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PHASE I - FEASIBILITY STUDY

BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL PROJECT PHOENIX, ARIZONA

EBASCO
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PREPARED FOR

USDA SOIL CONSERVATION SERVICE
PHOENIX, ARIZONA

JULY 1985
REVISED, SEPTEMBER 1985

EBASCO
EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

7/85

PHASE I - FEASIBILITY STUDY
BULLDOG FLOODWAY & APACHE JUNCTION
FLOOD CONTROL PROJECT
PHOENIX, ARIZONA

REVISED SEPTEMBER 1985

Prepared By: Ebasco Services Incorporated
New York, New York

For: USDA Soil Conservation Service
Phoenix, Arizona

1088v

PHASE I - FEASIBILITY STUDY
BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT

RESPONSE TO REVIEW COMMENTS
SEPTEMBER 1985

The revised version of the Phase I Feasibility Study Report has been identified by the addition of "REVISED - SEPTEMBER 1985" to the cover and fly sheet.

Changes and additions in the text have been identified by the addition of vertical lines in the margins.

Major changes have been made to Section IV, Suitability Assessment: Soil Mechanics.

Additional analysis has been made to address the requirements of Engineering Standard 582, Open Channel, regarding the analysis of the 10 year, 100 year, and 50% of the 100 year discharges for both the aged and as-built conditions. Sediment loads were computed using Geologic Note Number 2. The results have been included in Section VI, Studies. Additional analysis has also been made to confirm the location of the hydraulic jump downstream from the energy dissipator on Bulldog Floodway.

A discussion has been added in Section IV to address the role played by the caliche in protecting the structural emergency spillway from undermining during passage of the freeboard event.

Additional calculations have been added to Section VIII, Supporting Data, where appropriate.

INDEX OF REVIEW COMMENTS

RESPONSE LOCATION

Phoenix Engineering Staff Comments:

Comment	Location of Change or Comment
I.9	✓P. I-2, paragraph 2
II.1	✓P.II-3, paragraph 2.6.1
II.2	✓Pen & Ink change: cross out "or frost"
II.3	✓P.II-8, paragraph 5.1.8
II.4	✓Backfill will be placed according to NEH-20
II.5	✓If required, the recommended check will be made
II.6	✓P.II-12, paragraph 6.1.11
II.7	✓P.II-13, paragraph 6.2.3
II.8	✓P.II-14, paragraph 6.4.3
II.9	✓P.II-15, paragraph 6.7.1
II-10	✓P.II-16, paragraph 6.8.1.f
IV.1	✓P.IV-2, P.IV-6, paragraph 2
IV.2	✓Being addressed in detail in Phase II Report
IV.3	✓P.IV-5,6
IV.4	✓Submitted with Letter USDA 3767-L0021
VI.1	✓P.VI-5, paragraph 2.4
VI.2	✓P.VI-7, 3rd paragraph
VI.3	✓P.VI-6, paragraph 2.5.c
VI.4	✓P.VI-8, paragraph 2.5.f
VI.5	✓P.VI-10, paragraph 4.2
VIII.1	Section VIII - Pp.80, 187, 188, 189 (note renumbered pages)
VIII.2	✓TR-25 Allows for this condition if additional freeboard is provided
VIII.3	✓Section VIII - Pp.41 thru 51

Phoenix Engineering Staff Comments (cont'd.)

Comment	Location of Change or Comment
VIII.4	We agree
VIII.5	We agree
VIII.6	This has been corrected
VIII.7	This will be done in Phase III
VIII.8	This will be done in Phase III
VIII.9	Section VIII - Pp. 85 thru 89 and 163 thru 189 Profiles will be plotted in Phase III when all Plan-Profile sheets are complete.

West National Technical Center Comments:

II.1	The Far West States Engineering Design Standards have been used. The results will be included in the Phase II Report
II.2	As agreed at our meeting in Santa Ana, this will be completed in Phase II.
II.3	P.II-14, paragraphs 6.4.3 and 6.4.4
IV.1	P.IV-2, paragraphs 3, 4, 5
IV.2	P.IV-6, paragraph 1
IV.3	P.IV-6, paragraph 2
IV.4	This will be addressed in Phase II in detail. (Discussed in Santa Ana 9/1/85)
IV.5	This has been accomplished and is reported in Phase II
VI.1.a	Pp.VI-2, 3, 9, 10 and Section VIII - Pp.41 thru 71
VI.1.b	Section VIII - Pp.67, 68
VI.2	We agree
VI.3	Section VIII - Pp.90 thru 99
VI.4	P.VI.4, paragraph 2.4
VI.5	P.VI-8, paragraph 2.5.f and Section VIII - P.158
VI.6	Section VIII - Pp.187 thru 189

United States Department of Agriculture

Soil Conservation Service

201 E. Indianola
Suite 200
Phoenix, Arizona 85012

August 15, 1985

Consulting Engineer
EBASCO Services, Inc. 91st Floor
Two World Trade Center
New York, N.Y. 10048

RE: Apache Junction/Bulldog Flood Control Project, Contract #53-9457-5-00475 Phase I Review - Site Characterization and Comparative Design Studies

Dear Mr. Montana:

The reviews of Phase I for the above subject have been completed. Enclosed you will find the following:

1. Arizona Design Review Report
2. WNTC Design Review Report
3. Flood Control District of Maricopa County review comments
4. City of Apache Junction review comments
5. Appendix V "Infinite slope analysis for cohesionless soils", EM 1110-2-1902, U.S. Army Corp of Engineers
6. Infinite slope analysis chart-prepared by WNTC
7. Engineering practice standards, "Open Channel"
8. Combined red line copy from WNTC and Arizona of the Phase I - Feasibility Study Report

The result of the reviews show that we are in agreement with the selected project features being recommended by EBASCO in the Phase I-Feasibility Study Report.

For completion of Phase I EBASCO shall revise the Feasibility Study Report in accordance with both the comments in the reviews and those red lined on the report. As agreed to during the Phase I presentation conference a copy of all the review comments shall be included in the final revised report. In addition, address all questions that have been raised in the reviews and include these responses in the final report.

The completion of this report will provide adequate documentation for this phase of work, however, additional documentation may be required for subsequent phases.

If you have any questions about the review comments please call Don Paulus.

Sincerely,

David O. Lambson
Contracting Officer

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

ARIZONA STATE OFFICE

ENGINEERING STAFF

PHOENIX, ARIZONA

8/12/85

DESIGN REVIEW REPORT

JOB: Apache Junction/Bulldog Flood Control Project

PROJECT: Buckhorn-Mesa WPP

LOCATION: Maricopa and Pinal Counties, Arizona

AUTHORITY: Public Law 566

Phase: Phase 1, Site Characterization and Comparative Design Studies. Contract # 53-9457-5-00475

SUMMARY: With concurrence of the comments and modifications established in this review we are in agreement with the project features recommended and presented by EBASCO in their report for Phase I, Site Characterization and Comparative Design Studies.

DESCRIPTION OF JOB: This job consists of the design and preparation of contract construction drawings and specifications for (1) Bulldog Floodway and (2) Apache Junction Floodway, Flood Retarding Structure, and Outlet in conformance with the functional requirements of the Buckhorn-Mesa Watershed Work Plan and Supplemental Work Plan No. 1, and the Environmental Impact Statement dated June 1976. The work is being carried out in accordance with specifications for design and engineering services, Architect-Engineering Contract #53-9457-5-00475.

SCOPE OF REVIEW: Review of Phase I-Feasibility Study Report submitted by EBASCO Services Incorporated to the Soil Conservation Service July 1985. Contents for review include: 1) Design Criteria, 2) Suitability Assessment for Soil Mechanics, 3) Hydrology for Apache Junction FRS & Floodway, 4) Study alternatives and 5) Supporting data

PURPOSE OF REVIEW: This review will determine: 1) if the correct design criteria for the project features have been established by the A&E. 2) If the A&E has pursued reasonable design concepts in evaluating the geological and soil mechanics testing information for its suitability for design 3) the completeness of the design hydrology study for Apache Junction FRS and Floodway and 4) the acceptance of the recommended project feature alternatives.

BASIS FOR REVIEW:

1) Buckhorn-Mesa Watershed Work Plan
2) National Engineering Manual
3) TR-48, (DAMS-2 Program)
4) TR-60, Earth Dams and Reservoirs
5) Sedimentation Report, 1974 Supplement, Buckhorn-Mesa Watershed
6) TR-25, Design of Open Channels
7) NEH-5, Hydraulics
8) NEH-14, Chute Spillways
9) Engineering Design Standards, Far West States
10) TR-2, Earth Spillways
11) TR-52, Layout of Earth Emergency Spillways...
12) Engineering Monograph No. 25, Bureau of Reclamation
13) NEH-11, Drop Spillways
14) "A Baffled Apron as a Spillway Energy Dissipator", by T. J. Rhone
15) Hydraulic Engineering Circular No. 14, U.S. Department of Transportation
16) NEH-20, Construction Specifications
17) Highway Research Program Report No. 108
18) Apache Junction/Bulldog Geology Report by Aubrey Sanders
19) Soil mechanics testing results from Lincoln Soils Laboratory
20) Hydrometerological Report No. 49
21) NOAA Atlas 2
22) NTC/TSC Note PO-6
23) Signal Butte FRS design Hydrology
24) TR-55, Urban Hydrology for Small Watersheds
25) NEH-4, Hydrology
26) NTC/TSC Tech Note PO-4
27) TR-16, Rainfall-Runoff Tables for Selected Run Off Curve Numbers
28) "Hydrologic Design Manual for Drainage Area less than 25 square miles for Arizona" by Department of Agriculture, February 1972
29) "Runoff Curve Numbers for Semiarid Range and Forest Conditions" ASAE June 1973
30) "Addition of Sideflow from a Broad Crested Weir to flow in a Open Channel at Supercritical Flow" by SCS, Agricultural Research Service

REVIEW COMMENTS:

SECTION I, INTRODUCTION:

1) Change watershed area to read 10.8 square miles.

SECTION II, DESIGN CRITERIA:

1) 2.6 - Mention transition from pipe principal spillway to rectangular channel. Also is this flow in the outlet channel supercritical or subcritical?

2) 3.3.4 - Frost?

3) 5.1.8 - A minimum of 1 foot of freeboard is required for subcritical flow channels. Documentation will be needed to allow a 6-inch freeboard in supercritical flow channels. Without this documentation 1 foot freeboard is a minimum.

4) 6.1.8 - Consideration should be given to structure backfill in accordance with NEH-20.

5) 6.1.9 - Check sources for size and soundness to determine if riprap is feasible.

6) 6.1.11 - Mention filter material for diaphragm around principal spillway conduit in accordance with TR-60.

7) 6.2.3 - Sudden drawdown conditions will be of concern for sloughing at the upstream face. Partial seepage shall be taken into account with a infinite slope stability analysis.

8) 6.4.3 - See comment #1 this section.

9) 6.7.1 - Caution: Loose rock riprap and bedding material has been used upstream of grouted rock side inlets unsuccessfully on a previous project.

10) 6.8.1 - Provide drainage for the AT&T conduit in accordance with TR-60. Drainage will be required for the principal spillway conduit, again in accordance with TR-60.

SECTION IV, SUITABILITY ASSESSMENT SOIL MECHANICS:

1) The definitions of "partial" and "full" cutoffs as given in the write up are misleading. We are looking for a full cutoff whether the depth extends to caliche or another suitably defined soil layer.

2) The soils in the fundation and those to be used in the embankment are nearly all coarse-grained SM and SC. Identification of dispersion properties is generally restricted to fine grained soils, since the dispersive property is at odds with "normal" clay behavior, (i.e. cohesion and impermeability). The design of the dam will not depend on those properties of the clay fines, so it is not necessary to do additional testing for dispersion.

3) Conclusions and Recommendations: Rework this section as per our discussions at the 7/25/85 morning meeting.

4) Submit a plan of testing for additional field permeability tests and standard penetration tests (wet & dry). Discuss with our Geologist, Aubrey Sanders to determine if additional investigations are necessary at the outlet of the baffle emergency spillway site.

SECTION V, HYDROLOGY:

In an initial review by the SCS June 26, 1985 the comment was made to apply the channel loss factor to the entire contributing drainage area rather than each sub-basin as shown in the report. An additional computer run was done to study the effects.

The results of applying the channel loss factor in this manner lowered the top of dam by approximately 0.5 foot.

As a result, we feel the slight additional costs in construction for the added conservatism does not warrant the added engineering time and costs to make changes to all the related hydraulic computations already established for the project features in this phase of work. Therefore, we will accept the hydrology as submitted.

NOTE: EBASCO shall submit the additional computer run as mentioned above for SCS documentation.

SECTION VI. STUDIES:

1) 2.4 - Include a gated outlet in the principal spillway design. Seepage will be controlled by a diaphragm and outlet drain material.

2) 2.5d - Show reference for statement, "Surface protection by soil cement is not considered satisfacatory because the velocity of water increases to about 10 feet per second.

3) 2.5e - Why was the comparision of spillway width and embankment height for economics stopped at a 100' wide spillway?

4) 2.5f - Documentation of scour, and plunge pool effect of the baffle emergency spillway needs to be included.

5) 4.2 - What will be the criteria followed in the structural design of the culverts?

SECTION VIII, SUPPORTING DATA:

1) For each energy dissipator, calculations need to be shown for discharges less than full flow to confirm that the hydraulic jump does not move further downstream. Erosion due to low flows is especially of concern at the Bulldog Floodway drop structure where the design does not include a stilling basin before flows enter the earth channel. (See enclosed criteria for analysis of flows less than Q100.)

2) Page 3 of 15, Apache Junction Floodway - increasing the slope to 0.0024 appears to put you in the unstable flow zone (0.7 Sc to 1.3Sc).

3) Document silt laden flow.

4) For ease of construction with steel in both faces of the channel walls we recommend that 10 inch minimum walls be used in design.

5) Additional concrete cover is required where flow velocities exceed 10 fps or is carrying an abrasive bed load. A minimum of 3 inch cover shall be provided over the top steel in the invert. This 1 inch additional thickness shall not be used in computations as increasing effective depth.

6) Make sure references are used consistantly throughout the supporting calculations.

7) For each floodway establish high water contour lines at the upstream banks and side inlet locations.

8) Establish dimensions for the "needed" rights-of-way throughout the project area. Flood Control District will adjust to these.

9) Run final water surface profiles to establish all water depths.

Donald E Paulus 8-15-85

Submitted by: Don Paulus, Government Representative Date

William E. Payne Jr. 8-15-85

Recommended by: Bill Payne, State Design Engineer Date

Ralph M Arrington 8-15-85

Approved by: Ralph Arrington, State Conservation Engineer Date

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WEST NATIONAL TECHNICAL CENTER
Engineering Staff
Portland, Oregon
August 12, 1985

DESIGN REVIEW REPORT

Job : Apache Junction FRS & Bulldog Floodway
Project : Buckhorn-Mesa WPP
Location : Pinal County, Arizona
Authority: PL-566 (WF 08)
Phase : Phase 1 - Site characterization and comparative design studies.

Summary:

This phase is considered adequate. Suggestions for improvement of the report or for use in subsequent design phases are given in the review comments below or redlined on the report.

Description of Job:

The job consists of approximately 9000 feet of open channel and approximately 8000 feet of earth dam with a reinforced concrete pipe principal spillway and a reinforced concrete emergency spillway.

Purpose of Review

The review was made to determine the adequacy of the design criteria established and recorded; the validity of requests for additional data; the adequacy of the design hydrology study for Apache Junction FRS and Floodway; and acceptability of the general features of the structural installations as developed.

Scope of Review:

The Phase 1 - Feasibility Study, Bulldog Floodway & Apache Junction Flood Control Project, Phoenix, Arizona, prepared by Ebasco Services Incorporated was reviewed.

Basis for Review:

The following references were used as a basis for the review:

1. National Engineering Manual
2. TR 25 Design of Open Channels
3. TR 60 Earth Dams and Reservoirs
4. U.S. Dept. of Transportation HEC 14
5. Buckhorn Mesa Watershed Supplemental Watershed Work Plan No. 1, June 1976.

Review Comments:

General

1. Specific reference is suggested for clarity. Redline comments are given in the returned report.

2. Editorial comments and suggestions concerning minor items are redlined in the report.

3. Adequate documentation has been provided for this phase. Additional documentation may be required for subsequent phases.

Design Criteria

1. Section II, Item 6.1.8. Engineering Design Standards - Far West States is suggested as criteria for determination of lateral earth pressure, particularly figures 2.11 through 2.14.

2. Section II, Item 6.2.3

a. Based on the potential for the riser to plug it is suggested that the steady and rapid draw down conditions be analyzed in accordance with TR60.

b. It is suggested that the infinite slope analysis be run on cohesionless embankment soils rather than the normal slip circle or random type analysis. The following material may be used for analysis by this method:

1. Appendix V "Infinite Slope Analysis for Cohesionless Soils", EM 1110-2-1902 U.S. Army Corps of Engineers.

2. Infinite slope analysis chart - prepared by WNTC

3. Section II Item 6.4.4. Because caliche is not uniform it is suggested that computations be made for pipe joint extensibility and provide articulation in the conduit to compensate for the lack of uniformity in the foundation and the stresses imposed by the strains in the embankment over time.

Suitability Assessment: Soils Mechanics

1. Section IV, Page IV-2, Third paragraph. A full cutoff to caliche or other relatively impermeable materials can be provided by designating the approximate cutoff trench limits on the drawings and noting that final depths will be determined in the field. It is suggested that discussion of the above alternative be included in Section IV and that it be compared to the other alternatives available.

2. Section IV, Page IV-6, Item 1. This statement is inaccurate. It is suggested that this statement be rewritten to reflect the true representations of the material tested and that the test results be used in the required settlement and stability analysis.

3. Section IV, Page IV-6, Item 2. As stated in comment 1 above full cutoff can be accomplished without excavating to caliche. It is suggested that this method be included as a viable cutoff alternative. It is further suggested that additional permeability data be provided for the completion of this item in the studies.

4. Section IV, Page IV-6, Item 3. This statement does not contain the designer's recommendation for crack control other than a request for conducting a laboratory testing program.

It is suggested that this statement be rewritten to provide the designer's recommendation for crack control.

5. Section IV, Page IV-6, Item 4. Based on this statement, it is suggested that additional data be obtained for assessing the collapsibility of the foundation. Lack of dispersion data is not in evidence and it is suggested that no additional dispersion data be provided.

Hydrology

The design hydrology seems to be in order. Channel loss factors were done correctly by Chapter 21 NEH 4 & TSC Technical Note Hydrology PO-4. The results are more conservative than if the entire drainage area was considered as one watershed rather than the 5 that were used.

Chapter 19 NEH 4 (revised) is recommended for use in this area. It is based on a more complete analysis of recent data than Chapter 21 procedure. The 10 day runoff would probably be reduced and the 6 & 24 hr. to a lesser degree. Therefore, the hydrology is conservative but acceptable.

Studies

1. Section VI, Page VI-2, Item 1.4.

a. The documentation in Section VIII for the earth channel assumes silt laden flow. (sheet 6 of 15). It is suggested that clear water flow be assumed unless sediment laden flows can be documented in accordance with the procedures as given in Geology Note No. 2.

b. It is suggested that documentation of Mannings "n" value be included in Section VIII.

2. Section VI, Page VI-1, Item 1.2, Second paragraph. In order to arrive at a cost comparison between trapezoidal and rectangular channels the supporting data (Section VIII, sheet 9 of 15), assumes that the excavation limits for the rectangular channel will begin at the bottom outside edge of the concrete. It is suggested that these limits be moved during final design to approximately 2 feet beyond the channel to permit installation and maintenance of forms.

3. Section VI, Page VI-2, Item 1.3. A baffled block chute was studied for the energy dissipator and determined more costly than the grouted riprap chute. No documentation is found showing this comparison. It is suggested that the documentation be provided.

4. Section VI, Page VI-4, Item 2.4.

a. A statement that the 36 inch diameter pipe was the work plan choice is suggested to be included in this item.

b. It is suggested that reference to use of a seepage diaphram be included in this section.

5. Section VI, Page VI-7, Item 2.5 f). No discussion is give to the part the caliche plays in protecting the structure. On its own the rock riprap "control section" is inadequate but combined with the caliche a strong case could be made that the structure will not be undermined during passage of the freeboard event. It is suggested that discussion of the role caliche plays in protecting the structure be included in item 2.5 f); the conclusions be documented in Section VIII; and that scour be addressed in the preliminary design phase.

6. Section VI, Page VI-8. The outlet of the Bulldog Floodway was designed as a sloping apron at design discharge of 4709 cfs. It is suggested that the apron be checked during final design at discharges less than design discharge to determine if the basin is adequate.

Paul J Monville
Submitted

Donald E. Walker
Approved

8-12-85
Date

FLOOD CONTROL DISTRICT
of
Maricopa County

3335 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 262-1501

D. E. Sagramoso, P.E., Chief Engineer and General Manager

BOARD of DIRECTORS
Tom Freestone, Chairman
George L. Campbell
Carole Carpenter
Fred Koory, Jr.
Ed Pastor

AUG 14 1985

Mr. Verne M. Bathurst, State Conservationist
Soil Conservation Service
201 East Indianola
Phoenix, Arizona 85012

Re: Apache Junction/Bulldog Flood Control Project
Phase I - Site Characterization and Comparative Design Studies

Dear Mr. Bathurst:

We have completed our review of the report for the referenced project. The following are our comments:

1. Section II

a. 5.32 - We recommend the use of a structural concrete spillway instead of an earth emergency spillway due to erosive velocities.

b. 6.2.1 - The upstream slope for the dam should be consistent in the report. In some parts of the report, 3.0 horizontal to 1 vertical is recommended.

c. 6.2.3 - Explain the word "uncontrolled" in the 3rd sentence of this section. Water behind the embankment is released slowly and stays up to 10 days.

d. 3.4.1 - The profile of the road embankments will be determined by Ebasco for the Flood Control District.

e. 6.6.2 - The Operations and Maintenance section of our office request the top width of the levee to be 14 feet.

f. 3.3 - How does the 10 day retention compare with other FRS structures in the Buckhorn-Mesa Watershed?

2. Section III - Minutes of Meetings

a. 1 - Crossing of Project Area by AT&T fiber-optic cable. We want to know your decision on the foundation treatment for the AT&T cable.

b. 4 - Crossings on Apache Junction Foodway and Bulldog Floodway.

c. Will concrete box culvert be suitable for Tomahawk Road?

d. A telephone cable is located at the intersection of Apache Trail and Tomahawk. Attached is the information submitted by Mountain Bell. Please inform us if this needs to be relocated. Also, in the same attachment, another telephone cable exists along Idaho Road. The depth of these cables are 30" to 36" below the existing ground.

e. The City of Apache Junction cancelled their plans for construction of a horse crossing over Bulldog Floodway.

f. 5. - Emergency Spillway Alignment - Please inform us of the final location of the emergency spillway and the extent of inundation downstream.

g. 8. - Responses to "Questions for Pre-Design Meeting" - Land rights for the structures should be finalized as soon as possible, in order to provide enough time for acquisition. The land area required around the side inlets should be defined together with the easements for the right to flow. Flows from east of Apache Trail contribute to the project watershed.

3. Section V - Hydrology

a. Potential for development upstream of the structures should be checked.

b. How will flow splits be maintained?

We appreciate the opportunity for this review. If you have any questions, please call us.

Sincerely,

Stanley L. Smith

D. E. Sagramoso, P.E.

Mountain Bell

Phoenix, Arizona
May 15, 1985

Flood Control District
of Maricopa County
3335 W. Durango Street
Phoenix, Arizona 85009

Dear Sirs:

Project No. Apache Junction FRS and Outlet, Bulldog Floodway

The above referenced development plans have been reviewed and the following items were noted:

Buried cable on west side of Idaho Road from McKellips to Superstition. Two cables located at intersection of Apache Trail and Tomahawk. There will be billing if relocation is necessary.

Telco engineer assigned to this project:

W. Pollard
835-2725

Yours truly,

Patricia Falck

Distribution Services-Liaison
3033 North Third Street, Room 806A
Phoenix, Arizona 85012

Attachment

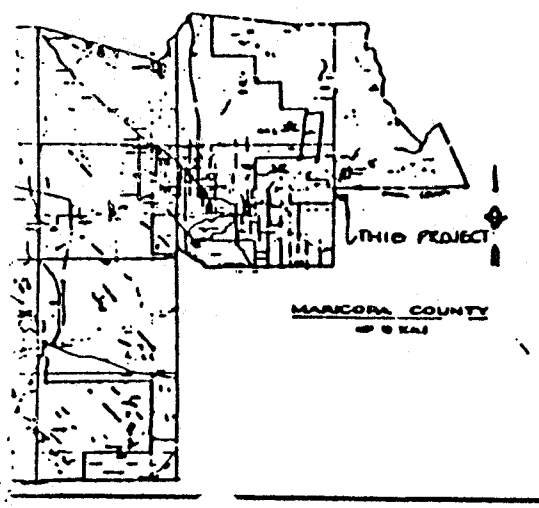
1 MPK
2CCF

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RIGHTS OF WAY PLAN

APACHE JUNCTION F.R.S., OUTLET & BULLDOG FLOODWAY

FLOOD CONTROL DISTRICT of MARICOPA COUNTY



Greiner Engineering
Phoenix — Arizona

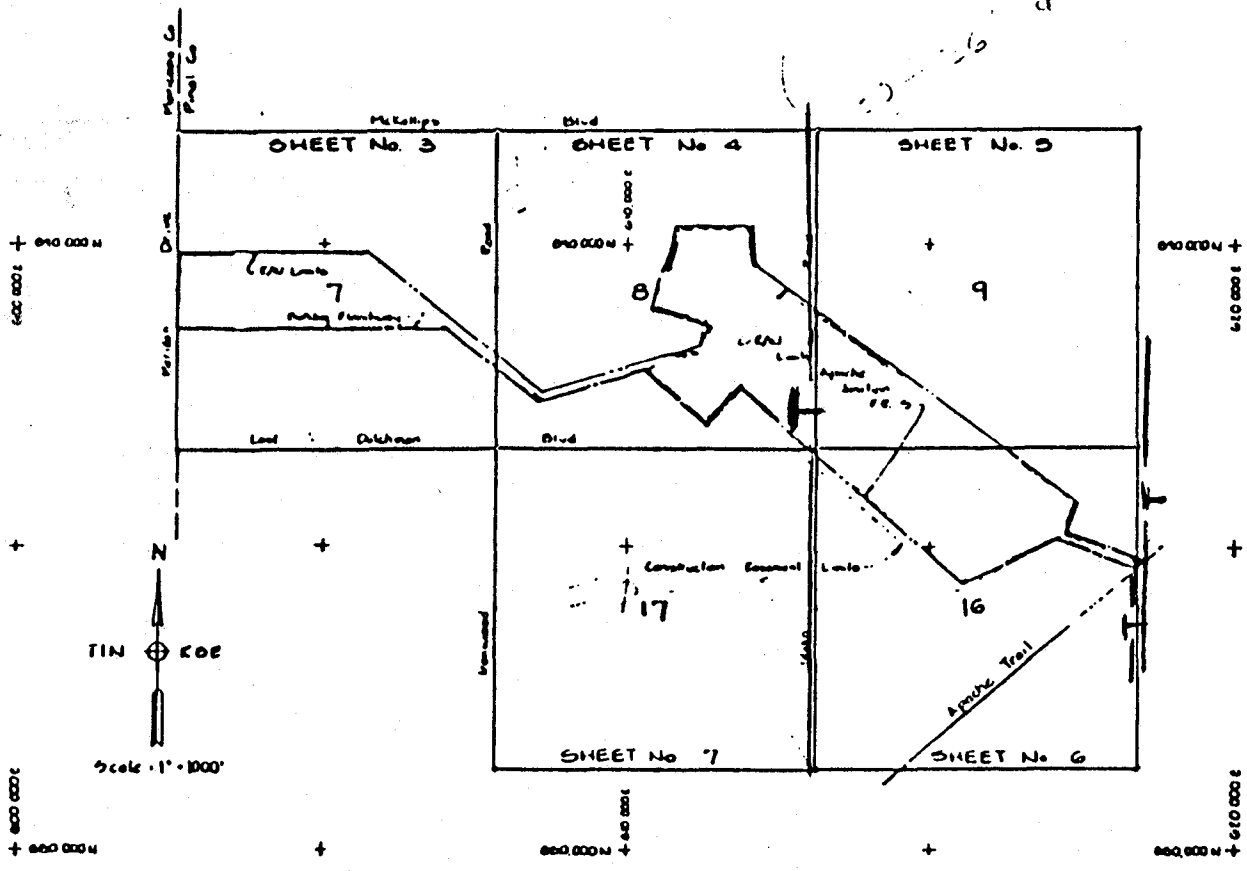
D.E. SAGRAMOSO P.E
CHIEF ENGINEER AND GENERAL MANAGER

FLOOD CONTROL DISTRICT of Maricopa County

R.O.S. RIGHTS OF WAY
APACHE JUNCTION F.R.S.
BULLDOG FLOODWAY

1 of 7

F.C.D. CONTRACT NO.



NOTE:

Basis of coordinates for this survey were taken from a SCS benchmark of the proposed center line of the Bulldog Flood Ch. Bulldog Floodway, and Apache Junction Floodway. The N 1/4 corner, Section 7, T1N, R8E was used as common coordinate point with the bearing between said N 1/4 corner and the NW corner of Section 7 being used as the basis of bearing.

For the record bearings on the Bulldog Floodway and the Apache Junction FCD please refer to the Soil Conservation Service "Land Rights Plan" drawings dated 6-80.

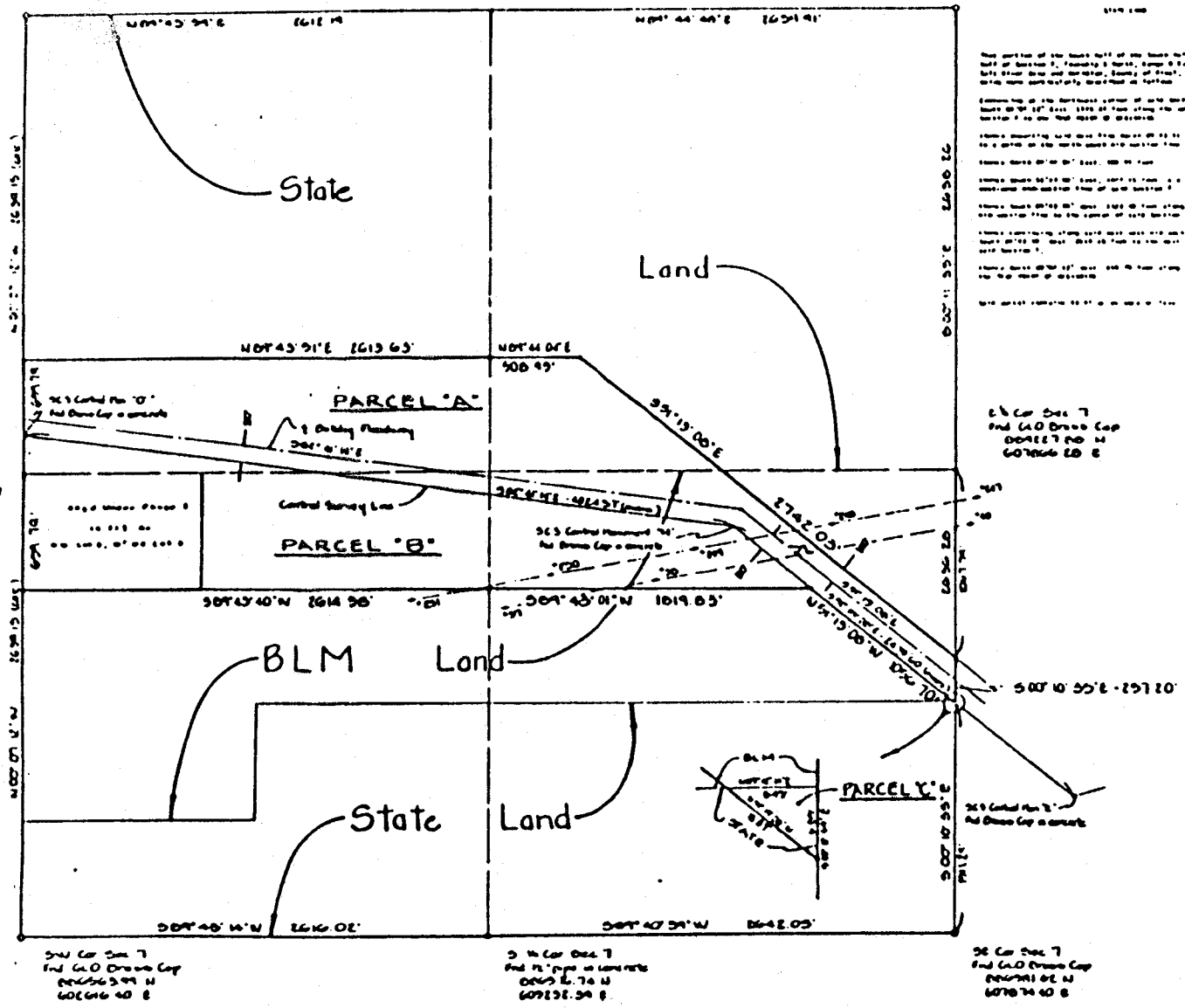
FLOOD CONTROL DISTRICT of Maricopa County

SHEET INDEX

R.O.S. & RIGHTS OF WAY
APACHE JUNCTION F.R.S.
BULLDOG FLOODWAY

2 of 7

Greiner Engineering



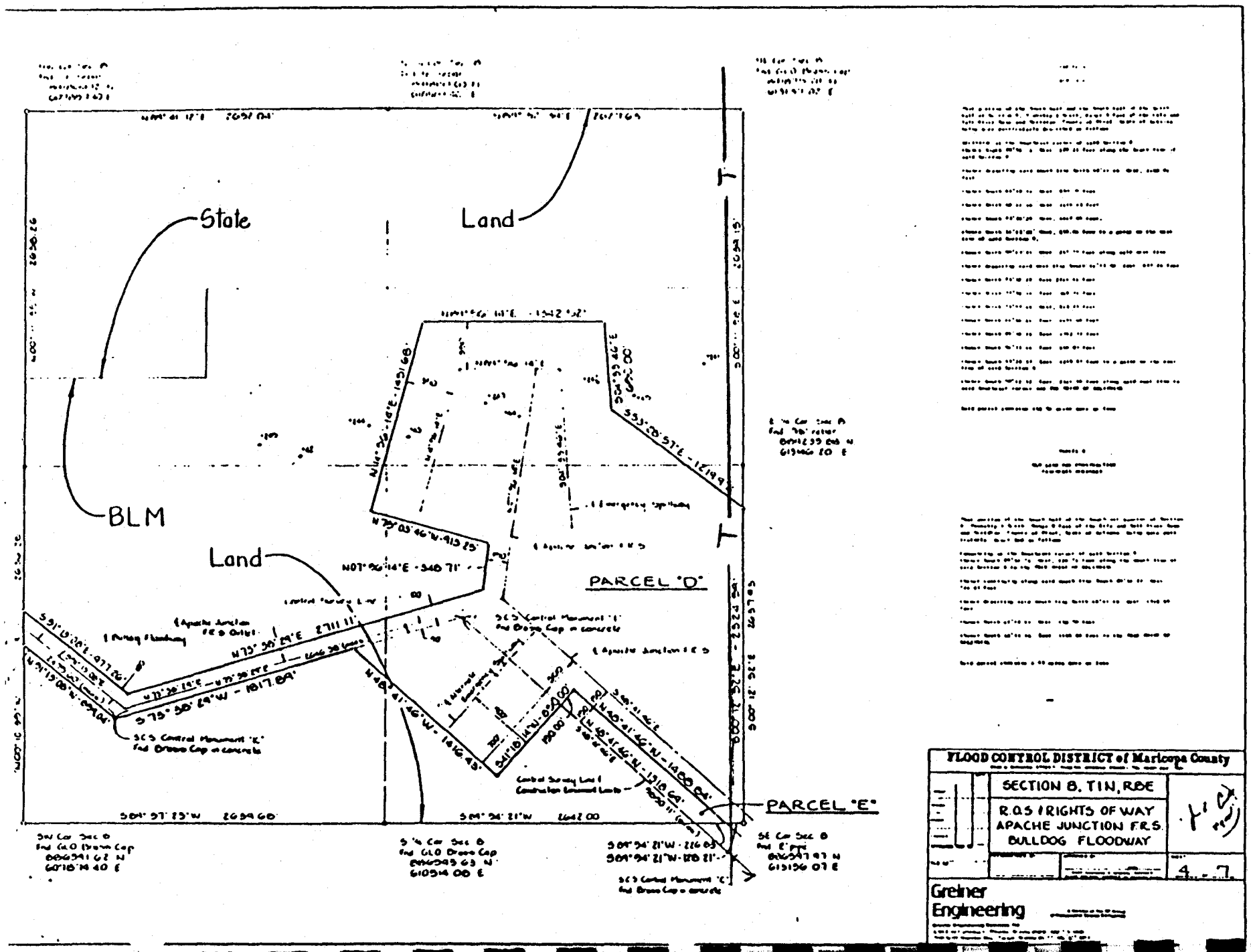
FLOOD CONTROL DISTRICT of Maricopa County

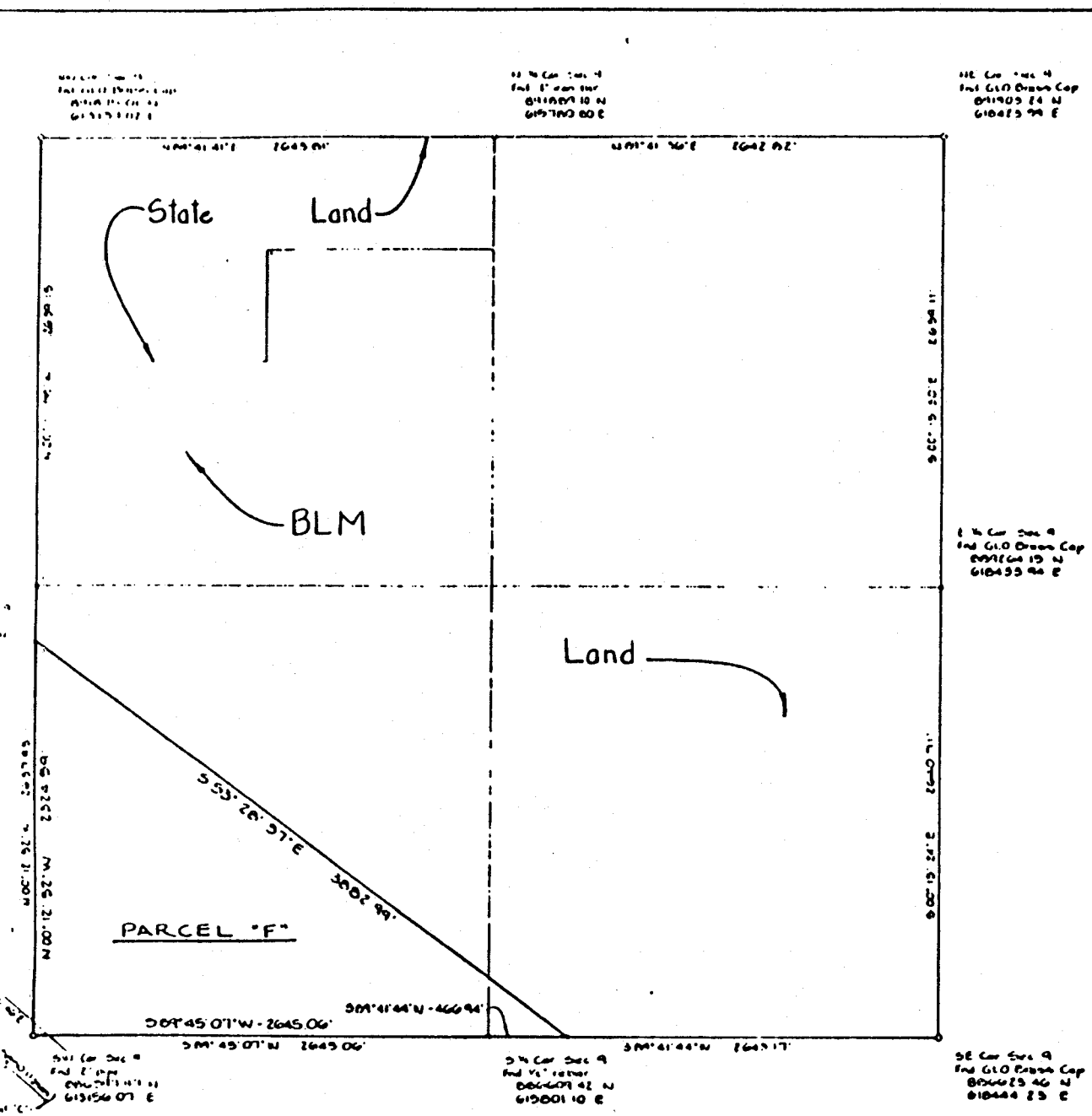
SECTION 7, T1N, R8E

R.O.S. • RIGHTS OF WAY
APACHE JUNCTION F.R.S.
BULLDOG FLOODWAY

3 of 7

Greiner Engineering


State
Land
BLM
Land
PARCEL "D"
PARCEL "E"
FLOOD CONTROL DISTRICT of Maricopa County
SECTION 8, T1N, R8E
R.O.S / RIGHTS OF WAY
APACHE JUNCTION F.R.S.
BULLDOG FLOODWAY
4 - 7
Greiner
Engineering



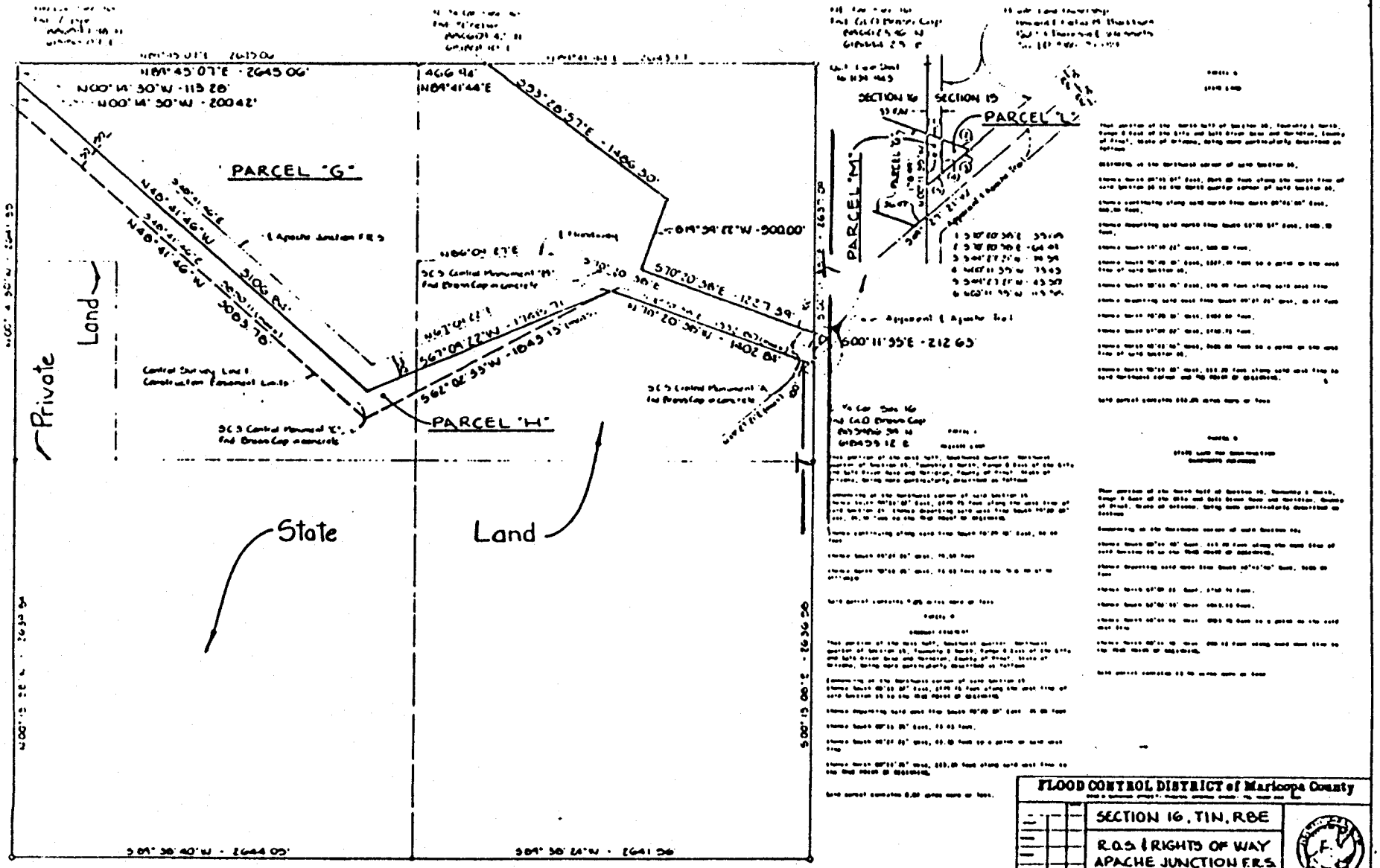
FLOOD CONTROL DISTRICT of Maricopa County

SECTION 9, T1N, R8E

R.O.S. & RIGHTS OF WAY
APACHE JUNCTION F.R.S.
BULLDOG FLOODWAY

5 - 7

Greiner Engineering



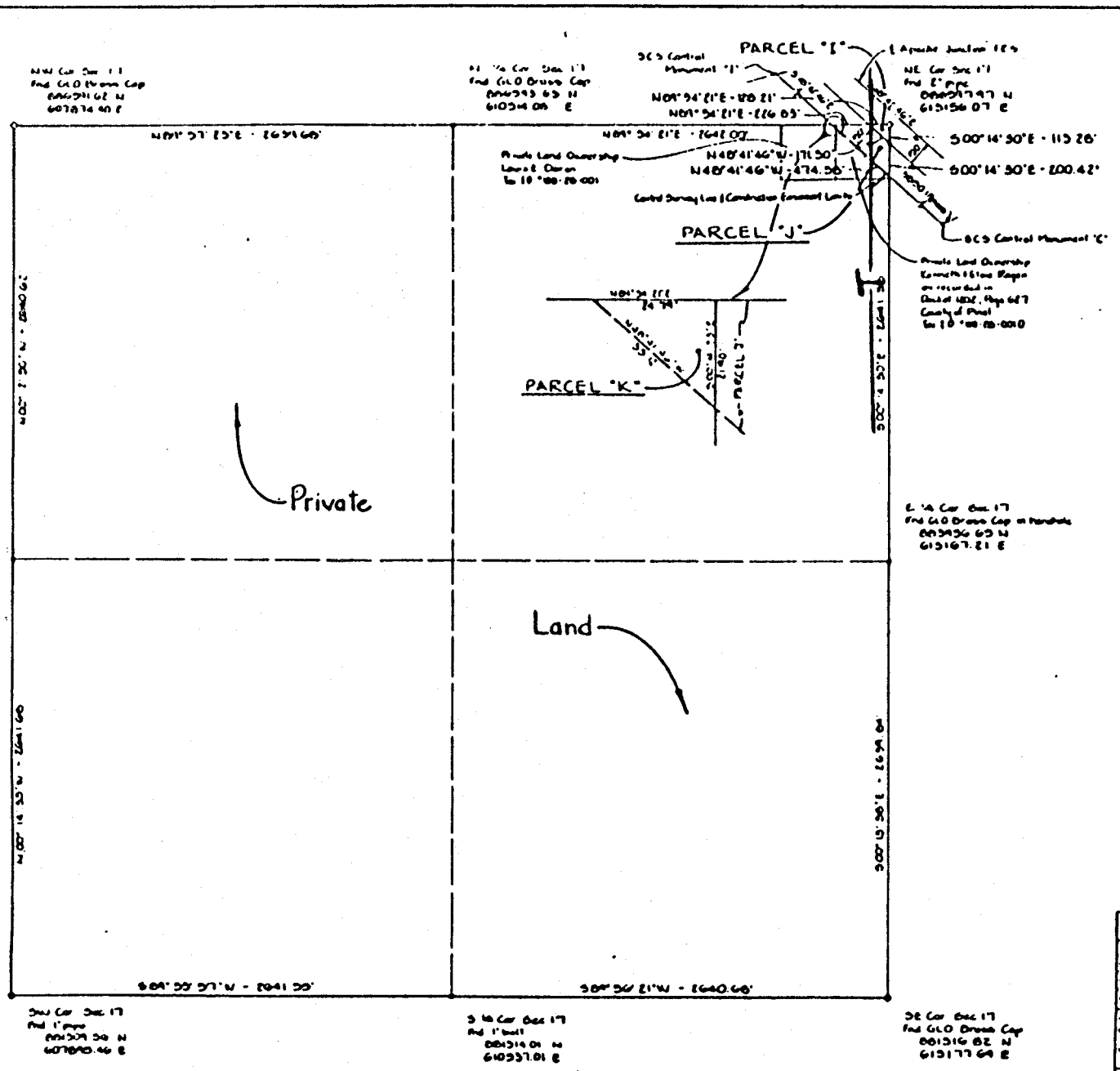
FLOOD CONTROL DISTRICT of Maricopa County

SECTION 16, T1N, R8E

R.O.S. & RIGHTS OF WAY
APACHE JUNCTION F.R.S.
BULLDOG FLOODWAY

6 - 7

Greiner Engineering



FLOOD CONTROL DISTRICT of Maricopa County

SECTION 17, T1N, R8E

R.O.S. (RIGHTS OF WAY
APACHE JUNCTION E.R.S.
BULLDOG FLOODWAY

Greiner Engineering

City of Apache Junction

August 12, 1985

Mr. Don Paulus
Engineering Section
Soils Conservation Service
201 East Indianola
Phoenix, AZ 85012

RE: Bulldog Floodway and Apache Junction F.R.S.
Phase I - FEASIBILITY STUDY - July 1985

Dear Mr. Paulus,

At the request of the FCDMC, we have reviewed the above-referenced study and submit the following comments for your consideration:

1. Apache Junction Floodway

   Should the floodway be designed to cross in the vicinity of the EAST line of Section 16, T1N, R8E, which is an alignment for Tomahawk Road (mile roadway), a culvert should be designed for the same storm frequency as considered for Idaho and Brown (Lost Dutchman Boulevard) Roads.

2. Emergency Spillway

   Observing that alternatives have been considered for different types of an emergency spillway, has consideration been given to the routing of storm flows to the South? If yes, we would appreciate reviewing those limits and estimated flow depths.

3. The preliminary road profile of Idaho and Brown (Lost Dutchman) Roads, with a 30 MPH design speed should be reconsidered for an ultimate design speed of 45 MPH, as ultimately these roadways have the potential to be developed into 4 to 6 lane roadways in the long term. As the City of Apache Junction street sections for mile roadways are similar to Pinal County, the roadway base (ramp) should be graded to accommodate the future pavement, curb and sidewalk section, even though only a 2-lane (24-28' roadway) may be constructed in the interim with this project.

1001 NORTH IDAHO • APACHE JUNCTION, ARIZONA 85220-0190 • TELEPHONE (602) 982-8002

4. In regard to road closures, no objection is expressed to completely closing an area to traffic, so long as only a one-mile roadway is closed at any one time.

We appreciate the opportunity to comment on this project, and will be happy to assist you further.

Cordially,

Richard

Richard W. Broman
Director of Public Works

RWB:sh

xc: City Manager
FCDMC

File 307.06

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I. INTRODUCTION

I. INTRODUCTION

On April 8, 1985, Ebasco Services Incorporated was awarded a contract by the 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 features to be designed are a part of the Buckhorn-Mesa Watershed Flood Control Project in Maricopa and Pinal Counties, Arizona. The Buckhorn-Masa Watershed is located in eastern Maricopa and northwestern Pinal Counties and has a total watershed area of approximately 108 square miles.

Ebasco's contract consists of five phases: Phase I - Site Characterization and Comparative Design Studies, Phase II - Soil Mechanics Report, Phase III - Preliminary Design, Phase IV - Final Design, and Phase V - Service During Construction. This report summarizes the findings of Phase I.

Phase I of the Contract was divided into four main areas including establishment of design criteria, review of geological and soils information provided by SCS, completion of the design hydrology for the Apache Junction FRS and Floodway with a review of the Apache Junction Outlet and Bulldog Floodway hydrology, and comparative design studies of the project features.

The alternatives to be studied for the project features were established in the contract and are summarized as follows:

* Apache Junction Floodway
    - Channel -
        - concrete
        - earth (DS of energy dissipator)
    - Side Inlets -
        - concrete headwall and entrance channel
        - pipe inlet
    - Energy Dissipator -
        - grouted rock drop

* Apache Junction FRS
    - Principle Spillway Outlet -
        - reinforced concrete impact basin
    - Principle Spillway Inlet -
        - SCS standard riser
    - Principle Spillway Conduit -
        - 36 inch diameter reinforced concrete pipe
    - Emergency Spillway -
        - earth
        - earth with mechanical improvement (soil cement, etc.)
        - baffle chute
        - type C drop
    - Embankment -
        - earthfill

* Apache Junction Outlet
    - Channel -
        - concrete trapezoidal
    - Side Inlets -
        - concrete headwall and entrance channel
        - pipe inlet

* Bulldog Floodway
    - Channel -
        - rectangular concrete
        - trapezoidal earth (DS of energy dissipator)
    - Side Inlets -
        - concrete headwall and entrance channel
        - pipe inlet
        - side inlet junction structure
    - Energy Dissipator -
        - grouted rock drop

In certain instances suggestions have been made for alternatives other than those included above. These are discussed in the report.

II. DESIGN CRITERIA

II. DESIGN CRITERIA

USDA SOIL CONSERVATION SERVICE
BULLDOG FLOODWAY AND APACHE JUNCTION

FLOOD CONTROL

EBASCO SPECIFICATION

DESIGN CRITERIA

EBASCO SERVICES INCORPORATED

CIVIL DEPARTMENT

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

1088v

EBASCO SERVICES INCORPORATED

EBASCO SPECIFICATION
DESIGN CRITERIA

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EBASCO SERVICES INCORPORATED

EBASCO SPECIFICATION
DESIGN CRITERIA

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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 1650 feet and terminates into an earth channel behind the FRS. The earth channel is approximately 1100 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 2900 feet long running in the southwesterly direction before ending into the Bulldog floodway. A transition from 2.5 feet semi-circular to the 3.5 feet wide rectangular channel will be provided at the end of the principal spillway.

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 7350 feet and terminates into an earth channel which is approximately 1350 feet long.

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 Enginering 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 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. A concrete bedding will be provided between the pipe and the 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 For the earth emergency spillway, the excavated slope will be no steeper than 2 horizontal to 1 vertical. The stability of slopes will be investigated.

6.6.2 If levees are provided to contain the spillway, the top width of the levee will be minimum 12 feet and the side slopes will be minimum 3 horizontal to 1 vertical. The stability of slope will be investigated.

6.6.3 The Oe/b analysis will be performed for the earth emergency spillway for the freeboard hydrograph flow to provide safety against breaching - TR 52.

6.6.4 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. MINUTES OF MEETINGS

MINUTES OF MEETING
COMPARATIVE DESIGN STUDY CONFERENCE
BULLDOG FLOODWAY AND APACHE JUNCTION FLOODWAY, FRS, AND OUTLET
JULY 24, 25, 1985

LOCATION: USDA SCS STATE OFFICE
201 E. INDIANOLA AVE.
PHEONIX, ARIZONA

ATTENDANCE: SEE ATTACHED LIST

The meeting was opened by Don Paulus at 1:00 P.M.

A presentation was made by Ebasco in accordance with the attached agenda with some reorganization to accomadate the schedule of the engineers from the Maricopa County Flood Control District.

Following a review of the revised schedule the following issues were raised pertaining to the material presented:

* Ebasco will check extent of backwater at each side inlet.

* The assumption of sediment laden water in the design of the earth portions of both the Apache Junction Floodway and Bulldog Floodway was questioned by SCS. Don Paulus agreeded to provide Ebasco with calculations used on a previous project for projecting sediment load.

* Nick Karan asked if the cost of landrights as considered in the recomemdation that a rectangular channel be build instead of a rectangular channel for the Apache Junction Floodway. The reply was that they had not been but all agreeded that less land would be required for the rectangular channel.

* Ebasco was asked to check extent of backwater behind each side inlet.

* The question was raised regarding the extend of sediment build up in the concrete lined channels. It was agreeded that the velocities were high enough to keep the channels flushed of sediment.

* Ebasco is recommending that a 30 inch principal spillway be used instead of the 36 inch that was in the work plan. When asked, SCS was not aware as to why a 36 inch pipe was recommemded but thought it might be for maintenance purposes. SCS will documment their decision on pipe size in their review comments.

* There was general discusson regarding the design of Idaho and Brown Roads. Main concerns involved the speed limit and use of a four way stop at the intersection. SCS and Maricopa County will provide Ebasco with the design criteria needed.

* A general discussion insued regarding the design of the culverts under Idaho and Brown roads. It was agreeded that the approach used by Ebasco was conservative and acceptable.

* Hydrologists from the MCFCD asserted that there is a depression in Apache Trail approximately 1000 feet upstream of the floodway and that additonal drainage area should be included east of Apache Trail. Ebasco pointed out that this area was looked at in detail in April and that it had been agreed that the area east of Apache Trail did not contribute to the Apache Junction Floodway (see minutes of April meeting). Ebasco also pointed out that increasing the drainage area would have no effect on the FBH since the floodway is not designed to carry the flow which would overflow the channel a go around the FRS.

* There was general discussion over the defination of "complete cutoff". Earlier statements by SCS indicated to Ebasco that they desired a cutoff to caliche due to the possibility of buried and incised channels. The SCS TSC representative stated that he did not believe it was necessary to provide a cutoff to caliche to have a complete cutoff and that something less than a cutoff to caliche might be acceptable. It was agreeded that this alternative would be considered in Phase II of the work. Additional investigation needed would be defined by Ebaso with the objective of having field work complete in early August.

* The issue involving the collapsibility of the soil was addressed. Nick Koran pointed out that it is normal practice to run the SPT in a saturated state which the SCS had not done. After general discussion it was agreeded that the additional field work would include SPT in a saturated state adjacent to previous holes where SPT were obtained in the dry state.

* The issue of the use of anti-seep collars was raised and it was pointed out that SCS no longer uses them and that a diaphram is the method utilized.

* SCS stated that they would like a Type A-1 bedding used under the principle spillway conduit. (TR-5)

* Discussion on Design Criteria:

    * SCS asked that Ebasco document its use of .025 for Mannings n for both the aged and as-built conditions. They generally use .027 for aged and .024 for as-built.

    * Page II.3, Para. 2.5.1 - Describe transition to be used in narritive.

* Page II.8 - It was agreeded that the freeboard used in all cases would be 20% of the depth or 1 foot which ever is greater.

* Page II.8 - Curves in subcritical flow require superelevation. ?

* Page II.13 - SCS requested that we document that no steady state seepage conditon exists. A stability analysis will have to be made for the drawdown condition on the upstream slope after partial saturation.

* Discussion on Suitability Assessment:

  * Page IV.6 para. 1 - SCS requested that Ebasco show agreement that the design can be completed based on correlated data.

  * Page IV.6 para. 3 - SCS agrees with the statement but would like it written with a more positive approach.

  * Page IV.6 para. 2 - SCS would like to have the depth of cutoff to be defined on the plans but incorporate in the Specifications that the final depths will be as determined by the engineer in the field at the time of construction. A sample specification was provided.

  * Page IV.6 para. 4 - Regarding the question of the soil being collapsibility, it was agreeded that SPT would be run as discussed earlier subject to agreement with this approach by Ebasco's Chief Civil Engieer. SCS also stated that they were not concerned with the material be dispersive and would document this belief in their review comments.

SCS agreeded to provide Ebasco with the following:

* Revised copy of SM-1

* A copy of the procedure to be used in estimating the degree of scour downstream from the baffle chute

* Sample of previous calculations they have made to estimate the amount of sediment in runoff water for use in the stability analysis of the earth channels

* NEH-20 on a floppy disk

Name	..zation	Phone
C. Montana	Ebasco Services Inc.	212-839-1421
D. Hunter	"	212-839-1409
S Goyal	"	212-839-3722
V Bolano	"	212-839-1483
G. Rockwell	"	714-662-4122
S Leckband	SCS	602-241-5144
Jeff Bell	City of Apache Jct	602-982-8002
Bill Payne	SCS	602-241-5152
Ray Koffman	SRP (Power)	236-2765
Bill Phillips	SRP (Power)	236-2732
Earl Monville	SCS	505.221.2557
Don Paulus	SCS	602-241-5743
Nick Karan	FCD	262-1501
Joe Tram	FCD	262-1501
Dave Johnson	"	"
Cora Fernandez	"	"
Dick McNamara	"	"
B.W. Stobe	"	"
John Sullivan	SCS	241-5149
John Weaver	SCS	241-5147

BUCKHORN-MESA WATERSHED

APACHE JUNCTION FLOODWAY, FRS, OUTLET, AND BULLDOG FLOODWAY

COMPARATIVE DESIGN CONFERENCE AGENDA

JULY 24, 25, 1985

INTRODUCTIONS	DON PAULUS
PROJECT SCHEDULE AND STATUS	CARL MONTANA
SUITABILITY ASSESSMENT - SOIL MECHANICS	VIC BOLANO
HYDROLOGY	DAVE HUNTER
BREAK	
STUDIES	
APACHE JUNCTION FLOODWAY INLETS CHANNEL ENERGY DISSIPATOR	CARL MONTANA
APACHE JUNCTION FRS PRINCIPAL SPILLWAY EMERGENCY SPILLWAY EARTH MODIFIED EARTH TYPE C DROP BAFFLE CHUTE EMBANKMENT IDAHO AND BROWN ROAD CROSSING	SHIAM GOYAL
APACHE JUNCTION OUTLET & BULLDOG FLOODWAY INLETS CHANNEL ENERGY DISSIPATOR	CARL MONTANA
COUNTY CONTRACTS	GLENN ROCKWELL

MINUTES OF MEETING
PHASE I PREDESIGN CONFERENCE
BULLDOG FLOODWAY AND APACHE JUNCTION FLOODWAY, FRS, AND OUTLET
APRIL 16, 1985

LOCATION: USDA SCS STATE OFFICE
201 E. INDIANOLA AVE.
PHOENIX, ARIZONA

Attendance: See attached list

The meeting was opened by Don Paulus at 8:30 a.m. The following items were addressed:

1. Crossing of Project Area by AT&T fiber-optic cable

Lee Kupfer of Black & Veatch, AT&T's engineers, explained the need for AT&T to install a fiber optic cable through the dam site. The cable is to run east-west, 40 ft. north of the present alignment of Brown Road. The installation is to take place between June 1985 and February 1986. AT&T requested guidance on requirements regarding method of installation and depth of burial under the dam. Ebasco pointed out that we had not yet studied the geologic material supplied by SCS and that a final decision would probably not be reached on foundation treatments until the end of August. It was also pointed out that the cable would be crossing the proposed borrow area. Various options were discussed including depth of burial into the caliche, method of backfill, and impacts on the operation of the borrow area. It was decided that AT&T would submit a proposal to SCS and that SCS would review the proposal with Ebasco.

2. Idaho Road and Brown Road Crossings

The original proposal, as included in the scope-of work, was to have the intersection of Idaho Road and Brown Road (also called Lost Dutchman Road) occur coincident with the centerline of the dam. This had been agreed to between the SCS and project sponsor, the Maricopa County Flood Control District (MCFCD). The City of Apache Junction took exception with this alignment. A second proposal was made by the MCFCD of moving the western portion of Brown Road south from the dam and eastern portion north from the dam. This proposal presents problems with the recreation area to be developed upstream of the dam. No decisions were reached; however, the MCFCD asked Ebasco to submit a proposal to them to serve as their engineer in resolving land rights issues including roads and utilities.

3. Impacts of Idaho Road and Brown Road Alignment on Phase I

The alignment and cross-section of Idaho Road and Brown Road affect the hydrologic and hydraulic analysis of the Apache Junction FRS inasmuch as they reduce storage volume and restrict drainage patterns in the flood pool.

Ebasco requested the width and side slopes of the road embankments to use in developing the reservoir capacity. Since this cannot await final decisions on the

road locations, Ebasco must assume the maximum volumes, which correspond to the original crossing location on the crest. The FCD gave the roadway width as 48 feet curb-to-curb plus 10'-wide shoulders, with side slopes of 3:1 or steeper. It was noted that this configuration may exceed the proposed 100-foot wide right-of-way at the base of the embankments. A new configuration for the intersection may affect Ebasco's effort beyond the original scope of work. It was agreed that the hydrologic and hydraulic analysis would be completed based on the assumption that the roads would cross the reservoir as originally proposed i.e.: in a straight line following their current alignments meeting at the top of the dam. The roadways within the flood pool area will be kept above the 25-year flood level.

4. Crossings on Apache Junction Floodway and Bulldog Floodway:

Additional crossings including Tomahawk Road (north-south) which crosses the Apache Floodway, and Ironwood Road, Meridian Road (north-south) and a horse trail which will cross Bulldog Floodway, were brought up by the MCFCD. No piers in the floodways will be allowed for these structures. Ebasco will provide the hydraulic information at these crossings. Various utilities, including telephone, gas, and water lines, exist or are planned for these crossings. The Maricopa County Flood Control District inquired whether Ebasco could act as the County's engineer for all land rights issues related to these roads and utilities. A proposal to this effect will be prepared by Ebasco and submitted to the District.

The horse trail crossing and Tomahawk Road Crossings were not included in the contract scope-of-work. Clarification will have to be reached on the input from the County, SCS, City of Apache Junction and Ebasco.

5. Emergency Spillway Alignment

The SCS, FCD, Ebasco and Dan Lawrence, the Dam Safety Engineer of the Arizona Department of Water Resources, discussed the Emergency Spillway. SCS reminded Ebasco that the earth channel "shoe" Alternate #1 passing to the north of the Salt River Project transmission line has been eliminated because transmission towers would have to be moved. The remaining alternatives to be considered are moving the earth channel south so as not to interfere with any transmission towers, Alternate #2, or the structural spillway in the main dam. Ebasco inquired whether the excess capacity (above the 100-year flow) of the Apache FRS Outlet and the Bulldog Floodway have been considered in computing inflows to the Signal Butte FRS for the ESH and the FBH. Harry Millsaps later advised Ebasco that these excess flows had been included.

We examined aerial photos of the areas downstream from both spillway alternatives. It was observed that development was denser downstream from the proposed structural spillway and also closer to it than the development in the area downstream of the earth spillway site, posing a likelihood of greater damage in the event of the spillway flowing. Ebasco suggested moving the structural spillway to the west limb of the dam so that it discharged into the same area as the earth spillway alternative. SCS will evaluate this change and advise Ebasco during the week of April 22.

6. Hydrologic Analysis

The Ebasco and SCS hydrologists met separately to discuss methodology and provide additional data to Ebasco. Mr. Millsaps noted that the version of TR-20 used on the studies to date is not the most recent and used the Modified Coefficient Method for routing rather than the Att-Kin Method. Although it would be desirable to have the Signal Butte and Apache/Bulldog parts of the project done by the same methods, for Ebasco to obtain and get an old version of TR-20 operable would delay the schedule 2 to 4 weeks; therefore Ebasco will proceed with the available version, which is up-to-date. Also, Ebasco obtained information on Curve Number reduction factors from Mr. Millsaps, as well as a Soil Survey map. Ebasco purchased two aerial photographs directly from Landis Aerial Surveys for use in drainage basin delineation.

The hydrology studies for developing inflows at the side inlets of Bulldog Floodway are not yet complete but are estimated to be available by Friday, April 26. Ebasco requested SCS to delay issuing the Notice to Proceed until this data is available. SCS agreed to delay the Notice to Proceed until all hydrologic data to be supplied by them is available.

7. Design Note 21

SCS personnel inquired of Ebasco how it intended to carry out the provisions of Design Note 21 and if Ebasco had any questions regarding it. Ebasco was not familiar with this document since it was not included in the package of material previously supplied to Ebasco by SCS nor was it listed in the "Topics of Discussion" in the agenda of the predesign meeting prepared by SCS. It was agreed that Ebasco would review Design Note 21 and evaluate its impact on the project cost and schedule and get back to SCS in the week of April 22, 1985.

8. Responses to "Questions for Pre-Design Meeting" from Ebasco

Question: What are landrights based on? How high can we raise the top-of-dam?

Answer: The sponsors have rights or will obtain rights to flood to the limits of the land rights boundaries shown on the landrights map.

Question: The emergency spillway earth channel as proposed will outlet directly into the Apache Junction outlet channel and could cause its loss should it flow. Has a pipe been considered for the Apache Junction outlet channel?

Answer: A pipe is not to be considered. SCS prefers an open channel. There was also some discussion regarding the ability of the concrete channel to carry more than the design flows due to freeboard capacity and the impact of that on the sizing of downstream structures in the watershed. SCS informed Ebasco that this had been taken into account in the watershed planning stage.

Question: Does the stage storage data provided contain the volume for material excavated as borrow material?

Answer: A new stage storage curve will have to be developed to incorporate the volume occupied by the road fills.

Question: Can SCS supply copies of the appropriate soil surveys?
Answer: SCS provided the soil survey data.

Question: What purpose does running the emergency spillway storm serve?
Answer: The ESH is used to determine the limits of area required for purchase of flowage easements. It will be used as in completing the innundation map preparation required in Phase IV. There was discussion about moving the portion of the innundation map preparation for the ESH and FBH flows to Phase I to aid in a decision on whether or not the structural spillway alternative should be eliminated. It was decided that SCS could make the decision without the use of the maps (see 5 above) and Ebasco was not requested to change the sequence of work.

Question: Can we obtain copies of construction costs on recently completed projects?
Answer: Yes, SCS will supply copies of abstracts on recently advertised work when bids are received.

Question: Procedures to be used for conduit design. Can manufacturers' recommendations be used? Are TR-5, TR-18, and DN-2, to be used. Can we get copies of TN-1, TN-2, and SN-5 that are listed in the list of references?
Answer: Manufacturers' recommendations cannot be used. TR-5 and TR-18 must be followed. TN-1, TN-2, and SN-5, do not apply.

Question: What procedures are being used by SCS to design the energy dissipators at the ends of the concrete channels?
Answer: Design Note 22 to be provided by SCS. HEC-14 and COE 110-2-1603. SCS will also send copies of plans for Signal Butte Project.

Question: What procedure is used by SCS to estimate depth of scour below the baffle chute structure?
Answer: U. S. Bureau of Rec. Technical Note 25, Queen Creek Dam Study done by Lauretson at the University of Arizona.

Question: Has SCS considered using the material excavated during channel construction for the FRS fill?
Answer: Yes, it is generally not economical due to increased haul distances.

Question: What have you used as allowable velocities in the Calachi?
Answer: Allowable velocities in the Calachi range from 0 to 8 feet per second depending on the type of Calachi and its characteristics. Velocity should not be used in the ES spillway design, use TR-52 procedures.

Question: Is there any flow in the Apache Junction Floodway from the area east of Apache Trail?
Answer: There is no inflow to Apache Junction Floodway from the area east of Route 88 (Apache Trail). There is significant inflow along the western edge of Apache Trail.

Question: Will we be required to use SCS standard computation sheets?
Answer: SCS intended to supply standard computation sheets for TR-5 computations and TR-18 computations. Ebasco is not required to use them but they make the use of the TR's easier. SCS will supply these.

9. Additional items:

a. Soil Mechanics Note 1 is being revised but was not available at the time of the meeting. SCS will send copies ASAP.

b. SCS does not allow the use of filter fabrics in the earth fill.

c. Environmental Impact Statement Considerations: Ebasco will not design an irrigation system. The 6:1 side slopes will not be used, Ebasco will design for stability. No top soil will be included on the dam in Ebasco's design; top soil will be added under the landscape contract if needed.

d. Ebasco suggested that consideration be given to placing fill on dry side of optimum and inquired if SCS would entertain the idea of additional testing for this purpose. SCS stated that they have recently completed a report on this subject that they will make available to Ebasco. Options to SCS standard fill placement procedures were not ruled out.

ATTENDANCE LIST

Name	Organization	Phone
Don Paulus	SCS	241-5143
Lee Kupfer	Black & Veatch	(913) 967-2000
Ken Reinert	Coates Field Serv.	266-8116
Myron Temchin	Ebasco	(212) 839-1408
Dan Lawrence	Az. Dept. of Water Resources	245-1541
Bill Payne	SCS	241-5152
Bob Payette	FCD	262-1501
Leonard Eddy	FCD	262-1501
M J McNulty	City of Apache Junction	982-8002
Jeff Bell	City of Apache Junction	982-8002
Richard W. Broman	City of Apache Junction	982-8002
Wm. Ruddick	BLM	863-4464
Vic Bolano	Ebasco	(212) 839-1483
Glen Rockwell	Ebasco	(714) 662-4122
Carl Montana	Ebasco	(212) 839-1421
David Hunter	Ebasco	(212) 839-1409
Shiam Goyal	Ebasco	(212) 839-3722
Nick Karan	MCFCD	262-1501
Cora Fernandez	MCFCD	262-1501
Erv McLuty	MCFCD	262-1501
Ray Koffman	SRP	236-2768

MINUTES OF MEETING

Phase I : Monthly Meeting and Hydrology Review
May 22, 23, 1985
Phoenix, Arizona

Attended by:

SCS - Don Paulus, Bill Payne, S. Leckband, Aubrey Sanders

EBASCO - Carl Montana, Shiam Goyal, Glenn Rockwell

FCD - Nick Karan, Cora Fernandez, R. W. Shobe

NOTE: In reviewing these minutes one should refer to Ebasco letter USDA 3767-L005 and attachments (Agenda, Preliminary Design Criteria and Preliminary Findings on Suitability of Soils Data).

I. AGENDA ITEMS

1. Status of AT&T Cable

SCS referred to their letter to AT&T of May 13, 1985. Lee Kupfer was contacted by SCS following the receipt of letter and has been informed that AT&T agrees to its content and will supply the requested data and reimburse the county for added costs. AT&T's main concern right now is to get necessary permits and approvals to start work. EBASCO's contract will be modified accordingly prior to needed reviews and coordination.

2. Status of EBASCO's Contract with FCD

EBASCO has provided the FCD with a proposal to design Ironwood and Brown Roads based on current alignment and includes known utilities (water and telephone) in SCS' construction package for Apache Junction FRS. FCD to review proposal and get back to EBASCO. Pay items relative to the road crossings will be separate from Apache Junction FRS but one package of plans and specs will be produced including both the road crossings and associated work with the FRS. FCD will locate all utilities and provide information to EBASCO.

FCD stated that it did not appear at this time that they were responsible for the proposed maintenance and horse crossing over Bulldog Floodway. They will coordinate with the Town of Apache Junction to resolve this issue.

A general discussion arose over the width of Bulldog Floodway at the three crossing locations (Meridian Road, Ironwood Road and horse trail). FCD was not aware that the channel width in these areas would range from approximately 20 to 40 feet. They had assumed that box culverts with a span not exceeding 12 feet could be constructed across the channel. After detailed discussion it was agreed by SCS and EBASCO that piers would not be allowed in the channel and that EBASCO would

minimize the width as much as possible within site conditions and design considerations. The FCD asked that they be provided with the channel widths ASAP; it was agreed that the widths would be agreed upon at the end of Phase I, which should be about August 2, 1985.

3. Design Note 21 Requirements

   SCS provided EBASCO with a letter defining requirements and intent of DN 21. EBASCO will review the letter and respond to SCS.

4. Type C Drop Structure Modification

   It was agreed to withhold the issuance of this modification until further analysis was made on the use of an earth spillway at Alternate 2 location. If an earth spillway is feasible there may be no need to study the use of a Type C Drop at that location. SCS does not intend to utilize a Type C Drop at the currently proposed Baffle Chute location.

5. Reference for Design of Curved Side Inlets

   SCS will check Signal Butte Floodway Design Procedure and get back to EBASCO.

6. Review of Design Criteria

   See II., which follows.

7. Review of Preliminary Findings on Geologic and Soils Data

   See III., which follows.

8. Regional Subsidence Considerations

   SCS stated that this is not an issue at the location of this project.

9. Hydrology Review

   See IV., which follows.

10. Billing Procedures

    All correspondence and contract modifications will go to C. Montana. Payment will be made to the address shown on the invoice.

11. Freeboard Requirements for the Apache Junction FRS

    SCS criteria will be met. When site configuration is established contact will be made with the Division of Safety of Dams (D. Lawrence) for concurrence.

12. Transmission Line Location

SCS provided EBASCO with survey notes locating the transmission line tower along Bulldog Run.

13. Location and Type of Emergency Spillway Used on Signal Butte

The plans provided EBASCO showed an emergency spillway at Signal Butte that could have conflicted with the Bulldog Floodway Outlet. SCS informed EBASCO that this was not constructed and that a structural spillway was used at a different location.

14. Apache Junction FRS Conduit

The Apache Junction FRS Conduit will discharge directly into the concrete channel without the use of an energy dissipator. SCS agreed, but asked that the reasoning be documented in the design report.

15. Bulldog Floodway Centerline

It was pointed out by EBASCO that since the concrete channel widens at the side inlets as you move downstream, the centerline becomes offset at these locations. A "control line" will be established starting with the most upstream centerline with offsets and adjustments made as progression is made downstream.

16. Minimum Embankment Slopes on the Apache Junction FRS

SCS agreed that the minimum slopes would be those established by stability analysis and that an upstream slope of 2.5:1 and a downstream slope of 2:1 could be utilized.

17. Baffle Chute Design Criteria

SCS provided EBASCO with an additional reference published by the Bureau of Reclamation "Baffled Apron as a Spillway Energy Dissipator." The maximum discharge per foot of width requirement of 60 cfs has been exceeded many times. SCS stated that they have exceeded 100 cfs/foot on some of their designs and would not have any difficulty with a design based on discharges in this range. SCS also provided the following additional design requirement:

- Inlet designed for the freeboard discharge.
- Chute designed for 2/3 of freeboard discharge.
- Exit Channel designed for Emergency Spillway flow.

18. Use of High Density Polyethylene Membrane

This method of crack control will not be used on this site.

II. DESIGN CRITERIA

Don Paulus (SCS) and S. Goyal (EBASCO) discussed the EBASCO Specification USDA 3767.001 S01 (Preliminary) Design Criteria, "Bulldog Floodway and Apache Junction Flood Control." The following comments and suggestions were given by SCS:

Para. 3.2.2 For the design of earth channels, tractive stress analysis should be performed to find the economical cross-section. However, it was acceptable to design the Apache Junction Floodway earth channel without the tractive stress analysis because the excavations can be used for the FRS embankment. In caliche higher velocities, as much as 8 ft/sec may be permitted.

Para. 3.3.4 EBASCO should check freeboard requirement with the State. Emergency spillway hydrograph storm is considered as the design flood.

Para. 3.3.6 For flood routing, EBASCO should document and confirm in letter form if the loss of storage volume due to the road embankments is negligible. If not, delete the sentence.

Para. 3.4.1 EBASCO will size the culverts under the two roads. The design of the culverts will be part of the other contract with Maricopa County Flood Control District.

Para. 5.1.11 (a) The coefficient of friction 'n' should be .02 and modified as required by Supplement B to NEH 5.

(b) See comment on Para. 3.2.2 for velocity. For silt content documentation should be provided from sedimentation report.

Para. 5.2.1 The SCS computer program works out the principal spillway conduit discharge rating curve. Reference to TR29 and the equation is not necessary. The standard detail for inlet riser has half-round slope at the base. If k = .7 is applicable it should be noted in the criteria.

Para. 5.3.5 Reference should be made to the new literature, A Baffled Apron As a Spillway Energy Dissipator" by T. J. Rhone, supplied by SCS. Restriction of 60 cfs will not be necessary, and should be deleted. The paragraph may be modified if required.

Para. 5.4.1 SCS provided a copy of Hydraulic Design of Energy Dissipators for Culverts and Channels; Hydraulic Engineering Circular No. 14, U.S. Dept. of Transportation for design of plunge pool energy dissipator.

Para. 6.1.1 & 6.1.6 Delete High Density Polyethylene Membrane.

Para. 6.1.5 Corrosion protection should be in accordance with SCS Specification NEH 20, Chapter 2.

Para. 6.2.3 The end of construction and long-term properties for the material should not be different. Therefore, condition 1 and the property identification can be deleted.

Para. 6.4.2 The width of the service road should be a minimum of 14 feet.

Para. 6.6.3 Because of low permeability, drawdown condition may not apply.

Para. 6.7.1 For size of riprap HRP 108 should be used. If grouted riprap is used provide a cutoff key at the upstream end. If riprap with bedding is used upstream of the grouted riprap it should be drained.

Para. 6.9.1 EBASCO should provide specifications of the material to be used as joint filler.

Para. 6.9.3 In the concrete spillway waterstop should be provided at articulated joint (see Signal Butte Dwg.).

General - The criteria should be reviewed against SCS Engineering Design Standard for the Western states.

III. REVIEW OF PRELIMINARY FINDINGS ON SUITABILITY OF GEOLOGIC AND SOILS DATA

SCS pointed out that the stationing is wrong in the Geologic Report and that the field permeability tests reported at Stations 97 + 50 and 92 + 00 were actually run at 97 + 00 and 91 + 00, respectively. All tests were run in caliche only. SCS agrees that constructing a cutoff over 20 feet deep to caliche does not seem reasonable for a dam of this size; however, at the time the site investigation was conducted it was assumed that a cutoff to caliche was going to be built, so no tests were run in the material above the caliche. SCS is concerned that buried channels of clean sand in unidentified buried washes exist as deep as the top of caliche at 24 feet. It would be unreasonable to conduct an investigation extensive enough to be certain that all of the buried washes were identified. It was agreed that a reasonable approach might be to construct a cutoff to a predetermined depth (say 5 feet) or to caliche, whichever is shallower and conduct further investigations, including field permeability tests, in those areas where a cutoff to caliche will not be provided. After further discussion, SCS stated they would prefer that a cutoff to caliche be constructed.

SCS agrees that Method C should have been used in preparing soil samples and not Method A. They also agree that the moisture contents of the samples on which tests were run were too high. SCS is not in agreement on placing the fill on the dry side of optimum. SCS is not in agreement in-house that placing the fill on the dry side of optimum is the solution to the cracking problem and believe that placing the material on the dry side is detrimental to obtaining a well constructed homogeneous fill. A "crack control drain" will be included in the design regardless of the moisture content at which the fill is placed and they prefer that we stay with a range of $\pm 2\%$ of optimum in our specifications.

SCS agrees to have the tests rerun using Method C compaction with the moisture contents lower than those previously used; i.e., closer to optimum.

The SCS Soil Mechanics Laboratory in Lincoln, Nebraska was contacted and the soil samples previously tested were located. Four samples with gravel content ranging from 17 to 24 percent gravel will be prepared by Method C compaction at 95% S.P.D. and tests run at optimum moisture. It will take about 1 month before a report will be available from the laboratory. SCS feels that soil parameters (strength, permeability and consolidation) will not vary enough to make a difference in design and that EBASCO should proceed with embankment design using the previously provided parameters. (It is the belief of SCS engineers that the coarse material content must exceed 30% before any significant variation will be noticed in the soil parameters.) The test results will be used to verify the values used in design and in preparing the Construction Specifications.

SCS agrees that all foundation parameters, other than permeability, can be determined from correlations with available Standard Penetration Tests and classification data. They do not anticipate consolidation or strength problems with the foundation material. SCS agreed that additional investigation would be required if the structural spillway exceeds 300 feet in length.

The final point of discussion concerned adequacy of investigation and design procedures to be used involved the earth emergency spillway Alternate 2. SCS requires the following:

- The calichi be treated as an easily erodable soil (Class E) and the spillway be designed using TR-52 requirements with Oe/b resulting from the freeboard storm.

- The stability of the spillway be checked using TR-25 tractive stress procedures against the Emergency Spillway Storm Discharge.

The second condition is an addition to that agreed to at the pre-design meeting.

IV. HYDROLOGY REVIEW

A thorough review was made of the completed hydrologic calculations. The following recommendations were made:

- The storm distribution used in developing the "local storm" should be HMR-5, which is closest to the SCS Type B.

- TR-52 requires that Oe/b be checked for the freeboard storm; TR-60 requires that the PMP used for an area like Arizona be of the duration and distribution that produces the maximum reservoir level in the reservoir when routed through the

spillway system. SCS agrees that for this site it is most likely the 6-hour storm and would accept a 6-hour routing only if EBASCO can document this, otherwise they would like a 24-hour storm routed also.

- o SCS noted that the Channel Loss Factor used by EBASCO was obtained from NEH-4 and was not modified as required by TSC Technical Note PO-4 Hydrology. Upon further discussion, it was noted that EBASCO had never received this Technical Note. EBASCO was provided with a copy which will be utilized in making the necessary change to the input data. It was agreed that DAMS II could be used but that the data would have to be adjusted.

There was discussion on EBASCO's Drainage Area and Tc computation. It was agreed the drainage areas are within acceptable tolerances. SCS provided cross-section data on some of the drainage ways in the basin and requested that EBASCO look at it to see if it will effect velocities and therefore the time-of-concentration.

SCS pointed out that the current reference to be used in obtaining the 10-Day Curve Numbers is TR-60 and not NEH-4, Table 21.2. In this case the results are the same.

V. ADDITIONAL MATERIAL FURNISHED BY SCS

- o TSC Technical Note - Hydrology - PO-4.
- o A Baffled Apron as a Spillway Energy Dissipator by T. J. Rhone, U.S. Department of the Interior Bureau of Reclamation Engineering and Research Center, Denver, Colorado.
- o Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular 14, U.S. Department of Transportation, Federal Highway Administration.

IV. SUITABILITY ASSESSMENT: SOIL MECHANICS

IV. SUITABILITY ASSESSMENT: SOIL MECHANICS

A review and evaluation of the geological and soil mechanics testing information provided by the Soil Conservation Service (SCS) has been conducted to ascertain its suitability for the design of the project. This assessment summarizes Ebasco's concern over the suitability of the information provided in the SCS reports and outlines those areas where additional information is required for the geotechnical design of each major project component, mainly: a) Apache Junction Flood Retarding Structure (FRS), b) Apache Junction Floodway, and c) Bulldog Floodway.

APACHE JUNCTION FLOOD RETARDING STRUCTURE

Insitu Foundation Conditions

Borings and test pits located along the centerline of the dam show the subsurface materials to consist mainly of silty sands (SM) and clayey sands (SC) 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. Generally, as shown on Figure IV.1, caliche is found at shallow depths near the west abutment and fluctuates to maximum depths of 24 feet near the east abutment. Overall the depth to caliche varies between four and eight feet beneath existing grade.

During the field testing program three permeability tests were performed. It was noted by the SCS during a meeting held on May 23, 1985, that the test locations given in the Geological Investigation Report were incorrect. The correct locations were Stations 97+00 and 91+00 respectively. The permeability test at Station 97+00 was conducted on the caliche material encountered from a depth of three to thirty feet. The permeability rate reported for this test is 0.37 ft/day (1.2×10^{-4} cm/sec). Two other permeability tests also conducted in the caliche at Station 91+00, at depth intervals of 2.5 ft to 10 ft and 2.5 ft to 20 ft, yielded coefficients of 1.8 ft/day (6.4×10^{-4} cm/sec) and 0.43 ft/day (1.5×10^{-4} cm/sec), respectively.

The consolidation, permeability, and strength laboratory testing program subsequently conducted on the foundation soils is summarized in Table IV.1. Three undisturbed samples classified as silts (ML) and obtained at Station 52+50 were used. These cohesive soil samples, however, are only representative of a minority of foundation materials at the site.

At the time the site investigation and laboratory testing program was conducted, SCS envisioned that a cutoff to caliche would be provided for the Flood Retarding Structure due to the possible existence of unidentified buried channels of clean sand. Due to the depths to caliche, which are much greater than five feet near the east abutment and the middle section of the dam as shown on Figure IV.1, it does not appear that a cutoff to caliche will be the most cost effective design. Furthermore, sufficient data is not available to justify this concept.

It is Ebasco's opinion that prior to selecting a cutoff to caliche along the entire FRS, a cutoff to a predetermined depth (or to caliche whichever is shallower) which will prevent significant seepage through the foundation should be investigaged.

If this shallower cutoff scheme is not feasible, alternative cutoffs to caliche such as a slurry wall or excavation and backfill should be explored.

In order to study the above options, additional data is necessary. The in-situ densities and permeabilities of the existing subsurface soils along with a conservative permeability value for the unidentified buried wash materials will be required to perform a seepage analysis and ascertain whether, in a worst case condition, seepage through the foundation with a cutoff not reaching caliche is acceptable. If results indicate that such cutoff is not acceptable, a feasibility level conceptual design and cost estimate will be performed for the two cutoffs to caliche alternatives; mainly a slurry wall or excavation and backfill. It must be noted that in order to investigate the various foundation cutoff alternatives additional laboratory test data must be obtained. SCS has verbally agreed that this is a reasonable approach. However, concern has been expressed about the dispersion, collapsibility and consolidation characteristics of the foundation materials.

Four dispersion tests conducted on the foundation materials yielded the following results:

Sample Number	Location	Classification	% Passing #200 Sieve	Dispersion (%)
84W - 2912	Dam 58+90	SC	25	20
84W - 2914	Dam 53+90	CL	64	20
84W - 2915	Dam 53+90	CL	60	13
84W - 2916A	Dam 53+90	ML	53	6

Dispersion values greater than 20 to 25 percent are usually indicative that dispersion in the field may be a problem while values greater than 50 percent strongly indicate that the soils are susceptible to erosion damage. It does not appear, based on the results presented above that dispersion is a concern. However, the testing performed is extremely limited when considering that only one test was conducted on the SC material which is predominant in the area. Additional tests must be performed to assure that dispersion is not a design concern.

Currently, laboratory test data is not available to determine the possible collapsibility of the foundation materials upon contact with water and under embankment surcharge loading. The Standard Penetration Tests conducted along the centerline of the dam show that the subsurface materials are dense to very dense. This would tend to indicate that the soils are not collapsible since the in-place densities are probably high when compared to the maximum density. However, the boring logs also show that the soils are generally cemented to some degree and that calcium carbonate ($CaCo_3$) is present. Thus it is possible that the soil structure is very strong in the dry state (therefore high blow counts were recorded), but may have a low in-situ density and a propensity for collapsing upon contact with water and under a certain load. Therefore, laboratory testing must be performed to ascertain the collapsibility potential of the subsurface materials.

Embankment Characteristics

The consolidation, permeability and strength parameters for the proposed embankment materials was conducted by testing eight disturbed samples: one soil sample was obtained from the centerline of the dam and the seven others from the borrow area. Standard Proctor compaction tests (Method A - ASTM D698) were performed to determine maximum dry density and optimum moisture content. Soil samples for consolidation, permeability and triaxial strength testing were prepared by compacting the disturbed material to approximately 95% of maximum density obtained from the Standard Proctor test with moisture contents on the wet side of optimum. The moisture contents ranged between 1.7% and 4.2% above optimum with an average of 2.9%. Table IV.2 presents a summary of test results.

Since the borrow area materials to be used for construction of the embankment contain approximately 15% of fine gravel and will most probably be placed at optimum moisture or on the dry side of optimum (placement specification will require a moisture range of ± 2% of optimum as agreed with SCS during the May 23 meeting instead of the -4% to optimum originally proposed by Ebasco) it was believed that some additional tests should be performed at optimum moisture content or on the dry side of optimum using Method C for the compaction of samples. This information was presented to SCS during the May 23 meeting and it was agreed that additional permeability tests would be conducted according to our recommendations on the following available samples:

SAMPLE NO.	% PASSING #200 SIEVE	% RETAINED ON #4 SIEVE	% RETAINED ON 3/4 INCH SIEVE
84W - 2946	16%	24%	1%
84W - 2957	19%	20%	1%
84W - 2949	23%	19%	3%
84W - 2967	29%	17%	1%

These additional permeability tests would provide coefficients to be used for calculating possible seepage through the embankment and define possible requirements for drains.

Ebasco also noted that the material to be used for embankment construction would have the following approximate gradation requirements which closely resembles the gradation of the soils to be tested:

a) % passing #200 sieve - 20% minimum
b) % retained on #4 sieve - 20% to 25% maximum
c) all materials must pass through the one inch sieve

SCS believed that neither the consolidation nor the strength characteristics of the materials would differ significantly from those previously tested and thus preferred not to run additional tests on the borrow area soils. Ebasco agrees that for calculating the factor of safety for embankment stability and settlement of the embankment under its own weight, the previously obtained laboratory test results, shown on Table IV.2, will be adequate. However, for increased representivity it would have been preferable to use soil parameters obtained from samples compacted and tested at optimum moisture contents or on the dry side of optimum instead of on the wet side of optimum as currently is the case.

Conclusions and Recommendations

As a result of a detailed review and evaluation of the soils mechanics data presented in the SCS reports and as discussed in the previous pages, Ebasco believes that site specific laboratory test data is not available to conduct the required foundation analysis of settlement and shear failure, and the investigation of foundation cutoff alternatives for the design of the Flood Retarding Structure.

The following three areas where the currently available data is not suitable must be highlighted:

1. Insitu foundation soils - Settlement and strength data is not available for the cohesionless soil samples representative of the majority of foundation materials along the FRS and therefore the settlement or stability analysis (shear strenght parameters for foundation soils) can not be performed using site specific soil parameters obtained from laboratory tests. Since laboratory test data is not available for the cohensionless soils, all parameters used in the required settlement and stability analysis will be obtained from published correlations utilizing the available field data and classification test results for the FRS. Consolidation and strength laboratory data is available for the cohesive materials encountered durng the field exploration program.

2. Study of cutoff alternatives - Insitu densities and permeabilities of the foundation soils are not currently available and therefore a conclusive study of various cutoff alternatives can not be conducted. Based on a preliminary analysis it does not appear that a cutoff constructed by excavating to caliche and backfilling is the optimal solution. However, unless additional data is provided other alternatives can not be studied. provided in Soil Mech. Report?

3. Dispersion and collapsibility of foundation soils - Available test data does not seem to indicate that the soils are dispersive, however, the available data is extremely limited. Similarly, potential collapsibility of the foundation soils does not appear to be a concern based on the high blow counts noted while drilling, however since the material is cemented, the high blow counts could be due to the cementation of the soils rather than high insitu densities. Thus additional data must be obtained to assure that neither dispersion or collapsibility are potential problem areas.

The following items summarize our recommendations for additional field and laboratory tests required for the analysis and design of the Apache Junction FRS:

1. Perform additional field density and permeability tests at various locations along the centerline of the dam to ascertain the characteristics of the predominant SM-SC soils and if possible also SP soils;

2. Perform additional dispersion tests on the SM-SC soils;

3. Conduct a limited laboratory testing program to ascertain the potential for collapsibility of the existing foundation materials.

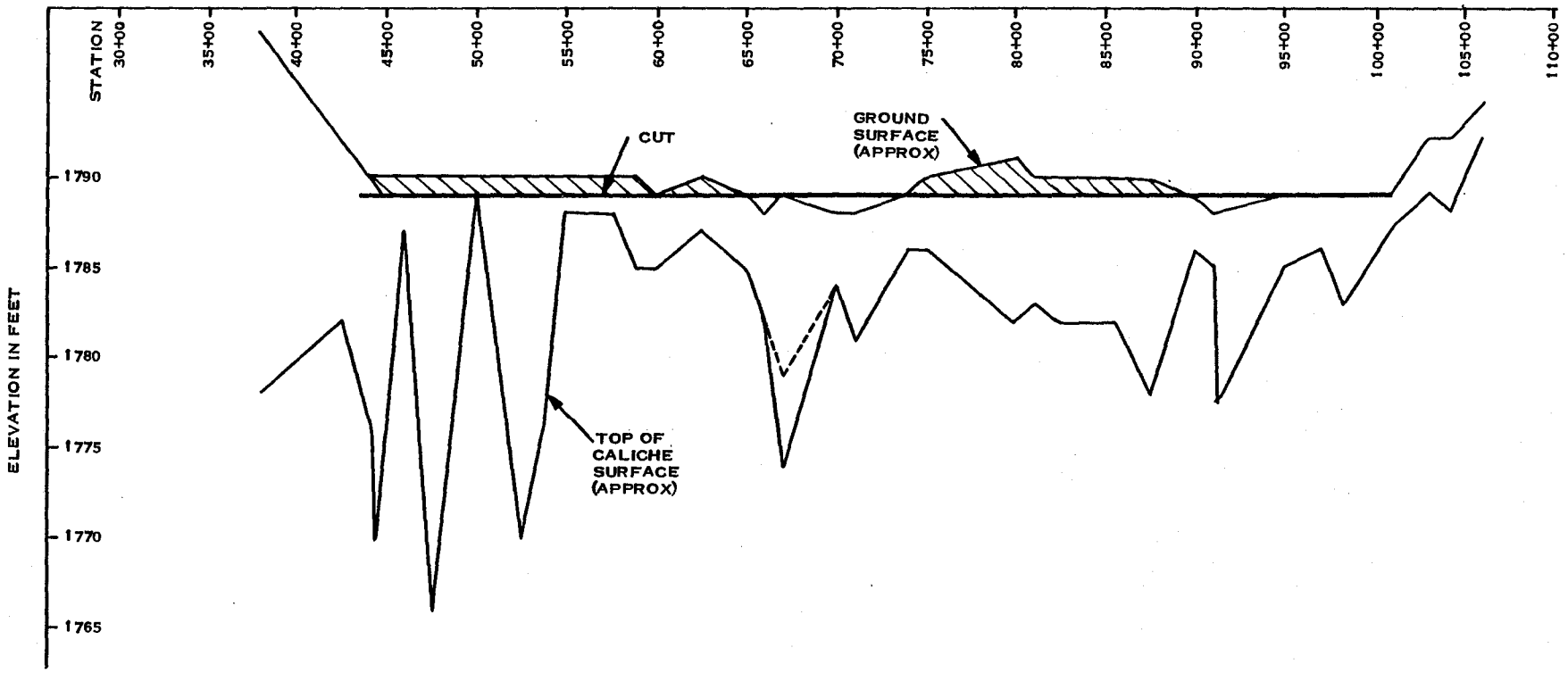
It must be noted that a testing program to address the above items can be quickly designed and implemented and will prove relatively inexpensive when considering the additional information to be generated and associated construction savings if it can be justified that a full cutofff is not required.

APACHE JUNCTION FLOODWAY AND BULLDOG FLOODWAY

The subsurface investigations conducted along the floodways included drilling a total of six boreholes and excavating sixty-one test pits. The soils and subsurface conditions encountered were similar to those found along the centerline of the FRS, mainly silty sands (SM) underlain by caliche. The depths to caliche varies from zero to seventeen feet along the Apache Junction Floodway and from zero to twelve feet along the Bulldog Floodway.

The laboratory soils testing performed consisted of gradation, Atterberg limits, and percent soluble salts on three samples obtained along the Apache Junction Floodway and eleven samples from the Bulldog Floodway. Determination of natural moisture content on three of these samples was also performed.

For the design of the channels, side inlets and energy dissipators associated with the floodways, all soil parameters required will be obtained from correlations with the standard penetration and classification tests described above and the results of other laboratory tests conducted for the FRS which includes consolidation, permeability, and strength data. Additional compaction test will be required to control placement of those soils not classified as SC or SM. Currently all compaction test data consists of eight Standard Proctor tests performed on SM or SC materials.



USDA-SOILS CONSERVATION SERVICE

APACHE JUNCTION FRS

SUBSURFACE PROFILE ALONG CENTERLINE OF FRS

FIGURE IV-1

EBASCO SERVICES INCORPORATED

TABLE IV.1

SCS - APACHE JUNCTION FRS

LABORATORY TEST RESULTS

UNDISTURBED FOUNDATION SAMPLES

Sample Location (Station)	Field Sample Number	Sample Depth (feet)	Classification	Liquid Limit	Plasticity Index	% Passing #200	% Passing #4	PERMEABILITY (cm/sec)	TRIAXIAL SHEAR TEST			
									ø	c (psf)	ø	c (psf)
DAM 52+50	11.2	3.5'-4.7'	ML	25	3	80%	100%	7.0×10^{-4}	9°	5470	45°	0
DAM 52+50	11.3	12'-13.2'	ML	29	5	85%	100%	2.8×10^{-4}	4°	2370	40°	0
DAM 52+50	11.4	12'-13.2'	ML	29	4	88%	100%	2.5×10^{-4}	10.5°	2300	41°	0

NOTES: 1) Consolidation tests were performed on all samples listed above.

2) Permeability coefficients reported above were obtained from consolidation tests under a "no load" condition.

TABLE IV.2

SCS - APACHE JUNCTION FRS

LABORATORY TEST RESULTS

COMPACTED SAMPLES

Sample Location (Station)	Field Sample Number	Sample Depth (feet)	Classification	Liquid Limit	Plasticity Index	% Passing #200	% Passing #4	STANDARD PROCTOR d max	STANDARD PROCTOR w o	SAMPLE PREPARATION Sample Molding Moisture	SAMPLE PREPARATION Sample Compaction	PERME-ABILITY (cm/sec)	TRIAXIAL SHEAR ø	TRIAXIAL SHEAR c (psf)	TRIAXIAL SHEAR ø	TRIAXIAL SHEAR c (psf)
DAM 52+00	11.1	5'-10'	SC	36	12	37%	86%	118.0 pcf	12%	16.2%	95.3%	$2.5x10^{-4}$	19°	1575	37°	0
BORROW 91+00 400 US	152.1	0'-4'	SC-SM	21	5	36%	91%	125.5 pcf	9%	12.3%	95.3%		22°	1875	37°	0
BORROW 52+00 600 US	38.1	10'-15'	SC	30	11	16%	76%	123.5 pcf	11%	13.3%	95.2%				39.5°	0
BORROW 100+00 600 US	160.1	2.5'-3'	SM	NP	NP	23%	81%	120.0 pcf	11.5%	14.7%	94.9%	$2.8x10^{-4}$	32.5°	1500	37°	375
BORROW 92+00 600 US	164.1	0.5'-2.5'	SM	NP	NP	35%	87%	106.5 pcf	16.5%	20.6%	95.0%	$1.4x10^{-4}$	29.5°	1575	38°	100
BORROW 62+00 800 US	36.3	7'-8'	SM	28	5	19%	80%	122.0 pcf	11.5%	13.2%	94.9%		41.0°	1350	39°	100
BORROW 62+00 800 US	36.4	15'-20'	SM	28	2	26%	86%	119.5 pcf	12.0%	14.4%	95.0%	$4.6x10^{-4}$	21.0°	1900	35.5°	275
BORROW 78+00 1000 US	40.1	10'-15'	SM	28	4	29%	83%	121.5 pcf	11.5%	13.6%	95.0%		24.5°	1250	38.5°	0

NOTES: 1) Consolidation tests were performed on all samples listed above.

2) Permeability coefficients reported above were obtained from consolidation tests under a "no load" condition.

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V. HYDROLOGY

V. HYDROLOGY

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

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

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

Precipitation

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

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

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

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

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

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

Times of Concentration

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

Curve Numbers

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

Channel Loss Factors

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

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

Runoff Depth and Inflow Hydrograph Computations

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

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

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

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

References - Hydrology

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

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

TABLE V.1. HYDROLOGIC SUMMARY

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

TABLE V.2. INFLOWS TO FRS

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

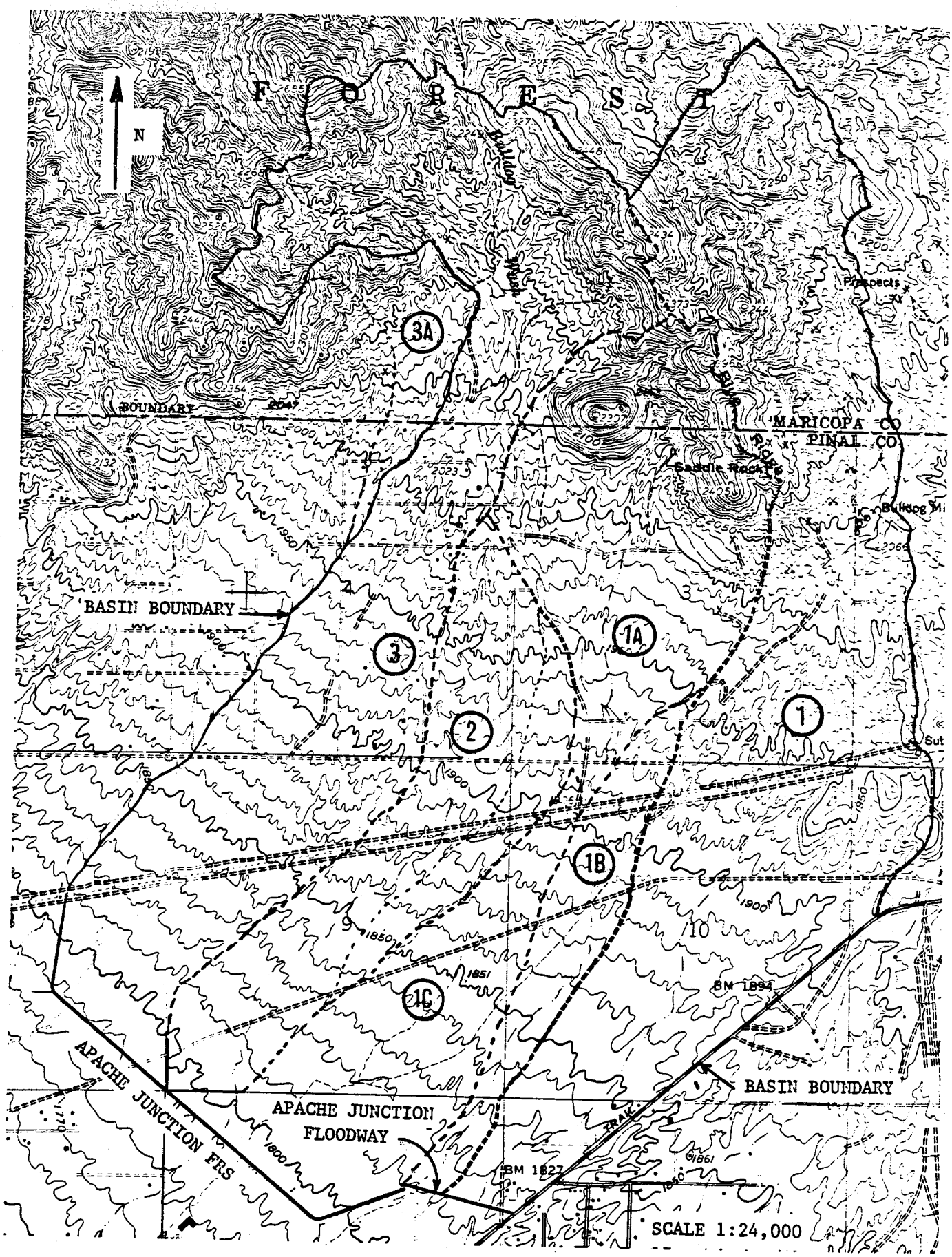

FIGURE V.1. BASIN MAP

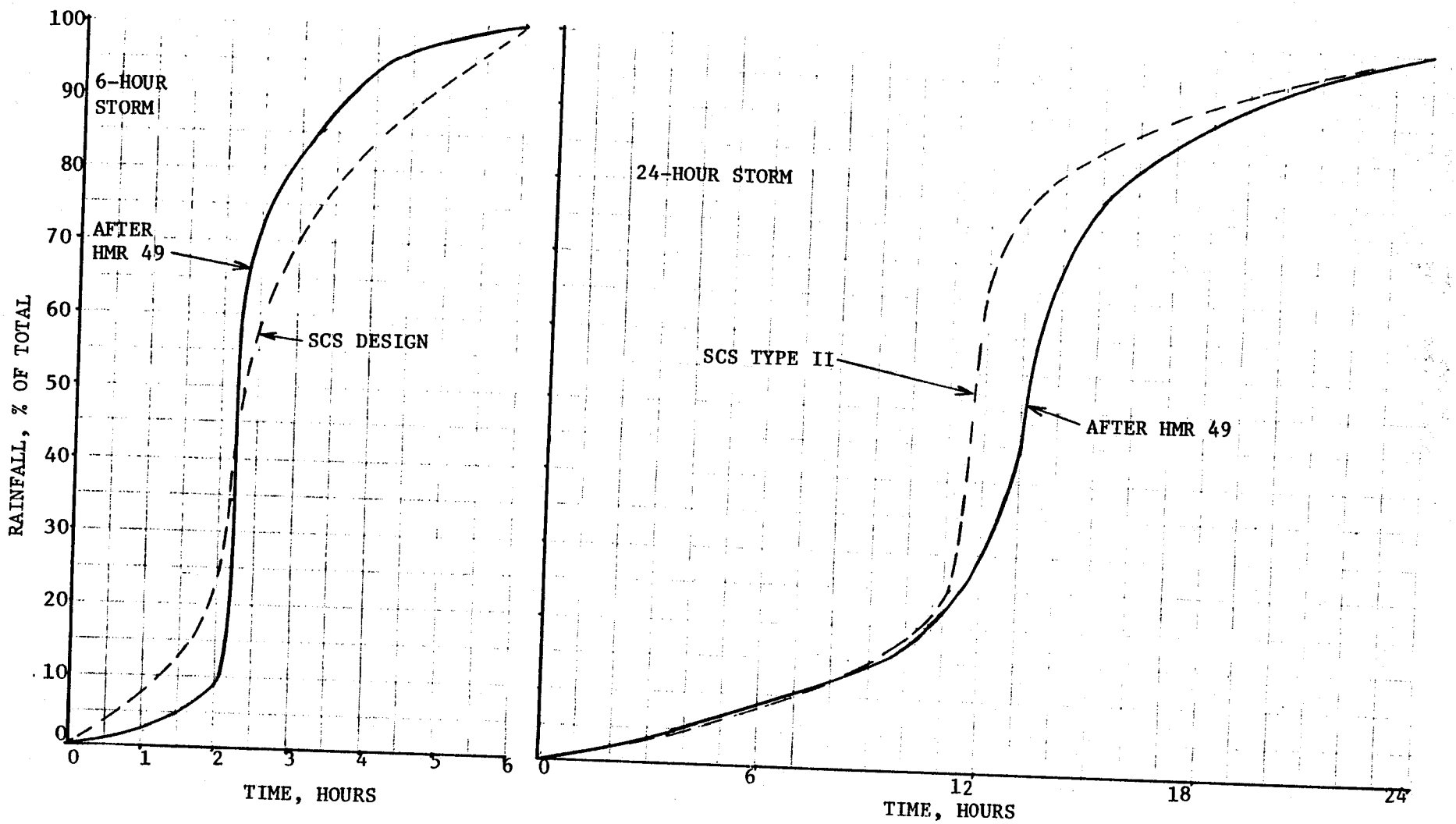

FIGURE V.2. PRECIPITATION DISTRIBUTIONS

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH I [illegible] CFS

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

FIGURE V.3

PRINCIPAL SPILLWAY
INFLOW HYDROGRAPH (I)
PART A

[illegible]	24	21	1799.1	23.9	0.0	.
85.93	25	22	1794.1	24.1	0.0	.
86.94	25	22	1794.1	24.4	0.0	.I
87.95	26	23	1794.1	24.6	0.0	.I
88.96	27	23	1794.1	24.9	0.0	.I
89.97	27	23	1794.1	25.3	0.0	.I
90.98	28	24	1794.1	25.6	0.0	.I
91.99	29	24	1794.1	26.0	0.0	.I
93.01	30	25	1794.2	26.4	0.0	.I
94.02	31	25	1794.2	26.8	0.0	.P
95.03	32	26	1794.2	27.3	0.0	.P
96.04	33	26	1794.2	27.8	0.0	.P
97.05	34	27	1794.2	28.4	0.0	.P
98.06	35	28	1794.2	29.0	0.0	.P
99.07	36	28	1794.2	29.6	0.0	.P
100.08	38	29	1794.2	30.3	0.0	.P
101.09	39	30	1794.2	31.0	0.0	.P
102.10	41	31	1794.3	31.9	0.0	.P
103.11	43	32	1794.3	32.8	0.0	.P
104.13	45	33	1794.3	33.7	0.0	.P
105.14	48	34	1794.3	34.8	0.0	.P
106.15	51	36	1794.3	36.0	0.0	.P
107.16	54	37	1794.4	37.3	0.0	.P
108.17	57	39	1794.4	38.7	0.0	.P
109.18	61	41	1794.4	40.3	0.0	.P
110.19	66	43	1794.5	42.1	0.0	.P
111.20	72	46	1794.5	44.2	0.0	.P
112.21	79	49	1794.5	46.5	0.0	.PI
113.22	88	53	1794.6	49.3	0.0	.PI
114.24	100	57	1794.6	52.5	0.0	.PI
115.25	116	63	1794.7	56.5	0.0	.PI
116.26	139	64	1794.8	61.8	0.0	.P I
117.27	177	65	1795.0	69.6	0.0	.P I
118.28	255	66	1795.2	82.2	0.0	.P I
119.29	1192	69	1796.1	137.0	0.0	.P I
120.30	2893	75	1798.0	301.6	0.0	. P
121.31	662	79	1799.3	443.7	0.0	. P I
122.32	272	80	1799.5	476.0	0.0	. P I
123.33	184	81	1799.6	488.3	0.0	. P I
124.34	143	81	1799.7	495.2	0.0	. PI
125.36	118	81	1799.7	499.4	0.0	. P
126.37	102	81	1799.8	501.8	0.0	. P
127.38	90	81	1799.8	503.1	0.0	. P
128.39	80	81	1799.8	503.4	0.0	. X
129.40	73	81	1799.8	503.0	0.0	.IP
130.41	67	81	1799.8	502.1	0.0	.IP
131.42	62	81	1799.7	500.7	0.0	.IP
132.43	58	81	1799.7	499.0	0.0	.IP
133.44	54	81	1799.7	496.9	0.0	.IP
134.45	51	81	1799.7	494.5	0.0	.IP
135.46	48	81	1799.7	491.9	0.0	.IP
136.48	46	81	1799.6	489.0	0.0	.IP
137.49	43	81	1799.6	486.0	0.0	.IP
138.50	41	80	1799.6	482.8	0.0	.IP
139.51	40	80	1799.6	479.5	0.0	.IP
140.52	38	80	1799.5	476.0	0.0	.IP
141.53	36	80	1799.5	472.4	0.0	.IP
142.54	35	80	1799.5	468.7	0.0	.IP
143.55	34	80	1799.4	464.9	0.0	.IP
144.56	33	80	1799.4	461.0	0.0	.IP
145.57	32	80	1799.4	457.1	0.0	.IP
146.59	31	80	1799.3	453.0	0.0	.IP
147.60	30	80	1799.3	448.9	0.0	.IP

Revised output to show effects of changed weir length for 30" riser (changed from 18' to 15') see sec VIII p32)

FIGURE V.3, PART B

148.61	29	79	1799.3	444.7	0.0	.IP
149.62	28	79	1799.2	440.4	0.0	.IP
150.63	27	79	1799.2	436.1	0.0	.IP
151.64	27	79	1799.1	431.7	0.0	.IP
152.65	26	79	1799.1	427.3	0.0	.IP
153.66	25	79	1799.1	422.9	0.0	.IP
154.67	25	79	1799.0	418.3	0.0	. P
155.68	24	79	1799.0	413.8	0.0	. P
156.69	24	79	1799.0	409.2	0.0	. P
157.71	23	78	1798.9	404.6	0.0	. P
158.72	23	78	1798.9	400.0	0.0	. P
159.73	22	78	1798.8	395.3	0.0	. P
160.74	22	78	1798.8	390.6	0.0	. P
161.75	21	78	1798.8	385.8	0.0	. P
162.76	21	78	1798.7	381.1	0.0	. P
163.77	20	78	1798.7	376.3	0.0	. P
164.78	20	78	1798.6	371.5	0.0	. P
165.79	20	78	1798.6	366.7	0.0	. P
166.80	19	77	1798.5	361.8	0.0	. P
167.81	19	77	1798.5	357.0	0.0	. P
168.83	19	77	1798.5	352.1	0.0	. P
169.84	18	77	1798.4	347.2	0.0	. P
170.85	18	77	1798.4	342.3	0.0	. P
171.86	18	77	1798.3	337.4	0.0	. P
172.87	17	76	1798.3	332.5	0.0	. P
173.88	17	76	1798.2	327.5	0.0	. P
174.89	17	76	1798.2	322.6	0.0	. P
175.90	17	76	1798.2	317.7	0.0	. P
176.91	16	76	1798.1	312.7	0.0	. P
177.92	16	76	1798.1	307.8	0.0	. P
178.93	16	75	1798.0	302.8	0.0	. P
179.95	16	75	1798.0	297.8	0.0	. P
180.96	16	75	1797.9	292.9	0.0	. P
181.97	15	75	1797.9	287.9	0.0	.P
182.98	15	75	1797.8	282.9	0.0	.P
183.99	15	75	1797.8	277.9	0.0	.P
185.00	15	74	1797.7	273.0	0.0	.P
186.01	15	74	1797.6	268.0	0.0	.P
187.02	14	74	1797.6	263.0	0.0	.P
188.03	14	74	1797.5	258.0	0.0	.P
189.04	14	74	1797.5	253.0	0.0	.P
190.06	14	74	1797.4	248.0	0.0	.P
191.07	14	73	1797.4	243.1	0.0	.P
192.08	14	73	1797.3	238.1	0.0	.P
193.09	13	73	1797.2	233.1	0.0	.P
194.10	13	73	1797.2	228.1	0.0	.P
195.11	13	73	1797.1	223.1	0.0	.P
196.12	13	73	1797.1	218.2	0.0	.P
197.13	13	72	1797.0	213.2	0.0	.P
198.14	13	72	1797.0	208.2	0.0	.P
199.15	13	72	1796.9	203.2	0.0	.P
200.16	12	72	1796.8	198.3	0.0	.P
201.18	12	72	1796.8	193.3	0.0	.P
202.19	12	72	1796.7	188.4	0.0	.P
203.20	12	71	1796.7	183.4	0.0	.P
204.21	12	71	1796.6	178.4	0.0	.P
205.22	12	71	1796.6	173.5	0.0	.P
206.23	12	71	1796.5	168.6	0.0	.P
207.24	12	70	1796.5	163.7	0.0	.P
208.25	12	70	1796.4	158.8	0.0	.P
209.26	11	70	1796.3	153.9	0.0	.P

FIGURE V.3, PART C

210.27	11	69	1796.3	149.0	0.0	.P
211.28	11	69	1796.2	144.2	0.0	.P
212.30	11	69	1796.2	139.4	0.0	.P
213.31	11	69	1796.1	134.5	0.0	.P
214.32	11	68	1796.1	129.7	0.0	.P
215.33	11	68	1796.0	124.9	0.0	.P
216.34	11	68	1795.9	120.2	0.0	.P
217.35	11	68	1795.8	115.4	0.0	.P
218.36	11	67	1795.7	110.7	0.0	.P
219.37	11	67	1795.7	105.9	0.0	.P
220.38	10	67	1795.6	101.2	0.0	.P
221.39	10	66	1795.5	96.5	0.0	.P
222.40	10	66	1795.4	91.8	0.0	.P
223.42	10	66	1795.3	87.2	0.0	.P
224.43	10	66	1795.2	82.5	0.0	.P
225.44	10	65	1795.1	77.9	0.0	.P
226.45	10	65	1795.0	73.3	0.0	.P
227.46	10	65	1795.0	68.7	0.0	.P
228.47	10	65	1794.9	64.1	0.0	.P
229.48	10	64	1794.8	59.5	0.0	.P
230.49	10	61	1794.7	55.1	0.0	.P
231.50	10	55	1794.6	51.0	0.0	.P
232.51	9	50	1794.5	47.4	0.0	.P
233.53	9	46	1794.5	44.2	0.0	.P
234.54	9	42	1794.4	41.3	0.0	.P
235.55	9	39	1794.4	38.7	0.0	.P
236.56	9	36	1794.3	36.3	0.0	.P
237.57	9	34	1794.3	34.2	0.0	.P
238.58	9	31	1794.3	32.2	0.0	.P
239.59	9	29	1794.2	30.4	0.0	.P
240.60	5	27	1794.2	28.6	0.0	.P
241.61	0	25	1794.2	26.6	0.0	.
T	I	D	E	VOL	A	I

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

		18	1804.89	3931.42		94.99	8721.42										
		19	1807.44	7374.64		101.22	8057.80										
		20	1810.00	11441.84		107.88	7141.58										
TYPE	INH	PHAR	VOL-MAX	AMAX	HP	VOLCFS											
SCS-ESH	100.0	1802.89	921.6	0.0	3.11	3.2											

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. INDICATORS ON PLOT SHOULD BE FOR FRN & MA CRITIC.

	PLOT					1 IN = 2000. CFS											EXIT SLOPE
						0.	2000.	4000.	6000.	8000.	10000.	12000.	14000				
T	I	Q	E	WSL	A	I	I	I	I	I	I	I	I	I	I	I	I
0.00	0	0	1793.5	13.7	0.0	.											
0.09	0	0	1793.5	13.7	0.0	.											
0.17	0	0	1793.5	13.7	0.0	.											
0.26	0	0	1793.5	13.7	0.0	.											
0.35	0	0	1793.5	13.7	0.0	.											
0.43	0	0	1793.5	13.7	0.0	.											
0.52	0	0	1793.5	13.7	0.0	.											
0.61	0	0	1793.5	13.7	0.0	.											
0.69	0	0	1793.5	13.7	0.0	.											
0.78	0	0	1793.5	13.7	0.0	.											
0.86	0	0	1793.5	13.7	0.0	.											
0.95	0	0	1793.5	13.7	0.0	.											
1.04	0	0	1793.5	13.7	0.0	.											
1.12	0	0	1793.5	13.7	0.0	.											
1.21	0	0	1793.5	13.7	0.0	.											
1.30	0	0	1793.5	13.7	0.0	.											
1.38	0	0	1793.5	13.7	0.0	.											
1.47	0	0	1793.5	13.7	0.0	.											
1.56	0	0	1793.5	13.7	0.0	.											
1.64	0	0	1793.5	13.7	0.0	.											
1.73	0	0	1793.5	13.7	0.0	.											
1.82	0	0	1793.5	13.7	0.0	.											
1.90	0	0	1793.5	13.7	0.0	.											
1.99	11	0	1793.5	13.8	0.0	.											
2.07	188	2	1793.6	14.5	0.0	.I											
2.16	957	12	1794.0	18.5	0.0	.	I										
2.25	2911	31	1794.3	32.2	0.0	.		I									
2.33	5845	65	1794.8	63.1	0.0	.			I								
2.42	8828	89	1795.8	115.9	0.0	.				I							
2.51	11019	71	1796.7	185.4	0.0	.					I						
2.59	12133	25	1797.6	267.6	0.0	.						I				I	
2.68	12285	77	1798.5	354.3	0.0	.										X	
2.77	11670	79	1799.2	439.3	0.0	.									I		
2.85	10560	118	1799.9	518.0	0.0	.E							I				
2.94	9300	295	1800.4	587.5	0.0	.E						I					
3.03	8109	471	1800.9	646.9	0.0	.E					I						
3.11	7038	696	1801.3	696.8	0.0	.E				I							
3.20	6126	882	1801.6	738.2	0.0	. E			I								
3.28	5353	1052	1801.9	772.3	0.0	. E		I									
3.37	4708	1204	1802.1	800.2	0.0	. E		I									
3.46	4191	1328	1802.2	822.9	0.0	. E	I										
3.54	3788	1430	1802.3	841.6	0.0	. E	I										
3.63	3479	1514	1802.4	857.0	0.0	. E	I										
3.72	3246	1585	1802.5	870.0	0.0	. E	I										
3.80	3068	1645	1802.6	881.0	0.0	. E	I										
3.89	2934	1696	1802.7	890.5	0.0	. E	I										
3.98	2834	1742	1802.7	898.8	0.0	. E	I										
4.06	2739	1782	1802.8	906.2	0.0	. E	I										
4.15	2607	1816	1802.8	912.4	0.0	. E	I										
4.24	2415	1845	1802.9	917.3	0.0	. E	I										
4.32	2173	1867	1802.9	920.4	0.0	. E	I										
4.41	1915	1875	1802.9	921.6	0.0	. E	I										
4.50	1673	1871	1802.9	921.1	0.0	. E											
4.58	1458	1857	1802.9	919.0	0.0	. I E											
4.67	1279	1834	1802.8	915.5	0.0	. I E											
4.75	1141	1809	1802.8	911.2	0.0	. I E											
4.84	1037	1782	1802.8	906.1	0.0	. I E											
4.93	959	1752	1802.7	900.6	0.0	. I E											
5.01	902	1720	1802.7	894.0	0.0	. I E											
5.10	856	1688	1802.7	887.0	0.0	. I E											
5.19	810	1655	1802.6	880.0	0.0	. I E											
5.27	762	1622	1802.6	876.9	0.0	. I E											
5.36	712	1588	1802.5	870.7	0.0	. I E											
5.45	662	1554	1802.5	864.4	0.0	. I E											
5.53	614	1519	1802.5	858.0	0.0	. I E											
5.62	573	1484	1802.4	851.5	0.0	. I E											
5.71	542	1448	1802.4	845.0	0.0	. I E											
5.79	520	1413	1802.3	838.6	0.0	. I E											
5.88	505	1379	1802.3	832.3	0.0	. I E											
5.96	492	1345	1802.2	826.1	0.0	. I E											
6.05	476	1312	1802.2	820.0	0.0	. I E											
6.14	450	1280	1802.2	814.1	0.0	. I E											
6.22	407	1247	1802.1	808.3	0.0	. I E											
6.31	351	1214	1802.1	802.0	0.0	. I E											
6.40	289	1180	1802.0	795.8	0.0	.I E											
6.48	230	1145	1802.0	789.3	0.0	.I E											
6.57	177	1109	1801.9	782.7	0.0	.I E											
6.66	134	1073	1801.9	776.0	0.0	.I E											
6.74	101	1036	1801.8	769.4	0.0	.I E											
6.83	75	1000	1801.8	762.7	0.0	. E											
6.92	56	964	1801.7	756.2	0.0	. E											
7.00	42	933	1801.7	749.7	0.0	. E											
7.09	32	905	1801.6	743.4	0.0	. E											
7.17	25	877	1801.6	737.3	0.0	. E											
7.26	20	850	1801.5	731.2	0.0	. E											
7.35	18	824	1801.5	725.4	0.0	. E											

FIGURE V.4

6-HOUR EMERGENCY

SPILLWAY INFLOW

HYDROGRAPH (I)

8.30	0	580	1801.0	678.0	0.0	
8.38	0	561	1801.0	667.0	0.0	
8.47	0	543	1801.0	663.0	0.0	
8.56	0	526	1801.0	659.2	0.0	
8.64	0	510	1801.0	655.5	0.0	

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

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	Q/C	V/C	S/C	S/C.25
SCS-FBH	100.0	1809.37	2019.3	0.0	9.60	1515.9	105.7	10460.7	10566.3	6.43	10.41	0.005	0.007

PLOT 1 BW = 10000. CFS EXIT SLOPE

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

0.00	0	0	1793.5	13.7	0.0
0.09	0	0	1793.5	13.7	0.0
0.17	0	0	1793.5	13.7	0.0
0.26	0	0	1793.5	13.7	0.0
0.35	0	0	1793.5	13.7	0.0
0.43	0	0	1793.5	13.7	0.0
0.52	0	0	1793.5	13.7	0.0
0.61	0	0	1793.5	13.7	0.0
0.69	0	0	1793.5	13.7	0.0
0.78	0	0	1793.5	13.7	0.0
0.86	0	0	1793.5	13.7	0.0
0.95	0	0	1793.5	13.7	0.0
1.04	0	0	1793.5	13.7	0.0
1.12	0	0	1793.5	13.7	0.0
1.21	1	0	1793.5	13.7	0.0
1.30	3	0	1793.5	13.7	0.0
1.38	11	0	1793.5	13.8	0.0
1.47	30	1	1793.5	13.9	0.0
1.56	67	2	1793.6	14.3	0.0
1.64	126	3	1793.6	14.9	0.0
1.73	206	7	1793.8	16.1	0.0
1.82	302	10	1794.0	17.8	0.0
1.90	406	15	1794.0	20.3	0.0
1.99	561	21	1794.1	23.6	0.0
2.07	1496	30	1794.2	30.8	0.0
2.16	4768	58	1794.7	52.8	0.0
2.25	11768	68	1795.8	111.5	0.0
2.33	21084	73	1797.2	228.3	0.0
2.42	29621	79	1799.0	408.9	0.0
2.51	35179	433	1800.8	638.5	0.0
2.59	37362	1694	1802.7	890.0	0.0
2.68	36727	3329	1804.3	1136.7	0.0
2.77	34004	5000	1805.7	1359.6	0.0
2.85	30133	6501	1806.8	1547.7	0.0
2.94	26064	7731	1807.7	1697.6	0.0
3.03	22376	8737	1808.3	1811.8	0.0
3.11	19161	9472	1808.7	1895.1	0.0
3.20	16483	9981	1809.0	1952.9	0.0
3.28	14248	10310	1809.2	1990.2	0.0
3.37	12409	10494	1809.3	2011.1	0.0
3.46	10946	10566	1809.4	2019.3	0.0
3.54	9812	10555	1809.4	2018.0	0.0
3.63	8943	10483	1809.3	2009.9	0.0
3.72	8284	10369	1809.3	1996.9	0.0
3.80	7779	10226	1809.2	1980.7	0.0
3.89	7399	10065	1809.1	1962.5	0.0
3.98	7111	9894	1809.0	1943.0	0.0
4.06	6842	9716	1808.9	1922.8	0.0
4.15	6487	9530	1808.8	1901.6	0.0
4.24	5987	9329	1808.6	1878.8	0.0
4.32	5371	9106	1808.5	1853.6	0.0
4.41	4725	8858	1808.4	1825.5	0.0
4.50	4121	8588	1808.2	1794.8	0.0
4.58	3588	8299	1808.0	1762.0	0.0
4.67	3144	7998	1807.8	1727.8	0.0
4.75	2801	7691	1807.6	1693.0	0.0
4.84	2543	7385	1807.4	1658.2	0.0
4.93	2350	7110	1807.3	1623.9	0.0
5.01	2209	6842	1807.1	1590.4	0.0
5.10	2094	6582	1806.9	1557.0	0.0
5.19	1982	6330	1806.7	1526.2	0.0
5.27	1863	6086	1806.5	1495.6	0.0
5.36	1741	5848	1806.4	1465.9	0.0
5.45	1618	5617	1806.2	1436.9	0.0
5.53	1500	5392	1806.0	1408.7	0.0
5.62	1399	5173	1805.9	1381.3	0.0
5.71	1328	4962	1805.7	1354.9	0.0
5.79	1270	4759	1805.5	1329.4	0.0
5.88	1232	4564	1805.4	1305.0	0.0
5.96	1200	4378	1805.2	1281.8	0.0
6.05	1161	4201	1805.1	1259.6	0.0
6.14	1097	4031	1805.0	1238.2	0.0
6.22	992	3875	1804.8	1217.5	0.0
6.31	853	3736	1804.7	1196.9	0.0
6.40	702	3596	1804.6	1176.2	0.0
6.48	559	3456	1804.4	1155.5	0.0
6.57	431	3317	1804.3	1134.9	0.0
6.66	325	3176	1804.2	1114.4	0.0
6.74	236	3042	1804.1	1094.2	0.0
6.83	182	2908	1803.9	1074.5	0.0
6.92	136	2779	1803.8	1055.3	0.0
7.00	102	2653	1803.7	1036.7	0.0
7.09	87	2532	1803.5	1018.9	0.0
7.18	72	2416	1803.4	1001.7	0.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

FIGURE V.5

6-HOUR FREEBOARD

INFLOW HYDROGRAPH (I)

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S
SCS-FBH	300.0	1605.11	1261.3	0.0	5.65	793.7	143.7	8720.5	8864.2	2.93	9.73	0.006	

PLOT 1 IN = 2000. CFS EXIT

T(HR)	I(CFS)	D	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I
0.00	0	0	1793.5	0.0	0.0	.						
0.27	97	1	1793.5	1.1	0.0	.						
0.53	309	5	1793.6	5.5	0.0	. I						
0.80	450	13	1793.9	13.6	0.0	. I						
1.06	512	26	1794.1	23.8	0.0	. I						
1.33	549	41	1794.3	34.7	0.0	. I						
1.60	577	58	1794.5	46.0	0.0	. I						
1.86	591	77	1794.7	57.4	0.0	. I						
2.13	597	97	1794.9	68.5	0.0	. I						
2.40	600	99	1795.2	79.5	0.0	. I						
2.66	601	100	1795.4	90.6	0.0	.P I						
2.93	601	102	1795.6	101.6	0.0	.P I						
3.19	612	103	1795.8	112.7	0.0	.P I						
3.46	643	104	1796.0	124.2	0.0	.P I						
3.73	671	105	1796.1	136.4	0.0	.P I						
3.99	684	105	1796.3	149.0	0.0	.P I						
4.26	698	106	1796.4	161.8	0.0	.P I						
4.53	717	107	1796.6	175.1	0.0	.P I						
4.79	730	108	1796.7	188.6	0.0	.P I						
5.06	737	108	1796.9	202.4	0.0	.P I						
5.32	750	109	1797.1	216.4	0.0	.P I						
5.59	768	110	1797.2	230.6	0.0	.P I						
5.86	778	111	1797.4	245.2	0.0	.P I						
6.12	783	112	1797.6	260.0	0.0	.P I						
6.39	785	113	1797.7	274.7	0.0	.P I						
6.66	786	113	1797.9	289.5	0.0	.P I						
6.92	786	114	1798.0	304.3	0.0	.P I						
7.19	791	115	1798.2	319.2	0.0	.P I						
7.45	806	115	1798.3	334.2	0.0	.P I						
7.72	820	116	1798.4	349.6	0.0	.P I						
7.99	828	117	1798.6	365.1	0.0	.P I						
8.25	839	117	1798.7	380.9	0.0	.P I						
8.52	855	118	1798.8	397.0	0.0	.P I						
8.79	868	118	1799.0	413.3	0.0	.P I						
9.05	885	119	1799.1	430.0	0.0	.P I						
9.32	1012	120	1799.3	448.2	0.0	.P I						
9.58	1189	126	1799.5	469.8	0.0	.E I						
9.85	1304	186	1799.7	493.8	0.0	.E I						
10.12	1398	248	1799.9	518.7	0.0	.E I						
10.38	1696	320	1800.1	546.5	0.0	. E I						
10.65	2011	408	1800.4	579.3	0.0	. E I						
10.92	2191	576	1800.6	614.7	0.0	. E I						
11.18	2375	814	1800.9	649.6	0.0	. E I						
11.45	2797	1062	1801.2	685.9	0.0	. E I						
11.71	3165	1343	1801.5	725.0	0.0	. E I						
11.98	3363	1751	1801.8	762.6	0.0	. E I						
12.25	3948	2155	1802.1	800.2	0.0	. E I						
12.51	5147	2662	1802.4	847.3	0.0	. E I						
12.78	6027	3358	1802.8	904.0	0.0	. E I						
13.05	6518	4172	1803.1	959.2	0.0	. E I						
13.31	7792	5006	1803.5	1015.6	0.0	. E I						
13.58	9609	6039	1804.0	1085.6	0.0	. E I						
13.84	10732	7194	1804.5	1163.8	0.0	. E I						
14.11	10928	8310	1804.9	1231.5	0.0	. E X						
14.38	8957	8864	1805.1	1261.3	0.0	. X1						
14.64	6564	8490	1805.0	1241.2	0.0	. I E						
14.91	5239	7635	1804.7	1193.6	0.0	. I E						
15.18	4507	6863	1804.4	1141.3	0.0	. I E						
15.44	3552	6071	1804.0	1087.7	0.0	. I E						
15.71	2790	5260	1803.6	1032.8	0.0	. I E						
15.97	2418	4518	1803.3	982.6	0.0	. I E						
16.24	2189	3899	1803.0	940.7	0.0	. I E						
16.51	1928	3384	1802.8	905.8	0.0	. I E						
16.77	1749	2975	1802.6	876.3	0.0	. I E						
17.04	1667	2706	1802.4	851.4	0.0	. I E						
17.31	1608	2480	1802.3	830.4	0.0	. I E						
17.57	1544	2288	1802.1	812.6	0.0	. I E						
17.84	1506	2126	1802.0	797.6	0.0	. I E						
18.10	1473	1991	1802.0	785.1	0.0	. I E						
18.37	1364	1870	1801.9	773.8	0.0	. I E						
18.64	1234	1749	1801.8	762.6	0.0	. I E						
18.90	1161	1632	1801.7	751.7	0.0	. I E						
19.17	1126	1528	1801.6	742.1	0.0	. I E						
19.44	1099	1440	1801.6	734.0	0.0	. I E						
19.70	1080	1366	1801.5	727.1	0.0	. I E						
19.97	1067	1304	1801.5	721.3	0.0	. I E						
20.23	1031	1268	1801.4	716.1	0.0	. IE						
20.50	948	1229	1801.4	710.4	0.0	. IE						
20.77	883	1185	1801.3	704.0	0.0	. I E						
21.03	850	1141	1801.3	697.5	0.0	. I E						
21.30	809	1097	1801.2	691.1	0.0	. IE						
21.56	754	1053	1801.2	684.6	0.0	. IE						
21.83	719	1009	1801.1	678.2	0.0	. IE						
22.10	697	967	1801.1	672.0	0.0	. I E						
22.36	654	926	1801.0	666.0	0.0	. I E						

FIGURE V.6

24-HOUR PMF INFLOW HYDROGRAPH (I)

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

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

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

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH 1 INCH= 500. CFS

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

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

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

T, HR. I, CFS

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

FIGURE V.7, PART B

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

T, HR. I, CFS

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

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

FIGURE V.7, PART C

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

VI. STUDIES

VI. STUDIES

1.0 APACHE JUNCTION FLOODWAY

1.1 General

The Apache Junction Floodway starts from the west side of the Apache Trail and terminates behind the Apache Junction Flood Retarding Structures (FRS). The floodway intercepts the storm flows from the drainage Basins 1, and 1A+1B as shown in Figure V.1. The inflows from the various basins are given in Table V.2. The floodway consists of the following sections:

a) Concrete lined channel;

b) Energy dissipator, and

c) An earth channel.

1.2 Concrete Lined Channel

The concrete lined channel starts from the west side of the Apache Trail and ends at the energy dissipator. The channel is 1645 feet long. Since the channel alignment follows a relatively flat grade, a mild (subcritical) slope has been adopted for the hydraulic design of the channel. The channel intercepts two drainages from Basins 1, and 1A+1B. Weir inlets have been provided for these two drainages. The portion of the channel before the inlet for Basin 1, in a length of 500 feet, has been designed for 25% of the inflow from Basin 1 to account for any local drainage to the beginning of the channel. Inlet for Basin 1A+1B is towards the end of the channel. The locations of the inlets will have to be confirmed by field verification.

The major portion of the floodway is designed for a flow of 1046 cfs from Basin 1. Trapezoidal and rectangular cross sections were studied for the channel. Based upon initial construction and future maintenance costs a rectangular cross section shallower than the best hydraulic section has been adopted for the channel. The width of the channel has been increased at the

inlets. A plan and profile of the channel is shown in Figure VI.1. The Manning's "n" equal to .015 has been adopted for the concrete lining.

1.3 Energy Dissipator

The concrete lined channel ends into the energy dissipator. The concrete channel has been extended further to the west to move the energy dissipator away from the embankment and also to avoid deep cuts for the energy dissipator and the downstream earth channel.

Two types of energy dissipators, baffled block chute and grouted riprap chute with stilling basin were studied. The economics favored the latter which has been adopted. The plan and profile is shown in Figure VI.2.

1.4 Earth Channel

The earth channel downstream of the energy dissipator on the Apache Junction Floodway was designed to meet the requirements of Engineering Standard 582, Open Channel. The channel was designed for the 100 year storm flow of 1560 cfs. The concentration of fine sediment was computed using the procedures outlined in Geologic Note Number 2 and the trip report by Neville Curtis dated March 7, 1983 to Verne M. Bathurst. The average annual sediment production rates were obtained from the 1974 Sedimentation Supplement prepared by SCS. Using these procedures the 100 year sediment concentration for the Apache Junction Floodway was found to be 10,000 ppm.

Mannings n values were computed for both the aged and as-built conditions and were found to be 0.027 and 0.024 respectively. The allowable velocity was computed using procedures in TR-25 and was found to be 2.92 fps. Since the 10 year discharge (921 cfs) exceeded 50% of the design discharge (780 cfs) it was used in making the as-built stability check. The design discharge of 1560 cfs was used to make the aged stability check. The resulting channel has a bottom width of 130 feet, side slopes of 3 horizontal to 1 vertical, and a bottom slope of 0.00056 ft/ft.

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

Calculations are provided with the supporting data.

2.0 APACHE JUNCTION FLOOD RETARDING STRUCTURE (FRS)

2.1 General

The Apache Junction Flood Retarding Structure (FRS) will protect the City of Apache Junction and the new development northwest of Apache Trail against the flash floods in the local natural drainages. The peak flood flows will be stored behind the FRS embankment and released slowly over a period of a few days. The embankment is required for flood protection only. In accordance with Section 520.22 of the National Engineering Manual, the embankment has been classified as a Class C structure.

The FRS is an earth embankment approximately 8500 feet long with a maximum height of approximately 20 feet. The embankment is 14 feet wide at the top with 2.5 horizontal to 1 vertical upstream slope and 2 horizontal to 1 vertical downstream slope. One 30-inch diameter reinforced concrete pipe has been provided through the embankment to serve as a principal spillway. An emergency spillway has also been provided to safely pass the emergency spillway hydrograph (ESH) storm and to have sufficient capacity for passing the freeboard hydrograph (FSH) storm without overtopping the dam.

2.2 FRS Hydraulic Characteristics

a) Stage Storage Curve

A stage storage curve was developed for the storage area Fig. VI.3. Increase in the storage capacity due to the 4-foot deep and 900-foot wide borrow area between contour lines of El. 1797

and 1808, and reduction due to the embankment fill were accounted for in the stage storage curve. The upstream slope of the embankment was taken as 3 horizontal to 1 vertical (conservative assumption, as the proposed slope is 2.5 horizontal to 1 vertical). The loss of storage due to the Idaho and Brown road embankments was neglected, since the road fill will be taken from the reservoir area.

b) Sedimentation

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

c) Flood Routing Studies

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

2.4 Principal Spillway

A comparison of the computer output data for the 36-inch diameter conduit, as proposed in the Work Plan, and a 30 inch diameter pipe (Table VI.1) indicates that the top of the embankment for the 30-inch outlet is a few inches higher than that required for the 36-inch outlet, and will need approximately 4000 cubic yards of extra fill in the embankment. However, it can also be seen from the computer output that the outflow in the principal spillway outlet conduit has reduced from 120 to 81 cfs for the PSH storm. The flow in the emergency spillway has also been reduced by about 5% for the ESH storm and

about 2% for the FBH storm. The saving in cost of principal spillway, outlet channel over a length of approximately 1500 feet up to the first inlet (Basin 4A), Bulldog Floodway and the Emergency Spillway will be much more than the additional cost of the embankment fill. Therefore, the 30-inch diameter outlet pipe is recommended.

For the two-way covered riser-height of 10 feet below the spillway crest, the invert of the pipe at the inlet is fixed at El. 1783.5. A baffle riser with a gated out has been selected for the inlet to the principal spillway. The principal spillway is located at Sta. 100 + 92.52 of the FRS. Geotechnical investigations along the centerline of the principal spillway indicate that the caliche is only about 3 to 4 feet below ground, approximately at El. 1785 feet. Therefore, the pipe is supported on a concrete cradle founded directly on caliche. The trench in the soil is backfilled with the embankment material compacted in accordance with the applicable specifications. Since the pipe is supported on the firm foundation, no analysis for the settlement of the pipe or joint extensibility is necessary. A piping and seepage control diaphragm is provided in accordance with TR-60 and will be designed in accordance with Soil Mechanics Note No. 1. The diaphragm will be outleted into the outlet channel.

The spillway pipe has an outlet directly into the Apache Junction outlet channel. No energy dissipator has been provided because the outlet channel is a concrete channel and the exit velocity is less than 20-feet per second. A transition section from 2.5 feet circular to a square section will be provided at the end of the pipe. The profile of the principal spillway and details are shown in Figure VI.4.

2.5 Emergency Spillway

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

1. Type C Drop Structure

2. Baffle Block Chute, and

3. Earth Channel.

b) Due to the high walls in the drop structure as compared to the walls in the baffle block chute, the baffle block chute has been determined to be more economical than the Type C drop. The study was made for 150 feet long crest for both the structures. The extra height of embankment required for the drop structure spillway due to the head losses in the entrance channel is an additional cost not in favor of the drop structure spillway. The baffle block chute does not have significant entrance channel losses due to its location at Sta. 97+50. The drop structure spillway was proposed at Sta. 112+400, where an entrance channel is required.

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

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

1. Earth channel without any protection

2. Earth channel with bed and side protection by

   Soil cement

   Maccaferri Gabions or riprap

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

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

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

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

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

On the basis of the comparative cost studies baffle block chute spillway with 100 feet long crest is recommended. The top of embankment will be at El. 1809.35.

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

The geologic investigation indicated that the top of caliche in the area downstream of the structure is approximately at elevation 1779. The control section will therefore be founded on caliche. The channel downstream of the control section will be protected by a loose rock riprap apron (flexible apron) for a distance of approximately 25 feet. The depth of retrogression in the exit channel will be controlled by the caliche and will be limited to a few feet. The loose rock riprap provided downstream of the control section will flex downward to a stable slope and protect the caliche under the control section.

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

The plan and profile of the spillway is shown in Figure VI.5.

3.0 APACHE JUNCTION OUTLET CHANNEL AND BULLDOG FLOODWAY

Apache Junction FRS Outlet channel and the Bulldog Floodway extend from the Apache Junction FRS Outlet to Signal Butte FRS. The floodway consists of three parts: the first part is a rectangular reinforced concrete lined channel having a total length of 10250 ft; the second part is a drop which constitutes a grouted riprap chute and a stilling basin to confine the hydraulic jump; and the third part is an earth channel of trapzoid section with a bottom width of 100 ft. and side slope of 3 (H) on 1 (V). Along the floodway there are fourteen inlets; three of them are side channel inlets, while the remaining eleven are weir inlets. The criterion for selecting the proper type of inlet is 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" (Reference 1) the upper limit of Q_2/Q_1 is 1.4 for weir inlet; beyond this limit a side channel inlet is adopted. Table VI.2 depicts the designed inlet discharge together with those in the floodway before and after each inlet, and the selected inlet type.

Based on the data presented in Table VI.2, these inlets are designed in accordance with Figure 9 of Reference 1 for the weir inlets and Figure 5-1, Hydraulic Junction Structures, of TR-25 (Reference 2) for the side channel inlets. The results are presented in Tables VI.3 and VI.4. In the design computation, the Manning's n value adopted for the concrete channel was 0.015.

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" (Ref. 3). 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 trapzoidal earth channel beyond the stilling basin carries a discharge of 5466 cfs with 10.6 feet depth of water. The geometry of the chute and stilling basin is shown in Figure VI.6.

The earth channel downstream of the energy dissipator was designed in accordance with the requirements of Engineering Standard 582, Open Channel, using the same procedures described for the earth channel on Apache Junction in Paragraph 1.4. The 100 year sediment concentration for Bulldog Floodway was found to be 20400 ppm. The aged and as-built Mannings n values used were

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 (2713 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 were similar to those found for Apache Junction and indicated that the velocity approach is conservative. We recommend that the results optained using the velocity approach be used since it appears that the tractive stress procedure is being applied beyond its area of applicability and the results obtained using the velocity approach are not unreasonable.

Calculations are provided with the supporting data, Section VIII.

4.0 IDAHO AND BROWN ROADS

4.1 General

The Idaho and Brown Roads traverse the Apache Junction Flood Retarding Structure storage area. These roads will obstruct the storm flows from the drainage Basins 1, 1A+1B, 1A+1C and 2, to the principal and the emergency spillways. The roads are required to be above the 25 year storm water level in the reservoir.

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

4.2 Culverts

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

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

A 10 feet by 7 feet culvert, which will give a differential head of approximately 3 inches across the road, is recommended for Idaho Road. A corrugated metal pipe may be used which will be sited to produce identical head loss. If corrugated metal is used it will be unlined on the inside as reguested by SCS. The same size culvert will be used under the Brown Road.

4.3 Road Profile

The Idaho and Brown Roads intersect each other near the center line of the FRS embankment. The portion of the roads from the intersection to the center line of the FRS embankment is planned to be horizontal. Since it is planned that the intersection will have a four-way stop sign, the vertical curves in the road profile should be designed for a very low speed so as to drop the road surfaces as quickly as possible. This will provide a large area of flow across the road for the flows exceeding the 25 year storm.

A preliminary profile with a 30 MPH design speed vertical curve will have only 0.1 feet of differential head across the road for the FBH inflow at the maximum stage of the storage. Assuming the same differential head across the Brown Road the FRS embankment approximately from sta 32+00 to sta 77+50 should be raised by 0.2 feet.

References - Studies

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

2. SCS Technical Release 25, Design of Open Channels

3. U.S. Department of Transportation, Hydraulic Engineering Circular No. 14, Hydraulic Design of Energy Dissipators

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FIGURE VI.1

BY S GOYAL DATE 7-8-85 / 9-17-85 SHEET ____ OF ____

CHKD. BY C. Zee DATE 7/9/85 Y.C. YANG 9-17-85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

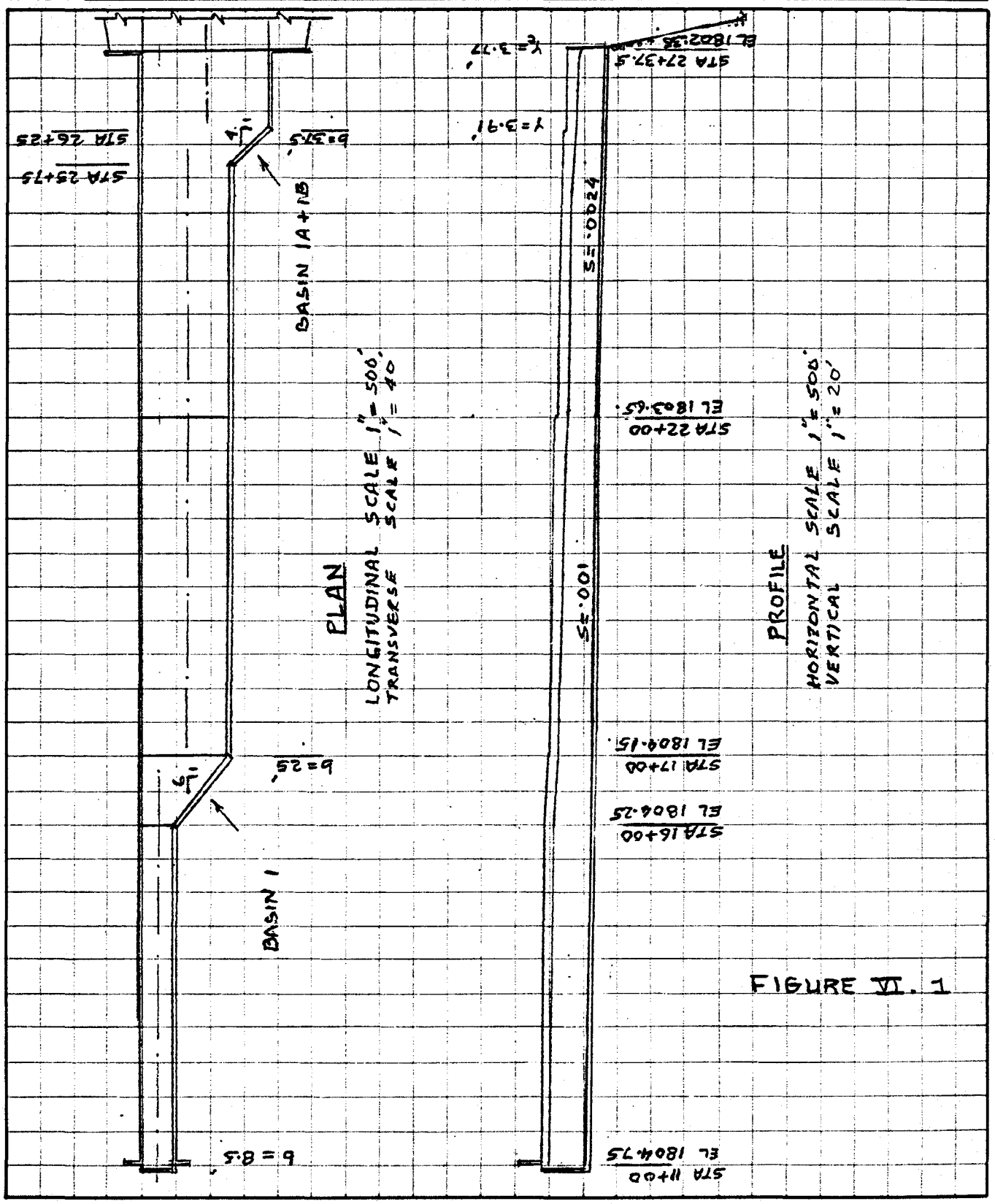

FIGURE VI. 1

501/8-81

FIGURE VI.2

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BY S GOYAL DATE 7-2-85 / 9-17-85 SHEET ____ OF ____

CHKD. BY C. Lee DATE 7/8/85 Y.C. YANG 9-17-85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY - ENERGY DISSIPATOR

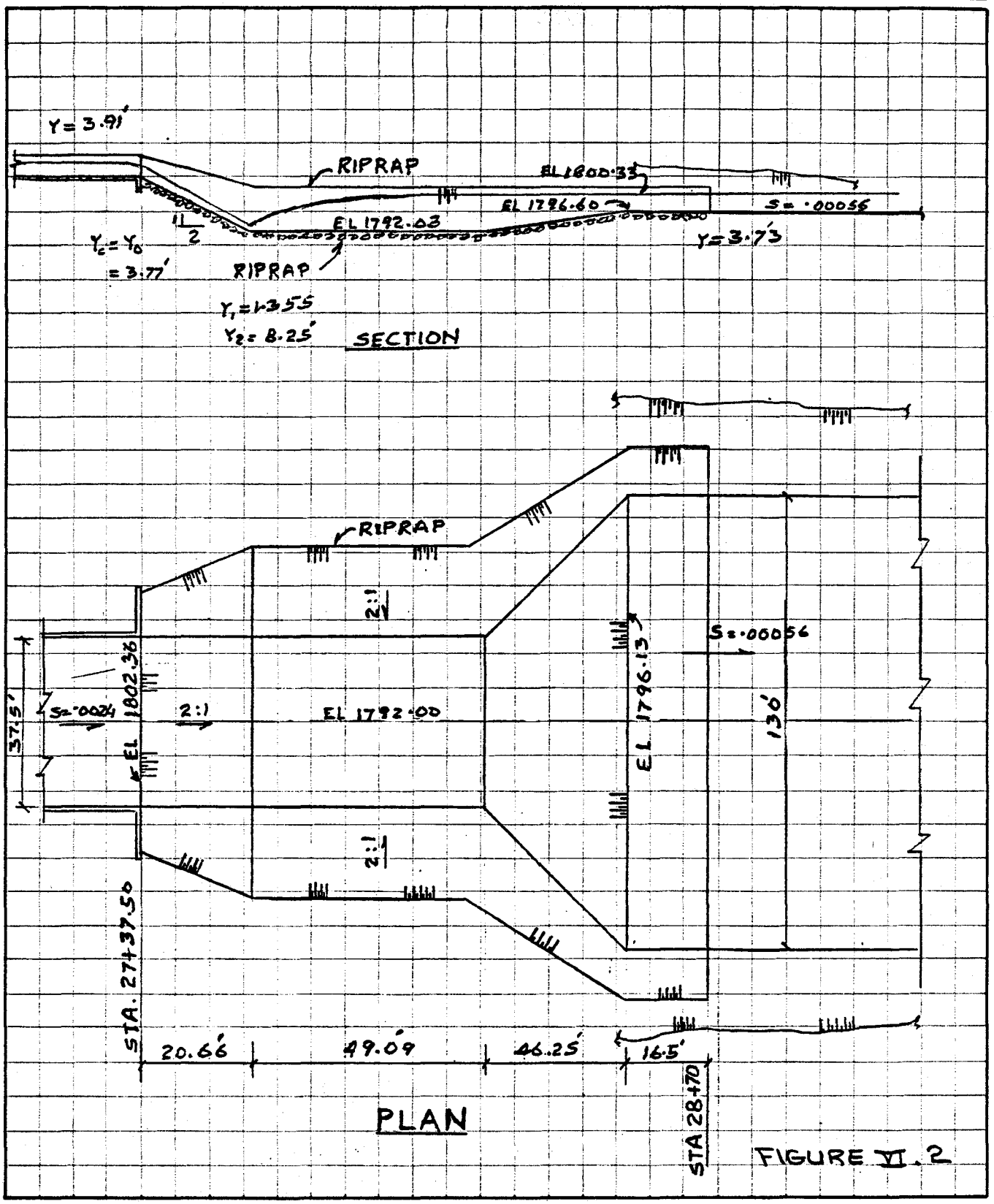
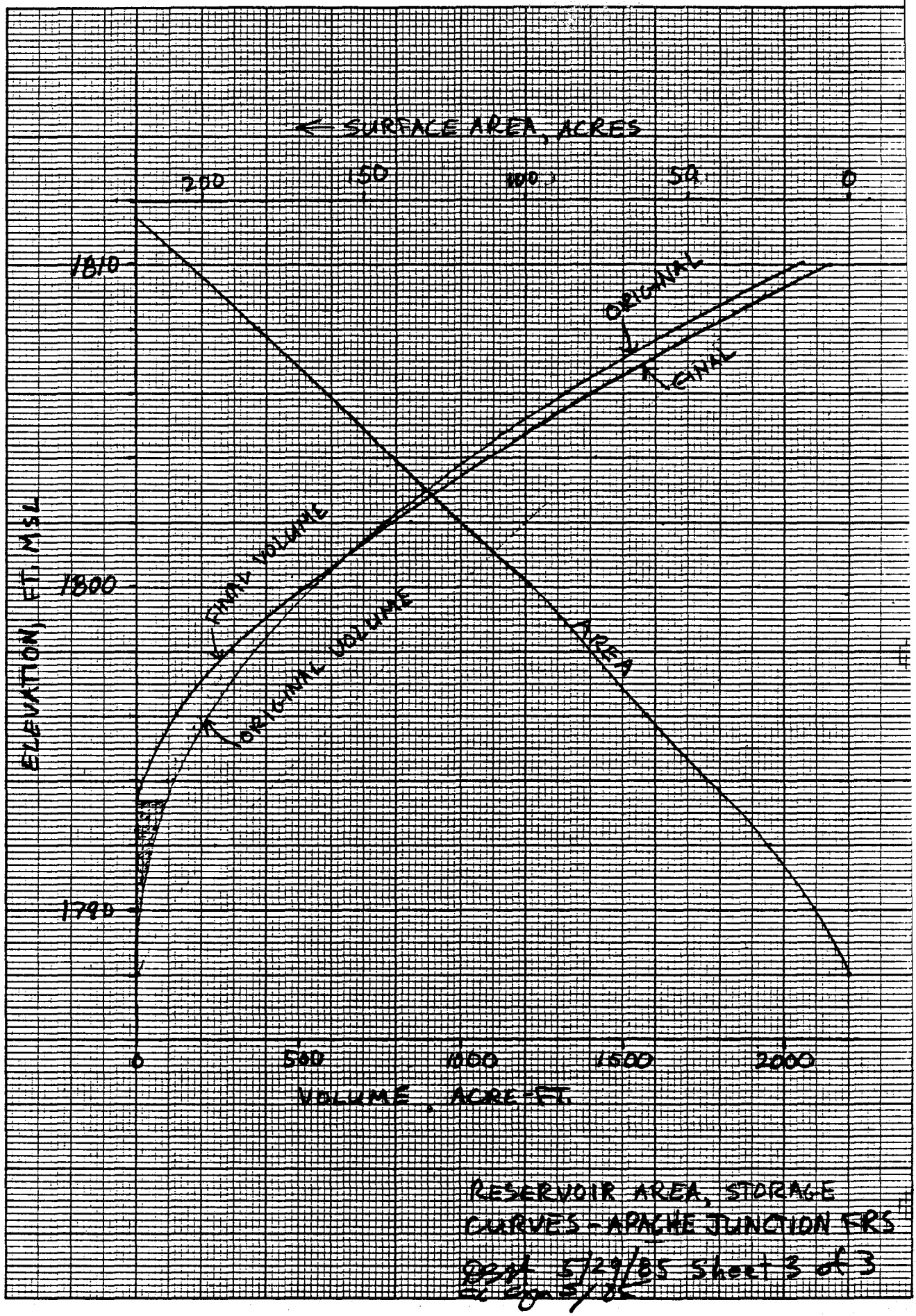


FIGURE VI.2

581/8-81

FIGURE VI.3



RESERVOIR AREA, STORAGE CURVES - APACHE JUNCTION FRS

5/29/85 Sheet 3 of 3

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

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-19-85 / 9-17-85

CHKD. BY Y.C. YANG DATE 7-8-85 / 9-17-85

CLIENT USDA SCS PHOENIX ARIZONA

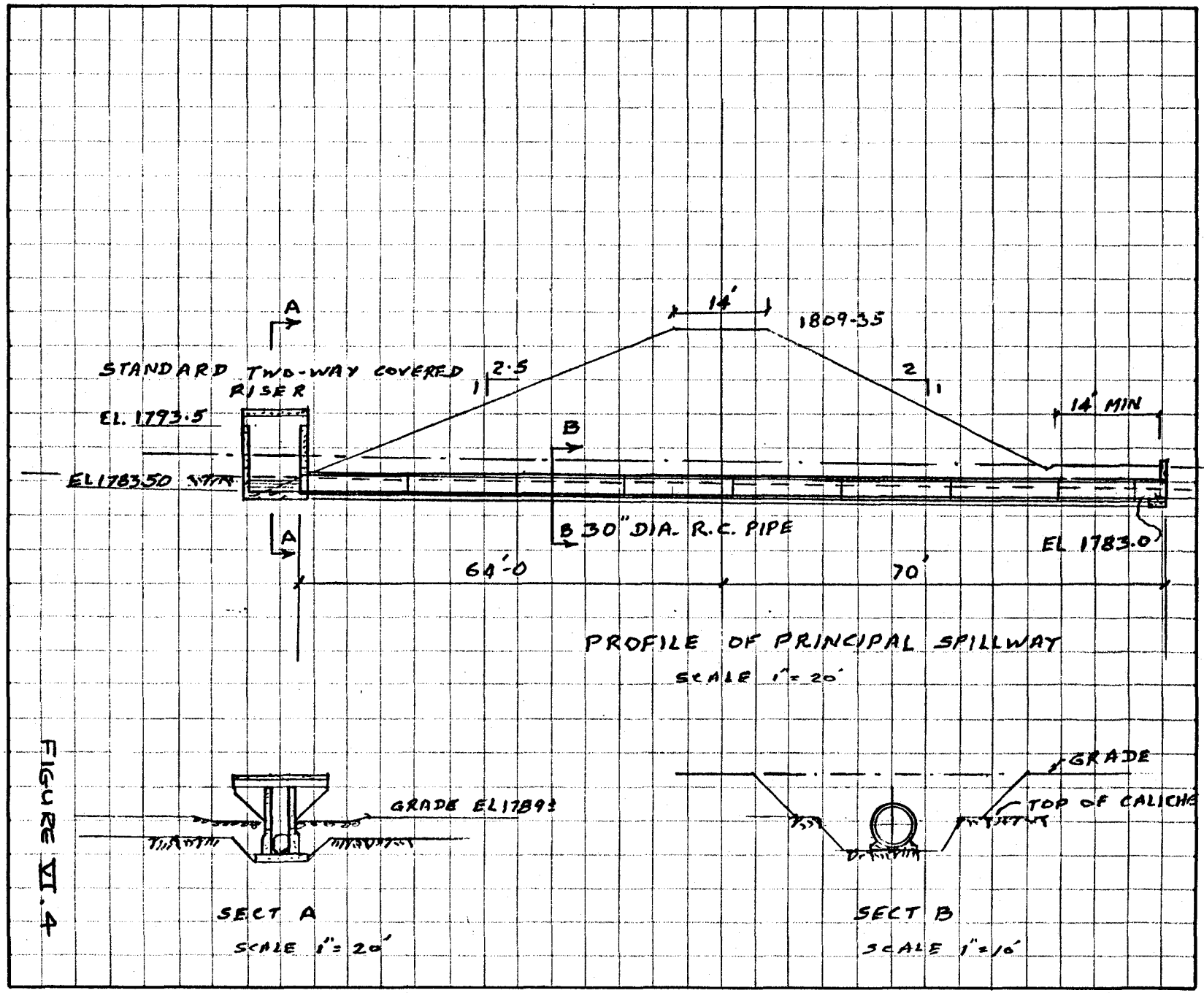
OFS NO. _____ SHEET ____ OF ____

DEPT. NO. _____

PROJECT BULLDOG FLOODWAYE APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FRS PRINCIPAL SPILLWAY

FIGURE VI.4



81/8-81

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FIGURE VI.5

BY Y.C. YANG DATE 6-13-85

CHKD. BY S. Goyal DATE 7-8-85

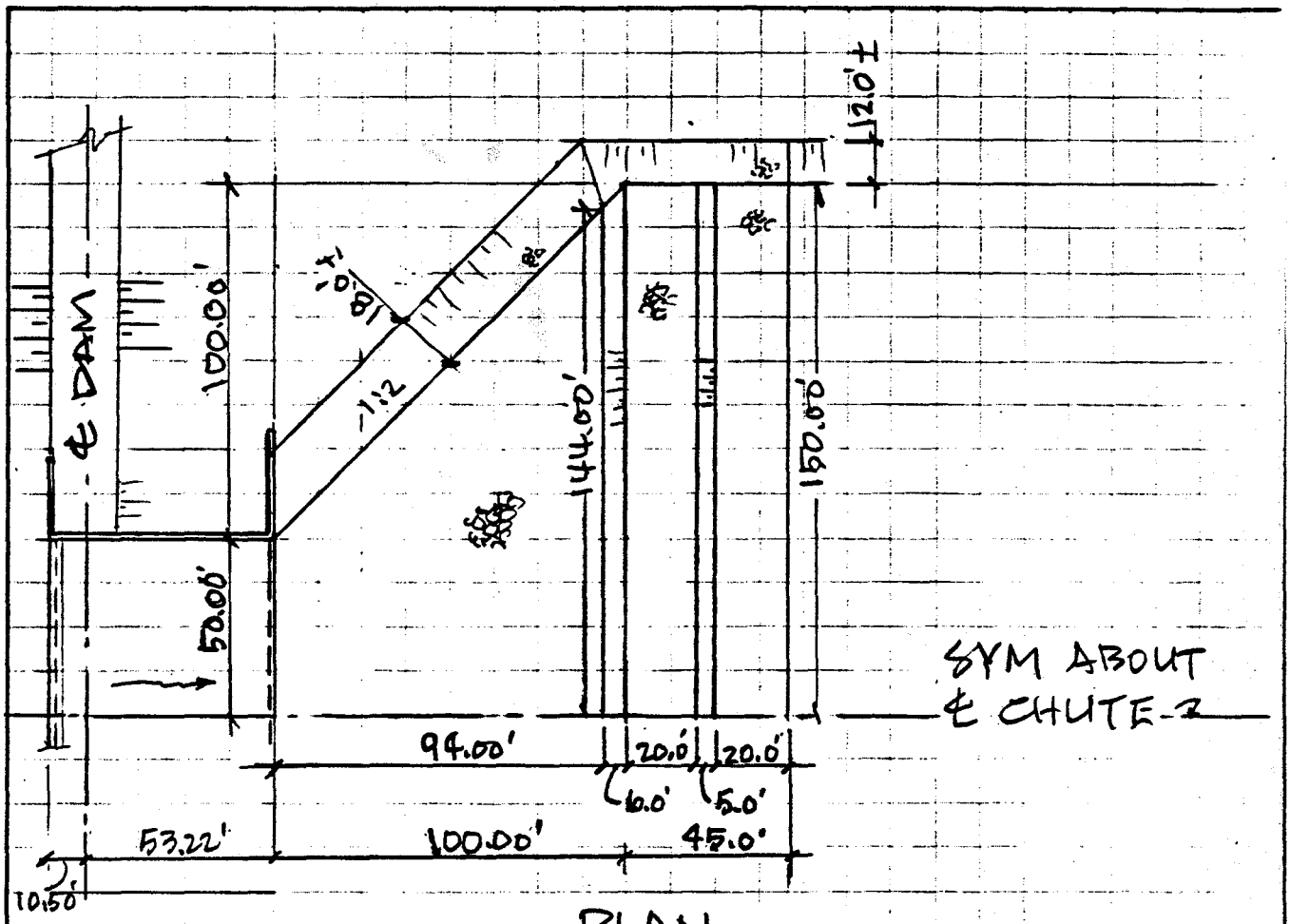
SHEET ____ OF ____

OFS NO. 37167.100 DEPT. NO. 650

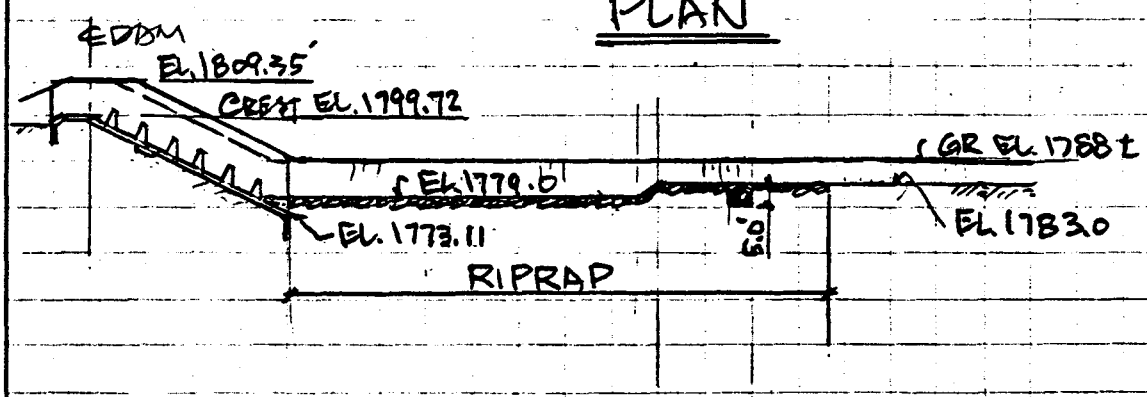
CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BAFFLE SPILLWAY — 100' WIDE



PLAN



SECT. ALONG ℄ CHUTE

1" = 50'-0

FIGURE VI.5

881/8-81

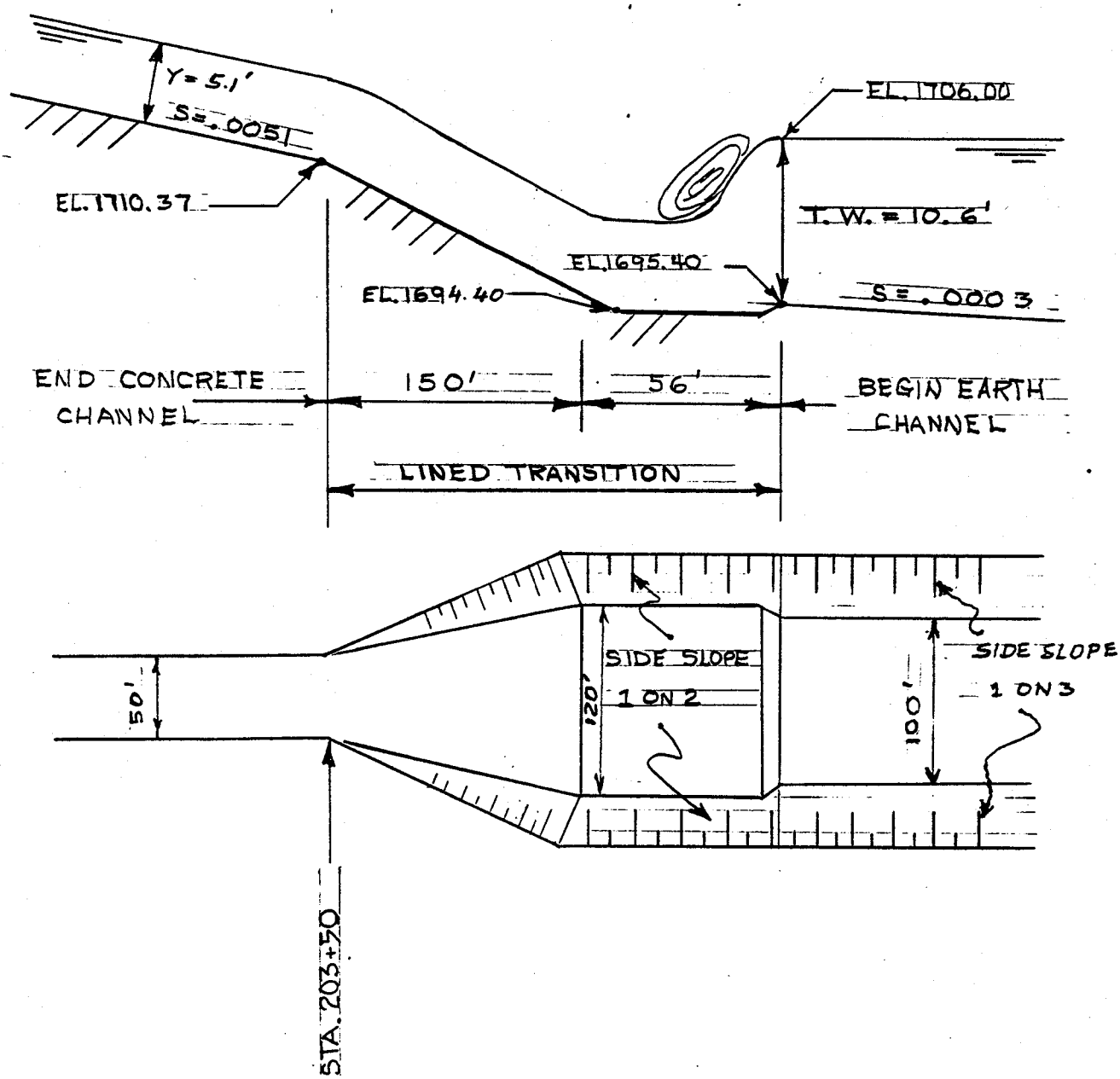


FIGURE VI.6

BULLDOG FLOODWAY ENERGY DISSIPATOR

9-17-85

TABLE VI.1

OUTLET PIPE (in)	36	30
Principal Spillway		
Crest El. (feet)	1793.5	1793.5
Outflow PSH (cfs)	120.4	80.8
Emergency Spillway (Baffled Block Chute)		
Crest El. (feet)	1799.46	1799.72
Crest Length (feet)	100	100
Outflow ESH (CFS)	1904.9	1807.8
Outflow FBH (cfs)	10735.2	10505.8
Embankment		
Top El. (feet)	1809.21	1809.35
Fill (c.y.)	320830	324795

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NEW YORK

TABLE VI.2

BY C. Zec DATE 6/4/85 SHEET 1 OF ____

CHKD. BY S.G. Yal DATE 6/5/85 OFS NO. ____ DEPT. NO. ____

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Bulldog Wash Peak Discharge for Inlet Junction & Flood Channel

		Apachie Junction outlet	Discharge for Flood Channel Design cfs
Inlet 4A	→ 397 cfs	↓ 120 cfs 517	517
4B	→ 525	↓ 517 cfs 1042	1040
4C	→ 155	↓ 1040 cfs 1195	1181
4D	→ 71	↓ 1181 cfs 1252	1183
4E	→ 327	↓ 1183 cfs 1510	1480
4F	→ 56	↓ 1480 cfs 1536	1486
4G	→ 611	↓ 1486 cfs 2097	2087
4H	→ 37	↓ 2087 cfs 2124	2088
5A	→ 2348	↓ 2088 cfs 4436	4293
5B	→ 157	↓ 4293 cfs 4450	4408
5C	→ 36	↓ 4408 cfs 4444	4405
6A	→ 345	↓ 4405 cfs 4750	4709
6B	→ 126	↓ 4709 cfs 4835	4713
6C	→ 753	↓ 4713 cfs 5466	

Note: Apachie Junction Outlet flow is taken as 120 cfs instead of 99 cfs. Since the Outlet pipe diameter has been reduced to 30 in., the pipe outflow is 81 cfs instead of 120 cfs. Reduction in the base flow by 39 cfs will reduce the height of channel walls in the final design.

FORM 581 REV 7-71

TABLE VI. 2

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TABLE VI.3

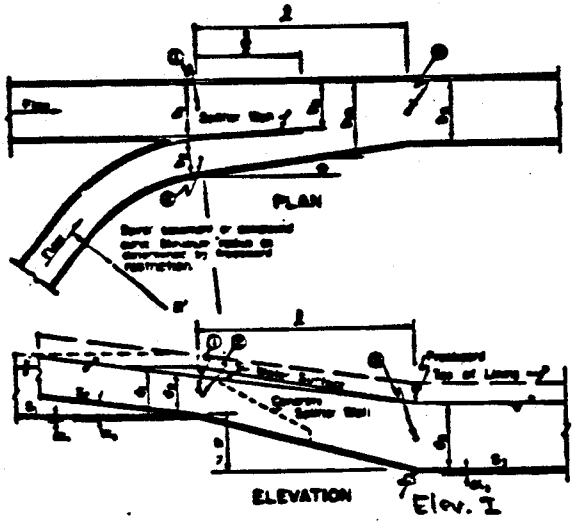
BY C. Zee DATE 6/13/85 SHEET 21 OF

CHKD. BY S Goyal DATE 6-26-85 OFS NO. DEPT. NO.

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlets Summary



All dimensions in ft except S

Inlet	b_1	b_2	b_3	d_1	d_2	d_3	S_1	S_2	S_3	ℓ	b_5	h	Elev I	R'
4A	4.5	8.0	10.0	2.3	2.7	3.5	0.012	0.018	0.0085	63	4.0	0.6 (7")	1766.20	101
4B	10.0	9.0	18	3.5	3.0	3.9	0.0085	0.018	0.0061	52	8.75	0.08 (1")	1748.84	126
5A	35	27.5	50	3.9	4.3	4.9	0.0051	0.0084	0.0051	160	24.75	2.08 (2'1")	1722.36	410

TABLE VI.3

581/8-81

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TABLE VI.4

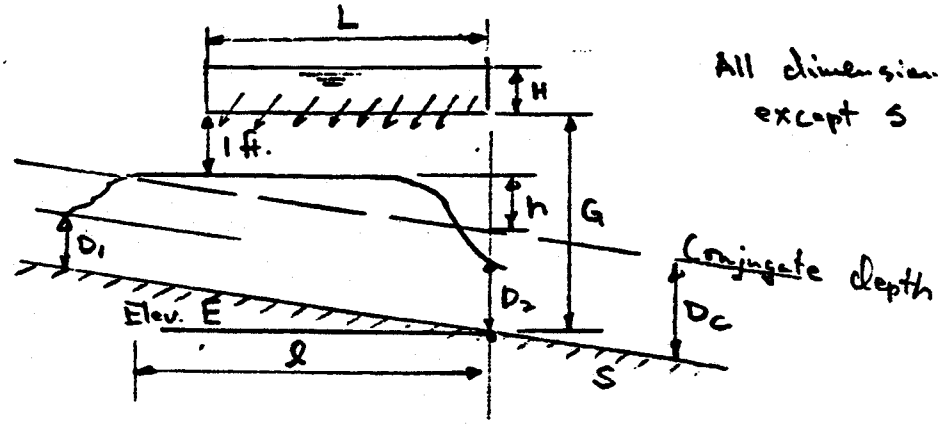
BY C. 2 DATE 6/13/85 SHEET 20 OF

CHKD. BY S.G. Yal DATE 6-26-85 OFS NO. DEPT. NO.

CLIENT USDA — SCS PHOENIX

PROJECT Building Floodway

SUBJECT Weir Inlets Summary



All dimension in ft except S

Inlet	Elev. E	ℓ	D_1	D_2	D_c	h	G	L	H	S
4C	1745.80	190	3.9	5.3	5.7	1.2	7.9	15	2.2	0.0061
4D	1739.94	72	3.8	4.7	5.3	0.4	6.7	8	2.0	0.0052
4E	1736.41	470	3.8	5.7	5.3	2.4	8.7	35	2.1	0.0052
4F	1733.06	19	3.7	4.6	5.2	0.1	6.3	6	2.0	0.00495
4G	1729.22	643	3.7	6.2	5.2	3.2	9.4	60	2.2	0.00495
4H	1727.96	0	3.9	4.3	5.8	0	6.8	5	1.8	0.0051
5B	1718.66	0	4.8	6.3	7.6	0	8.6	15	2.3	0.0051
5C	1717.39	0	4.9	6.3	7.8	0	8.8	5	1.8	0.0051
6A	1715.12	96	4.9	6.6	7.8	0.5	9.3	40	2.0	0.0051
* 6B	1704.74	—	—	—	—	—	5.3	12	2.3	0.0408
** 6C	1695.36	—	—	—	—	—	9.8	60	2.5	0.0002

* Enter stilling basin

** Enter earth channel

TABLE VI.4

881/8-81

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TABLE VI.5

BY C. Zee DATE 6/12/85 SHEET 25 OF

CHKD. BY S Goy. DATE 6-26-85 OFS NO. DEPT. NO.

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Bulldog Floodway alignment

Location	Station No.	Distance	Elev.	Channel slope	Section (b x d)
Dam Outlet	101 + 50		1783.00'		
		1350'		0.012	35' x 2.2'
Upstream (4A)	115 + 00.00	63'	1766.80'	Inlet Structure	
Downstream (4A)	115 + 63.00		1766.20		
		600.00'		0.0085	10' x 3.5'
Slope Breaking pts	121 + 63.00	691.11'	1761.10	0.0140	10' x 2.9'
	128 + 54.11		1751.42		
		69.88'		0.0085	10' x 3.5
Curve PC	129 + 23.99	96.16'	1750.83	0.0085	10' x 3.5'
PT.	130 + 20.15		1750.01		
		129.85		0.0085	10' x 3.5'
Upstream (4B)	131 + 50.00	52'	1748.92	Inlet Structure	
Downstream (4B)	132 + 02.00		1748.84		
		498.0'		0.0061	18' x 3.9'
Downstream (4C)	137 + 00		1745.80		
		300.0'		0.0061	18' x 3.9'
Slope Breaking Pt.	140+00		1743.97	Width Transition	
		775.0'		0.0052	22' x 3.76'
Downstream (4D)	147 + 75		1739.94		
		114.37'		0.0052	22' x 3.8'
Curve PC	148 + 39.37		1739.35		
		565.63'		0.0052	22' x 3.8'
Downstream (4E)	154 + 55.00		1736.41	Width Transition	
		145.00'		0.0052	28' x 3.7'
Slope Breaking Pt.	156+00		1735.66		
		442.42'		0.00495	28' x 3.7'
Curve PT	160 + 42.42		1733.47		
		82.58'		0.00495	28' x 3.7'
Downstream (4F)	161 + 25		1733.06		
		775.0'		0.00495	28' x 3.7'
Downstream (4G)	169 + 00		1729.22		

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TABLE VI.5 (CONT.)

BY C. Zee DATE 6/12/85 SHEET 26 OF

CHKD. BY S Goyal DATE 6-27-85 OFS NO. DEPT. NO.

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Bulldog Floodway alignment

Location	Station No.	Distance	Elev.	Slope	Channel Section (b×d)
Downstream (4G)	169+00		1729.22		
		100'		0.00495	28'×3.7'
Slope breaking Pt	170+00		1728.73	width Transition	
		150'		0.0051	35'×3.9'
Downstream (4H)	171+50		1727.96		
		690'		0.0051	35'×3.9'
Upstream (5A)	178+40	160'	1724.44	Inlet structure	
Downstream (5A)	180+00		1722.36		
		725'		0.0051	50'×4.8'
Downstream (5B)	187+25		1718.66		
		250'		0.0051	50'×4.9'
Downstream (5C)	189+75		1717.39		
		445'		0.0051	50'×4.9'
Downstream (6A)	194+20		1715.12		
		30.96'		0.0051	50'×5.1'
Curve PC	194+50.96	191.30'	1714.96	0.0051	50'×5.1'
PT	196+42.26		1713.98		
		707.74		0.0051	50'×5.1'
End of Concrete Channel	203+50		1710.37		
		56'			Stilling Basin
Downstream (6B)	204+12		1704.74		
		144'			
End of Stilling Basing	205+56		1695.4		
		194			Earth Channel
Downstream (6C)	207+50		1695.36	0.0002	120'×10.6' Trapezoid. Section side slope 1a2
		1150'			
End of Earth Channel	219+00		1695.13		

VII. CORRESPONDENCE

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L0024

September 6, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Review of Proposed AT&T Cable Crossing

Dear Mr. Paulus:

We have completed our review of the information you provided with your letter of August 7, 1985 regarding the proposed AT&T cable crossing and have the following comments:

Drawing WR-52932 Section 4 - The slope of the excavated trench should not be steeper than 1 horizontal to 0.5 vertical. For proper compaction of the backfill adjacent to the concrete encasement, the distance between the formed concrete face and the side of the excavated trench should be a minimum of 4 feet. If this minimum width is not provided, concrete should be provided the full width of the excavated trench up to the top of the encasement.

Drawing WR-52608

1. The RGS 4-inch pipe embedded at a depth of 10 feet below existing ground should be kept at that depth for at least 10 feet beyond the upstream and downstream toes of the embankment.

2. Section 4 detail (Drawing WR-52932) should apply for the concrete encasement from sta. 4875+00 to 4880+00 to avoid the possible flow of water in and out of the conduit in the vicinity of the embankment in case the conduit is damaged at the bottom; i.e., the conduit should have concrete encasement entirely around it including the bottom.

3. A piping and seepage control diaphragm will be provided around the concrete encasement as required by TR-60.

Very truly yours,

Carl Montana

Carl J. Montana
Project Manager

CJM:rg
cc: J L Ebasz
G E Rockwell
D Groner
S N Goyal

EBASCO SERVICES INCORPORATED

EBASCO

Two World Trade Center, New York, N.Y. 10048

File Ref: USDA 3767-L0023

September 5, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Response to City and County Comments
Phase I Feasibility Study

Dear Mr. Paulus:

Your review of the Phase I Feasibility Study resulted in four sets of comments, one each from your office, the SCS regional office, the City of Apache Junction, and the Flood Control District of Maricopa County. The SCS comments are being responded to through revision to the Phase I Feasibility Study Report. Most of the City and County comments are more general in nature and will be responded to through this letter. Their letters should be referred.

City of Apache Junction:

Apache Junction Floodway - If and when Tomahawk Road is constructed the culvert should be designed to pass the design storm (the 100-year storm) in the Apache Junction Floodway at that point. Idaho and Brown Road culverts are designed to pass flows through segments of the reservoir which should not be the basis of design for Tomahawk Road.

Emergency Spillway - The depths and inundated area resulting from discharges through the Emergency Spillway will be determined in Phase IV of the contract.

Idaho and Brown Roads - The road profiles and widths used in design were based on information provided at earlier meetings. It had been agreed that the fill width would be 64 feet and the speed limit 30 mph. The increased width will have minimal effect on the current design since it will only increase the culvert sizes under the roads. An increase in speed limit will have a more significant effect since it will result in longer elevated sections through the reservoir, thus reducing the weir length for flow across the roads for the emergency and freeboard storms. This in turn would affect the top of dam elevation. SCS has agreed to resolve this issue with the City.

Flood Control District:

1.a. A structural concrete spillway is being used.

1.b. At the present time we are recommending a 2-1/2 to 1 upstream slope. The final determination will not be made until the completion of slope stability analysis in Phase II.

1.c. "Uncontrolled" means there are no manually operated gates or other devices, such as flashboards, which must be manipulated for the spillway to function.

1.d. Ebasco will design these roads under a separate contract with the County.

1.e. The levees referred to were in the earth emergency spillway. At the time paragraph 6.6.2 was written there was the possibility that an earth spillway would be used for the emergency spillway. SCS criteria requires that extremely wide earth spillways be divided by levees running parallel to the direction of flow. An earth spillway is not being used on this site, therefore no levees will be used.

1.f. The 10-day criteria is standard for SCS. Exactly how the drawdown time on this site compares to other sites in the project will have to be answered by SCS.

2.a. The AT&T proposal is currently being reviewed. Ebasco's recommendations will be provided in a separate letter.

2.b. This appears to be a statement.

2.c. Yes

2.d. The cable will have to be relocated. It will also have to be rerouted or otherwise handled during construction. We are in contact with Mountain Bell.

2.e. No comment.

2.f. The final alignment is as shown as Alternate 1 on the plans provided by SCS. The inundated area will be established in Phase IV.

EBASCO SERVICES
INCORPORATED

Mr. D. R. Paulus
USDA Soil Conservation Service

2.g. We understand the urgency of this information and will make this item one of the first things done in Phase III. It has been agreed with SCS that no flows from the area east of Apache Trail will be included in the design.

3.a. Future condition curve numbers were used in the design.

3.b. This is an issue that will have to be addressed by the government entity having control over that area.

Very truly yours,

Carl J. Montana
Project Manager

CJM:rg

cc: J L Ehasz
G E Rockwell
D Groner
S N Goyal
V M Bolano

EBASCO SERVICES INCORPORATED

Two World Trade Center New York, N Y 10048

EBASCO

File Ref: USDA 3767-L0022

September 3, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Request for Standard Drawings

Dear Mr. Paulus:

As a result of the studies completed in Phase I of the contract, it has been agreed that a 30-inch conduit will be used in lieu of the 36-inch conduit proposed in the Work Plan. It has also been decided to use the SCS Standard Baffle Riser on this site.

Please provide us with reproducible copies of:

ES 3230-1010-R - (Standard Baffle Riser)

ES 5030-CR - (Standard Conduit Detail)

If at all possible we would like to have a structural engineer from the regional office attend the meeting in Santa Ana in October. We will have started into design at that time and I believe there will be significant issues that would best be resolved at this early date. I would appreciate you giving this serious consideration in light of the short schedule.

Very truly yours,

Carl Montana

Carl J. Montana
Project Manager

CJM:rg

cc: J L Ehasz
G E Rockwell
D Groner
S Goyal
V M Bolano

EBASCO SERVICES INCORPORATED
2000 W. MacArthur Blvd., Santa Ana, CA 92711, (714) 662-4000

EBASCO

29 August 1985

Mr Wayne Pollard
Mountain Bell Telephone Company
460 North Mesa Drive, Room 105
Mesa, AZ 85201

Dear Mr Pollard:

Confirming our telephone conversation on August 29, 1985, I am enclosing one copy each of the following:

1. Letter dated 15 May, 1985 from Moutain Bell to FCDMC.
2. Pertinent attachment pages to said letter.

Schematic location of three (3) telephone cable locations were marked on the attached sheets 2, 4, 6 and 7 by Mountain Bell. I've highlighted these in yellow crayon.

We need the distance from the centerline of road to the cable and the depth of cable. It is assumed that all three cables cross completely across the rights-of-way.

Thanks in advance for your information and help.

Very truly yours,

D Groner

D Groner
Consulting Engineer

DG:JAS
Encls.

cc: C Montana
G Rockwell

EBASCO

Interoffice Correspondence

DATE 29 August 1985 FILE REF.

TO Distribution OFFICE LOCATION

FROM C J Montana OFFICE LOCATION Los Angeles

SUBJECT BULLDOG FLOODWAY AND APACHE JUNCTION PROJECT
RECORD OF PHONE CALL CONVERSATION 8/28/85
BETWEEN C MONTANA AND D PAULUS

Shiam Goyal and I were in Santa Ana from August 27 thru August 29 to work with Dave Groner and Glen Rockwell on the Bulldog Floodway and Apache Junction project. While there a number of questions arose. We called Don Paulus on August 28th. The following is a record of the conversation: (Questions & Responses).

Q. Who will SCS have in attendance at the October 1st meeting in Santa Ana?

R. Don Paulus and Cliff Deal will attend the meeting. Cliff Deal is the Soil Mechanics Engineer from the Portland Regional Office.

Q. Why is the Riprap shown by SCS on all previous projects grouted? Is the rock sized by some criteria and then grouted anyway?

R. In general, we have found that the rock size required is so large that it is not available. No design procedure has been used for the side inlets; the rock is grouted in lieu of rock design procedures being used. We have used a Corp of Engineers procedure for design of the rock in the chutes which I will provide you.

Q. Will you make a TR-50 run for us for channel design if we provide the input data?

R. No. Make sure you use TR-67 and DN-21.

Q. I believe it is not in our or your best interest to modify the standard specifications by deleting options not used. In many cases, more than one option may be used. It just seems like a potential source of error.

R. I agree, but we have been directed by our administrative office that this procedure must be used. Some claims have resulted from options having not been deleted. The deletions must be made.

Q. In Section VI, Studies, Para. 5)4.2 of your review comments on the Feasibility Study, you asked for the design criteria to be used in design of the culverts under the roads; we will not be designing these culverts under this contract.

R. We realize this, however, they must be designed in accordance with SCS criteria since they are considered to be part of this project.

Q. Can we use corrugated metal for these conduits under the road?

R. Yes, we do not want the pipe coated on the inside, only on the outside. Fires have been started in pipes coated on the inside.

Q. The regional office comments ask that a joint extensibility calculation be made for the principal spillway conduit. Since the pipe will be bedded on Caliche for its entire length, there is no anticipated settlement. The procedures in TR-18 require that there be settlement for the calculation to be made. It seems to me that under the circumstances the calculation is not appropriate.

R. I agree. Just document your reasoning.

Q. The City of Apache Junction has again raised the question regarding the flow below the emergency spillway. We believe this issue should be resolved so that changes in design are not required at some later date. It also appears that the peak discharges from subwatershed 3 without the dam exceed the corresponding discharges from the emergency spillway down the flow area they are concerned about.

R. No changes will be made in design. The decision on spillway location has been made. The question of inundated area will be answered in Phase IV.

Q. The City of Apache Junction has asked that the roads through the reservoir area be designed for 45 mile per hour speed limit and that they be widened to 4 to 6 lane widths. All the work we have done has been based on the previously-agreed-to 30 MPH speed limit with a 64 foot width. Will this work have to be redone? The work required to do the increased width is minimal since we will only have to increase the culvert size. However, the higher speed limit will result in a longer elevated section through the reservoir which will reduce the weir length for flow across the roads through the reservoir. This could result in higher dam elevations. Will we be compensated for this additional work?

R. I will resolve this with the City and get back to you.

Q. Do you want maintenance ramps into the concrete channels?

R. No.

Q. Have you been placing bedding under the concrete channel slabs?

R. No. We have been excavating to grade and pouring without bedding. We have used waterstops. Do not use cork joint filler. We have had good success with the two part joint sealer that is in the signal butte specs.

CJM:JAS
0016u:78

Distribution

G Rockwell
C Montana
D Groner
S Goyal
V Bolano
D Paulus

EBASCO SERVICES INCORPORATED

EBASCO

Two World Trade Center, New York, N.Y. 10048

File Ref: USDA 3767-L0021

Via Telecopier

August 13, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Additional Field Testing Requirements

Dear Mr. Paulus:

Attached find Ebasco's recommendations for the additional field testing required for design of the Apache Junction Flood Retarding Structure.

Seven field permeability tests have been assigned on the SC, SM-SC, SM-SP and caliche materials at the locations and depths noted on Table I. A typical test installation is shown on Figure 1 and includes:

1. drilling, using a 3¼-inch ID hollow stem auger to the bottom of the test section;

2. placing a 2-inch diameter, Schedule 40, PVC pipe with a 5-foot slotted screen section (0.010 or 0.020 inch) and capped at the bottom;

3. placing a medium-to-coarse sand in the area between the outside of the slotted PVC pipe and the drilled hole as the augers are slowly withdrawn in order to prevent caving of the surrounding hole;

4. placing a 2-foot bentonite pellet seal above the slotted screen section;

5. backfilling the remaining hole with random material.

Prior to performing the test and collecting the required data, water should be placed inside the PVC pipe in order to saturate the zone to be tested. It is recommended that Standard Penetration Tests be conducted throughout the entire depth to be drilled in order to obtain continuous samples and classify the materials. The type of test to be conducted, either a falling head or constant head, will be dependent on the permeability of the materials.

The collapsibility potential of the foundation soils will be determined by performing seven in-situ density tests at the locations and depths shown on Table II. Representative bag samples should be collected for each soil tested and standard proctor, moisture content and liquid limit tests be performed in the laboratory. Based on the results of the field density tests and data currently available (standard proctor, water contents, and liquid limits), Ebasco will be able to determine whether undisturbed samples will be required while the drilling contractor is still in the field.

In case the materials encountered while drilling or trenching are significantly different from those noted in the tables, alternate locations must be selected for performing the tests. Similarly, it may be decided in the field to expand the scope of work if further information is deemed necessary.

As we have discussed, Victor Bolano will be in the field on Wednesday afternoon (8/21) and all day Thursday (8/22) and Friday (8/23). Please schedule the field work such that Victor can maximize the interface with your geologist, observe the testing performed and be totally acquainted with field conditions.

It is estimated that the in-situ density tests, installation of the PVC pipes and the permeability tests can be completed in a maximum of five or six days. If you have any questions or require additional information please call me at 212/839-1421 or Victor Bolano at 212/839-1483.

Very truly yours,

Carl Montana

Carl J. Montana
Project Manager

CJM/VMB:rg
attachments

cc: J L Ehasz
G E Rockwell
S N Goyal
V M Bolano

United States
Department of
Agriculture

Soil
Conservation
Service

Suite 200
201 E. Indianola Ave.
Phoenix, AZ 85012

July 30, 1985

Carl Montana
Consulting Engineer
EBASCO Services, Inc., 91st Floor
Two World Trade Center
New York, N. Y. 10048

RE: Apache Junction/Bulldog, Contract #53-9457-5-00475

Dear Mr. Montana:

As requested during the Phase I Feasibility Study Conference, I have enclosed the following:

1.) NEH-20 with the July 3, 1984 Amendment #1 and Arizona Bulletin No. 210-5-24. This is an additional copy to the one supplied April 1, 1985.

2.) Trip Report by Neville Curtis, Sedimentation Geologist dated March 7, 1983. This report gives the procedure used for estimating Sediment yield to Pass Mountain for the 100 year event.

We have reviewed our NEH-20 file on the Word Processor and have decided not to send you a copy. Approximately one-half of the specifications and material specifications still have not been reviewed for errors.

Sincerely,

Donald E. Paulus

Donald E. Paulus
Government Representative

Enclosures

United States
Department of
Agriculture

Soil
Conservation
Service

Suite 200
201 E. Indianola Ave.
Phoenix, AZ 85012

August 7, 1985

Carl Montana
Consulting Engineer
EBASCO Service, Inc. 91st Floor
Two World Trade Center
New York, N.Y. 10048

RE: Apache Junction/Bulldog, Contract #53-9457-5-00475,
Proposed AT&T Cable Crossing

Dear Mr. Montana:

We have enclosed for your information and review the items as listed in the attached cover letter dated July 30, 1985 from Black & Veatch.

These items are being submitted by Black & Veatch in accordance with the coordination terms and reviews that were agreed to.

Sincerely,

Donald E. Paulus
Government Representative

cc: Ralph Arrington, SCE
Bill Payne. DE

BLACK & VEATCH
ENGINEERS-ARCHITECTS

TEL. (913) 967-2000
TELEX 42-6263

1500 MEADOW LAKE PARKWAY
MAILING ADDRESS: P.O. BOX NO. 8405
KANSAS CITY, MISSOURI 64114

AT&T Communications
Southern Transcontinental
Lightguide System
Permits and Licenses

B&V Project 11380
B&V File M620-31.32.0200
July 30, 1985

U.S. Department of Agriculture
Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Attention: Mr. Don Paulas

Gentlemen:

Enclosed for your review are four copies of the following items.

- Design Drawings WR-52607 (Revision 1), WR-52608 (Revision 3), and WR-52932 (Revision 2), showing how the lightguide cable will be constructed under the Apache/Bulldog Flood Retension Structure.

- Soil boring logs AJ-1 and AJ-2 for the borings taken where the lightguide intersects with the dam. The boring locations are called out on Drawing WR-52608.

- Specification Sections 2E - Conduit System, 2I - Excavation and Trenching, 2J - Cast-in-Place Concrete. Note that special backfill and compaction requirements for the area under the dam are called for on Drawing WR-52932.

We understand that the Soil Conservation Service will stake the dam and culvert locations prior to lightguide construction if notified one week before construction start. By copy of this letter to Burnup and Sims, we are advising the Contractor that he is to request dam and culvert staking through Mr. Don Paulas at (602) 241-5145.

If you have any questions or comments, please call me at (913) 339-2464.

Very truly yours,

BLACK & VEATCH

H. Lee Kupfer

H. Lee Kupfer

kab
Enclosures

cc: AT&T-C
Mr. A. Lindley
Mr. K. Reinert
Mr. G. Hyatt

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

File Ref. USDA 3767-L0019

August 5, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Meridian and Ironwood Road Crossings

Dear Mr. Paulus:

At the end of the Comparative Design Study Conference on July 24, 1985, the following tentative information was provided to the Flood Control District regarding floodways and road intersections:

Meridian Road Crossing

Approximate Location	STA 195 + 10 ±
Channel Width	50 feet
Depth of Water	5.1 feet
Channel Bed Elevation	1714.66 feet
Height of Wall (Min.)	6'3" Add for floating debris

Ironwood Road Crossing

Approximate Location	STA 139 + 20
Channel Width	22 feet
Depth of Water	3.76 feet
Channel Bed Elevation	1744.57 feet
Height of Wall (Min.)	4'7" Add for floating debris

On July 25, 1985 the Flood Control District requested similar information regarding the intersection of Apache Junction Floodway and Tomahawk Road.

EBASCO SERVICES
INCORPORATED

Mr. D. R. Paulus
USDA Soil Conservation Service

Page Two
August 5, 1985

Since Tomahawk Road is neither located on the Apache Junction Floodway drawings, nor since the exact bearing and coordinates of the road are known, it will not be possible to furnish the channel characteristics. However, the following information regarding the channel in that area may be useful for initial planning:

From Northing 618021 to 618485

Channel Width	8.5 feet
Depth of Water	5.48 feet
Channel Bed Elevation	1806.17 to 1806.67 feet
Height of Wall	6 feet Add for floating debris

Please note that all the information is subject to change, depending upon SCS comments on the Comparative Design Study and the final designs.

Please pass this information on to the Flood Control District. If they need further information please let us know.

Very truly yours,

Carl J. Montana
Project Manager

CJM/SG:rg

cc: J L Ehasz
S Goyal
G Rockwell

Suite 200
201 E. Indianola Ave.
Phoenix, AZ 85012

July 30, 1985

Carl Montana
Consulting Engineer
EBASCO Services, Inc., 91st Floor
Two World Trade Center
New York, N. Y. 10048

RE: Apache Junction/Bulldog, Contract #53-9457-5-00475

Dear Mr. Montana:

As requested during the Phase I Feasibility Study Conference, I have enclosed the following:

1.) NEH-20 with the July 3, 1984 Amendment #1 and Arizona Bulletin No. 210-5-24. This is an additional copy to the one supplied April 1, 1985.

2.) Trip Report by Neville Curtis, Sedimentation Geologist dated March 7, 1983. This report gives the procedure used for estimating Sediment yield to Pass Mountain for the 100 year event.

We have reviewed our NEH-20 file on the Word Processor and have decided not to send you a copy. Approximately one-half of the specifications and material specifications still have not been reviewed for errors.

Sincerely,

Donald E. Paulus
Government Representative

cc: Bill Payne
Ralph Arrington

Enclosures

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

Our Ref: USDA 3767-L0019

July 31, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Pheonix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Minutes of Comparative Design Study Conference

Dear Mr. Paulus:

Attached is a copy of the minutes of the Comparative Design Study Conference held in your office July 24, 25, 1985. Let me know if you would like any changes or additions.

As we agreed, your written comments on the Phase I Report will provide additional documentation on the meeting.

Very truly yours,

Carl Montana

Carl Montana
Project Manager

CM/lm

Attachment

cc: J. L. Ehasz w/ att.
G. Rockwell w/ att.
S. Goyal w/ att.
V. Bolano w/ att.
D. Hunter w/ att.

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L0018

July 16, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Pheonix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Meeting Agenda

Dear Mr. Paulus:

Attached is the proposed agenda for the Comparative Design Conference to be held in your office July 24, 25, 1985.

Very truly yours,

Carl Montana

Carl Montana
Project Manager

cc: S. Goyal
D. Hunter
V. Bolano

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref. USDA 3767-L0017

July 16, 1985

Mr. Paul Monville
USDA Soil Conservation Service
Federal Building
511 N. W. Broadway
Room 514
Portland, Oregon 97209-3489

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
PHASE I - FEASIBILITY REPORT

Dear Paul:

Don Paulus called me today and asked that I send you two additional copies of the Phase I Report. I have included both a bound and unbound copy so you can more easily make copies if necessary.

Very truly yours,

Carl Montana
Project Manager

CM:mq

ENC.

cc: D. Paulus
S. Goyal

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L0016

July 12, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT
CONTRACT NO. 53-9457-5-00475
PHASE I - FEASIBILITY REPORT
REVISED FIGURE VI.6

Dear Mr. Paulus:

Please replace Figure VI.6 in your copies of the Phase I Feasibility Report with the attached Figure VI.6, revised 7/12/85.

Very truly yours,

Carl Montana

Carl Montana
Project Manager

CM:mq
Attach.
cc: G Rockwell (w/Attach.)

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767L0015

July 11, 1985

Mr. Dan Lawrence
Arizona Department of Water Resources
99 East Virginia
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Phase I - Feasibility Study Report

Dear Mr. Lawrence:

As a follow-up to our conversation today, I have enclosed a copy of the Phase I Feasibility Study Report for the Bulldog Floodway and Apache Junction Flood Control Project, which Ebasco is designing for the USDA Soil Conservation Service.

As you know, we will be meeting with the SCS in their office on the afternoon of July 24th to review the report. Since it is at this point in time that we hope to "fix" the project features, I would appreciate your comments prior to that date.

I look forward seeing you at the meeting on the 24th.

Sincerely,

Carl Montana

Carl Montana

CM/lm
Attachment

cc: D. Paulus
J. Ehasz
M. Temchin

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L0014

FEDERAL EXPRESS

July 9, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Contract No. 53-9457-5-00475
Phase I - Feasibility Report

Dear Mr. Paulus:

Transmitted herewith are three (3) copies of the Feasibility Report for the subject contract.

We look forward to meeting with you on July 24th to review its contents. If at all possible, I would appreciate it if you could let me know prior to the meeting if there are major issues with it that will have to be resolved.

Call me if you have any questions.

Very truly yours,

Carl Montana

Carl J. Montana
Project Manager

CJM:rg
attachments

cc: J L Ehasz - w/att.
M S Temchin
S Goyal
G Rockwell - w/att.

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L0013

July 3, 1985

Mr. Donald R. Paulus
Government Representive
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Review of AT&T-C Proposal
SCS Letter Dated June 6, 1985

Dear Mr. Paulus:

The following is in response to the questions asked in your letter of June 6, 1985 regarding the AT&T-C cable along Lost Dutchmans Boulevard.

1. The culvert is sized to pass 200 cfs with a differential head of .25 feet. It will be located 350 feet (measured along the centerline of the road) from the centerline of the dam. We propose to use a box culvert 7 feet high and 10 feet wide with an invert at elevation 1785 feet.

2. The centerline locations have not been changed from those origionally provided by the SCS.

3. The maximum lake level attained during passage of the emergency spillway storm is elevation 1802.5 feet.

4. The earthfill placement requirements will be Class A compaction to at least 95 percent of the maximum density obtained from compaction tests performed by Method C, ASTM designation D698. The moisture content shall be within 2 percent of optimum. The material shall have a maximum particle size of 1 inch with a minimum of 75 percent passing the number 4 seive.

Please call me if you have any questions.

Very truly yours,

Carl Montana
Project Manager

cc: Ehasz
Temchin
Goyal
Bolano
Rockwell

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L0012

July 2, 1985

Mr. Donald R. Paulus
Government Representation
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT
SCS LETTER OF JUNE 26, 1985

Dear Mr. Paulus:

Reference is made to your letter of June 26, 1985.

We have completed the routings requested in paragraphs 2.b and 3 and have determined that the effect of not including the modified channel loss factor for the emergency and freeboard hydrographs is minor and that the 100 year - 24 hour type II storm does not flow out the emergency spillway when routed through the site.

We will provide the documentation requested in paragraphs 4, 5, and 6.

I believe there is a misunderstanding regarding the work requested in paragraphs 1 and 2.a. It remains our opinion that we have correctly applied the modified channel loss factor as required by the Soil Conservation Service's National Engineering Handbook Section 4, Chapter 21 and PO-4. As you know, each of the watersheds for which we have not applied the factor has a drainage area less than 1 square mile and drains directly into the reservoir of the Apache Junction FRS. I believe the references are clear and have been applied properly with sound engineering judgement and logic.

Based on your request over the telephone today, we will perform the routing as requested in 2.a for your use. We do not agree to apply the results of this routing to our studies which, at this point, have been completed.

Very truly your,

Carl Montana

Carl Montana
Project Manager

cc: J. Ehasz
S. Goyal
D. Hunter
G. Rockwell

United States Department of Agriculture

Soil Conservation Service

201 E. Indianola
Suite 200
Phoenix, Arizona 85012

June 26, 1985

Carl Montana
Consulting Engineer
EBASCO Services, Inc., 91st Floor
Two World Trade Center
New York, N.Y. 10048

RE: Apache Junction/Bulldog, Contract #53-9457-5-00475

Dear Mr. Montana:

As agreed in our 6-26-85 phone conversation with Dave Hunter of your staff and Harry Millsaps of our staff the following work shall be added or corrected to your submitted hydrology report.

1. Calculate the modified channel loss factor for the entire Drainage Area and not each sub-basin as shown in your report. This calculated value will then be used for each sub-basin.

2. Re-run the routing program for the following conditions:

   a. To include the newly calculated channel loss factor for the principle spillway hydrograph.

   b. Not to include the channel loss factor for either the Emergency or Freeboard hydrographs.

3. Test the 100 year-24 hour type II storm to make sure we do not get flow out the emergency spillway for this rainfall event.

4. Include all input data as part of the report.

5. Document WNTC comment for using QDIRECT versus PDIRECT in establishing the runoff distribution curve.

6. Show the 100 year-6 hour rainfall amount on the Hydrologic Summary Sheet.

Sincerely,

Donald E. Paulus

Donald E. Paulus
Government Representative

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L0011

July 2, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT
INVOICE FOR PROGRESS PAYMENT NUMBER 2
CONTRACT NO. 53-9457-5-00475
INVOICE NO. USDA-853074-5

Dear Mr. Paulus:

Attached is the original and two copies of the invoice for work completed thru June 27, 1985 on the subject contract. I have also attached a copy of the rationale behind the percent completion.

Please note that we have included the increases resulting from Modifications 1 and 2 in the price per phase.

Call me if you have any questions.

Very truly yours,

Carl Montana
Project Manager

CM:mq

Attach.

cc: J L Ehasz
G Rockwell
S Goyal
C Socrates

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y 10048

EBASCO

File Ref: USDA 3767-L0010

June 17, 1985

Mr. Donald R. Paulus
Government Representative
USAD Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Hydrology Report

Dear Mr. Paulus:

As we agreed over the phone today, I have enclosed two copies of the "Hydrology Report" we prepared for the subject project. I would appreciate it if you could have Harry look it over and let us know if there is anything you have difficulty with. A report on the hydrology will be included as part of the "Preliminary Design Report" which will be submitted July 10th.

Thank you for your cooperation.

Very truly yours,

Carl J. Montana
Project Manager

CJM:rg
attachments

cc: J L Ehasz
M S Temchin
S N Goyal
D S Hunter

EBASCO SERVICES INCORPORATED

EBASCO

Two World Trade Center, New York, N.Y. 10048

File Ref: USDA 3767-L009

June 13, 1985

Mr. David O. Lambson
Contract Specialist
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT
CONTRACT NO. 53-9457-5-00475
CONTRACT MODIFICATIONS 1 & 2

Dear Mr Lambson:

Enclosed are signed copies of contract modifications 1 and 2.

Very truly yours,

Carl Montana
Consulting Engineer

CM:mq

ENC.

cc: J L Ehasz
G Rockwell
S Goyal

United States
Department of
Agriculture

Soil
Conservation
Service

Suite 200
201 E. Indianola
Phoenix, AZ 85012

May 30, 1985

Ebasco Services, Inc.
Two World Trade Center, 91st Floor
New York, NY 10048

Attn: Carl Montana, Consulting Engineer

RE: Design Services for Bulldog and Apache Junction FRS & Outlet
Contract No. 53-9457-5-00475

Gentlemen:

Enclosed for your review and signature are two copies each of contract modification Nos. 1 & 2 of the above referenced contract. Item amended is described in Section 14 of both modifications.

Please sign return original copies to this office. The other copies may be retained for your files.

Sincerely,

David O. Lambson
Contracting Officer

Enclosures (4)

cc: Don Paulus, Gov't Rep

EBASCO SERVICES INCORPORATED

EBASCO

3000 W. MacArthur Blvd., Santa Ana, CA 92704, (714) 662-4000

File Ref: USDA3767-LK008

June 11, 1985

Mr. David O. Lambson
Contract Specialist
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT
CONTRACT NO. 53-9457-5-00475
DESIGNATION OF ALTERNATE TO NEGOTIATE,
SIGN, AND ADMINISTER CONTRACT MODIFICATIONS

Dear Mr. Lambson:

In accordance with Paragraph K-9, page 55, of the subject contract, I am hereby designating Mr. Carl Montana, Project Manager, as being authorized to negotiate, sign, and administer contract modifications for the Bulldog Floodway and Apache Junction Flood Control Project.

Please call me at 713-954-4111 if you have any questions.

Very truly yours,

R. M. Morse

Robert M. Morse
Vice President

cc: J L Ehasz
H M Blum
C Montana

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L007

June 10, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT
INVOICE FOR PROGRESS PAYMENT NUMBER 1
CONTRACT NO. 53-9457-5-00475
INVOICE NO. USDA-852462-5

Dear Mr. Paulus:

Attached is the original and two copies of the invoice for work completed thru May 26, 1985 on the subject contract. I have also attached a copy of the rationale behind the 35% completion.

Please note that we have not included the increases resulting from Modifications 1 and 2 in the price per phase at this point.

Call me if you have any questions.

Very truly yours,

Carl Montana

Carl Montana
Project Manager

CM:mq
Attach.
cc: J L Ehasz
G Rockwell
S Goyal

United States
Department of
Agriculture

Soil
Conservation
Service

201 E. Indianola Ave.
Suite 200
Phoenix, Arizona 85012

June 6, 1985

Carl Montana
Consulting Engineer
EBASCO Services, Inc. 91st Floor
Two Work Trade Center
New York, N.Y. 10048

RE: Apache Junction/Bulldog, Contract #53-9457-5-00475
Follow-up to the minutes for the May 22, 23, 1985 monthly meeting and hydrology review

Dear Mr. Montana:

Enclosed are the following:

1. WEST NTC BULLETIN NO. W210-5-12 - to be filed with NEH-20.

2. ARIZONA BULLETIN NO. 210-5-24 - to be filed with NEH-20.

3. AT&T-C letter dated May 31, 1985 with attachments.

4. Engineering Design Standards, FAR WEST STATES - as requested.

Please review the AT&T-C proposal and reply with any comments as soon as possible. In addtion, AT&T-C contractor has scheduled the concrete portions of the cable and the manholes as his first phase of work. As a result AT&T-C would appreciate the following as it is available.

1. Culvert locations along Lost Dutchmans Blvd., sizes, and invert elevations.

2. Final centerline location.

3. Final impoundment elevation for the emergency spillway frequency.

4. Requirements for placement of earthfill.

In review of the minutes dated May 29, 1985 section:

I.5. No additional criteria was followed in the design of Signal Butte Floodway side inlets.

II. Para 3.2.2. The 8 ft/sec velocity may not be suitable for the caliche in this area (i.e. Emergency Spillway investigation). Need to determine from the investigations and perhaps the overall design picture in this area. (Elevations, grades, location, etc.).

III. As discussed by phone we are interested in pursuing the shallower cutoff depth.

Also please return the HEC-14 after you have had it copied.

Sincerely,

Donald E. Paulus
Government Representative

Enclosure

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L006

May 29, 1985

Mr. Donald R. Paulus
Government Representative
USAD Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Minutes of Monthly Meeting & Hydrology Review
May 22, 23, 1985

Dear Mr. Paulus:

Attached are copies of the minutes of the meeting held in your office last week. We found the meeting very productive. Please thank everyone who participated; Susan and Harry were especially helpful.

Very truly yours,

Carl J. Montana
Project Manager

CJM:rg
attachments

cc: J L Ehasz - w/att.
G Rockwell - "
M S Temchin- "
S Goyal - "
V M Bolano - "
D S Hunter - "

United States
Department of
Agriculture

Soil
Conservation
Service

Suite 200
201 E. Indianola Ave.
Phoenix, AZ 85012

Subject: ADMIN SERV - Bulldog Floodway & Apache Junction FRS & Outlet-Design Services Contract No. 53-9457-5-00457

Date: May 20, 1985

To: Don Paulus, Government Representative
SCS, State Office

File Code:

The work commencement notice was delivered to Ebasco Service, Inc., on May 6, 1985. Accordingly, the 306 calendar days performance time commences on May 7, 1985, and ends on the close of business March 8, 1986.

David O. Lambson
Contracting Officer

cc: Ebasco Service, Inc.
Ralph Arrington, SCE
Bill Payne, SDE

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref: USDA 3767-L005

May 17, 1985

Mr. Donald R. Paulus
Government Representive
USAD Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Monthly Meeting & Hydrology Review
May 22, 23, 1985

Dear Mr. Paulus,

This letter confirms the dates of May 22, 23, 1985 for our next meeting to be held in your office. I plan to be in your office at 12:30 PM on the 22nd and can spend the morning of the 23rd with you. I have attached an agenda for the meeting; please feel free to make any additions that you feel are needed.

I have also attached a copy of the "Design Criteria" as required in Paragraph B.1, Criteria, of the Contract and some preliminary findings related to our review of the geology and soils testing reports. We will review these at the meeting.

I would like you to have the Maricopa County officials at the meeting so we can discuss our interface with them regarding the roads, bridges, and utilities.

Very Truly Yours,

Carl Montana

Carl Montana
Project Manager

Attachments

cc: Ehasz
Rockwell
Temchin
Goyal

BUCKHORN-MESA WATERSHED

APACHE JUNCTION FLOODWAY, FRS, OUTLET AND BULLDOG FLOODWAY

AGENDA FOR MONTHLY MEETING

MAY 22, 23, 1985

USDA SCS OFFICE - PHEONIX, ARIZONA

1. STATUS OF AT&T CABLE CROSSING.

2. STATUS OF EBASCO SERVICES INCORPORATED AGREEMENTS WITH MARICOPA COUNTY FOR COORDINATION OF UTILITIES, ROAD AND BRIDGE CROSSINGS.

   A. METHOD OF CONTRACTING - PLANS AND SPECS

   B. INSPECTIONS OF ROAD AND BRIDGE CONSTRUCTION

3. REVIEW OF DESIGN NOTE 21 REQUIREMENTS

4. STATUS OF MODIFICATION FOR STUDY OF TYPE C DROP STRUCTURE

5. REFERENCE FOR DESIGN OF CURVED SIDE INLETS ON BULLDOG FLOODWAY.

6. REVIEW OF DESIGN CRITERIA (SEE ATTACHED).

7. REVIEW OF PRELIMINARY FINDINGS ON SUITABILITY OF GEOLOGICAL AND SOIL MECHANICS DATA (SEE ATTACHED).

8. REGIONAL SUBSIDENCE CONSIDERATIONS.

9. REVIEW OF PRELIMINARY FINDINGS ON HYDROLOGY REVIEW.

   A. DRAINAGE AREAS - SOME DIFFERENCES BASED ON AERIAL PHOTOS

   B. CURVE NUMBERS - GENERALLY THE SAME (WITHIN 1)

   C. TIMES OF CONCENTRATION - NEW TC'S ABOUT 30% SHORTER (METHODOLOGY USED ON BULLDOG FLOODWAY WAS UTILIZED AND SIMILAR R AND N VALUES WERE USED.

   D. PMP, 100, AND 10 YEAR RAINFALLS - SLIGHT VARIATION FROM SIGNAL BUTTE FRS HYDROLOGY FOR EXTREEM EASTERN END OF DRAINAGE AREA (LOWER THAN 1974 HYDROLOGY).

   E. INFLOW HYDROGRAPH COMPARISONS.

10. BILLING PROCEDURES

11. FREEBOARD REQUIREMENTS FOR APACHE JUNCTION FRS - SCS & STATE

12. STATUS OF LOCATION OF TRANSMISSION TOWER ON BULLDOG FLOODWAY.

13. LOCATION AND TYPE OF EMERGENCY SPILLWAY USED ON SIGNAL BUTTE DAM AS IT RELATES TO OUTLET TO BULLDOG FLOODWAY

14. APACHE JUNCTION FRS CONDUIT WILL GO DIRECTLY INTO CONRETE CHANNEL WITHOUT THE USE OF AN ENERGY DISSIPATOR

15. METHOD OF HANDLING BULLDOG FLOODWAY CENTERLINE TO ACOUNT FOR SHIFT THAT OCCURS WHERE SIDE CHANNEL INLETS JOIN CHANNEL. THIS WILL CREATE AN ALIGNMENT THAT DIFFERS FROM THE ONE SHOWN ON CURRENT SCS DRAWINGS.

16. MIMIMUM UPSTREAM SLOPE OF EMBANKMENT WILL BE 2.5 TO 1 UNLESS FLATTER SLOPES ARE REQUIRED BY STABILITY ANALYSIS.

17. BAFFLE CHUTE DESIGN CRITERIA:
    A. RECOMMENDED FLOW PER FOOT OF WITH
    B. COMPUTATION OF DEPTH OF SCOUR AT DOWNSTREAM TOE

18. USE OF HIGH DENSITY POLYETHYLENE MEMBRANE FOR CRACK CONTROL

United States
Department of
Agriculture

Soil
Conservation
Service

Suite 200
201 E. Indianola
Phoenix, AZ 85012

May 13, 1985

H. Lee Kupfer
Black & Veatch Engineers - Architects
1500 Meadow Lake Parkway
P.O. Box 8405
Kansas City, MO 64114

RE: Comments on proposal for passing AT&T cable through the Apache Junction flood control project site.

Dear Mr. Kupfer:

Per your request by letter to Mr. Al Lindley dated April 19, 1985, the Soil Conservation Service, EBASCO, and Flood Control District of Maricopa County have reviewed your proposal.

First, additional information is needed as to the suitability of the proposal. We need the following:

1. Plan of the proposed exploration to determine caliche depth.
2. Profile showing the results of the exploration.
3. Plan and profile of the proposed installation. This should include provisions for passing under the proposed culverts along Lost Dutchmans Rd.
4. Installation details including typical sections of the proposed excavations.
5. Construction specifications for the work including backfill placement.
6. Location and details of manholes.

Because of concerns about the potential for differential settlement and seepage thru the foundation area disturbed by this installation we feel the questions to backfill placement will be best answered only after the foundation and embankment design have been completed by EBASCO. Therefore, we can not comment on the range of moisture contents, densities, or method of placement at this time.

Next, if PVC conduit is to be used we would want to see the concrete encasement reinforced. An alternative to this approach would be to use a steel conduit encased with non-reinforced concrete.

The installation of a telephone cable is a Land Rights item which is ineligible for Federal cost-sharing under Public Law 83-566. The Flood Control District of Maricopa County is responsible for all Land Rights costs, including costs for design, increased construction costs, and construction inspection. We are, on behalf of the Flood Control District of Maricopa County, requesting that AT&T state their willingness to pay for the following land rights items.

1. Design Costs (Estimated at $5,865)
2. Construction Costs (Not determined)
3. Construction Inspection (Not determined)

We would appreciate an early reply to these questions since we may request that EBASCO do this design work and we may have to modify our contract with EBASCO accordingly, and bill the Flood Control District of Maricopa County for the increased cost.

The Flood Control District is also responsible for any damage to the cable or disruption of service during construction. We will submit the plan & specifications for this dam to AT&T for review.

Any work that might be needed on this cable after the dam has been constructed might require that the dam be breached or other associated excavation work. This will require SCS approval of the design and specifications, which might be more than is called for in the original plans and specifications.

W. Wayne Killgore
Asst. State Conservationist (W)

cc: Dan Sagramoso, FCDMC
Carl Montana, EBASCO
Al Lindley, AT&T Communications

United States
Department of
Agriculture

Soil
Conservation
Service

Suite 200
201 E. Indianola Ave.
Phoenix, Arizona 85012

RECEIVED
MAY 7 1985
JOAQUIN J. PEREZ

April 29, 1985

Ebasco Services Incorporated
3000 W. McArthur Blvd.
Santa Ana, CA 92704

RE: DESIGN SERVICE FOR BULLDOG AND APACHE JUNCTION FRS
& OUTLET CONTRACT NO. 53-9457-5-00457

Gentlemen:

You were awarded Contract No. 53-9457-5-00475 for design services on the Bulldog Floodway and Apache Junction FRS & Outlet on April 8, 1985.

You are hereby notified to commence and complete all work within 306 calendar days. Performance time begins the day following receipt of this notice.

If you have any questions regarding this contract, please contact Don Paulus, Government Representative, at 602-241-5143.

Sincerely,

David O. Lambson
Contracting Officer

cc: Don Paulus, Gov't Rep.
Ralph Arrington, SCE
Bill Payne, SDE

United States
Department of
Agriculture

Soil
Conservation
Service

201 E. Indianola Ave.
Suite 200
Phoenix, Arizona 85012

April 25, 1985

Carl Montana
Consulting Engineer
EBASCO Services Incorporated
Two Work Trade Center
New York, NY 10048

RE: Apache Junction/Bulldog Contract #53-9457-5-00475

Dear Mr. Montana:

As of this date we have not received the minutes summarizing the discussions and decisions reached during the pre-design conference which was held 4-16-85.

After the pre-design conference the following materials were supplied by the SCS:

1. Topographic map of downstream area of the Apache Dam.

2. One copy of the drawings and specifications for Signal Butte FRS and Pass Mountain Diversion and Outlet.

3. Development Guide for Apache Junction.

Enclosed are the following materials:

1. Copy of the cover of HEC-14, Hydraulic Design of Energy Dissipators for Culverts and Channels.

2. West NTC Bulletin No. 210-4-28, ENG-Construction-Computation of Performance Time for Contracts Using the Federal Acquisition Regulation, with rainfall summary tables.

3. Abstract of proposals for a.) Signal Butte Floodway and b.) RWCD, Reach-3.

4. SCS-ENG-353A, Rev. 11-71, Grain Size Distribution/Soil Classification.

5. Underground Conduit Loading worksheets (2 of 2) (use with TR-5).

6. Joint Gap computation sheet (use with TR-18).

7. Pipe Strength Computation sheet.

8. Work sheet for data on Flood Routing Hydraulics.

9. Tractive Stress, d75 > 1/4" and d75 <1/4"; and Tractive Power d75 < 1/4" work sheets.

10. Report: Cracking of Dams in Arizona, April 27, 1978. (Since this report additional studies in this subject area have been completed by the SCS. Results of these studies are presently being put into report but will not be available during this design contract. However, you may want to discuss some of the results with the members of the Crack Study Team. Some of the present conclusions may differ from those given in the 1978 report!).

11. Bulldog Floodway Design Hydrology, Revised 1985. (Both revised pages and void pages are enclosed.)

The title of the paper on strength of caliche which you were interested in is "A Classification of Ca Horizons in Soils of a Desert Region". Reprinted from Soil Science Society of America Proceedings, Volume 25, No. 1, Jan.-Feb. 1961, pages 52-61.

Under separate cover we are sending the following:

1. Mylar drawings of:

   a. Title Sheet Apache Junction Floodwater Retarding Structure

   b. Plan and Profile Apache Junction FRS, 9 sheets

   c. Plan and Profile Apache Junction Floodway, 2 sheets

   d. Plan and Profile Apache Junction FRS Outlet, 2 sheets

   e. Title Sheet Bulldog Floodway

   f. Plan and Profile Bulldog Floodway, 6 sheets

2. SCS-ENG-313C mylar sheets, 21 sheets

3. SCS-ENG-317 mylar sheets, 5 sheets

In answer to a few of the questions which came up during the pre-design conference:

1. Right of Entry permits will continually be renewed until time of construction.

2. Apache Junction Floodway will begin at station 11+00 as drawn on the plan and profile mylars, (NOTE: station 10+00 work plan equals station 11+00 present).

3. We will not study the cost of land acquisition downstream of the dam in choosing our Emergency Spillway location. Therefore, no additional downstream routings will be needed.

4. No earth test sections will be done for crack studies of Apache FRS.

We have reviewed your proposal of considering a third alternate emergency spillway structure. This would be a low Type C drop structure along the earth emergency spillway centerline. We are interested in this type of alternative and would like for you to submit to us a proposal to perform the additional work. The work shall follow the specifications set for Phase I of this contract.

Sincerely,

Donald E. Paulus

Donald E. Paulus
Government Representative

BLACK & VEATCH
ENGINEERS-ARCHITECTS

TEL (913) 967-2000
TELEX 42-6263

1500 MEADOW LAKE PARKWAY
MAILING ADDRESS PO BOX NO 8405
KANSAS CITY MISSOURI 64114

AT&T Communications
Southern Transcontinental
Lightguide System
Permits and Licenses

B&V Project 11380
B&V File M620-31.32.0600
April 19, 1985

AT&T Communications
221 East Indianola, Suite 216
Phoenix, Arizona 85012

Attention: Mr. Al Lindley

Gentlemen:

Enclosed for your information is the conference memorandum for our April 16, 1985, meeting with the Soil Conservation Service (SCS), the Maricopa County Flood Control District (MCFCD), and several other organizations with interest in the Apache Junction flood control project. Our purpose for attending was to coordinate cable design through the flood control project site with design of the flood control structure.

Based on this meeting and subsequent discussions with Mr. Don Paulus of the SCS, Black & Veatch (B&V) has developed the following proposed design coordination agreement terms for review by AT&T Communications (AT&T-C).

AT&T-C Commitments

1. AT&T-C will determine the depth of caliche material under the dam at the cable crossing and construct the cable at a depth of at least three feet below the top of the caliche material, or at least 10 feet deep, whichever is deepest. Cable construction at this depth will extend to points beyond each side of the dam core base. The cable will be placed in a four inch diameter PVC conduit, encased in concrete. The excavated caliche material will be backfilled to the top of the surrounding caliche material and compacted to 97 percent of maximum density, at -1 percent to +3 percent of optimum moisture content as determined by ASTM D698. Caliche backfill partical size will not exceed six inches. Remaining backfill will be compacted to 95 percent of maximum density at ± 5 percent optimum moisture.

2. AT&T-C will construct cable under all other portions of the flood control project right-of-way at a depth of at least four feet below existing grade. The cable will be placed in a four inch diameter PVC conduit encased in concrete. Backfill will be compacted to 95 percent of maximum density.

3. AT&T-C will place easily visable cable marker poles at 500 foot centers, and cable warning tape at one above all cable constructed within the proposed flood control project right-of-way.

4. Cable maintenance is planned to be from manholes west of the dam or east of the impoundment area. If cable excavation is required at the dam, AT&T-C will reconstruct the dam to the original design specifications.

5. AT&T-C will provide SCS/MCFCD with construction and as-built cable construction drawings.

SCS/MCFCD Commitments

1. SCS/MCFCD will finalize the dam centerline location, core base width, and maximum impoundment water elevation by September 1, 1985.

2. SCS/MCFCD will provide design and construction required to interface the dam's drain system with the cable under the dam. SCS will advise AT&T-C at least three days before excavating to the cable for this interface.

3. SCS/MCFCD will limit barrowing to outside the limits of the corridor that will be granted to AT&T-C by the Bureau of Land Management. (This corridor could adjoin a corridor excluded from barrowing for Lost Dutchman Road construction across the impoundment area)

B&V believes that these proposed terms offer a practical and fair means of sharing the work required to interface the two projects. By copy of this letter to Mr. Don Paulus of the SCS, Ms. Cora Hernandez of the MCFCD, and Mr. Carl Montana of Ebasco Services, we request that these parties provide comments to B&V through Mr. Paulus concerning the proposed coordination terms by May 10, 1985.

An addendum based on a conservative estimate of how these terms will affect the lightguide contractor's work will be discussed at a prebid meeting on April 24, 1985 and issued on April 29, 1985, pending an initial concurrance from AT&T-C.

Please provide us with AT&T-C comments at your earliest convenience.

If you have any questions, please call.

Very truly yours,

BLACK & VEATCH

H. Lee Kupfer

H. Lee Kupfer

kfb
Enclosure
cc: AT&T-C, w/encl.
Mr. Bill Simson, w/encl.
Mr. Ken Reinart, w/encl.
Mr. Clay Ricker, w/encl.
Mr. Don Paulus, w/encl.
Mr. Carl Montana, w/encl.

BLACK & VEATCH

CONFERENCE MEMORANDUM

AT&T Communications
Southern Transcontinental
Lightguide System

B&V Project 11380
B&V File M620-31.15.0200
April 19, 1985

Meeting held in Soil Conservation Service offices in Phoenix on April 16, 1985.

Attending:

Soil Conservation Service (SCS)

LTR

Maricopa County Flood Control District

LTR

Coates Field Services

K. Reinart

Ebasco Services

LTR

Salt River Project

LTR

Black & Veatch (B&V)

L. Kupfer

Background. AT&T must show that cable design across the future Apache Junction Flood control structure has been coordinated with the flood control structure design in order to obtain a grant for this area from BLM. The Soil Conservation Service has recently retained Ebasco to design the Apache Junction Flood Retaining Structure, which will cross the lightguide cable route near the intersection at Lost Dutchman and Idaho Roads. Maricopa County Flood Control District is the local project administrator for the (SCS).

Meeting. The purpose of the meeting was to address design concerns from outside the SCS, and other project pre-design items. B&V and Coates attended only the first hour of the meeting, which was devoted to AT&T's interests.

1. B&V described the cable route (40 feet north of Lost Dutchman Road), noted that cable construction must precede dam construction, and asked how cable construction could accommodate dam design.

2. Ebasco advised that the cable would not be a design consideration if constructed at least two feet below the top of the caliche soil, and backfill was adequately compacted. Preliminary soil data indicates the caliche soil is typically five feet deep along the dam site, and as deep as 12 feet at isolated areas. Specific excavation requirements for the dam will not be known until September 1, 1985. A conservative cable depth based on information known today would be 15 feet.

CONFERENCE MEMORANDUM

3. Ebasco noted that floodway area barrowing will affect cable depth across a majority of the floodway. A preliminary SCS report calls for barrowing from an area 1200 feet wide along the upstream side of the dam (1700 feet of cable route). Barrow depths will vary depending upon dam design alternatives and the soils found in the barrow area. The cable would have to be 15 feet deep under the entire barrow area to be conservative based on information known to date. Ebasco's planned soil investigations would have to be supplemented by a special investigation along the cable route to determine a practical cable depth.

4. Ebasco noted that barrowing could be limited to either side of a corridor containing the cable. The restriction would result in extra construction cost.

5. B&V asked when bids would be requested for the flood control project work. The SCS responded that bidding would not proceed until additional funding was available.

6. Coates asked if the project had obtained environmental approval. The SCS indicated there were no environmental obstacles.

7. The SCS expressed concern that cable maintenance could require excavation that would breach the dam. B&V advised that the cable would be placed in conduit encased in concrete under the dam. Cable maintenance would be performed by replacing the cable from manholes or excavations located away from the dam.

8. The SCS expressed concern that they could be exposed to liability and extra costs resulting from cable construction under the flood control project. B&V advised that the cable would be constructed such that it would not be visable to the dam structure.

9. Maricopa County Flood Control District advised that road construction alternatives may require the dam centerline location be moved to the intersection of Lost Dutchman and Idaho Roads.

10. B&V advised that they would consider alternatives for interfacing cable construction with dam design and construction.

kab

11046 (SH) 5-82

EBASCO SERVICES INCORPORATED

RECORD OF TELEPHONE CONVERSATION

~~FOR SHEARON HARRIS NUCLEAR POWER PLANT~~

INSTRUCTIONS:
White – Retain for preparer's use
Yellow & Pink – To Project Engineer ~~(yellow until then be forwarded to client)~~

FILE

TO FILE - TELEPHONE CONVERSATION

DATE 4-24-85

FROM S GOYAL

SUBJECT USDA - SCS - PHOENIX AR. BULLDOG/APACHE JUNCTION FLOOD CONTROL PROJ

CHARGE DEPT NO. 550 USDA 3767.100 ~~CAR 6418~~.

DOCUMENTS REFERENCED/APPROVED (FCR'S, DCN'S, ETC.)

DISCUSSION: The layout of Idaho road and Lost Dutchmans road intersection and the dam were discussed with Don Paulus. Burial of ATET cables in the reservoir area and under the dam were also discussed.

Don informed Ebasco that the layout of roads and the dam will stay as shown on the drawing. The dam width would be locally increased to account for the road intersection. The top of roads at the intersection and the top of the dam will be at the same elevation. The layout of roads has however not been finalized

Don will inform ATET that the cables will have to be lowered under the existing locally and also that the layout of road may change in the final design.

COMMENTS: Don informed Ebasco that County has received the Ebasco proposal for roads etc this morning

cc. Carl Montana.

BY S. Goyal NAME TITLE 550 DEPT NO.

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref.: USDA.3767-L002

April 24, 1985

Mr. Donald R. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: BULLDOG FLOODWAY AND APACHE JUNCTION
FLOOD CONTROL PROJECT
MINUTES OF PREDESIGN MEETING

Dear Mr. Paulus:

Attached are the Minutes of the Predesign Meeting held in your office on April 16, 1985. I have identified items that we agreed would be done by each of us throughout them.

If you have any questions or comments please call me.

I would like to thank you for the time you gave us on the 15th; it was very helpful. Please thank Harry for us.

Very truly yours,

Carl Montana

Carl Montana
Project Manager

CM:mq

ATTACH.

cc: M S Temchin
G Rockwell
S N Goyal

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

EBASCO

File Ref.: USDA 3767-L001

April 22, 1985

Mr. Donald E. Paulus
Government Representative
USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Subject: Bulldog Floodway and Apache Junction
Flood Control Project
Design Note 21

Dear Mr. Paulus:

As agreed, we are evaluating the subject design note which was brought to our attention for the first time at the pre-design meeting held on April 16, 1985 in Phoenix.

A preliminary review, made without going into actual computations, indicates that Design Note 21 may not significantly affect Ebasco's design effort if we are not required to provide documentary calculations for all potential reinforcing steel substitutions. Conversely, should SCS require that an analysis be made for each reinforcing steel calculation made on the basis of Grade 40 steel, including those for the standard drawings to be provided by SCS, we believe the impacts on our cost and schedule could be significant.

I am sure you understand that we cannot adequately evaluate the effect the introduction of Design Note 21 will have on our design effort until SCS defines what will be required to satisfactorily document compliance. We would appreciate clarification on this as soon as possible.

Very truly yours,

Carl Montana

Carl J. Montana, P.E.
Project Manager

CJM:rg

cc: J L Ehasz
M S Temchin
G Rockwell
S N Goyal

EBASCO SERVICES INCORPORATED
Two World Trade Center, New York, N.Y. 10048

EBASCO

April 8, 1985

Mr. Donald E. Paulus
Government Representative
USDA Soil Conservation
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Dear Mr. Paulus:

As requested, I have attached a list of questions we would like to discuss at our April 16th meeting. We are completing the detail schedule for Phases I and II and will bring it with us to the pre-design meeting.

Very truly yours,

Carl J. Montana
Project Manager

CJM:rg
attachment

bc: S N Goyal - w/att.
M S Temchin - "
D S Hunter - "
V M Bolano - "

QUESTIONS FOR PRE-DESIGN MEETING

1. What are landrights acquisitions based on? How high can we raise top-of-dam?

2. Emergency spillway earth channel as proposed will outlet directly into the concrete outlet channel and would cause its loss should it flow. Has a pipe been considered for the Apache Junction Outlet?

3. Does the stage storage data provided contain the volume for material excavated as borrow material?

4. Can we obtain copies of the approrpiate soil surveys?

5. What purpose does running the emergency spillway storm serve?
   a) Structural spillway must be stable for the PMP
   b) The earth emergency must be checked using Oe/b for PMP.

6. Can we obtain copies of construction costs for use on cost estimates?

7. Procedures to be used for conduit design. Can manufacturer's recommendations be used? Are TR-5, TR-18, and DN-2 to be used? Obtain copies of TN-1, TN-2, and SN-5 that are listed in the list of references. How do they apply?

8. What procedure is used by SCS to design the energy dissipators at the end of the concrete channels? DN 22 COE EM 1110-2-1603 HYDRAULIC DESIGN

9. What procedure is used by SCS for estimating the depth of scour below the baffle chute structure? BUR REC. AND PROC. FR

10. Has consideration been given to using the excavated material from the channel construction as the earth fill in the FRS?

11. What have you used as allowable velocities in the Calachi? DO NOT USE VELOCITY IN TR-52.

12. How have you been treating the Calachi when evaluating it in accordance with TR-52 requirements? WE WILL EVALUATE

13. Explain the reference to "error" on page 6 of the Watershed Supporting Data.

14. Is there any inflow to the Apache Floodway at STA 10 + 00 from the area east of the Apache Trail? Is any inflow from the Apache Trail?

15. Will we be required to use your standard computation sheets, such as the one for conduit design?

United States
Department of
Agriculture

Soil
Conservation
Service

201 E. Indianola Ave.
Suite 200
Phoenix, Arizona 85012

April 1,1985

Carl Montana
Consulting Engineer
EBASCO Services Incorporated
Two World Trade Center
New York, NY 10048

RE: Apache Junction-Bulldog Design Contract
Phase I, Pre-design Conference

Dear Mr. Montana:

Atached is a copy of the tentative agenda for the Phase I, pre-design conference.

The design references listed in the "topics for discussion" on the attached agenda are enclosed for your review. Additional information on soil test results and utility information are also enclosed.

Please submit to us by April 10th for our review, any additional criteria or methods that you believe would be advantageous in design. In addition, please send a detailed design schedule for this phase of work.

Additional materials that are being furnished by the SCS will be available at this conference.

Donald E. Paulus

Donald E. Paulus
Government Representative

BUCKHORN-MESA

APACHE JUNCTION FLOODWAY, FRS, OUTLET AND BULLDOG FLOODWAY

MEETING: April 16, 1985 8:30 a.m. - tentative

LOCATION: Soil Conservation Service, Phoenix Office, 201 E. Indianola Avenue, Suite 200

ATTENDANCE: Soil Conservation Service (SCS)
EBASCO Services, Inc.
Flood Control District of Maricopa County (FCDMC)
City of Apache Junction
Salt River Project

SUBJECT: Phase 1, Pre-design Conference

TOPICS FOR DISCUSSION:

A. Design concerns from outside the SCS
   1. City of Apache Junction
   2. Pinal county
   3. FCDMC
   4. Salt River Project
   5. AT&T

B. Review SCS design standards and criteria. (NOTE: Design references have been generally categorized as shown below for discussion purposes.)

   1. HYDRAULICS

      a.) NEH-5
      b.) TR-39
      c.) TR-29
      d.) TR-70
      e.) TR-48

   2. STRUCTURE

      a.) TR-18
      b.) TR-46
      c.) TR-30
      d.) TR-5
      e.) TR-67
      f.) NEH-6
      g.) Eng. Monograph No. 25 (USBR)
      h.) TR-63
      i.) NEH-14
      j.) TR-50
      k.) TR-49
      l.) NEH-11

3. SOILS/LAYOUT

a.) TR-25
b.) ICES Lease-11
c.) SMN-3
d.) ENG-PO-18
e.) SMN-1 (NOTE: Being revised. May be available by this meeting)
f.) TR-52
g.) TR-2

4. HYDROLOGY

a.) TR-66
b.) TR-16
c.) Hydrometeorological Report No. 49
d.) Hydrology-PO-6 (Rev. 2)
e.) TR-20
f.) TR-61
g.) NEH-4
h.) NOAA-Atlas 2
i.) Curve Number Reduction Factors (NOTE: This material will be available at the time of this meeting)

5. OTHER

a.) TR-60
b.) NEH-20
c.) NEH-2
d.) Catalog of National Engineering Standard Drawings

C. Additional criteria or methods the A&E believes would be advantageous

D. Review the detailed design schedule for Phase 1

E. Review specification

F. Review contract requirements

G. General questions

United States
Department of
Agriculture

Soil
Conservation
Service

201 E. Indianola Ave.
Suite 200
Phoenix, Arizona 85012

February 22, 1985

Carl J. Montana
EBASCO Services Inc.
Two World Trade Center
New York, NY 10048

RE: Apache Junction - Bulldog Specifications

Dear Mr. Montana:

As a result of our meeting held 2/11/85, we have made extensive revisions to restructure and clairfy the specifications of the subject job. Enclosed you should find the revised specification and examples of the following:

1. Soils mechanics report (narative only)

2. Design reports

3. Operation and maintenance report

Under separate cover you will receive the following examples:

1. Grouted rock drop structure

2. SCS impact basin

3. SCS standard cover riser

4. Grouted rock plunge pool

Examples of a Design Hydrology Report and Hydrologic Investigation, Emergency Action Plan are being copied and will be sent by express mail when completed.

Please read the specification carefully and review the example work furnished. Submit your cost proposal following the new format of the revised specification.

If you have any questions please call me.

Sincerely,

Donald E. Paulus

Donald E. Paulus
Government Representative

EBASCO SERVICES INCORPORATED
3000 W. MacArthur Blvd., Santa Ana, CA 92704, (714) 662-4000

EBASCO

February 5, 1985

USDA Soil Conservation Service
Suite 200
201 East Indianola
Phoenix, Arizona 85012

Attention: David O. Lambson
Contract Specialist

Re: COST PROPOSAL FOR BULLDOG FLOODWAY AND
APACHE JUNCTION FLOODWAY, FRS AND OUTLET

Attached you will find our cost proposal with supporting documentation. This cost proposal is based upon our understanding of the "Scope-of-Work" as presented in the specifications, the supporting data provided, and conversations with Don Paulus on January 31, 1985, documented in the attached Memo to File.

As you know, the scope-of-work requires a fixed price on all phases of work. Phase II calls for a fixed price while asking for comparative design studies and cost estimates on the general features of the project with no limit on the type or number of structures to be studied. Phase III requires a fixed price for final design on features that have yet to be established. We are sure you realize this makes establishing a fixed price extremely risky from our point of view. The most significant example would be the possibility of Ebasco having to design a reinforced concrete drop structure in lieu of an earth emergency spillway. We have had to base our estimates on the assumption that we would have to design the most complex structures resulting from the Phase II studies.

It is our belief that the most equitable approach for both the SCS and Ebasco would be to have Phase I redefined as a Feasibility Study including the Geology and Soil Mechanics Review together with the Hydrologic and Hydraulic Analysis of the Apache Junction FRS. It should not include slope stability analysis, drain design, seepage analysis and other detail design studies which should be in Phase II or Phase III. This would permit us to establish all features prior to effort being spent on design, quantities, cost estimates, and specifications as would be the case under the present scope of work. Phase II, Preliminary Design, could then be limited to a finite number of alternatives established upon completion of Phase I. Phase III, Final Design, would then naturally be tied to the selected alternative. The price for Phase II could be negotiated after completion of Phase I, and Phase III would be negotiated upon completion of Phase II. This arrangement would

give both the SCS and Ebasco a well defined scope of work in each phase upon which to base our estimates. We would like you to consider this suggestion and would be happy to discuss this with you over the phone or at our meeting on the 19th.

The price proposal provided is based upon the scope-of-work and includes the following assumptions:

ASSUMPTIONS MADE RELATIVE TO CONTRACT IN PREPARING ESTIMATE:

1. Section C, Paragraph A.4 (Pg. 8): "Other Conferences" shall be considered out-of-scope and billed at a rate to be agreed upon. All "specified conferences" are included in the price proposal. It is also assumed that conferences for Bulldog Floodway can be held concurrently with Apache Junction conferences.

2. Section C. Paragraph B.2 (Pg. 13): It is assumed for purposes of this estimate that the geological investigation and materials testing is adequate for design.

3. Section C, Paragraph B.3.a.III.A.3 (Pg. 14): SCS will supply Ebasco with reproducible copies of the plan and plan-profile sheets which will be suitable for use in completion of Phase I.

4. Section C, Paragraph B.3.a.III.I.2 (Pg. 22): Analysis will be made utilizing TR-52. Cost proposal includes the cost of studying structural alternatives and the assumption that a structural spillway will be required based on the existing geology report and discussions with Don Paulus on January 31, 1985.

5. Section C, Paragraph C.1.b (Pg. 25): In preparing the cost proposal it was assumed, based on conversations with Don Paulus, that energy dissipators are required at the ends of both the Apache Junction Floodway and the Bulldog Floodway. It was also assumed that a structural emergency spillway will be required for the Apache Junction FRS.

6. Section C, Paragraph C.3.a (Pg. 26): No hydrology study is required for the Bulldog Floodway Project.

7. Section C, Paragraph C.3.c (Pg. 26): Topography is available on which to prepare the inundation maps.

8. Section C, Paragraph C.4.b (Pg. 26): The Ironwood and Meridian road crossings will be designed and construction plans and specifications prepared by the Flood Control District of Maricopa County. Ebasco will coordinate with the District.

9. Section C, Paragraph C.4.c (Pg. 26): Relocation and modification of utilities will be handled by the utility. Ebasco will coordinate its design with the utility.

10. Section C, Paragraph D.4 (Pg. 29): The topography provided by the SCS is adequate for Final Design and Quantities.

11. The irrigation system referred to in the EIS is not required.

12. The "model study" referred to in footnote 14 in the Supplement to the Work Plan is not a part of this contract.

If you have any questions please feel free to call me at (714) 662-4105. I look forward to our meeting on February 19, 1985.

Very truly yours,

Joaquin J. Perez

Joaquin J. Perez
Manager, Projects Development

JJP/

EBASCO

Interoffice Correspondence

DATE February 1, 1985 FILE REF

TO FILE OFFICE LOCATION

FROM C J Montana OFFICE LOCATION

SUBJECT RECORD OF TELEPHONE CONVERSATION 1/31/85
USDA SOIL CONSERVATION SERVICE, PHOENIX, ARIZONA

On January 31, 1985 Myron Temchin and I spoke to Don Paulus, SCS Government Representative on the Bulldog Floodway and Apache Junction Project to resolve questions that arose while we were preparing the price proposal.

Question: As we see the project, energy dissipators may be required at the ends of both the Bulldog Floodway and Apache Junction Floodway. The plans provided do not reflect this. How do you see this and should our price proposal include the costs associated with these?

Response: SCS now believes that energy dissipators will be needed at the outlet of both dloodways and your price should include this work.

Question: Has the Oe/b requirement been met regarding the use of an earth emergency spillway as proposed in the two alternate layouts provided? Is there the possibility that we will have to design a structural emergency spillway?

Response: SCS now anticipates that a structural emergency spillway will be required. The SCS Geologist has stated that an earth spillway cannot satisfy current requirements. SCS would like an evaluation of this but Ebasco should assume a structural spillway will be needed.

Question: Are maps available for the area downstream of the dam on which we can prepare the inundation maps associated with the dam break analysis?

Response: Yes!

Question: Are we expected to complete the model study referred to in the Work Plan Supplement in footnote 14?

Response: No!

Question: Can we get reproducibles of the plan and plan-profile sheets provided so we can use them in completing Phase I?

Response: Yes!

Question: What do you propose to do with Idaho Road where it intersects the proposed centerline of the Apache Junction FRS?

Response: The road will be continued by ramping it up and over the dam.

Question: Who will be responsible for completing any design work and preparing plans and specifications for any modifications required to the utility towers both in the dam area and along Bulldog Floodway?

Response: This work will be completed by the utility company. Ebasco must coordinate with the utility.

Question: Who will be responsible for designing and preparing plans and specifications for the road crossings along Bulldog Floodway?

Response: This work will be performed by Maricopa County. Ebasco must coordinate with the County and provide them with the information needed for design such as line, grade, opening.

Question: Are you satisfied with the accuracy of the topography provided for final design purposes?

Response: Yes! The topography provided on the plan-profile sheets is 1983 topo.

Question: Do you want the flat side slope (6 to 1) on the dam as stated in the EIS for visual resource purposes and the installation of an irrigation system also called for in the EIS?

Response: Neither is required. (Don called this information back to us after clarifying it with other members of the staff in Phoenix.)

CJM:rg

cc: J L Ehasz
M L Temchin

VIII. SUPPORTING DATA

SECTION VIII SUPPORTING DATA

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HYDROLOGY

DJA 4/30/85

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

Drainage APACHE JUNCTION FRS

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

Area 6.15 (prelim.) mi^2 (km^2)

Month July

Step	Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16	12.65 in. (mm)					
2. Reduction for barrier-elevation [fig. 2.18]	80 %					
3. Barrier-elevation reduced PMP [step 1 X step 2]	10.12 in. (mm)					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	76	90	96	100	111	115 %
5. Convergence PMP for indicated durations [steps 3 X 4]	7.69	9.11	9.72	10.12	11.23	11.64 in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	7.69	1.42	.61	.40	1.11	.41 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	100 %					
8. Areally reduced PMP [step 6 X step 7]	[illegible] in. (mm)					
9. Drainage average PMP [accumulated values of step 8]	7.69	9.11	9.72	10.12	11.23	11.64 in. (mm)
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d.	4.5 in. (mm) REVISED					
2. Areal reduction [figure 3.20]	100 %					
3. Adjustment for month [one of figs. 3.12 to 3.17]	83 %					
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	3.74 in. (mm)					
5. Durational variation [table 3.9] ~~3.6~~	36	63	84	100	139	157 %
6. Orographic PMP for given durations [steps 4 X 5]	1.35	2.35	3.13	3.74	5.19	5.86 in. (mm)
C. Total PMP						
1. Add steps A9 and B6	9.0	11.5	12.8	13.9	16.4	17.5 in. (mm)

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

2

DJA 4/30/85

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

Drainage APACHE JUNCTION FRS

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

Area 6.15 (prelim.) mi^2 (km^2)

Month August

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

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

DJH 4/30/85

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

Drainage APACHE JUNCTION FRS

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

Area 6.15 (prelim.) mi^2 (km^2)

Month September

Step	Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16	13.9 in. (mm) August is greater					
2. Reduction for barrier-elevation [fig. 2.18]	80 %					
3. Barrier-elevation reduced PMP [step 1 X step 2]	11.0 in. (mm)					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].						
5. Convergence PMP for indicated durations [steps 3 X 4]						%
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]						in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]						in. (mm)
8. Areally reduced PMP [step 6 X step 7]						%
9. Drainage average PMP [accumulated values of step 8]						in. (mm)
B. Orographic PMP						in. (mm)
1. Drainage average orographic index from figure 3.11a to d.	4.5 in. (mm) REVISE					
2. Areal reduction [figure 3.20]	100 %					
3. Adjustment for month [one of figs. 3.12 to 3.17]	100 %					
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	4.5 in. (mm)					
5. Durational variation [table 39] ~~3.6~~						
6. Orographic PMP for given durations [steps 4 X 5]						%
C. Total PMP						in. (mm)
1. Add steps A9 and B6						in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.						
3. Comparison with local-storm PMP (see sec. 6.3).						

DSA 4/30/85

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

Drainage APACHE JUNCTION FRS Area 6.15 (prelim) mi^2 (km^2)
Latitude 33°27' Longitude 111°31' Minimum Elevation 1790 ft (m)

Steps correspond to those in sec. 6.3A.

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

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

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

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

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

9. Time sequence of incremental PMP according to:

   Hourly increments [table 4.7]. 0.3 0.8 10.1 1.7 0.5 0.3 in. (mm)

   Four largest 15-min. increments [table 4.8]. 6.9 1.8 0.8 0.6 in. (mm)

EBASCO SERVICES INCORPORATED

BY DSA DATE 6/26/85 (revision) SHEET 1 OF 4

CHKD. BY _____ DATE _____ OFS NO. 3767.100 DEPT. NO. 930

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

SUBJECT 100-year, 25-year PRECIPITATION

24-HOUR PRECIPITATION

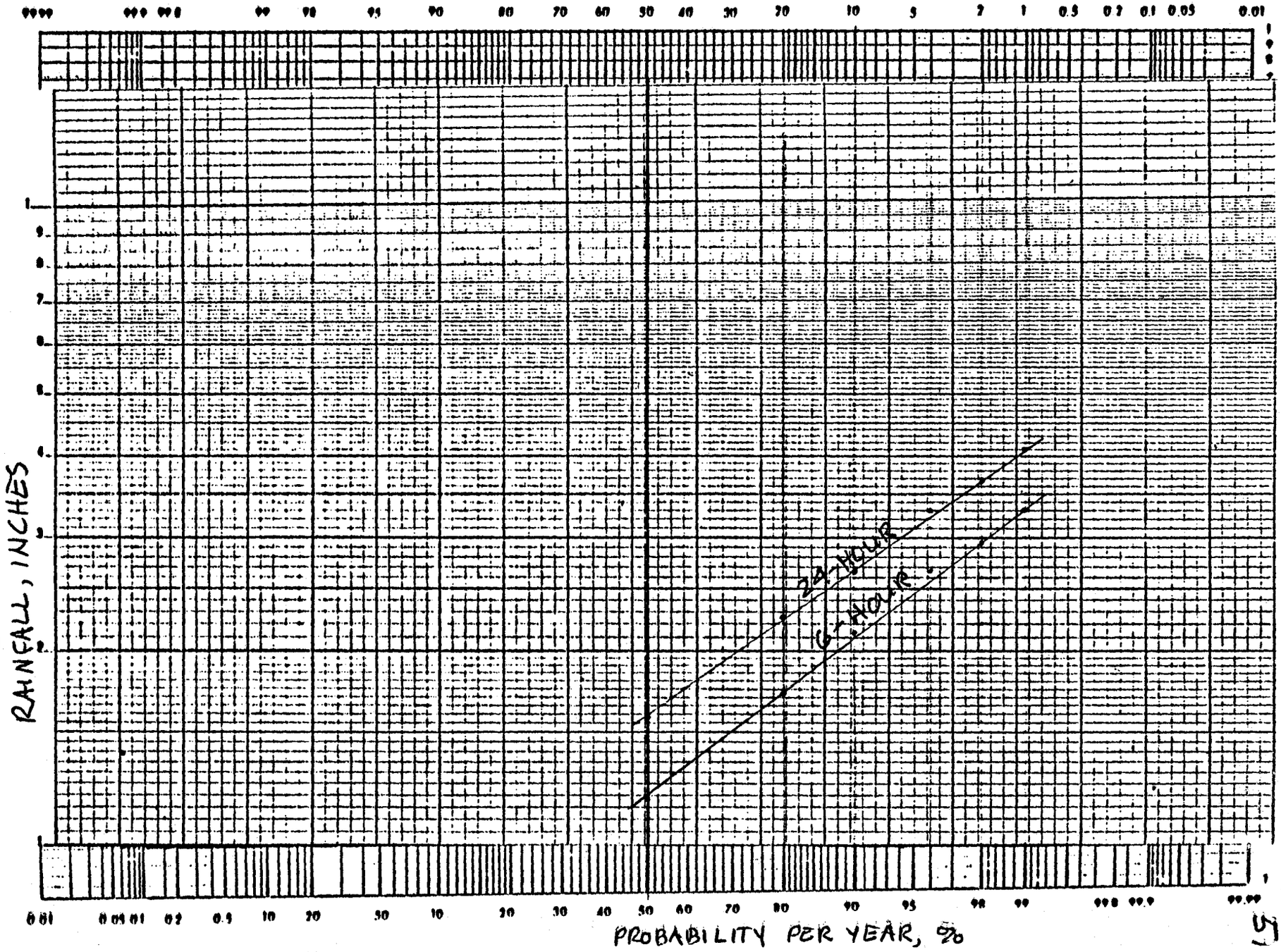
Return Period, yr.	Map Value, in.*	Factor**	Plotted Value, in.	Curve Value, in. (NEXT PAGE)
100	4.10	1	4.10	4.10
50	3.65	1	3.65	3.65
25	3.30	1	3.30	3.20
10	2.70	.99	2.67	2.67
5	2.35	.96	2.26	2.24
2	1.80	.88	1.58	1.58

6-HOUR PRECIPITATION

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

* SOURCE: NOAA ATLAS 2, VOLUME VIII

** SOURCE: TSC TECHNICAL NOTE PO-6


K+E SEMI-LOGARITHMIC 47 4970
2 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO.
RAINFALL, INCHES
24-HOUR
6-HOUR
PROBABILITY PER YEAR, %
Probability (Long-axis) by 3 Cycle Log

EBASCO SERVICES INCORPORATED

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

CHKD. BY ____ DATE ____ OFS NO. 3767.100 DEPT. NO. 930

CLIENT USDA-SCS

PROJECT APACHE JCT. FRS

SUBJECT 10-day, 25+100-yr precipitation

From TSC NOTE PO-6 (Rev. 2)

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

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

2. Region 7 from Fig. B-1

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

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

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

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

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

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

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

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

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

$E_{5,4}(6\ hr)$
$= P_{100} \times .25(P_{100}-P_{100})$
$3.3 + .24(3.7-3.3)$
$= 6.00$ in

581/8-81

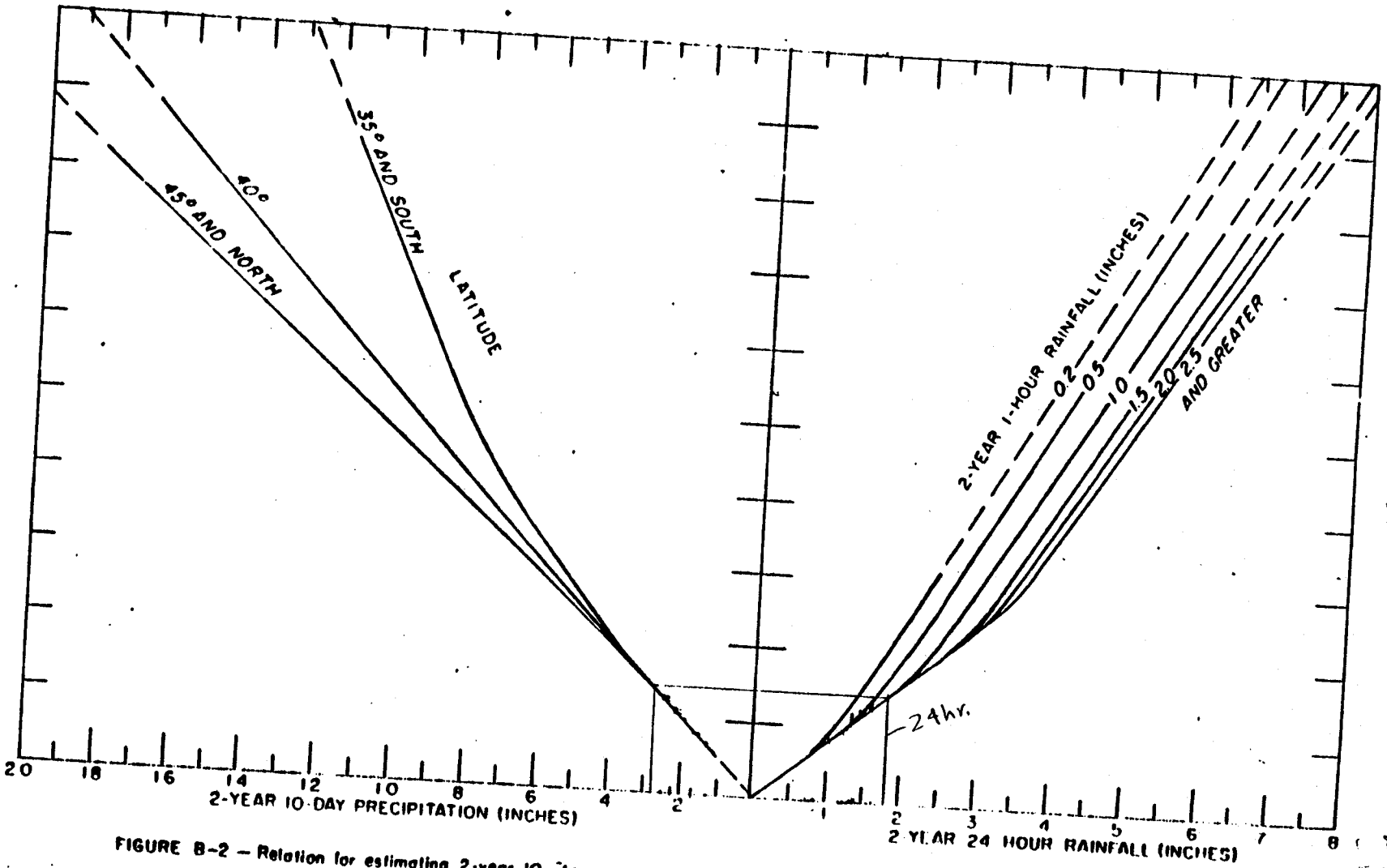


FIGURE B-2 — Relation for estimating 2-year 10-day precipitation from 2-year 1- and 24-hour rainfall and latitude

BH 5/2/85

3/4

DJH 5/2/85

4/4

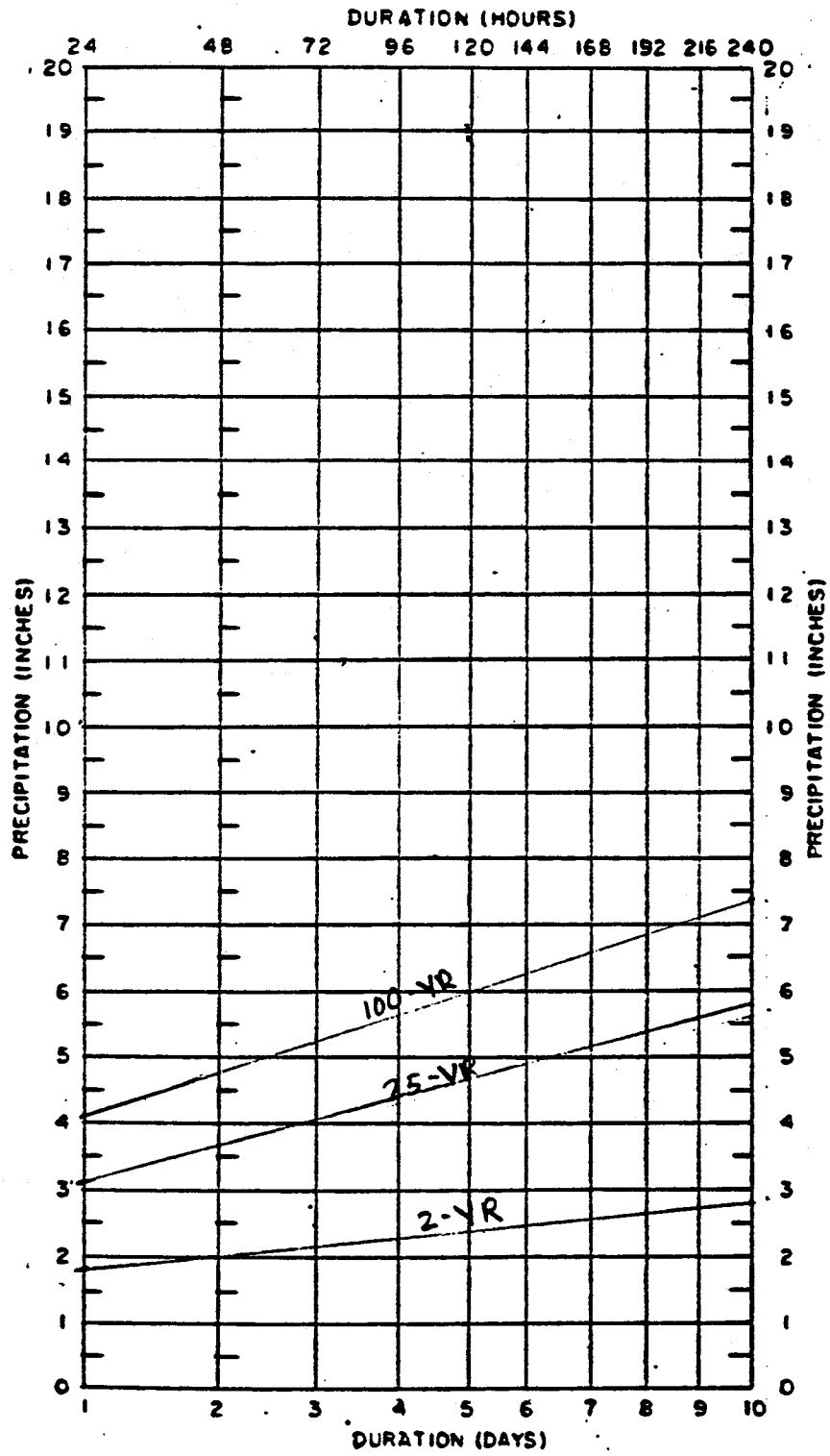
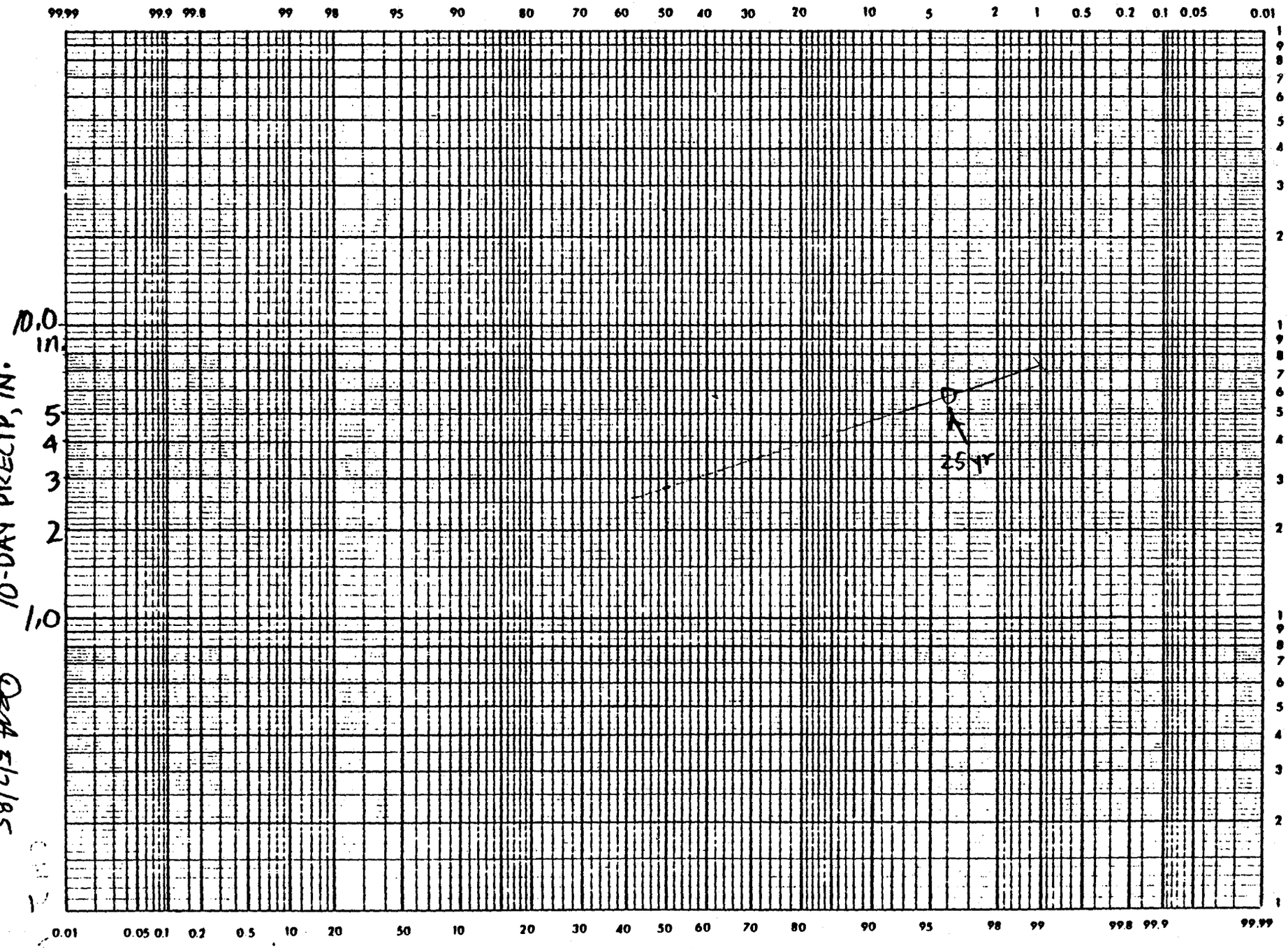


FIGURE B-4—Duration-interpolation diagram



QBA 5/2/85

GRAPH PAPER From Your COPIER—HPBooks

EBASCO SERVICES INCORPORATED

BY BJA DATE 5/3/85 SHEET 1 OF

CHKD. BY Cjm DATE 5/85 OFS NO. 3767.100 DEPT. NO. 930

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASIN AND SUB-BASINS

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

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BY GA DATE 5/3/85 SHEET 2 OF

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PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS AND SUBBASINS

SUMMARY

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

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BY EJA DATE 5/3/85 SHEET 3 OF

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PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - AREAS

Planimeter Calibration (Map scale 1:24000)

1 square mile reads 0.~~468~~, 0.465, 0.465, 0.465

To convert reading to sq. mi, divide by 0.465

Total drainage basin (not including 3A)

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

Subbasin 1

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

Subbasin 1A

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

Subbasin 1B

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

Subbasin 1C

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

Subbasin 2

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

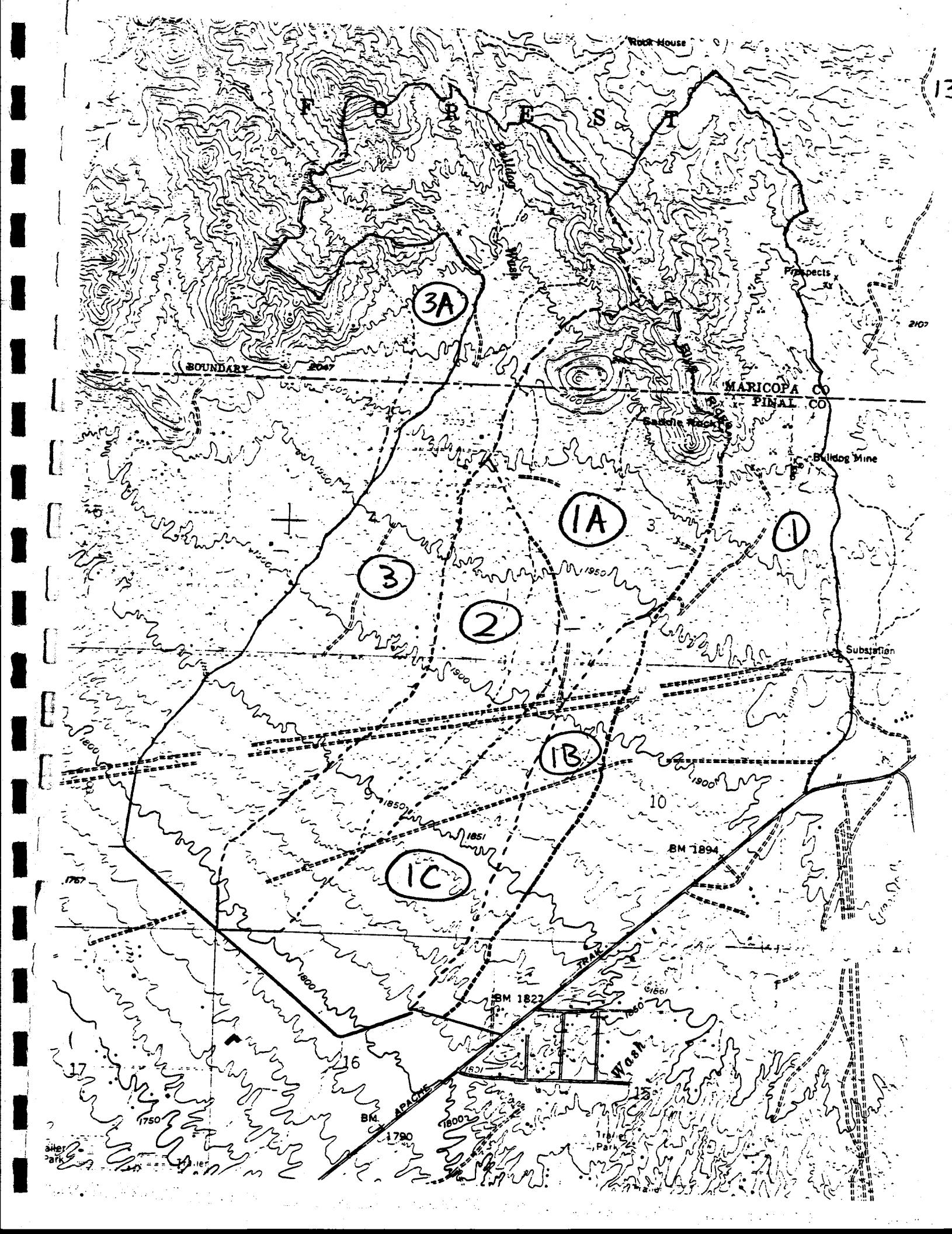
Subbasin 3

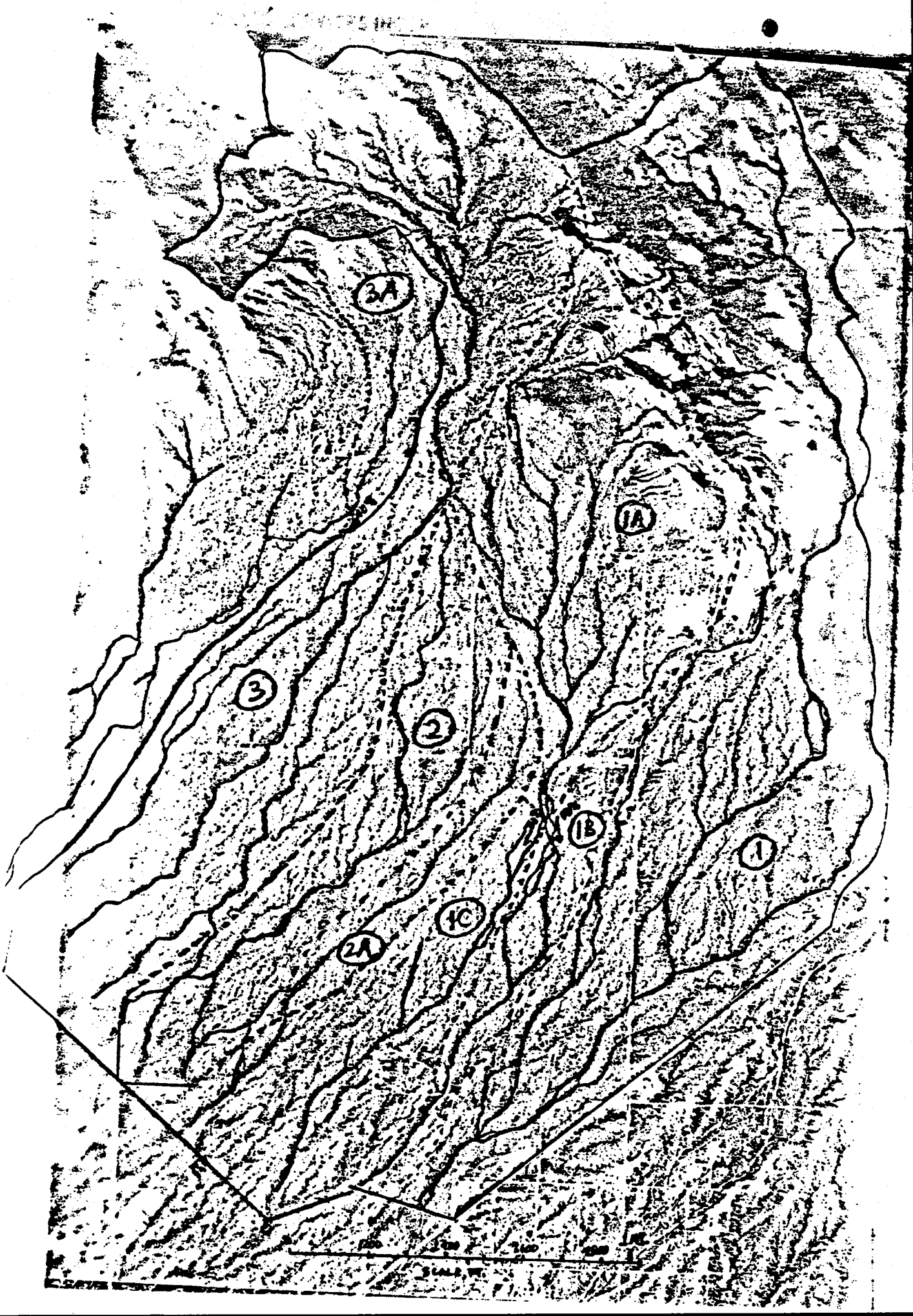
.771, .770 use $\frac{.771}{.465}$ = 1.658 sq.mi.
adj. = 1.667

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

Subbasin 3A

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


Rock House
F O R E S T
Bulldog
Wash
Prospects
3A
BOUNDARY
2047
MARICOPA CO
PINAL CO
Saddle Rock
Bulldog Mine
1A
1
3
2
Substation
1B
10
BM 1894
1C
TRAIL
BM 1822
Wash
APACHE
BM
1790
Trailer Park
17
16
15
1750
1800
1850
1900
1950
2100
2107


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

BOOZ ALLEN & HAMILTON INCORPORATED

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

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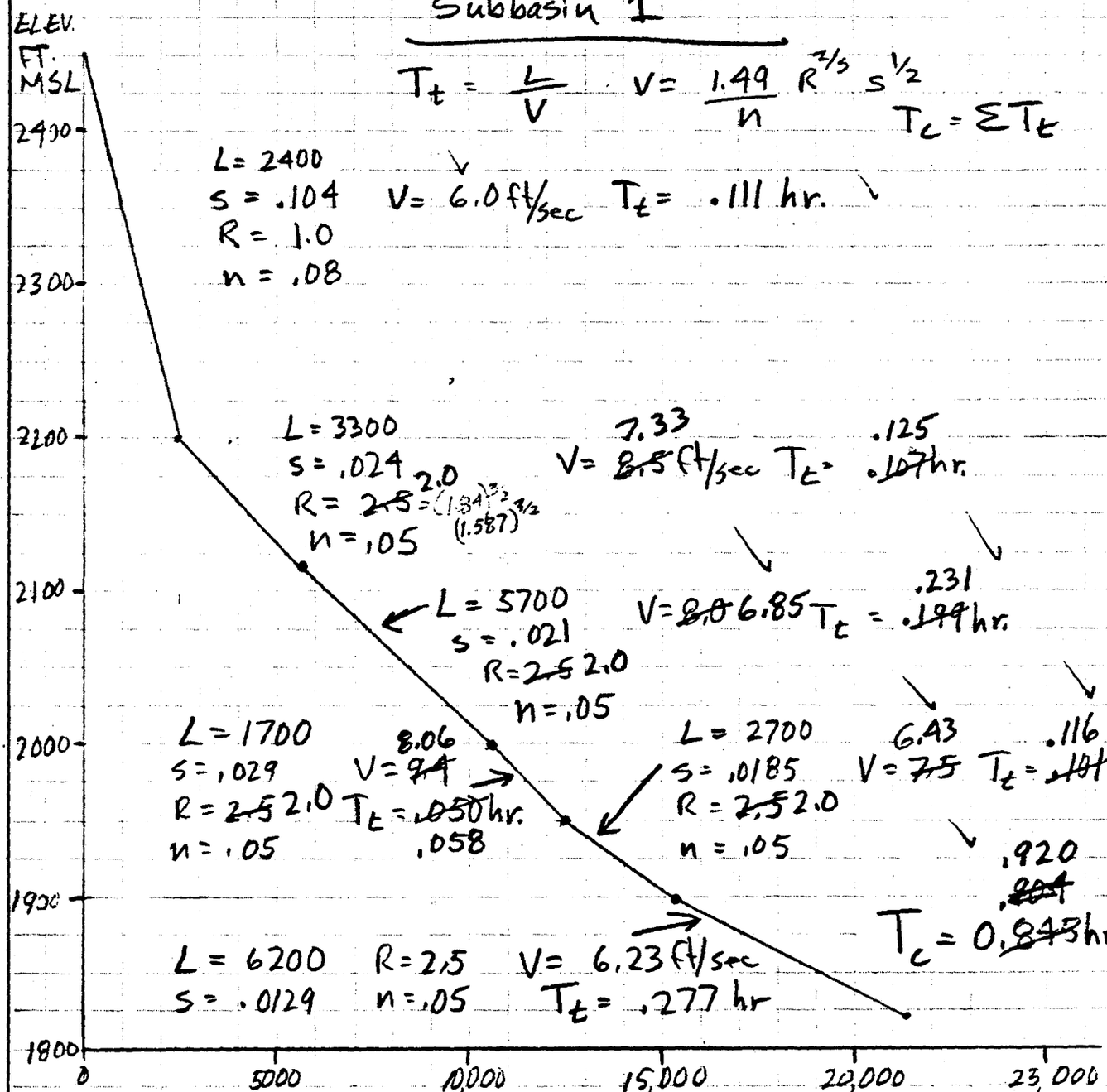
PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - T_c's

Subbasin 1

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



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

$L = 3300$, $s = .024$, $R = \cancel{2.5}\ 2.0 = (1.34)^{3/2} = (1.587)^{3/2}$, $n = .05$ $V = \cancel{8.5}\ 7.33$ ft/sec $T_t = \cancel{.107}\ .125$ hr.

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

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

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

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

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

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

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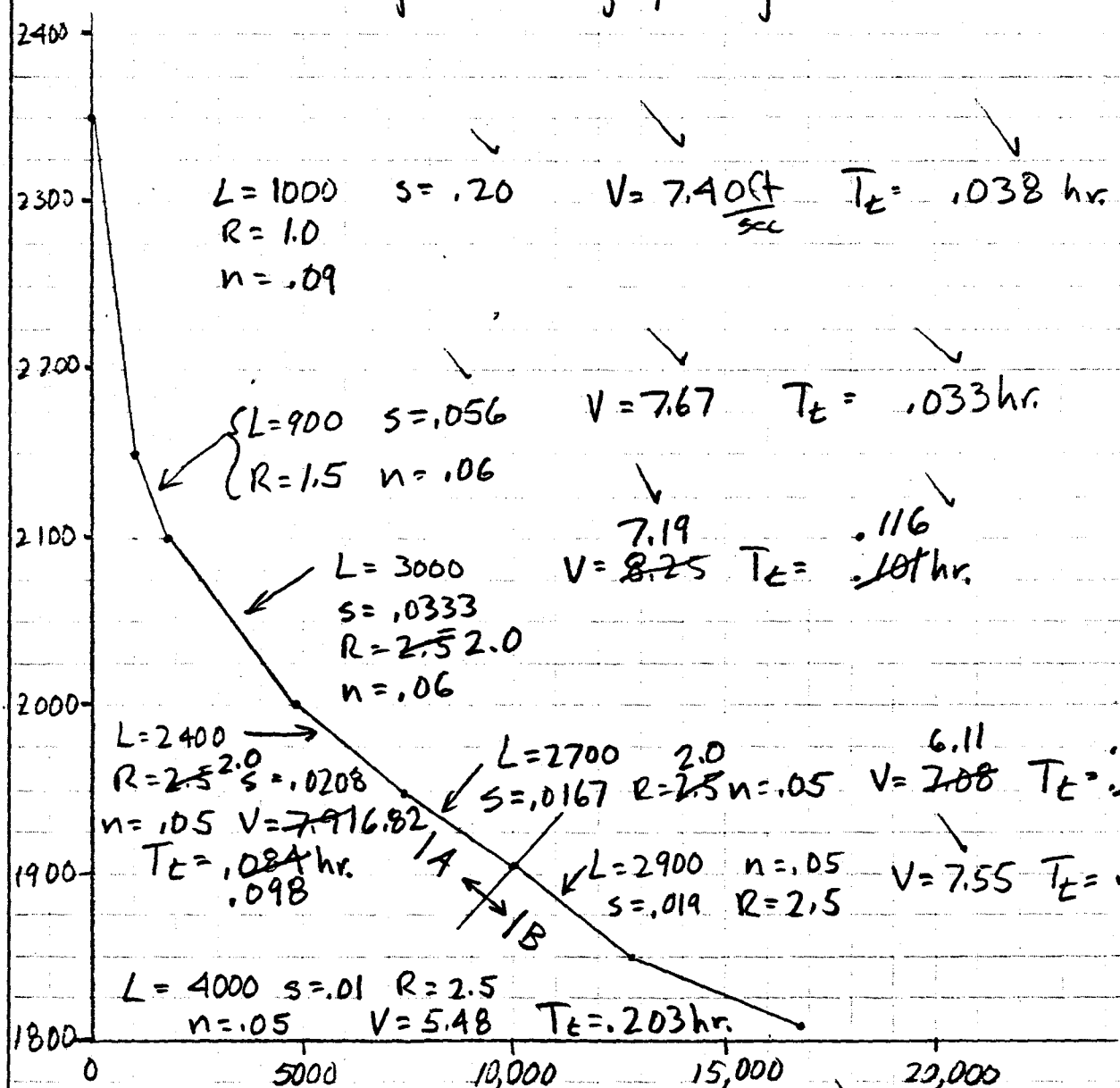
PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - T_c's

Subbasin 1A+1B

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



T_t (1A) = ~~.362~~ .408 hr.

T_t (1B) = .310 T_c (1A+1B) = ~~.672~~ .718 hr.

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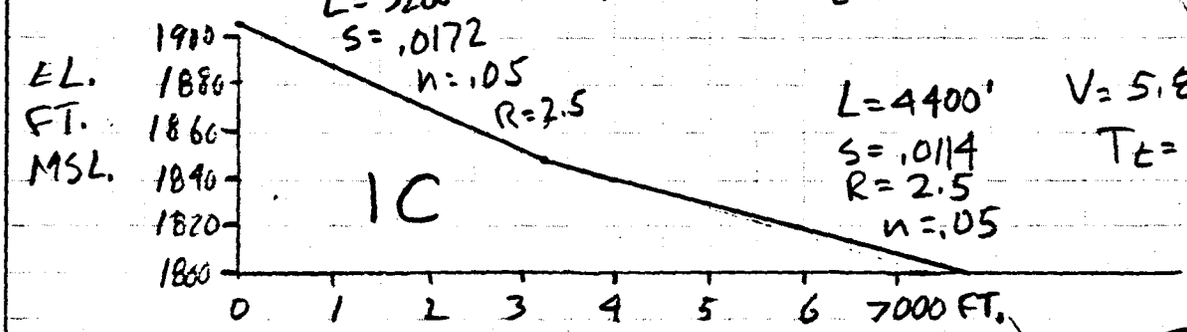
PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS - T_c's

Subbasin 1A + 1C

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

V = 7.19 T_t = .124 hr

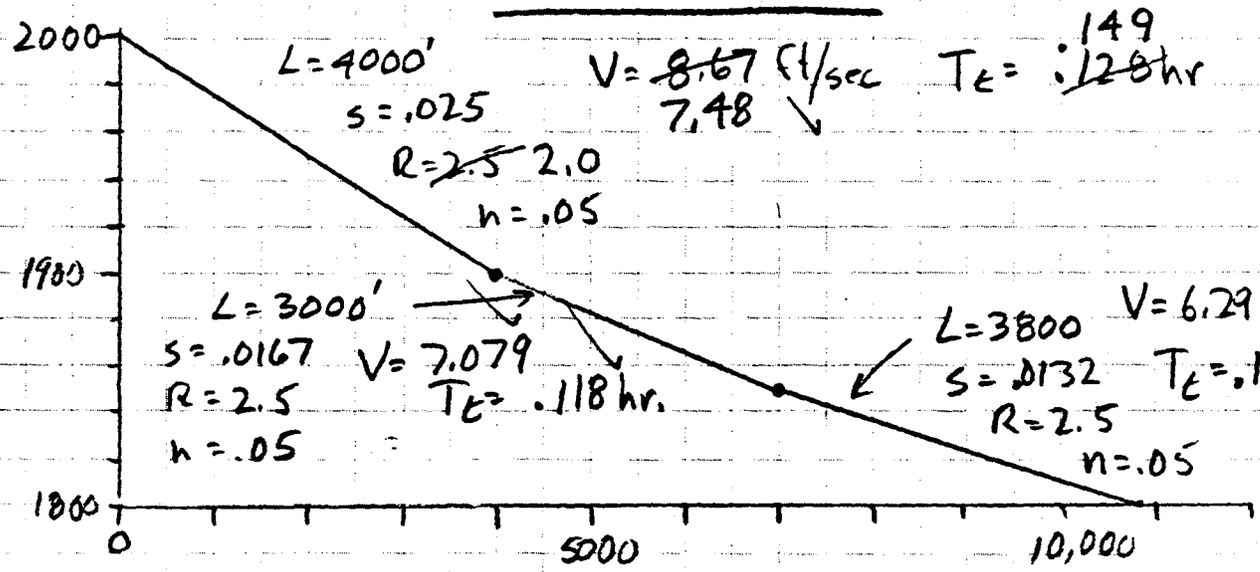


L = 4400'
S = .0114
R = 2.5
n = .05

V = 5.845
T_t = .209 hr

$T_c = T_t(1A) + T_t(1C) = \cancel{.362}\ .408 + .333 = \cancel{.695}\ .741$ hr

Subbasin 2



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

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

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

V = 7.079
T_t = .118 hr.

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

V = 6.29
T_t = .168 hr

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

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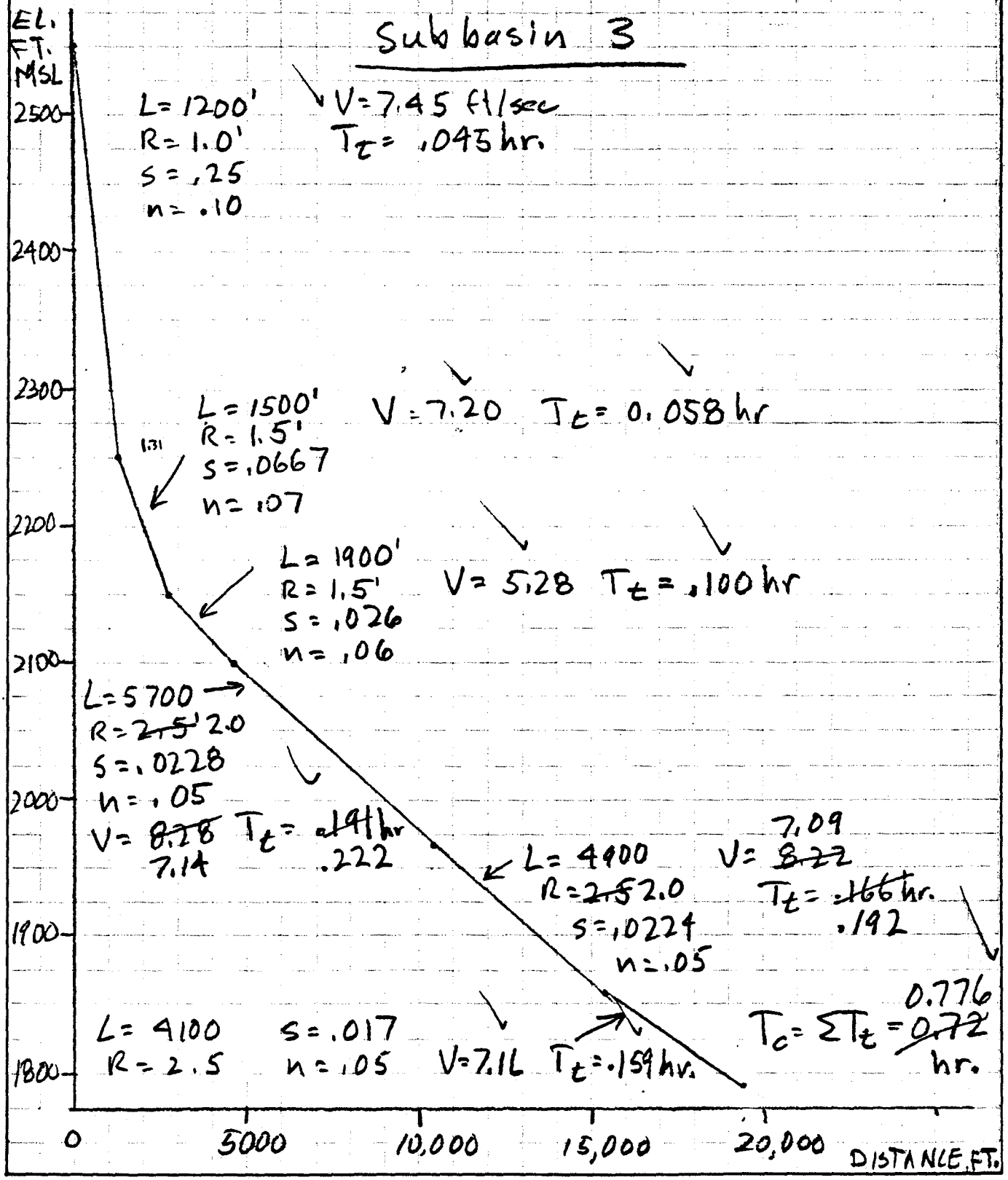
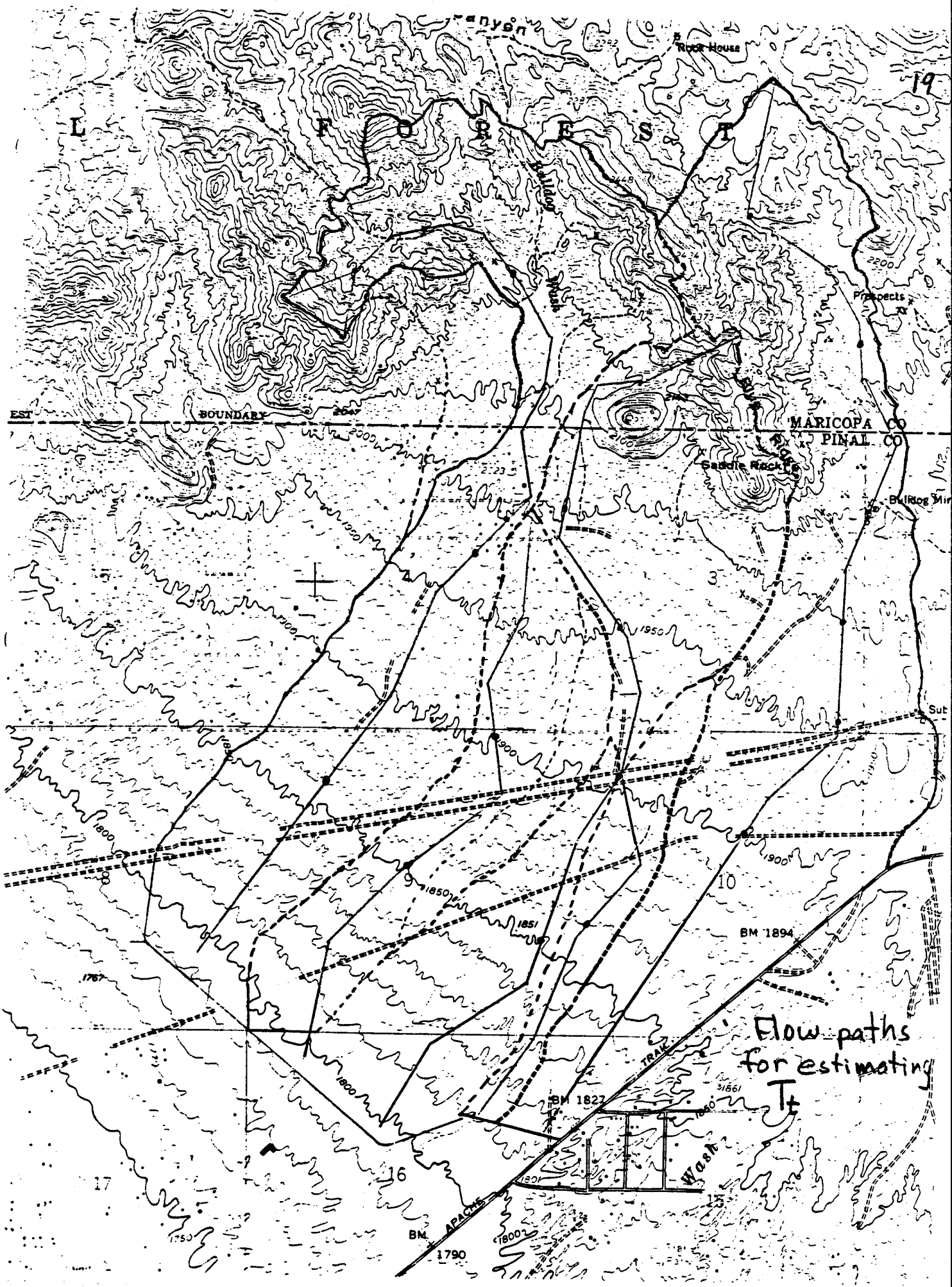
SUBJECT DRAINAGE BASINS- T_c's




19
L F O R E S T
Canyon
Rock House
Bulldog
Wash
Prospects
BOUNDARY
MARICOPA CO
PINAL CO
Saddle Rock
Bulldog Mi
3
10
BM 1894
Flow paths
for estimating
T_t
TRAIL
BM 1822
Wash
APACHE
BM
1790
16
17
15

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BY DA DATE 5/8/85 SHEET 1 OF 4

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PROJECT APACHE JCT. FRS

SUBJECT DRAINAGE BASINS – SOIL CLASSIFICATION/SHORT DUR. CN'S

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

Sub-basin 1

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

(assume all unidentified area is G1)

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

SDCN for Subbasin 1

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

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SUBJECT DRAINAGE BASINS - SHORTDURATION CN's

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

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

SDCN = 88

subbasin 1B Area = .25 sq. mi.

1E	.08, .08	.017	7	B
29D	—	.233	93	B

SDCN = 83

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

Subbasin 2

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

Subbasin 3 Area = 1.667 sq. mi.

29D	~~.379~~, .390, .392	.841	50%	B
1E				B
22-23	~~.094~~, .092, .093	.20	12%	C
G1	—	.626	38%	

(assume all unidentified area is G1

SDCN = 87

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

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BY DJA DATE 5/10/85 SHEET 3 OF 1

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PROJECT APACHE JUNCTION FRS

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

CURVE NUMBERS

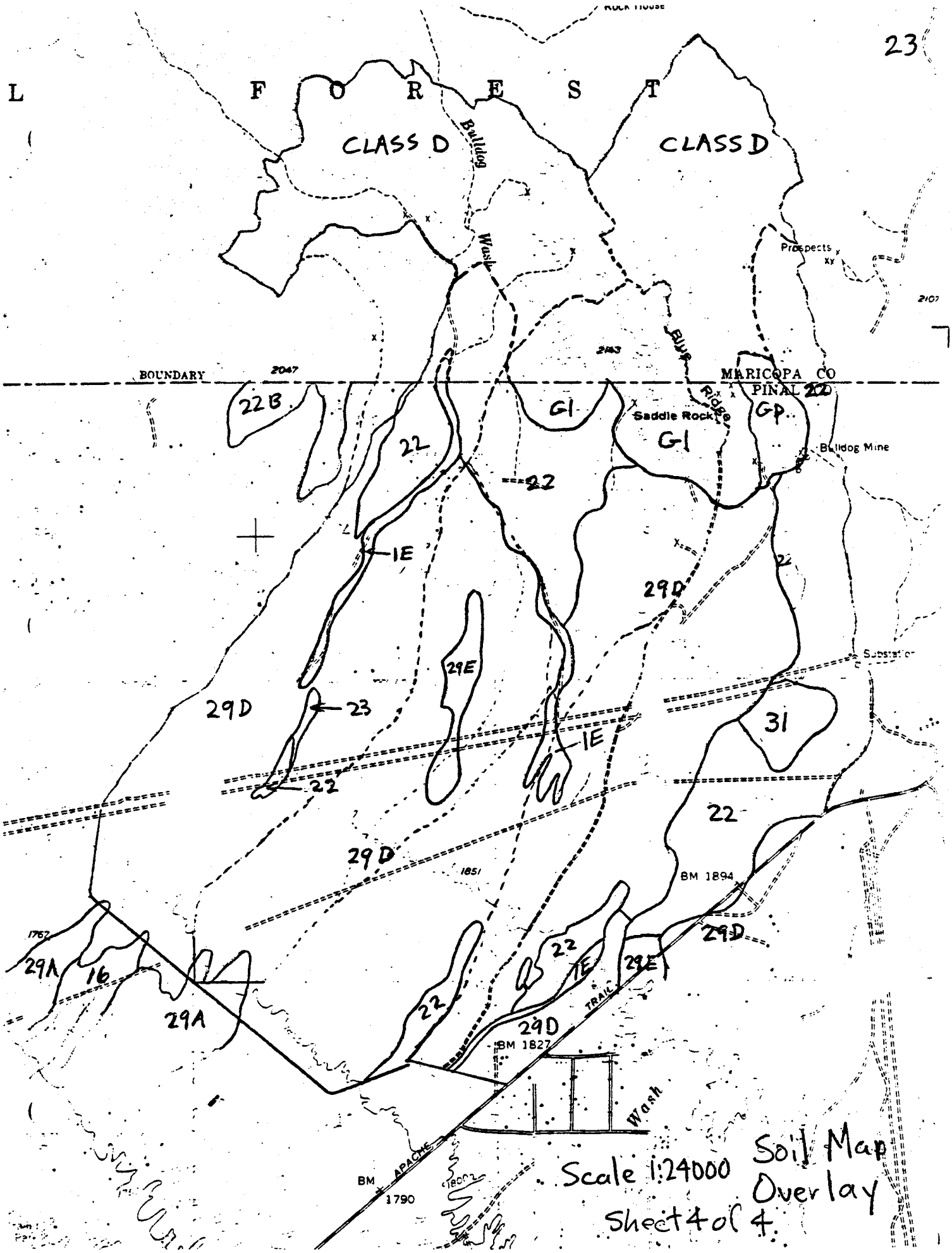
SUB BASIN	SDCN	FUTURE SDCN [1]	6-HR CN [2]	24 HR CN [2]	10-DAY CN [3]
1	88	89	84	80	65
0.7(1A) +1B	86	87	81	78	62
0.3(1A) +1C	85	86	80	77	61
2	83	84	77	74	57
3	87	88	82	79	64
3A	87	88	82	79	64

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

Concentration Times

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

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



Scale 1:24000 Soil Map Overlay

Sheet 4 of 4.

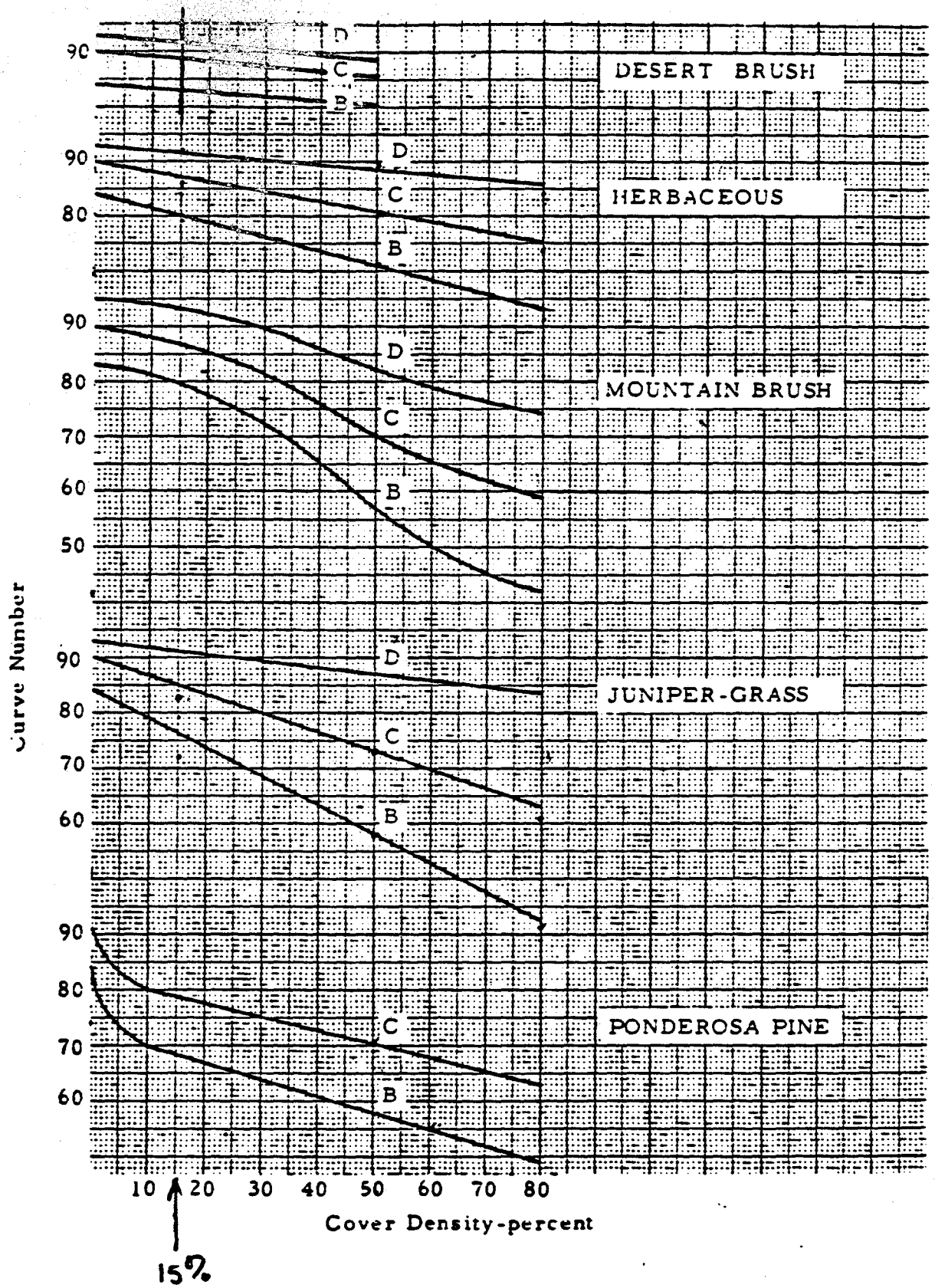


Fig. 10

HYDROLOGIC SOIL - COVER COMPLEXES
AND ASSOCIATED CURVE NUMBERS

Soil Conservation Service

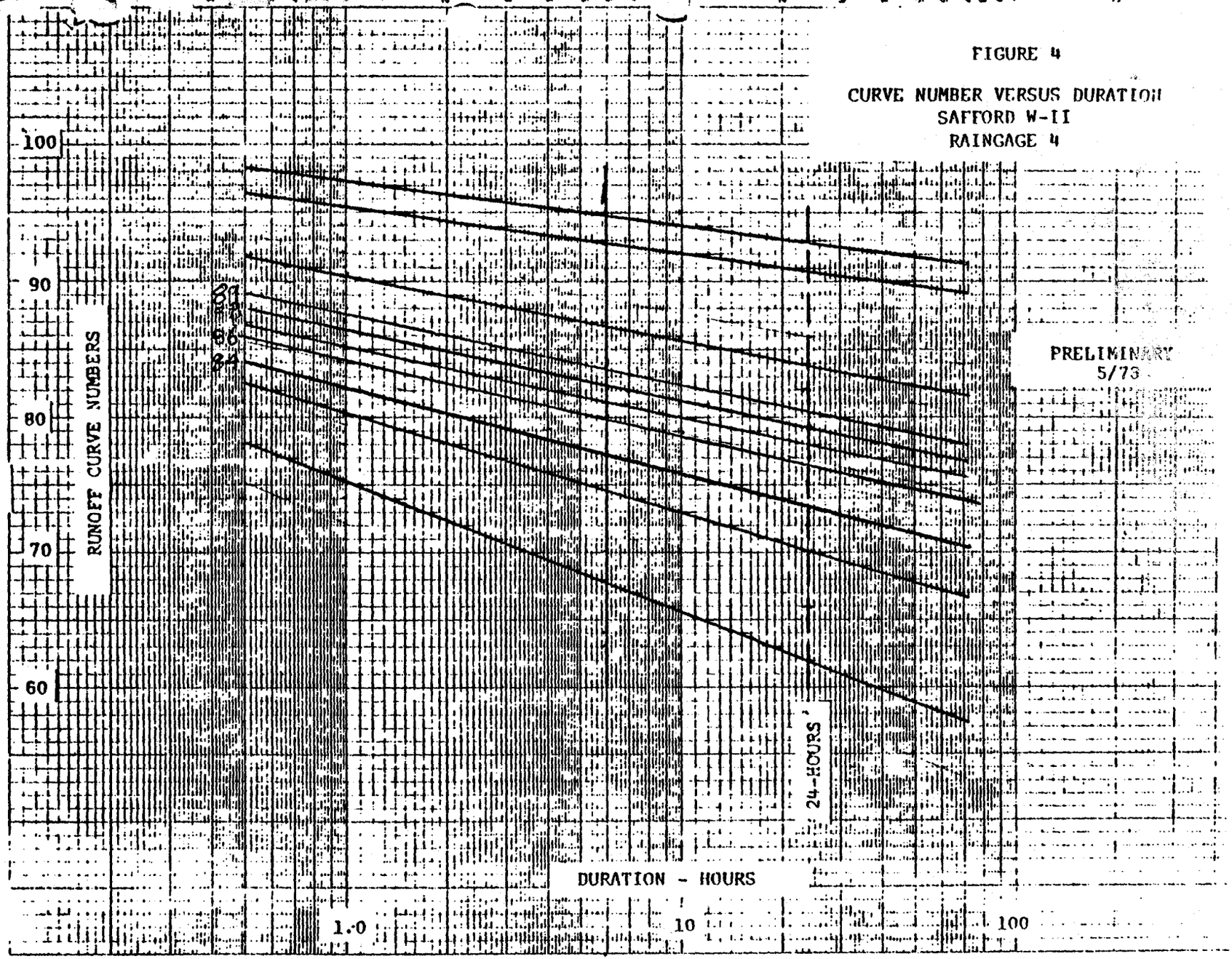


FIGURE 4

CURVE NUMBER VERSUS DURATION
SAFFORD W-II
RAINGAGE 4

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BY D.H. DATE 3/29/85 SHEET 1 OF 2

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PROJECT APACHE JCT. FRS

SUBJECT CHANNEL LOSS FACTORS - CLIMATIC INDEX

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

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

Phoenix, Annual Precipitation 7.11 in.

Annual Temperature 85.1 Daily high
57.3 Daily low

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

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PROJECT APACHE JCT. FRS

SUBJECT MODIFIED CHANNEL LOSS FACTORS

Climatic Index = 0.4

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

Modification re TSC TECHNICAL NOTE PO-4

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

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

.943

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

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

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

.949

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PROJECT APACHE JCT. FRS

SUBJECT RUNOFF VOLUMES FOR "QDIRECT"

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

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

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

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BY DM DATE 5/29/85 SHEET 1 OF 2

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PROJECT APACHE JCT. FRS

SUBJECT PMP DISTRIBUTIONS

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

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

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

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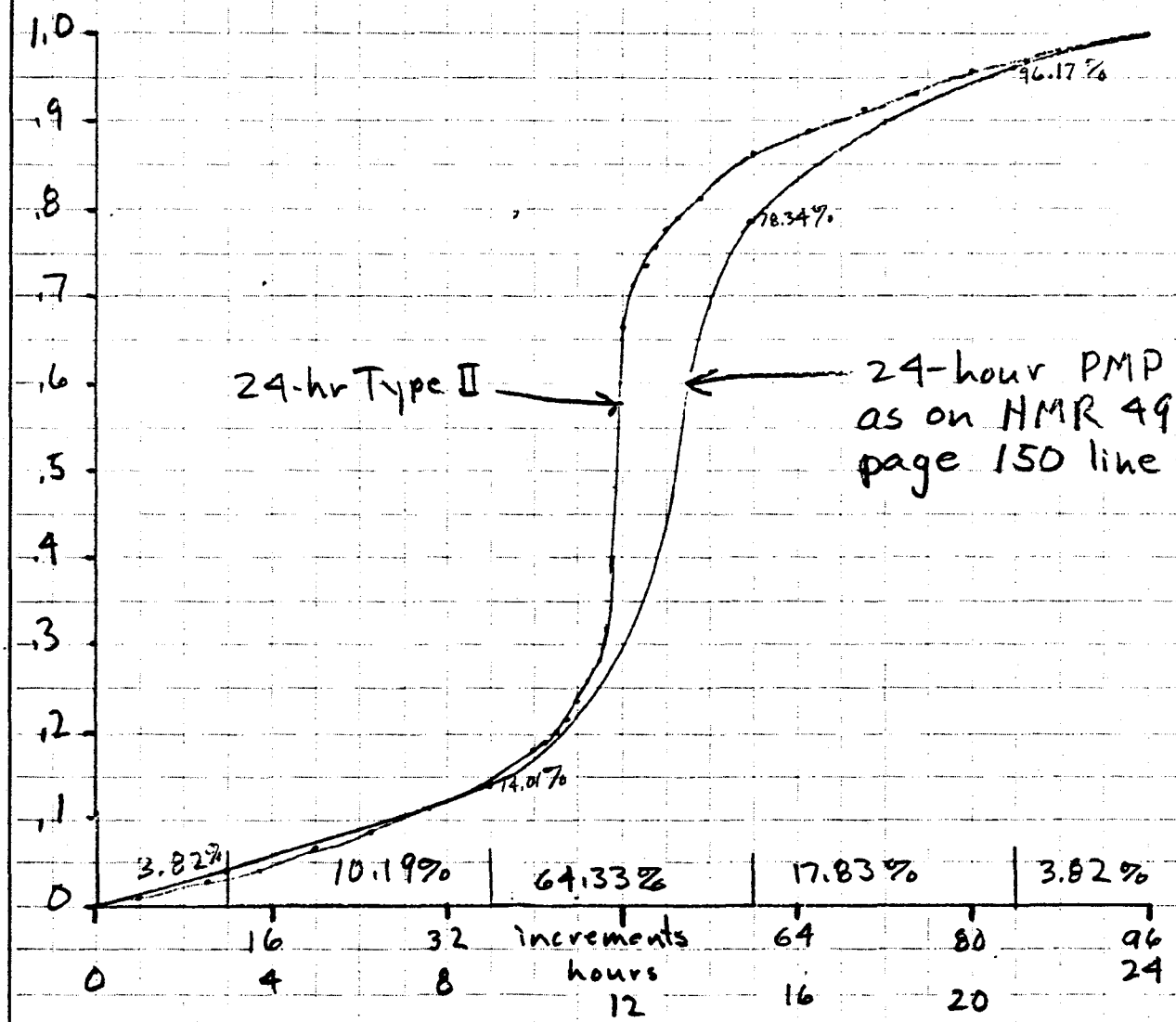
PROJECT APACHE

SUBJECT 24 HR PMP DISTRIBUTION

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

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

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



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

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

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

CLIENT APACHE- BULLDOG

PROJECT ____

SUBJECT REPORT OF TELEPHONE CONVERSATION - RUNOFF DISTRIBUTION

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

From: D. Hunter

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

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

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

      DAMS2      12/03/82  APACHE JCT. FRS INFLOW & ROUTING                  00000900
      RAINTABLE  HMR5      6.        6-HR PMP IN 15-MIN. INCREMENTS         00000910
                           0.        .005      .011      .0164     .0219    00000920
                           .036      .051      .066      .08       .584     00000930
                           .715      .774      .818      .848      .88      00000940
                           .911      .942      .951      .96       .969     00000950
                           .978      .984      .989      .995      1.       00000960
      ENDTABLE                                                              00000970
      WSDATA       C  1    84.       1.86      .82                          00001010
      PDIRECT    1                              6.        13.7               00001015
      QDIRECT              2.        3.14                                   00001020
      GD,DESIGN P          HMR5                                             00001030
      XSECTN     1                                                          00001040
                           1805.8    0.        0.                           00001050
                           1806.8    59.       20.                          00001060
                           1807.8    177.      40.                          00001070
                           1808.8    329.      60.                          00001080
                           1809.8    506.      80.                          00001090
                           1810.8    701.      100.                         00001100
                           1811.8    909.      120.                         00001110
                           1812.8    1130.     140.                         00001120
                           1813.8    1360.     160.                         00001130
                           1814.8    1570.     182.                         00001131
                           1815.8    1812.     206.                         00001132
      ENDTABLE                                                              00001135
      GD,REACH   0     C 1AB1        1200.                                  00001140
      WSDATA       C  1    81.       .77       .63                          00001150
      PDIRECT    1                              6.        13.7               00001155
      QDIRECT              1.97      3.02                                   00001160
      GD,DESIGN P          HMR5                                             00001170
      GD,ADDHYD 0       1AB                                                 00001180
      WSDATA       C  1    80.       .75       .65                          00001190
      PDIRECT    1                              6.        13.7               00001195
      QDIRECT              1.89      2.91                                   00001200
      GD,DESIGN            HMR5                                             00001210
      GD,ADDHYD 0       1BC                                                 00001220
      WSDATA       C  1    77.       .67       .38                          00001230
      PDIRECT    1                              6.        13.7               00001235
      QDIRECT              1.68      2.51                                   00001240
      GD,DESIGN            HMR5                                             00001250
      GD,ADDHYD 2        12                                                 00001260
      STRUCTURE  AJFRS     RESERVOIR ADJUSTED FOR SEDIMENT,BORROW           00001310
                           1792.                                0.          00001315
                           1794.                                18.3        00001320
                           1796.                                124.2       00001325
                           1798.                                299.3       00001330
                           1800.                                529.8       00001335
                           1802.                                791.6       00001340
                           1804.                                1085.2      00001345

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

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Revised run to show weir length for a 30" riser (previously used 18)

DAMS2 INPUT FOR
BAFFLE CHUTE AND
PRINCIPAL SPILLWAY DESIGN RUNS

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

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

      DAMS2     12/03/82  APACHE JCT. FRS INFLOW & ROUTING                    00000900
      RAINTABLE MMR5      6.        6-HR PMP IN 15-MIN. INCREMENTS          00000910
                          0.        .005      .011      .0164     .0219     00000920
                          .036      .051      .066      .08       .584      00000930
                          .715      .774      .818      .848      .88       00000940
                          .911      .942      .951      .96       .969      00000950
                          .978      .984      .989      .995      1.        00000960
      ENDTABLE                                                              00000970
      WSDATA      C  1    84.       1.86      .82                           00001010
      QDIRECT             1.32      2.07                                    00001020
      GD,DESIGN P         MMR5                                              00001030
      XSECTN    1                                                           00001040
                          1805.8    0.        0.                            00001050
                          1806.8    59.       20.                           00001060
                          1807.8    177.      40.                           00001070
                          1808.8    329.      60.                           00001080
                          1809.8    506.      80.                           00001090
                          1810.8    701.      100.                          00001100
                          1811.8    909.      120.                          00001110
                          1812.8    1130.     140.                          00001120
                          1813.8    1360.     160.                          00001130
                          1814.8    1570.     182.                          00001131
                          1815.8    1812.     206.                          00001132
      ENDTABLE                                                              00001135
      GD,REACH  0     C 1AB1        1200.                                   00001140
      WSDATA      C  1    81.       .77       .63                           00001150
      QDIRECT             1.27      1.95                                    00001160
      GD,DESIGN           MMR5                                              00001170
      GD,ADDHYD 0       1AB                                                 00001180
      WSDATA      C  1    80.       .75       .65                           00001190
      QDIRECT             1.21      1.87                                    00001200
      GD,DESIGN           MMR5                                              00001210
      GD,ADDHYD 0       1BC                                                 00001220
      WSDATA      C  1    77.       .67       .38                           00001230
      QDIRECT             1.04      1.55                                    00001240
      GD,DESIGN           MMR5                                              00001250
      GD,ADDHYD 2        12                                                 00001260
      STRUCTURE AJFRS     RESERVOIR ADJUSTED FOR SEDIMENT,BORROW            00001310
                          1793.5                                  0.        00001315
                          1794.                                   18.3      00001320
                          1796.                                   124.2     00001325
                          1798.                                   299.3     00001330
                          1800.                                   529.8     00001335
                          1802.                                   791.6     00001340
                          1804.                                   1085.2    00001345
                          1806.                                   1402.8    00001350
                          1808.                                   1755.3    00001355
                          1810.                                   2141.6    00001360
      ENDTABLE                                                              00001370
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DAMS2 XEQ 06/26/85        STRUCTURE SITE ANALYSIS COMPUTER PROGRAM
      REV 12/03/82  SCS TECHNICAL RELEASE 48, DATED OCT.1982 (USER MANUAL)

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

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

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DAMS2 INPUT FOR 25-YEAR RAINFALL

3A

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

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

      DAMS2     12/03/82  APACHE JCT. FRS INFLOW & ROUTING                    00000900
      WSDATA      C  1    84.       1.86      .82                            00001010
      QDIRECT             2.        3.14      4.52      12.32                00001020
      RAINTABLE HR49      24.       24-HOUR PMP IN 1-HOUR INCREMENTS         00001022
                          0.        .012      .025      .038      .053       00001023
                          .069      .086      .103      .121      .14        00001024
                          .17       .22       .295      .44       .69        00001025
                          .783      .83       .865      .897      .921       00001026
                          .944      .962      .977      .989      1.         00001027
      ENDTABLE                                                               00001028
      GO,DESIGN P         HR49                                               00001030
      XSECTN    1                                                            00001040
                          1805.8    0.        0.                             00001050
                          1806.8    59.       20.                            00001060
                          1807.8    177.      40.                            00001070
                          1808.8    329.      60.                            00001080
                          1809.8    506.      80.                            00001090
                          1810.8    701.      100.                           00001100
                          1811.8    909.      120.                           00001110
                          1812.8    1130.     140.                           00001120
                          1813.8    1360.     160.                           00001130
                          1814.8    1570.     182.                           00001131
                          1815.8    1812.     206.                           00001132
      ENDTABLE                                                               00001135
      GO,REACH  0     C 1AB1        1200.                                    00001140
      WSDATA      C  1    81.       .77       .63                            00001150
      QDIRECT             1.97      3.02      4.58      12.77                00001160
      GO,DESIGN           HR49                                               00001170
      GO,ADDHYD 0       1AB                                                  00001180
      WSDATA      C  1    80.       .75       .65                            00001190
      QDIRECT             1.89      2.91      4.45      12.61                00001200
      GO,DESIGN           HR49                                               00001210
      GO,ADDHYD 0       1BC                                                  00001220
      WSDATA      C  1    77.       .67       .38                            00001230
      QDIRECT             1.68      2.51      4.14      12.16                00001240
      GO,DESIGN           HR49                                               00001250
      GO,ADDHYD 2        12                                                  00001260
      STRUCTURE AJFRS     RESERVOIR ADJUSTED FOR SEDIMENT,BORROW             00001310
                          1793.5                                  0.         00001315
                          1794.                                   18.3       00001320
                          1796.                                   124.2      00001325
                          1798.                                   299.3      00001330
                          1800.                                   529.8      00001335
                          1802.                                   791.6      00001340
                          1804.                                   1085.2     00001345
                          1806.                                   1402.8     00001350
                          1808.                                   1755.3     00001355
                          1810.                                   2141.6     00001360
      ENDTABLE                                                               00001370


      WSDATA      C       82.       1.74      .69                            00001372
      QDIRECT             1.94      3.07      4.44      12.24                00001374
      PCOLDATA  ELEV                1793.5                                   00001380
      CLPROFILE                     APACHE FRS DAM CENTERLINE                00001390
                0.        1808.     920.      1796.     1110.     1792.      00001400
                1480.     1788.     5710.     1788.     5910.     1792.      00001410
                6210.     1790.     7000.     1790.     7450.     1792.      00001420
                8050.     1800.     8150.     1804.     8480.     1808.      00001430
      ENDTABLE                                                               00001440
      TEMPLATE  14.       2.5       2.                                       00001441
      PSDATA    1         135.      36.                 .013      1786.      00001450
      PSINLET             1.        18.                                      00001460
      ESCREST   ELEV                                                         00001470
      ESDATA    42        800.      .025      2.        .025                 00001480
      ESPROFILE 42        800.      0.        1000.     4.                   00001482
      BTMWIDTH  FEET      300.      275.      250.                           00001485
      GO,DESIGN L P C E   HR49                                               00001490
      ENDJOB                                                                 00001500

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DAMS2 INPUT FOR 24-HOUR PMF (EARTH SPILLWAY)

EBASCO SERVICES INCORPORATED

BY DJA DATE 5/28/85 SHEET 1 OF 3

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

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

SUBJECT PLANIMETRY FOR RESERVOIR VOLUMES

Planimeter reading in tenths of cm^2

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

.5693 to get acres

Elevation	Reading	Area, acres	Interpolated from curve:	Cum. Volume ac-ft.
1788	1.0, 0.9, .9	0.53		0.
1790			10.4	11.0
1792	42.4, 42.7	24.2		45.6
1794			43.5	113.3
1796	109.5, 109.7	62.4		219.2
1798			80.7	362.3
1800	173.7, 173.3,	98.8		541.8
1802			120.0	760.6
1804	248.3, 249.0	141.6		1022.2
1806			162.0	1325.8
1808	319.8, 321.2	182.5		1670.3
1810			203.8	2056.6
1812	398.1, 397.3	226.4		

Sediment volume = 95 acre-ft.

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

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

EBASCO SERVICES INCORPORATED

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

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

CLIENT USDA/SCS

PROJECT APACHE JCT. FRS

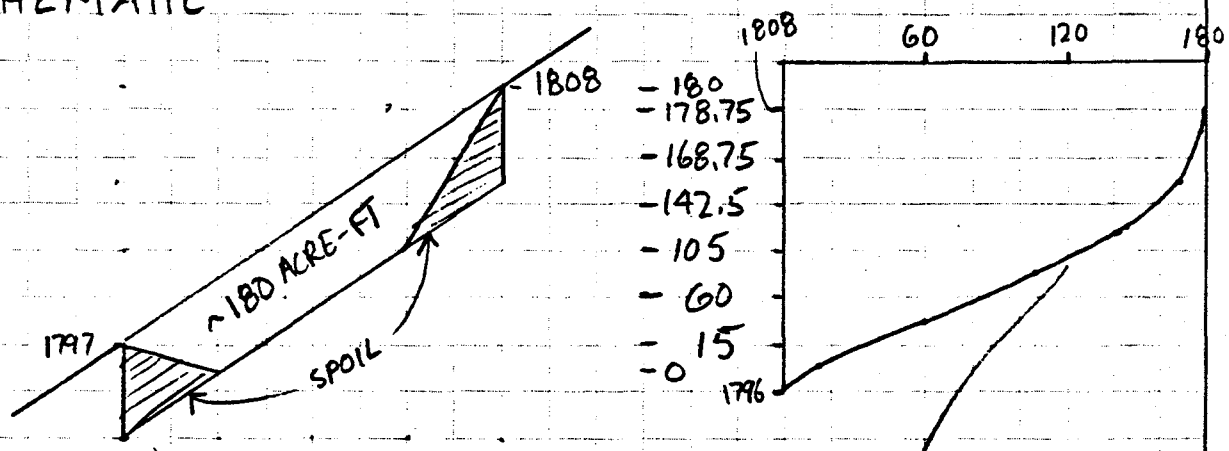
SUBJECT RESERVOIR VOLUME ADJUSTMENTS

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

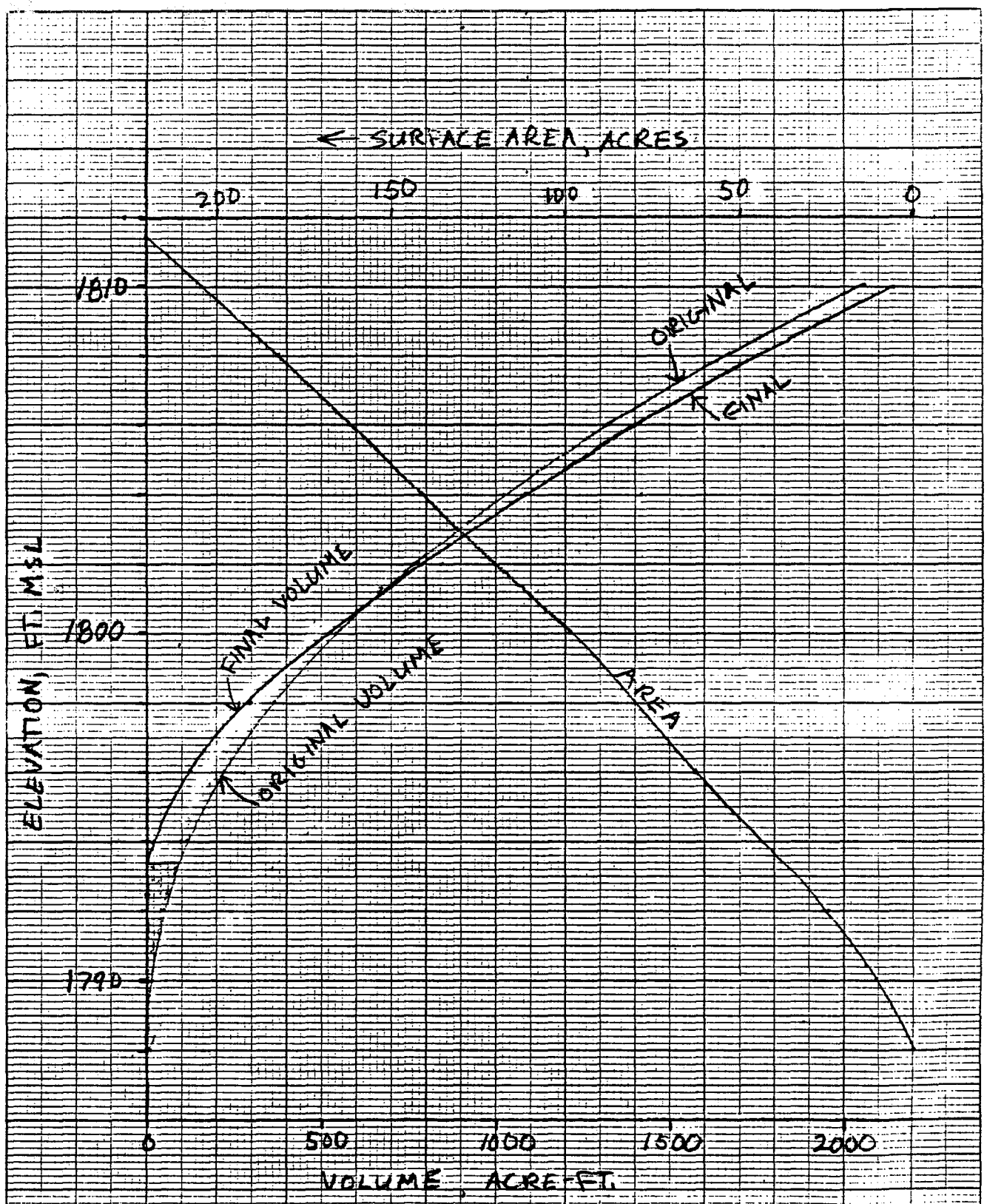
AVG. 4' DEEP INCLUDING 1' OF STRIPPING

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

SCHEMATIC



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



RESERVOIR AREA, STORAGE CURVES - APACHE JUNCTION FRS

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

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

EBASCO SERVICES INCORPORATED

BY [illegible] DATE 5/31/85 SHEET ____ OF ____

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

CLIENT APACHE JCT. FRS

PROJECT

SUBJECT SPILLWAY RATINGS

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

H. for unit width		B: 150	200	300 cf.
0.5	1.10	165	220	330
1	3.1	465	620	930
1.5	5.70	855	1140	1710
2	8.77	1315	1754	2631
2.5	12.25	1838	2450	3675
3	16.11	2416	3222	4833
3.5	20.30	3045	4060	6090
4	24.80	3720	4960	7440
4.5	29.59	4438	5918	8877
5	34.66	5199	6932	10398
5.5	39.99	5998	7998	11997
6	45.56	6834	9112	13668
6.5	51.37	7706	10274	15411
7	57.41	8612	11482	17223
7.5	63.67	9550	12733	19102
8	70.14	10522	14028	
8.5	76.82	11523	15364	
9	83.70	12555		
9.5	90.77	13616		
10	98.03	14705		
10.5				
11				

39/A0

EBASCO SERVICES INCORPORATED

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

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

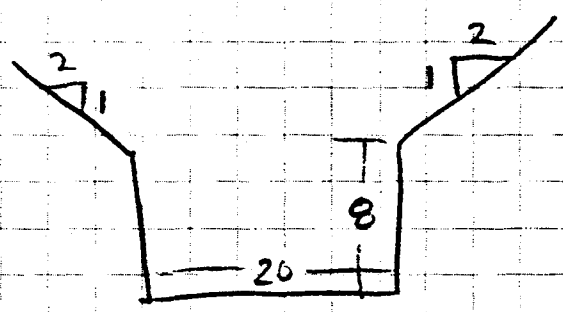
CLIENT USDA/SCS

PROJECT APACHE JCT. FLOODWAY

SUBJECT APACHE FLOODWAY RATING

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

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



5.49

S81/8-81

STUDIES

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 = $90 \frac{lb}{ft^3}$

A2

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 2 OF

CHKD. BY D DATE 9/4/85 OFS NO. 3767.100 DEPT. NO. 930

CLIENT U.S.D.A. SCS

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Volumes - Channel DESIGN

I. Apache Junction Floodway

D.A. # 1 : D.A. = 1.86 SM

Unit	Sed. Yield Rate	Percent Of W/S
7	.12 AF/SM/YR	50
12	.20 AF/SM/YR.	40
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

581/8-81

EBASCO SERVICES INCORPORATED

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 × .12 × .77 = 0.05
.20 × .20 × .77 = 0.03
.30 × .40 × .77 = 0.09
0.17 AF/YR

USING SAME RATE AS PREVIOUS PAGE (.65 & .35)

Fine = .65 (.17) = 0.11 AF/YR
Coarse = .35 (.17) = 0.06 AF/YR

TOTAL FINES To Apache Junction Early Channel = 0.32 AF/YR

A4

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 4 OF

CHKD. BY [illegible] DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930

CLIENT U.S.D.A Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yd. (cont.)

II. Bulldog Floodway

Drainage Area excluding all area above Apache Junction FRS

D.A. = 5.72 SM

A review of the data provided shows that the contributory area is made up of Units 1, 5, and 12. Units 5 and 12 have the same Sediment Yield Rate of .2 AF/SM/YR.

Due to the accuracy of the map and overall level of accuracy needed for this determination a overall percentage will be used for the two sediment yield rates for the entire watershed.

Therefore:

Unit	Sediment Yield Rate	Percent Of W/S
5 & 12	0.2 AF/SM/YR	80
1	0.4 AF/SM/YR.	20

Average Annual Sediment Production:

.80 × .20 × 5.72 = 0.92 AF
.20 × .40 × 5.72 = 0.46 AF
1.38 AF

581/8-81

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 5 OF

CHKD. BY D DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930

CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT BULLDOG FLOODWAY & Apache Junction

SUBJECT Sediment Yield

ONCE AGAIN USING RELATION
Provided by SCS, ie:

65 % Fines
35 % Coarse

AVERAGE ANNUAL SEDIMENT LOAD
in BULLDOG FLOODWAY

FINES = 0.65 x 1.38 = 0.90 AF/YR

COARSE = 0.35 x 1.38 = 0.48 AF/YR

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BY CJM DATE 8/85 SHEET 6 OF

CHKD. BY R DATE 9/4/85 OFS NO. 3767 DEPT. NO. 930

CLIENT U.S.D.A Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yield for 100 yr storm event

REF. Geologic Note # 2 (+ Neville Curtis trip Report for Pass Mtn Diversion)

III. Apache Junction Floodway

a. 100 yr. storm values

100 yr / 24 hr

Vol. of runoff = $Q_{100\,AF}$

W/S	D.A (SM)	Runoff (IN.)	Runoff A.F.
1	1.86	2.00	198
1A+1B	0.77	1.97	81

$Q_{100\,AF}$ = 279 Ac. Ft.

Peak Discharge = q_{100}

q_{100} = 1438 CFS (Prev. Calcs.)

$$C_{100\,AF} = 95\,(Q_{100} \times q_p)^{0.56}$$

$$= 95\,(279 \times 1438)^{0.56}$$

$$C_{100\,AF} = 130499$$

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CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment yield for 100 yr. storm event

III. (CONT.)

b. 2 YR. STORM VALUES

Vol. of RUNOFF = $Q_{2_{AF}}$

W/S	DA (SM)	Runoff (in)	Runoff (AF)
1	1.86	.32	32
1A+1B	0.77	.27	11

$\therefore Q_{2_{AF}} = 43$ Ac. Ft.

Peak Discharge = $q_{2_{AF}}$

$q_{2_{AF}} = 390$ CFS

$C_{2_{AF}} = 95(43 \times 390)^{0.56}$

$C_{2_{AF}} = 22052$

c. RATIO: Apache Junction Floodway

$C_{100_{AF}} / C_{2_{AF}} = 130499/22052 = 6$

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 62.4 lb/ft³ x 21.78 tons ft³ / lb ac-ft

= 379181 TONS ✓

SEDIMENT Content = $\bar{S}$

$$\bar{S}_{AF} = \frac{3724}{3724 + 379181} \times 1{,}000{,}000$$

$$\bar{S}_{AF} = 9726 \text{ ppm}$$

Apache Junction Floodway

SAY 10,000 ppm ✓

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BY CJM DATE 8/85 SHEET 9 OF

CHKD. BY DATE OFS NO. 3267 DEPT. NO. 960

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

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yield | For 100 yr storm

IV Bulldog Floodway

a. 2 & 100 YR RUNOFF AMOUNTS [1]

SWS	D.A. (Sm)	q_2 (IN.)	q_{100} in	q_2 (AF)	q_{100} (AF)
1	.47	.21	1.92	5	48
2	.62	.21	1.93	7	64
3	.15	.29	2.16	2	17
4	.06	.15	1.68	0.5	5
5	.33	.26	2.08	5	37
6	.05	.15	1.69	0.4	5
7	.69	.26	2.08	10	77
8	.03	.15	1.68	0.2	3
9	2.00	.35	2.33	37	248
10	.17	.15	1.70	1	15
11	.03	.15	1.68	0.2	3
12	.32	.24	2.00	4	34
13	.11	.15	1.69	1	10
14	.71	.26	2.08	10	79
				83.3	645

b. 2 & 100 yr Peak Discharges

$Q_{2_{BF}}$ = 653 CFS

$Q_{100_{BF}}$ = 5427 CFS

1/ Do not include volume of runoff and vol. of sediment from those areas behind Apache Junction FRS.

581/8-81

EBASCO SERVICES INCORPORATED

BY C.J.M. DATE 8/85 SHEET 10 OF

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CLIENT USDA SOIL CONSERVATION SERVICE

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Sediment Yield For 100 yr. storm event

C. RATION C_{100BF} / C_{2BF}

$$C_{100BF} = 95(645 \times 5427)^{0.56}$$

$$C_{100BF} = 438{,}966$$

$$C_{2BF} = 95(83.3 \times 653)^{0.56}$$

$$C_{2BF} = 42{,}622$$

$$C_{100BF}/C_{2BF} = 10.3$$

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/85 SHEET 11 OF

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

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT 100 year Sediment Yield

d. Bulldog Floodway Sediment Load

100 yr Sediment Load = 0.9 x 10.3 = 9.3 AF

WT. OF 100 yr Sed. = 1960 x 9.3

= 18228 Tons

WT. OF WATER = 645 x 62.4 x 21.78

= 876,601 Tons

Sediment Content = $\bar{S}_{BF}$

$$\bar{S}_{BF} = \frac{18228}{18228 + 876,601} \times 1,000,000$$

= 20,370 ppm ✓

581/8-81

EBASCO SERVICES INCORPORATED

BY CJM DATE 8/16/85 SHEET 12 OF
CHKD. BY D DATE 9/5/85 OFS NO. DEPT. NO.
CLIENT U.S.D.A. Soil Conservation Service
PROJECT Bulldog Floodway & Apache Junction
SUBJECT Apache Junction Floodway EARTH CHANNEL

e. Apache Junction Discharges:

Q_{100} = 1560 CFS (At end of earth)

50% Q_{100} = 780 CFS

Computation of TEN YEAR PEAK = Q_{10}

W/S	D.A. (SM)	CN	Tc (hrs)	CLF
1	1.86	80	.82	.943
1A+1B	.77	78	.63	1

RAINFALL = 2.58 IN.

W/S	R.O. (IN.)	C.L.F.	PEAK FACTOR TR-55	D.A (SM)	Q_{10} (CFS)
1	.96	.943	375	1.86	631
1A+1B	.86	1	440	0.77	291

Assume Peaks Add Q_{10} = 921 CFS

Q_{10} = 921 CFS > 50% Q_{100} so use Q_{10}

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BY CJM DATE 8/16/85 SHEET 13 OF

CHKD. BY D DATE 9/5/85 OFS NO. 3767 DEPT. NO. 930

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway + Apache Junction

SUBJECT Bulldog Floodway Discharge & Allowable Velocities

For Apache Junction + Bulldog Floodway

f. Bulldog Floodway Discharges:

Q_{100} = 5466 CFS

50% Q_{100} = 2713 CFS

Q_{10} = 2444 CFS

from Hydrology by Harry Millsaps

< 50% Q_{100}

∴ use 50% Q_{100}

g. Allowable Velocities TR-25

d_{75} = 4.76 mm

FOR EARTH FLOODWAYS

a. Bulldog Floodway Sediment Load 20,000 ppm

ALLOW. VEL. = V_b x D x A x B SS = 3:1

1.26 aged

= 4 x 1.2 x 1 x .83

1.18 as-built

ALLOW. VEL. = 3.98 fps

4.18 aged

3.92 as-built

b. Apache Junction Sediment Load 10,000 ppm

interpolated from Fig 6-2

ALLOW. VEL. = 3.2 x 1.1 x 1 x .83

1.06 aged

using as-built depths this would = 0.97

ALLOW. VEL. (aged) = 2.82 2.92 fps

(as-built) = 2.58 fps

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BY cjm DATE 10/31/85 SHEET 13A OF

CHKD. BY DATE DFS 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)

for earth channels!

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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

57

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*          FLOW PROFILES          *
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*          VERSION 1985           *
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*    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

60

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*          FLOW PROFILES          *
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*  CONSULTING CIVIL ENGINEERING   *
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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

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

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

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

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

6A

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

Summary earth channel

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
2.82 aged 2.58 as-built

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 ✓

Since this is within borrow of Apache FRS (& pool area?) we can live with being close to the allow. vel.

BULLDOG FLOODWAY:

Q(100) = 5466 CFS
50% Q(100) = 2713 CFS
Q(10) = 2444 CFS

SEDIMENT LOAD = 20000 PPM
ALLOWABLE VELOCITY = ~~3.98~~ FPS
4.18 aged 3.92 as-built

AGED CONDITION:

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

AS BUILT CONDITION:

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

EBASCO SERVICES INCORPORATED

BY cjm DATE 8-19-85 SHEET 27 OF

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

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

PROJECT Bulldog Floodway & Apache Junction

SUBJECT Manning's "n" for earth channels

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

d_{75} = 0.187 inches

BASIC "n" :

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

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

not recommended -

use NEH 5 Supplement B :

Basic "n" = .020

Only additional modification will be "Step 2" Surface Irregularity

As-Built "n" :

Estimate increase between smooth & minor immediately after construction

Modifying value = .004

∴ $"n"_{AB}$ = 0.024

581/9-81

EBASCO SERVICES INCORPORATED

BY cjm DATE 8-19-85 SHEET 27 OF

CHKD. BY DATE OFS NO. DEPT. NO.

CLIENT USDA Soil Conservation Service

PROJECT Bulldog Floodway & Apache Junction

SUBJECT MANNING'S "n" for 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

EBASCO SERVICES INCORPORATED

BY Cgm DATE 8/28 SHEET 29 OF

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

CLIENT USDA SCS

PROJECT Apache Junction - Bulldog Floodway

SUBJECT Apache Junction Channel - Tractive Stress Computation

Aged Condition:

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

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

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

From Fig. 6-11:

Assume Water Temp = 60°

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

$\rho = 1.938$

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

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

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 so: actual b/d much greater than given in curves: however using $b/d = 8$ $z = 3$

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

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

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

τ_{all} = .1 Fig 6.14

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

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

SM

SERVICES INCORPORATED

BY CJM DATE 8/28/85 SHEET 31 OF

CHKD. BY DATE 9/5/85 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 : $\nu = 1.22 \times 10^{-5}$

$e = 1.938$

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

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

From Fig 6.9 : $V/\sqrt{\tau/\rho} = 21.7$

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

$b/d = 100/10.6 = 9.4$

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

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

Allowable = 0.1 SEE previous calc.

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

12

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-22-85 SHEET 1 OF 15

CHKD. BY C. Lee DATE 7/2/85 OFS NO. USDA 3767-100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

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

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

Q PSH for Basin 1 = 1046

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

Q PSH = .25 x 1046 ✓
= 260 cfs

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

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

CHKD. BY C. Zee DATE 7/2/85 OFS NO. USDA3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

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

Q inlet #1 = 1046

For broad crested weir

$Q = CLH^{3/2}$

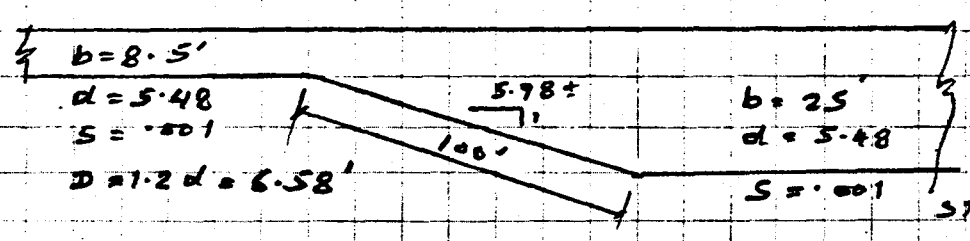
$C = 3.1$

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

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

– will inundate about 300' length of inlet

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



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

CHKD. BY C. Zu DATE 7/2/85 OFS NO. USDA 3767-100 DEPT. NO. 556

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

Increase the slope of the channel to .0024 less than so after STA 22+00 to follow the ground profile

$Q = 1046$

$b = 25$

$s = .0024$

for $d = 4.07$

bd $A = 101.75$

$b+2d$ $P = 33.14$

A/P $R = 3.07$

$n = .015$

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

Q/bV $d = 4.08$ o.k

Inlet 1A + 1B STA 25+75 TO 26+25 (Subject to Field verification)

$Q_2 = 514$ cfs

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

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

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

$L = 50'$ $H = 2.22$

For channel $Q = 1560$

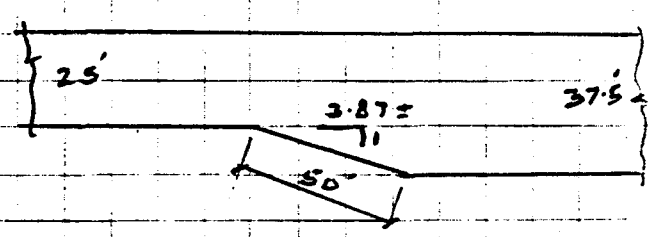
use concrete rectangular channel

$Q = 1560$

$b = 37.5$

$s = .0024$

for $d = 3.92$



bd $A = 147$

$b+2d$ $P = 45.34$

A/P $R = 3.242$

$n = .015$

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

Q/bV $d = 3.91$ o.k

EBASCO SERVICES INCORPORATED

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

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

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

STA 17+00

Bed El = 1813.25 - 6.58 = 1806.67

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

d = 5.48

STA 16+00

Bed El = 1806.67 - .001 x 500 = 1806.17

$v^2/2g$ .48

d 5.48

1812.13

STA. 17+00

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

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

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

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

d 5.48

STA 22+00

Bed El = 1805.64 - .001 x 500 = 1805.14

$v^2/2g$ = .91

d = 5.48

STA 25+00

Bed El = 1805.14 - .0024 x 300 = 1804.42

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

d = 4.08

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

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

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

STA 25+75

Bed El = 1804.42 - .0024 x 75 = 1804.24

$v^2/2g$ = 1.63

d = 4.08

STA 26+25

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

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

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

$$= 1804.24 - 0.08 = 1804.16$$

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

STA 26+25

Bed El = 1804.24 - .0024 x 50 = 1804.12

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

d = 3.91

STA 27+00

Bed El = 1804.12 - .0024 x 75 = 1803.94

$v^2/2g$ = 1.75

d = 3.91

Continue the same slope to STA 27+45 | Start of chute

Bed El = 1803.94 - .0024 x 45 = 1803.83

SUPERSEDED

Energy dissipator

$Q_{PSH} = 1560$ cfs

For $D_{75} = 4.76$ mm > 0.4 mm
Allowable velocity for unprotected channel
(TR 25 Fig 6-2) silt laden flow

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

$= 4 \times 1.1 \times 1 \times .83$ (3:1 side slope) DKS

$= 3.65$

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

Assume $b = 80'$
for 3:1 side slopes
$d = 4.60'$
$A = 431.48$
$P = 80 + 2\sqrt{10} \times 4.6$
$= 109.09$
$R = 3.955$
$V = 3.62$
$S = \left[\frac{V n}{1.486 R^{2/3}}\right]^2$ $n = .025$

$= .0006$

SUPERSEDED

The excavation from the channel can be used for the embankment

if $b = 100'$
$d = 4.2$ 2:1 side slope
$A = 455.28$ ← $4.2(100 + 2 \times 4.2)$
$P = 118.78$ ← $100 + 2\sqrt{5} \times 4.2$
$R = 3.83$
$V = \frac{1560}{455.28} = 3.43$
$S = .00056$

EBASCO SERVICES INCORPORATED

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

CHKD. BY C. Lee DATE 7/2/85 OFS NO. USDA 3767-100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

SUPERSEDED

Reservoir water level for ESH [illegible]

For 100' wide channel

∴ bed level = 1795.52

End of channel STA 39+50

∴ stilling basin STA 28+52

Bed slope = .00056

∴ Bed EL at STA 28+52 = 1795.52 + .00056 × 1098

= 1796.13'

Water EL = 1796.13 + 4.2 = 1800.33

SUPERSEDED

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

SUPERSEDED

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

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

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

Bed EL = 1803.83

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

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

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

For		
$Z_0 - Z_1$ =	12	12.2
Bed EL =	1791.83	1791.63
Y_1 =	1.28	1.273
Q =	1559	1560
V_1 =	32.5	32.68
$F_r = \frac{V}{\sqrt{gY}}$ =	5.06	5.10
$Y_2 = \frac{1}{2} Y_1 \left[\sqrt{1 + 8F_r^2} - 1\right]$ =	8.55	8.57

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

Bed of stilling basin = 1800.33 − 8.55 = 1791.78 < 1791.83

(For $Z_0 - Z_1 = 12.2$) → = 1791.76 > 1791.63 O.K.

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

= 6 × 8.55	6 × 8.57
= 51.3'	51.42

Use 52' ±

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

EBASCO SERVICES INCORPORATED

BY S Goyal DATE 6-27-85 / 9-16-85 SHEET 7A OF 15

CHKD. BY C. Lee DATE 7/2/85 Y.C YANG 9-17-85 OFS NO. USDA 3767-100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

Reservoir water level for ESH = 1799.72

For 130' wide channel d = 3.73 / Normal depth @ Q_{100} slope See separate calc.

∴ bed level = 1795.99

End of channel STA 39+50

" " stilling basin STA 28+53.5

Bed slope = .00056

∴ Bed EL at STA 28+52 = 1795.99 + .00056 x 1696.5

= 1796.60'

Water EL " = 1796.60 + 3.73 = 1800.33

Ref. Hydraulic Design of Energy Dissipators for Culverts and channel US DOT Page IV B-8

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

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

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

Bed EL = 1802.36

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

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

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

For $Z_o - Z_1 = 10.33$

Bed EL = 1792.03

$Y_1 = 1.355$

$Q = 1559.9$

$V_1 = 30.70$

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

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

$= 8.25$

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

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

Length of jump (for $F_r = 4.65$) = 5.9 x Y_2

= 5.9 x 8.25

= 48.7' Use 49' ± ✓

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

MASCO SERVICES INCORPORATED

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

CHKD. BY YCYANG DATE 9-17-85 OFS NO. USDA 3767.15 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULIDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY

Check energy dissipator for lower flows in the floodway

Q	921	390
$W_B = W_0 = 37.5'$,		
$Y_0 = Y_c = \left[\left(\frac{Q}{W}\right)^2 / g\right]^{1/3}$	2.66	1.5
$V_0 = Q/(W \times Y_c)$	9.23	6.93
Bed El = 1792.00		
$Z_0 - Z_1 = 1802.33 - 1792 = 10.33$		
$Q = Y_1 W_B [2g\{(Z_0 - Z_1) + (Y_0 - Y_1)\} + V_0^2]^{1/2}$		
$= Y_1\, 37.5 [64.4 \{10.33 + (Y_0 - Y_1)\} + V_0^2]^{1/2}$		
For $Y_1 =$	.834	.371
$Q =$	921.4	390.0
$V_1 = Q/(37.5 \times Y_1)$	29.45	28.03
$Fr_1 = V_1/\sqrt{gY_1}$	5.68	8.11
$Y_2 = \frac{1}{2} Y_1 [\sqrt{1 + 8 Fr_1^2} - 1]$	6.30	4.07 ← lower than basin depth
T.W req $= 1792.03 + Y_2$	1798.33	1796.10
T.W Avail $= 1796.60 + D$		1796.6
D_{normal} @ Q_{10}	2.48	
T.W. Avail	1799.08	
	0.4	0.4

The pool is alright for lower flows.

EBASCO SERVICES INCORPORATED

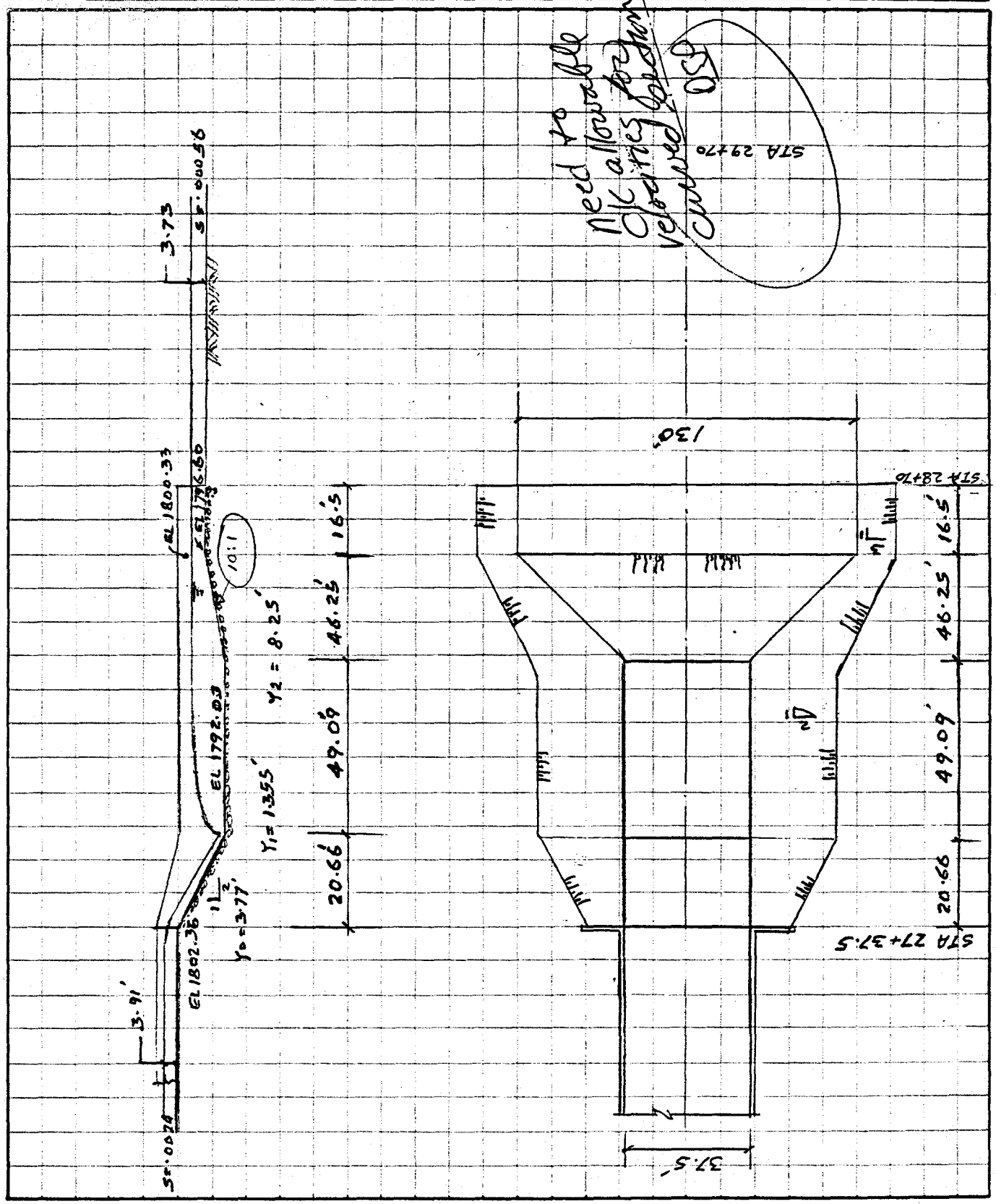
BY S. GOYAL DATE 6-27-85 / 9-17-85 SHEET 8 OF 15

CHKD. BY C. Zee DATE 6-28-85 / 9/2/85 Y.C. YANG 9-17-85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY



581/8-81

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

CHKD. BY C.Zu DATE 7/2/85 OFS NO. USDA 3767-100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT

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

$Q = 1046$ cfs

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

$b = 2d = 16.5'$

$d = 8.25$ $D = 1.2 \times 8.25 = 9.9'$

$A = 136.1$

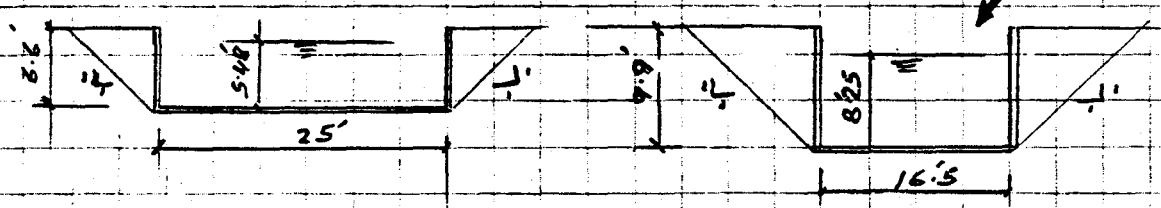
$P = 33$

$R = 4.125$

$V = 7.68$

$D = 1.2 \times 5.48 = 6.6'$ $S = .00091$ ok

most hydr. efficient



Adopted Alternate

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

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

yes NO yes

BRANDOW & JOHNSTON INCORPORATED

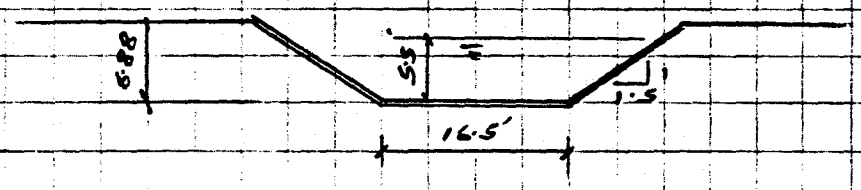
BY S GOYAL DATE 6-28-85 SHEET 10 OF 15

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

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT



$D = 1.25 \times 5.5 = 6.88$

Excavation $= (16.5 + 1.5 \times 6.88)\ 6.88 = 184.5$ CFT/FT

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

Concrete $= 41.3 \times .5$ — 6" lining class C channel

$= 20.7$ CFT/FT

Filter 10" $= 41.3 \times .8$

$= 33$ CFT/FT

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

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

8A

EBASCO SERVICES INCORPORATED

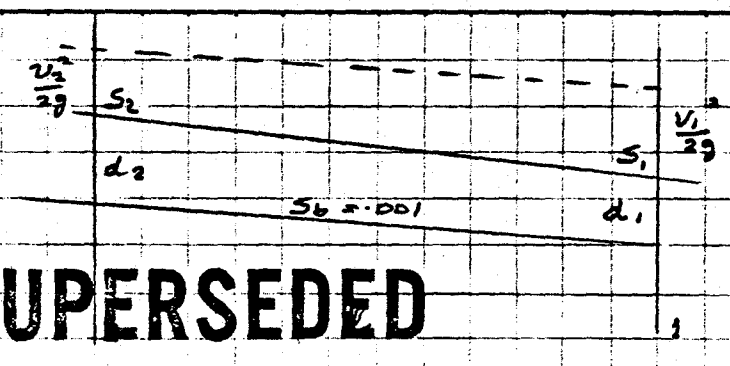
BY S Goyal DATE 7-8-85 SHEET 11 OF 15

CHKD. BY L. Zee DATE 7/4/85 OFS NO. USDA 3767.1m DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY WATER PROFILE



SUPERSEDED

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

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

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

$$v_2 = \frac{1.486}{n} R_2^{2/3} S_2^{1/2} = \frac{Q}{b d_2}$$

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

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

$$\text{or } d_2 R_2^{2/3} = \frac{1.46 \times .015}{25 \times 1.486\, S_2^{1/2}} = .4223 / S_2^{1/2}$$

S_1	S_2	S_b	ΔS	d_1	$\frac{v_1^2}{2g}$	d_2	$\frac{v_2^2}{2g}$	ΔE	l	Σl
.0024	.0020	.001	.0012	4.08	1.63	4.333	1.448	.0708	59	59
.0020	.0016	.001	.0008	4.333	1.448	4.67	1.246	.135	169	228
.0016	.0014	.001	.0005	4.67	1.246	4.885	1.139	.108	216	444
.0014	.0013	.001	.00035	4.885	1.139	5.0	1.087	.063	180	624

STA	d_1
25+75	4.08
22+00	4.08
21+41	4.33
19+72	4.67
17+56	4.885
15+76	5

SUPERSEDED

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

" 16+00 = 1811.727 + .0013 x 100 + .4(1.087 - .48) Transition loss

= 1812.1

≈ 1812.15 See sheet 4

∴

391/8-81

EBASCO SERVICES INCORPORATED

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

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

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT. FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

@ STA 26+25 :

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

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

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

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

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

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

BY TRIAL : $D_n = \underline{3.9154}$ — $D_c = 3.78$ ft

$$\frac{(BD_n)^{5/3}}{(B+2D_n)^{2/3}} = 321.4278$$

(0.K)

581/8-81

EBASCO SERVICES INCORPORATED

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

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

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT. PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

STA 26+25 TO STA 25+75 :

APPLY MOMENTUM EQUATION TO FIND DEPTH.

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

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

$$P_2 = \frac{1}{2}WB_2D_2^2 \; ; \qquad V_2 = \frac{Q_2}{B_2D_2}$$

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

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

$$F_f = W h_f'$$

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

ASSUME $h_f' = S_b$

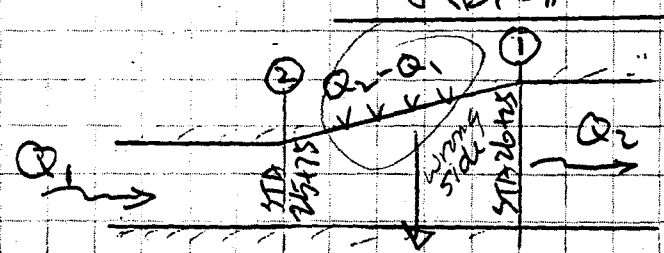
THEN $W\sin\theta = F_f$.

& (1) BECOMES

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

OR

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



EBASCO SERVICES INCORPORATED

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

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

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

FROM STA. 26+25 TO STA 25+75 :

$$\frac{1}{g}\left(\frac{Q_2^2}{B_2 D_2}\right)+\frac{1}{2}\left(B_2 D_2^2\right)+\frac{1}{8}\left(B_1-B_2\right)\left(D_1+D_2\right)^2=C_2$$

$$\frac{1}{g}\left(\frac{Q_1^2}{B_1 D_1}\right)+\frac{1}{2}\left(B_1 D_1^2\right)=C_1$$

STA	B	Q	D	C_1	C_2
26+25	37.50	1560.00	3.9154	802.182	
					//
26+18.75	35.9375	1495.75	4.422	788.578	802.182
					//
26+12.5	34.375	1431.50	4.684	772.337	788.532
					//
26+06.25	32.8125	1367.25	4.894	754.474	772.391
					//
26+00	31.25	1303.00	5.077	735.084	754.502
					//
25+93.75	29.6875	1238.75	5.244	714.305	735.109
					//
25+87.5	28.125	1174.50	5.401	692.237	714.369
					//
25+81.25	26.5625	1110.25	5.550	668.767	692.190
					//
25+75	25.00	1046.00	5.695		668.769

$D_n = 4.1$
$D_c = 3.8$

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY - WATER PROFILE

OFS NO. _____ DEPT. NO. _____

BY Y.C. YANG DATE 9-13-85

CHECKED BY S Goyal DATE 9-16-85

$E_1 = D_1 + Z_1 + \frac{V_1^2}{2g}$; $E_2 = D_2 + Z_2 + \frac{V_2^2}{2g} + \gamma H_e$ $\quad \Sigma E_1 = \Sigma E_2$ $\quad S_f = \left[\frac{0.015}{1.486}\frac{V}{R^{2/3}}\right]^2$

(1) STA	(2) EL	(3) ΔL	(4) So	(5) SGAL	(6) B	(7) A	(8) R^2/3	(9) Q	(10) V	(11) = Σ(5) Z	(12) D	(13) V²/2g	(14) ΣE₁	(15) Sf	(16) SFAVE	(17) γHe	(18) ΣE₂
25+75				0	250	142.375	2.483	1046	7.347	0	5.695	0.838	6.533	0.00089			
25+50		25	0.0024	0.06	"	141.0	2.472	"	7.418	0.06	5.640	0.855	6.555	0.00092	0.00090	0.023	6.556
25+00		50	0.0024	0.12	"	138.375	2.451	"	7.559	0.18	5.535	0.887	6.602	0.00097	0.00095	0.042	6.602
24+50		50	0.0024	0.12	"	135.75	2.429	"	7.705	0.30	5.430	0.922	6.652	0.00103	0.00100	0.050	6.652
24+00		50	"	0.12	"	133.125	2.407	"	7.857	0.42	5.325	0.959	6.704	0.00109	0.00106	0.053	6.705
23+00		100	"	0.24	"	128.125	2.364	"	8.164	0.66	5.125	1.035	6.820	0.00122	0.00115	0.115	6.819
22+00		100	"	0.24	"	123.375	2.322	"	8.478	0.90	4.935	1.116	6.951	0.00136	0.00129	0.129	6.949
21+00		100	0.0010	0.10	"	124.875	2.335	"	8.376	1.00	4.995	1.089	7.084	0.00131	0.00134	0.134	7.084
20+00		100	"	0.10	"	126.125	2.346	"	8.293	1.10	5.045	1.068	7.213	0.00127	0.00129	0.129	7.213
19+00		100	"	0.10	"	127.225	2.356	"	8.212	1.20	5.089	1.050	7.339	0.00124	0.00126	0.126	7.339
18+00		100	"	0.10	"	128.20	2.365	"	8.159	1.30	5.128	1.034	7.462	0.00121	0.00123	0.123	7.462
17+00		100	"	0.10	"	129.05	2.372	"	8.104	1.40	5.162	1.020	7.582	0.00119	0.00120	0.120	7.582
											OK DSP						
FROM STA 17+00 TO STA 16+00 COMPUTATION SEE NEXT PAGE																	
16+00			0.0010		8.5	62.807	1.938	1160	4.140	0	1.389	0.266	1.655	0.00046			
15+50		50	"	0.05	"	62.56	1.936	"	4.156	0.05	1.360	0.268	1.628	0.00047	0.00023	0.023	1.628
15+00		50	"	0.05	"	62.356	1.935	"	4.170	0.10	1.336	0.270	1.706	0.00047	0.00024	0.024	1.702
14+00		100	"	0.10	"	61.88	1.931	"	4.202	0.20	1.280	0.274	1.754	0.00048	0.00048	0.048	1.754
13+00		100	"	0.10	"	61.404	1.927	"	4.234	0.30	1.224	0.278	1.802	0.00049	0.00048	0.048	1.803
12+00		100	"	0.10	"	60.928	1.924	"	4.267	0.40	1.168	0.283	1.851	0.00050	0.00049	0.050	1.852
11+00		100	"	0.10	"	60.469	1.920	"	4.300	0.50	1.114	0.287	1.901	0.00051	0.00050	0.051	1.902
											OK DSP						

$y = 4.07735$

$y = 5.477$

$d_c = 3.1'$

5810/5-74

EBASCO SERVICES INCORPORATED

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

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

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JT FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — WATER PROFILE

FROM STA 17+00 TO STA 16+00 :-

$$\frac{1}{g}\left(\frac{Q_2^2}{B_2D_2}\right)+\frac{1}{2}\left(B_2D_2^2\right)+\frac{1}{8}\left(B_1D_1^2-B_2D_2^2\right)=C_2$$

$$\frac{1}{g}\left(\frac{Q_1^2}{B_1D_1}\right)+\frac{1}{2}\left(B_1D_1^2\right)=C_1$$

STA	B	Q	D	C_1	C_2
17+00	25.00	1046.0	5.162	596.377	
16+87.5	22.9375	947.75	5.489	567.104	596.350
16+75	20.875	849.50	5.778	534.356	567.084
16+62.5	18.8125	751.25	6.050	498.289	534.357
16+50	16.75	653.0	6.311	458.839	498.231
16+37.5	14.6875	554.75	6.570	416.036	458.812
16+25	12.625	456.5	6.833	369.751	416.064
16+12.5	10.5625	358.25	7.104	319.647	369.724
16+00	8.50	260.0	7.389		319.618

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-25-85 SHEET 12 OF 15

CHKD. BY S Goyal DATE 9-13-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY – BAFFLE CHUTE

$Q_{max} = 1560$ C.F.S. $W = 37.50'$ $S = \frac{1}{2}$

$q = \frac{Q}{W} = \frac{1,560}{37.5} = 41.6$ CFS/FT.

$\therefore D_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{41.6^2}{32.2}} = 3.77'$

$V_c = \sqrt[3]{qg} = \sqrt[3]{(41.6 \times 32.2)} = 11.02$ '/sec

TOTAL LENGTH OF CHUTE (MIN)

$L = (1803.58 - 1796.97)\sqrt{1^2+2^2} = 14.78$ (SLOPE)

$L_{HORIZ} = (1803.58 - 1796.97)\,2 = 13.22$

BAFFLE PIER HEIGHT:-

$H = 0.8 D_c = 0.8 \times 3.77 = 3.02'$ USE 3'-0

BAFFLE PIER WIDTH & SPACING

$B = \frac{3}{2}H = \frac{3}{2} \times 3.02 = 4.53'$ USE 4.5'

SLOPE DISTANCE BETWEEN BAFFLE PIERS:-

$D = 2H = 2 \times 3.00 = 6.00$

NO. OF BAFFLE PIERS PER ROW:-

$37.5 / 2 \times 4.5 = 4.17$

NO OF ROWS

$14.78 \div 6.0 - 1 = 1.45$ USE 4 ROWS (MIN)

LENGTH OF CHUTE:

$(4.0 + 1.) \times 6 = 30'$

EBASCO SERVICES INCORPORATED

BY E.C. ENG DATE 6-25-85 SHEET 12 A OF 15

CHKD. BY S Goyal DATE 9-13-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY — BAFFLE CHUTE

$L_{HORIZ} = 30.0 \times 2 / \sqrt{5} = 26.83'$

$F = 30.0 / \sqrt{5} = 13.42'$

TOP OF STILLING POOL EL.

$1803.58 - 13.42 = 1790.16'$

HEIGHT OF TRAINING WALL

$H = 3 \times 3 = 9'$

EBASCO SERVICES INCORPORATED

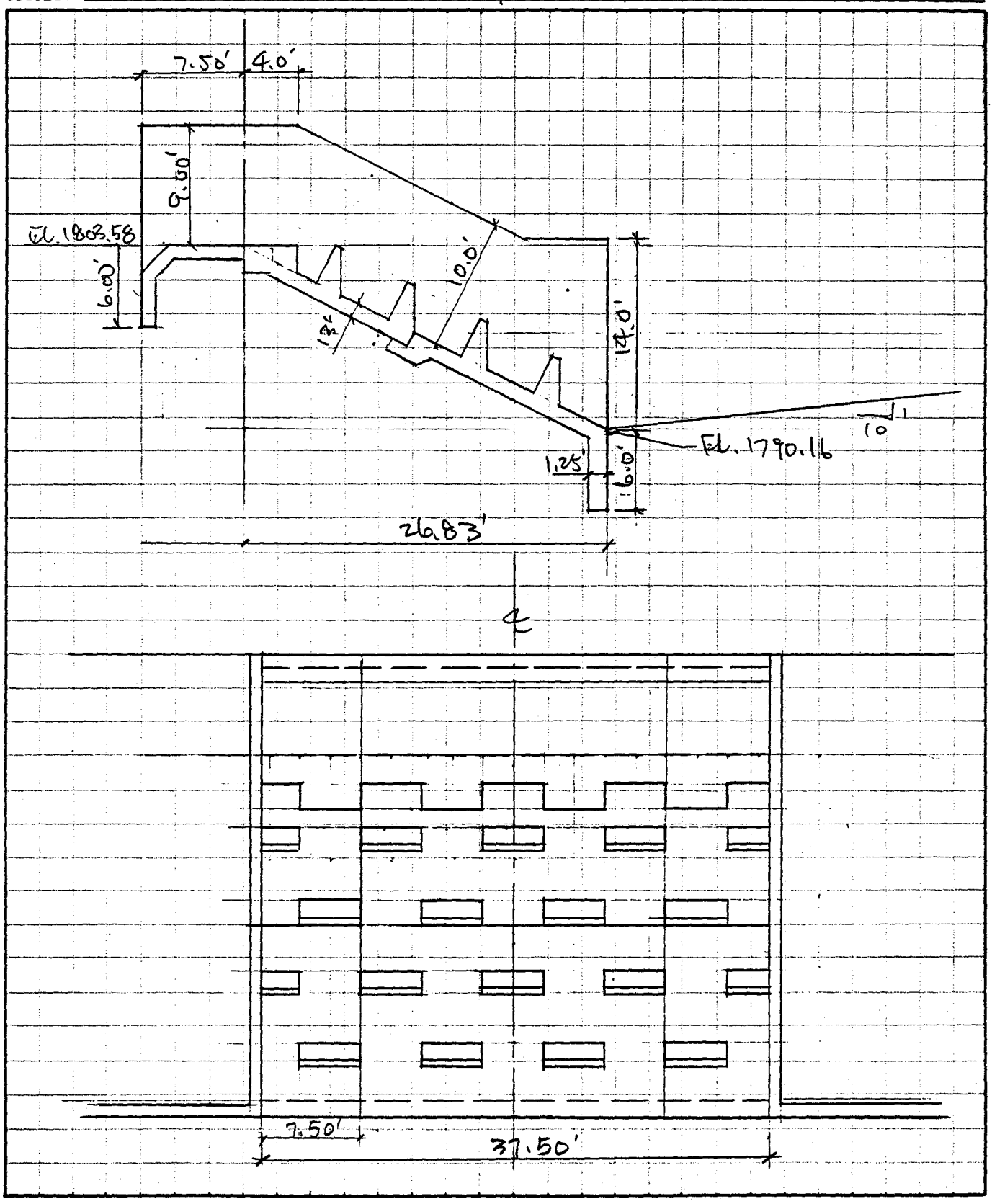
BY Y.C. YANG DATE 6-25-85 SHEET 12B OF 15

CHKD. BY S GOYAL DATE 9-16-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE FLOODWAY — BATTLE CHUTE



581/8-81

BASCO SERVICES INCORPORATED

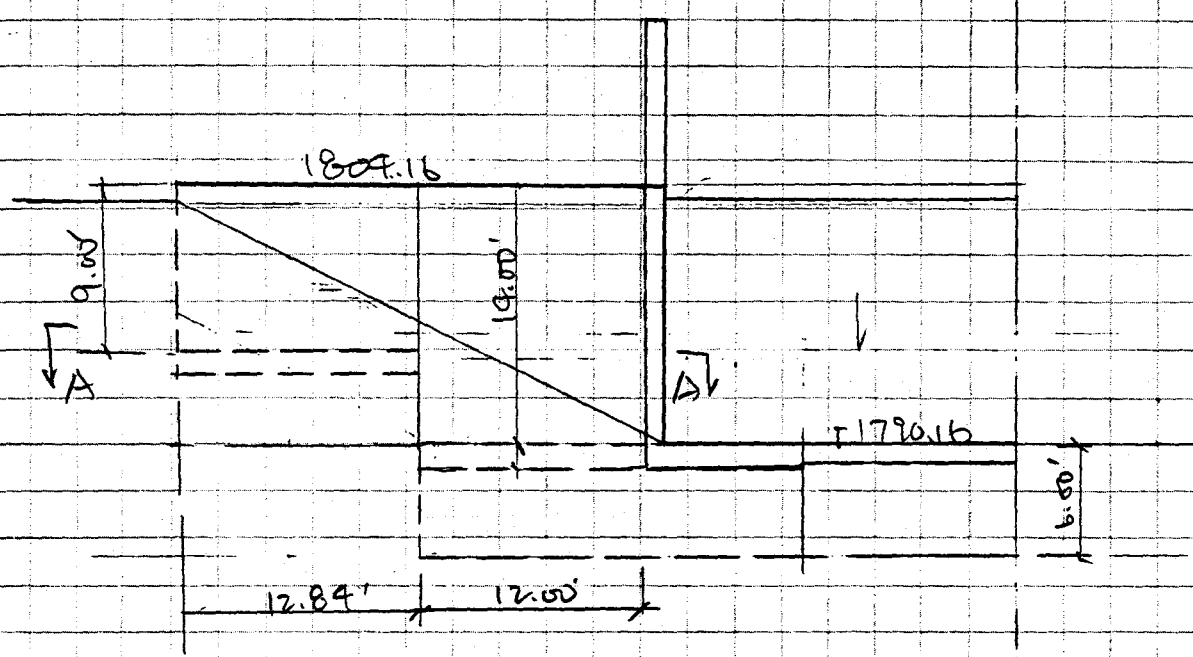
BY Y.C. YANG DATE 6-25-85 SHEET 12C OF 15

CHKD. BY S. Goyal DATE 9-18-85 OFS NO. 3767.100 DEPT. NO. 650

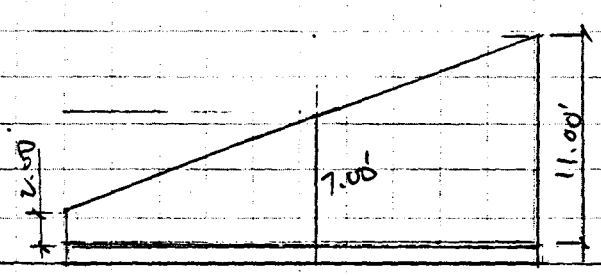
CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY – BAFFLE CHUTE



FRONT ELEVATION
(WING WALL)



SECT A-A

SERVICES INCORPORATED

BY Y.C. YANG DATE 6-25-85 SHEET 12D OF 15

CHKD. BY S Goyal DATE 9-18-8 OFS NO. 3767.100 DEPT. NO. 65

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY - BAFFLE CHUTE

QUANTITIES:-

SLAB:- (t = 16"):-

1.33 x 8.50 x 2 x 30.0 = 678.30 CF

SLAB: (t = 13"):-

13/12 x 22.50 x 30.0 = 731.25 CF

SLAB @ CREST:- (t = 12")

1.0 x (7.50 + 6.00) x 39.50 = 533.25 CF

C.O. WALL (t = 15"):-

15/12 x 6.0 x 39.50 = 296.25 CF

BAFFLES:-

(0.6 + 2.1) 3.0/2 x 4.5 x 14 = 255.15 CF

(0.6 + 2.1) 3.0/2 x 3.0 x 4 = 98.60 CF

4.0 x 1 x 4.5 x 4 = 72.00 CF

2.0 x 1.0/2 x (3 x 4.5 + 2 x 3.0) = 19.50

1.0 x 3.0 x 37.5 = 112.50

SIDE WALL:- (AVE t = 11")

2 x 11/12 x (7.50 + 4.0) x 9.0 = 189.75

2 x 11/12 x (26.83 - 4.0 - 6.0) 10.55/2 = 349.97

2 x 11/12 x (14.0 + 10.55/2) 6.0/2 = 138.49

3420.01

581/8-81

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-25-85 SHEET 12-E OF 15

CHKD. BY S G-yal DATE 9-16-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY – BAFFLE CHUTE

RETAINING WALL: (t = 12" & 15")

WALL: $2 \times 15/12 \times 14.0 \times 12.0$ = 420.00 C.F.

$2 \times 12/12 \times 9.0 \times 12.84$ = 231.12

SLAB: $2 \times 15/12 \times (12.25 + 8.25) 12.0/2$ = 307.50

$2 \times 12/12 \times (3.0 + 8.0) 12.84/2$ = 141.24

ΣV = 4519.87 C.F.

= 167.5 C.Y.

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EBASCO SERVICES INCORPORATED

BY Y. C. TANG DATE 6-26-85 SHEET 12 E OF 15

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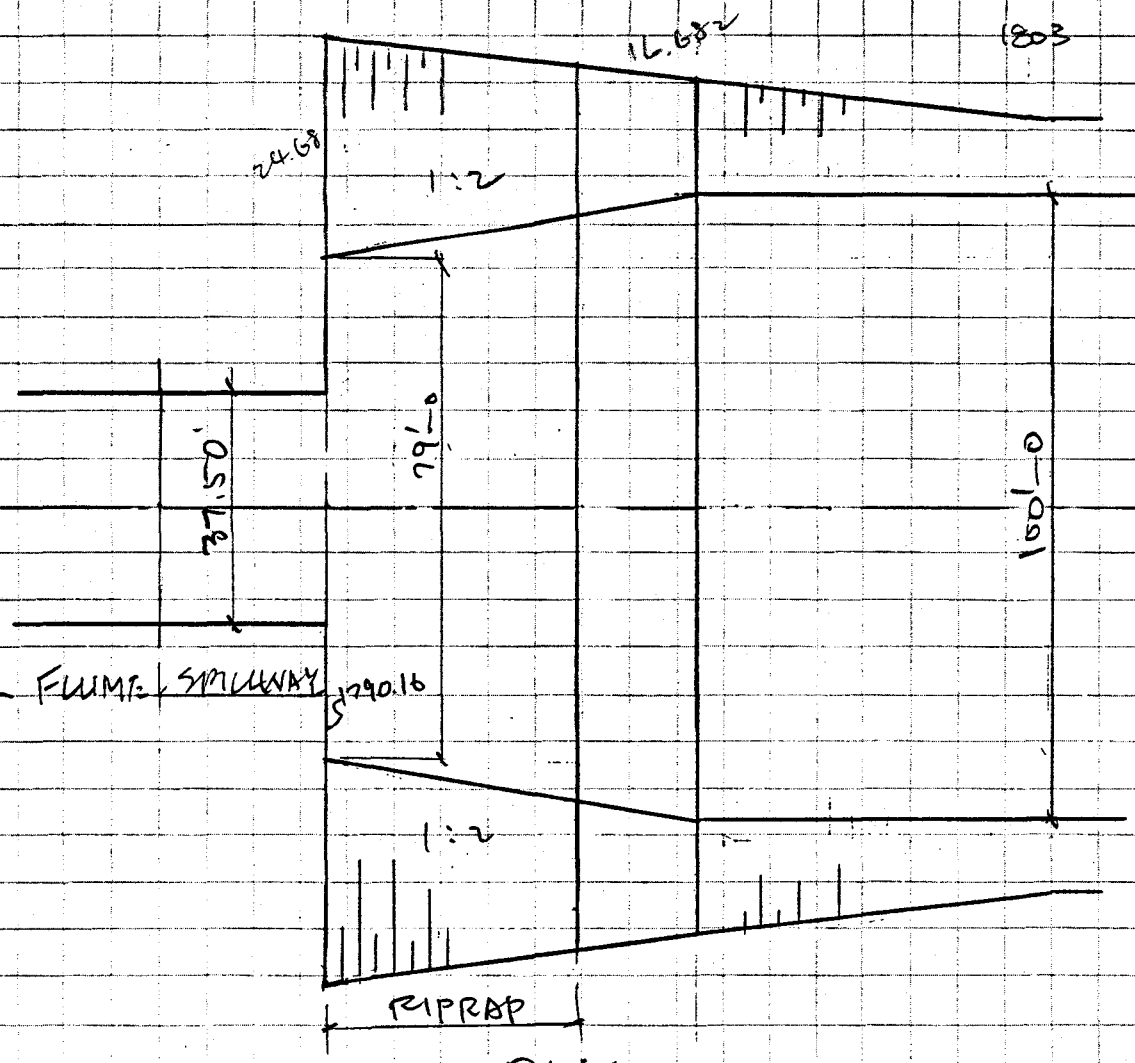
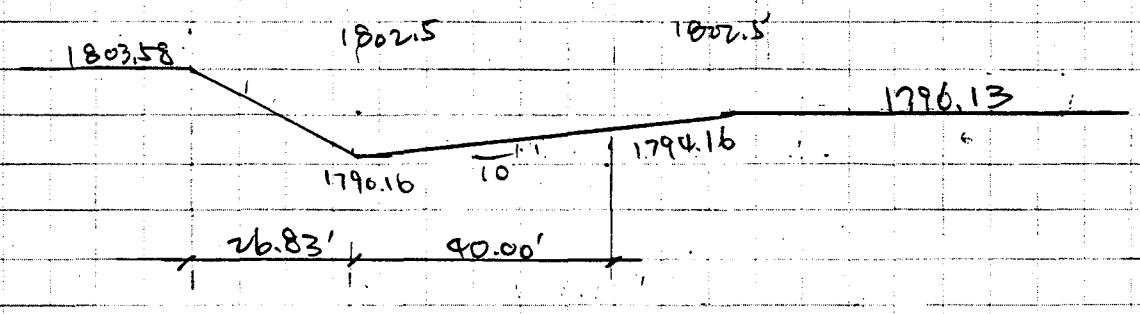
CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY — BAFFLE CHUTE



PLAN



PROFILE
1" = 30'-0

581/8-81

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BY Y.C. YANG DATE 6-26-85 SHEET 12 G OF 15

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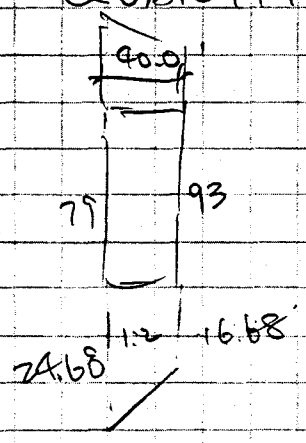
CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY - BAFFLE CHUTE

QUANTITIES ($t = 2.6'$)



$$A_1 = 40.0\,(79+93)\tfrac{1}{2} \times \frac{\sqrt{101}}{10} = 3457\ \square'$$

$$A_2 = 2(24.68 + 16.68)\frac{\sqrt{5}}{2} \times \frac{40.0}{2} \times \frac{\sqrt{101}}{10} = 1859\ \square'$$

$$\Sigma A = 5{,}316\ \square'$$

$$V = 5{,}316 \times 2.5 = 13{,}290\ CF$$

$$= 492\ C.Y.$$

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BY S GOYAL DATE 7-2-85 SHEET 12H OF 15

CHKD. BY Y.C. YANG DATE 9-17-85 OFS NO. USDA 3767.100 DEPT. NO. 550

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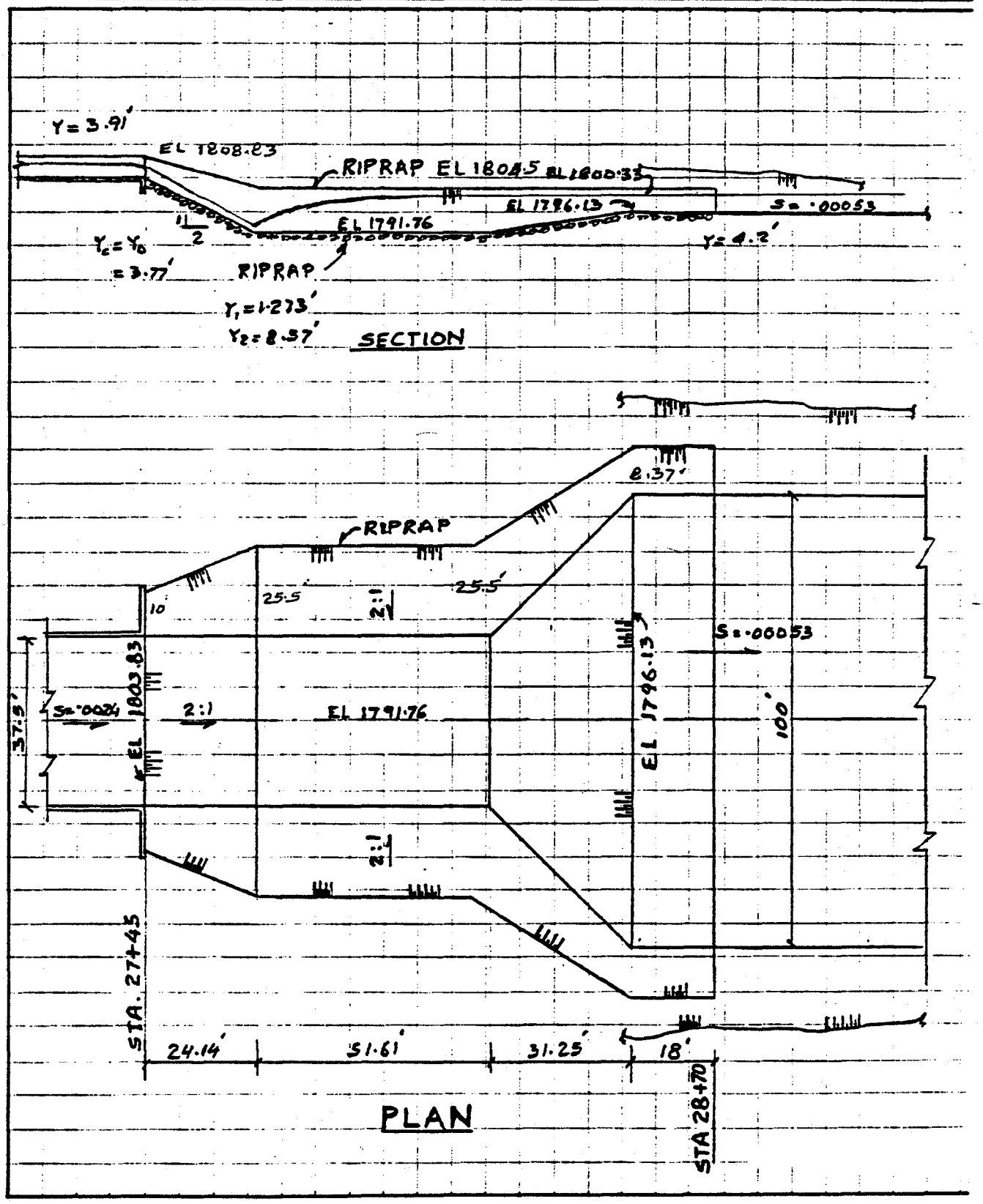
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT APACHE JUNCTION FLOODWAY - ENERGY DISSIPATOR



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BY S Goyal DATE 7-2-85 SHEET 121 OF 15

CHKD. BY Y.C. YANG DATE 8-17-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT APACHE JUNCTION FLOODWAY - ENERGY DISSIPATOR

RIPRAP

$37.5 \times 24.14 \frac{\sqrt{5}}{2} \times 2.5 = 2530$

$37.5 \times 51.61 \times 2.5 = 4838$

$2 \times (10 + 25.5) \frac{1}{2} \frac{\sqrt{5}}{2} \times 24.14 \times \frac{\sqrt{5}}{2} \times 2.5 = 2678$

$2 \times 25.5 \frac{\sqrt{5}}{2} \times 51.61 \times 2.5 = 7357$

$2 \times \frac{(25.5 + 8.37)}{2} \frac{\sqrt{5}}{2} \times 31.25 \times 1.5 = 1775$

$(37.5 + 100) \frac{1}{2} \times 31.25 \times 1.5 = 3223$

$2 \times 8.37 \times \frac{\sqrt{5}}{2} \times 18 \times 1.5 = 505$

$18 \times 100 \times 1.5 = 2700$

25606 cft

or 948 cyd.

Baffle chute	CONC	= 167	@ 300	=	$ 50100
	RIPRAP	= 492 cyd	@ 30	=	$ 14760
					$ 64860
Riprap basin	RIPRAP	= 948 cyd	@ 30	=	$ 28440

∴ RIPRAP BASIN IS ECONOMICAL AND WILL BE USED. ✓

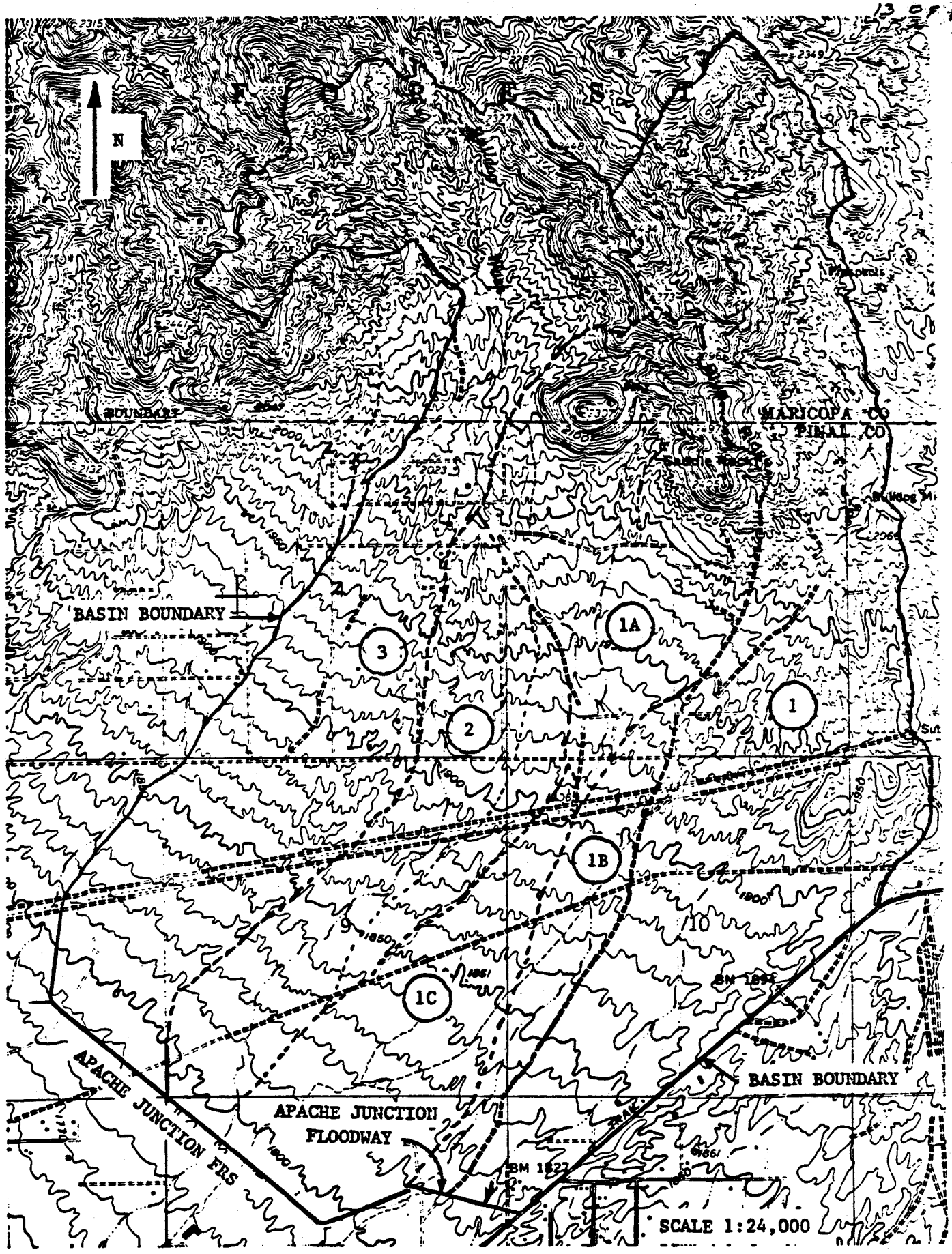


FIGURE 1. BASIN MAP

TABLE 2. INFLOWS TO FRS

	PSH	ESH	FBH	25-YEAR
PEAK INFLOWS, CFS/ TIME, HOURS				
Sub-basin 1	1046 120.3	3819 2.77	10638 2.77	608 120.3
Sub-basin 1A + 1B	514 120.0	1904 2.56	5511 2.56	289 120.0
Sub-basin 1A + 1C	476 120.0	1770 2.68	5202 2.68	264 120.0
Sub-basin 2	395 119.6	2060 2.38	6316 2.38	208 119.6
Sub-basin 3	1077 120.1	3950 2.62	11276 2.62	617 120.1
COMBINED PEAK INFLOWS, CFS	2893	12388	35614	1655
TIME OF PEAK, HOURS	120.3	2.59	2.59	120.3

EBASCO SERVICES INCORPORATED

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

CHKD. BY DATE OPS NO. DEPT. NO.

CLIENT USDA-SCS

PROJECT

SUBJECT SOIL PARAMETERS FOR TRACTIVE STRESS ANALYSIS

Tractive Stress Approach

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

Need for Actual Stress Determination:

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

Need for Allowable Tractive Stress

1) D_{50}

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

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

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

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

EB1/3-81

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 6-28-85 SHEET 1 OF 17

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL

Earth emergency spillway

From computer output

Length of crest (Ft)	OF/b	TOP OF Embankment (Feet)	Quantity of Fill (CYD)
400	7.3	1807.03	260092
350	8.3	1807.34	268269
300	9.6	1807.69	278038
275	10.5	1807.89	283335

The minimum width which satisfies OF/b criteria to be less than 10 is 300 feet. Design study is done for 300 wide crest and thereafter 350 wide crest will be considered if it is more economical than the 300 wide crest

For 300 wide crest

$Q_{ESH} = 2329.8$ cfs

$Q_{FBH} = 16084.9$ cfs

For earth channel assume $n = .025$

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

Approximate ground slope in the exit channel is 0.015.

$$\therefore V = \frac{1.486}{.025} (.015)^{1/2} R^{2/3} = 7.28 R^{2/3}$$

$$R = \frac{A}{P} = \frac{(300 + 2d)d}{300 + 2\sqrt{5}\,d}$$

$$Q = AV = (300 + 2d)d\,v$$

$$q = \frac{Q}{(300 + 2d)}$$

$$d_c = \sqrt[3]{q^2/g}$$

BASCO SERVICES INCORPORATED

BY S GUPAL DATE 6-28-85 SHEET 2 OF 17

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA 3767.10 DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION, FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL

d	R	V	Q	q	d_c	$d_c > d$
1.0	.99	7.24	2187	7.24	1.18	✓
1.5	1.48	9.46	4301	14.19	1.84	✓
2.0	1.97	11.43	6951	22.87	2.53	✓
2.5	2.45	13.23	10089	33.08	3.24	✓
3.0	2.93	14.90	13681	44.71	3.96	✓
3.5	3.40	16.47	17701	57.66	4.69	✓

$Q_{ESH} = 2329.8$

The flow is supercritical for all flows. The control is at the crest. However the velocity for Q_{ESH} is about 7.25 fps which is high for the soils and also for caliche which is considered to be a poor strength material. Protection by riprap or other material will be necessary.

For soil cement assume 'n' = .015 same as for concrete.

$$\therefore \quad V = \frac{1.486}{.015}(.015)^{1/2} R^{2/3} = 12.13\, R^{2/3}$$

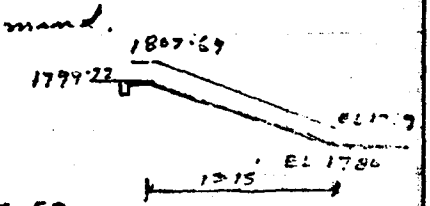
assume $d \simeq R$

$$\text{For } Q_{ESH} = 2329.8 = VA$$
$$= 12.13\, R^{2/3} \times 300 \times d$$
$$= 3639\, R^{5/3}$$

$d \simeq R = .765$ for 2/3 FBH $Q = 10723$, $d \simeq 1.9$, $V \simeq 18.6$

$V = 10.15$ fps

This velocity is considered to be high for soil cement without performing tests on the soil cement.



$$F = \frac{18.6}{\sqrt{32.2 \times 1.9}} = 2.38$$

conjugate depth $d_2 = 1.9 \times \frac{1}{2}\left(\sqrt{8F^2+1} - 1\right) = 5.52$

Soil cement quantity $\simeq 1400 \times (300 + 2\sqrt{5} \times 8) = 470000$ cu ft

EBASCO SERVICES INCORPORATED

BY S GUPAL DATE 6-28-85 SHEET 3 OF 17

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA [illegible] DEPT. NO. [illegible]

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL WITH RIPRAP

For riprap or wire mat use $n = .035$

Provide bed slope of 0.0175 as shown in SCS work plan

$$V = \frac{1.486}{.035} R^{2/3} (.0175)^{1/2} = 5.617 R^{2/3}$$

d	R	V	Q	q	d_c	$d_c > d$
1.0	.99	5.59	1687	5.59	.99	approx.
1.5	1.48	7.30	3318	10.95	1.55	✓
2.0	1.77	8.82	5363	17.64	2.13	✓
2.5	2.45	10.21	7784	25.53	2.72	✓
3.0	2.93	11.50	10556	34.5	3.33	✓
3.5	3.40	12.71	13657	44.48	3.95	✓

Flow is supercritical for 25 % of Q_{FBH} or greater

For $2/3\ Q_{FBH}$ $Q = 10723 = VA = 5.617 R^{2/3}(300 + 2d)d$

$d = 3.04$

$V = 11.6$

$F = 1.16$

$d_2 = 3.04 \times \frac{1}{2}\left(\sqrt{8 \times 1.16^2 + 1} - 1\right)$

$= 3.71$

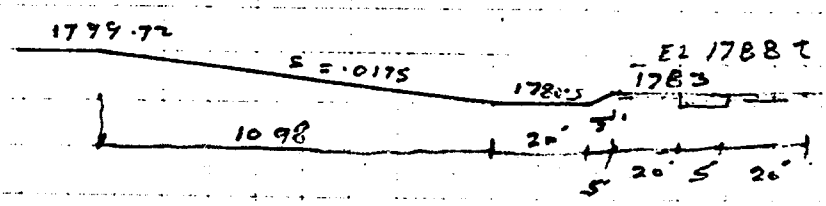
Q_{ESH} $= 2329 = 5.617 R^{2/3}(300 + 2d)d$

$d = 1.22$ $Q = 2350$

$V = 6.371$

$F = \frac{V}{\sqrt{gd}} = 1.016$

$d_2 \simeq d_1$



Too long a channel. Provide $S = .026$

Total length $\simeq = 739 + 70 = 809$ ft

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-2-85 SHEET 4 OF 17

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA 3767-100 DEPT. NO. S.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EARTH CHANNEL WITH RIPRAP

$$V = \frac{1.486}{.035} R^{2/3} S^{1/2}$$

$$= \frac{1.486}{.035} R^{2/3} (.026)^{1/2} = 6.846 R^{2/3}$$

For Q_{FBH} (16084.9) $d = 3.43$ $Q = 16693$ c.f.s.

$V = 15.29$

$2/3\ Q_{FBH}$ (10723) $d = 2.7$ $Q = 10789$ c.f.s.

$V = 13$

$F = 1.39$

$d_2 = 2.7 \times \frac{1}{2} \left[\sqrt{8 \times 1.39^2 + 1} - 1\right]$

$= 4.13$

$L = 4 \times 4.13 = 16.52$ ~ 20'

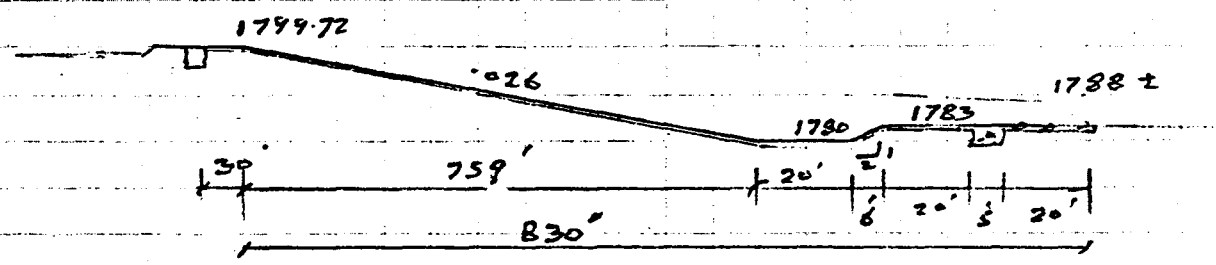
Q_{ESH} (2329) $d = 1.08$ $Q = 2337$ c.f.s.

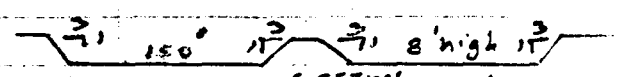
$V = 7.16$

$F = 1.21$

$d_2 = \frac{1.08}{2} \left\{\sqrt{8 \times 1.21^2 + 1} - 1\right\}$

$= 1.39$





SECTION 150'

Riprap = 860 (150 x 2 + 4 x √10 x 8)

= 345026 sq ft = 38336 sq yd

cost for 1' thick Gabions and fabric @ 21 = 805056

for 2 thick riprap

quantity = 345026 x 2/27 = 25557 cy

@ $30/yd = $766724

BOARD SERVICES INCORPORATED

BY S GOYAL DATE 7-2-85 SHEET 5 OF 17

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA 3767.100 DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMENGENCY SPILLWAY · EARTH CHANNEL WITH RIPRAP

For 350' crest

Extra riprap cost = $860 \times 50 \times \frac{2}{27} \times 30 = \$95,555$

Saving in fill = $(278 - 38 - 268.269) \times 1.2 = \$11,723$

∴ The cost of extra riprap is much more than the saving in the embankment height. Consider using 300 feet wide crest

ES CREST 1799.72 FT 498.1 ACFT 0.00 AC 80.8 CFS

PS STORAGE 484.4 ACFT BETWEEN ES CREST AND SED ACCUM ELEVATIONS

STARTING E 1793.50 FT 13.7 ACFT 0.00 AC 0.0 CFS

EFFECTIVE HEIGHT(H)= 11.7 FEET, PRODUCT = 5840. (H * STORAGE AT CREST EMG.)

INPUT DESIGN CLASS = C

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

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

30" PS OUTLET
EARTH SPILLWAY
6/28/85

****

RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

RATING TABLE NUMBER 2

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	276.10	82.48	561.05	0.00
15	1800.75	493.46	83.96	628.30	0.00
16	1801.68	1588.69	86.55	749.35	0.00
17	1802.81	3763.45	89.61	910.14	0.00
18	1804.86	9708.88	94.93	1222.16	0.00
19	1807.43	20136.55	101.19	1655.06	0.00
20	1810.00	33348.42	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	400.0	1802.28	833.1	0.0	2.56	335.0	88.2	2633.3	2721.5	1.10	5.95	0.009	0.012	11.7	1.6

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

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.012

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

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5.45	662	1518	1801.6	741.5	0.0	. I E		5.15
5.53	614	1463	1801.6	735.4	0.0	. I E		5.08
5.62	573	1408	1801.5	729.4	0.0	. I E		5.01
5.71	542	1355	1801.5	723.5	0.0	. I E		4.94
5.79	520	1303	1801.4	717.8	0.0	. I E		4.88
5.88	505	1254	1801.4	712.3	0.0	. I E		4.73
5.96	492	1207	1801.4	707.1	0.0	. I E		4.67
6.05	476	1161	1801.3	702.1	0.0	. I E		4.63
6.14	450	1116	1801.3	697.3	0.0	. I E		4.49
6.22	407	1074	1801.2	692.5	0.0	. I E		4.45
6.31	351	1031	1801.2	687.7	0.0	. I E		4.40
6.40	289	986	1801.2	682.8	0.0	.I E		4.35
6.48	230	941	1801.1	677.7	0.0	.I E		4.18
6.57	177	895	1801.1	672.6	0.0	.I E		4.10
6.66	134	848	1801.1	667.5	0.0	.I E		4.01
6.74	101	803	1801.0	662.5	0.0	.I E		3.92
6.83	75	758	1801.0	657.5	0.0	. E		3.83
6.92	56	715	1800.9	652.7	0.0	. E		3.74*
7.00	42	673	1800.9	648.1	0.0	. E		3.65*
7.09	32	633	1800.9	643.7	0.0	. E		3.57*
7.17	24	595	1800.8	639.5	0.0	. E		3.50*
7.26	18	559	1800.8	635.6	0.0	. E		3.32*
7.35	13	525	1800.8	631.8	0.0	. E		3.26*
7.43	10	493	1800.8	628.2	0.0	. E		3.21*
.2	7	482	1800.7	624.8	0.0	. E		3.11*
1	5	471	1800.7	621.5	0.0	. E		3.13*
	4	461	1800.7	618.2	0.0	. E		3.03*
	3	450	1800.7	614.9	0.0	. E		3.05*
	2	440	1800.6	611.8	0.0	. E		2.95*
	1	430	1800.6	608.7	0.0	. E		2.97*
	1	420	1800.6	605.7	0.0	. E		2.87*
	1	411	1800.6	602.7	0.0	. E		2.90*
	0	401	1800.5	599.8	0.0	. E		2.93*
	0	392	1800.5	597.0	0.0	. E		2.83*
	0	383	1800.5	594.2	0.0	. E		2.86*
	0	374	1800.5	591.5	0.0	. E		2.77*
	0	366	1800.5	588.8	0.0	. E		2.80*
	0	358	1800.4	586.3	0.0	. E		2.71*
I	I	O	E	VOL	A	I	I I I I I I I	VEL
						0.	2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-IDT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	400.0	1807.03	1584.2	0.0	7.30	1086.1	100.2	18330.0	18430.2	3.97	11.32	0.006	0.008	9.7	7.3

PLOT

1 IN = 10000. CFS

EXIT SLOPE = 0.008

T	I	O	E	VOL	A	I I I I I I I	VEL
						0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0 .		0.00
0.09	0	0	1793.5	13.7	0.0 .		0.00
0.17	0	0	1793.5	13.7	0.0 .		0.00
0.26	0	0	1793.5	13.7	0.0 .		0.00
0.35	0	0	1793.5	13.7	0.0 .		0.00
0.43	0	0	1793.5	13.7	0.0 .		0.00
0.52	0	0	1793.5	13.7	0.0 .		0.00
0.61	0	0	1793.5	13.7	0.0 .		0.00
0.69	0	0	1793.5	13.7	0.0 .		0.00
0.78	0	0	1793.5	13.7	0.0 .		0.00
0.86	0	0	1793.5	13.7	0.0 .		0.00
0.95	0	0	1793.5	13.7	0.0 .		0.00
1.04	0	0	1793.5	13.7	0.0 .		0.00
1.12	0	0	1793.5	13.7	0.0 .		0.00

```
6.48   559  1849 1801.8   768.6   0.0 .IE                                                    4.91*
6.57   431  1725 1801.8   759.4   0.0 . E                                                    4.77*
6.66   325  1600 1801.7   750.2   0.0 . E                                                    4.61*
6.74   244  1514 1801.6   741.1   0.0 . E                                                    4.52*
6.83   182  1433 1801.5   732.1   0.0 .E                                                     4.43*
6.92   136  1353 1801.5   723.3   0.0 .E                                                     4.34*
7.00   102  1276 1801.4   714.8   0.0 .E                                                     4.25*
7.09    77  1201 1801.4   706.6   0.0 .E                                                     4.09*
7.17    57  1130 1801.3   698.7   0.0 .E                                                     4.01*
7.26    43  1063 1801.2   691.2   0.0 .E                                                     3.94*
7.35    32   999 1801.2   684.1   0.0 .E                                                     3.80*
7.43    24   938 1801.1   677.4   0.0 .E                                                     3.75*
7.52    18   880 1801.1   671.1   0.0 .E                                                     3.62*
7.61    13   826 1801.0   665.1   0.0 .E                                                     3.49*
7.69    10   775 1801.0   659.4   0.0 .E                                                     3.38*
7.78     7   727 1800.9   654.1   0.0 .E                                                     3.28*
7.87     5   682 1800.9   649.1   0.0 .E                                                     3.18*
7.95     4   640 1800.9   644.5   0.0 .E                                                     3.09*
8.04     2   600 1800.8   640.1   0.0 .E                                                     3.01*
8.13     2   562 1800.8   635.9   0.0 .E                                                     2.94*
8.21     1   527 1800.8   632.0   0.0 .E                                                     2.88*
8.30     1   494 1800.8   628.4   0.0 .                                                      2.83*
8.38     1   482 1800.7   624.9   0.0 .                                                      2.74*
8.47     0   471 1800.7   621.5   0.0 .                                                      2.75*
8.56     0   461 1800.7   618.2   0.0 .                                                      2.66*
8.64     0   450 1800.7   614.9   0.0 .                                                      2.68*
  T      I     O     E     VOL     A  I         I         I         I         I         I         I         I   VEL
                                      0.    10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT
```

VOLUME FILL= 260092. CY, MAX. HEIGHT= 19.0 FT
TOP WIDTH= 14.0 FT, TOP LENGTH= 8325.5 FT
AREA OF DAM= 16.14 AC, AREA TO SEED= 16.14 AC (PROJECTED HORIZONTAL AREA)

****

RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

RATING TABLE NUMBER 3

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	251.92	82.48	561.05	0.00
15	1800.75	442.35	83.96	628.30	0.00
16	1801.68	1401.63	86.55	749.35	0.00
17	1802.81	3307.35	89.61	910.14	0.00
18	1804.86	8522.54	94.93	1222.16	0.00
19	1807.43	17683.81	101.19	1655.06	0.00

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20 1810.00 29311.81 107.08 2141.60 0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	350.0	1802.39	848.9	0.0	2.67	350.8	88.5	2493.3	2581.8	1.15	6.15	0.009	0.012	12.5	1.8

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

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.012

T	I	O	E	VOL	A	0. / 2000. / 4000. / 6000. / 8000. / 10000. / 12000. / 14000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	0	0	1793.5	13.7	0.0		0.00
1.30	0	0	1793.5	13.7	0.0		0.00
1.38	0	0	1793.5	13.7	0.0		0.00
1.47	0	0	1793.5	13.7	0.0		0.00
1.56	0	0	1793.5	13.7	0.0		0.00
1.64	0	0	1793.5	13.7	0.0		0.00
1.73	0	0	1793.5	13.7	0.0		0.00
1.82	0	0	1793.5	13.7	0.0		0.00
1.90	0	0	1793.5	13.7	0.0		0.00
1.99	11	0	1793.5	13.8	0.0		0.00
2.07	168	2	1793.6	14.5	0.0		0.00
2.16	957	15	1794.0	18.5	0.0		0.00
2.25	2911	37	1794.3	32.1	0.0		0.00
2.33	5845	65	1794.8	63.0	0.0		0.00
2.42	8828	69	1795.8	115.0	0.0		0.00
2.51	11019	71	1796.7	185.4	0.0		0.00
2.59	12133	75	1797.6	267.5	0.0		0.00
2.68	12285	77	1798.5	354.2	0.0		0.00
2.77	11670	79	1799.2	439.2	0.0		0.00
2.85	10560	135	1799.9	517.9	0.0		1.64*
2.94	9300	326	1800.4	587.2	0.0		2.72*
3.03	8109	583	1800.9	646.1	0.0		3.60*
3.11	7038	966	1801.3	694.7	0.0		4.43
3.20	6126	1277	1801.6	733.7	0.0		5.06
3.28	5353	1581	1801.8	764.5	0.0		5.49
3.37	4708	1861	1802.0	788.1	0.0		5.87
3.46	4191	2071	1802.1	805.8	0.0		6.15
3.54	3788	2227	1802.2	819.0	0.0		6.34
3.63	3479	2341	1802.3	828.6	0.0		6.45
3.72	3246	2424	1802.3	835.6	0.0		6.51
3.80	3068	2484	1802.3	840.7	0.0		6.64
3.89	2934	2526	1802.4	844.2	0.0		6.64
3.98	2834	2555	1802.4	846.7	0.0		6.66
4.06	2739	2574	1802.4	848.2	0.0		6.72
4.15	2607	2582	1802.4	848.9	0.0		6.75
4.24	2415	2576	1802.4	848.4	0.0		6.73
4.32	2173	2553	1802.4	846.5	0.0		6.66

6.66

4.41	1915	2512	1802.4	843.0	0.0	. I E	6.66
4.50	1673	2453	1802.3	838.1	0.0	. I E	6.61
4.58	1458	2381	1802.3	832.0	0.0	. I E	6.51
4.67	1279	2299	1802.2	825.1	0.0	. I E	6.38
4.75	1141	2211	1802.2	817.6	0.0	. I E	6.28
4.84	1037	2120	1802.1	809.9	0.0	. I E	6.18
4.93	959	2026	1802.1	802.2	0.0	. I E	6.06
5.01	902	1939	1802.0	794.7	0.0	. I E	5.95
5.10	856	1853	1802.0	787.4	0.0	. I E	5.84
5.19	810	1770	1801.9	780.5	0.0	. I E	5.74
5.27	762	1690	1801.9	773.7	0.0	. I E	5.64
5.36	712	1613	1801.8	767.2	0.0	. I E	5.55
5.45	662	1538	1801.8	760.8	0.0	. I E	5.46
5.53	614	1465	1801.7	754.7	0.0	. I E	5.29
5.62	573	1396	1801.7	748.7	0.0	. I E	5.22
5.71	542	1350	1801.6	742.9	0.0	. I E	5.17
5.79	520	1305	1801.6	737.2	0.0	. I E	5.03
5.88	505	1261	1801.5	731.7	0.0	. I E	4.98
5.96	492	1219	1801.5	726.4	0.0	. I E	4.94
6.05	476	1179	1801.5	721.2	0.0	. I E	4.81
6.14	450	1139	1801.4	716.3	0.0	. I E	4.78
6.22	407	1100	1801.4	711.3	0.0	. I E	4.74
6.31	351	1061	1801.3	706.3	0.0	. I E	4.61
6.40	289	1020	1801.3	701.2	0.0	.I E	4.55
6.48	230	978	1801.3	695.9	0.0	.I E	4.49
6.57	177	935	1801.2	690.5	0.0	.I E	4.42
6.66	134	892	1801.2	685.1	0.0	.I E	4.34
6.74	101	850	1801.1	679.7	0.0	.I E	4.25
6.83	75	808	1801.1	674.4	0.0	. E	4.17
6.92	56	767	1801.1	669.3	0.0	. E	4.08
7.00	42	727	1801.0	664.3	0.0	. E	3.90
7.09	32	689	1801.0	659.5	0.0	. E	3.82*
7.17	24	653	1801.0	654.9	0.0	. E	3.75*
7.26	18	618	1800.9	650.5	0.0	. E	3.68*
7.35	13	585	1800.9	646.3	0.0	. E	3.62*
7.43	10	553	1800.9	642.3	0.0	. E	3.45*
7.52	7	523	1800.8	638.5	0.0	. E	3.40*
7.61	5	495	1800.8	634.9	0.0	. E	3.37*
7.69	4	468	1800.8	631.5	0.0	. E	3.22*
7.78	3	442	1800.8	628.3	0.0	. E	3.19*
7.87	2	434	1800.7	625.2	0.0	. E	3.10*
7.95	1	425	1800.7	622.1	0.0	. E	3.13*
8.04	1	416	1800.7	619.1	0.0	. E	3.04*
8.13	1	408	1800.7	616.2	0.0	. E	3.07*
8.21	0	400	1800.6	613.3	0.0	. E	2.98*
8.30	0	392	1800.6	610.5	0.0	. E	3.01*
8.38	0	384	1800.6	607.7	0.0	. E	2.92*
8.47	0	376	1800.6	605.0	0.0	. E	2.96*
8.56	0	369	1800.6	602.4	0.0	. E	2.87*
8.64	0	361	1800.5	599.7	0.0	. E	2.91*
T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	350.0	1807.34	1638.2	0.0	7.61	1140.0	101.0	17225.1	17326.1	4.15	11.58	0.006	0.008	10.4	8.3

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.008

T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	0	0	1793.5	13.7	0.0	.	0.00

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5.45	1618	3803	1803.0	939.8	0.0	. I E 6.96*
5.53	1500	3550	1802.9	924.7	0.0	. I E 6.72*
5.62	1399	3314	1802.8	910.5	0.0	.I E 6.55*
5.71	1323	3153	1802.7	897.1	0.0	.I E 6.45*
5.79	1270	3002	1802.6	884.4	0.0	.I E 6.30*
5.88	1232	2860	1802.6	872.4	0.0	.I E 6.16*
5.96	1200	2727	1802.5	861.1	0.0	.I E 6.05*
6.05	1161	2601	1802.4	850.5	0.0	.I E 5.94*
6.14	1097	2481	1802.3	840.5	0.0	.IE 5.85*
6.22	992	2365	1802.3	830.6	0.0	.IE 5.69*
6.31	853	2248	1802.2	820.7	0.0	.IE 5.59*
6.40	702	2128	1802.1	810.6	0.0	.IE 5.47*
6.48	559	2006	1802.1	800.4	0.0	.IE 5.33*
6.57	431	1884	1802.0	790.0	0.0	. E 5.19*
6.66	325	1761	1801.9	779.7	0.0	. E 5.09*
6.74	244	1641	1801.8	769.6	0.0	. E 4.93*
6.83	182	1525	1801.8	759.8	0.0	. E 4.76*
6.92	136	1414	1801.7	750.4	0.0	.E 4.60*
7.00	102	1339	1801.6	741.4	0.0	.E 4.50*
7.09	77	1270	1801.6	732.8	0.0	.E 4.43*
7.17	57	1204	1801.5	724.4	0.0	.E 4.28*
7.26	43	1140	1801.4	716.4	0.0	.E 4.21*
7.35	32	1080	1801.4	708.7	0.0	.E 4.16*
7.43	24	1022	1801.3	701.4	0.0	.E 4.02*
7.52	18	967	1801.3	694.5	0.0	.E 3.90*
7.61	13	914	1801.2	687.9	0.0	.E 3.86*
7.69	10	865	1801.2	681.6	0.0	.E 3.75*
7.78	7	817	1801.1	675.6	0.0	.E 3.64*
7.87	5	773	1801.1	670.0	0.0	.E 3.55*
7.95	4	730	1801.0	664.7	0.0	.E 3.46*
8.04	2	690	1801.0	659.6	0.0	.E 3.37*
8.13	2	653	1801.0	654.8	0.0	.E 3.30*
8.21	1	617	1800.9	650.3	0.0	.E 3.23*
8.30	1	583	1800.9	646.0	0.0	.E 3.17*
8.38	1	551	1800.9	642.0	0.0	.E 3.02*
8.47	0	520	1800.8	638.2	0.0	.E 2.98*
8.56	0	492	1800.8	634.5	0.0	. 2.94*
8.64	0	465	1800.8	631.1	0.0	. 2.81*
T	I	O	E	VOL	A	I VEL

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

VOLUME FILL= 268269. CY, MAX. HEIGHT= 19.3 FT
TOP WIDTH= 14.0 FT, TOP LENGTH= 8374.2 FT
AREA OF DAM= 16.42 AC, AREA TO SEED= 16.42 AC (PROJECTED HORIZONTAL AREA)

****
RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

RATING TABLE NUMBER 4

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00

8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	227.74	82.48	561.05	0.00
15	1800.75	391.25	83.96	628.30	0.00
16	1801.68	1214.57	86.55	749.35	0.00
17	1802.81	2851.25	89.61	910.14	0.00
18	1804.86	7336.20	94.93	1222.16	0.00
19	1807.43	15231.07	101.19	1655.06	0.00
20	1810.00	25275.20	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	300.0	1802.52	867.6	0.0	2.79	369.5	88.8	2329.8	2418.6	1.22	6.31	0.008	0.012	13.6	2.1

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

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.012

T	I	Q	E	VOL	A	0. / 2000. / 4000. / 6000. / 8000. / 10000. / 12000. / 14000.	EXIT VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	0	0	1793.5	13.7	0.0		0.00
1.30	0	0	1793.5	13.7	0.0		0.00
1.38	0	0	1793.5	13.7	0.0		0.00
1.47	0	0	1793.5	13.7	0.0		0.00
1.56	0	0	1793.5	13.7	0.0		0.00
1.64	0	0	1793.5	13.7	0.0		0.00
1.73	0	0	1793.5	13.7	0.0		0.00
1.82	0	0	1793.5	13.7	0.0		0.00
1.90	0	0	1793.5	13.7	0.0		0.00
1.99	11	0	1793.5	13.8	0.0		0.00
2.07	188	2	1793.6	14.5	0.0	I	0.00
2.16	957	15	1794.0	18.5	0.0	I	0.00
2.25	2911	37	1794.3	32.1	0.0	I	0.00
2.33	5645	65	1794.8	63.0	0.0	I	0.00
2.42	8828	69	1795.8	115.0	0.0	I	0.00
2.51	11019	71	1796.7	185.4	0.0	I	0.00
2.59	12133	75	1797.6	267.5	0.0	I	0.00
2.68	12285	77	1798.5	354.2	0.0	X	0.00
2.77	11670	79	1799.2	439.2	0.0	I	0.00
2.85	10560	127	1799.9	517.9	0.0	E I	1.64*
2.94	9300	292	1800.4	587.3	0.0	E I	2.71*
3.03	8109	516	1800.9	646.6	0.0	E I	3.51*
3.11	7038	851	1801.3	695.9	0.0	E I	4.47
3.20	6126	1123	1801.6	735.8	0.0	E I	5.04
3.28	5353	1402	1801.8	767.8	0.0	E I	5.55
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	I	5.91

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 8.64     0   361 1800.7   615.8   0.0 . E                                                                    3.04*
  T       I     O     E     VOL     A  I         I         I         I         I         I         I         I  VEL
                                       0.     2000.     4000.     6000.     8000.    10000.    12000.    14000. EXIT

  TYPE        BW     EMAX  VOL-MAX   AMAX     HP   VOL-ES    Q-PS     Q-ES   Q-TOT   D/C    V/C   S/C   S/C.25   D-ES   DE/B
SCS-FBH     300.0  1807.69  1701.3     0.0   7.97  1203.2   101.8  16084.9  16186.7  4.38  11.89 0.006   0.008   11.4    9.6

        PLOT                                   1 IN =  10000. CFS                                  EXIT SLOPE = 0.008
                                               0.    10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT
  T       I     O     E     VOL     A  I         I         I         I         I         I         I         I  VEL
 0.00     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.09     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.17     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.26     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.35     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.43     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.52     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.61     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.69     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.78     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.86     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.95     0     0 1793.5    13.7   0.0 .                                                                        0.00
 1.04     0     0 1793.5    13.7   0.0 .                                                                        0.00
 1.12     0     0 1793.5    13.7   0.0 .                                                                        0.00
 1.21     1     0 1793.5    13.7   0.0 .                                                                        0.00
 1.30     3     0 1793.5    13.7   0.0 .                                                                        0.00
 1.36    11     0 1793.5    13.8   0.0 .                                                                        0.00
 1.47    30     1 1793.5    13.9   0.0 .                                                                        0.00
 1.56    67     2 1793.6    14.3   0.0 .                                                                        0.00
 1.64   126     4 1793.6    14.9   0.0 .                                                                        0.00
 1.73   206     8 1793.8    16.1   0.0 .                                                                        0.00
 1.82   302    13 1793.9    17.8   0.0 .                                                                        0.00
 1.90   406    21 1794.0    20.2   0.0 .                                                                        0.00
 1.99   561    26 1794.1    23.5   0.0 .I                                                                       0.00
 2.07  1496    35 1794.2    30.6   0.0 .I                                                                       0.00
 2.16  4768    64 1794.6    52.7   0.0 .    I                                                                   0.00
 2.25 11768    68 1795.8   111.3   0.0 .        I                                                               0.00
 2.33 21084    73 1797.2   228.1   0.0 .                I                                                       0.00
 2.42 29621    79 1798.9   408.7   0.0 .                        I                                               0.00
 2.51 35179   459 1800.8   638.2   0.0 .                            I                                           2.96*
 2.59 37362  2609 1802.6   886.4   0.0 .  E                            X                                          6.27*
 2.68 36727  5878 1804.2  1120.7   0.0 .     E                          I                                         8.74
 2.77 34004  9117 1805.5  1319.8   0.0 .        E                        I                                      10.37
 2.85 30133 11924 1806.4  1473.7   0.0 .           E                        I                                   11.56
 2.94 26064 13903 1807.0  1582.2   0.0 .              E           I                                              12.29
 3.03 22376 15165 1807.4  1651.4   0.0 .                E         I                                              12.70
 3.11 19161 15926 1807.6  1688.7   0.0 .                 E   I                                                  12.98
 3.20 16483 16187 1807.7  1701.3   0.0 .                 X                                                      13.05
 3.28 14248 16074 1807.7  1695.9   0.0 .               I E                                                      13.01
 3.37 12409 15697 1807.6  1677.6   0.0 .             I   E                                                      12.90
 3.46 10946 15154 1807.4  1650.8   0.0 .           I   E                                                        12.73
 3.54  9812 14570 1807.2  1618.8   0.0 .         I   E                                                          12.50
 3.63  8943 13935 1807.0  1584.0   0.0 .       I   E                                                            12.29
 3.72  8284 13284 1806.8  1548.3   0.0 .     I   E                                                              12.05
 3.80  7779 12641 1806.6  1512.1   0.0 .     I   E                                                              11.83
 3.89  7399 12023 1806.4  1479.2   0.0 .   I   E                                                                11.60
 3.98  7111 11440 1806.3  1447.2   0.0 .   I   E                                                                11.38
 4.06  6842 10894 1806.1  1417.3   0.0 .   I   E                                                                11.16
 4.15  6487 10377 1805.9  1386.9   0.0 .  I   E                                                                  10.96
 4.24  5987  9870 1805.7  1361.1   0.0 .  I   E                                                                  10.72
 4.32  5371  9358 1805.6  1333.0   0.0 .  I   E                                                                  10.49
                                                                                                                10.27
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4.41	4725	8831	1805.4	1364.[illegible]			10.27
4.50	4121	8292	1805.2	1274.5	[illegible]		10.02
4.58	3568	7749	1805.0	1244.8	0.0		9.73
4.67	3144	7238	1804.8	1215.3	0.0		9.47
4.75	2601	6821	1804.6	1186.3	0.0		9.25
4.84	2543	6416	1804.5	1158.1	0.0		9.03
4.93	2350	6028	1804.3	1131.2	0.0		8.82
5.01	2209	5662	1804.1	1105.7	0.0		8.59
5.10	2094	5319	1804.0	1081.8	0.0		8.38
5.19	1982	4999	1803.8	1059.5	0.0		8.19
5.27	1863	4698	1803.7	1038.6	0.0		7.98
5.36	1741	4415	1803.5	1019.0	0.0		7.79
5.45	1618	4148	1803.4	1000.4	0.0		7.56
5.53	1500	3695	1803.3	982.8	0.0		7.41*
5.62	1399	3656	1803.2	966.2	0.0		7.21*
5.71	1323	3432	1803.1	950.6	0.0		7.04*
5.79	1270	3224	1803.0	936.0	0.0		6.84*
5.88	1232	3031	1802.9	922.6	0.0		6.66*
5.96	1200	2654	1802.8	910.3	0.0		6.51*
6.05	1161	2736	1802.7	898.8	0.0		6.40*
6.14	1097	2623	1802.7	887.7	0.0		6.31*
6.22	992	2512	1802.6	876.8	0.0		6.21*
6.31	853	2401	1802.5	865.9	0.0		6.05*
6.40	702	2287	1802.4	854.7	0.0		5.92*
6.48	559	2170	1802.4	843.3	0.0		5.85*
6.57	431	2053	1802.3	831.7	0.0		5.70*
6.66	325	1935	1802.2	820.2	0.0		5.54*
6.74	244	1820	1802.1	808.8	0.0		5.44*
6.83	182	1707	1802.0	797.7	0.0		5.27*
6.92	136	1598	1802.0	787.0	0.0		5.10*
7.00	102	1494	1801.9	776.8	0.0		5.01*
7.09	77	1396	1801.8	767.2	0.0		4.86*
7.17	57	1303	1801.7	758.0	0.0		4.73*
7.26	43	1215	1801.7	749.4	0.0		4.60*
7.35	32	1159	1801.6	741.2	0.0		4.47*
7.43	24	1105	1801.6	733.3	0.0		4.42*
7.52	18	1054	1801.5	725.7	0.0		4.31*
7.61	13	1004	1801.4	718.5	0.0		4.19*
7.69	10	957	1801.4	711.5	0.0		4.16*
7.78	7	912	1801.3	704.9	0.0		4.06*
7.87	5	869	1801.3	698.6	0.0		3.97*
7.95	4	828	1801.2	692.6	0.0		3.88*
8.04	2	789	1801.2	686.8	0.0		3.80*
8.13	2	752	1801.2	681.3	0.0		3.72*
8.21	1	716	1801.1	676.1	0.0		3.65*
8.30	1	682	1801.1	671.1	0.0		3.58*
8.38	1	650	1801.0	666.3	0.0		3.52*
8.47	0	619	1801.0	661.8	0.0		3.38*
8.56	0	590	1801.0	657.5	0.0		3.33*
8.64	0	562	1800.9	653.4	0.0		3.29*
T	I	O	E	VOL	A		VEL

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

VOLUME FILL= 278038. CY, MAX. HEIGHT= 19.7 FT
TOP WIDTH= 14.0 FT, TOP LENGTH= 8431.3 FT
AREA OF DAM= 16.75 AC, AREA TO SEED= 16.75 AC (PROJECTED HORIZONTAL AREA)

****
RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

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RATING TABLE NUMBER 5

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.86	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	261.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	215.65	82.48	561.05	0.00
15	1800.75	365.69	83.96	628.30	0.00
16	1801.68	1121.04	86.55	749.35	0.00
17	1802.81	2623.20	89.61	910.14	0.00
18	1804.86	6743.03	94.93	1222.16	0.00
19	1807.43	14004.70	101.19	1655.06	0.00
20	1810.00	23256.89	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	275.0	1802.59	878.1	0.0	2.86	380.0	89.0	2235.1	2324.2	1.26	6.39	0.008	0.011	14.2	2.3

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

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.011

T	I	O	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	0	0	1793.5	13.7	0.0	.								0.00
0.17	0	0	1793.5	13.7	0.0	.								0.00
0.26	0	0	1793.5	13.7	0.0	.								0.00
0.35	0	0	1793.5	13.7	0.0	.								0.00
0.43	0	0	1793.5	13.7	0.0	.								0.00
0.52	0	0	1793.5	13.7	0.0	.								0.00
0.61	0	0	1793.5	13.7	0.0	.								0.00
0.69	0	0	1793.5	13.7	0.0	.								0.00
0.78	0	0	1793.5	13.7	0.0	.								0.00
0.86	0	0	1793.5	13.7	0.0	.								0.00
0.95	0	0	1793.5	13.7	0.0	.								0.00
1.04	0	0	1793.5	13.7	0.0	.								0.00
1.12	0	0	1793.5	13.7	0.0	.								0.00
1.21	0	0	1793.5	13.7	0.0	.								0.00
1.30	0	0	1793.5	13.7	0.0	.								0.00
1.38	0	0	1793.5	13.7	0.0	.								0.00
1.47	0	0	1793.5	13.7	0.0	.								0.00
1.56	0	0	1793.5	13.7	0.0	.								0.00
1.64	0	0	1793.5	13.7	0.0	.								0.00
1.73	0	0	1793.5	13.7	0.0	.								0.00
1.82	0	0	1793.5	13.7	0.0	.								0.00
1.90	0	0	1793.5	13.7	0.0	.								0.00
1.99	11	0	1793.5	13.8	0.0	.								0.00
2.07	188	2	1793.6	14.5	0.0	.I								0.00
2.16	957	15	1794.0	18.5	0.0	.	I							0.00
2.25	2911	37	1794.3	32.1	0.0	.		I						0.00
									I					0.00

7.61	5	589	1801.0	664.0	0.0	. E	3.96*
7.69	4	563	1801.0	659.9	0.0	. E	3.82*
7.78	3	539	1801.0	656.0	0.0	. E	3.79*
7.87	2	515	1800.9	652.3	0.0	. E	3.66*
7.95	1	493	1800.9	648.7	0.0	. E	3.64*
8.04	1	472	1800.9	645.3	0.0	. E	3.52*
8.13	1	451	1800.9	642.0	0.0	. E	3.40*
8.21	0	431	1800.8	638.8	0.0	. E	3.40*
8.30	0	413	1800.8	635.8	0.0	. E	3.29*
8.38	0	395	1800.8	632.9	0.0	. E	3.19*
8.47	0	377	1800.8	630.2	0.0	. E	3.20*
8.56	0	364	1800.7	627.5	0.0	. E	3.15*
8.64	0	358	1800.7	624.9	0.0	. E	3.07*
T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	275.0	1807.89	1735.1	0.0	6.16	1237.0	102.3	15424.0	15526.2	4.50	12.07	0.006	0.007	12.0	10.5

PLOT

1 IN = 10000. CFS

EXIT SLOPE = 0.007

T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	0	0	1793.5	13.7	0.0	.	0.00
0.17	0	0	1793.5	13.7	0.0	.	0.00
0.26	0	0	1793.5	13.7	0.0	.	0.00
0.35	0	0	1793.5	13.7	0.0	.	0.00
0.43	0	0	1793.5	13.7	0.0	.	0.00
0.52	0	0	1793.5	13.7	0.0	.	0.00
0.61	0	0	1793.5	13.7	0.0	.	0.00
0.69	0	0	1793.5	13.7	0.0	.	0.00
0.78	0	0	1793.5	13.7	0.0	.	0.00
0.86	0	0	1793.5	13.7	0.0	.	0.00
0.95	0	0	1793.5	13.7	0.0	.	0.00
1.04	0	0	1793.5	13.7	0.0	.	0.00
1.12	0	0	1793.5	13.7	0.0	.	0.00
1.21	1	0	1793.5	13.7	0.0	.	0.00
1.30	3	0	1793.5	13.7	0.0	.	0.00
1.38	11	0	1793.5	13.8	0.0	.	0.00
1.47	30	1	1793.5	13.9	0.0	.	0.00
1.56	67	2	1793.6	14.3	0.0	.	0.00
1.64	126	4	1793.6	14.9	0.0	.	0.00
1.73	206	8	1793.8	16.1	0.0	.	0.00
1.82	302	13	1793.9	17.8	0.0	.	0.00
1.90	406	21	1794.0	20.2	0.0	.	0.00
1.99	561	26	1794.1	23.5	0.0	.I	0.00
2.07	1496	35	1794.2	30.6	0.0	.I	0.00
2.16	4768	64	1794.6	52.7	0.0	. I	0.00
2.25	11768	68	1795.8	111.3	0.0	. I	0.00
2.33	21084	73	1797.2	228.1	0.0	. I	0.00
2.42	29621	79	1798.9	408.7	0.0	. I	0.00
2.51	35179	428	1800.8	638.3	0.0	. I	2.96*
2.59	37362	2410	1802.7	887.3	0.0	. E X	6.28*
2.68	36727	5446	1804.2	1123.9	0.0	. E I	8.71
2.77	34004	8497	1805.5	1326.6	0.0	. E I	10.43
2.85	30133	11162	1806.5	1485.6	0.0	. E I	11.62
2.94	26064	13077	1807.1	1599.8	0.0	. E I	12.37
3.03	22376	14379	1807.5	1674.7	0.0	. E I	12.84
3.11	19161	15192	1807.8	1717.5	0.0	. E I	13.11
3.20	16483	15526	1807.9	1735.1	0.0	. X	13.24
3.28	14248	15506	1807.9	1734.0	0.0	. I E	13.22
						I F	13.11
							12.97

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 0.64     0   615 1801.1   668.2   0.0 .E                                                                    3.52*
  T       I     O      E      VOL      A  I         I         I         I         I         I         I         I   VEL
                                           0.    10000.    20000.    30000.    40000.    50000.    60000.    70000. EXIT

          VOLUME FILL=  283335. CY,     MAX. HEIGHT=    19.9 FT
          TOP WIDTH=       14.0 FT,     TOP LENGTH=   8461.7 FT
          AREA OF DAM=    16.92 AC,     AREA TO SEED=  16.92 AC (PROJECTED HORIZONTAL AREA)
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RATING TABLE DEVELOPED
BY PROGRAM FOR PS AND EMG SPILLWAYS

RATING TABLE NUMBER 6

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	16.22	0.00
3	1794.04	22.45	22.45	20.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	261.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	203.56	82.48	561.05	0.00
15	1800.75	340.14	83.96	628.30	0.00
16	1801.68	1027.51	86.55	749.35	0.00
17	1802.81	2395.15	89.61	910.14	0.00
18	1804.86	6149.86	94.93	1222.16	0.00
19	1807.43	12778.33	101.19	1655.06	0.00
20	1810.00	21238.59	107.08	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	OE/B
SCS-ESH	250.0	1802.67	889.8	0.0	2.94	391.7	89.2	2133.0	2222.2	1.30	6.50	0.008	0.011	15.0	2.5

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

```
          PLOT                                  1 IN =   2000. CFS                                          EXIT SLOPE = 0.011
                                                 0.     2000.     4000.     6000.     8000.    10000.    12000.    14000. EXIT
   T       I     O      E      VOL      A  I         I         I         I         I         I         I         I   VEL
  0.00     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.09     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.17     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.26     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.35     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.43     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.52     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.61     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.69     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.78     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.86     0     0 1793.5    13.7    0.0 .                                                                              0.00
  0.95     0     0 1793.5    13.7    0.0 .                                                                              0.00
  1.04     0     0 1793.5    13.7    0.0 .                                                                              0.00
  1.12     0     0 1793.5    13.7    0.0 .                                                                              0.00
  1.21     0     0 1793.5    13.7    0.0 .                                                                              0.00
```

BASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-13-83 SHEET 1 OF 23

CHKD. BY S. G. Yang DATE 7-9-83 OFS NO. 3767.100 DEPT. NO. 1050

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BAFFLE CHUTE DESIGN - TOP OF DAM EL 1808.27

$Q_{max} = 13,162.7$ CFS. $W = 150$ FT. $S = 1/2$

FOR DESIGN BAFFLE CHUTE USE $2/3\ Q_{max}$

$\therefore\ Q = 2/3\ Q_{max} = 2/3 \times 13,162.7 = 8775.13$ CFS.

$$q = \frac{Q}{W} = \frac{8775.13}{150.0} = 58.5 \text{ CFS/FT.}$$

$$\therefore\ D_c = \sqrt[3]{\frac{q^2}{g}} = \left(\frac{58.5^2}{32.2}\right)^{1/3} = 4.74 \text{ FT.}$$

$$V_c = \sqrt[3]{gq} = (32.2 \times 58.5)^{1/3} = 12.35 \text{ '/sec.}$$

TOTAL LENGTH OF CHUTE:- (MIN.)

$L = (1808.27 - 1788 + 7/2)\sqrt{1^2+2^2} = 53.15'$ USE $L = 56.0'$

BAFFLE PIER HEIGHT:-

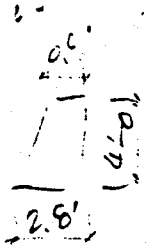
$H = 0.8 D_c = 0.8 \times 4.74 = 3.79'$ USE 4'-0

BAFFLE PIER WIDTH & SPACING:-

$B = 3/2 H = 3/2 \times 4.0 = 6.0'$

SLOPE DISTANCE BETWEEN BAFFLE PIERS:-

$D = 2H = 8.0'$



NO. OF BAFFLE PIERS PER ROW:-

$150/2 \times 6.0 = 12.50$

NO. OF ROWS:

$(56.0/8.00) - 1 = 6$ ROWS

HEIGHT OF WALL $= 3.5 \times 4 = 14'-0$

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EBASCO SERVICES INCORPORATED

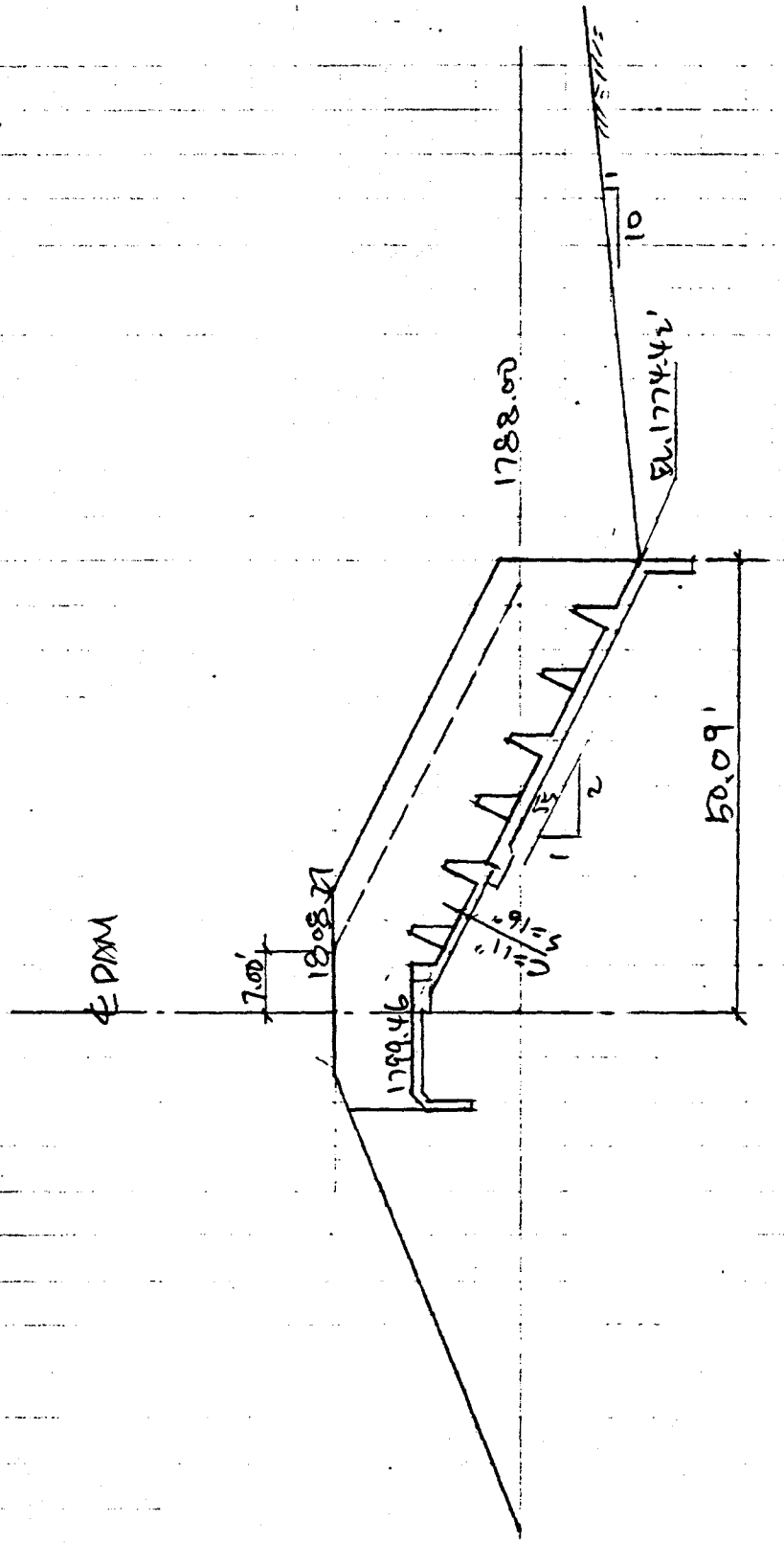
BY Y. C YANG DATE 6-13-85 SHEET 2 OF 23

CHKD. BY S Gouy-1 DATE 7-9-85 OFS NO. 3762.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY – BAFFLE APRON CHUTE DESIGN (150' WID



1" = 20'-0

581/8-81

EBASCO SERVICES INCORPORATED

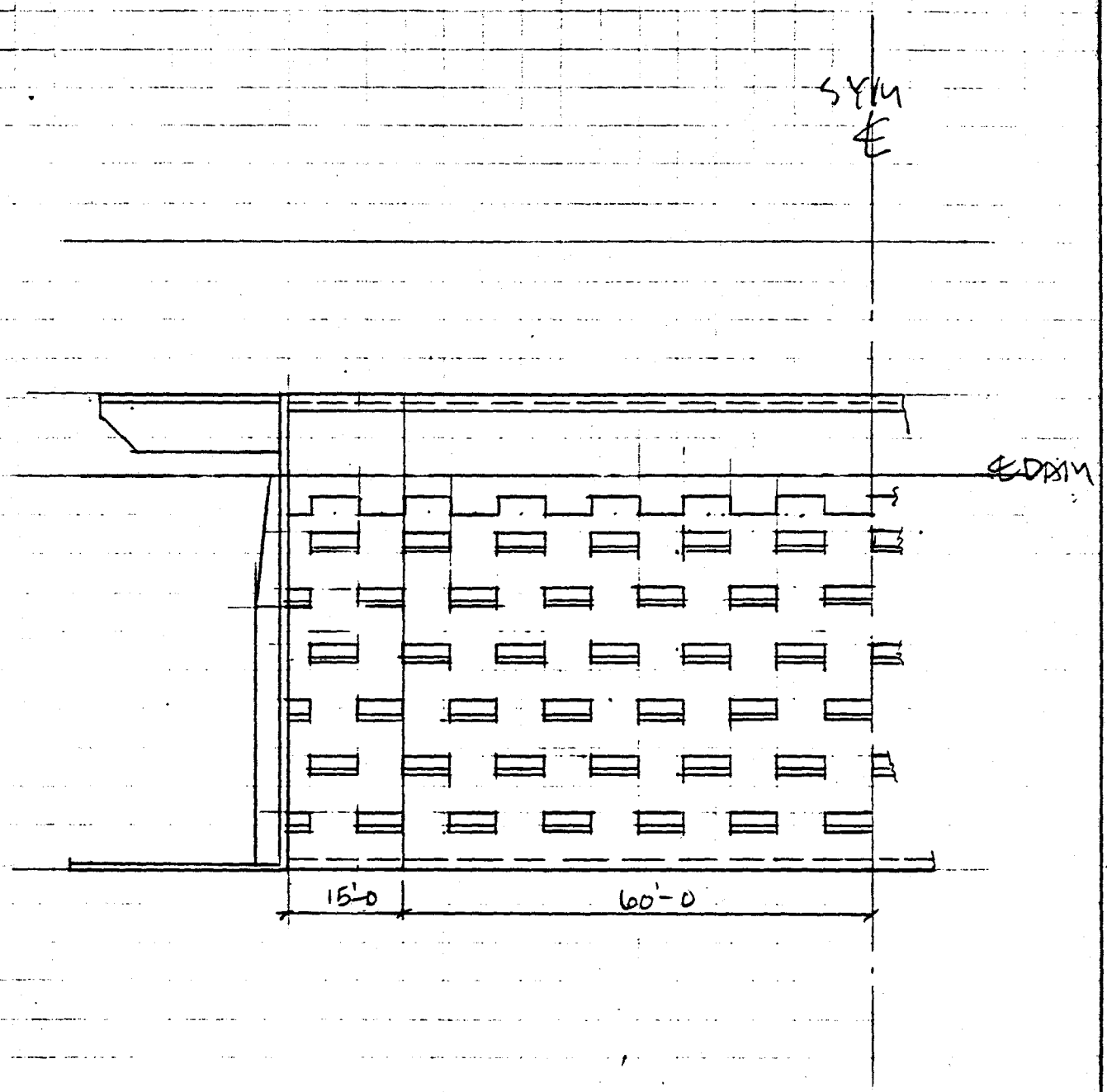
BY Y.C. YANG DATE 6-13-85 SHEET 3 OF 23

CHKD. BY S Goyal DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY - BAFFLE CHUTE W=150.0'



1" = 20'-0

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-13-85 SHEET 4 OF 23

CHKD. BY S Gayol DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT QUANTITIES (FOR 150' W CHUTE)

SLAB :-

CENTER SLAB : $120.0 \times 56.0 \times 11/12 = 6,160$ C.F.

SIDE SLAB : $30.0 \times 56.0 \times 16/12 = 2,240$

U/S SLAB : $150(8.5+\sqrt{8}) \times 12/12 = 1699$

$150 \times 4.0 \times 18/12 = 900$

D/S CUTOFF : $150 \times 6.0 \times 15/12 = 1,125$

12,124 C.F.

BAFFLES :-

PIERS $(0.8+2.8)\frac{4.0}{2} \times 6.0 \times 12.5 \times 6 = 3,240$ CF

U/S WEIR $2.50 \times 1.25/2 \times 150$

$+ (1.25+2.50) 250/2 \times 6.0 \times 12.5 = 586.$

3,826 CF

SIDE WALL :-

WALL : $2[14.0 \times 56.0 - (5.19 \times 2 \times 5.19)] 11/12 = 1339.$ CF

U/S WALL : $2 \times 8.81 \times 10.5 \times 14/12 = 170$

SLAB : $(2+4.)\frac{18.8}{2} \times 16/12 \times 2 = 150$

$37.2 \times 4.0 \times 16/12 \times 2 = 397$

2,056 CF

HEAD WALL :-

WALL : $(27.5 \times 15.0 - 8.5 \times 5.0) \times 12/12 \times 2 = 740$ CF

SLAB : $[27.5 \times 7.25 - (5.25 \times 7.5)/2] 12/12 \times 2 = 359$

1099 CF

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-13-85

CHKD. BY S. Goyal DATE 7-9-85

SHEET 5 OF 23

OFS NO. 3767.100 DEPT. NO. 1050

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT QUANTITIES (FOR 150 W CHUTE)

WING WALL:

WALL: $(31.0 \times 14.0 - 4.0 \times 4.0/2)\ 11/12 \times 2 = 781$

$(18.0 \times 4.5 - 4.5 \times 4.5/2)\ 18/12 \times 2 = 213$

SLABS: $(24.0 \times 14.0 - 11.0 \times 5.5/2)\ 18/12 \times 2 = 917$

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TOTAL CONC.

= 21,016 C.F.

= 778.5 C.Y.

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 6-18-85 SHEET 6 OF 23

CHKD. BY S Goyal DATE 7-8-85 OFS NO. 3767.100 DEPT. NO.

CLIENT USDA

PROJECT

SUBJECT DROP SPILLWAY DESIGN

CREST @ EL. 1799.46 W = 150.0'

$Q = 2/3\ Q_{max} = 2/3 \times 13162.7 = 8775.13$ CFS.

CRITICAL DEPTH @ OUTLET:

$$d_c = \sqrt[3]{\frac{(Q/W)^2}{g}} = \sqrt[3]{\frac{8775.13^2}{150^2 \times 32.2}} = 4.74'$$

MIN. DEPTH OF TAILWATER FROM TOP OF THE TRANSVERSE SILL:

$$t = 1.75\, d_c = 1.75 \times 4.74 = 8.30'$$

LENGTH OF STILLING BASIN APRON L_B

$$F_{min.} = 1799.46 - 1788.0 + 8.3 = 19.76'$$

$$h = 1.5\, d_c = 1.5 \times 4.74 = 7.11'$$

$$\frac{h}{F} = \frac{7.11}{19.76} = 0.36; \quad \frac{h}{t} = \frac{7.11}{8.30} = 0.86$$

FROM DIAG: ES-111 SH 5 OF 6:

$$\frac{L_B}{F} = 1.7; \quad L_B = 1.7 \times 19.76 = 33.59'$$

USE $L_B = 33.50'$

LOCATION OF FLOOR BLOCKS L_f:

FOR $\frac{h}{F} = 0.36$, $\frac{h}{t} = 0.86$

FROM DIAG: ES-111 SH 6 OF 6:

$$\frac{L_f}{F} = 1.3; \quad L_f = 1.3 \times 19.76 = 25.69'$$

HEIGHT OF FLOOR BLOCKS:

$$H_f = 0.8\, d_c = 0.8 \times 4.74 = 3.79'$$ USE 3'-9"

EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 6-18-85 SHEET 7 OF 23

CHKD. BY S. G. Yo DATE 7-8-85 OFS NO. 3767.160 DEPT. NO. 650

CLIENT USDA

PROJECT

SUBJECT DROP SPILLWAY DESIGN

FLOOR BLOCK WIDTH & LENGTH :-

$0.9 \times d_c = 0.9 \times 4.74 = 1.90'$ USE $2.00'$

FLOOR BLOCK SPACING :-

$2.0 \times 2/3 = 1.33' = 1'-4$

TRANSVERSE SILL HEIGHT

$0.4 d_c = 0.4 \times 4.74 = 1.90$

SIDEWALL HEIGHT

$t + 0.85 d_c = 8.30 + 0.85 \times 4.74 = 12.33'$

BY Y.C. YANG DATE 6-18-85

CHKD. BY S. G. Y. DATE 7-8-85

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

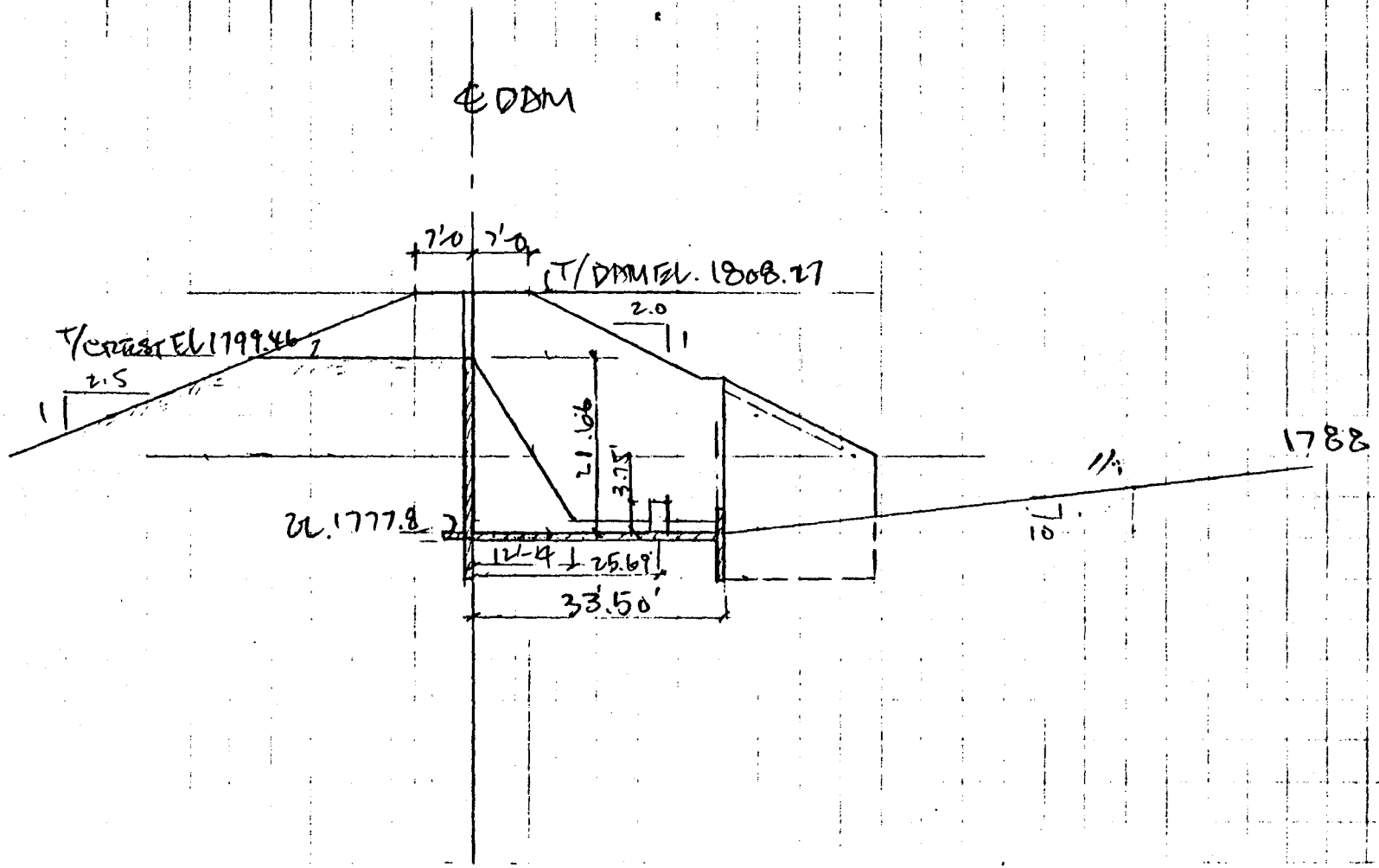
SUBJECT

BASCO SERVICES INCORPORATED

SHEET 8 OF 23

OFS NO. 3262.100 DEPT. NO. 650

127



ELEVATION THRU ℄ SPILLWAY

1" = 20'-0

B1/8-81

BASCO SERVICES INCORPORATED

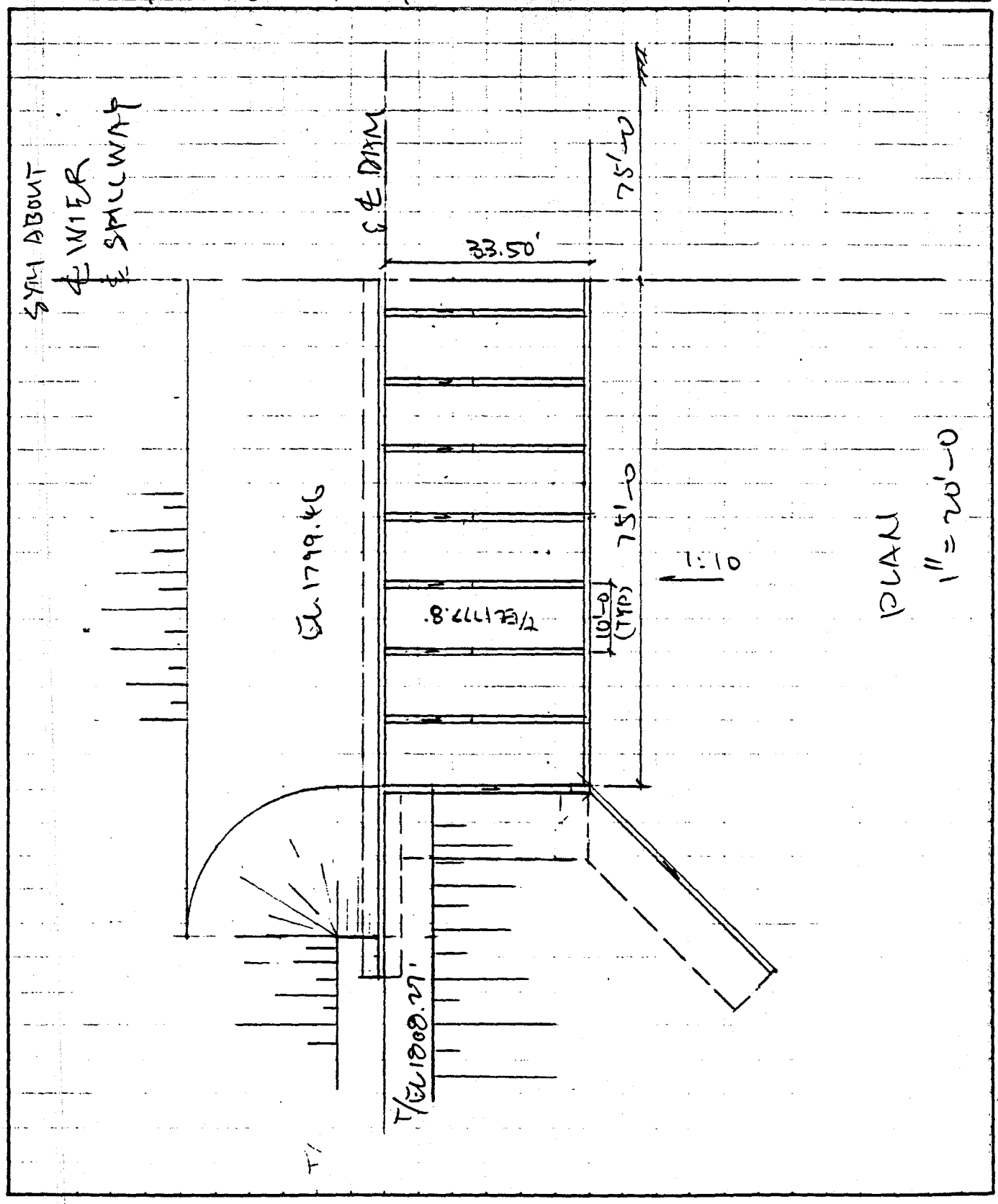
BY Y.C. YANG DATE 6-18-85 SHEET 9 OF 23

CHKD. BY S Gayan DATE 7-8-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



BOOZ-ALLEN SERVICES INCORPORATED

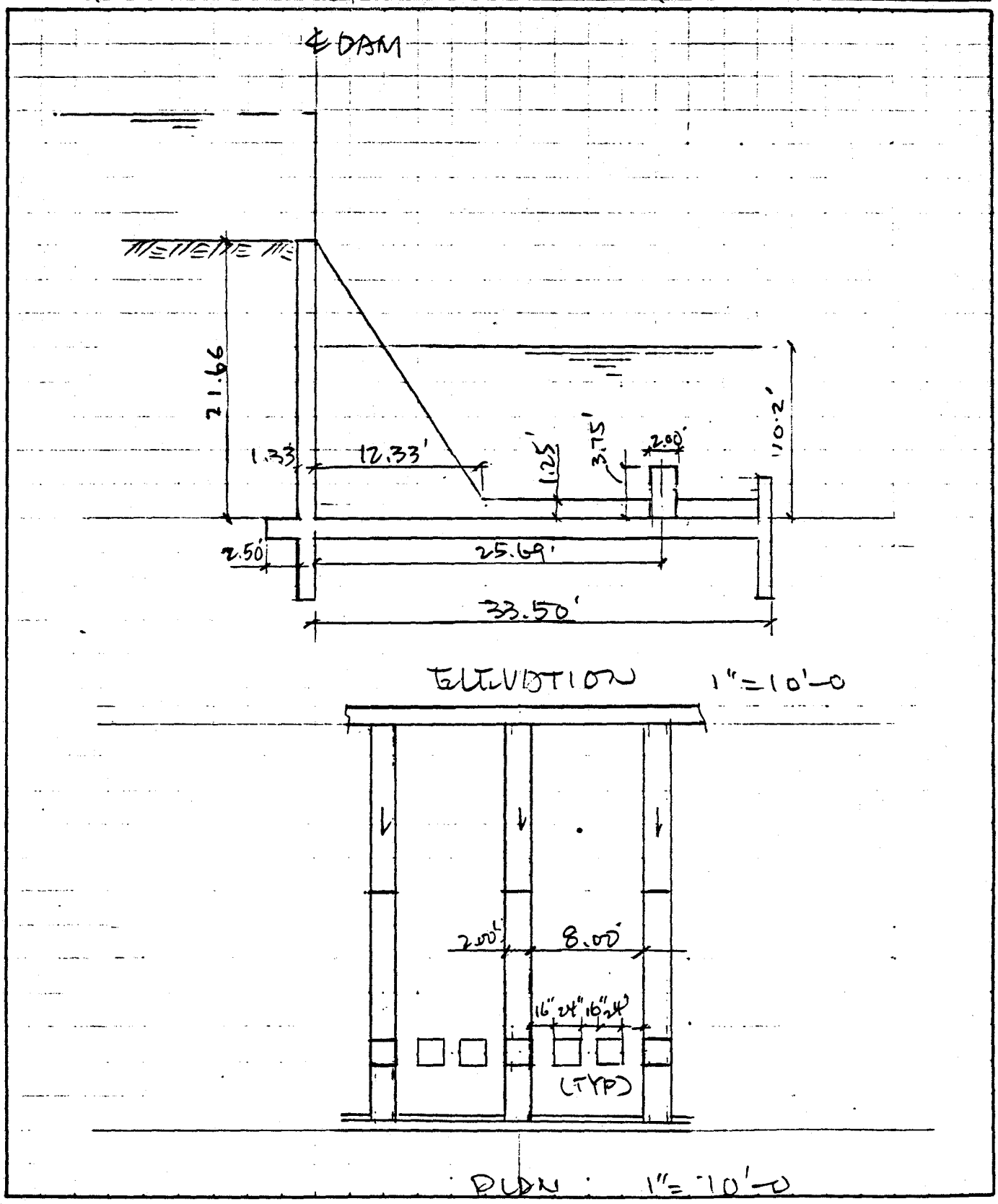
BY Y.C. YANG DATE 6-18-85 SHEET 10 OF 23

CHKD. BY S Goyal DATE 7-8-85 OFS NO. 3767.100 DEPT. NO. 656

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



BB1/8-81

EBASCO SERVICES INCORPORATED

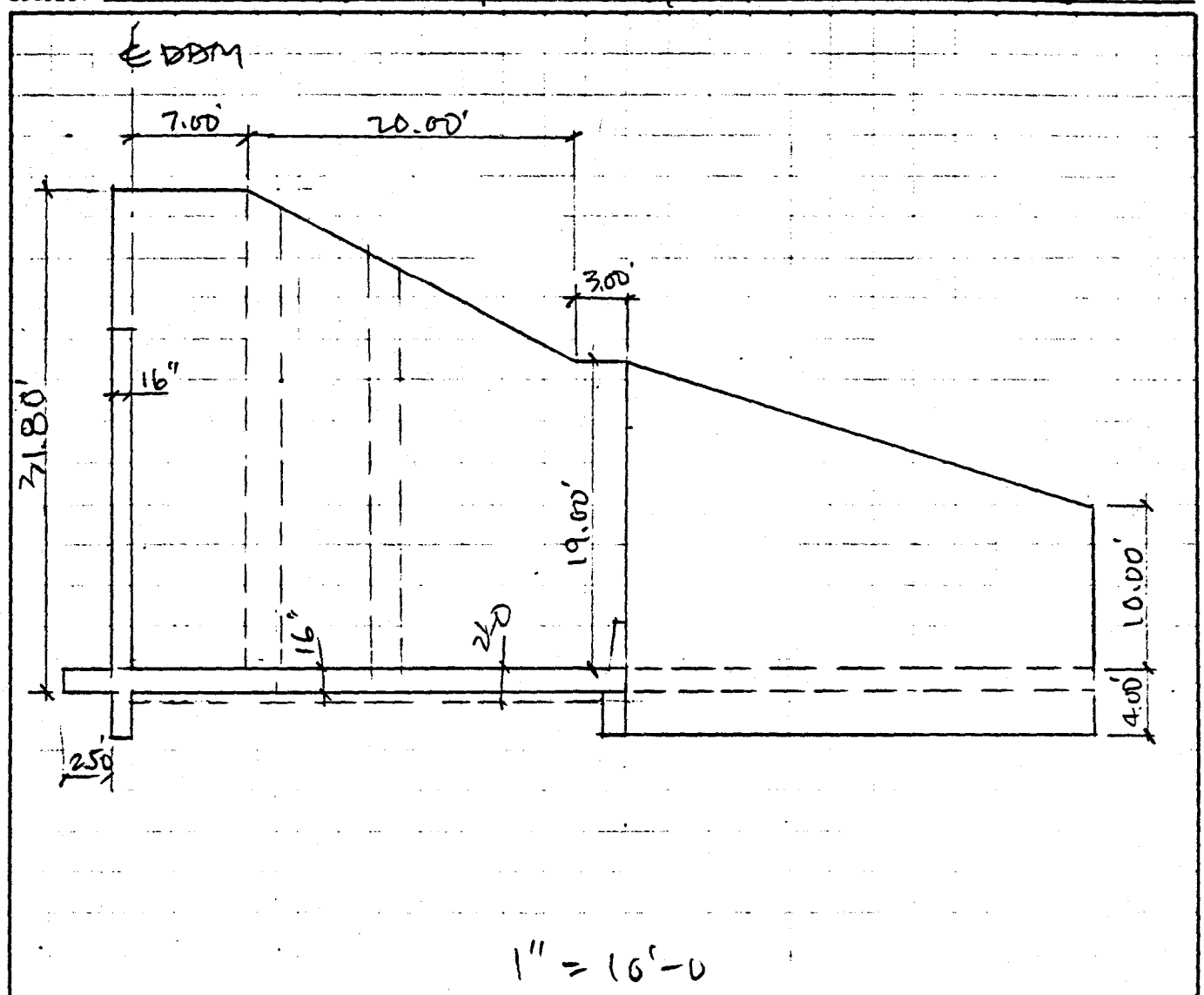
BY Y.C. YONG DATE 6-26-85 SHEET 11 OF 23

CHKD. BY S.G.Y. DATE 7-8-85 OFS NO. 3767.160 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



EBASCO SERVICES INCORPORATED

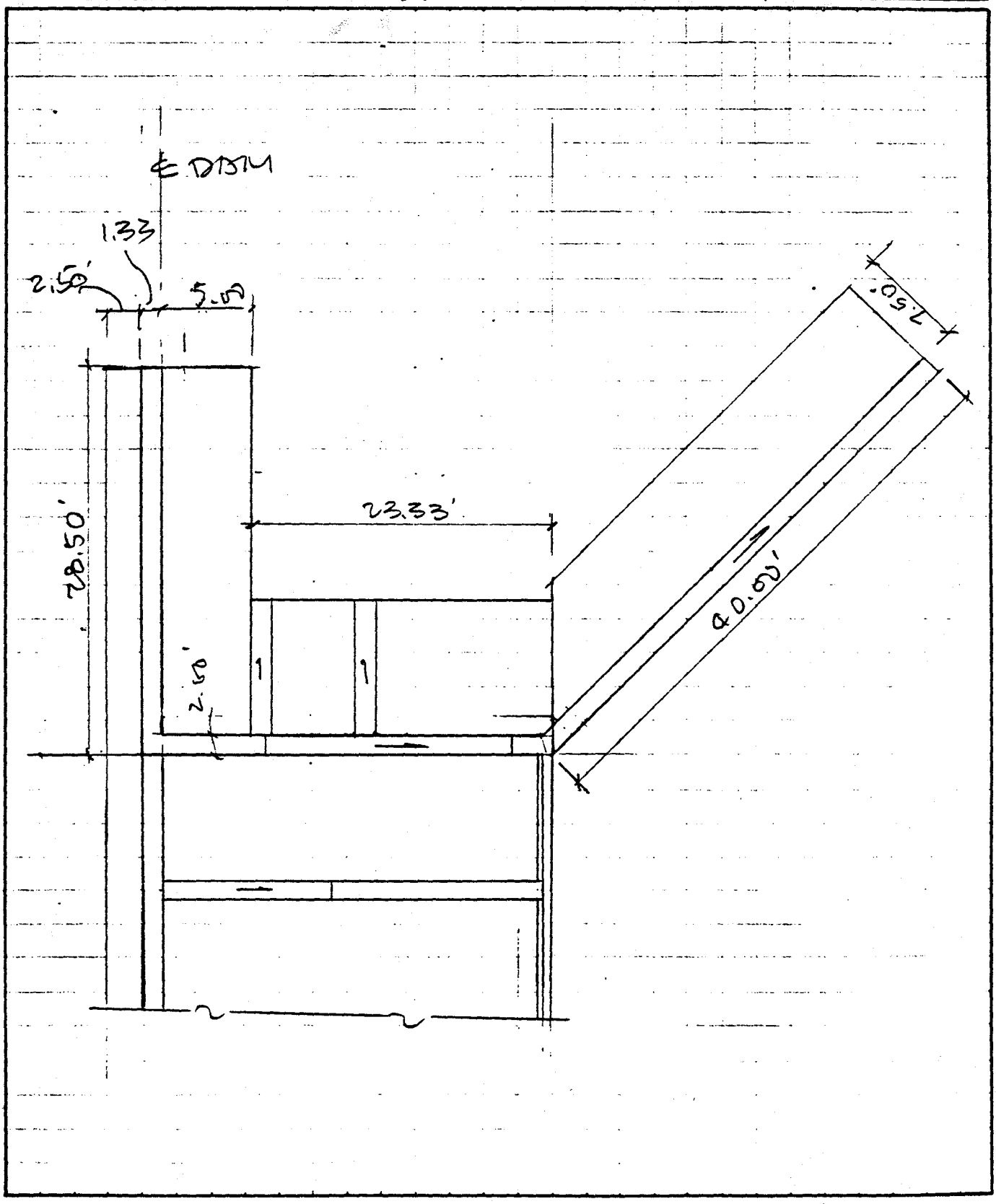
BY Y.C. YANG DATE 6-21-85 SHEET 12 OF 23

CHKD. BY S Goy DATE 7-8-85 OFS NO. 3767.150 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN



EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 6-26-85 SHEET 13 OF 23

CHKD. BY S. G. Y. DATE 7-8-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BULLDOG FLOODWAY — DROP SPILLWAY DESIGN

QUANTITIES:

SLAB: (t = 1.33')

16/12 × 33.50 × 150 = 6700.0 CF.

LONG. SILL: (t = 2.00')

24/12 × (33.50 − 0.75) × 1.25 × 14 = 1,146 CY.

BUTTRESS: (t = 2.00')

24/12 × 19.38 × 12.33 × 14 = 6,691 CF.

END SILLS: (t = 9" ~ 12")

10.5/12 × 150 × 3.0 = 393.75 CF.

HEAD WALL: (t = 1.33')

16/12 × 150 × 22.99 = 4598 CF.

C.O. WALL: (t = 1.33)

16/12 × (150.0 + 28.5 × 2) × 4.0 = 1104.00

SIDE WALL (t = 2'-0)

WALL 2.0 × [31.80 × 7.0 + (31.80 + 21.80) 20.0/2 + 21.80 × 3.0] × 2
= 3296.00 CF

SLAB 2 × 2.0 × 10.0 × 23.33 = 933.20 CF.

BUTTRESS = 2.0 (30.47 × 10.0/2 + 25.5 × 10.0/2) = 559.70 CF

EBASCO SERVICES INCORPORATED

BY Y. CYANG DATE _____ SHEET 14 OF 23

CHKD. BY S. G. Y. DATE 7. 8. 85 OFS NO. _____ DEPT. NO. _____

CLIENT USDA

PROJECT _____

SUBJECT DROP SPILLWAY

RETAINING WALL (t = 1.33')

U/S : 2 x 16/12 x 28.5 x 30.7 = 2338.52 CF

2 x 16/12 x 28.5 x 5.00 = 671.08 CF

D/S : (t = 1.50')

WALL : 2 x 18/12 x (23.0 + 14) x 40.0/2 = 2520 CF

SLAB : 2 x 18/12 (40.0 + 32.5) 7.5/2 = 815.63 CF

Σ = 31,766.88 CF

= 1,177 CY

PS STORAGE 454.1 ACFT BETWEEN ES CREST AN" "D ACCUM ELEVATIONS

STARTING E 1793.50 FT 13.7 ACFT 0.00 . 0.0 CFS

EFFECTIVE HEIGHT(H)= 11.5 FEET, PRODUCT = 5362. (H * STORAGE AT CREST EMG.)

INPUT DESIGN CLASS = C

6-11-85

SCS-ESH D= 6.00 HR P= 3.78 IN Q= 3.78 IN
TC= 0.69 HR CN= 82.00 VOL= 350.6 ACFT
PEAK 12387.9 CFS AT 2.59 HRS

SCS-FBH D= 6.00 HR P= 10.79 IN Q= 10.79 IN
TC= 0.69 HR CN= 82.00 VOL= 1000.8 ACFT
PEAK 35614.4 CFS AT 2.59 HRS

NO ENTRANCE LOSSES

36" OUTLET

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

RATING TABLE NUMBER 2

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.86	12.18	12.18	17.04	0.00
3	1794.22	34.45	34.45	30.21	0.00
4	1794.59	63.28	63.28	49.41	0.00
5	1794.95	97.43	97.43	68.60	0.00
6	1795.51	101.37	101.37	98.47	0.00
7	1796.08	104.33	104.33	131.03	0.00
8	1796.64	107.21	107.21	180.41	0.00
9	1797.21	110.02	110.02	229.78	0.00
10	1797.77	112.75	112.75	279.16	0.00
11	1798.33	115.42	115.42	337.79	0.00
12	1798.90	118.03	118.03	402.79	0.00
13	1799.46	120.59	120.59	467.79	0.00
14	1799.99	532.69	122.92	528.52	0.00
15	1800.52	981.33	125.22	597.32	0.00
16	1801.46	2349.35	129.24	721.47	0.00
17	1802.62	4586.42	134.00	883.11	0.00
18	1804.73	9805.59	142.24	1201.28	0.00
19	1807.37	18108.31	151.91	1643.47	0.00
20	1810.00	28191.87	161.01	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	250.0	1801.89	777.8	0.0	2.43	310.0	131.0	2998.3	3129.3	1.63	7.26	0.008	0.011	7.4	2.5

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

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.011

T	I	O	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	5	0	1793.5	13.7	0.0	.								0.00
0.17	19	0	1793.5	13.8	0.0	.								0.00
0.26	46	1	1793.5	14.0	0.0	.								0.00
0.35	81	3	1793.6	14.5	0.0	.								0.00
0.43	122	5	1793.7	15.2	0.0	.I								0.00
0.52	162	9	1793.8	16.1	0.0	.I								0.00
0.61	199	13	1793.9	17.4	0.0	.I								0.00
0.69	230	15	1794.0	18.8	0.0	.I								0.00
0.78	253	18	1794.0	20.4	0.0	.I								0.00

[illegible]	[illegible]	1356	[illegible]	[illegible]	[illegible]	. I	E	5.61
5.53	429	1287	1800.7	625.0	0.0	. I	E	5.46
5.62	400	1221	1800.7	619.0	0.0	. I	E	5.39
5.71	378	1158	1800.6	613.3	0.0	. I	E	5.25
5.79	363	1098	1800.6	607.9	0.0	. I	E	5.12
5.88	351	1042	1800.6	602.8	0.0	. I	E	5.00
5.96	342	989	1800.5	598.0	0.0	. I	E	4.90
6.05	331	956	1800.5	593.5	0.0	. I	E	4.84
6.14	313	928	1800.5	589.1	0.0	. I	E	4.72
6.22	284	899	1800.4	584.7	0.0	.I	E	4.69
6.31	244	870	1800.4	580.2	0.0	.I	E	4.65
6.40	202	841	1800.4	575.7	0.0	.I	E	4.51*
6.48	161	811	1800.3	571.1	0.0	.I	E	4.46*
6.57	124	780	1800.3	566.5	0.0	.I	E	4.40*
6.66	94	750	1800.2	561.8	0.0	.	E	4.33*
6.74	70	719	1800.2	557.1	0.0	.	E	4.26*
6.83	53	689	1800.2	552.5	0.0	.	E	4.09*
6.92	39	660	1800.1	548.0	0.0	.	E	4.02*
7.00	29	631	1800.1	543.7	0.0	.	E	3.95*
7.09	22	604	1800.1	539.4	0.0	.	E	3.88*
7.17	17	577	1800.0	535.4	0.0	.	E	3.82*
7.26	12	552	1800.0	531.4	0.0	.	E	3.76*
7.35	9	527	1800.0	527.7	0.0	.	E	3.60*
7.43	7	502	1799.9	524.0	0.0	.	E	3.54*
7.52	5	479	1799.9	520.6	0.0	. E		3.48*
7.61	4	456	1799.9	517.3	0.0	. E		3.32*
7.69	3	435	1799.9	514.1	0.0	. E		3.27*
7.78	2	414	1799.8	511.1	0.0	. E		3.24*
7.87	1	395	1799.8	508.2	0.0	. E		3.09*
7.95	1	376	1799.8	505.5	0.0	. E		3.06*
8.04	1	358	1799.8	502.8	0.0	. E		2.92*
8.13	1	342	1799.7	500.4	0.0	. E		2.90*
8.21	0	325	1799.7	498.0	0.0	. E		2.77*
8.30	0	310	1799.7	495.7	0.0	. E		2.77*
8.38	0	295	1799.7	493.5	0.0	.E		2.64*
8.47	0	281	1799.7	491.5	0.0	.E		2.51*
8.56	0	268	1799.7	489.5	0.0	.E		2.39*
8.64	0	255	1799.6	487.7	0.0	.E		2.40*
T	I	D	E	VOL	A	I	I I I I I I I I	VEL
						0.	2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	250.0	1807.09	1594.3	0.0	7.62	1126.5	150.9	17034.7	17185.6	5.10	12.84	0.005	0.007	8.1	11.3

PLOT

1 IN = 10000. CFS EXIT SLOPE = 0.007

T	I	D	E	VOL	A	I	I I I I I I I	VEL
						0.	10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0	.		0.00
0.09	14	0	1793.5	13.8	0.0	.		0.00
0.17	56	1	1793.5	14.0	0.0	.		0.00
0.26	133	3	1793.6	14.7	0.0	.		0.00
0.35	237	8	1793.7	16.0	0.0	.		0.00
0.43	353	14	1794.0	18.0	0.0	.		0.00
0.52	469	19	1794.0	20.8	0.0	.		0.00
0.61	576	25	1794.1	24.4	0.0	.I		0.00
0.69	663	32	1794.2	28.6	0.0	.I		0.00
0.78	728	39	1794.3	33.3	0.0	.I		0.00
0.86	775	47	1794.4	38.4	0.0	.I		0.00
0.95	808	55	1794.5	43.7	0.0	.I		0.00
1.04	838	63	1794.6	49.1	0.0	.I		0.00
1.12	895	73	1794.7	54.8	0.0	.I		0.00
1.21	1006	84	1794.8	61.1	0.0	.I		0.00
1.30	1170	97	1794.9	68.2	0.0	.I		0.00
1.38	1364	98	1795.1	76.6	0.0	.I		0.00
1.47	1561	100	1795.3	86.3	0.0	. I		0.00

```
 8.04     2   641 1800.1   545.2   0.0 .E                                                                  3.61*
 8.13     1   612 1800.1   540.7   0.0 .E                                                                  3.45*
 8.21     1   584 1800.1   536.4   0.0 .E                                                                  3.38*
 8.30     1   558 1800.0   532.4   0.0 .E                                                                  3.32*
 8.38     0   532 1800.0   528.5   0.0 .E                                                                  3.26*
 8.47     0   507 1800.0   524.8   0.0 .E                                                                  3.20*
 8.56     0   483 1799.9   521.2   0.0 .                                                                   3.06*
 8.64     0   460 1799.9   517.8   0.0 .                                                                   3.01*
   T      I    O      E     VOL     A  I        I        I        I        I        I        I        I    VEL
                                        0.    10000.   20000.   30000.   40000.   50000.   60000.   70000. EXIT

          VOLUME FILL=  261613. CY.     MAX. HEIGHT=    19.1 FT
          TOP WIDTH=       14.0 FT.     TOP LENGTH=   8334.6 FT
          AREA OF DAM=    16.19 AC.     AREA TO SEED=  16.19 AC (PROJECTED HORIZONTAL AREA)


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

                                RATING TABLE NUMBER  3
                     ELEV       Q-TOTAL      Q-PS       VOLUME       AREA
                     FEET        CFS         CFS        AC-FT       ACRE
                 1  1793.50      0.00        0.00       13.73       0.00
                 2  1793.86     12.18       12.18       17.04       0.00
                 3  1794.22     34.45       34.45       30.21       0.00
                 4  1794.59     63.28       63.28       49.41       0.00
                 5  1794.95     97.43       97.43       68.60       0.00
                 6  1795.51    101.37      101.37       98.47       0.00
                 7  1796.08    104.33      104.33      131.03       0.00
                 8  1796.64    107.21      107.21      180.41       0.00
                 9  1797.21    110.02      110.02      229.78       0.00
                10  1797.77    112.75      112.75      279.16       0.00
                11  1798.33    115.42      115.42      337.79       0.00
                12  1798.90    118.03      118.03      402.79       0.00
                13  1799.46    120.59      120.59      467.79       0.00
                14  1799.99    451.03      122.92      528.52       0.00
                15  1800.52    811.07      125.22      597.32       0.00
                16  1801.46   1910.03      129.24      721.47       0.00
                17  1802.62   3710.79      134.00      883.11       0.00
                18  1804.73   7925.98      142.24     1201.28       0.00
                19  1807.37  14662.73      151.91     1643.47       0.00


                20  1810.00  22884.98      161.01     2141.60       0.00

   TYPE        BW     EMAX  VOL-MAX   AMAX     HP   VOL-ES    Q-PS     Q-ES    Q-TOT   D/C    V/C   S/C   S/C.25   D-ES  DE/B
SCS-ESH      200.0  1802.06   799.7    0.0   2.59    331.9   131.7   2649.9   2781.6  1.74   7.48  0.008  0.010    8.3   3.1

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

         PLOT                          1 IN =   2000. CFS                                   EXIT SLOPE = 0.010
                                        0.     2000.    4000.    6000.    8000.   10000.   12000.   14000. EXIT
   T      I     O      E     VOL     A  I        I        I        I        I        I        I        I    VEL
 0.00     0     0 1793.5    13.7   0.0 .                                                                   0.00
 0.09     5     0 1793.5    13.7   0.0 .                                                                   0.00
 0.17    19     0 1793.5    13.8   0.0 .                                                                   0.00
 0.26    46     1 1793.5    14.0   0.0 .                                                                   0.00
 0.35    81     3 1793.6    14.5   0.0 .                                                                   0.00
 0.43   122     5 1793.7    15.2   0.0 .I                                                                  0.00
 0.52   162     9 1793.8    16.1   0.0 .I                                                                  0.00
 0.61   199    13 1793.9    17.4   0.0 .I                                                                  0.00
 0.69   230    15 1794.0    18.8   0.0 .I                                                                  0.00
 0.78   253    18 1794.0    20.4   0.0 .I                                                                  0.00
 0.86   269    21 1794.1    22.1   0.0 .I                                                                  0.00
 0.95   281    24 1794.1    23.9   0.0 .I                                                                  0.00
```

5.96	342	1097	1800.8	629.7	0.0	. I E	5.56
6.05	331	1051	1800.7	624.4	0.0	. I E	5.46
6.14	313	1006	1800.7	619.4	0.0	. I E	5.37
6.22	284	963	1800.6	614.5	0.0	.I E	5.21
6.31	244	920	1800.6	609.6	0.0	.I E	5.12
6.40	202	877	1800.6	604.8	0.0	.I E	5.03
6.48	161	835	1800.5	600.0	0.0	.I E	4.93
6.57	124	800	1800.5	595.1	0.0	.I E	4.80
6.66	94	774	1800.5	590.3	0.0	. E	4.75
6.74	70	749	1800.4	585.4	0.0	. E	4.69*
6.83	53	724	1800.4	580.6	0.0	. E	4.55*
6.92	39	699	1800.4	575.9	0.0	. E	4.49*
7.00	29	674	1800.3	571.2	0.0	. E	4.44*
7.09	22	651	1800.3	566.7	0.0	. E	4.38*
7.17	17	627	1800.2	562.2	0.0	. E	4.33*
7.26	12	605	1800.2	557.9	0.0	. E	4.19*
7.35	9	583	1800.2	553.8	0.0	. E	4.14*
7.43	7	562	1800.2	549.7	0.0	. E	4.10*
7.52	5	542	1800.1	545.8	0.0	. E	3.96*
7.61	4	522	1800.1	542.1	0.0	. E	3.93*
7.69	3	503	1800.1	538.4	0.0	. E	3.80*
7.78	2	485	1800.0	534.9	0.0	. E	3.77*
7.87	1	467	1800.0	531.5	0.0	. E	3.74*
7.95	1	450	1800.0	528.3	0.0	. E	3.62*
8.04	1	433	1800.0	525.1	0.0	. E	3.60*
8.13	1	416	1799.9	522.1	0.0	. E	3.47*
8.21	0	400	1799.9	519.2	0.0	. E	3.35*
8.30	0	385	1799.9	516.4	0.0	. E	3.34*
8.38	0	370	1799.9	513.7	0.0	. E	3.22*
8.47	0	356	1799.8	511.1	0.0	. E	3.22*
8.56	0	343	1799.8	508.6	0.0	. E	3.11*
8.64	0	330	1799.8	506.2	0.0	. E	3.00*
T	I	O	E	VOL	A	I	VEL

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

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	200.0	1807.62	1688.0	0.0	8.16	1220.2	152.8	15245.0	15397.8	5.45	13.26	0.005	0.007	9.2	14.0

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.007

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

T	I	O	E	VOL	A	I	VEL
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	14	0	1793.5	13.8	0.0	.	0.00
0.17	56	1	1793.5	14.0	0.0	.	0.00
0.26	133	3	1793.6	14.7	0.0	.	0.00
0.35	237	8	1793.7	16.0	0.0	.	0.00
0.43	353	14	1794.0	18.0	0.0	.	0.00
0.52	469	19	1794.0	20.8	0.0	.	0.00
0.61	576	25	1794.1	24.4	0.0	.I	0.00
0.69	663	32	1794.2	28.6	0.0	.I	0.00
0.78	728	39	1794.3	33.3	0.0	.I	0.00
0.86	775	47	1794.4	38.4	0.0	.I	0.00
0.95	808	55	1794.5	43.7	0.0	.I	0.00
1.04	838	63	1794.6	49.1	0.0	.I	0.00
1.12	895	73	1794.7	54.8	0.0	.I	0.00
1.21	1006	84	1794.8	61.1	0.0	.I	0.00
1.30	1170	97	1794.9	68.2	0.0	.I	0.00
1.38	1364	98	1795.1	76.6	0.0	.I	0.00
1.47	1561	100	1795.3	86.3	0.0	. I	0.00
1.56	1747	101	1795.5	97.4	0.0	. I	0.00
1.64	1910	102	1795.7	109.7	0.0	. I	0.00
1.73	2042	104	1796.0	123.1	0.0	. I	0.00
1.82	2142	105	1796.1	137.3	0.0	. I	0.00
1.90	2213	106	1796.3	152.1	0.0	. I	0.00
1.99	2321	106	1796.5	167.5	0.0	. I	0.00

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T	I	O	E	VOL	A
7.78	6	835	1800.5	600.0	0.0
7.87	4	795	1800.5	594.2	0.0
7.95	3	766	1800.4	588.7	0.0
8.04	2	738	1800.4	583.3	0.0
8.13	1	711	1800.4	578.2	0.0
8.21	1	685	1800.3	573.2	0.0
8.30	1	660	1800.3	568.4	0.0
8.38	0	636	1800.3	563.8	0.0
8.47	0	612	1800.2	559.3	0.0
8.56	0	590	1800.2	555.0	0.0
8.64	0	568	1800.2	550.9	0.0

```
0.     10000.     20000.     30000.     40000.     50000.     60000.     70000. VEL
                                                                                EXIT
```

VOLUME FILL= 275958. CY. MAX. HEIGHT= 19.6 FT
TOP WIDTH= 14.0 FT. TOP LENGTH= 8419.2 FT
AREA OF DAM= 16.68 AC. AREA TO SEED= 16.68 AC (PROJECTED HORIZONTAL AREA)

****

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

RATING TABLE NUMBER 4

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.86	12.18	12.18	17.04	0.00
3	1794.22	34.45	34.45	30.21	0.00
4	1794.59	63.28	63.28	49.41	0.00
5	1794.95	97.43	97.43	68.60	0.00
6	1795.51	101.37	101.37	98.47	0.00
7	1796.08	104.33	104.33	131.03	0.00
8	1796.64	107.21	107.21	180.41	0.00
9	1797.21	110.02	110.02	229.78	0.00
10	1797.77	112.75	112.75	279.16	0.00
11	1798.33	115.42	115.42	337.79	0.00
12	1798.90	118.03	118.03	402.79	0.00
13	1799.46	120.59	120.59	467.79	0.00
14	1799.99	369.36	122.92	528.52	0.00
15	1800.52	640.82	125.22	597.32	0.00
16	1801.46	1470.72	129.24	721.47	0.00
17	1802.62	2835.16	134.00	883.11	0.00
18	1804.73	6046.38	142.24	1201.28	0.00
19	1807.37	11217.15	151.91	1643.47	0.00
20	1810.00	17578.09	161.01	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESH	150.0	1802.25	828.9	0.0	2.79	361.2	132.5	2245.5	2378.0	1.87	7.81	0.007	0.010	9.7	4.1

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

PLOT 1 IN = 2000. CFS

EXIT SLOPE = 0.010

T	I	O	E	VOL	A
0.00	0	0	1793.5	13.7	0.0
0.09	5	0	1793.5	13.7	0.0
0.17	19	0	1793.5	13.8	0.0
0.26	46	1	1793.5	14.0	0.0
0.35	81	3	1793.6	14.5	0.0
0.43	122	5	1793.7	15.2	0.0
0.52	162	9	1793.8	16.1	0.0
0.61	199	13	1793.9	17.4	0.0

```
0.     2000.     4000.     6000.     8000.     10000.     12000.     14000. EXIT
                                                                          VEL
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.2
6.14	313	1099	1801.0	665.8	0.0	. I E	6.13
6.22	284	1061	1801.0	660.2	0.0	.I E	6.05
6.31	244	1024	1801.0	654.7	0.0	.I E	5.97
6.40	202	987	1800.9	649.1	0.0	.I E	5.89
6.48	161	949	1800.9	643.4	0.0	.I E	5.80
6.57	124	912	1800.8	637.8	0.0	.I E	5.62
6.66	94	874	1800.8	632.2	0.0	. E	5.52
6.74	70	837	1800.7	626.7	0.0	. E	5.41
6.83	53	801	1800.7	621.3	0.0	. E	5.30
6.92	39	766	1800.7	616.0	0.0	. E	5.19
7.00	29	732	1800.6	610.9	0.0	. E	5.09
7.09	22	699	1800.6	606.0	0.0	. E	4.99
7.17	17	667	1800.5	601.2	0.0	. E	4.90*
7.26	12	638	1800.5	596.7	0.0	. E	4.83*
7.35	9	621	1800.5	592.3	0.0	. E	4.71*
7.43	7	604	1800.4	587.9	0.0	. E	4.68*
7.52	5	587	1800.4	583.7	0.0	. E	4.57*
7.61	4	571	1800.4	579.6	0.0	. E	4.55*
7.69	3	555	1800.4	575.6	0.0	. E	4.44*
7.78	2	540	1800.3	571.7	0.0	. E	4.43*
7.87	1	525	1800.3	567.9	0.0	. E	4.32*
7.95	1	510	1800.3	564.3	0.0	. E	4.31*
8.04	1	496	1800.2	560.7	0.0	. E	4.21*
8.13	1	482	1800.2	557.2	0.0	. E	4.20*
8.21	0	469	1800.2	553.8	0.0	. E	4.11*
8.30	0	456	1800.2	550.5	0.0	. E	4.01*
8.38	0	443	1800.1	547.3	0.0	. E	4.01*
8.47	0	431	1800.1	544.1	0.0	. E	3.92*
8.56	0	419	1800.1	541.1	0.0	. E	3.83*
8.64	0	407	1800.1	538.2	0.0	. E	3.84*
T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	QE/B
SCS-FBH	150.0	1808.27	1808.0	0.0	8.81	1340.2	155.1	13162.7	13317.8	5.90	13.79	0.005	0.007	11.2	20.0

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.007

T	I	O	E	VOL	A	I I I I I I I	VEL
						0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	14	0	1793.5	13.8	0.0	.	0.00
0.17	56	1	1793.5	14.0	0.0	.	0.00
0.26	133	3	1793.6	14.7	0.0	.	0.00
0.35	237	8	1793.7	16.0	0.0	.	0.00
0.43	353	14	1794.0	18.0	0.0	.	0.00
0.52	469	19	1794.0	20.8	0.0	.	0.00
0.61	576	25	1794.1	24.4	0.0	.I	0.00
0.69	663	32	1794.2	28.6	0.0	.I	0.00
0.78	728	39	1794.3	33.3	0.0	.I	0.00
0.86	775	47	1794.4	38.4	0.0	.I	0.00
0.95	808	55	1794.5	43.7	0.0	.I	0.00
1.04	838	63	1794.6	49.1	0.0	.I	0.00
1.12	895	73	1794.7	54.8	0.0	.I	0.00
1.21	1006	84	1794.8	61.1	0.0	.I	0.00
1.30	1170	97	1794.9	68.2	0.0	.I	0.00
1.38	1364	98	1795.1	76.6	0.0	.I	0.00
1.47	1561	100	1795.3	86.3	0.0	. I	0.00
1.56	1747	101	1795.5	97.4	0.0	. I	0.00
1.64	1910	102	1795.7	109.7	0.0	. I	0.00
1.73	2042	104	1796.0	123.1	0.0	. I	0.00
1.82	2142	105	1796.1	137.3	0.0	. I	0.00
1.90	2213	106	1796.3	152.1	0.0	. I	0.00
1.99	2321	106	1796.5	167.5	0.0	. I	0.00
2.07	3370	108	1796.7	187.1	0.0	. I	0.00
[illegible]	[illegible]	110	[illegible]	[illegible]	[illegible]	[illegible]	0.00

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(3)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.E	5.[illegible]*
7.69	8	1193	1801.1	679.9	0.0	.E	5.72*
7.78	6	1137	1801.1	671.6	0.0	.E	5.55*
7.87	4	1085	1801.0	663.7	0.0	.E	5.44*
7.95	3	1034	1801.0	656.2	0.0	.E	5.34*
8.04	2	986	1800.9	649.0	0.0	.E	5.25*
8.13	1	940	1800.9	642.1	0.0	.E	5.10*
8.21	1	896	1800.8	635.5	0.0	.E	5.03*
8.30	1	855	1800.8	629.3	0.0	.E	4.90*
8.38	0	815	1800.7	623.3	0.0	.E	4.78*
8.47	0	777	1800.7	617.6	0.0	.E	4.66*
8.56	0	741	1800.6	612.2	0.0	.E	4.62*
8.64	0	706	1800.6	607.1	0.0	.E	4.52*
T	I	O	E	VOL	A	I	VEL

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

VOLUME FILL= 294086. CY, MAX. HEIGHT= 20.3 FT
TOP WIDTH= 14.0 FT, TOP LENGTH= 8480.0 FT
AREA OF DAM= 17.27 AC, AREA TO SEED= 17.27 AC (PROJECTED HORIZONTAL AREA)

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

****

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

RATING TABLE NUMBER 5

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.86	12.18	12.18	17.04	0.00
3	1794.22	34.45	34.45	30.21	0.00
4	1794.59	63.28	63.28	49.41	0.00
5	1794.95	97.43	97.43	68.60	0.00
6	1795.51	101.37	101.37	98.47	0.00
7	1796.08	104.33	104.33	131.03	0.00
8	1796.64	107.21	107.21	180.41	0.00
9	1797.21	110.02	110.02	229.78	0.00
10	1797.77	112.75	112.75	279.16	0.00
11	1798.33	115.42	115.42	337.79	0.00
12	1798.90	118.03	118.03	402.79	0.00
13	1799.46	120.59	120.59	467.79	0.00
14	1799.99	287.69	122.92	528.52	0.00
15	1800.52	470.57	125.22	597.32	0.00
16	1801.46	1031.40	129.24	721.47	0.00
17	1802.62	1959.53	134.00	883.11	0.00
18	1804.73	4166.77	142.24	1201.28	0.00
19	1807.37	7771.57	151.91	1643.47	0.00
20	1810.00	12271.20	161.01	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	Q-ES	DE/B
SCS-ESH	100.0	1802.56	873.4	0.0	3.10	405.6	133.7	1770.1	1903.9	2.07	8.21	0.007	0.010	12.1	5.9

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FBH 0/4 CRITICAL SLOPE.

```
          PLOT                                  1 IN =   2000. CFS                                                EXIT SLOPE = 0.010
                                                0.      2000.      4000.      6000.      8000.     10000.     12000.     14000. EXIT
```

T	I	O	E	VOL	A	I	VEL
0.00	0	0	1793.5	13.7	0.0	.	0.00
0.09	5	0	1793.5	13.7	0.0	.	0.00
0.17	19	0	1793.5	13.8	0.0	.	0.00
0.26	46	1	1793.5	14.0	0.0	.	0.00
0.35	81	3	1793.6	14.5	0.0	.	0.00
0.43	[illegible]	5	[illegible]	[illegible]	[illegible]	.	

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.45	463	1426	1802.0	790.1	0.0	. I	E	7.96
53	429	1386	1801.9	783.3	0.0	. I	E	7.84
.62	400	1347	1801.9	776.5	0.0	. I	E	7.78
5.71	378	1309	1801.8	769.8	0.0	. I	E	7.67
5.79	363	1271	1801.8	763.2	0.0	. I	E	7.55
5.88	351	1234	1801.7	756.8	0.0	. I	E	7.50
5.96	342	1199	1801.7	750.6	0.0	. I	E	7.39
6.05	331	1164	1801.6	744.5	0.0	. I	E	7.28
6.14	313	1130	1801.6	738.6	0.0	. I	E	7.18
6.22	284	1097	1801.6	732.8	0.0	.I	E	7.08
6.31	244	1063	1801.5	727.0	0.0	.I	E	7.04
6.40	202	1030	1801.5	721.1	0.0	.I	E	6.92
6.48	161	1003	1801.4	715.1	0.0	.I	E	6.80
6.57	124	976	1801.4	709.1	0.0	.I	E	6.74
6.66	94	948	1801.3	703.0	0.0	.	E	6.67
6.74	70	921	1801.3	696.9	0.0	.	E	6.60
6.83	53	893	1801.2	690.9	0.0	.	E	6.46
6.92	39	866	1801.2	684.9	0.0	.	E	6.39
7.00	29	840	1801.1	679.1	0.0	.	E	6.31
7.09	22	814	1801.1	673.3	0.0	.	E	6.24
7.17	17	789	1801.1	667.8	0.0	.	E	6.10
7.26	12	764	1801.0	662.3	0.0	.	E	6.04
7.35	9	740	1801.0	657.0	0.0	.	E	5.97
7.43	7	717	1800.9	651.9	0.0	.	E	5.84
7.52	5	694	1800.9	646.9	0.0	.	E	5.79
7.61	4	673	1800.9	642.0	0.0	.	E	5.66
7.69	3	651	1800.8	637.3	0.0	.	E	5.62
7.78	2	631	1800.8	632.8	0.0	.	E	5.50
7.87	1	611	1800.8	628.3	0.0	.	E	5.46
7.95	1	591	1800.7	624.1	0.0	.	E	5.35
8.04	1	573	1800.7	619.9	0.0	.	E	5.24
8.13	1	554	1800.7	615.9	0.0	.	E	5.14*
8.21	0	537	1800.6	612.0	0.0	.	E	5.11*
8.30	0	520	1800.6	608.2	0.0	.	E	5.02*
8.38	0	503	1800.6	604.6	0.0	.	E	4.92*
8.47	0	487	1800.5	601.0	0.0	. E		4.83*
8.56	0	472	1800.5	597.6	0.0	. E		4.74*
8.64	0	462	1800.5	594.3	0.0	. E		4.67*
T	I	O	E	VOL	A	I	I I I I I I I I	VEL
						0.	2000. 4000. 6000. 8000. 10000. 12000. 14000.	EXIT

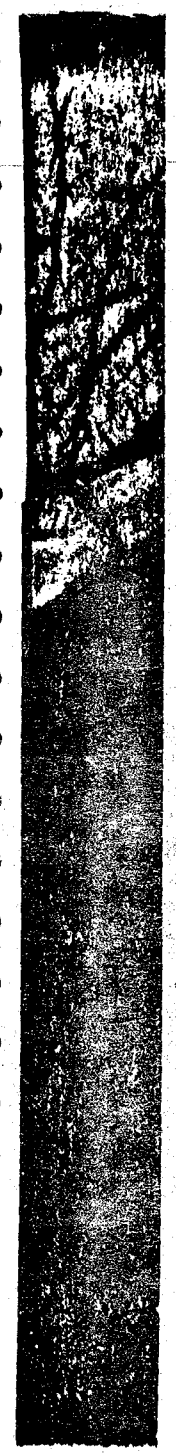
TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-FBH	100.0	1809.12	1972.6	0.0	9.66	1504.8	158.0	10586.5	10744.6	6.48	14.46	0.005	0.007	14.6	27.5

PLOT

1 IN = 10000. CFS

EXIT SLOPE = 0.007

T	I	O	E	VOL	A	I I I I I I I I	VEL
						0. 10000. 20000. 30000. 40000. 50000. 60000. 70000.	EXIT
0.00	0	0	1793.5	13.7	0.0 .		0.00
0.09	14	0	1793.5	13.8	0.0 .		0.00
0.17	56	1	1793.5	14.0	0.0 .		0.00
0.26	133	3	1793.6	14.7	0.0 .		0.00
0.35	237	8	1793.7	16.0	0.0 .		0.00
0.43	353	14	1794.0	18.0	0.0 .		0.00
0.52	469	19	1794.0	20.8	0.0 .		0.00
0.61	576	25	1794.1	24.4	0.0 .I		0.00
0.69	663	32	1794.2	28.6	0.0 .I		0.00
0.78	728	39	1794.3	33.3	0.0 .I		0.00
0.86	775	47	1794.4	38.4	0.0 .I		0.00
0.95	808	55	1794.5	43.7	0.0 .I		0.00
1.04	838	63	1794.6	49.1	0.0 .I		0.00
1.12	895	73	1794.7	54.8	0.0 .I		0.00
1.21	1006	84	1794.8	61.1	0.0 .I		0.00
1.30	1170	97	1794.9	68.2	0.0 .I		0.00
1.38	1364	98	1795.1	76.6	0.0 .I		0.00
1.47	1561	100	1795.3	[illegible]	0.0 . I		0.00



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5.62	1144	4688	1805.1	1243.2	0.0	.I	E	
5.71	1082	4485	1805.0	1240.4	0.0	.I	E	11.33
5.79	1038	4291	1804.8	1216.6	0.0	.I	E	11.15
5.88	1007	4115	1804.7	1193.9	0.0	.I	E	10.98
5.96	981	3964	1804.5	1172.1	0.0	.I	E	10.80
6.05	949	3819	1804.4	1151.2	0.0	.I	E	10.62
6.14	897	3679	1804.3	1131.0	0.0	.I	E	10.46
6.22	811	3543	1804.2	1111.3	0.0	.I	E	10.34
6.31	698	3408	1804.0	1091.9	0.0	.I	E	10.18
6.40	574	3274	1803.9	1072.5	0.0	.I	E	10.01
6.48	457	3140	1803.8	1053.3	0.0	.	E	9.84
6.57	352	3008	1803.7	1034.2	0.0	.	E	9.65
6.66	266	2877	1803.5	1015.4	0.0	.	E	9.51
6.74	199	2750	1803.4	997.0	0.0	.	E	9.32
6.83	149	2625	1803.3	979.0	0.0	.	E	9.14
6.92	111	2504	1803.2	961.6	0.0	.	E	9.00*
7.00	83	2388	1803.0	944.9	0.0	.	E	8.83*
7.09	63	2276	1802.9	928.7	0.0	.	E	8.62*
7.17	47	2168	1802.8	913.2	0.0	.	E	8.47*
7.26	35	2066	1802.7	898.4	0.0	.	E	8.32*
7.35	26	1967	1802.6	884.2	0.0	.	E	8.14*
7.43	20	1888	1802.5	870.6	0.0	.	E	8.00*
7.52	15	1813	1802.4	857.5	0.0	.	E	7.88*
7.61	11	1740	1802.4	844.9	0.0	.	E	7.72*
7.69	8	1671	1802.3	832.8	0.0	.	E	7.61*
7.78	6	1604	1802.2	821.2	0.0	.	E	7.46*
7.87	4	1540	1802.1	810.0	0.0	.	E	7.32*
7.95	3	1478	1802.1	799.2	0.0	.E		7.24*
8.04	2	1418	1802.0	788.9	0.0	.E		7.11*
8.13	1	1362	1801.9	779.0	0.0	.E		6.94*
8.21	1	1307	1801.8	769.4	0.0	.E		6.83*
8.30	1	1254	1801.8	760.3	0.0	.E		6.73*
8.38	0	1204	1801.7	751.5	0.0	.E		6.58*
8.47	0	1156	1801.6	743.1	0.0	.E		6.50*
8.56	0	1109	1801.6	735.0	0.0	.E		6.36*
8.64	0	1065	1801.5	727.2	0.0	.E		6.24*
T	I	O	E	VOL	A	I		VEL

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

VOLUME FILL= 318344. CY. MAX. HEIGHT= 21.1 FT
TOP WIDTH= 14.0 FT. TOP LENGTH= 8480.0 FT
AREA OF DAM= 18.02 AC. AREA TO SEED= 18.02 AC (PROJECTED HORIZONTAL AREA)

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

25 of 25

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EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 7-3-85 SHEET 1 OF 13

CHKD. BY S.G. Yo' DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 656

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROT.

SUBJECT BAFFLE CHUTE DESIGN — 100' WIDE

$Q_{max} = 10{,}505$ CFS.; $W = 100$ FT. $S = 1/2$

TOP OF DDM EL. @ EL 1809.35

FOR DESIGN BAFFLE CHUTE :

$Q = 2/3\, Q_{max} = 2/3 \times 10{,}505 = 7003.33$ CFS

$q = \frac{Q}{W} = \frac{7003.33}{100} = 70.03$ CFS/FT.

$\therefore D_c = \sqrt[3]{\frac{q^2}{g}} = \left(\frac{70.03^2}{32.2}\right)^{1/3} = 5.34'$

$V_c = \sqrt[3]{qg} = (70.03 \times 32.2)^{1/3} = 13.11$ '/sec.

TOTAL LENGTH OF CHUTE (MIN.)

$L = (1809.35 - 1788 + 7.0/2)\sqrt{5} = 55.57'$

USE $L = 59.50'$

BAFFLE PIER HEIGHT :-

$H = 0.8 D_c = 0.8 \times 5.34 = 4.27'$ USE $H = 4.25'$

BAFFLE PIER WIDTH & SPACING :-

$B = 3/2\, H = 3/2 \times 4.25 = 6.38'$ USE $B = 6'-4$

SLOPE DISTANCE BETWEEN BAFFLE PIERS :-

$D = 2H = 2(4.25) = 8.50'$

NO. OF BAFFLE PIERS PER ROW :-

$100/2 \times 6.33 = 7.90$

NO OF ROWS :- $(59.5/8.5) - 1 = 6$ ROWS

HEIGHT OF WALL : $3.3 \times 4.25 = 14.025'$ USE $14'-3$

EBASCO SERVICES INCORPORATED

BY Y.C. YANG DATE 7-3-85

CHKD. BY S. Goyal DATE 7-9-85

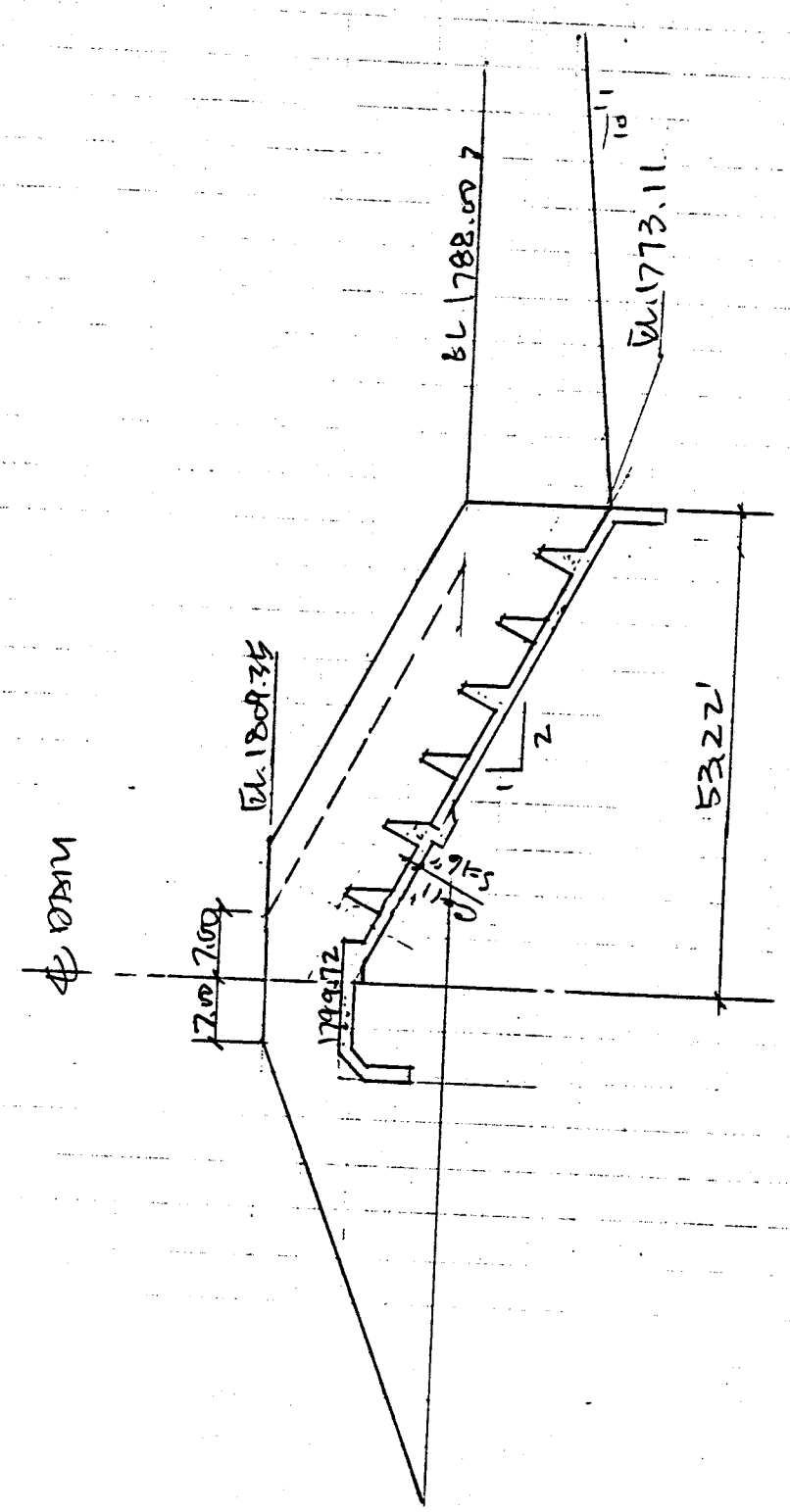
SHEET 2 OF

CLIENT USDA

OFS NO. 3767.100 DEPT. NO.

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT ~~BULLDOG FLOODWAY~~ - BAFFLE CHUTE SPILLWAY - 100 YR



EBASCO SERVICES INCORPORATED

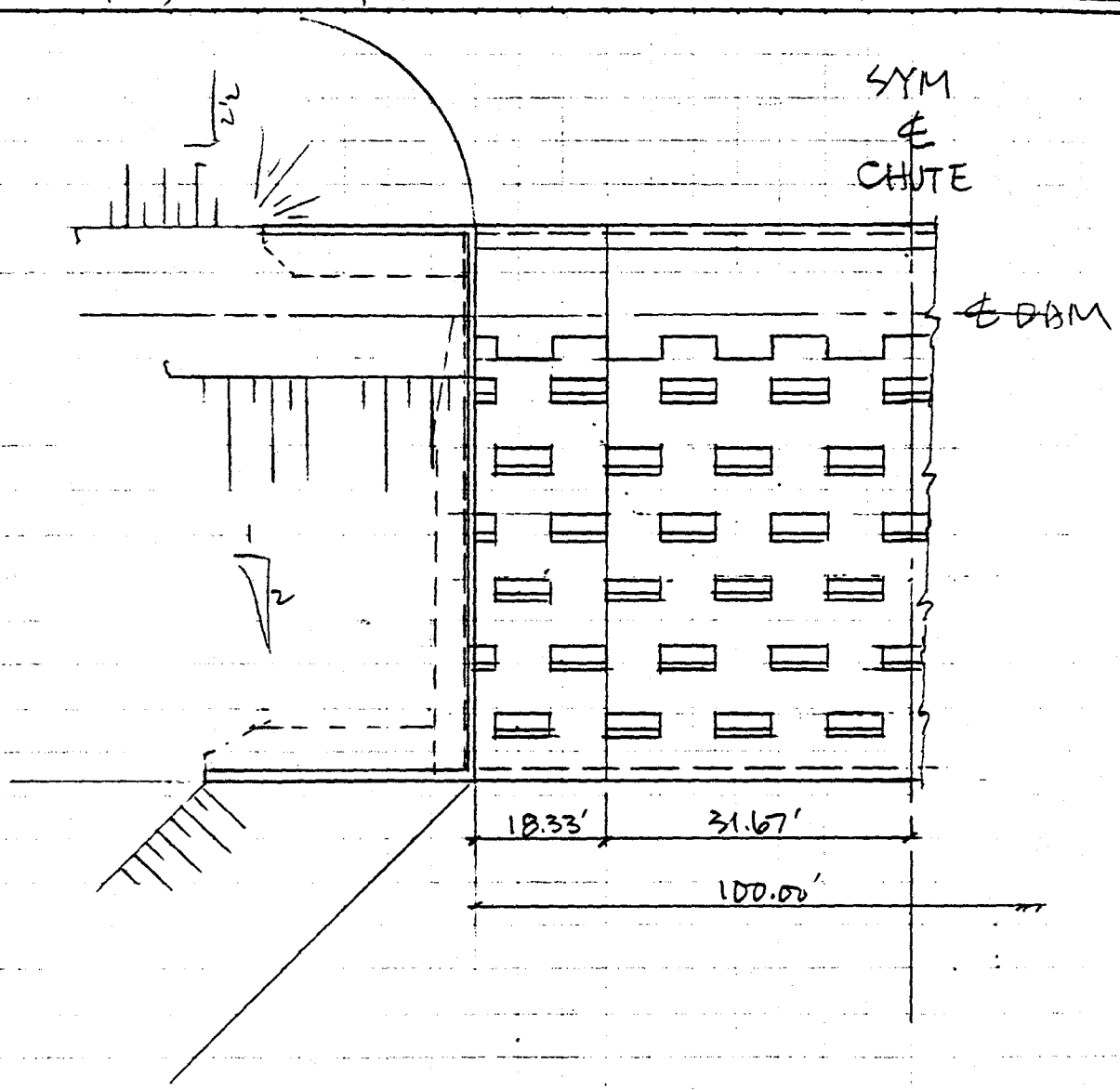
BY Y.C. YONG DATE 7-3-85 SHEET 3 OF 13

CHKD. BY S.G. yo DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 655

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT ~~BULLDOG FLOODWAY~~ - BAFFLE CHUTE SPILLWAY - 100 WIDE



1" = 20'-0

EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 7-3-85 SHEET 4 OF 13

CHKD. BY S Gyan DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 61

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT BAFFLE CHUTE SPILLWAY — 100 WIDE

QUANTITIES:

SLAB:

CENTER SLAB: 31.67 x 2 x 59.5 x 11/12 = 3,455 CF

SIDE SLAB: 18.33 x 2 x 59.5 x 16/12 = 2908

U/S SLAB: 100 (8.5 + √8) x 12/12 = 1,133

U/S CUTOFF W. 100 x 4.0 x 18/12 = 600

D/S C.O. WALL 100 x 6.0 x 15/12 = 750

8,846 CF

BAFFLES:

PIER: (0.85 + 3.0) 4.25 x 6.33 x 7.9 x 6 = 2,455 CF

U/S WTR: 2.5 x 1.25/2 x 100 + (1.25 + 2.50) 2.5/2 x 6.33 x 7.9 = 391

2,846 CF

SIDE WALL:

WALL: 2 [14.25 x 59.5 - 4.62 x 2 x 4.62] 11/12 = 1,476 CF

U/S WALL: 2 x 9.63 x 10.5 x 11/12 = 185

SLAB: (2+4) 18.8/2 x 16/12 x 2 = 150

37.2 x 4.0 x 16/12 x 2 = 397

2,208 CF

HEAD WALL:

WALL: (27.5 x 15.0 - 8.5 x 5.0) x 12/12 x 2 = 740 CF

SLAB: [27.5 x 7.25 - (5.25 x 7.5)/2] 12/12 x 2 = 359

1099 CF

EBASCO SERVICES INCORPORATED

BY Y. C. YANG DATE 7-3-85 SHEET 5 OF

CHKD. BY S. Goyal DATE 7-9-85 OFS NO. 3767.100 DEPT. NO.

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION PROTECTION

SUBJECT ~~BULLDOG~~ BAFFLE CHUTE SPILLWAY — 100 WIDE

WING WALL:

WALL: $(31.0 \times 14.25 - 4.0 \times 4.0/2)\, 11/12 \times 2 = 795$ CF

$(18.0 \times 4.5 - 4.5 \times 4.5/2)\, 18/12 \times 2 = 213$

SLAB: $(24.0 \times 14.0 - 11.0 \times 5.5/2)\, 18/12 \times 2 = 917$

1925 CF

TOTAL CONC. = 16,924 CF

= 627 C.Y.

EBASCO SERVICES INCORPORATED

BY Y. CYANG DATE 7-3-85 SHEET 6 OF 13

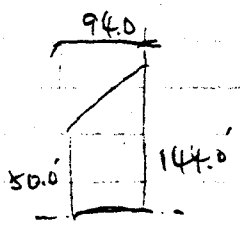
CHKD. BY S Goyal DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDD

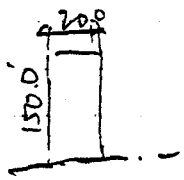
PROJECT

SUBJECT QUANTITIES - 100W BAFFLE SPILLWAY

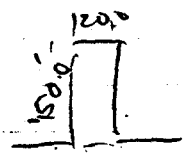
RIP-RAP. QUANTITIES (½) 2' THICK



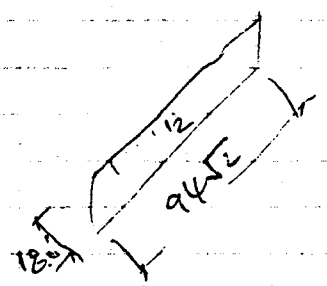
$2.0 \times (50.0 + 144.0)/2 \times 94.0 = 18{,}236$ CF



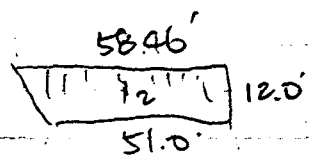
$2.0 \times 150.0 \times 20.0 = 6{,}000$ CF



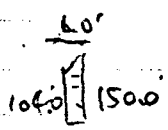
$2.0 \times 150.0 \times 20.0 = 6{,}000$ CF



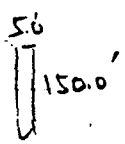
$2.0 \times 94.0\sqrt{2} \times 18.0 \times \sqrt{5}/2 = 5{,}351$ CF



$2.0 \times (58.46 + 51.0)/2 \times 12\frac{\sqrt{5}}{2} = 1{,}469$ CF



$2.0(144.0 + 150.0)/2 \times 6.0\frac{\sqrt{5}}{2} = 1972$ CF



$5.0(5.0 \times 150.0) = 3750$ CF

$\Sigma = 42{,}778$ CF

$2 \times \Sigma = 85{,}556$ CF $= 3{,}169$ CY

EBASCO SERVICES INCORPORATED

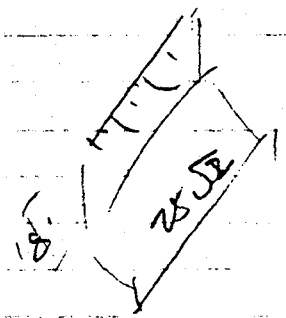
BY Y.C. YANG DATE 7-3-85 SHEET 7 OF 12

CHKD. BY S Goyal DATE 7-9-85 OFS NO. 3767.100 DEPT. NO. 6+0

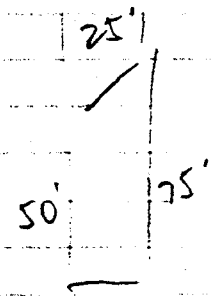
CLIENT

PROJECT

SUBJECT BOFFLE SPILLWAY — 150 WIDTH



$2.0 \times 25\sqrt{2} \times 18.0 \times \frac{\sqrt{5}}{2} = 1423$ CF



$2.0 \times (50.0 + 75.0)/2 \times 25 = 3125$ CF

$\Sigma = 4548$ CF

$2 \times \Sigma = 9096$ CF $= 337$ CY

TOTAL $= 3{,}169 - 337 = 2{,}832$ CY

as if we lower width of Emer Spw any less than 100' our outlet is 90' + we are intensifying the flow out of the spillway.

8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	350.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	499.11	0.00
14	1800.24	322.74	82.68	561.05	0.00
15	1800.75	576.84	83.96	629.30	0.00
16	1801.68	1383.70	86.55	749.35	0.00
17	1802.81	2683.15	89.41	913.14	0.00
18	1804.86	5767.42	94.93	1222.16	0.00
19	1807.43	10746.07	101.19	1655.06	0.00
20	1810.00	16837.68	107.08	2141.60	0.00

30" CS OUTLET
CONC. SPILLWAY

7/2/85

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	D-ES	DE/B
SCS-ESN	150.0	1802.51	866.8	0.0	2.79	369.7	89.8	2244.4	2333.3	1.87	7.81	0.007	0.010	11.2	4.6

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FOR 0/4 CRITECAL SLOPE.

1 IN = 2000. CFS EXIT SLOPE = 0.010

T	PLOT I	Q	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	0	0	1793.5	13.7	0.0	.								0.00
0.17	0	0	1793.5	13.7	0.0	.								0.00
0.26	0	0	1793.5	13.7	0.0	.								0.00
0.35	0	0	1793.5	13.7	0.0	.								0.00
0.43	0	0	1793.5	13.7	0.0	.								0.00
0.52	0	0	1793.5	13.7	0.0	.								0.00
0.61	0	0	1793.5	13.7	0.0	.								0.00
0.69	0	0	1793.5	13.7	0.0	.								0.00
0.78	0	0	1793.5	13.7	0.0	.								0.00
0.86	0	0	1793.5	13.7	0.0	.								0.00
0.95	0	0	1793.5	13.7	0.0	.								0.00
1.04	0	0	1793.5	13.7	0.0	.								0.00
1.12	0	0	1793.5	13.7	0.0	.								0.00
1.21	0	0	1793.5	13.7	0.0	.								0.00
1.30	0	0	1793.5	13.7	0.0	.								0.00
1.38	0	0	1793.5	13.7	0.0	.								0.00
1.47	0	0	1793.5	13.7	0.0	.								0.00
1.56	0	0	1793.5	13.7	0.0	.								0.00
1.64	0	0	1793.5	13.7	0.0	.								0.00
1.73	0	0	1793.5	13.7	0.0	.								0.00
1.82	0	0	1793.5	13.7	0.0	.								0.00
1.90	0	0	1793.5	13.7	0.0	.								0.00
1.99	11	0	1793.5	13.8	0.0	.								0.00
2.07	188	2	1793.6	14.5	0.0	.I								0.00
2.16	957	15	1794.0	18.5	0.0	. I								0.00
2.25	2911	37	1794.3	32.1	0.0	.	I							0.00
2.33	5845	65	1794.8	63.0	0.0	.			I					0.00
2.42	8828	69	1795.8	115.0	0.0	.				I				0.00
2.51	11019	71	1796.7	185.4	0.0	.					I			0.00
2.59	12133	75	1797.6	267.5	0.0	.						I		0.00
2.68	12285	77	1798.5	354.2	0.0	.						X		0.00
2.77	11670	79	1799.2	439.2	0.0	.						I		0.00
2.85	10560	157	1799.9	517.8	0.0	.E					I			2.32*
2.94	9300	420	1800.4	586.7	0.0	. E				I				4.07*
3.03	8109	687	1800.9	644.9	0.0	. E			I					5.14
3.11	7038	1008	1801.2	692.9	0.0	. E		I						6.03
3.20	6126	1267	1801.5	731.8	0.0	. E	I							6.62
3.28	5355	1494	1801.8	763.0	0.0	. E	I							7.09

8 OF 13

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```
 8.64     0   435 1800.5   590.7   0.0 . E                                                                  4.11*
  T       I     0     E     VOL     A  I        I        I        I        I        I        I        I-   VEL
                                       0.     2000.    4000.    6000.    8000.   10000.   12000.   14000. EXIT

  TYPE        BW     EMAX  VOL-MAX   AMAX     HP  VOL-ES    Q-PS     Q-ES   Q-TOT   D/C    V/C   S/C  S/C.25   D-ES   OE/D
SCS-FDN     150.0  1808.48  1847.2     0.0   8.75  1349.1   103.6  13048.4  13152.1  5.87  13.74  0.005  0.007   11.5   19.4

          PLOT                                  1 IN =  10000. CFS                                EXIT SLOPE = 0.007
                                                0.    10000.   20000.   30000.   40000.   50000.   60000.   70000. EXIT
  T       I     O     E     VOL     A  I        I        I        I        I        I        I        I        I   VEL
 0.00     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.09     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.17     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.26     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.35     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.43     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.52     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.61     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.69     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.78     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.86     0     0 1793.5    13.7   0.0 .                                                                        0.00
 0.95     0     0 1793.5    13.7   0.0 .                                                                        0.00
 1.04     0     0 1793.5    13.7   0.0 .                                                                        0.00
 1.12     0     0 1793.5    13.7   0.0 .                                                                        0.00
 1.21     1     0 1793.5    13.7   0.0 .                                                                        0.00
 1.30     3     0 1793.5    13.7   0.0 .                                                                        0.00
 1.38    11     0 1793.5    13.8   0.0 .                                                                        0.00
 1.47    30     1 1793.5    13.9   0.0 .                                                                        0.00
 1.56    67     2 1793.6    14.3   0.0 .                                                                        0.00
 1.64   126     4 1793.6    14.9   0.0 .                                                                        0.00
 1.73   206     8 1793.8    16.1   0.0 .                                                                        0.00
 1.82   302    13 1793.9    17.8   0.0 .                                                                        0.00
 1.90   406    21 1794.0    20.2   0.0 .                                                                        0.00
 1.99   561    26 1794.1    23.5   0.0 .I                                                                       0.00
 2.07  1496    35 1794.2    30.6   0.0 .I                                                                       0.00
 2.16  4768    64 1794.6    52.7   0.0 .    I                                                                   0.00
 2.25 11768    68 1795.8   111.3   0.0 .            I                                                           0.00
 2.33 21084    73 1797.2   228.1   0.0 .                    I                                                   0.00
 2.42 29621    79 1798.9   408.7   0.0 .                                I                                       0.00
 2.51 35179   639 1800.8   637.6   0.0 .E                                           I                            4.42*
 2.59 37362  2494 1802.6   885.5   0.0 . E                                            X                           7.80*
 2.68 36727  4799 1804.2  1124.2   0.0 .   E                                          I                          10.19
 2.77 34004  7059 1805.6  1334.5   0.0 .     E                                      I                          11.86
 2.85 30133  9033 1806.6  1506.1   0.0 .       E                                    I                          13.07
 2.94 26064 10537 1807.3  1636.9   0.0 .           E                  I                                          13.84
 3.03 22376 11691 1807.9  1730.5   0.0 .            E          I                                               14.42
 3.11 19161 12468 1808.2  1792.6   0.0 .            E      I                                                   14.78
 3.20 16483 12927 1808.4  1829.2   0.0 .             E  I                                                       14.99
 3.28 14248 13136 1808.5  1845.9   0.0 .             EI                                                         15.08
 3.37 12409 13152 1808.5  1847.2   0.0 .            IX                                                          15.07
 3.46 10946 13026 1808.4  1837.1   0.0 .           I E                                                          15.03
 3.54  9812 12799 1808.3  1819.0   0.0 .          I  E                                                          14.95
 3.63  8943 12506 1808.2  1795.6   0.0 .         I   E                                                          14.80
 3.72  8284 12173 1808.1  1769.0   0.0 .        I    E                                                          14.65
 3.80  7779 11818 1807.9  1740.7   0.0 .        I    E                                                          14.47
 3.89  7399 11456 1807.8  1711.8   0.0 .       I     E                                                          14.30
 3.98  7111 11097 1807.6  1683.1   0.0 .       I     E                                                          14.13
 4.06  6842 10744 1807.4  1654.9   0.0 .       I     E                                                          13.96
 4.15  6487 10422 1807.3  1626.9   0.0 .      I      E                                                          13.80
 4.24  5987 10092 1807.1  1598.2   0.0 .      I      E                                                          13.61
 4.32  5371  9744 1806.9  1567.9   0.0 .     I       E                                                          13.42
```

4.41	4725	9373	1806.8	1535.7	0.0	.	13.22
4.50	4121	8992	1806.6	1501.7	0.0	. I	13.01
4.58	3588	8578	1806.4	1466.5	0.0	. I E	12.80
4.67	3144	8166	1806.2	1430.8	0.0	. I E	12.56
4.75	2801	7756	1806.0	1395.1	0.0	. I E	12.30
4.84	2543	7355	1805.7	1360.2	0.0	. I E	12.04
4.93	2350	6968	1805.5	1326.5	0.0	. I E	11.79
5.01	2209	6598	1805.3	1294.4	0.0	. I E	11.55
5.10	2094	6247	1805.1	1263.9	0.0	. I E	11.30
5.19	1982	5915	1804.9	1235.0	0.0	. I E	11.07
5.27	1863	5622	1804.8	1207.5	0.0	. I E	10.83
5.36	1741	5362	1804.6	1181.1	0.0	. I E	10.65
5.45	1618	5111	1804.4	1155.7	0.0	. I E	10.44
5.53	1500	4868	1804.3	1131.2	0.0	. I E	10.24
5.62	1399	4635	1804.1	1107.6	0.0	.I E	10.05
5.71	1323	4412	1804.0	1085.0	0.0	.I E	9.84
5.79	1270	4199	1803.9	1063.5	0.0	.I E	9.67
5.88	1232	3998	1803.7	1043.2	0.0	.I E	9.49
5.96	1200	3809	1803.6	1024.0	0.0	.I E	9.28
6.05	1161	3629	1803.5	1005.9	0.0	.I E	9.14
6.14	1097	3459	1803.3	988.6	0.0	.I E	8.96
6.22	992	3294	1803.2	971.9	0.0	.I E	8.75
6.31	853	3132	1803.1	955.6	0.0	.I E	8.58*
6.40	702	2972	1803.0	939.3	0.0	.I E	8.40*
6.48	559	2812	1802.9	923.2	0.0	.I E	8.21*
[illegible]	431	2659	1802.8	907.2	0.0	. E	8.03*
[illegible]	325	2531	1802.7	891.3	0.0	. E	7.89*
[illegible]	244	2405	1802.6	875.7	0.0	. E	7.74*
[illegible]	182	2282	1802.5	860.5	0.0	. E	7.54*
[illegible]	136	2163	1802.4	845.8	0.0	. E	7.39*
[illegible]	102	2048	1802.3	831.6	0.0	. E	7.25*
[illegible]	77	1938	1802.2	818.0	0.0	. E	7.07*
[illegible]	57	1833	1802.1	805.0	0.0	. E	6.90*
[illegible]	43	1733	1802.0	792.6	0.0	. E	6.74*
7.35	32	1638	1801.9	780.8	0.0	. E	6.59*
7.43	24	1548	1801.8	769.6	0.0	. E	6.46*
7.52	18	1462	1801.8	759.0	0.0	.E	6.28*
7.61	13	1381	1801.7	749.0	0.0	.E	6.17*
7.69	10	1318	1801.6	739.4	0.0	.E	6.03*
7.78	7	1257	1801.5	730.3	0.0	.E	5.91*
7.87	5	1199	1801.5	721.6	0.0	.E	5.79*
7.95	4	1143	1801.4	713.2	0.0	.E	5.68*
8.04	2	1090	1801.3	705.3	0.0	.E	5.57*
8.13	2	1039	1801.3	697.7	0.0	.E	5.48*
8.21	1	991	1801.2	690.5	0.0	.E	5.34*
8.30	1	945	1801.2	683.5	0.0	.E	5.26*
8.38	1	901	1801.1	677.0	0.0	.E	5.13*
8.47	0	859	1801.1	670.7	0.0	.E	5.00*
8.56	0	819	1801.0	664.7	0.0	.E	4.95*
8.64	0	781	1801.0	659.0	0.0	.E	4.85*
T	I	O	E	VOL	A	I	VEL

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

VOLUME FILL= 299776. CY, MAX. HEIGHT= 20.5 FT
TOP WIDTH= 14.0 FT, TOP LENGTH= 8480.0 FT
AREA OF DAM= 17.45 AC, AREA TO SEED= 17.45 AC (PROJECTED HORIZONTAL AREA)

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

****

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

RATING TABLE NUMBER 5

	ELEV FEET	Q-TOTAL CFS	Q-PS CFS	VOLUME AC-FT	AREA ACRE
1	1793.50	0.00	0.00	13.73	0.00
2	1793.77	7.94	7.94	15.22	0.00
3	1794.04	22.45	22.45	27.68	0.00
4	1794.32	41.24	41.24	35.11	0.00
5	1794.59	63.50	63.50	49.54	0.00
6	1795.23	66.42	66.42	83.53	0.00
7	1795.87	68.69	68.69	117.52	0.00
8	1796.52	70.88	70.88	169.34	0.00
9	1797.16	73.01	73.01	225.54	0.00
10	1797.80	75.08	75.08	281.74	0.00
11	1798.44	77.10	77.10	353.15	0.00
12	1799.08	79.06	79.06	424.13	0.00
13	1799.72	80.98	80.98	498.11	0.00
14	1800.24	243.11	82.49	561.05	0.00
15	1800.75	414.05	83.96	629.30	0.00
16	1801.68	958.74	86.55	749.35	0.00
17	1802.81	1841.80	89.61	913.14	0.00
18	1804.86	3959.48	94.93	1222.16	0.00
19	1807.43	7426.04	101.19	1655.06	0.00
20	1810.00	11728.97	107.09	2141.60	0.00

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	B/C	V/C	S/C	S/C.25	D-ES	DE/D
SCS-ESW	100.0	1802.86	918.4	0.0	3.14	420.3	89.8	1907.8	1897.6	2.10	8.26	0.007	0.010	14.2	0.5

********** WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN PLOT SHOULD BE FOR FOR 0/4 CRITICAL SLOPE.

PLOT 1 IN = 2000. CFS EXIT SLOPE = 0.010

T	I	Q	E	VOL	A	0. I	2000. I	4000. I	6000. I	8000. I	10000. I	12000. I	14000. I	EXIT VEL
0.00	0	0	1793.5	13.7	0.0	.								0.00
0.09	0	0	1793.5	13.7	0.0	.								0.00
0.17	0	0	1793.5	13.7	0.0	.								0.00
0.26	0	0	1793.5	13.7	0.0	.								0.00
0.35	0	0	1793.5	13.7	0.0	.								0.00
0.43	0	0	1793.5	13.7	0.0	.								0.00
0.52	0	0	1793.5	13.7	0.0	.								0.00
0.61	0	0	1793.5	13.7	0.0	.								0.00
0.69	0	0	1793.5	13.7	0.0	.								0.00
0.78	0	0	1793.5	13.7	0.0	.								0.00
0.86	0	0	1793.5	13.7	0.0	.								0.00
0.95	0	0	1793.5	13.7	0.0	.								0.00
1.04	0	0	1793.5	13.7	0.0	.								0.00
1.12	0	0	1793.5	13.7	0.0	.								0.00
1.21	0	0	1793.5	13.7	0.0	.								0.00
1.30	0	0	1793.5	13.7	0.0	.								0.00
1.38	0	0	1793.5	13.7	0.0	.								0.00
1.47	0	0	1793.5	13.7	0.0	.								0.00
1.56	0	0	1793.5	13.7	0.0	.								0.00
1.64	0	0	1793.5	13.7	0.0	.								0.00
1.73	0	0	1793.5	13.7	0.0	.								0.00
1.82	0	0	1793.5	13.7	0.0	.								0.00
1.90	0	0	1793.5	13.7	0.0	.								0.00
1.99	11	0	1793.5	13.8	0.0	.								0.00
2.07	188	2	1793.6	14.5	0.0	.I								0.00

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T	I	O	E	VOL	A		VEL
7.43	10	800	1801.4	714.2	0.0	E	6.33
7.52	7	775	1801.4	708.6	0.0	E	6.26
7.61	5	751	1801.3	703.2	0.0	E	6.14
7.69	4	727	1801.3	697.9	0.0	E	6.02
7.78	3	704	1801.2	692.8	0.0	E	5.97
7.87	2	682	1801.2	687.9	0.0	E	5.85
7.95	1	661	1801.2	683.1	0.0	E	5.81
8.04	1	640	1801.1	678.5	0.0	E	5.70
8.13	1	620	1801.1	674.0	0.0	E	5.56
8.21	0	600	1801.1	669.6	0.0	E	5.56
8.30	0	581	1801.0	665.4	0.0	E	5.46
8.38	0	563	1801.0	661.3	0.0	E	5.37
8.47	0	545	1801.0	657.4	0.0	E	5.27
8.56	0	528	1800.9	653.6	0.0	E	5.26
8.64	0	511	1800.9	649.8	0.0	E	5.18*

0. 2030. 4030. 6000. 8000. 10000. 12000. 14000. EXIT

TYPE	BW	EMAX	VOL-MAX	AMAX	HP	VOL-ES	Q-PS	Q-ES	Q-TOT	D/C	V/C	S/C	S/C.25	Q-ES	OE/Q
SCS-FBH	100.0	1809.35	2015.2	0.0	9.62	1517.1	105.6	10505.8	10611.4	6.45	14.43	0.005	0.007	15.4	28.9

PLOT 1 IN = 10000. CFS EXIT SLOPE = 0.007

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

T	I	O	E	VOL	A		VEL
0.00	0	0	1793.5	13.7	0.0		0.00
0.09	0	0	1793.5	13.7	0.0		0.00
0.17	0	0	1793.5	13.7	0.0		0.00
0.26	0	0	1793.5	13.7	0.0		0.00
0.35	0	0	1793.5	13.7	0.0		0.00
0.43	0	0	1793.5	13.7	0.0		0.00
0.52	0	0	1793.5	13.7	0.0		0.00
0.61	0	0	1793.5	13.7	0.0		0.00
0.69	0	0	1793.5	13.7	0.0		0.00
0.78	0	0	1793.5	13.7	0.0		0.00
0.86	0	0	1793.5	13.7	0.0		0.00
0.95	0	0	1793.5	13.7	0.0		0.00
1.04	0	0	1793.5	13.7	0.0		0.00
1.12	0	0	1793.5	13.7	0.0		0.00
1.21	1	0	1793.5	13.7	0.0		0.00
1.30	3	0	1793.5	13.7	0.0		0.00
1.38	11	0	1793.5	13.8	0.0		0.00
1.47	30	1	1793.5	13.9	0.0		0.00
1.56	67	2	1793.6	14.3	0.0		0.00
1.64	126	4	1793.6	14.9	0.0		0.00
1.73	206	8	1793.8	16.1	0.0		0.00
1.82	302	13	1793.9	17.8	0.0		0.00
1.90	406	21	1794.0	20.2	0.0		0.00
1.99	561	26	1794.1	23.5	0.0	I	0.00
2.07	1496	35	1794.2	30.6	0.0	I	0.00
2.16	4768	64	1794.6	52.7	0.0	I	0.00
2.25	11768	68	1795.8	111.3	0.0	I	0.00
2.33	21084	73	1797.2	228.1	0.0	I	0.00
2.42	29621	79	1798.9	408.7	0.0	I	0.00
2.51	35179	459	1800.8	638.2	0.0	I	4.35*
2.59	37362	1729	1802.7	889.5	0.0	E X	7.81*
2.68	36727	3374	1804.3	1136.0	0.0	E I	10.19
2.77	34004	5051	1805.7	1358.5	0.0	E I	11.94
2.85	30133	6554	1806.8	1546.2	0.0	E I	13.17
2.94	26064	7785	1807.7	1695.7	0.0	F I	14.07
3.03	22376	8792	1808.3	1809.5	0.0	E I	14.75
3.11	19161	9525	1808.7	1892.4	0.0	E I	15.19

```
8.47     J  1277 1802.1   807.3   0.0 .E
8.56     O  1228 1802.0   798.3   0.0 .E
8.64     U  1180 1802.0   789.7   0.0 .E                                                                  6.87*
  T      E     O      E     VOL     A  I          I         I         I         I         I         I      6.74*
                                       0.     10000.    20000.    30000.    40000.    50000.    60000.    6.67*
                                                                                                  I      VEL
                                                                                              70000. EXIT
                VOLUME FILL=  324795. CY.      MAX. HEIGHT=    21.3 FT
                TOP WIDTH=       14.0 FT.      TOP LENGTH=   8480.0 FT
                AREA OF DAM=   18.21 AC.       AREA TO SEED=  18.21 AC (PROJECTED HORIZONTAL AREA)

*****WARNING.....TOP OF DAM EXCEEDS CLPROFILE ENDPOINT - APACHE FRS DAM CENTERLINE
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EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-3-85 SHEET 1 OF 2

CHKD. BY Y.C YANG DATE 7-9-85 OFS NO. USDA 3-[illegible] DEPT. NO. S.C.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EXIT CHANNEL

Q_{ESH} = 2244 for L = 150 conc. spillway

Q_{ESH} = 2329 for L = 300' earth spillway

Assume Q = 2300 cfs for the channel design

Natural ground slope is .012

For stable channel condition

Allowable velocity = 2.5 × .9 × 1.0 × .86 (5'-10" free for D_{75} = 4.7" 3:1 side slope)

= 1.935

Assume V = 2

$A = \frac{2300}{2} = 1150$ sq ft

$d = R$

$V = \frac{1.486}{.025} R^{2/3} (.012)^{1/2} = 2$

or $R^{2/3} = \frac{2 \times .025}{1.486 \times (.012)^{1/2}} = .31$

R = .17

This will need very wide channel about 6755'

∴ provide a weir in the channel to provide adequate depth of water d/s of the spillway to avoid scouring at that location.

Protect the weir by flexible apron of riprap

For 300' wide channel

$q = \frac{2300}{300} = 7.66$ cfs

$d_c = 1.22$

$V_c = \frac{7.66}{1.22} = 6.27$ fps

$L = d\sqrt{10} = 3.16\,d$

Provide 2 ft thick riprap for 3.16 d length

EBASCO SERVICES INCORPORATED

BY S GOYAL DATE 7-3-85 SHEET 2 OF 2

CHKD. BY Y.C. YANG DATE 7-9-85 OFS NO. USDA 3767-100 DEPT. NO. 5

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EXIT CHANNEL

For $V = 2$ fps

$d = \frac{2300}{300 \times 2} = 3.83$ $\qquad R = \frac{(300 + 2 \times 3.83)\, 3.83}{300 + 2\sqrt{5} \times 3.83}$

$= \frac{1178}{317} = 3.71$

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

$= .000196$

Provide a slope of .0002

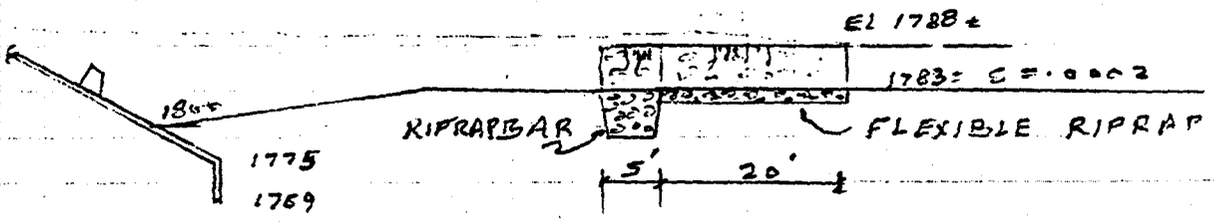
Provide a channel 300 feet wide 5 feet deep at the weir with a slope of .0002

Length of channel ≈ 400'

Provide weir protection for another 5' depth of scour d/s of the weir.

Length of flexible riprap = 3.16 x 5

= 15.8 say 20' long



EBASCO SERVICES INCORPORATED

BY S Goyal DATE 9-10-85 SHEET 2A OF 2

CHKD. BY Y.C. YANG DATE 9-17-85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - EXIT CHANNEL

The geological investigations (TP 201, 202, E 205') indicate existence of caliche at about EL 1779. The control section in the 300' wide channel will be extended from EL 1783 down to caliche. This caliche formation will minimize downstream degradation in the exit channel below the top of caliche. To further protect the caliche foundation at the control section and thereby to protect the control section a flexible apron (loose riprap) will be provided downstream of the control section in a length of 25 feet. This loose riprap will settle down in a scour as the degradation starts downstream of the control section and will protect the caliche. This riprap may need maintenance depending upon the extent & frequency of operation of the spillway.

From Engineering Monograph No. 25, "Hydraulic Design of Stilling Basins and Energy Dissipators" Bureau of Reclamation, Section 9, the scour downstream of the baffle chute is expected to be less than 10' (extrapolated for 70 cfs/ft design discharge). Therefore the chute is extended to EL 1773 ± (1783 - 10) and an additional 5 feet deep cut off is provided for additional safety against undermining of the chute.

As the caliche exists at about EL 1779 the area between the chute and the control section will be excavated to caliche and provided with riprap protection (Top EL 1779). This will form a pool at least 6.5' deep for the design flow and give better energy dissipation downstream of the chute.

The arrangement as discussed above should provide the required protection.

BASCO SERVICES INCORPORATED

BY V.C. YANG CHKD. BY S. Gay

SHEET 1 OF 2

OFS NO. 3767.160 DEPT. NO. 650

CLIENT MS DA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT EMERGENCY SPILLWAY - RIPRAP SIZE

D/S RIPRAP SIZE :- What Criteria?

$Q = 2400$ CFS ; $b = 300.00$; $Z = 3.0$; $S = 0.026$

$$q^* = \frac{Q}{b + 2(1+Z^2)^{1/2}} = \frac{2400}{300 + 2(1+3^2)^{1/2}} = 7.835$$

DN-22 & TR-25 1.

$$R/k = \frac{0.064}{S(S^2+1)^{1/2}}\left(1 - \frac{S}{0.58}\right) + 0.2$$

$$= \frac{0.064}{0.026\sqrt{0.026^2+1}}\left(1 - \frac{0.026}{0.58}\right) + 0.2$$

$$= 2.5504$$

2. $$\frac{V}{\sqrt{R}} = 32.63\left(1 - \frac{k}{6R}\right)^{1/2} \log\left(6\frac{R}{k}\right)\sqrt{S}$$

$$= 32.63\left(1 - \frac{1}{6 \times 2.5504}\right)^{1/2} \log(6 \times 2.5504)\sqrt{0.026}$$

$$= 6.026.$$

3. $$R = \left(\frac{q^*}{V/\sqrt{R}}\right)^{2/3} = \left(\frac{7.835}{6.026}\right)^{2/3} = 1.192$$

4. $$k = \frac{R}{(R/k)} = \frac{1.192}{2.5504} = 0.467$$

5. $$V = \frac{q^*}{R} = \frac{7.835}{1.192} = 6.572 \text{ '/sec}$$

6. $$A = \frac{Q}{V} = \frac{2400}{6.572} = 365.18 \text{ □'}$$

7. $$\tau_{AV} = 62.5RS = 62.5 \times 1.192 \times 0.026 = 1.937$$

8. $$y = (b^2 + 4AZ)^{1/2} - b/2Z$$

$$= [(300^2 + 4 \times 365.18 \times 3)^{1/2} - 300]/2 \times 3 = 1.203'$$

EBASCO SERVICES INCORPORATED

BY [illegible] DATE 7-8-85

CHKD. BY S.G.Yoo DATE 7-9-85

SHEET 2 OF 2

OFS NO. 3767.100 DEPT. NO. 650

CLIENT USDA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD PROTECTION

SUBJECT D/S RIPRAP

9. $D/y = 300/1.203 = 249.4$

FROM FIG B-1 $C_{\tau s} = 1.13$

FROM FIG B-2: $C_{\tau b} = 1.3$

FROM FIG B-4: $K = 0.87$

$$K_s = \frac{C_{\tau s}}{K} k = 1.13 \times \frac{0.467}{0.87} = 0.606'\phi$$

$$K_b = C_{\tau b}\, k = 1.3 \times 0.467 = 0.607'\phi$$

SAY 8"ϕ

THICKNESS OF RIPRAP LAYER.

$$t = 3 \times d_{50} = 3 \times 8'' = 24''$$

BOOZ ALLEN & HAMILTON SERVICES INCORPORATED

BY S GOYAL DATE 7-3-85 SHEET 1 OF 2

CHKD. BY Y.C. YIANG DATE 7-9-85 OFS NO. DEPT. NO.

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY, COMPARATIVE STUDY

The quantity of concrete in Type C drop structure for 150' wide crest = 1183 cyd

The quantity of concrete in the Baffle block structure for 150' wide crest = 778 cyd.

Due to high walls in the drop structure the quantity of concrete is 40% more than that in the baffle block chute channel.

The saving in conc = 1183 - 778 = 405 cyd
Extra riprap which is necessary d/s of baffle chute = 1132 cyd.

cost of conc. @ 300 = $121500 plus
" " Riprap @ 30 = 33,960 minus

For drop structure spillway located in the vicinity of STA 112+00 the embankment will be higher than that for baffle block chute at STA 97+50 due to head losses in the entrance channel. This will further increase the cost of drop structure proposal.

Further studies are done for baffle block chute and earth channel spillway.

For 150' and 100' baffled chute
extra fill in embankment = 324795 - 299776 = 5019 cyd
@ $1.2 = $6023
Saving in conc. = $50 \times 59.5 \times \frac{11}{12}$ = 2727 cft = 101 cyd
@ $300 = $30300

∴ 100' crest baffle block chute is more economical.

EBASCO SERVICES INCORPORATED

BY S Goyal DATE 7-3-85 SHEET 2 OF 2

CHKD. BY Y.C. Yang DATE 7-9-85 OFS NO. USDA 3767.100 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY APACHE JUNCTION FLOOD CONTROL

SUBJECT EMERGENCY SPILLWAY - COMPARATIVE STUDY

Earth spillway with riprap protection 300' crest

Top of embankment El 1807.69

Riprap = 25557 cyd @ 30 = $766710

Baffled block chute spillway 100' crest

Top of embankment El 1809.35

Concrete 627 cyd @ 300 = $188,100
(incl. Reinf element)

Riprap 5725 cyd @ 30 = $171,750

Extra fill in embankment
(324795 - 278038)
= 46757 cyd @ 1.2 = $56,108

415,958

$ 415,958

∴ Baffle block chute spillway 100' long crest is more economical than the earth channel spillway with riprap protection.

EBASCO SERVICES INCORPORATED
NEW YORK

BY C. Zee DATE 6/4/85 SHEET 1 OF 29
CHKD. BY S.G.Yal DATE 6/5/85 OFS NO. 3767.100 DEPT. NO. 550
CLIENT USDA — SCS PHOENIX
PROJECT Bulldog Floodway
SUBJECT Bulldog Wash Peak Discharge for Inlet Junction & Flood Channel

		Apachie Junction outlet	Discharge for Flood Channel Design
Inlet 4A	→ 397 cfs	120 cfs 517	517 cfs
4B	→ 525	517 cfs 1042	1040
4C	→ 155	1040 cfs 1195	1181
4D	→ 71	1181 cfs 1252	1183
4E	→ 327	1183 cfs 1510	1480
4F	→ 56	1480 cfs 1536	1486
4G	→ 611	1486 cfs 2097	2087
4H	→ 37	2087 cfs 2124	2088
5A	→ 2348	2088 cfs 4436	4293
5B	→ 157	4293 cfs 4450	4408
5C	→ 36	4408 cfs 4444	4405
6A	→ 345	4405 cfs 4750	4709
6B	→ 126	4709 cfs 4835	4713
6C	→ 753	4713 cfs 5466	

Note: Apache Junction Outlet flow is taken as 120 cfs instead of 99 cfs. Since the Outlet pipe diameter has been reduced to 30 in., the pipe outflow is 81 cfs. instead of 120 cfs. Reduction in the base flow by 39 cfs will reduce the height of channel walls in the final design.

FORM 581 REV 7-71

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NEW YORK

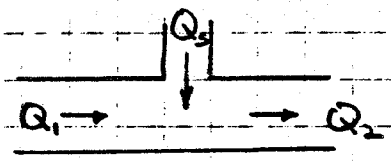
BY C. Zee DATE 6/5/85 SHEET 2 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Criteria for Weir / Side Channel Inlet



Criteria for Perpendicular Side Inlet

$Q_2/Q_1 = 1.40$ based on Fig. 9 in a report entitled "Addition of Sideflow from a broad crested weir to Flow in an open channel at Supercritical Velocity"

Junction	Q_3 cfs	Q_1 cfs	Q_2 cfs	Q_2/Q_1	Inlet Type	Remarks
4A	397	120	517	4.3	Side Channel	
4B	525	517	1042	2.0	Side Channel	
4C	155	1040	1195	1.149	Weir	Side Channel Inlets
4D	71	1181	1252	1.060	Weir	
4E	327	1183	1510	1.3	Weir	
4F	56	1480	1536	1.0	Weir	
4G	611	1486	2097	1.4	Weir	Weir Inlets
4H	37	2087	2124	1.0	Weir	
5A	2348	2088	4436	2.1	Side Channel	
5B	157	4293	4450	1.0	Weir	
5C	36	4408	4444	1.0	Weir	
6A	345	4405	4750	1.078	Weir	
6B	126	4709	4835	1.0	Weir	Stilling Basin
6C	753	4713	5466	1.2	Weir	Earth Channel.

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BY C. Zea DATE 6/6/85 SHEET 3 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlet at Junction 4A

$Q_1 = 120$ cfs $\rightarrow$ $Q_3 = 517$ cfs

$\uparrow Q_2 = 397$ cfs

For $Q_1 = 31$ cfs and outlet of 30" Ø, see sh. 3a

$Q_1 = 120$ cfs $\quad b_1 = 2d_1 \quad$ Super-Critical flow $F \geq 1.20$

use $F = 1.25$

Since the outlet from dam is 3' Ø, chose $b_1 = 4.5'$ &

$d_1 = \frac{1}{2} \times 4.5 = 2.25'$ for best section

$A_1 = 2.25 \times 4.5 = \underline{10.125}$ ft^2 $\quad R_1 = \frac{10.125}{4.5 + 2 \times 2.25} = 1.125'$.

$V_1 = \frac{120}{10.125} = \underline{11.85}$ fps $\quad F_1 = \frac{V_1}{\sqrt{g d_1}} = \frac{11.85}{\sqrt{32.2 \times 2.25}} = 1.39 > 1.2$ o.k.

For concrete lining channel, $n = 0.015$

$$S_1 = \left(\frac{Vn}{1.486 R_1^{2/3}}\right)^2 = \left(\frac{11.85 \times 0.015}{1.486 \times (1.125)^{2/3}}\right)^2 = 0.0122 \quad \text{o.k.}$$

$Q_2 = 397$ cfs $\quad$ use $d_2 = 1.2 \times 2.25 = \underline{2.7'}$

Try $V_2 = 20$ fps $\quad F_2 = \frac{V_2}{\sqrt{g d_2}} = \frac{20}{\sqrt{32.2 \times 2.7}} = 2.14 > 1.2$ o.k.

$b_2 = \frac{397}{2.7 \times 20} = 7.35$ Say 7.5' and $d_2 = 2.65'$ $\quad R_2 = \frac{19.88}{12.8} = 1.55$

$$S_2 = \left(\frac{0.015 \times 20}{1.486 \times (1.55)^{2/3}}\right)^2 = 0.023 \quad \text{too big}$$

Try $V_2 = 18$ cfs $\quad$ use $d_2 = \underline{2.7'}$

$\underline{b_2} = \frac{397}{18 \times 2.7} = 8.16$ Say $\underline{8.0'}$ $\quad V_2 = \frac{397}{8 \times 2.7} = \underline{18.4}$ fps o.k.

$\underline{S_2} = \left(\frac{0.015 \times 18.4}{1.486 \times (1.612)^{2/3}}\right)^2 = \underline{0.018}$ o.k. $\quad R_2 = \frac{2.7 \times 8}{13.4} = \underline{1.612}$

< 0.02 of ground slope

EBASCO SERVICES INCORPORATED

BY C. Lee DATE 6/20/85 SHEET 3a OF 29

CHKD. BY S Goyal DATE 6-24-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlet at Junction 4A

$Q_1 = 31$ cfs

Since the outlet from dam is 30", chose $b_1 = 3.5'$

$d_1 = 2.18'$ $S_1 = 0.012$ $A_1 = 7.63\ ft^2$ $V_1 = 10.62$ fps

$R_1 = \frac{7.63}{7.86} = 0.97$ $S_1 = \left(\frac{10.62 \times 0.015}{1.486 \times 0.97^{2/3}}\right)^2 = 0.01197$ say 0.012 ok.

$F_1 = \frac{10.62}{\sqrt{32.2 \times 2.18}} = 1.27 > 1.25$ O.K.

All other parameters for side channel inlet design will NOT be changed.

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BY C. Zee DATE 6/6/85 SHEET 4 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlet at Junction 4A

$Q_3 = 517$ cfs

$b_3 \geq 0.8(b_1 + b_2) \geq 0.8(4.5 + 8) = 10'$ use $10'$

Try $d_3 = 3.5'$ $V_3 = \frac{517}{35} = 14.77$ fps $F_3 = \frac{14.77}{\sqrt{g d_3}} = 1.39$ > 1.2 o.k

$A_3 = 3.5 \times 10 = 35$ ft^2 $R_3 = \frac{35}{17} = 2.06$

$S_3 = \left(\frac{14.77 \times 0.015}{1.486 \times (2.06)^{2/3}}\right)^2 = 0.0085$ use 0.0085.

Curved Section

$b_2 = 8.0'$ $V_2 = 18.4$ fps $d_2 = 2.7'$

1' free board

Min. $R' = 0.037\, b_2 V_2^2 = 0.037 \times 8 \times 18.4^2 = 100.2'$ use $101'$

$l = c V_2 (b_1 + b_2 - b_3)^{1/3} = 2.5\,(4.5 + 8.0 - 10)^{1/3} \times 18.4 = 62.43$

Say $63'$

Splitter Wall $= l/2 = 31.5'$

$b_5 = \frac{b_1(b_1 + b_2 + b_3)}{2(b_1 + b_2)} = \frac{4.5(4.5 + 8 + 10)}{2(4.5 + 8)} = 4.05'$ Say $4'$

Approximate Mid-Section

$b_m = \frac{(b_1 + b_2) + b_3}{2} = 11.25$ $V_m = \frac{Q_1 + Q_2}{b_m d_m} = \frac{517}{33.75} = 15.3$ fps

$d_m = \frac{1}{2}\left[\frac{Q_1 + Q_2}{V_1 b_1 + V_2 b_2} + d_3\right] = 3.0$ $R_m = \frac{b_m d_m}{b_m + 2d_m} = 1.96'$ $P_m = 17.25'$

Unequal Width Main Channel

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

EBASCO SERVICES INCORPORATED

BY C. Zee DATE 6/7/85 SHEET 5 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 28167.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlet at Junction 4A

$$\frac{517^2}{32.2\times 35} + \frac{10\times 3.5^2}{2} - \frac{10\times 3.5h}{2} = \frac{120^2}{32.2\times 10.125} + \frac{397^2}{32.2\times 21.6} + \frac{10\times 2.25h}{2}$$

$$+ \frac{4.5\times 2.25^2}{2} + \left(\frac{10-4.5}{2}\right)\times 2.7^2 -$$

$$- \frac{17.25\times 63\times \overline{0.015}^2\times 15.3^2}{2.21\times 1.96^{1/3}}$$

$$237.17 + 61.25 - 17.5h = 44.17 + 226.61 + 11.25h + 11.39 + 20.05 - 20.70$$

$$298.42 - 17.5h = 281.52 + 11.25h \qquad \underline{h} = 0.588' \quad \text{Say } \underline{7''} = \underline{0.583'}$$

Summary for Inlet Design at 4A

$Q_1 = (120)^{81}$ cfs $\quad b_1 = (4.5)^{3.5'}$ $\quad d_1 = (2.25)^{2.18'}$ $\quad S_1 = 0.012$

$Q_2 = 397$ cfs $\quad b_2 = 8.0'$ $\quad d_2 = 2.7'$ $\quad S_2 = 0.018$

$Q_3 = 517$ cfs $\quad b_3 = 10'$ $\quad d_3 = 3.5$ $\quad S_3 = 0.0085$

$l = 63'$ $\quad b_s = 4.0'$ $\quad R' = 101'$ $\quad h = 7'' = 0.583'$

For flood channel between Inlets 4A & 4B with slope 0.014:

$Q = 517$ cfs $\quad b = 10'$ $\quad d = 2.9'$ $\quad A = 29$ ft^2 $\quad R = 1.84'$

$v = 517/29 = 17.8$ fps $\quad S = \left(\frac{17.8\times 0.015}{1.486\times 1.84^{2/3}}\right)^2 = 0.0143$ O.K.

EBASCO SERVICES INCORPORATED

BY C. Zee DATE 6/7/85 SHEET 6 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bullday Floodway

SUBJECT Side Channel Inlet at Junction 4B

$Q_1 = 517$ cfs $Q_3 = 1042$ cfs

$Q_2 = 525$ cfs

$Q_1 = 517$ cfs from computation at Junction 4A

$d_1 = 3.5'$ $b_1 = 10'$ $A_1 = 35$ ft.^{2} $S_1 = 0.0085$

$V_1 = 14.77$ fps. $F_1 = 1.39 > 1.2$

$Q_2 = 525$ cfs use $d_2 = 3'$ $\left(1.2 \geq \frac{d_1}{d_2} \geq 0.8\right)$

$b_2 = 9'$ $A_2 = 27$ $V_2 = 19.44$ fps

$F_2 = \frac{19.44}{\sqrt{g d_2}} = 1.97 > 1.2$ o.k. $R_2 = \frac{27}{15} = 1.8'$

$S_2 = \left(\frac{19.44 \times 0.015}{1.486 \times 1.8^{2/3}}\right)^2 = 0.0175$ o.k. < 0.02 ground slope

$Q_3 = 1042$ cfs

$b_3 \geq 0.8(10+9) = 15.2'$ use $b_3 = 18'$

Try $d_3 = 3.86'$ $A_3 = 69.48$ $V_3 = 15$ fps $R_3 = 2.70'$

$S_3 = \left(\frac{0.015 \times 15}{1.486 \times 2.7^{2/3}}\right)^2 = 0.0061$ $F_3 = \frac{15}{\sqrt{32.2 \times 3.86}} = 1.345$

Curved section

$b_2 = 9'$ $V_2 = 19.44$ fps $d_2 = 3$

1' free board Min $R' = 0.037 b_2 V_2^2 = 125.84'$ Say 126'

$l = 2.66 \times 19.44 (10+9-18)^{1/3} = 51.7'$ Say 52'

Splitter Wall $= \frac{l}{2} = 26'$ long

$b_3 = \frac{9(10+9+18)}{2(10+9)} = 8.76'$ Say 8.75'

EBASCO SERVICES INCORPORATED

BY [illegible] DATE 6/7/85 SHEET 7 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlet at Junction 4B

Approximate Mid-Section

$$b_m = \frac{(b_1+b_2)+b_3}{2} = 18.5' \qquad d_m = \frac{1}{2}\left[\frac{Q_1+Q_2}{V_1b_1+V_2b_2}+d_3\right] = 3.5'$$

$$V_m = \frac{1042}{3.5\times 18.5} = 16.1 \text{ fps} \qquad R_m = \frac{64.75}{25.5} = 2.54' \qquad P_m = 25.5'$$

Unequal Width Main Channel

$$\frac{Q_3^2}{gA_3} + \frac{b_3d_3^2}{2} - \frac{b_3d_3h}{2} = \frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} + \frac{b_3d_1h}{2} + \frac{b_1d_1^2}{2} + \left(\frac{b_3-b_1}{2}\right)d_2^2 - \frac{P_m\,l\,n^2V_m^2}{2.21\,R_m^{1/3}}$$

$$\frac{1042^2}{32.2\times 69.48} + \frac{18\times 3.86^2}{2} - \frac{18\times 3.86h}{2} = \frac{517^2}{32.2\times 35} + \frac{525^2}{32.2\times 27} + \frac{18\times 3.5h}{2} + \frac{10\times 3.5^2}{2} + \left(\frac{18-10}{2}\right)\times 3^2 - \frac{25.5\times 52\times 0.015^2\times 16.1^2}{2.21\times 2.54^{1/3}}$$

$$485.31 + 134.10 - 34.74h = 237.2 + 317.03 + 31.5h + 61.25 + 36 - 25.65$$

$$619.41 - 34.74h = 625.83 + 31.5h \qquad \underline{h} = 0.096' \text{ Say } 0'1''$$

Summary of Inlet Design at 4B

$Q_1 = 517$ cfs $\quad b_1 = 10' \quad d_1 = 3.5' \quad S_1 = 0.0085$

$Q_2 = 525$ cfs $\quad b_2 = 9' \quad d_2 = 3.0' \quad S_2 = 0.0175$

$Q_3 = 1024$ cfs $\quad b_3 = 18' \quad d_3 = 3.86' \quad S_3 = 0.0061$

$l = 52' \quad b_s = 8.75' \quad R' = 126' \quad h = 0'1'' \ (0.0833)$

EBASCO SERVICES INCORPORATED

BY C. Zee DATE 6/10/85 SHEET 8 OF 29

CHKD. BY S. Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bullfrog Floodway

SUBJECT Weir Inlet at Junction 4C

$Q_1 = 1040$ cfs $\quad Q_2 = 1195$ cfs $\quad Q_2/Q_1 = 1.149$

$Q_s = 155$ cfs

$Q_1 = 1040$ cfs, from computation at Junction 4B

$d_1 = 3.86'$ $\quad b_1 = 18'$ $\quad S_1 = 0.0061$ $\quad F_1 = 1.345$

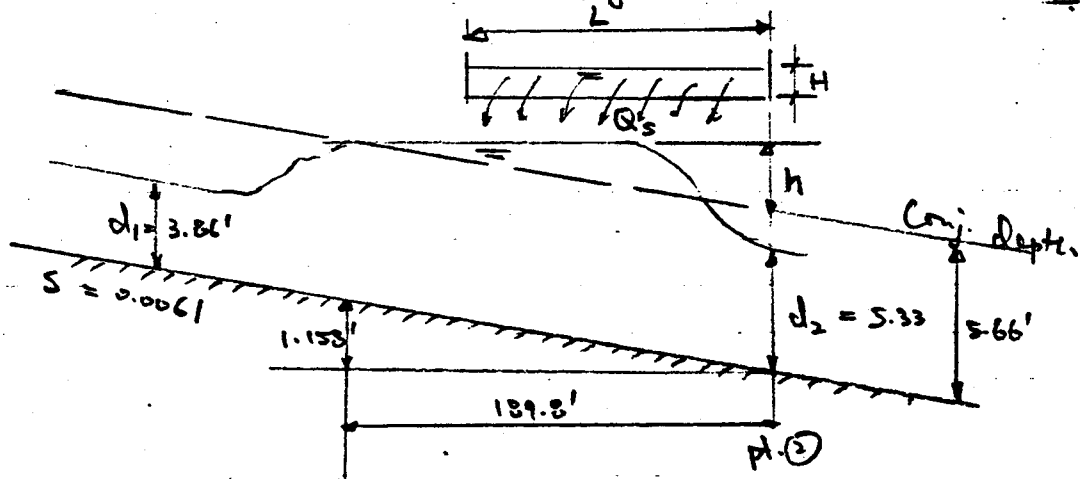
From fig. 9. $Q_2/Q_1 = 1.149$. $F_1 = 1.345$, $h/d_1 = 0.3$

$F_2 = 0.95$ (Just below inlet) $\quad h = 0.3 \times 3.86$

$= \frac{V_2}{\sqrt{g d_2}} = \frac{1195}{18 d_2 \sqrt{g d_2}}$, $d_2 = 5.33'$ $\quad = 1.158'$

$\div 0.0061 = 189.8'$

$= l$



Conjugate depth for $d_1 = d_1 \times \frac{1}{2}(\sqrt{1+8F_1^2} - 1)$

$= 3.86 \times \frac{1}{2} \times 2.933 = 5.66'$

Water Surface Elev. in the region of Hyd. Jump. at pt. 2 $= 5.66 + 1.158 = 6.82'$

$Q_s = 155$ cfs $= 3.1 \times L \times H^{3/2}$ $\quad LH^{3/2} = 50$

L	20'	15'	use L = 15' H = 2.23'
H	1.84	2.23'	

BARNARD ENGINEERS INCORPORATED

BY C. Zee DATE 6/7/85 SHEET 9 OF 29

CHKD. BY S.G. Yal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 4D

$Q_1 = 1181$ cfs → $Q_2 = 1252$ cfs

↑ $Q_3 = 71$ cfs

$Q_2/Q_1 = 1252/1181 = 1.060$

For floodway between Inlets 4C & 4D.

$Q_1 = 1181$ cfs $b_1 = 22'$ $d_1 = 3.76'$ $V_1 = 14.25$ fps

$F_1 = \frac{V_1}{\sqrt{g d_1}} = \frac{14.25}{\sqrt{32.2 \times 3.76}} = 1.295$ $R_1 = \frac{82.72}{29.52} = 2.80'$

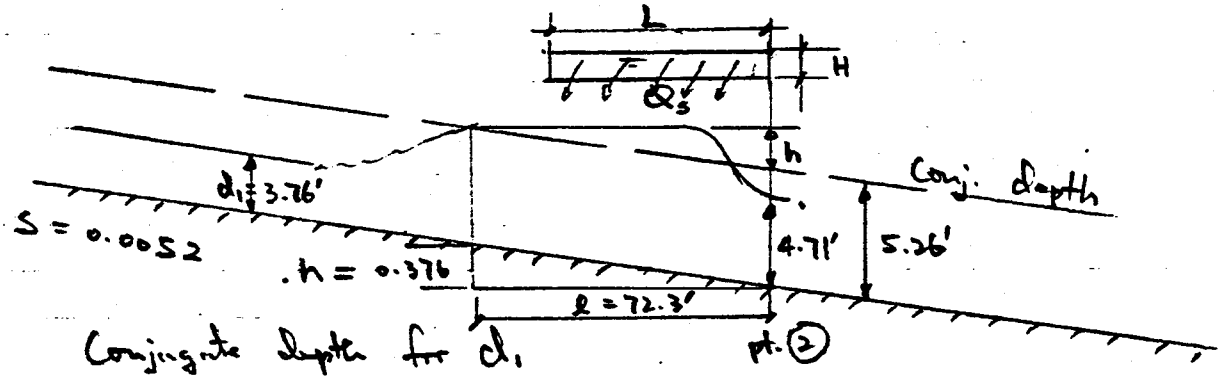
$S_1 = \left(\frac{V_1 n}{1.486 R_1^{2/3}}\right)^2 = \left(\frac{14.25 \times 0.015}{1.486 \times 2.80^{2/3}}\right)^2 = 0.0052$

From Fig. 9, $Q_2/Q_1 = 1.060$ $F_1 = 1.295$ $h/d_1 = 0.10$

$h = 0.376$

$F_2 = 0.98$ (Just below Inlet) $\div 0.0052 = 72.3'$

$= \frac{V_2}{\sqrt{g d_2}} = \frac{1252}{22 d_2 \sqrt{g d_2}}$ $d_2 = 4.714$ $= l$



Conjugate depth for d_1

$= d_1 \times \frac{1}{2}\left(\sqrt{1 + 8F_1^2} - 1\right) = 3.76 \times \frac{1}{2} \times 2.79 = 5.26'$

Water Surface Elev. at pt. 2 $= 5.26 + 0.376 = 5.64$

$Q_3 = 71$ cfs $= 3.1 \times L \times H^{3/2}$ $LH^{3/2} = 22.9$

L	10'	8'	Say L = 8' H = 2'
H	1.74'	2.04	

SERVICES INCORPORATED

BY C. Zee DATE 6/10/85 SHEET 10 OF 29

CHKD. BY S G. yol DATE 6-26-85 OFS NO. 3767.160 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 4E

$Q_1 = 1183$ cfs $\quad Q_2 = 1510$ cfs $\quad Q_3/Q_1 = 1.276$

$Q_3 = 327$ cfs

For floodway between Inlets 4D & 4E. (See Inlet 4D)

$Q_1 = 1183$ cfs $\quad b_1 = 22'$ $\quad d_1 = 3.76'$ $\quad V_1 = 14.25$ fps

$F_1 = 1.295$ $\quad R_1 = 2.80'$ $\quad S_1 = 0.0052$

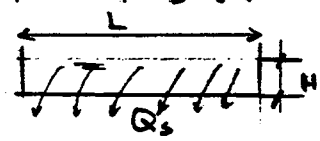
From Fig. 9. $Q_3/Q_1 = 1.276$ $\quad F_1 = 1.295$ $\quad h/d_1 = 0.65$

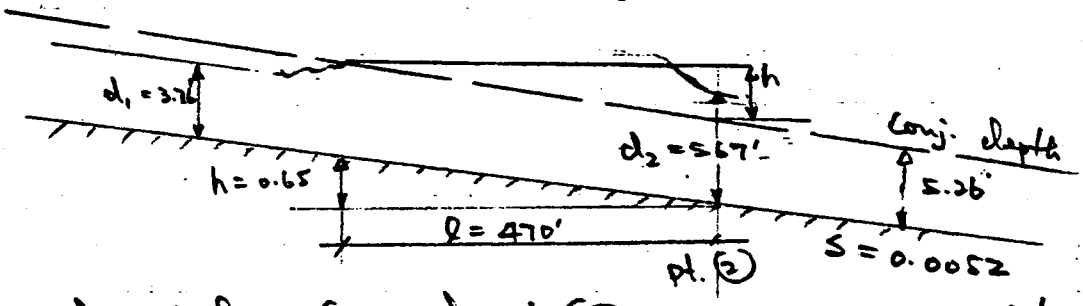
$h = 2.444 \div 0.0052 = 470'$

$F_2 = 0.895$ (Just below inlet)

$= \dfrac{1510}{22 d_2 \sqrt{g d_2}}$ $\quad d_2 = 5.67'$

Conjugate depth for $d_1 = d_1 \times \frac{1}{2}\left(\sqrt{1+8F_1^2} - 1\right) = 5.26'$





Water Surface Elev. at pt. 2 $= 5.26 + 0.65 = 5.91'$

$Q_3 = 327$ cfs $= 3.1 \times L \times H^{3/2}$ $\quad LH^{3/2} = 105.48$

L	50	40	30	35	Say $L = 35'$ $H = 2.1'$
H	1.6'	1.9'	2.3'	2.08'	

EBASCO SERVICES INCORPORATED

BY C. Zee DATE 6/10/85 SHEET 11 OF 27

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 4F

$Q_1 = 1480^{cfs}$ $Q_2 = 1536^{cfs}$ $Q_2/Q_1 = 1.038$

$Q_s = 56^{cfs}$

For floodway between Inlets 4E & 4F.

$Q_1 = 1480^{cfs}$ $b_1 = 28'$ $V_1 = 14.27$ fps $d_1 = 3.70'$

$F_1 = \frac{14.27}{\sqrt{32.2 \times 3.70}} = 1.307$ $R_1 = \frac{28 \times 3.7}{35.4} = 2.93$

$S_1 = \left(\frac{14.27 \times 0.015}{1.486 \times 2.93^{2/3}}\right)^2 = 0.00495$

From Fig. 9 : $Q_2/Q_1 = 1.038$ $F_1 = 1.307$ $h/d_1 = 0.025$

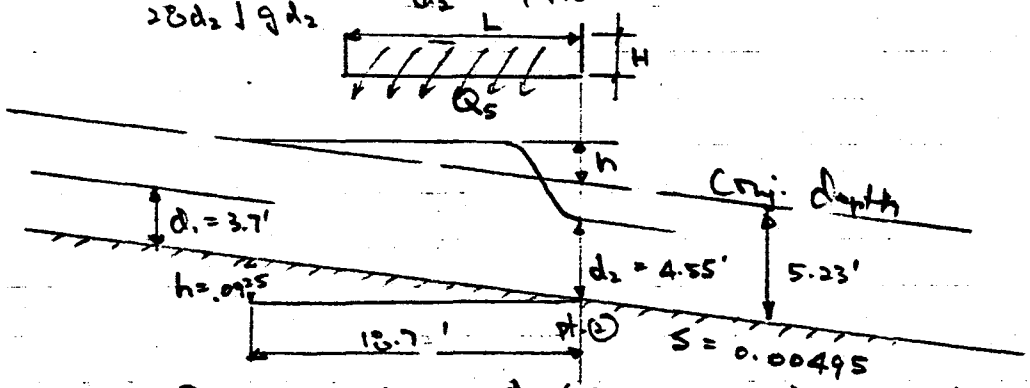
$h = 0.0925'$

$\div 0.00495 = 18.7'$

$= \ell$

$F_2 = 0.995$ (Just below Inlet)

$= \frac{1536}{28 d_2 \sqrt{g d_2}}$ $d_2^{3/2} = 9.716$ $d_2 = 4.55'$



Conjugate Depth for $d_1 = \frac{d_1}{2}\left(\sqrt{1+8F_1^2} - 1\right) = 5.23'$

Water level elev. at pt. ② $= 5.23 + 0.093 = 5.32'$

$Q_s = 51$ cfs $= 3.1 \times L \times H^{3/2}$ $16.45 = L H^{3/2}$

L	5'	6'	Say L = 6' H = 1.96'
H	2.2'	1.96	

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BY C. Zee DATE 6/10/85 SHEET 12 OF 29

CHKD. BY S. Gayo DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 4G

$Q_1 = 1436$ cfs $\quad Q_2 = 2097$ cfs

$Q_3 = 611$ cfs

$Q_2/Q_1 = 1.411$

For floodway between Inlets 4F & 4G (see Inlet 4F)

$Q_1 = 1436$ cfs $\quad b_1 = 23'$ $\quad V_1 = 14.27$ fps $\quad d_1 = 3.70'$

$F_1 = 1.307$ $\quad R_1 = 2.93$ $\quad S_1 = 0.00495$

From Fig. 9, $Q_2/Q_1 = 1.411$ $\quad F_1 = 1.307$ $\quad h/d_1 = 0.86$

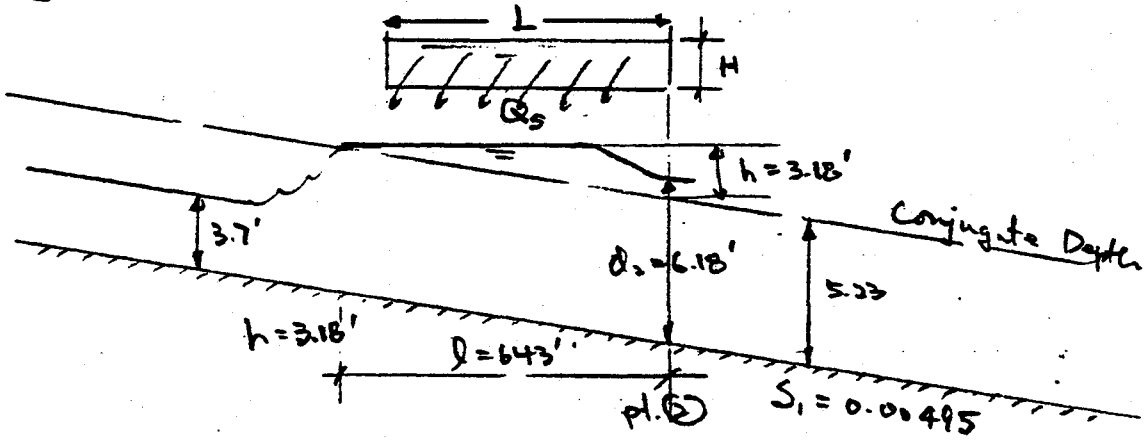
$h = 3.18$

$\div 0.00495 = 643'$

$F_2 = 0.86$ (Just below inlet)

$= \dfrac{2097}{28 d_2 \sqrt{g d_2}}$ $\quad d_2^{3/2} = 15.35$ $\quad d_2 = 6.18'$

Conjugate depth for $d_1 = 5.23'$



Water level Elev. at Pt. 2 = 6.18 + 3.18 = 9.36'

$Q_3 = 611$ cfs $= 3.1 \times L \times H^{3/2}$ $\quad 197.1 = L H^{3/2}$

L	40'	50'	60'	Say L = 60' $\quad$ H = 2.2'
H	2.89'	2.5'	2.2	

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BY C. Zee DATE 6/10/85 SHEET 13 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 4H

$Q_1 = 2087$ cfs $Q_2 = 2124$ cfs

$Q_3 = 37$ cfs

For floodway between Inlets 4G & 4H

$Q_1 = 2087$ cfs $b_1 = 35'$ $d_1 = 3.9'$ $V_1 = 15.29$ fps

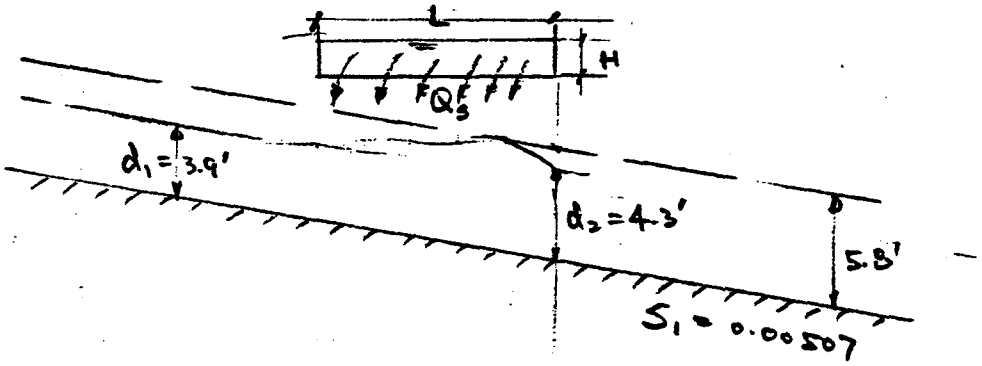
$\mathbb{F}_1 = \frac{15.29}{\sqrt{32.2 \times 3.9}} = 1.36$ $R_1 = \frac{136.5}{42.8} = 3.19'$

$S_1 = \left(\frac{15.29 \times 0.015}{1.486 \times 3.19^{2/3}}\right)^2 = 0.00507$

From Fig. 9, $Q_2/Q_1 = 1.018$ $\mathbb{F}_1 = 1.36$ $h/d_1 = 0$

$\mathbb{F}_2 = 1.2 = \frac{2124}{35\, d_2 \sqrt{g d_2}}$, $d_2 = 4.30'$ $h = 0$

Conjugate depth for $d_1 = \frac{1}{2} \times 3.9 \times \left(\sqrt{1 + 8 \times \overline{1.36}^2} - 1\right) = 5.8'$



$Q_3 = 37$ cfs $= 3.1 \times L \times H^{3/2}$ $LH^{3/2} = 11.94$

L 5' o.k.

H 1.8'

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BY C. Zee DATE 6/10/85 SHEET 14 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 558

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlet at Junction 5A

$Q_1 = 2088$ cfs $Q_3 = 4436$ cfs

$Q_2 = 2348$ cfs

From computation of Inlet at Junction 4H

$Q_1 = 2087$ cfs $b_1 = 35'$ $d_1 = 3.9'$ $V_1 = 15.29$ fps

$F_1 = 1.36$ $R_1 = 3.19'$ $S_1 = 0.00507$

$Q_2 = 2348$ cfs use $b_2 = 27.5'$ $\left(1.2 \geq \frac{d_1}{d_2} \geq 0.8\right)$

Try $V_2 = 20$ fps $d_2 = 4.3'$

$A_2 = 118.25$ ft^2 $R_2 = 118.25/36.1 = 3.28'$ $F_2 = \frac{20}{\sqrt{g \times 4.3}} = 1.69$ o.k

$S_2 = \left(\frac{20 \times 0.015}{1.486 \times 3.28^{2/3}}\right)^2 = 0.00836$ o.k.

$Q_3 = 4436$ cfs

$b_3 \geq 0.8(35 + 27.5) = 50'$ use $b_3 = 50'$ $d_3 = 4.9'$

$A_3 = 245$ ft^2 $R_3 = \frac{245}{59.8} = 4.1'$ $V_3 = 18.1$ fps

$S_3 = \left(\frac{18.1 \times 0.015}{1.486 \times 4.1^{2/3}}\right)^2 = 0.0051$

Curved Section

$b_2 = 27.5'$ $V_2 = 20$ fps $d_2 = 4.3'$

1' free board Min $R' = 0.037\, b_2 V_2^2 = 407'$ say 410'

$\ell = 3.42 \times 20 \times (35 + 27.5 - 50)^{1/3} = 158.7'$ say 160'

Splitter Wall $= \ell/2 = 80'$

$b_s = \frac{27.5\,(35 + 27.5 + 50)}{2\,(35 + 27.5)} = \frac{27.5 \times 112.5}{125} = 24.75'$ o.k.

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BY C. Zea DATE 6/11/85 SHEET 15 OF 24

CHKD. BY S. Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlet at Junction 5A

Approximate Mid-section

$$b_m = \frac{(b_1+b_2)+b_3}{2} = \frac{112.5}{2} = 56.25'$$

$$d_m = \frac{1}{2}\left[\frac{Q_1+Q_2}{b_1V_1+b_2V_2} + d_3\right] = \frac{1}{2}\left[\frac{2088+2348}{35\times15.29+27.5\times20} + 4.9\right] = 4.51'$$

$$V_m = \frac{4436}{253.69} = 17.49 \text{ fps} \qquad R_m = \frac{253.69}{65.27} = 3.89' \qquad P_m = 65.27'$$

Unequal Width Main Channel

$$\frac{Q_3^2}{gA_3} + \frac{b_3d_3^2}{2} - \frac{b_3d_3h}{2} = \frac{Q_1^2}{gA_1} + \frac{Q_2^2}{gA_2} + \frac{b_3d_1h}{2} + \frac{b_1d_1^2}{2} + \left(\frac{b_2-b_1}{2}\right)d_2^2 - \frac{P_m l n^2 V_m^2}{2.21 R_m^{1/3}}$$

$$\frac{\overline{4436}^2}{245g} + \frac{50\times\overline{4.9}^2}{2} - \frac{50\times4.9h}{2} = \frac{\overline{2087}^2}{136.5g} + \frac{\overline{2348}^2}{118.25g} + \frac{50\times3.9h}{2} + \frac{35\times\overline{3.9}^2}{2} + \left(\frac{50-35}{2}\right)\times\overline{4.3}^2 - \frac{65.27\times160\times\overline{0.015}^2\times\overline{17.5}^2}{2.21\times3.89^{1/3}}$$

$$2494.4 + 600.3 - 122.5h = 991.0 + 1447.9 + 97.5h + 266.2 + 138.7 - 207.0$$

$$457.9 = 220h \qquad h = 2.08' \qquad \text{Say } h = 2'1''$$

Summary of Inlet Design at 5A

$Q_1 = 2088$ cfs $\quad b_1 = 35' \quad d_1 = 3.9' \quad S_1 = 0.00507$

$Q_2 = 2348$ cfs $\quad b_2 = 27.5' \quad d_2 = 4.3' \quad S_2 = 0.00836$

$Q_3 = 4436$ cfs $\quad b_3 = 50' \quad d_3 = 4.9' \quad S_3 = 0.0051$

$l = 160' \quad b_5 = 24.75' \quad R' = 410' \quad h = 2'1''$ (2.083')

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BY C. Zea DATE 6/11/85 SHEET 16 OF 29

CHKD. BY S Coyo/ DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 5B

$Q_1 = 4293^{cfs}$ $Q_2 = 4450^{cfs}$ $Q_3/Q_1 = 1.0366$

$Q_5 = 157^{cfs}$

For floodway between inlets 5A & 5B

$Q_1 = 4293^{cfs}$ $b_1 = 50'$ $d_1 = 4.8'$ $A_1 = 240\ ft^2$

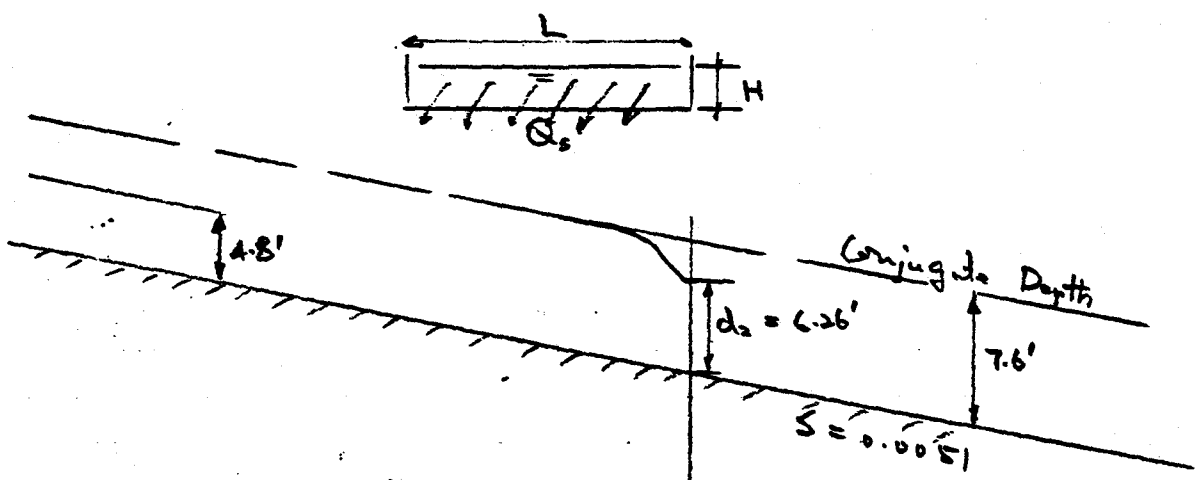
$R_1 = 4.0'$ $V_1 = 17.88$ fps $F_1 = \frac{17.88}{\sqrt{32.2 \times 4.8}} = 1.43$ ok

$S_1 = \left(\frac{17.88 \times 0.015}{1.486 \times 4.0^{2/3}}\right)^2 = 0.00571$ ok.

From Fig. 9, $Q_2/Q_1 = 1.0366$ $F_1 = 1.43$ $h/d_1 = 0$ $F_2 = 1.0$

$F_2 = \frac{4450}{50\, d_2 \sqrt{g d_2}} = 1$ $d_2 = 6.265'$ $h = 0$

Conjugate Depth for $d_1 = \frac{1}{2} \times 4.8 \times \left(\sqrt{1 + 8 \times 1.43^2} - 1\right) = 7.6'$



$Q_5 = 157 = 3.1\, L H^{3/2}$ $LH^{3/2} = 50.65$

L 15'

H 2.25 o.k.

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BY C. Zee DATE 6/11/85 SHEET 17 OF 29

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CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 5C

$Q_1 = 4408^{cfs}$ $Q_2 = 4444^{cfs}$ $Q_2/Q_1 = 1.01$

$Q_3 = 36^{cfs}$

From computation of Inlet 5A

$Q_1 = 4408$ $b_1 = 50'$ $d_1 = 4.9'$

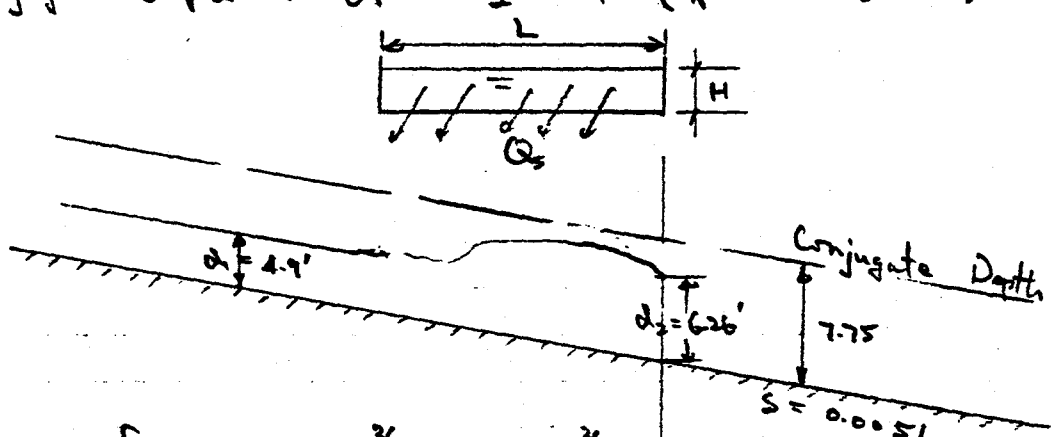
$A_1 = 245\ ft.^2$ $R_3 = 4.1'$ $V_3 = 18.0'\ fps$

$S_1 = \left(\frac{18.0 \times 0.015}{1.486 \times 4.1^{2/3}}\right)^2 = 0.0051$ $F_1 = \frac{18}{\sqrt{g \times 4.9}} = 1.43$

From Fig. 9, $Q_2/Q_1 = 1.01$ $F_1 = 1.43$ $h/d_1 = 0$ $F_2 = 1.0$

$F_2 = 1 = \frac{4444}{50\, d_2 \sqrt{g d_2}}$ $d_2 = 6.26'$ $h_o = 0$

Conjugate Depth for $d_1 = \frac{1}{2} \times 4.9 \times \left(\sqrt{1 + 8 \times \overline{1.43}^2} - 1\right) = 7.75'$



$Q_3 = 36^{cfs} = 3.1 \times LH^{3/2}$ $LH^{3/2} = 11.6$

L	4'	5'	Say L = 5' H = 1.75'
H	2'	1.75'	

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BY C. Lee DATE 6/11/85 SHEET 18 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlet at Junction 6A

$Q_1 = 4405$ cfs $Q_2 = 4750$ cfs $Q_2/Q_1 = 1.078$

$Q_s = 345$ cfs

From Computation of Inlet 5C

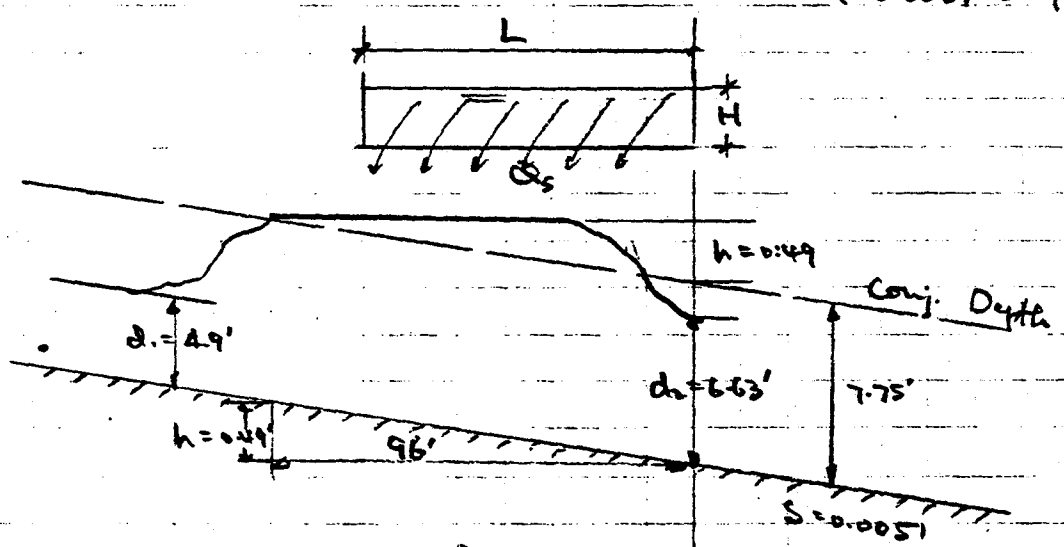
$Q_1 = 4405$ cfs $b_1 = 50'$ $d_1 = 4.9'$ Conj. Depth $= 7.75'$

$A_1 = 245$ ft^2 $R_3 = 4.1'$ $V_3 = 18.0$ $S_1 = 0.0051$ $F_1 = 1.43$

From Fig. 9, $Q_2/Q_1 = 1.078$ $F_1 = 1.43$, $h/d_1 = 0.1$ $F_2 = 0.98$

$F_2 = 0.98 = \dfrac{4750}{50\, d_2 \sqrt{g d_2}}$ $d_2 = 6.63'$ $h = 0.1 \times 4.9 = 0.49'$

$\div 0.0051 = 96'$



$Q_s = 345 = 3.1\, L H^{3/2}$ $L H^{3/2} = 111.3$

L 30' 40' use $L = 40'$ $H = 1.97$

H 2.39' 1.97

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BY C. Zo DATE 2/11/85 SHEET 19 OF 29

CHKD. BY S Goyal DATE 5-27-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA - SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlets at Junctions 6B & 6C

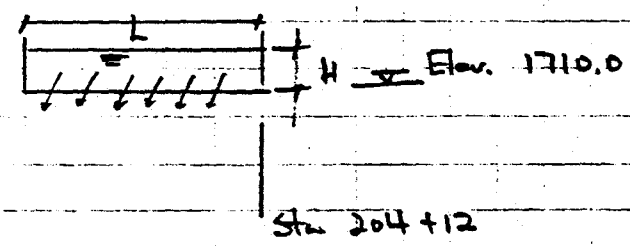
Inlet 6B $Q_1 = 4709^{cfs}$ $Q_2 = 4835^{cfs}$

$Q_3 = 126^{cfs}$

$Q_3 = 126^{cfs}$ enters the floodway at the Stilling Basin

$= 3.1 L H^{3/2}$ $40.65 = L H^{3/2}$

$L = 12'$ $H = 2.25'$



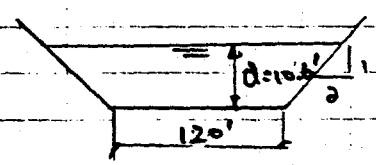
Inlet 6C $Q_1 = 4713^{cfs}$ $Q_2 = 5466^{cfs}$

$Q_3 = 753^{cfs}$

From Stilling Basin Design, p. 22

$b = 120'$ $d = 10.6$ $V = 3.65$ fps

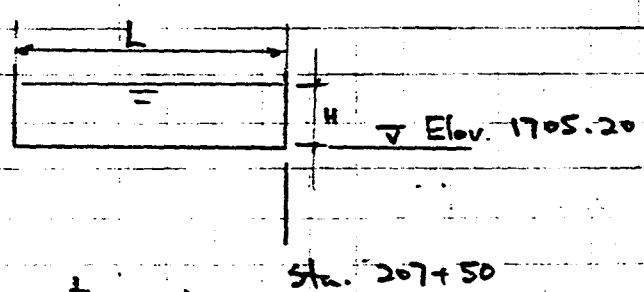
$F = \frac{3.65}{\sqrt{gd}} = 0.20$



$Q_3 = 753^{cfs} = 3.1 L H^{3/2}$ $242.9 = L H^{3/2}$

L 60'

H 2.5'



Submergence may not exist because the water may have already spread in the main channel.

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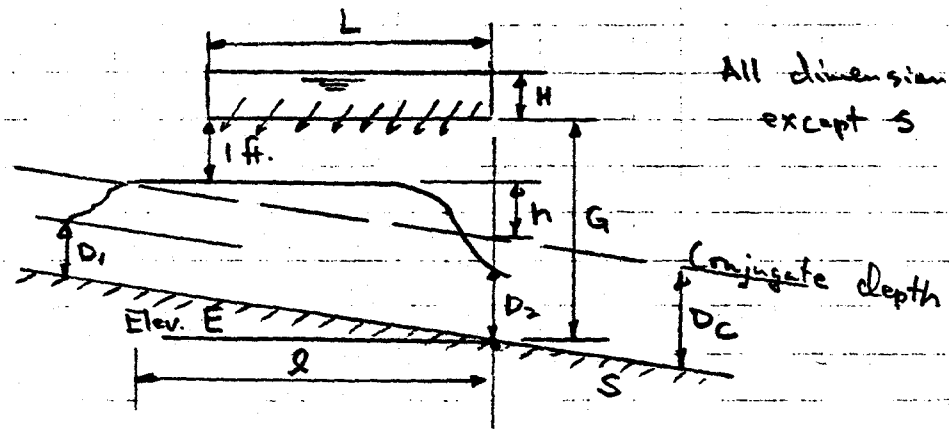
BY C. Zee DATE 6/13/85 SHEET 20 OF 29

CHKD. BY S.G.Yal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Weir Inlets Summary



All dimension in ft except S

Inlet	Elev. E	ℓ	D_1	D_2	D_c	h	G	L	H	S
4C	1745.80	190	3.9	5.3	5.7	1.2	7.9	15	2.2	0.0061
4D	1739.94	72	3.8	4.7	5.3	0.4	6.7	8	2.0	0.0052
4E	1736.41	470	3.8	5.7	5.3	2.4	8.7	35	2.1	0.0052
4F	1733.06	19	3.7	4.6	5.2	0.1	6.3	6	2.0	0.00495
4G	1729.22	643	3.7	6.2	5.2	3.2	9.4	60	2.2	0.00495
4H	1727.96	0	3.9	4.3	5.8	0	6.8	5	1.8	0.0051
5B	1718.66	0	4.8	6.3	7.6	0	8.6	15	2.3	0.0051
5C	1717.39	0	4.9	6.3	7.8	0	8.8	5	1.8	0.0051
6A	1715.12	96	4.9	6.6	7.8	0.5	9.3	40	2.0	0.0051
* 6B	1704.74	—	—	—	—	—	5.3	12	2.3	0.0908
** 6C	1695.36	—	—	—	—	—	9.8	60	2.5	0.0002

* Enter stilling basin

** Enter earth channel

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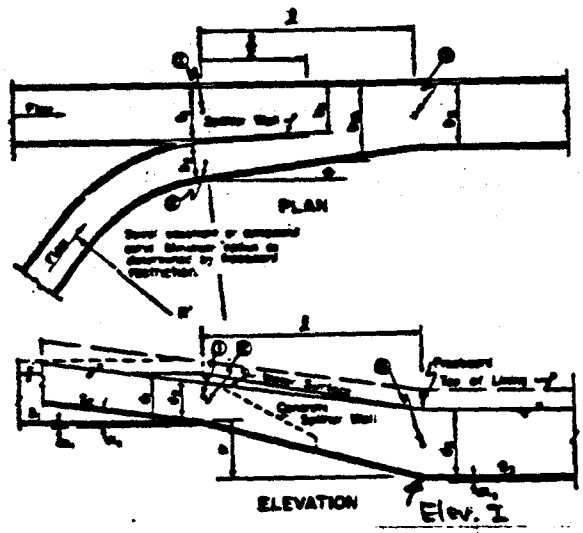
BY C. Zee DATE 6/13/85 SHEET 21 OF 29

CHKD. BY S Goyal DATE 6-26-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Side Channel Inlets Summary



All dimensions in ft except S

Inlet	b_1	b_2	b_3	d_1	d_2	d_3	S_1	S_2	S_3	l	b_5	h	Elev I	R'
4A	4.5	8.0	10.0	2.3	2.7	3.5	0.012	0.018	0.0085	63	4.0	0.6 (7")	1766.20	101
4B	10.0	9.0	18	3.5	3.0	3.9	0.0085	0.018	0.0061	52	8.75	0.08 (1")	1748.84	126
5A	35	27.5	50	3.9	4.3	4.9	0.0051	0.0084	0.0051	160	24.75	2.08 (2'1")	1722.36	410

SERVICES INCORPORATED

BY C. Lee DATE 6/13/85 SHEET 22 OF 29

CHKD. BY SG-pol DATE 6-27-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bullfrog Floodway

SUBJECT Drop Structure

At Sta. 203+50, Channel bottom Elev. = 1710.37'

$Q = 4709$ cfs $b_0 = 50'$ $d_0 = 5.1'$ $A_0 = 255$ ft^2

$V_0 = 18.47$ fps $F_0 = 1.44$ $S_0 = 0.0051$

Downstream Channel: (~~After 6C~~, however backwater effect will be taken into consideration)

$Q = 5466$ cfs $n = 0.025$ $S = 0.0002$

Try $b = 120'$ side slope

SUPERSEDED

$Qn/b^{8/3}S^{1/2} = 5466 \times 0.025 / 120^{8/3} \times 0.0002^{1/2} = 0.0273$

$d/b = 0.0883$ $d = 10.6'$ $TW = 10.6'$ $V_n = 5466/1497$

$= 3.65$ fps

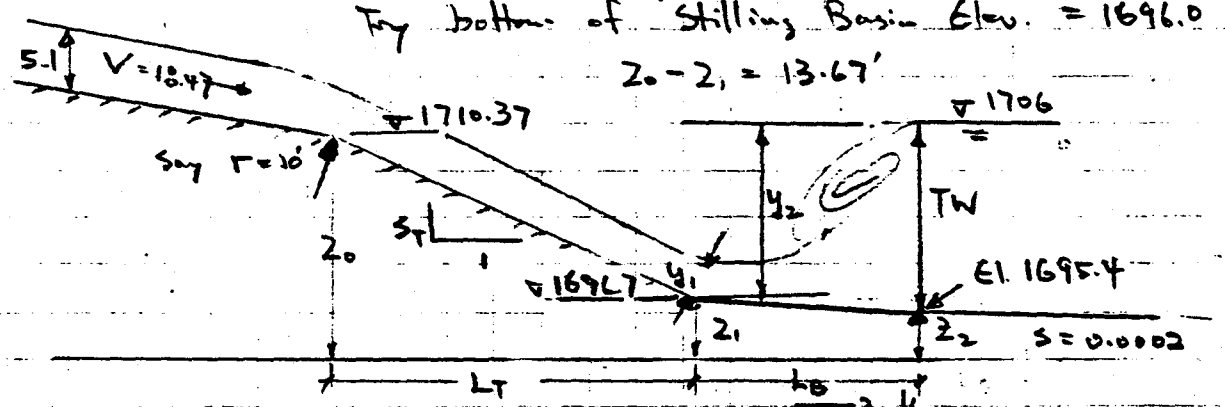
$y_2 = \frac{1}{J} \times 5.1 \times \left[\sqrt{1 + 8 \times 1.44^2} - 1\right] = 8.14'$

(See Earth Channel Design, p. 24)

Since $TW > y_2$, use sloping apron in the basin

Try bottom of Stilling Basin Elev. = 1696.0

$Z_0 - Z_1 = 13.67'$



$4709 = 120\, y_1 \left[2g\,(Z_0 - Z_1 + 5.1 - y_1) + 18.47^2\right]^{1/2}$

$= 120\, y_1 \left[64.4 \times (18.77 - y_1) + 341.1\right]^{1/2}$

$y_1 = 1.02$, $Q = 122.4 \times 38.53 = 4715 \approx 4709$ o.k.

$V_1 = 4709 / 120 \times 1.02 = 38.47$ fps $F_1 = 6.71$

$y_2 = \frac{1.02}{J}\left[\sqrt{1 + 8 \times 6.71^2} - 1\right] = 9.18'$ $y_2 + Z_1 = 1705.88$

$\approx Z_2 + TW$

$= 1706$ o.K.

581/8-81

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BY C. Zee DATE 6/14/85 SHEET 23 OF 29

CHKD. BY S Goyal DATE 6-27-85 OFS NO. 3767.100 DEPT. NO. 556

CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Drop Structure

Width of Basin = 120' Same width as downstream Channel

$$W_B = W_0 + 2\frac{Z_0 - Z_1}{3F_0 S_T}\sqrt{S_T^2+1}$$

$$120 = 50 + \frac{2 \times 13.67}{3 \times 1.44 \times S_T}\sqrt{S_T^2+1} \qquad S_T = 0.0908$$

$L_T = (Z_0 - Z_1)/S_T = 13.67/0.0908 = 150'$ SUPERSEDED

Length of Jump:

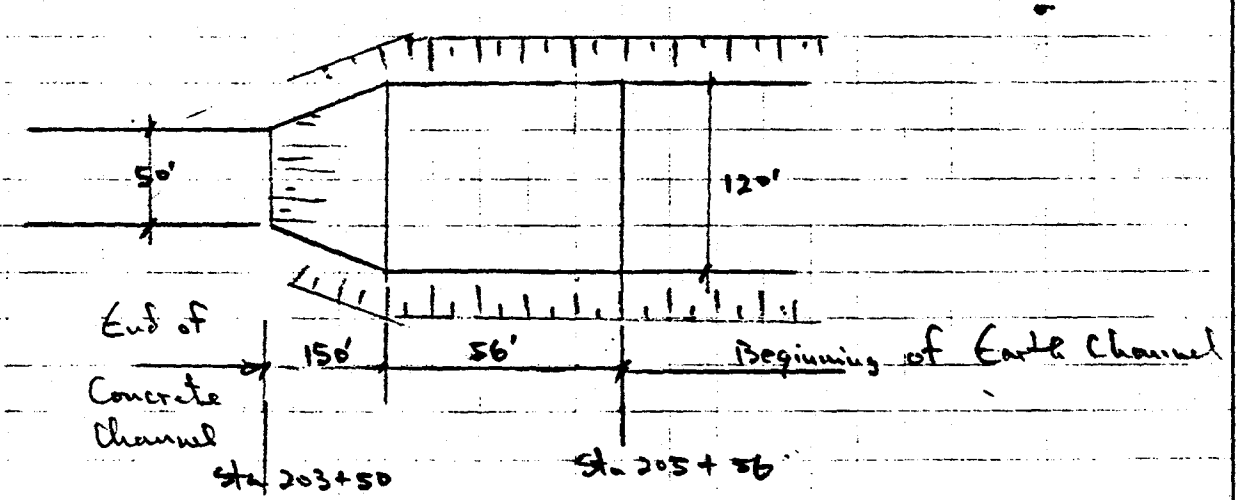
$F_1 = 6.71$ from Figs VI-15 & VI-18, HEC-14, $TW/y_1 = 10.6/10.2 = 10.4$

$\tan\alpha = 0.025$ $y_2 = 9.27$ $L_j = 56'$ SUPERSEDED

$(TW - y_2)/56 = (10.6 - 9.27)/56 = 0.025 \approx \tan\alpha$

L = total length of stilling basin

= 150 + 56 = 206' at Sta. 205+56



Stilling Basin

Downstream Channel slope use 0.0002 c.k.

Ref. Hydraulic Design of Energy Dissipators for Culvert & Channels HEC No. 14 DOT, Federal Highway Admin. 12/78

EBASCO SERVICES INCORPORATED

BY S Goyal DATE 9-11-85 SHEET 23A OF 29

CHKD. BY Y.C YANG DATE 9-17-85 OFS NO. USDA 3767-100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY DROP STRUCTURE

At sta. 203+50 channel bottom Elev. = 1710.37'

$Q = 4709$ cfs $b_o = 50'$ $d_o = 5.1'$

$A_o = 255$ ft^2

$V_o = 18.47$ fps $F_o = 1.44$ $S_o = .0051$

For downstream channel see separate calculations for earth channel. Backwater effect is taken into consideration

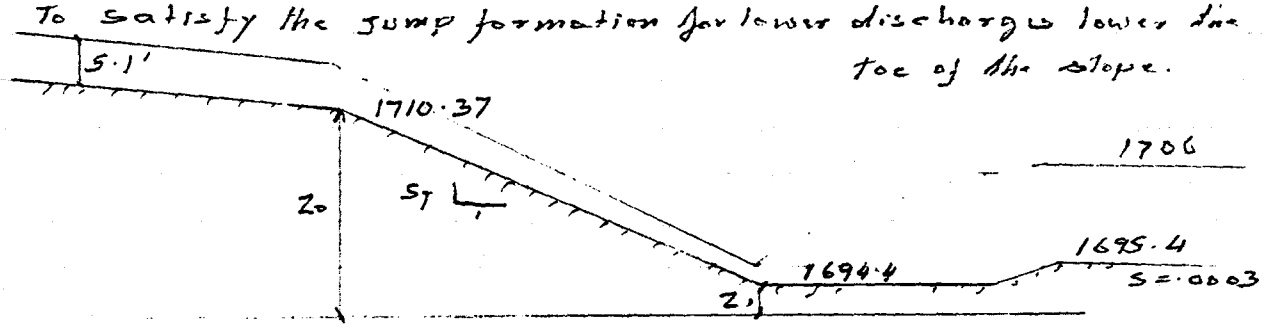
$Q = 5466$ cfs after GC

$S = .0003$

$b = 100$ ft Side slope = 3:1

From Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular No 14, US Dept. of Transportation.

To satisfy the jump formation for lower discharge lower the toe of the slope.



$$4709 = 120\, y_1 \left[2g\,(Z_o - Z_1 + 5.1 - y_1) + 18.47^2\right]^{1/2}$$

$$= 120\, y_1 \left[64.4(1710.37 - 1694.4 + 5.1 - y_1) + 341.1\right]^{1/2}$$

$y_1 = .97$ $Q = 120 \times .97 \times 40.44 = 4707.4$ o.k

$$V_1 = \frac{4709}{.97 \times 120} = 40.455$$

$F_1 = 7.24$

$$y_2 = \frac{.97}{2}\left[\sqrt{1 + 8F^2} - 1\right] = 9.46$$

$y_2 + Z_1 = 1694.4 + 9.46 = 1703.86 < 1706$ o.k.

$$W_B = W_o + 2\,\frac{Z_o - Z_1}{3F\,S_T}\sqrt{S_T^2 + 1}$$

$$\sim 120 = 50 + \frac{2 \times 15.97}{3 \times 1.44}\sqrt{1 + \frac{1}{S_T^2}} \quad \text{or} \quad S_T = .106$$

$$L_T = (Z_o - Z_1)/S_T = \frac{15.97}{.106} = 150.35' \text{ say } 150'$$

For $F_1 = 7.24$ Length of Jump $= 6.1 \times 9.46 = 57.7'$ say 55' (FIG VII-D-3) and the slope of

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BY S Goyal DATE 9-13-85 SHEET 23B OF 29

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CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY DROP STRUCTURE

Checking for lower flows

For incoming channel $b = 50'$

$Q =$	2713	1000
$S =$	.0051	.0051
$n =$	.015	.015
$d =$ (Assumed)	3.58	1.92
$A = bd = 50d$	179	96
$V = \frac{Q}{A}$	15.16	10.42
$P = b + 2d$	57.16	53.84
$R = A/P$	3.13	1.78
$V = \frac{1.486}{n} R^{2/3} S^{1/2}$	15.14	10.40
	o.k	o.k.

For exit channel $b = 100'$

$Q =$	2713	1000
$S =$	.0003	.0003
$n =$ (as built)	.024	.024
$Z =$	3H:1V	3H:1V
$d =$ (Assumed)	6.7	3.74
$A = (b + 3d)d$	804.67	416
$V = Q/A$	3.37	2.40
$P = b + 2 \times \sqrt{10}\, d$	142.37	123.65
$R = A/P$	5.65	3.36
$V = \frac{1.486}{n} R^{2/3} S^{1/2}$	3.40	2.41
	o.k	o.k

For hydraulic Jump

$$Q = 120\, y_1 \left[2g\{(Z_0 - Z_1) + y_0 - y_1\} + V_0^2 \right]^{1/2}$$

$Q =$	2713	1000
$Z_0 - Z_1 =$	15.97	15.97
$y_0 =$	3.58	1.92
$y_1 =$ (Assumed)	.594	.236
$V_0 =$	15.16	10.42
$Q =$	2715 ok	999.5 o.k

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BY S Goyal DATE 9-13-85 SHEET 23C OF 29

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CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT BULLDOG FLOODWAY DROP STRUCTURE

Q	2713	1000
y_1	.594	.236
$V_1 = \frac{Q}{120 y_1}$	38.06	35.31
$F_1 = V/\sqrt{g y_1}$	8.7	12.81
$y_2 = \frac{y_1}{2}\left[\sqrt{1+8F_1^2}-1\right]$	7.02	4.16
T.W. req. $= Z_1 + y_2$	1701.42	1698.56
T.W. Depth $D =$	6.7	3.74
T.W. Avail $= 1695.4 + D$	1702.1	1699.14
	O.K.	O.K.

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BY C. Zee DATE 6/20/85 SHEET 24 OF 29

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CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Earth Channel Design

Given channel soil material data:

$d_{75} = 4.76^{mm}$ $d_{65} = 3.36^{mm}$ $d_{50} = 2.36^{mm}$

Ref. Design of Open Channels, USDA SCS Technical Release 25, Oct. 1977

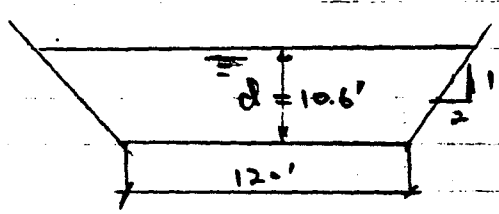
From Fig. 6-2, $d_{75} = 4.76^{mm}$. Basic Velocity = 4.1 fps for sediment laden channel, and

for a trapezoidal section of side slope 2 (H) on 1 (V) and depth of water = 10.6', correction factors B = 0.7 and D = 1.26, therefore

Allowable Velocity in the Earth Channel

$= 4.1 \times 1.26 \times 0.7 = 3.62$ fps $\simeq 3.65$ fps for

Q = 5466 cfs, S = 0.0002



SUPERSEDED

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BY C. Zee DATE 6/12/85 SHEET 25 OF 29

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CLIENT USDA — SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Bulldog Floodway alignment

Location	Station No.	Distance	Elev.	Channel slope	Section (b x d)
Dam Outlet	101 + 50		1783.00'		
		1350'		0.012	35' x 2.2'
Upstream (4A)	115 + 00.00		1766.80'	Inlet Structure	
		63'			
Downstream (4A)	115 + 63.00		1766.20		
		600.00'		0.00B5	10' x 3.5'
Slope Breaking pts	121 + 63.00	691.11'	1761.10	0.0140	10' x 2.9'
	128 + 54.11		1751.42		
		69.88'		0.0085	10' x 3.5
Curve PC	129 + 23.99	96.16'	1750.83	0.0085	10' x 3.5'
PT	130 + 20.15		1750.01		
		129.85		0.0085	10' x 3.5'
Upstream (4B)	131 + 50.00	52'	1748.92	Inlet Structure	
Downstream (4B)	132 + 02.00		1748.84		
		498.0'		0.0061	18' x 3.9'
Downstream (4C)	137 + 00		1745.80		
		300.0'		0.0061	18' x 3.9'
Slope Breaking Pt.	140+00		1743.97	Width Transition	
		775.0'		0.0052	22' x 3.76'
Downstream (4D)	147 + 75		1739.94		
		114.37'		0.0052	22' x 3.8'
Curve PC	148 + 39.37		1739.35		
		565.63'		0.0052	22' x 3.8'
Downstream (4E)	154 + 55.00		1736.41	Width Transition	
		145.00'		0.0052	28' x 3.7'
Slope Breaking Pt.	156+00		1735.66		
		442.42'		0.00495	28' x 3.7'
Curve PT	160 + 42.42		1733.47		
		82.58'		0.00495	28' x 3.7'
Downstream (4F)	161 + 25		1733.06		
		775.0'		0.00495	28' x 3.7'
Downstream (4G)	169 + 00		1729.22		

581/8-81

EBASCO SERVICES INCORPORATED

BY C. Zee DATE 6/12/85 SHEET 26 OF 29

CHKD. BY S Goyal DATE 6-27-85 OFS NO. 3767.100 DEPT. NO. 550

CLIENT USDA – SCS PHOENIX

PROJECT Bulldog Floodway

SUBJECT Bulldog Floodway alignment

Location	Station No.	Distance	Elev.	Slope	Channel Section (b×d)
Downstream (4G)	169+00		1729.22		
		100'		0.00495	28'×3.7'
Slope breaking Pt.	170+00		1728.73	width Transition	
		150'		0.0051	35'×3.9'
Downstream (4H)	171+50		1727.96		
		690'		0.0051	35'×3.9'
Upstream (5A)	178+40		1724.44	Inlet structure	
		160'			
Downstream (5A)	180+00		1722.36		
		725'		0.0051	50'×4.8'
Downstream (5B)	187+25		1718.66		
		250'		0.0051	50'×4.9'
Downstream (5C)	189+75		1717.39		
		445'		0.0051	50'×4.9'
Downstream (6A)	194+20		1715.12		
		30.96'		0.0051	50'×5.1'
Curve PC	194+50.96	191.30'	1714.96	0.0051	50'×5.1'
PT	196+42.26		1713.98		
				0.0051	50'×5.1'
		707.74			
End of Concrete Channel	203+50		1710.37		
		56'			Stilling Basin
Downstream (6B)	204+12		1704.74		
		144'			
End of Stilling Basing	205+56		1695.4		
		194			Earth Channel
Downstream (6C)	207+50		1695.36	0.0002	120'×10.6' Trapezoid. Section Side Slope 1 on 2
		1150'			
End of Earth Channel	219+00		1695.13		

581/8-81

Ariz

Buckhorn Mesa W/S

Hem 4/23/85

Bulldog Wash - Peak Discharge Summary
USING ESTI. "NORMAL" Draining Areas for each Inlet.

Subarea or 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	653	2444	5427

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

1 - X-Section No. and Shows Accumulative Discharges along the 1000' way.

ARIZ, Buckhorn Mesc W/S
~~Hem~~ 4/24/85
Building Wash - Peak Discharge Summary
USING "MAXIMUM" Drainage Areas for Inlets 4A, 4B, 4C, 4E, 4G

Subarea or X-Section (No.)	2-year 24-Hour (CFS)	10-year 24-Hour (CFS)	100-year 24-Hour (CFS)
✓ 4A (1)	67	332	785
✓ 4B (2)	74	370	874
✓ 4C (3)	50	208	464
4D (4)	5	29	71
✓ 4E (5)	56	231	516
4F (6)	4	23	56
✓ 4G (7)	101	427	960
4H (8)	3	15	37
✓ 5A (9)	348	1242	2629
5B (10)	8	61	157
5C (11)	2	15	36
6A (12)	32	149	345
6B (13)	8	51	126
6C (14)	75	331	753

4A - Subarea No. And Discharges are for Individual Subareas and can be used for Inlet Design

(1) - X-Section No. And Shows Accumulative Discharges along the Floodway. Should Not be USED in Inlet Design

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

CHKD. BY DATE OPS NO. DEPT. NO.

CLIENT USDA - SCS

PROJECT

SUBJECT SOIL PARAMETERS FOR TRACTIVE STRESS ANALYSIS

Tractive Stress Approach

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

Need for Actual Stress Determination:

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

Need for Allowable Tractive Stress

1) D_{50}

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

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

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

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

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BY S GOYAL DATE 6-26-85 SHEET 1 OF 7
CHKD. BY OSA DATE 7-17-85 / 7/3/85 OFS NO. USDA 3767.1 DEPT. NO. 550
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT IDAHO & BROWN ROAD CULVERTS

Reservoir storage east of Idaho road is approximately

$\frac{3300}{5600} = .589$ of the total storage

STORAGE		Total	East of Idaho
EL	1793.5	0	0
	1794	18.3	17
	1796	124.2	73
	1798	259.3	176
	1800	529.8	312
	1802	771.6	466

Inflow 25 year

Total peaks from drainage basins

1	689
1A + 1B	331
1A + 1C	303
2	245
	1568

Assuming all peaks together the inflow is $\frac{1568}{1568+705} = .69$ of the total inflow

The peak inflow = 1881 x .69 = 1298 cfs

Assuming that the reservoir is level at El 1794.0

Inflow after hr 104.13

Interval	Time	cfs	Acft (x)	Share .69x	Int	Time	cfs	Acft (x)	Share .69x
2.02 hr	105.14	31	5.0	3.5	1.01	118.28	165	14	10
2.02	107.16	25	6.0	4.0	1.01	119.29	767	64	44
2.02	109.18	40	7.0	5.0	1.01	120.30	1881	157	108.5
2.02	111.20	47	8.0	5.5	1.01	121.31	434	36	25
2.02	113.22	57	9.5	6.5	1.01	122.32	177	15	10.5
2.03	115.25	75	12.5	8.5	1.01	123.33	120	10	7
1.01	117.27	115	9.5	6.5	1.01	124.34	93	8	5.5

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BY S GOYAL DATE 6-26-85 SHEET 2 OF 7

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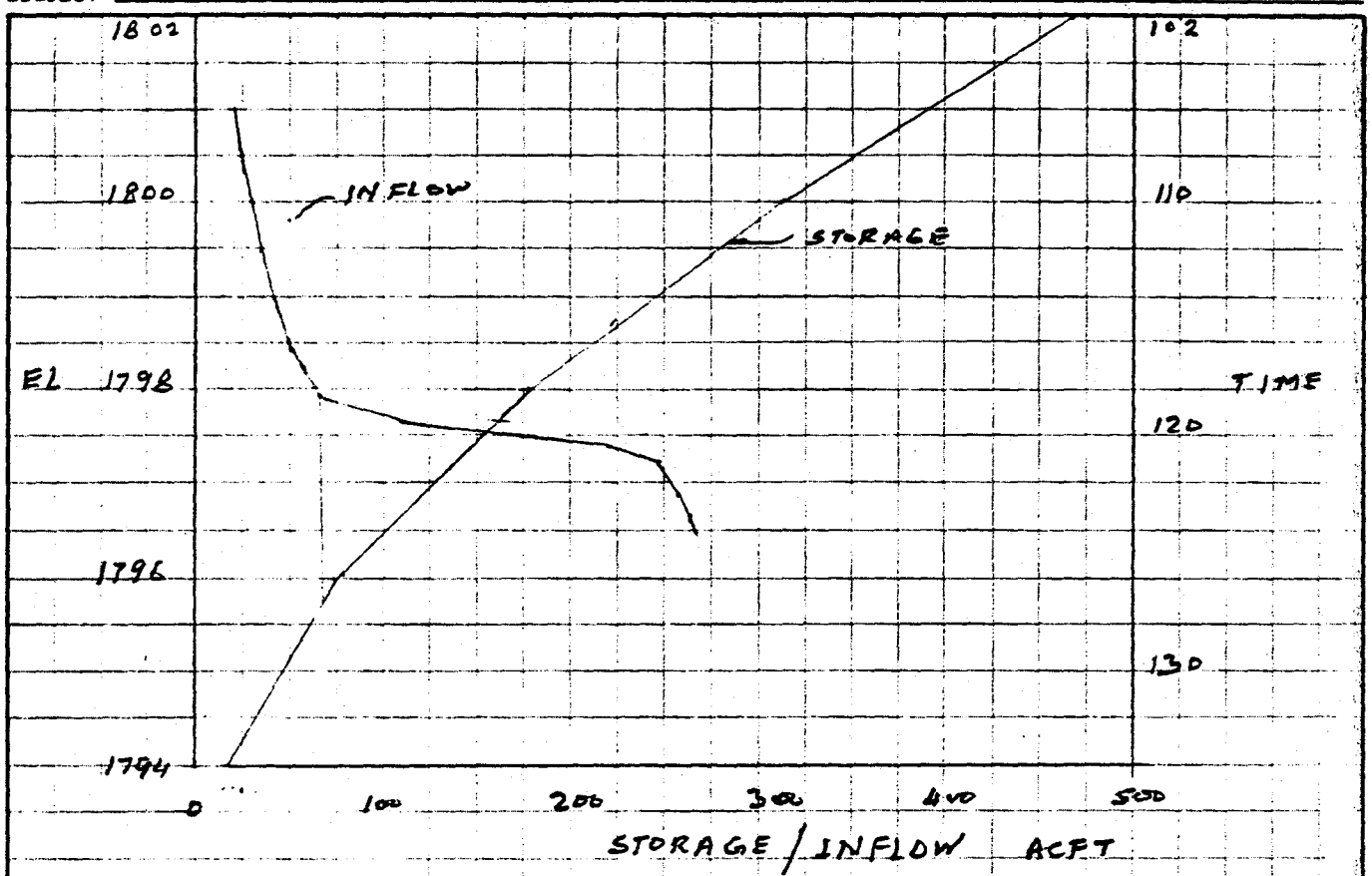
CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT IDAHO & BROWN ROAD CULVERTS



Inflow (Additional)

UP TO TIME	Acft	cummulative inflow in storage	If no flow is assumed through
106.15	3.5 +17	20.5	the culvert from time 104 to 118 hrs,
108.17	4	24.5	the storm is stored to EL 1795.8
110.19	5	29.5	with storage of 66.5 Acft
112.21	5.5	35	Assume .25' differential head
114.24	6.5	41.5	∴ Road level = 1798.1 + .25 + .5 free board
116.26	8.5	50	= 1798.85
117.27	6.5	56.5	Storage at EL 1798.1 + .25
118.28	10	66.5	Level 1798.35 is ≈ 200 Acft
119.29	44	110.5	∴ Outflow required up to 120 hrs
120.30	108.5	219	In two hours
121.31	25	244	= (219 − 200) = 19 Acft i.e. 9.5/hr
122.32	10.5	254.5	In three hours upto 121 hrs
122.33	7	261.5	= 244 − 200 = 44 i.e. 14.7/hr
124.34	5.5	267	

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BY S GOYAL DATE 6-26-85 SHEET 3 OF 7
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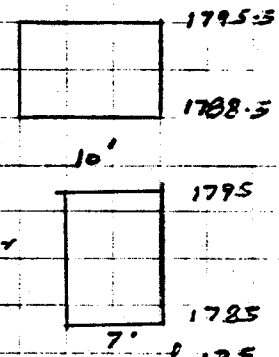
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT IDAHO & BROWN ROAD CULVERTS

Design the culvert for 15 Acft/hr (1815 cfs) say 200 cfs with top of culvert below El 1795.5 and invert at El 1788

To minimize differential across the road assume a velocity of 3 ft/sec through the culvert

$$A = \frac{200}{3} = 67 \text{ sq ft}$$

Provide a 10' x 7' high culvert



$$V = \frac{200}{10 \times 7} = 2.38$$

entrance loss $= .5 \frac{V^2}{2g} = .05$

exit loss $= \frac{V^2}{2g} = .1$

friction loss $= SL = 200 \times .0022 = .05$

$.2$ o.k. Assumed $.25$

For culvert running full $S = \left[\frac{V n}{1.486 R^{2/3}}\right]^2$

$R = \frac{10 \times 7}{34} = 2.06$

$$= \left[\frac{2.38 \times .015}{1.486 \times 2.06^{2/3}}\right]^2$$

$$= .00022$$

Provide the same culvert under the Brown Road with top of road at El $1798.85 + .25 = 1799.1'$

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BY S GOYAL DATE 6-26-85 7-1-85 SHEET 9 OF 7
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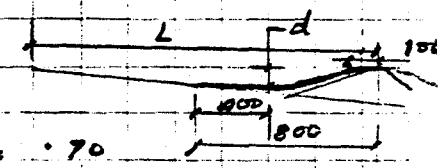
CLIENT USDA SCS PHOENIX ARIZONA
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL
SUBJECT IDAHO & BROWN ROAD PROFILES

The profiles of the two roads should be such that there is enough area of water flow across the road in case of FBH storm. Any heading up against the road will raise the top elevation of the FRS embankment

Q FBH Assuming all the peaks together

basin	1	11501
	1A + 1B	5576
	1A + 1C	5246
	2	6252
		28575



ratio of inflow $= \frac{28575}{28575 + 12112} = .70$

For the maximum stage of the reservoir inflow
$= 19161 \times .7$
$= 13413$ cfs

El. of Reservoir = 1807.69
Top of road = 1799.1
d = 8.59
Length of road = 1600' approx.

$\therefore$ Area $= \frac{1500 + 400}{2} \times 8.59 = 8160$

Normal to flow $= 8160 / \sqrt{2} = 5770$

$v = \frac{13413}{5770} = 2.33$ fps

$\frac{v^2}{2g} = .08'$ say $.1'$

Provide a rise in top of FRS embankment by
$0.1 \times 2 = .2'$
Raise the top of dam by .2 east of road intersection.

NOTE THIS TO BE CONFIRMED AFTER FINAL PROFILES OF THE ROAD ARE AVAILABLE.

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BY S GOYAL DATE 7-2-85 SHEET 5 OF 7

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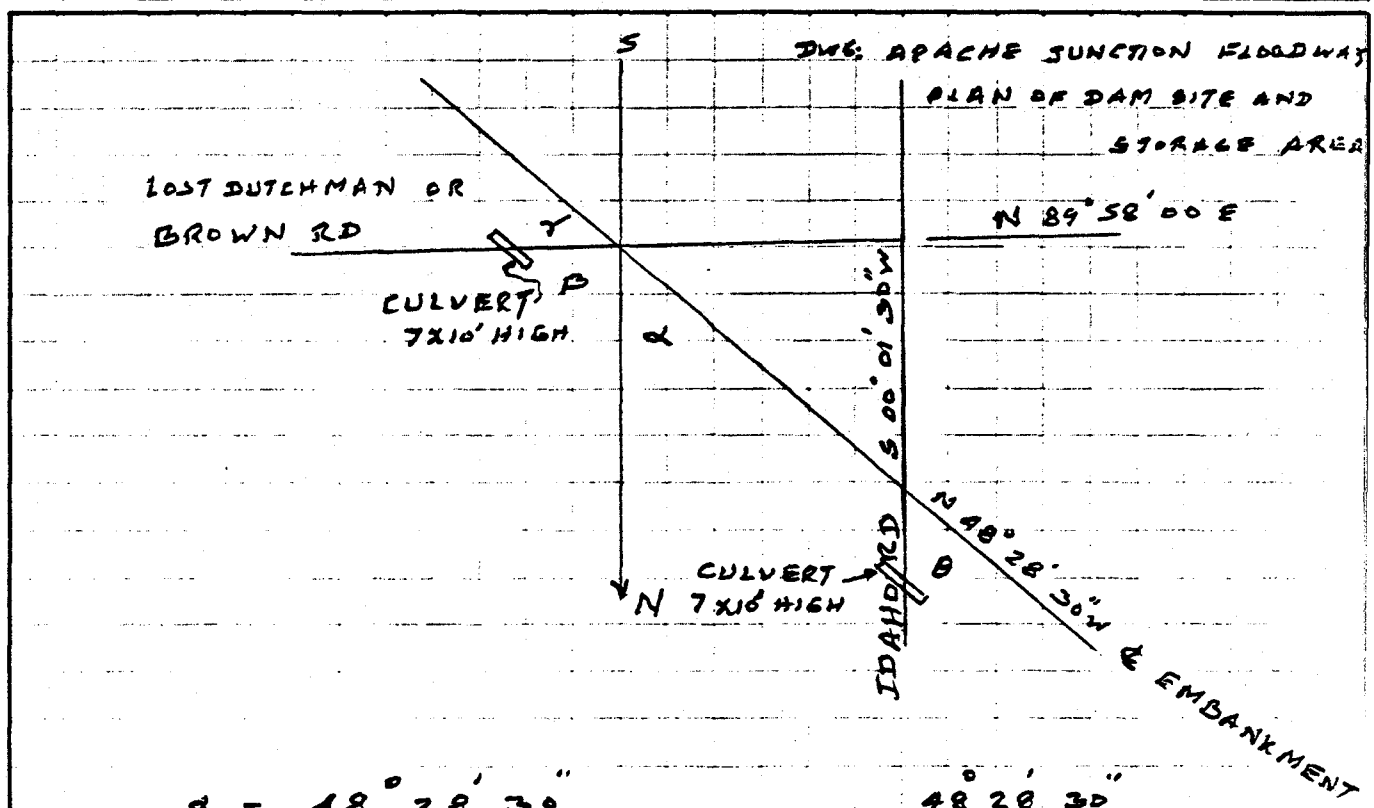
PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT CULVERT UNDER IDAHO & BROWN ROADS



$\alpha = 48^\circ\ 28'\ 30''$

$\beta = 89\ 58\ 00$

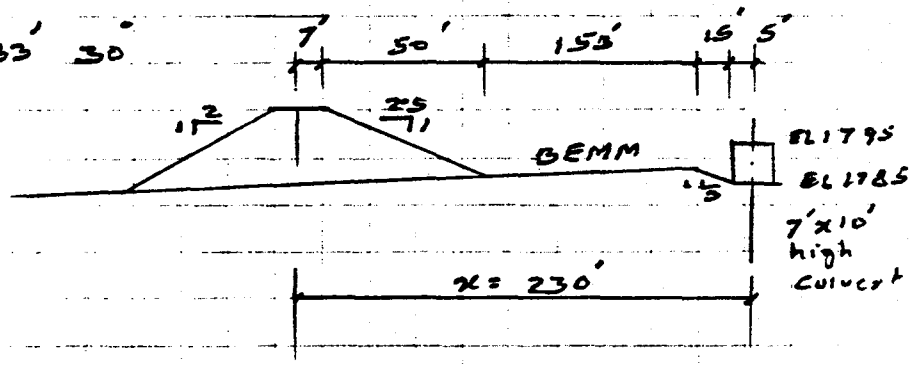
$138\ 26\ 30$

$48^\circ\ 28'\ 30''$

$0\ 01\ 30$

$\theta = 48\ 30\ 0$

$\therefore \gamma = 41^\circ\ 33'\ 30''$



Distance along the road (BROWN ROAD) $= \dfrac{230}{\sin\gamma}$

$= 346.7'$ say $350'$

Distance along the road (Idaho Road) $= \dfrac{230}{\sin\theta}$

$= 307.1$ say $310'$

$x = 232.7$ O.K.

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BY S GOYAL DATE 7-2-85 SHEET 6 OF 7

CHKD. BY Y.C. YONG DATE 7-9-85 OFS NO. USDA 2767.100 DEPT. NO. 550

CLIENT USDA SCS PHOENIX ARIZONA

PROJECT BULLDOG FLOODWAY & APACHE JUNCTION FLOOD CONTROL

SUBJECT CULVERT DATA BROWN ROAD (LOST DUTCHMAN ROAD

DISCHARGE CAPACITY = 200 CFS

DIFFERENTIAL HEAD ACROSS THE CULVERT (MAX) = 0.25 feet

Distance from ℄ Embankment to ℄ culvert along Brown Road = 350 feet

Invert Elevation = 1785 feet

Top of opening (max) = 1795 feet

Suggested concrete culvert 7 feet x 10 feet

Cross-Sectional area 70 square feet.

TABLE 2. INFLOWS TO FRS

	PSH	ESH	FBH	25-YEAR
PEAK INFLOWS, CFS/ TIME, HOURS				
Sub-basin 1	1046	3953 ~~3819~~	11501 ~~10638~~	~~608~~ 689
	120.3	2.77	2.77	120.3
Sub-basin 1A + 1B	514	1796 ~~1904~~	5576 ~~5511~~	~~289~~ 331
	120.0	~~2.56~~ 2.64	2.56	120.0
Sub-basin 1A + 1C	476	1657 ~~1770~~	5246 ~~5202~~	~~264~~ 303
	120.0	~~2.68~~ 2.66	~~2.68~~ 2.58	120.0
Sub-basin 2	395	1847 ~~2060~~	6252 ~~6316~~	~~208~~ 245
	119.6	2.38	2.38	119.6
Sub-basin 3	1077	3978 ~~3950~~	12112 ~~11276~~	~~617~~ 705
	120.1	2.62	2.62	120.1
COMBINED PEAK INFLOWS, CFS	2893	12285 ~~12388~~	37362 ~~35614~~	~~1655~~ 1881
TIME OF PEAK, HOURS	120.3	~~2.59~~ 2.68	2.59	120.3