289.61	284.82
24.00	DISCHG	280.15	269.16	247.76	218.19	187.77	162.35	143.03	129.53	120.56	114.80
25.00	DISCHG	111.14	108.83	107.37	106.45	105.88	105.53	105.31	105.17	105.08	105.03
26.00	DISCHG	105.01	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.7684 CFS-HRS= 13560.66 ACRE-FT= 1120.65

SUMMARY TABLE 1

ALT	STORM	ID	DA SQ-MI.	RAIN TBLE	AMC	DELTA-T HRS.	TZERO HRS.	PRECIP IN.	PRECIP DURATION	PEAK-Q CFS	PEAK-TIME	PEAK-ELEV	RUNOFF IN.	CSM
1	1	~~1~~4A	.89	2	2	.10	.00	1.45	24.00	66.96	12.27	.00	.24	75.24
1	1	2	.89	2	2	.10	.00	1.45	24.00	171.01	12.32	.00	5.70	192.14
1	1	~~2~~4B	.99	2	2	.10	.00	1.45	24.00	73.66	12.27	.00	.24	74.41
1	1	2	1.88	2	2	.10	.00	1.45	24.00	244.23	12.29	.00	2.82	129.91
1	1	~~3~~4C	.45	2	2	.10	.00	1.45	24.00	50.02	12.20	.00	.29	111.16
1	1	3	2.33	2	2	.10	.00	1.45	24.00	288.91	12.28	.00	2.33	124.00
1	1	~~4~~4D	.06	2	2	.10	.00	1.45	24.00	4.80	12.00	.00	.15	80.03
1	1	4	2.39	2	2	.10	.00	1.45	24.00	288.53	12.30	.00	2.28	120.72
1	1	~~5~~4E	.50	2	2	.10	.00	1.45	24.00	55.58	12.20	.00	.29	111.16
1	1	5	2.89	2	2	.10	.00	1.45	24.00	335.95	12.30	.00	1.93	116.25
1	1	~~6~~4F	.05	2	2	.10	.00	1.45	24.00	3.55	12.02	.00	.15	70.97
1	1	6	2.94	2	2	.10	.00	1.45	24.00	335.75	12.31	.00	1.90	114.20
1	1	~~7~~4G	1.04	2	2	.10	.00	1.45	24.00	100.87	12.27	.00	.29	96.99
1	1	7	3.98	2	2	.10	.00	1.45	24.00	434.01	12.31	.00	1.48	109.05
1	1	~~8~~4H	.03	2	2	.10	.00	1.45	24.00	2.70	11.99	.00	.15	90.03
1	1	8	4.01	2	2	.10	.00	1.45	24.00	433.68	12.31	.00	1.47	108.15
1	1	~~9~~5A	2.24	2	2	.10	.00	1.45	24.00	347.54	12.14	.00	.35	155.15
1	1	9	6.25	2	2	.10	.00	1.45	24.00	734.06	12.22	.00	1.07	117.45
1	1	~~10~~5B	.17	2	2	.10	.00	1.45	24.00	7.93	12.15	.00	.15	46.67
1	1	10	6.42	2	2	.10	.00	1.45	24.00	736.66	12.23	.00	1.05	114.75
1	1	~~11~~5C	.03	2	2	.10	.00	1.45	24.00	2.40	12.00	.00	.15	80.03
1	1	11	6.45	2	2	.10	.00	1.45	24.00	735.45	12.23	.00	1.04	114.02
1	1	~~12~~6A	.32	2	2	.10	.00	1.45	24.00	31.85	12.13	.00	.24	99.52
1	1	12	6.77	2	2	.10	.00	1.45	24.00	759.67	12.23	.00	1.00	112.21
1	1	~~13~~6B	.11	2	2	.10	.00	1.45	24.00	8.10	12.01	.00	.15	73.61
1	1	13	6.88	2	2	.10	.00	1.45	24.00	756.04	12.25	.00	.99	109.89
1	1	~~14~~6C	.71	2	2	.10	.00	1.45	24.00	74.83	12.16	.00	.26	105.40
1	1	14	7.59	2	2	.10	.00	1.45	24.00	826.17	12.23	.00	.92	108.85
1	1	~~1~~4A	.89	2	2	.10	.00	2.58	24.00	332.34	12.20	.00	.89	373.41
1	1	2	.89	2	2	.10	.00	2.58	24.00	431.20	12.24	.00	6.36	484.50
1	1	~~2~~4B	.99	2	2	.10	.00	2.58	24.00	369.56	12.20	.00	.89	373.29
1	1	2	1.88	2	2	.10	.00	2.58	24.00	799.33	12.22	.00	3.48	425.17
1	1	~~3~~4C	.45	2	2	.10	.00	2.58	24.00	207.66	12.14	.00	1.00	461.46
1	1	3	2.33	2	2	.10	.00	2.58	24.00	992.03	12.21	.00	3.00	425.76
1	1	~~4~~4D	.06	2	2	.10	.00	2.58	24.00	29.22	11.97	.00	.69	486.94
1	1	4	2.39	2	2	.10	.00	2.58	24.00	987.30	12.23	.00	2.94	413.10
1	1	~~5~~4E	.50	2	2	.10	.00	2.58	24.00	230.73	12.14	.00	1.00	461.46
1	1	5	2.89	2	2	.10	.00	2.58	24.00	1191.81	12.23	.00	2.60	412.39
1	1	~~6~~4F	.05	2	2	.10	.00	2.58	24.00	22.84	11.98	.00	.69	456.71
1	1	6	2.94	2	2	.10	.00	2.58	24.00	1189.75	12.24	.00	2.57	404.68
1	1	~~7~~4G	1.04	2	2	.10	.00	2.58	24.00	427.36	12.21	.00	1.00	410.92
1	1	7	3.98	2	2	.10	.00	2.58	24.00	1606.10	12.24	.00	2.16	403.54
1	1	~~8~~4H	.03	2	2	.10	.00	2.58	24.00	15.42	11.97	.00	.69	514.07
1	1	8	4.01	2	2	.10	.00	2.58	24.00	1604.07	12.24	.00	2.15	400.02
1	1	~~9~~5A	2.24	2	2	.10	.00	2.58	24.00	1242.44	12.10	.00	1.11	554.66
1	1	9	6.25	2	2	.10	.00	2.58	24.00	2714.09	12.17	.00	1.78	434.25
1	1	~~10~~5B	.17	2	2	.10	.00	2.58	24.00	60.59	12.09	.00	.70	356.39
1	1	10	6.42	2	2	.10	.00	2.58	24.00	2749.71	12.18	.00	1.75	428.30
1	1	~~11~~5C	.03	2	2	.10	.00	2.58	24.00	14.61	11.97	.00	.69	486.94
1	1	11	6.45	2	2	.10	.00	2.58	24.00	2746.97	12.19	.00	1.75	425.89
1		~~12~~6A	.32	2	2	.10	.00	2.58	00	149.02	12.08	.00	.89	465.68
1		12	6.77	2	2	.10	.00	2.58	00	2865.23	12.18	.00	1.70	423.22

1	1	13	6.88	2	2	.10	.00	2.58	24.00	2858.89	12.20	.00	1.69	415.54
1	1	~~14~~6C	.71	2	2	.10	.00	2.58	24.00	331.00	12.11	.00	.94	466.20
1	1	14	7.59	2	2	.10	.00	2.58	24.00	3168.23	12.18	.00	1.62	417.42
1	3	~~1~~4A	.89	2	2	.10	.00	4.05	24.00	785.11	12.17	.00	2.00	882.15
1	3	2	.89	2	2	.10	.00	4.05	24.00	877.60	12.21	.00	7.47	986.07
1	3	~~2~~4B	.99	2	2	.10	.00	4.05	24.00	874.32	12.18	.00	2.00	883.15
1	3	2	1.88	2	2	.10	.00	4.05	24.00	1749.12	12.19	.00	4.59	930.39
1	3	~~3~~4=	.45	2	2	.10	.00	4.05	24.00	463.99	12.12	.00	2.16	1031.10
1	3	3	2.33	2	2	.10	.00	4.05	24.00	2181.96	12.19	.00	4.12	936.46
1	3	~~4~~4D	.06	2	2	.10	.00	4.05	24.00	71.04	11.96	.00	1.68	1184.00
1	3	4	2.39	2	2	.10	.00	4.05	24.00	2174.55	12.21	.00	4.06	909.85
1	3	~~5~~4E	.50	2	2	.10	.00	4.05	24.00	515.55	12.12	.00	2.16	1031.10
1	3	5	2.89	2	2	.10	.00	4.05	24.00	2636.14	12.20	.00	3.73	912.16
1	3	~~6~~4F	.05	2	2	.10	.00	4.05	24.00	56.38	11.97	.00	1.69	1127.58
1	3	6	2.94	2	2	.10	.00	4.05	24.00	2634.43	12.21	.00	3.70	896.07
1	3	~~7~~4G	1.04	2	2	.10	.00	4.05	24.00	959.67	12.19	.00	2.16	922.76
1	3	7	3.98	2	2	.10	.00	4.05	24.00	3571.90	12.21	.00	3.29	897.46
1	3	~~8~~4H	.03	2	2	.10	.00	4.05	24.00	36.94	11.96	.00	1.68	1231.34
1	3	8	4.01	2	2	.10	.00	4.05	24.00	3568.24	12.22	.00	3.28	889.83
1	3	~~9~~5A	2.24	2	2	.10	.00	4.05	24.00	2629.26	12.09	.00	2.33	1173.77
1	3	9	6.25	2	2	.10	.00	4.05	24.00	5942.87	12.15	.00	2.94	950.86
1	3	~~10~~5B	.17	2	2	.10	.00	4.05	24.00	157.09	12.07	.00	1.70	924.04
1	3	10	6.42	2	2	.10	.00	4.05	24.00	6042.93	12.16	.00	2.91	941.27
1	3	~~11~~5C	.03	2	2	.10	.00	4.05	24.00	35.52	11.96	.00	1.68	1184.00
1	3	11	6.45	2	2	.10	.00	4.05	24.00	6038.44	12.17	.00	2.90	936.19
1	3	~~12~~6A	.32	2	2	.10	.00	4.05	24.00	344.80	12.06	.00	2.00	1077.50
1	3	12	6.77	2	2	.10	.00	4.05	24.00	6317.98	12.16	.00	2.86	933.23
1	3	~~13~~6B	.11	2	2	.10	.00	4.05	24.00	125.87	11.97	.00	1.69	1144.31
1	3	13	6.88	2	2	.10	.00	4.05	24.00	6311.39	12.17	.00	2.84	917.35
1	3	~~14~~6C	.71	2	2	.10	.00	4.05	24.00	752.89	12.09	.00	2.08	1060.41
1	3	14	7.59	2	2	.10	.00	4.05	24.00	7018.70	12.16	.00	2.77	924.73

SUMMARY TABLE 3

	DISCHARGE, CFS									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
XSEC/STRUC NO. 1 ALTERNATE 1	332.34	785.11	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 2 ALTERNATE 1	799.33	1749.12	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 3 ALTERNATE 1	992.03	2181.96	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 4 ALTERNATE 1	987.30	2174.55	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 5 ALTERNATE 1	1191.81	2636.14	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 6 ALTERNATE 1	1189.75	2634.43	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 7 ALTERNATE 1	1606.10	3571.90	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 8 ALTERNATE 1	1604.07	3568.24	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 9 ALTERNATE 1	2714.09	5942.87	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 10 ALTERNATE 1	2749.71	6042.93	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 11 ALTERNATE 1	2746.97	6038.44	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 12 ALTERNATE 1	2865.23	6317.98	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 13 ALTERNATE 1	2858.89	6311.39	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 14 ALTERNATE 1	3168.23	7018.70	.00	.00	.00	.00	.00	.00	.00	.00

ENDJOB CARD ENCOUNTERED. END OF JOB.

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@RUN,L SCS04M,1604000101/  SCS0401,SCS04,5,5000/1000

@SYM PRINT$,1,FCD=04

@ASG,T 25.,F///50

@ASG,T 23.,F///50

@ASG,T 22.,F///50

@XQT   SCS76*ABS.TR20/CONVEX
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III C-45

"USING NORMAL DRAINAGE AREAS"

BUCKHORN MESA W/S
BULLDOG WASH FLOODWAY
INLET DESIGN HYDROLOGY
2-YEAR, 24-HRW
10-YEAR, 24-HRW
100-YEAR, 24-HRW

(DES/TR20.ADWH)
4/23/85
HRW

NOTE!! 105 CFS Base Flow (P. Spy Flow) From Apache Junction FRS was Added To Each Storm, Based on Work Plan Supplement dated June 1976

PASS= 1

EXECUTIVE CONTROL CARD 33 OPERATION LIST

LISTING OF DATA IN CORE

0 BULLDOG WASH,DESIGN HYDROLOGY

VELOCITY INCREMENT

1 CTABLE		.2000			
8	.0000	.0800	.1800	.2500	.3200
8	.3700	.4100	.4500	.4900	.5100
8	.5400	.5700	.5900	.6100	.6300
8	.6500	.6600	.6700	.6900	.7000
8	.7100	.7200	.7300	.7400	.7500
8	.7600	.7700	.7700	.7800	.7900
8	.7900	.8000	.8100	.8100	.8200
8	.8200	.8300	.8300	.8400	.8400
8	.8400	.8500	.8500	.8600	.8600
8	.8600	.8600	.8700	.8700	.8700
8	.8800	.8800	.8800	.8900	.8900
8	.8900	.8900	.8900	.8900	.9000
8	.9000	.9000	.9000	.9000	.9100
8	.9100	.9100	.9100	.9100	.9100
8	.9200	.9200	.9200	.9200	.9200
8	.9200	.9200	.9200	.9300	.9300
9 ENDTBL					

TIME INCREMENT

4 DIMHYD					
8	.0000	.0300	.1000	.1900	.3100
8	.4700	.6600	.8200	.9300	.9900
8	1.0000	.9900	.9300	.8600	.7800
8	.6900	.5600	.4600	.3900	.3300
8	.2800	.2410	.2070	.1740	.1470
8	.1260	.1070	.0910	.0770	.0660
8	.0550	.0470	.0400	.0340	.0290
8	.0250	.0210	.0180	.0150	.0130
8	.0110	.0090	.0080	.0070	.0060
8	.0050	.0040	.0030	.0020	.0010
8	.0000	.0000	.0000	.0000	.0000
9 ENDTBL					

COMPUTED PEAK K FACTOR = 484.00

TIME INCREMENT

```
8                .0000       .0080       .0170       .0260       .0350
8                .0450       .0550       .0650       .0760       .0870
8                .0990       .1120       .1250       .1400       .1560
8                .1740       .1940       .2190       .2540       .3030
8                .5150       .5830       .6240       .6540       .6820
8                .7050       .7270       .7480       .7670       .7840
8                .8000       .8160       .8300       .8440       .8570
8                .8700       .8820       .8930       .9050       .9160
8                .9260       .9360       .9460       .9550       .9650
8                .9740       .9830       .9920      1.0000      1.0000
9 ENDTBL

                TIME INCREMENT
5 RAINFL 2                  .5000

8                .0000       .0050       .0110       .0160       .0220
8                .0280       .0350       .0410       .0480       .0560
8                .0630       .0710       .0800       .0890       .0980
8                .1090       .1200       .1330       .1470       .1630
8                .1810       .2040       .2350       .2830       .6630
8                .7350       .7720       .7990       .8200       .8380
8                .8540       .8680       .8800       .8910       .9020
8                .9120       .9210       .9290       .9370       .9450
8                .9520       .9590       .9650       .9720       .9780
8                .9840       .9890       .9950      1.0000      1.0000
9 ENDTBL

                TIME INCREMENT
5 RAINFL 3                  .0200

8                .0000       .0080       .0162       .0246       .0333
8                .0425       .0524       .0630       .0743       .0863
8                .0990       .1124       .1265       .1420       .1600
8                .1800       .2050       .2550       .3450       .4370
8                .5300       .6030       .6330       .6600       .6840
8                .7050       .7240       .7420       .7590       .7750
8                .7900       .8043       .8180       .8312       .8439
8                .8561       .8678       .8790       .8898       .9002
8                .9103       .9201       .9297       .9391       .9483
8                .9573       .9661       .9747       .9832       .9916
8               1.0000      1.0000      1.0000      1.0000      1.0000
9 ENDTBL
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STANDARD CONTROL INSTRUCTIONS

```
6 RUNOFF  1   1        6        .4700      78.0000      .54001 0 0 1 0 1
6 REACH   3   2   6    5     1700.0000       .8600      .00001 0 0 1 0 1
6 RUNOFF  1   2        6        .6200      78.0000      .56001 0 0 1 0 1
6 ADDHYD  4   2   5 6  7                                    1 0 0 1 0 1
6 REACH   3   3   7    5      540.0000       .8600      .00000 0 0 0 0 0
6 RUNOFF  1   3        6        .1500      81.0000      .47001 0 0 1 0 1
6 ADDHYD  4   3   5 6  7                                    1 0 0 1 0 1
6 REACH   3   4   7    5     1000.0000       .8700      .00000 0 0 0 0 0
6 RUNOFF  1   4        6        .0600      75.0000      .10001 0 0 1 0 1
6 ADDHYD  4   4   5 6  7                                    1 0 0 1 0 1
6 REACH   3   5   7    5     1030.0000       .8700      .00000 0 0 0 0 0
6 RUNOFF  1   5        6        .3300      80.0000      .47001 0 0 1 0 1
6 ADDHYD  4   5   5 6  7                                    1 0 0 1 0 1
6 REACH   3   6   7    5      600.0000       .8800      .00000 0 0 0 0 0
6 RUNOFF  1   6        6        .0500      75.0000      .13001 0 0 1 0 1
6 ADDHYD  4   6   5 6  7                                    1 0 0 1 0 1
6 REACH   3   7   7    5      720.0000       .8800      .00000 0 0 0 0 0
6 RUNOFF  1   7        6        .6900      80.0000      .58001 0 0 1 0 1
6 ADDHYD  4   7   5 6  7                                    1 0 0 1 0 1
6 REACH   3   8   7    5      350.0000       .9000      .00000 0 0 0 0 0
6 RUNOFF  1   8        6        .0300      75.0000      .07001 0 0 1 0 1
6 ADDHYD  4   8   5 6  7                                    1 0 0 1 0 1
6 REACH   3   9   7    5      750.0000       .9000      .00000 0 0 0 0 0
6 RUNOFF  1   9        6       2.0000      83.0000      .41001 0 0 1 0 1
6 ADDHYD  4   9   5 6  7                                    1 0 0 1 0 1
6 REACH   3  10   7    5      810.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF  1  10        6        .1700      75.0000      .33001 0 0 1 0 1
6 ADDHYD  4  10   5 6  7                                    1 0 0 1 0 1
6 REACH   3  11   7    5      280.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF  1  11        6        .0300      75.0000      .10001 0 0 1 0 1
6 ADDHYD  4  11   5 6  7                                    1 1 0 1 0 1
6 REACH   3  12   7    5      440.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF  1  12        6        .3200      79.0000      .34001 0 0 1 0 1
6 ADDHYD  4  12   5 6  7                                    1 0 0 1 0 1
6 REACH   3  13   7    5      970.0000       .9100      .00000 0 0 0 0 0
6 RUNOFF  1  13        6        .1100      75.0000      .12001 0 0 1 0 1
6 ADDHYD  4  13   5 6  7                                    1 0 0 1 0 1
6 REACH   3  14   7    5        .0000     340.0000      .91000 0 0 0 0 0
6 RUNOFF  1  14        6        .7100      80.0000      .40001 0 0 1 0 1
6 ADDHYD  4  14   5 6  7                                    1 1 0 1 0 1
  ENDATA
```

END OF LISTING

16.95 .367 (RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1476 CFS-HRS= 5.72 ACRE-FT= .47

SUBROUTINE ADDHYD CROSS SECTION 4
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.32	188.414	(NULL)
16.96	115.055	(NULL)
19.47	112.727	(NULL)
21.65	111.740	(NULL)
23.65	110.888	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.9594 CFS-HRS= 3321.88 ACRE-FT= 274.52

SUBROUTINE REACH CROSS SECTION 5
LENGTH= 1030.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .22

SUBROUTINE RUNOFF CROSS SECTION 5
AREA= .33 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	31.795	(RUNOFF)
16.99	2.884	(RUNOFF)
19.48	2.204	(RUNOFF)
21.58	1.939	(RUNOFF)
23.58	1.692	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2610 CFS-HRS= 55.59 ACRE-FT= 4.59

SUBROUTINE ADDHYD CROSS SECTION 5
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.30	215.579	(NULL)
16.96	117.937	(NULL)
19.48	114.928	(NULL)
21.65	113.660	(NULL)
23.64	112.561	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.2107 CFS-HRS= 3377.48 ACRE-FT= 279.12

SUBROUTINE REACH CROSS SECTION 6
LENGTH= 600.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .12

AREA= .05 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .13

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.02	3.548	(RUNOFF)
12.47	1.318	(RUNOFF)
12.96	.768	(RUNOFF)
13.46	.604	(RUNOFF)
13.96	.493	(RUNOFF)
14.46	.440	(RUNOFF)
14.96	.405	(RUNOFF)
15.46	.365	(RUNOFF)
15.96	.319	(RUNOFF)
16.96	.305	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1484 CFS-HRS= 4.79 ACRE-FT= .40

SUBROUTINE ADDHYD CROSS SECTION 6
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.32	216.116	(NULL)
16.96	118.242	(NULL)
19.47	115.165	(NULL)
21.65	113.846	(NULL)
23.64	112.723	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.1195 CFS-HRS= 3382.28 ACRE-FT= 279.51

SUBROUTINE REACH CROSS SECTION 7
LENGTH= 720.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 7
AREA= .69 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .58

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.29	57.825	(RUNOFF)
19.48	4.603	(RUNOFF)
21.64	4.007	(RUNOFF)
23.64	3.490	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2611 CFS-HRS= 116.27 ACRE-FT= 9.61

SUBROUTINE ADDHYD CROSS SECTION 7
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.32	272.798	(NULL)
16.95	124.278	(NULL)
19.48	119.765	(NULL)
21.65	117.845	(NULL)

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TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.2873 CFS-HRS= 3498.56 ACRE-FT= 289.12

SUBROUTINE REACH CROSS SECTION 8
LENGTH= 350.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 8
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .07

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.99	2.701	(RUNOFF)
12.46	.825	(RUNOFF)
12.96	.471	(RUNOFF)
13.46	.369	(RUNOFF)
13.96	.299	(RUNOFF)
14.46	.266	(RUNOFF)
14.96	.245	(RUNOFF)
15.45	.221	(RUNOFF)
15.96	.193	(RUNOFF)
16.95	.184	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1479 CFS-HRS= 2.86 ACRE-FT= .24

SUBROUTINE ADDHYD CROSS SECTION 8
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.32	272.997	(NULL)
19.47	119.907	(NULL)
21.66	117.953	(NULL)
23.66	116.297	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.2606 CFS-HRS= 3501.42 ACRE-FT= 289.36

SUBROUTINE REACH CROSS SECTION 9
LENGTH= 750.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 9
AREA= 2.00 INPUT RUNOFF CURVE= 83.0 TIME OF CONCENTRATION= .41

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	310.299	(RUNOFF)
16.97	21.109	(RUNOFF)
19.46	15.965	(RUNOFF)
21.55	14.034	(RUNOFF)
23.55	12.203	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .3499 CFS-HRS= 451.57 ACRE-FT= 37.32

SUBROUTINE ADDHYD CROSS SECTION 9
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.19	551.803	(NULL)
16.96	145.571	(NULL)
19.47	135.868	(NULL)
21.59	131.912	(NULL)
23.59	128.428	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.3921 CFS-HRS= 3953.00 ACRE-FT= 326.68

SUBROUTINE REACH CROSS SECTION 10
LENGTH= 810.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 10
AREA= .17 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .33

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.15	7.934	(RUNOFF)
16.99	1.025	(RUNOFF)
19.46	.803	(RUNOFF)
20.46	.719	(RUNOFF)
21.53	.726	(RUNOFF)
22.45	.640	(RUNOFF)
23.51	.640	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1489 CFS-HRS= 16.34 ACRE-FT= 1.35

SUBROUTINE ADDHYD CROSS SECTION 10
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	556.041	(NULL)
16.96	146.592	(NULL)
19.47	136.665	(NULL)
21.60	132.608	(NULL)
23.60	129.040	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.3458 CFS-HRS= 3969.32 ACRE-FT= 328.02

SUBROUTINE REACH CROSS SECTION 11
LENGTH= 280.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .04

SUBROUTINE RUNOFF CROSS SECTION 11
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.00	2.401	(RUNOFF)
12.46	.808	(RUNOFF)
12.96	.466	(RUNOFF)
13.46	.365	(RUNOFF)
13.96	.297	(RUNOFF)
14.46	.265	(RUNOFF)
14.96	.244	(RUNOFF)
15.45	.220	(RUNOFF)
15.96	.192	(RUNOFF)
16.95	.183	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1476 CFS-HRS= 2.86 ACRE-FT= .24

SUBROUTINE ADDHYD CROSS SECTION 11
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDPOGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	555.391	(NULL)
16.96	146.775	(NULL)
19.47	136.807	(NULL)
21.60	132.715	(NULL)
23.60	129.131	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 4.60

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
8.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
9.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
10.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
11.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.11	108.18	129.08	182.01	277.61
12.00	DISCHG	404.58	514.84	555.14	526.61	469.80	418.11	376.84	339.81	305.81	278.23
13.00	DISCHG	258.20	243.63	231.24	220.23	211.54	205.41	200.53	195.55	190.39	185.93
14.00	DISCHG	182.71	180.14	177.58	174.97	172.72	171.11	169.75	168.28	166.68	165.26
15.00	DISCHG	164.24	163.26	161.99	160.49	159.11	158.07	157.06	155.72	154.15	152.71
16.00	DISCHG	151.62	150.71	149.79	148.85	148.04	147.45	147.08	146.87	146.77	146.75
17.00	DISCHG	146.76	146.63	146.22	145.58	144.94	144.45	143.94	143.26	142.44	141.68
18.00	DISCHG	141.10	140.53	139.81	138.94	138.15	137.56	137.16	136.90	136.76	136.69
19.00	DISCHG	136.67	136.67	136.69	136.73	136.77	136.80	136.65	136.19	135.49	134.79
20.00	DISCHG	134.24	133.85	133.61	133.47	133.39	133.35	133.14	132.63	131.89	131.17
21.00	DISCHG	130.60	130.40	130.66	131.26	131.94	132.50	132.72	132.49	131.92	131.29
22.00	DISCHG	130.78	130.42	130.19	130.04	129.96	129.91	129.69	129.16	128.40	127.63
23.00	DISCHG	127.05	126.84	127.09	127.70	128.38	128.92	129.13	128.89	128.31	127.66
24.00	DISCHG	127.06	125.66	122.71	118.65	114.62	111.45	109.16	107.64	106.65	106.03
25.00	DISCHG	105.65	105.40	105.24	105.14	105.08	105.05	105.03	105.01	105.00	105.00
26.00	[redacted]CHG	105.00	105.00	105.00	105.00	105[redacted]	105.00	105.00	105.00	105.00	105.00
27.00	[redacted]CHG	105.00	105.00	105.00	105.00	10[redacted]	105.00	105.00	105.00	105.00	105.00
28.00	[redacted]SCHG	105.00	105.00	105.00	105.00	105	105.00	105.00	105.00	105.00	105.00

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TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.3380 CFS-HRS= 3972.17 ACRE-FT= 328.26

SUBROUTINE REACH CROSS SECTION 12
LENGTH= 440.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 12
AREA= .32 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .34

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.13	31.848	(RUNOFF)
16.98	2.616	(RUNOFF)
19.46	2.009	(RUNOFF)
20.45	1.788	(RUNOFF)
21.52	1.791	(RUNOFF)
22.45	1.577	(RUNOFF)
23.52	1.570	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2353 CFS-HRS= 48.60 ACRE-FT= 4.02

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SUBROUTINE ADDHYD CROSS SECTION 12
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	581.837	(NULL)
16.96	149.389	(NULL)
19.47	138.812	(NULL)
21.60	134.481	(NULL)
23.59	130.677	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.2663 CFS-HRS= 4020.76 ACRE-FT= 332.28

SUBROUTINE REACH CROSS SECTION 13
LENGTH= 970.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 13
AREA= .11 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .12

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.01	8.097	(RUNOFF)
12.46	2.914	(RUNOFF)
12.96	1.698	(RUNOFF)
13.46	1.332	(RUNOFF)
13.96	1.087	(RUNOFF)
14.46	.969	(RUNOFF)
14.96	.892	(RUNOFF)
15.46	.804	(RUNOFF)
15.96	.793	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .1482 CFS-HRS= 10.52 ACRE-FT= .87

SUBROUTINE ADDHYD CROSS SECTION 13
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	579.986	(NULL)
16.96	150.056	(NULL)
19.47	139.330	(NULL)
21.60	134.883	(NULL)
23.60	131.024	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.2418 CFS-HRS= 4031.27 ACRE-FT= 333.14

SUBROUTINE REACH CROSS SECTION 14
LENGTH= .00 INPUT COEFFICIENT=340.0000 INPUT ROUTINGS= .91

AVERAGE WATER VELOCITY= .000 AVERAGE ROUTING COEFF= .0000 NUMBER OF ROUTINGS= .00

SUBROUTINE RUNOFF CROSS SECTION 14
AREA= .71 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .40

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	74.832	(RUNOFF)
16.98	6.207	(RUNOFF)
19.46	4.745	(RUNOFF)
20.45	4.224	(RUNOFF)
21.56	4.202	(RUNOFF)
23.55	3.672	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .2611 CFS-HRS= 119.64 ACRE-FT= 9.89

SUBROUTINE ADDHYD CROSS SECTION 14
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	652.514	(NULL)
16.96	156.263	(NULL)
19.47	144.075	(NULL)
21.59	139.075	(NULL)
23.59	134.686	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 5.74

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.0	DISCHG	105.00	105.00	105.00	105.00	5.00	105.00	105.00	105.00	105.00	105.0
8.0	DISCHG	105.00	105.00	105.00	105.00	.00	105.00	105.00	105.00	105.00	105.(

10.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
11.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.09	107.66	127.33	185.00	300.54
12.00	DISCHG	461.02	599.73	652.07	617.38	547.95	485.74	435.41	390.29	348.96	315.31
13.00	DISCHG	291.21	273.52	258.53	245.22	234.74	227.40	221.50	215.46	209.21	203.82
14.00	DISCHG	199.94	196.83	193.71	190.54	187.81	185.88	184.24	182.43	180.48	178.77
15.00	DISCHG	177.54	176.34	174.77	172.94	171.26	170.01	168.76	167.12	165.18	163.41
16.00	DISCHG	162.10	161.00	159.87	158.73	157.74	157.04	156.60	156.35	156.24	156.22
17.00	DISCHG	156.25	156.08	155.55	154.76	153.98	153.39	152.77	151.92	150.91	149.98
18.00	DISCHG	149.28	148.58	147.68	146.62	145.66	144.94	144.46	144.16	143.99	143.91
19.00	DISCHG	143.89	143.90	143.93	143.97	144.02	144.06	143.87	143.28	142.41	141.55
20.00	DISCHG	140.88	140.42	140.14	139.97	139.88	139.83	139.56	138.92	138.00	137.10
21.00	DISCHG	136.42	136.20	136.55	137.31	138.15	138.83	139.07	138.76	138.06	137.28
22.00	DISCHG	136.66	136.23	135.94	135.77	135.68	135.62	135.33	134.67	133.71	132.77
23.00	DISCHG	132.07	131.84	132.18	132.94	133.78	134.45	134.68	134.36	133.63	132.83
24.00	DISCHG	132.11	130.29	126.57	121.50	116.54	112.70	109.96	108.13	106.95	106.21
25.00	DISCHG	105.75	105.46	105.28	105.16	105.10	105.06	105.03	105.01	105.00	105.00
26.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.1205 CFS-HRS= 4150.91 ACRE-FT= 343.03

ENDCMP

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PASS= 2

EXECUTIVE CONTROL CARD 37A OPERATION BASFLO, NEW BASE FLOW= 105.00
EXECUTIVE CONTROL CARD ******** OPERATION
EXECUTIVE CONTROL CARD 38 OPERATION COMPUT, FROM XSECTN/STRUCT 1/ 0 TO XSECTN/STRUCT 14/ 0
STARTING TIME= .00 RAIN DEPTH= 2.58 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 SOIL CONDITION= 2
ALTERNATE NO.= 1 STORM NO.= 1

SUBROUTINE RUNOFF CROSS SECTION 1
AREA= .47 INPUT RUNOFF CURVE= 78.0 TIME OF CONCENTRATION= .54

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	163.384	(RUNOFF)
19.45	7.952	(RUNOFF)
21.61	6.859	(RUNOFF)
23.62	5.934	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .8389 CFS-HRS= 254.45 ACRE-FT= 21.03

SUBROUTINE REACH CROSS SECTION 2
LENGTH= 1700.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .39

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	265.286	(NULL)
19.46	112.950	(NULL)
21.65	111.843	(NULL)
23.66	110.919	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 11.1892 CFS-HRS= 3393.95 ACRE-FT= 280.48

SUBROUTINE RUNOFF CROSS SECTION 2
AREA= .62 INPUT RUNOFF CURVE= 78.0 TIME OF CONCENTRATION= .56

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	215.380	(RUNOFF)
19.46	10.492	(RUNOFF)
21.63	9.051	(RUNOFF)
23.62	7.805	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .8394 CFS-HRS= 335.88 ACRE-FT= 27.76

SUBROUTINE ADDHYD CROSS SECTION 2
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	479.874	(NULL)
19.46	123.443	(NULL)
21.64	120.892	(NULL)
23.64	118.719	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.3022 CFS-HRS= 3729.83 ACRE-FT= 308.23

SUBROUTINE REACH CROSS SECTION 3
LENGTH= 540.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 3
AREA= .15 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	69.219	(RUNOFF)
19.46	2.802	(RUNOFF)
21.58	2.426	(RUNOFF)
23.58	2.092	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9975 CFS-HRS= 96.56 ACRE-FT= 7.98

SUBROUTINE ADDHYD CROSS SECTION 3
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	542.383	(NULL)
19.46	126.243	(NULL)
21.64	123.293	(NULL)
23.64	120.788	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.7815 CFS-HRS= 3826.40 ACRE-FT= 316.21

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SUBROUTINE REACH CROSS SECTION 4
LENGTH= 1000.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .21

SUBROUTINE RUNOFF CROSS SECTION 4
AREA= .06 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	29.217	(RUNOFF)
12.45	6.830	(RUNOFF)
12.95	3.646	(RUNOFF)
13.45	2.740	(RUNOFF)
13.95	2.168	(RUNOFF)
14.45	1.889	(RUNOFF)
14.95	1.709	(RUNOFF)
15.45	1.518	(RUNOFF)
15.95	1.308	(RUNOFF)
16.95	1.223	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6898 CFS-HRS= 26.71 ACRE-FT= 2.21

SUBROUTINE ADDHYD CROSS SECTION 4

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	542.852	(NULL)
19.46	127.163	(NULL)
21.65	123.981	(NULL)
23.65	121.370	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.5926 CFS-HRS= 3853.12 ACRE-FT= 318.42

SUBROUTINE REACH CROSS SECTION 5
LENGTH= 1030.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .22

SUBROUTINE RUNOFF CROSS SECTION 5
AREA= .33 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.15	142.569	(RUNOFF)
16.95	8.014	(RUNOFF)
19.46	5.073	(RUNOFF)
21.58	5.176	(RUNOFF)
23.58	4.467	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9424 CFS-HRS= 200.71 ACRE-FT= 16.59

SUBROUTINE ADDHYD CROSS SECTION 5
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.23	670.310	(NULL)
19.46	133.131	(NULL)
21.64	129.108	(NULL)
23.64	125.788	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.8537 CFS-HRS= 4053.92 ACRE-FT= 335.02

SUBROUTINE REACH CROSS SECTION 6
LENGTH= 600.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 6
AREA= .05 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .13

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.98	22.835	(RUNOFF)
12.46	5.607	(RUNOFF)
12.95	3.014	(RUNOFF)
13.45	2.270	(RUNOFF)
13.95	1.800	(RUNOFF)
14.45	1.562	(RUNOFF)

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15.45	1.259	(RUNOFF)
15.95	1.088	(RUNOFF)
16.95	1.017	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6939 CFS-HRS= 22.39 ACRE-FT= 1.85

SUBROUTINE ADDHYD CROSS SECTION 6
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	671.990	(NULL)
19.46	133.895	(NULL)
21.64	129.700	(NULL)
23.64	126.292	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.7597 CFS-HRS= 4076.35 ACRE-FT= 336.87

SUBROUTINE REACH CROSS SECTION 7
LENGTH= 720.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 7
AREA= .69 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .58

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	265.178	(RUNOFF)
19.45	12.483	(RUNOFF)
21.63	10.700	(RUNOFF)
23.63	9.216	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9429 CFS-HRS= 419.86 ACRE-FT= 34.70

SUBROUTINE ADDHYD CROSS SECTION 7
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	932.011	(NULL)
19.46	146.373	(NULL)
21.65	140.380	(NULL)
23.65	135.499	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9396 CFS-HRS= 4496.25 ACRE-FT= 371.57

SUBROUTINE REACH CROSS SECTION 8
LENGTH= 350.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .06

SUBROUT RUNOFF CROSS SECTION 8

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PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	15.422	(RUNOFF)
12.45	3.462	(RUNOFF)
12.95	1.837	(RUNOFF)
13.45	1.380	(RUNOFF)
13.95	1.089	(RUNOFF)
14.45	.947	(RUNOFF)
14.95	.857	(RUNOFF)
15.45	.761	(RUNOFF)
15.95	.656	(RUNOFF)
16.95	.613	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6903 CFS-HRS= 13.36 ACRE-FT= 1.10

SUBROUTINE ADDHYD CROSS SECTION 8
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.24	932.420	(NULL)
19.46	146.834	(NULL)
21.65	140.719	(NULL)
23.65	135.775	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9115 CFS-HRS= 4509.63 ACRE-FT= 372.68

SUBROUTINE REACH CROSS SECTION 9
LENGTH= 750.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 9
AREA= 2.00 INPUT RUNOFF CURVE= 83.0 TIME OF CONCENTRATION= .41

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.10	1109.321	(RUNOFF)
16.95	53.487	(RUNOFF)
19.43	39.642	(RUNOFF)
21.55	34.470	(RUNOFF)
23.55	29.708	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.1146 CFS-HRS= 1438.64 ACRE-FT= 118.89

SUBROUTINE ADDHYD CROSS SECTION 9
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.15	1962.994	(NULL)
19.45	186.500	(NULL)
21.59	175.008	(NULL)
23.59	165.310	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0948 CFS-HRS= 5948.34 ACRE-FT= 491.57

SUBROUTINE REACH CROSS SECTION 10
LENGTH= 810.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 10
AREA= .17 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .33

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.09	60.586	(RUNOFF)
16.96	3.430	(RUNOFF)
19.45	2.586	(RUNOFF)
20.45	2.288	(RUNOFF)
21.51	2.283	(RUNOFF)
22.45	1.999	(RUNOFF)
23.51	1.983	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6970 CFS-HRS= 76.47 ACRE-FT= 6.32

SUBROUTINE ADDHYD CROSS SECTION 10
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	1997.601	(NULL)
19.45	189.076	(NULL)
21.59	177.216	(NULL)
23.59	167.218	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0428 CFS-HRS= 6024.77 ACRE-FT= 497.89

SUBROUTINE REACH CROSS SECTION 11
LENGTH= 280.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .04

SUBROUTINE RUNOFF CROSS SECTION 11
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	14.608	(RUNOFF)
12.45	3.415	(RUNOFF)
12.95	1.823	(RUNOFF)
13.45	1.370	(RUNOFF)
13.95	1.084	(RUNOFF)
14.45	.945	(RUNOFF)
14.95	.855	(RUNOFF)
15.45	.759	(RUNOFF)
15.95	.654	(RUNOFF)
16.95	.612	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .4897 CFS-HRS= 13.35 ACRE-FT= 1.10

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SUBROUTINE ADDHYD CROSS SECTION 11
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	1996.769	(NULL)
19.45	189.535	(NULL)
21.60	177.559	(NULL)
23.59	167.508	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 4.60

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
8.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
9.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.04	105.22	105.62	106.29	107.12
10.00	DISCHG	108.05	109.13	110.50	112.15	113.93	115.77	117.98	121.12	125.15	129.54
11.00	DISCHG	134.04	139.61	148.34	159.98	172.98	190.25	254.87	457.18	800.50	1227.49
12.00	DISCHG	1663.20	1953.51	1980.80	1784.50	1511.49	1268.78	1075.38	914.16	778.06	672.00
13.00	DISCHG	595.32	539.54	494.17	455.76	425.86	404.41	387.21	370.58	354.14	340.12
14.00	DISCHG	329.80	321.41	313.28	305.20	298.23	293.08	288.66	284.00	279.10	274.72
15.00	DISCHG	271.46	268.30	264.40	259.96	255.85	252.69	249.54	245.59	241.07	236.90
16.00	DISCHG	233.68	230.95	228.22	225.46	223.10	221.33	220.12	219.37	218.94	218.73
17.00	DISCHG	218.63	218.12	216.87	215.04	213.22	211.76	210.26	208.31	206.01	203.88
18.00	DISCHG	202.22	200.57	198.52	196.15	193.96	192.29	191.13	190.36	189.89	189.63
19.00	DISCHG	189.48	189.42	189.41	189.43	189.47	189.48	189.02	187.74	185.86	183.96
20.00	DISCHG	182.46	181.38	180.67	180.23	179.97	179.79	179.18	177.80	175.84	173.91
21.00	DISCHG	172.40	171.82	172.44	173.93	175.62	177.03	177.56	176.95	175.47	173.82
22.00	DISCHG	172.44	171.46	170.80	170.38	170.13	169.95	169.32	167.93	165.93	163.94
23.00	DISCHG	162.41	161.84	162.42	163.93	165.63	167.00	167.51	166.88	165.40	163.72
24.00	DISCHG	162.14	158.42	150.83	140.48	130.19	121.99	116.03	112.03	109.42	107.77
25.00	DISCHG	106.73	106.07	105.66	105.40	105.24	105.14	105.08	105.04	105.02	105.01
26.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0339 CFS-HRS= 6038.12 ACRE-FT= 498.99

SUBROUTINE REACH CROSS SECTION 12
LENGTH= 440.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 12
AREA= .32 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .34

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.08	149.017	(RUNOFF)

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19.45	5.612	(RUNOFF)
20.45	4.955	(RUNOFF)
21.52	4.925	(RUNOFF)
22.45	4.311	(RUNOFF)
23.52	4.266	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .8896 CFS-HRS= 183.72 ACRE-FT= 15.18

SUBROUTINE ADDHYD CROSS SECTION 12
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	2124.018	(NULL)
19.45	195.141	(NULL)
21.59	182.418	(NULL)
23.59	171.712	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.9595 CFS-HRS= 6221.84 ACRE-FT= 514.17

SUBROUTINE REACH CROSS SECTION 13
LENGTH= 970.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 13
AREA= .11 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .12

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.98	51.232	(RUNOFF)
12.46	12.369	(RUNOFF)
12.96	6.654	(RUNOFF)
13.45	5.003	(RUNOFF)
13.95	3.963	(RUNOFF)
14.45	3.456	(RUNOFF)
14.95	3.125	(RUNOFF)
15.45	2.774	(RUNOFF)
15.95	2.395	(RUNOFF)
16.95	2.238	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .6927 CFS-HRS= 49.17 ACRE-FT= 4.06

SUBROUTINE ADDHYD CROSS SECTION 13
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.17	2124.523	(NULL)
19.45	196.819	(NULL)
21.60	183.704	(NULL)
23.60	172.805	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.9318 CFS-HRS= 6271.00 ACRE-FT= 518.24

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SUBROUTINE REACH CROSS SECTION 14
LENGTH= .00 INPUT COEFFICIENT=340.0000 INPUT ROUTINGS= .91

AVERAGE WATER VELOCITY= .000 AVERAGE ROUTING COEFF= .0000 NUMBER OF ROUTINGS= .00

SUBROUTINE RUNOFF CROSS SECTION 14
AREA= .71 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .40

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.11	330.999	(RUNOFF)
16.96	17.235	(RUNOFF)
19.45	12.854	(RUNOFF)
21.55	11.217	(RUNOFF)
23.55	9.694	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= .9429 CFS-HRS= 432.07 ACRE-FT= 35.71

SUBROUTINE ADDHYD CROSS SECTION 14
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.16	2443.640	(NULL)
19.45	209.673	(NULL)
21.59	194.899	(NULL)
23.59	182.475	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 5.74

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
8.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
9.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.03	105.19	105.54	106.15	106.95
10.00	DISCHG	107.86	108.91	110.22	111.81	113.59	115.52	117.93	121.41	126.09	131.42
11.00	DISCHG	137.06	143.93	154.37	168.38	184.32	204.94	285.11	535.62	963.64	1498.83
12.00	DISCHG	2048.55	2397.76	2418.61	2162.10	1810.07	1524.48	1288.79	1091.80	925.57	795.87
13.00	DISCHG	703.63	636.04	581.05	534.44	498.38	472.73	451.92	431.61	411.53	394.45
14.00	DISCHG	381.98	371.75	361.72	351.79	343.28	337.09	331.67	325.89	319.84	314.53
15.00	DISCHG	310.59	306.66	301.78	296.27	291.24	287.42	283.51	278.56	272.92	267.79
16.00	DISCHG	263.90	260.55	257.18	253.79	250.89	248.77	247.34	246.45	245.95	245.71
17.00	DISCHG	245.60	244.92	243.31	241.02	238.77	237.01	235.13	232.68	229.82	227.19
18.00	DISCHG	225.19	223.14	220.56	217.61	214.93	212.90	211.50	210.60	210.04	209.73
19.00	DISCHG	209.57	209.50	209.50	209.52	209.58	209.60	208.96	207.31	204.95	202.60
20.00	DISCHG	200.77	199.48	198.63	198.11	197.80	197.60	196.79	195.01	192.85	190.15
21.00	DISCHG	188.31	187.71	188.58	190.50	192.61	194.32	194.89	194.02	192.14	190.09
22.00	DISCHG	188.41	187.23	186.43	185.93	185.63	185.44	184.60	182.79	180.28	177.82
23.00	DISCHG	175.96	175.35	176.21	178.12	180.24	181.93	182.46	181.58	179.68	177.59
24.00	DISCHG	175.71	170.79	161.04	147.95	135.20	125.25	118.11	113.31	110.21	108.24
25.	DISCHG	107.01	106.24	105.76	105.45	105.27	105.16	105.09	105.05	105.02	105.01
26.	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105

28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.8095 CFS-HRS= 6703.07 ACRE-FT= 553.94

ENDCMP

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PASS= 3

EXECUTIVE CONTROL CARD 39A OPERATION BASFLO, NEW BASE FLOW= 105.00
EXECUTIVE CONTROL CARD ******** OPERATION
EXECUTIVE CONTROL CARD 40 OPERATION COMPUT, FROM XSECTN/STRUCT 1/ 0 TO XSECTN/STRUCT 14/ 0
STARTING TIME= .00 RAIN DEPTH= 4.05 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 SOIL CONDITION= 2
ALTERNATE NO.= 1 STORM NO.= 3

SUBROUTINE RUNOFF CROSS SECTION 1
AREA= .47 INPUT RUNOFF CURVE= 78.0 TIME OF CONCENTRATION= .54

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.17	397.265	(RUNOFF)
19.38	15.363	(RUNOFF)
21.61	13.152	(RUNOFF)
23.62	11.315	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.9232 CFS-HRS= 583.36 ACRE-FT= 48.21

SUBROUTINE REACH CROSS SECTION 2
LENGTH= 1700.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .39

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	495.845	(NULL)
19.44	120.365	(NULL)
21.65	118.123	(NULL)
23.66	116.287	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 12.2736 CFS-HRS= 3722.87 ACRE-FT= 307.66

SUBROUTINE RUNOFF CROSS SECTION 2
AREA= .62 INPUT RUNOFF CURVE= 78.0 TIME OF CONCENTRATION= .56

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.18	524.593	(RUNOFF)
19.45	20.276	(RUNOFF)
21.62	17.356	(RUNOFF)
23.62	14.882	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.9254 CFS-HRS= 770.41 ACRE-FT= 63.67

SUBROUTINE ADDHYD CROSS SECTION 2
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	1018.891	(NULL)
19.39	140.629	(NULL)
21.63	135.474	(NULL)
23.64	131.160	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 6.3875 CFS-HRS= 4493.28 ACRE-FT= 371.32

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SUBROUTINE REACH CROSS SECTION 3
LENGTH= 540.00 INPUT COEFFICIENT= .8600 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 10.443 AVERAGE ROUTING COEFF= .8600 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 3
AREA= .15 INPUT RUNOFF CURVE= 81.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.12	154.664	(RUNOFF)
19.45	5.196	(RUNOFF)
21.58	4.470	(RUNOFF)
23.58	3.837	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.1584 CFS-HRS= 208.94 ACRE-FT= 17.27

SUBROUTINE ADDHYD CROSS SECTION 3
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.19	1159.764	(NULL)
19.45	145.836	(NULL)
21.64	139.898	(NULL)
23.64	134.053	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.8759 CFS-HRS= 4702.24 ACRE-FT= 388.59

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SUBROUTINE REACH CROSS SECTION 4
LENGTH= 1000.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .21

SUBROUTINE RUNOFF CROSS SECTION 4
AREA= .06 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.96	71.040	(RUNOFF)
12.45	15.108	(RUNOFF)
12.95	7.881	(RUNOFF)
13.45	5.842	(RUNOFF)
13.95	4.578	(RUNOFF)
14.45	3.959	(RUNOFF)
14.95	3.558	(RUNOFF)
15.45	3.143	(RUNOFF)
15.95	2.697	(RUNOFF)
16.95	2.502	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6823 CFS-HRS= 65.14 ACRE-FT= 5.38

SUBROUT ADDHYD CROSS SECTION 4

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	1162.645	(NULL)
19.45	147.695	(NULL)
21.65	141.265	(NULL)
23.65	136.099	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.6824 CFS-HRS= 4767.41 ACRE-FT= 393.98

SUBROUTINE REACH CROSS SECTION 5
LENGTH= 1030.00 INPUT COEFFICIENT= .8700 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 11.377 AVERAGE ROUTING COEFF= .8700 NUMBER OF ROUTINGS= .22

SUBROUTINE RUNOFF CROSS SECTION 5
AREA= .33 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .47

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.12	326.939	(RUNOFF)
19.46	11.224	(RUNOFF)
21.58	9.662	(RUNOFF)
23.58	8.298	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0780 CFS-HRS= 442.56 ACRE-FT= 36.57

SUBROUTINE ADDHYD CROSS SECTION 5
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.20	1458.511	(NULL)
19.45	158.912	(NULL)
21.64	150.848	(NULL)
23.64	144.320	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.9530 CFS-HRS= 5210.27 ACRE-FT= 430.58

SUBROUTINE REACH CROSS SECTION 6
LENGTH= 600.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 6
AREA= .05 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .13

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	56.379	(RUNOFF)
12.45	12.427	(RUNOFF)
12.95	6.519	(RUNOFF)
13.45	4.841	(RUNOFF)
13.95	3.801	(RUNOFF)
14.45	3.288	(RUNOFF)
14.95	2.955	(RUNOFF)

15.95	2.243	(RUNOFF)
16.95	2.080	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6936 CFS-HRS= 54.65 ACRE-FT= 4.52

SUBROUTINE ADDHYD CROSS SECTION 6
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	1464.704	(NULL)
19.45	160.456	(NULL)
21.64	152.036	(NULL)
23.64	145.324	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.8560 CFS-HRS= 5265.02 ACRE-FT= 435.10

SUBROUTINE REACH CROSS SECTION 7
LENGTH= 720.00 INPUT COEFFICIENT= .8800 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 12.467 AVERAGE ROUTING COEFF= .8800 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 7
AREA= .69 INPUT RUNOFF CURVE= 80.0 TIME OF CONCENTRATION= .58

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.19	611.441	(RUNOFF)
21.63	19.975	(RUNOFF)
23.63	17.119	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0791 CFS-HRS= 925.85 ACRE-FT= 76.51

SUBROUTINE ADDHYD CROSS SECTION 7
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.21	2066.022	(NULL)
21.64	171.976	(NULL)
23.64	162.408	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.0477 CFS-HRS= 6191.02 ACRE-FT= 511.63

SUBROUTINE REACH CROSS SECTION 8
LENGTH= 350.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 8
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .07

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS

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12.45	7.643	(RUNOFF)
12.95	3.967	(RUNOFF)
13.45	2.941	(RUNOFF)
13.95	2.298	(RUNOFF)
14.45	1.985	(RUNOFF)
14.95	1.785	(RUNOFF)
15.45	1.576	(RUNOFF)
15.95	1.351	(RUNOFF)
16.95	1.254	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6789 CFS-HRS= 32.51 ACRE-FT= 2.69

SUBROUTINE ADDHYD CROSS SECTION 8
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.22	2067.384	(NULL)
21.65	172.647	(NULL)
23.65	162.968	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.0181 CFS-HRS= 6223.57 ACRE-FT= 514.32

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SUBROUTINE REACH CROSS SECTION 9
LENGTH= 750.00 INPUT COEFFICIENT= .9000 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 15.300 AVERAGE ROUTING COEFF= .9000 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 9
AREA= 2.00 INPUT RUNOFF CURVE= 83.0 TIME OF CONCENTRATION= .41

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.09	2347.550	(RUNOFF)
19.39	71.641	(RUNOFF)
21.55	61.956	(RUNOFF)
23.55	53.181	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.3253 CFS-HRS= 3001.34 ACRE-FT= 248.03

SUBROUTINE ADDHYD CROSS SECTION 9
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.13	4272.460	(NULL)
19.38	256.431	(NULL)
21.59	234.288	(NULL)
23.59	215.850	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.2487 CFS-HRS= 9225.12 ACRE-FT= 762.36

SUBROUTINE REACH CROSS SECTION 10
LENGTH= 810.00 INPUT COEFFICIENT= .9100 PUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .12

SUBROUTINE RUNOFF CROSS SECTION 10
AREA= .17 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .33

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.07	157.086	(RUNOFF)
16.95	7.025	(RUNOFF)
19.45	5.221	(RUNOFF)
21.51	4.570	(RUNOFF)
23.51	3.943	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.7022 CFS-HRS= 186.76 ACRE-FT= 15.43

SUBROUTINE ADDHYD CROSS SECTION 10
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	4386.975	(NULL)
19.39	261.641	(NULL)
21.59	238.719	(NULL)
23.59	219.654	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.1912 CFS-HRS= 9411.87 ACRE-FT= 777.80

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SUBROUTINE REACH CROSS SECTION 11
LENGTH= 280.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .04

SUBROUTINE RUNOFF CROSS SECTION 11
AREA= .03 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .10

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.96	35.520	(RUNOFF)
12.45	7.554	(RUNOFF)
12.95	3.940	(RUNOFF)
13.45	2.721	(RUNOFF)
13.95	2.289	(RUNOFF)
14.45	1.979	(RUNOFF)
14.95	1.779	(RUNOFF)
15.45	1.571	(RUNOFF)
15.95	1.348	(RUNOFF)
16.95	1.251	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6823 CFS-HRS= 32.57 ACRE-FT= 2.69

SUBROUTINE ADDHYD CROSS SECTION 11
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS

19.39	262.561	(NULL)
21.59	239.409	(NULL)
23.59	220.234	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 4.60

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.01	105.07	105.32	105.80	106.48	107.28	108.15	109.05
8.00	DISCHG	109.97	110.98	112.21	113.65	115.20	116.78	118.48	120.40	122.51	124.69
9.00	DISCHG	126.86	129.26	132.19	135.64	139.24	142.76	146.43	150.73	155.62	160.64
10.00	DISCHG	165.49	171.04	178.46	187.53	196.90	205.65	215.60	229.07	245.55	262.43
11.00	DISCHG	278.23	297.73	327.11	364.54	403.19	450.98	645.64	1175.25	2001.10	2942.31
12.00	DISCHG	3822.84	4335.73	4288.74	3792.07	3156.37	2596.81	2152.36	1789.60	1491.03	1261.48
13.00	DISCHG	1095.91	975.59	879.17	798.93	736.83	692.03	656.08	622.00	588.91	560.84
14.00	DISCHG	540.04	523.03	506.68	490.62	476.77	466.41	457.43	448.09	438.38	429.72
15.00	DISCHG	423.16	416.76	409.05	400.36	392.34	386.08	379.83	372.11	363.37	355.33
16.00	DISCHG	349.05	343.67	338.33	332.99	328.38	324.90	322.48	320.93	319.98	319.45
17.00	DISCHG	319.14	318.04	315.59	312.06	308.56	305.73	302.79	299.04	294.65	290.58
18.00	DISCHG	287.39	284.19	280.27	275.77	271.62	268.43	266.17	264.67	263.73	263.16
19.00	DISCHG	262.83	262.65	262.57	262.55	262.56	262.54	261.60	259.18	255.65	252.09
20.00	DISCHG	249.25	247.19	245.82	244.95	244.41	244.02	242.84	240.23	236.59	233.00
21.00	DISCHG	230.15	229.06	230.14	232.84	235.90	238.48	239.41	238.25	235.52	232.46
22.00	DISCHG	229.89	228.04	226.76	225.95	225.45	225.10	223.88	221.29	217.60	213.92
23.00	DISCHG	211.07	210.00	211.06	213.76	216.84	219.33	220.23	219.07	216.35	213.26
24.00	DISCHG	210.34	203.40	189.43	170.49	151.63	136.55	125.52	118.10	113.25	110.18
25.00	DISCHG	108.24	107.01	106.24	105.75	105.45	105.27	105.16	105.08	105.04	105.01
26.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.1813 CFS-HRS= 9444.43 ACRE-FT= 780.49

SUBROUTINE REACH CROSS SECTION 12
LENGTH= 440.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .06

SUBROUTINE RUNOFF CROSS SECTION 12
AREA= .32 INPUT RUNOFF CURVE= 79.0 TIME OF CONCENTRATION= .34

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.06	344.800	(RUNOFF)
16.95	14.456	(RUNOFF)
19.45	10.686	(RUNOFF)
21.51	9.715	(RUNOFF)
23.52	8.025	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0000 CFS-HRS= 413.04 ACRE-FT= 34.13

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SUBROUTINE ADDHYD CROSS SECTION 12
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	4687.683	(NULL)
19.39	273.233	(NULL)
21.59	248.602	(NULL)
23.59	228.146	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.1045 CFS-HRS= 9857.50 ACRE-FT= 814.62

SUBROUTINE REACH CROSS SECTION 13
LENGTH= 970.00 INPUT COEFFICIENT= .9100 INPUT ROUTINGS= .00

AVERAGE WATER VELOCITY= 17.189 AVERAGE ROUTING COEFF= .9100 NUMBER OF ROUTINGS= .14

SUBROUTINE RUNOFF CROSS SECTION 13
AREA= .11 INPUT RUNOFF CURVE= 75.0 TIME OF CONCENTRATION= .12

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
11.97	125.874	(RUNOFF)
12.45	27.398	(RUNOFF)
12.95	14.389	(RUNOFF)
13.45	10.671	(RUNOFF)
13.95	8.371	(RUNOFF)
14.45	7.243	(RUNOFF)
14.95	6.506	(RUNOFF)
15.45	5.744	(RUNOFF)
15.95	4.937	(RUNOFF)
16.95	4.579	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.6903 CFS-HRS= 120.00 ACRE-FT= 9.92

SUBROUTINE ADDHYD CROSS SECTION 13
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.15	4691.604	(NULL)
19.40	276.608	(NULL)
21.60	251.191	(NULL)
23.59	230.334	(NULL)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 3.0736 CFS-HRS= 9977.52 ACRE-FT= 824.54

SUBROUTINE REACH CROSS SECTION 14
LENGTH= .00 INPUT COEFFICIENT=340.0000 INPUT ROUTINGS= .91

AVERAGE WATER VELOCITY= .000 AVERAGE ROUTING COEFF= .0000 NUMBER OF ROUTINGS= .00

SUBROUT RUNOFF CROSS SECTION 14

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.09	752.894	(RUNOFF)
16.95	32.735	(RUNOFF)
19.41	24.131	(RUNOFF)
21.55	20.936	(RUNOFF)
23.55	18.004	(RUNOFF)

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.0794 CFS-HRS= 952.80 ACRE-FT= 78.74

SUBROUTINE ADDHYD CROSS SECTION 14
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
12.14	5426.918	(NULL)
19.40	300.738	(NULL)
21.59	272.089	(NULL)
23.59	248.297	(NULL)

HYDROGRAPH, TZERO= .00 DELTA T= .10 DRAINAGE AREA= 5.74

TIME											
.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
1.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
2.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
3.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
4.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
5.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
6.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
7.00	DISCHG	105.00	105.00	105.01	105.06	105.27	105.70	106.34	107.12	107.97	108.86
8.00	DISCHG	109.78	110.77	111.96	113.40	115.05	116.85	118.86	121.18	123.79	126.54
9.00	DISCHG	129.33	132.35	135.96	140.17	144.60	148.96	153.47	158.75	164.75	170.92
10.00	DISCHG	176.92	183.76	192.83	203.92	215.40	226.19	238.50	255.09	275.37	296.18
11.00	DISCHG	315.61	339.98	376.41	422.69	470.41	527.48	782.45	1456.42	2497.76	3679.13
12.00	DISCHG	4783.92	5382.58	5281.95	4628.55	3825.95	3145.83	2604.55	2161.22	1796.30	1515.52
13.00	DISCHG	1316.47	1170.81	1053.95	956.53	881.63	828.12	784.60	742.87	702.31	668.02
14.00	DISCHG	642.85	622.06	601.81	582.00	565.02	552.55	541.51	529.87	517.85	507.28
15.00	DISCHG	499.33	491.36	481.65	470.82	460.96	453.38	445.58	435.87	424.91	414.97
16.00	DISCHG	407.38	400.79	394.16	387.56	381.90	377.71	374.83	372.99	371.88	371.26
17.00	DISCHG	370.91	369.44	366.25	361.81	357.47	354.04	350.34	345.59	340.12	335.09
18.00	DISCHG	331.23	327.23	322.27	316.66	311.56	307.68	304.97	303.18	302.07	301.40
19.00	DISCHG	301.02	300.82	300.73	300.71	300.74	300.71	299.42	296.26	291.81	287.39
20.00	DISCHG	283.93	281.45	279.81	278.77	278.14	277.70	276.11	272.73	268.12	263.64
21.00	DISCHG	260.18	259.05	260.63	264.11	267.96	271.09	272.07	270.40	266.89	263.08
22.00	DISCHG	259.94	257.70	256.18	255.21	254.61	254.20	252.59	249.20	244.53	239.96
23.00	DISCHG	236.50	235.38	236.94	240.42	244.28	247.34	248.27	246.59	243.08	239.23
24.00	DISCHG	235.75	226.49	208.42	184.34	160.90	142.59	129.38	120.49	114.71	111.05
25.00	DISCHG	108.76	107.32	106.42	105.86	105.52	105.31	105.18	105.10	105.05	105.02
26.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
27.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
28.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00
29.00	DISCHG	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00	105.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 2.9506 CFS-HRS= 10930.32 ACRE-FT= 903.28

ENDC

SUMMARY TABLE 1

ALT	STORM	ID	DA SQ-MI.	RAIN TBLE	AMC	DELTA-T HRS.	TZERO HRS.	PRECIP IN.	PRECIP DURATION	PEAK-Q CFS	PEAK-TIME	PEAK-ELEV	RUNOFF IN.	CSM
1	1	~~1~~4A	.47	2	2	.10	.00	1.45	24.00	29.99	12.28	.00	.21	63.81
1	1	2	.47	2	2	.10	.00	1.45	24.00	134.56	12.33	.00	10.56	286.29
1	1	~~2~~4B	.62	2	2	.10	.00	1.45	24.00	39.03	12.29	.00	.21	62.94
1	1	2	1.09	2	2	.10	.00	1.45	24.00	173.39	12.31	.00	4.67	159.07
1	1	~~3~~4C	.15	2	2	.10	.00	1.45	24.00	16.67	12.20	.00	.29	111.16
1	1	3	1.24	2	2	.10	.00	1.45	24.00	187.80	12.30	.00	4.14	151.45
1	1	~~4~~4D	.06	2	2	.10	.00	1.45	24.00	4.80	12.00	.00	.15	80.03
1	1	4	1.30	2	2	.10	.00	1.45	24.00	188.41	12.32	.00	3.96	144.93
1	1	~~5~~4E	.33	2	2	.10	.00	1.45	24.00	31.80	12.20	.00	.26	96.35
1	1	5	1.63	2	2	.10	.00	1.45	24.00	215.58	12.30	.00	3.21	132.26
1	1	~~6~~4F	.05	2	2	.10	.00	1.45	24.00	3.55	12.02	.00	.15	70.97
1	1	6	1.68	2	2	.10	.00	1.45	24.00	216.12	12.32	.00	3.12	128.64
1	1	~~7~~4G	.69	2	2	.10	.00	1.45	24.00	57.92	12.29	.00	.26	83.95
1	1	7	2.37	2	2	.10	.00	1.45	24.00	272.80	12.32	.00	2.29	115.10
1	1	~~8~~4H	.03	2	2	.10	.00	1.45	24.00	2.70	11.99	.00	.15	90.03
1	1	8	2.40	2	2	.10	.00	1.45	24.00	273.00	12.32	.00	2.26	113.75
1	1	~~9~~5A	2.00	2	2	.10	.00	1.45	24.00	310.30	12.14	.00	.35	155.15
1	1	9	4.40	2	2	.10	.00	1.45	24.00	551.80	12.19	.00	1.39	125.41
1	1	~~10~~5B	.17	2	2	.10	.00	1.45	24.00	7.93	12.15	.00	.15	46.67
1	1	10	4.57	2	2	.10	.00	1.45	24.00	556.04	12.20	.00	1.35	121.67
1	1	~~11~~5C	.03	2	2	.10	.00	1.45	24.00	2.40	12.00	.00	.15	80.03
1	1	11	4.60	2	2	.10	.00	1.45	24.00	555.39	12.21	.00	1.34	120.74
1	1	~~12~~6A	.32	2	2	.10	.00	1.45	24.00	31.85	12.13	.00	.24	99.52
1	1	12	4.92	2	2	.10	.00	1.45	24.00	581.84	12.21	.00	1.27	118.26
1	1	~~13~~6B	.11	2	2	.10	.00	1.45	24.00	8.10	12.01	.00	.15	73.61
1	1	13	5.03	2	2	.10	.00	1.45	24.00	579.99	12.22	.00	1.24	115.31
1	1	~~14~~6C	.71	2	2	.10	.00	1.45	24.00	74.83	12.16	.00	.26	105.40
1	1	14	5.74	2	2	.10	.00	1.45	24.00	652.51	12.21	.00	1.12	113.68
1	1	~~1~~4A	.47	2	2	.10	.00	2.58	24.00	163.38	12.20	.00	.84	347.62
1	1	2	.47	2	2	.10	.00	2.58	24.00	265.29	12.24	.00	11.19	564.44
1	1	~~2~~4B	.62	2	2	.10	.00	2.58	24.00	215.38	12.21	.00	.84	347.39
1	1	2	1.09	2	2	.10	.00	2.58	24.00	479.87	12.22	.00	5.30	440.25
1	1	~~3~~4C	.15	2	2	.10	.00	2.58	24.00	69.22	12.14	.00	1.00	461.46
1	1	3	1.24	2	2	.10	.00	2.58	24.00	542.38	12.22	.00	4.78	437.41
1	1	~~4~~4D	.06	2	2	.10	.00	2.58	24.00	29.22	11.97	.00	.69	486.94
1	1	4	1.30	2	2	.10	.00	2.58	24.00	542.85	12.24	.00	4.59	417.58
1	1	~~5~~4E	.33	2	2	.10	.00	2.58	24.00	142.57	12.15	.00	.94	432.03
1	1	5	1.63	2	2	.10	.00	2.58	24.00	670.31	12.23	.00	3.85	411.23
1	1	~~6~~4F	.05	2	2	.10	.00	2.58	24.00	22.84	11.98	.00	.69	456.71
1	1	6	1.68	2	2	.10	.00	2.58	24.00	671.99	12.24	.00	3.76	399.99
1	1	~~7~~4G	.69	2	2	.10	.00	2.58	24.00	265.18	12.22	.00	.94	384.32
1	1	7	2.37	2	2	.10	.00	2.58	24.00	932.01	12.24	.00	2.94	393.25
1	1	~~8~~4H	.03	2	2	.10	.00	2.58	24.00	15.42	11.97	.00	.69	514.07
1	1	8	2.40	2	2	.10	.00	2.58	24.00	932.42	12.24	.00	2.91	388.51
1	1	~~9~~5A	2.00	2	2	.10	.00	2.58	24.00	1109.32	12.10	.00	1.11	554.66
1	1	9	4.40	2	2	.10	.00	2.58	24.00	1962.99	12.15	.00	2.09	446.13
1	1	~~10~~5B	.17	2	2	.10	.00	2.58	24.00	60.59	12.09	.00	.70	356.39
1	1	10	4.57	2	2	.10	.00	2.58	24.00	1997.60	12.16	.00	2.04	437.11
1	1	~~11~~5C	.03	2	2	.10	.00	2.58	24.00	14.61	11.97	.00	.69	486.94
1	1	11	4.60	2	2	.10	.00	2.58	24.00	1996.77	12.16	.00	2.03	434.08
1	1	~~12~~6A	.32	2	2	.10	.00	2.58	24.00	149.02	12.08	.00	.89	465.68
1	1	12	4.92	2	2	.10	.00	2.58	24.00	2124.02	12.16	.00	1.96	431.71

1	1	13	5.03	2	2	.10	.00	2.58	24.00	2124.52	12.17	.00	1.93	422.37
1	1	~~14~~6C	.71	2	2	.10	.00	2.58	24.00	331.00	12.11	.00	.94	466.20
1	1	14	5.74	2	2	.10	.00	2.58	24.00	2443.64	12.16	.00	1.81	425.72
1	3	~~1~~4A	.47	2	2	.10	.00	4.05	24.00	397.26	12.17	.00	1.92	845.24
1	3	2	.47	2	2	.10	.00	4.05	24.00	495.85	12.22	.00	12.27	1054.99
1	3	~~2~~4B	.62	2	2	.10	.00	4.05	24.00	524.59	12.18	.00	1.93	846.12
1	3	2	1.09	2	2	.10	.00	4.05	24.00	1018.89	12.20	.00	6.39	934.76
1	3	~~3~~4C	.15	2	2	.10	.00	4.05	24.00	154.66	12.12	.00	2.16	1031.10
1	3	3	1.24	2	2	.10	.00	4.05	24.00	1159.76	12.19	.00	5.88	935.29
1	3	~~4~~4D	.06	2	2	.10	.00	4.05	24.00	71.04	11.96	.00	1.68	1184.00
1	3	4	1.30	2	2	.10	.00	4.05	24.00	1162.64	12.21	.00	5.68	894.34
1	3	~~5~~4E	.33	2	2	.10	.00	4.05	24.00	326.94	12.12	.00	2.08	990.72
1	3	5	1.63	2	2	.10	.00	4.05	24.00	1458.51	12.20	.00	4.95	894.79
1	3	~~6~~4F	.05	2	2	.10	.00	4.05	24.00	56.38	11.97	.00	1.69	1127.58
1	3	6	1.68	2	2	.10	.00	4.05	24.00	1464.70	12.21	.00	4.86	871.85
1	3	~~7~~4G	.69	2	2	.10	.00	4.05	24.00	611.44	12.19	.00	2.08	886.15
1	3	7	2.37	2	2	.10	.00	4.05	24.00	2066.02	12.21	.00	4.05	871.74
1	3	~~8~~4H	.03	2	2	.10	.00	4.05	24.00	36.94	11.96	.00	1.68	1231.34
1	3	8	2.40	2	2	.10	.00	4.05	24.00	2067.38	12.22	.00	4.02	861.41
1	3	~~9~~5A	2.00	2	2	.10	.00	4.05	24.00	2347.55	12.09	.00	2.33	1173.77
1	3	9	4.40	2	2	.10	.00	4.05	24.00	4272.46	12.13	.00	3.25	971.01
1	3	~~10~~5B	.17	2	2	.10	.00	4.05	24.00	157.09	12.07	.00	1.70	924.04
1	3	10	4.57	2	2	.10	.00	4.05	24.00	4386.97	12.14	.00	3.19	959.95
1	3	~~11~~5C	.03	2	2	.10	.00	4.05	24.00	35.52	11.96	.00	1.68	1184.00
1	3	11	4.60	2	2	.10	.00	4.05	24.00	4384.19	12.14	.00	3.18	953.09
1	3	~~12~~6A	.32	2	2	.10	.00	4.05	24.00	344.80	12.06	.00	2.00	1077.50
1	3	12	4.92	2	2	.10	.00	4.05	24.00	4687.68	12.14	.00	3.10	952.78
1	3	~~13~~6B	.11	2	2	.10	.00	4.05	24.00	125.87	11.97	.00	1.69	1144.31
1	3	13	5.03	2	2	.10	.00	4.05	24.00	4691.60	12.15	.00	3.07	932.72
1	3	~~14~~6C	.71	2	2	.10	.00	4.05	24.00	752.89	12.09	.00	2.08	1060.41
1	3	14	5.74	2	2	.10	.00	4.05	24.00	5426.92	12.14	.00	2.95	945.46

III C-78

103-76-12, 24-hour.

SUMMARY TABLE 3

	10-YEAR Q1	100-YR Q2	DISCHARGE,CFS Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
XSEC/STRUC NO. 1 ALTERNATE 1	163.38	397.26	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 2 ALTERNATE 1	479.87	1018.89	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 3 ALTERNATE 1	542.38	1159.76	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 4 ALTERNATE 1	542.85	1162.64	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 5 ALTERNATE 1	670.31	1458.51	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 6 ALTERNATE 1	671.99	1464.70	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 7 ALTERNATE 1	932.01	2066.02	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 8 ALTERNATE 1	932.42	2067.38	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 9 ALTERNATE 1	1962.99	4272.46	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 10 ALTERNATE 1	1997.60	4386.97	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 11 ALTERNATE 1	1996.77	4384.19	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 12 ALTERNATE 1	2124.02	4687.68	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 13 ALTERNATE 1	2124.52	4691.60	.00	.00	.00	.00	.00	.00	.00	.00
XSEC/STRUC NO. 14 ALTERNATE 1	2443.64	5426.92	.00	.00	.00	.00	.00	.00	.00	.00

ENDJOB CARD ENCOUNTERED. END OF JOB.

III D HYDRAULIC DESIGN

D. HYDRAULIC DESIGN

D.1 General

The flow entering the FRS outlet channel will be supercritical and remains that way throughout the length of the concrete channel in the FRS Outlet and Bulldog Floodway. Flow in the earth portion of the Bulldog Floodway will be subcritical.

There are sixteen inlets along the floodway; nine are weir inlets, and seven are side channel inlets. The criterion for selecting the proper type of inlet was based on the ratio of Q_2 (discharge after inlet)/Q_1 (discharge before inlet). According to the report supplied by SCS entitled "Addition of Sideflow from a Broad Crested Weir to flow in an Open Channel at Supercritical Flow" the upper limit of Q_2/Q_1 is 1.4 for weir inlet; beyond this limit a side channel inlet is adopted.

The inlets were designed in accordance with Figure 5-1, Hydraulic Junction Structures, of TR-25 for the side channel inlets. In the design computation, the Manning's "n" value adopted for the concrete channel was 0.015.

Discrepancies in survey information were corrected during the preliminary design phase with the result that all of the major inlets were relocated to correspond to the location of the natural drainage channels. The main channel dimensions and slopes were not changed significantly. As a result of the revised topography, inlets 4C, 4G, 5B and 6A were designed as side channel inlets.

Inlets 4C, 4G, 5B and 6A were originally designed as overflow weir inlets. The natural topography and channel invert elevation at the location of these inlets result in the channel wall being several feet above the invert of the wash, resulting in extensive inundation behind the weir during overflow conditions. A comparison was made between the cost and extent of inundation of weir inlets and curved side channel inlets for each of these locations. The decision was made by SCS to choose the side channel inlet configuration for all four inlets.

A review of the floodway alinement showed that the final bend in the Bulldog Floodway occurred near the intersection with Meridian Road. Since this would complicate the road bridge crossing of the floodway, the curve P.I. was moved downstream from station 195+50.9 to station 197+20.9.

The bridge crossings of the floodway at Ironwood and Meridian Roads were coordinated with the Flood Control District of Maricopa County. The bridge abutments will serve as a continuation of the floodway walls.

Curves in the concrete floodway channel, where the flow is supercritical, were designed to handle the superelevation requirement and standing wave phenomenon at minimum cost. The floor will remain level rather than superelevated and extra wall height will be provided consistent with superelevation and wave height. The extra wall heights required for curves 4 and 5 are minimal because of the small width of the former and the large radius of the latter. For curve 6 a compound radius curve, with increased radius at the beginning and end was selected because it significantly reduces both the wave height and the length over which extra wall height must be provided.

The floor of the concrete channel throughout will be kept level in the horizontal direction rather than incurring the complication of a slope to the middle of the channel. This is considered acceptable since flow occurs in the channel very infrequently.

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 50 ft. wide with a depth of water of 5.1 ft. for a discharge of 4709 cfs. The trapezoidal earth channel beyond the stilling basin carries a discharge of 5466 cfs with 10.6 feet depth of water.

The earth channel downstream of the energy disipator was designed in accordance with the requirements of Engineering Standard 582, Open Channel. The channel was designed for the 100-year storm flow. 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 Bulldog Floodway was found to be 20,400 ppm. The aged and as-built Mannings "n" values were used, 0.027 and 0.024, respectively. The allowable velocity was found to be 3.98 fps using the procedures in TR-25. The as-built stability check was made using 50% of the 100 year discharge (2733 cfs) since it exceeded the 10 year discharge (2444 cfs). The design discharge of 5466 cfs was used in making the aged condition stability check. The resulting channel has a 100 foot bottom width, side slopes of 3 horizontal to 1 vertical, and a bottom slope of 0.0003 ft/ft.

A stability check was made using tractive stress procedures. The results indicated that the velocity approach is conservative. It was agreed that the results obtained using the velocity approach be used since it appears that the tractive stress procedure is being applied beyond its area of appplicability and the results obtained using the velocity approach are not unreasonable.

Calculations are provided with the supporting data.

BY S GOYAL DATE 10-29-85 SHEET 1 OF 54

CHKD. BY N.I.C DATE 1/22/86 OFS NO. USDA 3767300 DEPT. NO. 550

CLIENT USDA - SCS - PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

PEAK DISCHARGES FOR INLET JUNCTIONS

			APACHE JUNCTION OUTLET	TYPE	DISCHARGE FOR CHANNEL DESIGN
INLET	4A	→ 397 CFS	↓ 81 CFS ↓ 478	S	478 CFS
	4B	→ 525	↓ 478 ↓ 1003	S	1001
	4C	→ 155	↓ 1001 ↓ 1156	S	1142
	4D	→ 71	↓ 1142 ↓ 1213	W	1144
	4E	→ 327	↓ 1144 ↓ 1471	W	1441
	4F	→ 56	↓ 1441 ↓ 1497	W	1447
	4G	→ 611	↓ 1447 ↓ 2058	S	2048
	4H	→ 37	↓ 2048 ↓ 2085	W	2049
	5A	→ 2348	↓ 2049 ↓ 4397	S	4254
	5B	→ 157	↓ 4254 ↓ 4411	S	4369
	5C	→ 36	↓ 4369 ↓ 4405		4366
	6A	→ 345	↓ 4366 ↓ 4711		4670
	6B	→ 126	↓ 4670 ↓ 4796		4674
	6C	→ 753	↓ 4674 ↓ 5427		

The channel flows are less than those furnished by SCS by 18 cfs (99 - 81) due to lower flow from the 30° FRS outlet.

INLETS

The flows in the main channel at the inlets have decreased by 39 cfs as compared to the flows indicated in the PHASE I Report due to change in outlet diameter from 36" to 30" diameter in the final stages of the PHASE I study.

The hydraulic computations for the junctions and the channels are revised in this phase III.

Channel FRS outlet to 4A inlet

S.C. #1
f 2-3, 2-6

$Q = 81$ cfs
$S = .012$
$b = 3.5'$
$v = \frac{1.486}{n} R^{2/3} S^{1/2}$

$n = .015$
Assumed $= 2.18'$ $P = 7.86$ $A = 7.63$ $R = 0.97$
$\therefore v = 10.64$
$\therefore d = 2.175'$ 0.k
$d_{cr} = \left[\left(\frac{Q}{b}\right)^2/g\right]^{1/3} = 2.55'$ $A_c = 8.93$ $R_c = 1.04$

$S_{cr} = \left[\frac{Q/A}{1.486} \frac{n}{R^{2/3}}\right]^2$

$= .00796$

$\therefore S > 1.3 S_{cr}$

$\therefore$ Freeboard $= .2 \times d$
$= .2 \times 2.18'$
$= .44'$ Provide 1' minimum.

$\therefore$ Height of wall $= 2.18 + 1$
$= 3.18$ Provide 3'-3" wall.

BY S GOYAL DATE 10-29-85 SHEET 3 OF 54

CHKD. BY N.H. DATE 1/22/86 OFS NO. USDA 376.300 DEPT. NO. 550

CLIENT USDA - SCS · PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWA

DWG. 2-6

INLET 4A - SCI #1

$Q_1 = 81$ cfs $b_1 = 3.5'$ $d_1 = 2.18'$ $A_1 = 7.63$ $V_1 = 10.62$

$Q_2 = 397$ cfs $b_2 = 8'$

$d_2 = 2.7$

$V_2 = 18.4$ $A_2 = 21.6$ $R_2 = 1.61$

$S_2 = \left[\frac{V}{1.486} n R^{2/3}\right]^2 = .018$

$d_{c_2} = 4.24$ $S_{c_2} = .0053 < \frac{S_2}{1.3}$

$Q_3 = Q_1 + Q_2 = 478$ cfs

$b_3 = 10' > 0.8(b_1 + b_2)$ i.e. $> 9.2'$

$S_3 = 0.0085$

Assume $d_3 = 3.31$ $A_3 = 33.1$ $R = 1.99$

$V_3 = 14.46$ fps

$\therefore d_3 = 3.306$ O.K

$d_{c_3} = 4.14$ $S_{c_3} = .0045 < \frac{S_3}{1.3}$

$l = C V_2 (b_1 + b_2 - b_3)^{1/3}$ for $d_2 = 2.7$

$= 2.5 \times 18.4 (3.5 + 8 - 10)^{1/3}$

$= 52.66'$ say 53'

length of splitter wall = $l/2 = 26'-6"$

$b_m = \frac{(b_1 + b_2) + b_3}{2} = 10.75$

$d_m = \frac{1}{2}\left[\frac{Q_1 + Q_2}{V_1 b_1 + V_2 b_2} + d_3\right] = 2.95$

$A_m = 31.73$ $P_m = 16.65$ $R_m = 1.906$

$V_m = \frac{Q_1 + Q_2}{b_m d_m} = 15.07$ fps

$b_s = \frac{b_1 (b_1 + b_2 + b_3)}{2 (b_1 + b_2)} = \frac{3.5 (3.5 + 8 + 10)}{2 (3.5 + 8)} = 3.27$ say 3'-3"

Unequal width main channel

$$\frac{Q_3^2}{g A_3} + \frac{b_3 d_3^2}{2} - \frac{b_3 d_3 h}{2} = \frac{Q_1^2}{g A_1} + \frac{Q_2^2}{g A_2} + \frac{b_3 d_1 h}{2} + \frac{b_1 d_1^2}{2} + \left(\frac{b_3 - b_1}{2}\right) d_2^2 - \frac{\rho_m l n^2 V_m^2}{2.21 R_m^{1/3}}$$

$\therefore 214.37 + 54.78 - 16.55 h = 26.70 + 226.61 + 10.9 h + 8.32 + 23.69 - 16.4$

$27.45 h = 0.29$

$h = .01$ provide 3" drop

BY S GOYAL DATE 10-30-85 / 11-22-85 SHEET 4 OF 54

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PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

DWG 2-6 S.C. #1

Radius of bend $R_2' = 1.2 \frac{V_2^2 b_2}{g S}$ S is superelevation

Assume 1:8

$= \frac{1.2 \times 18.4^2 \times 8}{32.2 \times 1}$

$= 100.9$ use $R_2' = 101'$

Height of wall $= 1.2 d_2 + 0.25 d_{c3} \left[1 - 11.1 \left(\frac{S_3}{S_2} - 1\right)^2\right] + \frac{1.2 V_2^2 b_2}{g R_2}$

$= 1.2 \times 3.31 + .25 \times 4.14 \left[1 - 11.1 \left(\frac{.00825}{.0045} - 1\right)^2\right] + 1$

↑ neglected being < 0

$= 3.97 - 0 + 1$

$= 4.97$ say 5'-0

Height of spiller wall = $d_2 = 2.7' > d_1$ use 2'-9"

" lower end = 6"

Height of wall for inlet = $1.2 \times 2.7 + \frac{1.2 V_2^2 b_2}{g R_2}$

$= 3.24 + 1 = 4.24$ use 4'-3

Provide beginning of junction at STA 115+10

EL. at junction = $1783 - (11510 - 10150) \cdot 012$

$= 1766.68$

Provide a 45° curve and a 20' straight reach in the side inlet

length of channel = $\frac{2\pi \times 101}{360} \times 45 + 20 = 99.33'$

Bed EL at inlet = $1766.68 + 99.33 \times .018 = 1768.47$

The bed elevation is lower than the ground contours by about a foot

BY S GOYAL DATE 11-22 85 SHEET 5 OF 54

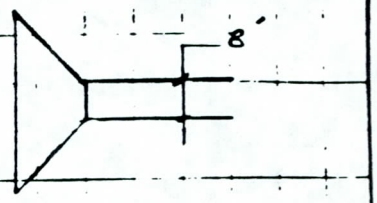
CHKD. BY N.D.J DATE 1/22/86 OFS NO. USDA 3767.30a DEPT. NO. 550

CLIENT USDA - SCS - PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY AND APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL EL 1 of 1

DWG 2-6



Provide straight inlet

Q = 397 cfs

b = 8'

Make inlet 8' wide with wing walls 20' WIDE channel 2:1 slopes

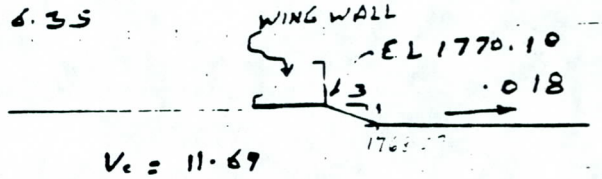
$\therefore Q = 3.1 \times 8 H_e^{3/2}$

$H_e = 6.35$

Provide the inlet at a higher level to approximately match the ground contours. Say at EL 1770.10

U/s Energy level = 1770.10 + 6.35

= 1776.45'



$D_c = \left[\left(\frac{397}{8}\right)^2 / 32.2\right]^{1/3} = 4.244$ $V_c = 11.69$

Total energy at inlet = $1770.10 + 4.244 + \frac{11.69^2}{64.4} = 1776.47$

For normal flow energy line in the channel

$= 1768.47 + d_2 + \frac{V_2^2}{2g}$

$= 1768.47 + 2.7 + \frac{18.4^2}{64.4}$

$= 1776.43 < 1776.47$ o.k

Water level for submergence of land = 1776.45'

Top of dike = 1776.47 + 1 = 1777.47 say 1777.50

EL at the end of inlet junction at STA 115+63

= 1766.68 - .25

= 1766.43

Inlet velocity in the arroyo = $\frac{397}{(20 + 2 \times 6.25)\, 6.25} = 1.95$ cfs

Depth of flow assumed 6.25'

$H_e = 6.25 + \frac{1.95^2}{64.4} = 6.31 < 6.35$ o.k

BY S GOYAL DATE 11-22-85 SHEET 6 OF 54

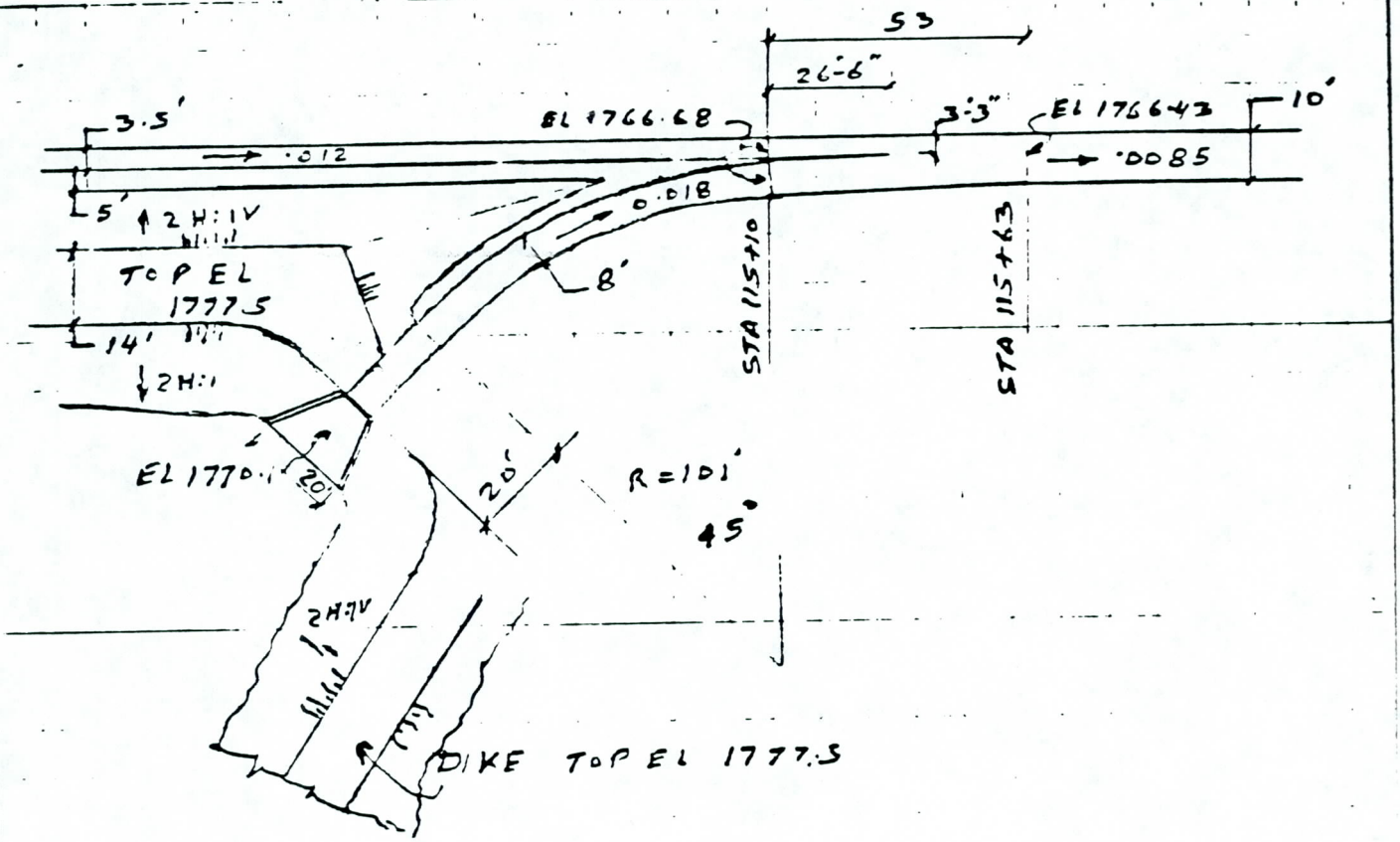
CHKD. BY N.H-f DATE 1/22/86 OFS NO. USDA 3767.360 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL (S [illegible])

DWG 2-6



PLAN INLET 4A

1"=40'

BY S GOYAL DATE 10-30-85 SHEET 7 OF 54
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PROJECT BULLDOG FLOODWAY AND APACHE JUNCTION FLOOD CONTROL
SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

Channel STA 115+63 to 121+63

El. @ STA 115+63 = 1766.68 − .25 = 1766.43

Q = 478
S = .005
b = 10'
d = 3.31'
Height of wall = 1.2 x 3.31
= 3.97 or 3.31+1 = 4.35
Provide 4.5' high

El at STA 121+63
= 1766.43 − (121+63 − 115+63) x .005
= 1761.33

Channel STA 121+63 To 128+54.11

Q = 478
S = .014
b = 10'
Assume d = 2.77' A = 27.7 R = 1.78
∴ v = 17.23
d = 2.774 ok .00453
d_c = ~~2.55~~ 4.14 S_c = ~~.0077~~ < $\frac{S}{1.3}$ = .0107692
Height of wall = 1.2 x 2.77
= 3.32 or 2.77+1 = 3.77
Use 4.0 high
El at STA 128+54.11 = 1761.33 − (12854.11 − 12163) .014 = 1751.65

Channel STA 128+54.11 to PC STA 129+23.99

Q = 478
S = .005
b = 10'
d = 3.31'
Height of wall = 4.5' as between STA 115+63 to 121+63

El at Sta 129+23.99 = 1751.65 − (12923.99 − 12854.11) x .005
= 1751.06

BY S GOYAL DATE 10-30-85 SHEET 6 OF 54
CHKD. BY [illegible] DATE 1/22/86 OFS NO. USDA 3X7-38 DEPT. NO. 550
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PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT APACHE JUNCTION FRS OUTLET CHANEL & BULLDOG FLOODWAY

Channel STA 129+23.99 to 130+20.15

$Q = 478$
$S = .0085$
$b = 10'$
$d = 3.31'$ $\quad V = 14.46$ $\quad R = 9.995'$

Height of wall $= 1.2 \times 3.31 + \frac{1.2\, V^2 b}{2R}$
$= 3.97 + .78$
$= 4.75' > (3.31 + 1.0)$

Provide 4'-9" outer curve wall
and 4'-6" inner curve wall

EL at STA 130+20.15 $= 1751.06 - (13020.15 - 12923.99) \times .0085$
$= 1750.24$

Channel STA 130+20.15 to 132+20

$Q = 478$
$S = .0085$
$b = 10'$
$d = 3.31$

Height of wall = 4'-6"

EL at 132+20 $= 1750.24 - (13220 - 13020.15) \times .0085$
$= 1748.54$

Inlet QB

$Q_1 = 478$ $\quad b_1 = 10'$ $\quad d_1 = 3.31$ $\quad A_1 = 33.1$ $\quad V_1 = 14.46$

$Q_2 = 525$ $\quad b_2 = 9'$
$d_2 = 3.25$
$D_2 = 17.95$ $\quad A_2 = 29.25$ $\quad R_2 = 1.89$
$S_2 = .014$
$d_{c_2} = \frac{4.73}{4.44}$ $\quad S_{c_2} = .051 < \frac{S_2}{1.3}$

$Q_3 = 1003$ cfs
$b_3 = 18' > 0.8(b_1 + b_2)$
$S_3 = .0061$
Assume $d_3 > 3.76$ $\quad A_3 = 67.68$ $\quad R = 2.65$
$\therefore V_3 = 14.82$
$\therefore d_3 = 3.76$ O.K
$d_{c_3} = 4.59$ $\quad S_{c_3} = .0034 < \frac{S_3}{1.3}$

S.C.I. # 2 (4B)
SHTS 2-15, 2-41, 2-4

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BY S GOYAL DATE 10-30-85 / 11-22-85 SHEET 9 OF 54
CHKD. BY N Hui DATE 1/22/86 OFS NO. USDA 3767.3 DEPT. NO. 550
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PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

SCI #2

DWG 2-15

$Q = CV_1 (b_1 + b_2 \cdot b_3)^{1/3}$ for $d_2 = 3.25$

$= 2.83 (10 + 9 \cdot 18)^{1/3} \times 17.96$

$= 508$ say 52'

Splitter wall length = L_3 = 26'

$b_m = 18.5'$

$d_m = 3.52$

$A_m = 65.08$ $P_m = 25.54$ $R_m = 2.55$

$V_m = 15.41$

$b_3 = 9.74'$

$$\frac{Q_3^2}{gA_3} + \frac{b_3 d_3^2}{2} - \frac{b_3 d_3 h}{2} = \frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} + \frac{b_3 d_1 h}{2} + \frac{b_1 d_1^2}{2} + \left(\frac{b_3 - b_1}{2}\right) d_2^2 - \frac{P_m L n^2 V_m^2}{2.21 R_m^{1/3}}$$

$\therefore 461.62 + 127.24 - 33.84h = 214.37 + 292.64 + 29.79h + 54.78 + 42.25 - 23.5$

or $63.63h = 8.32$

$h = 0.13$

$R_2' = \frac{1.2 \times 17.95^2 \times 9}{32.2 \times 1} = 108.07$ say 110'

Height of wall $= 1.2 \times 3.76 + .25 \times 4.59 \left[1 - 11.1\left(\frac{.0061}{.0054} - 1\right)^2\right] + 1$

$= 4.5 + 0 + 1 = 5.5'$

Height of splitter wall = $d_1 = 3.31 > d_2$ use 3'-6"

" lower end = 6"

Height of wall for inlet $= 1.2 \times 3.25 + \frac{1.2 \times 17.95^2 \times 9}{32.2 \times 110}$

$= 3.9 + 1 = 4.9$ use 5'-0

Beginning of Junction at STA 132+20 EL 1748.54

End of Junction at STA 132+72 EL 1748.54 - .13 = 1748.41

Provide 45° curve in the side inlet plus 20' straight.

length of channel $= \frac{2\pi \times 110}{360} \times 45° + 20 = 106.39'$

EL at the inlet = 1748.54 + 105.39 x .014 = 1750.03

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BY S GOYAL DATE 11-22-85 SHEET 10 OF 54

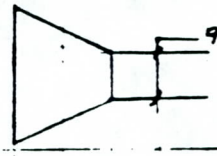
CHKD. BY N Hung DATE 1/22/86 OFS NO. USDA376730 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY INLET 4B SCI # 2

DWG 2-15

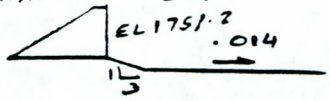


Provide straight inlet

$Q = 525$ cfs

$b = 9'$

Make inlet 9' wide with wing walls 25' channel 2:1 slopes



$Q = 3.1 \times 9\ H_c^{3/2}$

$\therefore H_c = 7.07'$

Provide the inlet at a higher level say at EL 1751.2

U/S energy level $= 1751.2 + 7.07$

$= 1758.27$

$D_c = \left[\left(\frac{525}{9}\right)^2 / 32.2\right]^{1/3} = 4.728 \qquad V_c = 12.338$

Total energy at the inlet $= 1751.2 + 4.728 + \frac{12.338^2}{64.4}$

$= 1758.29$

For normal flow in the channel energy line is

$= 1750.03 + 3.25 + \frac{17.95^2}{64.4}$

$= 1758.28 < 1758.29$ o.k

Water level for submergence of land $= 1758.27$

Top of Dike $= 1758.19 + 1 = 1759.29$ say 1759.50

EL at the end of Junction at STA 137+72

$= 1748.54 - .13$

$= 1748.41$

Velocity in the arroyo $= \frac{525}{(25 + 2 \times 7)7} = 1.92$

(Assumed $d = 7'$)

$H_c = 7 + \frac{1.92^2}{2g} = 7.06 < 7.07$ o.k

BY S GOYAL DATE 11-19-85 SHEET 11 OF 54

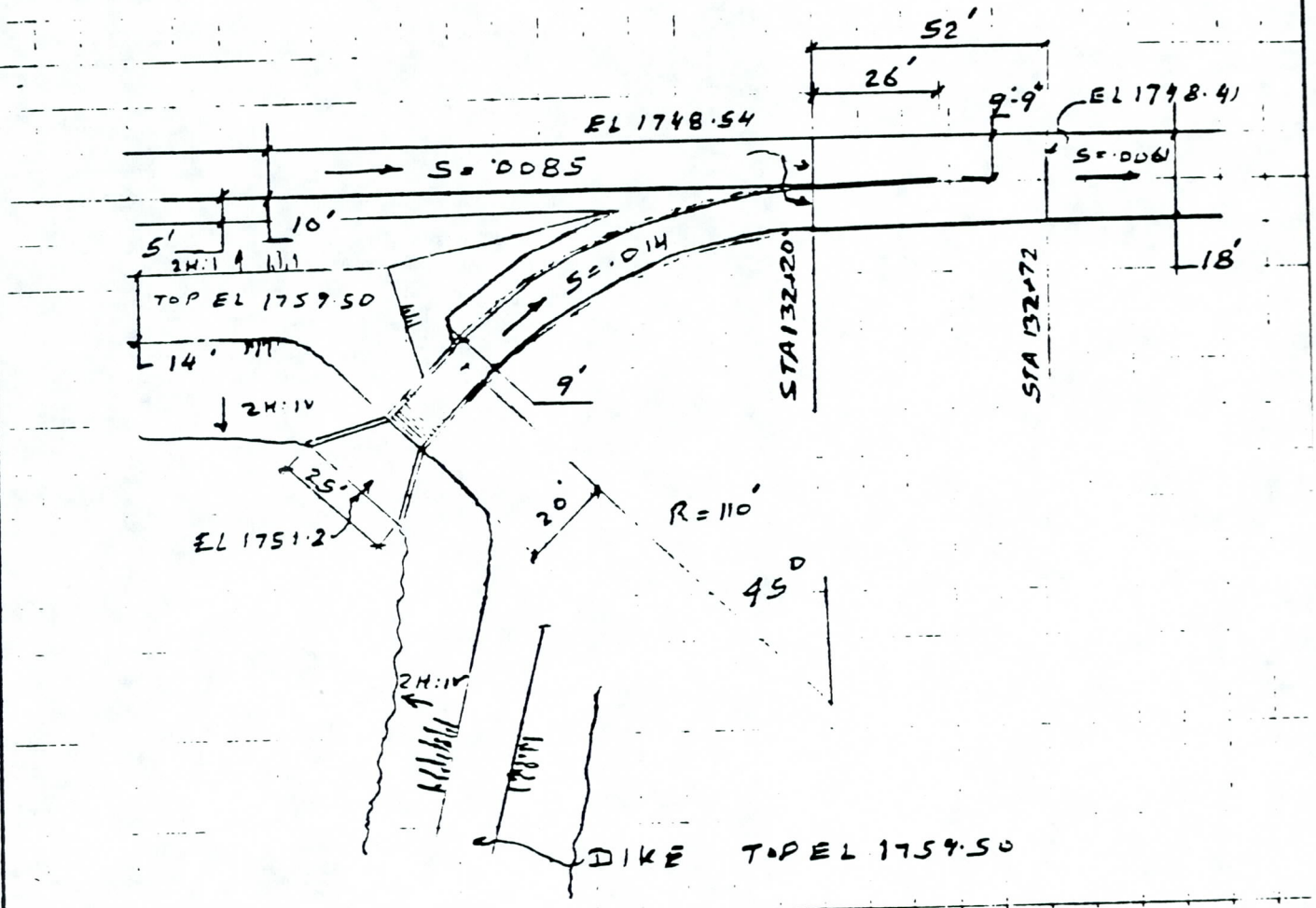
CHKD. BY N HUQ DATE 1/22/86 OFS NO. 3767-300 DEPT. NO.

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL SCI #2

SUBJECT

DWG 2-15



PLAN INLET AB

1" = 40'

561/8-81

BY S GOYAL DATE 10-31-85 / 11-25 85 SHEET 12 OF 54

CHKD. BY N. Hung DATE 1/23/86 OFS NO. USDA 3767.300 DEPT. NO. 550

CLIENT USDA - SCS - PHOENIX

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

CHANNEL STA 132+72 to 137+75

Q = 1001 ≤ 1003 Sheet 6

∴ b = 18'

S = .0061

d = 3.76

El at Sta 137+00 = 1748.41 − (13700 − 13272) x .0061

= 1745.80 as in the Phase I

Height of wall = 1.2 x 3.76

= 4.51

or 3.76 + 1 = 4.76 provid. 4'-9"

El at STA 137+75 = 1748.41 − (13775 − 13272) x .0061

= 1745.34

561/8-81

SCI #4 (4C)

SHT 2-17, 2-63, 2-50

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BY S GOYAL DATE 11-19-85 / 12-2-85 SHEET 13 OF 54

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CLIENT USDA - SCS. PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY INLET 4C SCI #4

INLET 4C DWG 2-17

$Q_1 = 1001$ cfs $b_1 = 18'$ $d_1 = 3.76'$ $A_1 = 67.68$ $V_1 = 14.79$

$Q_2 = 155$ cfs $b_2 = 3.0$

Assume $d_2 = 3.13$

$V_2 = 16.51$ $A_2 = 9.39$ $R_2 = 1.014$

$S_2 = \left\{\frac{Vn}{1.486 R^{2/3}}\right\}^2 = .0273$

$d_{c_2} = 4.36$ $S_{c_2} = .0124 < \frac{S_2}{1.3}$

$Q_3 = Q_1 + Q_2 = 1156$ cfs

$b_3 = 18 > .8(b_1 + b_2)$ $\therefore$ <16.8

$S_3 = .0052$

Assume $d_3 = 4.375$ $A_3 = 78.75$ $R = 2.944$ $V_3 = 14.67$

$\therefore d_3 = 4.377$ O.K

$d_{c_3} = 5.04$ $S_{c_3} = .0035 < \frac{S_3}{1.3}$

$\ell = C V_2 (b_1 + b_2 - b_3)^{1/3}$ for $d_2 = 3.13$

$= 2.75 \times 16.51 (18 + 3 - 18)^{1/3}$

$= 65.48$ say 66

length of splitter wall $= \ell/2 = 33.0'$

$b_m = (b_1 + b_2) + b_3 = 19.5$

$d_m = \frac{1}{2}\left\{\frac{Q_1^2 + Q_2}{V_1 b_1 + V_2 b_2} + d_3\right\} = \frac{1}{2}\left\{\frac{1001 + 155}{14.79 \times 18 + 16.51 \times 3.0} + 4.375\right\} = 4.018$

$A_m = 78.35$ $P_m = 27.54$ $R_m = 2.845$

$V_m = \frac{Q_1 + Q_2}{A_m} = 14.75$

$b_3 = \frac{b_m (b_1 + b_2 + b_3) - d_m}{2(b_1 + b_2)} = 18.71$ say 18.84'

constant width main channel

$$\frac{Q_3^2}{\partial A_3} + \frac{b_3 d_3^2}{2} - \frac{b_3 d_3 h}{2} = \frac{Q_1^2}{\partial A_1} + \frac{Q_2^2}{\partial A_2} + \frac{b_3 d_1 h}{2} + \frac{b_3 d_1^2}{2} - \frac{P_m \ell n^2 V_m^2}{2.21 R_m^{1/3}}$$

$\therefore 527.00 + 172.27 - 39.38 h = 459.78 + 79.46 + 33.84 h + 127.24 - 28.41$

$73.22 h = 61.19$

$h = 0.84'$

Radius of bend $R' = \frac{1.2 V_2^2 b_2}{\partial S}$ S is superelevation

$= \frac{1.2 \times 16.51^2 \times 3}{32.2 \times .5}$ .5'

$= 60.9$ use 60'

561/8-81

Dia 2-17

Height of wall $= 1.2 d_2 + 0.25 d_{c2}\left[1 - 11.1\left(\frac{S_2}{S_{c2}} - 1\right)^2\right] + \frac{1.2 V_2^2 b_2}{g R_2}$

$= 1.2 \times 4.375 + 0 + .5$

$= 5.75 \rightarrow$ say $5'-9''$

Height of splitter wall $= d_1 = 3.76' > d_2$ use $3'-9''$

" " lower end $= 0.5'$ i.e. $6''$

Height of inlet wall $= 1.2 \times 3.13 + .5$ for the curve

$= 4.256$ use $4'-3''$

Provide beginning of Junction at STA 137+75

EL of Junction $= 1745.80 - (13775 - 13700) \times .0061$

$= 1745.34$

Provide a 45° curve in the side channel plus 20' straight

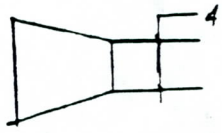
Length of channel $= \frac{2\pi \times 60}{360} \times 45 + 20 = 67.12'$

EL at the inlet $= 1745.34 + 67.12 \times .0273$

$= 1747.17$

which is close to ground elevation.

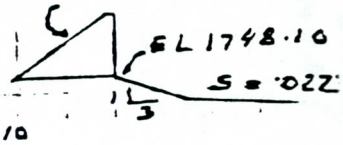
Provide a straight inlet



$Q = 3.1 W He^{3/2}$

$\therefore He = \left(\frac{155}{3.1 \times 3.0}\right)^{2/3}$

$= 6.52'$



Provide the inlet at a higher level at 1748.10

U/S energy level $= 1748.10 + 6.52 = 1754.62$

$Dc = \left[\left(\frac{155}{3}\right)^2 / 32.2\right]^{\frac{1}{3}} = 4.36$ $Vc = 11.85$

Total energy at the inlet $= 1748.10 + 4.36 + \frac{11.85^2}{64.4}$

$= 17$

For normal flow in the channel energy line is

$= 1747.17 + 3.13 + \frac{16.51^2}{64.4}$

$= 1754.53 < 1754.62$ O.K

BY S GOYAL DATE 11-19-85 / 11-25-85 / 12-02-85 SHEET 15 OF 57

CHKD. BY N Hung DATE 1/23/86 OFS NO. USDA 3767.300 DEPT. NO. 550

CLIENT USDA · SCS - PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY INLET 4C SCI #4

DWG 2-17.

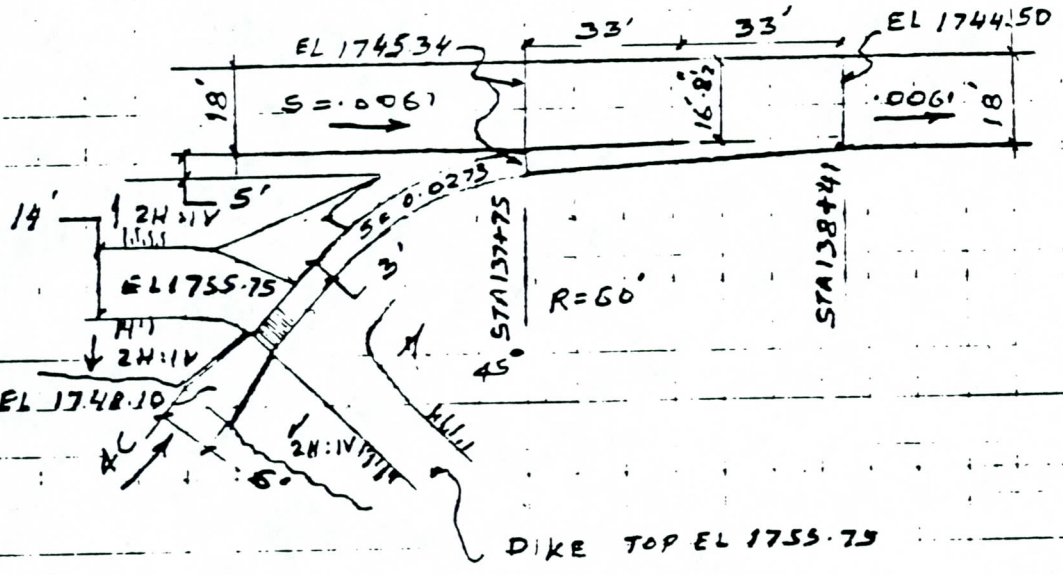
Water level for submergence of land = 1754.64 say 1754.75

Top of Dike = 1754.64 + 1 = 1755.64 say 1755.75

EL at the end of Junction at STA 138+41
= 1745.34 − .84 = 1744.50

Velocity in the arroyo = $\frac{155}{(6+2\times6.5)6.5}$ = 1.26
(Assumed d = 6.5)

∴ He. $6.5 + \frac{1.26^2}{64.4}$ = 6.52 o.k



PLAN 4C

1" = 40'

CHANNEL 138+41 To 140+00

$Q = 1142$

$b = 18'$

$S = .0052$

Assume $d = 4.34$ $A = 78.12$ $R = 2.93$ $V = 14.62$ $d = 4.34$ O.K.

$d_c = \left[\left(\frac{1142}{18}\right)^2/32.2\right]^{1/3} = 5.00$

$\therefore S_c = .0035 < \frac{S}{1.3}$

Height of wall $= 1.2 \times 4.34 = 5.208$

or $4.34 + 1 = 5.34'$ use $5'-6''$

Bed El. at STA $140+00 = 1744.50 - [14000 - 13841] \times .0052$

$= 1743.69$

TRANSITION FROM STA 140+00 To 140+20

$Q = 1142$ $b_1 = 18'$ $S_1 = .0052$ $V_1 = 14.62$ $d_1 = 4.34$

$b_2 = 22'$ $S_2 = .0052$

Assume $d_2 = 3.69$ $A_2 = 81.18$ $R_2 = 2.76$ $V_2 = 14.07$ $d_2 = 3.69$ O.K.

$\therefore$ Average $d = (4.34 + 3.69)\frac{1}{2} = 4.02$

$V = (14.62 + 14.07)\frac{1}{2} = 14.35$

$F = \frac{V}{\sqrt{g}d} = 1.26$

$\therefore$ Transition angle $\tan\alpha = \frac{1}{3F} = .26$

Transition provided 1 in 10 is O.K.

Bed EL at STA $140+20 = 1743.69 - [14020 - 14000] \times .005$

$= 1743.59$

CHANNEL STA 140+20 TO 149+75

$Q = 1142$, $S = .052$, $b = 22'$, $d = 3.69'$

$d_c = \left[\left(\frac{1142}{22}\right)^2 / 32.2\right]^{1/3} = 4.37$

$S_c = .0313 < \frac{S}{1.3}$

Height of wall = $1.2 \times 3.69 = 4.43$
or $3.69 + = 4.69$ use 4'-9"

For height of wall near inlet 4D see sheet 19
Bed El. at STA 149+75 = $1743.59 - [14975 - 14020] \times .052$
$= 1738.62'$

INLET 4D W.I.# 3 DWG 2-19

$Q_1 = 1142$ $b_1 = 22'$ $S_1 = .052$, $d_1 = 3.69$ $V_1 = 14.07$

$Q_3 = 71$

$Q_2 = 1213$ $b_2 = 22'$

$\therefore F_1 = \frac{V_1}{\sqrt{g d_1}} = \frac{14.07}{\sqrt{32.2 \times 3.69}} = 1.29$

Conjugate depth = $d_1 \frac{1}{2}\left(\sqrt{1 + 8F_1^2} - 1\right) = 5.14'$

$\frac{Q_2}{Q_1} = \frac{1213}{1142} = 1.06$

$\therefore$ From Fig 9 of the draft copy of Report for ASCE
$h/d = .1$
or $h = .1 \times 3.69 = .37'$
$L = \frac{.37}{.052} = 7.115$ say 72'

F_2 (just below inlet) = $.98 = \frac{V_2}{\sqrt{g d_2}} = \frac{Q_2}{b_2 d_2 \sqrt{g d_2}}$

$\therefore d_2 = \left[\frac{1213}{22 \times \sqrt{32.2}} \cdot \frac{1}{.98}\right]^{2/3} = 4.62'$

Provide 8' long weir

W.I. # 3 (415)
SHT 2-18, 2-27

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11-21-85 / 12-02-85 SHEET 18 OF 54
CHKD. BY N Hung DATE 1/23/85 OFS NO. USDA 3767.30 DEPT. NO. 550
CLIENT USDA - SCS - PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY

WI - #3
DWG 2-1E

$Q_3 = 71$
$= C L H^{3/2}$
$\therefore 71 = 3.1 \times 8 \; H^{3/2}$
$\sim H = 2.02$
Provide 3ft high dike

G = Conjugate depth + h_v + 1
= 5.14 + .37 + 1 min = 6.51 say 6.5'
∴ Water level = 1738.62 + 6.5 = 1745.12
Ground level is approx 1746. Provide wall at EL 1746.00

Q D/S channel = 1144 b = 22' S = .0052
Assume d = 3.69 A = 81.18 R = 2.76 V = 14.07 d = 3.69 ok

$d_c = \left[\left(\frac{1144}{22}\right)^2 / 32.2\right]^{1/3} = 4.38$

$S_c = .00314 < \frac{S}{3}$ o.k

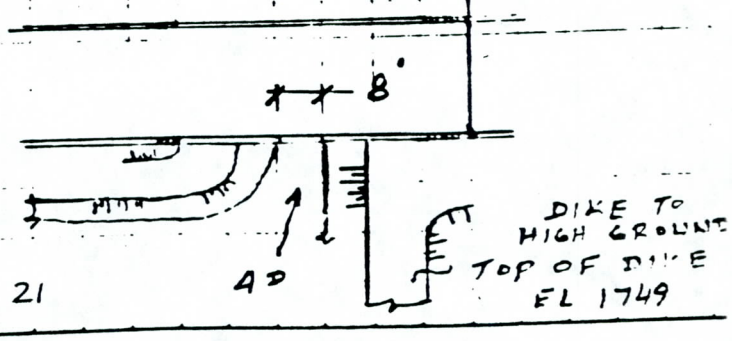
∴ Height of wall = 1.2 × 3.69 = 4.42
~ 3.69 + 1 = 4.69 use 4'-9"

For inlet see Sheet 19

Water level for submergence of pipe

= 1746 + H
= 1746 + 2.02 = 1748.02 say 1748.5

Top of dike at EL 1749'



BY Y.C. YANG DATE 9-30-85 Sc'd 11/2/85/12-07-85 SHEET 19 OF 54

CHKD. BY Sc'd DATE 10-1-85 V.H.g 1/23/86 OFS NO. 3767.200 DEPT. NO. 650

CLIENT USDA

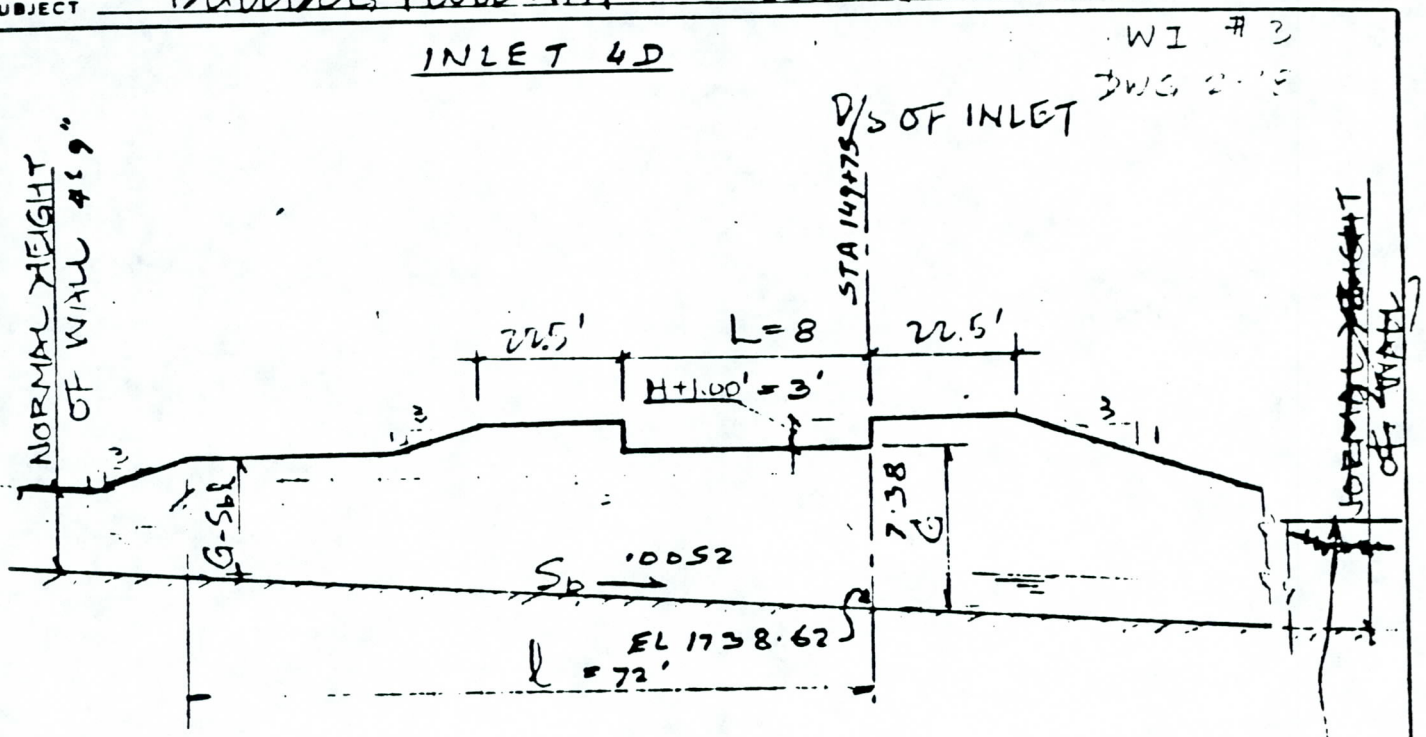
PROJECT BULLDOG FLOODWAY & APACHE JTN FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — CHANNEL WALL DETAIL

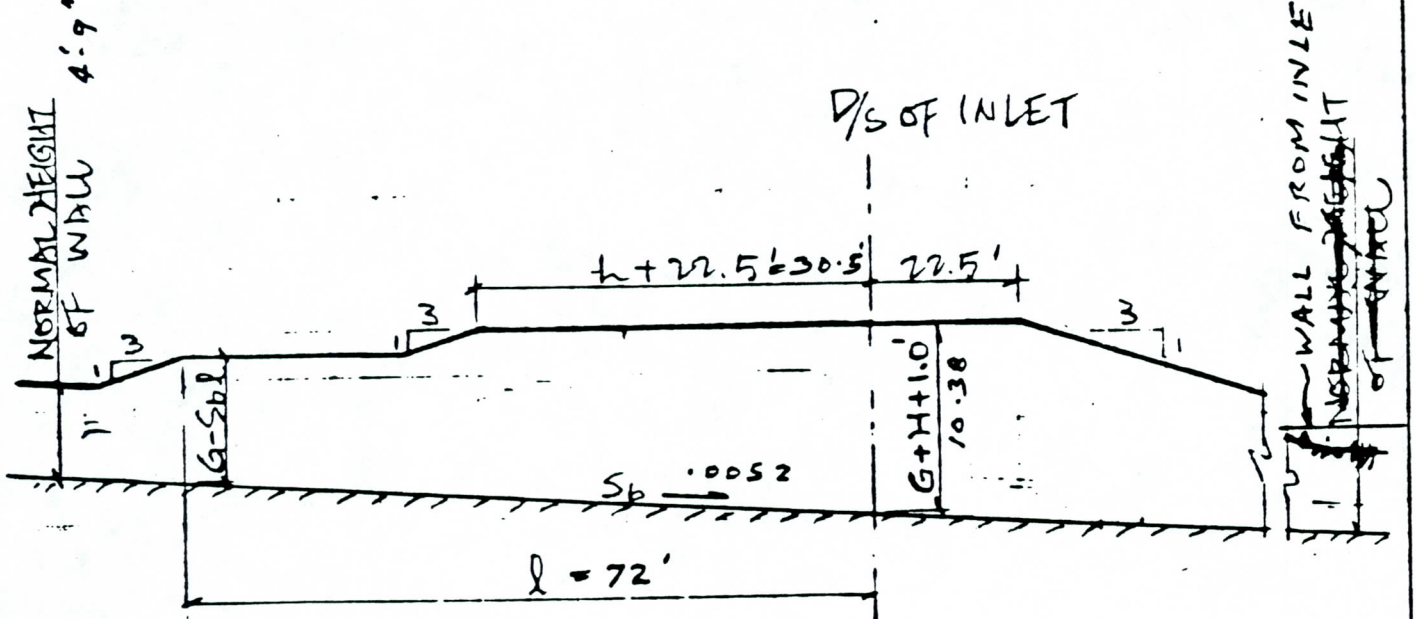
INLET 4D

WI #3

DWG 2-15



WALL DETAIL @ WEIR INLET (INLET SIDE)



WALL DETAIL @ WEIR INLET (OPPOSITE SIDE)

W.I. # 4 (4E)
SHTS 2-19, 2-28, 2-34

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11.21.85 / 12-02-85 SHEET 20 OF 54
CHKD. BY N. H DATE 1/23/86 OFS NO. USDA 3767.2.0 DEPT. NO. 550
CLIENT USDA - SCS - PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY DWG 2.19 WI #4

CHANNEL STA 149+75 TO STA 154+55

$Q = 1144 \quad b = 22' \quad S = .0052$

bcd El at STA 154+55 = 1738.62 - [15455 - 14975] x .0052
= 1736.12

The height of wall is governed by inlet 4E.

INLET 4E

$Q_1 = 1144 \quad b_1 = 22' \quad S_1 = .0052 \quad d_1 = 3.69 \quad V_1 = 14.07$
$Q_2 = 327$
$Q_3 = 1471 \quad b_2 = 22'$

$\therefore F_1 = \frac{14.07}{\sqrt{32.2 \times 3.69}} = 1.29$

Conjugate depth = 5.14'

$\frac{Q_3}{Q_1} = \frac{1471}{1144} = 1.286$

∴ From Fig 9

$h/d = .65$
$h = .65 \times 3.69 = 2.4'$
$l = 2.4 \div .0052 = 461.25$ say 462'

F_2 just below rnld = .9 = $\frac{V_2}{\sqrt{g d_2}} = \frac{Q_2}{b_2 d_2 \sqrt{g d_2}}$

$\therefore d_2 = \left[\frac{1471}{22 \times \sqrt{32.2}} \cdot \frac{1}{.9}\right]^{2/3} = 5.55$

G = Conjugate depth + h + 1
= 5.14 + 2.4 + 1 = 8.54'
El of Weir = 1736.12 + 8.54 = 1744.66

Provide 50' long weir to reduce submergence of land and height of dike

$Q_3 = 327 = 3.1 \times 50\, H^{3/2}$

$\therefore H = 1.645$

water level for submergence of land
$= 1744.66 + 1.645 = 1746.305$
say 1746.5

Top of Dike $= 1747.50$

Q in channel D/S = 1441 $b_2 = 22'$ $S = .0052$

Assume $d = 4.315$, $A = 94.93$, $R = 3.099$, $V = 15.186$ $d = 4.313$ o.k

$d_c = \left[\left(\frac{1441}{22}\right)^2 / 32.2\right]^{1/3} = 5.11$

$S_c = .00317 < S/3$

$\therefore$ Height of wall $= 1.2 \times 4.315 = 5.176$
or $4.315 + 1 = 5.315$

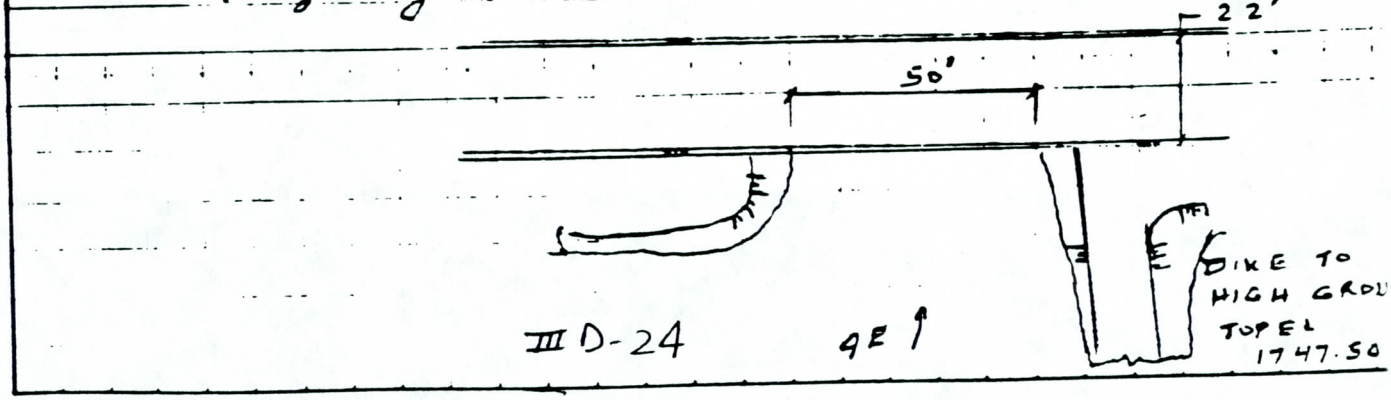
Effect of curve in channel

Extra free board $= \frac{1.2\, V_b^2}{g R}$ $R = 2097.35'$

$= \frac{1.2 \times 15.186^2 \times 22}{32.2 \times 2097.35}$

$= .09'$

Height of wall $= 5.315 + .09 = 5.405$ use 5'-6"



III D-24 9E

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-30-85 S GOYAL 11/21/85/12-02-85 SHEET 22 OF 54

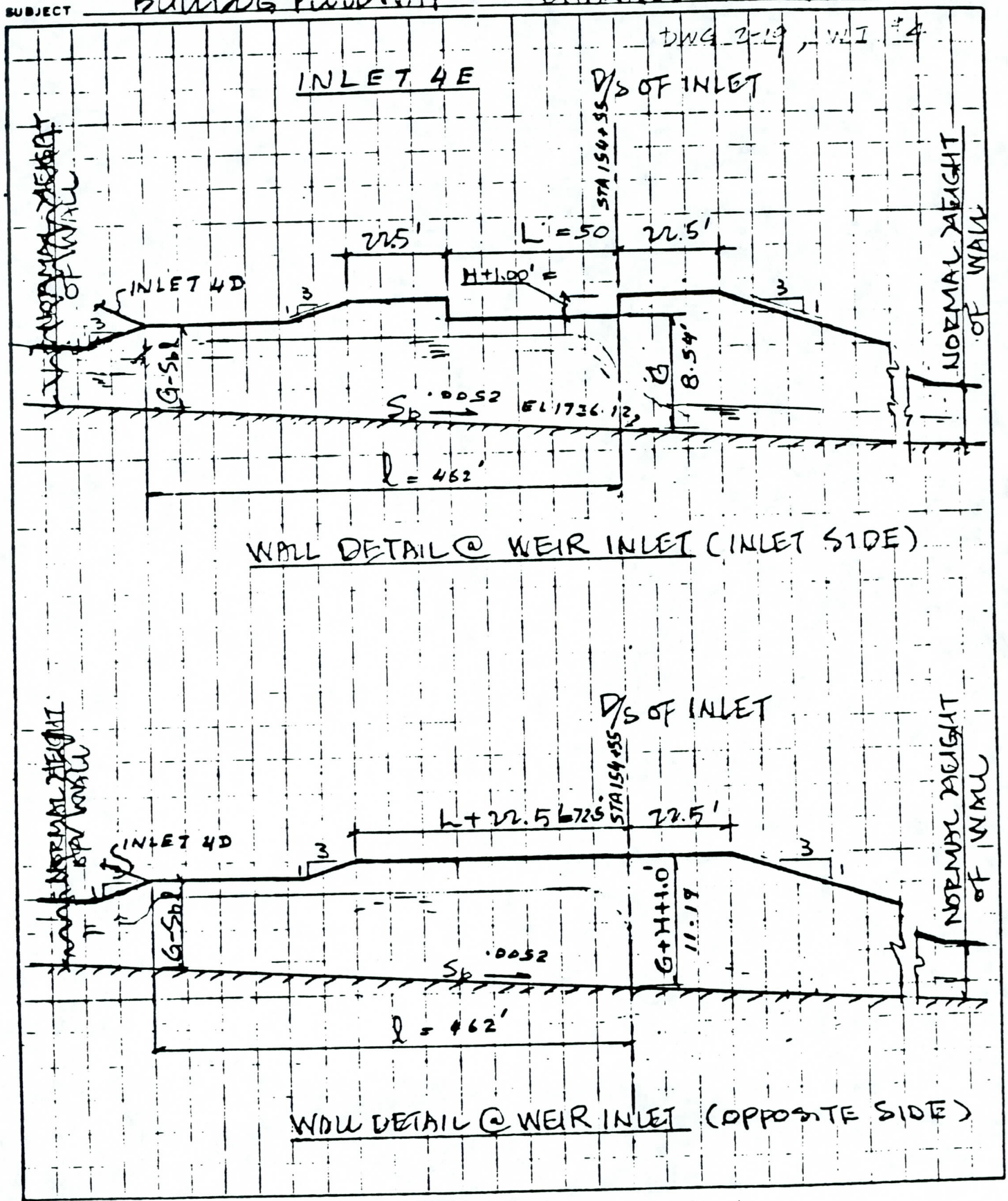
CHKD. BY S Goyal DATE 10-1-85 N.K. 11/23/86 OPS NO. 3767.203 DEPT. NO. 1650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JTN FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — CHANNEL WALL DETAIL

DWG 2-19, WI #4



CHANNE STA 154+55 TO 156+00

$Q = 1441$ $b = 22'$ $S = .0052$ $d = 4.315'$

Height of wall 5'-6"

Bed El at STA 156+00 = 1736.12 - [15600 - 15455] x 00.52

= 1735.37

TRANSITION STA 156+00 To STA 156+30

$Q = 1441$ $b_1 = 22'$ $d_1 = 4.315$ $V_1 = 15.186$

$b_2 = 28'$ $S_2 = .00475$

Assume $d_2 = 3.64$ $A_2 = 101.92$, $R_2 = 2.89$ $V_2 = 14.14$ $d_2 = 3.64$ o.k

Average $V = (15.186 + 14.14)\frac{1}{2} = 14.663$

$d = (4.315 + 3.64)\frac{1}{2} = 3.978$

$F = \frac{V}{\sqrt{g}\,d} = 1.29$

Transition angle $\tan\alpha = \frac{1}{3F} = .258$

Transition provide 1 in 10 is o k

Bed El at STA 156+30 = 1735.37 - [15630 - 15600] x .0475

= 1735.22

CHANNEL STA 156+30 To STA 164+70

$Q = 1441$ $b = 28$ $S = .00495$ $d = 3.64$

$d_c = \left[\left(\frac{1441}{28}\right)^2/32.2\right]^{1/3} = 4.35$

$S_c = .0029 < \frac{S}{1.3}$

Height of walls = 1.2 x 3.64 = 437

= 3.64 + 1 = 4.64 Use 4'-9"

Bed El of STA 164+70 = 1735.22 - [16470 - 15630] x .00495

= 1731.06

W.I. #5 (41)
SHTS 2-20, 2-27

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11-21-85 / 12-02-85 SHEET 24 OF 54
CHKD. BY N Hung DATE 1/23/86 OFS NO. USDA 7.767.3 DEPT. NO. 55
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL W.I. #5
SUBJECT BULLDOG FLOODWAY DWG 2-20

INLET 4F

$Q_1 = 1441$ $b_1 = 28'$ $S_1 = .00495$ $d_1 = 3.64$ $V_1 = 14.14$

$Q_3 = 56$

$Q_2 = 1497$ $b_2 = 28'$

$\therefore F_1 = \frac{V}{\sqrt{g d}} = \frac{14.14}{\sqrt{32.2 \times 3.64}} = 1.306$

Conjugate depth $= d_1 \frac{1}{2}\left(\sqrt{1+8F_1^2} - 1\right) = 5.145$

$=$

$\frac{Q_2}{Q_1} = \frac{1497}{1441} = 1.039$

From Fig 9 of draft copy of Report for ASCE

$h/d = .04$

$h = .04 \times 3.64 = 0.15'$

$L = \frac{0.15'}{.00495} = 30.3' \rightarrow$ say $30'$

F_2 Just below inlet $= .992 = \frac{V_2}{\sqrt{g d_2}} = \frac{Q_2}{b_2 d_2 \sqrt{g d_2}}$

$\therefore d_2 = \left[\frac{1497}{28\sqrt{32.2}} \cdot \frac{1}{.992}\right]^{2/3} = 4.48'$

Provide 6' long weir

$Q = C L H^{3/2} = 56$

$H = \left(\frac{56}{3.1 \times 6}\right)^{2/3} = 2.08$

G = conjugate depth + h + 1

$= 5.145 + 0.15 + 1_{min} = 6.295$

$\therefore$ Weir EL $= 1731.06 + 6.295 = 1737.355$

Ground level is approx at EL 1739

$\therefore$ provide weir at EL 1739.00

Water level for submergence of land $= 1739 + 2.08$

$= 1741.00$ say 1742

BY S GOYAL DATE 11-21-85 / 12-02-85 SHEET 25 OF 54
CHKD. BY N Hung DATE 1/23/86 OFS NO. USDA 376-3 DEPT. NO. 52
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL WI #5
SUBJECT BULLDOG FLOODWAY

DWG 2-23

Top of Dike at EL 1742 feet

Q D/S channel = 1447 $b = 28'$ $S = .0495$

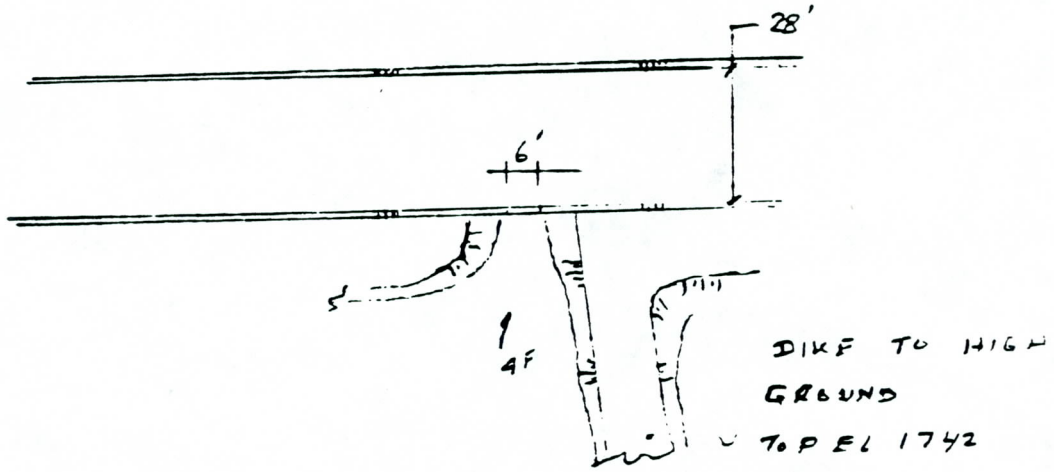
Assume $d = 3.65$ $A = 102.2$ $R = 2.895$ $V = 14.158$ $d = 3.65$ O.K

$d_c = \left[\left(\frac{1447}{28}\right)^2 / 32.2\right]^{1/3} = 4.36$

$S_c = .0029 < \frac{S}{1.3}$ O.K

Height of wall = $1.2 \times 3.65 = 4.38$

w $3.65 + 1 = 4.65$ Use 4'-9"



For inlet see Sh 26.

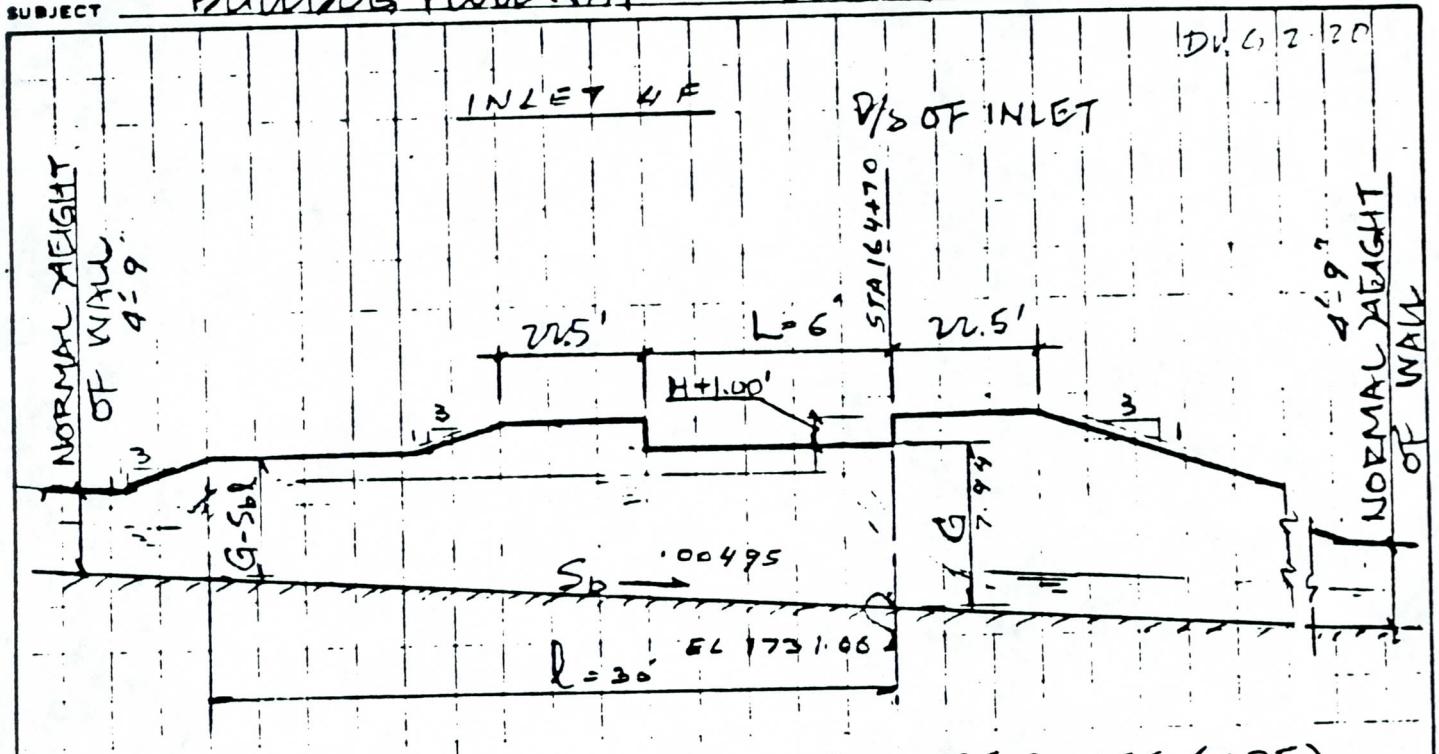
CHANNEL STA 164+70 TO STA 168+86

$Q = 1447$ $b = 28$ $S = .0495$ $d = 3.65$

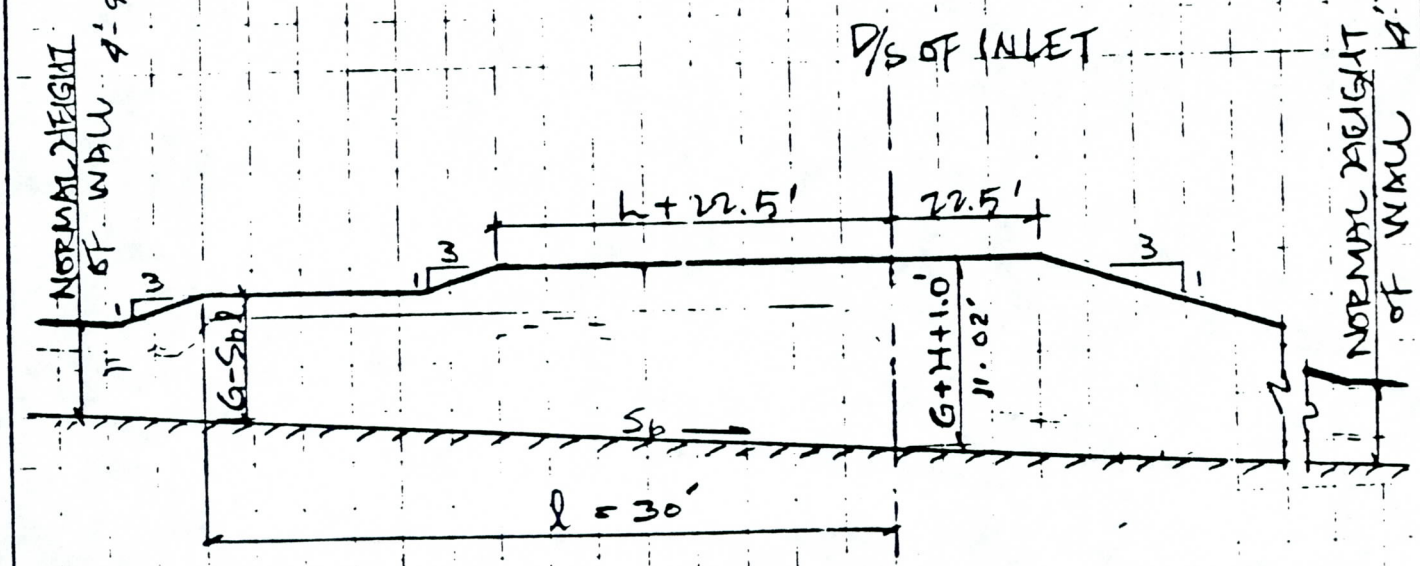
Bed EL at STA 169+ = $1731.06 - [16886 - 16470] \times .0495$
= 1729.00

Height of wall 4'-9"

BY Y.C. YANG DATE 9-30-85 S.C. YAL 11/2/85 / 12-02-85 SHEET 26 OF 54
CHKD. BY S. Goyal DATE 10-1-85 N.H. 1/23/86 OFS NO. 3767.203 DEPT. NO. 1650
CLIENT USDA
PROJECT BULLDOG FLOODWAY & APACHE JTN FLOOD PROTECTION
SUBJECT BULLDOG FLOODWAY — CHANNEL WALL DETAIL W.I. #



WALL DETAIL @ WEIR INLET (INLET SIDE)



WALL DETAIL @ WEIR INLET (OPPOSITE SIDE)

SATS 2-21, 2-49, 2-50

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11-21-85 SHEET 27 OF 54

CHKD. BY N Hung DATE 1/23/86 OFS NO. USDA 2767 200 DEPT. NO. 500

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY SCI #5

DWG 2-21

INLET 4G

To avoid the interference of 4G on 4F in the hydraulic performance, the inlet 4G should be made as a side channel inlet

Q_1 = [illegible] $b_1 = 28$ $d_1 = 3.65$ $A_1 = 102.2$ $V_1 = 14.58$

$Q_2 = 611$ $b_2 = 8.5$

Assume $d_2 = 3.8$

$V_2 = 18.92$ $A_2 = 32.3$ $K_2 = 2.006$

$$S_2 = \left[\frac{Vn}{1.486 R^{2/3}}\right]^2 = .0144$$

$d_{c_2} = 5.43$ $S_{c_2} = .0056 < \frac{S_2}{1.3}$

$Q_3 = 2058$

$b_3 = 35 > .8(b_1 + b_2)$ i.e. 29.2

$S_3 = .0051$

Assume $d_3 = 3.86$ $A_3 = 135.1$ $R_3 = 3.16$ $V_3 = 15.24$

$\therefore$ $d_3 = 3.858$ O.K.

$d_{c_3} = 4.75$ $S_{c_3} = .0027 < \frac{S_3}{1.3}$

$l = C V_3 (b_1 + b_2 - b_3)^{1/3}$ for $d_3 = 3.8$

$= 3.125 \times 18.92 (28 + 8.5 - 35)^{1/3} = 67.68$ say 68

length of uplift wall = $l_3 = 32'$

$b_m = \frac{(b_1 + b_2) + b_3}{2} = 35.75'$

$d_m = \frac{1}{2}\left[\frac{Q_1 + Q_2}{V_1 b_1 + V_2 b_2} + d_3\right] = 3.78$

$A_m = 135.01$ $P_m = 43.31$ $R_m = 3.12$

$V_m = 15.243$

$b_2 = \frac{b_1 (b_1 + b_2 + b_3)}{2 (b_1 + b_2)} = 27.42$ use 27'-5"

Unequal width channel

$$\frac{Q_2^2}{g A_2} + \frac{b_2 d_2^2}{2} - \frac{b_2 d_2 h}{2} = \frac{Q_1^2}{g A_1} + \frac{Q_2^2}{g A_2} + \frac{b_2 d_1 h}{2} - \frac{h d_1^2}{2}$$

$$+ \frac{b_2 - b_1}{2}(d_2^2) - \frac{f_m L V_m^2}{2.2 R_m}$$

$\therefore$ 973.60 + 260.74 − 67.55 h = 634.25 + 352.04 + 63.88 h + 180.52 + 50.50 h

or 131.43 h = 49.75 or h = 0.38

III D - 30

provide a drop of 0.38' in the length of the junction.
DWG 2-21

$R_2' = \frac{12 \times 16.92^2}{32.2} \times 8.5 = 113.37$ say 114'

Height of wall channel $= 1.2 \times 3.86 + .25 \times 4.75 \left[1 - 11.1 \left(\frac{.0051}{.0027} - 1\right)^3\right] + 1$
$= 4.63 + 1 = 5.63$ use 5'-9"

Height of spillway wall = $d_2 = 3.8' > d_1$
" " " at end = 6"
Height of wall for inlet = $1.2 \times 3.8 + 1$
$= 4.56 + 1 = 5.56$ Use 5'-9"

Beginning of Junction at STA = 169+00 less 14
= 168+86

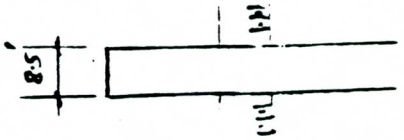
Bed EL of channel = 1731.06 - [16886 - 16470] × .0049
= 1729.00

End of Junction at STA 169+54
Bed EL of channel = 1729.00 - .38
= 1728.62

Provide a 55° curve for the side inlet channel
EL at the beginning of curve = $1729.00 + \left(\frac{2\pi \times 114}{360} \times 55\right) \times .0144$
= 1730.58

The ground level is very high. Provide a drop inlet

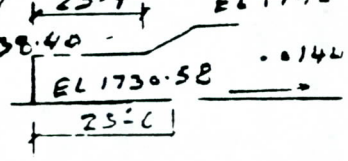
$\frac{W}{B} = \frac{25.5}{8.5} = 3$
$Q = 611$
$Q/W^{5/2} = 2.90$



From Fig ES-9c Sheet 5 chute spillway

$\delta = 0.92$ $\gamma = 0.26$

$\therefore D_T = 0.92 \times 8.5 = 7.82'$ $H_e = .26 \times 8.5 = 2.21'$



Top of crest = 1730.58 + 7.82
= 1738.40

Provide a 80' wide channel with 2H:1V side slopes

DWG 2-21

Effective $B = 25.5'$

$\therefore B' = B - .4 Z He$

$= 25.5 - .4 \times 2 \times 2.21 = 23.73$ say $23'-9"$

$B/W = 3$

$K = \frac{80 + .8 \times 2 \times 2.21}{8.5} = 9.8$

$\therefore$ From Fig ES-9a sheet 10 $K = .87$

Assume $Q = \frac{611}{.87} = 702$ so that $Q_K = .87 \times 702 = 611$

$\therefore$ For $Q = 702$ i.e. $\frac{Q}{W^{5/2}} = 3.33$ $W/B = 3$

from Fig ES-9a sheet 5

$Y = .29$

$He = .29 \times 8.5 = 2.47'$

$\therefore$ Water level for submergence $= 1738.40 + 2.47$

$= 1740.86$

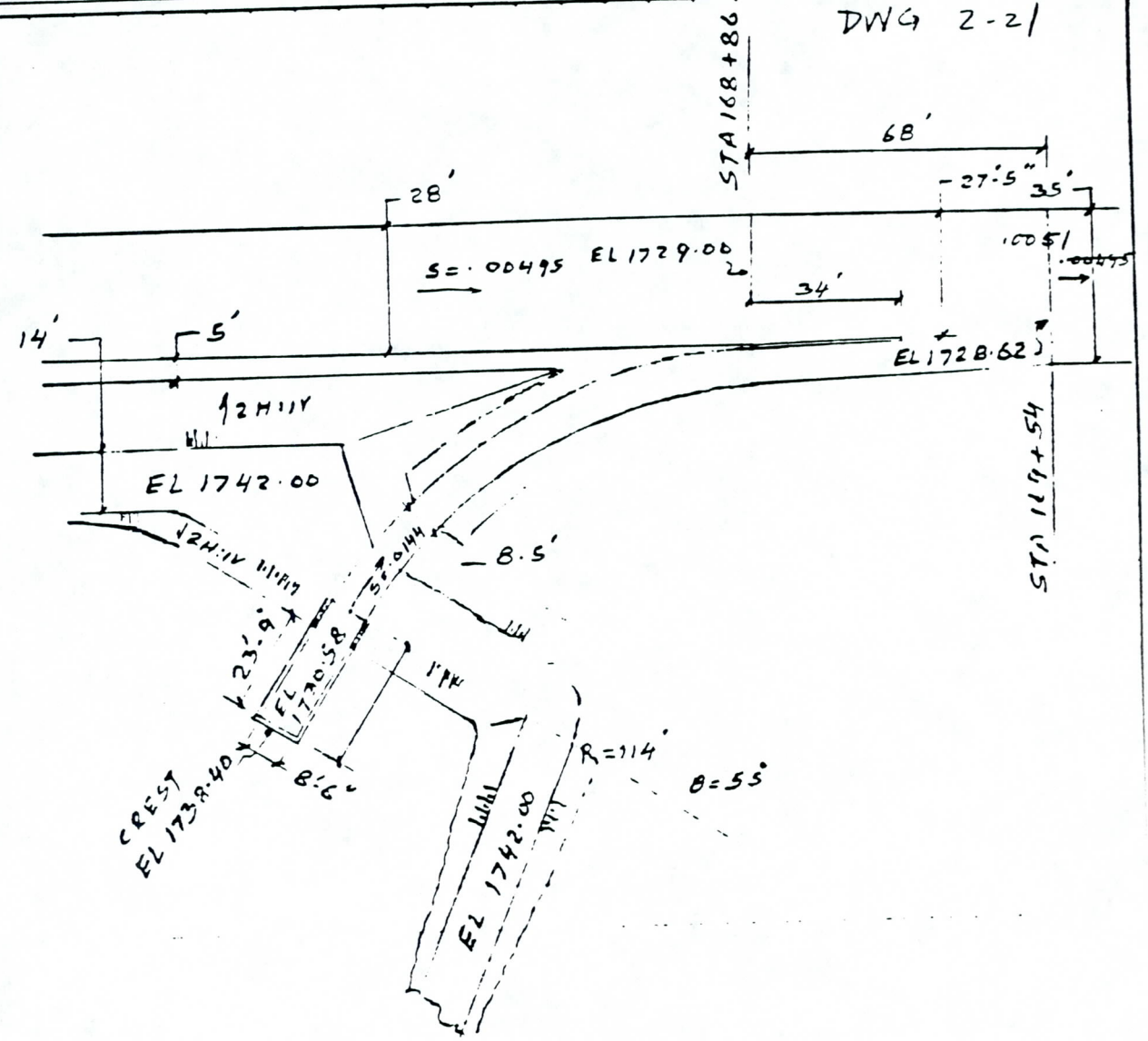
say 1741.00

Top of Dike at EL 1742.00

Velocity in the arroyo

$= \frac{611}{(80 + 2 \times 2.47) 2.47} = 2.91$

Provide riprap


DWG 2-21
STA 168+86
68'
28'
27.5'
35'
S=.00495
EL 1729.00
34'
.0051
.00495
14'
5'
EL 1728.62
1/2H:1V
EL 1742.00
STA 114+54
8.5'
2H:1V
S=.0144
23.9'
EL 1740.58
1'H
CREST
EL 1738.40
8'-6"
R=114'
θ=55°
EL 1742.00
1V:1H

PLAN 4G
1" = 4'

W.U. 1 & (4 of 5)
SH. 2-22, 2-35

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11-26-85 / 12-02-85 SHEET 31 OF 54
CHKD. BY N Hung DATE 1/23/86 OFS NO. USDA 3767 30 DEPT. NO. 650
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY INLET 4H W.U. #6

DWG 2-22

CHANNEL STA 169+54 TO STA 171+55

$Q = 2048$ $b = 35'$ $S = .0051$

Assume $d = 3.845$ $A = 134.575$ $R = 3.152$ $V = 15.21$

$\therefore d = 3.847$ o.k

$d_c = 4.74$

$S_c = .00269 < \frac{S}{1.3}$ o.k

Height of wall = $1.2 \times 3.845 = 4.61'$
or $3.845 + 1 = 4.845$ use 5'-0

Bed El at STA 171+55
$= 1728.62 \{17155 - 16954\} \times .0051$
$= 1727.59$

INLET 4H

$Q_1 = 2048$ $b_1 = 35'$ $S_1 = .0051$ $d_1 = 3.845$ $V_1 = 15.21$
$Q_3 = 37$
$Q_2 = 2085$
$\therefore F_1 = \frac{V_1}{\sqrt{g d_1}} = 1.37$

Conjugate Depth = $d_1 \times \frac{1}{2}(\sqrt{1+8F_1^2} - 1) = 5.755$

$\frac{Q_2}{Q_1} = \frac{2085}{2048} = 1.018$

$\therefore h/d_1 = 0$ From Fig 9 of Draft copy of the report for inlet

$F_2 = 1.2 = \frac{V_2}{\sqrt{g d_2}} = \frac{2085}{b_2 d_2} \cdot \frac{1}{\sqrt{g d_2}} = \frac{2085}{35\sqrt{g}} \cdot \frac{1}{d_2^{3/2}}$

$\therefore d_2 = 4.25$
$\ell = \frac{h}{S} = 0$
No hydraulic jump is formed
Depth of water = 4.25
Provide wall at $4.25 + 1 = 5.25'$ above floor level

III-D-34

DRG 2.00

$Q = 37$ cfs $= CL H^{3/2} = 3.1 L H_e^{3/2}$

Provide 5' long weir

$\therefore H_e = \left(\frac{37}{3.1 \times 5}\right)^{2/3} = 1.79'$

Provide 1' free board

If the flow in the main channel is less than 2048 cfs hydraulic jump may form in the main channel.

By trials assume $d_1 = 3'$ $A = 105$ $P = 41$ $R = 2.56$

$V_1 = 13.24$

$Q_1 = 1390.5$

$Q_2 = Q_1 + 37 = 1427.5$

$\frac{Q_2}{Q_1} = 1.027$

$F_1 = \frac{V_1}{\sqrt{g d_1}} = 1.347$

Conjugate depth $= 3 \times \frac{1}{2}\left(\sqrt{1 + 8 \times 1.347^2} - 1\right)$

$= 4.41$

$h/d_1 = 0$

$\therefore h = 0$

$F_2 = 1 = \frac{1427.5}{35\sqrt{32.2}\, d_2^{3/2}}$

$\therefore d_2 = 3.72$

For flows lower than 1390.5 cfs in the main channel hydraulic jump may form. Therefore the weir weir should be located above 4.41 which is less than 5.25'. 4.41' is less than height of u/s walls i.e 5'-0". O.K.

Provide inlet at STA 171+55 III D-35
D/S End

BY S GOYAL DATE 11.26.85/12.02.85 SHEET 33 OF 54

CHKD. BY N Hume DATE 1/22/86 OFS NO. USDA 3707.30 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY INLET 4H WI #6

DWG 2-22

Bed El of STA 171+55 = 1727.59

EL of Weir = 1727.59 + 5.25 = 1732.84.
This is lower than the Spoil. Provide the Weir of EL 1733.5

∴ Water level for submerging of land
= 1733.5 + 1.79
= 1735.29 say 1735.5

Top of Dike of EL 1736.5

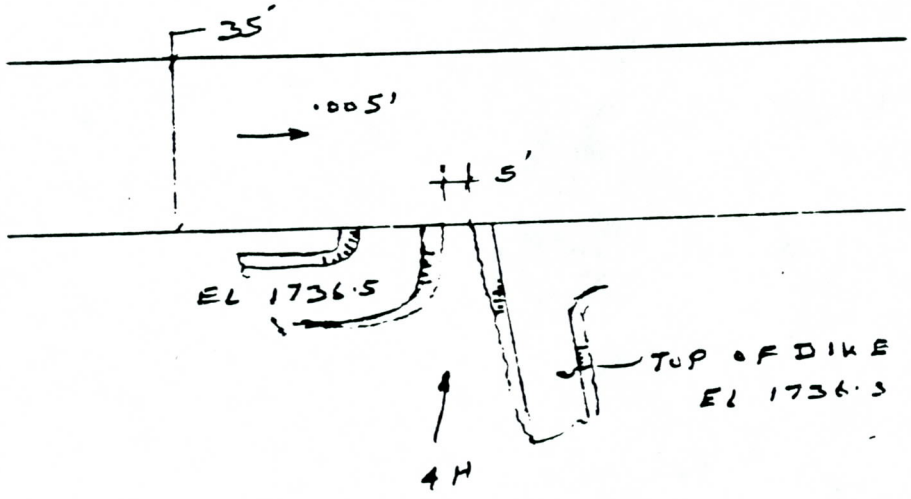
L D/S channel = 2049 b = 35' S = .005

Assume d = 3.847 A = 134.645 R = 3.154 V = 15.215

∴ d = 3.848 O.K.

Use Ht. Height of Wall 5'-0

For inlet see sheet 34



EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-30-85 S GOYAL 11/26/85 / 12-02-85 SHEET 34 OF 54

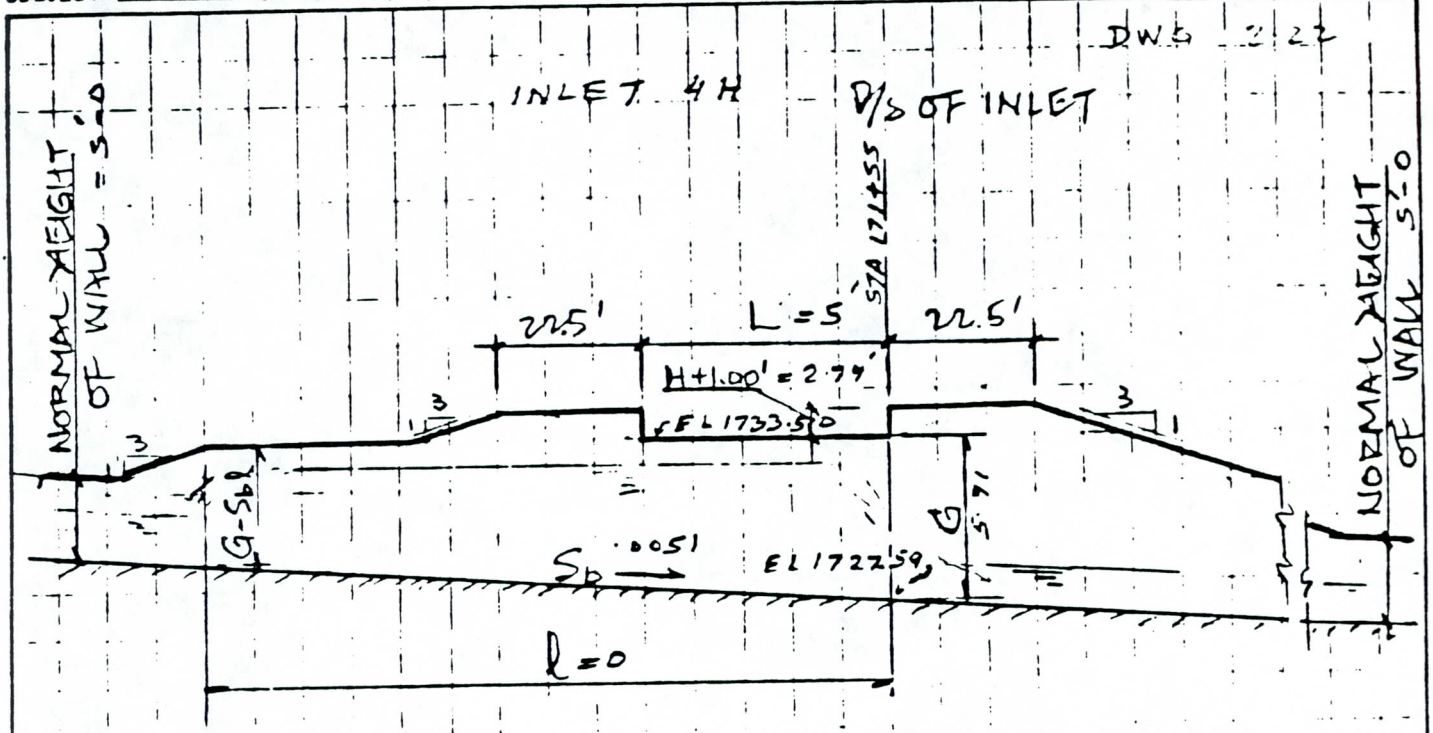
CHKD. BY S Goyal DATE 10-1-85 N.16 1/23/86 OFS NO. 3767.203 DEPT. NO. 1650

CLIENT USDA.

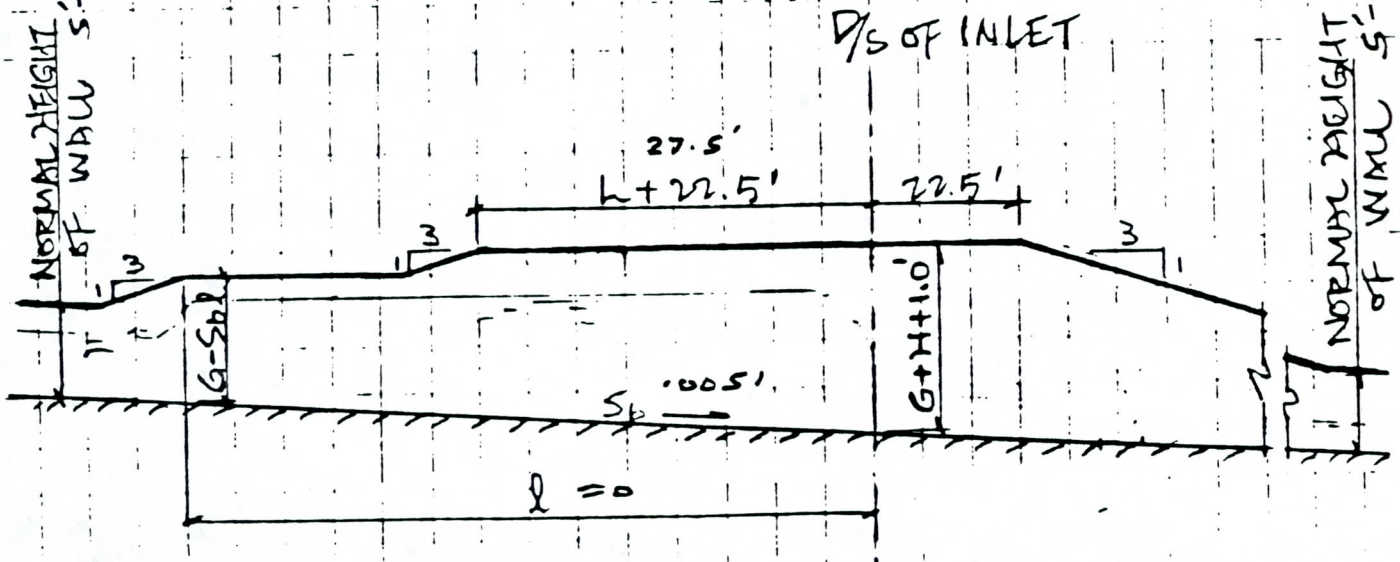
PROJECT BULLDOG FLOODWAY & APACHE JTN FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — CHANNEL WALL DETAIL WI *

DWG 2127



WALL DETAIL @ WEIR INLET (INLET SIDE)



WALL DETAIL @ WEIR INLET (OPPOSITE SIDE)

III D-37

S.C.I. #3 (5A)
SHTS 2-16, 2-51, 2-53, 2-5

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11-26-85/12-02-85 SHEET 35 OF 54
CHKD. BY N. Hung DATE 1/23/86 OFS NO. USDA-27-20 DEPT. NO. 5550
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY AND LOCAL JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY SCI #3
DWG 2-16

CHANNEL STA 171+55 TO STA 182+80

$Q = 2049$ $b = 35'$ $S = .0051$

Bed El at STA 182+80 = 1727.59 − [18280 − 17155] × .0051
= 1721.85

Height of wall is 5'

INLET SA

$Q_1 = 2049$ $b_1 = 35'$ $d_1 = 3.847$ $A_1 = 134.45$ $V_1 = 15.2$

$Q_2 = 2348$ $b_2 = 27.5'$

$d_2 = 4.3$

$V_2 = 19.86$ $A_2 = 118.25$ $R_2 = 3.776$

$S_2 = .00826$

$d_{c_2} = 6.095$ $S_{c_2} = .0029 < \frac{S_2}{1.3}$

$Q_3 = 4397$

$b_3 = 50' = .8(b_1 + b_2)$

$S_3 = .0051$

Assume $d_3 = 4.87$ $A_3 = 243.5$ $R_3 = 4.076$ $V_3 = 18.05$

$\therefore d_3 = 4.871$ O.K.

$d_{c_3} = 6.216$ $S_{c_3} = .0024 < \frac{S_3}{1.3}$ O.K.

$l = C V_2 (b_1 + b_2 - b_3)^{1/3}$ for $d_2 = 4.3$

$= 3.42 \times 19.86 (35 + 27.5 - 50)^{1/3}$

$= 157.6 \rightarrow$ say 160'

Length of splitter wall $= l/2 = 80'$

$b_m = \frac{(b_1 + b_2) + b_3}{2} = 56.25'$

$d_m = \frac{1}{2}\left[\frac{Q_1^2 + Q_2^2}{V_1 b_1 + V_2 b_2} + d_3\right] = 4.473$

$A_m = 251.60$ $P_m = 65.20$ $R_m = 3.86$

$V_m = 17.48$

$b_s = \frac{35(35 + 27.5 + 50)}{2(35 + 27.5)} = 31.5'$

Unequal width main channel

$$\frac{Q_3^2}{g A_3} + \frac{b_3 d_3^2}{2} - \frac{b_3 d_3 h}{2} = \frac{Q_1^2}{g A_1} + \frac{Q_2^2}{g A_2} + \frac{b_3 d_3 h}{2} + \frac{b_1 d_1^2}{2}$$

III-D-38 $+ \left(\frac{b_3 - b_1}{2}\right) d_2^2 - \frac{P_m l_{11}^2 V_m^2}{2.21 R_m^{1.3}}$

DWG # 2-16

$\therefore 2465.80 + 592.92 - 121.75\,h = 968.36 + 1447.90 + 96.18\,h + 258.99 + 138.69 - 206.88$

$\therefore 217.93\,h = 451.67$

$h = 2.07$

Radius of bend $R_2' = \frac{1.2 \times 7.86^2 \times 27.5}{32.2 \times 1} = 404.22$ say 410'

Height of wall $= 1.2 \times d_3 + .25\, d_{c_2}\{1 - 11.1(\frac{S_2}{S_{c_2}} - 1)^2\}$ neglect $+ \frac{1.2 V_2^2}{2g} b_2$

$= 5.844 + 0 + 1$

$= 6.844$ use 7'-0

Height of splitter wall = $d_2 = 4.3 > d_1$ use 4'-4"

" " lower end = 6"

Height of wall for inlet $= 1.2 \times 4.3 + \frac{1.2 V_2^2 b_2}{2g R_2'}$

$= 5.16 + 1 = 6.16$ use 6'-3

Provide beginning of junction at STA 182+80

El at STA 182+80 = 1721.85

Provide a 30° curve and 30' straight reach in the inlet

Length of channel $= \frac{2\pi \times 410}{360} \times 30 + 30 = 246.68'$

El at the inlet $= 1721.85 + 246.68 \times .00826$

$= 1723.89$

This is about a foot lower than the ground.

Provide a straight inlet

$Q = 234 \ell = C_L H_e^{3/2} = 3.1 \times 27.5\, H_e^{3/2}$

$\therefore H_e = 9.12$

Total energy in the channel at the inlet

$= 1723.89 + 4.3 + \frac{19.86^2}{2g} = 1734.31$

BY S GOYAL DATE 11-26-85 / 12-02-85 SHEET 37 OF 54

CHKD. BY N. Hung DATE 1/23/86 OFS NO. USDA 3[illegible] DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY INLET SA SCI # 3

DWG 2-16

∴ Provide the inlet crest at 1734.31 - 9.12

= 1725.19

→ say 1725.25

Provide a 80' wide channel 2:1 side slopes

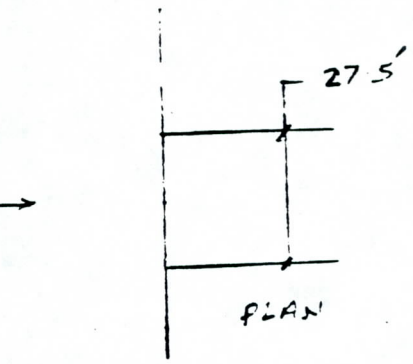
$$V = \frac{2748}{(80 + 2 \times 9)\,9} = 2.66$$

$$H_e = 9 + \frac{2 \times 2.66^2}{64.4} = 9.11 < 9.12 \quad \text{O.K}$$

Water level for subcritical flow = 1725.25 + 9.12

= 1734.37 → say 1734.50

Top of Dike at EL 1735.50



SECT

End of Junction at STA 184+40

End EL at STA 184+40 = 1721.85 - 2.07

= 1719.78

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11-27-85 SHEET 38 OF 54

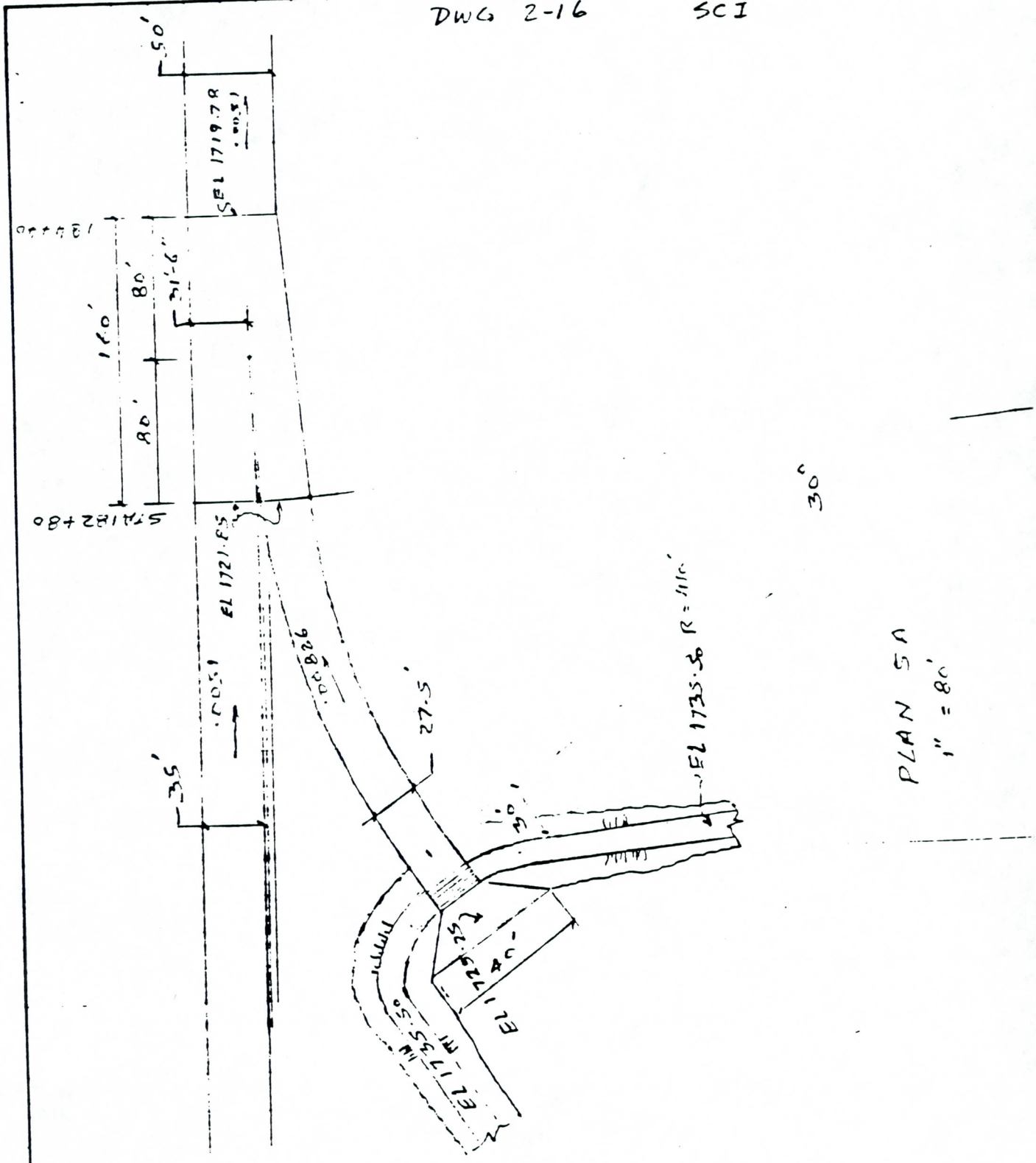
CHKD. BY N. HUNG DATE 1/23/86 OFS NO. USDA SCS DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY INLET SA SCI #3

DWG 2-16 SCI



SCI. #6 (5 of)
SHT. 2-23, 2-43, 2-4

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 11-27-85 SHEET 37 OF 54
CHKD. BY N. Hung DATE 1/23/86 OFS NO. USDA 3767.30 DEPT. NO. 550
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT BULIDOG FLOODWAY SCI #6
DWG. 2-23

CHANNEL STA 184+40 TO STA 187+00

$Q = 4254$ $b = 50'$ $S = .0151$

Assume $d = 4.77$ $A = 238.5$ $R = 4.01$ $V = 17.84$

$\therefore d = 4.768$ o.k

$d_c = 6.08$ $S_c = .0024$ $< \frac{S}{1.3}$ o.k

Height of walls $= 1.2 \times 4.77 = 5.72$

or $4.77 + 1 = 5.77$ use $5'-9'$

El at STA 187+00 $= 1719.75 - [18700 - 18440] \times .0151$

$= 1718.45$

INLET SB

$Q_1 = 4254$ $b_1 = 50'$ $d_1 = 4.77$ $A_1 = 238.5$ $V_1 = 17.84$

$Q_2 = 157$ $b_2 = 3.00$

Assume $d_2 = 4.00$ $\frac{d_2}{d_c} = 1.19 < 1.2$ o.k

$V_2 = 13.08$ $A_2 = 12$ $R_2 = 1.09$

$S_2 = \left[\frac{Vn}{1.486 R^{2/3}}\right]^2 = .0155$

$d_{c_2} = 4.398$ $S_{c_2} = .0124$

$\frac{S_2}{1.3} < S_{c_2}$ will need additional freeboard

$F_2 = \frac{V}{\sqrt{gd}} = 1.153 < 1.2$

Inlet SB does not satisfy the requirements of side channel inlet for $\frac{d_2}{d_c} < 1.2$ and $F > 1.2$

For $F_2 = 1.2$ the flow should be approximately 165 cfs which is not very much different from 157 cfs. Provide a side inlet for SB to properly drain the arroyo and avoid standing pool. Design the inlet for 165 cfs

$Q_1 = 4254$ $b_1 = 50'$ $d_1 = 4.77$ $A_1 = 238.5$ $V_1 = 17.84$

$Q_2 = 165$ Assumed $b_2 = 3$

$d_2 = 4$ $\frac{d_1}{d_2} = 1.19 < 1.2$ O.K

$V_2 = 13.75$ $A_2 = 12$ $R_2 = 1.09$

$S_2 = \left[\frac{V_n}{1.486 R^{2/3}}\right]^2 = .0172$

$d_{c_2} = 4.55$ $S_{c_2} = .0127 < \frac{S_2}{1.3}$ O.K

$F_2 = \frac{V}{\sqrt{g d}} = 1.21 > 1.2$

$Q_3 = Q_1 + Q_2$
$= 4419$

$b_3 = 50' > .8(b_1 + b_2)$ i.e. 42.4

$S_3 = .0051$

Assume $d_3 = 4.89$ $A_3 = 244.5$ $R_3 = 4.09$ $V_3 = 18.09$

i.e. $d_3 = 4.885$ O.K

$d_{c_3} = 6.24$ $S_{c_3} = .0024 < \frac{S_3}{1.3}$ O.K

$L = C V_3 (b_1 + b_2 - b_3)^{1/3}$ for $d_3 = 4$

$= 3.25 \times 13.75 (3)^{1/3} = 64.45 \rightarrow$ say 65'

Length of splitter wall $= L/2 = 32.5'$

$b_m = \frac{(b_1 + b_2) + b_3}{2} = 51.5$

$d_m = \frac{1}{2}\left[\frac{Q_1^2 d_1}{V_1 b_1 + V_2 b_2} + d_3\right] = 4.81$

$A_m = 247.85$ $P_m = 61.12$ $R_m = 4.06$

$V_m = 17.83$

$b_3 = \frac{50(50 + 3 + 50)}{2(50 + 3)} = 48.58$ 48'-7"

Equal width main channel

$$\frac{Q_3^2}{g A_3} + \frac{b_3 d_3^2}{2} - \frac{b_3 d_3 h}{2} = \frac{Q_1^2}{g A_1} + \frac{Q_2^2}{g A_2} + \frac{b_2 d_1 h}{2} + \frac{b_1 d_1^2}{2} - \frac{f_m L_m^2 V_m^2}{2.21 R_m^{1/3}}$$

$2480.35 + 597.80 - 122.25 h = 2356.4 + 70.46 + 114.25 h + 568.6 - 60.60$

$\therefore 241.5 h = 163.07$

$h = .68'$

Use S = .5'

Radius of bend $R_2 = \frac{1.2 \times 13.75^2 \times 3}{32.2 \times .5} = 42.27$ say 45'

Height of wall $= 1.2 \times d_2 + .25 d_{c2}\left[1 - 11.1\left(\frac{S_2}{S_{c2}} - 1\right)^2\right] + \frac{1.2 V_2^2 b_2}{2 R_2'}$

$= 5.87 + 0 + .3$

$= 6.37'$ use 6'-6"

Height of splitter wall $= d_1 = 4.77 > d_2$

∴ it drown end = 6"

Height of wall for inlet $= 1.2 \times 4 + \frac{1.2 V_2^2 b_2}{2 R_2'}$

$= 4.84 + .5$

$= 5.3$ use 5'-6"

Provide beginning of Junction at STA 187+00

EL = 1718.45

Part of a 45° curve with 20' straight section on the end inlet

Length of channel $= 2\pi \times 45 \times \frac{45}{360} + 20 = 55.34$

EL at the inlet $= 1718.45 + 55.34 \times .0172$

$= 1719.40$

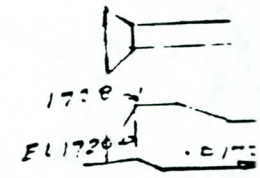
This is lower than ground contours

provide inlet crest at EL 1720 Straight inlet

Total energy at the inlet in the channel

$= 1719.40 + 4 + \frac{13.75^2}{64.4}$

$= 1726.34$



$Q = 165 = 3.1 \times L \times H_e^{3/2}$

for $L = 3'$ $H_e = 6.80'$

∴ Total energy u/s inlet $= 1720 + 6.8 = 1726.8$ > 1726.3 o.k

Water level for submergence $= 1726.8$ say 1727

Top of Drke at EL 1728

Provide channel 3' wide with 2:1 side slope

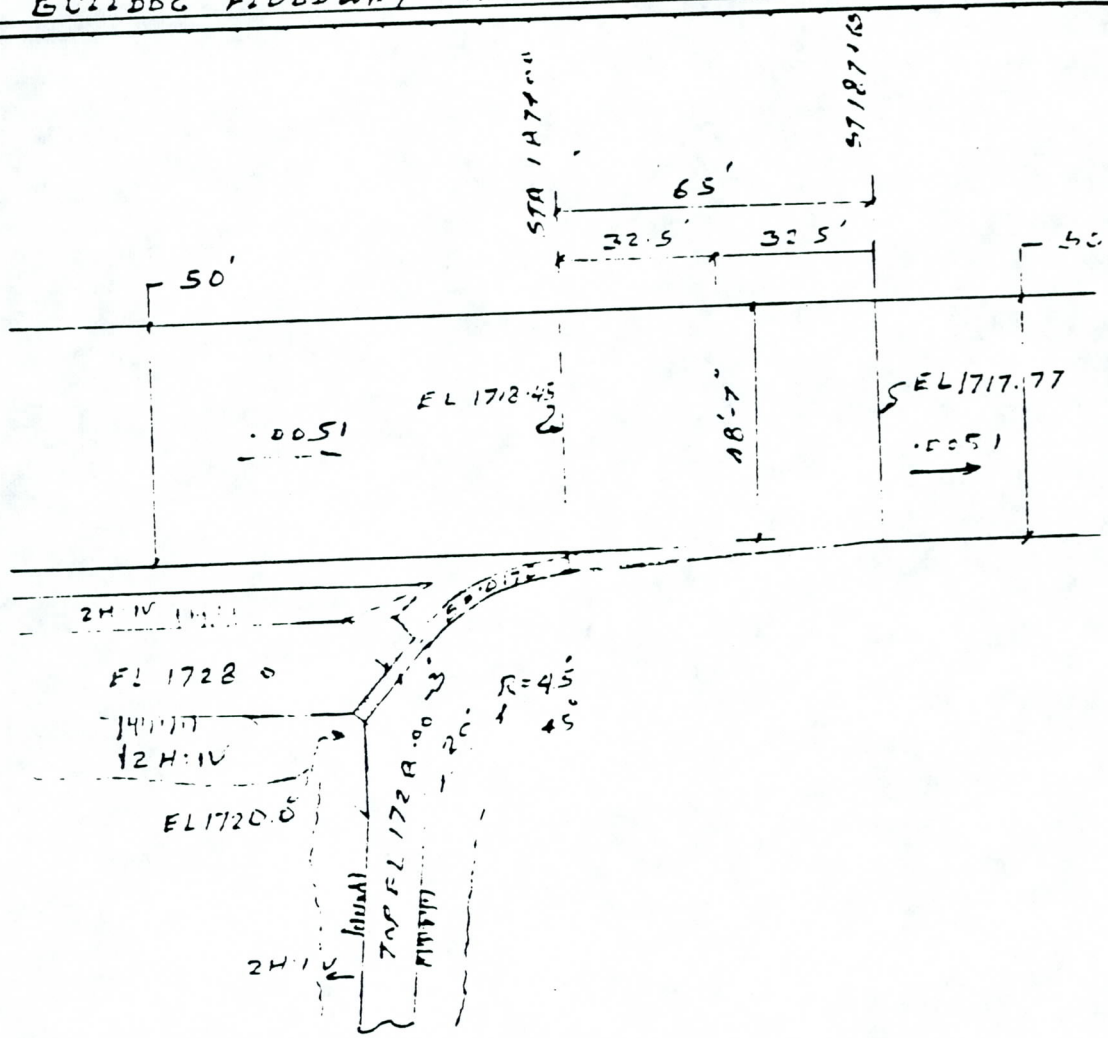
$V = \frac{165}{(3 + 2 \times 6.7) 6.7} = 1.5$ fps o.k

(d assumed 6.7' $H_e = 6.7 + \frac{1.5^2}{64.4} = 6.73 \approx 6.8$ o.k)

End of Junction at STA 187+65

Bed EL $= 1718.45 - .68 = 1717.77$

III D-44


STA 1+47.00
STA 1+87.65
65'
32.5'
32.5'
50'
50'
EL 1718.45
EL 1717.77
.0051
.0051
18'-7"
2H:1V
EL 1728.0
12H:1V
EL 1720.0
R=45'
45°
2'
TOP EL 1722.00
2H:1V

PLAN 5B
1" = 40'

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 12-02-85 SHEET 32 OF 54
CHKD. BY N.H.J DATE 1/23/86 OFS NO. USDA 7[illegible] DEPT. NO.
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & ARNOLD JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY WI #7
DWG 2-24

CHANNEL STA 187+45 TO 189+40

$Q = 4369$ $b = 50'$ $S = .0051$

Assume $d' = 4.85$ $A = 2425$ $R = 4.06$ $V = 18.01$

$\therefore d = 4.851$ O.K

$d_c = 6.19$ $S_c = .0024 < \frac{S}{1.3}$ O.K

Height of wall = $1.2 \times 4.85 = 5.82$

or $4.85 + 1' = 5.85$ use 6.0

End EL at STA 189+40 = $1717.77 - [18940 - 18765] \times .0051$

$= 1716.88$

INLET SC

$Q_1 = 4369$ $b_1 = 50'$ $S_1 = .0051$ $d_1 = 4.85$ $V_1 = 18$

$Q_3 = 36$

$Q_2 = 4405$

$\therefore F_1 = \frac{V_1}{\sqrt{g d_1}} = 1.44$

conjugate depth = $d_1 \times \frac{1}{2}(\sqrt{1 + 8F_1^2} - 1) = 7.75'$

$Q_2/Q_1 = 1.008$

$\therefore h/d_1 = 0$ From Fig 9 of Draft copy of the report

$F_2 = 1.38 = \frac{V_2}{\sqrt{g d_2}} = \frac{4405}{50 \times d_2} \frac{1}{\sqrt{g d_2}} = \frac{4405}{50} \frac{1}{\sqrt{g}} d_2^{-3/2}$

$\therefore d_2 = 5.02$

$\frac{h}{S} = 0$

No hydraulic jump is formed

Depth of water = 5.02

Provide weir at EL = $1716.88 + 5.02 + 1' =$ [illegible]

D.W.S. 2-24

$Q = 36$ cfs $= CLH^{3/2} = 3.1 L H_e^{3/2}$

Provide 5' long weir

$\therefore H_e = \left(\frac{36}{3.1 \times 5}\right)^{2/3} = 1.75$

Provide 1' freeboard

If the flow in the main channel is less than this a hydraulic jump may form in the main channel

Assume $d = 3'$ $A = 15$ $R = 2.68$

$\therefore Q_1 = 2047$

$Q_2 = Q_1 + 36 =$

$\frac{Q_2}{Q_1} = 1.0176$

$F_1 = 1.39$

conjugate depth $= 3 \times \frac{1}{2}\left(\sqrt{1 + 8 \times 1.39^2} - 1\right)$

$= 4.58'$

This is less than the height of wall in the channel and moreover no hydraulic jump is formed even with this low flow. Weir is located about (5.0 ± 1) i.e. 6.02 ft above the bed.

Provide inlet at STA 189+40
D/S end

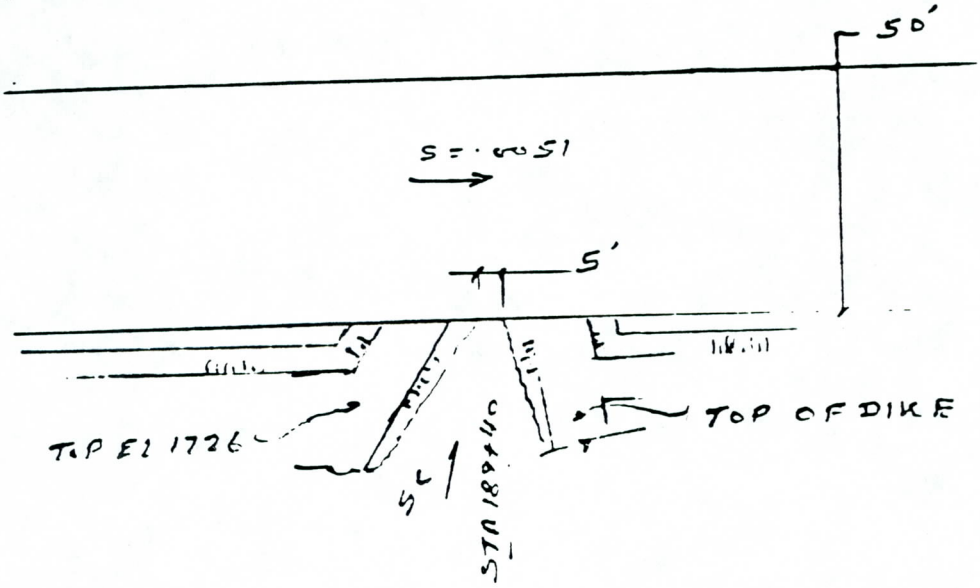
Bed El = 1716.02

Weir El = 1722.02

Weir elevation is approximately at the ground level
Provide weir at El 1723.00
Water level for submergence of land
$= 1723 + 1.75 = 1724.75$

Top of Dike at El 1726.00

BY S Gevell DATE 12-02-85 SHEET 45 OF 54
CHKD. BY N Hunt DATE 1/23/86 OFS NO. USDA 2-6-7 DEPT. NO. 5700
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY INLET SC WI #7



PLAN SC

For relief SC see sheet 46

CHANNEL STA 189+40 TO ~~194+30~~ 193+96

Q = 4366 b = 50' S = .0051

d = 4.85

Use 6' height of walls on upstream of the inlet

Bed El at STA 174+30 = 1716.88 - [19396 - 18940] x .0051

= ~~1714.38~~
1714.55

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 9-30-85 S GOYAL 12-02-85 SHEET 46 OF 54

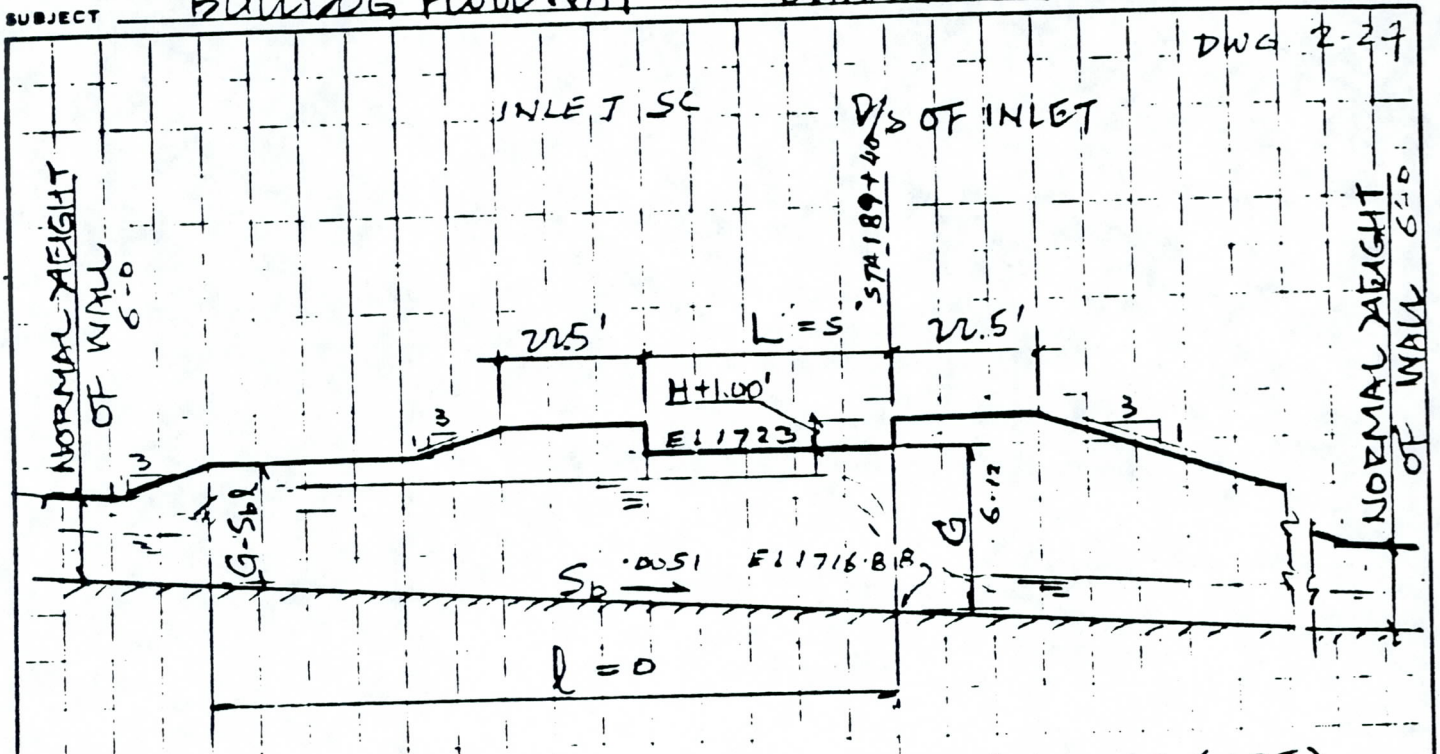
CHKD. BY S Goyal DATE 10-1-85 N.H.J 1/23/86 OFS NO. 3767.203 DEPT. NO. 1650

CLIENT USDA

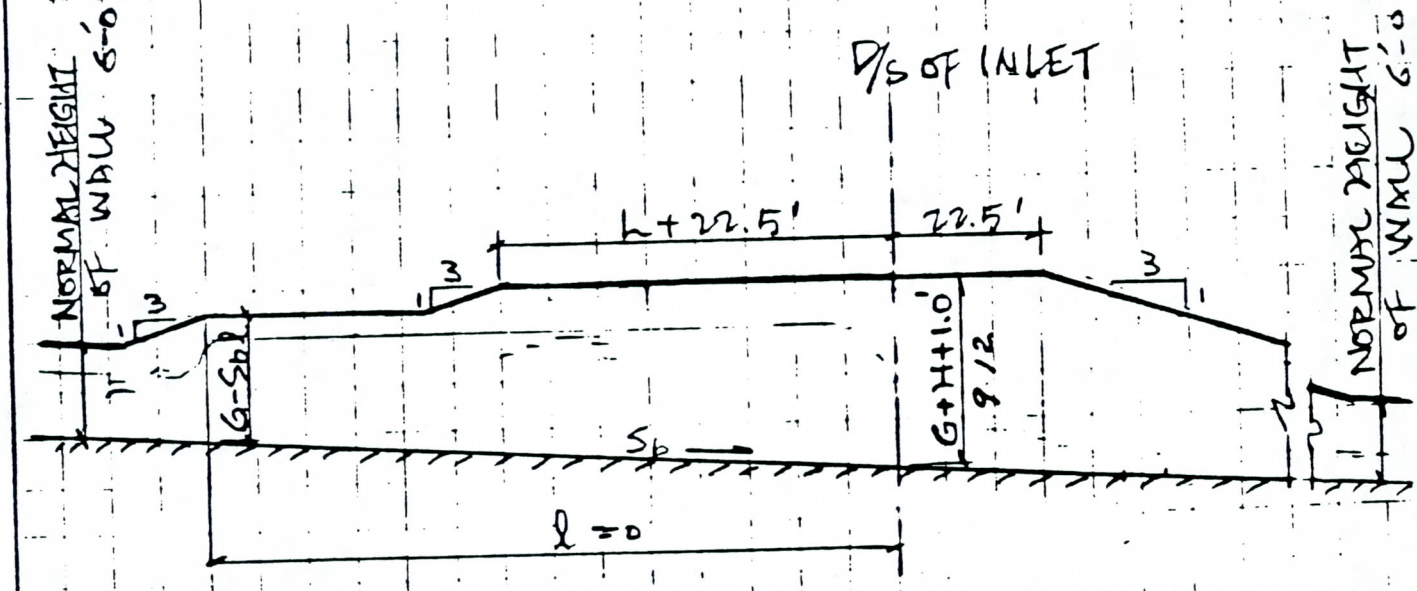
PROJECT BULLDOG FLOODWAY & APACHE JTN FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — CHANNEL WALL DETAIL WI-#

DWG 2-27



WALL DETAIL @ WEIR INLET (INLET SIDE)



WALL DETAIL @ WEIR INLET (OPPOSITE SIDE)

SHTS 2-25, 2-36, 2-37

EBASCO SERVICES INCORPORATED

SHEET 47 OF 54

BY S GOYAL DATE 12-2-85

CHKD. BY N. Ibrahim DATE 1/23/86

OFS NO. USDA 3747-3 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY INLET 6A (Ex. 2-36) SCI #7

$Q_1 = 4366$ $b_1 = 50'$ $d_1 = 4.85$ $A_1 = 242.5$ $V_1 = 18.01$

$Q_2 = 345$ $b_2 = 7$

$d_2 = 4.05$ $\frac{d_1}{d_2} = 1.20$ O.K

$V_2 = 12.17$ $A_2 = 28.35$ $R_2 = 1.88$

$S_2 = \left[\frac{Vn}{1.486\, R^{2/3}}\right]^2 = .0065$

$d_{c_2} = 4.23$ $S_{c_2} = .0058 > \frac{S_2}{1.3}$

Provide extra free board in the inlet

$Q_3 = 4711$

$b_3 = 50' > .8(b_1 + b_2)$ i.e 45.6

$S_3 = .0051$

Assume $d_3 = 5.09$ $A_3 = 254.3$ $R_3 = 4.23$ $V_3 = 18.50$

$\therefore d_3 = 5.09$ ok

$d_{1_3} = 6.51$ $S_{c_3} = .0024 < \frac{S_3}{1.3}$ O.K

$l = CV_2(b_1 + b_2 - b_3)^{1/3}$ for $d_2 = 4.05$

$= 3.3 \times 12.17 (7)^{1/3} = 76.8$ say 77'

Length of splitter wall $= l/2 = 38.5'$

$b_m = \frac{(b_1 + b_2) + b_3}{2} = 53.5'$

$d_m = \frac{1}{2}\left[\frac{Q_1^2 + Q_2}{V_1 b_1 + V_2 b_2} + d_3\right] = 4.935$

$A_m = 264.0$ $P_m = 63.37$ $R_m = 4.166$

$V_m = 17.84$

$b_s = \frac{50(50+7+50)}{2(50+7)} = 46.93$ 46'-11"

Equal width channel

$$\frac{Q_3^2}{gA_3} + \frac{b_3 d_3^2}{2} - \frac{b_3 d_3 h}{2} = \frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} + \frac{b_3 d_1 h}{2} + \frac{b_1 d_1^2}{2} - \frac{P_m l n^2 V_m^2}{2.21 R_m^{1/3}}$$

$\therefore 270821 + 647.70 - 127.25h = 2441.18 + 130.39 + 121.25h + 585.66 - 98.26$

$\approx 248.5h = 294.55$

$h = 1.19'$

for $Q = 1'$

Radius of bend $R'_2 = \frac{1.2 \times 12 \cdot 17^2 \times 7}{32.2 \times 1} = 38.64$ use 40'

Height of wall $= 1.2 \times d_2 + .25\, d_{c_2}\left[1 - 111\left(\frac{S_3}{S_{f_2}} - 1\right)^2\right] + 1.2\,\frac{V_2^2 b_2}{g R'_2}$

$= 6.108 + 0 + .966$

$= 7.074$ use 7'-0"

Height of spillway wall $= d_1 = 4.85 > d_0$

" " lower end $= 6''$

Height of wall for inlet $= 1.2 \times d_2 + .25\, d_{c_2}\left[1 - 111\left(\frac{S_2}{S_{f_2}} - 1\right)^2\right] + 1.2\,\frac{V_2^2 b_2}{g R'_2}$

$= 1.2 \times 4.05 + .25 \times 4.23\left[1 - 111\left(\frac{.0065}{.0056} - 1\right)^2\right] + 1.2 \times \frac{12.17^2 \times 7}{32.2 \times 40}$

$= 4.864 - .886 + .966$

$= 6.712$ use 6' 9"

Provide beginning of Junction at STA ~~194+30~~ 193+96

El = 1714 ~~35~~ 55

Provide a 60° curve

Length of channel $= 2\pi \times 40 \times \frac{60}{360} = 41.88'$

El at inlet $= 1714\,\overset{55}{\cancel{38}} + 41.88 \times .0065$

$= 1714\,\overset{83}{\cancel{65}}$

This is slightly lower than the ground contour

Provide inlet at El 1714.~~25~~ 95 straight inlet.

Total energy at inlet $= 1714\,\overset{83}{\cancel{65}} + 4.05 + \frac{12.17^2}{64.4} = 1721.\overset{19}{00}$

$Q = 345 = 3.1 \times L \times H_e^{3/2}$

for $L = 7'$ $H_e = 6.32$

$\therefore$ Total energy $= 1714.\overset{95}{25} + 6.32 = 1721.\overset{27}{97} > 1721.$

Water level for submergence $= 1721.\overset{27}{97}$ say 1721.25

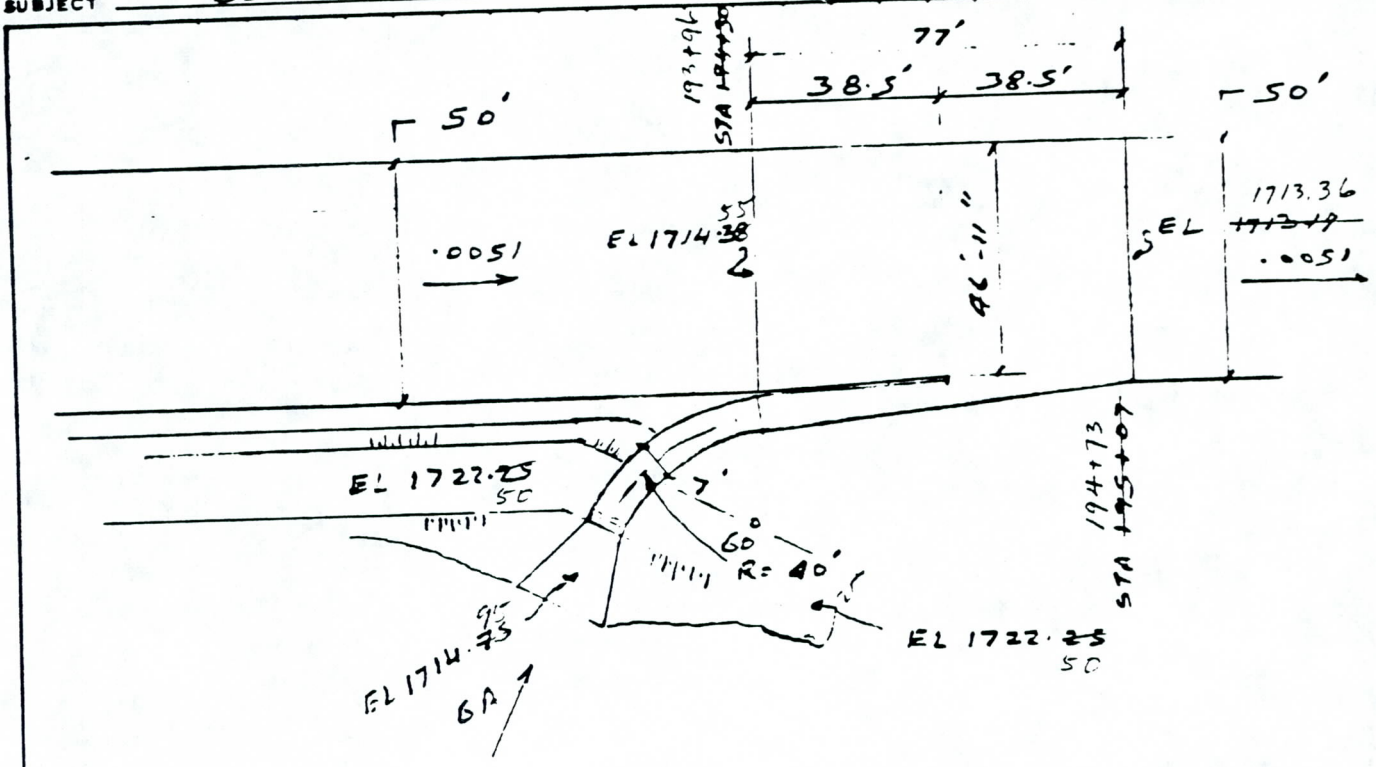
Top of dike at El $1722.\overset{00}{25}$

Provide channel 7' wide 2:1 side slopes

$V = \frac{345}{(7 + 2 \times 6.2)\,6.2} = 2.87$ fps

III. D-51

BY S GOYAL DATE 12-2-85 SHEET 49 OF 54
CHKD. BY [illegible] DATE 1/23/86 OFS NO. USDA 3767.30 DEPT. NO. CCA
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY INLET 6A SCJ #7



PLAN 6A
1"=40'

EL at the end of junction at STA 194+73 / ~~195+07~~
= ~~1714.38~~ 1714.55 − 1.19 = ~~1713.19~~ 1713.36

CHANNEL STA 194+73 / ~~195+07~~ TO STA 202+00

$Q = 4670$ $b = 50'$ $S = .0051$

Assume $d = 5.063$ $A = 253.15$ $R = 4.21$ $V = 18.45$

$\therefore d = 5.063$ o k

$d_c = 6.47$ $S_c = .00239$ $< \frac{S}{1.3}$ o k

Height of wall = 1.2×5.063
= 6.07 use 6'-3"

EL STA 202+00 = $1713.19 - [202.00 - 194.73] \times .0051$
= 1709.66

W.I. # 6 (8
SHTS 2-26, 2-40

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 12-02 85 SHEET 50 OF 54
CHKD. BY [illegible] DATE 1/23/86 OFS NO. 3767-3.. DEPT. NO. ...
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT BULLDOG FLOODWAY INLET 6B WI # 9
DWG 2-26

INLET 6B

$Q_1 = 4670$ $b_1 = 50'$ $S_1 = .0851$ $d_1 = 5.063$ $V_1 = 18.45$

$Q_3 = 126$

$Q_2 = 4796$

$F_1 = \frac{V_1}{\sqrt{g d_1}} = 1.445$

conjugat. depth $= d_1 \times \frac{1}{2}[\sqrt{1 + 8F_1^2} - 1] = 8.12$

$\frac{Q_2}{Q_1} = 1.027$

$\therefore h/d = 0$ From Fig 9 Draft copy of Report

$F_2 = 1.2 = \frac{V_2}{\sqrt{g d_2}} = \frac{Q_2}{b_2\sqrt{g}\, d_2^{3/2}}$

$\therefore d_2 = \left(\frac{4796}{50 \times \sqrt{32.2}} \frac{1}{1.2}\right)^{2/3} = 5.83'$

$\ell = \frac{h}{S} = 0$

No hydraulic jump is formed

Depth of water $= 5.83'$

Provide weir at EL $= 1709.66 + 5.83 + 1$

$= 1716.49$

$Q = 126 = 3.1 \times 40 \times H_e^{3/2}$ for a 40' long weir

$H_e = \left[\frac{126}{3.1 \times 40}\right]^{2/3} = 1.01'$

Provide 1' free board

Water level for submergence $= 1716.49 + 1.01$

$= 1717.5$ say 1717.72

Top of Dike at EL 1718.5'

DWG 2-26

If the flow in the main channel is less than 4670 cfs a hydraulic jump may form in the main channel

Assume $d_1 = 4'$ $A_1 = 200$ $R_1 = 3.45$

$\therefore V_1 = 16.15$

$Q_1 = 3230$

$Q_2 = 3230 + 126$

$= 3356$

$\frac{Q_2}{Q_1} = 1.039$

$F_1 = \frac{V_1}{\sqrt{g d_1}} = 1.423$

$h/d = 0$ From Fig 9

$h = 0$

$F_2 = 1$

$\therefore d_2 = \left\{ \frac{Q_2}{F_2 b \sqrt{g}} \right\}^{2/3} = \left\{ \frac{33.56}{1 \times 50 \sqrt{32.2}} \right\}^{2/3}$

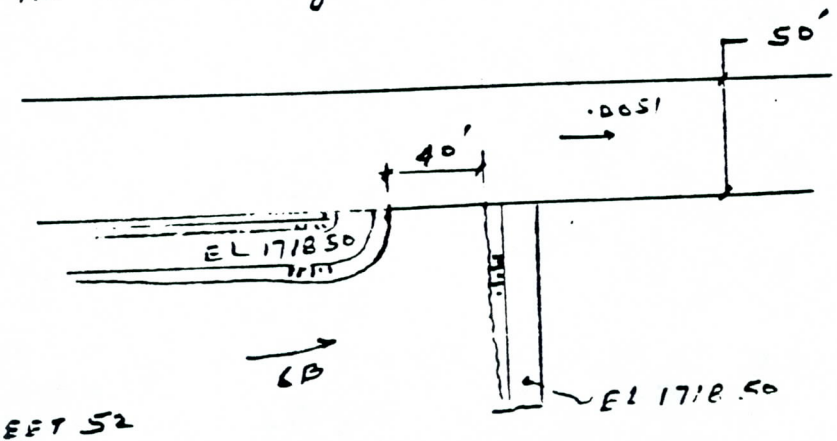
$= 5.19$

Conjugate depth for the main channel

$= 4 \times \frac{1}{2} \left(\sqrt{1 + 8 \times 1.423^2} - 1 \right)$

$= 6.29 < (5.83 + 1)$

∴ The location of the weir at 6.83' is alright



SEE SHEET 52

PLAN 6C

EBASCO SERVICES INCORPORATED

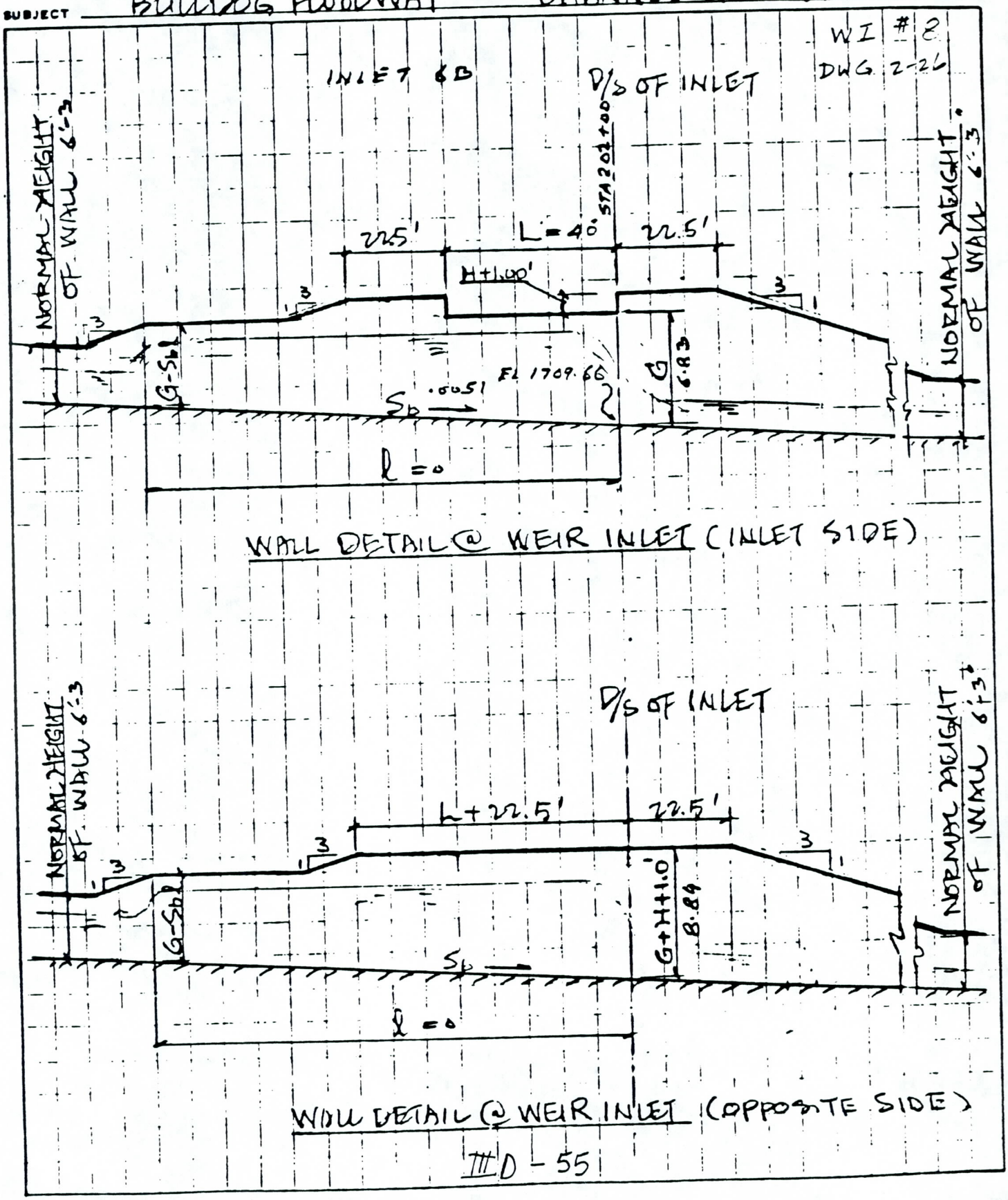
BY Y.C. YANG DATE 9-30-85 S.G.YAL 12/2/85 SHEET 52 OF 54

CHKD. BY S.G.Yal DATE 10-1-85 N. Hung 1/23/86 OFS NO. 3767.203 DEPT. NO. 1650

CLIENT USDA.

PROJECT BULLDOG FLOODWAY & APACHE JTN FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — CHANNEL WALL DETAIL



III D - 55

CHANNEL STA 202+00 TO 203+00

$Q = 4674 \quad b = 50' \quad S = .0051$

$d = 5.063$

Use 6:3" walls as U/S STA 202+00

BED EL = $1709.66 - [203{+}00 - 202{+}00] \times .0051$

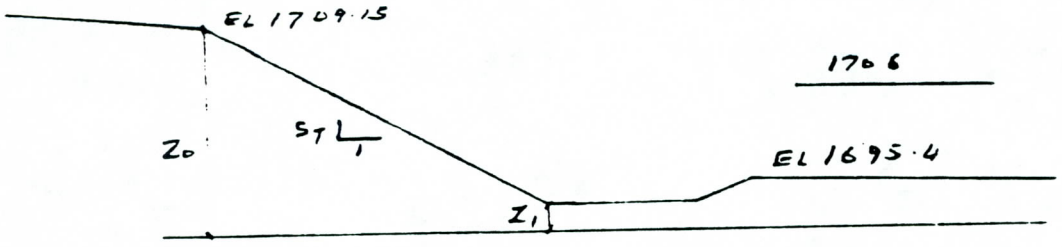
$= 1709.15$

DROP STRUCTURE STA 203+00

$Q = 4674$ $b_0 = 50'$ $d_0 = 5.063$ $A_0 = 253.15$

$V_0 = 18.46$ fps

$F_0 = 1.446$ $S_0 = .0051$



From H.E. CIRCULAR NO 14 US DOT (III-B-9)

$$4674 = 120 y_1 \left[2g\left(Z_0 - Z_1 + 5.063 - y_1\right) + 18.46^2\right]^{1/2}$$
$$= 120 y_1 \left[64.4\left(1709.15 - 1694.4 + 5.063 - y_1\right) + 340.77\right]^{1/2}$$

for $y_1 = .99$ $Q = 4681.6$ O.K

$$V_1 = \frac{4674}{9.9 \times 120} = 39.34$$

$F_1 = 6.97$

$$y_2 = \frac{.99}{2}\left[\sqrt{1 + 8F^2} - 1\right] = 9.27$$

$y_2 + Z_1 = 1694.4 + 9.27 = 1703.67 < 1706$ O.K

$$W_B = W_0 + 2\frac{Z_0 - Z_1}{3 \times S_T}\sqrt{S_T^2 + 1}$$

$$\text{or } 120 = 50 + 2\frac{\times (1709.15 - 1694.4)}{3 \times 1.446}\sqrt{\frac{S_T^2 + 1}{S_T^2}}$$

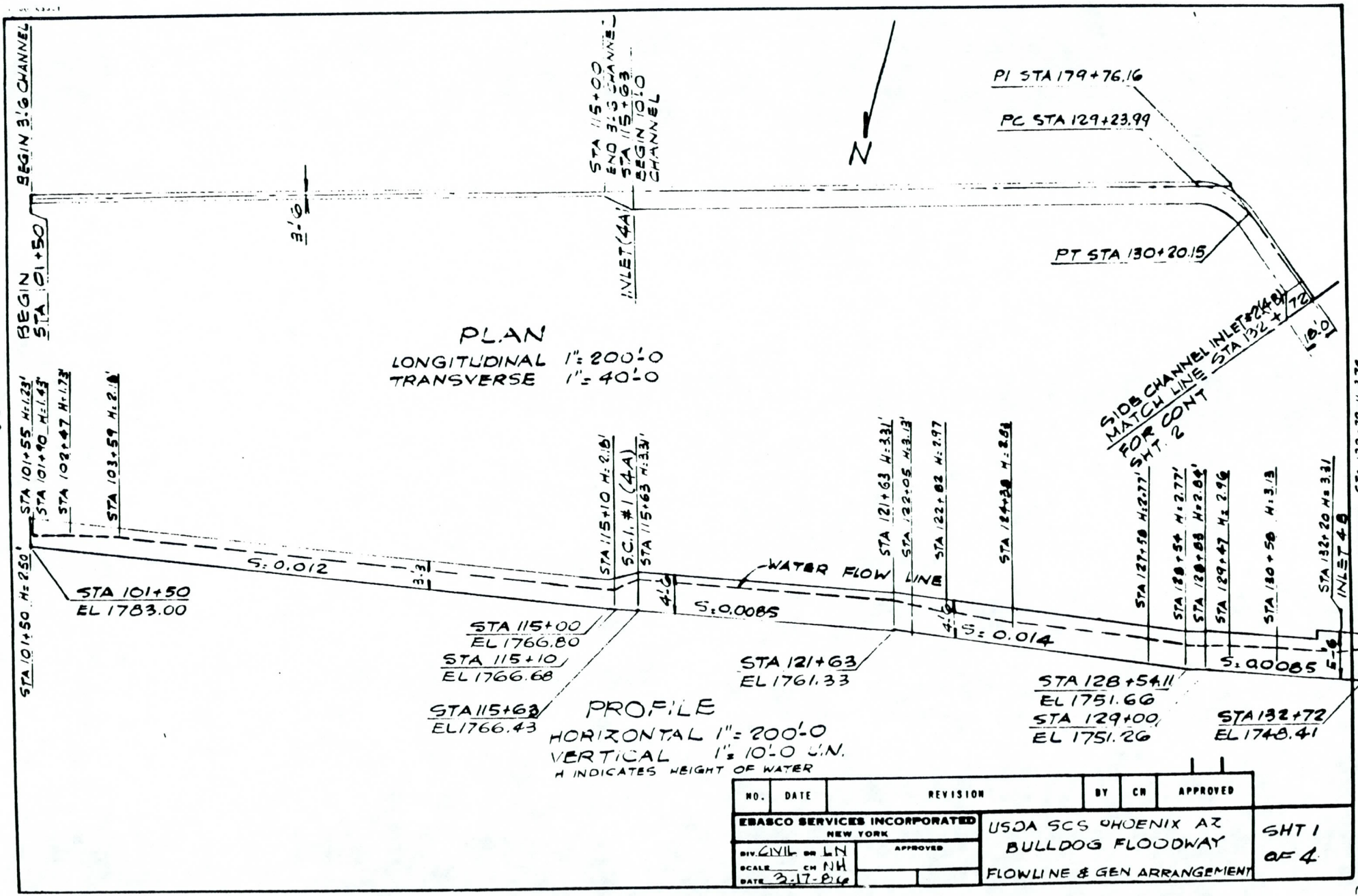
$$\text{or} \quad S_T = .0976$$

$L_T = (Z_0 - Z_1)/S_T = 151.1$ say 150'

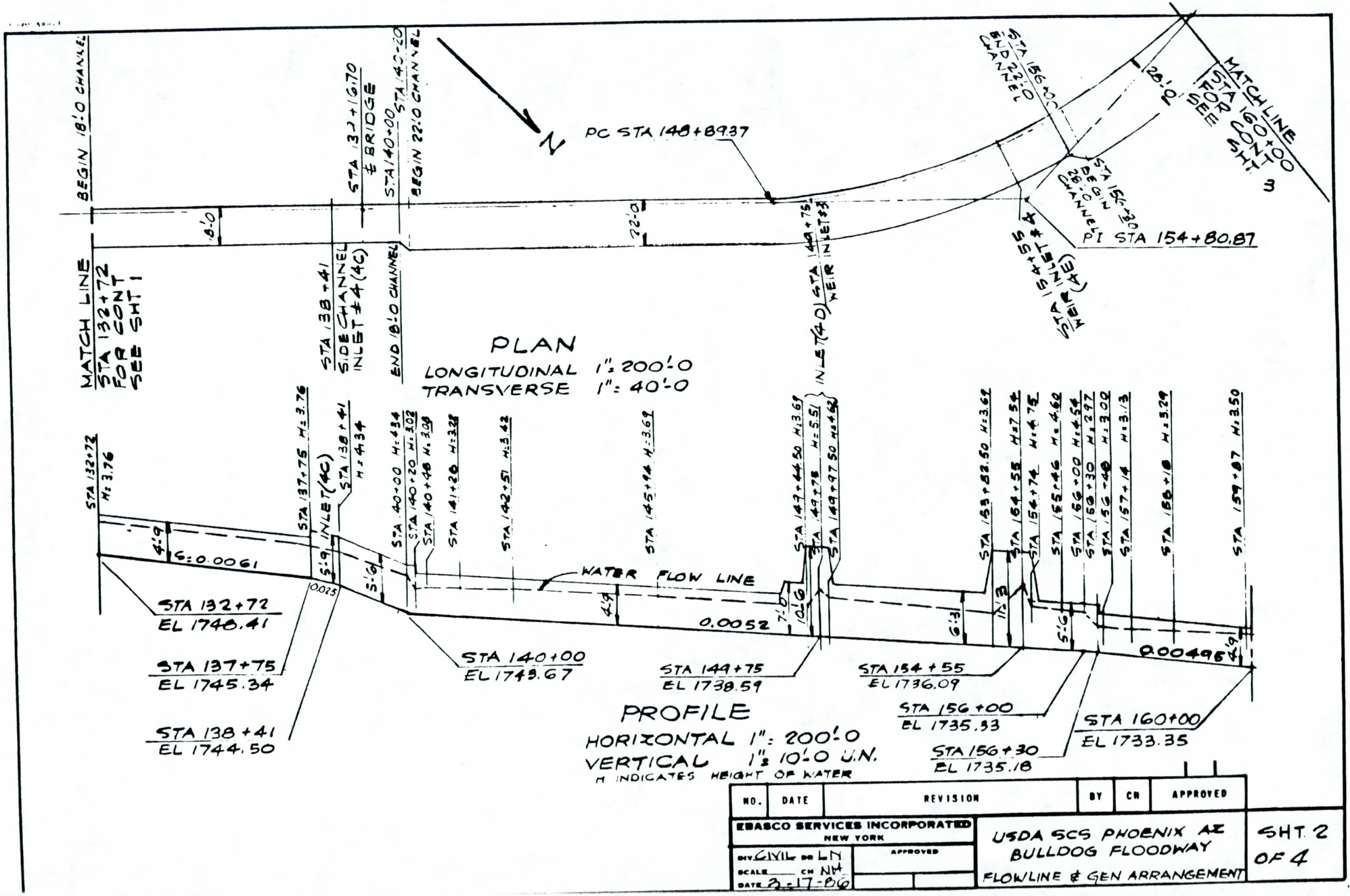
III D-57

For $F_1 = 6.97$ Length of Jump $= 6.1 \times 9.27 = 56.5$ say 55'

The drop design in Phase I can be used with change in S_T


BEGIN 3'-6" CHANNEL
BEGIN STA 101+50
STA 115+00 END 3'-6" CHANNEL
STA 115+63 BEGIN 10'-0 CHANNEL
N
PI STA 179+76.16
PC STA 129+23.99
PT STA 130+20.15
3'-6"
INLET (4A)
PLAN
LONGITUDINAL 1"= 200'-0
TRANSVERSE 1"= 40'-0
S108 CHANNEL INLET STA 132+72
MATCH LINE FOR CONT SHT. 2
10'-0"
STA 101+50 H=2.50'
STA 101+55 H=1.23'
STA 101+90 H=1.43'
STA 102+47 H=1.73'
STA 103+59 H=2.1'
STA 115+10 H=2.15'
S.C.I. #1 (4A)
STA 115+63 H=3.33'
STA 121+63 H=3.31'
STA 122+05 H=3.13'
STA 122+82 H=2.97
STA 124+28 H=2.81
STA 127+58 H=2.77'
STA 128+54 H=2.77'
STA 128+88 H=2.84'
STA 129+42 H=2.96
STA 130+58 H=3.13
STA 132+20 H=3.31
STA 132+72 H=3.78
INLET 4B
S=0.012
3:1
4:1
S=0.0085
WATER FLOW LINE
S=0.014
S=0.0085
5:1
STA 101+50
EL 1783.00
STA 115+00
EL 1766.80
STA 115+10
EL 1766.68
STA 115+63
EL 1766.43
STA 121+63
EL 1761.33
STA 128+54.11
EL 1751.66
STA 129+00
EL 1751.26
STA 132+72
EL 1748.41
PROFILE
HORIZONTAL 1"= 200'-0
VERTICAL 1"= 10'-0 U.N.
H INDICATES HEIGHT OF WATER
NO. DATE REVISION BY CH APPROVED
EBASCO SERVICES INCORPORATED NEW YORK
DIV. CIVIL DR LZ
SCALE CH NH
DATE 3-17-81
APPROVED
USDA SCS PHOENIX AZ
BULLDOG FLOODWAY
FLOWLINE & GEN ARRANGEMENT
SHT 1 OF 4

III D-58


BEGIN 18'-0 CHANNEL
STA 132+72
MATCH LINE
STA 132+72 FOR CONT SEE SHT 1
18'-0
STA 138+41
SIDE CHANNEL INLET #4(4C)
STA 137+75 H=3.76
STA 138+41 H=4.34
STA 132+72 H=3.76
INLET(4C)
END 18'-0 CHANNEL
STA 137+75
STA 140+00
BEGIN 22'-0 CHANNEL
STA 140+00 H=4.34
STA 140+20 H=3.02
STA 140+48 H=3.09
STA 141+20 H=3.28
STA 142+51 H=3.42
STA 145+14 H=3.69
PC STA 148+89.37
N
22'-0
STA 147+44.50 H=3.69
STA 147+75 INLET #3
INLET(4D) STA
WEIR
STA 149+97.50 H=4.62
STA 149+78 H=5.51
STA 153+82.50 H=3.62
STA 154+55 H=7.54
STA 154+74 H=4.75
STA 155+46 H=4.62
STA 156+00 H=4.54
STA 156+30 H=2.97
STA 156+48 H=3.02
STA 157+14 H=3.13
STA 158+18 H=3.29
STA 159+87 H=3.50
STA 156+00
BEGIN 22'-0 CHANNEL
STA 155+55 INLET #4
STA INLET (4E) WEIR
STA 154+80.87
PI STA 154+80.87
28'-0
STA 154+30
BEGIN 28'-0 CHANNEL
MATCH LINE STA 160+00 FOR CONT SEE SHT 3
4:1
S=0.0061
5:1
5:1
10.0%
WATER FLOW LINE
4:1
7'-0
10'-0
0.0052
6:1
11:3
5'-0
0.00496
4:1
STA 132+72
EL 1748.41
STA 137+75
EL 1745.34
STA 138+41
EL 1744.50
STA 140+00
EL 1743.67
STA 149+75
EL 1738.59
STA 154+55
EL 1736.09
STA 156+00
EL 1735.93
STA 156+30
EL 1735.18
STA 160+00
EL 1733.35
PLAN
LONGITUDINAL 1": 200'-0
TRANSVERSE 1": 40'-0
PROFILE
HORIZONTAL 1": 200'-0
VERTICAL 1" = 10'-0 U.N.
H INDICATES HEIGHT OF WATER
NO. DATE REVISION BY CH APPROVED
EBASCO SERVICES INCORPORATED NEW YORK
DIV. CIVIL DR LZ
SCALE CH NZ
DATE 3-17-86
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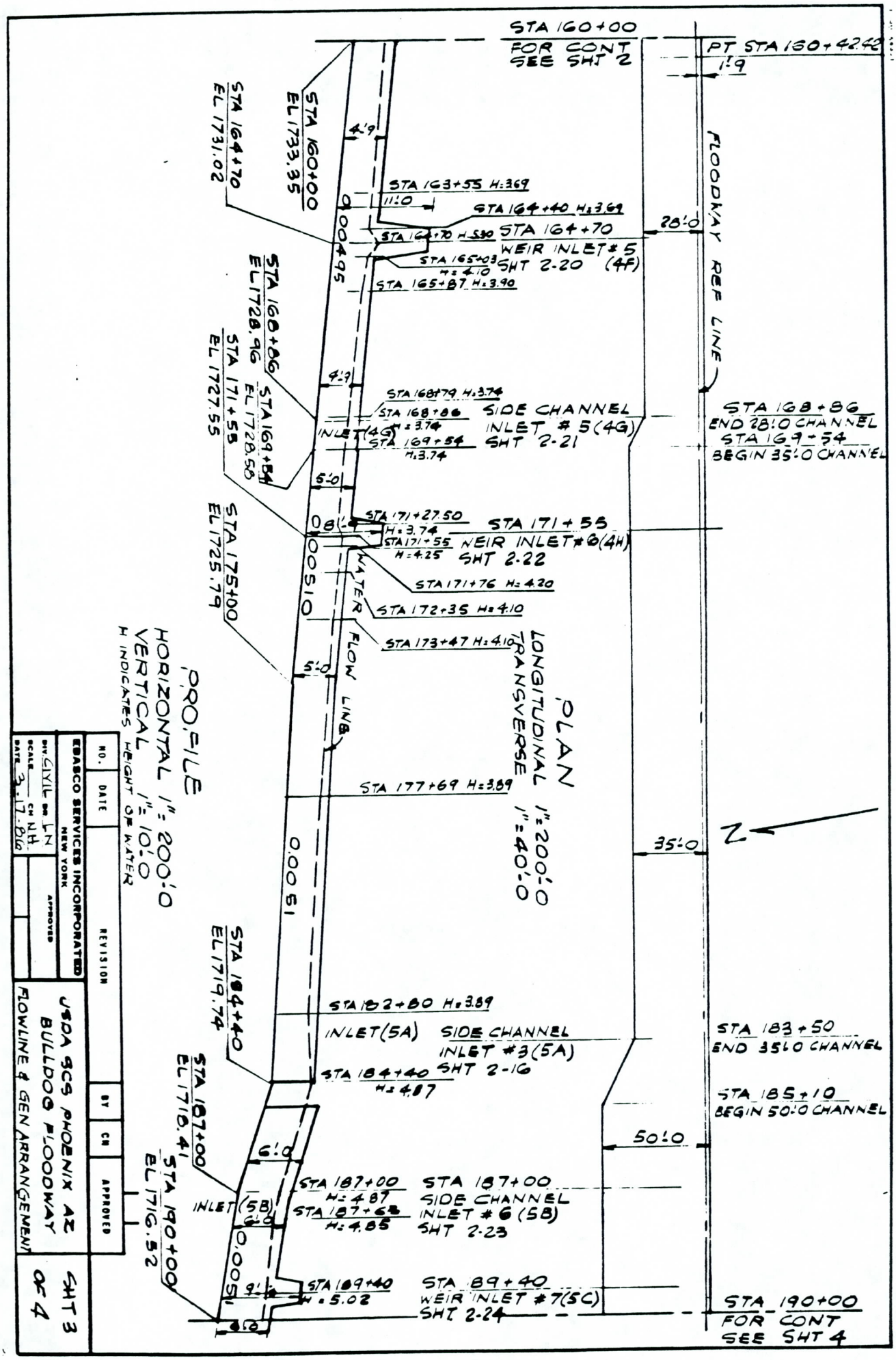
USDA SCS PHOENIX AZ
BULLDOG FLOODWAY
FLOWLINE & GEN ARRANGEMENT
SHT 2 OF 4

III D-59

09-Q III



EBASCO SERVICES INCORPORATED
NEW YORK

NO.	DATE	REVISION	BY	CH	APPROVED

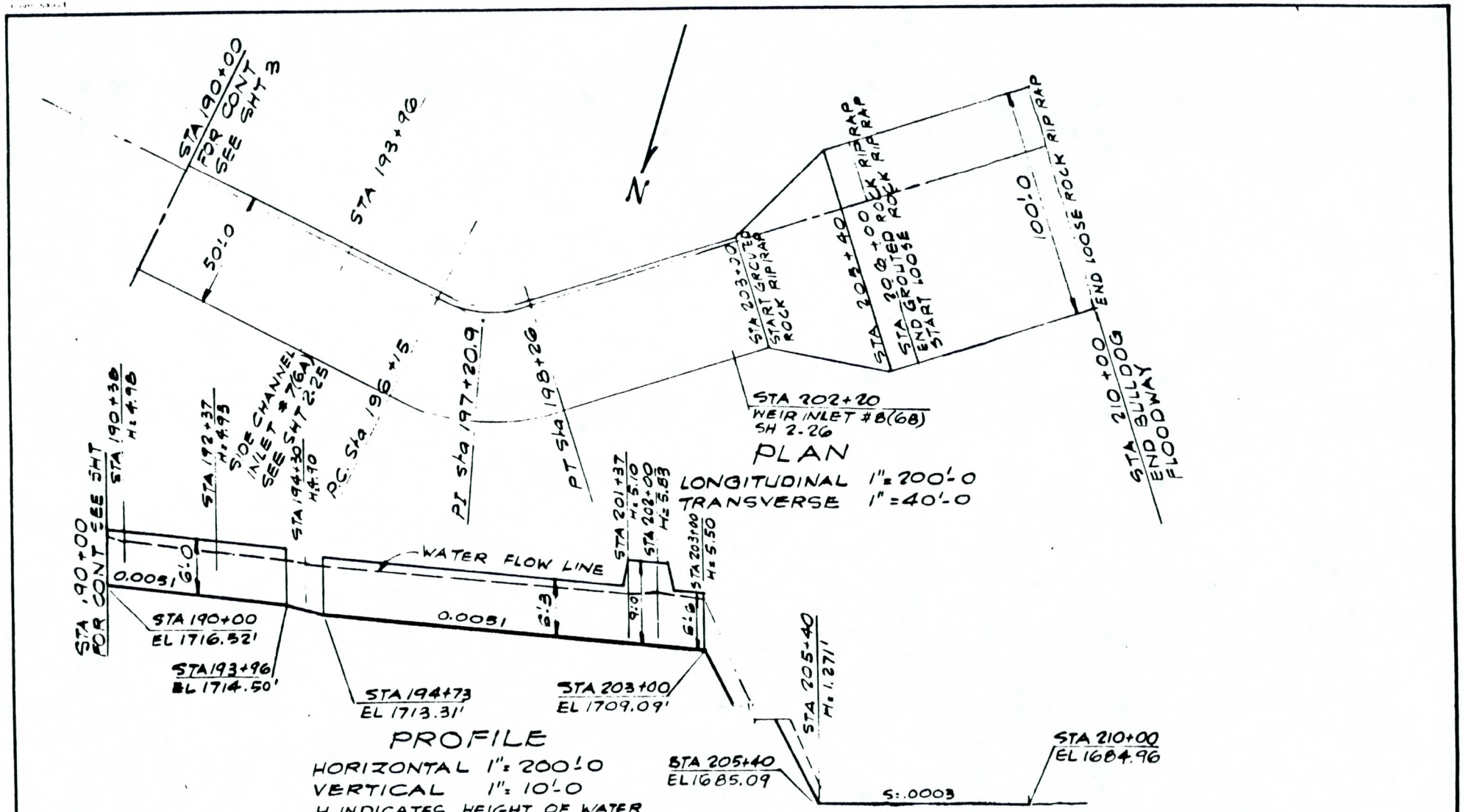
DRY GYLK SH LN
SCALE CH N.H.
DATE 3-17-81G

APPROVED

USDA SCS PHOENIX AZ
BULLDOG FLOODWAY
FLOWLINE & GEN ARRANGEMENT

SHT 3 OF 4

19-D III



NO.	DATE	REVISION	BY	CH	APPROVED

EBASCO SERVICES INCORPORATED
NEW YORK

DIV. CIVIL DR. LN
SCALE ____ CH NH
DATE 3-17-86
APPROVED

USDA SCS PHOENIX AZ
BULLDOG FLOODWAY
FLOWLINE & GEN ARRANGEMENT

SHT 4
OF 4

BY S GOYAL DATE 1-15-86 SHEET 1 OF 15

CHKD. BY ____ DATE ____ OFS NO. USDA 3767 3 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

$$S_2 = \left[\frac{v_2 n}{1.486 R_2^{2/3}}\right]^2 = .0557$$

$$S_3 = \left[\frac{v_3 n}{1.486 R_3^{2/3}}\right]^2$$

$$S_{av} = \frac{S_2 + S_3}{2}$$

$$He_3 = He_2 + S_b l - S_{av} l$$ Neglecting expansion losses

$$\therefore l = \frac{He_2 - He_3}{S_{av} - S_b}$$

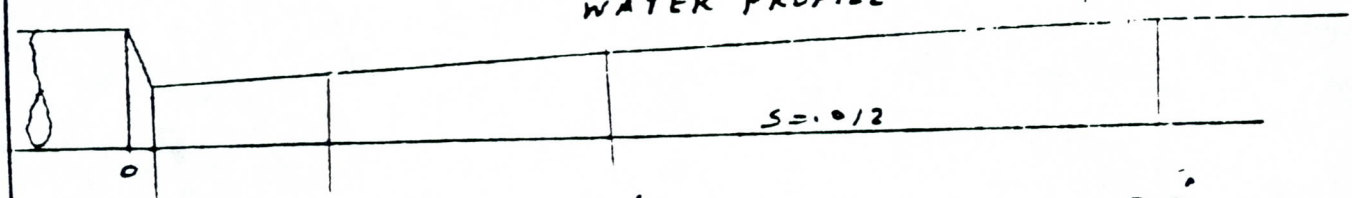
Working in steps of He

He_3 =	6.72	5.5	4.5
Assumed He_3 =	5.5	4.5	3.94
Assumed d_3 =	1.43	1.73	2.18
(by trial) v_3 =	16.18	13.38	10.64
$\therefore$ CHECK He_3 =	5.5	4.51	3.94
S_3 =	.0367	.0220	.012
S_2 =	.0557	.0367	.022
S_{av} =	.0462	.0294	.017
l =	35'	57'	112'

$\therefore$ Length of curve is approximately

$35 + 57 + 112 = 204'$

WATER PROFILE



BY S GOYAL DATE 1-15-86 SHEET 2 OF 15

CHKD. BY _____ DATE _____ OFS NO. USDA 3767.3 DEPT. NO. 550

CLIENT USDA - SCS - PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY AND APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

WATER PROFILE CHANGE IN SLOPE AT STA 121+63

S = .0085 | S = .014

Q = 478

d = 3.31

b = 10'

v = 14.44

$He = \frac{v^2}{2g} + d = 6.548$

d = 2.77

b = 10'

v = 17.256

He = 7.394

	He_1	6.548	6.75	7.0	7.25	7.394
Assumed	He_2	6.75	7.00	7.25	7.394	
Assume	d_2	3.13	2.965	2.835	2.77	
∴	v_2	15.27	16.12	16.86	17.256	
CHECK	He_2	6.76	7.00	7.25	7.394	
	S_2	.0099	.0116	.0131	.014	
	S_1	.0085	.0099	.0116	.0131	
	S_{av}	.0092	.01075	.0124	.01355	
$\ell = \frac{He_2 - He_1}{S_b - S_{av}}$, ℓ		42'	77'	156'	320'	

Length of curve approximately is equal to 595'

WATER PROFILE

S = .0085			S = .014	
L	0	42	119	275
d	3.31	3.13	2.965	2.835

S

2

BY S GOYAL DATE 1-15-86 SHEET 3 OF 15

CHKD. BY _____ DATE _____ OFS NO. USDA 376730 DEPT. NO. 550

CLIENT USDA - SCS - PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY AND APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS OUTLET CHANNEL & BULLDOG FLOODWAY

WATER PROFILE CHANGE IN SLOPE AT STA 128+54.11

S = .014 | S = .0085

Q = 478
d = 2.77
b = 10
v = 17.256

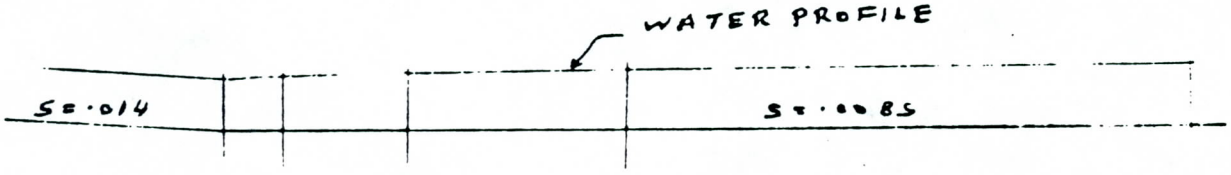
Q = 478
d = 3.31
b = 10'
v = 14.44

$He = \frac{v^2}{2g} + d = 7.394$

He = 6.548

	He_1	7.394	7.25	7.00	6.75
Assumed	He_2	7.25	7.00	6.75	6.548
Assumed	d_2	2.835	2.965	3.13	3.31
∴	v_2	16.86	16.12	15.27	14.41
Check	He_2	7.25	7.00	6.75	6.548
	S_2	.0131	.0116	.0099	.0085
	S_1	.014	.0131	.0116	.0099
	S_{av}	.01355	.0124	.01075	.0092
$\ell = \frac{He_1 - He_2}{S_{av} - S_b}$	ℓ	29'	64'	111	286'

length of curve approximately is equal to 490'



L 0 29 93 204 490

d 2.77 2.835 2.965 3.13 3.31

BY S GOYAL DATE 1-15-86 SHEET 4 OF 15

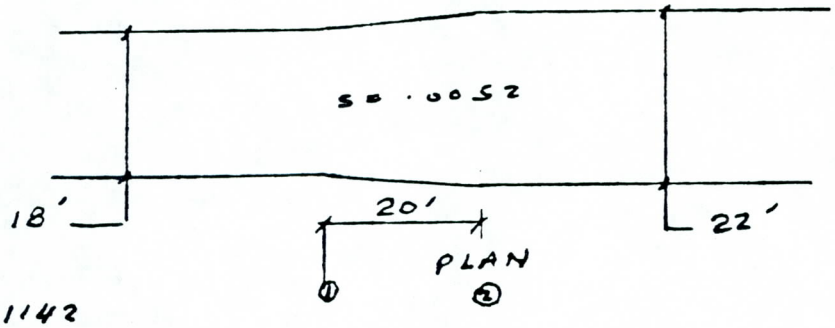
CHKD. BY ____ DATE ____ OFS NO. USDA 3767 3rd DEPT. NO. 550

CLIENT USDA · SCS - PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY

WATER PROFILE TRANSITION AT STA 140+00



Q = 1142
b = 18'
d = 4.34
v = 14.62
He = 7.66

Neglect expansion loss

Q = 1142
b = 22'
d = 3.69
v = 14.07
He = 6.76

$He_2 = He_1 + S_b \times 20 - S_{av} \times 20 = He_1 - (S_{av} - S_b)20$

$S_1 = .0052$

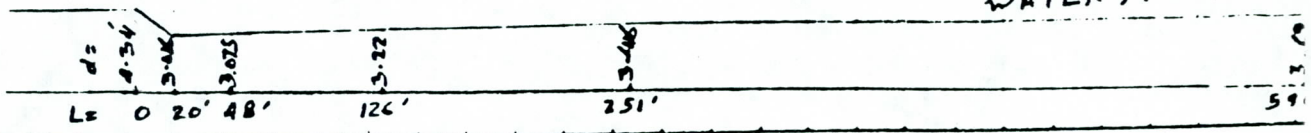
Assume $He_2 = 7.615$ ∴ $d_2 = 3.016$; $v_2 = 17.21$ $He_2 = 7.616$ o.k

$S_2 = \left[\frac{v_2 n}{1.486 R_2^{2/3}}\right]^2 = .0096$ $S_{av} = .0074$

∴ $He_2 = 7.66 - 20(.0074 - .0052) = 7.616$ o.k

	He_1	7.616	7.5	7.25	7.00	6.76
Assumed	He_2	7.5	7.25	7.00	6.76	
Assumed	d_2	3.075	3.222	3.416	3.69	
∴	v_2	16.88	16.11	15.196	14.07	
check	He_2	7.5	7.25	7.00	6.76	
	S_2	.009	.0078	.0066	.0052	
	S_1	.0096	.009	.0078	.0066	
	S_a	.0093	.0084	.0072	.0059	
	l	28'	78'	125'	343'	

WATER PROFILE



BY S GOYAL DATE 1-15-86 SHEET 5 OF 15

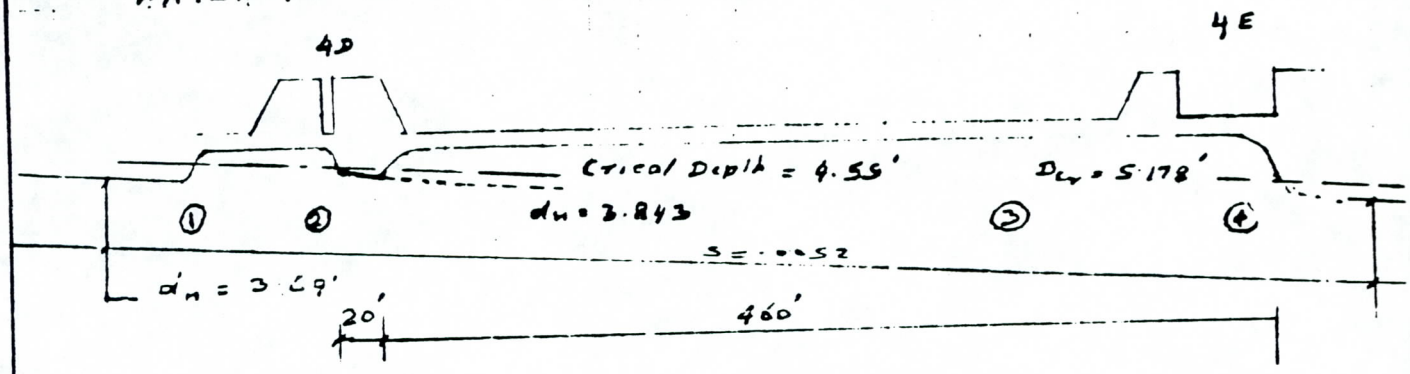
CHKD. BY ____ DATE ____ OFS NO. USDA 3767.300 DEPT. NO. 650

CLIENT USDA - SCS - PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY

WATER PROFILE D/S INLET 4D STA 149+75



Normal depth at 1 = 3.69
conjugate depth at 1 = 5.14
swell at 2 = .37
∴ Depth of water at 2 = 5.51
Depth of water below 2 = 4.62

Q = 1213 b = 22'
S = .0052
d = 3.843 R = 2.848 v = 14.353
v = 14.347 o k

The depth of flow would have reduced to 3.843 before reaching 4E, but the inflow at 4E would cause the flow to swell. This swell may join the swell of 4D

Normal depth at 3 = 3.69'
Conjugate depth at 3 = 5.14'
Swell at 4 = 2.4'
depth of water at 4 = 7.54
Depth of water below 4. = 5.55'

Q = 1471
D_{cr} = 5.178

WATER PROFILE D/S INLET 4E STA 154+55

$Q = 1471$ $b = 8.2'$

$d = 5.55'$ $v = 12.047$

$He = 7.804$

For steep slope the corresponding supercritical depth of flow $d = 4.837$

$v = 13.823$ $S = \left[\frac{vn}{1.486 R^{2/3}}\right]^2 = .00387$

$He = 7.804$ 0.4

He at 45' (STA 155) = $7.804 + .0052 \times 45 - S_{av} \times 45$

He_1	7.804	7.827	7.88
d_1	4.837	4.75	4.6
S_1	0.00387	.00408	.00484
d_2	4.75	4.6	4.54
v_2	14.076	14.536	14.728
He_2	7.827	7.88	7.908
S_2	.00408	.00484	.00466
S_{av}	.00398	.00446	.00476
L	18.85'	71.6'	62.2'

$L = \frac{He_2 - He_1}{(S_o - S_{av})}$

∴ Total Length = 18.85 + 71.6 + 62.2 = 152.69'

Beginning of transition is at (5600 − 1545) = 145

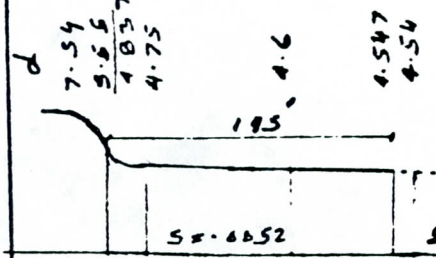
∴ by interpolation depth of flow at Sta 156+00

$= 4.54 + \frac{4.6 - 4.54}{62.2} \times (152.69 - 145)$

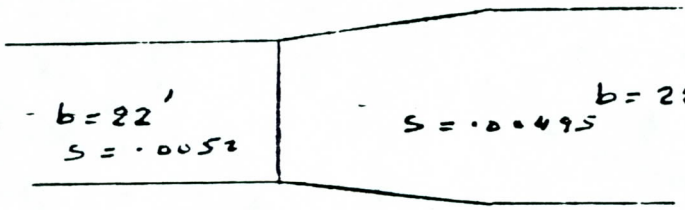
$= 4.547'$

$v = 14.705$

$He = 7.905$



WATER PROFILE D/S TRANSITION STA 156+00



From the calc for d/s inlet 4E

$Q = 1471$

$d = 4.547$

$v_1 = 14.705$

$\therefore S = .00466$

$He_1 = 7.905$

$He_2 = He_1 + S_b L - \Delta H$

Assuming $S_b L - \Delta H = .075$

$He_2 = He_1 - .075$

$= 7.83 = \frac{v_2^2}{2g} + d_2$

$Q = 1471$

$S = .00495$

Assume $d = 3.69$

$\therefore v = \frac{Q}{A} = 14.237$

$v = \frac{1.486}{n} R^{2/3} S^{1/2} = 14.24$ o.k

$He = 6.838$

$\therefore d_2 = 2.97$ $b = 28$

$v_2 = 17.689$ $S = .00965$

$He_2 = 7.827$ o.k

$h_{ex} = .1 \times \frac{(17.689 - 14.705)^2}{2g} = -.014$

$S_b l = .00495 \times 30 = +.1485$

$h_f = \frac{(.00965 + .00466)}{2} \times 30 = -.215$

Net loss $= -.215 - .014 + .1485 = .0805 \simeq .075$

$\therefore$ He at the end of the transition $= 7.905 - .08$

$= 7.825$

say 7.83

BY S GOYAL DATE 1-16-86 SHEET 8 OF 15

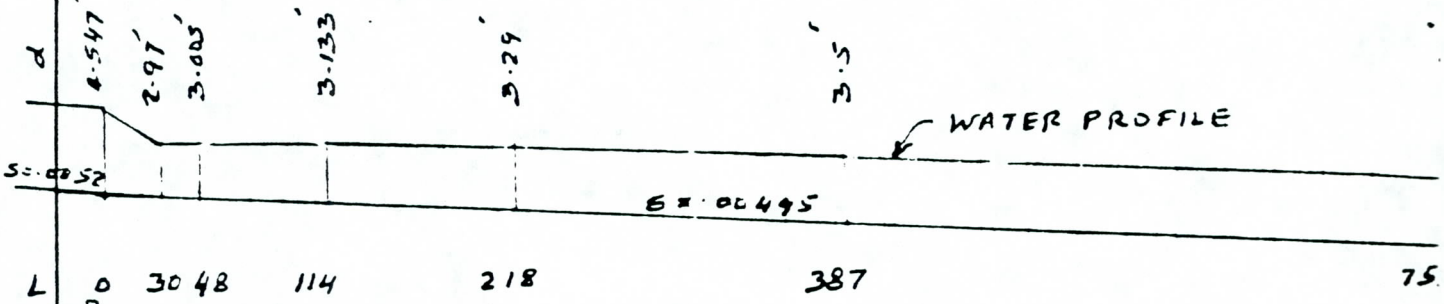
CHKD. BY _____ DATE _____ OFS NO. USDA 3767.3 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY

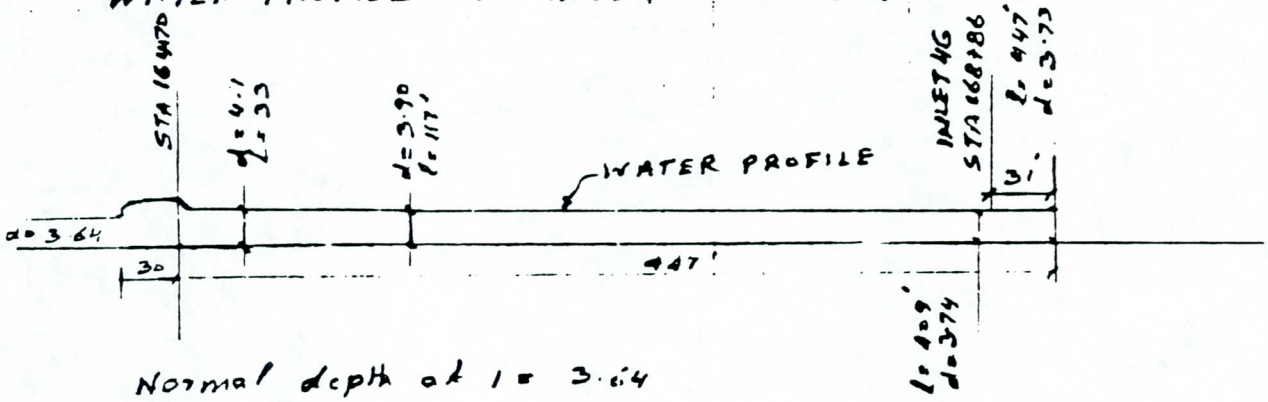
	He_1	7.83	7.75	7.5	7.25	7.00
Assume	He_2	7.75	7.5	7.25	7.00	6.838
"	d_2	3.005	3.133	3.29	3.5	3.69
∴	Z_0	17.483	16.758	15.97	15.01	14.237
check	He_2	7.751	7.494	7.25	7.00	6.838
	S_a	.00431	.00818	.00704	.00587	.00495
	S_1	.00965	.00931	.00818	.00704	.00587
	S_b	.00948	.00875	.00761	.00643	.00539
$\frac{He_1 - He_2}{S_a - S_b}$	l	18'	66'	94'	169'	368'



The water profile is worked out for a discharge of 1471 cfs (discharge in channel equal to sum of $Q_1 + Q_2$). The maximum flow in the channel is 1441 which will give a slightly lower profile. d_n for 1441 cfs flow is 3.64' instead of 3.69' for a flow of 1471 cfs.

The flow will be a normal flow before reaching inlet 4F

WATER PROFILE D/S INLET 4F STA 164+70



Normal depth at 1 = 3.64

Conjugate depth = 5.145

Swell at 2 = 0.15

∴ Depth of water at 2 = 5.295

Depth of water below 2 = 4.48'

$Q = 1497$ $b = 28'$

$S = .00495$

For normal flow $d = 3.73$ $R = 2.95$ $v = \frac{1.486}{n} R^{2/3} S^{1/2} = 14.32$

check $v = 14.33$ ok

$He = \frac{v^2}{2g} + d = 6.919$

Just below 2 $d = 4.48$ $v = 11.93$ $l = \frac{H_2 - He_1}{S_b - S_{av}}$

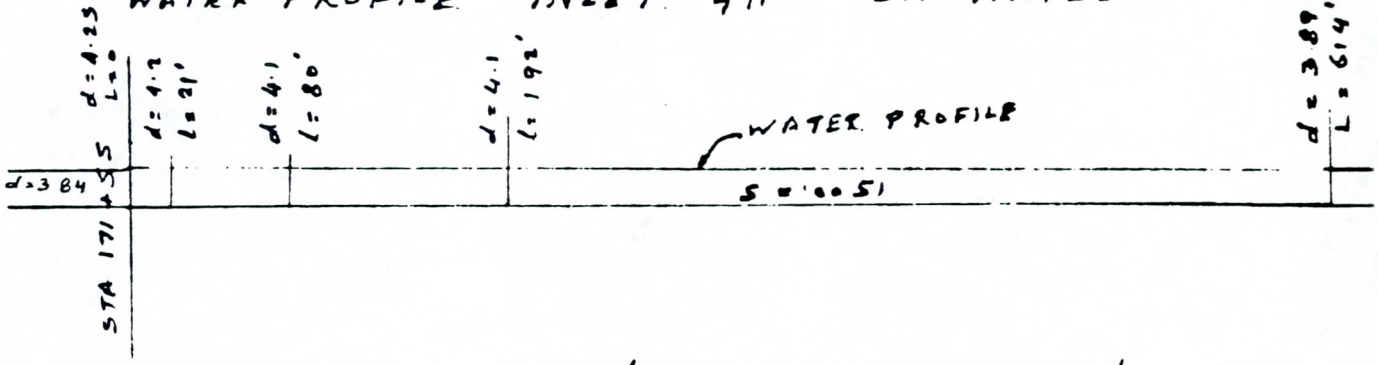
∴ $He = 6.69$ $S_b = .00495$

$d_{cr} = 4.46$ $v_{cr} = 11.99$ $He_{d_n} = 6.69$

	He_1	6.69	6.693	6.700	6.74 →	6.818	6.818
	d_1	4.46	4.40	4.30	4.10	3.90	3.7
	S_1	.00288	.00300	.00322	.00372	.004329	.004329
Assume	d_2	4.40	4.30	4.10	3.90	3.73	3.74
∴	v_2	12.15	12.434	13.04	13.709	14.33	14.295
∴	He_2	6.673	6.700	6.74	6.818	6.92	6.9132
∴	S_2	.00300	.00322	.00372	.004329	.00496	.0049/8
and	S_{av}	.00294	.00311	.003469	.004024	.00464	.0046236
∴	l	1.49'	4.09'	27.30'	84.46'	324.8'	291.6
	Σl	1.49	5.58	32.88	117.34	447.14	408.9

The water surface profile reached normal flow at a distance of 447' from the inlet 4F whereas the inlet 4G is at a distance of 416 ft. The flow at the inlet 4G will be very close to the normal flow. The depth of flow is 3.74' ≈ 3.75' (normal depth) about 7ft (416-409) u/s of the inlet. The effect will be negligible.

WATER PROFILE INLET 4H · STA 171+55



$Q = 2085$ $b = 35'$ $S = .0051$ $d = 3.89$

$H_c = 7.53$

$d = 4.25$ Just below inlet (Page 31)

$v = 14.017$

$H_e = 7.30$ $\quad l = \frac{H_2 - H_1}{S_b - S_w}$ $\quad S = \left[\frac{vn}{1.486 R^{2/3}}\right]^2$

$S_b = .0051$

	H_{e_1}	7.30	7.324	7.378	7.444
	d_1	4.25	4.2	4.1	4.0
	S_1	.003886	.00403	.00434	.00468
Assume	d_2	4.2	4.10	4.00	3.89
	v_2	14.184	14.529	14.893	15.31
	H_{e_2}	7.324	7.378	7.444	7.531
	S_2	.00403	.00434	.00468	.0051
	S_w	.003958	.004185	.00451	.00489
	l	20.9	59.1	118.3	421.6
	Σl	20.9	80.0	198.3	613.9

The next inlet SA is at STA 182+80

BY S GOYAL DATE 1-23-86 SHEET 12 OF 15

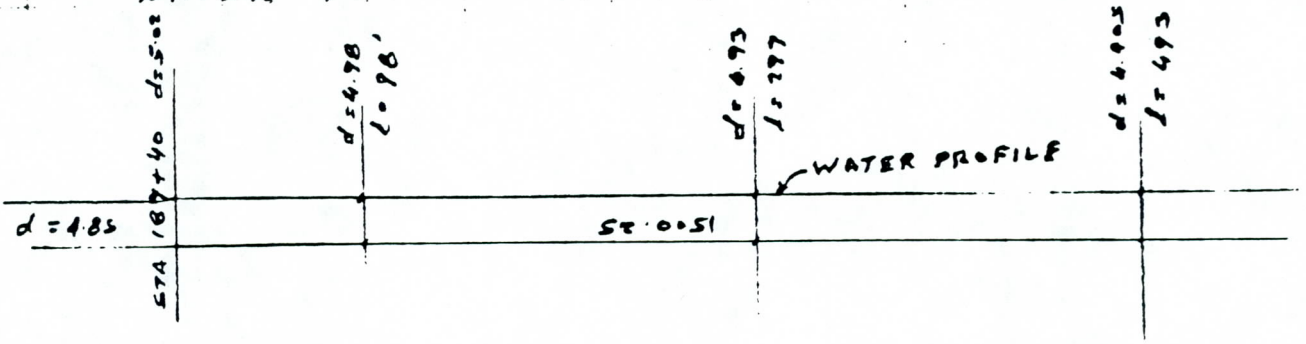
CHKD. BY _____ DATE _____ OFS NO. USDA 3767-300 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY AND APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY

WATER PROFILE INLET SC STA 189+40



$Q = 4405$ $b = 50'$ $S = .0051$ $d_c = 4.876$ $H_c = 9.945$

$d = 5.02$ just below the inlet (page 43)

$v = 17.5498$

$H_c = 9.8025$

$S_b = .0051$

$l = \frac{H_2 - H_1}{S_b - S_{av}}$ $S = \left[\frac{VN}{1.486 R^{2/3}}\right]^2$

	H_{c_1}	9.8025	9.83967	9.88875	9.88875	9.88875
	d_1	5.02	4.98	4.93	4.93	4.93
	S_1	.00466	.004777	.0049297	.0049297	.0049297
Assume	d_2	4.98	4.93	4.876	4.90	4.905
	v_2	17.6907	17.87018	18.068	17.9796	17.96
	H_{e_2}	9.83967	9.88875	9.945	9.91965	9.9144
	S_2	.004777	.0049297	.005102	.0050249	.0050085
	S_{av}	.0047186	.0048523	.0050158	.0049773	.0049692
	l	97.5'	199'	670'	251	196'
	Σl	97.5	296.5	966.5	548	493

The depth of flow at Inlet 6A at a distance of 490' (STA 194+30) will be 4.905' whereas the normal depth is 4.876' for a discharge of 4405 cfs. The difference is only .029' fraction of an inch and only .6% of the depth. This is negligible and effect on Inlet 6A should be negligible.

BY SGOYAL DATE 1-23-86 SHEET 13 OF 15

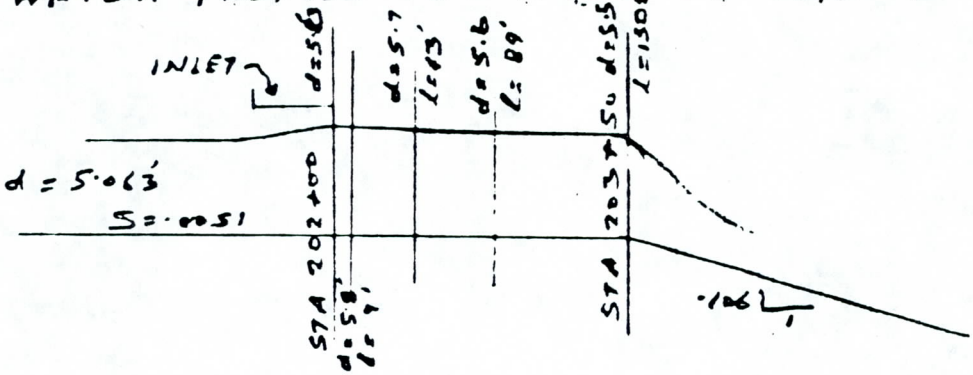
CHKD. BY _____ DATE _____ OFS NO. USDA 3767.300 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY

WATER PROFILE AT INLET 6B STA 202+00



$Q = 4796$ $b = 50'$ $S_f = .0051$ $d_c = 5.15$ $H_c = 10.537$

$d = 5.83'$ just below H_c inlet (page 50)

$v = 16.453$

$H_e = 10.033$ $L = \frac{H_{e2} - H_{e1}}{S_b - S_{av}}$ $S = \left[\frac{vn}{1.486 R^{2/3}}\right]^2$

$S_b = .0051$

	H_{e1}	10.033	10.0469	10.0973	10.1557
	d_1	5.83	5.8	5.7	5.6
	S_1	.003476	.003504	.0037266	.003936
Assume	d_2	5.8	5.7	5.6	5.5
	v_2	16.538	16.83	17.179	17.44
	H_{e2}	10.0469	10.0973	10.1557	10.2229
	S_2	.003532	.0037266	.002936	.0041613
	S_{av}	.003504	.0036293	.0038315	.0040486
	L	8.7'	34	46	64
	El	9'	43'	89'	153'

∴ The depth of flow at the beginning of the energy dissipator slope would be 5.5' & normal depth 5.15 and the total energy would be 10.22' instead of 10.537. The difference is very small to cause any significant effect on the energy dissipator design.

III D-74

ENERGY DISSIPATOR WATER PROFILE

Incoming flow

$Q = 4674$

$b = 50'$

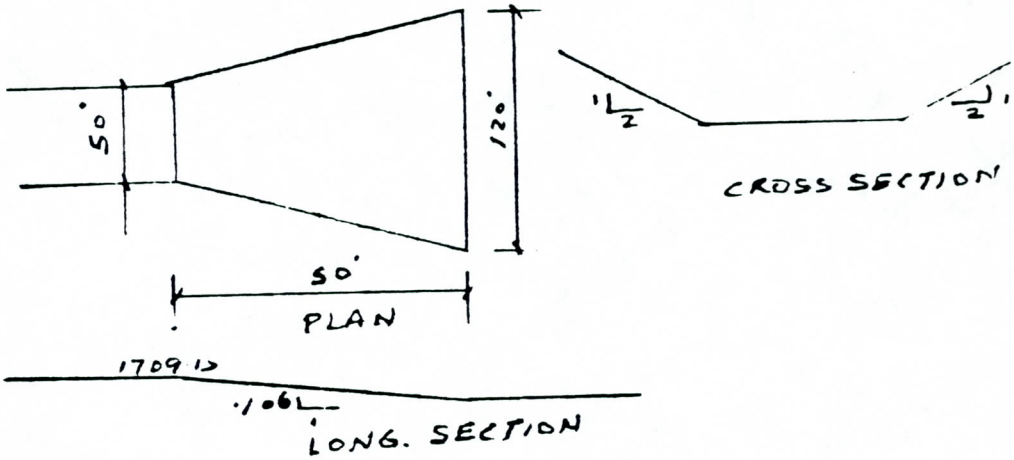
$S = .0051$

$n = .015$

$d = 5.063$ $\quad v = 18.46$

$He = d + \frac{v^2}{2g} = 10.354$

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
He_2	10.30	9.839	9.945	9.923	9.902
ΔHe_{exp}	1.01	.347	.503	.472	.440
He_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 $n = .02 \quad S = .01238 \quad He = 10.354 - .44 = 9.914$

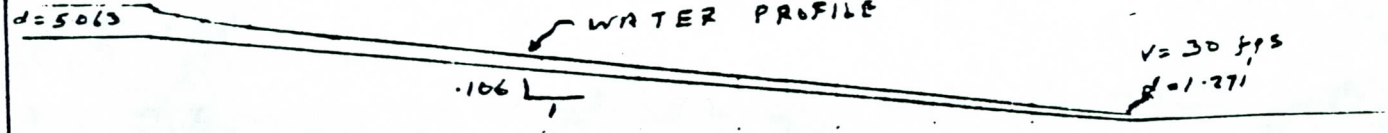
Neglecting the effect of slope on normal and vertical depths of flow

$S_o = .106$ $n = .02$ $Q = 4674$

$S = \left[\frac{Vn}{1.086 R^{2/3}}\right]^2$; $He = H_{e_1} - S_{av} L + \Delta Z$; $He = \frac{v^2}{2g} + d$

L	b	Assumed d	A	V	R	S_1	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	573	9.90	
7.5	53.5	3.64	221.24	21.13	3.17	.01236	.0199	.11	795	10.595	6.93	10.57	0
15	57	3.24	205.68	22.73	2.897	.02286	.0201	.15	795	11.24	8.02	11.26	0
38	64	2.69	180.63	25.04	2.454	.03431	.0286	.43	1.59	12.40	9.74	12.43	0
45	71	2.32	175.48	26.63	2.158	.0461	.04402	.60	1.59	13.39	11.02	13.34	0
60	78	2.03	166.58	28.06	1.913	.060	.0531	.80	1.59	14.18	12.22	14.25	0
75	85	1.825	161.79	28.89	1.737	.072	.0662	.10	1.59	14.78	12.96	14.79	0
90	92	1.66	158.23	29.54	1.59	.085	.0785	1.18	1.59	15.19	13.55	15.21	0
105	99	1.53	156.15	29.93	1.475	.0966	.0908	1.36	1.59	15.42	13.91	15.44	0
120	106	1.427	155.33	30.09	1.38	.1065	.1016	1.523	1.59	15.486	14.06	15.486	0
135	113	1.343	155.366	30.08	1.3055	.1149	.1107	1.66	1.59	15.416	14.05	15.396	0
150	120	1.271	155.75	30.01	1.239	.12256	.1187	1.78	1.59	15.22	13.98	15.25	0

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.



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*          FLOW PROFILES             *
*                                    *
*           CALCULATION              *
*                                    *
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*          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             *
*                                    *
*           CALCULATION              *
*                                    *
*                                    *
*                                    *
*          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            *
*                                    *
*            CALCULATION             *
*                                    *
*                                    *
*                                    *
*           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

VELOVITY = 5466/1394 = 3.92 fps OK

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

67

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 (M) DATE 9/5/85 DEPT. NO.
OFS 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

EBASCO SERVICES INCORPORATED

BY CJM DATE 8-19-85 SHEET 2Y OF ____

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

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT MANNING'S "n" for earth 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

D.27

EBASCO SERVICES INCORPORATED

BY CSM DATE 8/28 SHEET 29 OF
CHKD. BY (Y) 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: $\nu = 1.22 \times 10^{-5}$
$e = 1.938$

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

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

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 $b/d = 8$ $Z = 3$

$\tau_s = 0.046\ (1.15) = .053$
$\tau_b = 0.046\ (1.30) = .060$

581/B-81

EBASCO SERVICES INCORPORATED

BY SM DATE 8/28 SHEET 30 OF ____

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

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

T_{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_{95} < .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

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/28/85
CHKD. BY ⌀ DATE 9/5/85
SHEET 31 OF _____
OFS NO. _____ DEPT. NO. _____
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 : $\nu = 1.22 \times 10^{-5}$

$e = 1.938$

$$\therefore \frac{v^3}{g \nu S_e} = \frac{3.92^3}{32.2(1.22\times10^{-5})(.0003)} = 5.11 \times 10^8$$

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

From Fig 69 : $V/\sqrt{T/e} = 21.7$

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

$b/d = 100/10.6 = 9.4$

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

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

Allowable = 0.1 SEE previous calc.

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

EBASCO SERVICES INCORPORATED

BY CJM DATE 2/20/86 SHEET 1 OF 45

CHKD. BY GM DATE 3/5/86 OFS NO. DEPT. NO.

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway

SUBJECT Change In Design Of Baffle Chute

On 2/20/86 I received a call from Don Paulus regarding the fact that the borrow area for Signal Butte will extend very close to the grouted riprap energy dissipator at the end of Bulldog Floodway. The floor of the completed borrow area will be approximately 10 feet below the present grade and therefore about 10 feet below the present grade of the earth exit channel from the chute. We discussed possible solutions and agreed that there were probably two:

(1) Extend the earth channel and add a second drop structure into the borrow area,

(2) Increase the length and drop on the presently proposed structure.

The 2nd alternative was selected:

(1) A check (CALCS. ATTACHED) show there is no change req'd in the rock size,

(2) Less rock will be req'd since there will be only one pool req'd

(3) The length of the earth channel can be reduced by extending the borrow area toward the chute reducing excavation costs.

III D-95

581/8-81

2/45

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**********************************
*                                *
* FLOW PROFILES CALCULATION      *
*        VERSION NO. 1.0         *
*                                *
**********************************
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BULLDOG FLOODWAY
(PROJECT)

SCS
(CLIENT)

CHUTE DESIGN 4674 CFS
(TASK)

3767.400
(CHARGE NUMBER)

2-22-86
(DATE)

BY CARL
(NAME)

SHIAM
(CHECKER)

EBASCO SERVICES INCORPORATED

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 4674 CFS
2-22-86

3/45

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

TOTAL NUMBER OF CROSS-SECTIONS	13
FLOW ALONG MAIN CHANNEL	4674
COMPUTATION STARTS FROM UPSTREAM	1

4/45

INPUT AND OUTPUT

1 DISTANCE AT THIS SECTION 0

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	50
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	5.066
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	=	5.066	NORMAL DEPTH YN	=	2.26064
CRITICAL DEPTH YC	=	5.95402	FROUDE NUMBER F	=	1.29859
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.58692E-03

2 DISTANCE AT THIS SECTION 20

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	55
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	3.51069	NORMAL DEPTH YN	=	2.13957
CRITICAL DEPTH YC	=	5.65281	FROUDE NUMBER F	=	2.13019
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.60991E-03

3 DISTANCE AT THIS SECTION 40

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	60
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	3.0793	NORMAL DEPTH YN	=	2.03404
CRITICAL DEPTH YC	=	5.38418	FROUDE NUMBER F	=	2.40892
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	.0036346

5/4

INPUT AND OUTPUT

4 DISTANCE AT THIS SECTION 60

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	65
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	2.67187	NORMAL DEPTH YN	=	1.94113
CRITICAL DEPTH YC	=	5.14322	FROUDE NUMBER F	=	2.78107
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.66056E-03

5 DISTANCE AT THIS SECTION 80

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	70
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	2.37663	NORMAL DEPTH YN	=	1.85858
CRITICAL DEPTH YC	=	4.92597	FROUDE NUMBER F	=	3.1015
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.68734E-03

6 DISTANCE AT THIS SECTION 100

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	75
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	2.14632	NORMAL DEPTH YN	=	1.78467
CRITICAL DEPTH YC	=	4.7291	FROUDE NUMBER F	=	3.39184
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.71473E-03

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 4674 CFS
2-22-86

6/4

INPUT AND OUTPUT

7 DISTANCE AT THIS SECTION 120

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	80
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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 =	1.96399	NORMAL DEPTH YN =	1.71804
CRITICAL DEPTH YC =	4.54988	FROUDE NUMBER F =	3.64819
CHANNEL FLOW Q =	4674	CRITICAL SLOPE SC =	3.74246E-03

8 DISTANCE AT THIS SECTION 140

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	85
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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 =	1.81741	NORMAL DEPTH YN =	1.65759
CRITICAL DEPTH YC =	4.38601	FROUDE NUMBER F =	3.86993
CHANNEL FLOW Q =	4674	CRITICAL SLOPE SC =	3.77035E-03

9 DISTANCE AT THIS SECTION 160

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	90
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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 =	1.69817	NORMAL DEPTH YN =	1.60246
CRITICAL DEPTH YC =	4.23559	FROUDE NUMBER F =	4.0571
CHANNEL FLOW Q =	4674	CRITICAL SLOPE SC =	3.79826E-03

3/45

INPUT AND OUTPUT

10 DISTANCE AT THIS SECTION 180

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	95
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.60015	NORMAL DEPTH YN	=	1.55193
CRITICAL DEPTH YC	=	4.09699	FROUDE NUMBER F	=	4.21086
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.82609E-03

11 DISTANCE AT THIS SECTION 200

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	100
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.51881	NORMAL DEPTH YN	=	1.50541
CRITICAL DEPTH YC	=	3.96884	FROUDE NUMBER F	=	4.3333
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.85381E-03

12 DISTANCE AT THIS SECTION 220

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	105
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.45068	NORMAL DEPTH YN	=	1.46242
CRITICAL DEPTH YC	=	3.84998	FROUDE NUMBER F	=	4.4273
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.88128E-03

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 4674 CFS
2-22-86

INPUT AND OUTPUT

13 DISTANCE AT THIS SECTION 240

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	110
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.39307	NORMAL DEPTH YN	=	1.42253
CRITICAL DEPTH YC	=	3.7394	FROUDE NUMBER F	=	4.49619
CHANNEL FLOW Q	=	4674	CRITICAL SLOPE SC	=	3.90843E-03

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 4674 CFS
2-22-86

9/4:

SUMMARY

ITEM		SECTIONS NO. 1	NO. 2	NO. 3
DISTANCE	=	0.000	20.000	40.000
WATER DEPTH	=	5.066	3.511	3.079
ENERGY HEAD	=	8.722	10.666	11.253
NORMAL DEPTH	=	2.261	2.140	2.034
CRITICAL DEPTH	=	5.954	5.653	5.384
FROUDE NUMBER	=	1.299	2.130	2.409
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.006	0.019	0.025
BOTTOM WIDTH	=	50.000	55.000	60.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	70.264	69.043	72.317
AREA	=	304.629	217.738	203.722
HYDRAULIC RADIUS	=	4.193	3.080	2.762

ITEM		SECTIONS NO. 4	NO. 5	NO. 6
DISTANCE	=	60.000	80.000	100.000
WATER DEPTH	=	2.672	2.377	2.146
ENERGY HEAD	=	12.275	13.124	13.858
NORMAL DEPTH	=	1.941	1.859	1.785
CRITICAL DEPTH	=	5.143	4.926	4.729
FROUDE NUMBER	=	2.781	3.102	3.392
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.034	0.044	0.054
BOTTOM WIDTH	=	65.000	70.000	75.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	75.687	79.507	83.585
AREA	=	187.949	177.661	170.187
HYDRAULIC RADIUS	=	2.443	2.203	2.012

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 4674 CFS
2-22-86

10/45

SUMMARY

ITEM		SECTIONS NO. 7	NO. 8	NO. 9
DISTANCE	=	120.000	140.000	160.000
WATER DEPTH	=	1.964	1.817	1.698
ENERGY HEAD	=	14.449	14.890	15.184
NORMAL DEPTH	=	1.718	1.658	1.602
CRITICAL DEPTH	=	4.550	4.386	4.236
FROUDE NUMBER	=	3.648	3.870	4.057
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.064	0.073	0.082
BOTTOM WIDTH	=	80.000	85.000	90.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	87.856	92.270	96.793
AREA	=	164.834	161.086	158.603
HYDRAULIC RADIUS	=	1.857	1.730	1.625

ITEM		SECTIONS NO. 10	NO. 11	NO. 12
DISTANCE	=	180.000	200.000	220.000
WATER DEPTH	=	1.600	1.519	1.451
ENERGY HEAD	=	15.339	15.370	15.296
NORMAL DEPTH	=	1.552	1.505	1.462
CRITICAL DEPTH	=	4.097	3.969	3.850
FROUDE NUMBER	=	4.211	4.333	4.427
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.090	0.097	0.103
BOTTOM WIDTH	=	95.000	100.000	105.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	101.401	106.075	110.803
AREA	=	157.135	156.495	156.530
HYDRAULIC RADIUS	=	1.538	1.465	1.404

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 4674 CFS
2-22-86

SUMMARY

ITEM		SECTIONS NO. 13
DISTANCE	=	240.000
WATER DEPTH	=	1.393
ENERGY HEAD	=	15.135
NORMAL DEPTH	=	1.423
CRITICAL DEPTH	=	3.739
FROUDE NUMBER	=	4.496
MANNING ROUGHNESS	=	0.020
BOTTOM SLOPE	=	0.100
CRITICAL SLOPE	=	0.004
FRICTION SLOPE	=	0.107
BOTTOM WIDTH	=	110.000
CHANNEL SIDE SLOPE	=	2.000
CHANNEL TOP WIDTH	=	115.572
AREA	=	157.119
HYDRAULIC RADIUS	=	1.352

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* FLOW PROFILES CALCULATION      *
*       VERSION NO. 1.0          *
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BULLDOG FLOODWAY
(PROJECT)

SCS
(CLIENT)

CHUTE DESIGN 3000 CFS
(TASK)

3767.400
(CHARGE NUMBER)

2-24-86
(DATE)

BY CARL
(NAME)

SHIAM
(CHECKER)

EBASCO SERVICES INCORPORATED

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 3000 CFS
2-24-86

13/45

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

TOTAL NUMBER OF CROSS-SECTIONS	13
FLOW ALONG MAIN CHANNEL	3000
COMPUTATION STARTS FROM UPSTREAM	1

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 3000 CFS
2-24-86

INPUT AND OUTPUT

1 DISTANCE AT THIS SECTION 0

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	50
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	3.24
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	=	3.24	NORMAL DEPTH YN	=	1.73863
CRITICAL DEPTH YC	=	4.5218	FROUDE NUMBER F	=	1.69459
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	3.85433E-03

2 DISTANCE AT THIS SECTION 20

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	55
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	2.53371	NORMAL DEPTH YN	=	1.64452
CRITICAL DEPTH YC	=	4.28174	FROUDE NUMBER F	=	2.27251
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	3.88723E-03

3 DISTANCE AT THIS SECTION 40

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	60
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	2.13451	NORMAL DEPTH YN	=	1.5627
CRITICAL DEPTH YC	=	4.06943	FROUDE NUMBER F	=	2.72401
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	3.92137E-03

15/45

INPUT AND OUTPUT

4 DISTANCE AT THIS SECTION 60

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	65
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.85685	NORMAL DEPTH YN	=	1.49079
CRITICAL DEPTH YC	=	3.88034	FROUDE NUMBER F	=	3.12185
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	3.95626E-03

5 DISTANCE AT THIS SECTION 80

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	70
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.65626	NORMAL DEPTH YN	=	1.42699
CRITICAL DEPTH YC	=	3.71084	FROUDE NUMBER F	=	3.45873
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	3.99154E-03

6 DISTANCE AT THIS SECTION 100

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	75
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.5059	NORMAL DEPTH YN	=	1.36994
CRITICAL DEPTH YC	=	3.55802	FROUDE NUMBER F	=	3.73736
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.02691E-03

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 3000 CFS
2-24-86

INPUT AND OUTPUT

7 DISTANCE AT THIS SECTION 120

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	80
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.39044	NORMAL DEPTH YN	=	1.31855
CRITICAL DEPTH YC	=	3.41948	FROUDE NUMBER F	=	3.96013
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.06219E-03

8 DISTANCE AT THIS SECTION 140

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	85
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.30006	NORMAL DEPTH YN	=	1.27196
CRITICAL DEPTH YC	=	3.29328	FROUDE NUMBER F	=	4.13138
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.09719E-03

9 DISTANCE AT THIS SECTION 160

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	90
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.22812	NORMAL DEPTH YN	=	1.2295
CRITICAL DEPTH YC	=	3.17778	FROUDE NUMBER F	=	4.25688
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.13188E-03

17/45

INPUT AND OUTPUT

10 DISTANCE AT THIS SECTION 180

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	95
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.16991	NORMAL DEPTH YN	=	1.1906
CRITICAL DEPTH YC	=	3.07166	FROUDE NUMBER F	=	4.34344
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.16611E-03

11 DISTANCE AT THIS SECTION 200

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	100
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.12203	NORMAL DEPTH YN	=	1.15481
CRITICAL DEPTH YC	=	2.97378	FROUDE NUMBER F	=	4.39808
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.19987E-03

12 DISTANCE AT THIS SECTION 220

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	105
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.08197	NORMAL DEPTH YN	=	1.12174
CRITICAL DEPTH YC	=	2.88317	FROUDE NUMBER F	=	4.42754
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.23311E-03

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 3000 CFS
2-24-86

19/4

INPUT AND OUTPUT

13 DISTANCE AT THIS SECTION 240

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	110
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.04785	NORMAL DEPTH YN	=	1.09107
CRITICAL DEPTH YC	=	2.79903	FROUDE NUMBER F	=	4.43788
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	4.26581E-03

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 3000 CFS
2-24-86

SUMMARY

ITEM		SECTIONS NO. 1	NO. 2	NO. 3
DISTANCE	=	0.000	20.000	40.000
WATER DEPTH	=	3.240	2.534	2.135
ENERGY HEAD	=	7.413	8.567	9.561
NORMAL DEPTH	=	1.739	1.645	1.563
CRITICAL DEPTH	=	4.522	4.282	4.069
FROUDE NUMBER	=	1.695	2.273	2.724
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.012	0.023	0.035
BOTTOM WIDTH	=	50.000	55.000	60.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	62.960	65.135	68.538
AREA	=	182.995	152.194	137.183
HYDRAULIC RADIUS	=	2.838	2.294	1.973

ITEM		SECTIONS NO. 4	NO. 5	NO. 6
DISTANCE	=	60.000	80.000	100.000
WATER DEPTH	=	1.857	1.656	1.506
ENERGY HEAD	=	10.441	11.135	11.632
NORMAL DEPTH	=	1.491	1.427	1.370
CRITICAL DEPTH	=	3.880	3.711	3.558
FROUDE NUMBER	=	3.122	3.459	3.737
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.048	0.061	0.073
BOTTOM WIDTH	=	65.000	70.000	75.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	72.427	76.625	81.024
AREA	=	127.591	121.424	117.478
HYDRAULIC RADIUS	=	1.741	1.569	1.437

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 3000 CFS
2-24-86

20/45

SUMMARY

ITEM		SECTIONS NO. 7	NO. 8	NO. 9
DISTANCE	=	120.000	140.000	160.000
WATER DEPTH	=	1.390	1.300	1.228
ENERGY HEAD	=	11.939	12.075	12.068
NORMAL DEPTH	=	1.319	1.272	1.230
CRITICAL DEPTH	=	3.419	3.293	3.178
FROUDE NUMBER	=	3.960	4.131	4.257
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.084	0.093	0.100
BOTTOM WIDTH	=	80.000	85.000	90.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	85.562	90.200	94.912
AREA	=	115.102	113.885	113.547
HYDRAULIC RADIUS	=	1.335	1.254	1.189

ITEM		SECTIONS NO. 10	NO. 11	NO. 12
DISTANCE	=	180.000	200.000	220.000
WATER DEPTH	=	1.170	1.122	1.082
ENERGY HEAD	=	11.946	11.741	11.477
NORMAL DEPTH	=	1.191	1.155	1.122
CRITICAL DEPTH	=	3.072	2.974	2.883
FROUDE NUMBER	=	4.343	4.398	4.428
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.004	0.004	0.004
FRICTION SLOPE	=	0.106	0.110	0.113
BOTTOM WIDTH	=	95.000	100.000	105.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	99.680	104.488	109.328
AREA	=	113.878	114.721	115.948
HYDRAULIC RADIUS	=	1.136	1.092	1.056

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 3000 CFS
2-24-86

21/45

SUMMARY

ITEM		SECTIONS NO. 13
DISTANCE	=	240.000
WATER DEPTH	=	1.048
ENERGY HEAD	=	11.177
NORMAL DEPTH	=	1.091
CRITICAL DEPTH	=	2.799
FROUDE NUMBER	=	4.438
MANNING ROUGHNESS	=	0.020
BOTTOM SLOPE	=	0.100
CRITICAL SLOPE	=	0.004
FRICTION SLOPE	=	0.114
BOTTOM WIDTH	=	110.000
CHANNEL SIDE SLOPE	=	2.000
CHANNEL TOP WIDTH	=	114.191
AREA	=	117.460
HYDRAULIC RADIUS	=	1.024

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* FLOW PROFILES CALCULATION      *
*       VERSION NO. 1.0          *
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BULLDOG FLOODWAY
(PROJECT)

SCS
(CLIENT)

CHUTE DESIGN 1000 CFS
(TASK)

3767.400
(CHARGE NUMBER)

2-24-86
(DATE)

BY CARL
(NAME)

SHIAM
(CHECKER)

EBASCO SERVICES INCORPORATED

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 1000 CFS
2-24-86

23/45

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

TOTAL NUMBER OF CROSS-SECTIONS	13
FLOW ALONG MAIN CHANNEL	1000
COMPUTATION STARTS FROM UPSTREAM	1

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 1000 CFS
2-24-86

INPUT AND OUTPUT

1 DISTANCE AT THIS SECTION 0

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	50
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	1.56
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	=	1.56	NORMAL DEPTH YN	=	.903868
CRITICAL DEPTH YC	=	2.24542	FROUDE NUMBER F	=	1.75195
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	4.68335E-03

2 DISTANCE AT THIS SECTION 20

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	55
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	1.05538	NORMAL DEPTH YN	=	.85422
CRITICAL DEPTH YC	=	2.11672	FROUDE NUMBER F	=	2.89816
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	4.74641E-03

3 DISTANCE AT THIS SECTION 40

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	60
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.896279	NORMAL DEPTH YN	=	.811198
CRITICAL DEPTH YC	=	2.00454	FROUDE NUMBER F	=	3.40942
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	4.80838E-03

BULLDOG FLOODWAY
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INPUT AND OUTPUT

4 DISTANCE AT THIS SECTION 60

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	65
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.798973	NORMAL DEPTH YN	=	.773483
CRITICAL DEPTH YC	=	1.90581	FROUDE NUMBER F	=	3.7494
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	.0048691

5 DISTANCE AT THIS SECTION 80

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	70
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.73725	NORMAL DEPTH YN	=	.740092
CRITICAL DEPTH YC	=	1.81816	FROUDE NUMBER F	=	3.9349
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	4.92839E-03

6 DISTANCE AT THIS SECTION 100

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	75
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.694591	NORMAL DEPTH YN	=	.710275
CRITICAL DEPTH YC	=	1.73977	FROUDE NUMBER F	=	4.02125
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	4.98614E-03

INPUT AND OUTPUT

7 DISTANCE AT THIS SECTION 120

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	80
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	= .662886	NORMAL DEPTH YN	= .683452
CRITICAL DEPTH YC	= 1.66919	FROUDE NUMBER F	= 4.0476
CHANNEL FLOW Q	= 1000	CRITICAL SLOPE SC	= 5.04234E-03

8 DISTANCE AT THIS SECTION 140

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	85
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	= .637687	NORMAL DEPTH YN	= .659164
CRITICAL DEPTH YC	= 1.60525	FROUDE NUMBER F	= 4.04075
CHANNEL FLOW Q	= 1000	CRITICAL SLOPE SC	= 5.09702E-03

9 DISTANCE AT THIS SECTION 160

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	90
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	= .616492	NORMAL DEPTH YN	= .637045
CRITICAL DEPTH YC	= 1.54704	FROUDE NUMBER F	= 4.01739
CHANNEL FLOW Q	= 1000	CRITICAL SLOPE SC	= 5.15018E-03

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INPUT AND OUTPUT

10 DISTANCE AT THIS SECTION 180

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	95
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.59789	NORMAL DEPTH YN	=	.616796
CRITICAL DEPTH YC	=	1.49377	FROUDE NUMBER F	=	3.98719
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	5.20187E-03

11 DISTANCE AT THIS SECTION 200

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	100
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.581087	NORMAL DEPTH YN	=	.598175
CRITICAL DEPTH YC	=	1.44481	FROUDE NUMBER F	=	3.95524
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	5.25214E-03

12 DISTANCE AT THIS SECTION 220

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	105
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.565634	NORMAL DEPTH YN	=	.580978
CRITICAL DEPTH YC	=	1.39964	FROUDE NUMBER F	=	3.92398
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	5.30108E-03

BULLDOG FLOODWAY
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INPUT AND OUTPUT

13 DISTANCE AT THIS SECTION 240

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.02
CHANNEL BOTTOM WIDTH	110
CHANNEL BOTTOM SLOPE (DECIMAL)	.1
CHANNEL SIDE SLOPE	2
WATER DEPTH AT CONTROL SECTION	0
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	=	.551259	NORMAL DEPTH YN	=	.565038
CRITICAL DEPTH YC	=	1.35781	FROUDE NUMBER F	=	3.89457
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	.0053487

BULLDOG FLOODWAY
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SUMMARY

ITEM		SECTIONS NO. 1	NO. 2	NO. 3
DISTANCE	=	0.000	20.000	40.000
WATER DEPTH	=	1.560	1.055	0.896
ENERGY HEAD	=	3.821	5.330	5.959
NORMAL DEPTH	=	0.904	0.854	0.811
CRITICAL DEPTH	=	2.245	2.117	2.005
FROUDE NUMBER	=	1.752	2.898	3.409
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.005	0.005	0.005
FRICTION SLOPE	=	0.016	0.049	0.072
BOTTOM WIDTH	=	50.000	55.000	60.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	56.240	59.222	63.585
AREA	=	82.867	60.273	55.383
HYDRAULIC RADIUS	=	1.454	1.009	0.865

ITEM		SECTIONS NO. 4	NO. 5	NO. 6
DISTANCE	=	60.000	80.000	100.000
WATER DEPTH	=	0.799	0.737	0.695
ENERGY HEAD	=	6.283	6.329	6.210
NORMAL DEPTH	=	0.773	0.740	0.710
CRITICAL DEPTH	=	1.906	1.818	1.740
FROUDE NUMBER	=	3.749	3.935	4.021
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.005	0.005	0.005
FRICTION SLOPE	=	0.090	0.101	0.108
BOTTOM WIDTH	=	65.000	70.000	75.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	68.196	72.949	77.778
AREA	=	53.210	52.695	53.059
HYDRAULIC RADIUS	=	0.776	0.719	0.679

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 1000 CFS
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SUMMARY

ITEM		SECTIONS NO. 7	NO. 8	NO. 9
DISTANCE	=	120.000	140.000	160.000
WATER DEPTH	=	0.663	0.638	0.616
ENERGY HEAD	=	6.006	5.768	5.525
NORMAL DEPTH	=	0.683	0.659	0.637
CRITICAL DEPTH	=	1.669	1.605	1.547
FROUDE NUMBER	=	4.048	4.041	4.017
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.005	0.005	0.005
FRICTION SLOPE	=	0.111	0.112	0.112
BOTTOM WIDTH	=	80.000	85.000	90.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	82.652	87.551	92.466
AREA	=	53.910	55.017	56.244
HYDRAULIC RADIUS	=	0.650	0.626	0.606

ITEM		SECTIONS NO. 10	NO. 11	NO. 12
DISTANCE	=	180.000	200.000	220.000
WATER DEPTH	=	0.598	0.581	0.566
ENERGY HEAD	=	5.292	5.075	4.874
NORMAL DEPTH	=	0.617	0.598	0.581
CRITICAL DEPTH	=	1.494	1.445	1.400
FROUDE NUMBER	=	3.987	3.955	3.924
MANNING ROUGHNESS	=	0.020	0.020	0.020
BOTTOM SLOPE	=	0.100	0.100	0.100
CRITICAL SLOPE	=	0.005	0.005	0.005
FRICTION SLOPE	=	0.111	0.110	0.109
BOTTOM WIDTH	=	95.000	100.000	105.000
CHANNEL SIDE SLOPE	=	2.000	2.000	2.000
CHANNEL TOP WIDTH	=	97.392	102.324	107.263
AREA	=	57.515	58.784	60.031
HYDRAULIC RADIUS	=	0.589	0.573	0.558

BULLDOG FLOODWAY
SCS
CHUTE DESIGN 1000 CFS
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SUMMARY

ITEM		SECTIONS NO. 13
DISTANCE	=	240.000
WATER DEPTH	=	0.551
ENERGY HEAD	=	4.691
NORMAL DEPTH	=	0.565
CRITICAL DEPTH	=	1.358
FROUDE NUMBER	=	3.895
MANNING ROUGHNESS	=	0.020
BOTTOM SLOPE	=	0.100
CRITICAL SLOPE	=	0.005
FRICTION SLOPE	=	0.109
BOTTOM WIDTH	=	110.000
CHANNEL SIDE SLOPE	=	2.000
CHANNEL TOP WIDTH	=	112.205
AREA	=	61.246
HYDRAULIC RADIUS	=	0.545

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*
* FLOW PROFILES CALCULATION *
* VERSION NO. 1.0 *
*
****

BULLDOG FLOODWAY
(PROJECT)

SCS
(CLIENT)

TAILWATER 3000 CFS
(TASK)

3767.400
(CHARGE NUMBER)

2-24-86
(DATE)

BY CJM
(NAME)

SG
(CHECKER)

EBASCO SERVICES INCORPORATED

BULLDOG FLOODWAY
SCS
TAILWATER 3000 CFS
2-24-86

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

TOTAL NUMBER OF CROSS-SECTIONS	2
FLOW ALONG MAIN CHANNEL	3000
COMPUTATION STARTS FROM DOWNSTREAM	-1

BULLDOG FLOODWAY
SCS
TAILWATER 3000 CFS
2-24-86

INPUT AND OUTPUT

1 DISTANCE AT THIS SECTION 1

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.027
CHANNEL BOTTOM WIDTH	100
CHANNEL BOTTOM SLOPE (DECIMAL)	.0003
CHANNEL SIDE SLOPE	3
WATER DEPTH AT CONTROL SECTION	7
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	=	7	NORMAL DEPTH YN	=	7.54902
CRITICAL DEPTH YC	=	2.94388	FROUDE NUMBER F	=	.255571
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	7.69518E-03

2 DISTANCE AT THIS SECTION 2

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.027
CHANNEL BOTTOM WIDTH	100
CHANNEL BOTTOM SLOPE (DECIMAL)	.0003
CHANNEL SIDE SLOPE	3
WATER DEPTH AT CONTROL SECTION	0
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	=	7.0001	NORMAL DEPTH YN	=	7.54902
CRITICAL DEPTH YC	=	2.94388	FROUDE NUMBER F	=	.255565
CHANNEL FLOW Q	=	3000	CRITICAL SLOPE SC	=	7.69518E-03

BULLDOG FLOODWAY
SCS
TAILWATER 3000 CFS
2-24-86

SUMMARY

ITEM		SECTIONS NO. 1	NO. 2
DISTANCE	=	1.000	2.000
WATER DEPTH	=	7.000	7.000
ENERGY HEAD	=	7.195	7.195
NORMAL DEPTH	=	7.549	7.549
CRITICAL DEPTH	=	2.944	2.944
FROUDE NUMBER	=	0.256	0.256
MANNING ROUGHNESS	=	0.027	0.027
BOTTOM SLOPE	=	0.000	0.000
CRITICAL SLOPE	=	0.008	0.008
FRICTION SLOPE	=	0.000	0.000
BOTTOM WIDTH	=	100.000	100.000
CHANNEL SIDE SLOPE	=	3.000	3.000
CHANNEL TOP WIDTH	=	142.000	142.001
AREA	=	847.000	847.014
HYDRAULIC RADIUS	=	5.871	5.871

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*                                *
* FLOW PROFILES CALCULATION      *
*        VERSION NO. 1.0         *
*                                *
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BULLDOG FLOODWAY
(PROJECT)

SCS
(CLIENT)

TAILWATER 1000 CFS
(TASK)

3767.400
(CHARGE NUMBER)

2-24-86
(DATE)

BY CJM
(NAME)

SG
(CHECKER)

EBASCO SERVICES INCORPORATED

BULLDOG FLOODWAY
SCS
TAILWATER 1000 CFS
2-24-86

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

TOTAL NUMBER OF CROSS-SECTIONS	2
FLOW ALONG MAIN CHANNEL	1000
COMPUTATION STARTS FROM DOWNSTREAM	-1

BULLDOG FLOODWAY
SCS
TAILWATER 1000 CFS
2-24-86

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INPUT AND OUTPUT

1 DISTANCE AT THIS SECTION 1

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.027
CHANNEL BOTTOM WIDTH	100
CHANNEL BOTTOM SLOPE (DECIMAL)	.0003
CHANNEL SIDE SLOPE	3
WATER DEPTH AT CONTROL SECTION	5
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	=	5	NORMAL DEPTH YN	=	4.00332
CRITICAL DEPTH YC	=	1.43776	FROUDE NUMBER F	=	.145728
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	9.60128E-03

2 DISTANCE AT THIS SECTION 2

MAX. PERMISSIBLE VELOCITY	0
MANNING ROUGHNESS	.027
CHANNEL BOTTOM WIDTH	100
CHANNEL BOTTOM SLOPE (DECIMAL)	.0003
CHANNEL SIDE SLOPE	3
WATER DEPTH AT CONTROL SECTION	0
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	=	4.99984	NORMAL DEPTH YN	=	4.00332
CRITICAL DEPTH YC	=	1.43776	FROUDE NUMBER F	=	.145736
CHANNEL FLOW Q	=	1000	CRITICAL SLOPE SC	=	9.60128E-03

BULLDOG FLOODWAY
SCS
TAILWATER 1000 CFS
2-24-86

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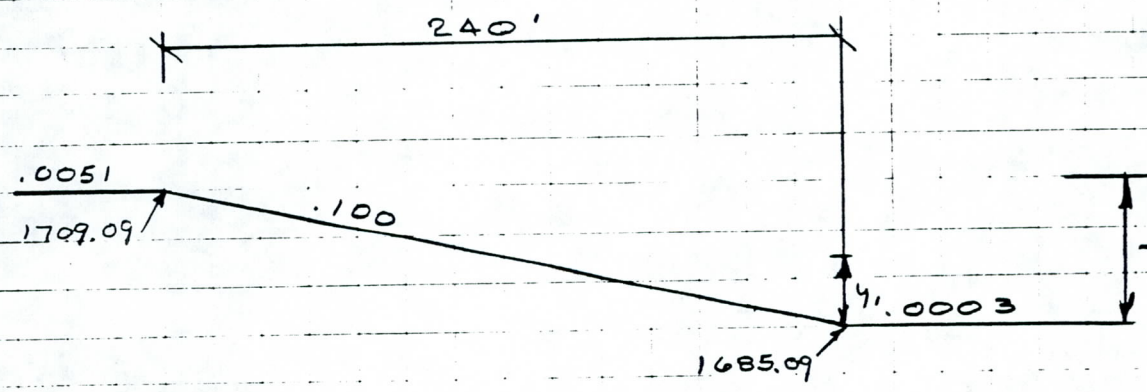
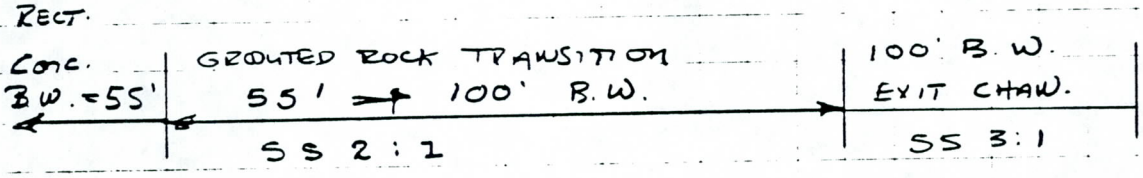
SUMMARY

ITEM		SECTIONS NO. 1	NO. 2
DISTANCE	=	1.000	2.000
WATER DEPTH	=	5.000	5.000
ENERGY HEAD	=	5.047	5.047
NORMAL DEPTH	=	4.003	4.003
CRITICAL DEPTH	=	1.438	1.438
FROUDE NUMBER	=	0.146	0.146
MANNING ROUGHNESS	=	0.027	0.027
BOTTOM SLOPE	=	0.000	0.000
CRITICAL SLOPE	=	0.010	0.010
FRICTION SLOPE	=	0.000	0.000
BOTTOM WIDTH	=	100.000	100.000
CHANNEL SIDE SLOPE	=	3.000	3.000
CHANNEL TOP WIDTH	=	130.000	129.999
AREA	=	575.000	574.979
HYDRAULIC RADIUS	=	4.369	4.368





From Previous Calcs:

DISCHARGE (CFS)	y_1 (ft)	T.W. (ft.)	y_2 (ft)
1000	0.6	4.0	3.0
3000	1.1	7.5	6.3
4674	1.5	10.2	8.6

It is recognized that the equation for y_2 is for rect. flat channels and that $L = 6y_2$ is an approximation however they are accurate enough for this application.

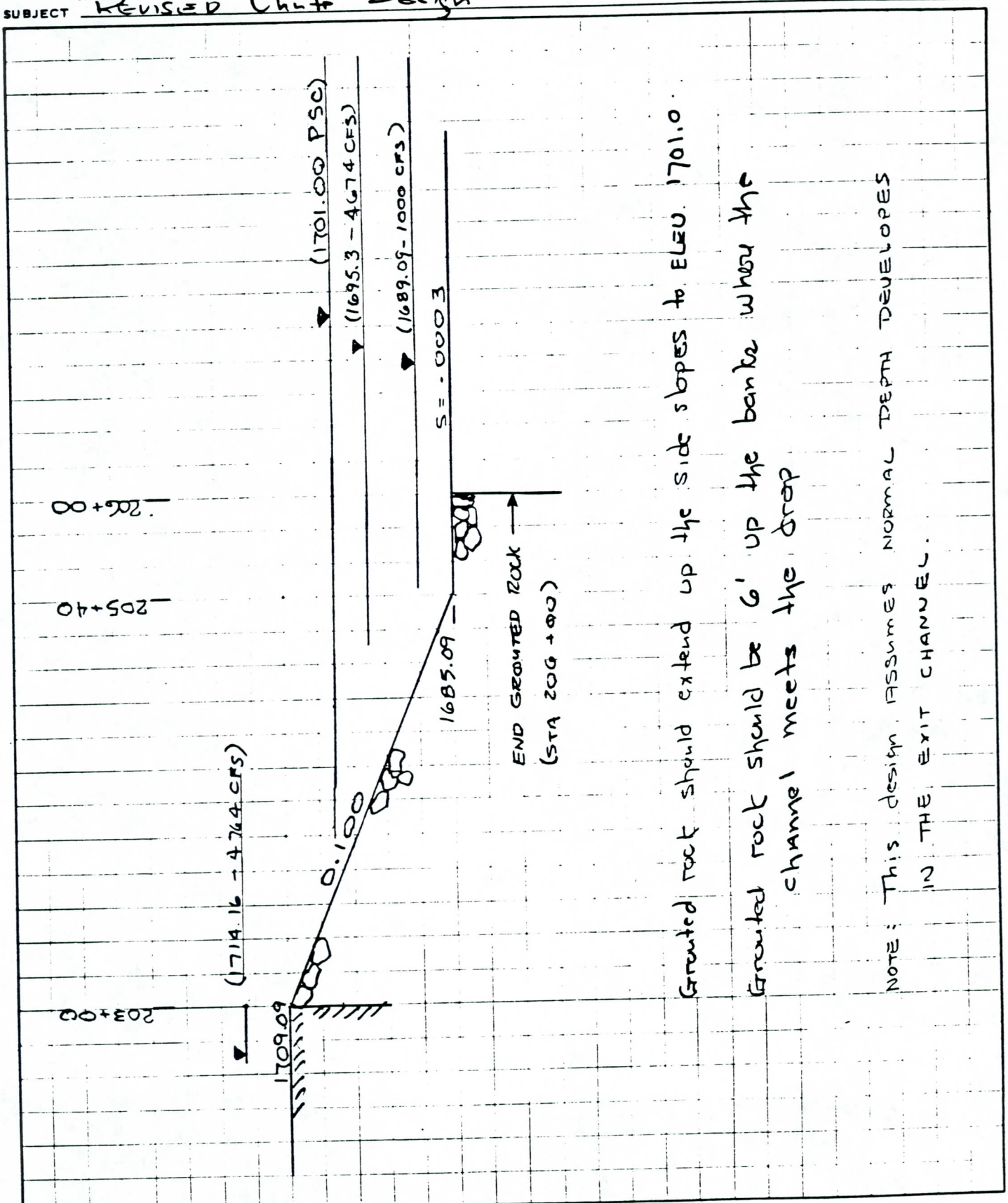
$$y_2 = \frac{y_1}{2}\left(\sqrt{1+8F_1^2} - 1\right)$$

Length Of Jump = $6\,y_2$ = 6×8.6 = 51.6'

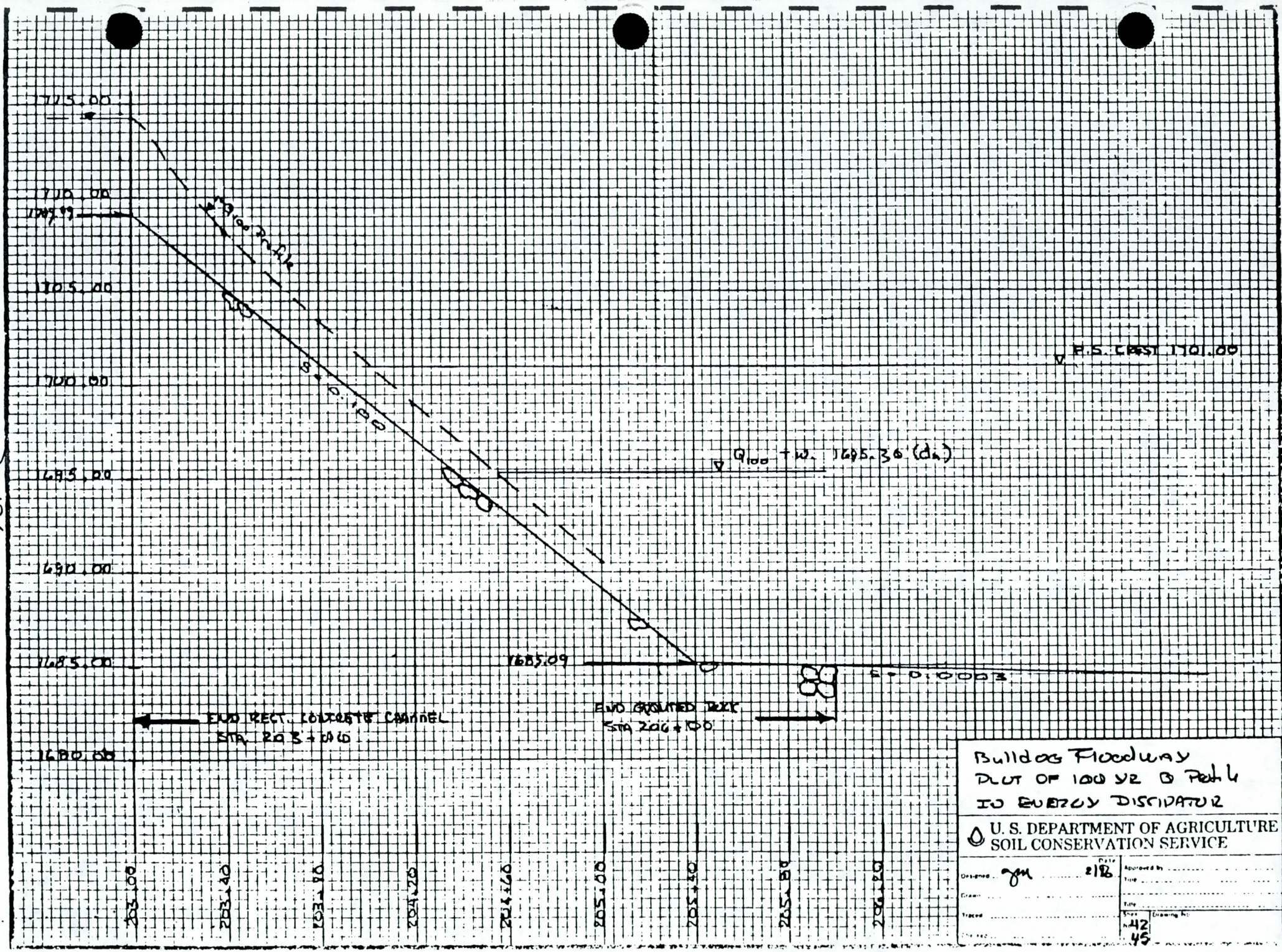
Say 50 FT.

EBASCO SERVICES INCORPORATED

BY CJM DATE 2/25/86
CHKD. BY GN DATE 3/5/86
SHEET 41 OF 45
OFS NO. DEPT. NO.
CLIENT USDA SCS
PROJECT Bulldog Floodway
SUBJECT Revised Chute Design



581/8-81

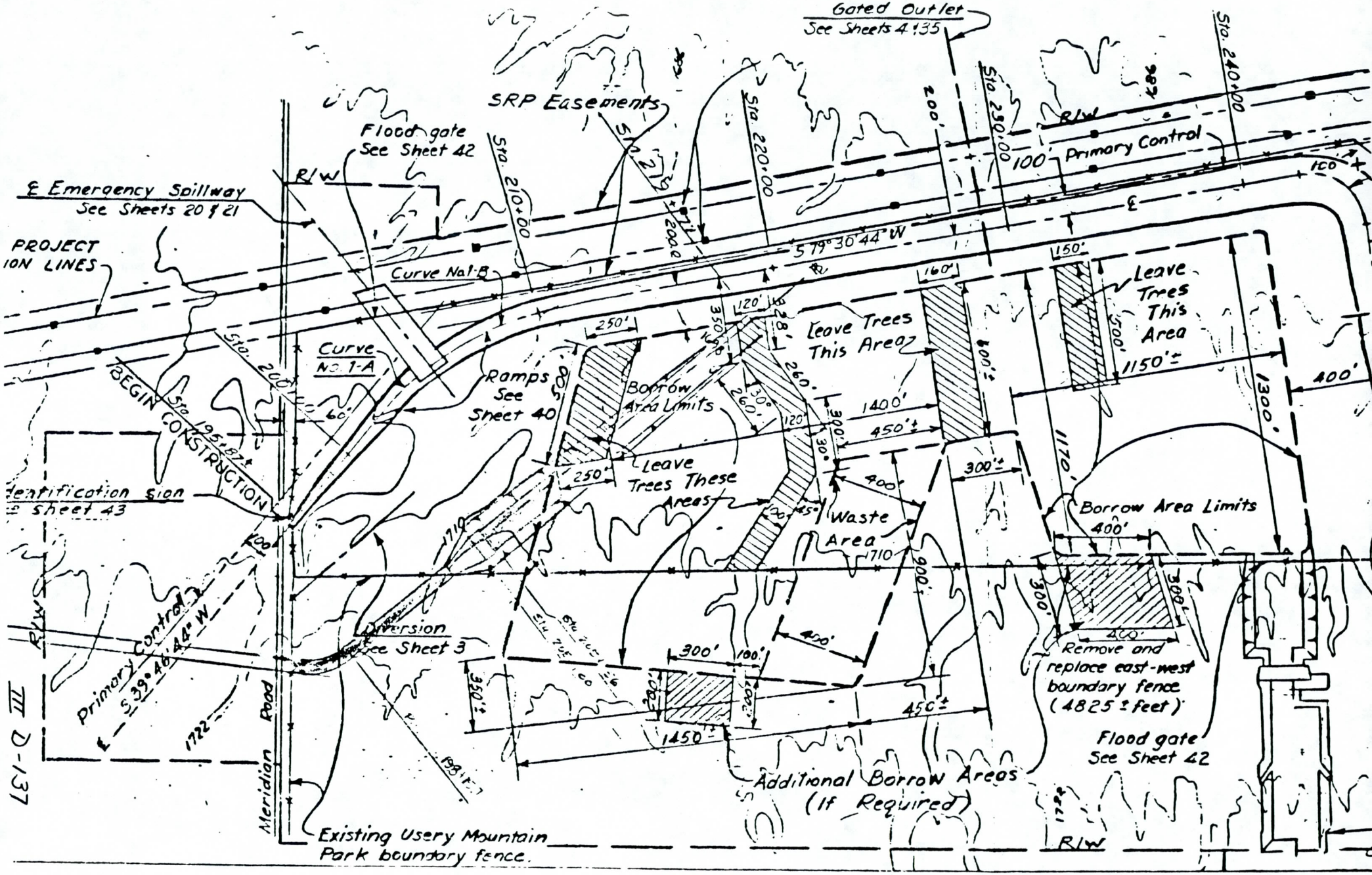


III C-136

Bulldog Floodway
PLOT OF 100 YR Q Path 4
TO ENERGY DISSIPATOR

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed gjm Date 2/18
Drawn
Traced
Checked
Approved by
Title
Title
Sheet No. 42 45
Drawing No.



Supersedes Layout
Of Bulldog Chute

BY CJM DATE 3/4/86 SHEET 44 OF 45

CHKD. BY JM DATE 3/5/86 OFS NO. 3767 DEPT. NO. 930

CLIENT USDA SCS

PROJECT Bulldog Floodway

SUBJECT REVISED Chute Design

DUE to the relatively short length of EXIT CHANNEL RESULTING FROM EXCAVATION OF THE BORROW AREA IT IS UNREASONABLE TO ASSUME NORMAL DEPTH WILL DEVELOPE IN THE CHANNEL. However a check with Harry Millsaps on Don Paulus on 3/4/86 shows from the Signal Butte Flood Routing that the level in the reservoir reaches elev. 1700 within 1 hr. after the start of inflow. It is safe to assume that the lake level will be up well before high discharges occur in Bulldog Floodway.

Use layout as shown on sheet 42

MEMO TO FILE: DESIGN OF BULLDOG FLOODWAY GROUTED ROCK CHUTE

On Monday, March 10, 1986, I met with Don Paulus, Lee Sails, and Harry Millsaps in the SCS Office in Phoenix. Don informed me that the routings they used in determining that the reservoir level would be up to elevation 1700 within 1 hour of the start of inflow on Signal Butte were in error and that we could not rely on the tailwater being high enough to force the jump on the Bulldog Floodway chute to occur on the slope. We discussed the options which include:

(1) constructing a sill or berm in the reservoir area at the end of the exit channel to creat tailwater,

(2) constructing a pit at the base of the chute to force the jump on the grouted rock structure and lining the exit channel since even if the jump is forced to occur on the slope by this means the exit channel velocities will be to high,

(3) not changing the design but relying on the fact that we are in caliche in the exit channel and adding a 6 foot deep toe wall of grouted rock at the end of the chute to protect it from undermining. (we will expect some erosion in the exit channel in this case).

After extensive discussion on the advantages and disadvantages of each option it was decided to go with the third. One of the basic reasons for selecting this option is that since the channel is behind the Signal Butte Dam no hazard is created by the instability of the exit channel and the added costs of the first two options is not justified. The fact that the channel is already at the elevation of the floor of the reservoir, is in caliche, and a deep cutoff is being added at the end of the chute should protect the structure. Maintenance of the exit channel will be required. This will be added to the Operation and Maintenace Plan.

C. Martin
3/12/86

Donald E Paulus advised on telephon on 8-7-86 that Flood District and SCS would like to depress the energy dissipator floor below the Signal Butte borrow area excavation level (El 1695) for energy dissipation. No berm at the downstream end will be required. The stilling basin floor should be lowered to the extent necessary.

The design of the energy dissipator is therefore revised as follows

$Q = 4674$ cfs

$S_o = .0051$ DWG 86001-AZ-CH SH 11 OF 30

$B_o = 50$

Invert El $= 1709.09'$

$Y_o = 5.063$

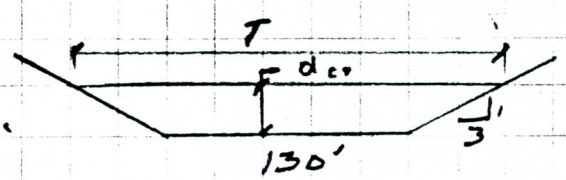
$V_o = 18.46$

$F_o = \frac{V}{\sqrt{gy}} = 1.446$

Since the tail water levels in Signal Butte reservoir are not available and the stilling basin ends into a short channel which opens up into a wide borrow area assume the water level near the critical depth at the end of the exit channel.

Bottom width of exit channel $= 130'$ (assumed)

Side slopes 3H : 1V



For the channel in caliche assume $n = .02$

From computer program Flow Profile Calculation Version 1.1 the depth of water at the basin is approximately equal to 4.5 ft

BY S GOYAL DATE 8-15-86 SHEET 1 OF 4

CHKD. BY GR DATE 8-19-86 OFS NO. USDA 3767.400 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY ENERGY DISSIPATOR

Donald E Paulus advised on telephon on 8-7-86 that Flood District and SCS would like to depress the energy dissipator floor below the Signal Butte borrow area excavation level (El 1645) for energy dissipation. No berm at the downstream end will be required. The stilling basin floor should be lowered to the extent necessary.

The design of the energy dissipator is therefore revised as follows

$Q = 4674$ cfs

$S_o = .0051$ DWG 86001-AZ-CH SH 11 OF 30

$B_o = 50$

Invert El = 1709.09'

$Y_o = 5.063$

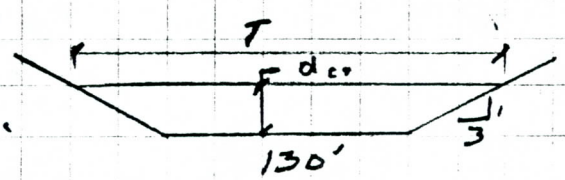
$V_o = 18.46$

$F_o = \frac{V}{\sqrt{gy}} = 1.446$

Since the tail water levels in Signal Butte reservoir are not available and the stilling basin ends into a short channel which opens up into a wide borrow area assume the water level near the critical depth at the end of the exit channel.

Bottom width of exit channel = 130' (assumed)

Side slopes 3H : 1V



For the channel in caliche assume $n = .02$

From computer program Flow Profile Calculation Version 1.1 the depth of water at the basin is approximately equal to 4.5 ft

$\therefore$ Tail water level (min) = 1695 + 4.5
= 1699.5

Assume floor of stilling basin at EL 1688.5

$\therefore Q = b y_1 [2g(Z_0 - Z_1 + 5.063 - Y_1) + 18.46^2]^{1/2}$

$Z_0 - Z_1 + 5.063 = 1709.09 - 1688.5 + 5.063$
$= 25.653$

For $Y_1 = 1.066$
$Q = 4676$ ok
$V = 43.86$
$F = \frac{V}{\sqrt{gy}} = 7.486$

$\therefore y_2 = \frac{y_1}{2}[\sqrt{1+8F^2} - 1] = 10.765$

$\therefore$ Tailwater level required = 1688.5 + 10.765
= 1699.26 < 1699.5 o.k

$W_B = W_0 + 2\frac{Z_0 - Z_1}{3 F_0 S_T}\sqrt{S_T^2 + 1}$

$100 = 50 + 2\frac{20.59}{3 \times 1.446}\left(1 + \frac{1}{S_T^2}\right)^{1/2}$

$\therefore S_T = .1933$
$L_T = (Z_0 - Z_1)\frac{1}{S_T} = 106.48' < 110'$ o.k

Length of Jump = 6.1 x 10.765
= 65.67 $\simeq$ 65 o.k.

BY S Goyal DATE 8-15-86 SHEET 3 OF 4

CHKD. BY GR DATE 8-19-86 OFS NO. USDA 3767.4 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG ENERGY DISSIPATOR

Rais the floor to EL 1695 in a slope of 3 horizontal to 1 vertical and continue the channel to the borrow area.

Since the grouted riprap is provided through soil and caliche drainage of the floor and sides should be provided

Where the exit channel is not in caliche provide loose riprap at the bed and sides to EL 1703.

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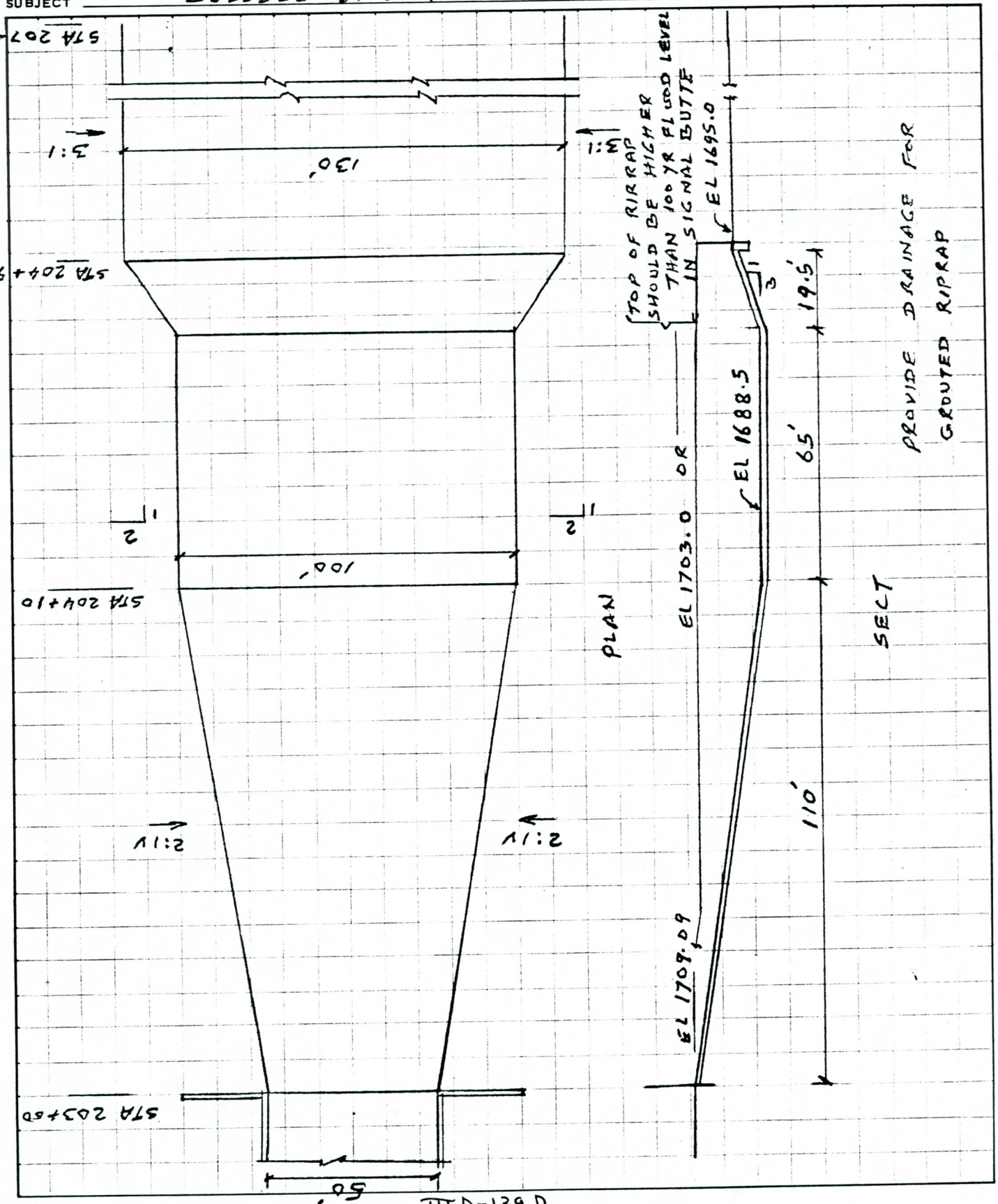
BY S Goyal DATE 8-15-86 SHEET 4 OF 4

CHKD. BY GR DATE 8/19-86 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG ENERY DISSIPATOR



581/8-81

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 1 OF

CHKD. BY (D) 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

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BY CJM DATE 8/85 SHEET 2 OF
CHKD. BY [illegible] 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

DA # 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
1	.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

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BY CJM DATE 8/85 SHEET 3 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 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 x .12 x .77 = 0.05
.20 x .20 x .77 = 0.03
.30 x .40 x .77 = 0.09
0.17 AF/YR

USING SAME RATE AS PREVIOUS PAGE (1.65 & .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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BY CJM DATE 8/85 SHEET 4 OF
CHKD. BY [illegible] DATE 9/9/85 OFS NO. 3767 DEPT. NO. 930
CLIENT U.S.D.A Soil Conservation Service
PROJECT Bulldog Floodway & Apache Junction
SUBJECT Sediment Yld (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

581/B-81

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BY CJW DATE 8/85 SHEET 5 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

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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EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 6 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 100 yr storm event

REF. Ecologic 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_{A100}

q_{A100} = 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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BY CJM DATE 8/85 SHEET 7 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

III (CONT.)

b. 2 YR. STORM VALUES

Vol. of RUNOFF = $Q2_{AF}$

W/S	DA (SM)	RUNOFF (IN)	RUNOFF (AF)
I	1.86	.32	32
IA+IB	0.77	1.27	11

$\therefore Q2_{AF} = 43$ Ac. Ft.

Peak Discharge = $q2_{AF}$

$q2_{AF} = 390$ CFS

$C2_{AF} = 95(43 \times 390)^{0.56}$

$C2_{AF} = 22052$

c. RATIO: Apache Junction Floodway

$C100_{AF} / C2_{AF} = 130499/22052 = 6$

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BY CJM DATE 8/85 SHEET 8 OF
CHKD. BY ⓓ DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930
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 8/86 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	0.8	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 Discharge

$Q_{2_{BF}} = 653$ 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 ⓓ 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 ✓ 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 = $\overline{S}_{BF}$

$$\overline{S}_{BF} = \frac{18228}{18228 + 876,601} \times 1,000,000$$

= 20,370 ppm

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BY CJM DATE 8/16/85 SHEET 12 OF ____
CHKD. BY ② 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	DA (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

581/8-81

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BY CJM DATE 8/16/85 SHEET 13 OF ____

CHKD. BY [illegible] 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 CJM 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)

III E FOUNDATIONS & EMBANKMENT DESIGN

E. FOUNDATIONS DESIGN

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 age. Features of the project intersect numerous ephemeral washes which have their origin mainly in the Goldfield Mountains. Loose alluvial deposits of recent age in the washes. Caliche is intermittently exposed throughout the project area, especially in the smaller washes, and generally is present at shallow depths elsewhere. 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 Outlet and Bulldog Floodway 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. The depth to caliche varies significantly along the length of the structure from one foot to approximately twenty-four feet. 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 the caliche, the subsurface soils appear to be dense to very dense as indicated by the blowcounts 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.

Details of the test programs and analysis of results are provided in the "Phase II - Soils Mechanics Report".

Much of the concrete floodway will rest upon caliche. No special bedding will be placed under the bottom slab, either on the caliche or other soils. Non-caliche soils will be compacted before construction of the channel to avoid possible settlement.

The energy dissipator at the end of the concrete channel is designed with a grouted riprap chute and stilling basin, a total of 300 feet to the beginning of the unlined earth channel.

Grouted riprap will be provided upstream from each of the inlets to the floodway in the region where velocities may be high and scour may occur.

The earth channel has a bottom width of 100 feet and side slopes of 3:1. No special treatment will be required to withstand maximum velocities of about 3.5 fps.

As shown on D Gruner's sketch dated 11/21/85 the weep holes along the channel walls will be protected using Ca #4 mesh.

In order to meet the requirements of SMN #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)

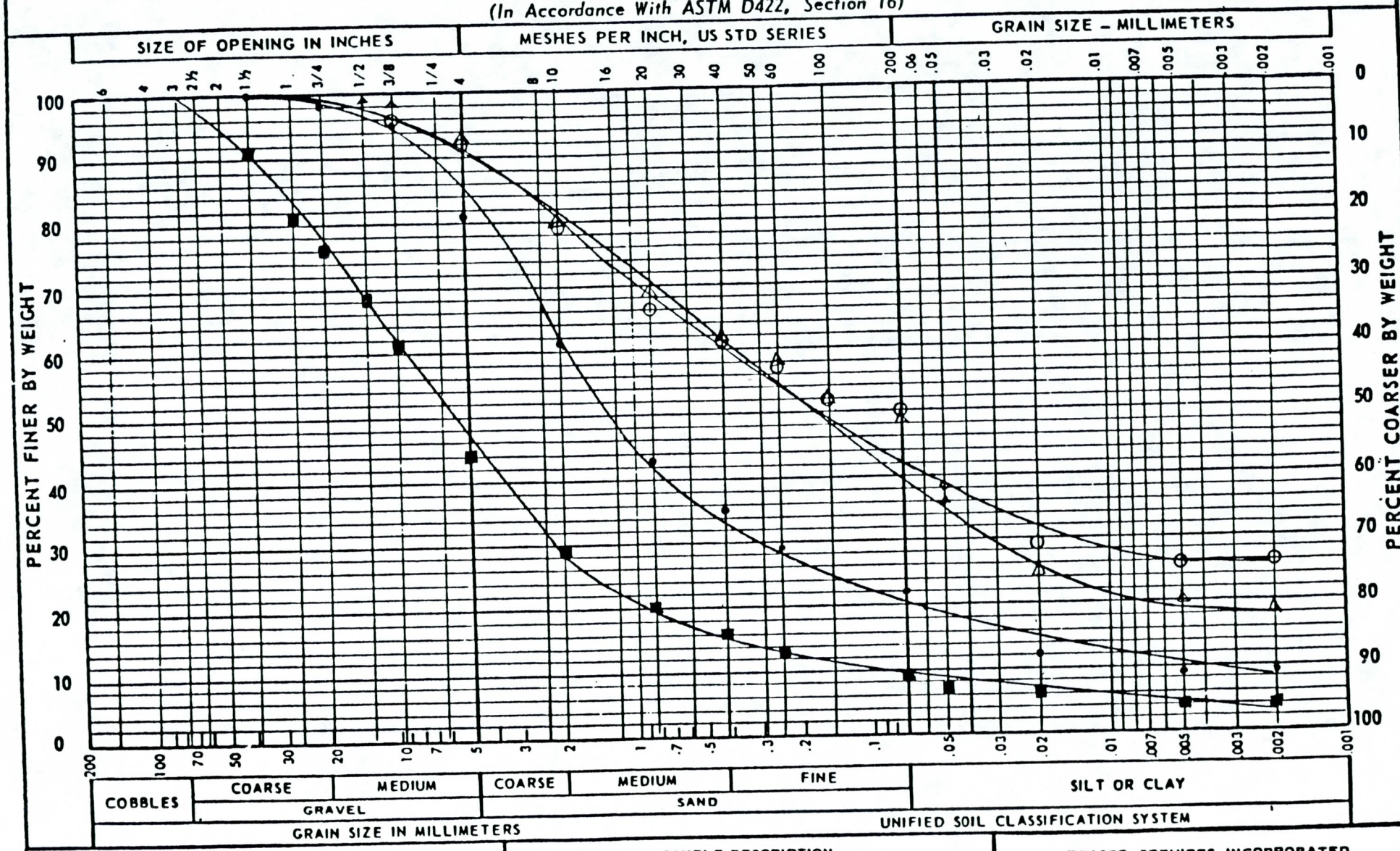
However, if this free draining gravel is used, a filter material must be also used (fine to coarse sand meeting the gradation requirements shown on sheet 4) to assure compatibility with existing soils.

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 DESCRIPTION
SAMPLE NO.	● LAB # 2928
SAMPLE LOCATION	○ LAB # 2932
SAMPLE ELEVATION	△ LAB # 2941
	■ LAB # 2940

EBASCO SERVICES INCORPORATED

APACHE JCT FRS
PROJECT

DRAWN BY	CHECKED BY	DATE
V BOLAND	SG	11-8

GRADATION RANGE OF BORROW AREA SOILS

4-3 III

FORM #14

III F STRUCTURAL DESIGN

F. STRUCTURAL DESIGN

F.1 General

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 ft additional fill
Drainage	3 in. diameter weep holes @ 8 ft.backed by longitudinally continuous filters.

The drainage will effectively reduce the uplift to an amount well below the gravity forces.

Minimum wall thickness has been established as ten inches. A one-inch wearing allowance is provided on the bottom slab of the chann joints are provided between the slab and the walls.

Doweled expansion joints will be provided at intervals of 30 the floodway.

Alternatives examined in the study and design phases, in a minor changes in some of those items described above, were a

1. Inlets locations were moved to correspond to corrected natural drainage channels.

2. Inlets 4C, 5B, and 6A were changed from overflow weir to curved side channel inlets to reduce extensive ponding which would occur because of the topography.

F. STRUCTURAL DESIGN

F.1 General

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 ft additional fill
Drainage	3 in. diameter weep holes @ 8 ft.backed by longitudinally continuous filters.

The drainage will effectively reduce the uplift to an amount well below the gravity forces.

Minimum wall thickness has been established as ten inches. A one-inch wearing allowance is provided on the bottom slab of the channels. Keyed joints are provided between the slab and the walls.

Doweled expansion joints will be provided at intervals of 30 feet along the floodway.

Alternatives examined in the study and design phases, in addition to minor changes in some of those items described above, were as follows:

1. Inlets locations were moved to correspond to corrected locations of natural drainage channels.

2. Inlets 4C, 5B, and 6A were changed from overflow weir to curved side channel inlets to reduce extensive ponding which would occur because of the topography.

3. Inlet 4G was changed from overflow weir to curved side channel inlet to eliminate the hydraulic interference caused by the short floodway reach between inlet 4F and 4G.

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. Road bridge abutment walls at Ironwood and Meridian Roads will be incorporated with the Bulldog Floodway channel walls to minimize construction costs.

7. Continuously reinforced U-shaped sections were chosen as compared with structurally independent retaining walls with a slab between the two walls. This was based on lower or equal cost and greater resistance to uplift by the integral section.

8. 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. Both were for reasons of aesthetics.

9. Washes will be filled behind inlets sufficient to eliminate ponding.

There are no utilities which will be affected by the Project known at this time.

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)

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 9/18/85 SHEET 2 OF 84

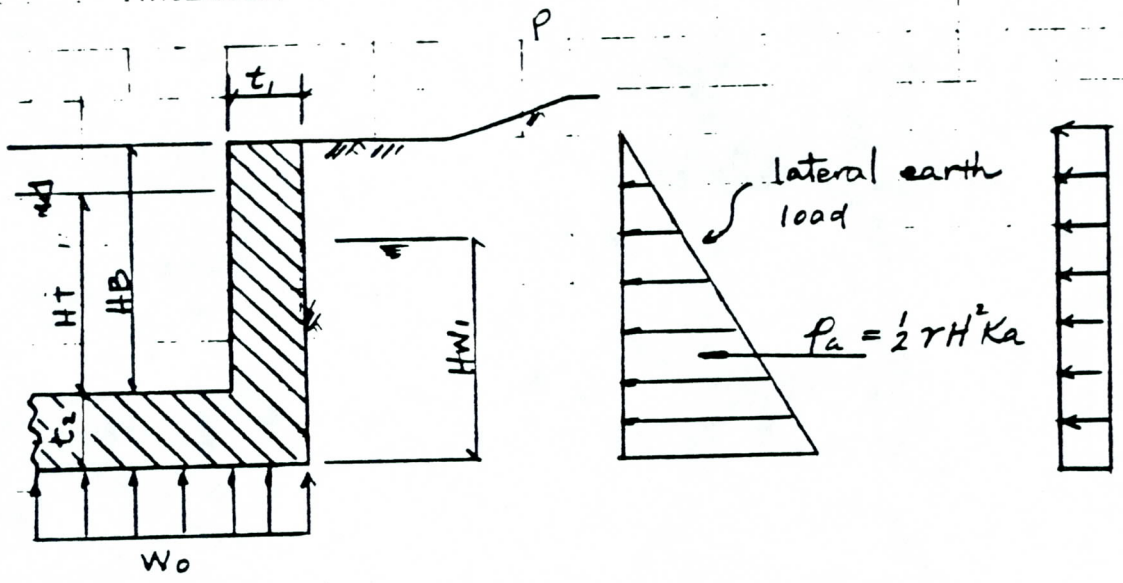
CHKD. BY P. Bodin DATE 9/19/85 OPS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT Assumptions for rectangular channel design

D: 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 : $78\#/' \times 2 = 156\#/'$

(5) $t_1 \geq 10$", $t_2 \geq 12$".

allow. soil bearing pressure ~~2500~~ 4000 psf

Coefficient of friction. soil to concrete ... 0.35

" soil to soil .55 (TR 50 P.7)

(6) $f_s = 40$ KSI. $f_c = 4$ KSI

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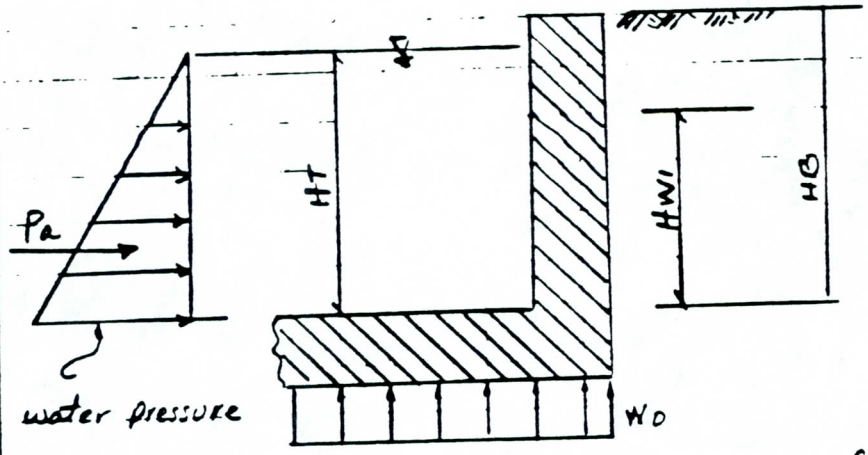
CHKD. BY P. Hall DATE 9/19/85
SHEET 3 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT Assumption for rectangular channel design :

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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OFS NO. 3767-300 DEPT. NO. 523

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY WATER PROFILE

STATION NO	WATER HT.		CHANNEL SLOPE
101+50	2.5		.012
101+55	1.23		
101+90	1.43		
102+47	1.73		
103+59	2.18		
115+10	2.18		
115+63	3.31	4A	.005
121+63	3.31		
122+05	3.13		.014
122+82	2.97		
124+38	2.83		
127+58	2.77		
128+54	2.77		.0085
128+83	2.84		
129+47	2.96		
130+58	3.13		
132+20	3.31		
132+72	3.76	4B	.0061
137+75	3.76		
138+41	4.34	4C	.0052
140+00	4.34		
140+20	3.02		
140+48	3.08		
141+26	3.22		
142+51	3.42		
145+94	3.69		
149+44.5	3.69		
149+75	5.51	4D	
149+97.5	4.62		
153+82.5	3.69		
154+55	7.54		
154+74	4.75		

STATION NO	WATER HT.		CHANNEL SLOPE
155+46	4.6		.0495
156+00	4.54		
156+30	2.97		
156+48	3.0		
157+14	3.13		
158+18	3.29		
159+87	3.50		
163+55	3.69		
164+40	3.69		
164+70	5.30		
165+03	4.10		
165+87	3.90		
168+79	3.74		
168+86	3.74		
169+54	3.74	4G	.0051
171+27.5	3.74		
171+55	4.25	4H	
171+76	4.20		
172+35	4.10		
173+47	4.10		
177+69	3.89		
182+80	3.89		.0051
184+40	4.87	5A	
187+00	4.87		
187+65	4.85	5B	.0051
189+40	5.02		
190+38	4.98		
192+37	4.93		
194+30	4.90		
201+37	5.10		
202+00	5.83		
203+00	5.50		

581/8-81

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SHEET 4-1 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY WATER PROFILE

STATION No	WATER HT	CHANNEL SLOPE
203+00	4.17	
204+10	2.03	
205+00	1.27	

581/8-81

* BEAM ON ELASTIC FOUNDATION

A): $t = 11''$

$k = 100$ kip/cu. ft

$k_s' = 1 \times 100 = 100$ KIP/SQ. FT.

$E_c = \omega^{1.5} \times 33\sqrt{f_c'} = 145^{1.5} \times 33 \times (4000)^{1/2} = 3.644 \times 10^6$ psi

$= 5.247 \times 10^5$ KSF.

$I = \frac{1}{12}(1)\left(\frac{11}{12}\right)^3 = .0641878$ ft^4

$\lambda = \left(\frac{K_s'}{4EI}\right)^{1/4} = \left(\frac{100}{4(5.247)\times 10^5 \times .0641878}\right)^{1/4} = .16506$

$\lambda L = .16506 \times 22 = 3.63313 > 3.1416$.

$t = 15''$

$I = \frac{1}{12}(1)\left(\frac{15}{12}\right)^3 = 0.16276$.

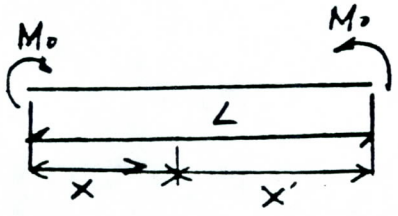
$\lambda = \left(100/4 \times 5.247 \times 10^5 \times 16276\right)^{1/4} = .1308$

$t = 13''$

$I = \frac{1}{12}(1)\left(\frac{13}{12}\right)^3 = .1059$

$\lambda = \left(\frac{K_s}{4EI}\right)^{1/4} = \left(\frac{100}{4 \times 5.247 \times 10^5 \times .1059}\right)^{1/4} = .14564$

B): * $M = \frac{M_0}{\sinh\lambda L + \sin\lambda L}\left(\sinh\lambda x \cos\lambda x' + \cosh\lambda x \sin\lambda x' + \sinh\lambda x' \cos\lambda x + \cosh x' \sin\lambda x\right)$



* "BEAM ON ELASTIC FOUNDATION" BY M. HETENYI P. 51

A): $L = 18'$

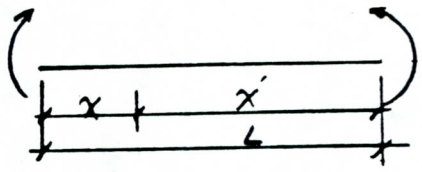
$\lambda = .16506$

$\lambda L = 2.97108$.

$$M = \frac{M_o}{\sin\lambda L + \sinh\lambda L}\left(\sinh\lambda x \cos\lambda x' + \cosh\lambda x \sin\lambda x' + \sinh\lambda x' \cos\lambda x + \cosh\lambda x' \sin\lambda x\right)$$

$\sin\lambda L = 0.169 \quad \sinh\lambda L = 9.731$

$M = 0.101\ M_o A$.



1. FOR $x = 6' \quad x' = 12' \quad \lambda x = 0.99, \ \lambda x' = 1.981$

$A = 1.16 \times (-0.40) + 1.53 \times 0.92 + 3.56 \times .55 + 3.69 \times .836$

$= -0.46 + 1.41 + 1.96 + 3.08 = 6.0$

$M = 0.101 \times 3.0 = 0.61\ M_o$. ←

2. FOR $x = 2' \quad x = 16' \quad \lambda x = 0.33012 \quad \lambda x' = 2.64096$

$A = .336 \times -.877 + 1.055 \times 0.48 + 6.98 \times .946 + 7.05 \times .324$

$= -.30 + 0.51 + 6.60 + 2.28 = 9.1$

$M = 0.101 \times 9.1\ M_o = 0.92\ M_o$ ←

3. FOR $x = 4' \quad x = 14' \quad \lambda x = .66024, \ \lambda x' = 2.31$

$A = (.71 \times -.67 + 1.226 \times 0.74 + 4.99 \times 0.79 + 5.08 \times 0.613)$

$= -.48 + 0.91 + 3.94 + 3.11 = 7.48$

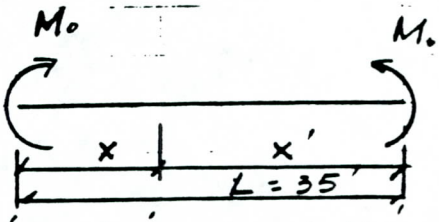
$M = 0.101 \times 7.48 = 0.75\ M_o$ ←

4. FOR $x = 3'$

$A = \frac{0.92 + 0.75}{2} M_o = 0.84\ M_o$ ←

B) $L = 35'$ $\lambda = .14564$ $t = 1'-1$

$\lambda L = .14564 \times 35 = 5.097 > \pi$



$\sin \lambda L = -.927$ $\sinh \lambda L = 81.76$

$$M = \frac{M_o}{\sin \lambda L + \sinh \lambda L} (\sinh \lambda x \cos \lambda x' + \cosh \lambda x \sin \lambda x' + \sinh \lambda x' \cos \lambda x + \cosh \lambda x \sin \lambda$$

$$= \frac{M_o}{-.927 + 81.76} A = .012371 M_o A$$

FOR $x = 4.0$ $\lambda x = .58256$ $\lambda x' = 4.51484$ $x' = 31.0'$

$A = .616075 \times -.1962 + 1.1745 \times -.9805 + 45.676 \times .83506 + 45.687 \times .5502$

$= -.12 + (-1.15) + 38.14 + 25.14 = 62.01$

$M = .012371 \times 62.1 M_o = 0.767 M_o$

$x = 6.0$ $\lambda x = 0.87384$ $\lambda x' = 4.22356$ $x' = 29.0'$

$A = .98937 \times (-.46960) + 1.4067 \times -.8829 + 34.13 \times .6419 + 34.15 \times .7668)$

$= -.465 + -1.242 + 21.91 + 26.18 = 46.38$

$M = .012371 \times 46.38 = 0574 M_o$

$x = 8.0$ $\lambda x = 1.165$, $x' = 27$ $\lambda x' = 3.932$

$A = 1.447 \times -.704 + 1.759 \times -.7106 + 25.49 \times .3947 + 25.51 \times .9187$

$= -1.02 + (-1.25) + 10.06 + 23.44 = 31.23$

$M = .01237 \times 31.23 = 0.3864 M_o$

$x = 10.0$ $\lambda x = 1.4564$ $x' = 25$ $\lambda x' = 3.641$

$A = 2.029 \times -.877 + 2.262 \times -.479 + 19.05 \times .1141 + 19.07 \times .9934$

$= -1.78 + -1.08 + 2.17 + 18.94 = 18.25$

$M = .01237 \times 18.25 = .226 M_o$

B): $X = 12.0$ $\lambda X = 1.74768$ $X' = 23.$ $\lambda X' = 3.350$

$A = 2.7835 \times -.9784 + 2.9577 \times -.2070 + 14.234 \times -.1760 + 14.27 \times .9843$

$= -2.723 - .612 - 2.51 + 14.04 = 8.20$

$M = 0.10\ M_o$

$x = 14.0$ $\lambda X = 2.039.$ $X' = 21'$, $\lambda X' = 3.0584$

$A = (3.7764 \times -.9965 + 3.9065 \times .0831 + 10.623 \times -.451 + 10.67 \times .892)$

$= -3.76 + 0.32 + (-4.79) + 9.52 = 1.29$

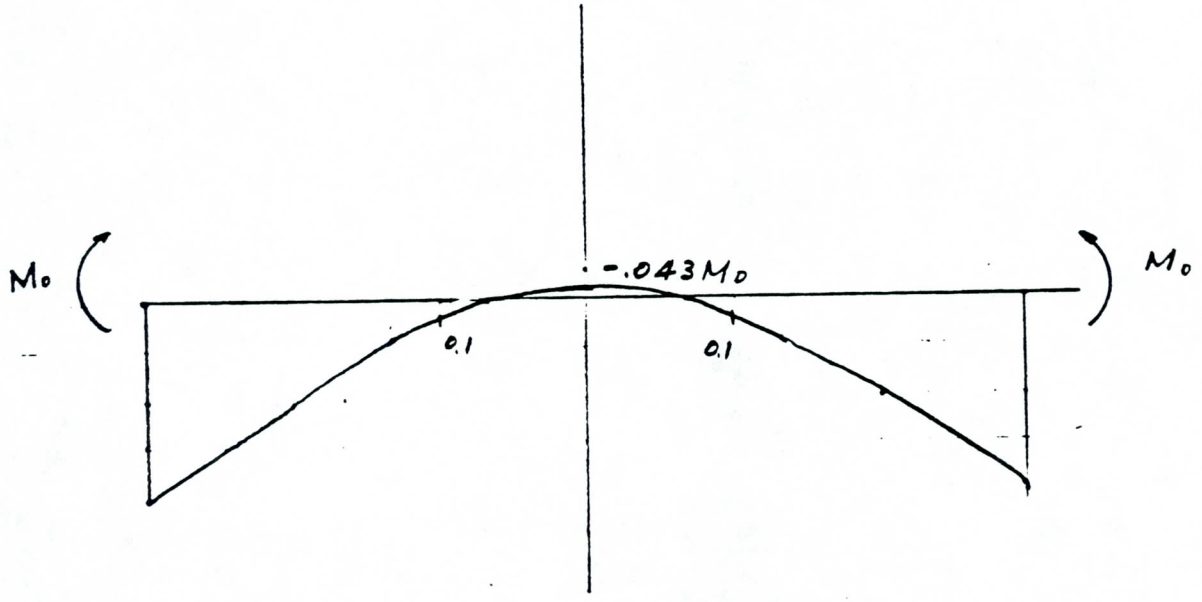
$M = 0$

$x = 17.5'$ $\lambda L/2 = 2.5485$

$$M = 2M_o \frac{\sinh\frac{\lambda L}{2}\cos\frac{\lambda L}{2} + \cosh\frac{\lambda L}{2}\sin\frac{\lambda L}{2}}{\sin\lambda L + \sinh\lambda L}$$

$= .024742 \cdot (6.35 \times -.8292 + 6,433 \times .559)$

$= .024742\,(-5.2654 + 3.5960) = -.0413\ M_o$



$L = 35'$

$\lambda = .16506 \qquad t = 11''$

$\lambda L = 5.777$

$\sin \lambda L = -0.484, \quad \sinh \lambda L = 161.393$

$$M = \frac{M_o A}{-.484 + 161.393} = .006215\, M_o A$$

1) $X = 6'-0 \qquad X' = 29'$

$\lambda X = .99036 \qquad \lambda X' = 4.78674$

$A = 1.16 \times .0742 + 1.532 \times -1.0 + 59.95 \times .5484 + 59.96 \times .8362$

$= 0 + (-1.532) + 32.87 + 50.14 = 81.47$

$M = 0.506\, M_o$

2) $X = 8.0 \qquad X' = 27.'$

$\lambda X = 1.32048, \quad \lambda X' = 4.456$

$A = 1.739 \times (-.25) + 2.0 \times (-.96) + 43.07 \times .2477 + 43.08 \times .9688$

$= -0.4 - 1.92 + 10.67 + 41.74 = 50.10$

$M = 0.311\, M_o$

$X = 10. \qquad X' = 25$

$\lambda X = 1.6506 \qquad \lambda X' = 4.1265$

$A = 2.51 \times (-.55) + 2.7 \times (-.833) + 30.97 \times (-.08) + 30.99 \times 1.0$

$= -1.4 - 2.2 - 2.5 + 31 = 24.9$

$M = 0.155\, M_o$

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BY N. Hung DATE 1/16/86
CHKD. BY [illegible] DATE 1/17/86
SHEET 10 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT ~~USDA SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 22' WIDE CHANNEL.

C): $L = 22'$ $\lambda = .1308$ $(t = 15'')$

$\lambda L = 22 \times 0.1308 = 2.8776$

$\sin \lambda L = .26093$

$\sinh \lambda L = 8.8576$

$$M = \frac{M_o}{\sin \lambda L + \sinh \lambda L} (\sinh \lambda x \cos \lambda x' + \cosh \lambda x \sin \lambda x' + \sinh \lambda x' \cos \lambda x + \cosh \lambda x' \sin \lambda x)$$

$$= \frac{M_o}{.26093 + 8.8576} \quad A = 0.1097 M_o A$$

FOR $x = 7'$ $x' = 15'$ $\lambda x = 0.9156$ $\lambda x' = 1.962$

$A = 1.049 \times -.3813 + 1.4493 \times .92445 + 3.486 \times .6093 + 3.627 \times .7929$

$= -0.4 + 1.340 + 2.124 + 2.876 = 5.94$

$M = 0.652 M_o$

FOR $x = 8'$ $x' = 14'$ $\lambda x = 1.0464$ $\lambda x' = 1.8312$

$A = 1.2481 \times (-.25747) + 1.5993 \times .96628 + 3.04057 \times 0.5007 + 3.2008 \times .8656$

$= -0.3213 + 1.5454 + 1.5224 + 2.771 = 5.5175$

$M = .605 M_o$

FOR $x = 11'$ $\lambda L/2 = 1.4388$

$$M_c = 2M_o \frac{\sinh \frac{\lambda L}{2} \cos \frac{\lambda L}{2} + \cosh \frac{\lambda L}{2} \sin \frac{\lambda L}{2}}{\sin \lambda L + \sinh \lambda L}$$

$$= 2M_o \frac{1.9892 \times .1316 + 2.2264 \times .9913}{.26093 + 8.8576} = \frac{4.9376 M_o}{9.1185} = 0.5415 M_o$$

$x = 9'$ $M_c = .5415 + \frac{2}{3}(.605 - .5415) = .584 M$

$L = 22'$ $\pm = 11''$ $\lambda = .16506$

$\lambda L = 3.6313 > \pi$

$M = .0544247\ A\ M_o$

1) $X = 3.0$ $x' = 19$ $\lambda X = .495$, $\lambda x' = 3.136$

$A = .5154 \times -1.0 + 1.125 \times .006 + 11.48 \times .8799 + 11.51 \times .475$

$= 15.06$

$M = 15.06 \times .0544247\ M_o = 0.82\ M_o$

2) $X = 5.0$

$A = 11.256$

$M = .6126\ M_o$

3) $X = 7.0$ $A = 7.81$

$M = .425\ M_o$

4) $X = 11.0$

$M = 0.2542\ M_o$

5) $X = 8.0$ $A = 6.47$ $M = 0.352\ M_o$

$SIN\lambda L = 4692$

D : $\lambda = .14564$ $L = 50$ $(t = 1'-1)$

$\lambda L = 7.28 > 3.14$

$$M = \frac{M_o}{\sin\lambda L + \sinh\lambda L}(\sinh\lambda x \cos\lambda x' + \cosh\lambda x \sin\lambda x' + \sinh\lambda x' \cos\lambda x + \cosh\lambda x' \sin\lambda x)$$

$$= \frac{M_o}{725.5 + .8} A = .0013768\, M_o A$$

$x = 7'-0$ $\lambda x = 1.01948$, $x' = 43$ $\lambda x' = 6.26252$

$A = (1.21 \times 1.0 + 1.57 \times -.021 + 262.3 \times 0.523 + 262.3 \times .852)$

$= 1.21 + 0 + 137.2 + 223.5 = 361.9$

$M = 0.50\, M_o$

$x = 11'-0$ $x' = 39$. $\lambda x = 1.60$ $\lambda x' = 5.68$

$A = (2.38 \times .824 + 2.58 \times (-.57) + 146.5 \times (-.03) + 146.5 \times 1.0$

$= 1.96 - 1.47 - 4.4 + 146.5 = 142.6$

$M = 0.196\, M_o$

$x = 12'-0$ $x' = 38$ $\lambda x = 1.748$, $\lambda x' = 5.534$

$A = (2.78 \times 0.73 + 2.96 \times -.68 + 126.6 \times -.176 + 126.6 \times .984)$

$= 2.02 - 2.0 - 22.3 + 124.6 = 102.3$

$M = 0.141\, M_o$

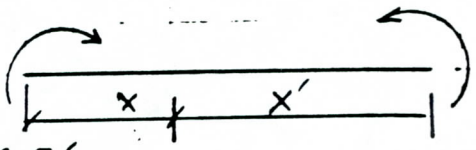
$x = 6'-0$ $x' = 44'$ $\lambda x = .8738$, $\lambda x' = 6.40816$

$A = .99 \times 1.0 + 1.41 \times .124 + 303.4 \times .642 + 303.4 \times .767$

$= 1.0 + .2 + 195 + 232.7 = 429.$

$M = .59\, M_o$

E): $L = 50'$ $\lambda = .16506$ ($t = 11''$)



$\lambda L = 8.253 > \pi$

$\sin \lambda L = .92144$ $\sinh \lambda L = 1919.56$

$$M = \frac{M_o}{.92144 + 1919.56} (\sinh \lambda x \cos \lambda x' + \cosh \lambda x \sin \lambda x' + \sinh \lambda x' \cos \lambda x + \cosh \lambda x' \sin \lambda$$

$= .0005207 M_o A$

(1) $x = 4'-0$ $\lambda x = 0.66024$ $x' = 46$ $\lambda x' = 7.59,276$

$A = .710 \times .2582 + 1.226 \times .9661 + 991.89 \times .7898 + 991.89 \times 0.6133$

$= 0.18 + 1.18 + 783.4 + 608.32 = 1393.08$

$M = .0005207 \times 1393.08 = 0.725 M_o$

$x = 6'-0$ $\lambda x = .9904$ $x' = 44$ $\lambda x' = 7.2626$

$A = 1.1604 \times .5575 + 1.226 \times .830 + 712.98 \times .5483 + 712.98 \times .8362$

$= .65 + 1.02 + 390.93 + 596.19 = 988.8$

$M = .51486 M$

$x = 8'-0$ $\lambda x = 1.32048$. $\lambda x' = 6.93252$

$A = 1.74 \times .796 + 2.01 \times .604 + 512.53 \times .2477 + 512.54 \times .9688$

$= 1.39 + 1.21 + 126.95 + 496.54 = 626.1$

$M = 0.326 M_o$

$x = 14.0$ $\lambda x = 2.31084$ $x' = 36'$ $\lambda x' = 5.94216$

$A = 4.99 \times .942 + 5.091 \times -.3344 + 190.37 \times -.674 + 190.38 \times .7384$

$= 4.70 + (-1.70) + (-128.31) + 140.57 = 15.26$

$M = .008 M_o$

E) $x = 25'$ $\lambda L/2 = 4.12$

$$M = \frac{2M_o\left(\sinh\frac{\lambda L}{2}\cos\frac{\lambda L}{2} + \cosh\frac{\lambda L}{2}\sin\frac{\lambda L}{2}\right)}{\sin\lambda L + \sinh\lambda L}$$

$$= \frac{2M_o \quad (30.972(-.553) + 30.988(-.833)}{.92144 + 1919.56}$$

$$= \frac{2M_o(-17.128 - 25.813)}{1920.48} = -.045\,M_o$$

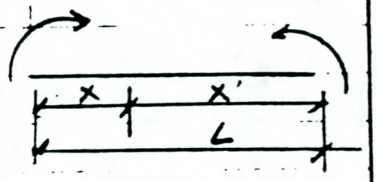
$x = 11'$ $x' = 39$ $\lambda x = 1.81566$, $\lambda x' = 6.43734$

$$A = 2.9912 \times .988 + 3.1539 \times .1535 + 312.37 \times (-.2424) + 312.37 \times .9702$$
$$= 2.96 + .48 + (-75.7) + 303.06 = 230.8$$

$$M = 0.120\,M_o$$

F) $L = 28'$ $\lambda = .1308$ $(t = 15")$

$\lambda L = .1308 \times 28 = 3.662 > 3.14$



$\sin\lambda L = -.4972$ $\sinh\lambda L = 19.4567$

$$M = \frac{M_0}{\sin\lambda L + \sinh\lambda L}\left(\sinh\lambda x \cos\lambda x' + \cosh\lambda x \sin\lambda x' + \sinh\lambda x' \cos\lambda x + \cosh\lambda x' \sin\lambda x\right)$$

$$= \frac{M_0}{-.4972 + 19.4567} A = .052744 M_0 A$$

(1) FOR $x = 7'-0$ $x' = 21$ $\lambda x = .9156$ $\lambda x' = 2.7468$

$A = 1.049 \times (-.9231) + 1.4493 \times 0.3846 + 7.7643 \times .6093 + 7.8284 \times .793$

$= -.9683 + 0.5574 + 4.7308 + 6.208 = 10.53$

$M = .555 M_0$

(2) FOR $x = 9'-0$ $x' = 19$, $\lambda x = 1.1772$, $\lambda x' = 2.485$

$A = 1.469 \times -.7921 + 1.7767 \times .6104 + 5.96 \times .3835 + 6.04 \times .9235$

$= -1.163 + 1.084 + 2.285 + 5.578 = 7.784$

$M = 0.4106 M_0$

(3) $x = 11'-0$ $x' = 17$. $\lambda x = 1.4388$, $\lambda x' = 2.2236$

$A = 1.9892 \times (-.6074) + 2.2264 \times .7943 + 4.566 \times .1316 + 4.6743 \times .9913$

$= -1.208 + 1.7684 + 0.60 + 4.6336 = 5.794$

$M = 0.3056 M_0$

(4) $x = 14'$ $\lambda L/2 = 1.831$

$$M = 2M_0 \frac{\sinh\frac{\lambda L}{2}\cos\frac{\lambda L}{2} + \cosh\frac{\lambda L}{2}\sin\frac{\lambda L}{2}}{\sin\lambda L + \sinh\lambda L} = \frac{2M_0}{19.4567 - .4972}(-3.04 \times .2572$$

$$+ 3.20 \times .9663) = \frac{4.62 M_0}{18.9595} = 0.244 M_0$$

$L = 25'$ $t = 11$ $\lambda = .16506$

$\lambda L = .16506 \times 28 = 4.62168 > \pi$

$\sin \lambda L = -.9956$, $\sinh \lambda L = 50.5274$

$$M = \frac{M_c}{-.9956 + 50.5274} = .02 M_c$$

1) For $x = 3'\text{-}0$ $x' = 25$

$\lambda x = 0.495$ $\lambda x' = 4.1265$

$A = 9.515 \times -.553 + 1.125 \times -.833 + 30.97 \times 0.85 + 30.99 \times .475$

$= -.29 - .94 + 27.25 + 14.72 = 40.74$

$M = .02 \times 40.74 = 0.815 M_c$

2) For $x = 6'\text{-}0$ $x' = 22'$

$\lambda x = .99036$, $\lambda x' = 3.63132$

$A = 1.16 \times -.85 + 1.53 \times -.47 + 16.86 \times .54539 + 18.89 \times .836$

$= -1.02 - .72 + 10.34 + 15.80 = 24.4$

$M = .02 \times 24.4 = 0.49 M_c$

3) For $x = 8'\text{-}0$ $x' = 20$

$\lambda x = 1.32048$, $\lambda x' = 3.3012$

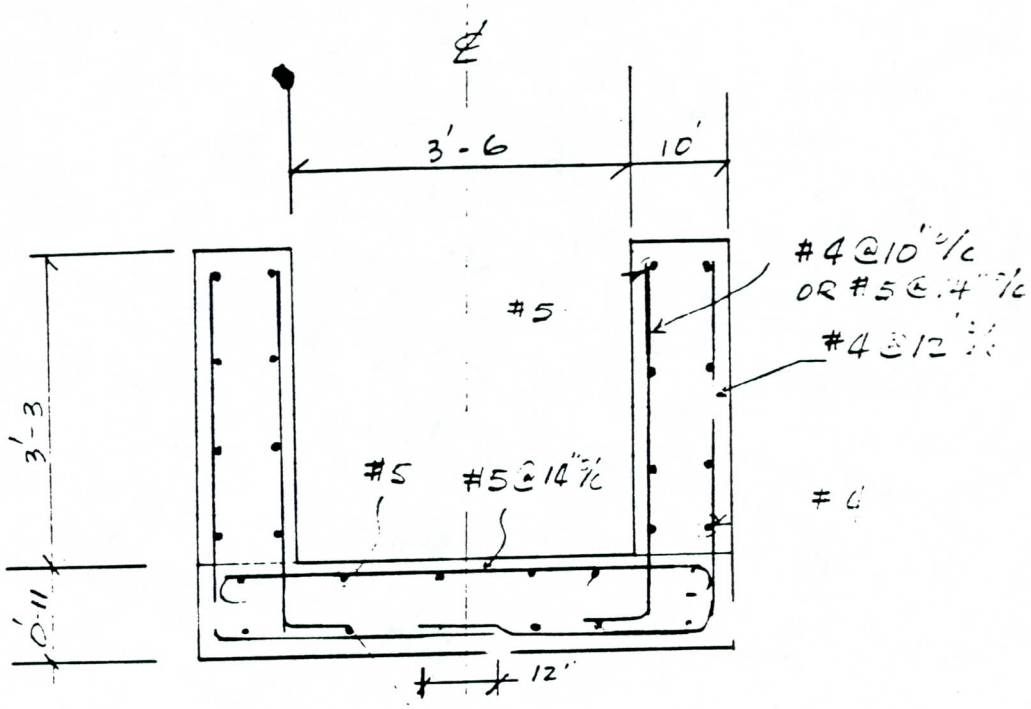
$A = 1.74 \times -.99 + 2.0 \times 0.16 + 13.55 \times 0.2477 + 13.59 \times 0.967$

$= -1.73 + 0.32 + 3.36 + 13.17 = 15.11$

$M = .02 \times 15.11 = 0.303 M_c$

EBASCO SERVICES INCORPORATED

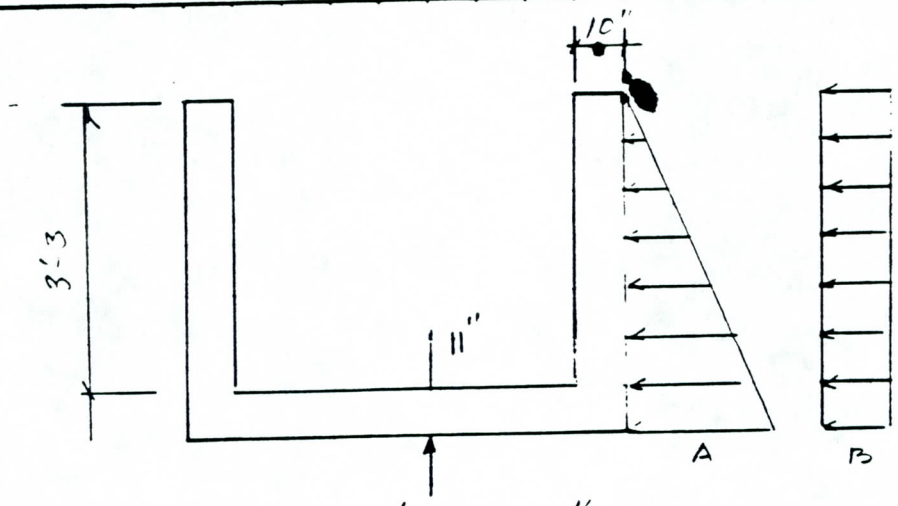
BY N. Young DATE 10/14/85
CHKD. BY [illegible] DATE 10/15/85
SHEET 17 OF 84
OFS NO. 3767-30[illegible] DEPT. NO. 21[illegible]
CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT 2-45 2-62
SUBJECT BULLDOG FLOODWAY 3'-6 WIDE CHANNEL DWG 2-5[illegible]



#4

III F-20

BY N. H... DATE 10/14/85
CHKD. BY T. B... DATE 10/15/85
SHEET 18 OF 84
OFS NO. 3767-3... DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY RECTANGULAR CHANNEL



A: EQUIVALENT FLUID PRESSURE = 78 PCF

B: ADDITIONAL SURCHARGE LOAD = 156 PCF

H = 3.25'

WALL DESIGN: t = 10"

UNEXPOSED FACE: $M = \frac{1}{6} \times 78 \times 3.25^3 + 156 \times \frac{3.25^2}{2} = 446'^{\#}/' + 823 = 1270'^{\#}/'$

$P_u = \frac{1}{2} \times 78 \times 3.25^2 + 156 \times 3.25 = 411 + 507 = 918'^{\#}$

$M_u = 1.8 \times 1.27 = 2.3'^{K}/'$ $P_u = 1.8 P_u = 1652^{\#}/'$

$F = .049$ $K_u = 2.3/.049 = 47$ $1.33K_u = 62$ $f = .002$

$A_s = .002 \times 12 \times 7 = 0.16^{\square"}/'$ # 4 @ 12"/c

EXPOSED FACE: $.002 \times 12 \times 10 = .24^{\square"}/'$ # 5 @ 15½"/c

OK # 4 @ 12"/c

FOOTING: MIN REINFORCEING REQ'D BY INSPECTION

TOP BARS: $.002 \times 12 \times 11 = .264^{\square"}/'$ # 5 @ 14"/c

" $.001 \times 12 \times 11 = .132^{\square"}/'$ # 4 @ 12"/c

EBASCO SERVICES INCORPORATED

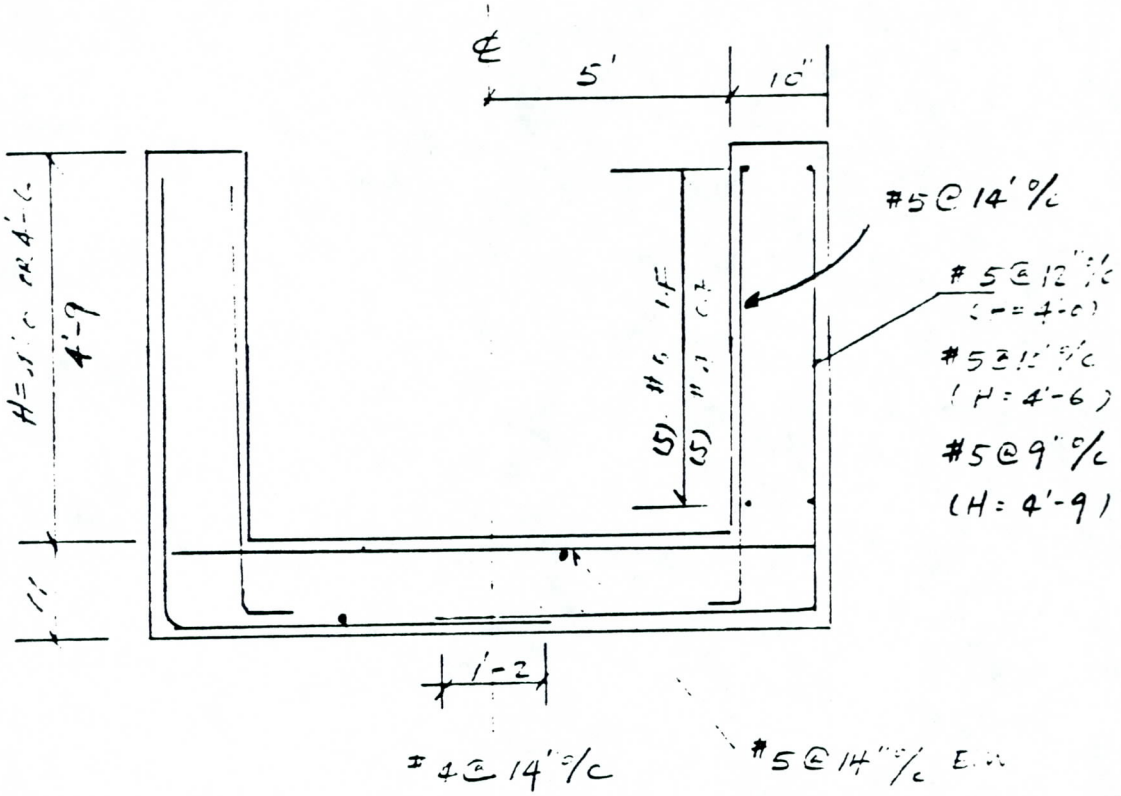
BY N. Hung DATE 10/14/86 SHEET 19 OF 84

CHKD. BY R. Brew DATE 10/15/86 OFS NO. 3767-300 DEPT. NO. 273

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT ~~APACHE-BULLDOG FLOOD CONTROL PROJECT~~

SUBJECT BULLDOG FLOODWAY 10' WIDE CHANNEL DWG 2-13 2-14 2-29



III F-22

581/8-81

10' x 4'-9 CHANNEL

H = 4'-9

A) WALL : UNEXPOSED FACE

$M = \frac{1}{6} \times 78 \times 4.75^3 + \frac{1}{2} \times 156 \times 4.75^2 = 1393 + 1760 = 3152^{1\#}/_{'}$

$M_u = 1.8M = 1.8 \times 3.15 = 5.67^{1K}/_{'}$

$K_u = 5.67/.049 = 116 \quad 1.33K_u = 154 \quad \rho = .0044$

$A_s = .0044 \times 12 \times 7 = 0.37$ #5@10"o/c

VERT. BAR : #5@10"o/c

HORIZ. " $A_{s\,min} = .01 \times 12 \times 10 = .12^{D"}/_{'}$ #4@14"o/c

EXPOSED FACE : $A_{s\,min} = .002 \times 12 \times 10 = 0.24^{D"}/_{'}$

#5@14"o/c

B) FOOTING : $t = 11" - 3 - 1 - \frac{1}{2} = 6.5" \quad F = .04225$

BOTTOM TRANS. BAR $K_u = 5.67/.04225 = 134.2$

$1.33K_u = 178 > 175 \quad \rho = .0050$

$A_s = .0050 \times 12 \times 6.5 = 0.39^{D"}/_{'}$ — #5@9"o/c

BOTTOM LONG BAR - $A_{s\,min} = .001 \times 12 \times 11 = .13^{D"}/_{'}$ #4@14"o/c

TOP BARS #5@14"o/c

$A_{s\,min} = .002 \times 12 \times 11 = 0.264^{D"}/_{'}$

10' x 4'-6 CHANNEL

H = 4.5 : UNEXPOSED FACE (VERT BARS) 1#/'

$M = \frac{1}{6} \times 78 \times 4.5^3 + \frac{1}{2} \times 156 \times 4.5^2 = 1185 + 1579 = 2764$

$M_u = 1.8M = 4.98$ 'K/'

$P_e = \frac{1}{2} \times 78 \times 4.5^2 + 156 \times 4.5 = 789 + 702 = 1491$ #/'

$V_u = 1.8 P_e = 2684$ #/'

t = 7"

$F = .049 \quad K_u = M_u/F = 4.98/.049 = 102 \quad 1.33 K_u = 135$

$\rho = .0038 \quad A_s = .0038 \times 12 \times 7 = 0.32$ □"/'

#5 @ 12" o/c

(THE EFFECTIVE $t = 10 - 2 - \frac{1}{2}" = 7.5"$)

$V_u = 2684/12 \times 7 = 32$ #/12" $< 2\phi\sqrt{f'_c} = 108$ #/12".

EXPOSED FACE (VERT BARS)

$A_{s\,min} = .002 \times 12 \times 10 = 0.24$ □"/' - #4 @ 10" o/c.

HORIZ BARS

UNEXPOSED FACE $.001 \times 12 \times 10 = .12$ □"/'

EXPOSED $.002 \times 12 \times 10 = .24$ □"/'

FOUNDATION:

TOP BARS: $A_{s\,min} = .002 \times 12 \times 11 = 0.264$ □"/' #5 @ 14" o/c

BOTTOM: $M = 4.98$ 'K/' $F = 6.5^2/1000 = .04225$

$K_u = M_u/F = 4.98/.04225 = 118 \quad 1.33 K_u = 157$

$\rho = .0045 \quad A_s = .0045 \times 6.5 \times 12 = 0.35$ □"/' —— #5 @ 10" o/c

10'x4'-0 CHANNEL

$H = 4.0'$

$M = \frac{1}{6} \times 78 \times 4^3 + \frac{1}{2} \times 156 \times 4^2$

$= 832'^{\#}/' + 1248 = 2080^{'\#}/' = 2.1^{'K}/'$

$M_u = 1.8 \times 2.1 = 3.78^{'K}/'$

REINF BAR @ BOTTOM OF FTG & O.F OF WALL

* FOR $t = 11'' - 3 - 1 - \frac{1}{2} = 6.5''$ $F = .04225$

$K_u = M_u/F = 3.78/.04225 = 90.$ $1.33 K_u = 119$

$\rho = .00337$ $A_s = .00337 \times 12 \times 6.5 = 0.27^{\square''}/'$ #5 @ 12"/c.

* REINF. @ O.F. OF WALL DETERMINED BY FOOTING REINF. STL

REINF. BARS @ I.F. OF WALL (E.W)

$A_{smin} = .001 \times 12 \times 11 = .132^{\square''}/'$ #4 @ 14"/c (MIN.)

TOP OF FTG. (E.W).

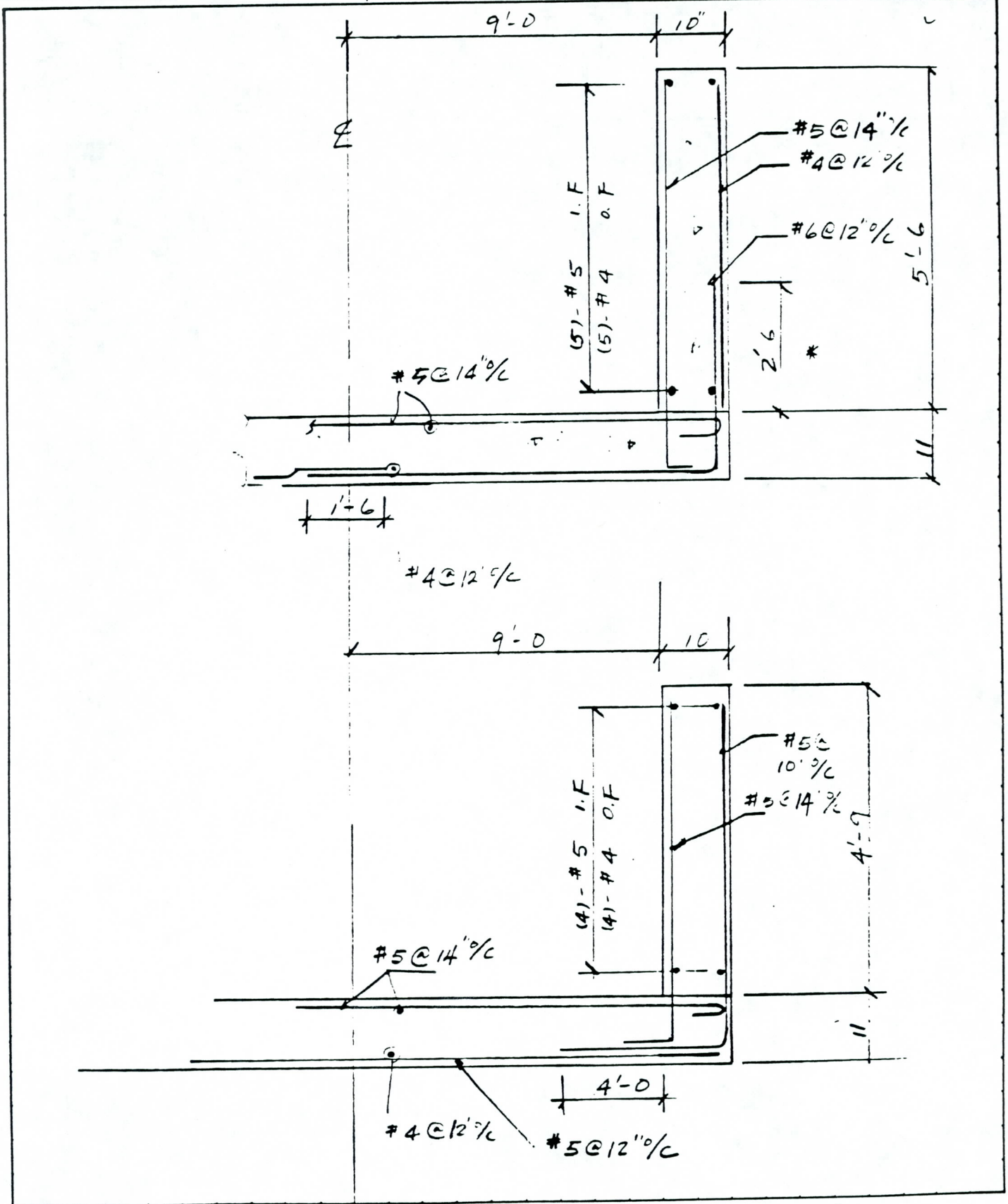
$A_{smin} = .002 \times 12 \times 11 = .264^{\square''}/'$ #5 @ 14"/c.

EBASCO SERVICES INCORPORATED

BY N.H. DATE 2/5/86
CHKD. BY T.B. DATE 2/6/86

SHEET 23 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 18'x5'-6 OR 18'x4'-9 CHANNEL



581/8-81

4'-9 HT. WALL
WALL DESIGN: SEE 10'x4'-9 CHANNEL

FOUNDATION: BOTTOM BAR (TRANSVERSE) (COEFF. SEE P.)

$X = 3'$ $M = 0.84 M_o = .84 \times 5.67 = 4.76^{'K}/_{'} > 4.44^{'K}/_{'}$

$X = 4'$ $M = 0.75 M_o = 0.75 \times 5.67 = 4.25^{'K}/_{'} < 4.44^{'K}/_{'}$

MOMENT CAPACITY OF #5@12"o/c

$\rho = .31/12 \times 6.5 = .00397$, $F = .04225$

$K_u = 140$ $M_u = 140 \times .04225 = 5.92^{'K}/_{'}$

$M = \frac{M_u}{1.33} = 5.92/1.33 = 4.44^{'K}/_{'}$

$X = 0$ STL. AREA REQ'D $= 0.39^{\square"}/_{'}$

STL. AREA PROVIDED: $0.31 \times \frac{12}{15} + 0.31 \times \frac{8}{12} = 0.[illegible] > 0.39^{\square"}/_{'}$

#5@10"o/c + #5@12"o/c

TOP BARS #5@14"o/c EACH WAY

$A_{s\,min} = .0012 \times 12 \times 11 = [illegible] < [illegible]$

#5@14"o/c

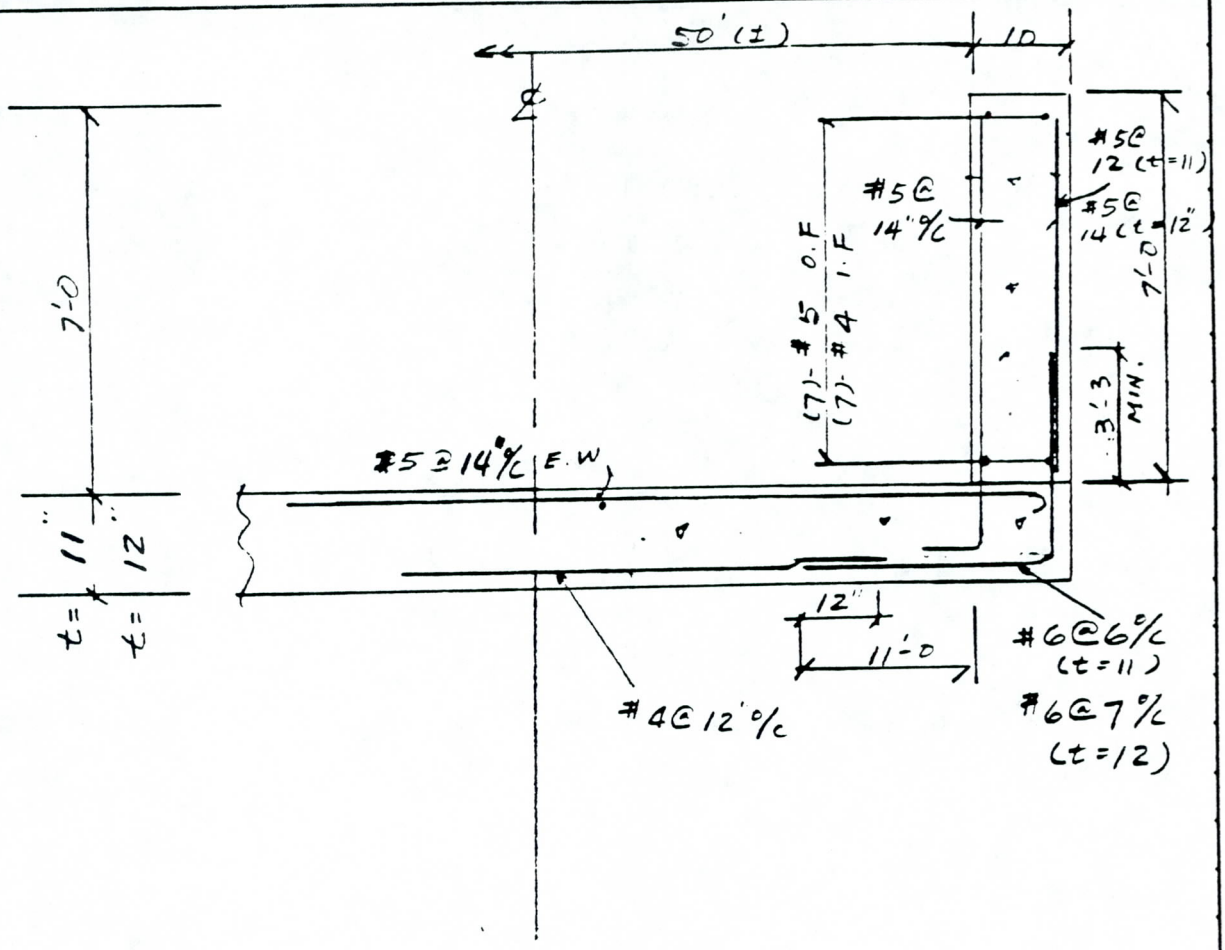
5'-6 HT. WALL SEE 22'x5'-6 CHANNEL DESIGN

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 2/4/86
CHKD. BY [illegible] DATE 2/6/86

SHEET 25 OF 84
OFS NO. 3767-307 DEPT. NO. 243

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 50'x7'-0 CHANNEL DWG 2-25, 2-36, 2-37



581/8-81

$M_0 = 14.9$ 'K/'

WALL DESIGN: SEE 22'x7'-0 CHANNEL

FOUNDATION DESIGN (t = 11")

BOTTOM BAR TRANSVERSE DIRECTION

X = 0. $M_u = 14.9$ 'K/' #6@6"o/c

X = 11.0 $M_u = 0.12$ $M_0 = 1.80$ 'K/'

FOR CAPACITY OF #4@12"o/c 11'-1-3-0.5 = 6.5'

$\rho = \frac{0.20}{12 \times 6.5} = .00256$ $F = 0.04225$, $K_u = 90.6$

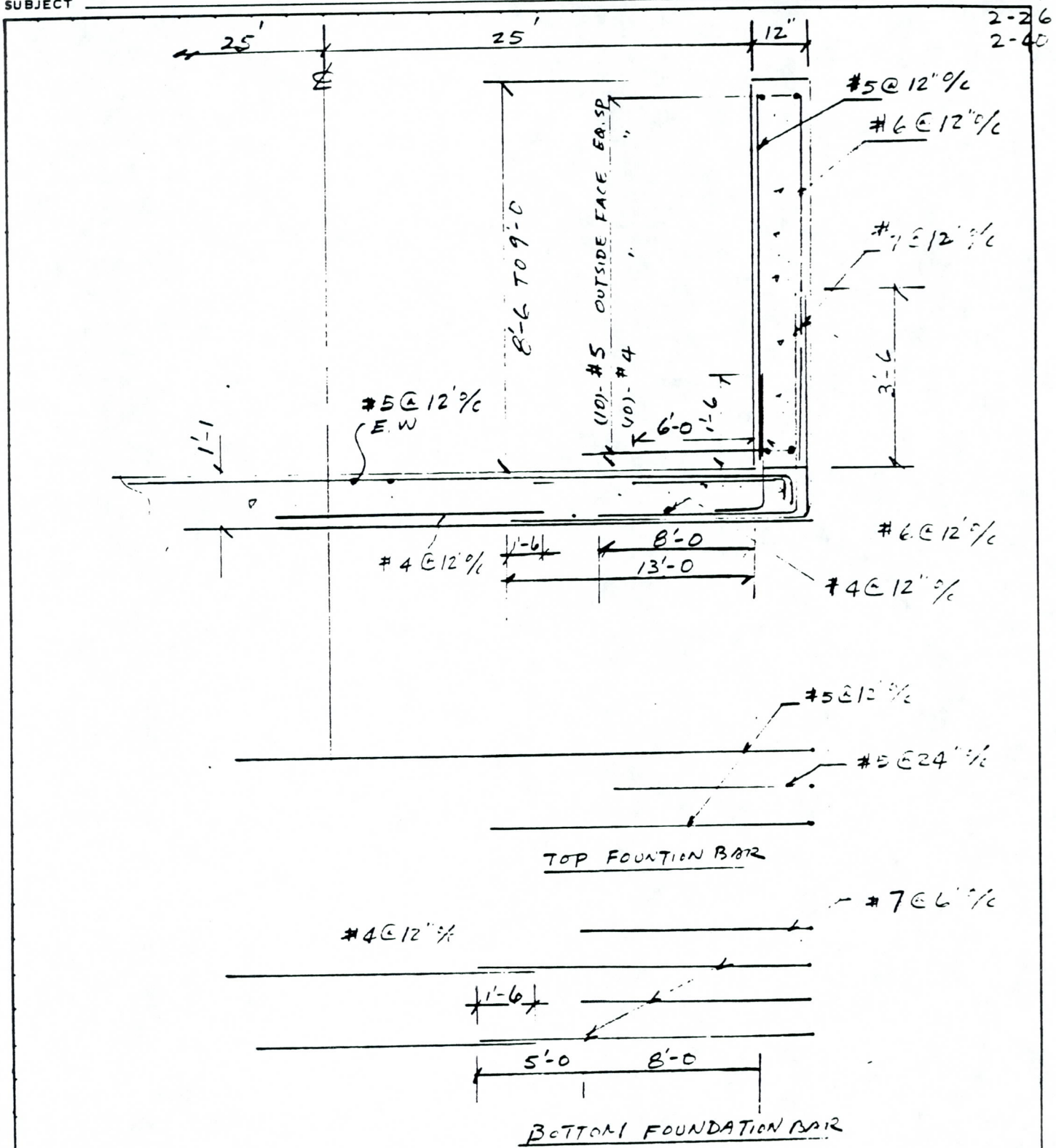
$M_u = K_u F = 90.6 \times 0.04225 = 3.83$ 'K/'

$M_u/1.33 = 2.87$ 'K/' > 1.80 'K/'

FOR t = 12" #6@7 o/c

FOR INFORMATION NOT SHOWN SEE 22'x7'-0 CHANNEL

BY N. Hering DATE 1/29/86
CHKD. BY [illegible] DATE 2/3/86
SHEET 27 OF 84
OFS NO. 3767-400 DEPT. NO. 243
CLIENT ~~USDA SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT 50' WIDE CHANNEL (9'-0) DWG 2-28 2-24 2-26 2-40



A): WALL DESIGN:

UNEXPOSED WALL : VERT. BARS :

$M = \frac{1}{6}\times 78\times 9^3 + \frac{1}{2}\times 156\times 9^2 = 9477 + 6315 = 15792^{\#/'}$

$M_u = 1.8M = 28.43^{'K/'}$ $F = 12\times 9^2/12000 = .081$

$K_u = M_u/F = 28.43/.091 = 331$ $\rho = .0105$

$A_s = .0105\times 12\times 9 = 1.134^{\square''/'}$ #7 @ 6" o/c

$V_u = 1.5(\frac{1}{2}\times 78\times 9^2 + 156\times 9) = 1.8(3160+1404) = 8312^{\#/'}$

$v_u = 8312/12\times 9 = 769^{\#/\square''} < 2\phi\sqrt{f_c'} = 107^{\#/\square''}$ O.K

H = 5'-6 $M1 = \frac{1}{6}\times 78\times 5.5^3 + \frac{1}{2}\times 156\times 5.5^2 = 2162+2360 = 4522^{\#/'}$

$= 4.5^{'K/'}$

$M_u = 1.8M1 = 8.14^{'K/'}$

$K_u = 8.14/.091 = 100.5$ $1.33K_u = 134$

$\rho = .0038$ $A_s = .0038\times 12\times 9 = 0.41^{\square''/'}$ #6 @ 12" o/c

HORIZ. BARS $A_{s\,min} = .01\times 12\times 12 = 0.15^{\square''/'}$ #4 @ 12" o/c

EXPOSED WATER HT = 8'-0

$M = \frac{1}{6}\times 62.4\times 8^3 = 5325^{'\#/'} = 5.33^{'K/'}$

$M_u = 1.8M1 = 9.59^{'K/'}$

$K_u = M_u/F = 9.59/.081 = 118.$ $1.33K_u = 157$

$\rho = .0045$ $A_s = .0045\times 9\times 12 = 0.486$ #6 @ 11" o/c

TRY t = 9.5" (12-2-0.5 = 9.5")

$F = 9.5^2/1000 = .09025$

$K_u = 9.59/.09025 = 106$ $\rho = .0030$ $1.33\rho = .004$

$A_s = .004\times 12\times 9.5 = .456^{\square''/'}$ — #6@11½" o/c

SINCE WT. HT is 7.89' INSTEAD 8'0 USE #6 @ 12" o/c

2. WATER HT = 8 - 1.5 = 6.5

$M = \frac{1}{6}\times 62.4\times 6.5^3 = 2856$ $M_u = 5140^{'\#/'}$

$K_u = 5.14/.081 = 63.4$ $1.33K_u = 84$.

$\rho = .00237$ $A_s = .00237 \times 12 \times 9 = 0.26^{sq.in.}/ft$

$A_{s\,min} = .002 \times 12 \times 12 = 0.29^{sq.in.}/ft$ #5 @ 12"o/c

HORIZONTAL BARS

(10)-#5 E. SPACING @ EXPOSED FACE

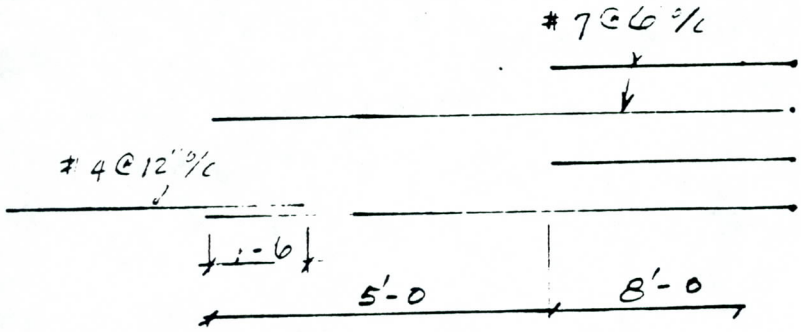
(10)-#4 " " UNEXPOSED FACE.

B) FOUNDATION: (COEF. SEE P.)

BOTTOM BARS: $M_i = 28.43^{k}/ft$

$x = 7'-0$ $M = 0.5 \times 28.43 = 14.20^{k}/ft$ #7 @ 12"o/c

$x = 12'-0$ $M = 0.140 \times$ " $= 3.98^{k}/ft$ — #4 @ 12"o/c



#7 @ 6"o/c

$\rho = 0.6/6 \times 8.5 = .0176$

$K_u = 393$ $F = 8.5^2/1000 = .07225$

$M_u = K_u F = 393 \times .07225 = 28.40^{k}/ft$

#4 @ 12"o/c $A_s = .20^{sq.in.}/ft$ $\rho = 0.20/12 \times 8.5 = .00196$

$K_u = 70$ $F = 8.5^2/1000 = .07225$

$M_u = K_u \cdot F = 70 \times .07225 = 5.05^{k}/ft$

$M_u = \frac{5.05}{1.33} = 3.80^{k}/ft$ — CAPACITY OF #4 @ 12"o/c

BY N. Hung DATE 1/29/86
CHKD. BY P.B[illegible] DATE 2/3/86
SHEET 30 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PRO[J]
SUBJECT BULLDOG FLOODWAY 50' x 9' CHANNEL

FOUNDATION : TOP BARS

MOMENT CAPACITY OF #5@12"o/c

$13 - 3 - 0.5 = 9.5"$

$F = .09025 \quad \rho = 0.31/12 \times 9.5 = .00270$

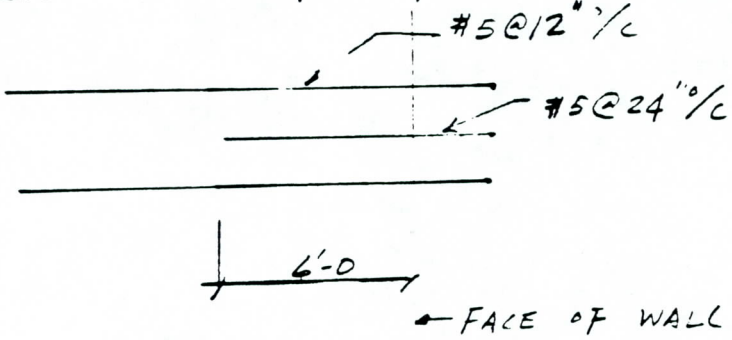
$K_u = 95 \quad M_u = K_u F = 95 \times .09025 = 8.57^{'K/'}$

$M_u/1.33 = 6.4^{'K/'}$ ←

$M_o = 9.59^{'K/'}$

$x = 0 \quad M = 9.59^{'K/'}$ #5@12"o/c + #5@24"o/c

$x = 6.0 \quad M = .59 \times 9.59 = 5.66^{'K/'}$ #5@12"o/c



EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/30/86

CHKD. BY [illegible] DATE 2/3/86

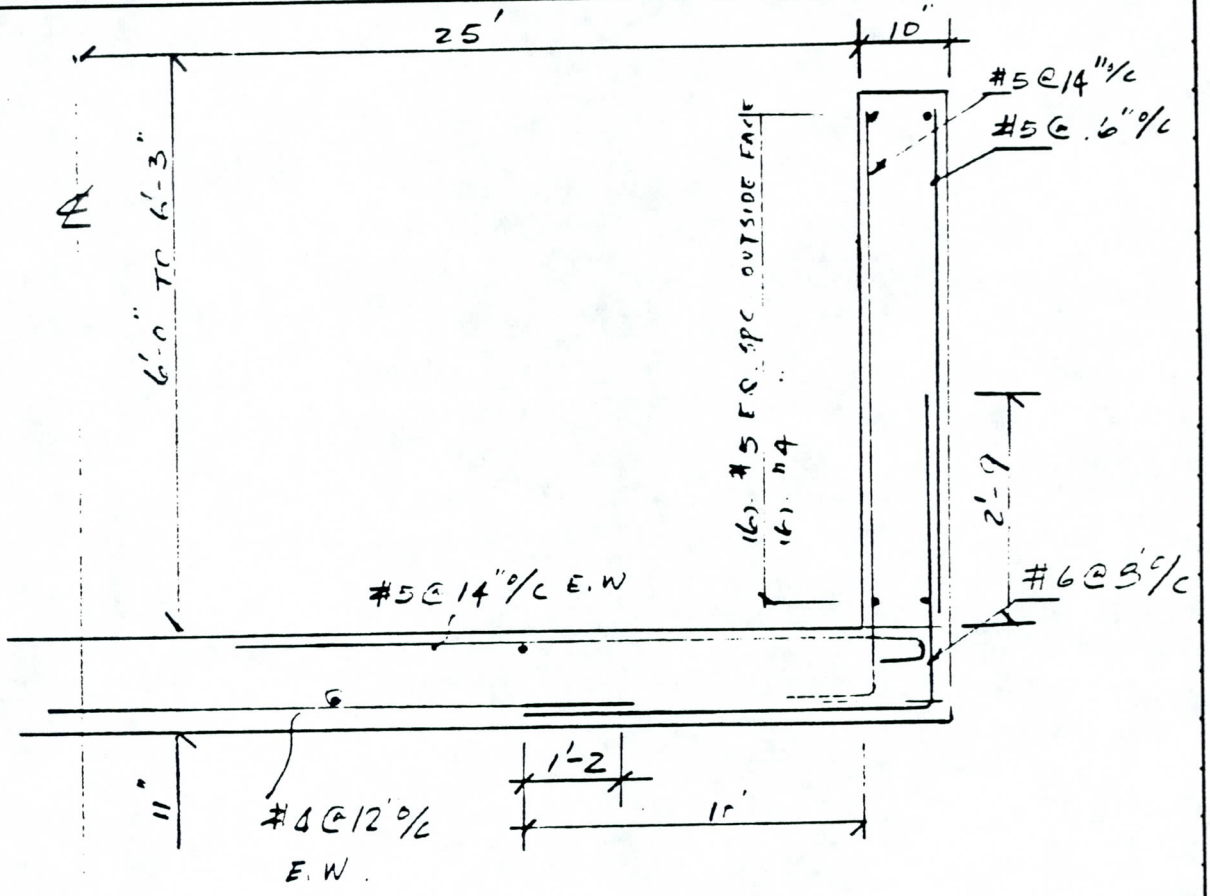
SHEET 31 OF 84

OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY 50' x 6'-3 CHANNEL (6'-0 TO 6'-3)



III F-34

581/8-81

WALL : SAME AS 22' WIDE x 6'-3" HT. CHANNEL

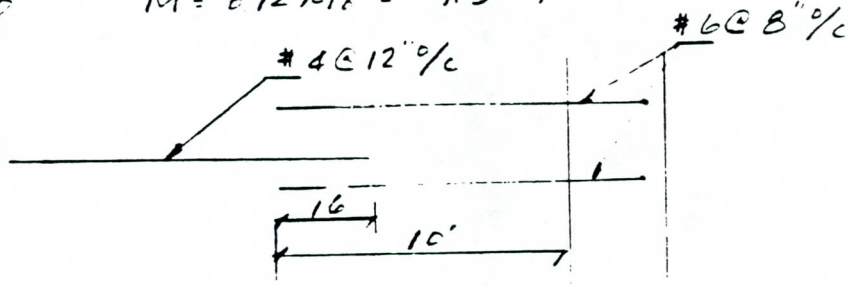
FOUNDATION :

BOTTOM BARS : $M_o = 11.2$ 'K/'

$X = 4.0$ $M = .725 M_o = 8.12$ 'K/'

$X = 8.0$ $M = .325 M_o = 3.64$ 'K/'

$X = 11.0$ $M = .12 M_o = 1.3$ 'K/'



#4@12"o/c

REF. TO APACHE FLOODWAY 37'-6 x 5'-9 CHANNEL

MOMENT CAPACITY OF #4@12"o/c = 2.83 'K/'

TOP BARS :

$A_{s\,min} = .002 \times 12 \times 11 = .264$ "/'

#5@14"o/c E.W.

EBASCO SERVICES INCORPORATED

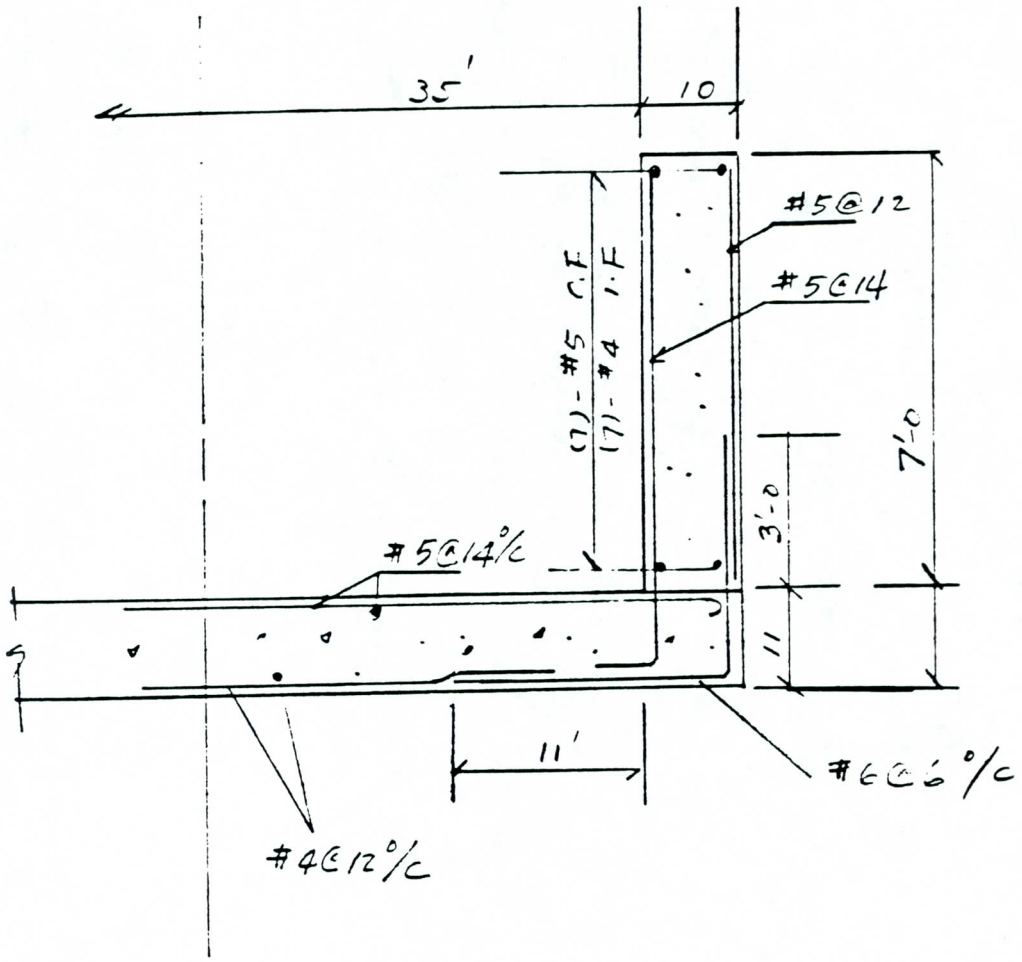
BY N. Hung DATE 2/4/86 SHEET 33 OF 84

CHKD. BY P. Brown DATE 2/3/86 OFS NO. 3767-3c DEPT. NO. 243

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY 35'x7' CHANNEL



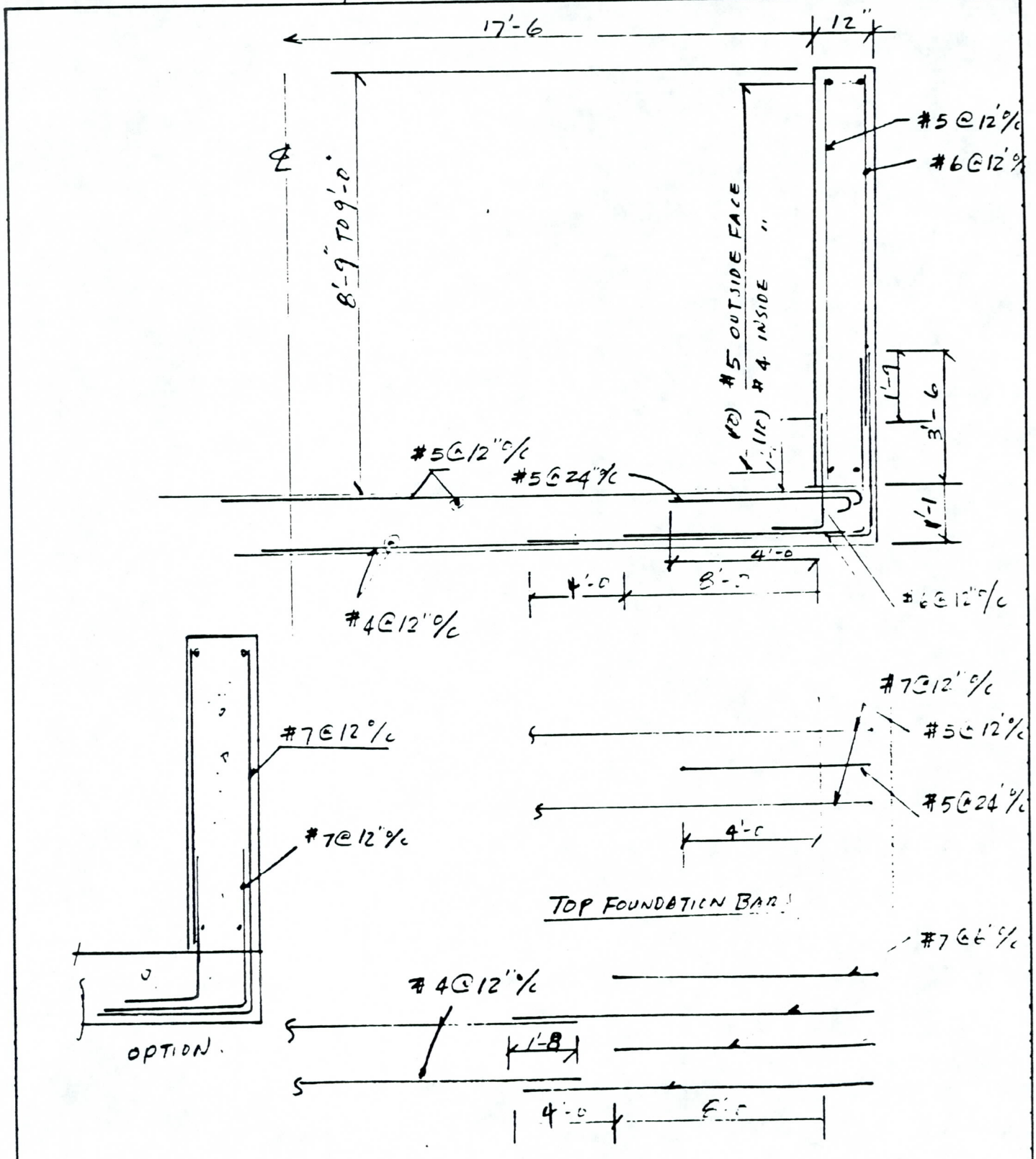
III F-36

EBASCO SERVICES INCORPORATED

BY N. Ibrahim DATE 1/8/86
CHKD. BY P.B.C.D. DATE 1/20/86

SHEET 34 OF 84
OFS NO. 2767-300 DEPT. NO. 243

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 35'x9' CHANNEL DWG 2-22, 2-35



III F-37

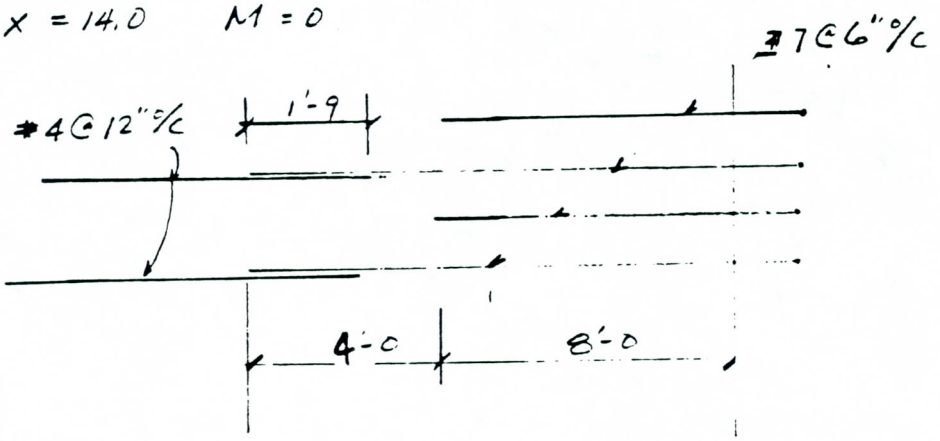
BY N. Hung DATE 1/18/86
CHKD. BY P. Bard DATE 1/20/86
SHEET 35 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT ADJUNCT BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY

WALL : SAME AS 50' WIDE CHANNEL

FOUNDATION :

BOTTOM BARS $M_o = 28.43$ 'K/' (COEF. SEE P.)

$x = 4'-0$	$M = .767 M_o$	$= 21.8$ 'K/'
$x = 6'-0$	$M = .574 M_o$	$= 16.3$ 'K/'
$x = 8'-0$	$M = .3864 M_o$	$= 10.98$ 'K/'
$x = 10'-0$	$M = .226 M_o$	$= 6.4$ 'K/'
$x = 12.0$	$M = 010 M_o$	$= 2.84$ 'K/'
$x = 17.5$	$M = -.0413 M_o$	$= -1.174$ 'K/'
$x = 14.0$	$M = 0$	



TOP BARS : SAME AS 50' WIDE CHANNEL

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/18/86

CHKD. BY [illegible] DATE 1/20/86

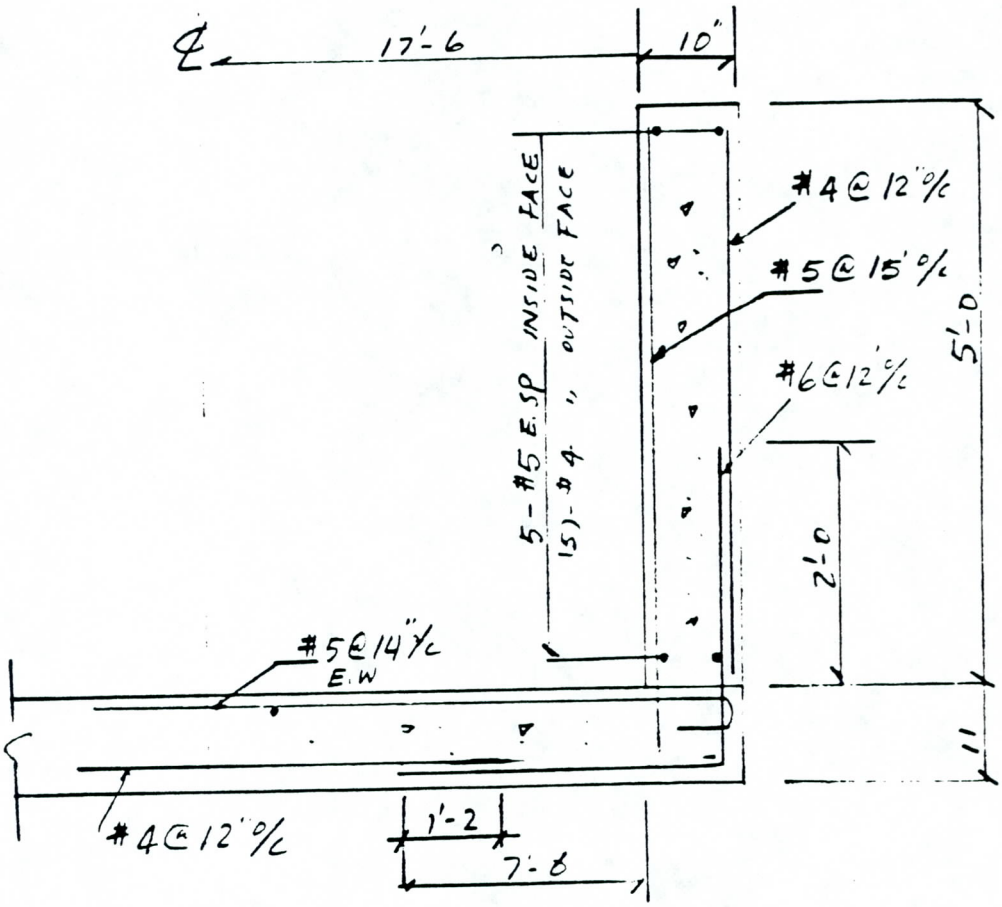
SHEET 36 OF 84

OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY 35'x5'-0 CHANNEL DWG 2-47, 2-29



III F-39

581/8-81

35'x5'-0 CHANNEL

WALL : $t = 10''$

UNEXPOSED FACE $H = 5'-0$

$M = \frac{1}{6} \times 78 \times 5^3 + \frac{1}{2} \times 5^2 \times 156 = 1625 + 1950 = 3575^{\#}/'$

$M_u = 1.8M = 1.8 \times 3.575 = 6.43^{'K}/'$

$F = .049$

$K_u = M_u/F = 6.43/.049 = 132 \qquad 1.33K_u = 175$

$A_s = .0050 \times 12 \times 7 = 0.42^{\square''}/' \quad$ — #6@12"o/c

$H = 3'-6$

$M = \frac{1}{6} \times 78 \times 3.5^3 + \frac{1}{2} \times 156 \times 3.5^2 = 557 + 955 = 1512^{\#}/'$

$M_u = 1.8M = 2.72^{'K}/'$

$F = .049$

$K_u = M_u/F = 2.72/.049 = 55.5 \qquad 1.33K_u = 74$

$\rho = .0021$

$A_s = .0021 \times 12 \times 7 = 0.18^{\square''}/' \quad$ #4@12"o/c

EXPOSED FACE

$A_{s\,min} = .0020 \times 12 \times 10 = 0.24^{\square''}/' \quad$ #5@15"o/c

FOUNDATION : $M_o = 6.43^{'K}/'$

BOTTOM BAR : $X = 0 \quad M = 6.43^{'K}/' \quad$ #6@12"o/c

$X = 6.0 \quad M = .506 \times 6.43 = 3.3^{'K}/' \quad$ #4@12"o/c

$X = 8.0 \quad M = .311 \times " = 2.0^{'K}/'$

$X = 7.0 \quad M = 2.7^{'K}/'$

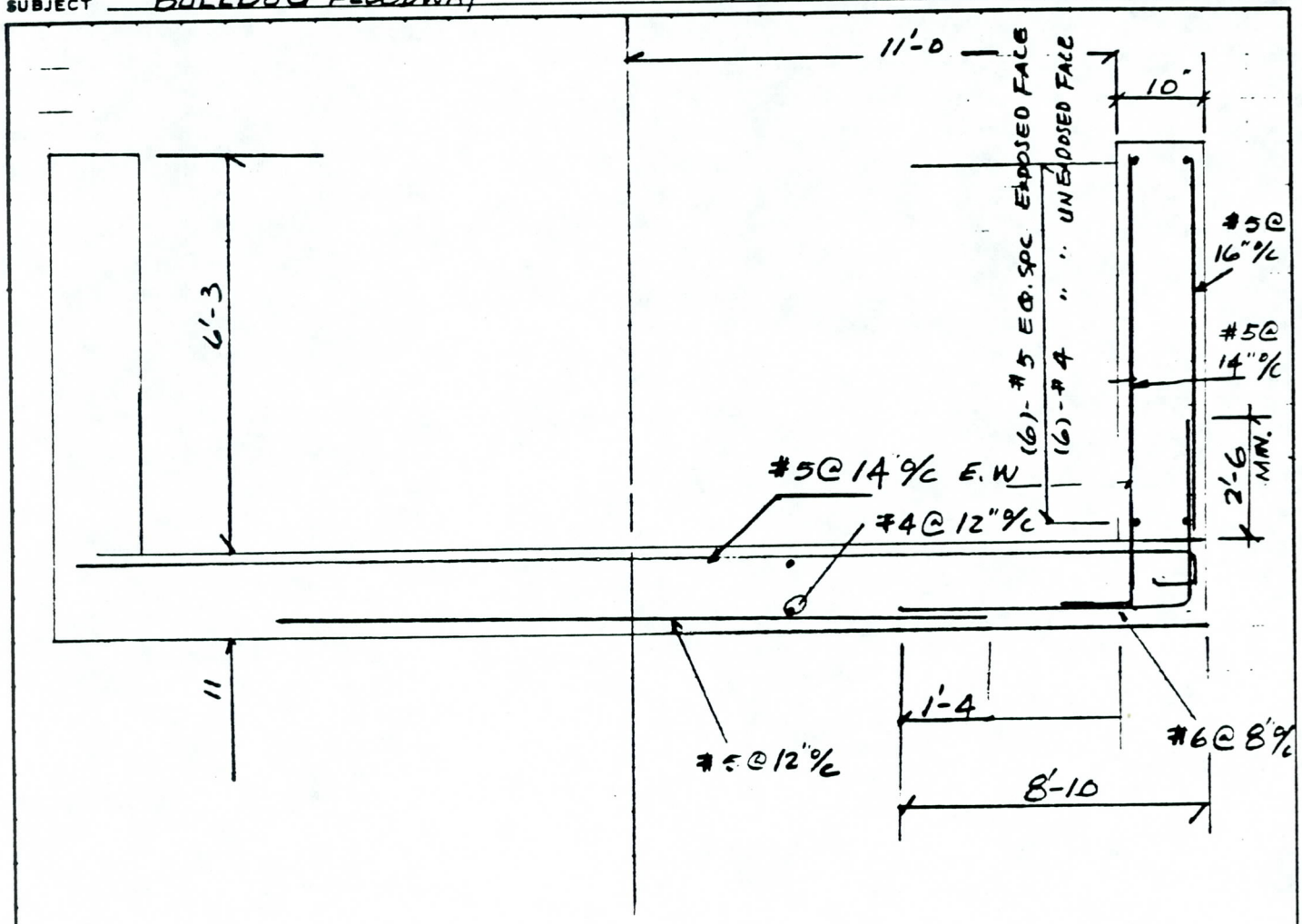
SEE 50' WIDE CHANNEL FOR MOMENT CAPACITY FOR #4@12"o/c

TOP BARS

$A_{s\,min} = .02 \times 12 \times 11 = .264^{\square''}/' \quad$ #5@14"o/c

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/20/86
CHKD. BY P. Bahl DATE 1/20/86
SHEET 38 OF OK 54
OFS NO. 3767-300 DEPT. NO. 243
CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 22'x6'-3" CHANNEL DWG 2-19.2-2



A): WALL DESIGN:

a) UNEXPOSED FACE: $H = 6'-3"$

$M = \frac{1}{6} \times 78 \times 6.25^3 + \frac{1}{2} \times 156 \times 6.25^2 = 3174 + 3046 = 6220^{\#/'}$

$P_a = \frac{1}{2} \times 78 \times 6.25^2 + 156 \times 6.25 = 1524 + 975 = 2500^{\#/'}$

$M_u = 1.8M = 1.8 \times 6220^{\#/'} = 11200^{\#/'} = 11.2^{K/'}$

$V_u = 1.8 P_a = 1.8 \times 2500 = 4500 = 4.50^{K/'}$

$d = 7"$ $F = .049$

$K_u = M_u/F = 11.2/.049 = 229 \longrightarrow P = .0066$

$A_s = .0066 \times 12 \times 7 = .554^{\square"/'}$ ___ #6@8"o/c

EBASCO SERVICES INCORPORATED

BY N. [illegible] DATE 1/21/86 SHEET 39 OF 84

CHKD. BY P. [illegible] DATE 1/22/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY 22' WIDE CHANNEL

$V_u = 4500/12\times7 = 45.9\ ^{\#}/_{"} < 2\phi\sqrt{f_c'} = 108\ ^{\#}/_{"}$

FOR $H = 3.75'$

$M = \frac{1}{6}\times78\times3.75^3 + \frac{1}{2}\times156\times3.75^2 = 685^{1\#/'} + 1096 = 1781^{1\#/'}$

$M_u = 1.8M = 3.2^{1K/'}$ $\quad F = .049$

$K_u = M_u/F = 3.2/.049 = 65.3$

$1.33K_u = 86.8$ $\quad \rho = .0025$

$A_s = .0025\times12\times7 = 0.21^{\square"}$ —— #5 @ 16"o/c

OR $A_s = .001\times12\times10 = .12^{\square"/'}$

EXPOSED FACE:

$M = \frac{1}{6}\times62.4\times5.25^3 = 1505^{1\#/'}$

$M_u = 1.8M = 2.71^{1K/'}$

$K_u = 2.71/.049 = 55.3$ $\quad 1.33K_u = 74$ $\quad \rho = .0021$

$A_s = .0021\times12\times7 = 0.18^{\square"/'}$

OR $A_s = .0020\times12\times10 = 0.24^{\square"/'}$

$.31\times12/0.24 = 15.5"o/c$ SAY #5@16"o/c

FOUNDATION: BOTTOM BARS (TRANSVERSE DIRECTION)

$x = 0$	$M_u = 11.2^{1K/'}$
$x = 3.0$	$M_u = 0.82M = 9.84^{1K/'}$
$x = 7.0$	$M_u = .425M = 4.76^{1K/'}$
$x = 11.0$	$M_u = .2542M = 2.84^{1K/'}$
$x = 8.0$	$M_u = .352M = 3.94^{1K/'}$

BOTTOM BAR : TRANSVERSE DIRECTION

$M_u = 11.2$ 'K $F = 6.5^2/1000 = .04225$

$K_u = M_u/F_u = 11.2/.04225 = 265.$

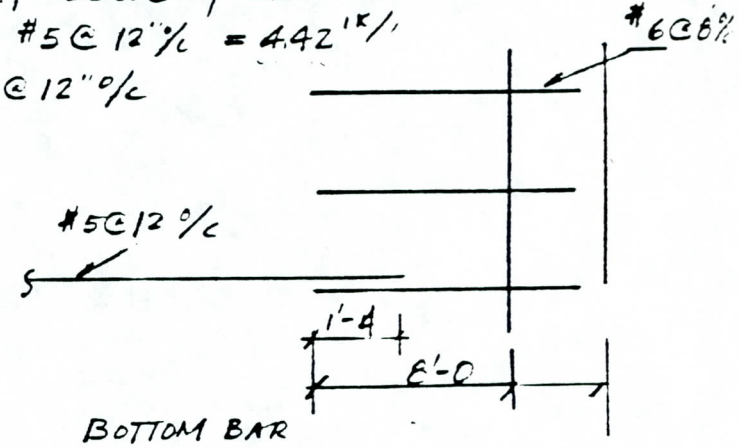
$\rho = .00775$ $A_s = .00775 \times 12 \times 6.5 = 0.6$ □"/' < 0.66 □"/'

6 @ 8" °/c

REF. TO APACHE FLOODWAY 25'x6'-9 CHANNEL

MOMENT CAPACITY OF #5 @ 12"/c = 4.42 'K/'

LONG. DIRECTION : # 4 @ 12" °/c



BOTTOM BAR

TOP BARS :

$A_{s\,min} = .002 \times 11 \times 12 = 0.264$ □"/'

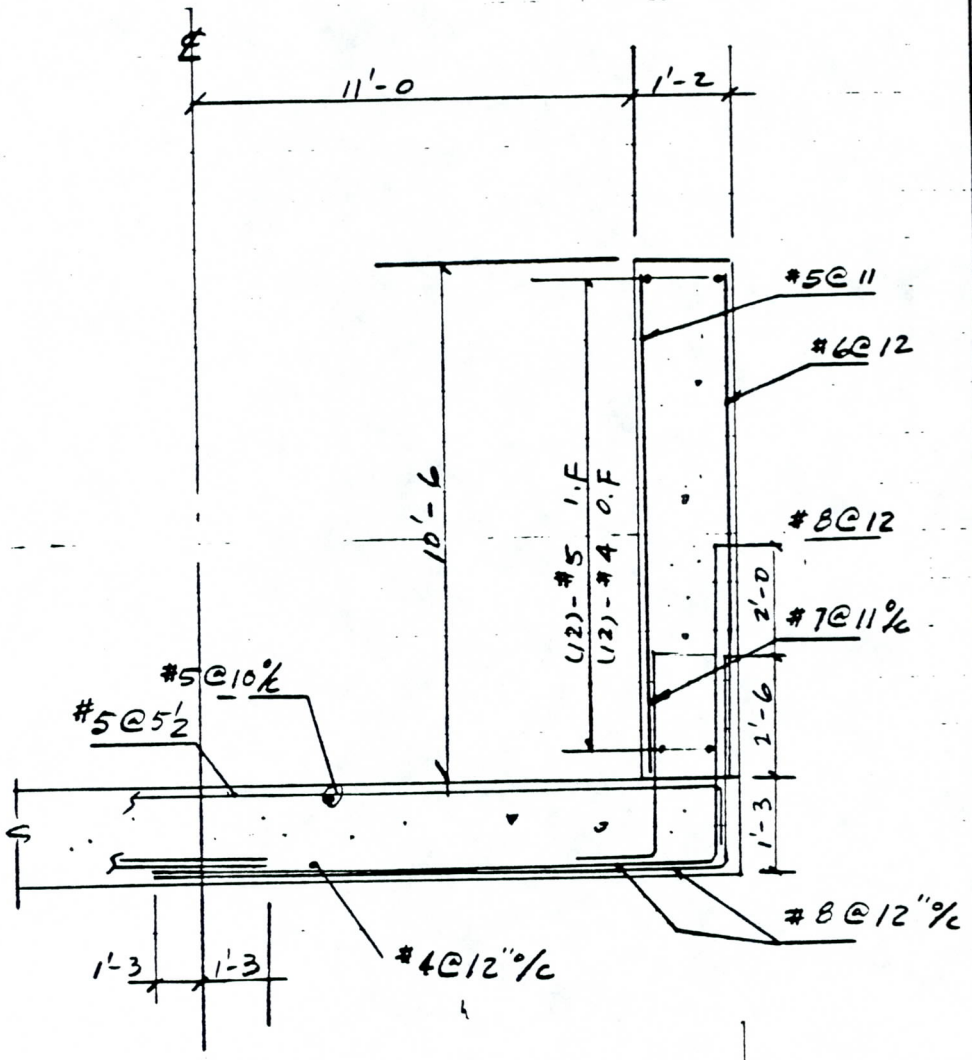
5 @ 14" °/c E.W

T & B

BY N. Hung DATE 1/27/86
CHKD. BY [illegible] DATE 1/22/86

SHEET 41 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 22'x10'-6 CHANNEL



EBASCO SERVICES INCORPORATED

BY N. [illegible] DATE 1/27/86
CHKD. BY [illegible] DATE 1/22/86
SHEET 42 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 22'x10'-6 CHANNEL

A): WALL DESIGN: 1) UNEXPOSED FACE

$H = 10'-6$

$M = \frac{1}{6} \times 78 \times 10.5^3 + \frac{1}{2} \times 156 \times 10.5^2$ 1#/'

$= 15050 + 8600 = 23650.$

$M_u = 1.8M = 42.57$ 1K/' $\quad F = .121$

$K_u = M_u/F = 42.57/.121 = 352. \quad \rho = .0105$

$A_s = .0105 \times 12 \times 11 = 1.386$ □"/'

$.79 \times 12 / 1.386 = 6.8" < 6.0" \quad$ #8 @ 6" o/c

$H = 8'-0$

$M = \frac{1}{6} \times 78 \times 8^3 + \frac{1}{2} \times 156 \times 8^2$

$= 6656 + 4992 = 11648$ 1#/' $=$

$M_u = 1.8 \times 11648 = 10108$ 1#/' $= 20966$ 1K/'

$K_u = 20.97/.121 = 173. \quad \rho = .0050$

$\rho = .0050 \quad A_s = .0050 \times 11 \times 12 = .66$ □"/' $\quad$ #8 @ 12" o/c

$H = 6'-0$

$M = \frac{1}{6} \times 78 \times 6^3 + \frac{1}{2} \times 156 \times 6^2 = 2808 + 2808 = 5616$ 1#/'

$= 5.6$ 1K/'

$M_u = 1.8M = 1.8 \times 5.6 = 10.1$ 1K

$K_u = 10.1/.121 = 83.5 \quad 1.33K_u = 111 \quad \rho = .00315$

$A_s = .00315 \times 12 \times 11 = 0.416$ □"/'

#6 @ 12" o/c

2) EXPOSED FACE: 7'-0" WATER 1K/'

FOR H=7'-0 $M = \frac{1}{6} \times 62.4 \times 7^3 = 3.56$

$M_u = 1.8M = 6.42$ 1K/'

$K_u = M_u/F = 6.42/.121 = 53.1 \quad 1.33K_u = 70.6 \quad \rho = .0020$

$A_s = .0020 \times 12 \times 11 = .20$ □"/' $\quad$ #5 @ 11" o/c

$A_{s\,min} = .02 \times 12 \times 14 = 0.336$ □"/'

(2) 9'-6 WATER HEIGHT.

$M = \frac{1}{6} \times 62.4 \times 9.5^3 = 8916.1^{\#}/'$

$M_u = 1.8M = 16.05^{'K}/'$ $\quad F = \frac{12 \times 11.5^2}{12000} = 132.2$

$K_u = 16.05/132.2 = 121.4$ $\quad 1.33K_u = 161$

USE $\rho = .0046$ $\quad A_s = .0046 \times 12 \times 11.5 = 0.63^{\square"}/'$ $\quad \#7 @ 11"/c$

$< .65^{\square"}/'$

B: FOUNDATION: BOTTOM BARS: (COEFFICIENT SEE P.)

TRANSVERSE $\quad M_o = 42.57^{'K}/'$

$x = 8.0$ $\quad M = .605 \times 42.57 = 25.7^{'K}/'$

$x = 11.0$ $\quad M = .5415 \times$ " $= 23.05^{'K}/'$

CHECK CAPACITY OF #8 @ 12"/c

$t = 15 - 3 - \frac{1}{2} - 1 = 10.5"$ $\quad F = .110$

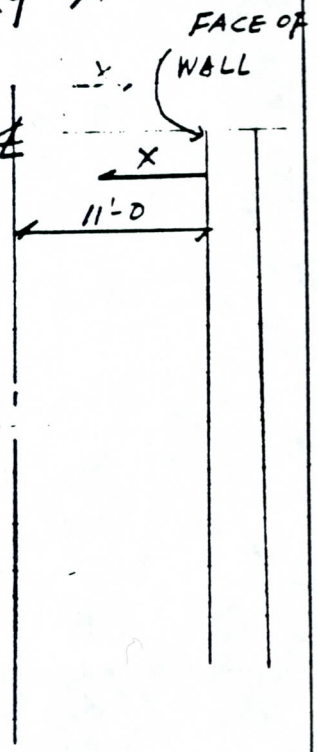
$A_s = 0.79^{\square"}/'$ $\quad \rho = 0.79/12 \times 10.5 = .00627$

$K_u = 217$ $\quad M_u = F K_u = .110 \times 217.0 = 23.9^{'K}/'$

USE #8 @ 6"/c $\quad x = 0' \sim 11'$

LONG.: $A_{s\,min} = .001 \times 12 \times 15 = 0.18^{\square"}/'$

#4 @ 12'/c



TOP BARS:

TRANS. DIRECTION: $M_o = 16.05^{'K}$

$x = 8.0$ $\quad M = .605 \times 16.05 = 9.71^{'K}/'$

CAPACITY OF #5 @ 5½"/c. $\quad F = .110$

$\rho = 0.31/5.5 \times 10.5 = .00537$

$K_u = 187$ $\quad M_u = K_u F = 187 \times .11 = 20.6^{'K}/'$

#5 @ 5½"/c

LONG. DIRECTION:

$A_{s\,min} = .002 \times 12 \times 15 = 0.36^{\square"}/'$

#5 @ 10"/c

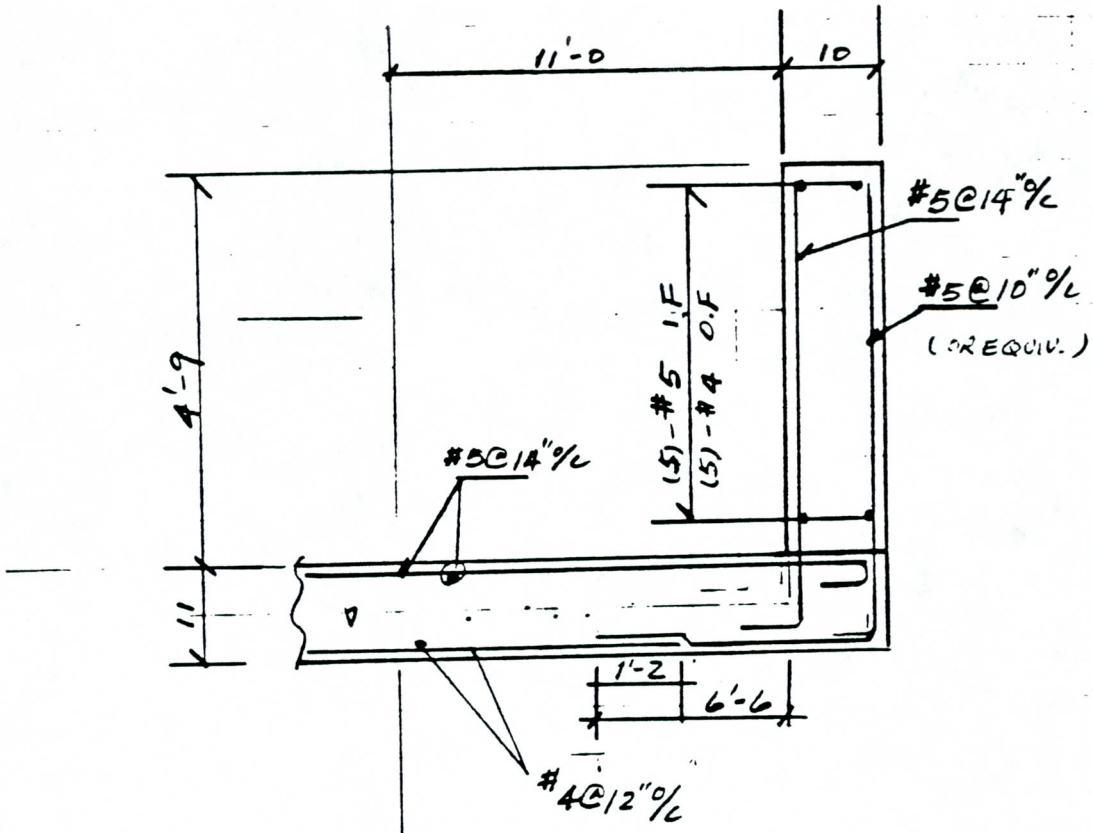
EBASCO SERVICES INCORPORATED

BY N. [illegible] DATE 2/5/86
CHKD. BY P. BARAN DATE 2/6/86

SHEET 44 OF 84
OFS NO. 3767-300 DEPT. NO.

CLIENT ~~USDA-SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY 22' x 4'-9 CHANNEL



581/8-81

(A) WALL DESIGN :

FOR $H = 4.75$ UNEXPOSED FACE : 2 VERT. BARS

$M = \frac{1}{6} \times 78 \times 4.75^3 + \frac{1}{2} \times 156 \times 4.75 = 1393 + 1760 = 3152^{\#/'}$

$M_u = 1.8M = 1.8 \times 3.15^{'K/'} = 5.67^{'K/'}$

$K_u = 5.67/.049 = 116.$ $1.33 K_u = 154$

$\rho = .0044$ $A_s = .0044 \times 12 \times 7 = 0.37^{D"/'}$ — #5@10"o/c

HORIZ BARS: $.001 \times 12 \times 10 = 0.12^{D"/'}$ #4@12"o/c

UNEXPOSED FACE

VERT BARS $.002 \times 12 \times 10 = 0.24^{D"/'}$ — #5@15"o/c

HORIZ. " $= .24^{D"/'}$ — #5@15"o/c

(B) FOUNDATION :

BOTTOM BARS. $M_o = 5.67^{'K/'}$

$X = 5.0$ $M = .6126\, M_o = 3.47^{'K/'}$ (REF. TO 22'x6'-3 CHANNEL

$X = 6.0$ $M = 0.520\, M_o = 2.94^{'K/'}$ — #4@12"o/c

MOMENT CAPACITY OF #4@12"o/c $= 2.83^{'K/'}$ (PER 37'-6 x 5'-9 CHANNEL OF APACHE FLOODWAY)

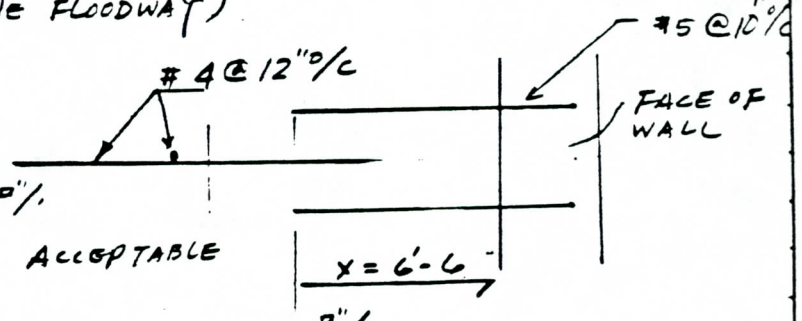
$M = 5.67$ $F = .04225$

$K_u = \frac{5.67}{.04225} = 134$

$1.33 K_u = 178$ $\rho = .0050$

$A_s = .0050 \times 12 \times 6.5 = 0.39^{D"/'}$

#5@10"o/c ACCEPTABLE



TOP BARS: $A_{s\,min} = .002 \times 12 \times 11 = .264^{D"/'}$

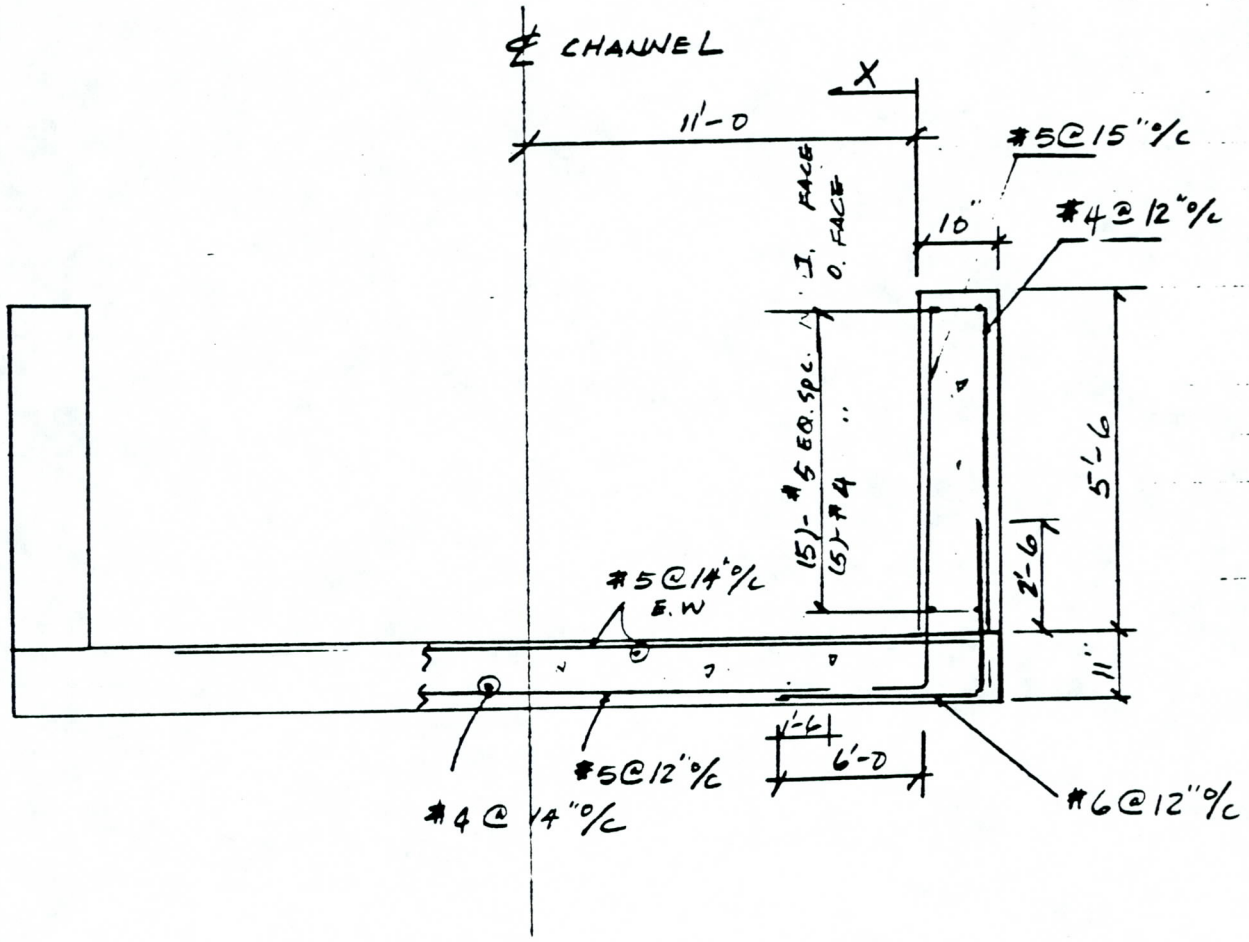
#5@14"o/c E.W.

EBASCO SERVICES INCORPORATED

BY N. H. DATE 2/11/86
CHKD. BY T. BREW DATE 2/12/86

SHEET 46 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT OK
SUBJECT BULLDOG FLOODWAY 22'x5'-6 CHANNEL DWG 2-14.2-29



A): WALL DESIGN : $t = 10''$

a). UNEXPOSED FACE $H = 5'-6$

$M = \frac{1}{6} \times 78 \times 5.5^3 + \frac{1}{2} \times 156 \times 5.5^2 = 2162^{1\#} + 2360 = 4522^{1\#/'}$

$M_u = 1.8M = 8140^{1\#} = 8.14^{'K/'}$

$F = .049 \quad K_u = M_u/F = 8.14/.049 = 166 < 175$

USE $\rho_{min} = .0050$, $A_s = .0050 \times 12 \times 7 = 0.42^{\square''/'}$ #6@12"o/c

b) EXPOSED FACE

$A_{s\,min} = .002 \times 12 \times 10 = 0.24^{\square''/'}$ #5@15"o/c

B): FOUNDATION : $M_o = 8.14^{'K/'}$

BOTTOM BARS (COEF. SEE P.)

$x = 7'-0 \quad M = .4250 \times 8.14 = 3.46^{'K/'}$

$x = 11'-0 \quad M = .2542 \times " = 2.07^{'K/'}$

$x = 5'-0 \quad M = .6126 \times " = 5.00^{'K/'}$ ---- #5@12"o/c

$x = 6'-0 \quad M = \quad = 4.23^{'K/'}$

$X = 0 \sim 6' \sim$ #6@12"o/c 6' ~ 11 (MIDDLE) - #5@12"o/c

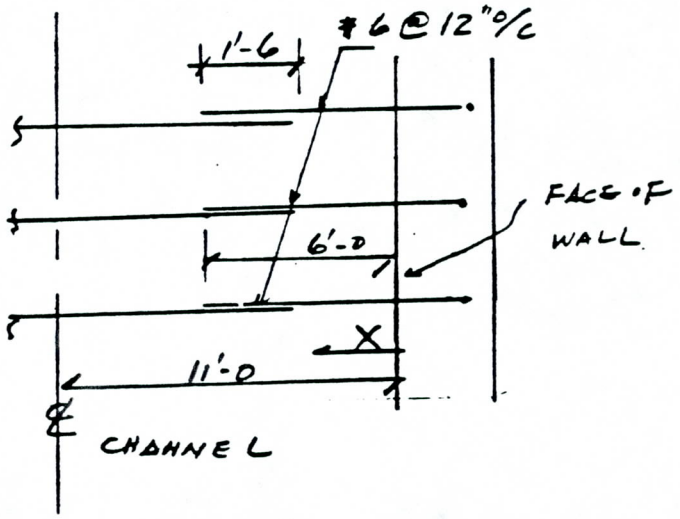
$M_o = 8.14$

$F = .04225$

$K_u = 8.14/.04225 = 193$

$\rho = .0056$

$A_s = .0056 \times 12 \times 6.5 = 0.44^{\square''/'}$ #6@12"o/c



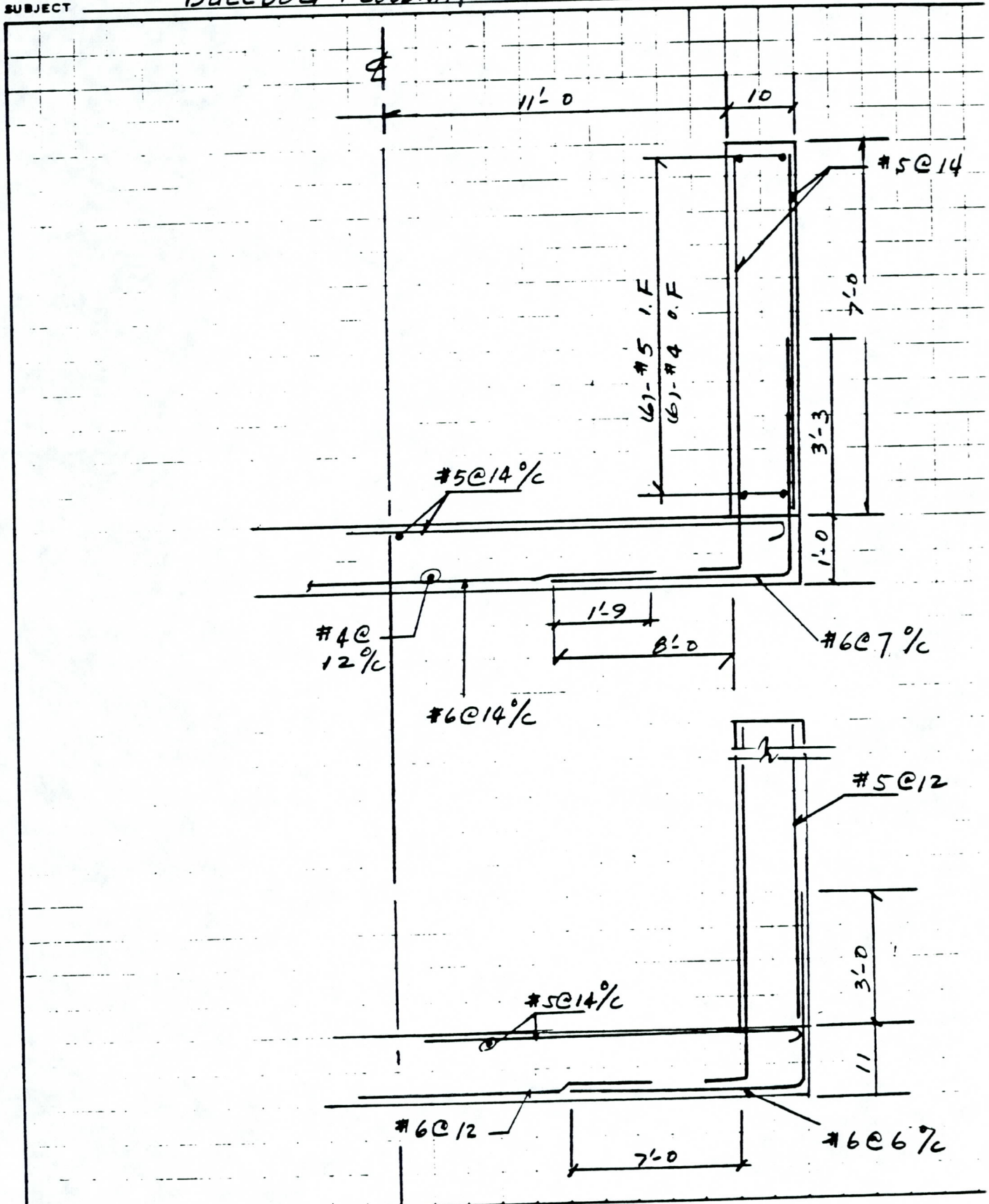
BOTTOM BARS

TOP BAR : #5@14"o/c E.W

BY N. Hung DATE 1/30/86
CHKD. BY P. Baker DATE 2/3/86

SHEET 48 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT
PROJECT SPRAGUE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 22'x7'-0 CHANNEL



581/8-81

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/30/86 SHEET 49 OF 84
CHKD. BY P.B. DATE 2/3/86 OFS NO. 3767-300 DEPT. NO.
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 22' WIDE CHANNEL

WALL DESIGN: UNEXPOSED WALL H = 7'-0

$M = \frac{1}{6} \times 78 \times 7^3 + \frac{1}{2} \times 156 \times 7^2$

$= 4459 + 3822 = 8281^{\#/'} = 8.3^{K/'}$

$M_u = 1.8\,M = 14.9^{K/'}$

$d = 10" - 3 = 7"$ $F = .049$. $K_u = 14.9/.049 = 304$

$\rho = .009$ $A_s = .009 \times 12 \times 7 = 0.756^{\square"/'}$

$0.44 \times 12/.756 = 7"$ — #6 @ 7"o/c

H = 4.0

$M = \frac{1}{6} \times 78 \times 4.0^3 + \frac{1}{2} \times 156 \times 4.0^2 = 832 + 1248 = 2080^{\#/'}$

$M_u = 1.8\,M = 3.74^{K/'}$

$K_u = 3.74/.049 = 76.3$ $1.33K_u = 101$. $\rho = .003$

$A_s = .0030 \times 12 \times 7 = .252^{\square"/'}$ #5 @ 14"o/c

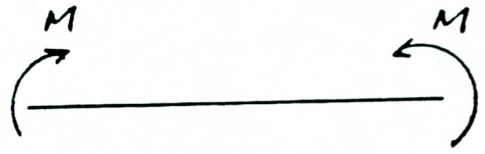
$A_{s\,min} = .001 \times 12 \times 10 = .120^{\square"/'}$

#5 @ 15½"o/c MIN.

EXPOSED FACE:

$A_{s\,min} = .002 \times 12 \times 10 = .24^{\square"/'}$

FOUNDATION: REF. TO 6'-3" WALL.



$M_o = 14.9^{K/'}$

1 FOR t = 12"

X = 7.0 $M_u = .4250\,M_o = 6.33^{K/'}$

x = 11' $M_u = .2542\,M = 3.79^{K/'}$

#6 @ 14"o/c $A_s = 0.44 \times \frac{12}{14} = 0.377$ $F = .05625$

$\rho = .377/12 \times 7.5 = .00419$

$K_u = 148$ $M = 148 \times .05625 = 8.3^{K/'}$

$M/1.33 = 6.24^{K/'}$ CAPACITY OF #6 @ 14"o/c.

2). FOR $t = 11"$ $d = 11 - 3 - 1 - 0.5 = 6.5"$ $F = .04225$

$M_u = 14.9$ 'K

$K_u = M/F = 14.9/.04225 = 353$ $\rho = .0105$

$A_s = .0105 \times 12 \times 6.5 = 0.82$ □"/'

$\frac{0.44 \times 12}{.82} = 6.4"$ o/c

#6@6" o/c ←

CAPACITY OF #6@12" o/c

$\rho = 0.44/12 \times 6.5 = .00564$

$a_u = 2.90$ $M_u = a_u d A_s = 2.9 \times 6.5 \times 0.44 = 8.3$ 'K/'

$X = 7.0'$ $M_u = 0.425 \times 14.9 = 6.3$ 'K/' < 8.3 'K/'

EBASCO SERVICES INCORPORATED

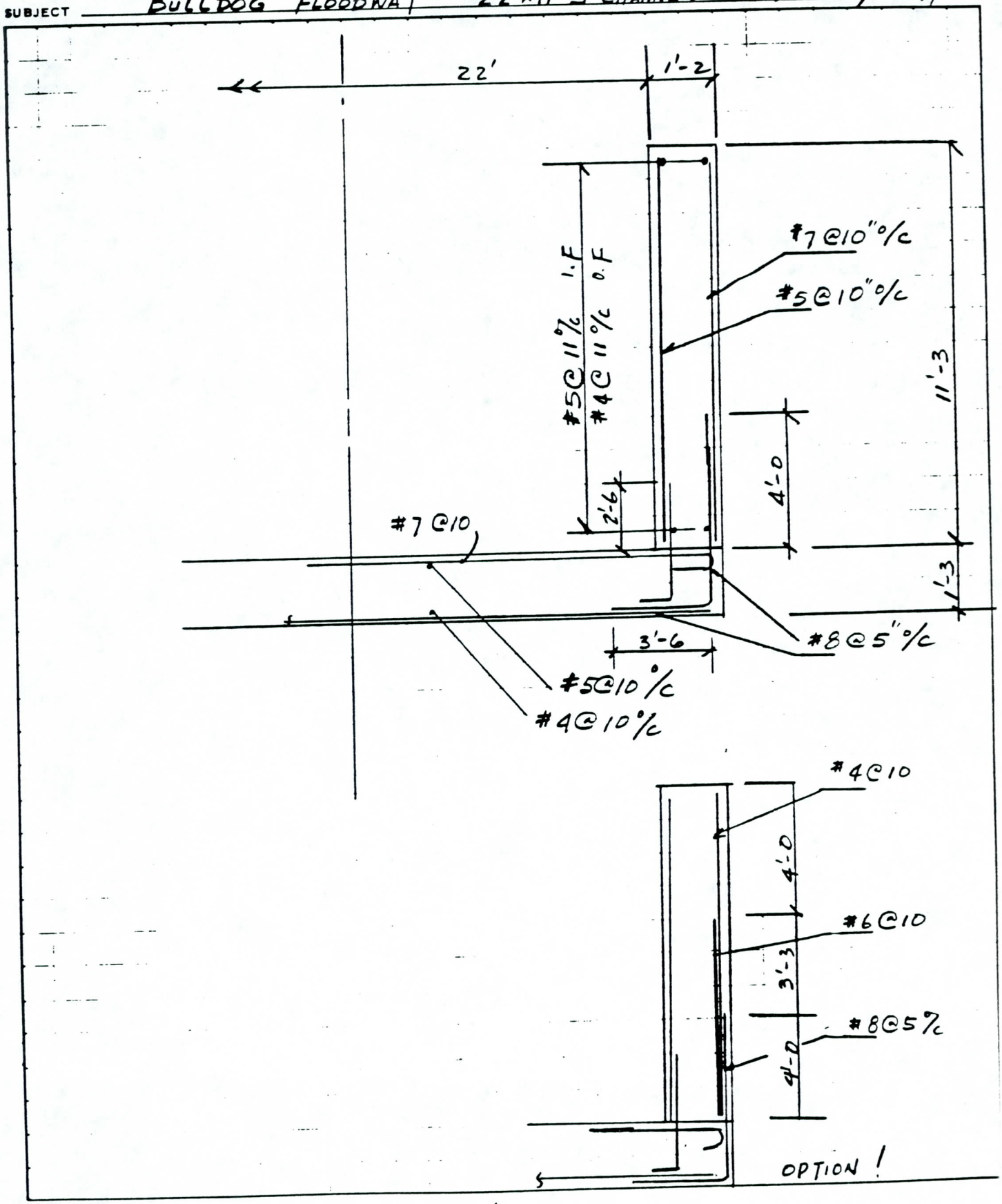
BY N. Hung DATE 1/31/86 SHEET 51 OF 84

CHKD. BY P. Bilda DATE 2/3/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY 22'x11'-3 CHANNEL DWG 2-28, 2-19, 2-3



581/8-81

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/31/86

CHKD. BY P. Reed DATE 2/3/86

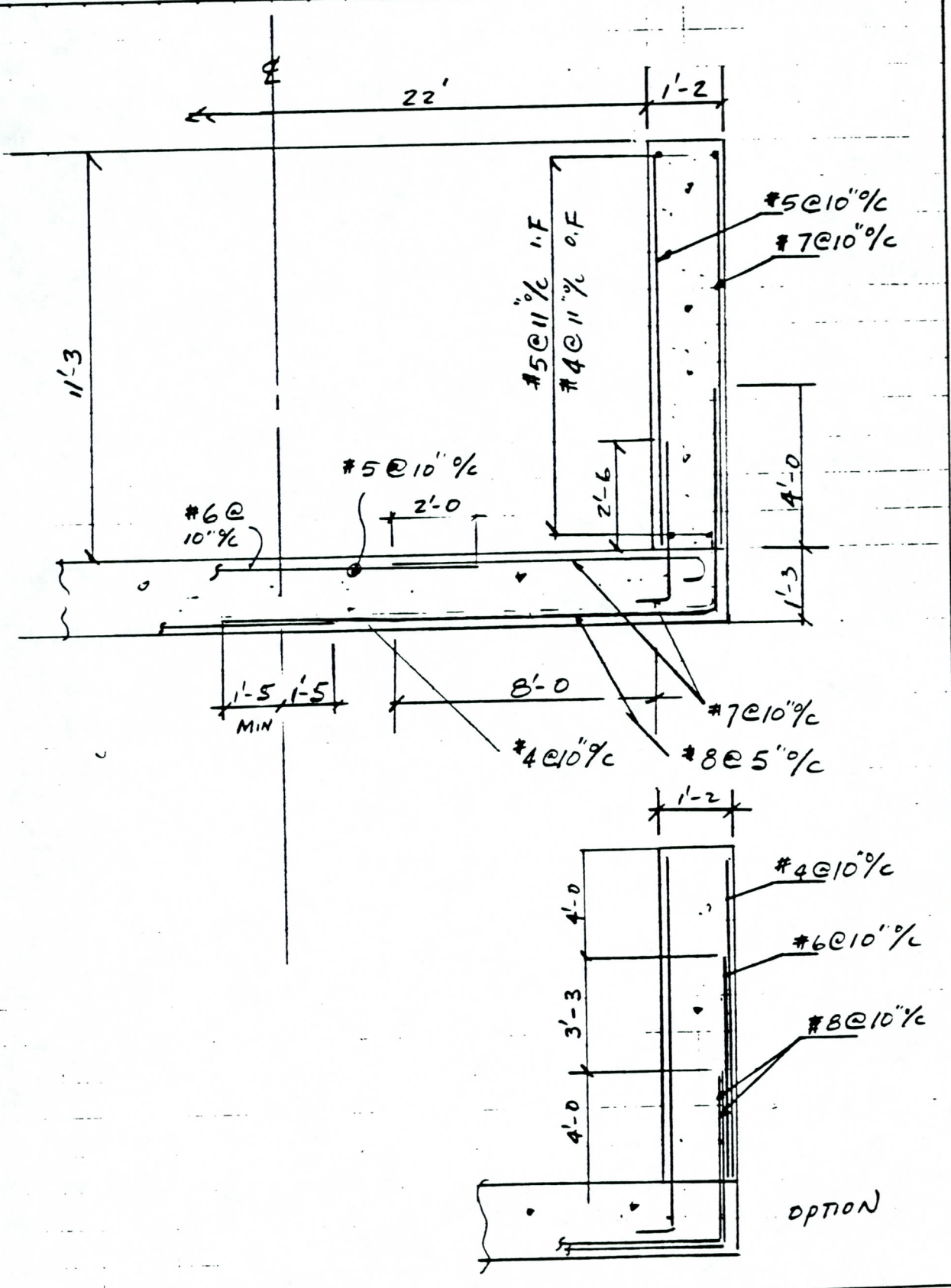
SHEET 52 OF 84

OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~APACHE BULLDOG FLOOD CONTROL PROJECT~~ USDA-SOIL CONSERVATION SERVICE

PROJECT

SUBJECT BULLDOG FLOODWAY 22'x11'-3 CHANNEL



581/8-81

FOUNDATION FOR H=11'-3 22' WIDE CHANNEL.

BOTTOM BARS

FOR X = 8'

$M = .605 M_o = .605M = 30.92^{1K/'}$

$F = .110$

$K_u = 30.92/.110 = 282$ $\rho = .00824$

$A_s = .00824 \times 12 \times 10.5 = 1.03^{\square''/'}$ #8 @ 5" o/c

$X = 9'$ $M = .584M = 29.8^{1K/'}$ $A_s = 1.03 \times 29.8/30.92 = .99^{\square''/'}$

TOP BARS: $X = 8$ $M_o = 20.16^{1K/'}$

$M = 12.2^{1K/'}$

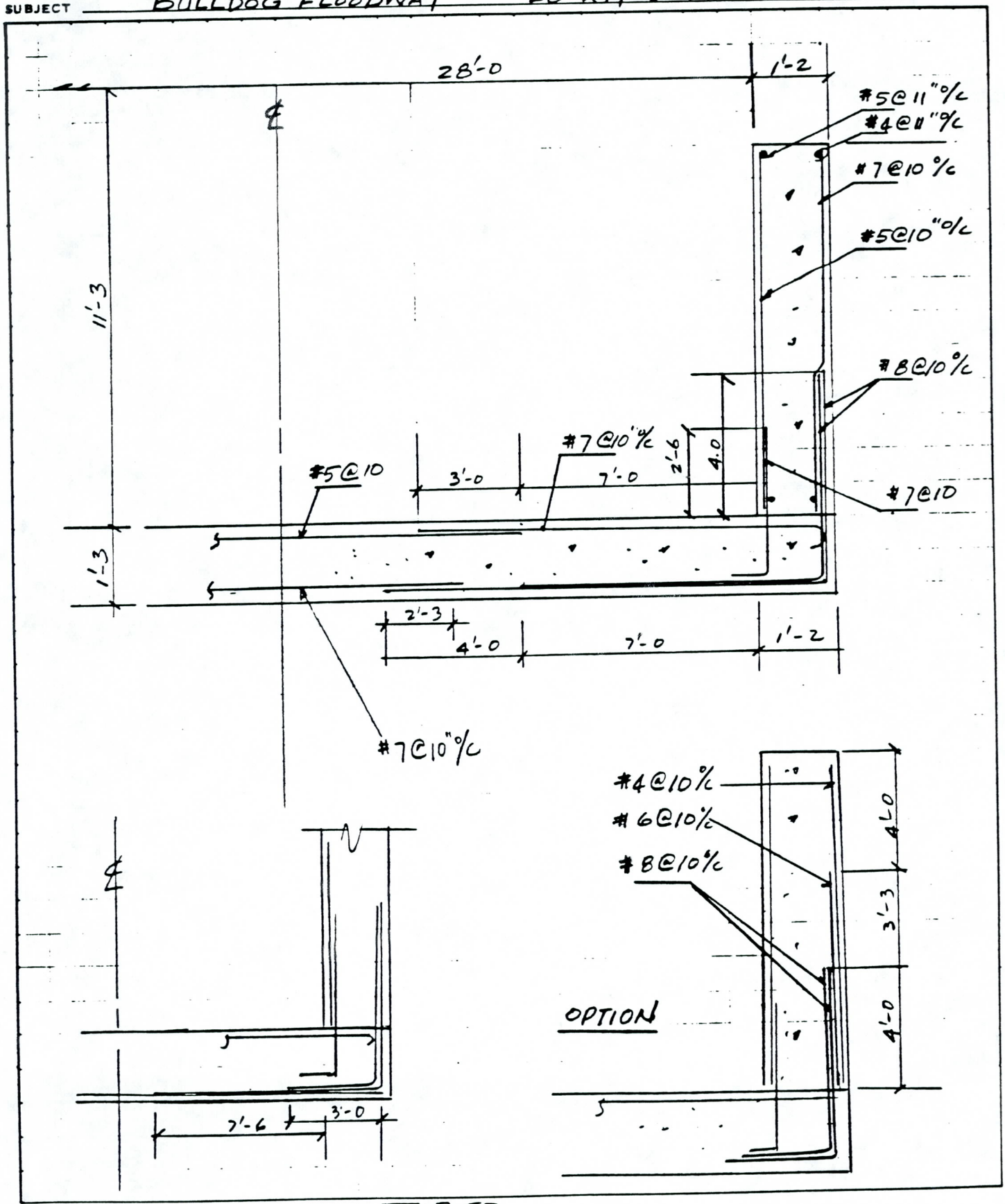
$K_u = 12.2/.132 = 92.4$ $1.33 K_u = 123.$

$\rho = .0035$ $A_s = .0035 \times 12 \times 11.5 = 0.483^{\square''/'}$ #6 @ 10" o/c

WALL DESIGN: SEE 28'x11'-3 CHANNEL

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/24/86
CHKD. BY [illegible] DATE 2/3/86
SHEET 54 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 28'x11'-3 CHANNEL



III F-57

581/8-81

WALL DESIGN: $t = 14''$

UNEXPOSED FACE:

$H = 11'-3$, $M = \frac{1}{6} \times 78 \times 11.25^3 + \frac{1}{2} \times 156 \times 11.25^2 = 18500 + 9870 = 28370'\#/'$

$P_e = \frac{1}{2} \times 78 \times 11.25^2 + 156 \times 11.25 = 4935 + 1765 = 6700\#/'$

$M_u = 1.8M = 51.1'^K/'$ $\quad V_u = 1.8 P_e = 1.8 \times 6700 = 12060\#/'$

$d = 14 - 3 = 11''$ $\quad F = 12 \times 11^2/1000 \times 12 = .121$

$K_u = M_u/F = 51.1/.121 = 422$, $v_u = V_u/bd = 12060/12 \times 11 = 91.4 < 2\phi\sqrt{f_c'} = 107\ \#/\text{in}^2$

$\rho = .01268$ $\quad A_s = .0127 \times 12 \times 11 = 1.68''^2/'$ $\quad \#8 @ 5\frac{1}{2}''$ o/c

$H = 7'-3''$

$M = \frac{1}{6} \times 78 \times 7.25^3 + \frac{1}{2} \times 156 \times 7.25^2 = 4954 + 4099 = 9053'\#/'$

$M_u = 1.8M = 16.3'^K/'$ $\quad F = .121$

$K_u = M_u/F = 16.3/.121 = 135$ $\quad 1.33K_u = 179$

$\rho_{min} = .0050$ $\quad A_s = .005 \times 12 \times 11 = 0.66''^2/'$

USE #7 @ 11" o/c

(OR #6 @ 11" o/c + #4 @ 11" o/c)

$H = 4'-0$

$M = \frac{1}{6} \times 78 \times 4^3 + \frac{1}{2} \times 156 \times 4^2 = 2080'\#/'$

$M_u = 1.8M = 3744'\#/' = 3.8'^K/'$

$K_u = 3.8/.121 = 31.4$ $\quad 1.33K_u = 42$ $\quad \rho = .0012$

$A_s = .0012 \times 12 \times 11 = 0.16''^2/'$

USE #4 @ 11" o/c

HORIZONTAL BARS: $.001 \times 12 \times 14 = .17''^2/'$

#4 @ 14" o/c

1. EXPOSED FACE W/ WATER HT. = 10'-3"

1) $H = 10.25'$

$M = \frac{1}{6} \times 62.4 \times 10.25^3 = 11200^{\#/'} = 11.2^{K/'}$

$M_u = 1.8M = 20.16^{K/'}$ $F = (14 - 2 - 0.5) = 11.5/1000^2 = .1322$

$K_u = M_u/F = 20.16/.1322 = 152$

$\rho_{min} = .005$ $A_s = .005 \times 12 \times 11.5 = .69$ ___ #7@10"o/c

2). $H = 8.0'$ $M = \frac{1}{6} \times 62.4 \times 8^3 = 5324^{\#/'}$

$M_u = 9.58^{K/'}$

$K_u = 9.58/.1322 = 72.5$ $\rho = .0021 \times 1.33 = .002793$

$A_s = .002793 \times 12 \times 11.5 = 0.385^{\square"/'}$ ___ #5@9 1/2"o/c

USE #5@10"o/c FOR $H = 7'-9"$

HORIZ. BARS

$A_{s\,min} = .002 \times 12 \times 14 = .336^{\square"/'}$ #5@11"o/c

BY N Hung DATE 1/24/86
CHKD. BY P. Bahl DATE 2/2/86
SHEET 57 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 28'x11'-3 CHANNEL

FOUNDATION :

BOTTOM BARS :

FOR $X = 7'-0$ $M = .555 \times 51.1^{'K} = 28.4^{'K}/'$

$F = 10.5^2/1000 = .110$

$K_u = M/F = 28.4/.110 = 259.$ $\rho = .0075$

$A_s = .0075 \times 12 \times 10.5 = 0.94^{\square"}/'$ — #8 @ 10"o/c

$X = 11'-0.$ $M = .3056 \times 51.1 = 15.62^{'K}/'$

$K_u = 15.61/.110 = 142.$ $\rho = .0050$

$A_s = .0050 \times 12 \times 10.5 = 0.63^{\square"}/'$ — #7 @ 10"o/c

$X = 0.$ $K_u = 51.1/.110 = 465.$ $\rho = .0141$

$A_s = .0141 \times 12 \times 10.5 = 1.77^{\square"}/'$ #8 @ 5"o/c

TOP BARS : $M_o = 20.16^{'K}/'$

FOR $X = 9'0.$ $M = .4106M = 8.28^{'K}/'$

COMPARE H = 8.0 — #5 @ 10"o/c

FOR $X = 0'$

$M_o = 20.16$ $F = .110$

$K_u = 20.16/.110 = 184$ $\rho = .00527$

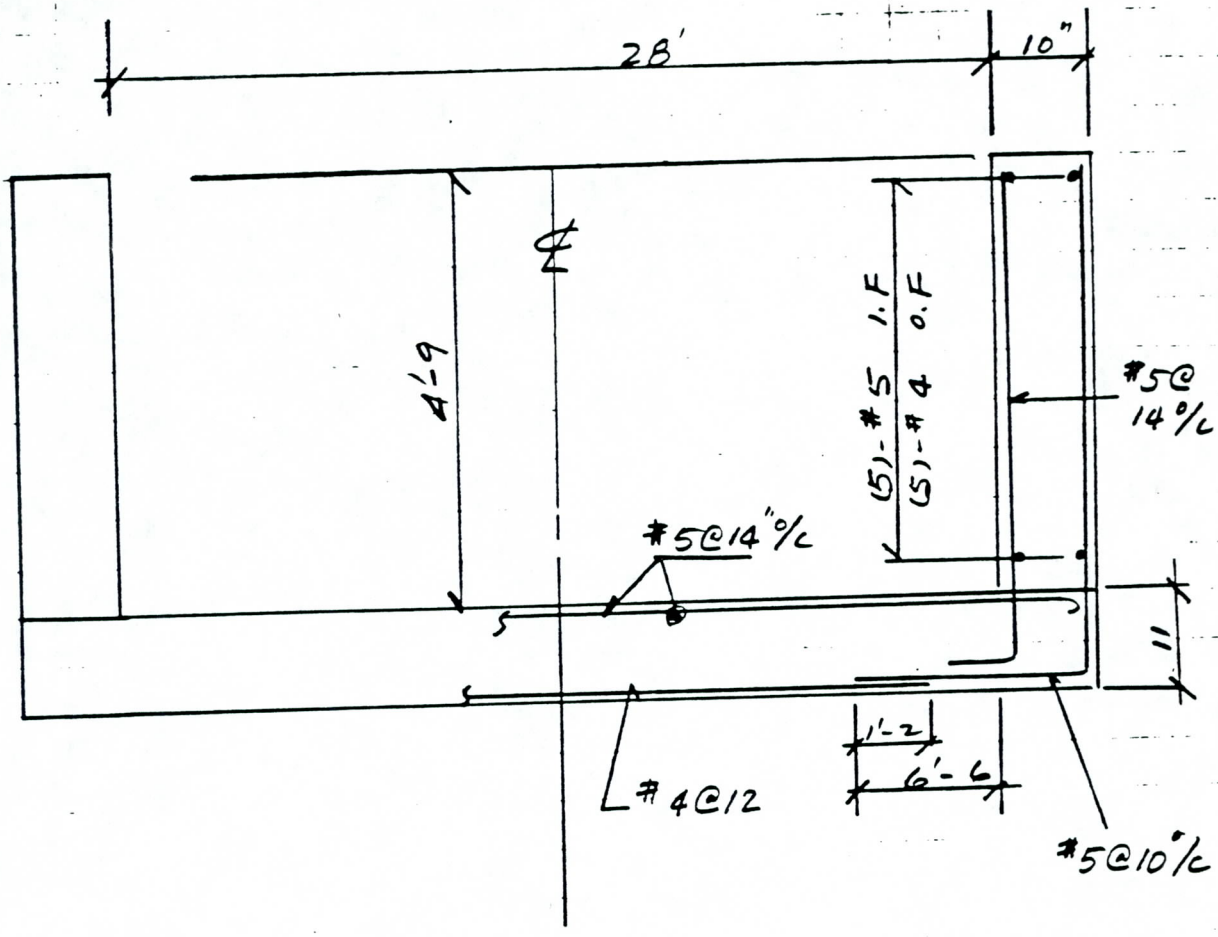
$A_s = .00527 \times 12 \times 10.5 = 0.66^{\square"}/'$ #7 @ 10"o/c

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 2/5/86
CHKD. BY P. Brand DATE 2/6/86

SHEET 58 OF 84
OFS NO. 3767-300 DEPT. NO.

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 28 x 4'-9 CHANNEL DWG 2-14, 2-29



CALCULATIONS SEE 22' x 4'-9 CHANNEL

581/8-81

III F-61

WALL DESIGN

UNEXPOSED FACE : VERT. BAR

$M = \frac{1}{6} \times 78 \times 6.5^3 + \frac{1}{2} \times 156 \times 6.5^2$

$= 3570 + 3296 = 6866$ '#/' $= 6.9$ 'K/'

$M_u = 1.8M = 12.36$ 'K/'

$K_u = M_u/F = 12.36/.049 = 252$ $\rho = .0074$

$A_s = .0074 \times 12 \times 7 = 0.62$ □"/' #6 @ 8"o/c

M = 4.0

$M = \frac{1}{6} \times 78 \times 4^3 + \frac{1}{2} \times 156 \times 4^2 = 832 + 1248 = 2.1$ 'K/'

$M_u = 1.8M = 3.78$ 'K/'

$K_u = 3.78/.049 = 77.1$ $\rho = .0022$

$A_s = 1.33 \times .0022 \times 12 \times 7 = 0.25$ □"/' #5 @ 14"o/c

HORIZ. BAR : $A_{s\,min} = .01 \times 12 \times 10 = 0.12$ □"/' — #4 @ 14"o/c

EXPOSED FACE : VERT. BAR

$M = \frac{1}{6} \times 62.4 \times 5.5^3 = 1730$ '#/' $= 1.73$ 'K/'

$M_u = 1.8M = 1.8 \times 1.73 = 3.1$ 'K/'

$K_u = M_u/F = 3.1/.049 = 63.2$ $1.33K_u = 84$

$\rho = .0024$ $A_s = .0024 \times 12 \times 7 = 0.20$ □"/' #5 @ 14"o/c

$A_{s\,min} = .002 \times 12 \times 10 = 0.24$ □"/'

HORIZ. BARS #5 @ 14"o/c

FOUNDATION :

TOP BARS : (E.W) #5 @ 14"o/c

$A_{s\,min} = .002 \times 12 \times 11 = 0.26$ □"/'

BOTTOM BARS : TRANSV. BAR : $M_u = 12.36$ 'K/' $F = 6.5^2/1000 = .0422$

$K_u = M_u/F = 12.36/.04225 = 293$ $\rho = .0087$

$A_s = .0087 \times 12 \times 6.5 = 0.68$ □"/' — #6 @ 7"o/c

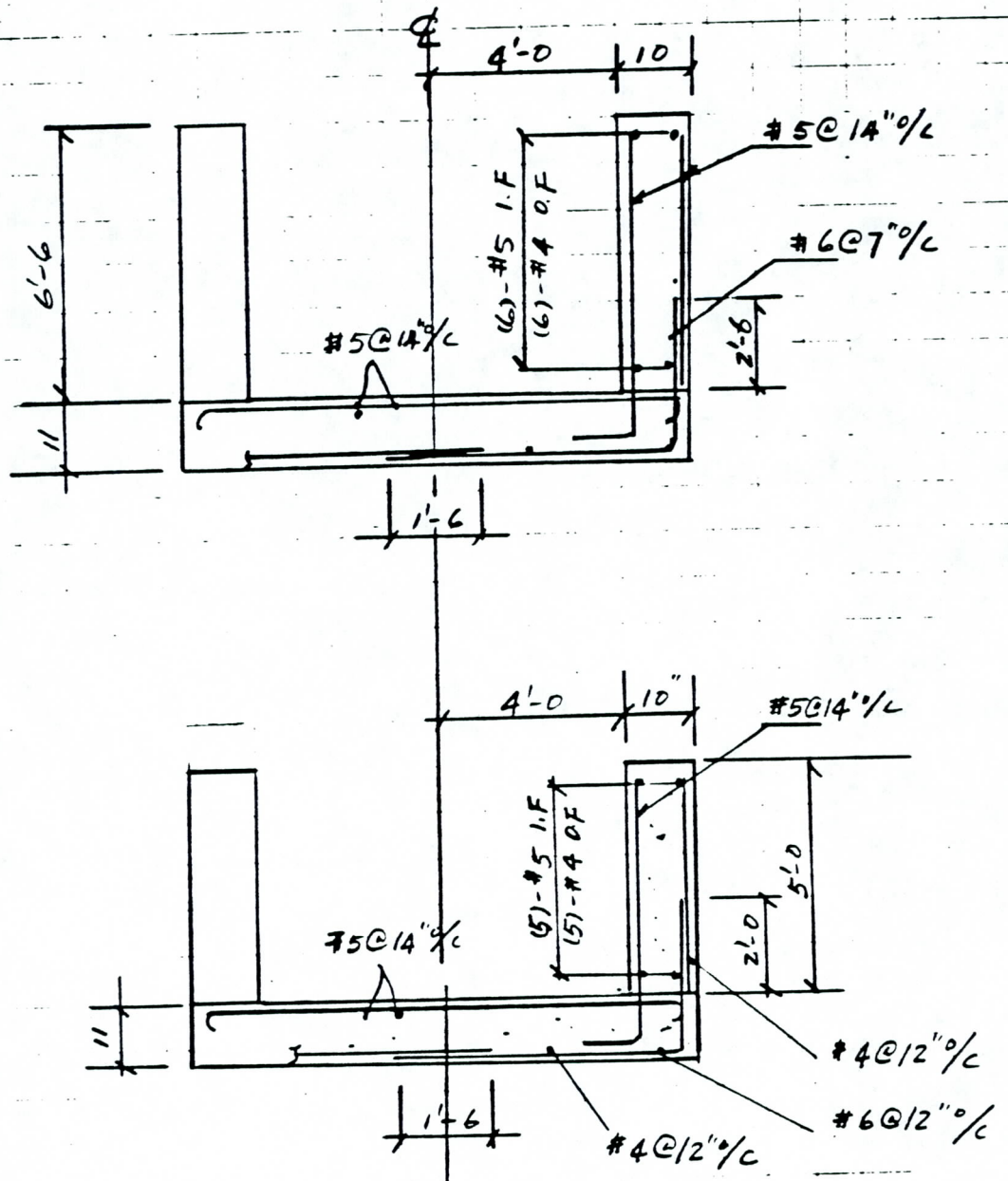
LONG BAR : $A_{s\,min} = .13$ □"/' #4 @ 12"o/c

EBASCO SERVICES INCORPORATED

BY N. [illegible] DATE 2/12/86
CHKD. BY [illegible] DATE 2/13/86

SHEET 60 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 8' WIDE CHANNEL DWG 2-45, 2-46, 2-6



5'-0 HT. WALL & FOUNDATION DESIGN
SEE 35' WIDE CHANNEL

III F-63

561/8-81

THICKNESS OF GROUTED ROCK DROP (t) DROP #2

WATER VELOCITY = 40.5 fps

$y_1 = 0.97$ $y_2 = 9.46$

$V^2/2g = 40.5^2/2\times32.2 = 25.47$ ft

TRY $t = 3'-0$

* $\text{UPLIFT} = \dfrac{(\frac{V^2}{2g} - T)(62.4)(T)^2}{2} = \dfrac{(25.47-3)(62.4)(9)}{2} = 6309$

$\text{WEIGHT} = (T)^3(150) + (T)^2(62.4)$

$= 27\times150 + 9\times62.4 = 4050 + 562 = 4612 < 6309$

TRY $t = 3'-6$

$\text{UPLIFT} = (25.47-3.5)\times62.4\times3.5^2/2 = 8397$

$\text{WEIGHT} = 3.5^3\times150 + 3.5^2\times62.4 = 6431 + 76.4 = 6507$

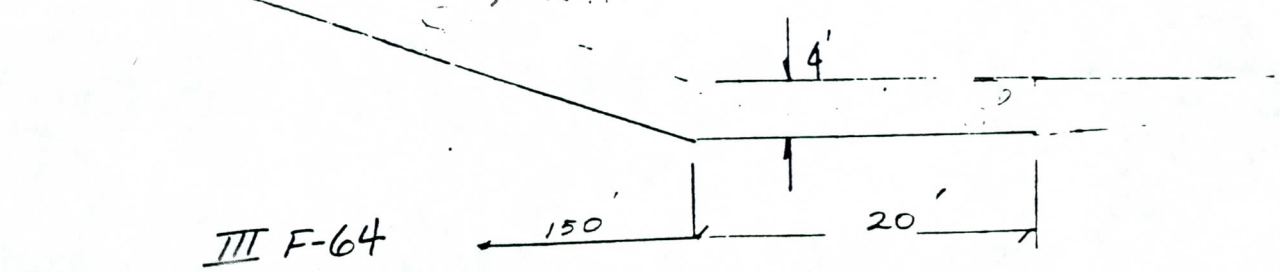
TRY $t = 4'-0$

$\text{UPLIFT} = (25.47-4.0)\times62.4\times4^2/2 = 10718$

$\text{WEIGHT} = 4.0^3\times150 + 4.0^2\times62.4 = 9600 + 999 = 10599$

$S.F = 10605/10718 = 0.99 \simeq 1.0$

* SAMPLE CALCULATIONS OF DETERMINING THICKNESS OF GROUTED ROCK DROP STRUCTURES, LETTER BY JACK STEVENSON DATED JUNE [illegible]

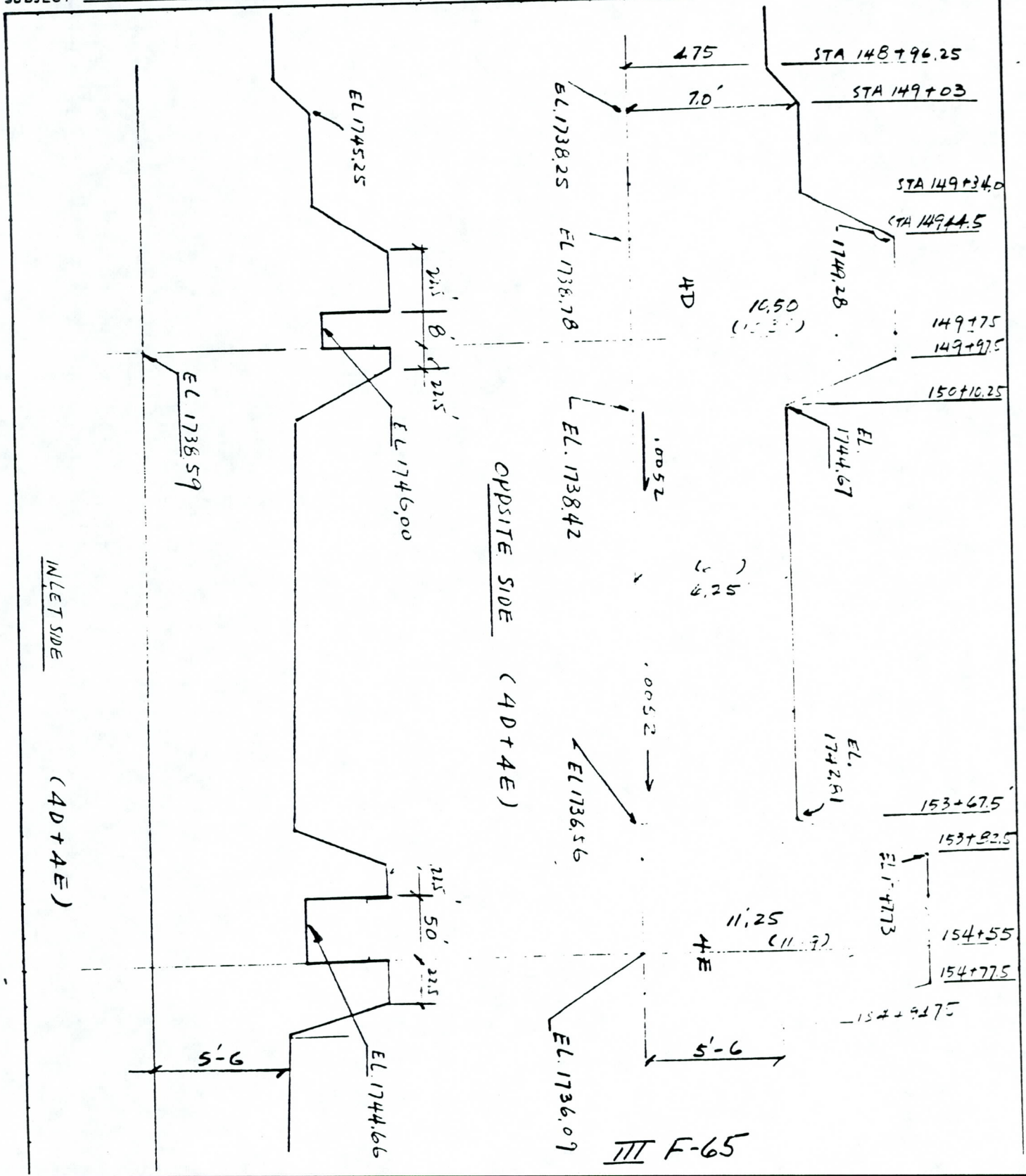


EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1.7.86
CHKD. BY P. Bell DATE 1.8.86

SHEET 62 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY WIER INLET #3 & #4 (4D + 4E)



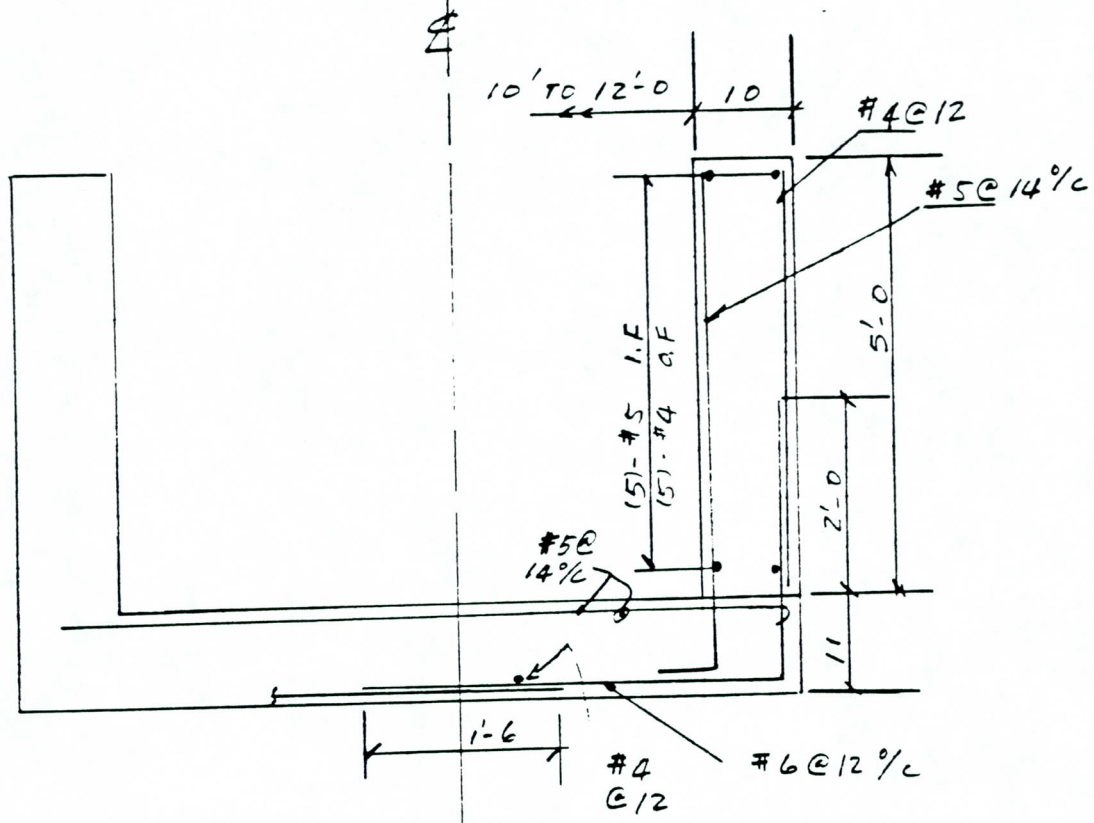
III F-65

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/23/86
CHKD. BY P.B. DATE 1/24/86

SHEET 63 OF 84
OFS NO. 3767-300 DEPT. NO. 293

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY SCI #1 (4A) DWG 2-6, 2-45, 2-46



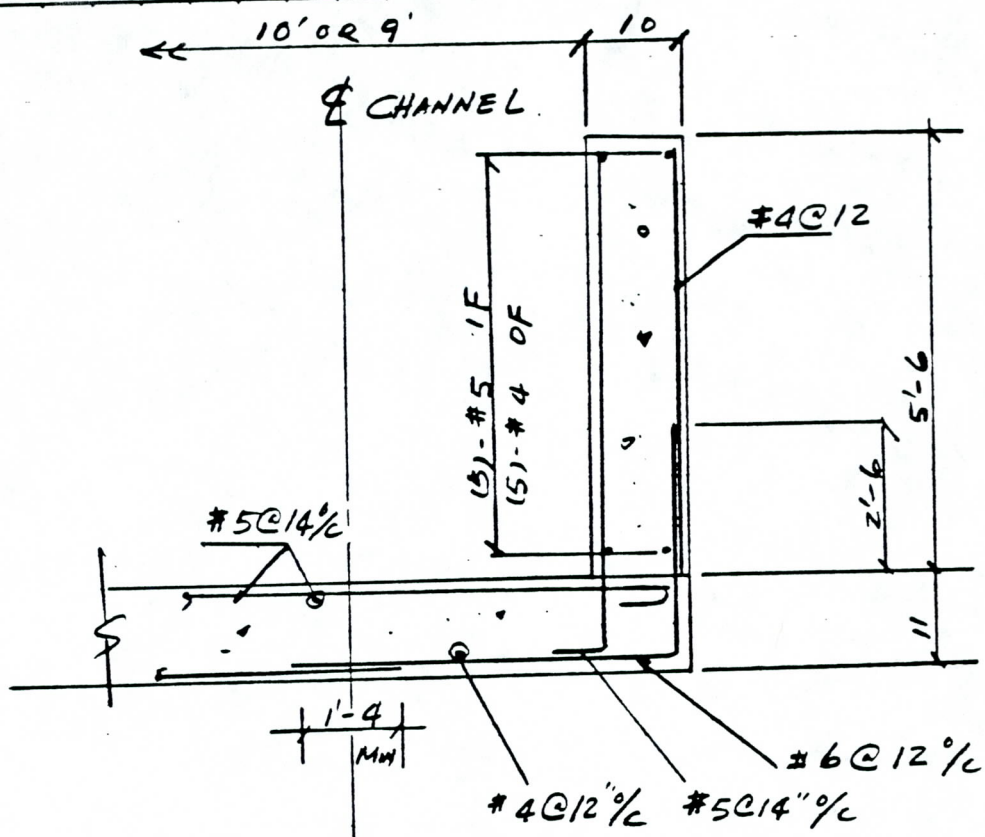
581/8-81

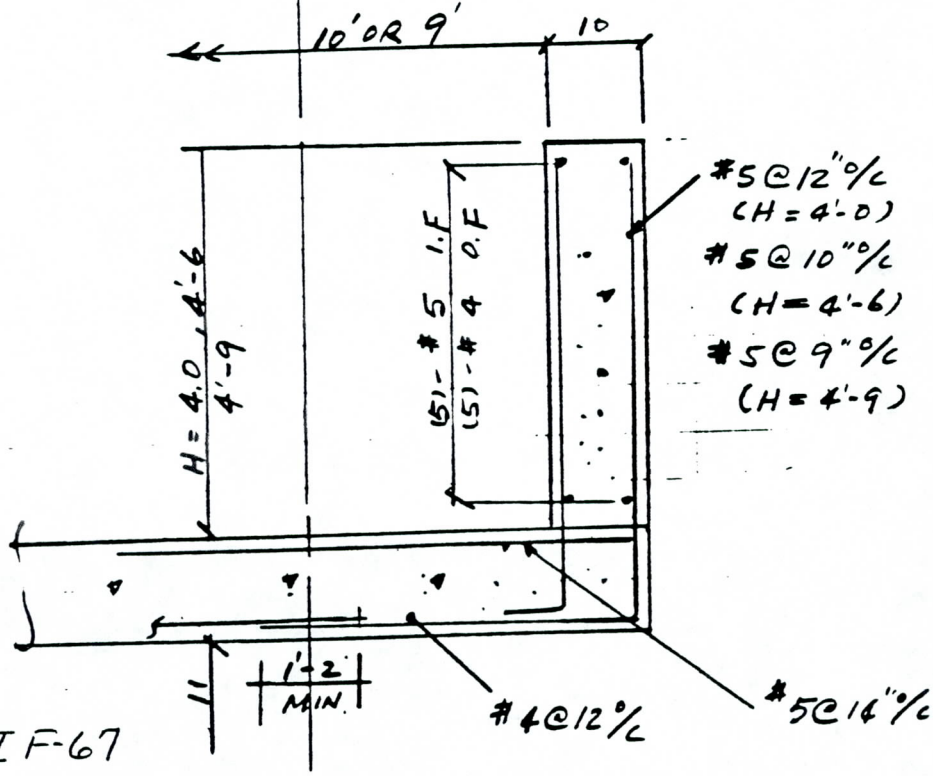
EBASCO SERVICES INCORPORATED

BY N. Hung DATE 11.28.86
CHKD. BY [illegible] DATE 1.24.86

SHEET 64 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY SCI #2 (4B)

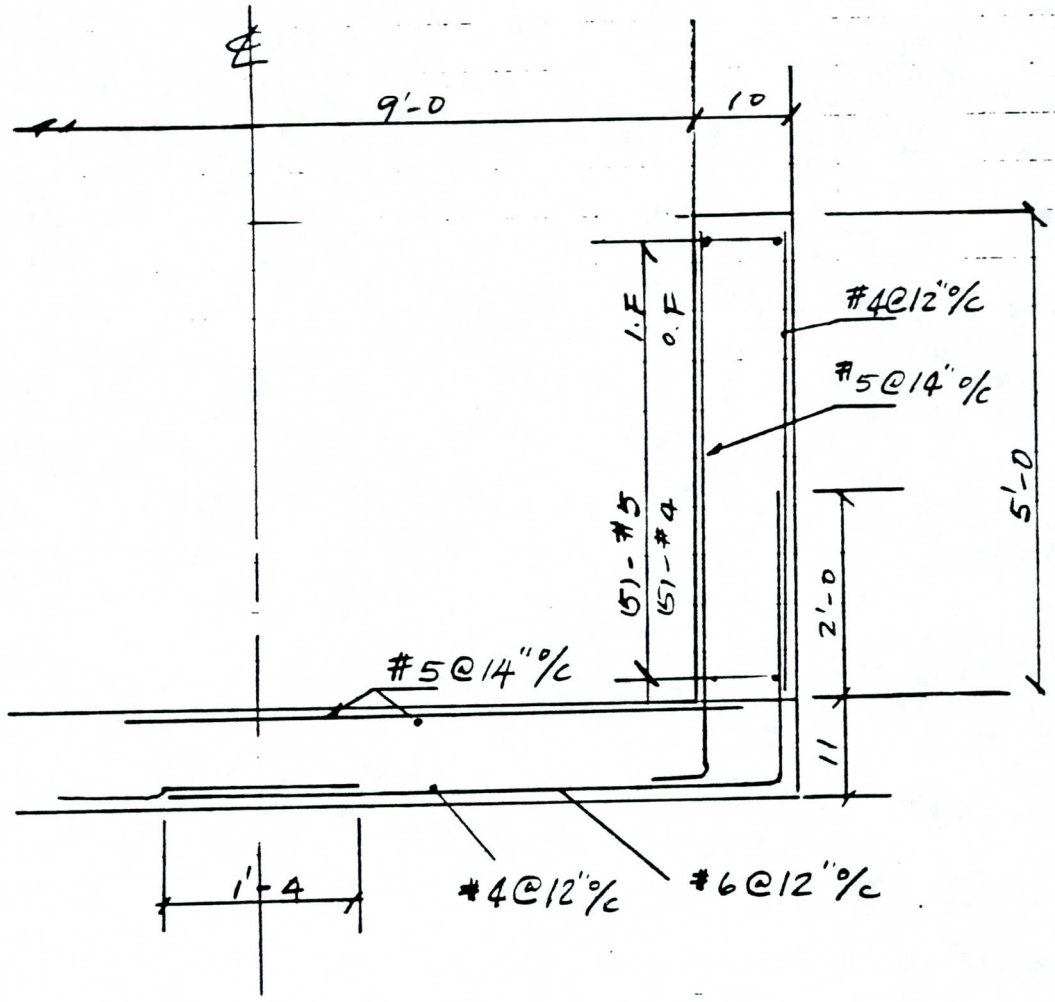




III F-67

EBASCO SERVICES INCORPORATED

BY N. Hung DATE 1/23/86
CHKD. BY P. Bhatt DATE 1/24/86
SHEET 65 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY SCI #2 (4B)



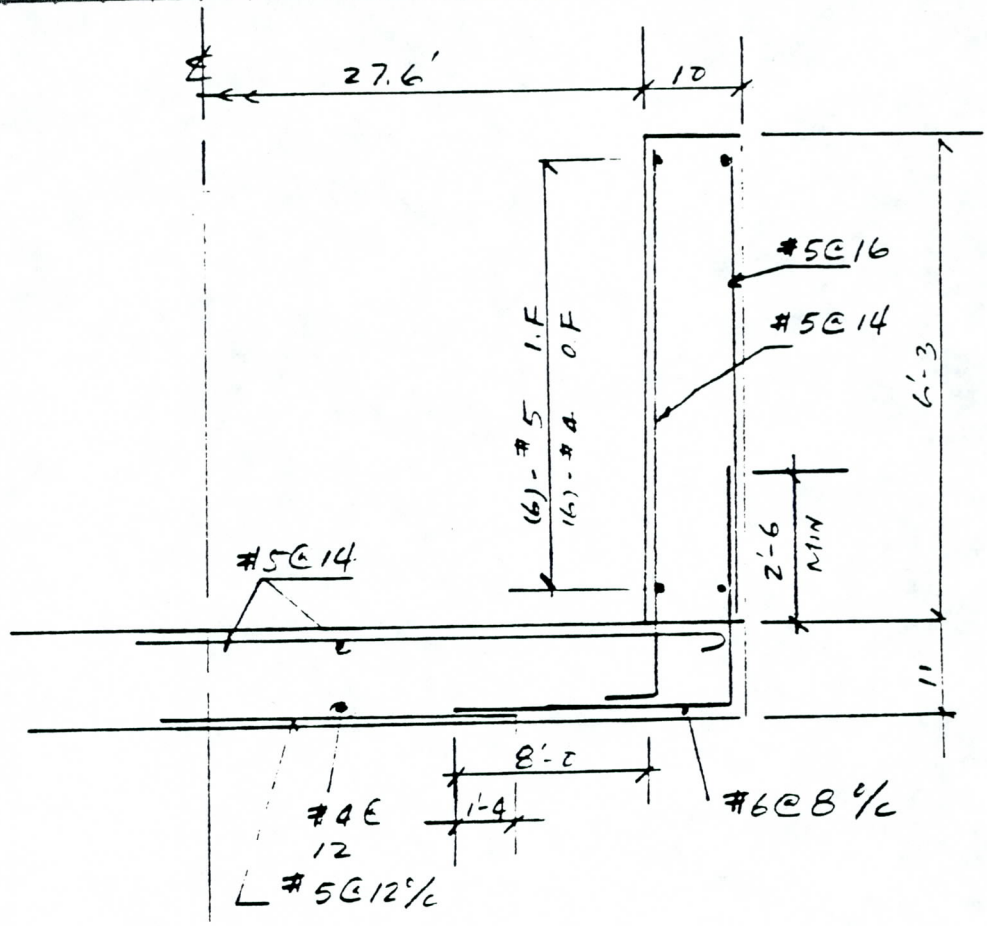
BY N. Huang DATE 1/23/86 SHEET 66 OF 84

CHKD. BY [illegible] DATE 1/24/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT ~~APACHE-BULLDOG FLOOD CONTROL PROJECT~~

SUBJECT BULLDOG FLOODWAY SCI #3 (5A) DWG

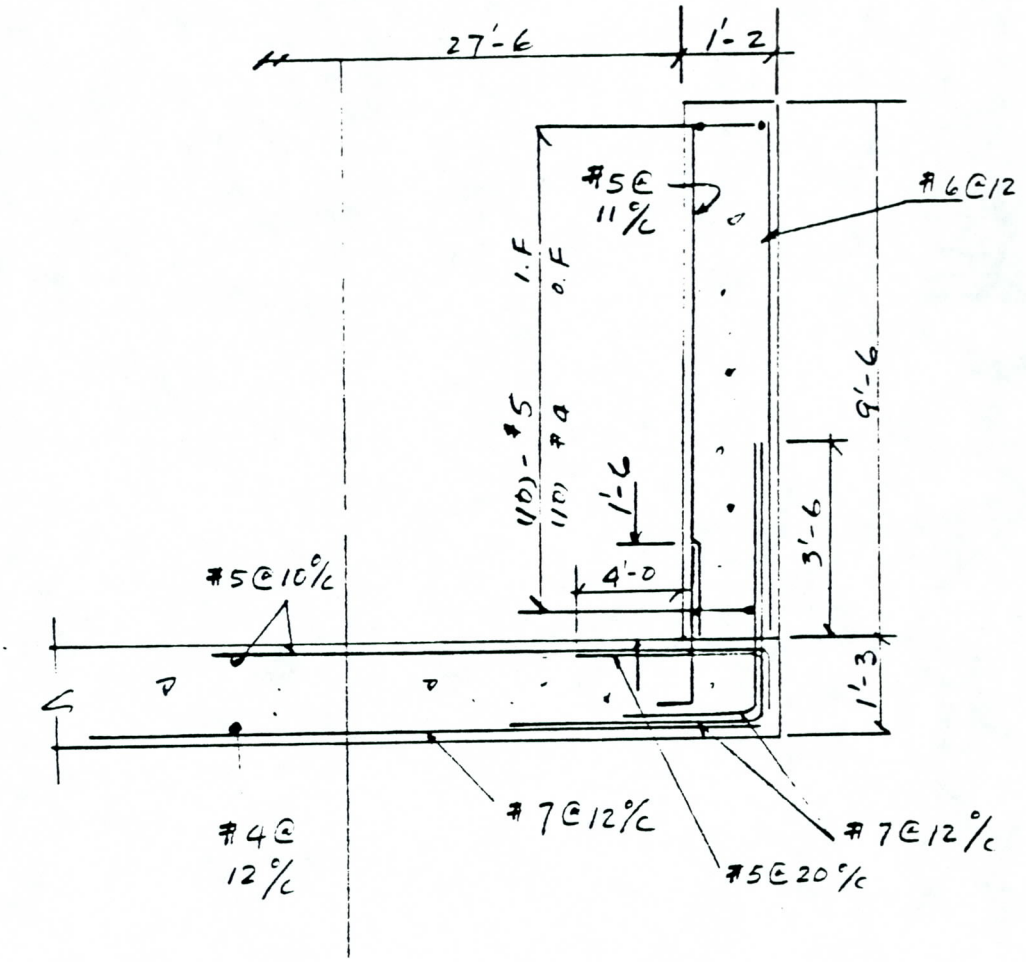


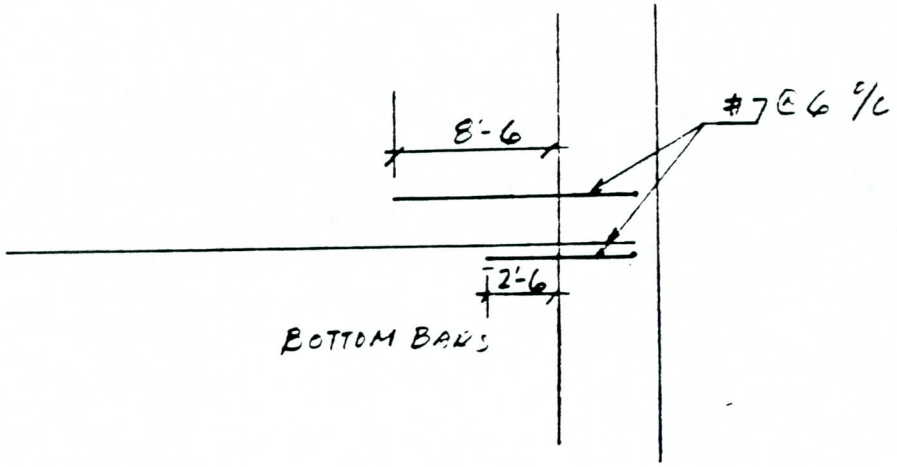
$M_c = 11.2$ 'K'/'

For $x = 6'$ $M = .49 M_c = .49 \times 11.2 = 5.5$ 'K'/'

$x = 8$ $M = 0.303 M_c = 3.4$ 'K'/' < 4.42 'K'/' #5@12"/c

BY N Hung DATE 1/23/86
CHKD. BY P. Burns DATE 1/24/86
SHEET 67 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PRO...
SUBJECT BULLDOG FLOODWAY SCI #3 (SA) DWG





EBASCO SERVICES INCORPORATED

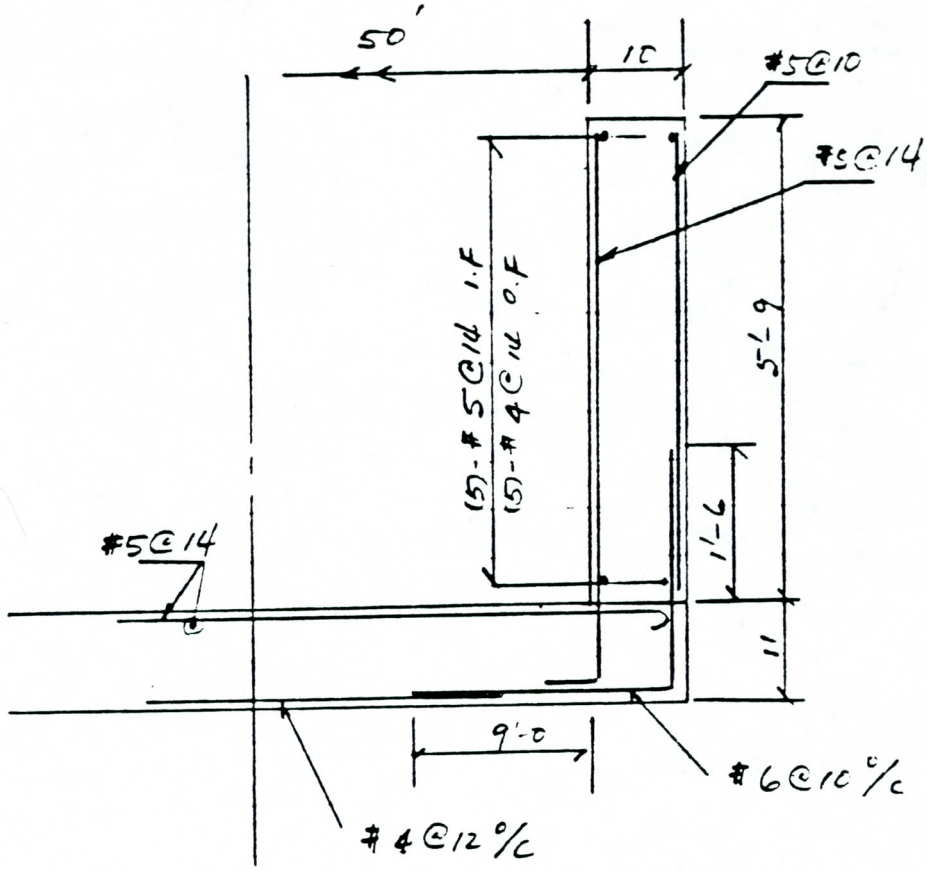
BY N.H.J DATE 1/23/86 SHEET 68 OF 84

CHKD. BY P.BADEN DATE 1/24/86 OFS NO. 3767-300 DEPT. NO. 247

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY SCI #3



581/8-81

EBASCO SERVICES INCORPORATED

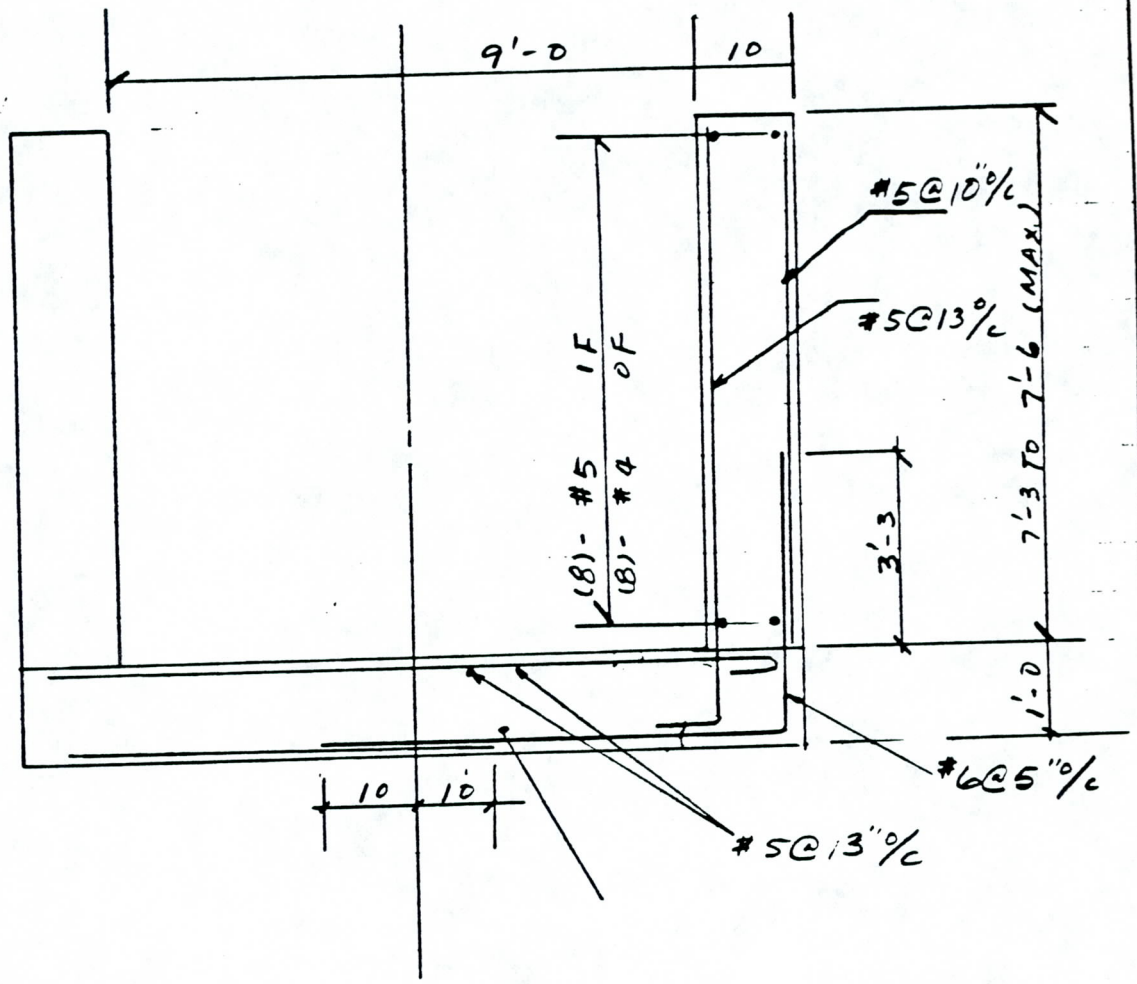
BY N. Hung DATE 10/31/85 SHEET 69 OF 84

CHKD. BY [illegible] DATE 11/2/85 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY SCI # 3 (4B)



WALL DESIGN $t = 10''$

UNEXPOSED FACE

$H = 7'-6$

$M = \frac{1}{6} \times 78 \times 7.5^3 + \frac{1}{2} \times 156 \times 7.5^2$

$= 5484 + 4387 = 9871$ '#/'

$M_u = 1.8M = 17.76$ 'K/'

$d = 10 - 3 = 7''$

$F = 12 \times 7^2/12000 = .049$

$K_u = \frac{M_u}{F} = \frac{17.76}{.049} = 363$

$p = .0108$

$A_s = .0108 \times 12 \times 7 = .91$ □"/'

#6 @ 5" o/c

$H = 4'-6$ $M = \frac{1}{6} \times 78 \times 4.5^3 + \frac{1}{2} \times 156 \times 4.5^2$

$= 1185 + 1580 = 2765$ '#/'

$M_u = 1.8M = 4977$ '#/' $= 5.0$ 'K/'

$K_u = M_u/F = 5.0/.049 = 102$

$p = .0030$ $A_s = .0030 \times 12 \times 7 \times 1.33$

$= 0.34$ □"/'

#5 @ 10" o/c

SHEAR O.K BY INSPECTION

EXPOSED FACE HT OF WT $= 6.25$

$M = \frac{1}{6} \times 62.4 \times 6.25^3 = 2540$ '#/'

$M_u = 1.8 \times 2.54 = 4.57$ 'K/'

$K_u = M_u/F = 4.57/.049 = 94$ $1.33K_u = 124$

$p = .0035$ $A_s = .0035 \times 12 \times 7 = 0.294$ □"/'

#5 @ 13" o/c MIN

$A_{s\,min} = .002 \times 12 \times 10 = .24$ □"/'

HORIZ. BARS .002 x 12 x 10 = .24 "/' EXPOSED FACE

.24 x 7.5/.31 = 5.8 (6) - #5

UNEXPOSED FACE :

.001 x 12 x 10 = .12 "

.12 x 7.5/.20 = 45 (6) - #4

FOUNDATION

EXPOSED FACE : .002 x 12 x 12 = 0.29 "/' #5 @ 12" o/c E.F.

UNEXPOSED FACE : # 6 @ 5" o/c TRANSVERSE DIRECTION

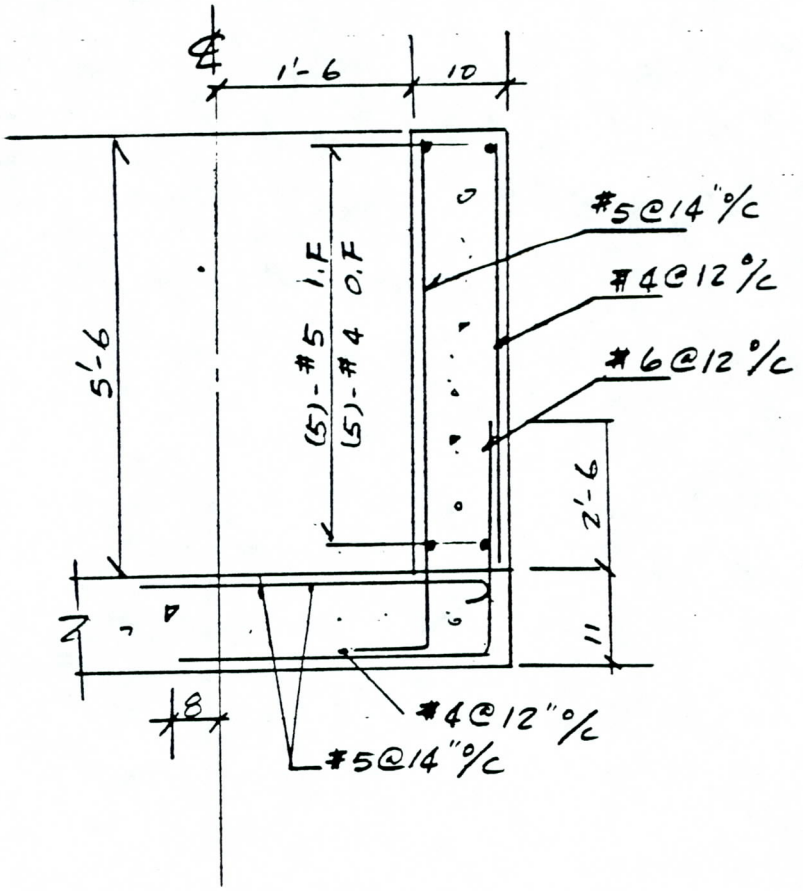
4 @ 12" o/c LONGITUDINAL DIRECTION

EBASCO SERVICES INCORPORATED

BY N. Aung DATE 2/4/86
CHKD. BY P.B. DATE 2/5/86

SHEET 72 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY SCI #6 (5B)



EBASCO SERVICES INCORPORATED

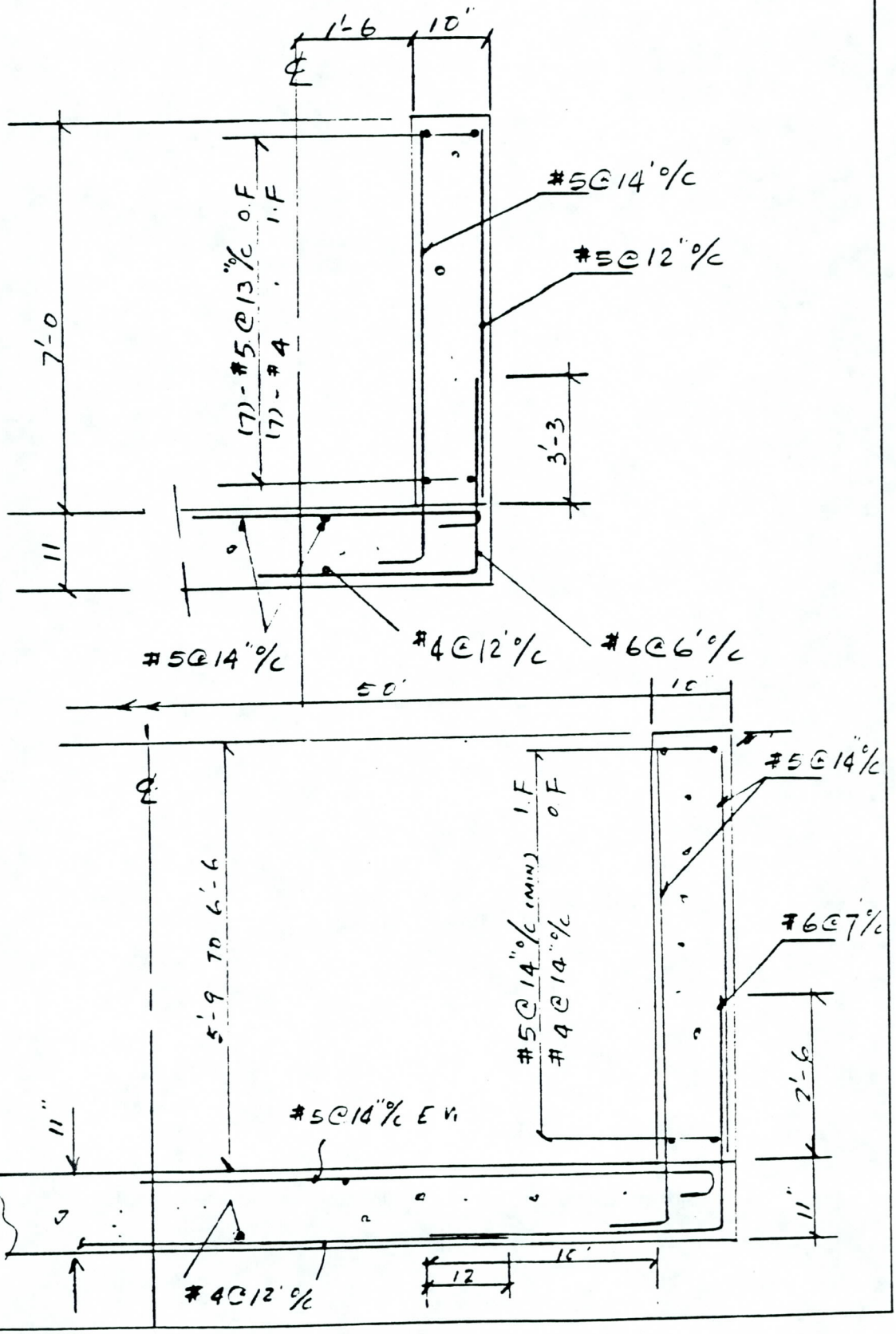
BY N. Hung DATE 1.23.86 SHEET 73 OF 84

CHKD. BY [illegible] DATE 1.24.86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

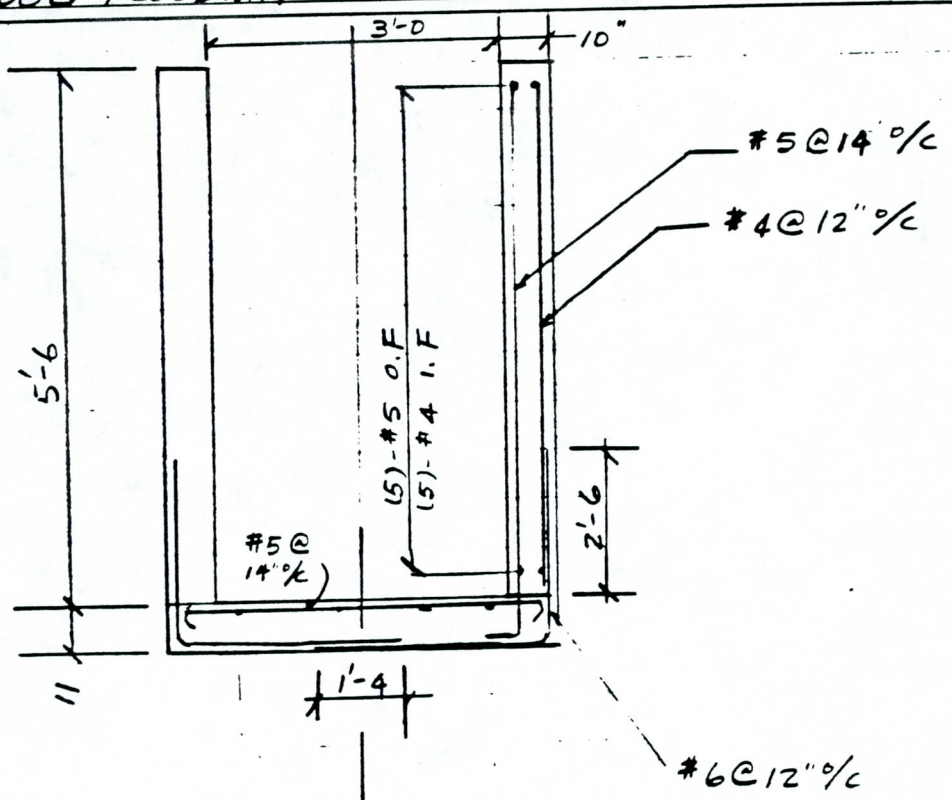
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY SCI #6 (SB) DWG 2-23, 2-43, 2-44



581/8-81

III F-76



A VERT. BARS.

WALL DESIGN · t = 10" UNEXPOSED FACE

H = 5'-6" $M = \frac{1}{6} \times 78 \times 5.5^3 + \frac{1}{2} \times 156 \times 5.5^2 = 2163 + 2360 = 4523$ #/'

$M_u = 1.8M = 8.1$ 'K/'

$F = .049$ $K_u = M_u/F = 8.1/.049 = 165$ $\rho = .005$

$A_s = .005 \times 12 \times 7 = 0.42$ #/' > 0.44 □"/'

H = 3'-0 $M = \frac{1}{6} \times 78 \times 3^3 + \frac{1}{2} \times 156 \times 3^2 = 351 + 702 = 1053$ #/' = 1.1 'K/'

$M_u = 1.8M = 1.90$ 'K/'

$K_u = 1.90/.049 = 39.1$ $Q_u = 2.96$

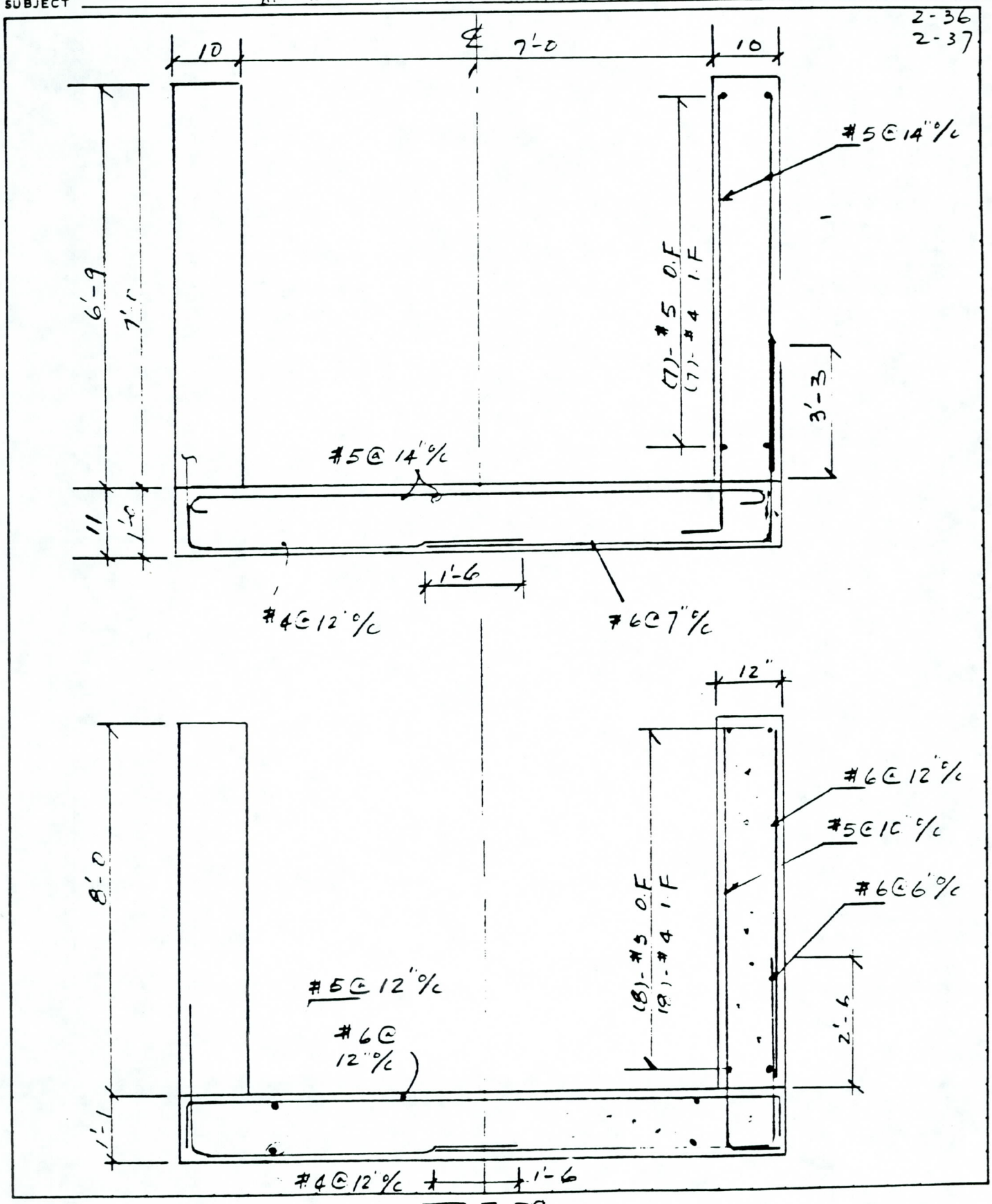
$A_s = \frac{1.9}{2.96 \times 7} \times 1.33 = 0.12$ □"/' #4@12"o/c

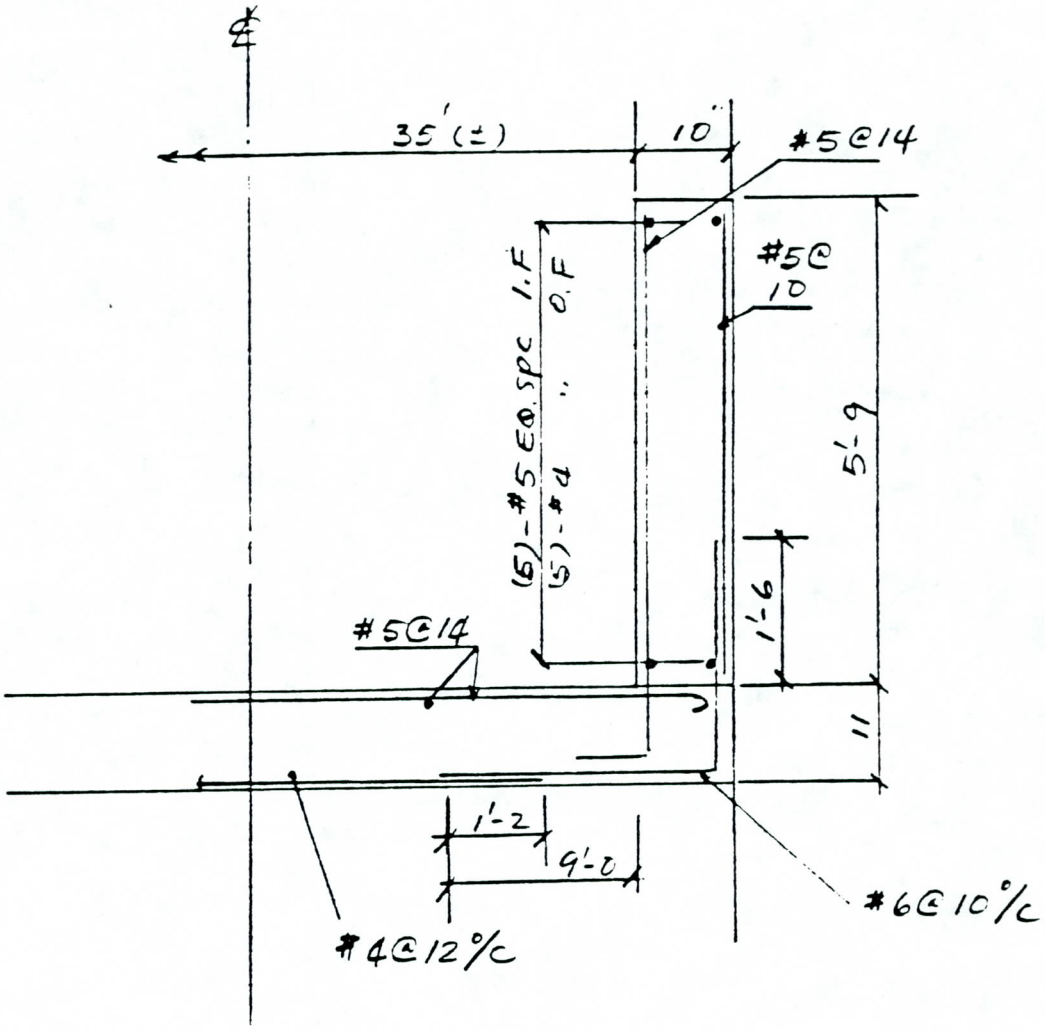
EXPOSED FACE : $A_{s\,min} = .002 \times 12 \times 10 = 0.24$ □"/' #5@15½"o/c

B) HORIZ. BAR : UNEXPOSED FACE $A_s = .001 \times 12 \times 10 = .14$ □"/' #4@16"o/c

III F-77 EXPOSED FACE $A_s = .002 \times 12 \times 10 = 0.24$ □"/' #5@15½"o/c

2-36
2-37


10
℄ 7'-0
10
#5 @ 14" o/c
6'-9
7'-0
(7)-#5 0.F
(7)-#4 1.F
3'-3
#5@14" o/c
11
1'-0
1'-6
#4@12" o/c
#6@7" o/c
12"
#6@12" o/c
#5@10" o/c
#6@6" o/c
8'-0
#5@12" o/c
#6@12" o/c
(8)-#5 0.F
(9)-#4 1.F
2'-6
1'-1
#4@12" o/c
1'-6



CALCULATION SEE APACHE FLOODWAY
37'-6 x 5'-9 CHANNEL.

EBASCO SERVICES INCORPORATED

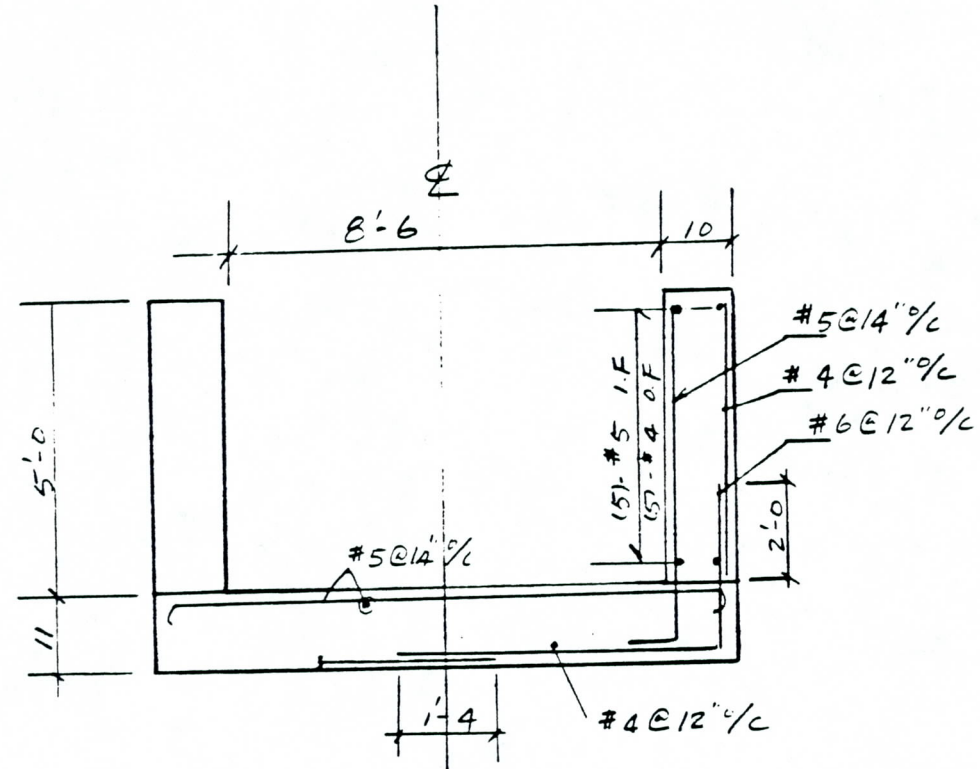
BY N. Ihaj DATE 2/14/86
CHKD. BY P. Bhalls DATE 2/15/86

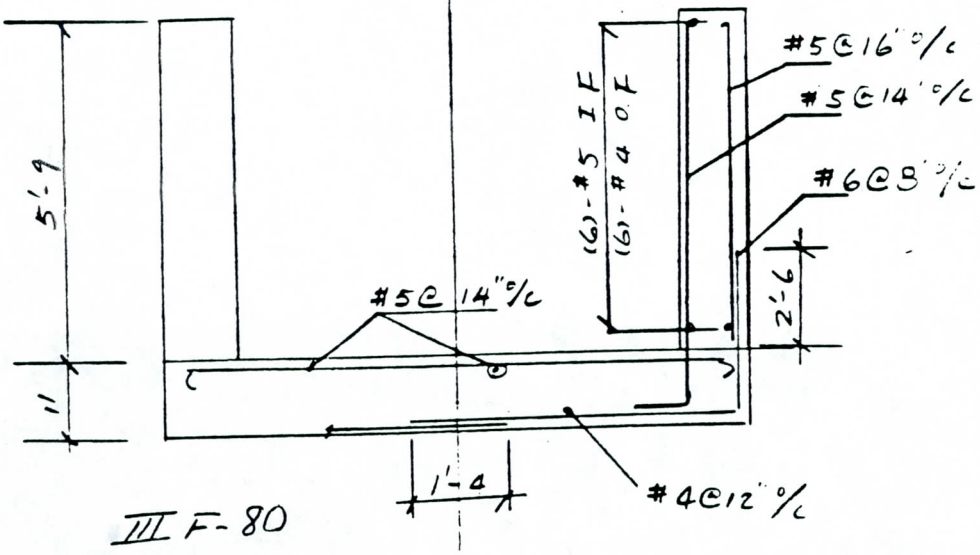
SHEET 77 OF 84
OFS NO. 3767-300 DEPT. NO. 243

CLIENT

PROJECT

SUBJECT BULLDOG FLOODWAY 8'-6 x 5'-0 CHANNEL 4G





III F-80

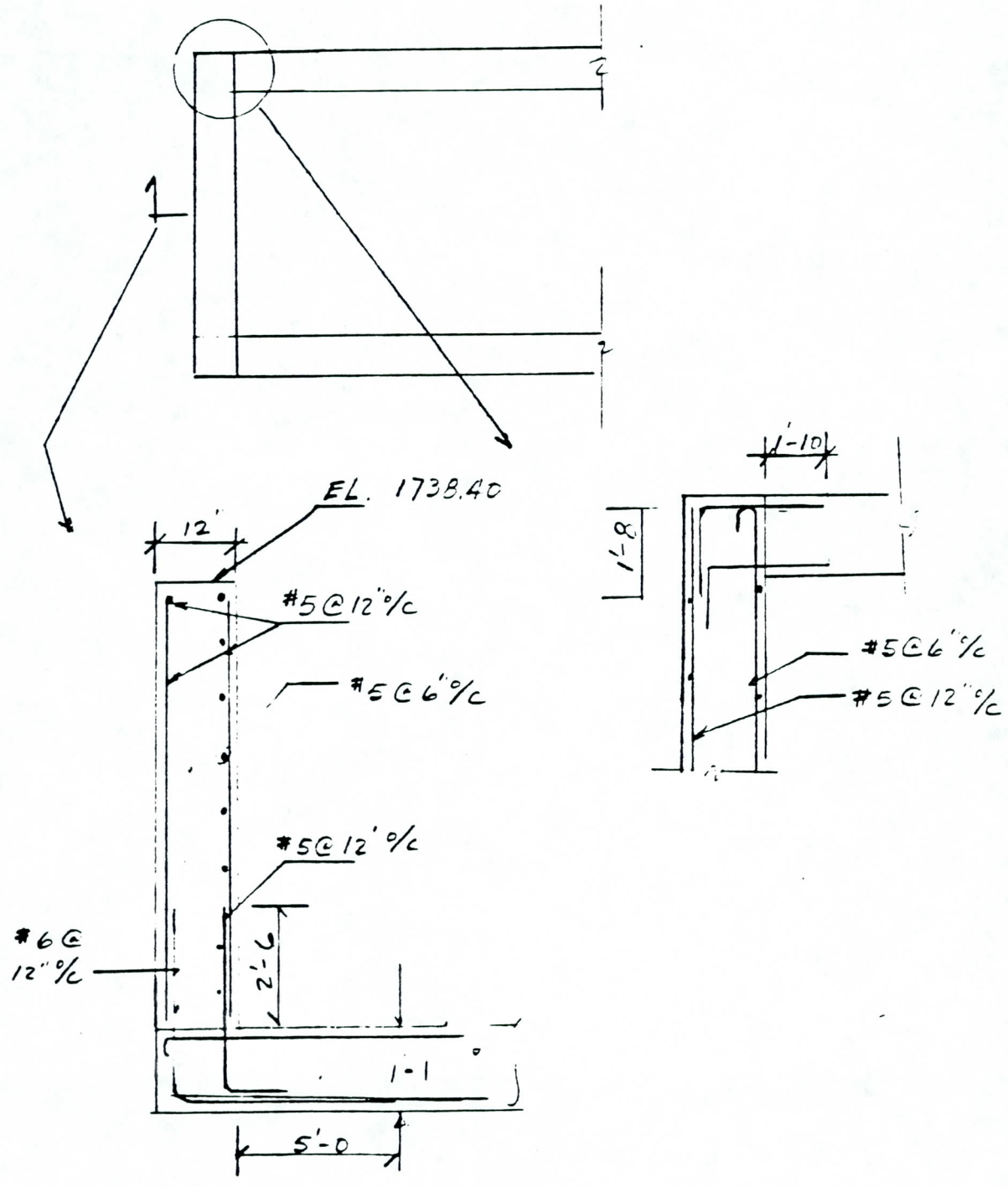
BY N. Hung DATE 2/20/86 SHEET 78 OF 84

CHKD. BY [illegible] DATE 2/21/86 OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY SCI #5 DWG 2-21

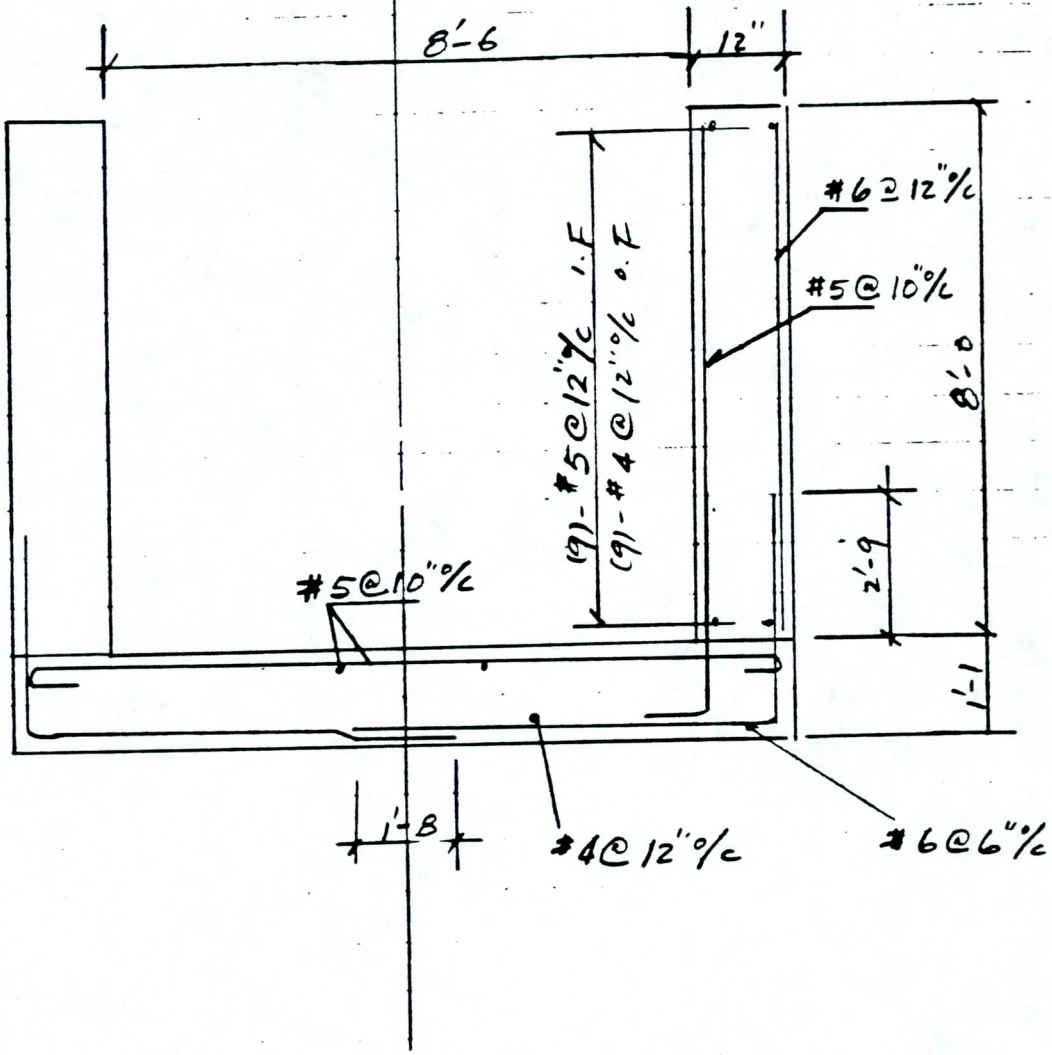


III F-81

EBASCO SERVICES INCORPORATED

BY N Hung DATE 2/20/86
CHKD. BY P. Baker DATE 2/21/86
SHEET 79 OF 84
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY 8'-6 x 8'-0 CHANNEL 4G

SCI #5



WALL DESIGN:

UNEXPOSED FACE

$M = \frac{1}{6} \times 78 \times 8^2 + 156 \times \frac{1}{2} \times 8^2 = 6656 + 4992 = 11648$ '#/'

$= 11.7$ 'K/'

$M_u = 1.8M = 21.0$ 'K/' $\quad F = .081$

$K_u = M_u/F = 21/.081 = 260 \quad a_u = 2.87$

$A_s = M/a_u d = \frac{21.0}{2.87 \times 9} = 0.81$ "/' $\quad$ #6 @ 6" o/c

$H = 5.5'$

$M = \frac{1}{6} \times 78 \times 5.5^3 + 156 \times \frac{1}{2} \times 5.5^2 = 2162 + 2360 = 4521$ '#/'

$= 4.5$ 'K/'

$M_u = 1.8M = 1.8 \times 4.5 = 8.1$ 'K/'

$K_u = 8.1/.081 = 100 \quad a_u = 2.95$

$A_s = \frac{8.1 \times 1.33}{2.95 \times 9} = 0.41$ $\quad$ #6 @ 12" o/c

EXPOSED FACE

$M = \frac{1}{6} \times 62.4 \times 7^3 = 3567$ '#/' $= 3.57$ "/'

$M_u = 1.8M_u = 6.42$

$K_u = 6.42/.081 = 79 \quad a_u = 2.96$

$A_s = \frac{6.42}{2.96 \times 9} \times 1.33 = 0.32$ "/' $\quad$ #5 @ 10" o/c

$A_{s\,min} = .02 \times 12 \times 12 = 0.28$ "/'

FOUNDATION DESIGN

BOTTOM BARS $\quad t = 13' - 1 - 3 - 0.5 = 8.5 \quad F = .07225$

$M_u = 21.0 \quad K = M_u/F = 21/.07225 = 291 \quad a_u = 2.85$

$A_s = \frac{21}{2.85 \times 8.5} = 0.87$ "/' $\quad$ #6 @ 6" o/c

TOP BARS: $M = 6.42^{1k/'}$

$K_u = 6.42/.07225 = 89.$ $\quad a_u = 2.955$

$A_s = \frac{M_u}{a_u d} \times 1.33 = \frac{6.42}{2.955 \times 8.5} \times 1.33 = 0.34^{D''/'}$ $\quad$ #5@10" o/c

$A_{s\,min} = .002 \times 12 \times 13 = 0.32^{D''/'}$

EBASCO SERVICES INCORPORATED

SHEET 82 OF 84

BY N. Hung DATE 2/5/86

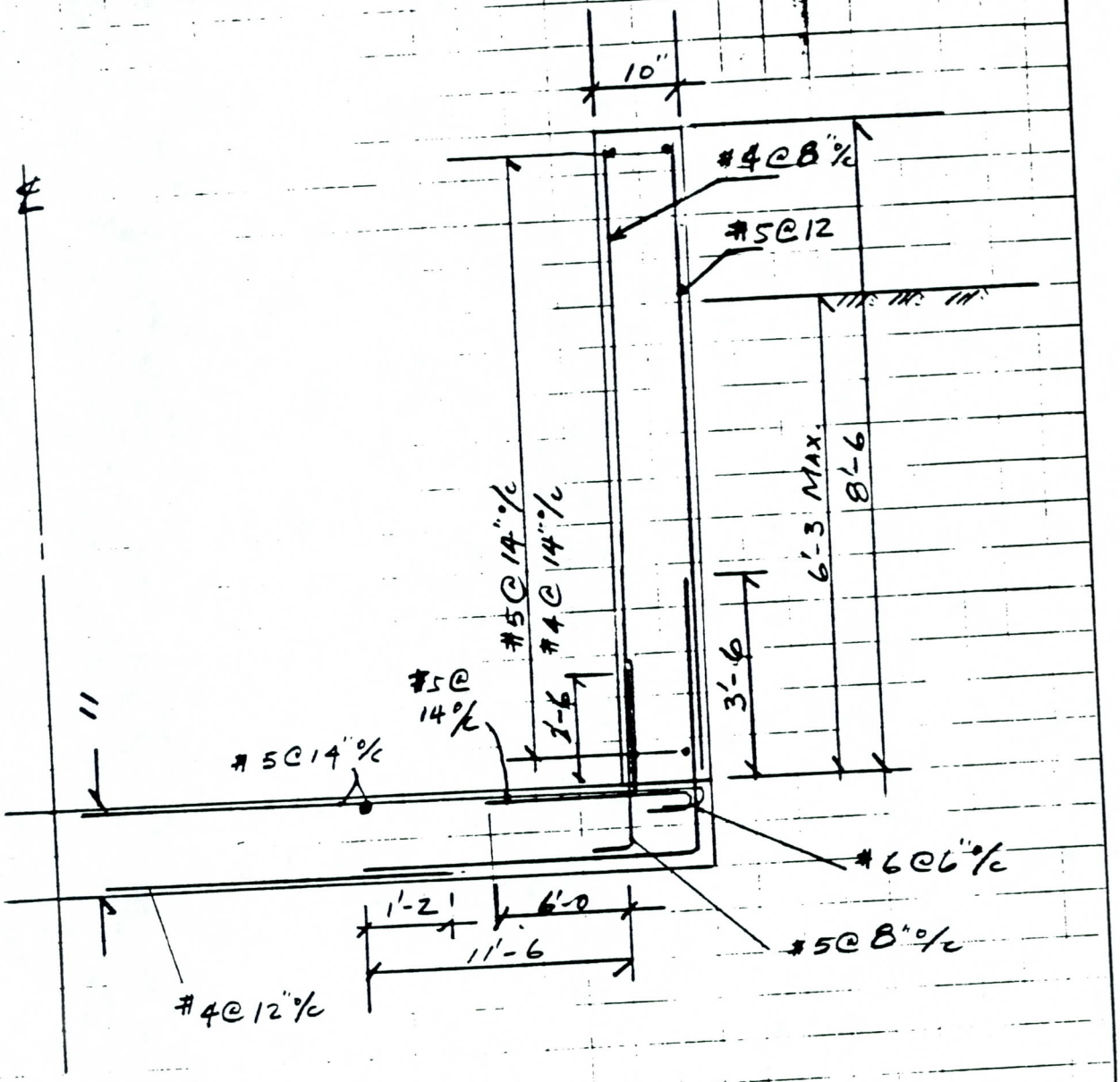
CHKD. BY P. Burke DATE 2/6/86

OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY



581/8-81

III F-85

ALLOWABLE BEARING PRESSURE ON SM-SC SOILS

SOIL PROPERTIES:

$\gamma_w = 110$ pcf
$\phi = 30°$
$c = 0$ psf

$$q_{ult} = cN_c + qN_q + \tfrac{1}{2}\gamma B N_\gamma \quad \text{(CONTINUOUS FOOTING)}$$

For $\phi = 30°$, $N_q = 18.40$ and $N_\gamma = 22.40$

(Foundation Eng'g Handbook, p 127, Table 3.1)

B = Assume minimum footing width of 3 feet
$q = \gamma D$ (assume a minimum "embedment" depth of 4 feet corresponding to minimum height of wall)

$$q_{ult} = (110 pcf)(4ft)(18.40) + (\tfrac{1}{2})(110 pcf)(3ft)(22.40)$$

$$q_{ult} = 8,096 psf + 3,696 psf$$

$$q_{ult} = 11,792 psf$$

$$q_{allow} = \frac{q_{ult}}{FS} = \frac{11,792 psf}{3} = 3,931 psf$$

Use a $q_{allow} = 4$ Ksf

BY V BOLAND DATE 10/10/85 SHEET 84 OF 84

CHKD. BY _____ DATE _____ OFS NO. _____ DEPT. NO. _____

CLIENT USDA

PROJECT APACHE JCT

SUBJECT MODULUS OF SUBGRADE REACTION

Upon review of the boring logs and published literature values for modulus of subgrade reaction it is recommended that the following value be used for design:

$$K_s = 150 \text{ Kcf}$$

Sources:

a) Bowles, Foundation Anal & Design, p. 269

b) NAVFAC, Fig 11-8, p 7-11-10

c) Richart, Hall and Woods, Vibrations of Soils and Foundations, p. 343

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. 950

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

$$T = 3 \text{ FEET}$$

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:

BY CJM DATE 12/2/85 SHEET 2 OF 21
CHKD. BY ✓ DATE 12/4/85 OFS NO. 3767.300 DEPT. NO. 930
CLIENT USDA Soil Conservation Service
PROJECT Bulldog Floodway And Apache Junction
SUBJECT DESIGN OF Grouted Rock Riprap (CONT.)

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

$$\left[\frac{D_{85}}{D_{50}} + \frac{D_{50}}{D_{15}}\right] \leq 5.5$$

$$\left[\frac{2.5}{1} + \frac{2}{1}\right] = 4.5 \quad \text{OK}$$

∴ 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

BY cjm DATE 12/2/85 SHEET 3 OF 21
CHKD. BY (✓) 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

$$\left[\frac{27}{18} + \frac{18}{12}\right] = 1.5 + 1.5 = 3 < 5.5 \text{ (OK)}$$

5. (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:

$$\therefore \quad D_{15} = 8 \quad (\text{USE } 9)$$
$$D_{50} = 16 \quad (\text{USE } 15)$$
$$D_{85} = 20$$
$$D_{100} = 24$$

∴ 24 inch Rock Riprap

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.

BY CJM DATE 12/24/85
CHKD. BY [signature] DATE 12/4/86
SHEET 5 OF 21
OFS NO. 3767.300 DEPT. NO. 930
CLIENT USDA SCS
PROJECT Bulldog Floodway & Apache Junction
SUBJECT DESIGN Grouted Rock Gradations FOR Bulldog Floodway Energy Diss

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)	G.F = 3.2 (OK)
D_{85}	=	40"	(36)	
D_{100}	=	48"	(48)	

• 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.

BY CJM DATE 12/2/85
CHKD. BY [illegible] DATE 12/4/85
SHEET 6 OF 21
OFS NO. 3763.302 DEPT. NO. 913

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 inches

D For condition A. 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)

BY CJM DATE 12/12/85 SHEET 7 OF 21
CHKD. BY [illegible] DATE 12/4/85 OFS NO. 3767300 DEPT. NO. 930
CLIENT LISDA SCS
PROJECT Bulldg Floodway & Apache Junction
SUBJECT Grouted Rock Gradations For Weir & S.d. 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 $2 \times D_{100}$

- 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)

BY [illegible] DATE 12/12/85
CHKD. BY [illegible] DATE 12/4/55
SHEET 2 OF 21
OFS NO. DEPT. NO.
CLIENT USDA SCS
PROJECT Building Floodway & Apache Junction
SUBJECT DESIGN OF Bedding TO BE PLACED UNDER ROCK RIPRAP

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 D100.

- 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
CHKD. BY [illegible] DATE 12/4/8
SHEET 9 OF 21
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 dissipaters 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:

BY S GOYAL DATE 1-21-86 SHEET 10 OF 21

CHKD. BY D.H DATE 1/24/86 OFS NO. USDA 3767.300 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY

ENERGY DISSIPATOR

Incoming flow

$Q = 4674$

$b = 50'$

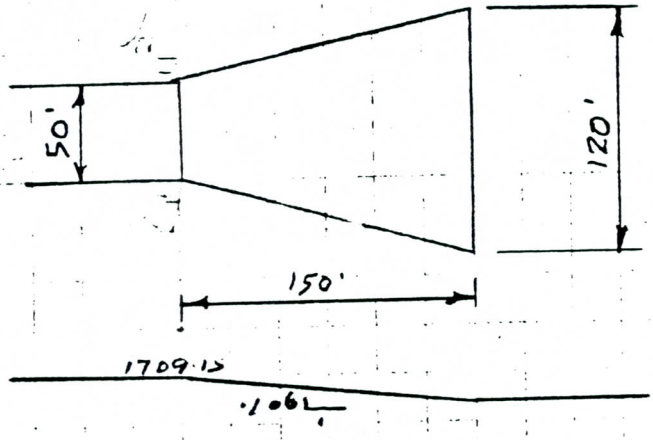
$S = .0051$

$n = .015$

$d = 5.063$ $\quad v = 18.46$

$He = d + \frac{v^2}{2g} = 10.354$

Bed EL = 1709.15



Immediately after the rectangular section assume that the water spreads into the trapezoidal section.

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

$Ke = 1$

d	4	4.2	4.15	4.16	4.17
v	20.147	19.055	19.318	19.265	19.213
He_2	10.30	9.839	9.945	9.923	9.902
ΔHe_{exp}	1.01	.347	.503	.472	.440
He_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 $n = .02 \quad S = .01238 \quad He = 10.354 - .44 = 9.914$

ENERGY DISSIPATOR

INCOMING FLOW

$Q = 1560$ CFS

$b = 37.5$ ft

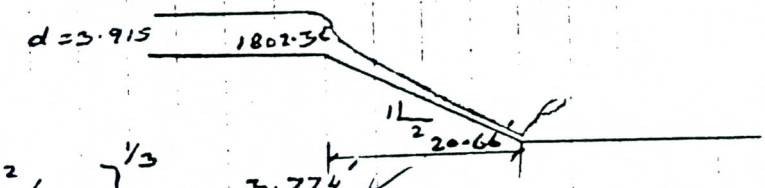
$S = .0024$

$n = .015$

$d = 3.915$ $\quad v = 10.63$

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

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. Neglect expansion loss

∴ Assume $d = 2.55 \quad 2.6$

$2g = 14.36 \quad 14.05$

$He = 5.75 \quad 5.67$ o.k

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

where $k_e = 1$

d_2	3.0	3.01
v_2	11.95	11.909
He_2	5.22	5.212
ΔH_{exp}	.463	.448
He_1	5.683	5.66 o.k

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

$$S = \left[\frac{v_{11}}{1.486 R^{2/3}}\right]^2 \quad \text{for } n = .02$$

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

$$= .0073$$

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

$S_b = .5$, $n = .02$

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
$v^2/2g + d$ H_e =	5.212	5.847	7.485	11.739	13.271
$\frac{H_{e_2} - H_{e_1}}{S_b - S_{av}}$ ℓ =	0	1.297	3.42	9.535	3.722
$\Sigma \ell$ =	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
H_e =	13.990	14.376
ℓ =	1.815	.994
$\Sigma \ell$ =	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)

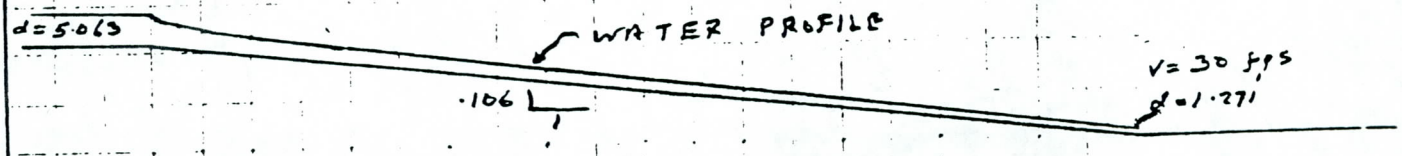
Neglecting the effect of slope on normal and vertical depths of flow

$S_b = .106$ $n = .02$ $Q = 4674$

$S = \left[\frac{V_n}{1.486 R^{2/3}}\right]^2$; $He = He_1 - S_{Av} L + \Delta Z$; $He' = \frac{v^2}{2g} + d$

L	b	"Assumed" d	A	V	R	S_1	S_{av}	$S_{Av} L$	ΔZ	He	$\frac{v^2}{2g}$	He'	
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	ok
15	57	3.24	205.68	22.73	2.877	.02286	.0261	.15	.795	11.24	8.02	11.26	ok
38	64	2.69	186.63	25.04	2.454	.03431	.0286	.43	1.59	12.40	9.74	12.43	ok
45	71	2.32	175.48	26.63	2.158	.0461	.0402	.60	1.59	13.39	11.02	13.34	ok
60	78	2.03	166.58	28.06	1.913	.060	.0531	.80	1.59	14.18	12.22	14.25	ok
75	85	1.825	161.79	28.89	1.737	.072	.0662	.10	1.59	14.78	12.96	14.79	ok
90	92	1.66	158.23	29.54	1.59	.085	.0785	1.18	1.59	15.19	13.55	15.21	ok
105	99	1.53	156.15	29.93	1.475	.0966	.0908	1.36	1.59	15.42	13.91	15.41	ok
120	106	1.427	155.33	30.09	1.38	.1065	.1016	1.523	1.59	15.486	14.06	15.486	ok
135	113	1.343	155.366	30.08	1.3055	.1149	.1107	1.66	1.59	15.416	14.05	15.396	ok
150	120	1.271	155.75	30.01	1.239	.12256	.1187	1.78	1.59	15.22	13.98	15.25	ok

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.



THICKNESS OF GROUTED ROCK DROP. (t)

WATER VELOCITY = 30.70 fps

$n_1 = 1.35$

$y_2 = 8.25$

TRY $t = 2'$

* UPLIFT $= \dfrac{\left(\frac{V^2}{2g} - T\right)(62.4)(T)^2}{2}$

$= \dfrac{\left(\frac{30.7^2}{2\times32.2} - 2\right)(62.4)4}{2} = 1576$ ↑

* WEIGHT $= (T^3)(150) + (T^2)(62.4)$

$= 8\times150 + 4\times62.4 = 1450$ ↓

$F.S = \dfrac{\text{WEIGHT}}{\text{UPLIFT}} = \dfrac{1450}{1576} = 0.92 < 1.0$

TRY $t = 2'-6$

UPLIFT $= \dfrac{\left(\frac{30.7^2}{2\times32.2} - 2.5\right)(62.4)(2.5^2)}{2} = 2366$ ↑

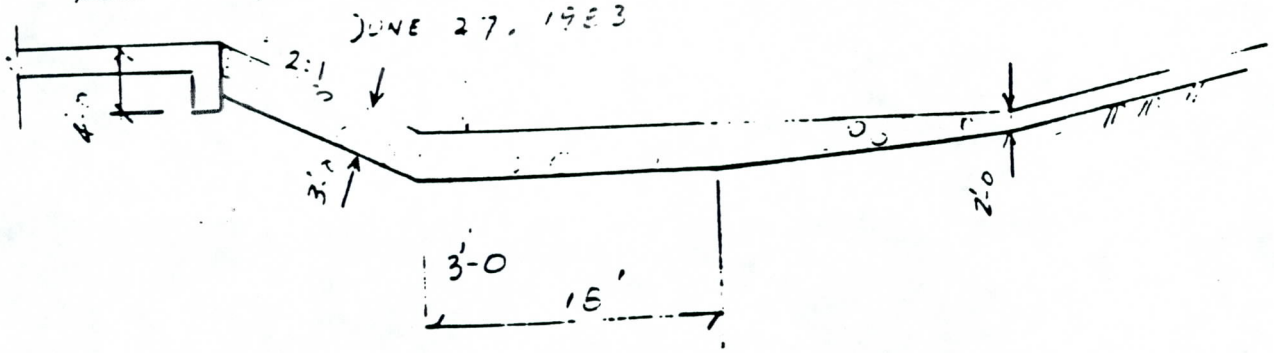
WEIGHT $= 2.5^3\times150 + 2.5^2(62.4)$

$= 2343 + 390 = 2733$

$F.S = 2733/2366 = 1.16 > 1.0$ OK

USE $t = 3'-0$

* SAMPLE CALCULATION OF DETERMINING THICKNESS OF GROUTED ROCK DROP STRUCTURES, LETTER BY JACK STEVENS DATED JUNE 27, 1983



EBASCO SERVICES INCORPORATED

BY CJM DATE 1/24/86 SHEET 15 OF 21

CHKD. BY ____ DATE ____ OFS NO. 3767.300 DEPT. NO. 930

CLIENT USDA SCS

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Grouted Rock Riprap For Energy Dissipators

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

D_{100}	=	24 inches
T	=	36 inches

III F-102

581/8-81

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.

Ceiteria For Bedding And Filter Fabric Design

Bedding:

$$D_{85\ BASE} > \frac{D_{15(RR)}}{5}$$

$$D_{15\ BASE} < \frac{D_{15\ (RR)}}{5}$$

$$D_{15\ BASE} > \frac{D_{15\ (RR)}}{40}$$

$$D_{50\ BASE} > \frac{D_{50\ (RR)}}{40}$$

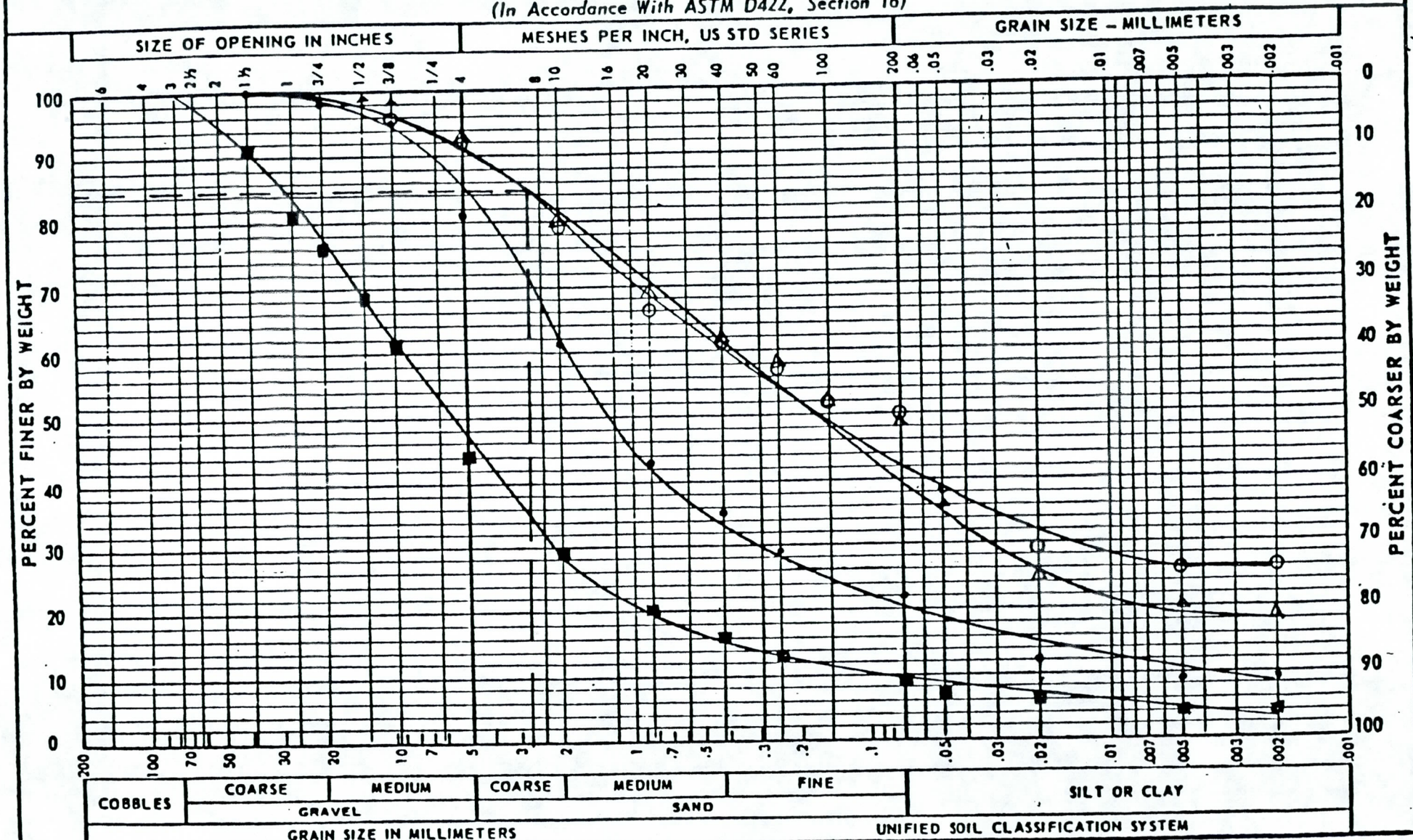
Fabric:

$$EOS \geq \frac{D_{85}}{1.2}$$

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	SS	17-8-85

III F-105

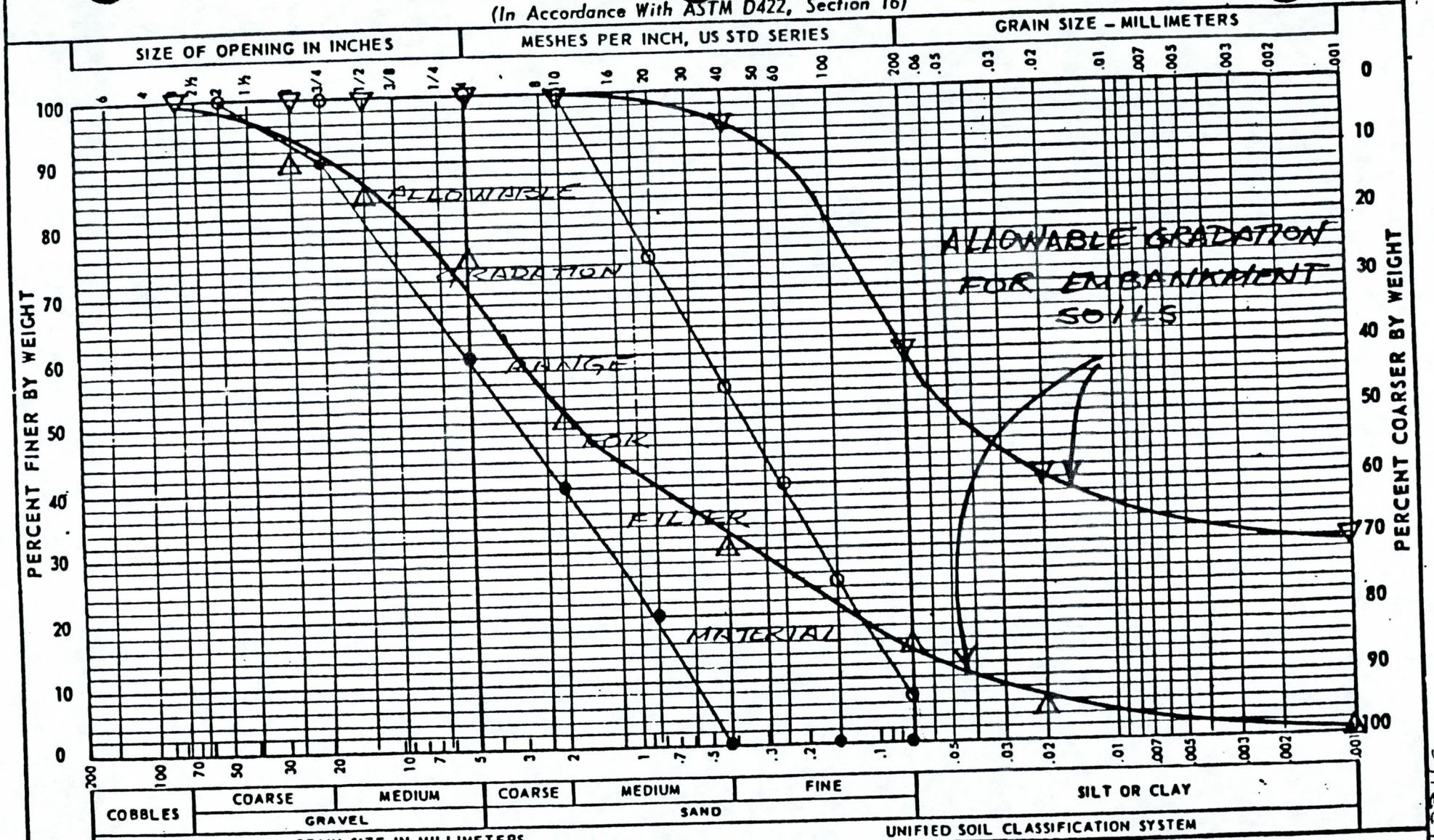
GRADATION RANGE OF BORROW AREA SOILS SHEET 18/21

FORM #14

FORM #1

MECHANICAL ANALYSIS GR[illegible] 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

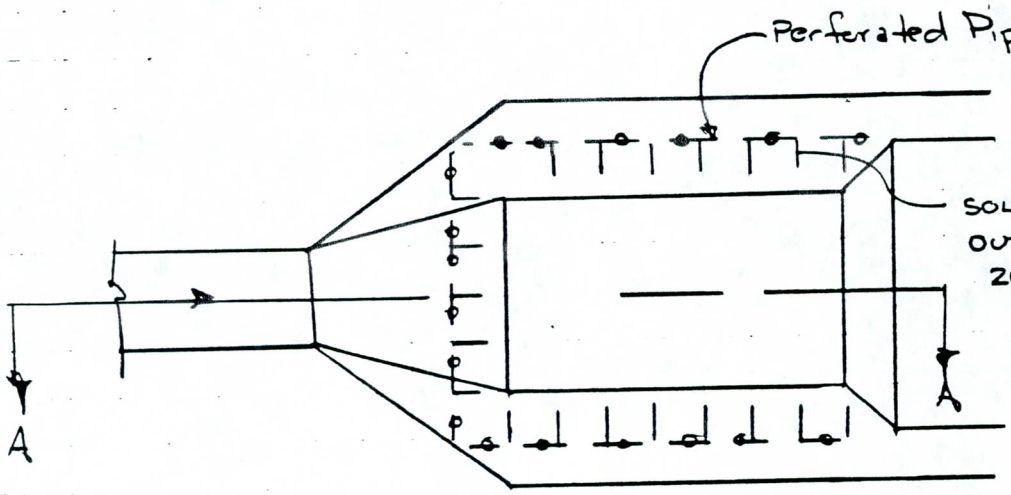
EBASCO SERVICES INCORPORATED

APACHE JCT FRS
PROJECT

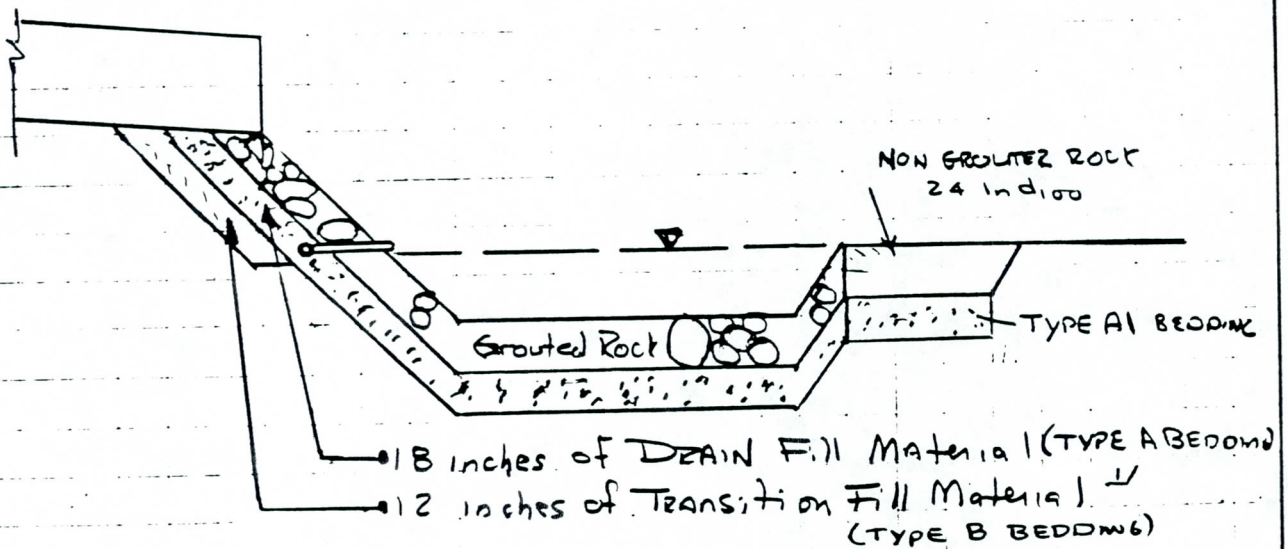
DRAWN BY	CHECKED BY	DATE
	SG	11-8-85

III F-106

SHEET 19/21



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

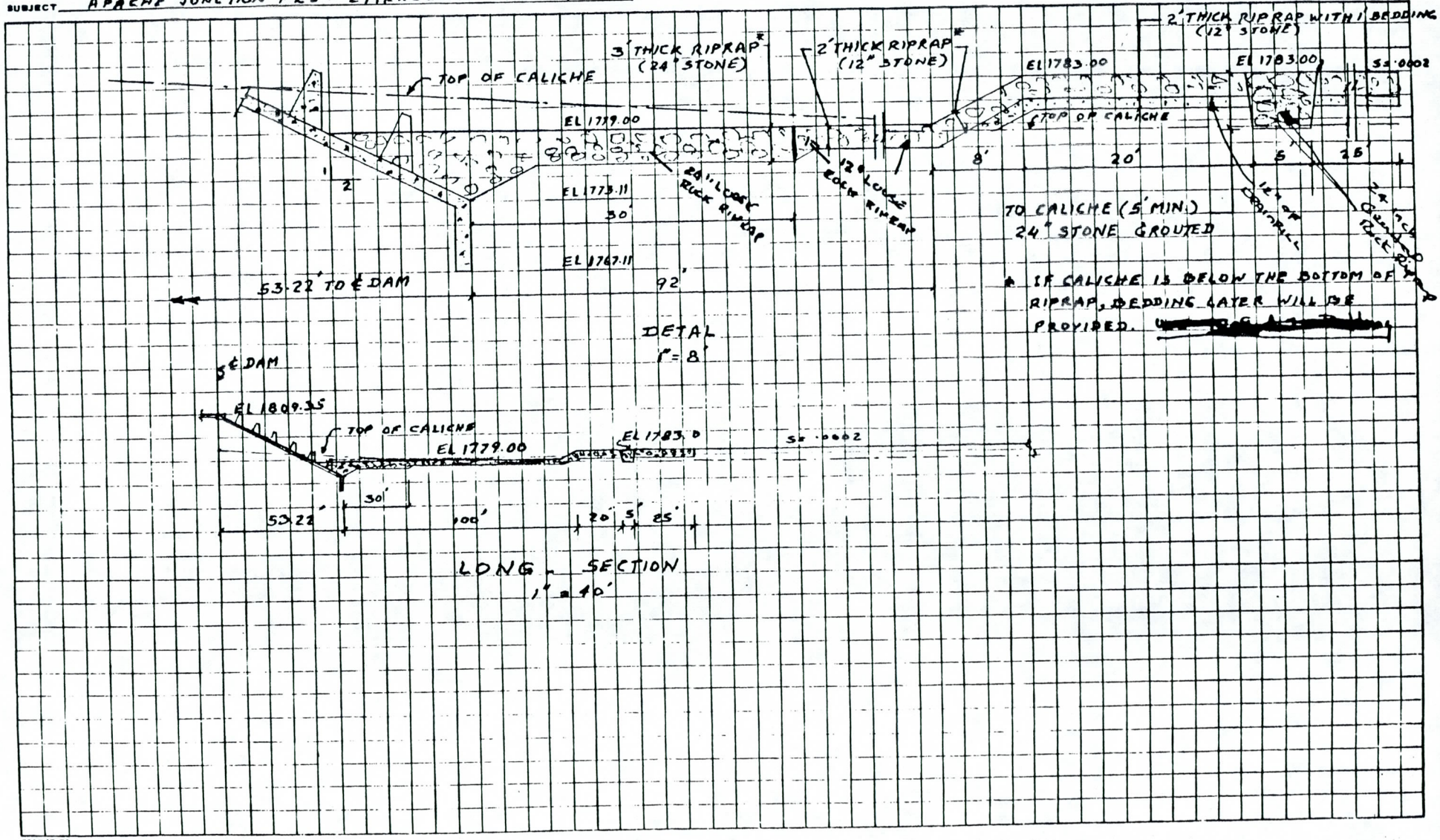
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS - EMERGENCY SPILLWAY

OPS NO. USDA 3767.300 DEPT. NO. 550

BY S GOYAL DATE 1-31-86

CHECKED BY _____ DATE _____



801D/8-74

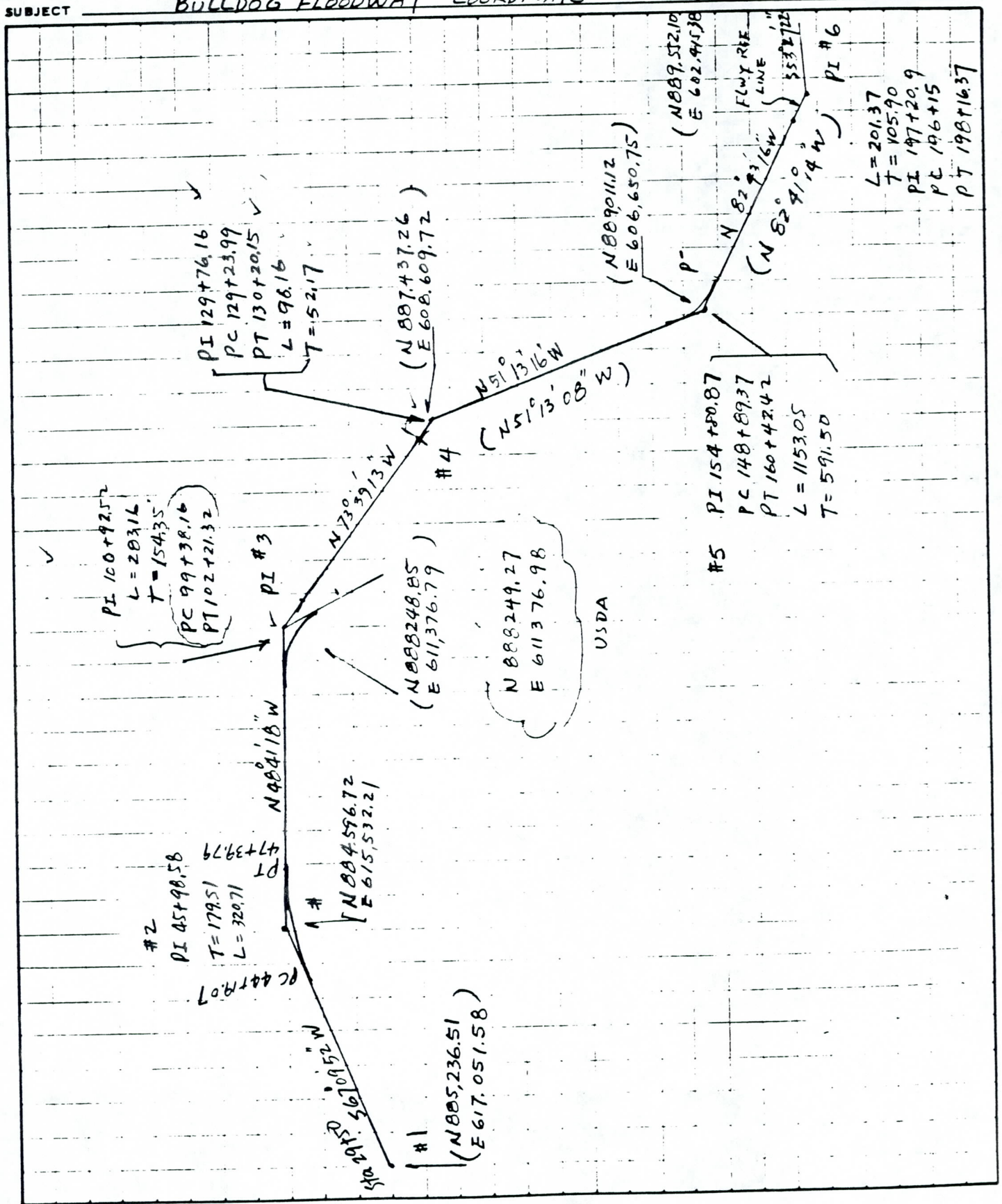
IIF-108

EBASCO SERVICES INCORPORATED

BY N. Id — DATE 12/12/85
CHKD. BY T. Bacon — DATE 12/19/85

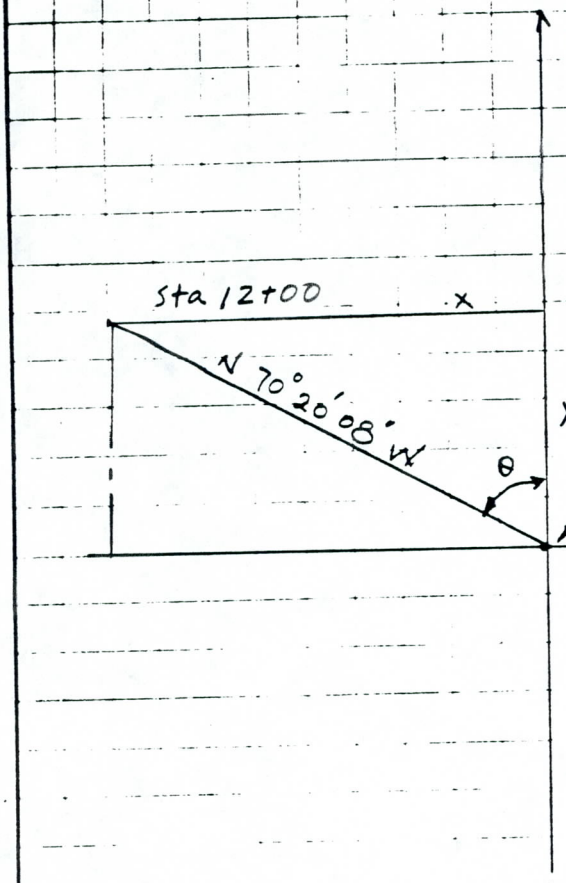
SHEET 1 OF 19
OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SOIL CONSERVATION SERVICE~~
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY COORDINATE



581/8-81

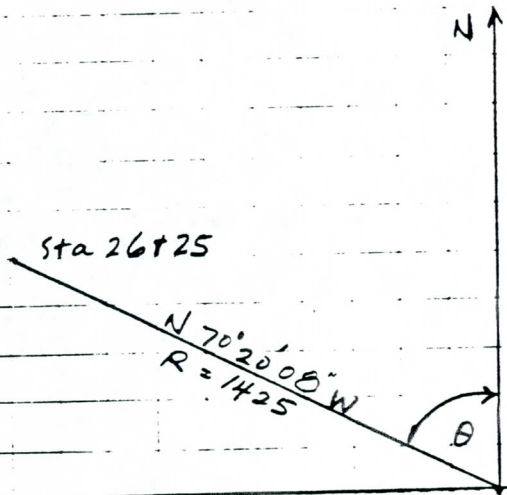
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT APACHE & BULLDOG FLOODWAY COORDINATE



sta 10+00
N 884689.68
E 618581.81

$\theta = 70°20'08"$
$= 70.33555555°$
$R = 1200 - 1000 = 200'$
$x = 200 \sin\theta$
$= 188.34'$
$y = 200 \cos\theta$
$= 67.30'$

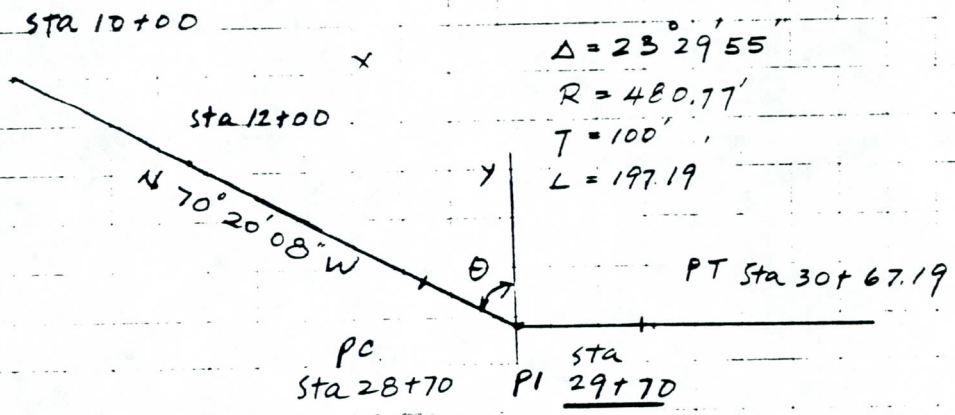
so sta 1200:
E (618581.81 - 188.34) = E 618393.47
N (884689.68 + 67.30) = N 884756.98



$\theta = 70.335555°$
$R = 2625 - 1200 = 1425'$
$x = 1425 \sin\theta = 1341.89'$
$y = " \cos\theta = 479.53'$

so sta 26+25:
E (618393.47 - 1341.89) = E 617051.58
N (884756.98 + 479.53) = N 885236.51

N 884,689.68
E 618,581.81



$R = 2970 - 1200 = 1770'$

$\theta = 70.335555°$

$x = R \sin\theta = 1770'(.9416795) = 1666.77'$

$y = R \cos\theta = 595.62'$

Sta 29+70

E (618393.47 - 1666.77) = E 616,726.70

N (884756.98 + 595.62) = N 885,352.60

EBASCO SERVICES INCORPORATED

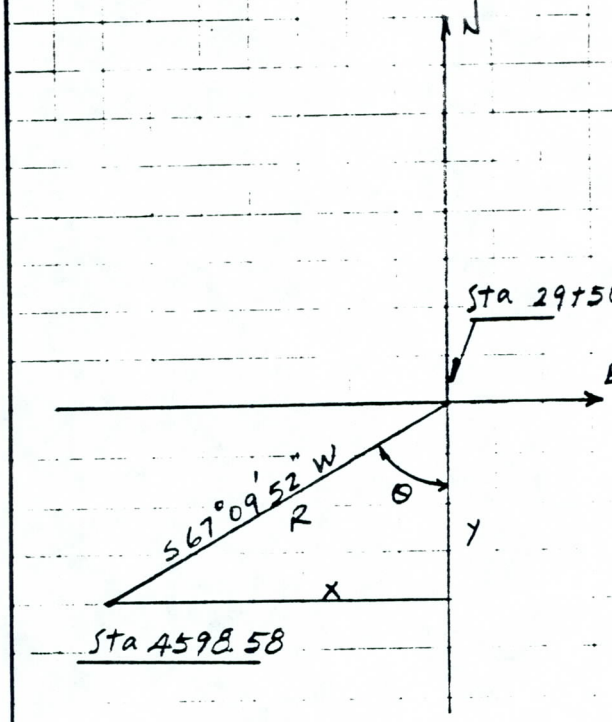
BY 12/12/85 DATE 12/12/85 SHEET 4 OF 19

CHKD. BY P. Barlow 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



$\theta = 67°09'52" = 67.164444°$

$R = (4419.07 - 2950) + 179.51 = 1648.58$

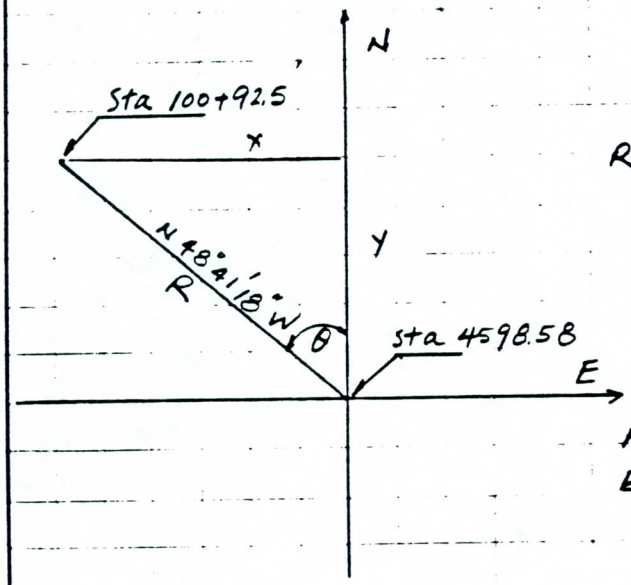
$x = R \sin\theta = 1519.37$

$y = R \cos\theta = 639.79$

Sta 4598.58

N (885,236.51 - 639.79) = 884,596.72

E (617,051.58 - 1519.37) = 615,532.21



$\theta = 48°41'18" = 48.688333$

$R = (9938.16 - 4739.79) + (179.51 + 154.35)$

$= 5532.23'$

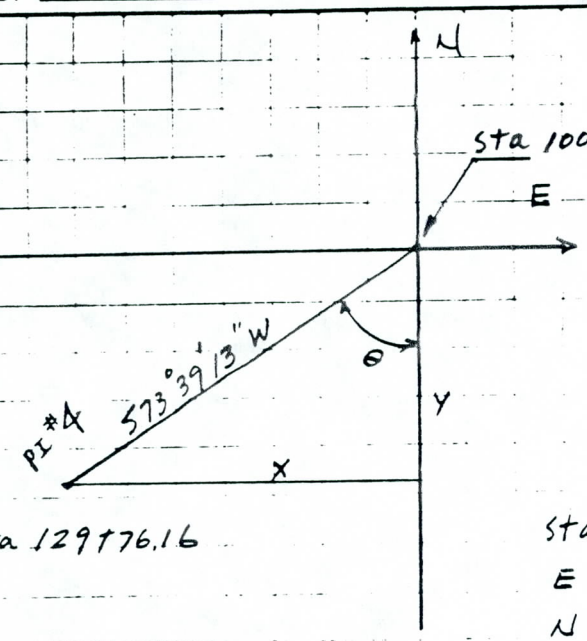
$x = R \sin\theta = 4155.42$

$y = R \cos\theta = 3652.13$

Sta 100+92.5

N (884,596.72 + 3652.13) = N 888,248.85

E (615,532.21 - 4155.42) = E 611376.79



$\theta = 73°39'13'' = 73.653611°$

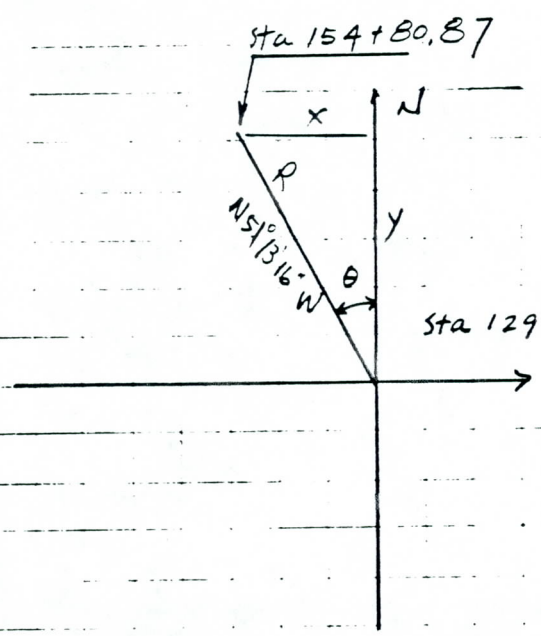
$R = (12923.99 - 10092.52) + 52.17$
$= 2883.64$

$x = R \sin\theta = 2767.07$

$y = R \cos\theta = 811.59$

Sta 129+76.16

Sta 129+76.16
$E\ (611376.79 - 2767.07) = E\ 608,609.72$
$N\ (888248.85 - 811.59) = N\ 887,437.26$



$\theta = 51°13'16'' = 51.221111°$

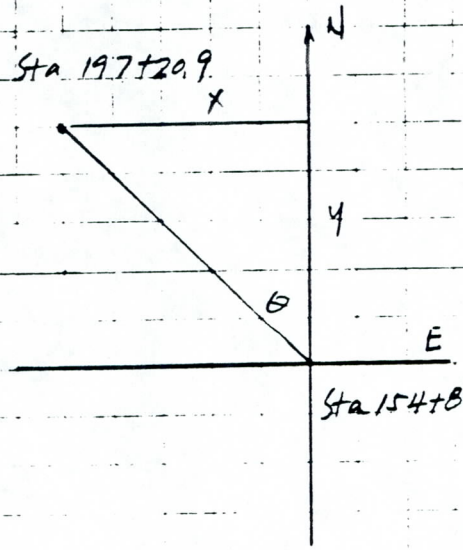
$R = (14889.37 - 13020.15) + 52.17 + 591.50 = 2512.89$

$x = R \sin\theta = 1958.97$

$y = R \cos\theta = 1573.86$

Sta 154+80.87
$E\ (608609.72 - 1958.97) = E\ 606,650.75$
$N\ (887437.26 + 1573.86) = N\ 889\,011.12$

BY N. Hung DATE 12/13/85
CHKD. BY T. Brand DATE 12/19/85
SHEET 6 OF 19
OFS NO. 3767-300 DEPT. NO. 243
CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY



$\theta = 82^\circ 43' 16'' W = 82.721111^\circ$

$R = (197+20.7) - (160+42.42) + 591.50$
$= 4269.78$

Sta 154+80.87 $R \sin\theta = 4235.37 = X$
$R \cos\theta = 540.98 = Y$

Sta 197+20.9 ↓

E $606650.75 - 4235.37 = 602,415.33$ ←
N $889011.12 + 540.98 = 889,552.10$ ←

$\theta = 82.721111$

BY N. [illegible] DATE 12/12/85
CHKD. BY [illegible] DATE 12/19/85

SHEET 7 OF 19
OFS NO. 3767-300 DEPT. NO. 243

CLIENT USDA-SOIL CONSERVATION SERVICE
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT
SUBJECT BULLDOG FLOODWAY COORDINATE

FOR $\theta = 51^\circ 13' 08'' = 51.218889$

$R = 2512.89$

$x = 1958.91 = R \sin\theta$

$y = 1573.94 = R \cos\theta$

Sta 154 + 80.87

E (608609.72 - 1958.91) = 606,650.81

N (887437.26 + 1573.94) = 889,011.20

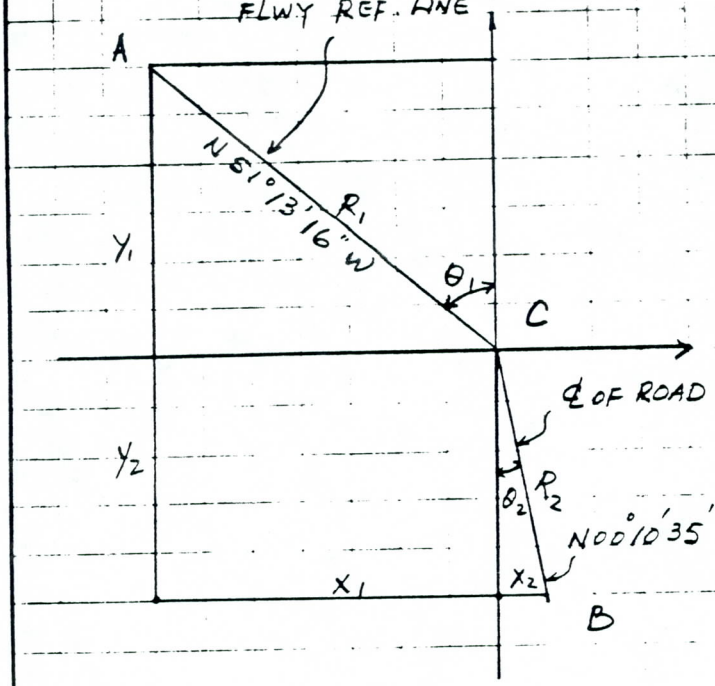
BY N. [illegible] DATE 12/12/85
CHKD. BY P. [illegible] DATE 12/19/85

SHEET 8 OF 19
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 884,689.68	E 616,581.81	
12+00	N 884,756.98	E 618,393.47	
26+25 (29+50)	N 885,236.51	E 617,051.58	
29+70	N 885,352.60	E 616,726.70	
45+98.58	N 884,596.72	E 615,532.21	
100+92.50	N 888,248.85	E 611,376.79	
129+76.16	N 887,437.26	E 608,609.72	
154+80.87	N 889,011.12	E 606,650.75	
197+20.9	N 889,552.10	E 602,415.38	

I) INTERSECTION OF ℄ ROAD & FLWY REFERENCE LINE



A: N 889011.12
E 606,650.75
$\theta_1 = 51°13'16" = 51.22111$

B: N 886,591.62
E 607,874.56

$\theta_2 = 00°10'35" = 0.1763888$

$Y_1 + Y_2 = 889011.12 - 886591.62$
$= 2419.50'$

$X_1 + X_2 = 607874.56 - 606650.75$
$= 1223.81'$

$\tan\theta_1 = 1.244688$,
$\tan\theta_2 = .0030785$

$X_1 = Y_1 \tan\theta_1 = (2419.50 - Y_2)\tan\theta_1$
$X_2 = Y_2 \tan\theta_2$

$X_1 + X_2 = (2419.50 - Y_2)\tan\theta_1 + Y_2 \tan\theta_2 = 1223.81$
$2419.50 \times 1.244688 - Y_2 \times 1.244688 + .0030785\, Y_2 = 1223.81$
$1787.71 = 1.2416095\, Y_2$, $Y_2 = 1439.83'$

$X_2 = Y_2 \tan\theta_2 = 1439.83\,(.0030785) = 4.43'$
$X_1 = 1223.81 - 4.43 = 1219.38'$
$Y_1 = 2419.50 - 1439.83 = 979.67'$

COORDINATION C: N (889011.12 - 979.67) = N 888,031.45
E (606,650.75 + 1219.38) = ~~E 618 70.13~~ E 607,870.13

$R_1 = (X_1^2 + Y_1^2)^{1/2} = (1219.38^2 + 979.67^2)^{1/2} = 1564.17'$

$R_2 = (X_2^2 + Y_2^2)^{1/2} = (4.43^2 + 1439.83^2)^{1/2} = 1439.84'$

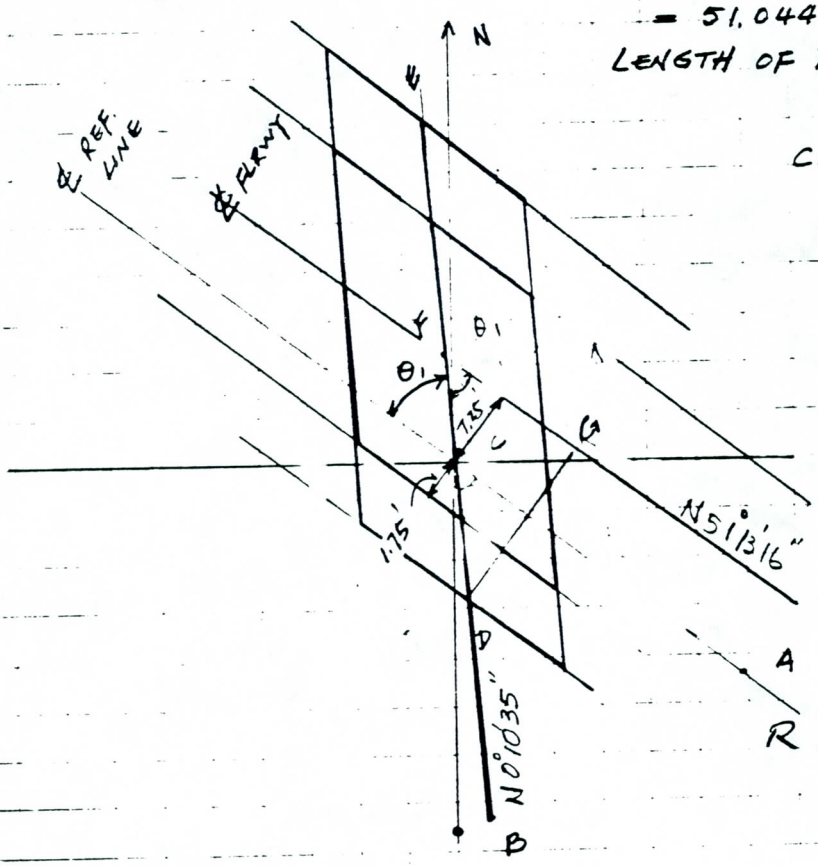
FLWY sta C. - 14889.37 + 591.50 - 1564.17 = 13916.70

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 :

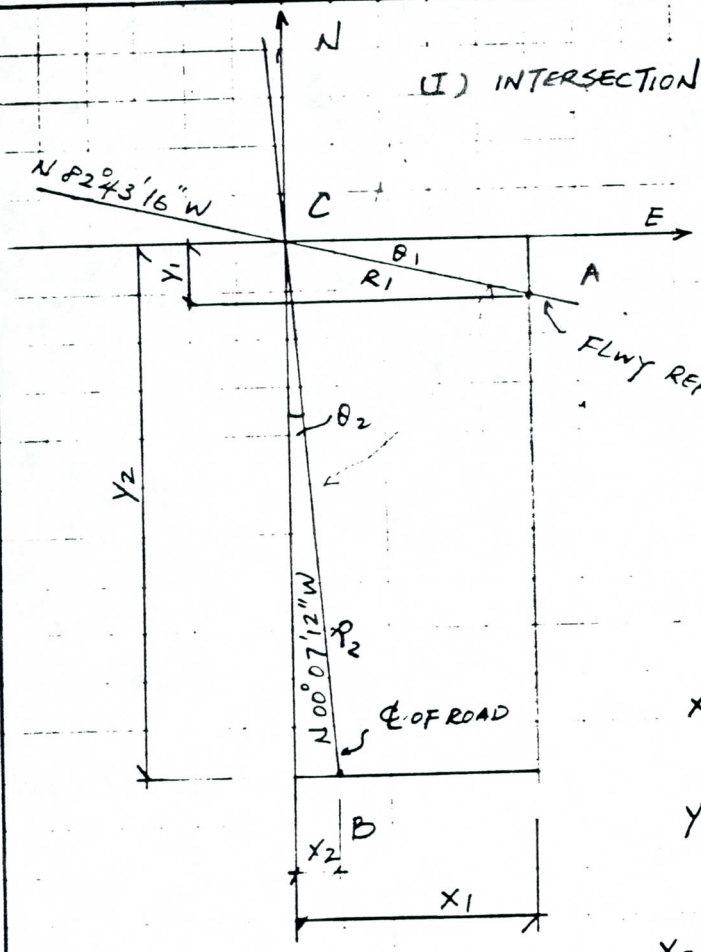
$14 + (35.88 + 26.57)$

$= 14 + 62.45$

$13916.70 - 23.5 = 13893.20$ /

$1744.5 - (13893.2 - 13841) \times .0052 = 1744.23$

$1744.23 + 4.34 + 1 = 1749.57$



(I) INTERSECTION OF ℄ MERIDIAN ROAD & FLWY. REF. LINE

A: N 889.011.12
E 606,650.75

$\theta_1 = 90° - (82°43'16) = 7°16'44"$
$= 7.27888889$

FLWY REF. LINE B: N 886,563.54
E 602,616.89

$\theta_2 = 00°07'12" = 0.12°$

$\tan\theta_1 = 0.1277284$, $\tan\theta_2 = .0020943$

$X_1 - X_2 = 606,650.75 - 602616.89$
$= 4033.86$

$Y_2 - Y_1 = 889,011.12 - 886,563.54$
$= 2447.58$

$X_2 = Y_2 \tan\theta_2$, $X_1 = Y_1 / \tan\theta_1$

$X_1 - X_2 = Y_1/\tan\theta_1 - Y_2 \tan\theta_2 = 4033.86$

$Y_1/\tan\theta_1 - (2447.58 + Y_1)\tan\theta_2 = 4033.86$
$7.8291124 Y_1 - 5.125967 - .0020943 Y_1 = 4033.86$
$7.8270181 Y_1 = 4038.986$, $Y_1 = 516.03$

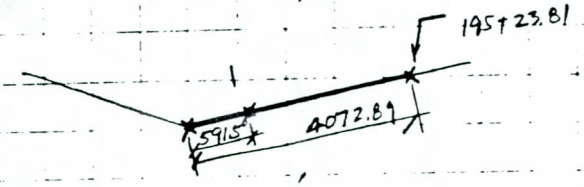
$X_1 = Y_1/\tan\theta_1 = 4040.07$, $X_2 = 6.21$
$Y_2 = 2963.61$

COORDINATION C N 889,011.12 + 516.03 = N 889527.15
E 606,650.75 - 4040.07 = E 602610.68

$R_1 = (X_1^2 + Y_1^2)^{1/2} = (4040.07^2 + 516.03^2)^{1/2} = 4072.89$
$R_2 = (X_2^2 + Y_2^2)^{1/2} = (6.21^2 + 2963.61)^{1/2} = 2963.62$

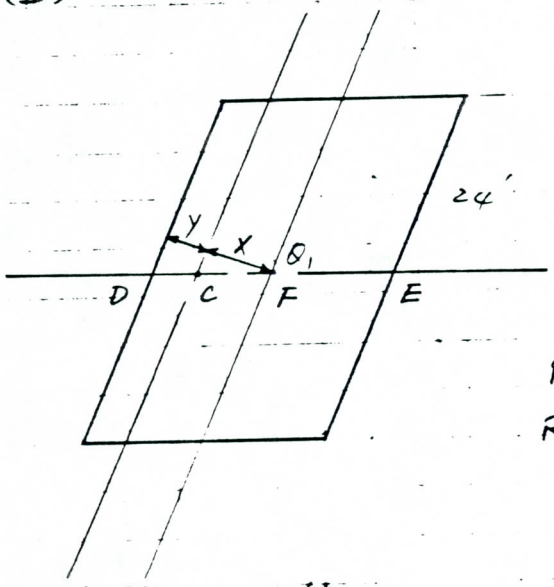
F sta C.: F sta 16042.42) + 4072.89 − 591.50 = 195 + 23.81 ←

R sta C: R sta 00+00 + (2963.62) = R sta 29 + 63.62 ←



LOCATION OF BRIDGE

(II)



LENGTH OF BRIDGE : 53.12'

$X = 25 - 1.75' = 23.25'$

$\theta_1 = 82°43'16'' - 00°07'12'' = 82°36'04''$

$= 82.6011°$

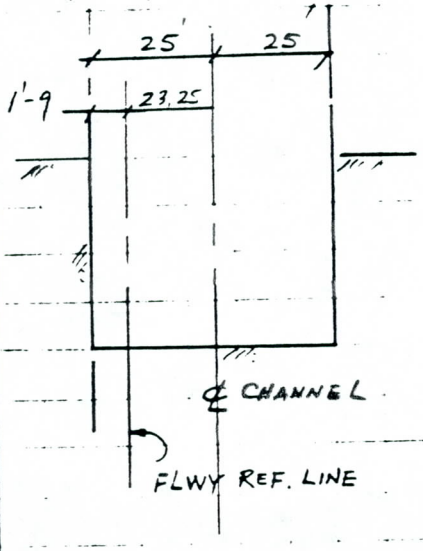
$DF = 53.12/2 = 26.56'$

$CF = X/\sin\theta_1 = 23.25/.9916736 = 23.45'$

$DC = 26.56 - 23.45 = 3.11'$

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



EBASCO SERVICES INCORPORATED

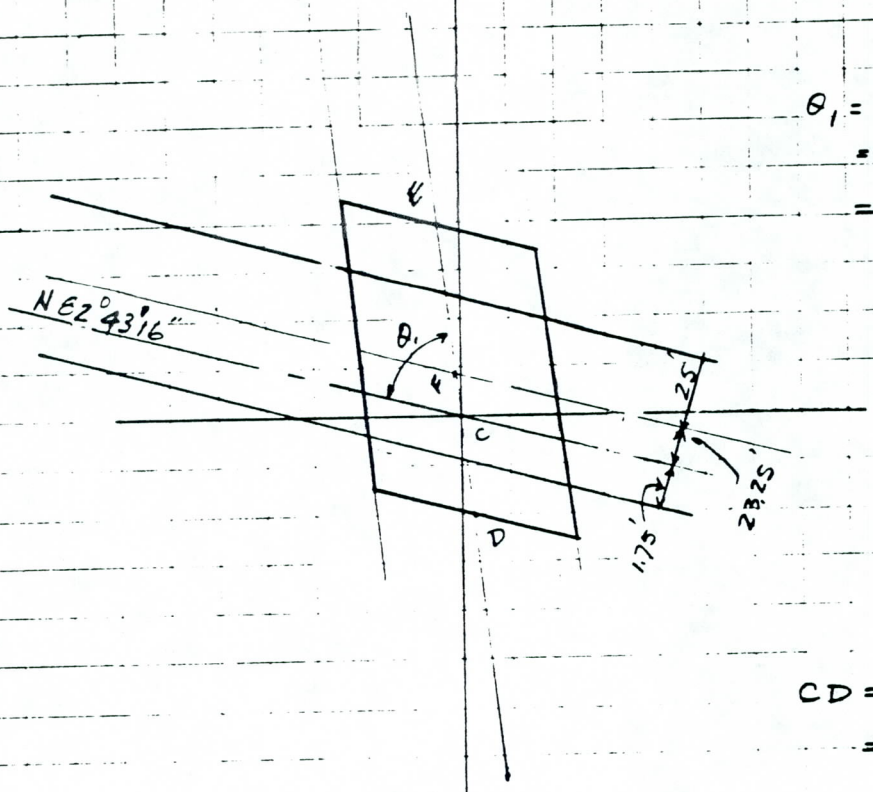
BY N. [illegible] DATE 12/16/85 SHEET 13 OF 19

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 MERIDIAN ROAD BRIDGE LOCATION



$\theta_1 = 82°43'16'' - 0°07'12''$

$= 82°36'4''$

$= 82.6011111$

$FD = 53.12'/2 = 26.56'$

$CF = 23.25'/\sin\theta_1$

$= 23.4452'$

$CD = 26.56 - 23.45$

$= 3.11'$

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 .9051 = 1713.23

ELEV. OF WATER: 1713.23 + 5.1 = 1718.33 + 1 = 1719.33

℄ 195+00

FOR BEARING OF FLWY REF. LINE (N 82°41'14")

$\theta_1 = 90° - (82°41'14") = 7°18'46" = 7.3127778°$

$\tan\theta_1 = 0.1283296$ $\tan\theta_2 = .0020943$

A: N 889,011.57 E 606,650.81

B: N 886,563.54 E 602,616.89

$x_1 - x_2 = 4033.92$ $y_2 - y_1 = 2448.03$

$y_1/\tan\theta_1 - (2448.03 + y_1)\tan\theta_2 = 4033.92$

$7.7924345\, y_1 - 5.1269092 - .0020943\, y_1 = 4033.92$

$7.7903402\, y_1 = 4039.0469$

$y_1 = 518.46862$

$x_1 = y_1/\tan\theta_1 = 4040.13$ $x_2 = 6.21$

$y_2 = 2966.50'$

COORDINATION C N 889,011.57 + 518.47 = N 889,530.04

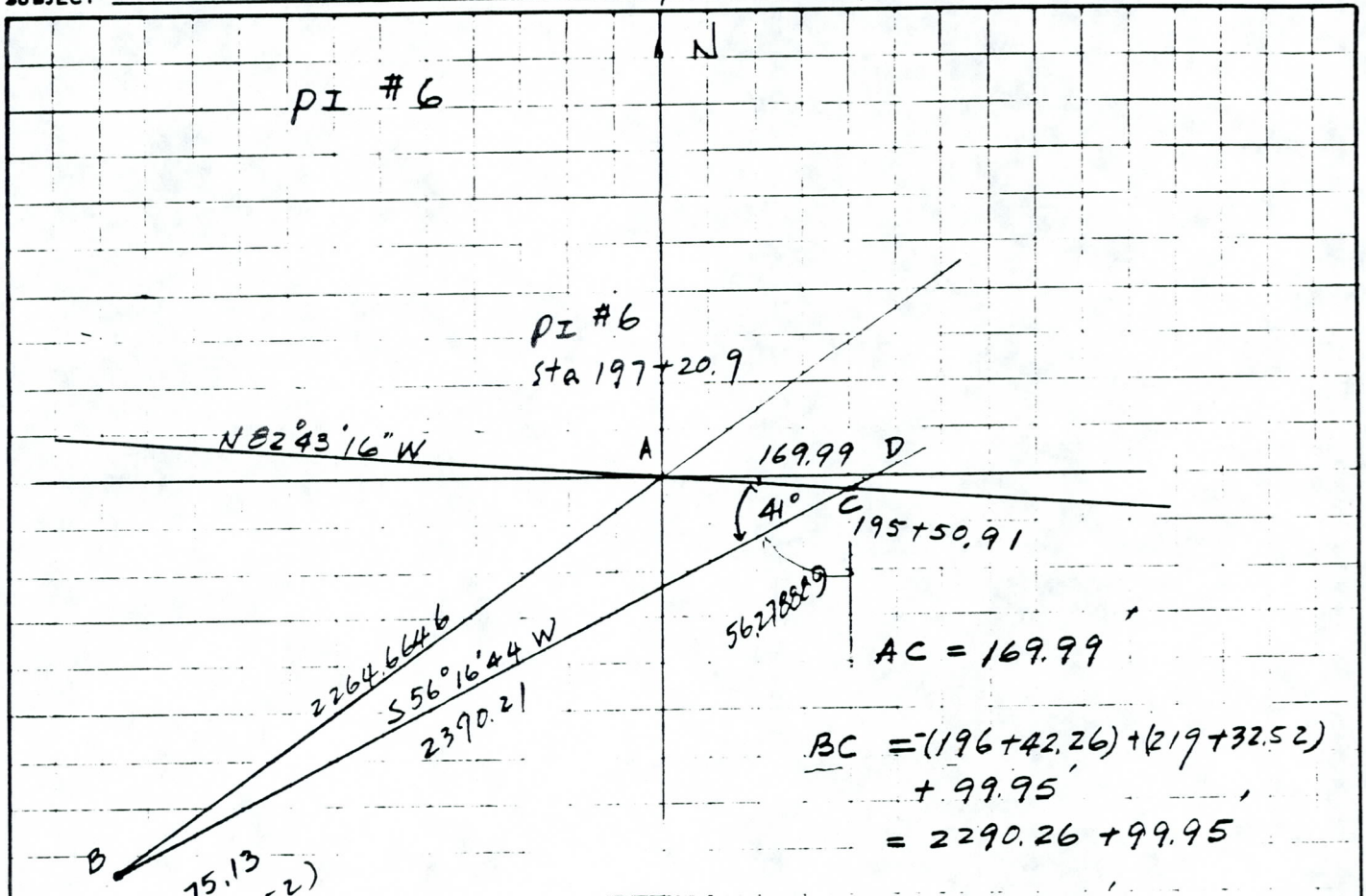
E 606,650.81 - 4040.13 = E 602610.68

R = 2966.51

N 889,530.03 0.01

E 602610.78 0.1

2966.63 0.12



$BC = (196+42.26) + (219+32.52) + 99.95'$

$= 2290.26 + 99.95$

$= 2390.21'$

$\angle ADC = 90 - 56.278889$

$= 33.721111°$

$\angle DAC = 90 - 82.721111$

$= 7.2788889$

$\angle ACB = 33.721111 + 7.2788889$

$= 41.°$

$\overline{AB}^2 = \overline{AC}^2 + \overline{BC}^2 - 2(AC)(BC)\cos\angle ACB$

$\overline{AB}^2 = 28896.6 + 5713103.8 - 2(169.99)(2390.21)\underset{0.7547095}{\cos\angle ACB}$

$= 5742000.4 - 613294.81$

$AB = 2264.66$

$\frac{BC}{\sin A} = \frac{AB}{\sin 41°}$

$\sin A = \frac{BC \cdot \sin 41°}{AB} = .6924301$

$A = 43.822785 = 136.17722$

EBASCO SERVICES INCORPORATED

BY N. H. 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

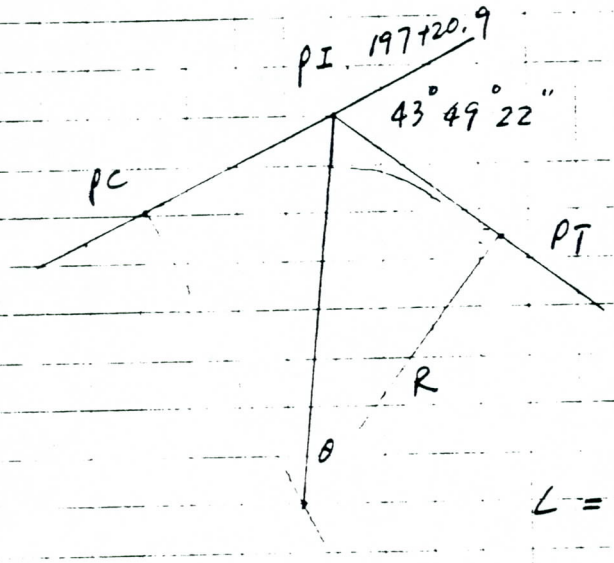
SUBJECT BULLDOG FLOODWAY COORDINATE

BEARING OF AB = 136.17722 + 7.278889 - 90°

= 53.456109°

= 53° 27' 22" ←

S 53° 27' 22" W



PC STA 196+15

T = 105.9

θ = 43.822785/2 = 21.911393°

R = T/tan θ

= 105.9 / 0.4022284 = 263.28

$$L = \frac{2\pi(263.28325)}{360} \times 43.822785$$

= 201.37'

PT Sta (196+15) + 201.37 = 198+16.37

STA NO. AT A :

(198+16.37) + (2264.6646 - 105.9)

= 219175.13 ←

$$D = \frac{5729.58}{R} = 21.762038 = 21° 45' 43"$$

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'

581/8-81

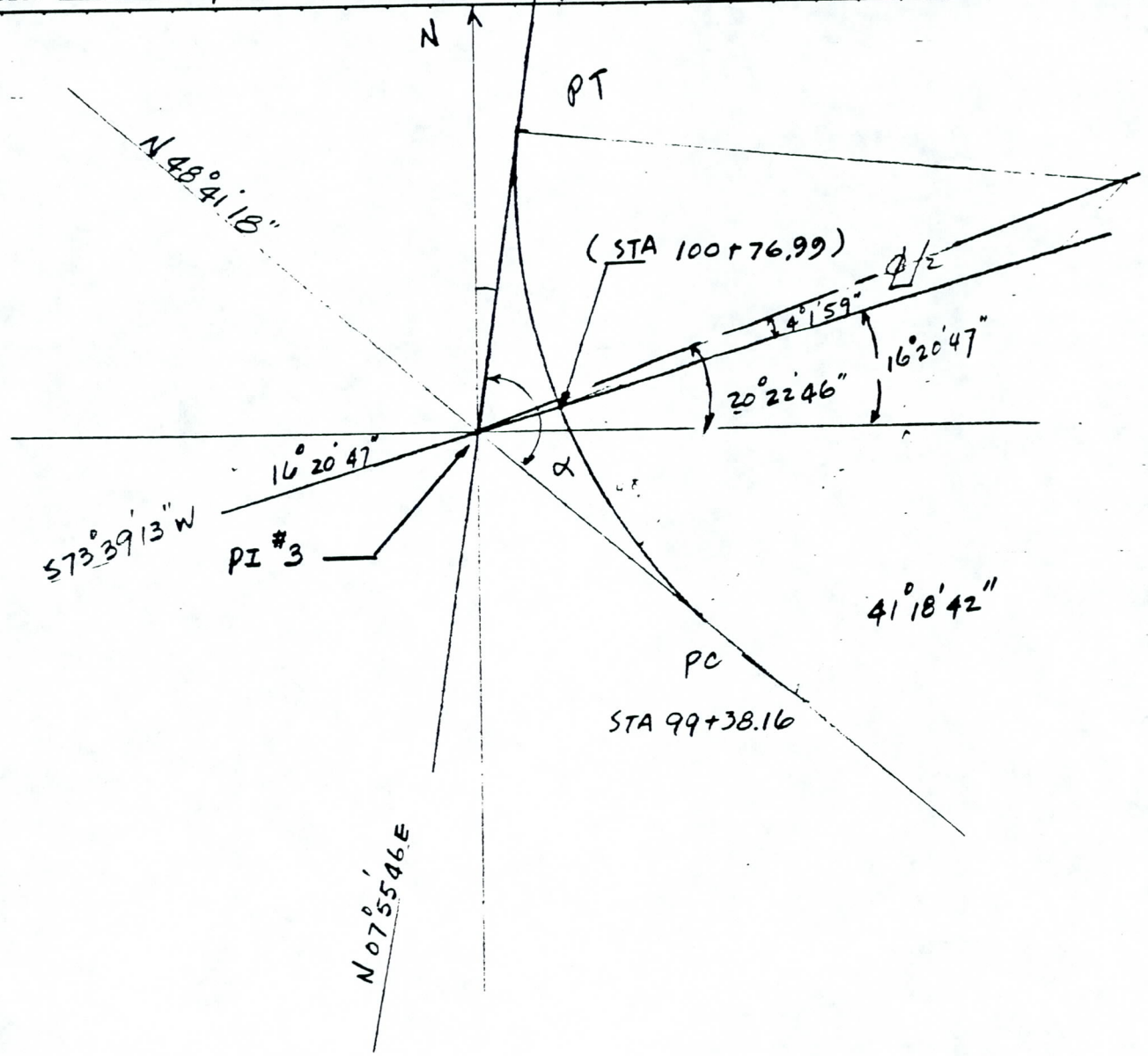
BY N. Hung DATE 1/15/86 SHEET 17 OF 19

CHKD. BY _____ DATE _____ OFS NO. 3767-300 DEPT. NO. 243

CLIENT ~~USDA SO'L CONSERVATION SERVICE~~

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT PRINCIPAL SPILLWAY ALIGNMENT



$\alpha = 180° - (48°41'18" + 7°55'46") = 180 - 56°37'4" = 123°22'56"$

$\alpha/2 = 61°41'28"$

$61°41'28" - 41°18'42" = 20°22'46"$

$20°22'46" - 16°20'47" = 4°1'59"$ ←

EBASCO SERVICES INCORPORATED

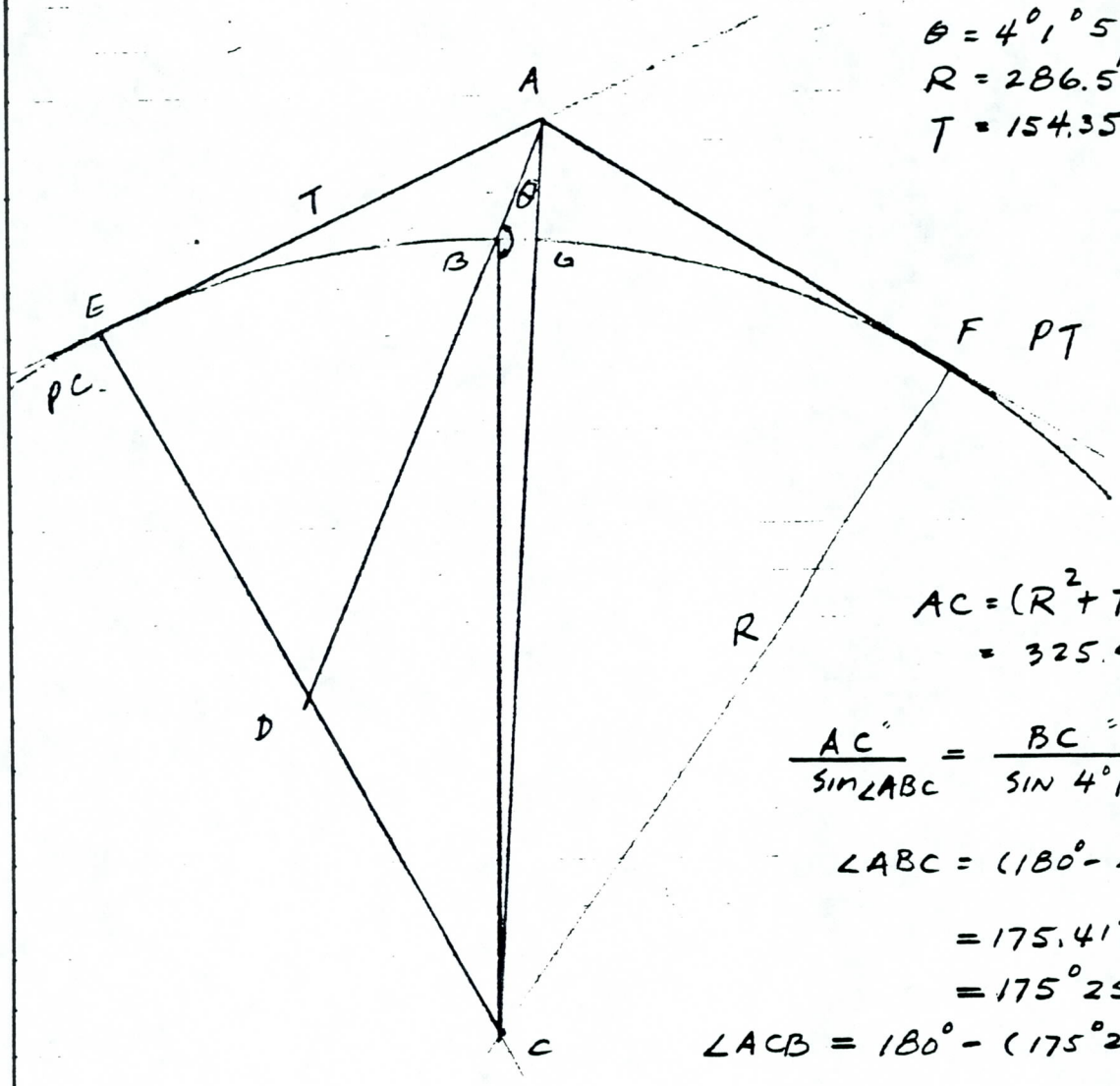
BY N Hung DATE 1/15/86 SHEET 18 OF 19

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



$\theta = 4°1'59''$

$R = 286.55'$

$T = 154.35'$

$AC = (R^2 + T^2)^{1/2}$

$= 325.4763'$

$$\frac{AC}{\sin \angle ABC} = \frac{BC}{\sin 4°1'59''} \qquad BC = 256'$$

$\angle ABC = (180° - 4.58220253)$

$= 175.41797$

$= 175°25'5''$

$\angle ACB = 180° - (175°25'5'' + 4°1'59'')$

$= 180° - (179°27'4'')$

$= 0°32'56''$

$\overset{\frown}{BG} = \frac{2\pi(286.55)}{360} \times 0°32'56'' = 2.75'$

$\overline{AB} = \frac{AC}{\sin \angle ABC} \times \sin \angle ACB \qquad \overline{AB} = \frac{325.4763}{.0798862} \times .0095797 = 39.03'$

STA NO. OF B : $(99+38.16) + \left(\frac{283.16}{2}\right) - (2.75')$

$= 10076.99$ ←

581/8-81

III F-125

EBASCO SERVICES INCORPORATED

SHEET 19 OF 19

CLIENT USDA-SOIL CONSERVATION SERVICE

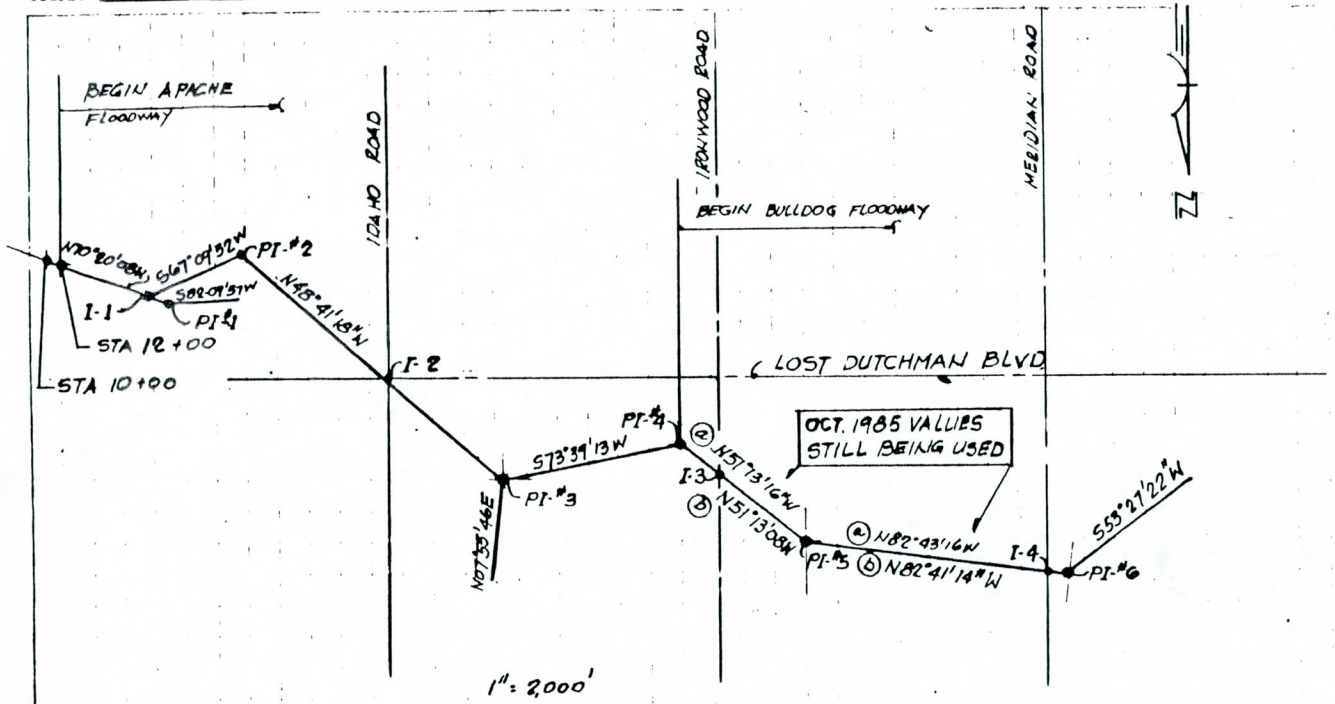
PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT ALIGNMENT SCHEMATIC

EFS NO. 3167.400 DEPT. NO.

BY CAC DATE

CHECKED BY NH DATE 1-16-86 DS



I-4

a. N 889,527.15
E 602,610.68

b. N 889,530.03
E 602,610.71

c. N 889,530.03
E 602,610.78

PI-#6

a. N 889,552.10
E 602,415.38

b. N 889,531.03
E 602,583.09

c. N 889,534.68
E 602,415.76

NOTES:

a. EBASCO CALCULATION, BASED UPON OCTOBER 1985 VALUES AND BEING USED.

b. SCS MARK-UP, APPARENTLY BASED UPON JAN. 1986 VALUES SHOWN IN LETTER.

c. EBASCO CALCULATIONS, BASED UPON JAN. 1986 VALUES SHOWN IN LETTER.

III F-1 926

5810/5-74

EBASCO SERVICES INCORPORATED

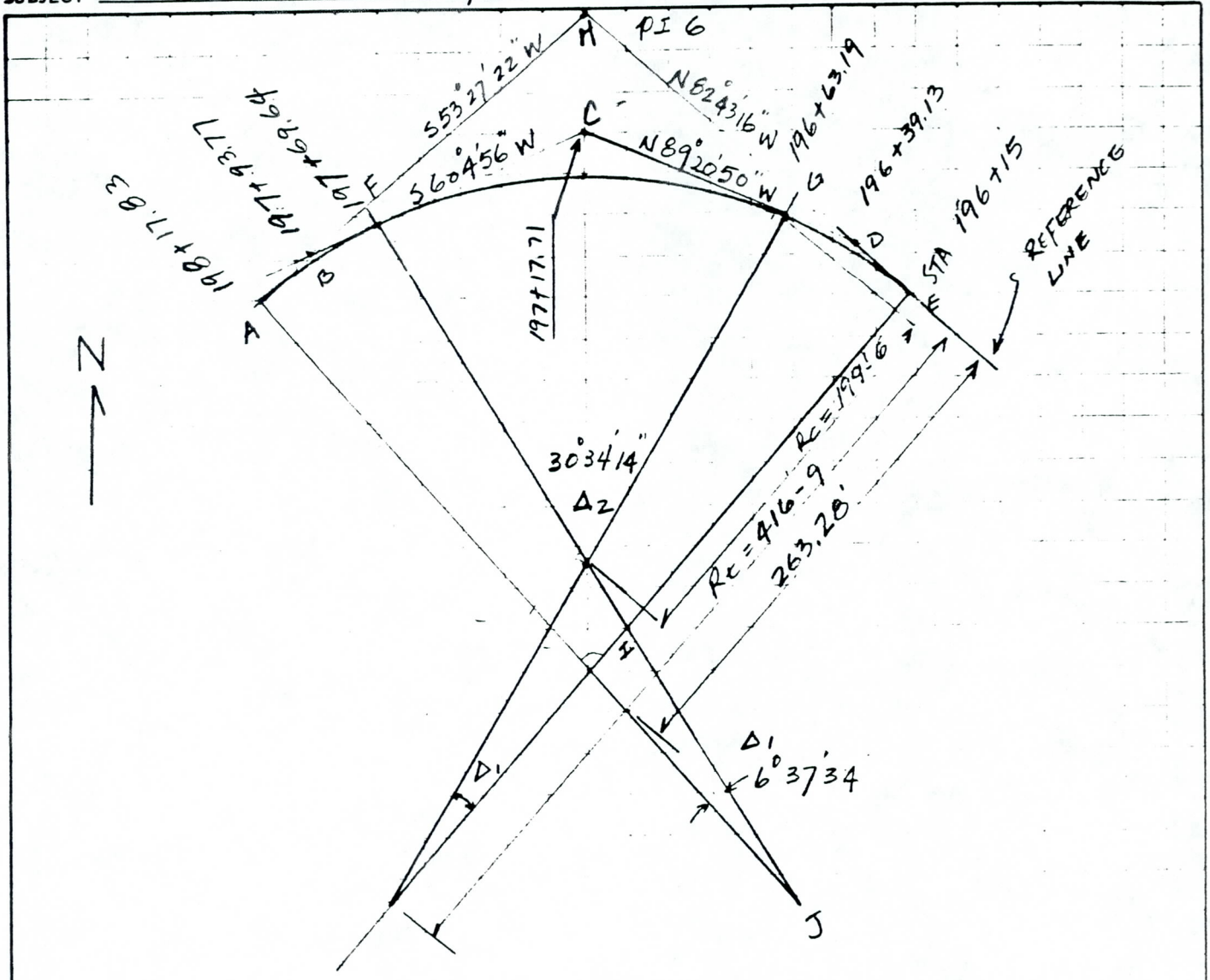
BY N. Hung DATE ~~4/2/86~~ 5/1/86 SHEET 20 OF 25

CHKD. BY LN DATE ~~4-8-86~~ 5/1/86 OFS NO. 3767-400 DEPT. NO. 243

CLIENT

PROJECT APACHE BULLDOG FLOOD CONTROL PROJECT

SUBJECT BULLDOG FLOODWAY PI #6 COMPOUND CURVE



APROACH & TERMINAL SECTION

$\Delta_1 = 6°37'34"$

$R_c = 416-9"$

$L = 48.19$

$T = 24.125$

CENTRAL SECTION

$\Delta_2 = 30°34'14"$

$R_c = 199'-6"$

$L = 106.45$

$T = 54.52$

STA	N	E	MK NO.	P.I. NO
197+93.77	889503.41	602349.68	B	PI #6 C
197+17.71	889,542.64	602417.86	C	PI #6 B
196+39.13	889,541.74	602496.50	D	PI #6 A

$R_t = 416.75'$ $\Delta = 6.626111°$

$R_t \tan \Delta = 48.412' = AF$

$FH = 105.9 - 48.412 = 57.488'$

$$\frac{FH}{\sin(\frac{30°34'14''}{2})} = \frac{FI}{\sin\frac{136°10'38''}{2}}$$

$$FI = 57.488 \times \frac{0.927762095}{0.263625197} = 202.31'$$

$$JF = (AJ^2 + AF^2)^{\frac{1}{2}} = 419.55'$$

$$R_o = IF - (JF - AJ) = 202.31 - (419.55 - 416.75)$$
$$= 202.31 - 2.80 = 199.51'$$

APPROACH & TERMINAL SECTION

$$L = 2\pi \times 416.75' \times \frac{6.626111}{360} = 48.19'$$

$T = 24.125$ $R_t = 416'-9''$

$\Delta = 6°37'34''$

CENTRAL SECTION

$$L = 2\pi \times \frac{199.51}{360} \times 30.57055 = 106.45'$$

$$T = 199.51 \times \tan\frac{30.57056}{2} = 54.52'$$

$\Delta = 30°34'14''$

EBASCO SERVICES INCORPORATED

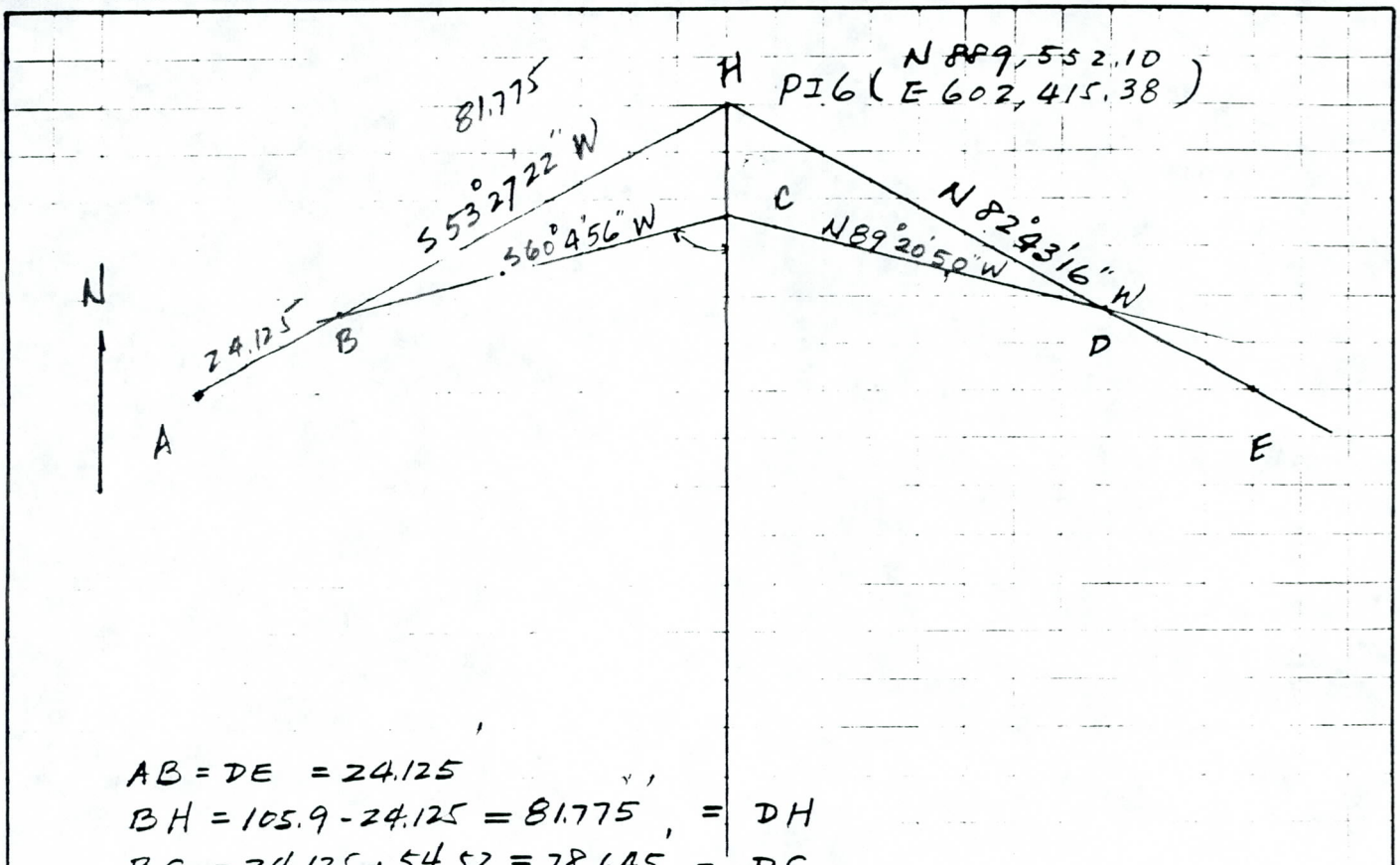
BY N. Hung DATE 4/3/86 SHEET 22 OF 29

CHKD. BY LNO DATE 4-8-86 OFS NO. 3767-400 DEPT. NO. 523

CLIENT USDA-SOIL CONSERVATION SERVICE

PROJECT APACHE-BULLDOG FLOOD CONTROL PROJECT

SUBJECT PI #6 COMPOUND CURVE COORDINATE



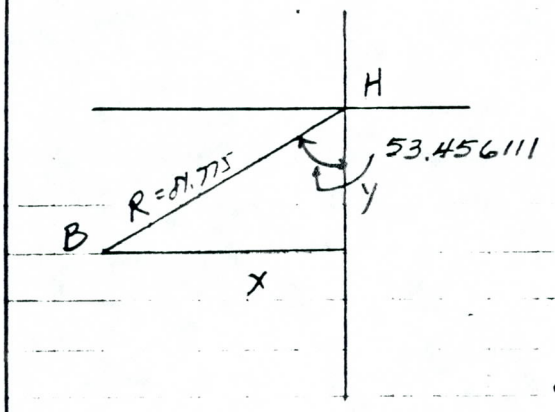
$AB = DE = 24.125$

$BH = 105.9 - 24.125 = 81.775$, $= DH$

$BC = 24.125 + 54.52 = 78.645 = DC$

$\angle AHE = 136°10'38"$

$\angle BCD = 149°25'46"$



COORDINATE OF B

$\theta = 53.45611$

$X = R \sin\theta = 81.775 \sin(53.45611)$

$= 65.70'$

$Y = R \cos\theta = 81.775 \cos(53.45611)$

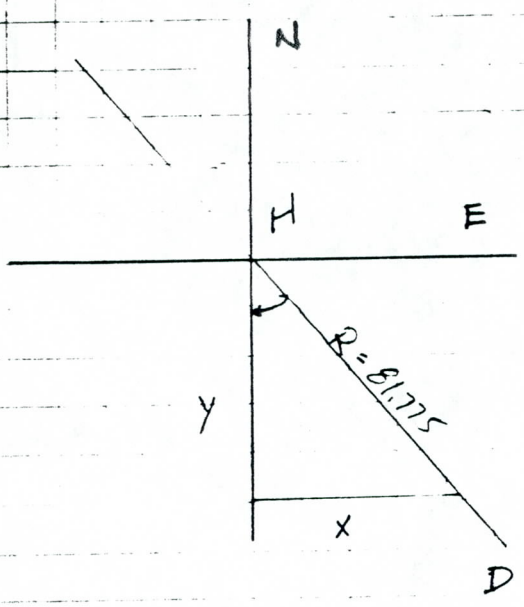
$= 48.69$

$889552.10 - 48.69 = N\ 889503.41$,

$602415.38 - 65.70 = E\ 602349.68$,

III F-129

581/8-81



COORDINATE OF D

$\theta = 82.72111.$

$X = R \sin 82.72111$

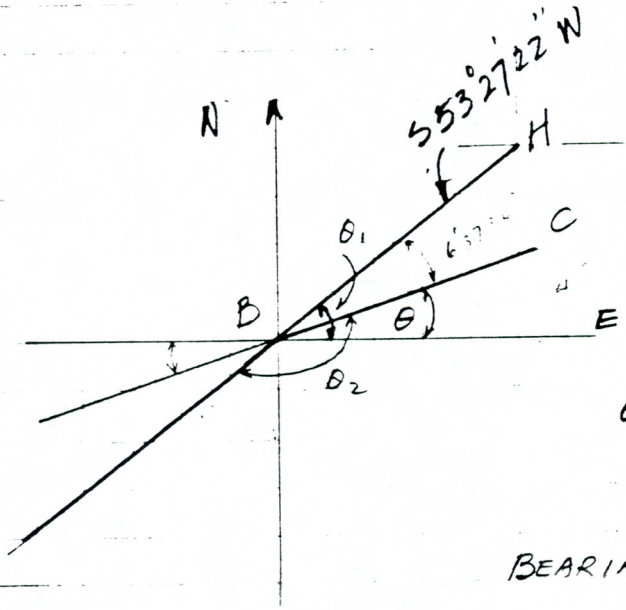
$= 81.12'$

$y = R \cos 82.72111$

$= 10.36'$

$889552.10 - 10.36 = N\ 889541.74$

$602415.38 + 81.12 = E\ 602496.50$



$\theta_1 = 90° - (53°27'22")$

$= 36°32'38"$

$\theta_2 = 180° - (6°37'34")$

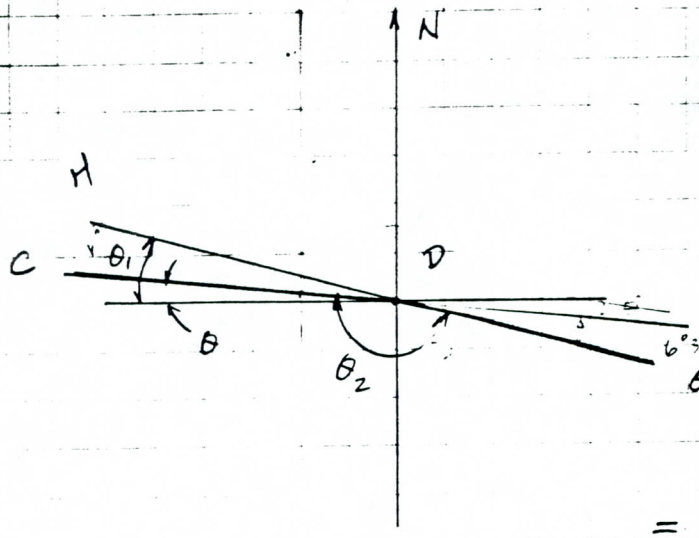
$= 173°22'26"$

$\theta = \theta_1 + \theta_2 - 180° = 209°55'4" - 180°$

$= 29°55'4"$

BEARING OF BC

S 60°4'56" W



$\theta_1 = 90^\circ - (82^\circ 43' 16'')$

$= 7^\circ 16' 44''$

$\theta_2 = 173^\circ 22' 26''$

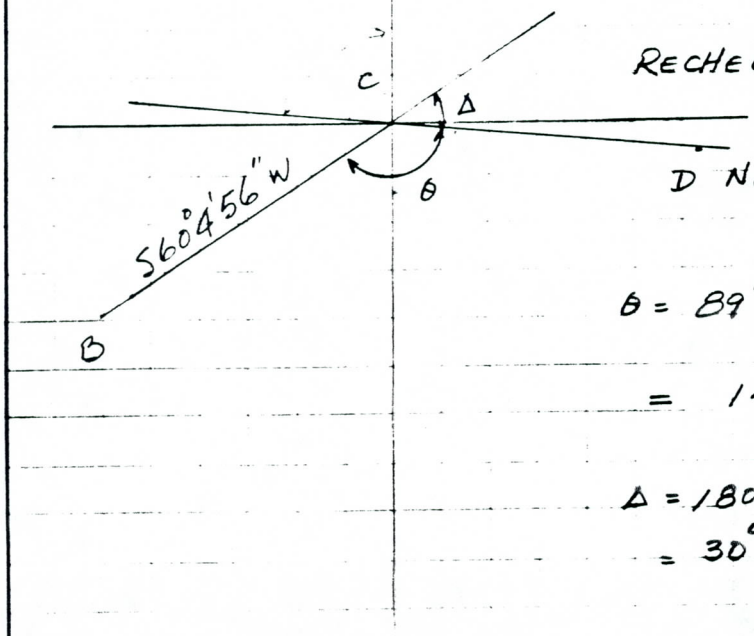
$\theta = \theta_1 + \theta_2 - 180^\circ$

$= 180^\circ 39' 10'' - 180^\circ$

$= 0^\circ 39' 10''$

BEARING of DC

N 89° 20' 50" W ←



RECHECK Δ

$\theta = 89^\circ 20' 50'' + 60^\circ 4' 56''$

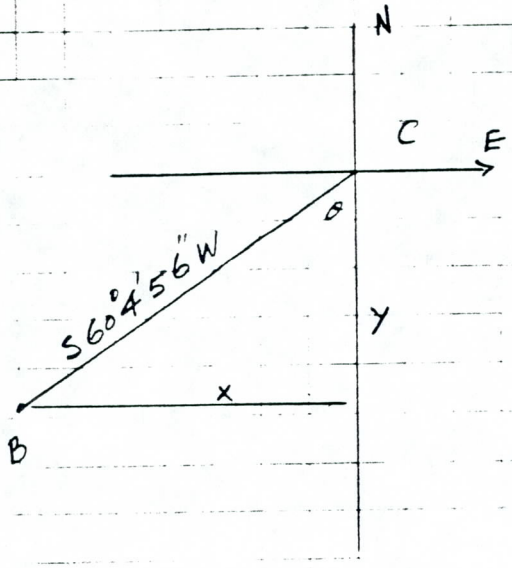
$= 149^\circ 25' 46''$

$\Delta = 180 - (149^\circ 25' 46'')$

$= 30^\circ 34' 14''$ O.K.

SUBJECT PI #6 COMPOUND CURVE COORDINATE

COORDINATE OF C



$R = BC = 24.125 + 54.52 = 78.645$

$\theta = 60.08222$

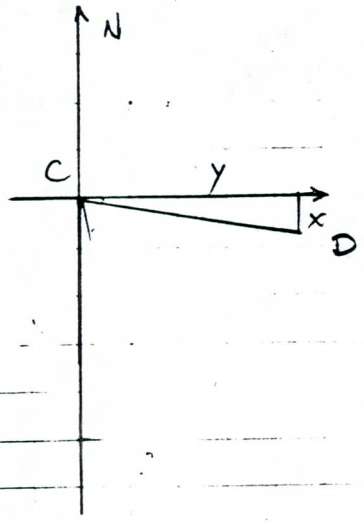
$X = 78.645 (\sin 60.08222) = 68.16$

$Y = \text{"} (\cos 60.08222) = 39.22$

N 889503.41 + 39.22 = N 889542.63
E 602349.68 + 68.16 = E 602417.84

RECHECK COORDINATE C

$\theta = 89.347222^\circ$, $R = 78.645$



$Y = 78.645 \times \sin\theta = 78.64$

$X = \text{"} \times \cos\theta = 0.90$

N 889541.74 + 0.9 = N 889542.64
E 602496.50 - 78.64 = E 602417.86 ok

IV CONSTRUCTION DRAWINGS

IV. CONSTRUCTION DRAWINGS

Sixty drawings were prepared for the Project tender documents. The drawing list is attached.

Two additional drawing indices have been included for convenience in coordinating structure with drawing. One index is arranged according to station numbering sequence. The other is arranged according to weir inlet and side channel inlet numbering sequence.

10/22/85

USDA-SOIL CONSERVATION SERVICE

APACHE-BULLDOG FLOOD CONTROL PROJECT

LIST OF DRAWINGS

Ebasco Sh. No.	Drawing Title
	Bulldog Floodway and Apache Junction Outlet Channel
2-1	Drawing Index and Project Location Map
2-2	Project Plan and Right-of-Way
	Apache Junction
2-3	Outlet Channel - Plan & Profile - Sta 101 + 50 to Sta 115 + 00
2-4	Outlet Channel - Plan & Profile - Sta 115 + 00 to Sta 129 + 00
2-5	Typ. Details & Sta 101 + 50 to Sta 114 + 10
2-6	Side Channel Inlet No. 1 - Details (4A)
	Bulldog Floodway
2-7	Plan and Profile - Sta 129 + 00 to Sta 145 + 00
2-8	Plan and Profile - Sta 145 + 00 to Sta 160 + 00
2-9	Plan and Profile - Sta 160 + 00 to Sta 175 + 00
2-10	Plan and Profile - Sta 175 + 00 to Sta 190 + 00
2-11	Plan and Profile - Sta 190 + 00 to Sta 206 + 00
2-12	Plan and Profile - Sta 206 + 00 to Sta 210 + 00
2-13	Details - Sta 116 + 00 to Sta 131 + 52
2-14	Details - Sta 133 + 00 to Sta 137 + 50
2-15	Side Channel Inlet No. 2 - Details (4B)
2-16	Side Channel Inlet No. 3 - Details (5A)
2-17	Side Channel Inlet No. 4 - Details (4C)
2-18	Weir Inlet No. 3 - Details (4D)
2-19	Weir Inlet No. 4 - Details (4E)
2-20	Weir Inlet No. 5 - Details (4F)

LIST OF DRAWINGS

(Continued)

Ebasco Sh. No.	Drawing Title
2-21	Side Channel Inlet No. 5 - Details (4G)
2-22	Weir Inlet No. 6 - Details (4H)
2-23	Side Channel Inlet No. 6 - Details (5B)
2-24	Weir Inlet No. 7 - Details (5C)
2-25	Side Channel Inlet No. 7 - Details (6A)
2-26	Weir Inlet No. 8 - Details (6B)
2-27	Bar Bending Schedule - Sh. 1 (W.1.3)
2-28	Bar Bending Schedule - Sh. 2 (W.1.4 & 7)
2-29	Bar Bending Schedule - Sh. 3 (Floodway)
2-30	Energy Dissipator No. 2 Details
2-31	Details - Sta 185 + 60 to Sta 186 + 40; 187 + 72.5 to 188 + 92.5; 189 + 82.5 to 193 + 42.50
2-32	Identification Sign
2-33	Fence Details
2-34	Weir Inlet No. 4 - Reinf. Details
2-35	Bar Bending Schedule - Sh. 4 (W.1 #6)
2-36	Side Channel Inlet No. 7 - Reinf. Details
2-37	Bar Bending Schedule - Sh. 5 (S.C. #7)
2-38	Details - Sta 139 + 70.37 to Sta 148 + 77
2-39	Bar Bending Schedule - Sh. 6 (Floodway)
2-40	Bar Bending Schedule - Sh. 7 (W.1.8)
2-41	Side Channel Inlet No. 2 - Reinf. Details
2-42	Bar Bending Schedule - Sh. 8 (S.C. #2)
2-43	Side Channel Inlet No. 6 - Reinf. Details (S.C. #6)
2-44	Bar Bending Schedule - Sh. 9 (S.C. #6)
2-45	Side Channel Inlet No. 1 - Reinf. Details (S.C. #1)
2-46	Bar Bending Schedule - Sh. 10 (S.C. #1)
2-47	Details Sta 165 + 12 to Sta 168 + 12; 171 + 97.5 to 180 + 10

LIST OF DRAWINGS

(Continued)

Ebasco Sh. No.	Drawing Title
2-48	Bar Bending Schedule - Sh. 11 (Floodway)
2-49	Side Channel Inlet No. 5 - Reinf. Details
2-50	Bar Bending Schedule - Sh. 12 (S.C. #5)
2-51	Side Channel Inlet No. 3 - Reinf. Details (S.C. #3)
2-52	Bar Bending Schedule - No. 13 (S.C. #3)
2-53	Side Channel Inlet No. 4 - Reinf. Details
2-54	Bar Bending Schedule - Sh. 14 (S.C. #4)
2-55	Details Sta 194 + 70.75 to Sta 201 + 80 - Sh. 1
2-56	Details at Bridge Crossings
2-57	Bar Bending Schedule - Sh. 15 (Floodway)
2-58	Details - Sta. 194 + 70.75 to Sta. 201 + 80 - Sh. 2
2-59	Details - Sta. 154 + 96 to Sta. 164 + 22
2-60	Bar Bending Schedule + Sh. 16. (Floodway)

10/22/86

INDEX OF DRAWINGS

ACCORDING TO FLOODWAY STATION SEQUENCE

BULLDOG

From Station	To Station	Dwgs Numbers	Structure Type
101 + 50	114 + 10	2-5, 2-29	Channel
114 + 10	116 + 00	2-6, 2-45, 2-46	Side Inlet #1
116 + 00	131 + 52	2-13, 2-29	Channel
131 + 52	133 + 00	2-15, 2-41, 2-42	Side Inlet #2
133 + 00	137 + 50	2-14, 2-29	Channel
137 + 50	138 + 74.75	2-17, 2-53, 2-54	Side Inlet #4
138 + 78.95	139 + 70.37	2-56, 2-57	Bridge
139 + 70.37	140 + 37	2-38, 2-39	Channel
140 + 37	148 + 77	2-38, 2-39	Channel
148 + 77	150 + 27	2-18, 2-27	Weir Inlet #3
150 + 27	154 + 96	2-19, 2-34, 2-28	Weir Inlet #4
154 + 96	164 + 22	2-14, 2-29, 2-59 2-60	Channel
164 + 22	165 + 12	2-20, 2-35	Weir Inlet #5
165 + 12	168 + 12	2-47, 2-29	Channel
168 + 12	171 + 0.75	2-21, 2-49, 2-50	Inlet Side C #5
171 + 07.5	171 + 97.5	2-22, 2-35	Weir Inlet #6
171 + 97.5	180 + 10	2-47, 2-29	Channel
180 + 10	185 + 60	2-16, 2-51, 2-52	Inlet Side C #3
185 + 60	186 + 40	2-31, 2-48	Channel
186 + 40	187 + 72.5	2-23, 2-43, 2-44	Inlet Side C #6
187 + 72.5	188 + 92.5	2-31, 2-48	Channel
188 + 92.5	189 + 82.5	2-24 2-28	Weir Inlet #7
189 + 82.5	193 + 42.5	2-31, 2-48	Channel
193 + 42.5	194 + 70.75	2-25, 2-36, 2-37	Side Inlet #7
194 + 70.75	195 + 76.29	2-56, 2-57	Bridge
195 + 76.29	201 + 80	2-55, 2-48, 2-58	Channel
201 + 80	203 + 00	2-26, 2-40	Weir Inlet #8

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