FINAL DESIGN REPORT

R.W.C.D. FLOODWAY REACH FIVE

APACHE JUNCTION - GILBERT WATERSHED

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

March 1987

RK FLOODWAY REACH-5

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ARIZONA STATE OFFICE
Engineering Staff
Phoenix, Arizona
March 16, 1987

DESIGN REPORT

Job: RWCD Floodway, Reach-5
Project: Apache Junction-Gilbert W.P.P.
Authority: PL-566
Phase: Final Design

Summary:

The hydraulic design of the main floodway was completed by the WNTC and assembled into the Final Hydraulic Design Report dated 10-3-86. This information, along with the reports listed under the Section, Basis for Design, were reviewed and used during the final design completed in the Arizona State Design Unit. The final design is complete except for final quantities and cost estimate. These items are scheduled to be completed and inserted into this report after the design review.

This project is defined as a Class VII job in that it exceeds the 1983 delegated approval authority for "Bankfill" discharge for channels in earth. In addition, a waiver will be needed where we have deviated from the general format of the NEH-20 Specifications. These deviations are noted in the appropriate section of this report.

Several meetings were held with the sponsors (Flood Control District of Maricopa County) to get their input for future needs. Major topics discussed included fencing, landleveling, and the East Maricopa Drainage Study. Minutes to these meetings are included in the design folder. Decisions reached are noted in the appropriate sections of this report.

Description of the Job:

This is an earth floodway which entends from the treminus of RWCD Floodway Reach-4 at Ray Raod to the Outlet from Leisure World Development at Guadalupe Road. Major features include: side inlet structures, channel protection through the Guadalupe and Power Road Bridges, turnout structure and outlet from the RWCD Canal at Warner Road, and the relocation of utilities and existing irrigation structures.

Variances from the project plan included: (1) using grouted rock protection vs. loose rock riprap through the portion of the floodway from Leisure World outlet to the end of the floodway bottom width transition downstream of Power Road. This was due to the number of inlets and extent of grouting that would be necessary to convey side flows safely into this reach of the floodway; (2) the RWCD irrigation canal outlet structure at Warner Road; (3) side slope transition through Elliot Road Bridge in order to maintain a constant floodway

bottom width; (4) gradual, long radius curves throughout the floodway layout to lessen construction costs and overall landrights costs, and (5) a sill (raised invert) at the Leisure World outlet to prevent backflow to the development during pumping operations.

Design Objective:

The existing floodway is being enlarged to provide a stable floodway with 100 year flood frequency capacity.

Basis for Design:

REPORTS

1. RWCD Floodway, Reach-5, Inlet Hydrology Analysis, October 85, by H. C. Millsaps.

2. Geologic Investigation Report for RWCD Floodway, Reach-5, April 85, by Aubrey Sanders.

3. Soil Mechanics Test Results - RWCD Floodway Reach 5.

4. Final Hydraulic Design Report, October 85, by WNTC.

REFERANCES

1. AISC, 8th Edition
2. WNTC Technical Note No. W-22
3. Steel Drainage & Highway Construction Products, Third Edition
4. TR-67
5. Hydraulic Engineering Circular - 14
6. Soil Mechanics Note - 1
7. Far West States
8. TR-55
9. NEH-5
10. Hp-41 PWSP (Water surface profile developed by Bassit)
11. Technical Note Eng. No. 1 (1-16-74)
12. TR-5

General Basic Data:

Limiting conditions or restraints during construction that would influence design are: (1) trench excavation of CMP pipe to the neat lines shown will influence the strength design; (2) structure excavation around the existing syphon box structure will influence design against tipping and sliding; (3) structure excavation and removal of the manhole sections at the syphon manhole structure will influence design against tipping and structural failure at the existing pipe connections; (4) full grout penetration will influence possible piping and structural failure in the future; and (5) tolerance limits set in waste site #3 will influence future landleveling costs by the sponsors, and tolerances set for waste along the right side of the floodway will influence positive drainage.

Layout:

Layout of the floodway has been altered to include gradual, long radius curves. These curves help decrease costs in the following ways: (1) The alignment will run along the existing floodway, where practical, to decrease the amount of excavation and (2) the sponsors will be able to sell the additional land made available along the east rights of way. In addition to the cost savings, this alignment helps in allowing more area for better entrance conditions to the side inlets and less area that the sponsors will have to obtain to implement the East Maricopa Drainage Study Plan.

Hydrology:

The 100 year - 24 hour precipitation was used in conjunction with TR-55 to determine the runoff capacity of the O & M drain structures along the west side of the floodway.

No design was done for the capacity of the Farm Tailwater Drains except to provide what was existing as a minimum.

Hydraulic Design:

Side Inlet #1 - has been designed with existing and future considerations in mind. The weir and channel have been designed to pass the existing flows into the floodway while at the same time the inlet bottom width and slope have been picked to provide a mild transition and adequate flowage clearance for the future bridge and East Maricopa Drainage Study (EMDS) channel.

Side Inlets #2 to #10 - have been designed to accomodate existing or future EMDS flows. The decision was made by FCD and SCS not to try to install future EMDS starter detention basins and pipe inlets. (see minutes to Mtg.)

The inlet weir elevations have been set at the 100 year floodway water surface in order to obtain the maximum amount of head for design. The differences in elevations between existing ground at the inlet and the Q 100 watersurface in the floodway are small (0.5' to 1.5') but mean a substantial cost savings from being able to reduce the width of the weir. Gravel protection is added upstream of the weirs in a shape that would provide adequate inflow to the system at the lesser head. The layout of this protection and the use of gravel should provide better protection against head cutting from sheet flow than the loose rock and bedding that was tried unsuccessfully on previous reaches.

The Warner Road turnout structure outlet has been designed according to HEC-14 for a rectangular cross section due to lack of information on hydraulic jumps in trapezoidal sections. Extra protection was used into the floodway to allow for uncertainties. (NOTE: This is a manually operated structure and can be monitored during flow.)

Leisure World design datum was checked vs. SCS datum at "Anderson" and the floodway watersurface elevation used by Leisure World checks with the SCS work plan elevation at Guadalupe Road.

Embankment Design:

Because of past experiences with rilling of the floodway side slopes and structural failures of both pipe side inlets and grouted weir side inlets from soil piping it was the designers judgement to use a transition material (diaphram) for each of the O & M inlet drains and a grouted wall (cut-off) along the grouted side inlets.

The earthfill has been specified according to findings of the RWCD Reach 1 investigating committee report on erosion of earth lining and bank erosion dated November 1985.

Gravel cover has been used throughout the job as a transition material that enables flow to dampen while flowing from a grouted protected reach to earth. In addition, gravel cover has been used on the floodway side slopes to prevent rilling near structures.

Structural Design:

Warner Road Turnout structure - Design consisted of a U-shaped channel section and articulated wingwalls. Basic structural criteria from TR-67 was used. A partially saturated earth loading was used to design for moment and uplift of the U-shaped section. A surcharge and sloped backfill was considered for the wingwalls.

The WNTC Engineering Technical Note No. W-22 was used as a conservative guide toward designing the thicknesses of the 18 inch and 42 inch diameter corragated metal pipe (NOTE: This method does not take into account the moment of inertia for the corragations). The results were compared with the methods used in the book of Steel Drainage and Highway Construction Products and found to be valid.

The thickness for the grouted rock structures were based on the location, frequency of use, and maximum velocities as described in Far West States for unreinforced channel linings.

Engineering Technical Note No. 1, dated 1-16-74 and TR-5 were used for the strength design of the RCP. A combination of live and dead loads were used.

Construction Materials:

The following items were used to evaluate the construction materials used for this job:

1. Where applicable, only one material for specific items will be used due to limited quantities on the job.

2. Cost installed

3. Availability of material

4. Ease of Construction

5. Ease of Inspection

6. Asthetics.

Grouted Rock was selected over soil cement due to the limited quantity and high initial mobilization costs to set up a plant for soil cement.

CMP was selected due to the ease of construction.

Landrights Requirements:

Surplus excavated material between Elliot and Guadalupe Roads will be designated as waste and placed in the adjacent farm fields to the east of the floodway. As part of the sponsors agreement with the landowner these fields will be landleveled. SCS has designed the landleveled fields and will place waste material to plus or minus 0.3 feet of the plan. The sponsors will work with the landowner after construction to get his fields laser leveled.

Irrigation structures to be relocated and/or completed as part of the SCS contract are: (1) syphon at Elliot Road (2) farm tailwater structures and (3) farm road dike.

Specifications:

O & M drains and farm tailwater drains have been set up as a cost per structure under Spec. 51. The price will include all pipe inlet structures, pipe excavation and backfill, and other appurtenances. This method of payment deviates from any of those given for CMP in Spec. 51.

Specification #7, Surveys; we have deleted the last sentence in Section 1, in order to include original and final surveys for computing quantities.

Operation and Maintenance:

(See Operation and Maintenance Plan) As discussed with the sponsors, Fence has not been added to this contract because of the remote area this reach of the floodway is in. Fencing will be included in the future landscape contract.

Submitted: Donald E Paulus 3-23-87
Head, Design Unit Date

Approved: Ralph M Arnold 3-23-87
State Conservation Engineer Date

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		RWCD REACH 5		
BY Tom Joyo	DATE 3-5-87	CHECKED BY	DATE	JOB NO.
SUBJECT Temporary Construction Easement				SHEET 1 OF

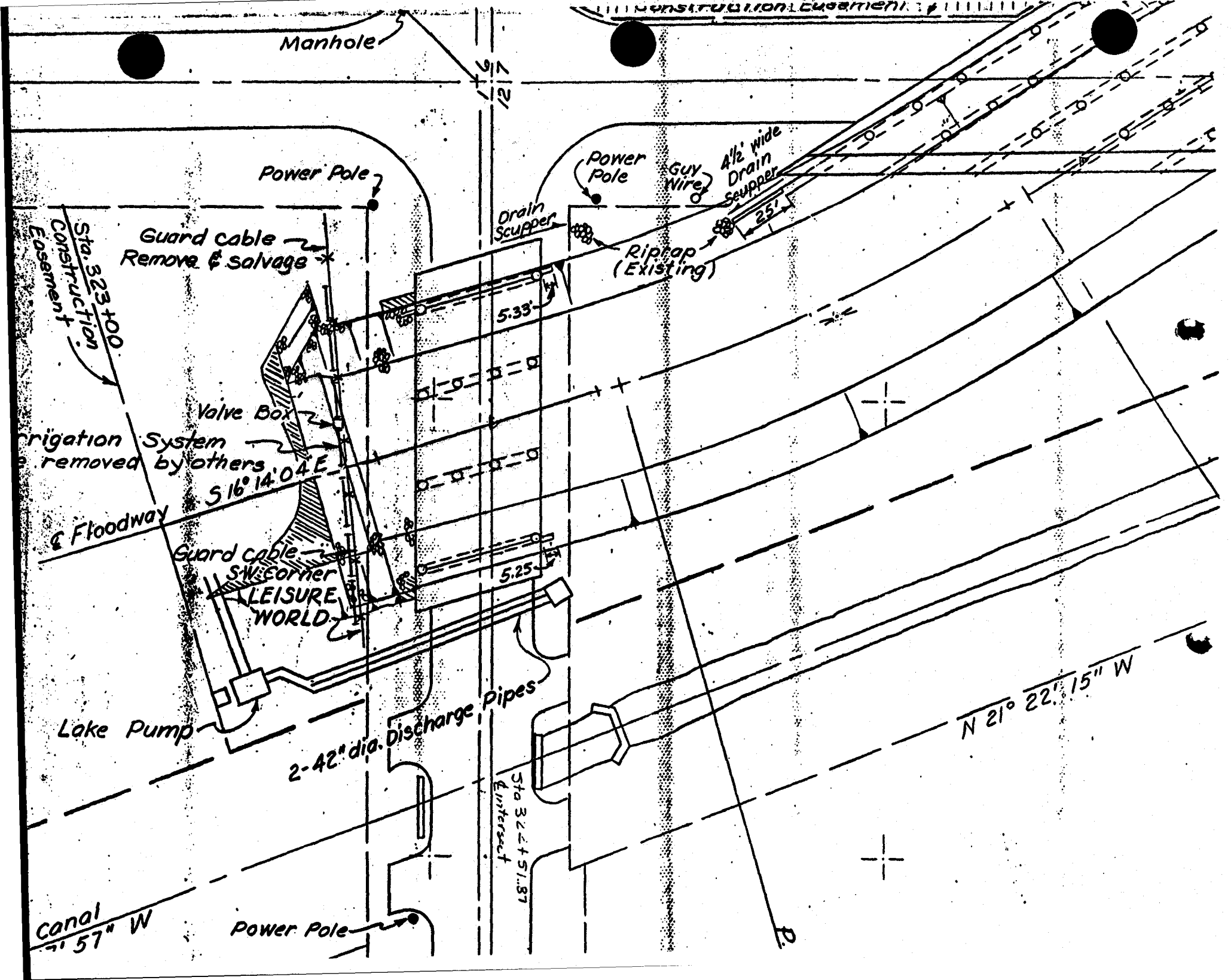
Needed From County —

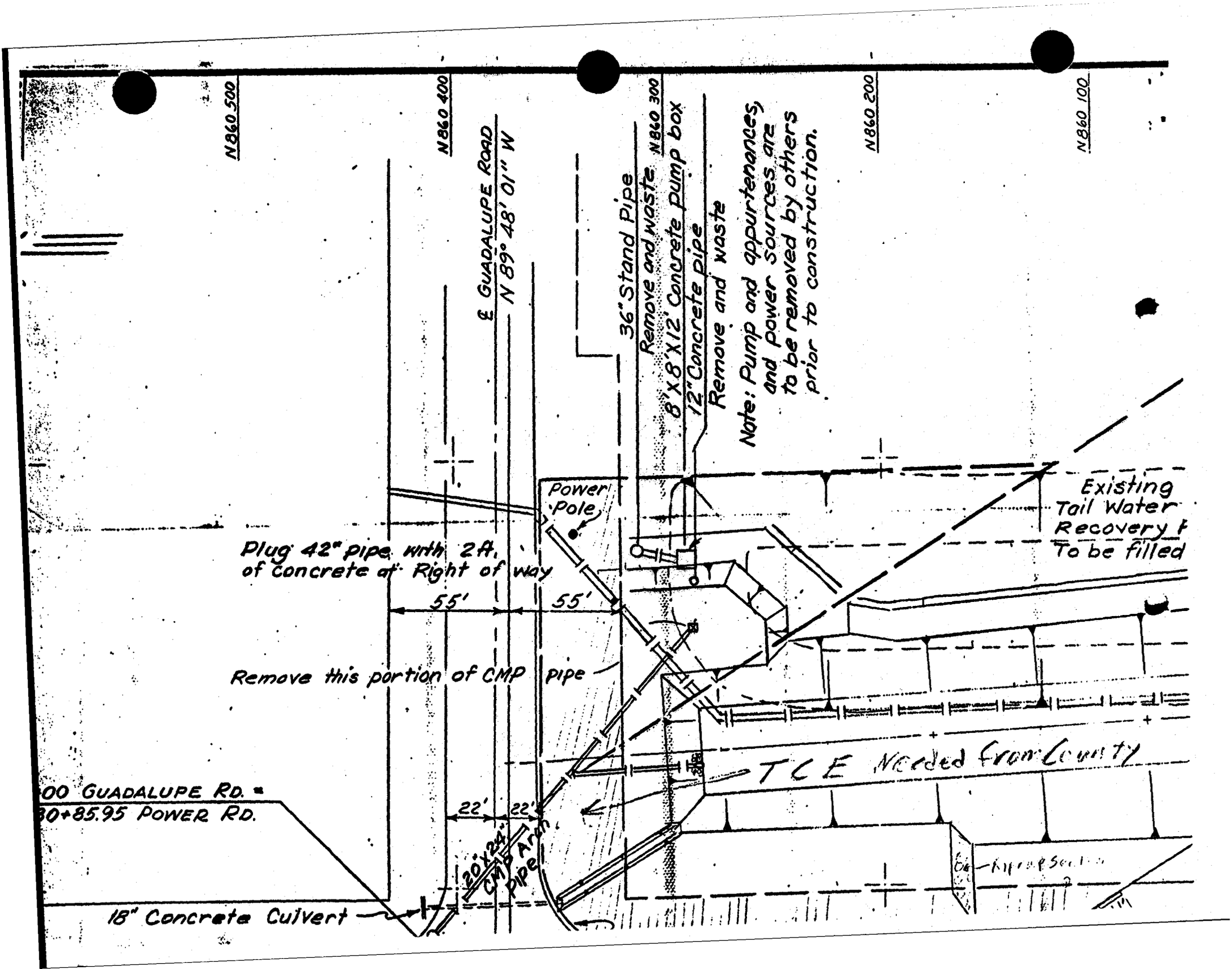
To Dick MacNamara

Cross hatched area shown in Southeast corner of Power Road and Guadalupe Road intersection is needed to remove and install 18 X 24" CMP Arch pipe and install riprap section as shown and alter existing dike in vicinity of power pole.

Tom Joyo

Mailed out 3-5-87


Construction Easement
Manhole
Power Pole
Power Pole
Guy Wire
4½' wide Drain Scupper
25'
Drain Scupper
Riprap (Existing)
Guard cable
Remove & salvage
Sta. 323+00 Construction Easement
5.33'
Valve Box
Irrigation System
removed by others
S 16° 14' 04" E
℄ Floodway
Guard cable
S.W. Corner LEISURE WORLD
5.25'
Lake Pump
2-42" dia. Discharge Pipes
Sta 324+51.87 ℄ intersect
N 21° 22' 15" W
Canal
Power Pole


N860 500
N860 400
N860 300
N860 200
N860 100
℄ GUADALUPE ROAD
N 89° 48' 01" W
36" Stand Pipe
Remove and waste
8'X8'X12' Concrete pump box
12" Concrete pipe
Remove and waste
Note: Pump and appurtenances, and power sources are to be removed by others prior to construction.
Power Pole
Existing Tail Water Recovery
To be filled
Plug 42" pipe with 2ft. of concrete at Right of way
55'
55'
Remove this portion of CMP pipe
TCE Needed from County
00 GUADALUPE RD.
30+85.95 POWER RD.
22'
22'
20'x24' CMP Arch Pipe
18" Concrete Culvert

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

Plans being sent separate cover
(not yet arrived)

FEB 26 1987

DSP

Ralph A ____
Tom J ____

Don Paulus
U. S. D. A.
Soil Conservation Service
201 E. Indianola, Suite 200
Phoenix, AZ 85012

RE: RWCD Floodway, Reach 5

Dear Don:

We are transmitting herewith a marked-up copy of the Reach 5 plans, showing our needs for temporary construction easements and fee acquisition of property in association with this project. There are 4 items, all in T1S R7E:

1. TCE with Leisure World, northwest corner of Guadalupe and Power, for a concrete cutoff wall, as marked.

2. Fee acquisition from the Morrison Brothers Ranch, off the southeast corner of Power and Guadalupe, as marked.

3. TCE for those portions of the west half of Section 7 east of the existing Floodway right-of-way, for field leveling.

4. TCE's from Southwest Properties, in Section 19, for filling and grading as marked.

We are also transmitting a marked-up copy of the plans showing the ramp and fence information you requested. As you know, it was agreed at our monthly coordination meeting, February 19, 1987, that we would not place fences until the landscaping is being placed. Therefore, the fence lines will be early input for the landscaping study.

will fill in with sed. with one row 10' wide & 0.5 deep

In addition to the marked and cited items, we anticipate possible backup at Station 477+00. Perhaps we can discuss this and whether to handle it with a structural or nonstructural solution.

If you have any questions, please give me a call. My direct line is 269-4722.

Sincerely,

Kebba Buckley

Kebba Buckley
Project Manager

Attachments: RWCD Reach 5 Plans

United States
Department of
Agriculture

Conservation
Service

201 , Indianola Ave.
Suite 200
Phoenix, AZ 85012

January 29, 1987

210
~~120~~-13-11

Dan Sagramoso, P.E.
Chief Engineer and General Manager
Flood Control District of Maricopa County
3335 W. Durango St.
Phoenix, AZ 85009

RE: RWCD, Reach-5

Dear Dan:

As requested we have enclosed the following information:

1. Temporary construction easement for Leisure World entrance. (1 sheet)

2. Rights of Way needed at the Guadalupe side inlet. (1 sheet)

3. Cost Estimate for the relocation of Morrison's tailwater pond. (3 pages of 3)

Also for your information the total acreage of Morrison's fields for possible landleveling is 149.5 acres. Actual area to be landleveled will be determined from the final design.

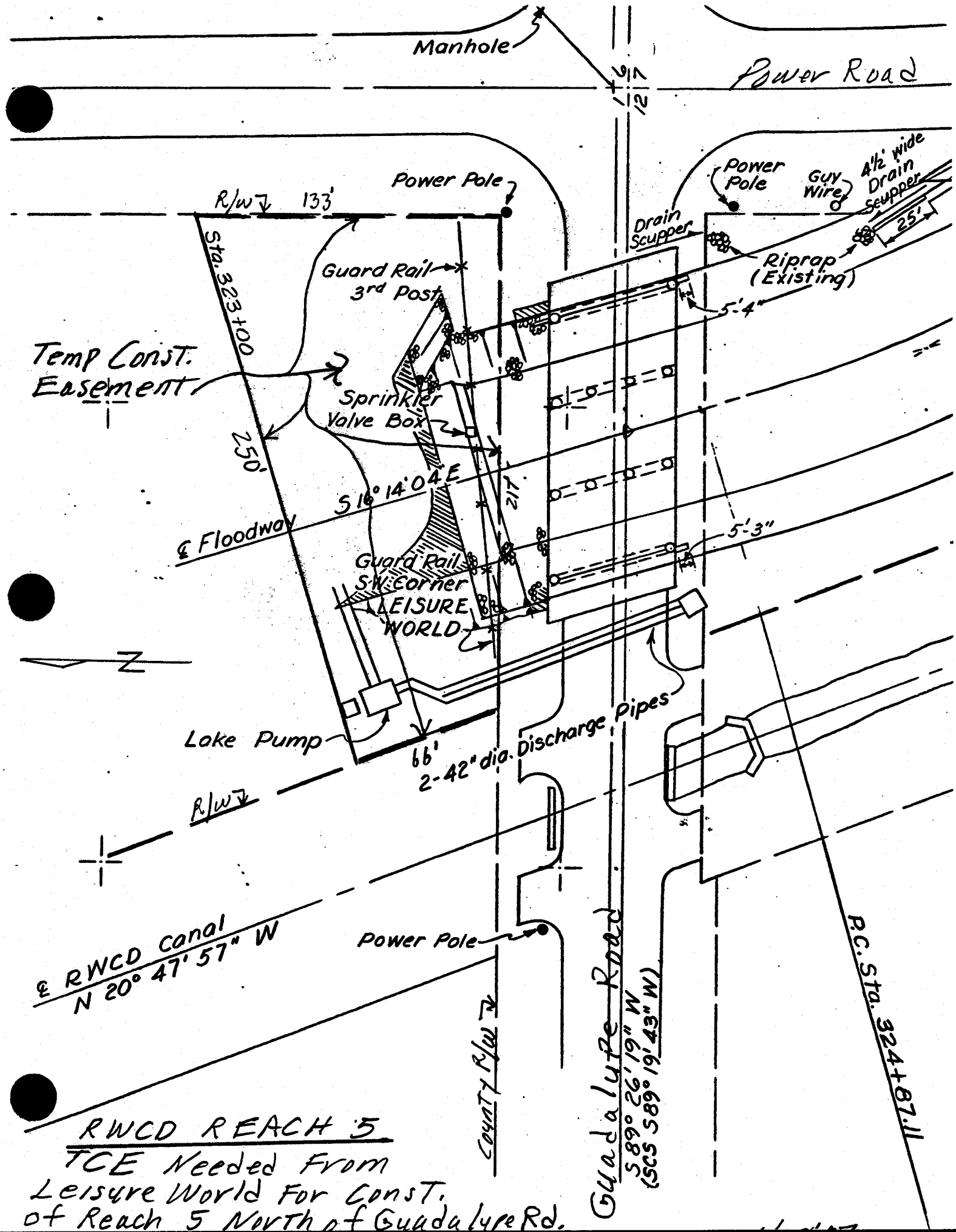
Sincerely,

Verne M. Bathurst
State Conservationist

cc: Ralph Arrington

DEP:jlg

EWA DSP

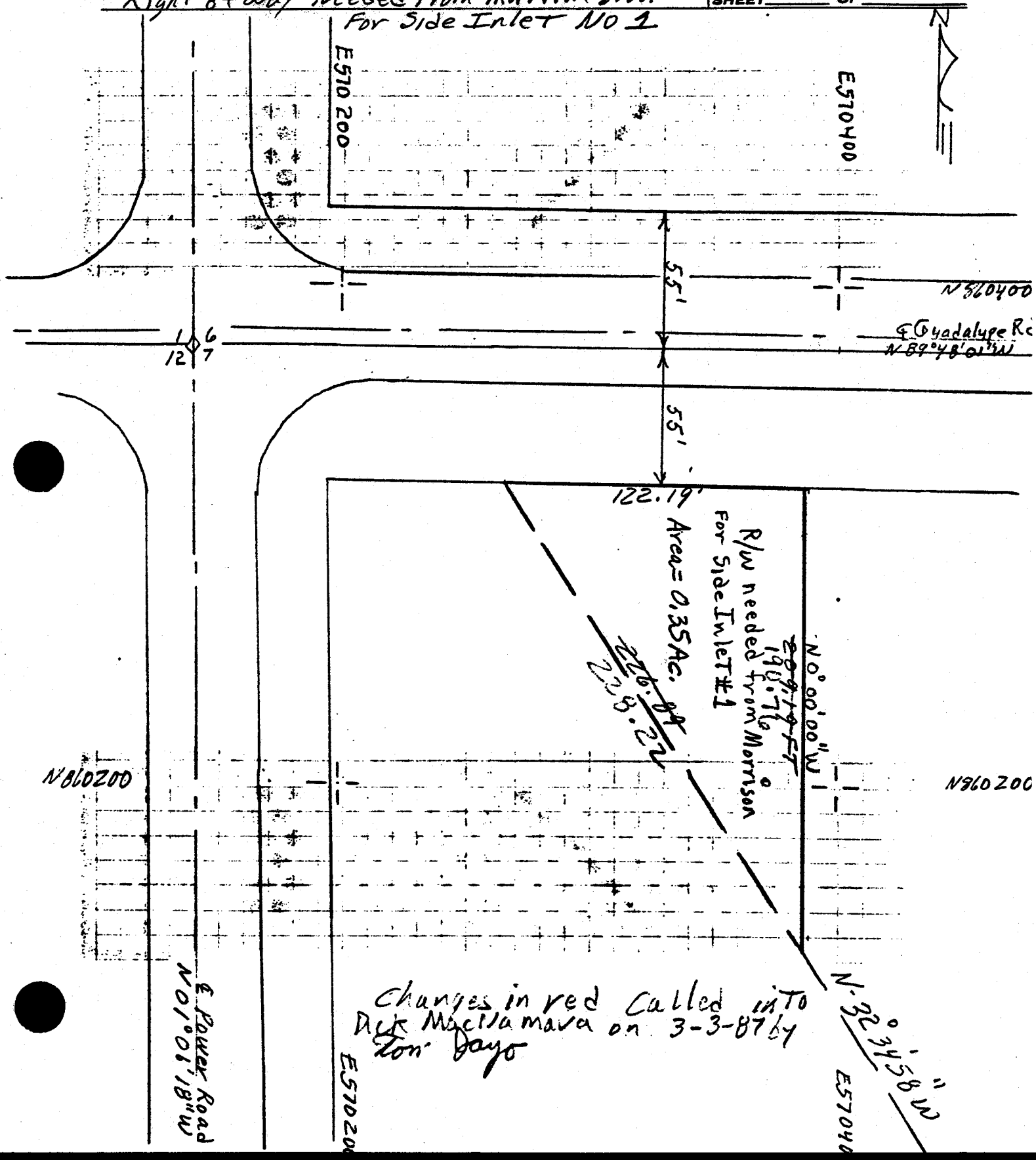


RWCD REACH 5
TCE Needed From
Leisure World For Const.
of Reach 5 North of Guadalupe Rd.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 1-28-87	CHECKED BY	DATE	JOB NO.
SUBJECT Right of Way Needed From Morrison Bros. For Side Inlet No 1				SHEET ____ OF ____



Changes in red called in to Dick MacNamara on 3-3-87 by Tom Jayo

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		RWCD REACH 5		
BY Tom Dayo	DATE 7-20-06	CHECKED BY	DATE	JOB NO.
SUBJECT Morrison Tailwater Pond Cost Estimate				SHEET 1 OF

Given- original ground for start of excavation assumed to be at field level just east of pond. Slope across top of ground assumed at 0.1 to 0.3 drop to west.

1.0 Excavated vol = 14,104 yd^3.

Cost to excavate pond if excavation was done in conjunction with SCS contract-

excavation cost estimated at $0.70 per cu yd.
earth fill cost estimated at $0.60 per cu yd

total $1.30 per cu yd.

total cost = 14,104 x 1.30 = $18,335.20

2.0 Tail water Pump Relocation

This item shall consist of the salvage and relocation of the existing tailwater pump, and 10 or 12 inch steel inlet and outlet pipe, valves and new stand pipe & pump base.

Payment will be made for this item at a lump sum price for all labor, materials, equipment, and all other services and items necessary and incidental to completion of the work. Payment will include compensation for Concrete, Class 3000, Precast Reinforced Concrete manhole Sections, welded steel pipe, Cleaning and painting metal work, irrigation appurtenances, Timber and steel reinforcement.

Estimated cost for this work is $10,000.00

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Joyo	DATE 1-20-86	CHECKED BY	DATE	JOB NO.
SUBJECT Morrison Tailwater Pond Cost Estimate				SHEET 2 OF

3. Clearing & Grubbing –

Pond 100'X370'X10 deep = 8.5 AC-FT = 14,104 yd³

Plan on 3' high berm around pond – 14' wide & 3 to 1 side slopes –

clear & grub area = $\frac{(100+50)(370+50)}{43,560}$ = 1.45 AC ±

Estimate clear & grub cost at $250.00/AC (Police bid on Reach 3 contract)

COST = 250.00 X 1.45 AC = $362.50

4. Structure Excavation

Excavation for stand pipe, pump & pipelines

estimate 400 cu yds @ $3.00/cu yd = $1200.00

5. Structure Back fill

back fill around stand pipe, pipe trenches etc.

estimate 400 cu yd @ 6.00/cu yd = $2400.00

TOTAL COST

Item No	$ Cost
1	18,335.20
2	10,000.00
3	362.50
4	1200.00
5	2400.00
	$ 32,297.70

NOTE This cost would relate to an SCS contract job. If work was done by contractors that normally work with Farmer land leveling etc. Cost would be less.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FILL to MATCH GROUND ELEVATION

SCS-ENG-529
2-80

EARTHWORK COMPUTATION SHEET Morrison

Location RWCD REACH 5 Owner TAILWATER RETENTION PIT
Watershed APACHE JUNCTION GILBERT Subwatershed _____ Site No. _____
Contractor _____ Computed by ADM Date 1-15-87
Item _____ Checked by _____ Date _____
Contract No. _____ Estimate _____ yd³ Actual _____ yd³

Station	End area (in²)	End area (ft²)	Sum of end areas (ft²)	Distance (ft)	Section products (ft³)	Volume (yd³) 54	Remarks
10+75		0					
			750.65	25.	18,766.25	347.53	stations not
11+00		750.65					Floodway stations
			1779.4	50.	88970.0	1647.59	
11+50		1028.75					
			2170.05	50.	108,502.5	2009.30	See Book 6
12+00		1141.3					
			2162.4	50.	108,120.0	2002.22	P9 16
12+50		1021.10					
			1,792.25	50.	89,612.5	1659.49	
13+00		771.15					
			1345.80	50.	67,290.0	1246.11	
13+50		574.65					
			949.95	50.	47,497.5	879.58	
14+00		375.30					
			878.91	50.	43,945.5	813.8	
14+50		503.61					
			967.31	100.	96,731.0	1,791.31	
15+50		463.70					
			846.3	50.	42,315.0	783.61	
16+00		382.60					
			597.13	50.	29,856.5	552.898	
16+50		214.53					
			307.54	50.	15,377.0	284.759	
17+00		93.01					
			93.01	50.	4,650.5	86.12	
17+50		0					

FILL TOTAL 14,104.34 yds³

Sheet _____ of _____ sheets

12/12/86

SUBJECT: RWCD Reach-5 side inlets
Meeting w/ FCD

Attendees: Don Paulus
Tom Jayo
Kebbby Buckley FCD
Nick Karen FCD
Dick McNamara FCD
Cora Fernandez FCD

Attached are notes that were followed for discussion at this mtg.

Conclusions:

1. FCD will look at obtaining a temporary construction easement to fill low areas of land outside the present east R/W to an elevation of the 100 yr water surface of the Floodway. (See design for more detail)

2. Because the Flwy Water Surface & existing grd. will be at the same elev., at the inlets in question, the available "head" of water at the Weir crest will be whatever the Sheet Flow depth is. This shallow depth will creat very long weir lengths for the design inlet Q's. Because of costs and other problems mentioned on the attached notes SCS proposed to eliminate the starter basins & Gated pipe inlets that would be incorporated into the future master drainage plan

SCS, however, would still provide the weir capacity into the floodway for the future or existing drainage whatever the worst case may be.

The FCDMC agreed with this proposal.

Donald Paulus
~~STATE~~ Design ENG.

cc. Ralph Arrington
Tom Jayo

Arizona RWCD REACH 6

Don Paulus & TJS 12-10-86

NOTES FOR MEETING WITH FCD- 1

ON NEED TO BUILD TEMPORARY POND & GATED PIPE - AT SIDE INLETS -

look at existing grd & Fill outside F/W

1. Original Plan

(a). Construct side inlets on Reach 5 to coinside with master drainage plan, such that work will not have to be removed.

(b). Construct smaller storage area behind side inlets in order to do the following:

1. To construct a gated pipe through berm.
2. Smaller storage area would tie into final storage area on two sides.

2. Problems with building smaller storage pond and installing gated pipe with Reach 5 contract.

(a). Temporary protection of collection pool area banks costly to SCS (ie. 2 inlets vs. 1 at each location)

(b) Gate, stand, diaphram and pipe (size? not known) will all limit future design alternatives.

(c) Sediment Problem - design for storage would change smaller pond would fill in rapidly

Maintenance Problem

Arizona RWCD REACH 6

Don Paulus & TJS 12-10-86

NOTES FOR MEETING WITH FCD (Cond)

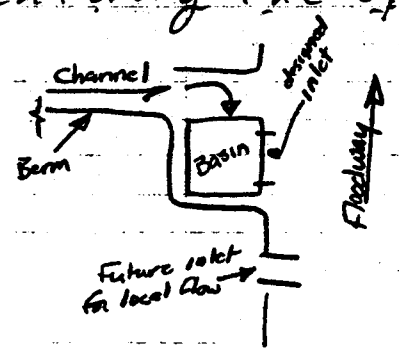
3. We are proposing the following

(a) For Master Drainage Plan

1. Channel would need to be above existing ground in order to contain the side inlet flow at proposed ele

2. Basins would have to be enclosed on 3 sides and another side inlet provided for local drainage thats not entering the system.

ie.



Because of the WS Elev. in the floodway is the same as exist. grd. basin & channel will need to be bermed for future Channel flows to get into the Floodway.

(b) For Present Reach 5 Design

1. We would provide a weir length for the higher flow - Millsaps or Master drainage plan

2. Side inlets would be designed for soil cement. or Grout 1' thick

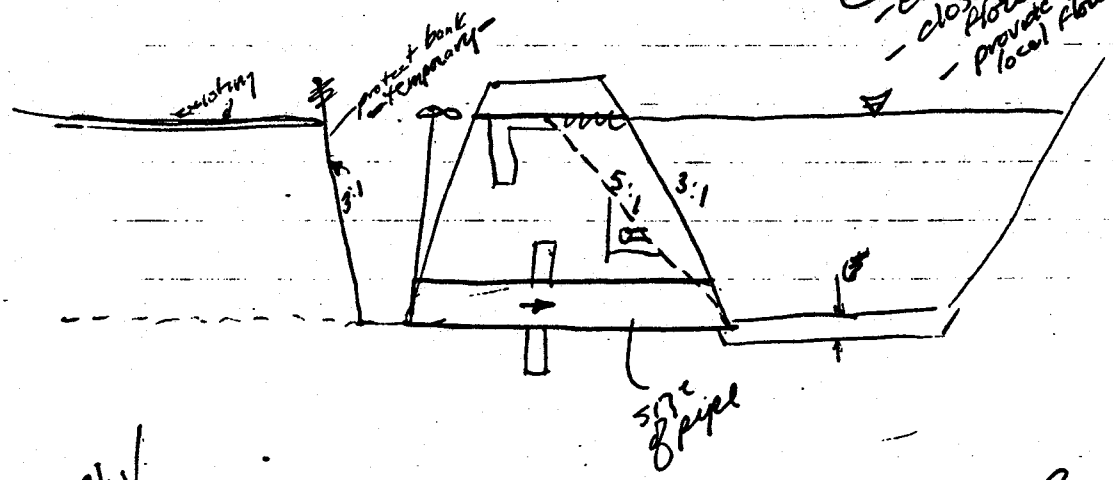
3. Soil cement slope = 5 to 1 for weir section and 3 to 1 to tie back into existing dike on both ends.

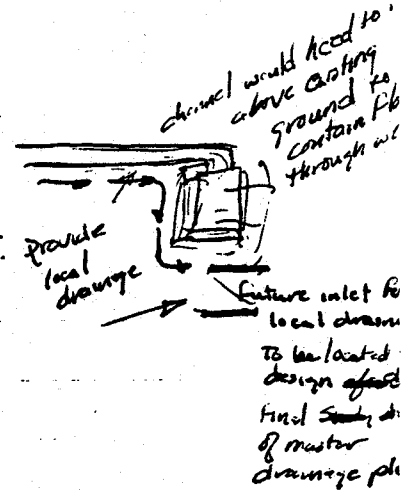
4. We would "not" build the temporary storage pond or put in the gated pipes -

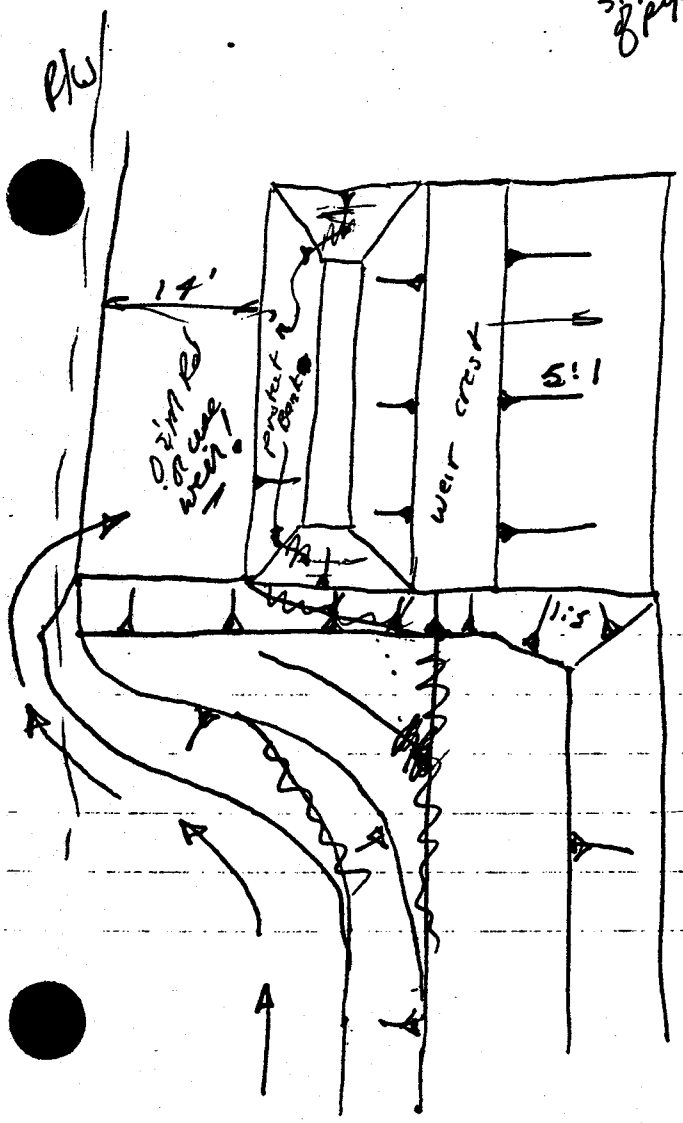
MTG

Weir Inlets ?

Show proposed future — ~~may have to add small inlet for local drainage?~~
- enlarge
- close off to local flow w/ Berms
- provide inlet for local flows







Reason for providing this storage area now —

1.) To construct gated pipe through berm

high if that's not needed →
- $ to SCS
- Temporary Protection of collection pool area banks
- Gate, stand etc
- diaphram

limiting future design alternatives. →
- pipe (size?)

! Sediment Problem
- 33' — design for storage.

33
33
66
14
80'

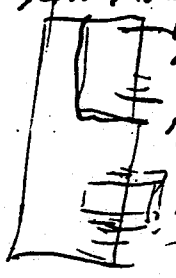
where we have basins proposed —

leaves most ~~for~~ ~~flexibility~~ for future design

* there may have to be enclosed + another side inlet provide for local drainage not getting into the system — provide weir length for this flow + existing head.

— or —

provide weir length of existing Cfs + head + let drainage study berm what's needed to provide additional head for additional Q + also provide inlet for local drainage.



D8

Foresight Developers

A division of Western Savings & Loan

OCTOBER 29, 1986

MR. DON PAULUS
SOIL CONSERVATION SERVICE
201 E. INDIANOLA
PHOENIX, AZ. 85012

RE: RWCD FLOODWAY CONSTRUCTION SOUTH OF GUADALUPE

DEAR DON:

THIS LETTER IS TO CONFIRM THE DISCUSSIONS WHICH TOOK PLACE AT OUR MEETING OF OCTOBER 8, 1986, AND A SUBSEQUENT CONVERSATION BETWEEN JAY AHRENS, ENGINEERING MANAGER, FORESIGHT DEVELOPERS, AND TOM JAYO WITH SCS.

*SUPERSTITION SPRINGS GOLF CLUB MAINTENANCE PERSONNEL WILL UPON PROPER NOTIFICATION OF A CONSTRUCTION START DATE BY SCS, REMOVE OR ABANDON THE EXISTING IRRIGATION AND LANDSCAPING, (CONTACT STEVE EASTHAM OF FORESIGHT DEVELOPERS, 890-5650. TWO WEEKS PRIOR TO START OF CONSTRUCTION).

*THE SCS'S CONTRACTOR WILL REMOVE THE 42" HEADGATES SOUTH OF GUADALUPE AND MAKE THEM AVAILABLE TO FORESIGHT FOR SALVAGE.

*FORESIGHT WILL CONTINUE TO DISCHARGE INTO THE FLOODWAY SOUTH OF GUADALUPE THROUGH ITS EXISTING PUMP SYSTEM IF REQUIRED TO PROTECT IT'S INVESTMENT IN THE RWCD FLOODWAY NORTH OF GUADALUPE. THE EFFECTS OF THIS DISCHARGE MUST BE CONSIDERED BY SCS CONSTRUCTION PLANNING.

I APPRECIATE YOUR EFFORTS TO KEEP US INFORMED ON THIS PROJECT AND LOOK FORWARD TO WORKING WITH YOU TO COMPLETE THE FLOODWAY. ATTACHED FOR YOUR USE IS A UTILITY PLAN SHOWING THE EXISTING IRRIGATION SYSTEM.

YOURS TRULY,

C.C. JOHN JACOBS, FORESIGHT DEVELOPERS
KEBBA BUCKLEY, FCDMC

Stephen Eastham

STEPHEN EASTHAM
DIRECTOR OF PLANNING & DEVELOPMENT

1517 So. Power Rd.
Mesa, Arizona

Anderson-Nichols

4120 NORTH 20TH STREET
PHOENIX, AZ 85016
(602) 957-3681

Letter of Transmittal

To: Flood Control District of Maricopa Co.
3335 W. Durango
Phoenix Az 85009
Attn: Kebba Buckley

Date: 2/20/86
Job Title: Master Drainage Plan East Maricopa C
Job No: 4458
Re:

Gentlemen:

We are sending you attached/ via Regular Mail the following items:

- ☐ Shop Drawings
- ☐ Prints
- ☐ Plans
- ☐ Samples
- ☐ Copy of Letter
- ☐ Change Order
- ☐ Specifications
- ☒ Other

COPIES	DATE	IDENT. NO.	DESCRIPTION
1	2/20/86		Inflows to RWCD Reach 5

FLOOD CONTROL DISTRICT
RECEIVED
FEB 24 '86

CIV ENG	HYDRO
ASST	LMgr
ADMIN	SUSP
C & O	FILE
ENGR	DESTROY
FINANCE	KEB

These are transmitted as checked below:

- ☐ For approval
- ☐ Approved as submitted
- ☐ For instructions
- ☒ For your use.
- ☐ Approved as noted
- ☐ Resubmit ____ copies for approval
- ☒ As requested
- ☐ Returned for corrections
- ☐ Return ____ corrected prints
- ☐ For review & comment
- ☐ ____

Remarks: IF FURTHER INFORMATION IS NEEDED PLEASE CONTACT ME!

THANKS

Copy to: SCS, Don Paulus

Signed: Steve Mills, PE

1-26-87

SUBJECT: RWCD Reach-5;
Meeting w/Morrison to discuss alternate landlevel designs & other design work between Guadalupe & Elliot Roads.

ATTENDEES:

Don Paulus	SCS
Tom Jayo	"
Dick McNamara	FCD
Keeba Buckley	"
Scot Clements	"
Steve Revie	SCS
Ken Morrison	Landowner
Marvin Morrison	"

A. LANDLEVELING:

The following alternatives were presented:

1.) Level fields 6, 5, & 7 (in that order) with all available material.
2.) Level all three fields using available fill from the Floodway excavation and local cut & fill on the Morrison farm. (Note: Additional cut & fill on the landowner would become the expense of the owner)
3.) Level a strip along the Fwy. as far east as the available fill from the Fwy. excavation will reach.

Morrison's agreed to pursue alternate #3. Steve Revie will now work with Morrison to come up with a final plan.

The X-section show on 12/11/86 notes has been modified to a 14' farm road top width and 1' field retention depth.

We asked Morrison's if they still want gates on the drain outlets from the farm fields. They replied yes and prefer we use a design simular to the existing structures.

We also asked if animal guards would be warrented. Morrison replied, "NO."

B. SUMP REVIEW

We reviewed what work will happen at the sump located in the Southeast corner of Guadalupe and Power.

1. SCS will fill this area with both Project earthwor and landleveling material.
2. Morrison will block ditch and remove the pump, pump controls and relocate Power Supply
3. SCS will remove & waste standpipe, pump base, etc.

C. GUADALUPE SIDE INLET

A conceptual plan was shown to Morrison picking up existing flow North and east along Guadalupe Rd. This plan will require approximately 1/2 acre of additional rights of way. Morrison agreed with the concept and the FCD will pursue obtaining the Landrights.

A mtg. was held at the Chandler F.O. after this mtg. with Keeba & Scot of the FCD to further discuss the inlet and the future master drainage plan.

Keeba brought up an alternate inlet location that would bisec Morrison's Field #7 possibly leaving Morrison with a valuble corner lot and at the same time reducing the sharp curve needed to bring flow into the RWCD Flwy.

SCS explained that we still would have to provide an inlet for the present conditions at the location discussed earlier with Morrison. However, SCS would look at what superelevation would be needed for the proposed Master drainage plan (MDP) channel, slopes, and clearances for going under the road, etc. to make sure that our proposed inlet can be linked to the MDP at this location. As a result, SCS is designing for future and exiting conditions at one location. If an alternate location is desired by Morrison in the future that will have to be worked out between the FCD & Morrison.

D. Information Needed

1.) Datum used in developing MDP. — rec'd 1-27-87
2.) Temporary construction easement for landleveling (FCD)
3.) " " " for Leisure world entrance. (SCS to supply FCD map)
4.) Relocation of Morrison Sump Cost estimate (SCS)
5.) R/W needed at the Guadalupe inlet (SCS to supply FCD map)

Don Paulus
State Design Engineer

cc Tom Jayo
Ralph Arrington
Steve Revie
Dick McNamara
Keeba Buckley

12/11/86

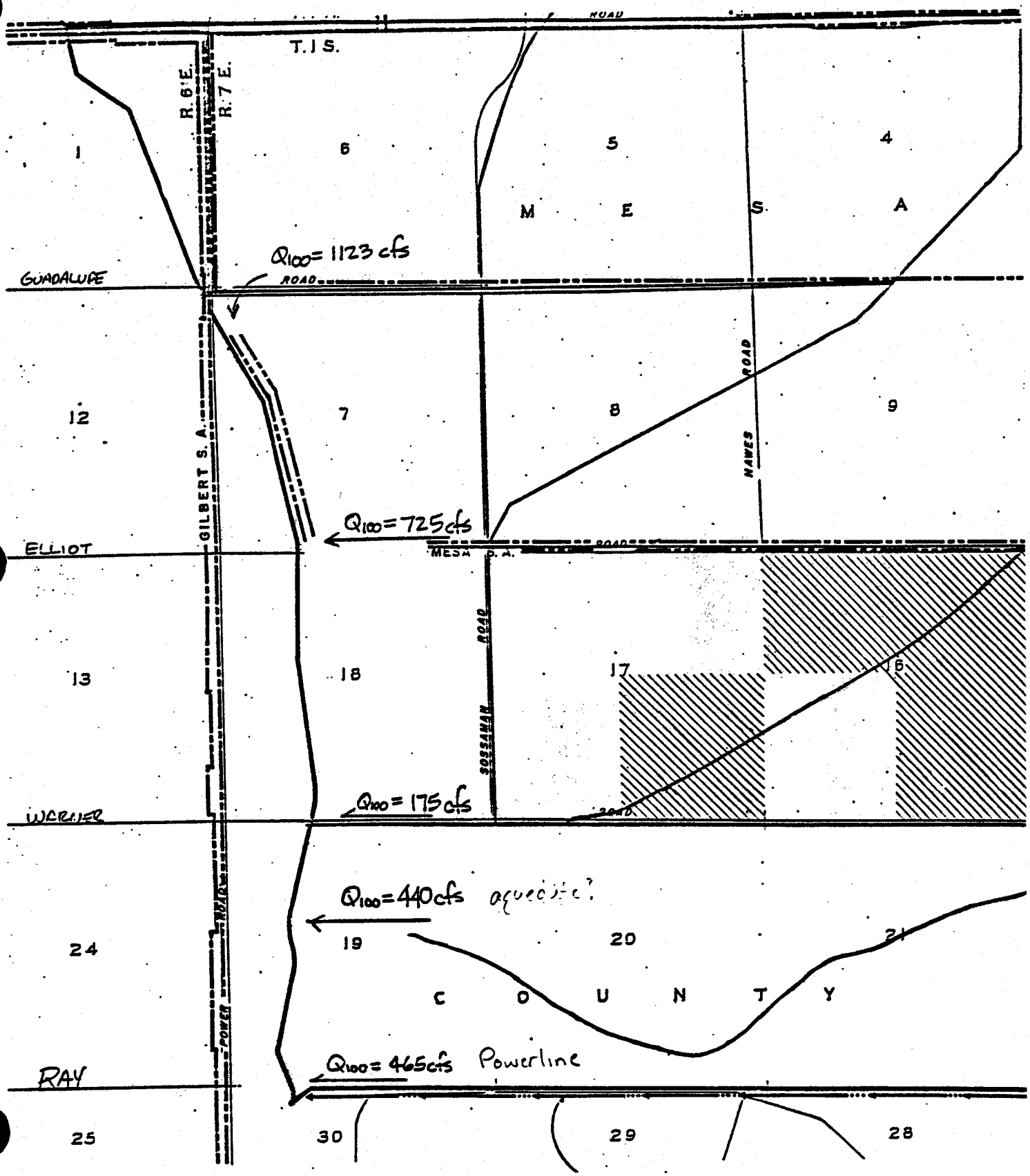
— RWCD Reach-5 —

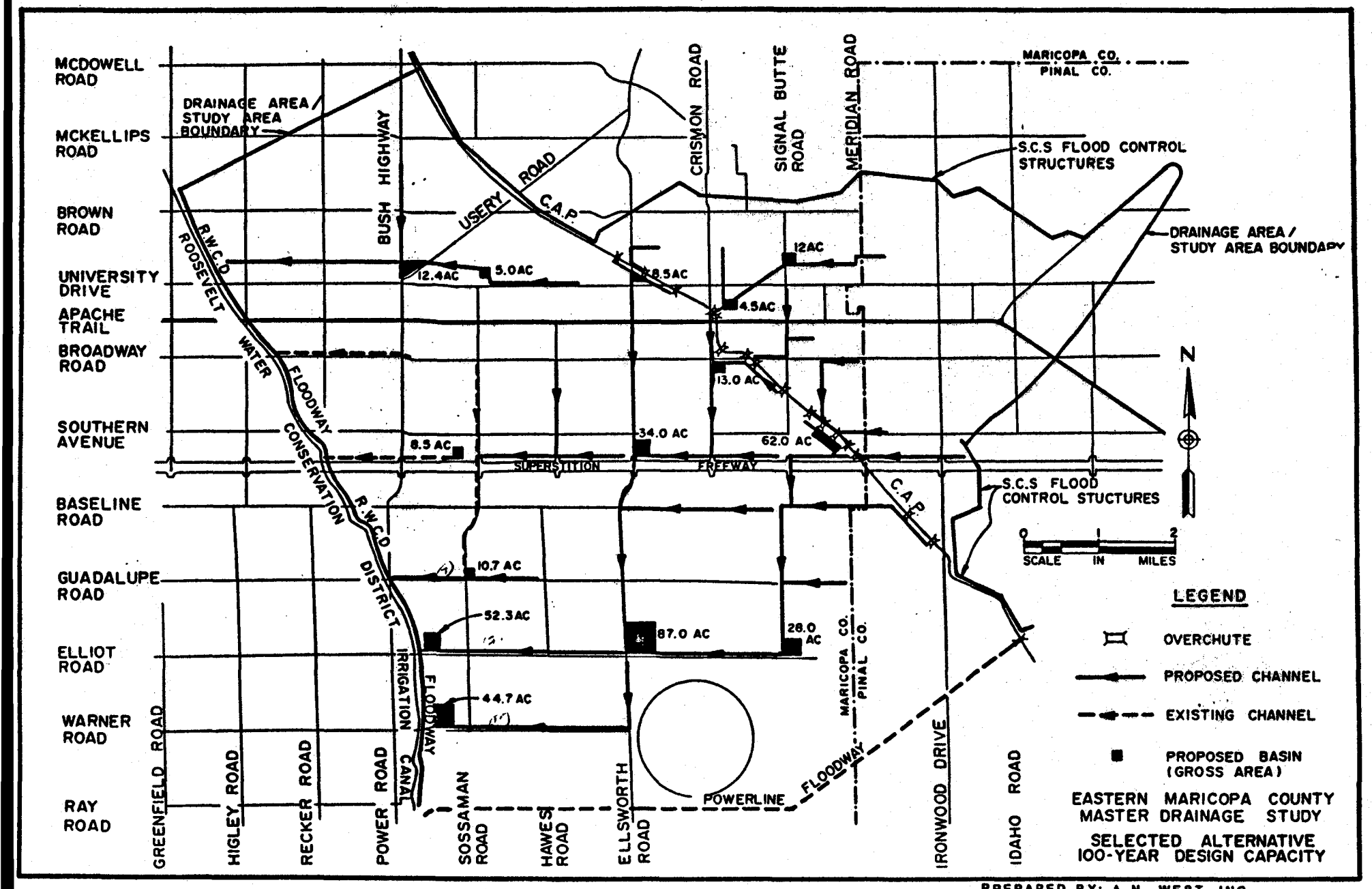
SUBJECT: Meeting w/ Morrison to establish design per the FCDMC landright agreement.

ATTENDEES: Don Paulus SCS
Tom Jayo SCS
Ken Morrison
Jim Lang
Keeba Buckley FCD
Dick McNamara FCD

A. LANDLEVELING:

1. Soil Scientist to determine suitability of Flwy materials for farming. Morrison will supply a backhoe or drilling to do the investigation. The Soil Scientist will determine the extent of the investigation. The investigation should include the reach between Guadalupe Rd and 1/4 mi So. of Elliot.
2. From the suitability analysis of the soils determine the amount of FILL available for landleveling. (NOTE: Unsuitable material may be used for landleveling in the lower lifts and/or Morrison may determine to use all soils + treat as necessary. This should be determined between the Soil Scientist and Morrison)
3. Design landleveled fields in the following order until "FILL" material is all used: #6, #5, #7. Drainage should be generally to the WEST. Work with Morrison on 'final' design until in agreement.
4. FCD will acquire temporary construction easements to include fields 5, 6 & 7.


T. 1 S.
R. 6 E.
R. 7 E.
1
6
5
4
M E S A
GUADALUPE
ROAD
Q100= 1123 cfs
12
7
8
9
GILBERT S. A.
NAWES
ROAD
Q100=725cfs
ELLIOT
MESA
13
18
17
16
SOSSAMAN
ROAD
Q100= 175 cfs
WORKER
Q100=440cfs aqueduct?
24
19
20
21
C O U N T Y
POWER
Q100= 465cfs Powerline
RAY
25
30
29
28

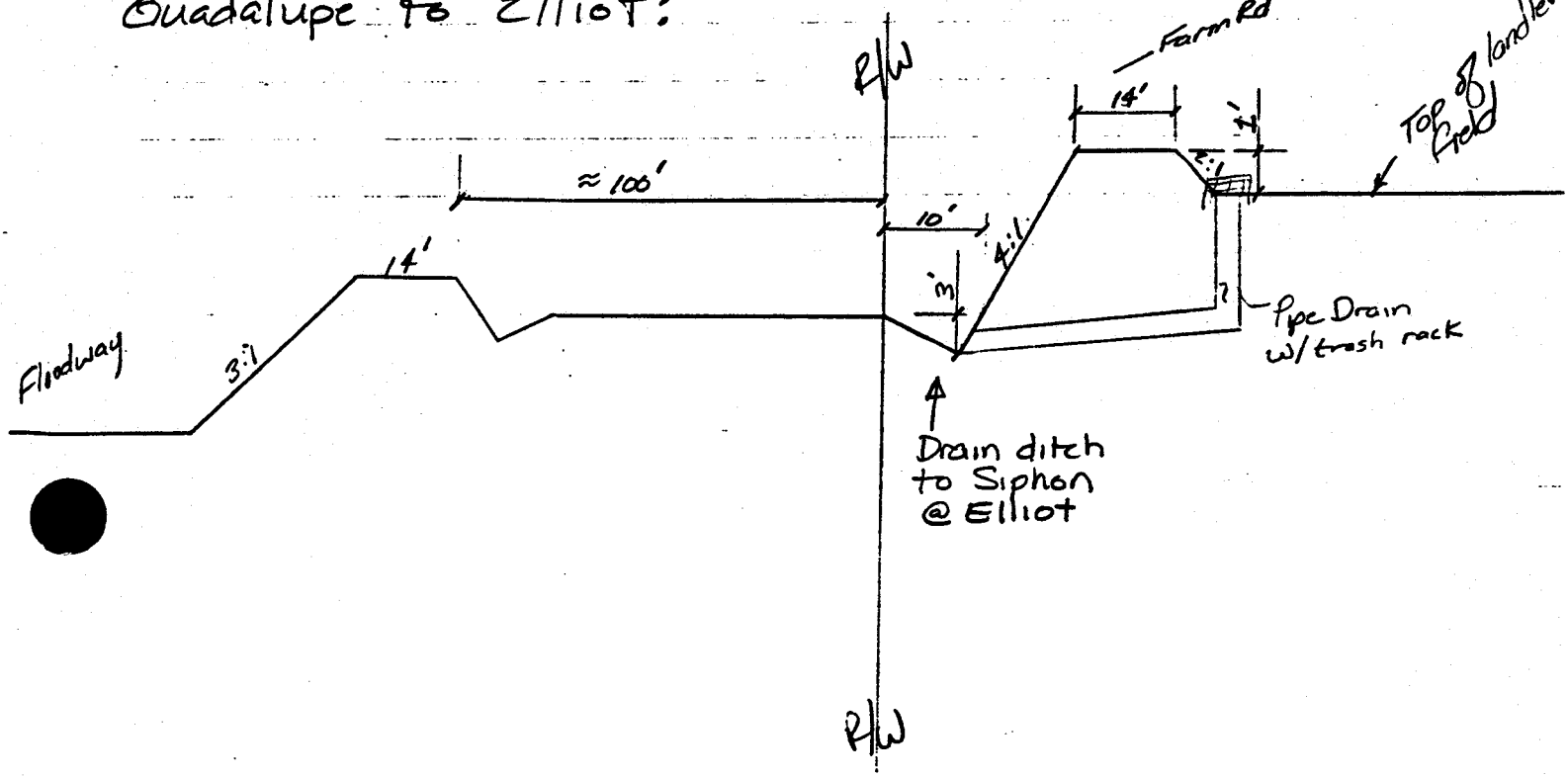


PREPARED BY: A N WEST, INC.

6/7/86

B. Farm Roads & drainage Culverts:

The following section will be maintained from Guadalupe to Elliot:



Locate pipe drains from landlevel design as needed.

C. Sump:

Morrison asked that the sump be filled and the pipe payed by the FCD for relocation as per agreement. (Morrison will not rebuild this sump) Morrison will remove all structures outside the FCD R/W + grant a TCE for filling existing sump. SCS will include structure removal for those items within the FCD R/W and within a TCE Northeast of the Quad./Power intersection for removal of an abandoned 36" pipe leading to the sump.

11 (SCS will prepare a #estimate for the FCD to construct a sump of equal volume. Volume calculations will be made from SCS survey)

Donald E Paulus
STATE DESIGN ENG.

cc. Wayne Kilgore
Ralph Arrington
Joe Knisley
Steve Revie
Tom Sayo

Side Inlet #1

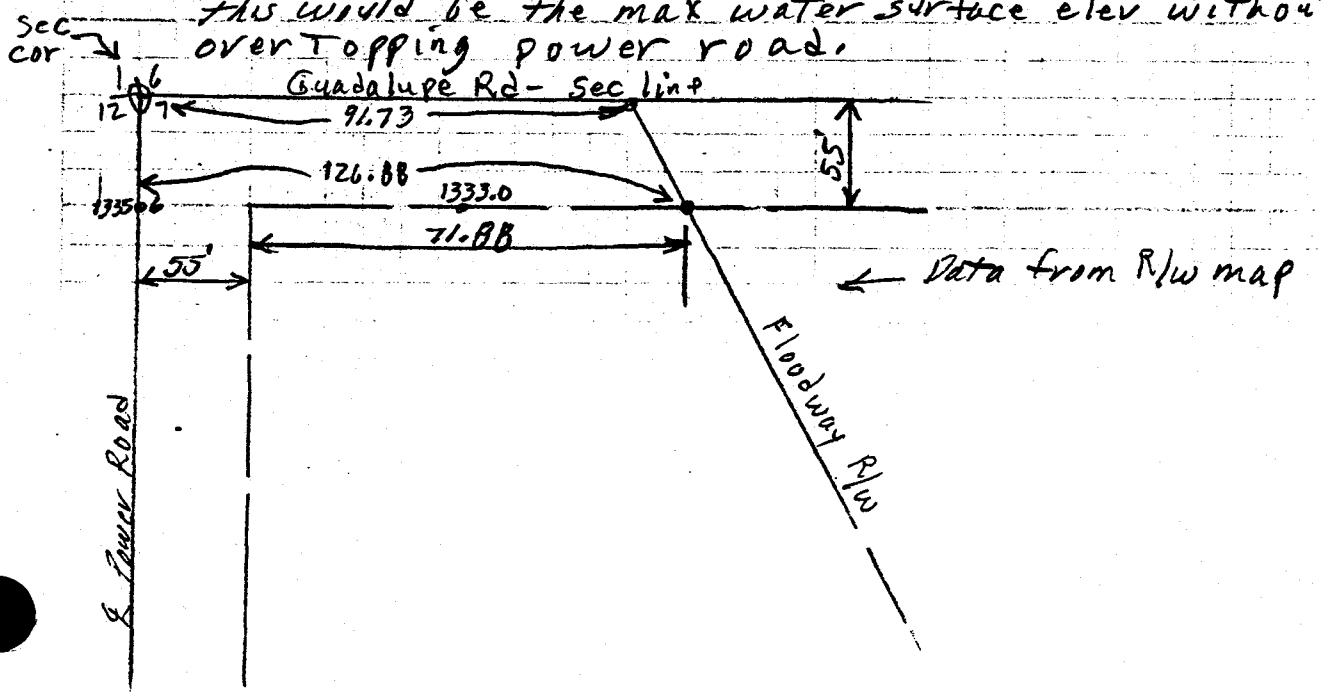
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Dayo	DATE 1-15-87	CHECKED BY DJ	DATE 3/87	JOB NO.
SUBJECT Inlet # 1 Design				SHEET 1 OF 21

Given: Elev @ Sec cor $\frac{1|6}{12|7}$ on brass cap = 1335.26

Top of pavement is approx 6" higher = 1335.26+0.5 = 1335.76
this would be the max water surface elev without overtopping power road.



Q = 2100 CFS = 100 yr flow per H.C. Millsaps Hydrology Analysis OCT 1985
Q_{100} hwl elev in Floodway = 1330.72

Top Left dike elev @ 330+00 (approx Junction) = 1334.01
invert elev @ 330+00 = 1322.26 with 11.75' left bank

Find weir length needed for head available

max head = 1335.6 − 1330.7 = 4.9' FT @ Guadalupe Rd.

Use 1334.4 for hwl @ weir - allows for 0" free board @ Floodway dike

Head = 1334.4 − 1330.7 = 3.7 FT

$Q = 3.1 L H^{3/2}$

$L = \frac{Q}{3.1 (H)^{3/2}} = \frac{2100}{3.1 (3.7)^{3/2}} = 95.2$ FT

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 1-20-86	CHECKED BY	DATE 3/87	JOB NO.
SUBJECT Inlet #1 Design				SHEET 2 OF 21

2.0 Find channel size into inlet for 2100 CFS

Plan on grouted rock riprap section -

$n = 0.040 \rightarrow$ Too high for Grouted Rock use 0.030

$Q = AV = 2100 \text{ CFS}$

$V = \frac{1.486 (R)^{2/3} S^{1/2}}{n} = \frac{2100}{A}$

$V = \frac{Q}{A} = \frac{2100}{A}$

$R = \frac{A}{P} = \frac{d(B.W.) + 2d^2}{B.W. + 4.47d}$

$\frac{2100}{3.7 B.W. + 27.38} = \frac{1.486 \left(\frac{3.7 B.W. + 27.38}{B.W. + 16.54}\right)^{2/3} (S)^{1/2}}{0.040}$

For $d = 3.7$

$R = \frac{3.7 B.W. + 27.38}{BW + 16.54}$

For B.W. = 50', $S = \cancel{0.01508}$ .0085 FT/FT, $A = 212.38 \text{ Ft}^2$ $V = 9.89$ Ft/sec

For B.W. = 100, $S = \cancel{0.00394}$ 0.0022 FT/FT, $A = 397.38$ " $V = 5.28$ Ft/sec

For B.W. = 150, $S = \cancel{0.00177}$ 0.0010 FT/FT, $A = 582.38$ " $V = 3.61$ Ft/sec

For B.W = 200, $S = \cancel{0.001}$ 0.0006, $A = 767.38$ " $V = 2.74$ Ft/sec

Use B.W. = 120 FT & $S = \cancel{0.00274}$ 0.0015.

Elev @ Quadalupe R/W = 1330.7 + 0.0015 (200) = 1331.0

Slope down from R/W on 3TO1 from Elev 1332.5± TO 1331.0 ~ approx 1.5 TO 2 FT.

Place 4 FT cutoff at R/W top @ Elev 1333.0±

NOTE

Above design was not used

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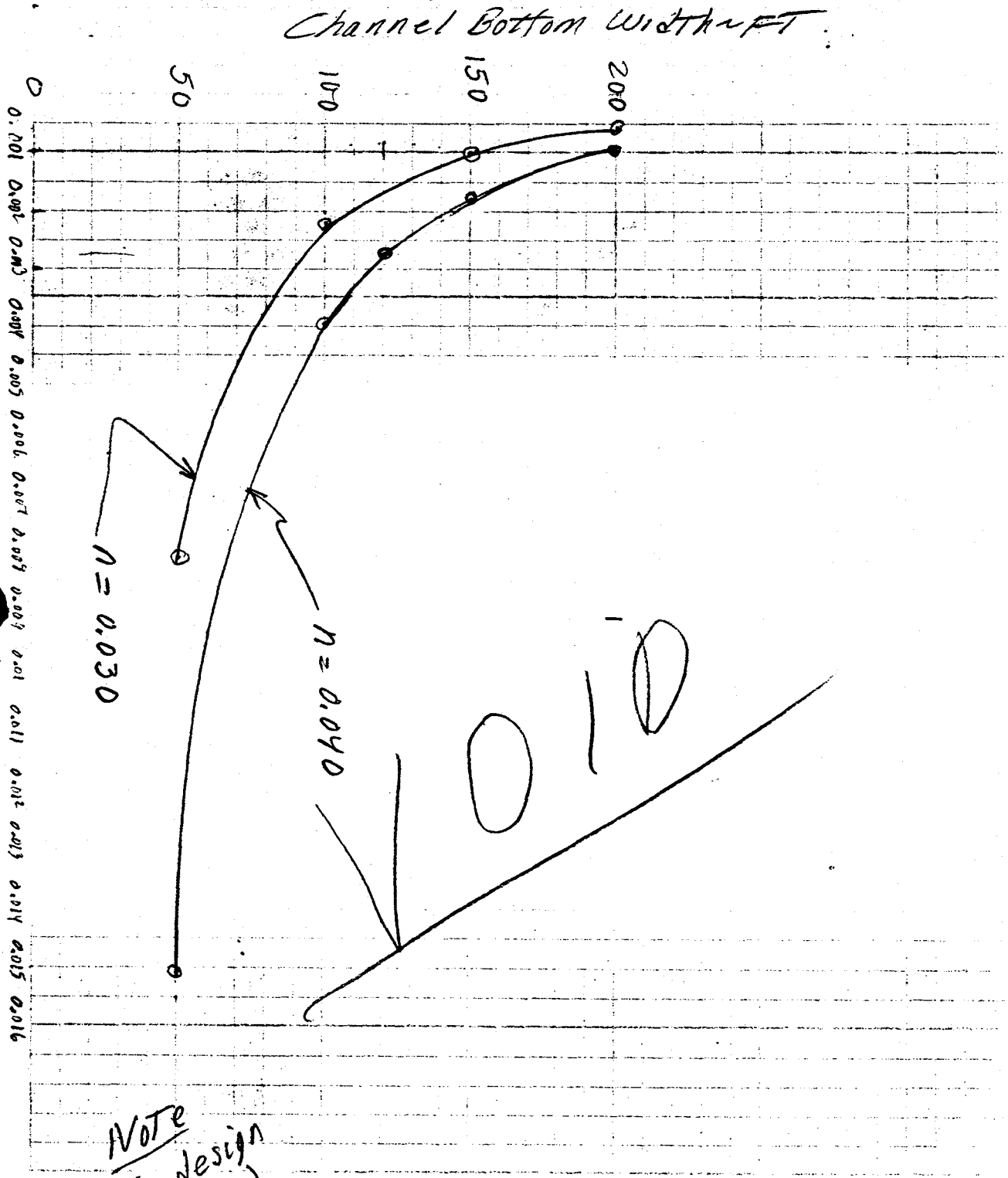
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 1-21-86	CHECKED BY OB	DATE 3/87	JOB NO.
SUBJECT Inlet #1 Design				SHEET 3 OF 21



Note
This design
NOT used

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SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 3-87	CHECKED BY DR	DATE 3/87	JOB NO.
SUBJECT Toe of Channel Curve - where Side inlet Joins Floodway				SHEET 4 OF 21

Given: $\Delta = 29^\circ 07' 20'' = I$
$T = 50'$

Find R -
L -
D -

$$R = \frac{T}{\tan \frac{I}{2}} = \frac{50}{\tan \frac{29^\circ 07' 20''}{2}} = \underline{\underline{192.49}}$$

$$L = RI = 192.49 \left(\frac{29^\circ 07' 20''}{360} \right)(2\pi) = \underline{\underline{97.84 \text{ FT}}}$$

$$D_{arc} = \frac{5729.578}{R_{arc}} = \frac{5729.578}{192.49} = 29.765825^\circ = \underline{\underline{29^\circ 45' 57''}}$$

$$C = 2R \left(\sin 0.005\, D(97.84) \right) = \underline{\underline{96.79 \text{ FT}}}$$

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Joyo	DATE 1-21-87	CHECKED BY DJB	DATE 3/87	JOB NO.
SUBJECT Inlet No 1 Design -				SHEET 5 OF 21

Use Master Drainage Plan Criteria -

Using Master Drainage Plan Elevs,

RWCD Invert El = 1323.1 } within 0.8' of present elev = 1322.26
W.S. El = 1330.8
inlet elev = 1327.0
top of Bank El = 1336.4 } all these elevs are from Master Drainage Plan sheet 7 of 20
(Need Datum Equation From Eva Buckle, Received 1/28/87 - DR)

Check to see what size channel would be needed to carry 2100 CFS if channel is graded from 1322.26 at Floodway Sta 330+00± to elev 1327.0 ± 0.8' at South R/w of Guadalupe Road.

Drop = 1327.0 − 1322.26 = 4.74 FT ±

length = 428 FT ±

$$\text{grade} = \frac{4.74}{428} = 0.0111 \text{ FT/FT}$$

n = 0.030
Q = 2100 CFS
Z = 3:1

$$V = \frac{1.486 (R)^{2/3} (S)^{1/2}}{n} = \frac{(1.486)}{0.030} (R^{2/3}) \overset{0.1054}{(0.0111)^{1/2}} = 5.22 (R)^{2/3}$$

$$V = \frac{Q}{A} = \frac{2100}{A} = 5.22 (R)^{2/3}, \quad R^{2/3} A = 402.29$$

$$R = \frac{A}{P} =$$

$$\frac{(A)^{5/3}}{(P)^{2/3}} = 402.29$$

$$\frac{[d(BW+3d)]^{5/3}}{[BW+6.32d]^{2/3}} = 402.29$$

For d = 3', BW = 61.4, A = 211.2, V = 9.94 FT/sec
For d = 4', BW = 35.1, A = 188.4, V = 11.15 FT/sec
For d = 5', BW = 20.5, A = 177.5, V = 11.83 FT/sec
For d = 6', BW = 10.8, A = 172.8, V = 12.15 FT/sec

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 2-2-87	CHECKED BY DJ	DATE 3/87	JOB NO.
SUBJECT INLET NO 1 Design				SHEET 5A OF 21

Using Master Drainage Plan Criteria -

This is an up date on sheet 5 due to channel length less then 428 FT.

Actual length turns out to be ~~294~~ 337.5 FT.

Drop = 1327.0 − 1322.28 = 4.72 FT

Grade = $\frac{4.74}{\cancel{294}\ 337.5}$ = 0.~~0161~~ 0.01399 FT/FT

n = 0.030
Q = 2100 CFS
Z = 3:1

$$V = \frac{Q}{A} = \frac{2100}{A} = \frac{1.486 (R)^{2/3} \left(\cancel{.0161}\ \cancel{.012288}\ .01399\right)^{1/2}}{0.030} = \cancel{6.087}\ 5.859 (R)^{2/3}$$

$$R^{2/3} A = 345.01, \quad \frac{[d(Bw+3d)]^{5/3}}{[Bw+6.32d]^{2/3}} = \cancel{345.01}\ 358.42$$

For Bw = 40 FT,

$$\frac{[d(40+3d)]^{5/3}}{[40+6.32d]^{2/3}} = \cancel{345.01}\ 358.42$$

By Trial d_N = ~~3.45~~ 3.52 FT − (1327 + ~~3.45~~ 3.52 = 1330.~~45~~ 52 < T.W. elev = 1330.72)

Area = ~~173.71~~ 177.97 FT^2

Velocity = $\frac{2100}{\cancel{173.71}\ 177.97}$ = ~~12.1~~ 11.8 FT/sec ok

Actual Conditions Tailwater will be ≈ 0.25' higher & velocity some what lower but still within allowable limit.

Note - Elevations from Master Drainage Plan were compared to SCS datum at R5-8 and R5-9 and found to be within 0.2 FT. SCS Datum is 0.2 FT lower. Based on this our design for entrance for Side inlet No 1 should fit future MDP for design of Channel under Guadalupe Road and into Side inlet No 1. We are assuming that MDP Channel into Side inlet No 1 was designed using Surtec Datum Elev. that fit R5-8 & R5-9 above.

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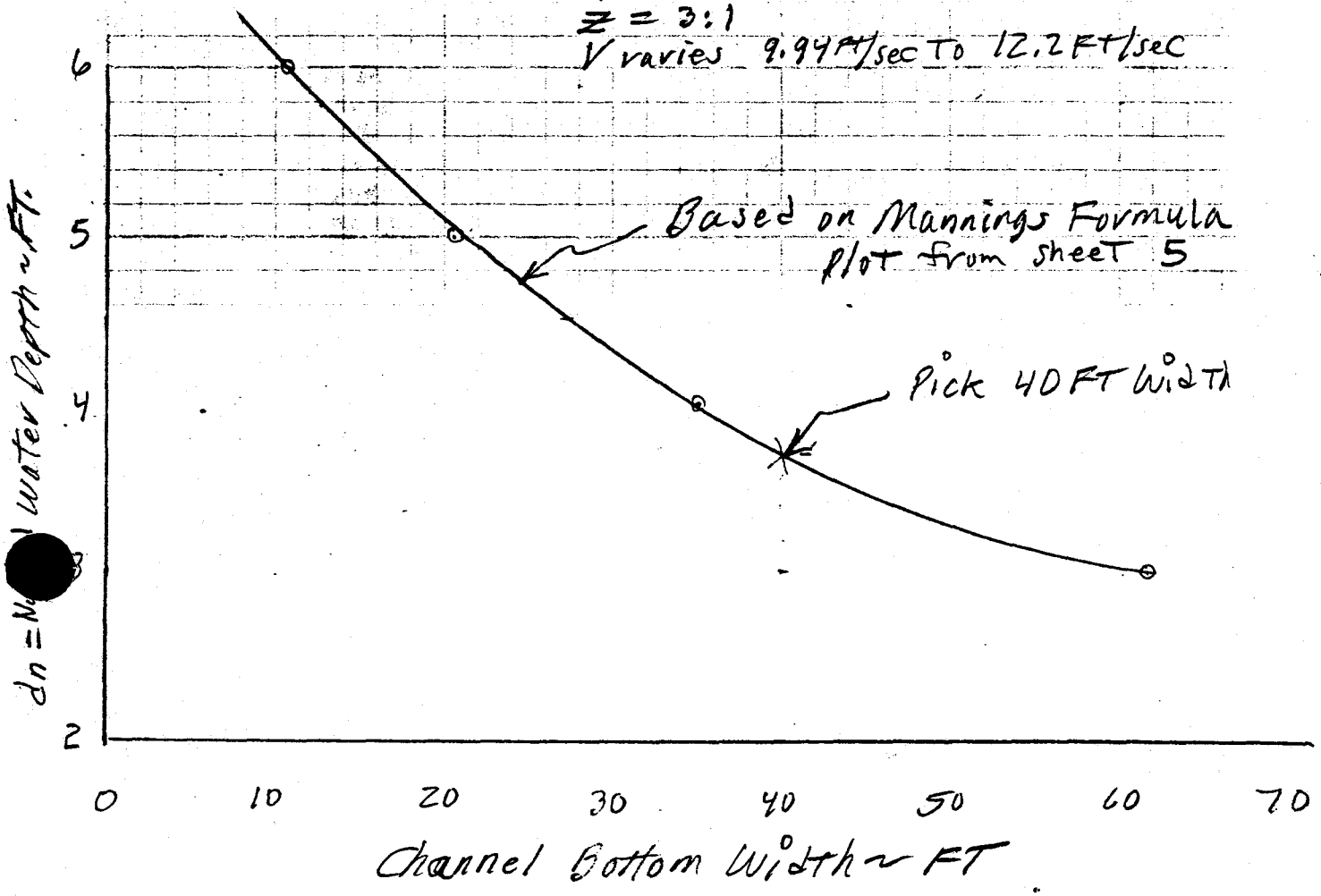
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 7-22-87	CHECKED BY BJP	DATE 3/87	JOB NO.
SUBJECT Inlet No 1 Design-Channel Quadalupe Rd to Floodway STA 330+00 ±				SHEET 6 OF 21

For Q = 2100 CFS
n = 0.030
Z = 3:1
V varies 9.94 FT/sec to 12.2 FT/sec



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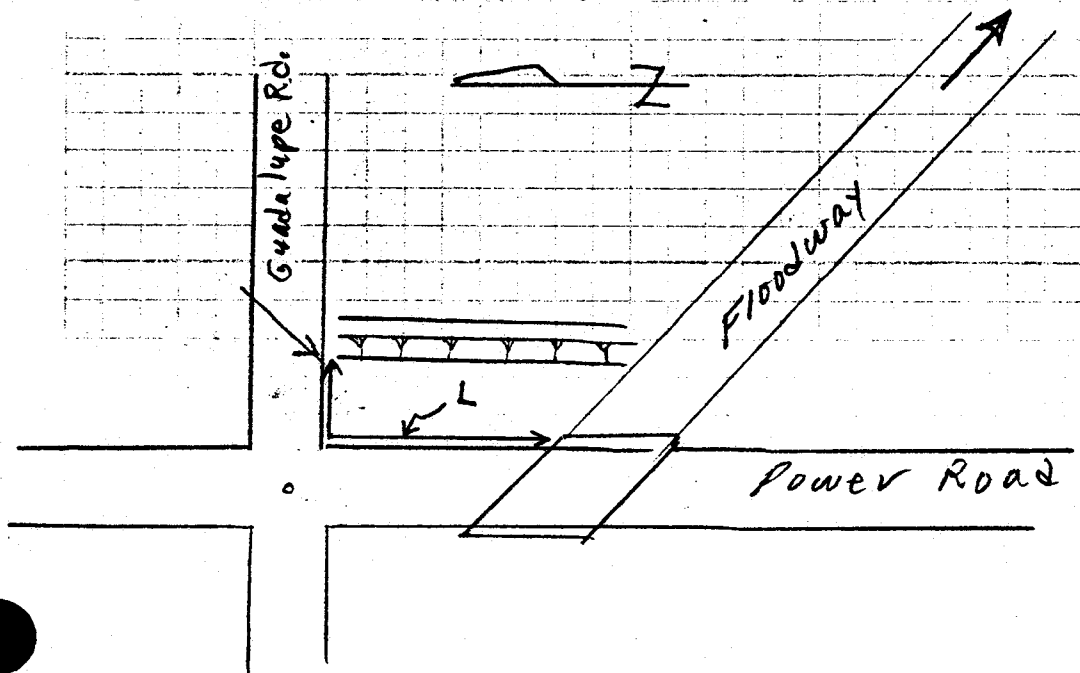
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 7-22-87	CHECKED BY DSP	DATE 3/87	JOB NO.
SUBJECT Inlet NO 1 DESIGN -				SHEET 7 OF 21

Find Water Depth vs weir length ~ "L" For weir sec at South side of Guadulupe Rd and along East side of Power Road



Given - Q = 2100

Using Weir EQU. - $Q = 3.1 L H^{3/2}$, $L = \frac{Q}{3.1(H)^{3/2}} = \frac{2100}{3.1(H^{3/2})} = \frac{677.42}{H^{3/2}}$

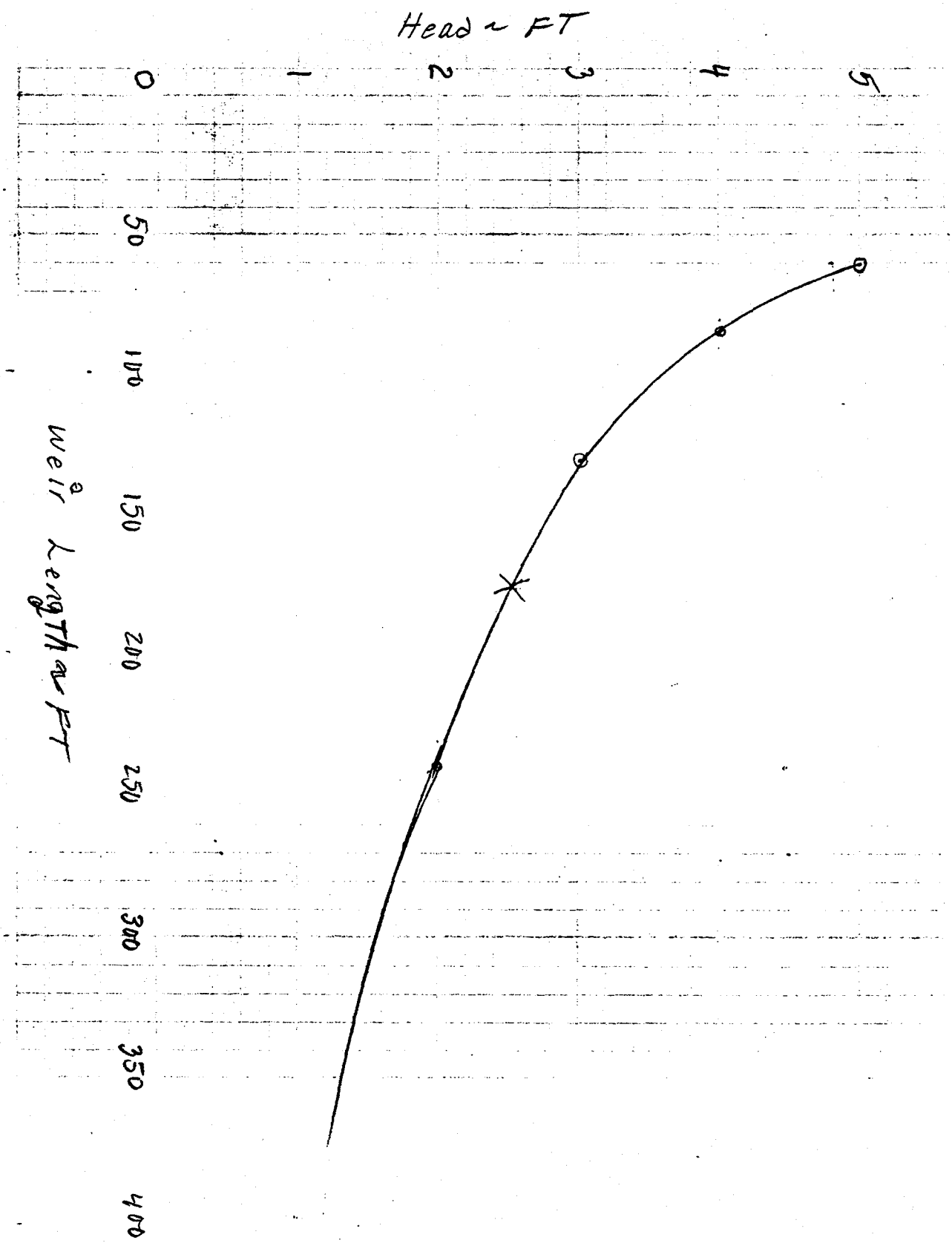
H ~ FT	L ~ FT
1	677.42 ~ Too long
2	239.5 ~ Possible
3	130.4
4	84.7
5 ~ Too high	60.6

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		RWCD REACH 5		
BY Tom Jayo	DATE 1-22-87	CHECKED BY DGP	DATE 3/87	JOB NO.
SUBJECT Inlet No 1 Design				SHEET 8 OF 21

Weir Head vs Weir Length @ Inlet.



COMPUTATION SHEET
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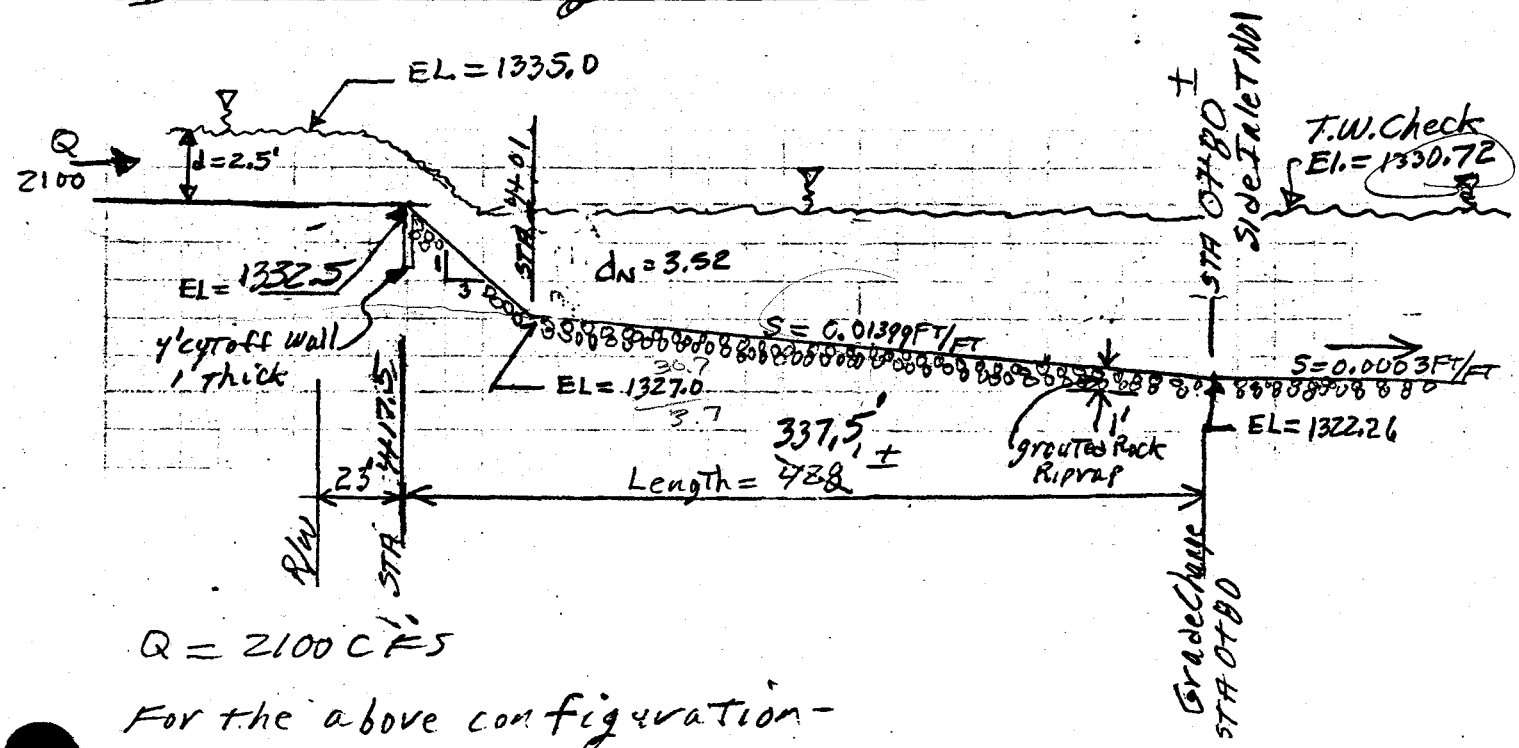
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 1-22-87	CHECKED BY DEJ	DATE 3/87	JOB NO.
SUBJECT Inlet No 1 Design -				SHEET 9 OF 21



Q = 2100 CFS

For the above configuration -

Channel width = 40 FT

Weir length needed @ Quadalupe Rd = 175'
& Power Road -

Weir length needed along Power Road = 175 - 40 = 135'

Note invert of 18" culvert under Quadalupe Rd = 1331.5 - check ok
1' lower then crest of weir → May want to lower crest to 1331.5 - ? - ~~yes~~ no - lower weir crest 1 foot in small area and build small 1' deep ditch from end of 18" culvert to weir crest.
max Q for 0.4' head @ inlet & outlet unsubmerged = 10 CFS ±

Make ditch with 3 FT bottom & 3 to 1 slopes with Q = approx - 4-5 CFS - water above 5 CFS will overtop ditch & flow over 40' wide weir crest.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		RWCD REACH 5		
BY Tom Joyo	DATE 1-23-87	CHECKED BY DEP	DATE 3/87	JOB NO.
SUBJECT Check on wether 24'x18" CMP Arch · from manhole				SHEET 10 OF 21

At SW. Cor Sec 6 To Morrison Tailwater Pond can be Turned To South & graded into Side Inlet No 1.

CMP Arch elev = 1323.44 ck elev OK 2/87 assume This is invert elev - Point 83 page 13 RWCD Reach 5 book 4.

It will have To outlet at the end of the outlet since if it went flat it would grade out at 100 upstream of end of side inlet #1. We would need 0.5 FT of Fall minimum and This would grade out near the end of side inlet a distance of 350 FT ±.

It would be more practical, if elevations permit, to tie into line at pavement edge and outlet it at beginning of inlet at start of ~~0.0111~~ 0.01399 slope.

Elevs need To be checked at this location To see if grade can be established. Ck elev. of invert at manhole at start of pipe, and @ outlet of CMP Arch pipe.

Elev of invert at manhole = 1329.5

overall present length = 190' ±

Assume uniform grade Manhole To outlet

$$\text{grade} = \frac{1329.5 - 1323.4}{190'} = \frac{6.1}{190} = 0.0321 \text{ FT/FT}$$

Make bend at 80' ± out from manhole

26.3

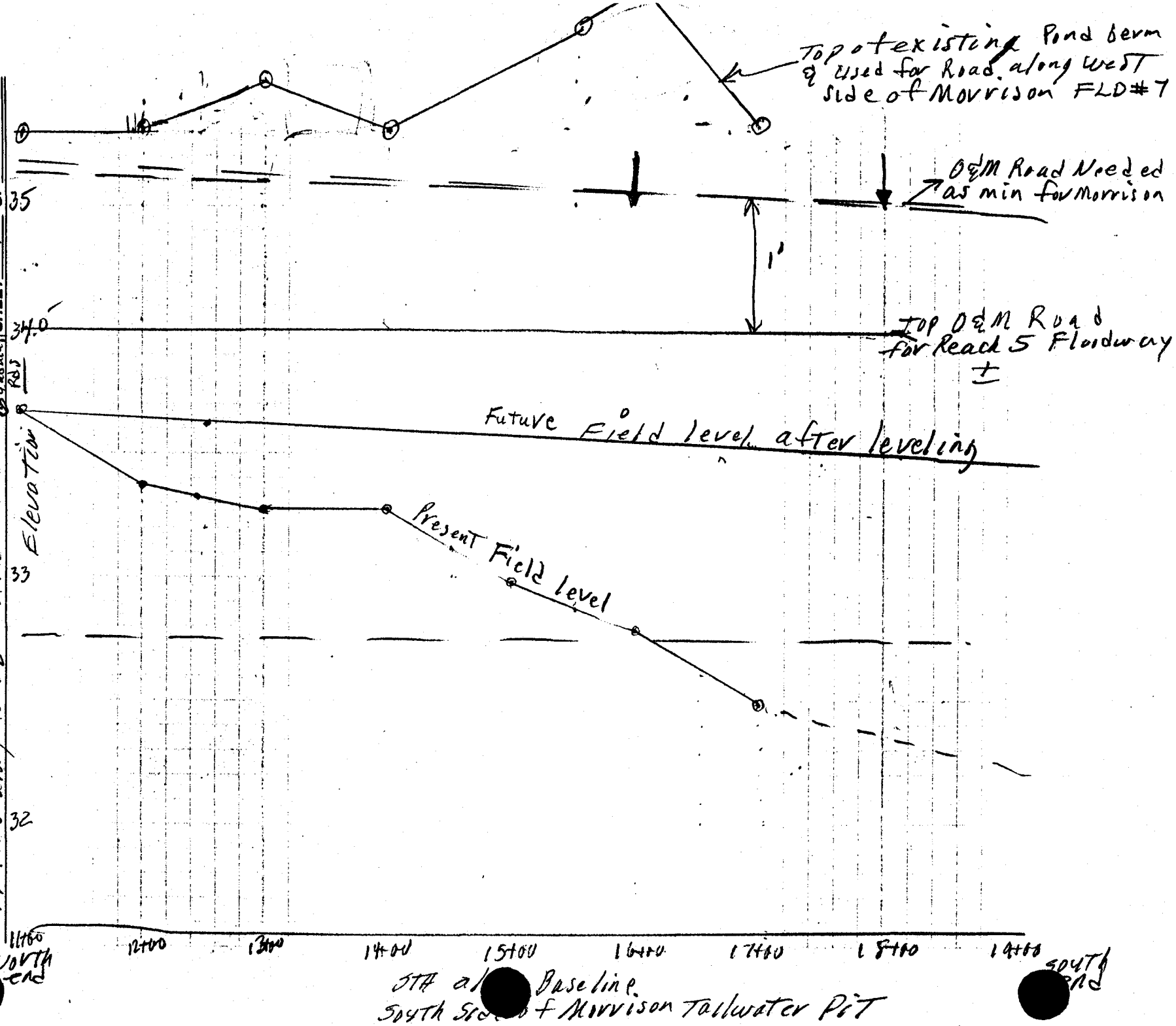
invert elev 80' out = 1329.5 − 0.0321(80) = 1326.93

this is 0.1' lower then elev 1327.0 which begins the side inlet No 1 channel grade of 0.0016 ~~0.0111~~ FT/FT (this should tie in satisfactory) (ok)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Dayo | DATE 1-28-87 | CHECKED BY | DATE | JOB NO.
SUBJECT Profiles along East Side of Morrison Pond — Power & Undaluff Rds | SHEET 1.1 OF 21



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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		RWCD REACH 5		
BY Tom Jayn	DATE 1-28-87	CHECKED BY DB	DATE 3/87	JOB NO.
SUBJECT Ck for Continuance of Master Drainage Study From Side Inlet No 1 up stream.				SHEET 12 OF 21

1) Ck Superelevation

Radius of 200' matches proposed inlet & much better then 450' radius proposed by Master Drainage Plan

Check MDP- Flow = 1125 CFS
radius = 200 FT.
S = slope = 0.0025 FT/FT
b = bottom width = 17.7 FT
V = 10.2 FT/sec
n = 0.016
All per MDP-
normal d in straight channel = 4.5'

Using For Western States Criteria -

Use n = 0.015 wood float finish concrete lined surface-

$$V = \frac{1.486 (R)^{2/3} (S)^{1/2}}{n} = \frac{1.486 (.0025)^{1/2} \left(\frac{A}{P}\right)^{2/3}}{0.015} = 4.953 \left(\frac{A}{P}\right)^{2/3}$$

$$V = 4.953 \frac{\left(17.7d + 1.5d^2\right)^{2/3}}{\left(17.7 + 3.6d\right)} = \frac{1125}{17.7d + 1.5d^2}$$

$$\left(17.7d + 1.5d^2\right)^{5/3} = 227.135 \left(17.7 + 3.6d\right)^{2/3}$$

By Trial - d = 4.35+, Area = 105.38 FT², $V = \frac{1125}{105.38} = 10.68$ FT/sec

SUPERELEVATION

For Sub critical velocity - & Trapezoidal Channel
(Page 6-8 - Eng Design Stds For West States)

$$S = \frac{V^2 (b + 2zd)}{2(gR - 2zV^2)}$$

$$S = \frac{(10.68)^2 (17.7 + 2(1.5)(4.35))}{2(32.2(200) - 2(3)(10.68)^2)} = 0.3 \text{ FT}$$

For Sub critical Velocity & Rectangular Channel (Page 6-7 Eng Design Stds For West States)

$$S = \frac{3V^2 b}{4gR} = \frac{3(10.68)^2 (17.7)}{4(32.2)(200)} = 0.24 \text{ FT}$$

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 1-29-87	CHECKED BY DSP	DATE 3/87	JOB NO.
SUBJECT CK on Freeboard on Curve Coming into Side Inlet NO 1				SHEET 13 OF 21

Find - dc = Critical depth -

Given $Q_c = 1125$ CFS
$b = 17.7$ FT
$z = 1.5$

$$\frac{Q_c}{b} = \frac{1125}{17.7} = 63.56, \quad \frac{z}{b} = \frac{1.5}{17.7} = 0.0847$$

From ES-24 Sheet 2 of 3 Eng Hnbk Hydraulics Sec 5

dc = 4.4 FT

Find: Critical slope -

T = width of X-sec at critical depth = 17.7 + 2(1.5)(4.4) = 30.9 FT
Area = 17.7(4.4) + 1.5(4.4)^2 = 106.92 FT^2

Perimeter = 17.7 + 2(1.803)(4.4) = 33.57,

$R = \frac{A}{P} = \frac{106.92}{33.57} = 3.185$
$(R)^{4/3} = 4.686$

$$d_m = \text{mean depth} = \frac{a}{T} = \frac{106.92}{30.9} = 3.46$$

From Sheet 5.4-10 Sec 5 Hydraulics above -

$$\text{Critical Slope} = S_c = \frac{14.56\, n^2 (d_m)}{(r)^{4/3}} \qquad \text{use } n = 0.015$$

$$S_c = \frac{14.56(0.015)^2(3.46)}{4.686} = 0.0024 \text{ FT/FT}$$

therefore MDP proposal has channel slope in unstable zone

determine Hw for unstable flow - Per 6.(b) page 6-6 (Far West States)

$$H_w = 0.25\, d_c \left[1 - 11.1\left(\frac{S_o}{S_c} - 1\right)^2\right] = 0.25(4.4)\left[1 - 11.1\left(\frac{0.0025}{0.0024} - 1\right)^2\right]$$

$$= 1.08 \text{ FT}$$

Freeboard - $= 0.2 H_e = 0.2\left(4.4 + \frac{(0.5^2)}{2(32.2)}\right) = 1.2$ FT

Total conc channel height = 4.4 + 0.3 + 1.08 + 1.2 = 6.98 FT

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 1-29-87	CHECKED BY DSP	DATE 3/87	JOB NO.
SUBJECT Ck on Freeboard on Curve Coming into Side Inlet No 1 cond				SHEET 14 OF 21

Elev- high point on Guadalupe Rd each side of future box culvert = 1335.5 ±

channel invert elev = 1327.3 ± @ future box culvert

Max. possible depth to work with

$$= \begin{array}{r} 1335.0 \\ 1327.3 \\ \hline 7.7 \text{ FT} \end{array}$$

clearance = 7.7 − 7.0 = 0.7 FT

water surface to high point = 1.2+0.7 = 1.9 FT

So channel would work as planned by Master Drainage plan - with trapezoidal section, & Q = 1125 CFS

Channel slope is very close to critical slope

If channel grade was reduced so that it was out of unstable zone = 0.7(0.0025) = 0.0017 FT/FT, flatter grade will raise channel 1.4 FT @ Guadalupe x-ing and max conc depth would change from 7.0 FT to 6.3 FT. with normal water depth at 4.8 FT ±. but elev of top of channel would be 1335.0 as compared to 1334.3 with the 0.0025 channel slopes or 0.7 FT higher at top. Flatter slope and greater flow depth will yield approx. the same results.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Joyo	DATE 7-29-87	CHECKED BY DSP	DATE 3/87	JOB NO.
SUBJECT CK on Freeboard on Curve Coming INTO SIDE INLET NO 1 - for Master Drainage Plan				SHEET 15 OF 21

2. Determine depth for rectangular Section

Given - Flow = 1125 CFS
radius = 200 FT
S_o = Slope = 0.0025
b = bottom width - assume 20 FT
n = 0.015

$$V = \frac{1.486 (R)^{2/3} (S)^{1/2}}{n} = \frac{1.486 (.0025)^{1/2}}{0.015} \left(\frac{20d}{20+2d}\right)^{2/3} \qquad R = \frac{A}{P} = \frac{20d}{20+2d}$$

$$= 4.953 \left(\frac{20d}{20+2d}\right)^{2/3} = \frac{1125}{20d}$$

$$(20d)^{5/3} = 227.12 (20+2d)^{2/3}$$

by trial $d = 5.1^{(+)}$, Area = 102 FT^2, V = 11.03 FT/sec

Find - height for Superelevation -

$$S = \frac{3V^2 b}{4g R}$$ = max height of water surface above normal depth of flow (feet)

$$S = \frac{3(11.03)^2(20)}{4(32.2)(200)} = \underline{0.28 \text{ FT}}$$

Find Critical depth dc -

Using E5-24 sht 2 of 3 Sec 5 Hydraulic - Eng Hnbk -
For $\frac{Q_c}{b} = \frac{1125}{20} = 56.25$, & $\frac{z}{b} = 0$
dc = 4.62 FT

Find Critical slope Sc
T = 20, Area = 20(4.62) = 92.4 FT^2
Perimeter = 20 + 2(4.62) = 29.24 FT
dm = 4.62

$$R = \frac{A}{P} = \frac{92.4}{29.24} = 3.16$$

$$(R)^{4/3} = 4.64$$

From Sheet 5.4-10 Sec 5 Hydraulics
$$S_c = \text{Critical slope} = \frac{14.56(0.015)^2(4.62)}{4.64} =$$
$$= \underline{0.0033 \text{ FT/FT}}$$

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 1-29-87	CHECKED BY DP	DATE 3/87	JOB NO.
SUBJECT CK on Freeboard on Curve Coming				SHEET 16 OF 21

INTO Side Inlet No 1

Find (wave) Hw for flow in unstable zone-

$$Hw = 0.25\,dc\left[1 - 11.1\left(\frac{so}{sc} - 1\right)^2\right] = 0.25(4.62)\left[1 - 11.1\left(\frac{0.0025}{0.0033} - 1\right)^2\right]$$

$= \underline{0.4\ FT}$ = wave height to be added to normal depth

Find - Freeboard -

$$\text{Freeboard} = 0.2\,He = 0.2\left[5.1 + \frac{(11.03)^2}{2(32.2)}\right] = \underline{1.4\ FT}$$

Find total depth of section = D

$$D = 5.1 + 0.2B + 0.4 + 1.4 = \underline{7.2\ FT}$$

$$\text{Clearance} = 7.7 - 7.2 = \underline{0.5\ FT}$$

water surface to high point $= 1.4 + 0.5 = \underline{1.9\ FT}$

Based on the above there would be enough clearance between the water surface and the bottom of the bridge 1 FT ± if bridge deck was 12 inches thick. Adjustments can also be made in sizing and grading MDP channel to make a satisfactory tie to Side Inlet No 1. We will therefore go with proposed side inlet as planned.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD - REACH 5		
BY Tom Jayo	DATE 1-26-87	CHECKED BY	DATE	JOB NO.
SUBJECT Needs For Side Inlet NO 1				SHEET 17 OF 21

1. Need Excavation Quantity including 2' over excation in Tailwater Pond
2. Need O&M Road & embankment earth fill quantity plus earth fill to fill Morrison Pond to elev 1332.5
3. Need Rock riprap quantity -
4. Need - Rock riprap spec - Done - see spec for other Side inlets
5. Need quantity for 24"x~~20~~ 18" CMP Arch - AL. pipe also line & grade -
6. Need structure excavation for 24 x ~~20~~ 18" CMP Arch
7. Need structure back fill for 24"x ~~20~~ 18" CMP Arch
8. Need animal guard design for end of 24x ~~20~~ 18" CMP Arch Done
9.

GUIDE FOR RATING SOILS FOR CORROSION TO UNCOATED METAL PIPE

Soil Property or Quality	Corrosivity Classes		
	Low (Slightly corrosive to non-corrosive)	Moderate (Moderately corrosive)	High (Severely to very severely corrosive)
Drainage clay and texture	somewhat excessively OR excessively drained - coarse OR well drained moderately coarse or medium OR somewhat poorly drained - coarse	Well drained - moderately fine OR moderately well drained - medium OR somewhat poorly drained - moderately coarse OR very poorly drained peats and mucks with water table at surface throughout the year	moderately well or well drained - fine OR moderately well drained - moderately fine OR somewhat poorly drained - medium or moderately fine OR poorly drained - coarse to moderately fine OR somewhat poorly, poorly very poorly drained - fine OR very poorly drained with fluctuating water table within 1 foot of surface OR peats and mucks with fluctuating water table
Total acidity 1/ (meq. H+/100 g.)	less than 8	8 through 12	more than 12
Conductivity saturation extract (mmhos/cc @ 25°C.)	less than 0.2	0.2 - 0.4	more than 0.4
Electrical resistivity at moisture equivalent. (ohm-cc @ 60°F.)	more than 5000	2000 - 5000	less than 2000

1/ Roughly equal to extractable acidity as determined by Soil Survey Laboratories, or sodium acetate cation exchange capacity (CEC, NaOAc) minus sum of bases (Ca+Mg+Na+K)

Morrison Farm - Soils Analysis by Bill Johnson - SCS

RWCD REACH 5
1/27/87

- Purpose - For Land leveling Morrison FLDS 5, 6 & 7

Sht 19 of 2

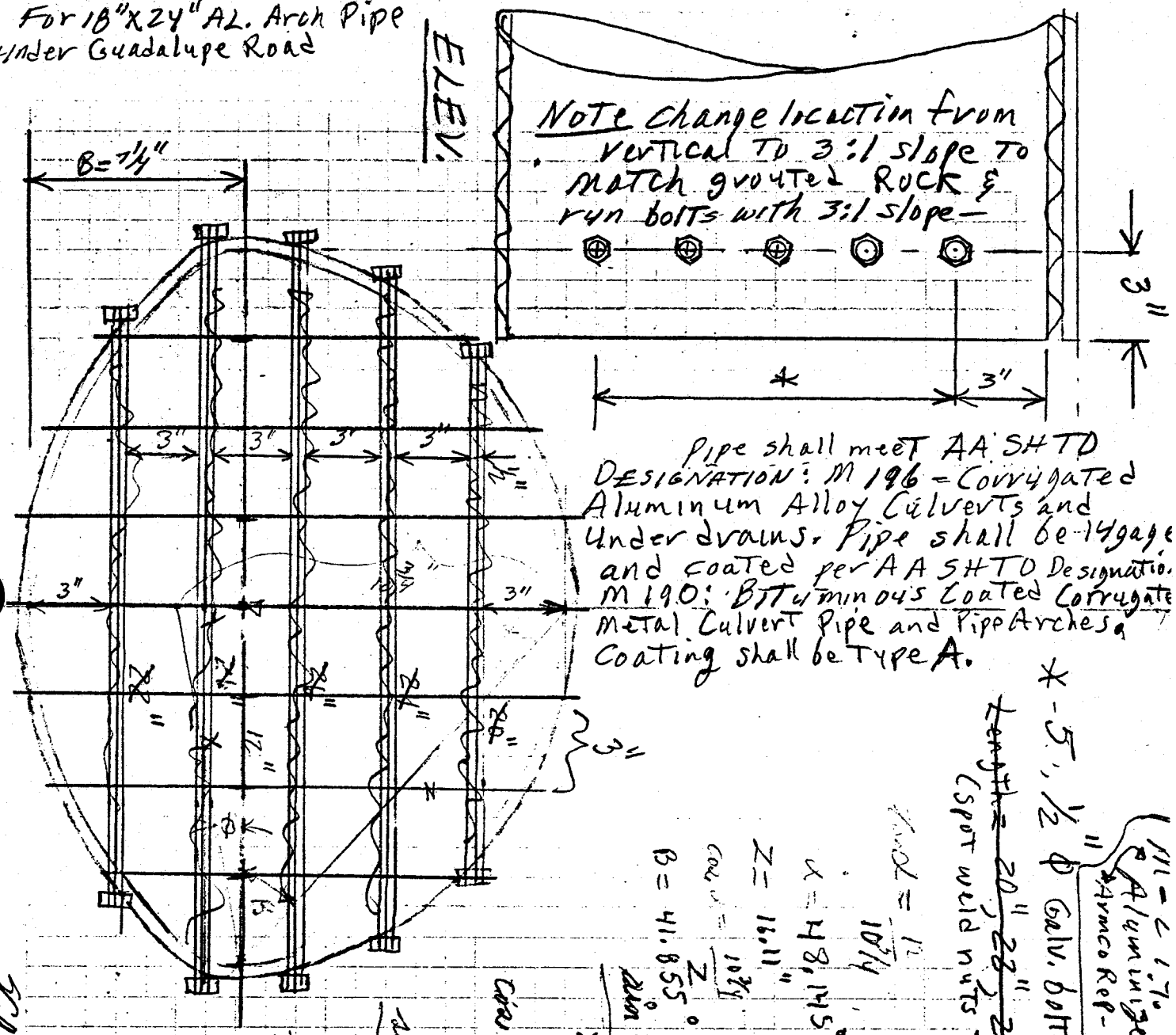
	Depth	Texture	pH	EC	SAR	% $CaCO_3$
Boring #1	5½'	CL	7.6	0.98	4.9	0.6
	7'	SCL	8.0	0.69	6.4	1.4
	8'	SCL	8.3	0.61	7.0	11.7
	9½'	L	8.5	0.63	8.0	10.2
	10½'	SCL	8.6	0.55	9.2	6.1
Boring #2	5'	SCL	8.0	0.53	8.7	0.4
	6'	CL	8.7	0.47	8.2	11.8
	7½'	SCL	8.5	0.52	7.5	11.5
	8½'	SCL	8.7	0.58	7.9	7.4
	9½'	L	8.7	0.51	7.9	7.7
	11'	CL	8.5	0.47	7.5	3.9
Boring #3	5½'	CL	8.6	0.54	5.8	11.3
	6½'	SCL	8.9	0.45	7.6	11.8
	8'	CL	9.1	0.50	8.3	11.5
	9½'	L	9.0	0.59	8.3	7.9
	10½'	L	8.9	0.59	8.3	4.4
Boring #4	5'	CL	8.3	0.68	8.0	3.7
	6'	SCL	8.3	0.58	6.8	4.3
	7'	CL	8.7	0.52	6.8	12.3
	8'	L	8.8	0.51	7.0	11.7
	9½'	L	8.7	0.47	6.8	7.4
	10½'	L	8.5	0.60	6.8	5.1

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACHS		
BY Tom Joyd DATE 2-4-86	CHECKED BY	DATE	JOB NO.
SUBJECT RODENT GUARD DETAILS			SHEET 20 OF 21

For 18"x24" AL. Arch Pipe under Guadalupe Road



Pipe shall meet AASHTO Designation: M 196 - Corrugated Aluminum Alloy Culverts and Underdrains. Pipe shall be 14 gage and coated per AASHTO Designation M 190: Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches. Coating shall be Type A.

* - 5', ½" Φ Galv. bolts and nuts @ 3" C-C. Length = 20", 22", 24", and 2 @ 26" (spot weld nuts to bolts)

(11 - 2 1.7 oz Aluminized Steel Type 2 Armco Rep - says to spec this - ?)

$\sin\alpha = \frac{12}{10\frac{3}{4}}$

$\alpha = 48.145°$

$Z = 11.11"$

$\cos\alpha = \frac{Z}{10\frac{3}{4}}$

$B = 41.855°$

$\sin 48.145$

$\cos\Phi = \frac{12}{X}$

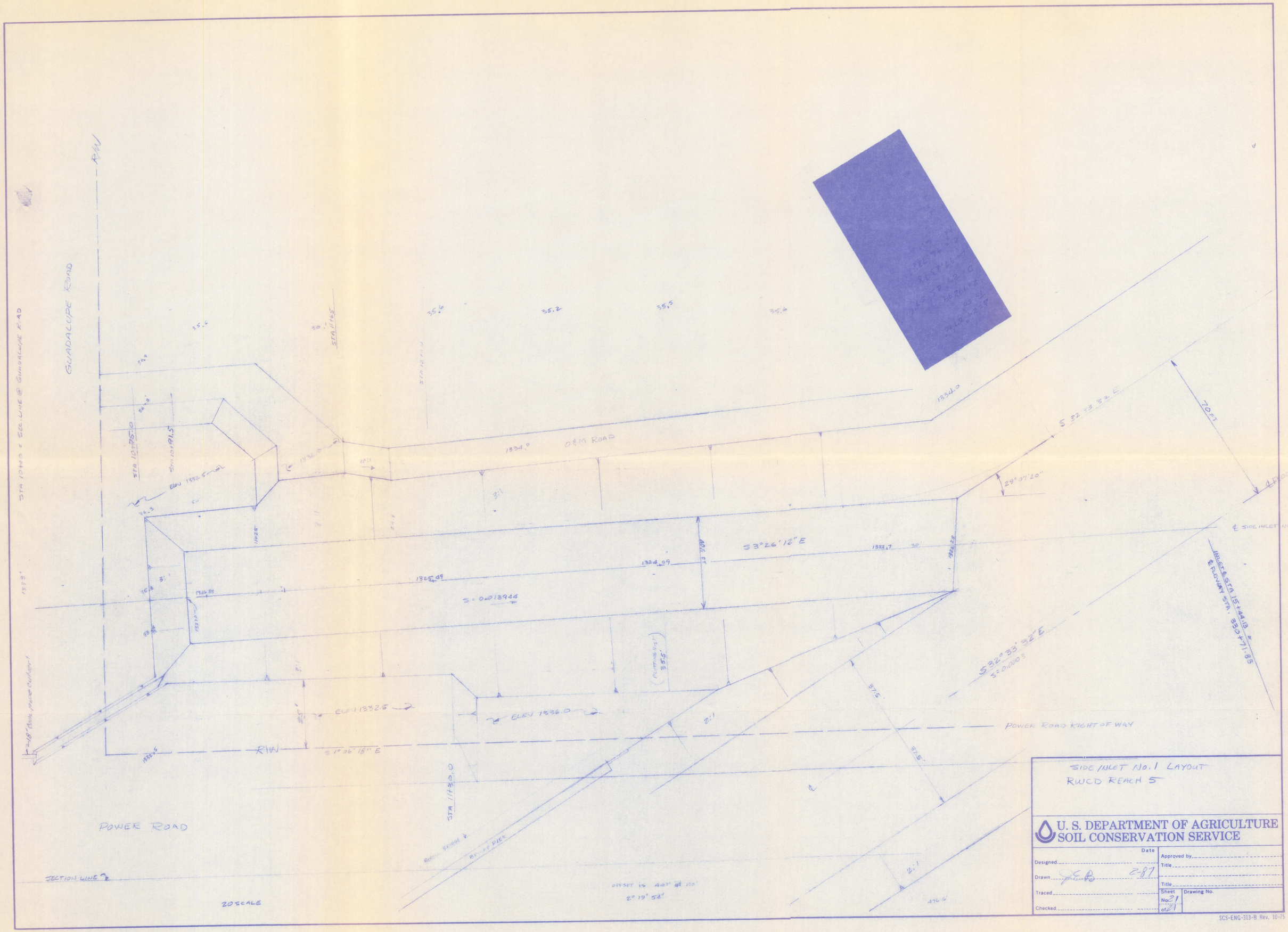
$\frac{\sin\alpha}{X} = \frac{\sin 41.855 + \Phi}{10\frac{3}{4} + Y}$

$X = \frac{\sin 48.145}{\sin 53.71} = 16.11$

$X = 12.072" = 10\frac{3}{4} + Y$

equivalent Circular Pipe = 21"

Corner radius = 3"
B = 7¼ in
AASHTO M 196


GUADALUPE ROAD
R/W
STA 10+70 = SCL LINE @ GUADALUPE RAD
STA 12+75.10
STA 10+91.5
ELEV 1332.5
STA 11+65
STA 12+10
35.6
35.2
35.5
35.6
1334.0
O&M ROAD
1334.0
S 32°33'32" E
70 FT
29°37'20"
℄ FLOODWAY
℄ SIDE INLET NO. 1
S 53°26'12" E
1324.09
1325.09
1322.7
S = 0.013944
INLET & STA 15+44.13 = ℄ FLOWLINE STA. 332+71.85
S 32°33'32" E
S = 0.0003
(PLOTTING SCALE) 355'
ELEV 1332.5
ELEV 1336.0
POWER ROAD RIGHT OF WAY
R/W
S 1°26'18" E
STA 11+30.0
POWER ROAD
SECTION LINE
20 SCALE
OFFSET IS 4.07' AT 100'
2° 19' 52"
476.6'
SIDE INLET No. 1 LAYOUT
RWCD REACH 5
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Date
Designed
Drawn 2-87
Traced
Checked
Approved by
Title
Title
Sheet No. 21 of 21
Drawing No.
SCS-ENG-313-B Rev. 10-75

LAYOUT

Inserts — LAYOUT

COMPUTATION SHEET

STATE ARIZONA PROJECT RWCD REACH 5 Alinement

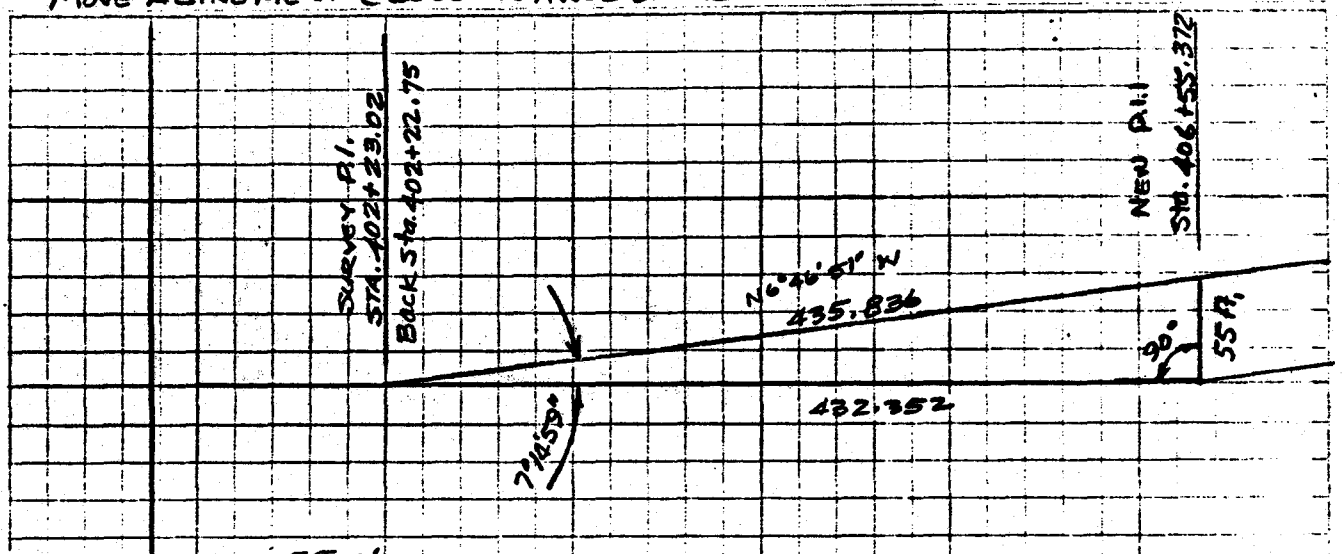
BY J.E.B. DATE 3 NOV 86 CHECKED BY DATE

SUBJECT ESTABLISH OFFSET ℄ SHEET 1 OF

As a suggestion from Lee Soule WTSC and The Flood Control District of Maricopa County the Floodway will be moved to the west side of the Right of way leaving only enough room for surface drain ditch and road ramps. Since bridges are constructed at Guadalupe, Power, and Elliot Roads we must return to the planning alinement at the bridges. Observation of the plans indicate we can use the existing curves and make the ℄ switch at those locations. Begin at Elliot Road Bridge sta 381+76.56 use planning ℄ survey ℄ and proceed down stream. At first curve (p.i. sta 402+23.02) continue south (downstream) 471.66 ft which is 60 ft right (west) of planning ℄. This p.i. station is 406+94.68. Parallel the survey plan ℄ at 60' right (west) to New p.i. sta 453+44.75 At this point the ℄ moves to a 50 ft right (west) offset. Run parallel to survey planning ℄ to New p.i. sta 480+25.67. From p.i. 480+25.67 return to survey ℄ and tie into the Reach 4 alinement.

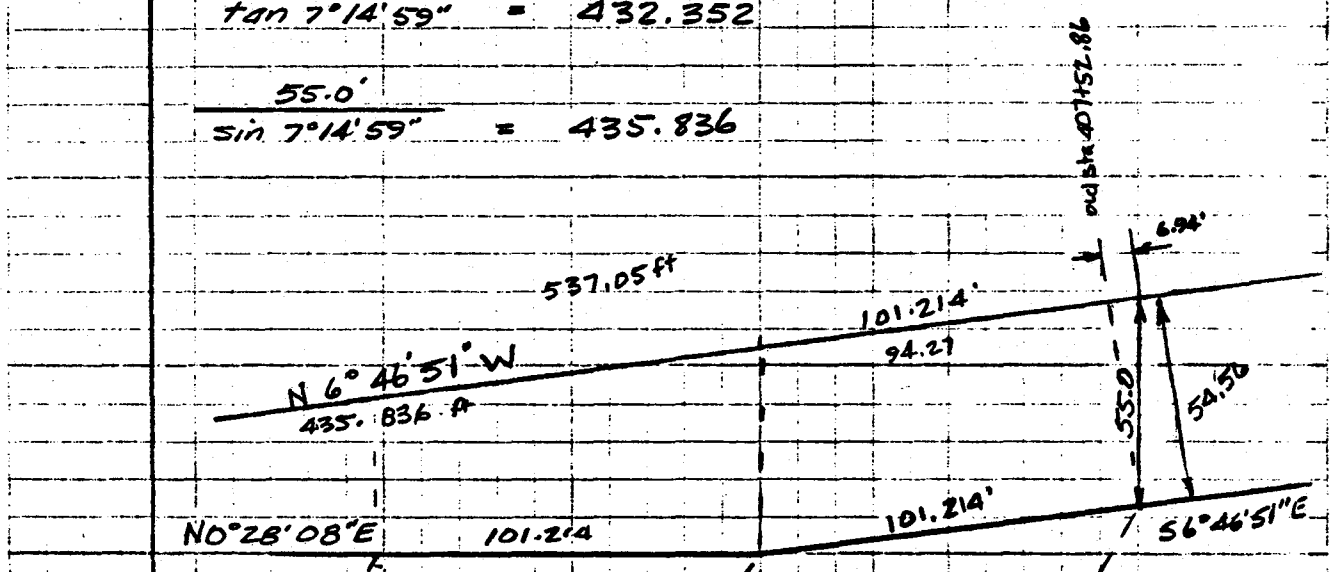
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: ARIZONA
PROJECT: APACHE JCT-GILBERT W.P.P. - RWCD FLOWAY REACH 5
BY: J.E.B. DATE: 5 NOV. 86
CHECKED BY: DATE: JOB NO.:
SUBJECT: MOVE ALINEMENT CLOSE TO RWCD CANAL
SHEET 2 OF



$$\frac{55.0'}{\tan 7°14'59''} = 432.352$$

$$\frac{55.0'}{\sin 7°14'59''} = 435.836$$



DO NOT USE STATIONS AS SHOWN
SEE SHEET 7

PT NO.= 0.
N-854,248.5120 R5-9
E-571,804.2580

****

BRNG=S-89.31520-E
DIST= 187.8700

PT NO.= 1. ℄
N-854,246.9746
E-571,992.1217

****

BRNG=S-0.28080-W
DIST= 1,188.3400

PT NO.= 2. PLANNING P.I.
N-853,058.6744
E-571,982.3968

****

BRNG=S-0.28080-W
DIST= 432.3520

PT NO.= 3. New P.I.
N-852,626.3369 55' off survey
E-571,978.8586

****

BRNG=S-6.46510-E
DIST= 101.2140

PT NO.= 4. P.T.
N-852,525.8309
E-571,990.8091

****

BRNG=S-89.31520-E
DIST= 55.0000

PT NO.= 5. old ℄
N-852,525.3808
E-572,045.8073

****

BRNG=N-6.46510-W
DIST= 537.0500

PT NO.= 6. PLAN P.I.
N-853,058.6742
E-571,982.3968

COMPUTATION SHEET

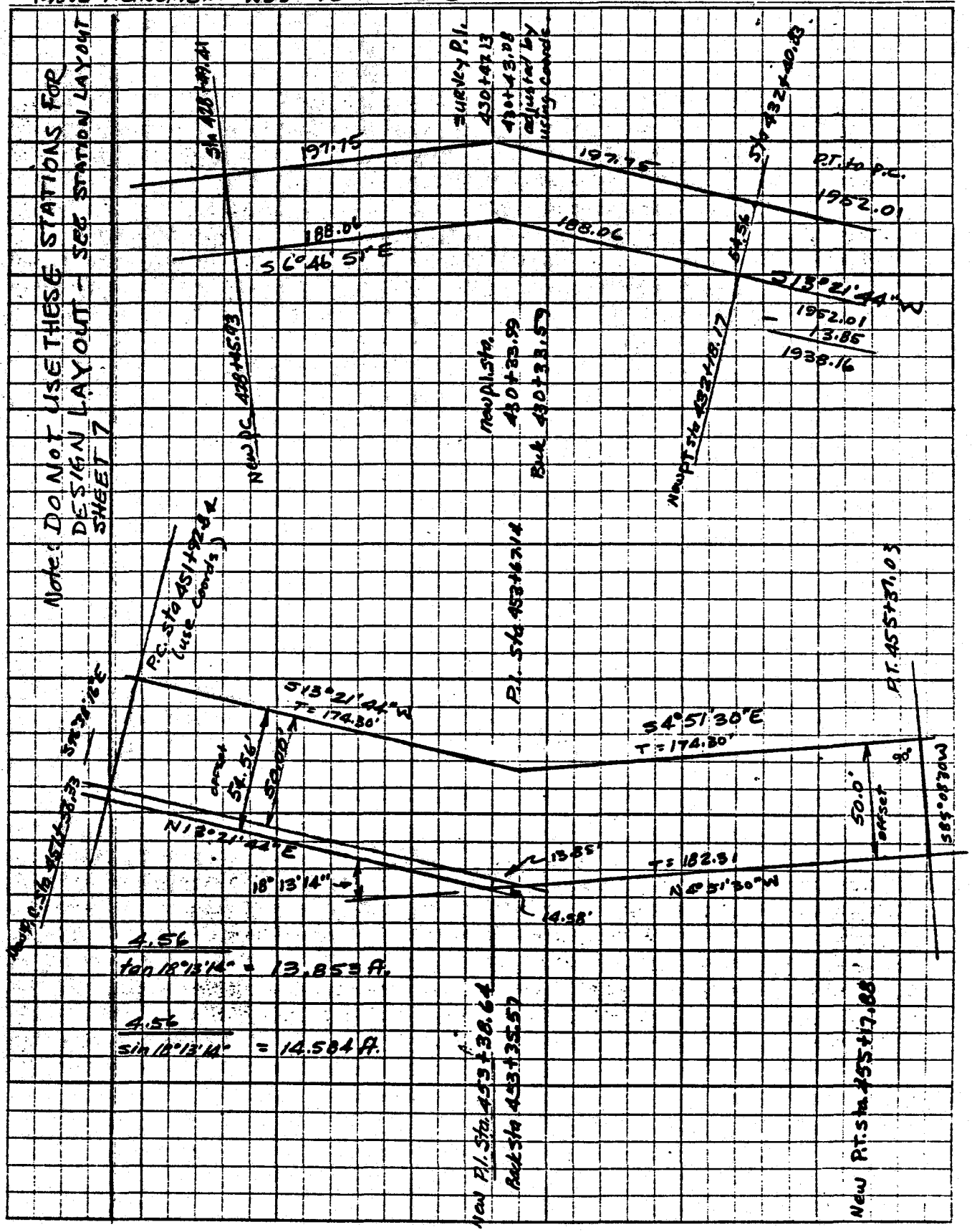
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT. - GILBERT W.P.P. - RWCD FLOWAY REACH 5		
BY J.E.B.	DATE 5 NOV. 86	CHECKED BY	DATE	JOB NO.

SUBJECT MOVE ALINEMENT WEST TO RWCD CANAL

SHEET 3 OF



COMPUTATION SHEET

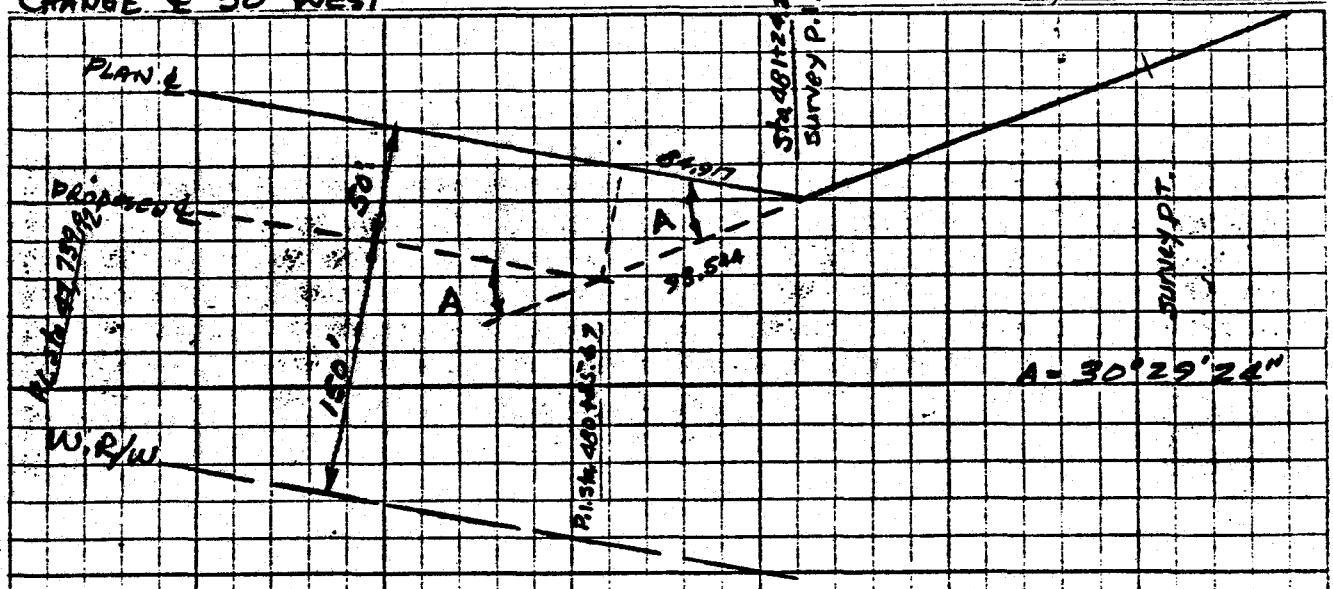
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	RWCD REACH 5		
BY J.E.B.	DATE 31 OCT. 86	CHECKED BY	DATE	JOB NO.

SUBJECT CHANGE ℄ 50' WEST

SHEET 4 OF



$$\frac{50'}{\sin 30.49^\circ} = 98.544$$

$$\frac{50'}{\tan 30.49^\circ} = 84.917$$

WTSC WORK PLAN P.I. STA 480+12.03

move station − 84.92 ft up & 50' RIGHT

New P.I. sta 479+27.11 50' RT old ℄

− 2 85.75

New P.C. Sta 476+41.36 50' RT of old ℄

+ 5 57.95 length curve

New P.T. sta. 481+99.31 back on Reach 4 ℄

COMPUTATION SHEET

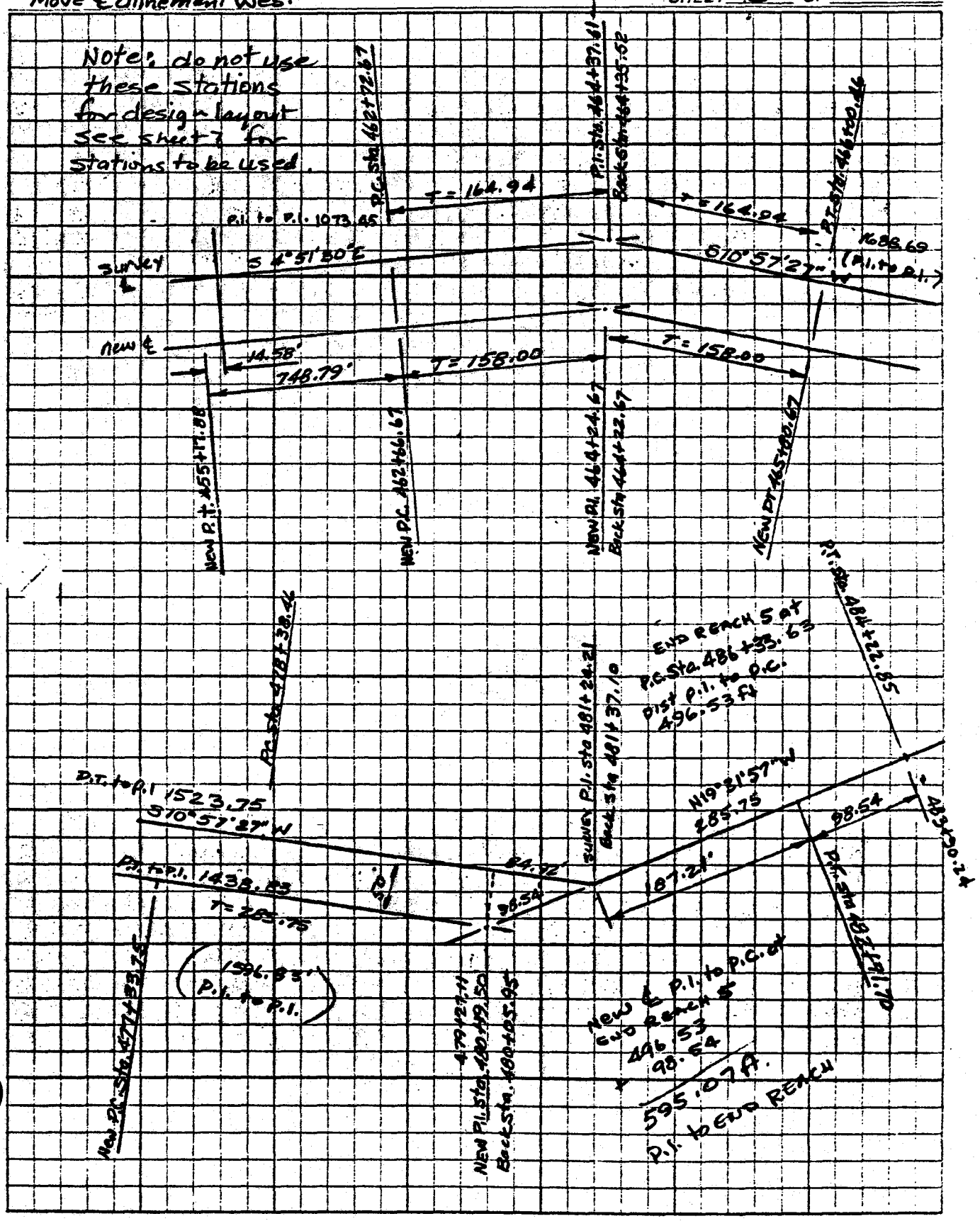
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT. - GILBERT W.P.P. - RWCD REACH 5		
BY J.E.B.	DATE 6 Nov. 1986	CHECKED BY	DATE	JOB NO.

SUBJECT Move & alinement west

SHEET 5 OF



COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT - GILBERT W.P.P. - RWCD REACH 5		
BY J.E.B.	DATE 6 NOV. 1986	CHECKED BY	DATE	JOB NO.

SUBJECT TRAVERSE DOWN SURVEY & RETURN ON NEW ℄ SHEET 6 OF

BEGIN AT CONTROL POINT R5-9
Coords. N854,248.512 & E 571,804.258

S89° 31' 52" E	187.87	
S 0° 28' 08" W	1188.34	
S 6° 46' 51" E	2824.41	
S 13° 21' 44" W	2324.06	
S 4° 51' 30" E	1073.45	
S 10° 57' 27" W	1688.69 ✓	
N 19° 31' 57" W	98.54	
N 10° 57' 27" E	1596.83	
N 4° 51' 30" W	1089.10	
N 13° 21' 44" E	2308.53	
N 6° 46' 51" W	2385.85	
N 0° 28' 08" E	432.35	= POINT 2?

PT NO.= 9. R5-9
N-854,248.5120
E-571,804.2580

****

BRNG=S-89.31520-E
DIST= 187.8700

PT NO.= 1. ℄ sta 390+34.68
N-854,246.9746
E-571,992.1217

****

BRNG=S-0.28080-W
DIST= 1,188.3400

PT NO.= survey ℄ sta 402+23.02
N-853,058.6744
E-571,982.3963

****

BRNG=S-6.46510-E
DIST= 2,824.4100
survey ℄ sta
PT NO.= 3. 430+47.13
N-850,254.0210
E-572,315.8800

****

BRNG=S-13.21440-W
DIST= 2,324.0600
survey ℄ sta.
PT NO.= 4. 453+67.14
N-847,992.8769
E-571,778.7747

****

BRNG=S-4.51300-E
DIST= 1,073.4500
survey ℄ sta.
PT NO.= 5. 464+37.61
N-846,923.2836
E-571,869.6877

****

BRNG=S-10.57270-W
DIST= 1,688.6900
survey ℄ sta
PT NO.= 6. 481+24.21
N-845,265.3810
E-571,548.7001

BRNG=N-19.31570-W
DIST= 98.5400
DESIGN ℄ sta
PT NO.= 7. 480+26.30
N-845,358.2502
E-571,515.7541

****

BRNG=N-10.57270-E
DIST= 1,596.8380
DESIGN ℄ sta.
PT NO.= 8. 464+31.56
N-846,925.9675
E-571,819.2809

****

BRNG=N-4.51300-W
DIST= 1,089.1000
DESIGN ℄ sta.
PT NO.= 10. 453+31.56
N-848,011.1545
E-571,727.0424

****

BRNG=N-13.21440-E
DIST= 2,308.5300
DESIGN ℄ sta.
PT NO.= 11. 430+45.31
N-850,257.1891
E-572,260.5586

****

BRNG=N-6.46510-W
DIST= 2,385.8500
DESIGN ℄ sta.
PT NO.= 12. 406+55.39
N-852,626.3502
E-571,978.8570

****

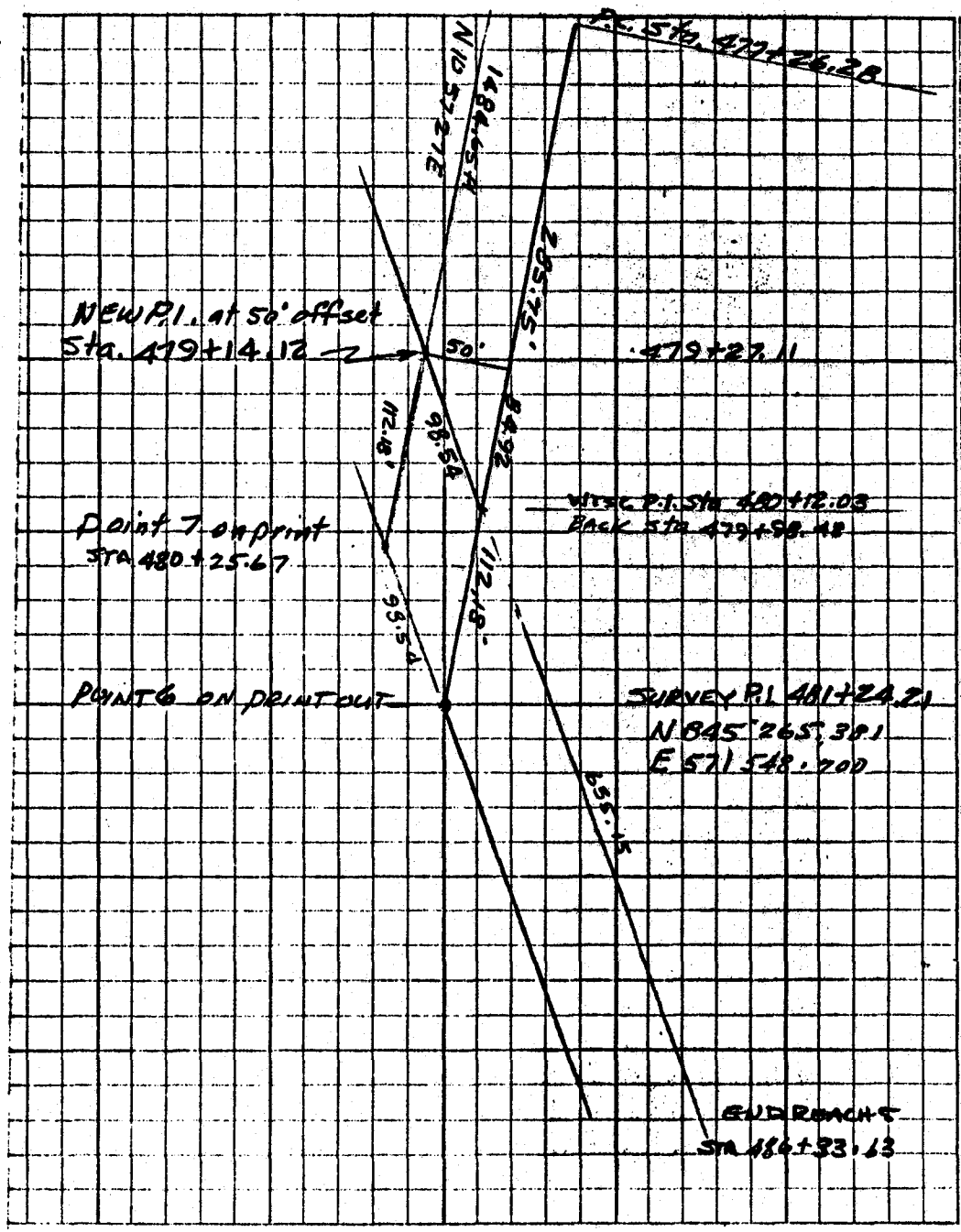
BRNG=N-0.28080-E
DIST= 432.3500
TIE BACK TO SURVEY ℄ PT 2
PT NO.= 2. check
N-853,058.6857 058.674
E-571,982.3952 982.397

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: ARIZONA
BY: J.E.B.
DATE: 18-Nov-86
PROJECT: AYMCHG JCT.-GILBERT WPP-RWCD REACH 5
CHECKED BY:
DATE:
JOB NO.:
SUBJECT: RELOCATE P.I. TO TIE INTO REACH 4 ALINEMENT
SHEET 6A OF



SEE PAGE 6 PRINTOUT

PT NO.= 0. (5)
N-846,923.2836
E-571,869.6877

****

BRNG=S-10.57270-W
DIST= 1,688.6900

PT NO.= 1.
N-845,265.3810
E-571,548.7001

****

BRNG=N-19.31570-W
DIST= 98.5400

P.I. on survey ℄ STA 480+26.30

PT NO.= 2.
N-845,358.2502
E-571,515.7541

****

BRNG=N-10.57270-E
DIST= 112.1800

STA 479+14.12 NEW P.I.

PT NO.= 3.
N-845,468.3850
E-571,537.0774

****

BRNG=N-10.57270-E
DIST= 1,484.6500

PT NO.= 4. (8)
N-846,925.9675
E-571,819.2809

****

Coords at end of Reach 5

Point 3 N845 468.385 E 571 537.077
+ 691.468 245.303
844,776.917 E 571 782.380

COMPUTATION SHEET

SCS-ENG-5234 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT.-GILBERT W.P.P.- RWCD REACH 5		
BY J.E.B. / DATE 7 NOV 1986	CHECKED BY	DATE	JOB NO.

SUBJECT: COMPUTE NEW STATIONS ON ℄ MOVED WEST — SHEET 7 OF

BEGIN AT SURVEY ℄ P.I. Sta 402+23.02

Distance to new P.I.	4 32.35
New P.I. Station	406+55.37
− Tan dist	1 01.21
New P.C. Station	405+54.16
+ length arc	2 02.16
New P.T. Station	407+56.32
− Tan dist	1 01.21
Back Sta ℄ P.I.	406+55.11
Distance P.I. to P.I.	23 85.85
New P.I. Station	430+40.96
− tan distance	1 97.75
New P.C. Station	428+43.21
+ length arc	3 91.42
New P.T. Station	432+34.63
− tan dist	1 97.75
Back sta at P.I.	430+36.88
Distance P.I. to P.I.	23 08.53
New P.I. Station	453+45.41
− tan dist	1 74.30
New P.C. Station	451+71.11
+ length arc	3 45.65
New P.T. station	455+16.76
− tan dist.	1 74.30
Back sta. at P.I.	453 42.46
Distance P.I. to P.I.	10 89.10
New P.I. Station	464+31.56 ✓ 464+31.56
− tan dist	1 64.94
New P.C. Station	462+66.62
+ length arc	3 27.79
New P.T. station	465+94.41
− tan dist.	1 64.94
Back sta. at P.I.	464+29.47
Distance P.I. to P.I.	14 84.65 ✓
New P.I. Station	479+14.12
− tan dist.	3 00.00
New P.C. Station	476+14.12

COMPUTATION SHEET

SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
ARIZONA	APACHE JCT.- GILBERT W.P.P.- RWCD REACH 5			
BY J.E.B.	DATE 7 NOV 1986	CHECKED BY	DATE	JOB NO.

SUBJECT Compute NEW STATIONS ON ℄ MOVED WEST SHEET B OF

New P.C. Station 476 + 14.12
+ length arc 5 85.77
New P.T. Station 481 + 99.89
- tan dist. 3 00.00
Back Station at P.I. 478 + 99.89
Dist. P.I. to P.C. 7 33.69

END REACH 5 at STA 486 + 33.58

Sta 486 + 33.58 = Reach 4 sta. 485 + 88.08

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
ARIZONA	APACHE JCT. - GILBERT WRP. - RWCD REACH 5			
BY J.E.B.	DATE 25 NOV. 86	CHECKED BY	DATE	JOB NO.

SUBJECT CHECK SURVEY & COORDS

SHEET 9 OF

SINCE I HAVE CHOSEN TO USE CONTROL POINT R5-9 SOUTH OF ELLIOT ROAD I WILL ALSO USE IT TO CHECK COORDINATES NORTH OF ELLIOT ROAD. - STEP 1 is to Check SURVEY & COORDS and tie into section corner at intersection of Guadalupe & Power Roads. Then step 2 will be to offset design & so floodway fits close to west Right of way

CONTROL POINT R5-9 coords. N854,248.512
E571,804.258

BEARING	QUAD	DISTANCE
S 89°31'52"E	2	187.87
N 0°28'08"E	1	1,146.74
N 12°54'15"W	4	2769.19
N 32°25'40"W	4	2285.02
N 21°12'27"W	4	426.33
S 68°47'33"W	3	100.00
S 88°40'38"E	2	231.00

R5-9.
854,248.5120
571,804.2580
10.
2.
89 31 52.0
187.8700
10.
854,246.9745
571,992.1217
1.
28 8.0
1,146.7400
11.
855,393.6761
572,001.5061

4.
12 54 15.0
2,769.1900
12.
858,092.9301
571,383.0878
4.
32 25 40.0
2,285.0200
13.
860,021.6425
570,157.7776
4.
21 12 27.0
426.3300
14.
860,419.0999
570,003.5542

3.
68 47 33.0
100.0000
15.
860,382.9252
569,910.3266
2.
88 40 38.0
231.0000
16.
860,377.5926 = 860,376.634
570,141.2650 = 570,139.894

could have checked better but I am going to use & for my layout

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	PROJECT APACHE JCT. - GILBERT W.P.P. - RWCD REACH 5		
86	CHECKED BY	DATE	JOB NO.
DS FOR SURVEY ℄ SOUTH ELLIOT Rd			SHEET 9A OF

Check original ℄
Begin at R5-9 @ Sta. 390+34.68
Coord. N854,248.512 & E571804.258
S 89° 31' 52" E, 187.87 ft
S 00° 28' 08" W, 1188.34
S 06° 46' 51" E, 2824.38
S 13° 21' 44" W, 2324.06
S 04° 51' 30" E, 1073.45
S 10° 57' 27" W, 1234.98
N 79° 02' 33" W, 199.85
END R5-2 @ sta 476+70.50
Coord. N845748.525, & E571,437.993

PT NO.= 8. R5-9
N-854,248.5120
E-571,804.2580

****

BRNG=S-89.31520-E
DIST= 187.8700

PT NO.= 1.
N-854,246.9746
E-571,992.1217

****

BRNG=S-0.28080-W
DIST= 1,188.3400

PT NO.= 2.
N-853,058.6744
E-571,982.3968

****

BRNG=S-6.46510-E
DIST= 2,824.3900

PT NO.= 3.
N-850,254.6508
E-572,315.8764

****

BRNG=S-13.21440-W
DIST= 2,324.0600

PT NO.= 4.
N-847,992.9067
E-571,778.7711

****

BRNG=S-4.51300-E
DIST= 1,073.4500

PT NO.= 5.
N-846,923.3134
E-571,869.6841

****

BRNG=S-10.57270-E
DIST= 1,234.9800

PT NO.= 6.
N-845,710.8490
E-571,634.9381

****

BRNG=N-79.82330-W
DIST= 199.8500

PT NO.= 7. .53
N-845,746.8366 R5-2

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE

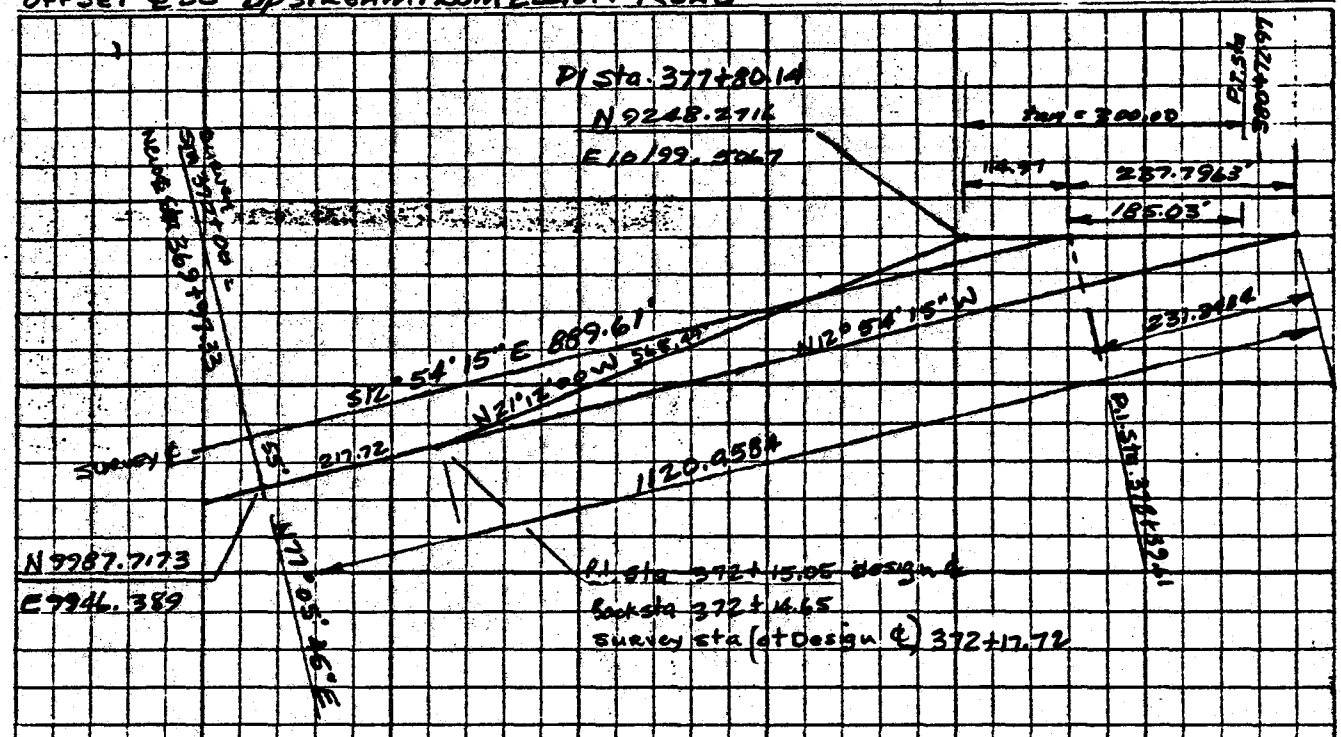
SOIL CONSERVATION SERVICE

GPO : 1969 O—364-109

STATE	PROJECT		
ARIZONA	APACHE JCT - GILBERT W.P.P. - RWCD REACH 5		
BY J.E.B.	DATE 24 Nov 1986	CHECKED BY	DATE	JOB NO.

SUBJECT OFFSET ℄ 55' UP STREAM FROM ELLIOTT ROAD

SHEET 10 OF



MAKE CORRECTIONS FROM P.T. STA 380+72.97 (Same for Survey ℄ & Design ℄)

Length of curve — 592.83 Design ℄

P.C. STA 374+80.14 Design ℄

Tan + 3 00.00

P.I. STA 377 + 80.14 Design ℄

P.I. to P.I. — 5 65.49

BACK STA 372+14.65

Tan + 1 15.00

P.T. STA 373+29.65

L. Arc — 2 29.60

P.C. STA 371 + 00.05

+ 1 15.00

P.I. STA 372+15.05

— 2 17.72

STA 369 + 97.33 = 370+00.00

0 • Sta 370+00 survey ℄
10,000.0000
10,000.0000
1 • TRAVERSE PRESENT ℄
& 55' offset line 2 •
12 54 15.0
889.6100
1 • SURVEY P.I. Coord
9,132.8571
10,198.6685
3 •
28 8.0
237.7963
2 • intersect survey ℄ & the 55' off set line
8,895.0688
10,196.7225
4 •
12 54 15.0
1,120.9584
3 • SURVEY ℄ STA 370+00 -55' Rt.
9,987.7173
9,946.3890
1 •
77 5 45.0
55.0000
4 • Return to sta 370+00 ℄
10,000.0000
9,999.9999

1 •
9,133.3055
10,198.5658
1 •
28 8.0
114.9700
A 2 • COORDS FOR NEW P.I.
9,246.2716
10,199.5067

-2 • BEARING-BEARING INTERSECT
2 • New P.I. Coord.
9,248.2716
10,199.5067
4 •
21 12 0.0
4 • SURVEY ℄ STA. 370+00 55' Rt. COORDS
9,987.7173
9,946.3890
2 •
12 54 15.0
4 •
21 12 0.0
565.4911 A
0 • New P.I. Coords
9,775.4923
9,995.0112
4 •
12 54 15.0
217.7236 A

2 • NEW CURVE DATA
8 17 45.0
4 •
115.0000
1 •
1,585.7357
2 •
8 17 45.0
3 •
229.5980
4 •
115.0000
5 •
229.3975

2 • NEW CURVE DATA
21 40 8.0
4 •
300.0000
1 •
1,567.5347
2 •
21 40 8.0
3 •
592.8313
4 •
300.0000
5 •
589.3046

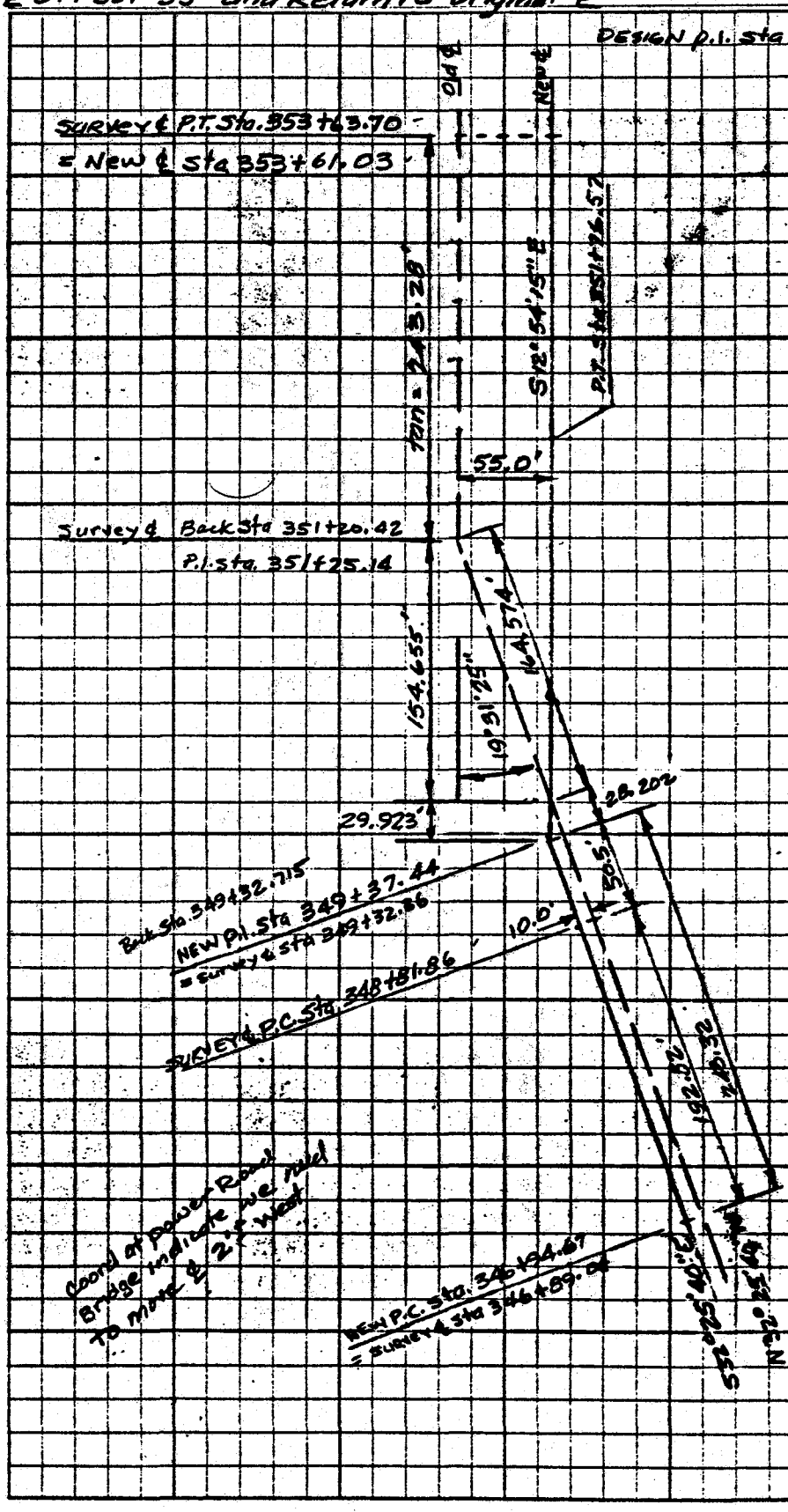
COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT.-GILBERT W.P.P.-RWCD REACH 5		
BY J.E.B.	DATE 25 NOV-1986	CHECKED BY	DATE	JOB NO.

SUBJECT ℄ OFFSET 55' and Return to original ℄ SHEET 11 OF



Solve rt. triangle
Known side = 55.0 ft.
Known angle = 19°31'25"

55.0 ft / tan 19°31'25" = 155.112'

55.0 ft / sin 19°31'25" = 164.574'

Solve rt. triangle
Known side = 10.0 ft.
Known angle = 19°31'25"

10.0 ft. / tan 19°31'25" = 28.202

10.0 ft. / sin 19°31'25" = 29.923

New ℄ sta.	353+61.030
−	243.280 Survey Tan
−	155.112
−	29.923
Back P.I. sta	349+32.715
+ tan dist	243.28
New P.T. sta	351+75.995
− L curve	481.84
New P.C. sta	346+94.155
+ tan dist	243.28
New P.I. sta.	349+37.435

P.I. sta.	372+15.05
Back P.I. sta.	349+32.72
	2282.33

COMPUTATION SHEET

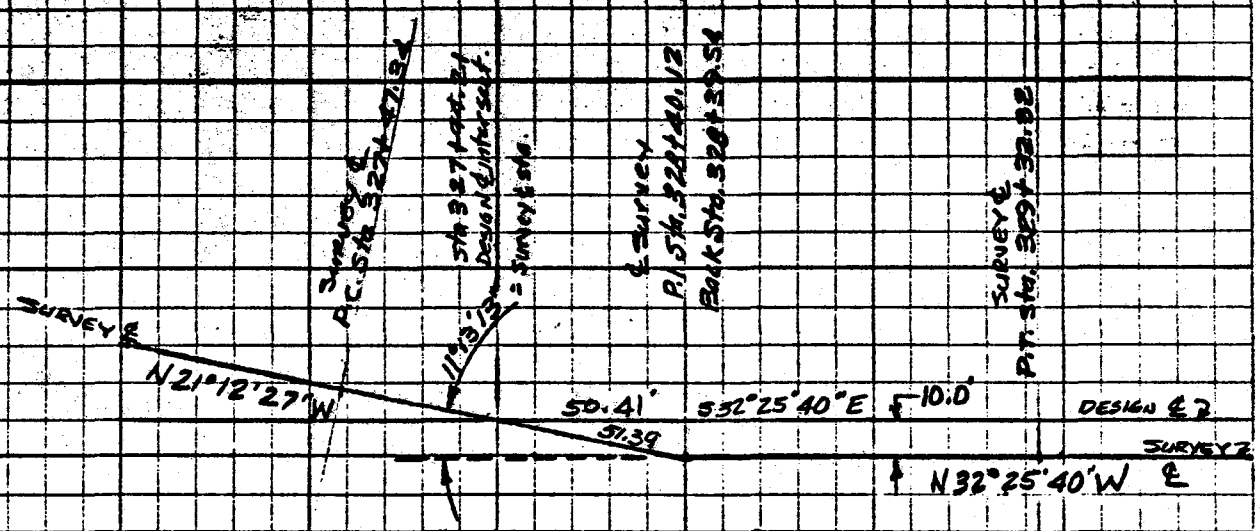
SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT. - GILBERT W.P.P. - RWCD REACH 5		
BY J.E.B.	DATE 28 NOV. 1986	CHECKED BY	DATE	JOB NO.

SUBJECT RETURN TO SURVEY ℄ SHEET 12 OF

AFTER REVIEWING SURVEY DATA FROM RIGHT OF WAY, SURTEC AND S.C.S. I SEE ENOUGH FLUCTUATION IN BEARINGS TO ASSUME WE SHOULD NOT PUT AN ANGLE POINT AT STA 340+00± ON OUR DESIGN THE CORRECTION CAN BE MADE (IF NEEDED) DURING LAYOUT.



$$\frac{10.0\ ft}{\tan 11°13'13''} = 50.41\ ft$$

$$\frac{10.0\ ft}{\sin 11°13'13''} = 51.39\ ft$$

FIND DISTANCE FROM NEW ℄ P.I. to P.I.

Survey ℄ sta. 349+32.36		New P.I. Sta	349+37.42
Survey ℄ Back Sta. 328+39.54		−	2092.82
2092.82 ft			328+44.62
		−	50.41
DESIGN ℄ P.I. sta. 349+38.00		New P.I. Back Sta.	327+94.21
DESIGN ℄ Back Sta 327+95.01		Tan	+ 92.78
		New P.T. Sta.	328+86.99
S 32°28'52"E 214.99 ft		L. curve	− 184.98
		New P.C. Sta	327+02.01
		tan	+ 92.78
		New P.I. Sta	327+94.79

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT. - GILBERT W.P.P. - RWCD REACH 5		
BY J.E.B.	DATE Dec/, 1986	CHECKED BY	DATE	JOB NO.

SUBJECT TRAVERSE UP SURVEY ℄ & RETURN ON NEW ℄ SHEET 13 OF

BEGIN AT POINT R5-9 N854248.512
E571804.258

QUAD	BEARING	DISTANCE
2	S89°31'52"E	187.87
1	N00°28'08"E	1146.74
4	N12°54'15"W	2769.19
4	N32°25'40"W	2285.02
4	N21°12'27"W	51.39
2	S32°25'40"E	2143.23
2	S12°54'15"E	2282.33
2	S21°12'00"E	565.49
3	S00°28'08"W	1261.71

0 • R5-9
854,248 • 5120
571,804 • 2580
1 • ℄
2 •
89 31 52 • 0
187 • 8700
1 • ℄ Sta 390+34.88
854,246 • 9745
571,992 • 1217
1 •
28 8 • 0
1,146 • 7400
2 • P.I. Sta. 378+82.61
855,393 • 6761
572,001 • 5061
4 •
12 54 15 • 0
2,769 • 1900
3 • P.I. Sta. 351+25.14
858,092 • 9301
571,383 • 0078

2 •
12 54 15 • 0
2,282 • 3300
7 • DESIGN ℄ Sta. 372+15.05
856,035 • 8305
571,798 • 1569
2 •
21 12 0 • 0
565 • 4900
8 • DESIGN ℄ Sta. 377+80.48
855,508 • 6107
572,002 • 6520
3 •
28 8 • 0
1,261 • 7100
9 • POINT 1 check back
854,246 • 9430
571,992 • 3267
ANGLE ERROR 92 • 1217

4 •
32 25 40 • 0
2,285 • 0200
4 • P.I. Sta. 328+40.12
860,021 • 6425
570,157 • 7776
4 •
21 12 27 • 0
51 • 3900
5 • DESIGN ℄ Sta. 327+94.79 *
860,069 • 5522
570,139 • 1875
2 •
32 25 40 • 0
2,143 • 2300
6 • DESIGN ℄ Sta. 349+37.44
858,260 • 5202
571,288 • 4647

COMPUTATION SHEET

SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT. - GILBERT WPP RWCD REACH 5		
BY J.E.B.	DATE 4DEC 1986	CHECKED BY	DATE	JOB NO.

SUBJECT LOCATE P.I. between Power & Guadalupe Roads

SHEET ____ OF ____

SECTION CORNER Coords N 860 376.634
(SCS COORDS.) E 570 139.894

BEARING S89°19'43" W and DIST. 150 ft.

(150') (cos 0°40'17") = 149.990

E 570 139.894 − 149.990 = E569 989.904

(150') (sin 0°40'17") = 1.758

N 860 376.634 − 1.758 = N 860 374.876

POINT 1 N860 069.5522 ← DESIGN & intersects
E 570 139.1875 SURVEY ℄
Bearing N32°25'40" W

POINT 2 N860 374.876 ← ℄ FLOODWAY at Sec lines
E 569 989.904 on Guadalupe Road
Bearing S16°10'00" E

```
-2.
 1.
 860,069.5500
 570,139.1875
              4.
  32 25 40.0
 2.
 860,374.8760
 569,989.9040
              2.
  16 10  0.0
 ..............
              4.
  32 25 40.0
    208.4443      A
 0.
 860,245.4911
 570,027.4121
              4.
  16 10  0.0
    134.7119      A
 ..............
```

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
ARIZONA	APACHE JCT. - GILBERT W.P.P., RWCD REACH 5			
BY J.E.B	DATE Dec. 3-1986	CHECKED BY	DATE	JOB NO.

SUBJECT TRAVERSE SURVEY ℄ & RETURN ON DESIGN ℄ SHEET 13 OF

BEGIN AT POINT R5-9 N854248.512
E571,804.258

QUAD	BEARING	DISTANCE
2	S89°31'52"E	187.87
1	N00°28'08"E	1146.74
4	N12°54'15"W	2768.73
4	N32°28'52"W	2285.02
4	N21°12'29"W	51.15
2	S32°28'52"E	2142.99
2	S12°24'15"E	2281.80
2	S21°12'00"E	565.49
3	S00°28'08"W	1261.71

COMPUTATION SHEET

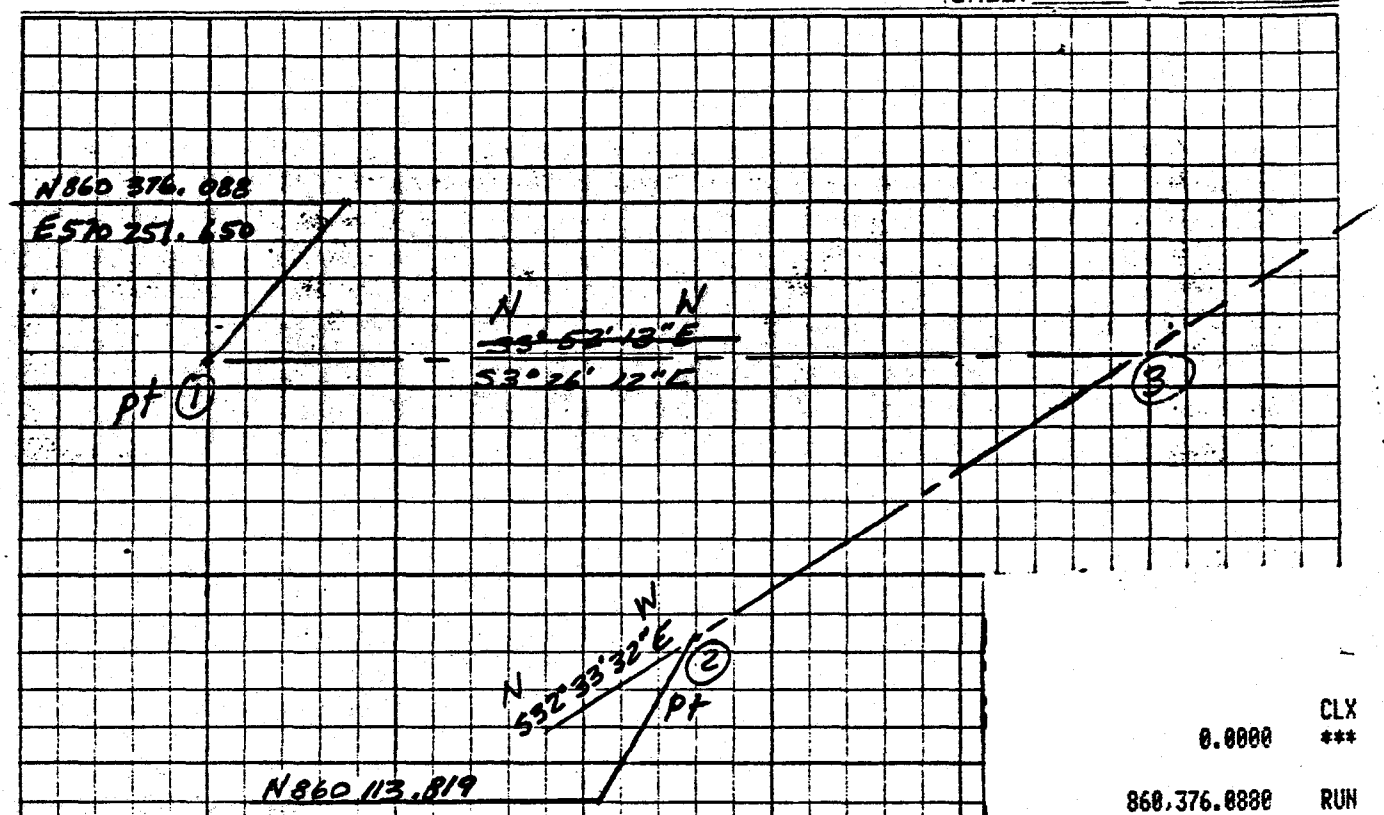
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
ARIZONA	APACHE JCT.-GILBERT W.P.P.-RWCD REACH 5		
BY J.E.B.	DATE 17FEB.87	CHECKED BY	DATE	JOB NO.

SUBJECT

SHEET ____ OF ____



TAPE CALCULATION By Noller Herbert

~~Bearing from pt 1 : N 352° 13' W~~

~~dist from pt 1 :~~

Distance 1 → 3 544.13 ~~22'~~ ~~551.64~~

Distance 2-3 333.26 ~~341.8398'~~

$$\boxed{\begin{aligned} N3 &= 859,\ 832.933\ \ \cancel{825.7031} \\ E3 &= 570,\ 284.2682\ \ \cancel{288.8846} \end{aligned}}$$

284.268

```
                    CLX
        0.0000      ***

      860,376.0880  RUN
E1=?
      570,251.6500  RUN
N2=?
      860,113.8190  RUN
E2=?
      570,104.9180  RUN
BRG1=?
            3.2612  RUN
QD=?
            4.0000  RUN
BRG2=?
           32.3332  RUN
QD=?
            4.0000  RUN

S 3.2612 E
DIST1=544.1334

S 32.3332 E
DIST2=333.2617

N3=859,832.9331
E3=570,284.2682
                    RUN

S 29.1737 E
DIST1-3=700.5257
```

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1969 O—364-125

STATE		PROJECT		
BY	DATE	CHECKED BY	DATE	JOB NO.
SUBJECT				SHEET ____ OF ____

℄ - ℄ intersect STA 330+71.88
DIST 33.26

WALK ON BRIDGE STA 327+38.62

NEW P.T. STA 327+10.01

BACK P.I. STA. 326+10.00

NEW P.C. STA 325+11.35

APPROX ℄ POWER ROAD BRIDGE & ℄ FLOODWAY
Intersection =
WALK STA 327+38.62
℄ pier underwalk to ℄ dist 76.5

℄ FLOODWAY STA = 327+151.2

0. 248
854,428.5120 R5-9
571,804.2580
1.
2.
39 31 52.0
187.8700
1. 246
854,~~426~~.9745 ℄
571,992.1217
1.
28 8.0
1,261.7100
2. 588.
855,~~688~~.6423 855,508.611
572,002.4469 572,002.652
4.
21 12 0.0
565.4900
3. 035.
856,~~215~~.8620 856,035.831
571,797.9519 571,798.157
4.
12 54 15.0
2,262.3300
4. 260
58,~~440~~.5517 858 260.520
1,288.2596 571 288.465
Walk on W. Side Power 4. Road Bridge
32 33 32.0
2,198.8400
5. 113.
860,~~293~~.8193
570,104.9183 W.M.Hwy
R/. Between Roads 4.
32 33 32.0
128.6200
6. 222
860,~~402~~.2252
570,035.6994 P.I.
Sec. Line Guadalupe 4.
16 14 4.0
159.6600
7. 375
860,555.5189 Sec line
569,991.0635
Sec. Corner 1.
9 37 47.0
148.5100
8. 376.4786
860,556.4786 = 860376.63

SIDE INLET DESIGN #2-10

Side Inlet Design #2-10

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

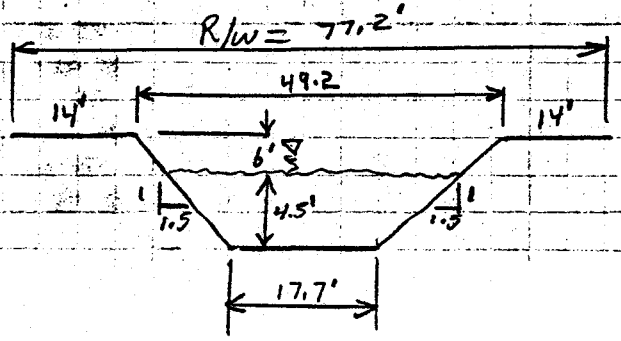
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-21-86	CHECKED BY DEB	DATE 3/87	JOB NO.
SUBJECT Side Inlet Design				SHEET 1 OF 45

1. Guadalupe & Power Road – Data from Master Drainage Plan

Given: C.P. = C054
Q_{100} = 1125 CFS

No detention basin shown on Master Plan

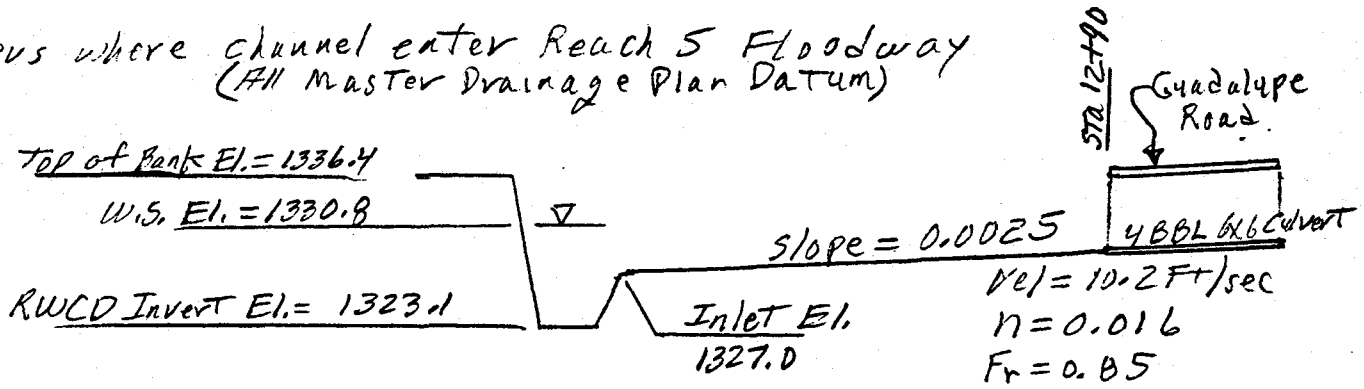


$49.2 = 17.7 + 1.5(4.5 + F_b)(2)$

$(4.5 + F_b) = \frac{31.5}{3} = 10.5$

$F_b = 6.0'$

Elevs where channel enter Reach 5 Floodway
(All Master Drainage Plan Datum)



At STA 12+90 – 4 BBL 6x6 culvert Planned

STA 8+23 (PC) begin channel

STA 15+35 (PT) – 712 FT Curve proposed
(400 FT Radius)

8-9

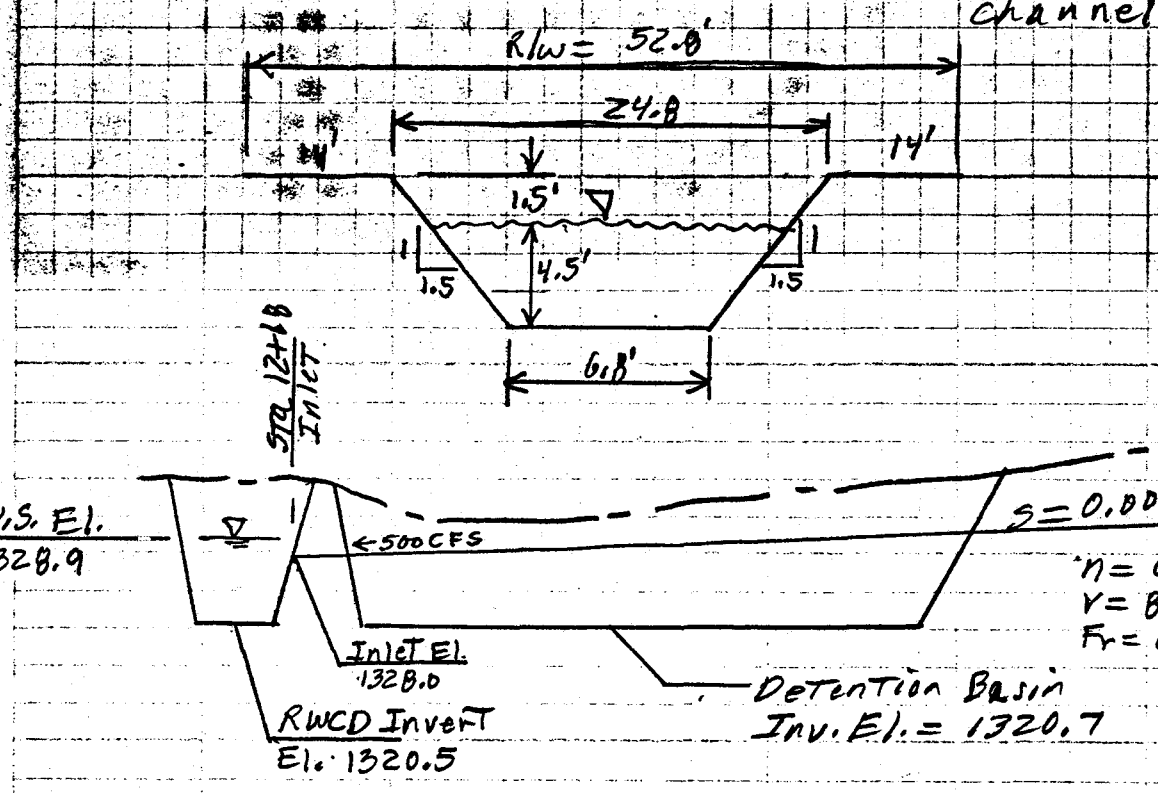
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona	PROJECT RWCD REACH 5		
BY Tom Jayo / DATE 11-21-81	CHECKED BY DGP	DATE 3/87	JOB NO.
SUBJECT Side Inlet Design			SHEET 2 OF 45

2. Elliot Road Inlet - Canal on north side of Elliot
Data from Master Drainage Plan

Given: C.P. = C0117
Q_{100} = 1850 CFS ~ 1350 into detention basin
500 CFS into Reach 5 via channel -



Detention Basin

Water depth = 12.5 FT
Vol = 739 Ac. FT.
Gross Area = 80 AC
Min Release Rate = 250 CFS

length proposed parallel to Elliot Road = 1850 FT

will need 1883.7 FT along Floodway channel to equate to 80 Acre basin.

COMPUTATION SHEET
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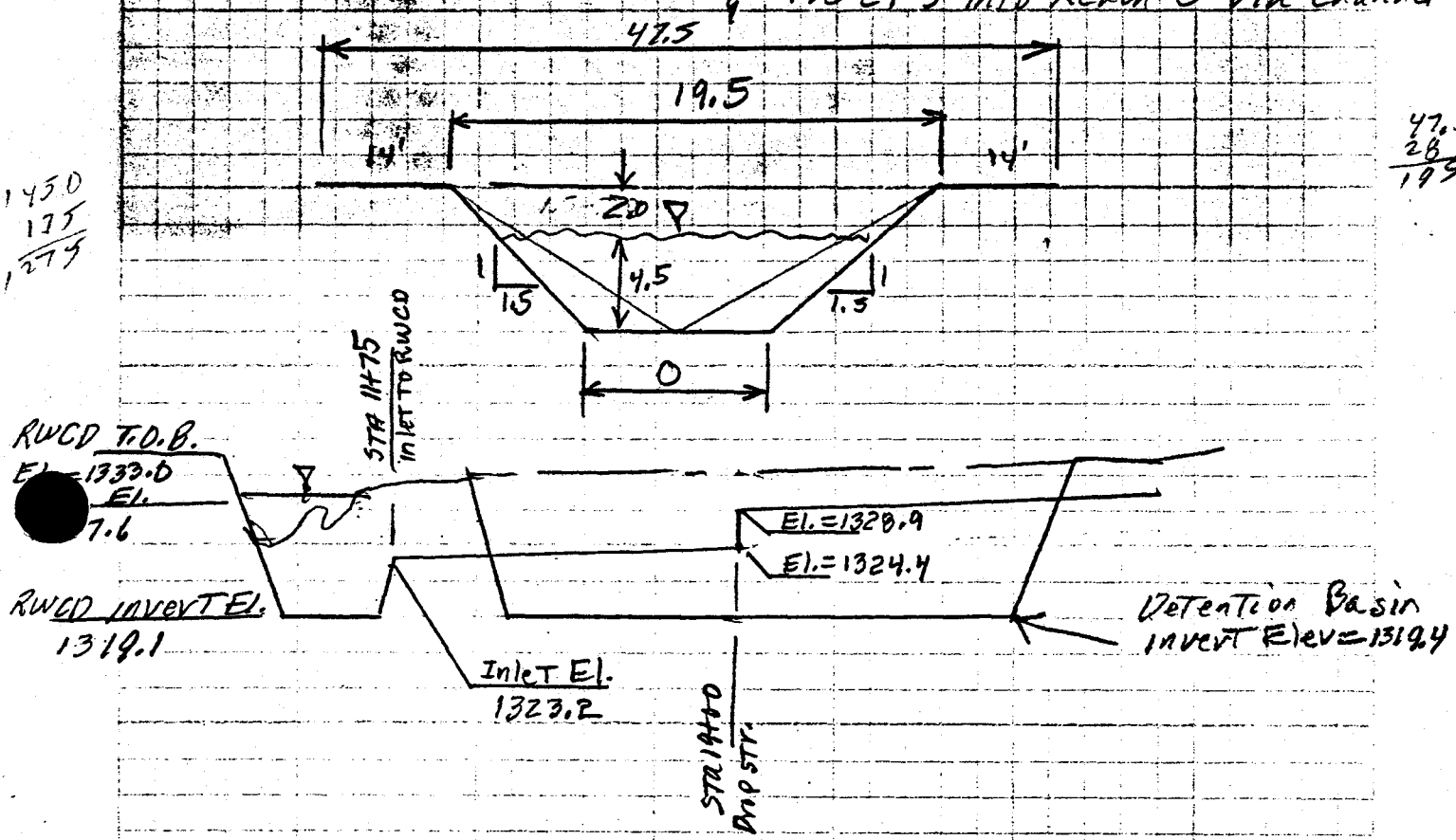
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-21-87	CHECKED BY DEP	DATE 3/87	JOB NO.
SUBJECT Side Inlet Design				SHEET 3 OF 45

3. Warner Road Inlet – canal on north side of Warner
Data from Master Drainage Plan

Given: C.P. E0126
Q_{100} = 1450 CFS ~ 1275 CFS into detention basin
& 175 CFS into Reach 5 via channel



Detention Basin

Water Depth = 8.5'
vol 24hr = 287 AC-FT
Gross Surface Area = 44.7 AC
Min Release Rate = 100 CFS
Basin length parallel to Warner Road = 1400'
Basin length along Floodway channel = 1390.8 FT based on 44.7 AC basin

C.P. C0127
Q_{100} = 5213 } in RWCD Floodway right below above inlet

Per Inlet Hydrology Analysis October 1985 H.C. Millsaps

Recommended Peak Discharge - Frequency For Year 2000, W/1-inch of Storage and W/O Master Drainage Plan

INLET NO	LOCATION	Discharge - cfs 1/ 10-Year	25-Year	100-Year	Master Drainage Plan	Rec Des Q
1	Quadalupe Rd. (119)	1200	1650 ~~1950~~	2100	1125	2100
2	1/2 Mi.: So. of Quad. Rd.	10	150	600		600
3	Elliot Rd. (123)	25	150	500	1850	1850
4	1/2 Mi.: So. of Elliot Rd.	20	50	100		100
5	3/4 Mi.: So. of Elliot Rd.	150	300	400		400
6	Warner Rd (129)	300	500	800	1450	1450
7	N. Side of Aquaduct	500	700	1200		1200
8	1/2 Mi.: So. of Warner Rd.	50	100	200		200
9	3/4 Mi.: So of Warner Rd.	50	100	200		200
10	Ray Road	50	100	200		200

1/ NOTE: These discharges are best estimates of flow distibution based on routed floods and judgement during Field Reconniassance.

Need 10 Side inlets on East Side of Floodway use higher flow where Millsaps & Master Drainage Plan differ.

COMPUTATION SHEET

SCS-ENG-5234 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACH 5

BY: Tom Joyo | DATE: 12-1-86 | CHECKED BY: DJP | DATE: 3/87 | JOB NO.

SUBJECT: Items Needed For Design of Side inlets | SHEET 5 OF 45

Needs -

1. Size of each inlet ✓
2. ℄ station of each inlet ✓
3. Floodway invert elev at each side inlet ✓
4. Top of dike elev at each side inlet ✓
5. Ground elev. at each side inlet ✓ at R/W line ✓
6. High water surface elev for Q_{100} storm ✓

COMPUTATION SHEET
SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Joyd | DATE 12-1-86 | CHECKED BY DJD | DATE 3/87 | JOB NO
SUBJECT East Side Inlets | SHEET 6 OF 45

a. All side inlets will be built as trapizoidal broad-crested weirs.

b. Figure critical depth at end of crest section

assume rectangular sec to start then check for trap-sec-

$Q = CLH^{3/2}$ use $C = 3.1$

For $H = 1.0'$

Inlet NO	Design Q CFS	(Approx. H FT)	$L = \frac{Q}{3.1(H)^{3/2}}$	Try H = 2	$L = \frac{Q}{3.1(H)^{3/2}}$
1	2100	1	677.4' (too long)	2	239.5 → Design max → 40 CFS/FT weir use max head available from Topo.
2	600	1	193.6'		
3	1850 ✓	1	596.8' (too long)	2	211.0
4	100	1	32.3'		
5	400	1	129.0'		
6	1450 ✓	1	467.7 (too long)	2	165.4
7	1200	1	387.1 (too long)	2	136.9
8	200	1	64.5		
9	200	1	64.5		
10	200	1	64.5		

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACH 5
BY: Tom Jayo | DATE: 12-2-86 | CHECKED BY: DRP | DATE: 3/87 | JOB NO.
SUBJECT: SIZE OF East Side Inlets Cont. | SHEET 7 OF 45

Inlet No	Approx Length	Approx STA	Flood way Bottom Elev.	Top Flwy Lt. Bnk. Elev.	Ground El. CR/W ±	Distance ℄ weir To R/W	Ground ℄ weir ±
1	200'	330+00			Red for Computer sheets. 1331.3		
2	190'	354+00	1321.54	1332.29	1331.7 Per Topo Map	78.25	1331.5±
3	200'	380+00	1320.76	1331.51	1331.2 1331.0	78.25	1331.0±
4	30'	408+00	1319.92	1330.67	1329.4 1329.7	131.95	1328.5±
5	120'	421+50	1319.52	1330.27	1329.7 1329.0	131.95	1328.5±
6	160'	432+00	1319.20	1329.95	1328.5 1328.5	132.81	1328.0±
7	130'	452+25	1318.59	1329.34	1327.0 1327.0	152.49	1326.0±
8	60'	464+00	1318.24	1329.06	1327.3 1326.3	135.75	1326.0±
9	60'	477+00	1317.85	1328.60	1327.0 1326.7	136±	1321.0±
10	60'	485+94±	1317.58	1328.33	1329.2 1328.3±	30'±	1328.0±

INLET No	③ Top Flwy Bnk Elev. (Per Prelim Design)	① Ground Elev ℄ R/W	Difference + or − ①−②	② Q-100 hwl elev.	Max head (H) ①−②	Freeboard ③−②	
1				1330.72			
2	1332.29	1331.7	−0.6	1330.36	+1.3	1.9	ok
3	1331.51	1331.0	−0.5	1329.53	+1.5	2.0	ok with 0.5' water ℄
4	1330.67	1329.7	−1.0	1328.78	+0.9	1.9	ok
5	1330.27	1329.0	−1.3	1328.39	+0.6	1.9	ok with 0.4' water ℄ R/W
6	1329.95	1328.5	−1.5	1328.10	+0.4	1.9	No good
7	1329.34	1327.0	−2.3	1327.53	* −0.5	1.8	No good
8	1328.99	1326.3	−2.8	1327.14	* −0.8	1.85	No good
9	1328.60	1326.7	−2.1	1326.73	0−	1.9	Possible
10	1328.33	1328.3	0.0	1326.46	+1.8	1.8	ok

* Need Fill behind Inlet

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACHS

BY: Tom Jayo | DATE: 12-3-86 | CHECKED BY: DSP | DATE: 3/87 | JOB NO.

SUBJECT: Sizing of East Side Inlets Cond. | SHEET 8 OF 45

Due to lack of head available between ground elevation at Right of way and Q 100 water surface elevation in floodway, the use of the elevation of water surface of flood water coming into side inlet was looked into. The depth of the sheet flow across irrigated land and desert land was discussed with Harry Milsaps on 12-3-86. Harry indicated you could expect between 0.5 to 1.0 feet of water during 100 year storms. Based on this we will use 1.0 foot of head above ground elevation at right of way to provide the required head for design of the side inlets for all inlets. We will also raise the elevation of the Left O&M road by 1.0 foot throughout the length of the floodway to provide for some freeboard when side inlets function.

INLET NO	Top Flwy Bank Elev.	Ground Elev @ RIW ①	hwl elev. @ RW ② = ① + 1' (sheet flow)	Q100 hwl. Elev. ③	Max Water depth ② − ③	
1				1330.72		
2	1333.29.5	1331.7	1332.7	1330.36	2.3	
3	1332.51.5	1331.0	1332.0	1329.53	2.5	
4	1331.67	1329.7	1330.7	1328.78	1.9	
5	1331.27	1329.0	1330.0	1328.39	1.6	
6	1330.95	1328.5	1329.5	1328.10	1.4	→ lacks 0.6' or 28c' long @ 1.4
7	1330.34	1327.0	1328.0	1327.53	0.5	→ lacks 1.5'
8	1329.99	1326.3	1327.3	1327.14	0.2	→ lacks 0.8'
9	1329.60	1326.7	1327.7	1326.73	1.0	OK
10	1329.33	1328.3	1329.3	1326.46	2.8	

From Lee Saele Floodway Design computer run.

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Jayo	DATE 12-3-86	CHECKED BY	DATE	JOB NO.
SUBJECT Sizing of Side Inlets Cond.			SHEET 9 OF 45

water level in floodway for Q100 storm is slightly below or slightly above ground elevation at right of way for inlets numbers 6, 7, 8 and 9. There is no way to get a head loss through weir without a long weir section that is unreasonable and uneconomical. These four inlets will be designed for a floodway storm that is less than a Q100 event. It is not likely that both the floodway and the subareas for inlets 6, 7, 8 & 9 will peak at the same time, therefore these four inlets will be based on a practical depth versus length combination.

See Sheet 15

Inlet No 6 - STA 432+00

Given - Q = 1450 CFS

Try H = 3.0 FT with hwl elev @ R/W = 1329.5
crest elev = 1329.5 - 3.0 = 1326.5 This is 1.6 FT below Q100 hwl elev.

Find L in equ. $Q = CLH^{3/2} + CZ(H)^{5/2}$ → (trapizoidal sec)

$L = \frac{Q - CZ(H)^{5/2}}{CH^{3/2}}$

$(3)^{5/2} = 15.59$
$(3)^{3/2} = 5.2$
$C = 3.1$

$L = \frac{1450 - 3.1(3)(15.59)}{3.1(5.2)} = 80.96$

Use 80 FT

Top of Dam grad to crest = 4.5 FT.
with 18 inch freeboard

For H = 2.0, L = 159.6'

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Joyo | DATE 12-3-86 | CHECKED BY | DATE | JOB NO.
SUBJECT Sizing of Side Inlets Cond | SHEET 10 OF 45

Inlet No 7 - STA 452+25

Given - Q = 1200 CFS

Try H = 3.0 FT with hwl elev @ RIW = 1328.0
crest elev. = 1328.0 - 3.0 = 1325.0 - This is 2.5 FT below Q_{100} hwl elev.

$$L = \frac{1200 - 3.1(3)(5.59)}{3.1(5.2)} = 65.45$$

Use 65 FT

For H = 2', L = 131.1

Top of O&M road to crest of weir = 5.3 FT
with 2.3 Foot freeboard.

INLET NO 8

Given - Q = 200 CFS

Try H = 1.9 FT with hwl elev @ RIW = 1327.3
crest elev = 1327.3 - 1.9 = 1325.4 This is 1.7 FT below Q_{100} hwl elev.

$$L = \frac{200 - 3.1(3)(4.98)}{3.1(2.62)} = 18.9 \text{ FT}$$

$(1.9)^{5/2} = 4.98$
$(1.9)^{3/2} = 2.62$

Top O&M Road to Crest = 4.7
Freeboard = 2.8 FT

Use 20 FT

For H = 1', L = 61.5

INLET NO 9

Given - Q = 200 CFS

Try H = 1.9 FT with hwl elev @ RIW = 1327.7
crest elev = 1327.7 - 1.9 = 1325.8 This is 0.9 FT below Q_{100} hwl elev.

L = 20 FT same as inlet No 8

Top O&M Road to Crest = 3.8 FT
Freeboard = 1.9 FT

COMPUTATION SHEET
SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACH 5
BY: Tom Dayo | DATE: 12-3-86 | CHECKED BY: DB | DATE: 3/87 | JOB NO.:
SUBJECT: Sizing of Side Inlets Cond. | SHEET 11 OF 45

Inlet No 10

Given - Q = 200 CFS
crest elev. = 1326.5
hwl elev @ R/W = 1329.0 (only 12" H_2O above ground)

$H = 29.0 - 26.5 = 2.5$ FT

$(2.5)^{5/2} = 9.88$

$Q = CLH^{3/2} + CEH^{5/2}$ (take into account trapezoidal weir)

$(2.5)^{3/2} = 3.95$

$$L = \frac{200 - 3.1(3)(9.88)}{3.1(3.95)} = 8.83$$

Top O&M Road to Crest = 2.8 FT
Freeboard = 0.3'

Use L = 12.0 FT

INLET NO 2

Given - Q = 600 CFS
crest elev. = 1330.4
hwl elev @ R/W = 1332.7 ~ 12" above field
$H = 1332.7 - 1330.4 = 2.3$ FT

$(2.3)^{5/2} = 8.02$

$(2.3)^{3/2} = 3.49$

$$L = \frac{600 - 3.1(3)(8.02)}{3.1(3.49)} = 48.56$$

Use 50 Feet

Top O&M road to crest = 2.9 FT
Free board = 0.6 FT.

INLET NO 3

Given: Q = 1850 CFS
crest elev. = 1329.5
hwl @ R/W = 1332.0 ~ 12" above field
$H = 1332 - 1329.5 = 2.5$ FT.

$(2.5)^{5/2} = 9.88$

$(2.5)^{3/2} = 3.95$

$$L = \frac{1850 - 3.1(3)(9.88)}{3.1(3.95)} = 143.58$$

Use 145 FT

Top O&M road to crest = 3.0 FT.
Freeboard = 0.5 FT

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Dayo | DATE 12-3-86 | CHECKED BY DP | DATE 3/87 | JOB NO.
SUBJECT Sizing of Side Inlets Cont'd. | SHEET 12 OF 45

INLET NO 4

Given - Q = 100 CFS
crest elev. = 1328.8
hwl @ R/W = 1330.7 ~ 12" above field
H = 1330.7 − 1328.8 = 1.9 FT

$$L = \frac{100 - 3.1(3)(4.98)}{3.1(2.62)} = 6.61$$

$(1.9)^{5/2} = 4.98$
$(1.9)^{3/2} = 2.62$

Use 10 FT

Top of m road to crest = 2.9 FT
Free board = 1.0 FT.

INLET NO 5

Given - Q = 400 CFS
crest elev. = 1328.4
hwl @ R/W = 1330.0 ~ 12" above field
H = 1330.0 − 1328.4 = 1.6 FT

$$L = \frac{400 - 3.1(3)(3.24)}{3.1(2.02)} = 59.07 \text{ FT.}$$

$(1.6)^{5/2} = 3.24$
$(1.6)^{3/2} = 2.02$

Use 60.0 FT

Top of m road to crest = 2.9 FT
Free board = 1.3 FT

COMPUTATION SHEET
SCS-ENG-5234 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Jayo | DATE 12-9-86 | CHECKED BY | DATE | JOB NO.
SUBJECT SIZING EAST SIDE INLETS COND. | SHEET 13 OF 45

INLET NO	Approx Station	① Water depth for Q_{100}	Q_{100} Flow	Bot width	Z	② For ① − 2.0 water depth FT.	Mannings "n"	Area P For ② FT²	
1	330+00	0	4900	95	3				
2	354+00	8.82	5100	140	3	6.82	0.027	1094.34	183.1
3	380+00	8.77	5100	140	3	6.77	0.027	1085.30	182.8
4	408+00	8.86	5100	140	3	6.86	0.027	1101.58	183.3
5	421+50	8.87	5300	140	3	6.87	0.027	1103.39	183.4
6	432+00	8.90	5300	140	3	6.90	0.027	1108.83	183.6
7	452+25	8.94	5300	150	3	6.94	0.027	1185.49	193.8
8	464+00	8.90	5900	150	3	6.90	0.027	1177.83	193.6
9	477+00	8.88	5900	150	3	6.88	0.027	1174.00	193.5
10	485+94	8.88	5900	150	3	6.88	0.027	1174.00	193.5

Determine New Q for Water depth 2.0 FT lower

$$Q = AV = \frac{A(1.486)(S)^{1/2}(R)^{2/3}}{n} = \frac{A(1.486)(0.0003)^{1/2}(R)^{2/3}}{0.027} = 0.858(A)(R)^{2/3}$$

INLET NO	Q for $d = d_{100} - 2$	% of Q_{100}
1		
2	3435.8 CFS	67.4%
3	3392.3 "	66.5%
4	3470.2 "	68.0%
5	3479.1 "	65.6%
6	3505.3 "	66.1%
7	3779.2 "	71.3%
8	3741.8 "	63.4%
9	3723.2 "	63.1%
10	3723.2	63.1%

X-Sec Area is reduced approx. 25%

& Flow is reduced roughly 29% to 37%

COMPUTATION SHEET
SCS-ENG-5534 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Dayo | DATE 12-9-86 | CHECKED DP | DATE 3/87 | JOB NO.
SUBJECT SIZING OF SIDE INLETS (COND) | SHEET 14 OF 45

Probability of Q_{100} storms for inlets 6, 7, 8 & 9 peaking at same time as Floodway was discussed with Harry Millsaps on 12-9-86. Harry pointed out that drainages for inlets 6, 7, 8 & 9 are very long and time of concentration for peak flows to occur at these inlets was in the range of 18 hours± and time of concentration for Floodway to peak at inlets 6, 7, 8, 9 was in the vicinity of 15 hours±. Therefore the peak flows for the side inlets 6, 7, 8, & 9 will already have gone by before the Floodway peaks at these locations. The Curve for the Floodway in the range of peak flow is relatively flat so there is a good possibility that you could have close to peak flows occurring in the floodway and at inlets 6, 7, 8 & 9 at the same time. Based on this new information the idea of lowering the crest of the side inlets below Q_{100} flow in floodway to obtain the head required for a short weir length is out. Write up as noted on sheet 9 is no longer valid.

Redesign inlets 6, 7, 8 & 9 based on crest elev at Q_{100} elev in Floodway and use what head is available to 45 for inlets 6 & 9. Raise Ground level to 1327.9 on inlet #7 & 1327.2 on inlet #8 outside R/W.

INLET NO 6 — STA 432+00

Given - Q = 1450 CFS
hwl elev @ R/W = 1329.5 ~ with 12" H_2O above field
Crest elev. = 1328.1
Head = H = 1.4 FT

$(1.4)^{3/2} = 2.32$
$(1.4)^{1/2} = 1.66$

Find L in eqn $L = \frac{Q - CH^{3/2}}{CH^{1/2}}$

$L = \frac{1450 - 3.1(3)(2.32)}{3.1(1.66)} = 277.58$ FT

use 280 FT

Top of O&M to Crest = 2.85 FT
Freeboard = 1.45 FT

COMPUTATION SHEET
SCS-ENG-5034 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT RWCD REACH 5
BY Tom Jayo DATE 12-10-86 CHECKED BY DJP DATE 3/87 JOB NO.
SUBJECT SIZING OF SIDE INLETS cont- SHEET 15 OF 45

Inlet No 7 ~ STA 452+25 (See Profile) blue line attached

Given: Q = 1200 CFS
hwl elev @ R/W = 1328.9 with 12" water above filled ground.
Crest elev @ Q_{100} = 1327.5 (Ground filled to Elev = 1327.9 = Q_{100} of floodway @ highest end of inlet)
Head = H = 1.4

$(1.4)^{3/2} = 1.66$
$(1.4)^{5/2} = 2.32$

Find L = $\frac{1200 - 3.1(3)(2.32)}{3.1(1.66)}$ = 229 FT

Use 229 FT

Top of O&M road to crest of weir = 2.8 FT
Freeboard = 1.4 FT

INLET NO 8 ~ STA 464+00 (See Profile) blue line attached

Given: Q = 200 CFS
hwl elev @ R/W = 1328.2 with 12" water above filled ground
Crest elev @ Q_{100} = 1327.1 (ground filled to elev = 1327.2 = Q_{100} of floodway highest end of inlet)
Head = H = 1.1 FT

$(1.1)^{5/2} = 1.27$
$(1.1)^{3/2} = 1.15$

Find L = $\frac{200 - 3.1(3)(1.27)}{3.1(1.15)}$ = 52.79

Use 53 FT

Top O&M road to crest = 2.9'
Freeboard = 1.8 FT

INLET NO 9 ~ STA 477+00

Given: Q = 200 CFS
hwl elev @ R/W = 1327.7
Crest elev @ Q_{100} = 1326.7
Head = H = 1.0

Find L = $\frac{200 - 3.1(3)(1)}{3.1(1)}$ = 61.5 FT

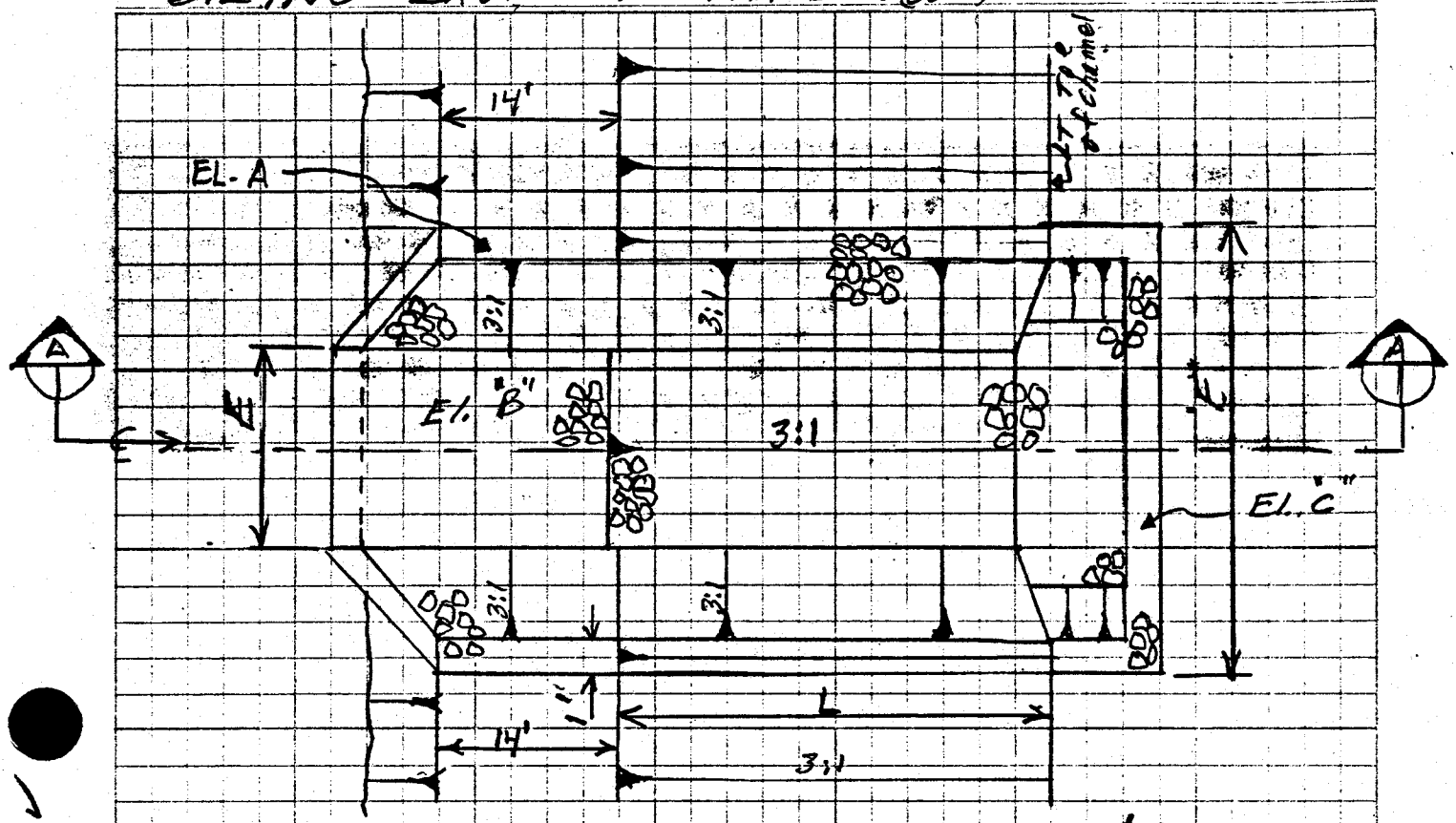
Use 62 FT

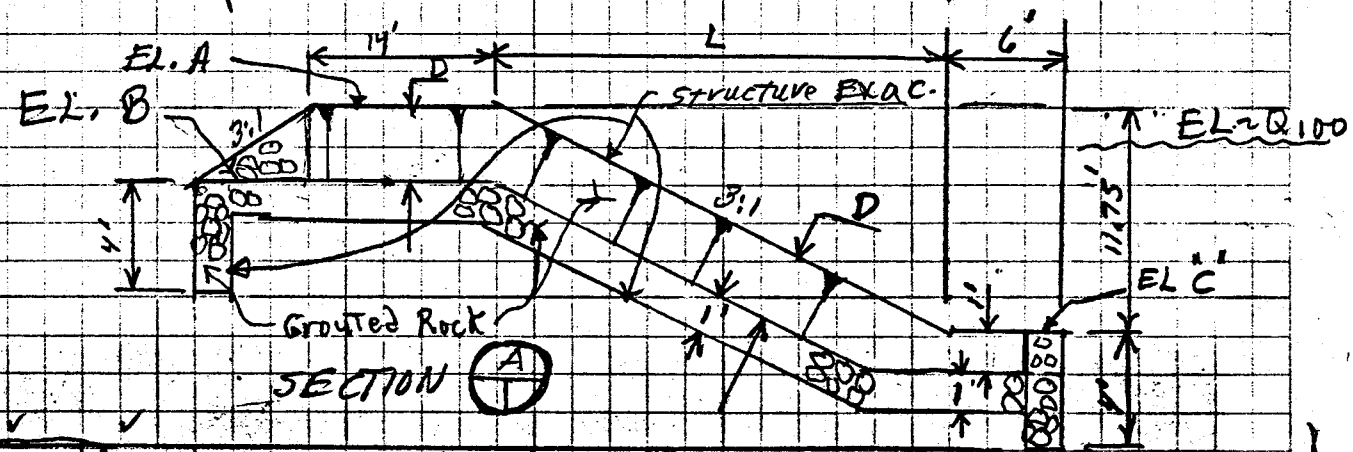
Top O&M road to crest = 2.9 FT
Freeboard = 1.9 FT

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACH 5
BY: Tom Joyo | DATE: 12-9-86 | CHECKED BY: DSP | DATE: 3/87 | JOB NO.
SUBJECT: SIZING EAST SIDE INLETS (cont) | SHEET 16 OF 45





make Table for columns checked ✓

INLET STR. NO	APPROX ℄ STA	ELEVATIONS A ✓	B ✓	C ✓	DIMENSIONS D ✓	E ✓	F ✓	L ✓	Q/PT	Q100 HWL Elev	"HWL E (−) B
1	330+00										
2	354+00	1333.3	1330.4	1321.5	2.9	50.0	69.4	35.25	12.01	1330.4	0
* 3	380+00	1331.5	1329.5	1320.8	3.0	204 ~~19.5~~	224 ~~19.5~~	35.25	12.44	1329.5	0
4	408+00	1331.7	1328.8	1319.9	2.9	10.0	29.4	35.25	10.0 ✓	1328.8	0
5	424+50	1331.3	1328.4	1319.5	2.9	60.0	79.4	35.25	6.67	1328.4	0
6	432+00	1331.0	1328.1	1319.2	2.9	280.0	299.4	35.25	5.18	1328.1	0
7	452+25	1330.3	1327.5	1318.6	2.8	229.0	247.8	35.25	5.24 ✓	1327.5	0
8	464+00	1330.0	1327.1	1318.2	2.9	53.0	72.4	35.25	3.18	1327.1	0
9	477+00	1329.6	1326.7	1317.85	2.9	62.0	81.4	35.25	3.23	1326.7	0
* 10	485+94	1329.3	1326.5	1317.6	2.8	~~12.0~~ 20.0	~~38.8~~ ~~32.8~~	35.25	~~10.67~~ 10 ✓	1326.5	0

* inlet #3 & 10 widened to reduce velocity — see page 28 & 29

COMPUTATION SHEET

SCS-ENG-A-29 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACH 5

BY: Tom Jayo | DATE: 12-10-86 | CHECKED BY | DATE | JOB NO.

SUBJECT: Elevs along Floodway East R/W from plan maps | SHEET 17 OF 45

Elliot Road - 383+00 - 1332.0
390+00 - 1330.0
400+00 - 1329.5
404+00 1329.5
410+00 - 1329.8
420+00 - 1329.0
425+00 - 1329.5
427+00 - 1329.0
430+00 - 1328.8
434+00 - 1328.0
436+00 - 1328.0
438+00 - 1328.0
440+00 - 1327.0
445+00 - 1327.5
449+00 - 1327.6
451+00 - 1327.0
452+50 - 1328.0 @ northside of Aquaduct
inlet # 7 @ 452+25
454+00 - 1328.0
455+17 - 1329.0
456+00 - 1328.0
457+00 - 1327.0
460+00 - 1327.0
462+50 - 1326.6
464+00 - 1326.3
468+00 - 1326.7
472+00 - 1327.2
476+50 - 1327.0
478+00 - 1328.0
478+00 thru 483+00 - 1328.0
485+00 - - 1327.5
486+00 - 1328.3

Above used to plot profile along east R/W from 383+00 to 486+00 - Used to find low areas for inlets 7 & 8

(See attached sheet me)

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
Tom Jayo | DATE 12-10-86 | CHECKED BY DP | DATE 3/87 | JOB NO.
SUBJECT Determine hwl Elevs For Inlets 7 & 8 | SHEET 18 OF 45

AT R/W Line with Topography X-Sec.

Inlet NO 7

Try Elev = 1328.0

From Profile Drwg. - Area = 1.98 □" x 500 FT/□" = 990 FT²

Given: Mannings "n" = 0.055 sparse desert

slope = 0.005 FT/FT (rough) - (0.005)^1/2 = 0.071

P = 452+00 - 438+00 + 1 = 1401 FT

R = A/P = 990/1401 = 0.71, (R)^2/3 = (0.71)^2/3 = 0.79

V = 1.486 (0.79)(0.071) / 0.055 = 1.52 FT/sec

Q = AV = 990 (1.52) = 1505 CFS

Try Elev = 1327.9

From Profile Drwg. - Area = 1.59 □" x 500 = 795 FT²

P = 1376

R = 795/1376 = 0.578 (R)^2/3 = 0.694

V = 1.486 (0.694)(0.071) / 0.055 = 1.331 FT/sec

Q = 795 (1.331) = 1058.4 CFS

interpolating - Existing flow elev.

1328.0	-	1505
X	-	1200
1327.9	-	1058.4

X = 1327.94 .317 (0.1) = 0.03 + 1327.9 = 1327.93

Grd @ R/W = 1327.0

flow depth = 0.93 FT.

∴ No additional Head to be gained by using X-section method. Assumption of 1.0 sheet flow holds.

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT RWCD REACH 5
BY Tom Jayo DATE 12-10-86 CHECKED DSP DATE 3/87 JOB NO.
SUBJECT Determine hwl Elev For Inlet # 8 AT SHEET 19 OF 45

Hw line using Profile from Topo. Map –

INLET NO 8

Try Elev. = 1327.2

From profile Drwg. Area = 1.43 ft² x 500 = 715 ft²

P = 477+00 − 456+80 = 1520'

$R = \frac{A}{P} = \frac{715}{1520} = 0.47$, $(R)^{2/3} = 0.605$

$V = \frac{1.486(0.605)(0.071)}{0.055} = 1.16$ ft/sec

Q = AV = 715(1.16) = 829.6 CFS too high –

Try Elev = 1327.0

From profile Drwg. Area = 0.90 ft² x 500 = 450 ft²

P = 470+25 − 460+00 = 1025'

$R = \frac{A}{P} = \frac{450}{1025} = 0.439$, $(R)^{2/3} = 0.578$

$V = \frac{1.486(0.578)(0.071)}{0.055} = 1.109$

Q = AV = 450(1.109) = 498.9 CFS too high

Try Elev = 1326.8

From Profile Drwg. Area = 0.44 ft² x 500 = 220 ft²

P = 468+75 − 461+25 = 750'

$R = \frac{A}{P} = \frac{220}{750} = 0.293$ $(R)^{2/3} = 0.441$

$V = \frac{1.486(0.441)(0.071)}{0.055} = 0.846$ ft/sec

Q = AV = 220(0.846) = 186.1 CFS

interpolating ≈ existing flow elevation

	498.9	—	1327.0
X = 1326.81	200	—	X = 1326.81
Grd @ R/W = 1326.3	186.1	—	1326.8

flow depth = 0.5 ft.

∴ No additional head to be gained using x-section method. Assume sheet flow = 1.0'

COMPUTATION SHEET
SCS-ENG-5134 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Jayo | DATE 12-12-86 | CHECKED BY DSP | DATE 3/87 | JOB NO.
SUBJECT Area Needed for TCE Outside R/W to bring the weir crests for inlets # 7 & 8 equal to Q100 elev. in floodway. | SHEET 20 OF 45

INLET NO 7 -

Area sheet 9 of Plans - STA 438+25 to 445+00

14.15
08.78
5.37" x 10,000 = 53,700 FT²

Area Sheet 10 of plans - STA 445+00 TO 452+50

97.36
89.42
7.94" x 10,000 = 79,400 FT²

TOTAL Area = 133,000 / 43,560 = 3.06 Acre

INLET NO 8

Area sheet 9 of Plans - STA 456+80 TO 465+00

36.90
28.00
8.90" x 10000 = 89,000 FT²

Area Sheet 10 of Plans STA 465+00 TO

22.56
14.39
8.17" x 10,000 = 81,700 FT²

TOTAL Area = 170,700 FT²

Area = 170,700 / 43,560 = 3.92 AC

TOTAL Area inlets 7 & 8 = 3.06
+ 3.92
TOTAL 6.98 AC -

COMPUTATION SHEET
SCS-ENG-513A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACH 5
BY: Tom Dayo | DATE: 12-12-86 | CHECKED BY: DSS | DATE: 3/87 | JOB NO.
SUBJECT: Design of Basins in Front of Side inlets | SHEET 21 OF 45

Basins are required in front of side inlets to effectively utilize the 1' foot of head above ground coming into the inlet. Basins will be designed to be rectangular generally using the full length of the weir.

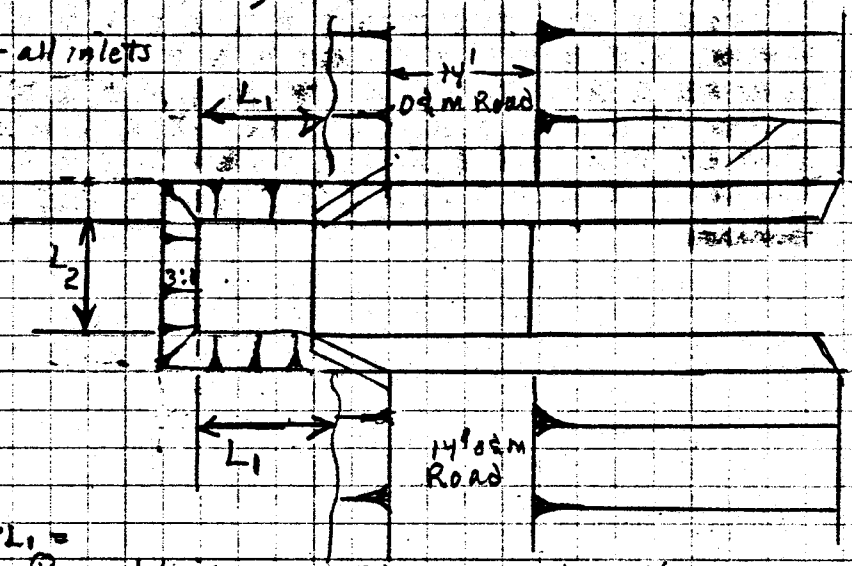
Given: H = head = 1' for all inlets

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

$C = 3.1$

Find $2L_1 + L_2$

$L_2 + 2L_1 = \frac{Q}{C(H)^{3/2}} = \frac{Q}{3.1(1)}$



Inlet No	Q-CFS	$L_2+2L_1 = \frac{Q}{3.1}$	Weir Length ft	L_2	Elev @ inlet Per Computer sheets	Elev @ R/W	Cut	L_1
1	2100							
2	600	193.6	50	56	1331.2	1331.7	1.0'	68.8 use 70'
3	1850	596.8	204* ~~145~~	213 ~~154~~	1330.9	1331.0	1.5'	* 191.9 ~~221.1~~ use 192' only 78' available
4	100	32.3	10	14.2	1329.4	1329.7	0.7'	9.05 use 10'
5	400	129.0	60	62.4	1328.5	1329.0	0.4'	33.3 - use 34'
6	1450	467.7	280	282.4	1328.5	1328.5	0.4'	92.7 - use 93'
7	1200	387.1	229	231.4	1326.5 (Filled to 1327.9)	1327.0	0.4'	77.85 - use 7[illegible]
8	200	64.5	53	53.6	1326.3 (Filled to 1327.2)	1327.3	0.1	5.45 use 6'
9	200	64.5	62	68.6	1327.4	1327.7 in hole	1.1'	0 - use 10'
10	200	64.5	20 ~~12~~	30.8 ~~22.8~~	1328.3 (1327.8 @ 10' out)	1328.3	1.8'	16.9 ~~20.9~~ use 17'

200
136
64
81

200
81
119

Need to flare inlet No 3 on 34.8° to keep within R/W

* Basin for inlet #3 fall outside R/W using L_2 = weir length therefore need to widen L_2

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: Arizona | PROJECT: RWCD REACH 5
BY: Tom Jayo | DATE: 12-24-86 | CHECKED BY | DATE | JOB NO.
SUBJECT: Design of Basins in Front of Side Inlets | SHEET 22 OF 45

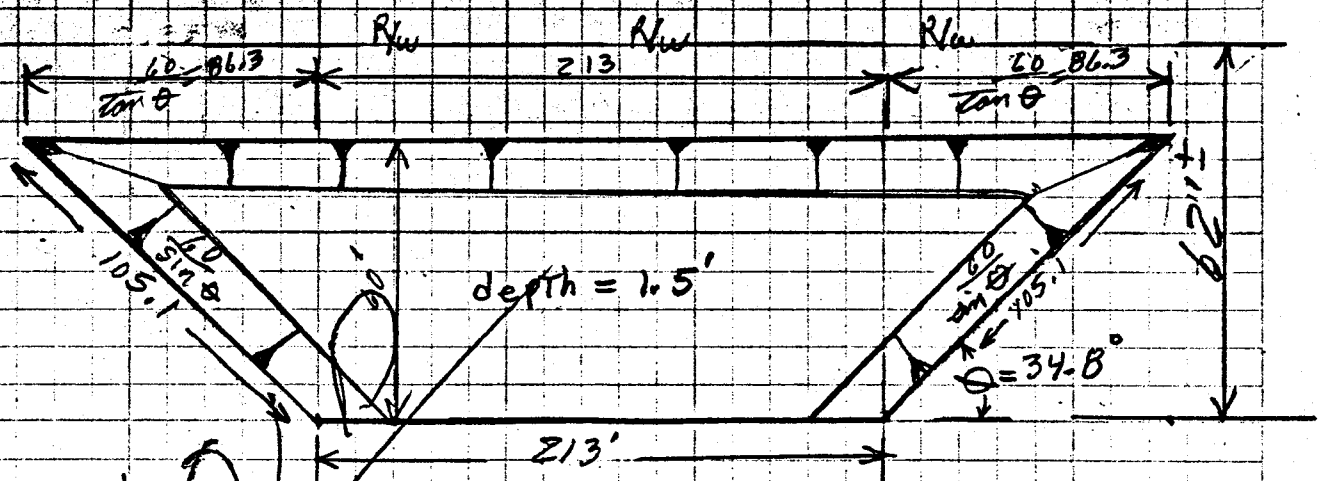
Inlet NO 3 - Basin -

Need to Flare this basin on 45° angle to Keep within R/W.

R/W TO ℄ inlet = 78' ±

East edge of inlet to R/W = 78' - 7 - 3(3±) = 62'

Keep basin 2' inside R/W = 62 - 2 = 60' ±



$$213 + 2\left(\frac{60}{\tan\theta}\right) + 2\left(\frac{60}{\sin\theta}\right) = 596.8$$

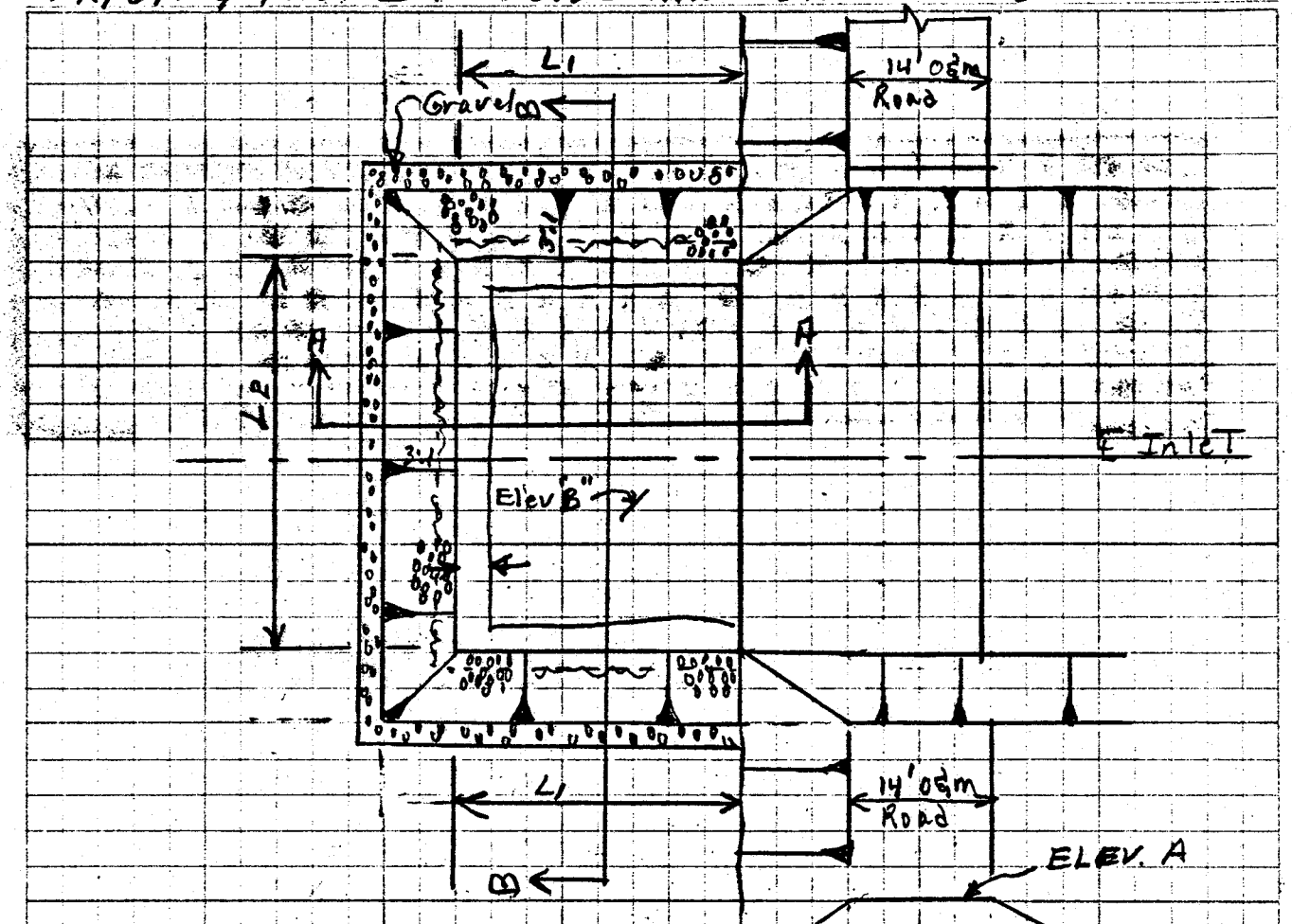
$$\frac{1}{\tan\theta} + \frac{1}{\sin\theta} = 3.1983$$

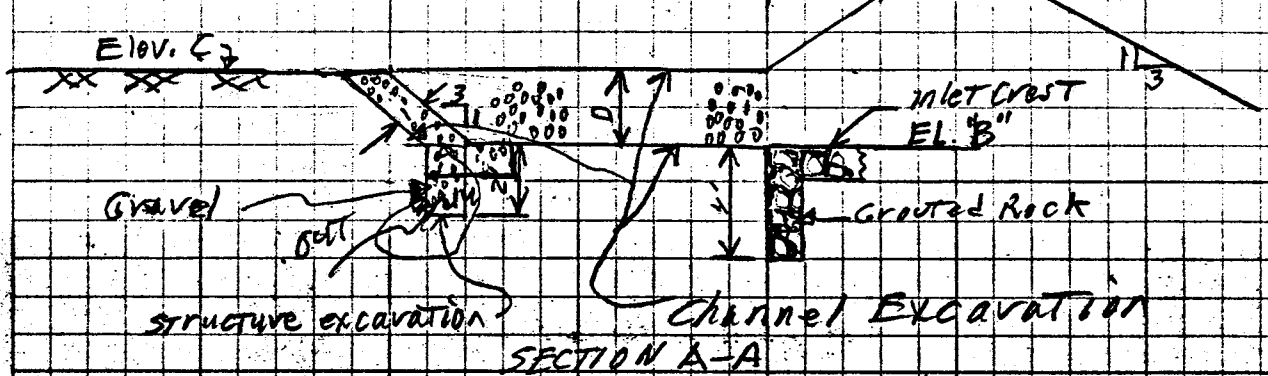
By Trial - $\theta = 34.8°$

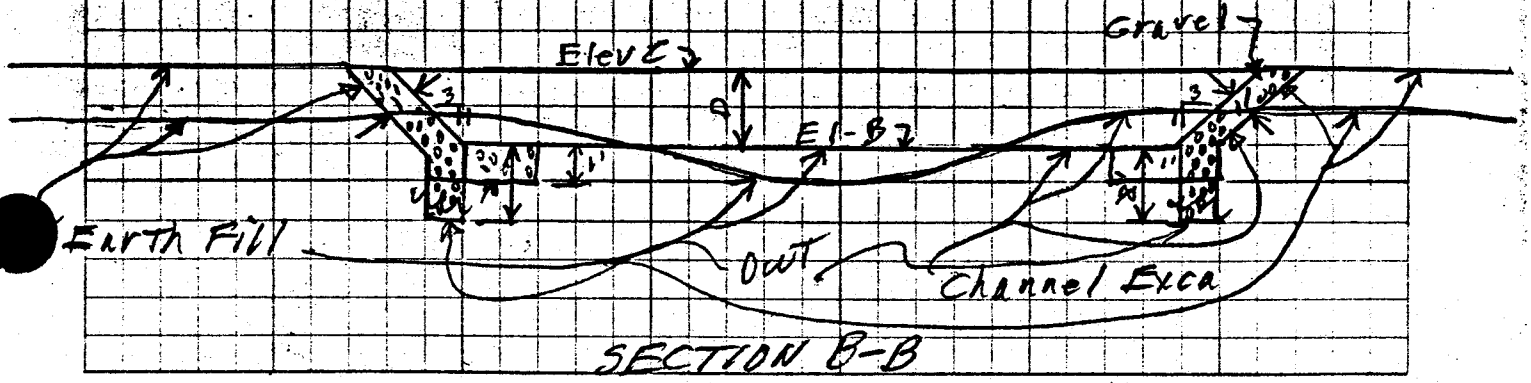
COMPUTATION SHEET
SCS-ENG-523A Rev. 9-65

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Jayo | DATE 12-24-86 | CHECKED BY DSB | DATE 3/87 | JOB NO.
SUBJECT LAYOUT & TABLE FOR SIDE INLET BASINS | SHEET 23 OF 45







COMPUTATION SHEET
SCS-ENG-223A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT RWCD REACH 5
BY Tom Jayo DATE 12-24-86 CHECKED BY DB DATE 3/87 JOB NO.
SUBJECT TABLE FOR SIDE INLET BASINS SHEET 24 OF 45

INLET NO	℄ STATION	L_1 Feet	L_2 Feet	Approx. D	Elev B	Elev A	Elev C.
2	354+00	70	56	1.0	1330.4	1333.3	
4	408+00	10	15	0.7	1328.8	1331.7	
5	424+50	34	63	0.4	1328.4	1331.3	
6	432+00	93	283	0.4	1328.1	1331.0	
* 7	452+25	78	232	0.4	1327.5	1330.3	1327.9
* ~~8~~	~~464+00~~	~~6~~	~~54~~	~~0.1~~	~~1327.1~~	~~1330.0~~	1327.2
9	477+00	10	69	1.1	1326.7	1329.6	
10	485+94	17	31	1.8	1326.5	1329.3	

* Note - Existing ground level will be raised to elev. 1327.9 from station 438+25 ± to station 452+50 ± inside and outside of right of way and to elev. 1327.2 for inlet No 8 from station 456+00 to station 472+00 ± inside and outside of right of way, as shown on sheets 9, 10, & 11.

eliminate # 8 basin due to min CUT = 0.1'

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Jayo | DATE 12-17-86 | CHECKED DP | DATE 3/87 | JOB NO.
SUBJECT Justification For Type of Material To Be Used for Side Inlet Protection. | SHEET 25 OF 45

Soil cement quantity for RWCD Reach 5 is between 2000 to 2500 cubic yards. Contact was made with Mr Easton of Benson Contracting, Dennis Granier of Peter Kewit Contracting and Jim Rautman of Grener Engineering to get input on the quantity needed to economically bring in a soil cement plant to the job site. They all indicated that 2500 cubic yards was not enough quantity to justify setting up a plant. A pugmill plant was set up on the Centennial Reach 1 based on 7300 cu yds of soil cement. It normally takes one to two weeks to set the plant up and the mobilization cost would raise the unit prices up to where it would not be competitive. Most of the jobs mentioned by contractors were in the range from 7300 cu yds to 268,000 cubic yards. The most practical way to handle the small volumes would be to have the soil cement made in a centralized plant and then hauled out in end dump trucks. This would bring the unit cost down. The situation on Reach 5 is that we have numerous short slopes that intersect other slopes. It is difficult to compact the short 3 to 1 slopes. Equipment is sometimes tied off on top to work the 3 to 1 slopes. Three to one slopes is about the steepest recommended for soil cement by above contractors. Inspection costs would go up if soil cement was used.

Based on the above grouted rock 12 inches thick will be looked at for Reach 5 in place of soil cement.

Tom Jayo

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Dayo | DATE 12-16-86 | CHECKED BY DSP | DATE 3/87 | JOB NO.
SUBJECT Check on Cost of Soil Cement-8" vs -12" | SHEET 26 OF 45

Grouted Rock.

1. Amount of soil cement on Centennial Job = 7,260 yd³
Cost = 16.00/cy yd.
Assume this would be minimum amount needed to set up batch plant on site

2. Estimate amount of 8" thick soil cement on RWCD Reach 5 Job -

(a) East Side inlets -

Total E value (From Table page 17) = 901'

901 (14.16) = 57808.16 FT² → center flat sec -
length

3:1 Sloped sections -

length along 3:1 slope = 9.5'/side X 2 sides = 19'/inlet.
coming into center sec -

Area RT & LT TO ℄ Flwy - [3.16(11.75) + 14] 9.52 = 486.76 FT²/side X2 = 973.52

Ends = 3.16(3) + $\frac{3.16(3)}{2}$(9) = 52.14 FT²/side X 2 sides = 104.28 FT²

TOTAL Area = 973.52 + 104.28 = 1077.8 FT²/inlet

For 9 inlets - Area = 1077.9(9) = 9700.2 FT²

TOTAL sq footage = 57,808.16 + 9700.2 = 67,508.4 FT²

vol for 8" thick soil cement

= 67,508.4 $(\frac{2}{3})(\frac{1}{27})$ = 1,667.7 cy yd.

317

Estimate between 2000 & 2500 C.Y. of 8" thick soil cement needed for entire job.

Not too practical to bring in plant for this small a yardage. Mobilization costs would raise unit prices to point of not being too practical.

COMPUTATION SHEET
SCS-ENG-ECSA Rev. 9-69

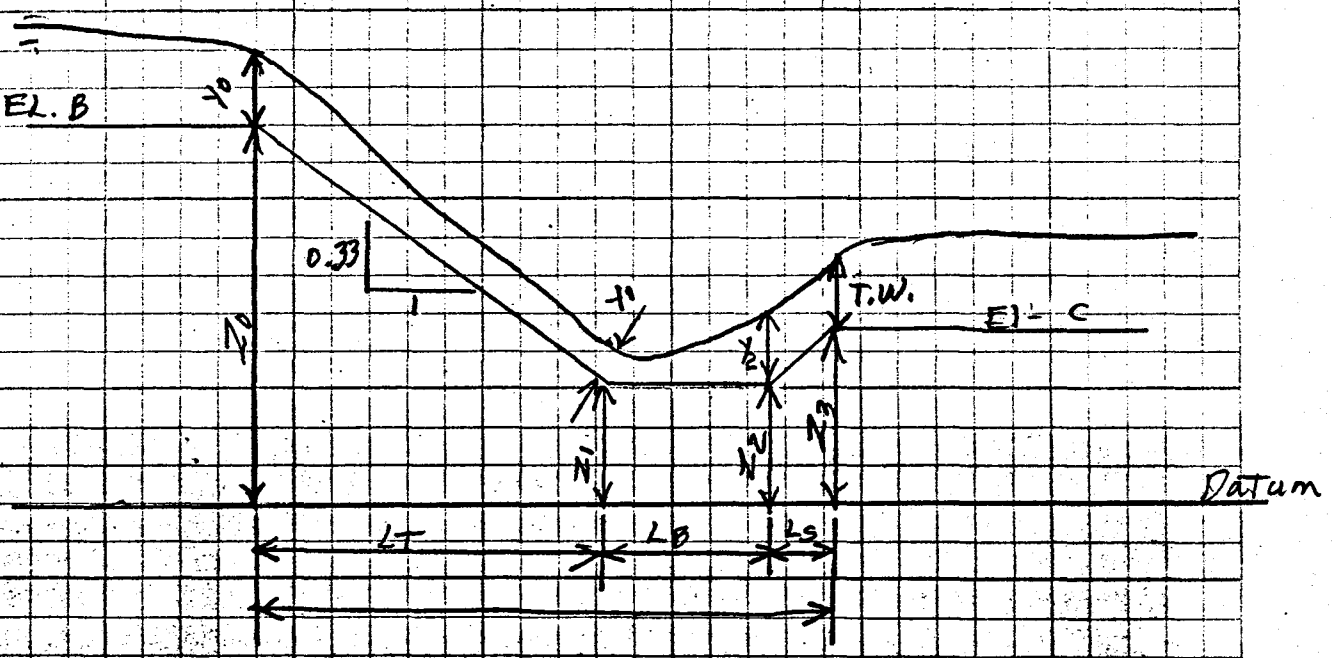
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Jayo | DATE 12-17-86 | CHECKED BY DS | DATE 3/87 | JOB NO.
SUBJECT JUSTIFICATION FOR USING 12 inch thick Grouted Rock – | SHEET 27 OF 45

1.0 Using Engineering Design Stds, Far West States
Figure 1.7 Minimum Section thickness
For channel Class C minimum thickness = 9 inches
Allowable velocity = 15 FT/sec

Use 12 inch grouted rock –
Allowable velocity = 17.6 FT/sec (Given)

Find – maximum velocity in Side Inlet
Use Hydraulic Engineering Circular No 14 Dec 1975



Given – Side inlet No 7 –
Q = 1200 CFS
Crest width = 22.9'
$Z_0 - Z_3$ = 8.9 FT.

Find – $Y_0 = Y_c$ (critical depth)

STATE Arizona PROJECT RWCD REACH 5
BY Tom Jayo DATE 12-18-86 CHECKED BY DSP DATE 3/87 JOB NO.
SUBJECT Justification for using 12 inch thick grouted Rock- SHEET 28 OF 45

From page III-8, Fig III-3, $Y_c = Y_0 = 0.315\sqrt[3]{\left(\frac{Q}{B}\right)^2}$

assume rectangular section since crest is long & depth is small < 1% of length

$$Y_0 = 0.315\sqrt[3]{\left(\frac{1200}{229}\right)^2} = 0.95 \text{ FT}$$

Find Y_0

$$V_0 = \frac{Q}{A} = \frac{1200}{229(0.95)+3(0.95)^2} = 5.45 \text{ FT/sec}$$

Find Y_1, V_1

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

$$L_T = 3(Z_0 - Z_1) = 3(27.5 - 17.6) = 29.7$$

$$W_B = 229 \text{ FT}$$

$$1200 = Y_1(229)\left[64.4(9.9 + 0.95 - Y_1) + 0.95^2\right]^{\frac{1}{2}}$$

$$Y_1^3 - 10.86 Y_1^2 + 0.49 = 0$$

$$Y_1 = 0.22 \text{ FT (By trial)}$$

$$V_1 = \frac{Q}{A} = \frac{1200}{229(0.22)+3(0.22)^2} = 23.75 \text{ FT/sec}$$

→ too high for 12" thick grouted rock-

"n" value for above analysis does not represent grouted rock- Try using PWSP program with HP-calculator- where "n" value of 0.03 is used to represent grouted rock-

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Joyce	DATE 12-18-86	CHECKED BY DP	DATE 3/87
JOB NO.			
SUBJECT Justification for Using 12" Thick Grouted Rock inlet #10			SHEET 29 OF 45

* * PWSP * *
Bottom Width = 12.0 ft.

SUPER
STA.=1+00.00
Q=200.00 CFS
BW=12.00 FT
Z=3.00:1
N=0.030
Scb=0.3333300 F/F
a=1.000
k=0.000
CB-EL.=100.00 FT
WS-EL.=101.76 FT
EGL-EL.=102.43 FT
D=1.758 FT
V=6.586 F/S
DC=1.758 FT
VC=6.586 F/S
FR=1.000

SUPER
STA.=1+0.50
CB-EL.=99.83 FT
WS-EL.=101.25 FT
EGL-EL.=102.42 FT
EGL-S=0.0197053 F/F
D=1.417 FT
V=8.684 F/S
DC=1.758 FT
VC=6.586 F/S
FR=1.444

SUPER
STA.=1+1.00
CB-EL.=99.67 FT
WS-EL.=100.97 FT
EGL-EL.=102.41 FT
EGL-S=0.0316902 F/F
D=1.308 FT
V=9.603 F/S
DC=1.758 FT
VC=6.586 F/S
FR=1.652

SUPER
STA.=1+1.50
CB-EL.=99.50 FT
WS-EL.=100.73 FT
EGL-EL.=102.39 FT
EGL-S=0.0404284 F/F
D=1.235 FT
V=10.313 F/S
DC=1.758 FT
VC=6.586 F/S
FR=1.818

Inlet #10 STA 48+94 BW = 12'

SUPER
STA.=1+2.00
CB-EL.=99.33 FT
WS-EL.=100.51 FT
EGL-EL.=102.36 FT
EGL-S=0.0485900 F/F
D=1.179 FT
V=10.913 F/S
DC=1.758 FT
VC=6.586 F/S
FR=1.962

SUPER
STA.=1+3.00
CB-EL.=99.00 FT
WS-EL.=100.10 FT
EGL-EL.=102.30 FT
EGL-S=0.0602757 F/F
D=1.098 FT
V=11.914 F/S
DC=1.758 FT
VC=6.586 F/S
FR=2.209

SUPER
STA.=1+4.00
CB-EL.=98.67 FT
WS-EL.=99.71 FT
EGL-EL.=102.23 FT
EGL-S=0.0753869 F/F
D=1.038 FT
V=12.742 F/S
DC=1.758 FT
VC=6.586 F/S
FR=2.420

SUPER
STA.=1+6.00
CB-EL.=98.00 FT
WS-EL.=98.96 FT
EGL-EL.=102.03 FT
EGL-S=0.0969427 F/F
D=0.956 FT
V=14.076 F/S
DC=1.758 FT
VC=6.586 F/S
FR=2.771

STA 48+94 = 12'

SUPER
STA.=1+8.00
CB-EL.=97.33 FT
WS-EL.=98.23 FT
EGL-EL.=101.78 FT
EGL-S=0.1242270 F/F
D=0.900 FT
V=15.122 F/S
DC=1.758 FT
VC=6.586 F/S
FR=3.057

SUPER
STA.=1+10.00
CB-EL.=96.67 FT
WS-EL.=97.53 FT
EGL-EL.=101.49 FT
EGL-S=0.1494471 F/F
D=0.859 FT
V=15.968 F/S
DC=1.758 FT
VC=6.586 F/S
FR=3.293

SUPER
STA.=1+14.00
CB-EL.=95.33 FT
WS-EL.=96.14 FT
EGL-EL.=100.76 FT
EGL-S=0.1823735 F/F
D=0.805 FT
V=17.244 F/S
DC=1.758 FT
VC=6.586 F/S
FR=3.660

SUPER
STA.=1+18.00
CB-EL.=94.00 FT
WS-EL.=94.77 FT
EGL-EL.=99.88 FT
EGL-S=0.2197443 F/F
D=0.771 FT
V=18.133 F/S
DC=1.758 FT
VC=6.586 F/S
FR=3.923

Inlet #10 Bw

SUPER
STA.=1+22.00
CB-EL.=92.67 FT
WS-EL.=93.42 FT
EGL-EL.=98.88 FT
EGL-S=0.2489746 F/F
D=0.748 FT
V=18.760 F/S
DC=1.758 FT
VC=6.586 F/S
FR=4.112

SUPER
STA.=1+24.00
CB-EL.=92.00 FT
WS-EL.=92.74 FT
EGL-EL.=98.35 FT
EGL-S=0.2667994 F/F
D=0.740 FT
V=19.001 F/S
DC=1.758 FT
VC=6.586 F/S
FR=4.185

SUPER
STA.=1+26.00
CB-EL.=91.33 FT
WS-EL.=92.07 FT
EGL-EL.=97.79 FT
EGL-S=0.2763340 F/F
D=0.733 FT
V=19.204 F/S
DC=1.758 FT
VC=6.586 F/S
FR=4.247

max velocity >126 velocity TH high

Inlet #10 STA

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	RWCD REACH 5			
BY Tom Jayb	DATE 12-10-86	CHECKED BY DSP	DATE 3/87	JOB NO.
SUBJECT Justification For Using 12" Thick Grouted Rock Inlet #4				SHEET 30 OF 45

* * PWSP *

Inlet #4 STA 40+00

SUPER
STA.=1+00.00
Q=100.00 CFS
BW=10.00 FT
Z=3.00:1
N=0.030
Sob=0.3333300 F/F
a=1.000
r=0.000
CB-EL.=100.00 FT
WS-EL.=101.28 FT
EGL-EL.=101.77 FT
D=1.275 FT
V=5.673 F/S
DC=1.275 FT
VC=5.671 F/S
FR=1.000

SUPER
STA.=1+0.50
CB-EL.=99.83 FT
WS-EL.=100.83 FT
EGL-EL.=101.76 FT
EGL-S=0.0236127 F/F
D=0.992 FT
V=7.772 F/S
DC=1.275 FT
VC=5.671 F/S
FR=1.525

SUPER
STA.=1+1.00
CB-EL.=99.67 FT
WS-EL.=100.57 FT
EGL-EL.=101.74 FT
EGL-S=0.0400757 F/F
D=0.906 FT
V=8.678 F/S
DC=1.275 FT
VC=5.671 F/S
FR=1.770

SUPER
STA.=1+1.50
CB-EL.=99.50 FT
WS-EL.=100.35 FT
EGL-EL.=101.72 FT
EGL-S=0.0524557 F/F
D=0.850 FT
V=9.380 F/S
DC=1.275 FT
VC=5.671 F/S
FR=1.967

Bottom Width = 10 FT

Inlet #4 STA 40+00

SUPER
STA.=1+2.00
CB-EL.=99.33 FT
WS-EL.=100.14 FT
EGL-EL.=101.68 FT
EGL-S=0.0641690 F/F
D=0.808 FT
V=9.968 F/S
DC=1.275 FT
VC=5.671 F/S
FR=2.137

SUPER
STA.=1+2.50
CB-EL.=99.17 FT
WS-EL.=99.94 FT
EGL-EL.=101.65 FT
EGL-S=0.0754767 F/F
D=0.774 FT
V=10.478 F/S
DC=1.275 FT
VC=5.671 F/S
FR=2.288

SUPER
STA.=1+3.00
CB-EL.=99.00 FT
WS-EL.=99.75 FT
EGL-EL.=101.60 FT
EGL-S=0.0864692 F/F
D=0.747 FT
V=10.931 F/S
DC=1.275 FT
VC=5.671 F/S
FR=2.424

SUPER
STA.=1+4.00
CB-EL.=98.67 FT
WS-EL.=99.37 FT
EGL-EL.=101.50 FT
EGL-S=0.1023219 F/F
D=0.705 FT
V=11.709 F/S
DC=1.275 FT
VC=5.671 F/S
FR=2.663

SUPER
STA.=1+5.00
CB-EL.=98.33 FT
WS-EL.=99.01 FT
EGL-EL.=101.38 FT
EGL-S=0.1226075 F/F
D=0.673 FT
V=12.357 F/S
DC=1.275 FT
VC=5.671 F/S
FR=2.868

SUPER
STA.=1+6.00
CB-EL.=98.00 FT
WS-EL.=98.65 FT
EGL-EL.=101.24 FT
EGL-S=0.1417186 F/F
D=0.649 FT
V=12.909 F/S
DC=1.275 FT
VC=5.671 F/S
FR=3.046

SUPER
STA.=1+8.00
CB-EL.=97.33 FT
WS-EL.=97.95 FT
EGL-EL.=100.90 FT
EGL-S=0.1676440 F/F
D=0.612 FT
V=13.795 F/S
DC=1.275 FT
VC=5.671 F/S
FR=3.339

SUPER
STA.=1+10.00
CB-EL.=96.67 FT
WS-EL.=97.25 FT
EGL-EL.=100.50 FT
EGL-S=0.1984959 F/F
D=0.588 FT
V=14.466 F/S
DC=1.275 FT
VC=5.671 F/S
FR=3.566

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Jayo — DATE 12-18-86	CHECKED BY DSB	DATE 8/87	JOB NO.
SUBJECT Justification For Using 12" Thick Grouted Rock inlet #4 BOTTOM WIDTH = 10 FT			SHEET 31 OF 45

SUPER
STA.=1+12.00
CB-EL.=96.00 FT
WS-EL.=96.57 FT
EGL-EL.=100.05 FT
EGL-S=0.2245176 F/F
D=0.570 FT
V=14.980 F/S
DC=1.275 FT
VC=5.671 F/S
FR=3.743

SUPER
STA.=1+16.00
CB-EL.=94.67 FT
WS-EL.=95.21 FT
EGL-EL.=99.04 FT
EGL-S=0.2542009 F/F
D=0.547 FT
V=15.692 F/S
DC=1.275 FT
VC=5.671 F/S
FR=3.993

SUPER
STA.=1+20.00
CB-EL.=93.33 FT
WS-EL.=93.87 FT
EGL-EL.=97.90 FT
EGL-S=0.2836199 F/F
D=0.535 FT
V=16.120 F/S
DC=1.275 FT
VC=5.671 F/S
FR=4.145

STA 40 B+00

SUPER
STA.=1+24.00
CB-EL.=92.00 FT
WS-EL.=92.53 FT
EGL-EL.=96.69 FT
EGL-S=0.3025099 F/F
D=0.527 FT
V=16.378 F/S
DC=1.275 FT
VC=5.671 F/S
FR=4.238

inlet #4

SUPER
STA.=1+28.00
CB-EL.=90.67 FT
WS-EL.=91.19 FT
EGL-EL.=95.43 FT
EGL-S=0.3143723 F/F
D=0.523 FT
V=16.535 F/S
DC=1.275 FT
VC=5.671 F/S
FR=4.295

SUPER
STA.=1+29.00
CB-EL.=90.33 FT
WS-EL.=90.86 FT
EGL-EL.=95.12 FT
EGL-S=0.3197303 F/F
D=0.522 FT
V=16.562 F/S
DC=1.275 FT
VC=5.671 F/S
FR=4.305

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 3		
BY Tom Jayo / DATE 12-18-86	CHECKED BY	DATE	JOB NO.
SUBJECT Justification For Using 12" Thick Grouted Rock inlet #4 Bottom Width = 20.0 FT			SHEET 32 OF 45

* * PNSP * *

SUPER
STA.=1+00.00
Q=200.00 CFS
BW=20.00 FT
Z=3.00:1
N=0.030
Scb=0.3333300 F/F
a=1.000
k=0.000
CB-EL.=100.00 FT
WS-EL.=101.36 FT
EGL-EL.=101.94 FT
D=1.358 FT
V=6.118 F/S
DC=1.358 FT
VC=6.116 F/S
FR=1.000

SUPER
STA.=1+0.50
CB-EL.=99.83 FT
WS-EL.=100.89 FT
EGL-EL.=101.93 FT
EGL-S=0.0217441 F/F
D=1.054 FT
V=8.188 F/S
DC=1.358 FT
VC=6.116 F/S
FR=1.498

SUPER
STA.=1+1.00
CB-EL.=99.67 FT
WS-EL.=100.63 FT
EGL-EL.=101.91 FT
EGL-S=0.0364517 F/F
D=0.962 FT
V=9.084 F/S
DC=1.358 FT
VC=6.116 F/S
FR=1.732

SUPER
STA.=1+1.50
CB-EL.=99.50 FT
WS-EL.=100.40 FT
EGL-EL.=101.89 FT
EGL-S=0.0475672 F/F
D=0.900 FT
V=9.786 F/S
DC=1.358 FT
VC=6.116 F/S
FR=1.925

Inlet #1D STA 485+94 BW = 20'

SUPER
STA.=1+2.00
CB-EL.=99.33 FT
WS-EL.=100.19 FT
EGL-EL.=101.86 FT
EGL-S=0.0581413 F/F
D=0.855 FT
V=10.371 F/S
DC=1.358 FT
VC=6.116 F/S
FR=2.086

SUPER
STA.=1+3.00
CB-EL.=99.00 FT
WS-EL.=99.79 FT
EGL-EL.=101.78 FT
EGL-S=0.0733442 F/F
D=0.789 FT
V=11.338 F/S
DC=1.358 FT
VC=6.116 F/S
FR=2.366

SUPER
STA.=1+4.00
CB-EL.=98.67 FT
WS-EL.=99.41 FT
EGL-EL.=101.69 FT
EGL-S=0.0930061 F/F
D=0.742 FT
V=12.126 F/S
DC=1.358 FT
VC=6.116 F/S
FR=2.602

SUPER
STA.=1+6.00
CB-EL.=98.00 FT
WS-EL.=98.68 FT
EGL-EL.=101.45 FT
EGL-S=0.1206879 F/F
D=0.679 FT
V=13.359 F/S
DC=1.358 FT
VC=6.116 F/S
FR=2.985

STA 485+94

SUPER
STA.=1+8.00
CB-EL.=97.33 FT
WS-EL.=97.97 FT
EGL-EL.=101.14 FT
EGL-S=0.1548741 F/F
D=0.639 FT
V=14.285 F/S
DC=1.358 FT
VC=6.116 F/S
FR=3.284

SUPER
STA.=1+10.00
CB-EL.=96.67 FT
WS-EL.=97.28 FT
EGL-EL.=100.77 FT
EGL-S=0.1851127 F/F
D=0.611 FT
V=14.998 F/S
DC=1.358 FT
VC=6.116 F/S
FR=3.521

SUPER
STA.=1+14.00
CB-EL.=95.33 FT
WS-EL.=95.91 FT
EGL-EL.=99.88 FT
EGL-S=0.2216181 F/F
D=0.575 FT
V=16.000 F/S
DC=1.358 FT
VC=6.116 F/S
FR=3.862

SUPER
STA.=1+18.00
CB-EL.=94.00 FT
WS-EL.=94.56 FT
EGL-EL.=98.85 FT
EGL-S=0.2595679 F/F
D=0.555 FT
V=16.621 F/S
DC=1.358 FT
VC=6.116 F/S
FR=4.079

Inlet #1D 8/6

SUPER
STA.=1+22.00
CB-EL.=92.67 FT
WS-EL.=93.21 FT
EGL-EL.=97.70 FT
EGL-S=0.2854934 F/F
D=0.544 FT
V=17.010 F/S
DC=1.358 FT
VC=6.116 F/S
FR=4.216

SUPER
STA.=1+24.00
CB-EL.=92.00 FT
WS-EL.=92.54 FT
EGL-EL.=97.10 FT
EGL-S=0.2995908 F/F
D=0.540 FT
V=17.144 F/S
DC=1.358 FT
VC=6.116 F/S
FR=4.264

SUPER
STA.=1+26.00
CB-EL.=91.33 FT
WS-EL.=91.87 FT
EGL-EL.=96.49 FT
EGL-S=0.3062963 F/F
D=0.537 FT
V=17.251 F/S < 17.0 F/S OK
DC=1.358 FT
VC=6.116 F/S
FR=4.302

Inlet #1D STA 485+94 BW = 20'

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Joyo / DATE 12-18-86	CHECKED BY	DATE	JOB NO.
SUBJECT Justification For Using 12" Grouted Rock inlet #3			SHEET 33 OF 45

BOTTOM WIDTH = 145 Feet

* * PWSP * *

SUPER
STA.=1+00.00
Q=1,850.00 CFS
BW=145.00 FT
Z=3.00:1
N=0.030
Sob=0.3333000 F/F
S=1.000
P=0.000
CB-EL.=100.00 FT
WS-EL.=101.70 FT
EGL-EL.=102.52 FT
D=1.696 FT
V=7.268 F/S
DC=1.696 FT
VC=7.268 F/S
FR=1.000

SUPER
STA.=1+0.50
CB-EL.=99.83 FT
WS-EL.=101.17 FT
EGL-EL.=102.51 FT
EGL-S=0.0179358 F/F
D=1.339 FT
V=9.271 F/S
DC=1.696 FT
VC=7.268 F/S
FR=1.431

SUPER
STA.=1+1.00
CB-EL.=99.67 FT
WS-EL.=100.89 FT
EGL-EL.=102.49 FT
EGL-S=0.0289288 F/F
D=1.226 FT
V=10.149 F/S
DC=1.696 FT
VC=7.268 F/S
FR=1.635

SUPER
STA.=1+1.50
CB-EL.=99.50 FT
WS-EL.=100.65 FT
EGL-EL.=102.47 FT
EGL-S=0.0371548 F/F
D=1.150 FT
V=10.840 F/S
DC=1.696 FT
VC=7.268 F/S
FR=1.802

Inlet #3 STA 380+00 BW=145

SUPER
STA.=1+2.00
CB-EL.=99.33 FT
WS-EL.=100.43 FT
EGL-EL.=102.45 FT
EGL-S=0.0449891 F/F
D=1.092 FT
V=11.423 F/S
DC=1.696 FT
VC=7.268 F/S
FR=1.947

SUPER
STA.=1+2.50
CB-EL.=99.17 FT
WS-EL.=100.21 FT
EGL-EL.=102.43 FT
EGL-S=0.0526216 F/F
D=1.046 FT
V=11.937 F/S
DC=1.696 FT
VC=7.268 F/S
FR=2.078

SUPER
STA.=1+3.00
CB-EL.=99.00 FT
WS-EL.=100.01 FT
EGL-EL.=102.40 FT
EGL-S=0.0601496 F/F
D=1.008 FT
V=12.399 F/S
DC=1.696 FT
VC=7.268 F/S
FR=2.199

SUPER
STA.=1+4.00
CB-EL.=98.67 FT
WS-EL.=99.61 FT
EGL-EL.=102.32 FT
EGL-S=0.0712776 F/F
D=0.947 FT
V=13.211 F/S
DC=1.696 FT
VC=7.268 F/S
FR=2.415

Inlet #3 STA 380+00 BW=145

SUPER
STA.=1+5.00
CB-EL.=98.33 FT
WS-EL.=99.23 FT
EGL-EL.=102.24 FT
EGL-S=0.0859083 F/F
D=0.900 FT
V=13.909 F/S
DC=1.696 FT
VC=7.268 F/S
FR=2.607

SUPER
STA.=1+6.00
CB-EL.=98.00 FT
WS-EL.=98.86 FT
EGL-EL.=102.14 FT
EGL-S=0.1002358 F/F
D=0.863 FT
V=14.522 F/S
DC=1.696 FT
VC=7.268 F/S
FR=2.779

SUPER
STA.=1+7.00
CB-EL.=97.67 FT
WS-EL.=98.50 FT
EGL-EL.=102.02 FT
EGL-S=0.1142048 F/F
D=0.833 FT
V=15.065 F/S
DC=1.696 FT
VC=7.268 F/S
FR=2.934

SUPER
STA.=1+9.00
CB-EL.=97.00 FT
WS-EL.=97.79 FT
EGL-EL.=101.76 FT
EGL-S=0.1341839 F/F
D=0.785 FT
V=15.989 F/S
DC=1.696 FT
VC=7.268 F/S
FR=3.205

Inlet #3 STA 380+00 BW=145

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Dayo / DATE 12-18-86	CHECKED BY	DATE	JOB NO.
SUBJECT Justification For Using 12" Grouted Rock inlet #3			SHEET 34 OF 45

Bottom Width = 145 Feet

Inlet #B1

SUPER
STA.=1+11.00
CB-EL.=96.33 FT
WS-EL.=97.08 FT
EGL-EL.=101.44 FT
EGL-S=0.1593155 F/F
D=0.750 FT
V=16.742 F/S
DC=1.696 FT
VC=7.268 F/S
FR=3.432

SUPER
STA.=1+13.00
CB-EL.=95.67 FT
WS-EL.=96.39 FT
EGL-EL.=101.07 FT
EGL-S=0.1822549 F/F
D=0.724 FT
V=17.363 F/S
DC=1.696 FT
VC=7.268 F/S
FR=3.622

SUPER
STA.=1+15.00
CB-EL.=95.00 FT
WS-EL.=95.70 FT
EGL-EL.=100.67 FT
EGL-S=0.2028937 F/F
D=0.703 FT
V=17.876 F/S
DC=1.696 FT
VC=7.268 F/S
FR=3.783

SUPER
STA.=1+19.00
CB-EL.=93.67 FT
WS-EL.=94.34 FT
EGL-EL.=99.75 FT
EGL-S=0.2288602 F/F
D=0.674 FT
V=18.664 F/S
DC=1.696 FT
VC=7.268 F/S
FR=4.033

Inlet #3 STA 380+00 BW = 145

SUPER
STA.=1+23.00
CB-EL.=92.33 FT
WS-EL.=92.99 FT
EGL-EL.=98.72 FT
EGL-S=0.2573588 F/F
D=0.655 FT
V=19.212 F/S
DC=1.696 FT
VC=7.268 F/S
FR=4.211

SUPER
STA.=1+27.00
CB-EL.=91.00 FT
WS-EL.=91.64 FT
EGL-EL.=97.61 FT
EGL-S=0.2786932 F/F
D=0.643 FT
V=19.595 F/S
DC=1.696 FT
VC=7.268 F/S
FR=4.336

SUPER
STA.=1+28.00
CB-EL.=90.67 FT
WS-EL.=91.31 FT
EGL-EL.=97.32 FT
EGL-S=0.2895860 F/F
D=0.640 FT
V=19.670 F/S max velocity
DC=1.696 FT
VC=7.268 F/S
FR=4.361

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Jayo / DATE 12-18-86	CHECKED BY	DATE	JOB NO.
SUBJECT Justification For Using 12" Grouted Rock in let #3			SHEET 35 OF 45

BOTTOM WIDTH = 200 Feet

* * PWSP * *

SUPER
STA.=1+00.00
Q=1,850.00 CFS
BW=200.00 FT
Z=3.00:1
N=0.030
Scb=0.3333300 F/F
a=1.000
k=0.000
CB-EL.=100.00 FT
WS-EL.=101.38 FT
EGL-EL.=102.05 FT
D=1.375 FT
V=6.591 F/S
DC=1.375 FT
VC=6.589 F/S
FR=1.001

SUPER
STA.=1+0.50
CB-EL.=99.83 FT
WS-EL.=100.89 FT
EGL-EL.=102.04 FT
EGL-S=0.0202168 F/F
D=1.060 FT
V=8.593 F/S
DC=1.375 FT
VC=6.589 F/S
FR=1.482

SUPER
STA.=1+1.00
CB-EL.=99.67 FT
WS-EL.=100.63 FT
EGL-EL.=102.02 FT
EGL-S=0.0338821 F/F
D=0.963 FT
V=9.470 F/S
DC=1.375 FT
VC=6.589 F/S
FR=1.713

SUPER
STA.=1+1.50
CB-EL.=99.50 FT
WS-EL.=100.40 FT
EGL-EL.=102.00 FT
EGL-S=0.0443068 F/F
D=0.899 FT
V=10.151 F/S
DC=1.375 FT
VC=6.589 F/S
FR=1.899

Inlet #3 STA 380+00 BW = 200'

SUPER
STA.=1+2.00
CB-EL.=99.33 FT
WS-EL.=100.18 FT
EGL-EL.=101.97 FT
EGL-S=0.0542960 F/F
D=0.851 FT
V=10.729 F/S
DC=1.375 FT
VC=6.589 F/S
FR=2.062

SUPER
STA.=1+2.50
CB-EL.=99.17 FT
WS-EL.=99.98 FT
EGL-EL.=101.94 FT
EGL-S=0.0641008 F/F
D=0.813 FT
V=11.234 F/S
DC=1.375 FT
VC=6.589 F/S
FR=2.208

SUPER
STA.=1+3.00
CB-EL.=99.00 FT
WS-EL.=99.78 FT
EGL-EL.=101.90 FT
EGL-S=0.0737581 F/F
D=0.782 FT
V=11.686 F/S
DC=1.375 FT
VC=6.589 F/S
FR=2.342

SUPER
STA.=1+4.00
CB-EL.=98.67 FT
WS-EL.=99.40 FT
EGL-EL.=101.82 FT
EGL-S=0.0879453 F/F
D=0.734 FT
V=12.470 F/S
DC=1.375 FT
VC=6.589 F/S
FR=2.580

Inlet No3 STA 380+00 BW = 200'

SUPER
STA.=1+5.00
CB-EL.=98.33 FT
WS-EL.=99.03 FT
EGL-EL.=101.71 FT
EGL-S=0.1064213 F/F
D=0.697 FT
V=13.133 F/S
DC=1.375 FT
VC=6.589 F/S
FR=2.786

SUPER
STA.=1+6.00
CB-EL.=98.00 FT
WS-EL.=98.67 FT
EGL-EL.=101.58 FT
EGL-S=0.1242249 F/F
D=0.668 FT
V=13.704 F/S
DC=1.375 FT
VC=6.589 F/S
FR=2.969

SUPER
STA.=1+7.00
CB-EL.=97.67 FT
WS-EL.=98.31 FT
EGL-EL.=101.44 FT
EGL-S=0.1412483 F/F
D=0.645 FT
V=14.201 F/S
DC=1.375 FT
VC=6.589 F/S
FR=3.131

SUPER
STA.=1+9.00
CB-EL.=97.00 FT
WS-EL.=97.61 FT
EGL-EL.=101.11 FT
EGL-S=0.1648031 F/F
D=0.610 FT
V=15.020 F/S
DC=1.375 FT
VC=6.589 F/S
FR=3.404

Inlet No3 STA 380+00 BW = 200'

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Jayo / DATE 12-18-86	CHECKED BY	DATE	JOB NO.
SUBJECT Justification For Using 12" Grouted Rock INLET NO 3 cont			SHEET 36 OF 45

Bottom Width = 200 feet

SUPER
STA.=1+11.00
CB-EL.=96.33 FT
WS-EL.=96.92 FT
EGL-EL.=100.73 FT
EGL-S=0.1933667 F/F
D=0.586 FT
V=15.660 F/S
DC=1.375 FT
VC=6.589 F/S
FR=3.622

SUPER
STA.=1+13.00
CB-EL.=95.67 FT
WS-EL.=96.23 FT
EGL-EL.=100.29 FT
EGL-S=0.2180753 F/F
D=0.567 FT
V=16.162 F/S
DC=1.375 FT
VC=6.589 F/S
FR=3.797

SUPER
STA.=1+15.00
CB-EL.=95.00 FT
WS-EL.=95.55 FT
EGL-EL.=99.81 FT
EGL-S=0.2390752 F/F
D=0.554 FT
V=16.560 F/S
DC=1.375 FT
VC=6.589 F/S
FR=3.937

SUPER
STA.=1+19.00
CB-EL.=93.67 FT
WS-EL.=94.20 FT
EGL-EL.=98.76 FT
EGL-S=0.2633999 F/F
D=0.536 FT
V=17.129 F/S
DC=1.375 FT
VC=6.589 F/S
FR=4.141

#3 STA 380+00
BW = 200

SUPER
STA.=1+23.00
CB-EL.=92.33 FT
WS-EL.=92.86 FT
EGL-EL.=97.61 FT
EGL-S=0.2879605 F/F
D=0.525 FT
V=17.486 F/S
DC=1.375 FT
VC=6.589 F/S
FR=4.270

Inlet

SUPER
STA.=1+27.00
CB-EL.=91.00 FT
WS-EL.=91.52 FT
EGL-EL.=96.39 FT
EGL-S=0.3042275 F/F
D=0.518 FT
V=17.711 F/S
DC=1.375 FT
VC=6.589 F/S
FR=4.352

SUPER
STA.=1+28.00
CB-EL.=90.67 FT
WS-EL.=91.18 FT
EGL-EL.=96.08 FT
EGL-S=0.3118413 F/F
D=0.517 FT
V=17.752 F/S → max velocity
DC=1.375 FT
VC=6.589 F/S
FR=4.367

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Jayo / DATE 12-18-86	CHECKED BY	DATE	JOB NO.
SUBJECT Justification For Using 12" Grouted Rock			SHEET 3.9 OF 45

INLET NO 7 Bottom Width = 229 FT.

* * PWSP * *

SUPER
STA.=1+00.00
Q=1,200.00 CFS
BW=229.00 FT
Z=3.00:1
N=0.030
Scb=0.3333300 F/F
a=1.000
k=0.000
CB-EL.=100.00 FT
WS-EL.=100.94 FT
EGL-EL.=101.41 FT
D=0.944 FT
V=5.483 F/S
DC=0.944 FT
VC=5.481 F/S
FR=1.001

SUPER
STA.=1+0.50
CB-EL.=99.83 FT
WS-EL.=100.53 FT
EGL-EL.=101.40 FT
EGL-S=0.0256122 F/F
D=0.693 FT
V=7.489 F/S
DC=0.944 FT
VC=5.481 F/S
FR=1.592

SUPER
STA.=1+1.00
CB-EL.=99.67 FT
WS-EL.=100.29 FT
EGL-EL.=101.37 FT
EGL-S=0.0460838 F/F
D=0.621 FT
V=8.364 F/S
DC=0.944 FT
VC=5.481 F/S
FR=1.877

SUPER
STA.=1+1.50
CB-EL.=99.50 FT
WS-EL.=100.08 FT
EGL-EL.=101.34 FT
EGL-S=0.0623042 F/F
D=0.576 FT
V=9.032 F/S
DC=0.944 FT
VC=5.481 F/S
FR=2.106

Inlet #7 STA-452+25

SUPER
STA.=1+2.00
CB-EL.=99.33 FT
WS-EL.=99.88 FT
EGL-EL.=101.30 FT
EGL-S=0.0779384 F/F
D=0.542 FT
V=9.593 F/S
DC=0.944 FT
VC=5.481 F/S
FR=2.303

SUPER
STA.=1+2.50
CB-EL.=99.17 FT
WS-EL.=99.68 FT
EGL-EL.=101.26 FT
EGL-S=0.0931590 F/F
D=0.517 FT
V=10.070 F/S
DC=0.944 FT
VC=5.481 F/S
FR=2.477

SUPER
STA.=1+3.00
CB-EL.=99.00 FT
WS-EL.=99.50 FT
EGL-EL.=101.20 FT
EGL-S=0.1078794 F/F
D=0.496 FT
V=10.487 F/S
DC=0.944 FT
VC=5.481 F/S
FR=2.631

SUPER
STA.=1+3.50
CB-EL.=98.83 FT
WS-EL.=99.31 FT
EGL-EL.=101.14 FT
EGL-S=0.1221252 F/F
D=0.480 FT
V=10.856 F/S
DC=0.944 FT
VC=5.481 F/S
FR=2.771

#7 STA 452+25

SUPER
STA.=1+4.00
CB-EL.=98.67 FT
WS-EL.=99.13 FT
EGL-EL.=101.08 FT
EGL-S=0.1358538 F/F
D=0.466 FT
V=11.186 F/S
DC=0.944 FT
VC=5.481 F/S
FR=2.897

SUPER
STA.=1+4.50
CB-EL.=98.50 FT
WS-EL.=98.95 FT
EGL-EL.=101.00 FT
EGL-S=0.1490268 F/F
D=0.454 FT
V=11.481 F/S
DC=0.944 FT
VC=5.481 F/S
FR=3.013

SUPER
STA.=1+5.00
CB-EL.=98.33 FT
WS-EL.=98.78 FT
EGL-EL.=100.92 FT
EGL-S=0.1616141 F/F
D=0.443 FT
V=11.748 F/S
DC=0.944 FT
VC=5.481 F/S
FR=3.118

SUPER
STA.=1+6.00
CB-EL.=98.00 FT
WS-EL.=98.43 FT
EGL-EL.=100.74 FT
EGL-S=0.1791337 F/F
D=0.427 FT
V=12.207 F/S
DC=0.944 FT
VC=5.481 F/S
FR=3.302

Inlet #452+25

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Joyo / DATE 12-18-86	CHECKED BY	DATE	JOB NO.
SUBJECT Justification For Using 12" Grouted Rock			SHEET 38 OF 45

INLET NO 7 - Bottom Width = 22.9 FT

SUPER
STA.=1+7.00
CB-EL.=97.67 FT
WS-EL.=98.08 FT
EGL-EL.=100.54 FT
EGL-S=0.2006440 F/F
D=0.414 FT
V=12.584 F/S
DC=0.944 FT
VC=5.481 F/S
FR=3.455

Inlet #7 ST

SUPER
STA.=1+8.00
CB-EL.=97.33 FT
WS-EL.=97.74 FT
EGL-EL.=100.32 FT
EGL-S=0.2197089 F/F
D=0.404 FT
V=12.897 F/S
DC=0.944 FT
VC=5.481 F/S
FR=3.584

SUPER
STA.=1+10.00
CB-EL.=96.67 FT
WS-EL.=97.06 FT
EGL-EL.=99.83 FT
EGL-S=0.2432673 F/F
D=0.390 FT
V=13.373 F/S
DC=0.944 FT
VC=5.481 F/S
FR=3.784

SUPER
STA.=1+12.00
CB-EL.=96.00 FT
WS-EL.=96.38 FT
EGL-EL.=99.30 FT
EGL-S=0.2687351 F/F
D=0.381 FT
V=13.702 F/S
DC=0.944 FT
VC=5.481 F/S
FR=3.924

452+25

SUPER
STA.=1+14.00
CB-EL.=95.33 FT
WS-EL.=95.71 FT
EGL-EL.=98.72 FT
EGL-S=0.2874459 F/F
D=0.374 FT
V=13.930 F/S
DC=0.944 FT
VC=5.481 F/S
FR=4.022

Inlet #7 ST

SUPER
STA.=1+18.00
CB-EL.=94.00 FT
WS-EL.=94.37 FT
EGL-EL.=97.50 FT
EGL-S=0.3051754 F/F
D=0.367 FT
V=14.204 F/S
DC=0.944 FT
VC=5.481 F/S
FR=4.141

SUPER
STA.=1+22.00
CB-EL.=92.67 FT
WS-EL.=93.03 FT
EGL-EL.=96.22 FT
EGL-S=0.3198307 F/F
D=0.364 FT
V=14.333 F/S
DC=0.944 FT
VC=5.481 F/S
FR=4.197

SUPER
STA.=1+26.00
CB-EL.=91.33 FT
WS-EL.=91.70 FT
EGL-EL.=94.91 FT
EGL-S=0.3269177 F/F
D=0.362 FT
V=14.394 F/S max velocity
DC=0.944 FT
VC=5.481 F/S
FR=4.224

25

SUPER
STA.=1+28.00
CB-EL.=90.67 FT
WS-EL.=91.03 FT
EGL-EL.=94.25 FT
EGL-S=0.3298235 F/F
D=0.362 FT
V=14.410 F/S
DC=0.944 FT
VC=5.481 F/S
FR=4.231

Inlet #7 STA 452+

SUPER
STA.=1+29.00
CB-EL.=90.33 FT
WS-EL.=90.70 FT
EGL-EL.=93.92 FT
EGL-S=0.3306657 F/F
D=0.362 FT
V=14.416 F/S
DC=0.944 FT
VC=5.481 F/S
FR=4.234

SUPER
STA.=1+29.70
CB-EL.=90.10 FT
WS-EL.=90.46 FT
EGL-EL.=93.69 FT
EGL-S=0.3310247 F/F
D=0.362 FT
V=14.419 F/S
DC=0.944 FT
VC=5.481 F/S
FR=4.235

COMPUTATION SHEET

SCS-ENG-ECSA Rev. 9-69

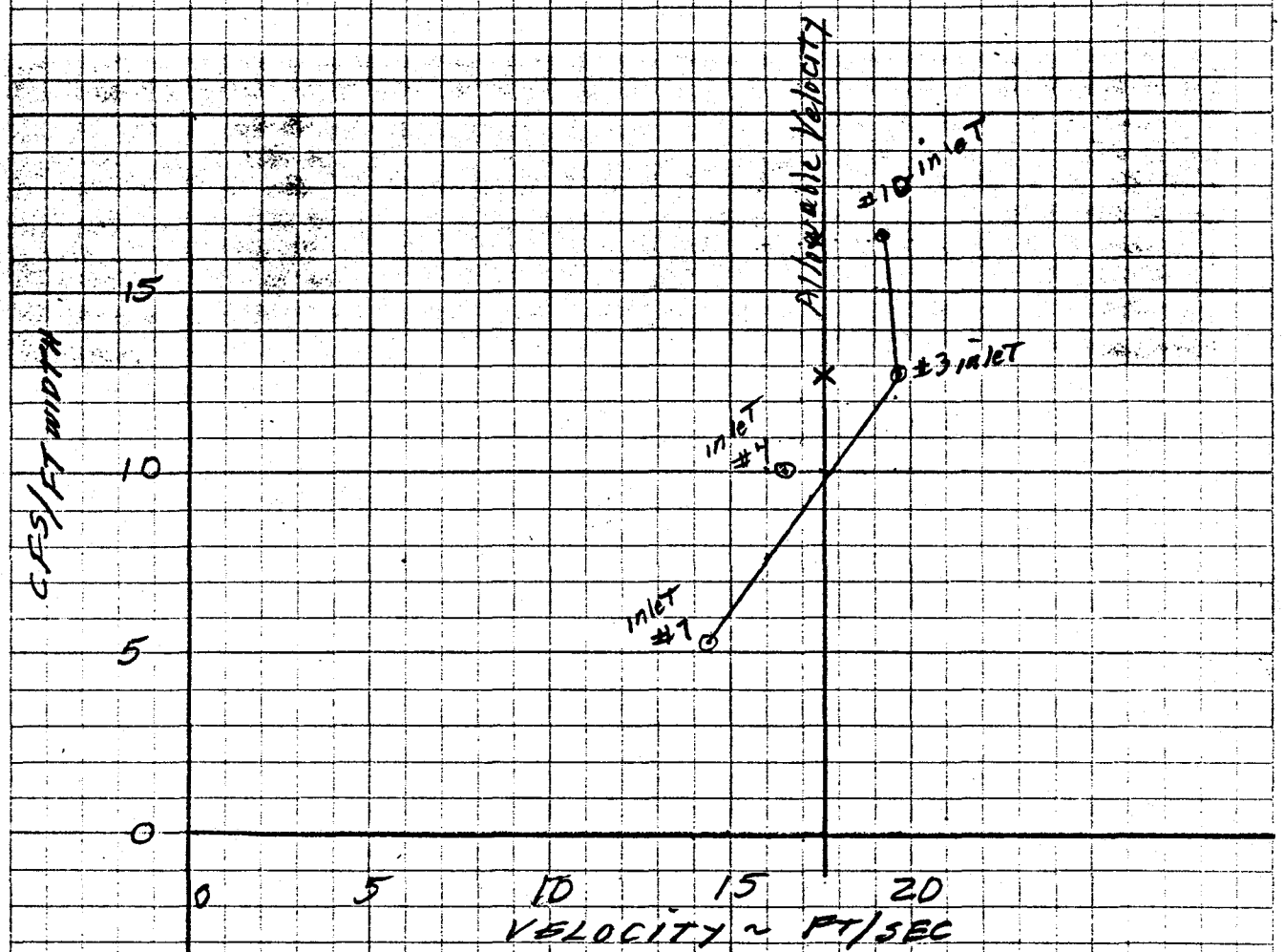
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5

BY Tom Sayo | DATE 12-19-86 | CHECKED BY | DATE | JOB NO.

SUBJECT Justification For Using 12" Thick grouted Rock | SHEET 39 OF 45

Curve - CFS/FT VS Velocity



COMPUTATION SHEET
SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACHS
BY Tom Jayo | DATE 12-23-86 | CHECKED BY DJP | DATE 3/87 | JOB NO.
SUBJECT Redesign Inlet NO 10&3 in Attempt To bring velocity down To 17.6 allowable. | SHEET 40 OF 45

1.0-Inlet #10

Try widening bottom width TO 20'

Given: Q = 200 CFS
crest elev. = 1326.5

$Q = 3.1 L H^{3/2} + C Z (H)^{5/2}$

$200 = 3.1(20)(H)^{3/2} + 3.1(3)(H)^{5/2} = 62(H)^{3/2} + 9.3(H)^{5/2}$

$\frac{200}{9.3} = \frac{62}{9.3} H^{3/2} + H^{5/2}$

$21.505 = 6.667 H^{3/2} + H^{5/2}$

by trial $H = 1.85 \pm$ - Velocity = 17.3 FT/sec Per PWSP H.P. program OK

2.0 Inlet NO 3

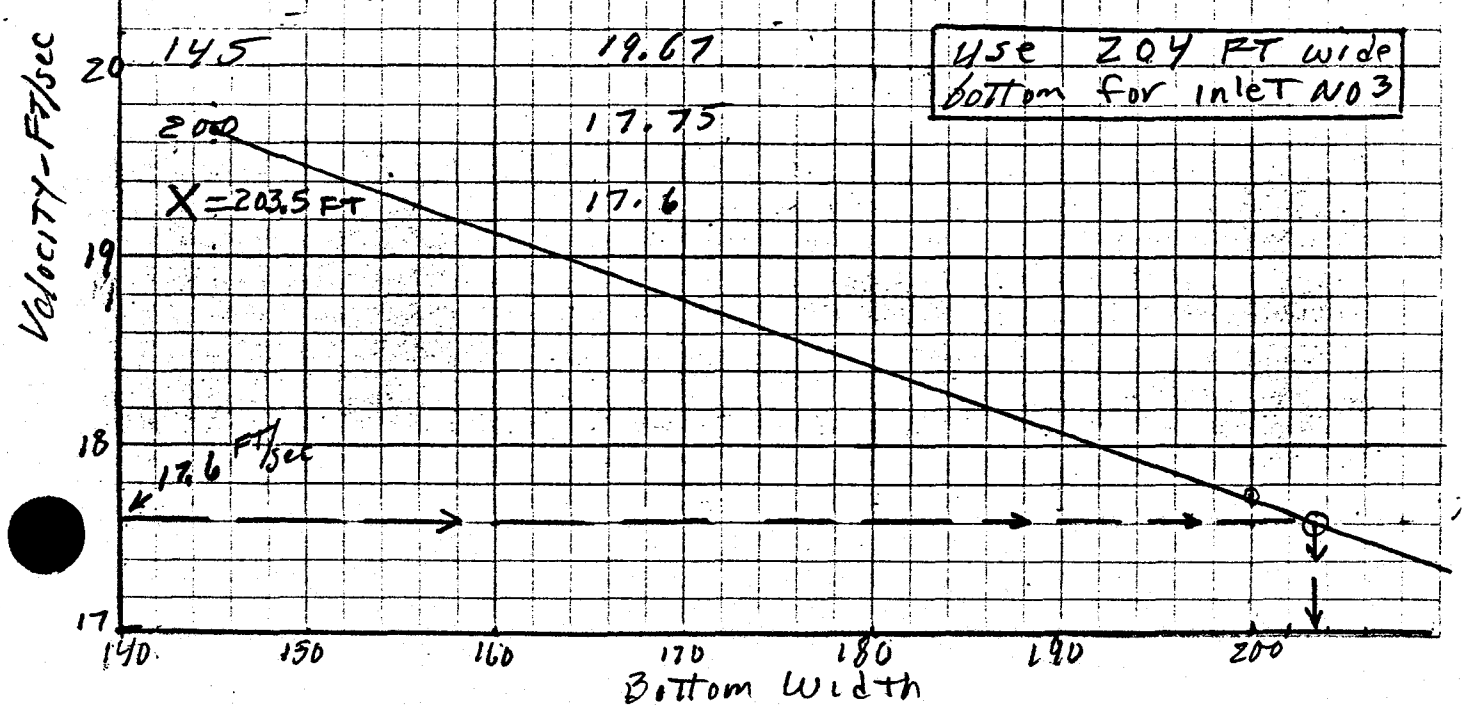
try widening bottom width TO 200 FT

Given Q = 1850 CFS, n = 0.03, drop = 9.7 Length = 28.1

Using Hewlett Packard PWSP program with BW. = 200'
max velocity = 17.75 FT/sec > 17.6 FT/sec
but very close.

Bottom Width	Velocity ~ F/S
145	19.67
200	17.75
X = 203.5 FT	17.6

Use 204 FT wide bottom for inlet NO 3



COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT RWCD REACH 5
BY Tom Joyo | DATE 12-23-86 | CHECKED BY DEP | DATE 3/87 | JOB NO.
SUBJECT Compare Cost of widenning Side Inlets | SHEET 41 OF 45

To bring Velocity ≤ 17.6 FT/sec vs thicker section from 12" to 18 inch. see sheet 24 for areas -

1.0
Vol to widen inlet 3 & 10

added width = (204-145) + (20-12) = 67 FT

length = 64.16

vol = 64.16 (67)(1)($\frac{1}{27}$) = 159.2 cubic yards

2.0 Vol to increase all 9 side inlets from 12" to 18"

Flat center sec - 57,808.16 (0.5)($\frac{1}{27}$) = 1070.5 cu yd.

3:1 sloped & end sections - 9700 (0.5)($\frac{1}{27}$) = 179.6 cu yd

TOTAL 1,250.1 cu yd.

159.2 cy compared to 1,250.1 c.y.

= 7.85 times as much grouted rock

@ 40.00/c.y. = $43,636.00 more cost. to thicken all sections

3. Make comparison of widenning vs thickenning for only inlets 3 & 10 -

a. Vol to widen from above 1.0 = 159.2 c.y.

b. Vol to thicken 3 & 10 from 12" to 18"

~~157~~ 223 (64.16)(0.5)($\frac{1}{27}$) + ~~1077.8~~ (64.16)(38.90)(0.5)($\frac{1}{27}$) = ~~206.5~~ 311.2 cu yd -

159.2 compared to ~~206.5~~ 311.2 cu yd -

= ~~47.3~~ 152.0 cu yds more to thicken inlets 3 & 10

= ~~$1892.00~~ $6080.00 increase in cost to thicken versus widenning inlets 3 & 10.

Result - Widen inlet #3 8 feet and widen inlet #10 59 feet.

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	RWCD REACH 5			
BY Tom Jayo	DATE 1-15-87	CHECKED BY DB	DATE 3/87	JOB NO.
SUBJECT Grouted Rock Riprap Gradation -				SHEET 42 OF 45

the rock shall be graded as follows:

Particle Size (inch)	Percent Passing (By dry weight)		
12	100	100	
9	40 - 85	43.	37%
6	10 - 50	30	33%
3	0 - 5	3	27%

No bedding or filter material is required.

U.S. Department of Agriculture
Soil Conservation Service

GRAIN SIZE ANALYSIS FOR
Grouted Rock Riprap
(Specify)

SCS-ENG-130
2-85

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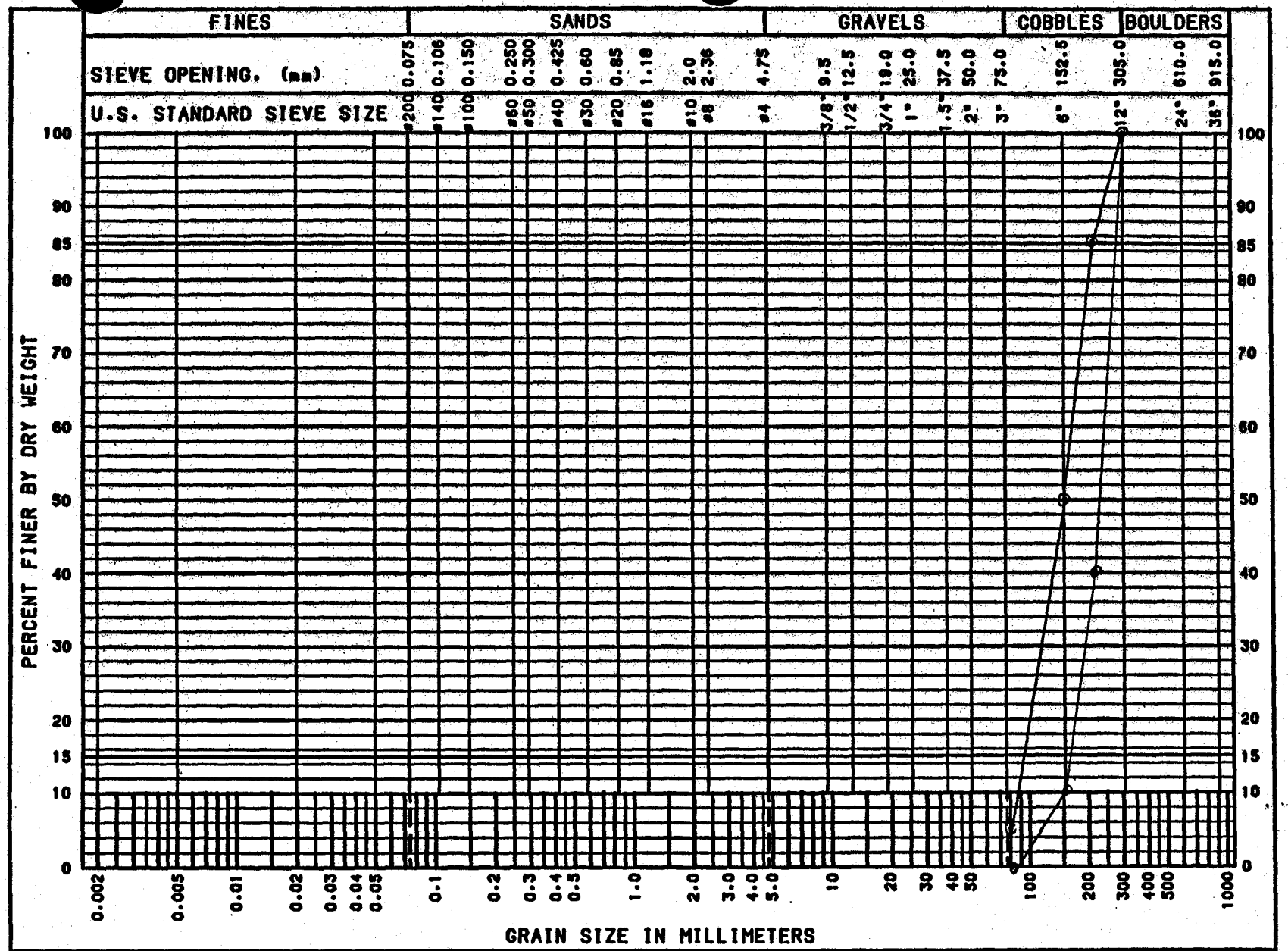
Project and state RWCD REACH 5 ARIZONA

Designed at SCS-Design Sec By TJS Date 1-15-87



REMARKS

may not have?

13. ITEMS OF WORK AND CONSTRUCTION DETAILS - IDAHO ROAD AND LOST DUTCHMAN BOULEVARD

Items of work to be performed in conformance with this specification and the construction details are:

Bid Item 8 , 12-inch Grouted Rock Riprap

need to be specific working w/ Bid sheets

(1) This item consists of furnishing and placing 12-inch grouted rock riprap, including the cement grout, at the locations shown on the drawings. where?

criteria used to guide upper Passing Limit

(2) The riprap shall be graded from 1 inch to 12 inches in diameter with: a minimum of 50 percent by weight greater than 6 inches in diameter, a minimum of 15 percent by weight greater than 9 inches in diameter, and a maximum of 15 percent by weight less than 3 inches in diameter.

too high change to 5%

(3) The riprap shall be equipment placed.

(4) In Section 6, Design of the Grout Mix, the Contractor shall be responsible for proportioning the mix. The grout shall consist of Portland cement, fine and coarse aggregate, water and an air entraining agent. The cement content shall be 5 1/2 bags per cubic yard of concrete. The maxmium nominal size of coarse aggregate shall be 3/4 inch. The slump shall be within the range of 6 to 10 inches. The air content (by volume) of the grout mixture at the time of placement shall be five (5) to seven (7) percent. At least five (5) days prior to placement of the grout, the Contractor shall furnish the Engineer with a statement of the mix proportions for approval.

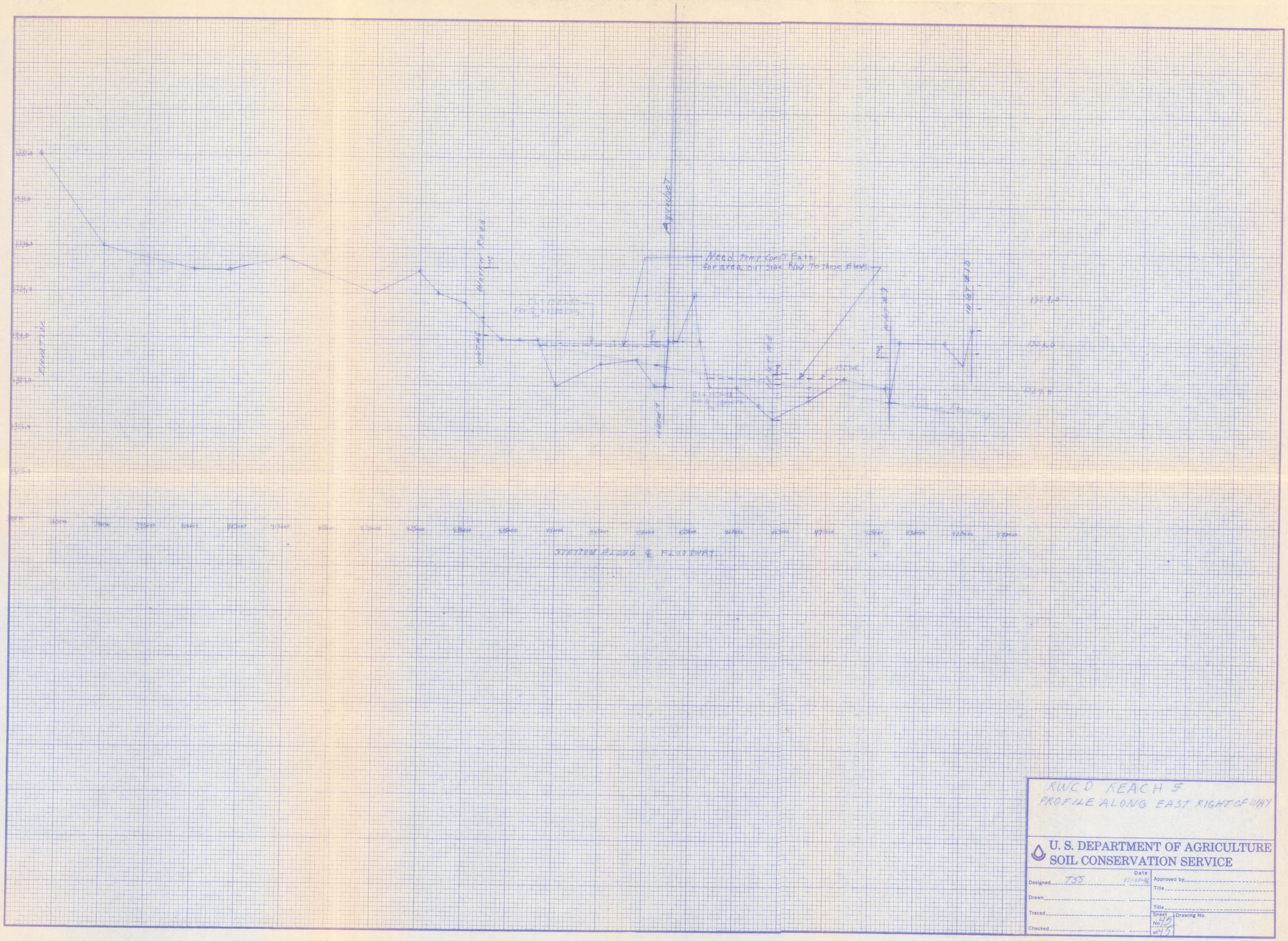
(5) Cement shall be Type II or Type IIA.

(6) The grout mix shall be integrally colored. The color grout shall blend with the natural earth tones at the site and can be produced using Davis Colors' Miami Buff additive or similar quality products produced by Colorful Admixtures or L.M. Scofield. The color tone of the goruted mix shall be approved by the Engineer prior to full production.

(7) Grout shall be placed such that a smooth surface is not created. Rock edges shall protrude 2 to 4 inches above the grout surface upon completion of the grouting process.

(8) Payment for drainfill and transition fill material where called for under the grouted rock riprap is made under the "Drainfill Specification", Construction Specification 24.

Carry Compound?



RWCD REACH 5
PROFILE ALONG EAST RIGHT OF WAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed TSS	Date 12-10-80	Approved by	
Drawn		Title	
Traced		Title	
Checked		Sheet No. 45 of 45	Drawing No.

SCS-EN-315 (Rev. 6-79)

SIDE INLET DESIGN #1

O & M SIDE INLETS

0 ¢m side Inlets

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
AZ		RWCD REACH-5		
BY ICC	DATE 12-5-86	CHECKED BY DB	DATE 3/87	JOB NO.
SUBJECT WEST SIDE INLETS & COLLECTOR DITCHES				SHEET 1 OF 4

Reference TR-55

~Hydrology for area between channel and canal.

Area ≃ 1500' × 30' = 1.03 Ac

ASSUME:

a) "B" Soil
b) CN = 75

For 100 yr. & 24 hrs storm:

Prec. = 6 inch
Runoff = 3.28 inch - Table 2-1

Slope = 2'/1500' × 100 = 0.13% - Flat

Peak Discharge = 1.4 cfs/in of runoff (Fig D-2)

q_p = 3.28(1.4) = 4.6 cfs

From TABLE E-1, slope = 0.13 & < 10 Acres

Adj. fact. = 0.52

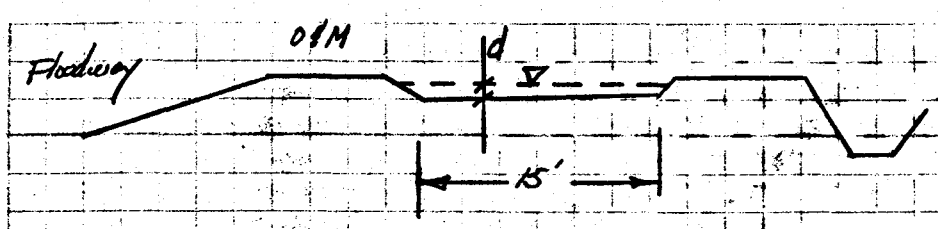
Design q = 4.6(0.52) = 2.4 cfs

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
AZ		RWCD - Reach-5		
BY ICC	DATE 12-18-86	CHECKED BY DB	DATE 5/87	JOB NO.
SUBJECT West Side Collector Ditches				SHEET 2 OF 4

OPTION 1 — Recommended Section



$q_d = 2.4\,cfs$ (From page 1)

$$Q = \frac{A\,1.486\,r^{2/3}\,s^{1/2}}{n}$$

Assume:
$n = 0.03$
$s = 0.0003$
flowing depth = 4.5"

$$r_h = A/P = \frac{15(0.375)}{15 + (0.375)2} = 0.357$$

$$Q = \frac{[15(0.375)]\,1.486\,(0.357)^{2/3}\,(0.0003)^{1/2}}{0.03} =$$

$$= \underline{2.43\,cfs} \simeq q_d \quad \underline{OK}$$

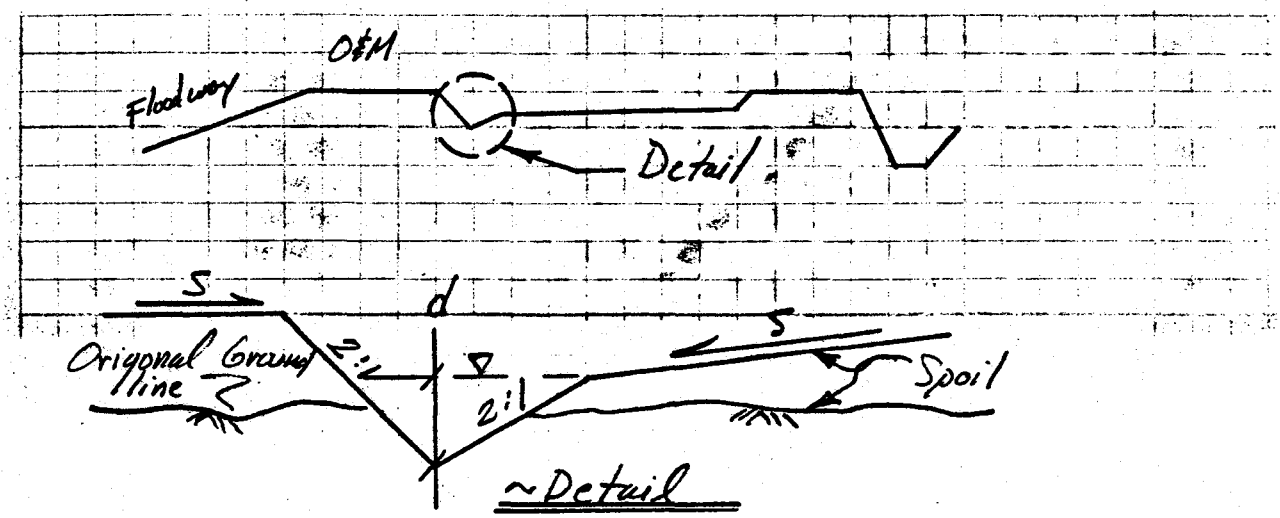
$$V = \frac{2.43}{15(0.375)} = \underline{0.43\,fps}$$

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
AZ	RWCD Reach-5		
BY ICC	DATE 12-18-86	CHECKED BY DEB	DATE 5/87	JOB NO.
SUBJECT West Side Collector Ditches			SHEET 3 OF 4

Option 2



~Detail

$q_d = 2.4 cfs$

$Q = A\, 1.486\, r^{2/3} s^{1/2} / n$

Assume:
$n = 0.003$
$s = 0.0003$
flowing depth $(d) = 17''$

$r_h = zd / 2\sqrt{z^2+1} = 0.634$

$A = zd^2 = 4.01 ft^2$

$Q = (4.01)\, 1.486\, (0.634)^{2/3} (0.0003)^{1/2} / 0.03 =$

$= \underline{2.54 cfs} \simeq q_p$ OK

$V = 2.54 / 4.01 = \underline{0.63 fps}$

Note: Note into the specs that spoil will be done first on west side of floodway to the cross-sections shown, but will not need to be compacted.

Worksheet 4: Graphical Peak Discharge method

Project RWCD Reach-5 By ICC Date 3-9-87

Location West Side Inlets & Collector Ditch Checked NS Date 3/87

Circle one: Present Developed

1. Data: (1500'x45' = 67,500 ft²) check using larger area & new TR-55

Drainage area ..... A_m = 0.0024 mi² (acres/640)

Runoff curve number .... CN = 75 (From worksheet 2)

Time of concentration .. T_c = ≈ 1.0 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = — percent of A_m (— acres or mi² covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	100		
3. Rainfall, P (24-hour)	in	6.0		
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.667		
5. Compute I_a/P		0.11		
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-____)	csm/in	350		
7. Runoff, Q ..... (From worksheet 2). Table 2-1	in	3.28		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0		
9. Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs	2.76		

PIPE DESIGN FOR O & M INLETS

Pipe design for O&M inlets

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

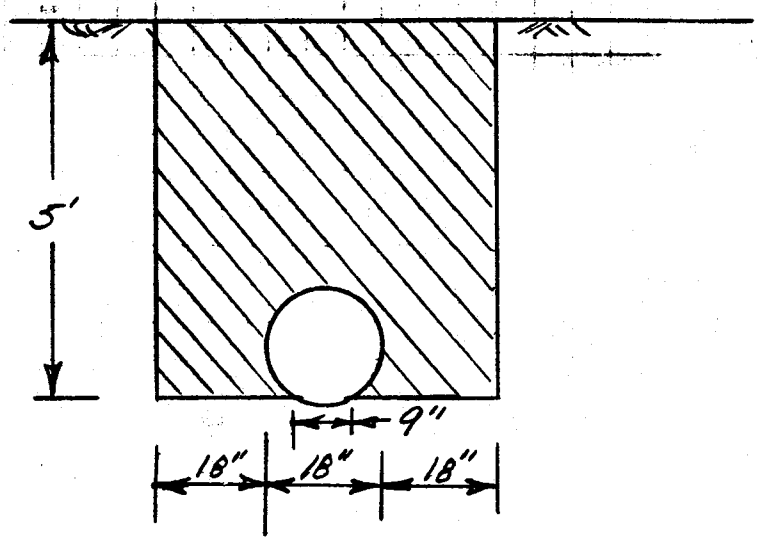
STATE		PROJECT		
AZ		RWCD Reach-5		
BY	DATE	CHECKED BY	DATE	JOB NO.
ICC	1-26-86	DS	1/87	
SUBJECT				SHEET 1 OF 2
Pipe Design For West Side Inlets:				

Use: Tech. Note W-22

EXTERNAL
PIPE LOAD
AND
VERTICAL
DEFLECTION

* INPUT DATA *
FILL DEPTH=3.25 FT
PIPE O.D.=18.000 IN.
SOIL UN.WT.=120.00 LB/CF
POINT LOAD=20,000.00 LBS
SOIL MOD.=1,000.00 PSI
E=30,000,000.00 PSI
WALL THIK.=~~0.0340~~ IN. 0.032
IMPACT FACT=1.20

RESULTS AT 3.3 FT.
TOP OF PIPE DEPTH
LL=1,494.58 LB/FT
DL=585.00 LB/FT
TL=2,079.58 LB/FT
V. DEF=0.35 IN.
% DEF=1.97%



Specs

1.) Minimum of 20 Guage
2) 95% standard Proctor
3) Cradle = 9-inches min.
4) Construct fill first and excavate to place pipe.
5) O&M - Keep water draining to inlets.
6) Minimum of 2' cover over pipe.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE 1-26-86	CHECKED BY DJD	DATE 1/87	JOB NO.
SUBJECT Station Locations for West side inlets				SHEET 2 OF 2

* start @ 335+00 and go to sta. 486+33.58
* Place inlet @ every 1500'

Station	Inlet
335+00	1
350+00	2
365+00	3
380+00	4
395+00	5
410+00	6
425+00	7
440+00	8
455+00	9
470+00	10
485+00	11

```
   * INPUT DATA *
FILL DEPTH=1.00 FT
PIPE O.D.=18.000 IN.
SOIL UN.WT.=120.00 LB/CF
POINT LOAD=20,000.00 LBS
SOIL MOD.=1,000.00 PSI
E=30,000,000.00 PSI
WALL THIK.=0.0520 IN.
IMPACT FACT=1.20

 RESULTS AT 1.0 FT.
 TOP OF PIPE DEPTH
LL=12,426.07 LB/FT
DL=180.00 LB/FT
TL=12,606.07 LB/FT
V. DEF=2.14 IN.
% DEF=11.87%

 %DEF>5%
TRY AGAIN...
```

```
   * INPUT DATA *
FILL DEPTH=2.00 FT
PIPE O.D.=18.000 IN.
SOIL UN.WT.=120.00 LB/CF
POINT LOAD=20,000.00 LBS
SOIL MOD.=1,000.00 PSI
E=30,000,000.00 PSI
WALL THIK.=0.0520 IN.
IMPACT FACT=1.20

 RESULTS AT 2.0 FT.
 TOP OF PIPE DEPTH
LL=3,713.26 LB/FT
DL=360.00 LB/FT
TL=4,073.26 LB/FT
V. DEF=0.69 IN.
% DEF=3.83%
```

nin[illegible] 505-in. bars

, in.									
507	.508	.509	.510	.511	.512	.513	.514	.515
7.7	37.9	38.3	38.4	38.7	39.0	39.2	39.4	39.6
7.2	37.4	37.7	37.8	38.1	38.4	38.6	38.8	39.0
6.5	36.7	37.0	37.2	37.5	37.8	37.9	38.2	38.4
5.9	36.0	36.4	36.5	36.9	37.1	37.3	37.6	37.8
5.3	35.5	35.8	35.9	36.3	36.6	36.8	37.0	37.2
4.6	34.8	35.2	35.2	35.7	35.9	36.1	36.4	36.6
4.0	34.2	34.5	34.7	35.0	35.3	35.5	35.8	36.0
3.3	33.6	33.8	34.0	34.4	34.7	34.9	35.2	35.4
2.7	32.9	33.2	33.4	33.8	34.1	34.2	34.5	34.7
2.0	32.3	32.6	32.8	33.1	33.4	33.6	33.9	34.1
1.4	31.6	32.0	32.2	32.5	32.8	33.0	33.2	33.5
0.7	30.9	31.3	31.4	31.8	32.1	32.3	32.6	32.8
0.1	30.3	30.6	30.8	31.2	31.5	31.6	32.0	32.2
9.4	29.6	30.0	30.2	30.6	30.8	31.0	31.3	31.6
8.8	29.0	29.3	29.5	29.9	30.2	30.4	30.6	30.9
8.1	28.3	28.7	28.9	29.2	29.5	29.7	30.0	30.3
7.4	27.6	28.0	28.2	28.6	28.8	29.1	29.4	29.6
6.8	27.0	27.4	27.5	27.9	28.2	28.4	28.7	29.0
6.1	26.4	26.7	26.8	27.2	27.6	27.8	28.0	28.3
5.4	25.6	26.0	26.2	26.5	26.8	27.1	27.4	27.7
4.7	25.0	25.3	25.5	25.8	26.2	26.4	26.7	27.0
4.0	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.3
3.4	23.6	24.0	24.2	24.5	24.9	25.1	25.4	25.6
2.7	22.9	23.2	23.6	23.8	24.2	24.4	24.7	25.0
2.0	22.[illegible]	[illegible]	22.8	23.2	23.5	23.8	24.0	24.3
1.3	2[illegible]	[illegible]	[illegible].1	22.5	22.8	23.1	23.4	23.6
0.5	20.[illegible]	[illegible]	21.4	21.8	22.1	22.4	22.7	23.0
9.9	20.1	20.4	20.7	21.0	21.4	21.6	22.0	22.2
9.1	19.4	19.8	20.0	20.4	20.7	21.0	21.3	21.6
8.4	18.7	19.0	19.3	19.7	20.0	20.3	20.6	20.9
7.7	18.0	18.3	18.6	19.0	19.3	19.6	19.9	20.2
7.0	17.3	17.5	17.9	18.3	18.6	18.9	19.2	19.5
6.3	16.6	16.9	17.2	17.5	17.9	18.2	18.5	18.8
5.5	15.8	16.2	16.5	16.8	17.2	17.5	17.8	18.1
4.8	15.1	15.5	15.8	16.1	16.5	16.8	17.1	17.4
4.1	14.4	14.7	15.1	15.4	15.7	16.0	16.4	16.6
3.3	13.7	14.0	14.3	14.7	15.0	15.3	15.7	16.0
2.6	13.0	13.3	13.6	14.0	14.3	14.6	15.0	15.3
1.9	12.2	12.5	12.9	13.2	13.6	13.9	14.2	14.5
1.2	11.5	11.8	12.2	12.5	12.9	13.2	13.5	13.8
0.4	10.7	11.1	11.4	11.8	12.1	12.4	12.8	13.1
9.6	10.1	10.4	10.7	11.0	11.4	11.7	12.1	12.4
8.9	9.2	9.6	9.9	10.3	10.7	11.0	11.3	11.7
8.1	8.5	8.9	9.2	9.5	9.9	10.2	10.6	10.9
7.4	7.7	8.1	8.4	8.8	9.2	9.5	9.9	10.2
6.6	7.0	7.4	7.7	8.0	8.4	8.8	9.1	9.4

Table I.3. **Wire and sheet-metal gages**

Name of gage	U.S. Standard gage*		The U.S. steel wire gage	American or Brown & Sharpe wire gage	New Birmingham Standard sheet & hoop gage	British Imperial or English legal standard wire gage
Principal use	Uncoated steel sheets and light plates		Steel wire except music wire	Nonferrous sheets and wire	Iron and steel sheets and hoops	Wire
Gage No.	Weight, oz per sq ft	Approx. thickness, in.	Thickness, in.			
7/0	.....	.....	0.4900	.....	0.6666	0.500
6/0	.....	.....	0.4615	0.5800	0.6250	0.464
5/0	.....	.....	0.4305	0.5165	0.5883	0.432
4/0	.....	.....	0.3938	0.4600	0.5416	0.400
3/0	.....	.....	0.3625	0.4096	0.5000	0.372
2/0	.....	.....	0.3310	0.3648	0.4452	0.348
0	.....	.....	0.3065	0.3249	0.3964	0.324
1	.....	.....	0.2830	0.2893	0.3532	0.300
2	.....	.....	0.2625	0.2576	0.3147	0.276
3	160	0.2391	0.2437	0.2294	0.2804	0.252
4	150	0.2242	0.2253	0.2043	0.2500	0.232
5	140	0.2092	0.2070	0.1819	0.2225	0.212
6	130	0.1943	0.1920	0.1620	0.1981	0.192
7	120	0.1793	0.1770	0.1443	0.1764	0.176
8	110	0.1644	0.1620	0.1285	0.1570	0.160
9	100	0.1495	0.1483	0.1144	0.1398	0.144
10	90	0.1345	0.1350	0.1019	0.1250	0.128
11	80	0.1196	0.1205	0.0907	0.1113	0.116
12	70	0.1046	0.1055	0.0808	0.0991	0.104
13	60	0.0897	0.0915	0.0720	0.0882	0.092
14	50	0.0747	0.0800	0.0641	0.0785	0.080
15	45	0.0673	0.0720	0.0571	0.0699	0.072
16	40	0.0598	0.0625	0.0508	0.0625	0.064
17	36	0.0538	0.0540	0.0453	0.0556	0.056
18	32	0.0478	0.0475	0.0403	0.0495	0.048
19	28	0.0418	0.0410	0.0359	0.0440	0.040
20	24	0.0359	0.0348	0.0320	0.0392	0.036
21	22	0.0329	0.0318	0.0285	0.0349	0.032
22	20	0.0299	0.0286	0.0253	0.0313	0.028
23	18	0.0269	0.0258	0.0226	0.0278	0.024
24	16	0.0239	0.0230	0.0201	0.0248	0.022
25	14	0.0209	0.0204	0.0179	0.0220	0.020
26	12	0.0179	0.0181	0.0159	0.0196	0.018
27	11	0.0164	0.0173	0.0142	0.0175	0.0164
28	10	0.0149	0.0162	0.0126	0.0156	0.0148
29	9	0.0135	0.0150	0.0113	0.0139	0.0136
30	8	0.0120	0.0140	0.0100	0.0123	0.0124
31	7	0.0105	0.0132	0.0089	0.0110	0.0116
32	6.5	0.0097	0.0128	0.0080	0.0098	0.0108
33	6	0.0090	0.0118	0.0071	0.0087	0.0100
34	5.5	0.0082	0.0104	0.0063	0.0077	0.0092
35	5	0.0075	0.0095	0.0056	0.0069	0.0084
36	4.5	0.0067	0.0090	0.0050	0.0061	0.0076
37	4.25	0.0064	0.0085	0.0045	0.0054	0.0068
38	4	0.0060	0.0080	0.0040	0.0048	0.0060
39	.....	.....	0.0075	0.0035	0.0043	0.0052
40	.....	.....	0.0070	0.0031	0.0039	0.0048

* U.S. Standard gage is officially a weight gage, in ounces per square foot as tabulated.

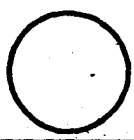


Table 1-1 Sizes, Corrugation Profiles, Thickness and Shapes Available for various Types of Steel Pipe.

Type of Pipe	Size (Diameter or Span)	Corrugation Profile	Specified Thickness Range	Shape
Corrugated Steel Pipe (Helical and Annular Pipe)	4-18 inch	1½ x ¼ inch	.034-.064 inch	Round
	12-96 inch	2⅔ x ½ inch	.040-.168 inch	Round, Pipe Arch**
	48-144 inch	3 x 1 inch 125 x 25 mm*	.064-.168 inch	Round
	48-120 inch	3 x 1 inch 125 x 25 mm*	.079-.168 inch	Pipe Arch
Structural Plate Pipe	5 feet thru 26 feet & larger	6 x 2 inch	.109-.280 inch	Round, Pipe-Arch Elliptical, Arch, and Other Special Shapes

*Available only in helical pipe **Sizes shown are for equivalent round pipe

Table 1-2 Handling Weight of Corrugated Steel Pipe (1½ x ¼ in)
Estimated Average Weights — Not for Specification Use)

Inside Diameter In Inches	Specified Thickness In Inches	Approximate Pounds Per Lineal Foot (Weights will vary slightly with Fabricated Method)		
		Galvanized	Full-Coated	Full-Coated and Invert Paved
4	0.034	1.7	2.3	
	0.040	2.1	2.7	
	0.052	2.6	3.3	
	0.064	3.3	4.2	
6	0.034	2.5	3.5	
	0.040	3.0	4.0	
	0.052	3.9	4.9	
	0.064	4.8	5.9	
8	0.034	3.4	4.7	
	0.040	4.0	5.3	
	0.052	5.2	6.5	
	0.064	6.3	7.6	
10	0.034	4.2	5.8	
	0.040	4.9	6.5	
	0.052	6.5	8.1	
	0.064	7.7	9.3	
12	0.034	5.0	7.0	8.5
	0.040	5.9	7.9	9.4
	0.052	7.6	9.6	11.1
	0.064	9.4	11.4	12.9
15	0.034	6.7	8.6	10.5
	0.040	7.3	9.7	11.6
	0.052	9.5	11.9	13.8
	0.064	11.7	14.1	16.0
18	0.034	7.4	10.3	12.5
	0.040	8.8	11.7	13.9
	0.052	11.4	14.3	16.5
	0.064	14.0	16.9	19.1

Note: Perforated Sub-Drains will weigh slightly less.

Table 1-3 Handling Weig
Estimated Ave

Inside Diameter In Inches	Specified Thickness In Inches
12	.052 .064 .079
15	.052 .064 .079
18	.052 .064 .079
21	.052 .064 .079
24	.052 .064 .079
30	.052 .064 .079
36	.052 .064 .079
42	.052 .064 .079
48	.052 .064 .079
54	.064 .079
60	.079 .109
66	.109 .138
72	.109 .138
78	.109 .138
84	.109 .138
90	.109 .138 .168
96	.138 .168

*Lock seam construction only; w
**For other coatings or linings the
Note: Pipe arch weights will be the
For example; for 42 x 29, 24
Smooth steel lined CSP weig

FILTER DESIGN FOR O & M INLETS

Filter Design for O&M inlets

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
AZ		RWCD Reach-5		
BY ICC	DATE 1-26-87	CHECKED BY DR	DATE 2/87	JOB NO.
SUBJECT Pipe Filter Design For West Side Inlets				SHEET 1 OF 6

USE SM-#1

From the Composite of all gradations of test samples the following curve will be used to design the filter.

mm/sieve	% Passing
0.002	47
0.005	50
0.02	67
0.05	86
#200	96

Step 4: Category 1

Step 5:

$D_{15} \leq 9 \times d_{85}$

$d_{85} = 0.048$

$D_{15} = 9(0.048) = \underline{0.432mm} > 0.2mm$ OK

Step 6:

$D_{15} \geq 4 \times d_{15} > 0.1mm$

$d_{15} = 0 \Rightarrow \underline{d_{15} = 0.1mm}$

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
BY ICC	DATE	CHECKED BY JJ	DATE 2/87	JOB NO.
SUBJECT				SHEET 2 OF 6

Step 8:

Min. $D_0 < 0.5$ mm $\Rightarrow D_{90} = 20$ mm (Max)

Sieve Size	% Passing
1 1/2 in.	100
3/4 in	90-100
3/8 in.	80-100
No. 4	65-100
No. 10	47-95
No. 20	26-70
No. 40	16-56
No. 60	6-40
No. 200	0-5

Requirements:

~ PI = 0 for material passing #40 sieve according to ASTM D-4318.

~ Compaction - Whacker
~ Drainfill shall be placed in layers not to exceed 18-inches.

~ Material passing #200 is to be non-plastic.

TO THE FILES: 3-12-87

Determine if local suppliers can meet the gradation specified in drainfill.

1. Salt River Sand & Rock - 833-8625
   Spoke with Denny Wilcox, called him back on 3-17-87 and he said they could not meet the spec.

2. Johnson Stewart Johnson - 834-1044
   Spoke with Danny James, he called back on 3-13-87 and said they could meet the gradations, but they would use different sieves. They would still fall within our gradation limits.

3. Pioneer Materials- 926-1700 or mobile 8-602-376-1802
   Spoke to Dave Sayer, he call back on 3-17-86.
   He gave us a price of $9.95/Ton. The gradation they can meet is as follows:

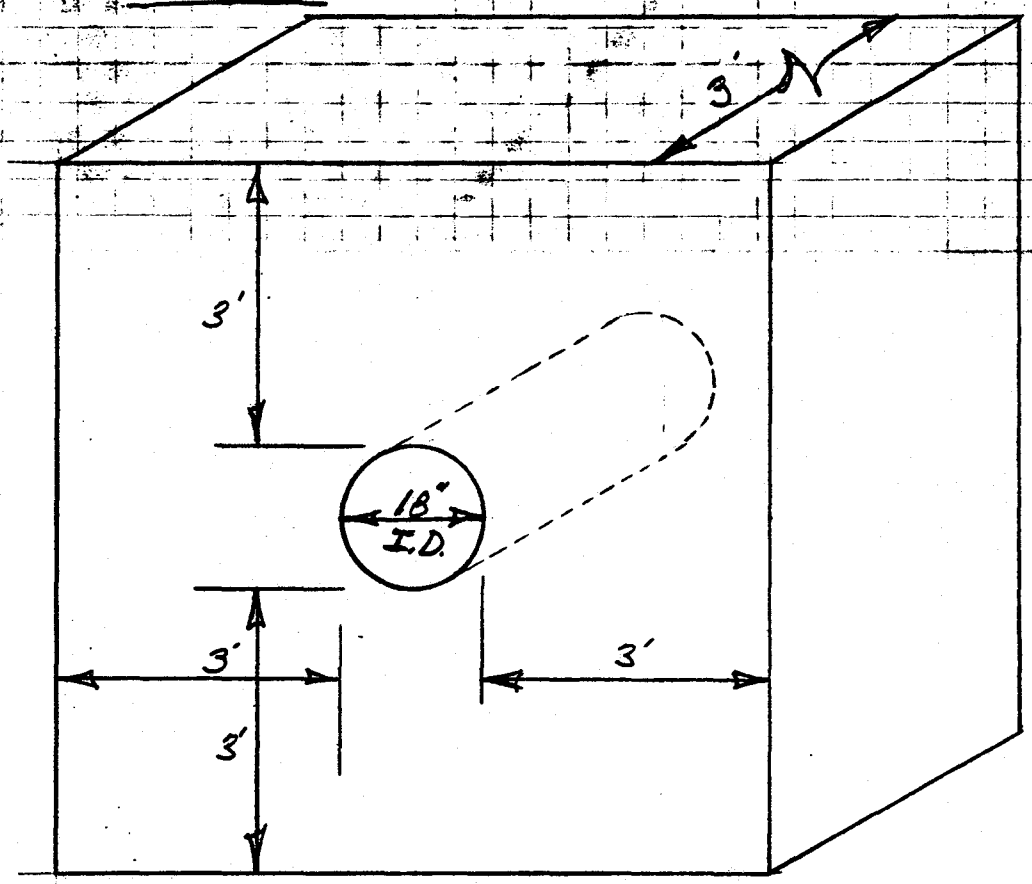
Seive	%Passing
1-1/2"	100
3/4"	100
3/8"	100
#4	97
#10	87
#20	49
#40	32
#60	19
#200	0.4

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5			
BY ICC	DATE 1-25-86	CHECKED BY DJS	DATE 2/87	JOB NO.	
SUBJECT Design Filter Drain				SHEET 4 OF 6	

Dimensions



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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 586

PROJECT and STATE

SAMPLE LOCATION

FIELD SAMPLE NO.

DEPTH

GEOLOGIC ORIGIN

TYPE OF SAMPLE

TESTED AT

APPROVED BY

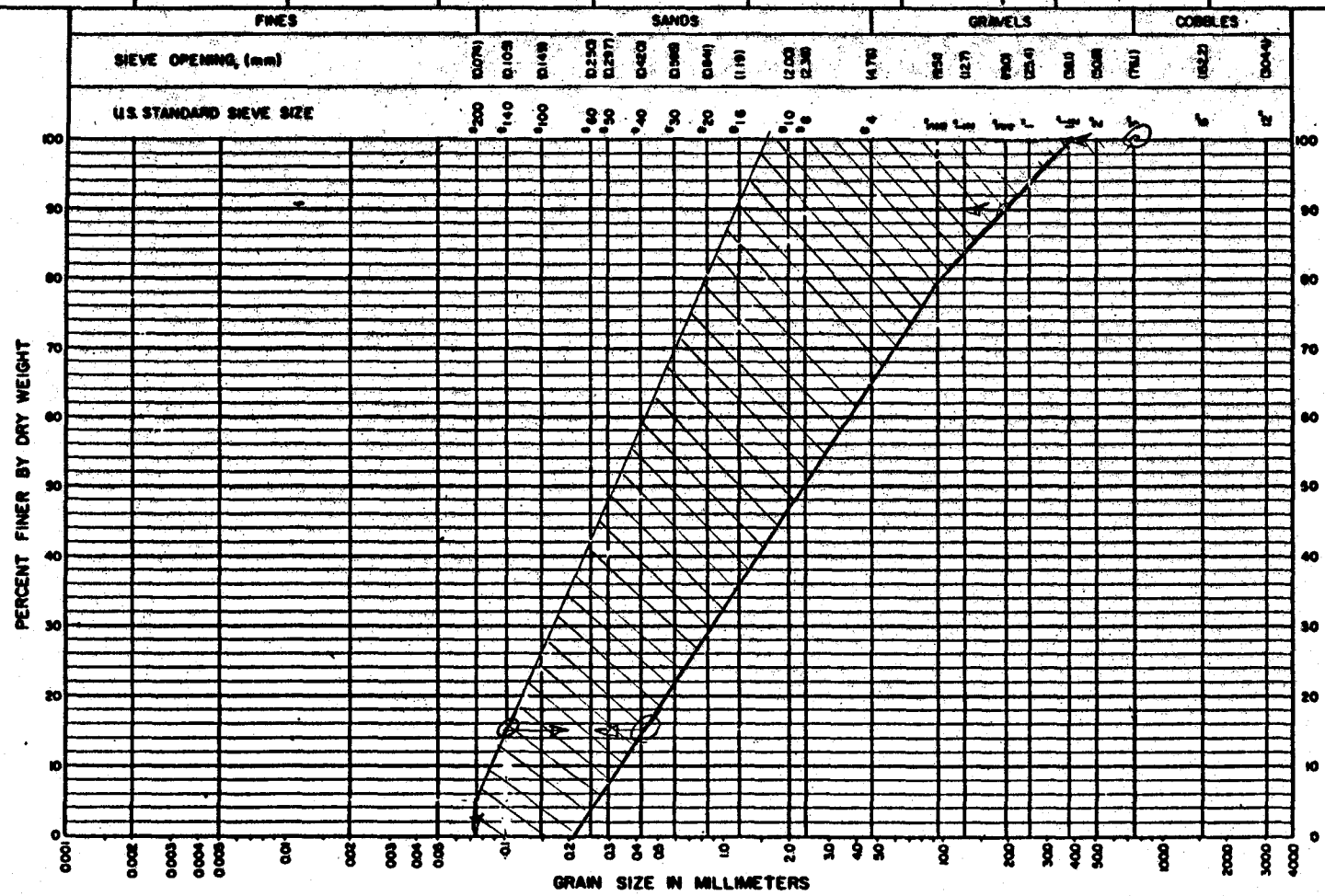
DATE

SYMBOL

DESCRIPTION Pipe Filter Design

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. _____

6 of 6

PROJECT and STATE

SAMPLE LOCATION

FIELD SAMPLE NO.

DEPTH

GEOLOGIC ORIGIN

TYPE OF SAMPLE

TESTED AT

APPROVED BY

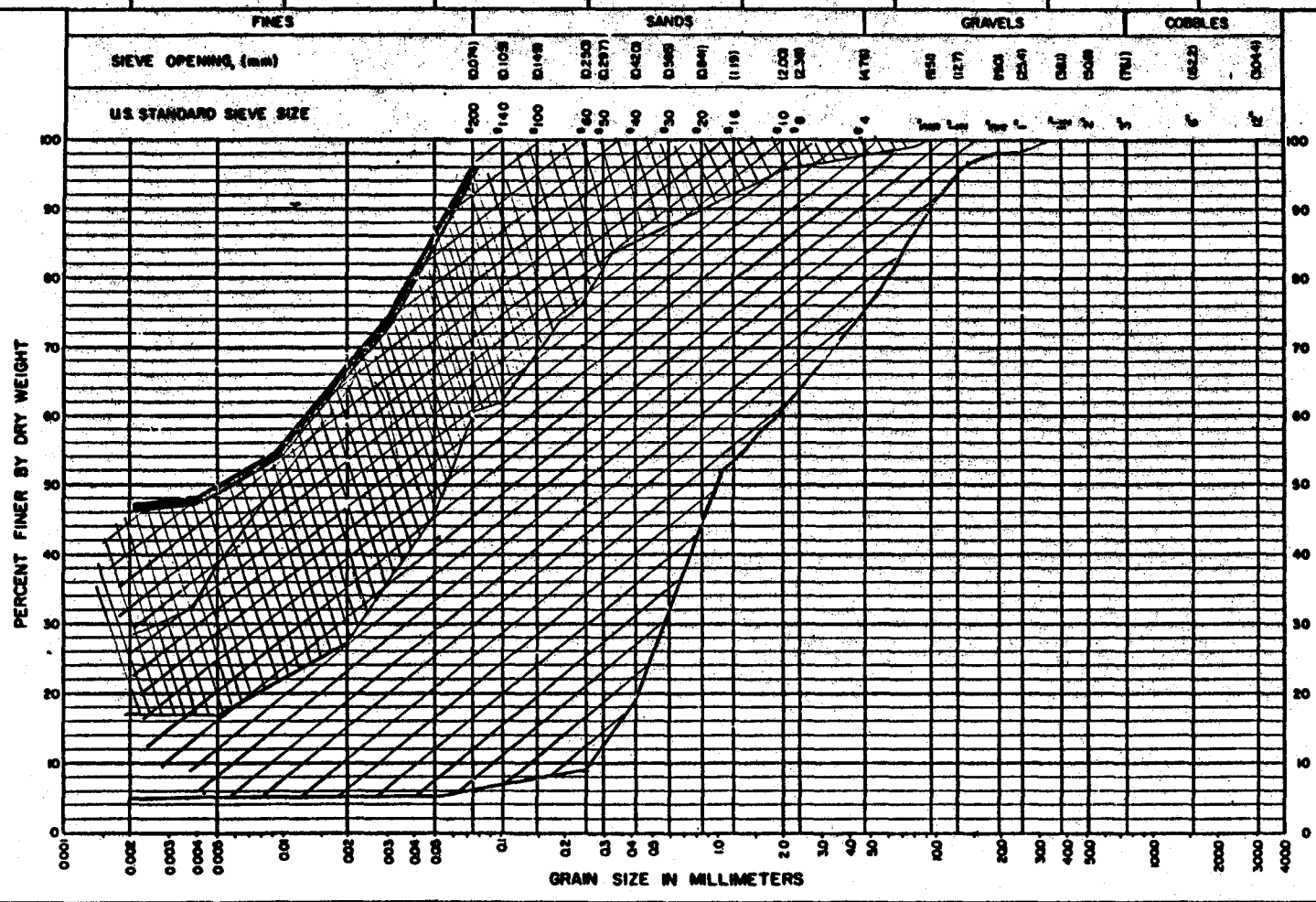
DATE

SYMBOL

DESCRIPTION *Composite of all soil gradations*

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. _____

PROJECT and STATE

SAMPLE LOCATION

FIELD SAMPLE NO.

DEPTH

GEOLOGIC ORIGIN

TYPE OF SAMPLE

TESTED AT

APPROVED BY

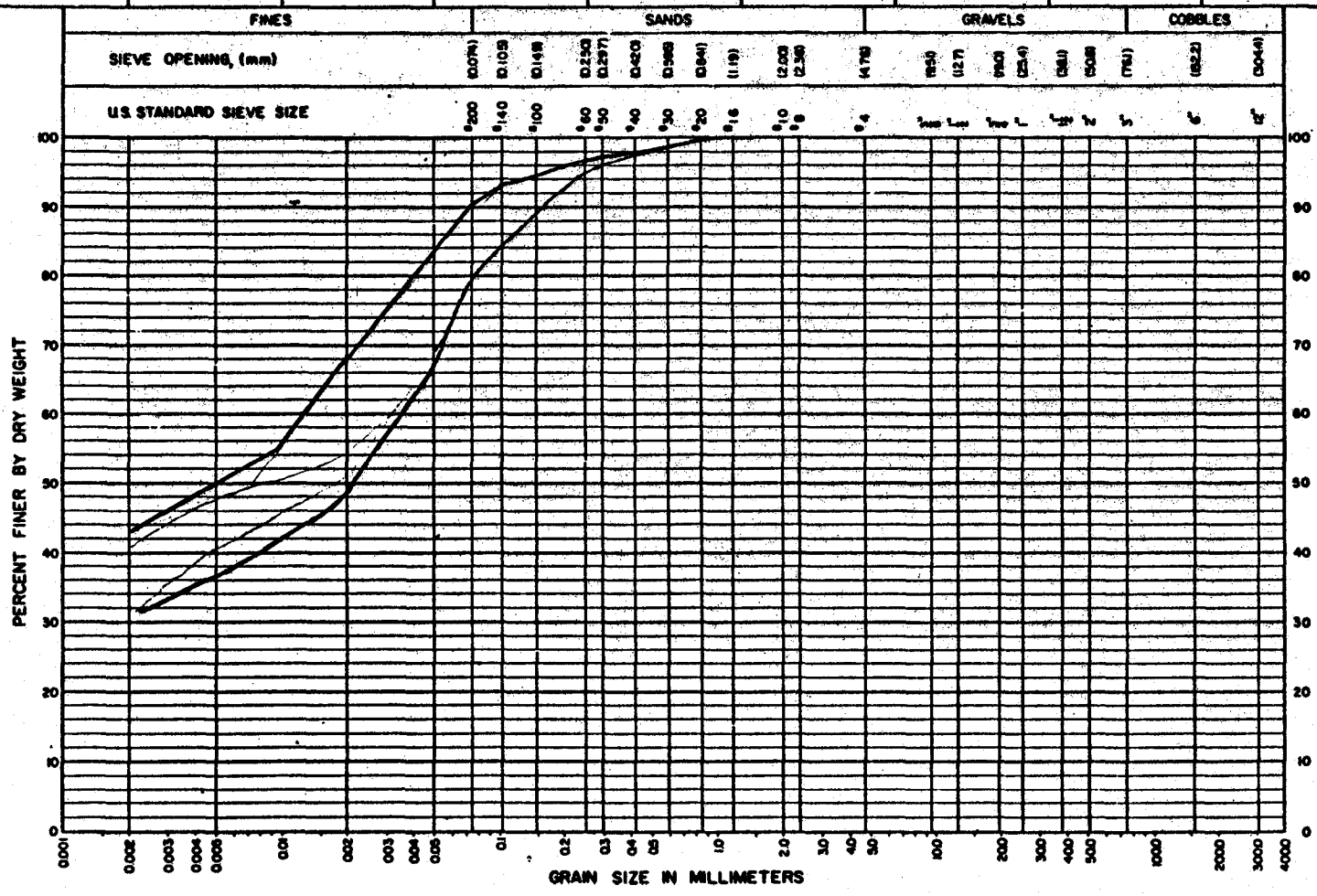
DATE

SYMBOL

DESCRIPTION Composite from soils 1, 11, 13, 32, 5, 4, 6, 7, 3, 8, 1, 15.1, 16.1, 19.1, 22.2

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

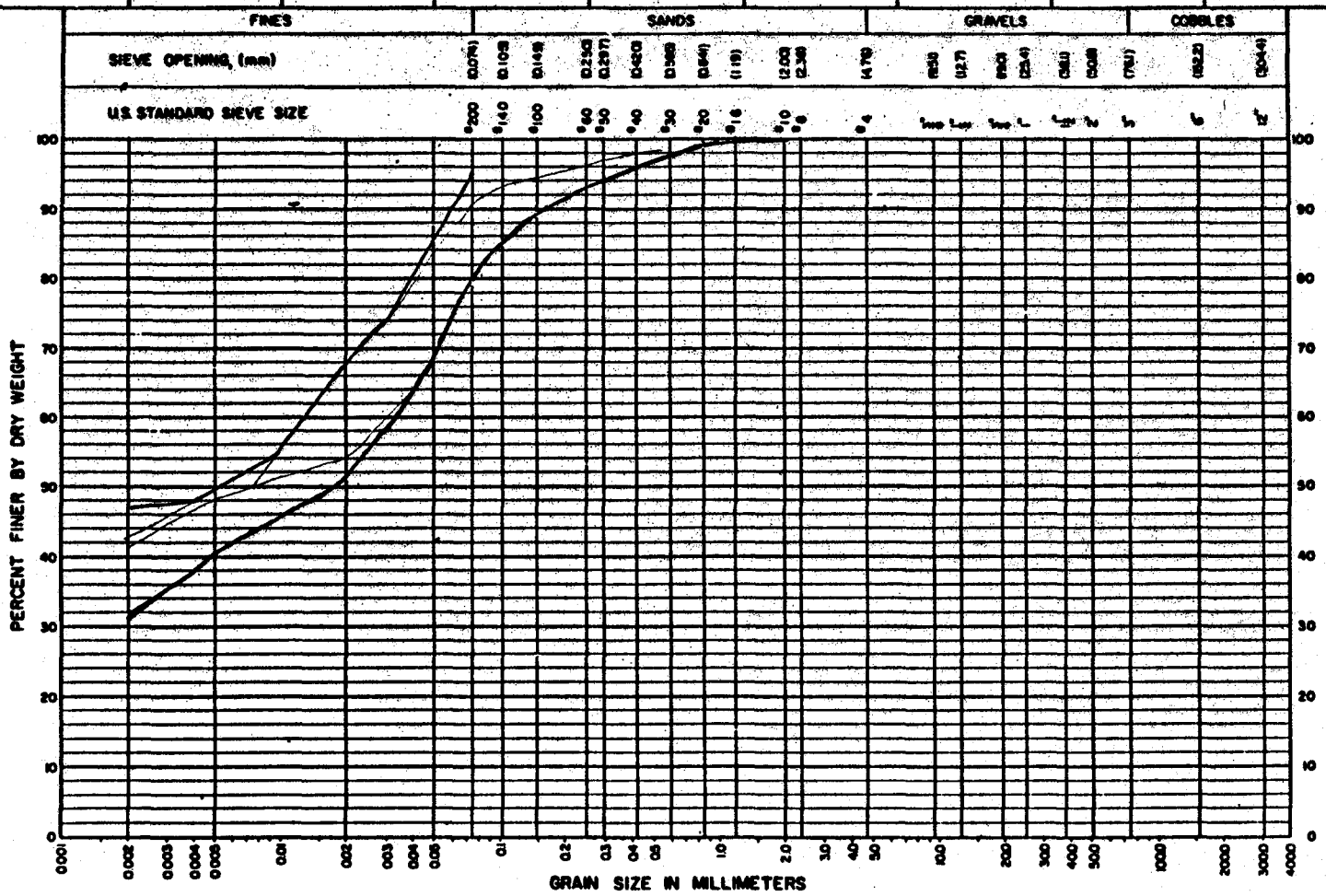
SOIL CLASSIFICATION

LABORATORY NO. ____

PROJECT and STATE			
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	SAMPLE LOCATION
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
SYMBOL	DESCRIPTION Composite From Smaller Gradation		

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. _____

PROJECT and STATE | SAMPLE LOCATION

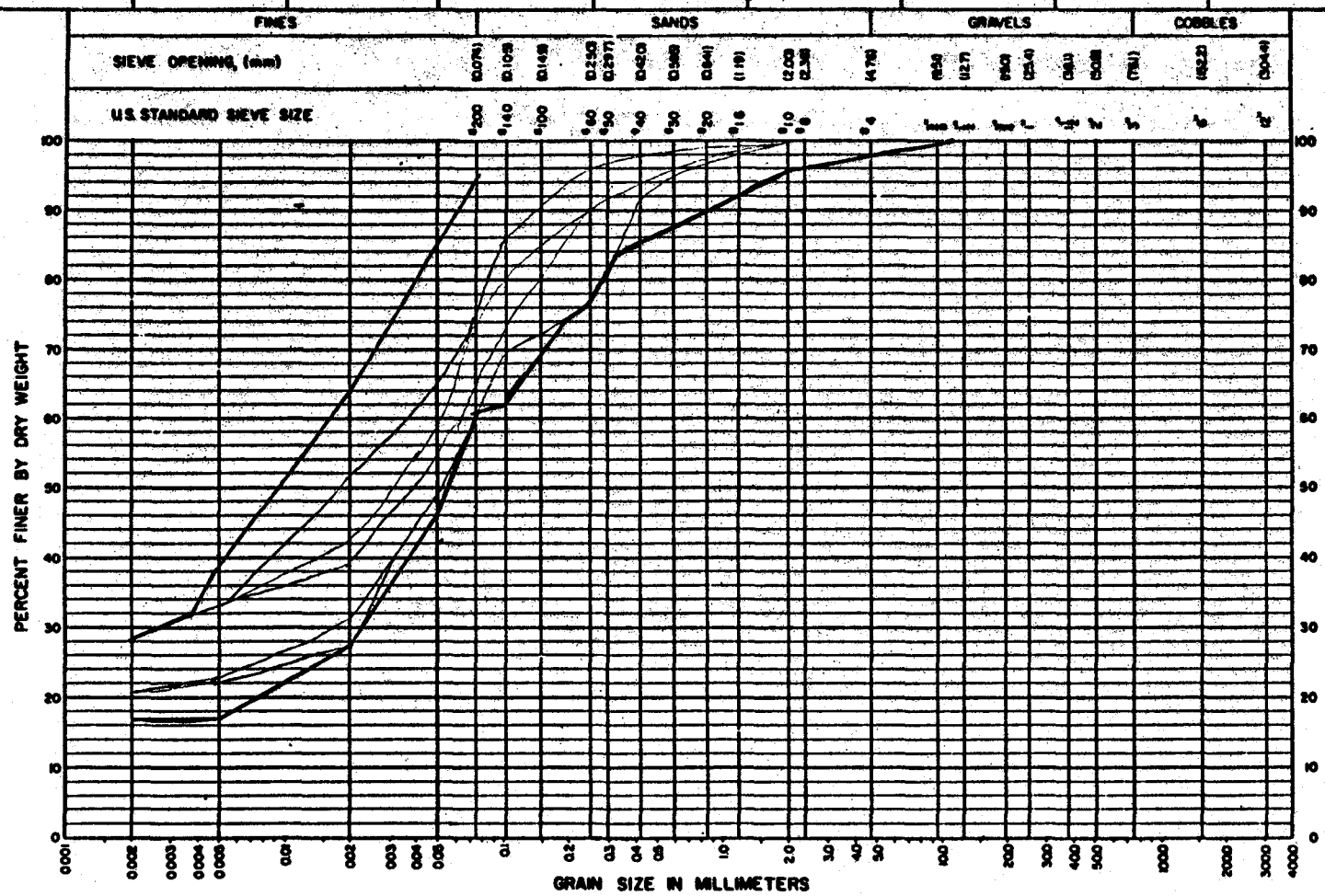
FIELD SAMPLE NO. | DEPTH | GEOLOGIC ORIGIN

TYPE OF SAMPLE | TESTED AT | APPROVED BY | DATE

SYMBOL | DESCRIPTION *Composite Consolidation Considerations*

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{20}	D_{30}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. _____

PROJECT and STATE

SAMPLE LOCATION

FIELD SAMPLE NO.

DEPTH

GEOLOGIC ORIGIN

TYPE OF SAMPLE

TESTED AT

APPROVED BY

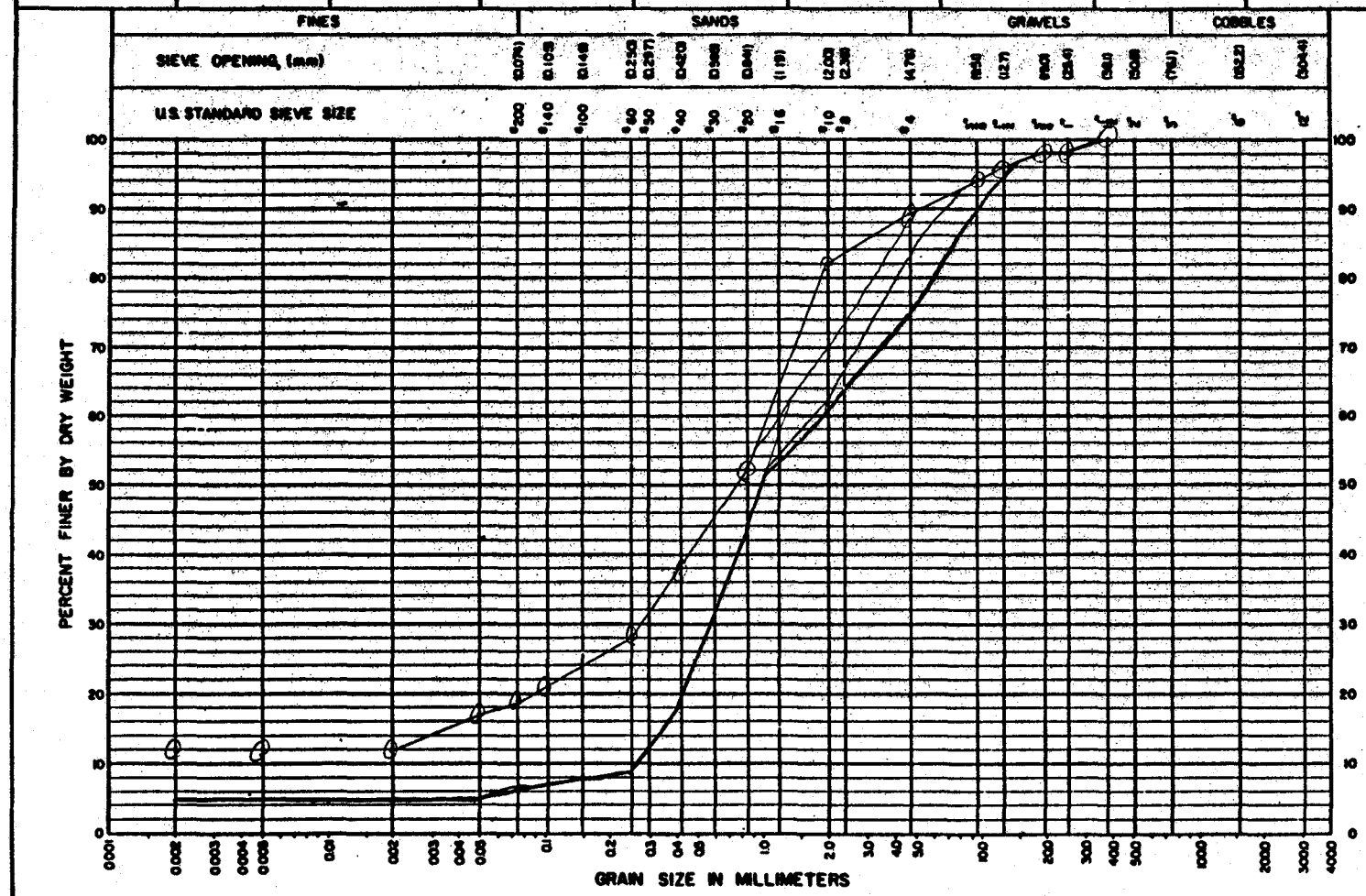
DATE

SYMBOL

DESCRIPTION *Composite from larger gradation*

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

GRAIN SIZE DISTRIBUTIONS
(Smaller Gradations)

Grain Size Distrubutions
(Smaller Gradations)

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

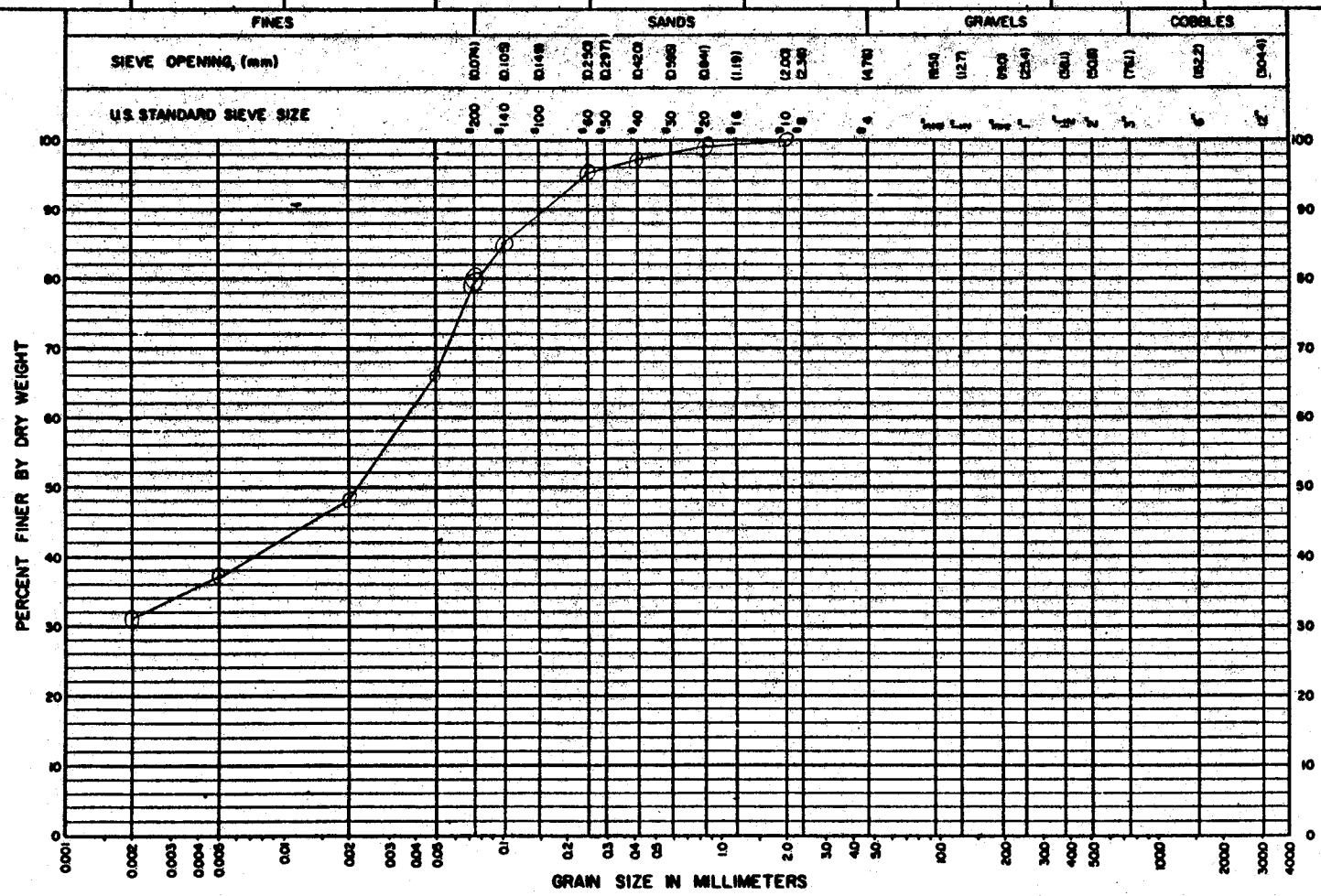
SOIL CLASSIFICATION

LABORATORY NO. 2978

PROJECT and STATE: PWCD Pos, AZ
FIELD SAMPLE NO.: 7
DEPTH: 5-6'
SAMPLE LOCATION: E 478+385
TYPE OF SAMPLE
TESTED AT
GEOLOGIC ORIGIN
APPROVED BY
DATE
SYMBOL: SC
DESCRIPTION: Smelly Gravelly Clay

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 2980

PROJECT and STATE: RWCD Roach's Tract

FIELD SAMPLE NO.: 1.3

DEPTH: 0.5-1.5'

SAMPLE LOCATION: 2 478+38.5

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

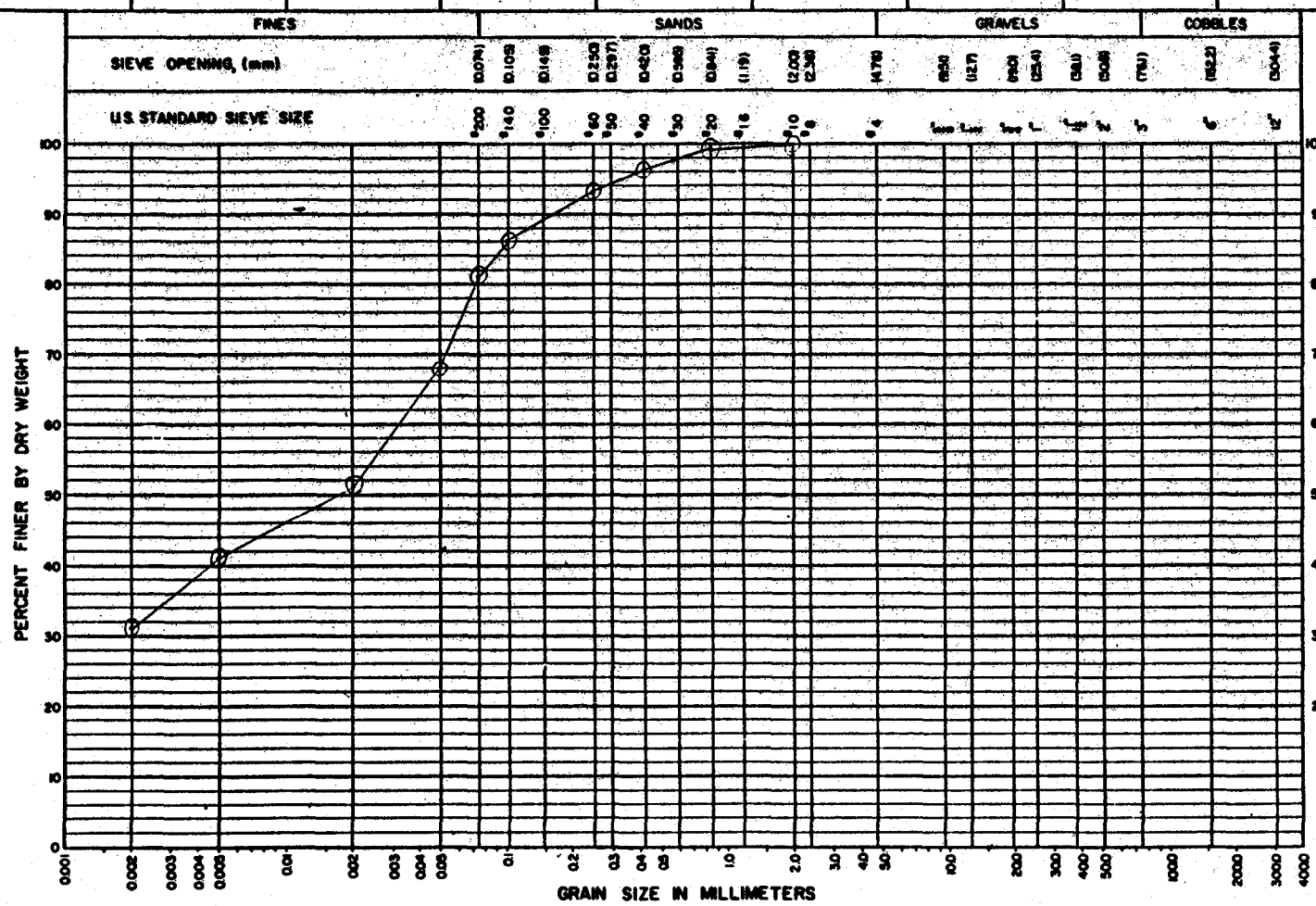
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

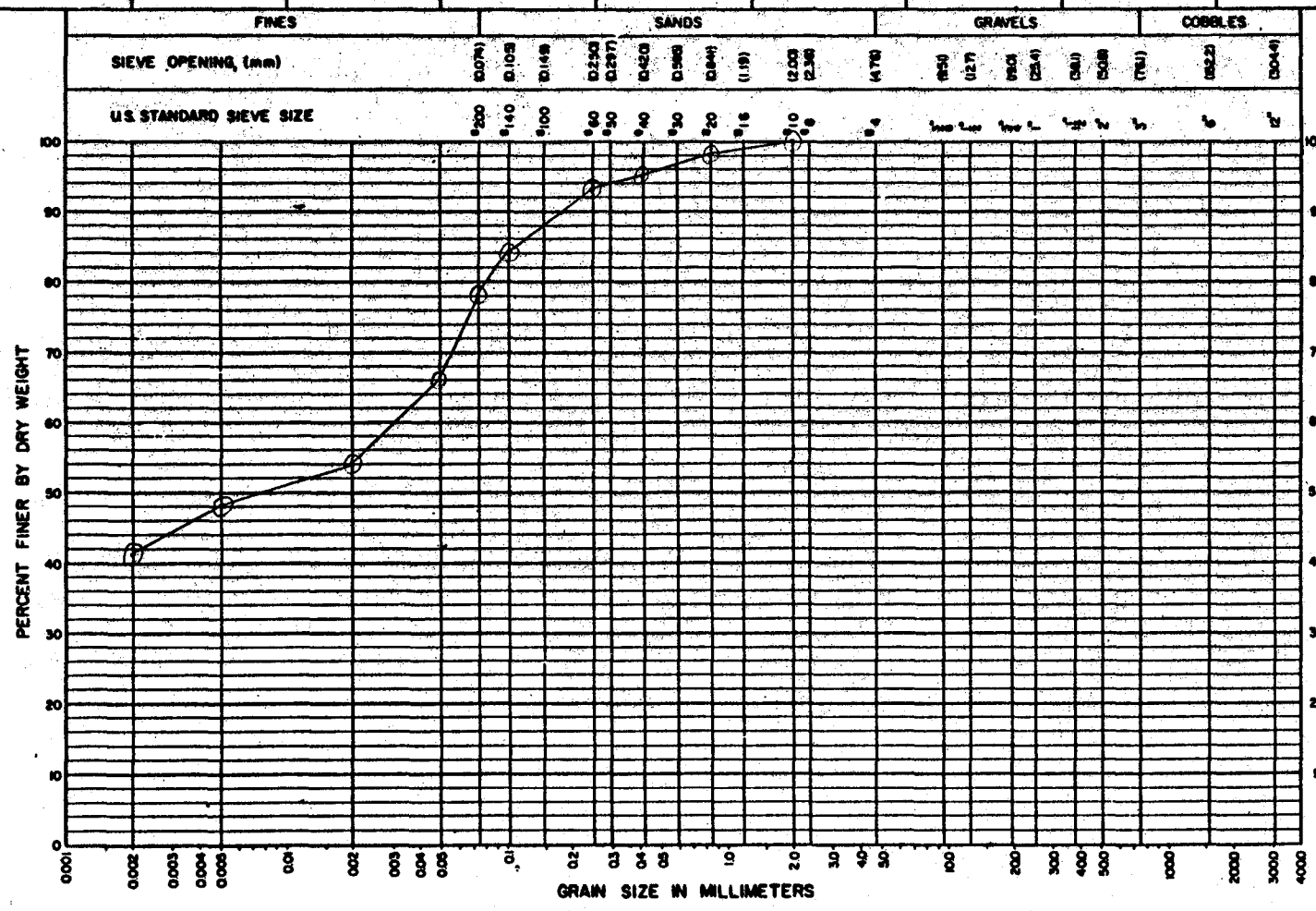
SOIL CLASSIFICATION

LABORATORY NO. 2983

PROJECT and STATE	Rincon Creek - S Dak
FIELD SAMPLE NO.	3.2
DEPTH	5' - 6'
GEOLOGIC ORIGIN	
SAMPLE LOCATION	Q 4 4 2 4 73
TYPE OF SAMPLE	
TESTED AT	
APPROVED BY	
DATE	
SYMBOL	CL
DESCRIPTION	

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 2999

PROJECT and STATE: RWCD Reach-5 WZ

FIELD SAMPLE NO.: 51

DEPTH: 4'-5.5'

SAMPLE LOCATION: E 449400

TYPE OF SAMPLE

GEOLOGIC ORIGIN

TESTED AT

APPROVED BY

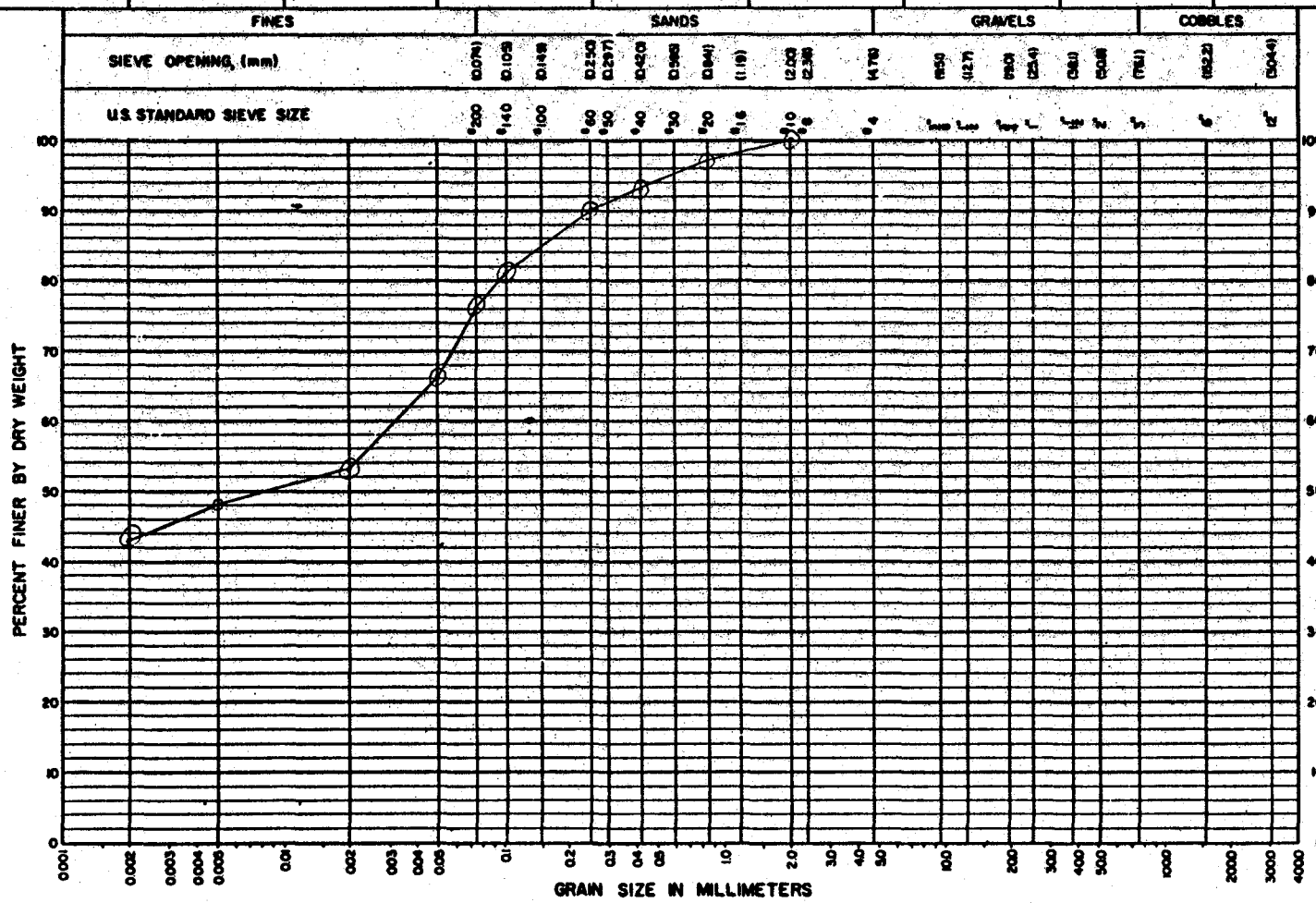
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 2991

PROJECT and STATE: RWCD Reach-5 Az

FIELD SAMPLE NO.: 6.1

DEPTH: 5'-6'

SAMPLE LOCATION: E 443700

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

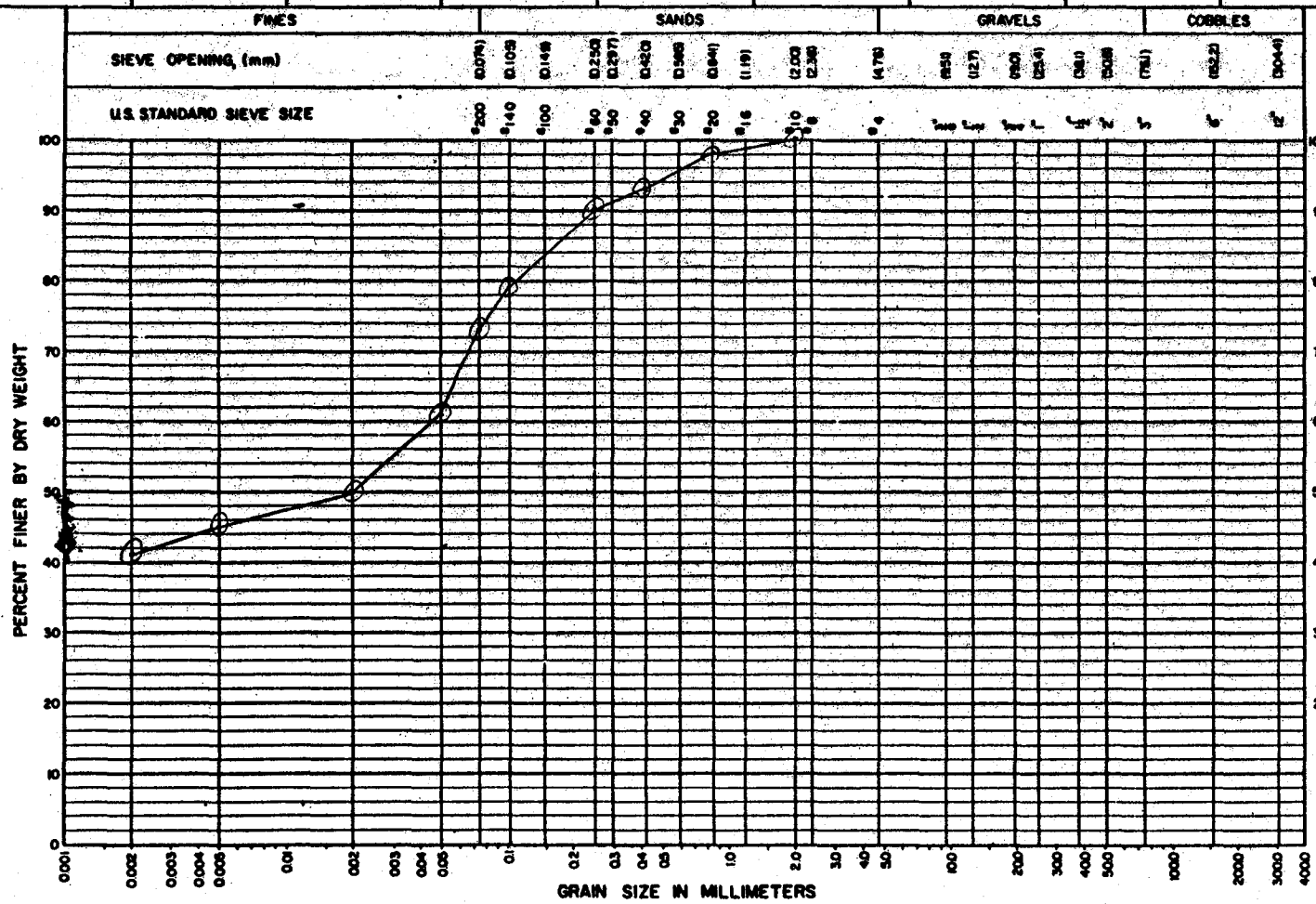
DATE

SYMBOL: C

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 2996

PROJECT and STATE: Rucd Ranch-5, AZ

FIELD SAMPLE NO.: 7.8

DEPTH: 0-1'

GEOLOGIC ORIGIN:

SAMPLE LOCATION: Q 436400

TYPE OF SAMPLE:

TESTED AT:

APPROVED BY:

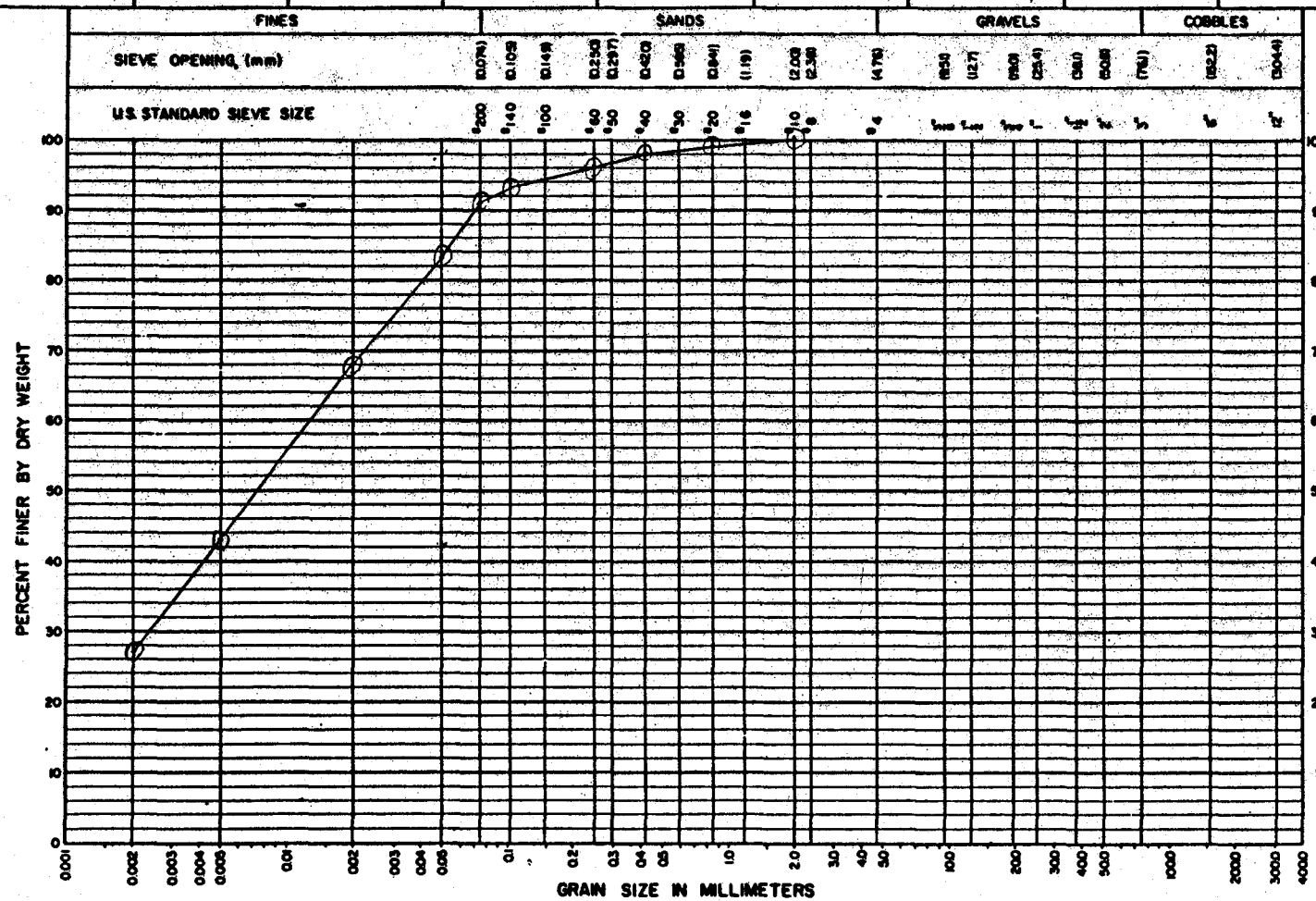
DATE:

SYMBOL: CL

DESCRIPTION:

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 2999

PROJECT and STATE: RWCD

FIELD SAMPLE NO.: 8.1

DEPTH: 8'-9'

SAMPLE LOCATION: E 428+29

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

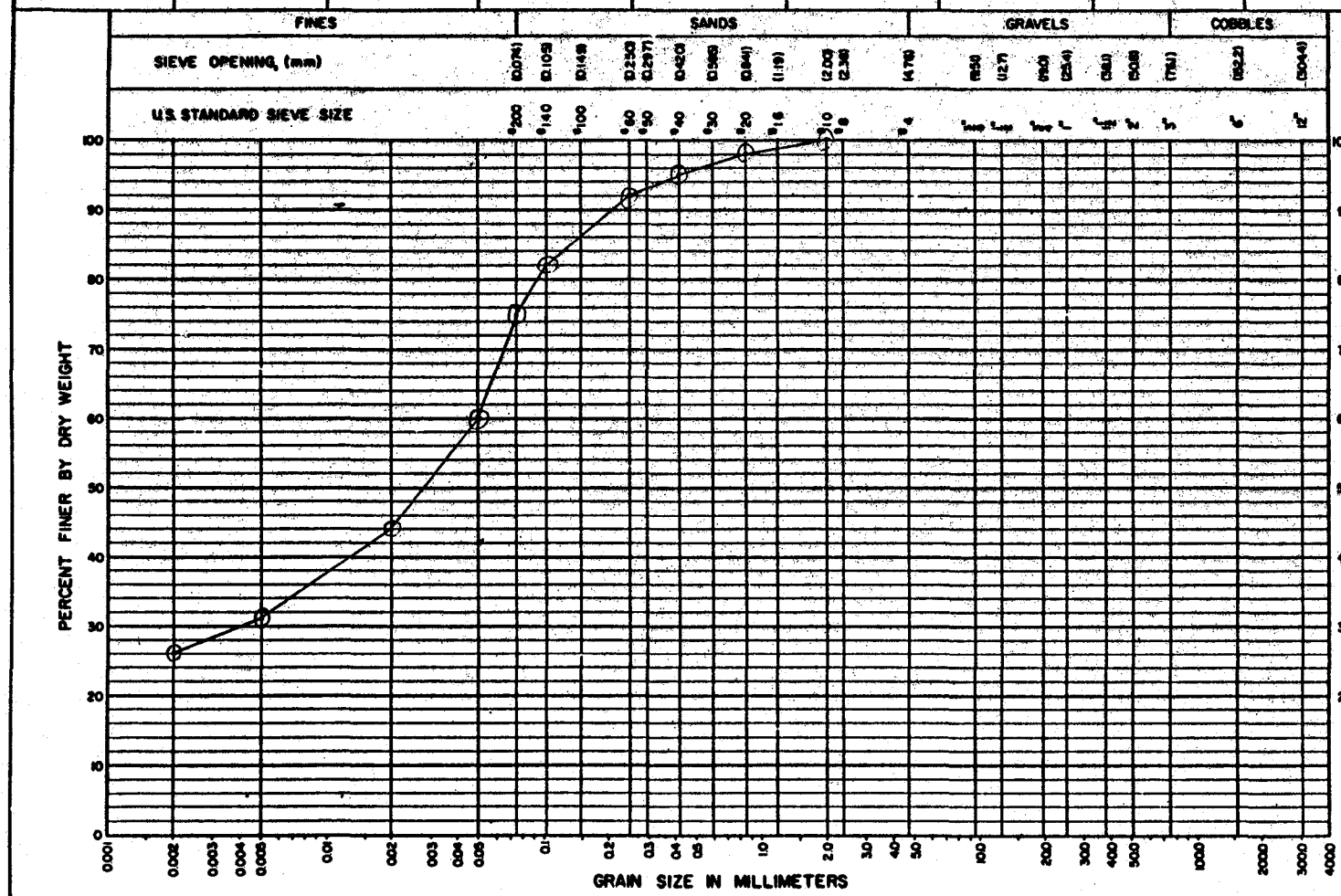
DATE: 1-15-86

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

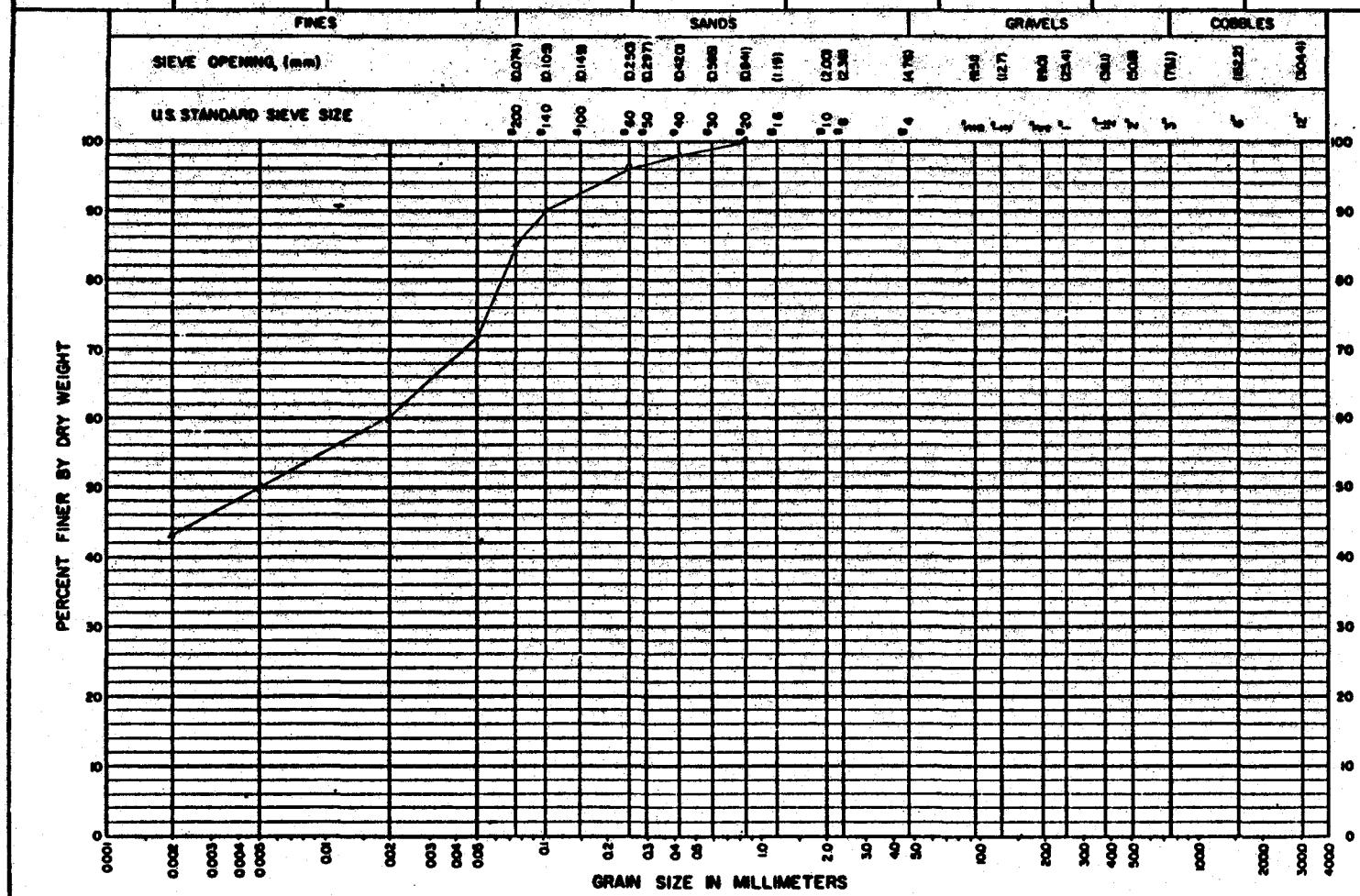
SOIL CLASSIFICATION

LABORATORY NO. 3911

PROJECT and STATE	AZ
FIELD SAMPLE NO.	RWCD R-5
TYPE OF SAMPLE	151
DEPTH	3-4'
GEOLOGIC ORIGIN	
SAMPLE LOCATION	2 384420
TESTED AT	
APPROVED BY	
DATE	
SYMBOL	CL
DESCRIPTION	

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_z



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

REMARKS:

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

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3065

PROJECT and STATE: AZ

FIELD SAMPLE NO.: 101

DEPTH: 3'-4'

SAMPLE LOCATION: RWCD R-5 2578+00

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

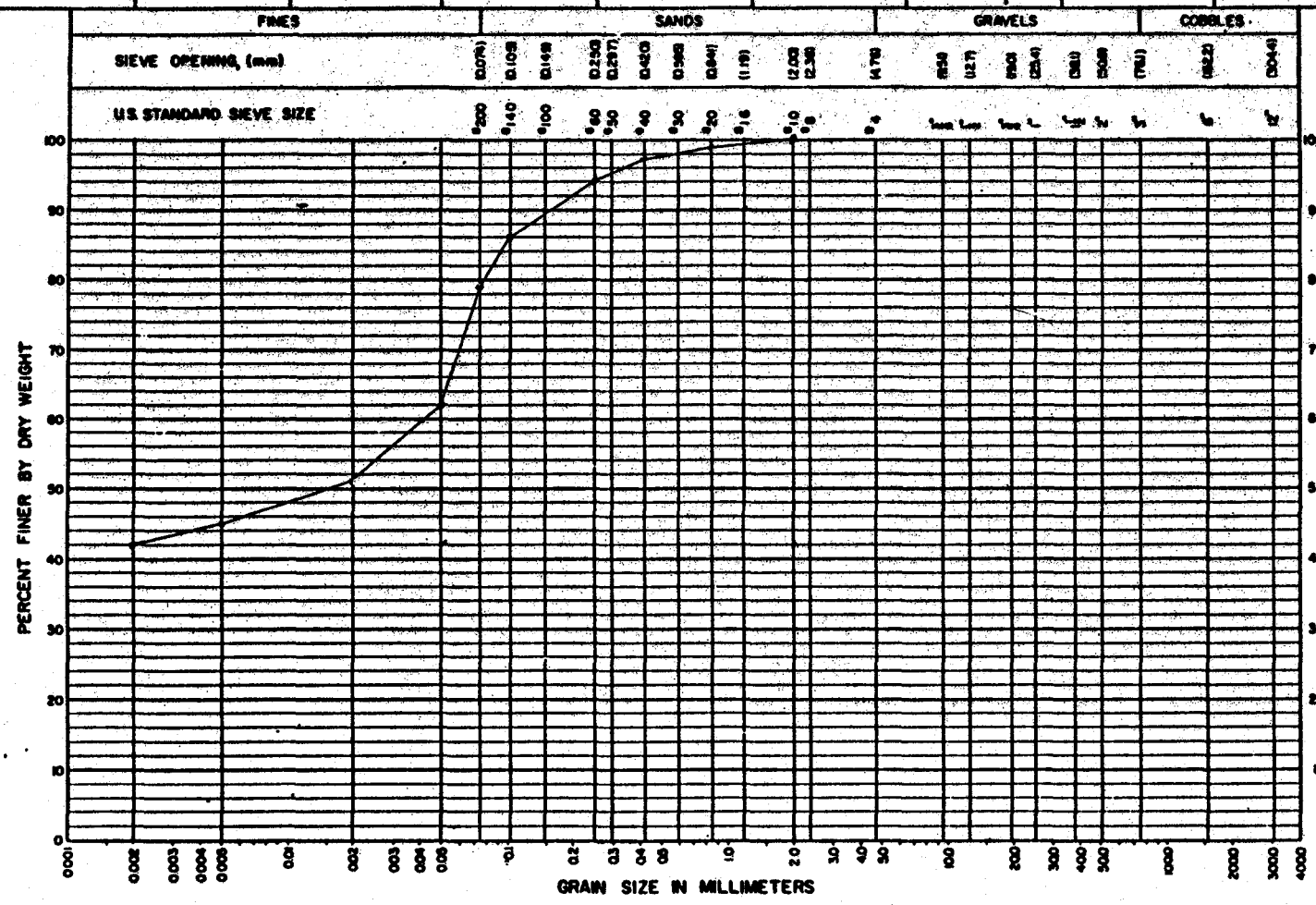
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

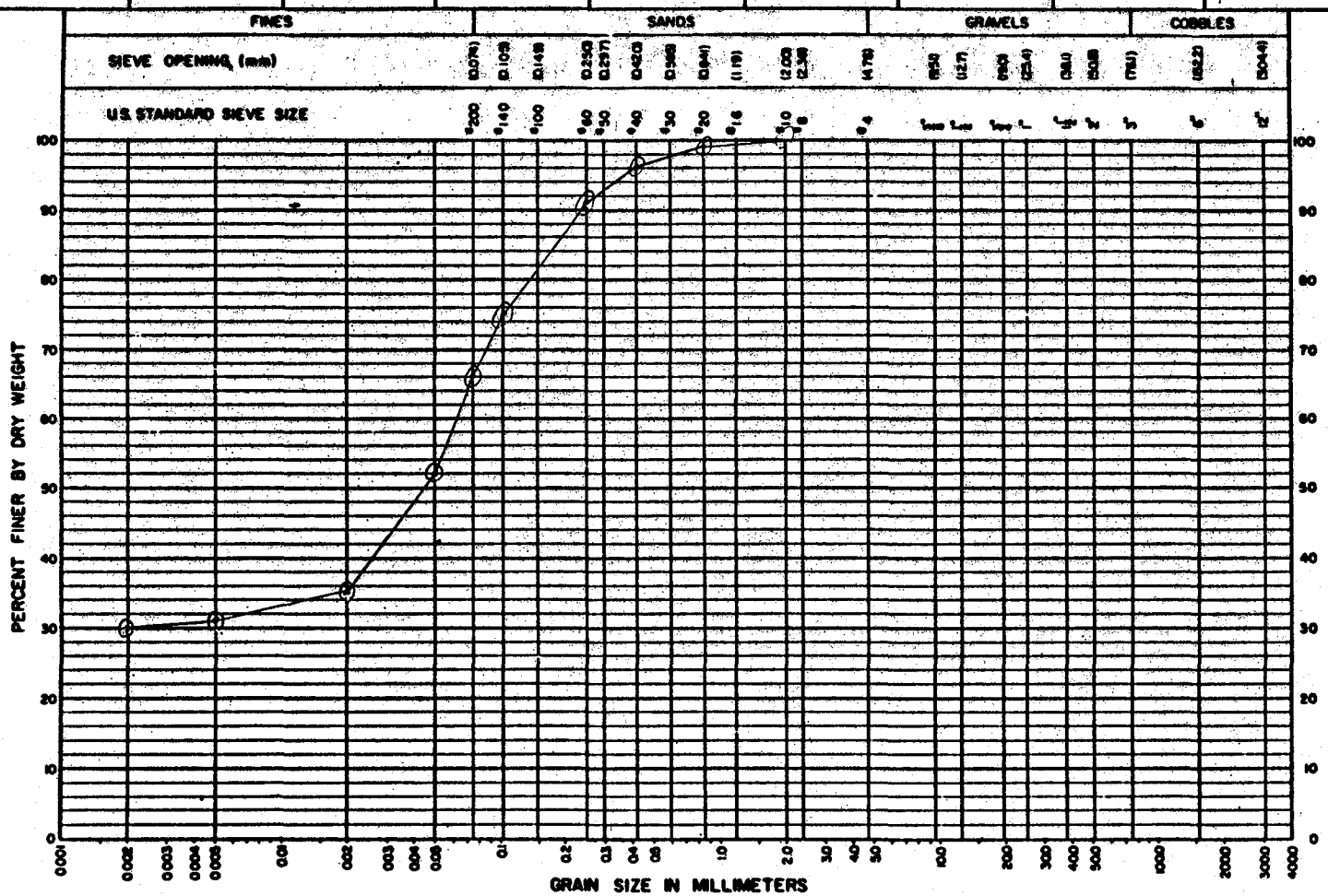
SOIL CLASSIFICATION

LABORATORY NO. 3021

PROJECT and STATE	AZ, RWCD R-5
FIELD SAMPLE NO.	191
DEPTH	8'-9'
GEOLOGIC ORIGIN	
SAMPLE LOCATION	E 360400
TYPE OF SAMPLE	
TESTED AT	
APPROVED BY	
DATE	
SYMBOL	CL
DESCRIPTION	

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

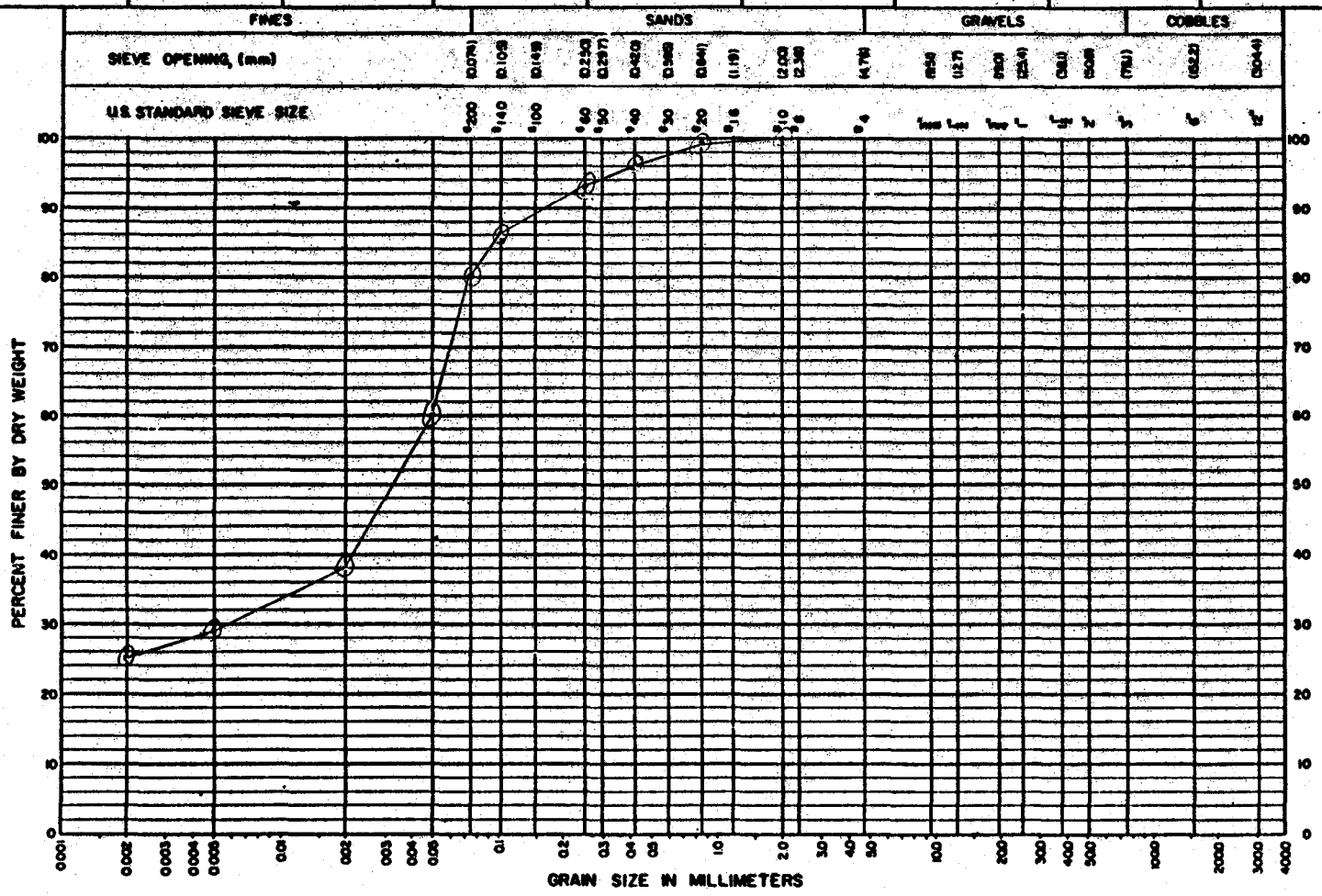
LABORATORY NO. 30235

PROJECT and STATE: AZ
FIELD SAMPLE NO.: 22.2
TYPE OF SAMPLE:
SYMBOL: CL
DESCRIPTION:

RWCD R-5
DEPTH: 8'-9'
TESTED AT:
GEOLOGIC ORIGIN:
APPROVED BY:
SAMPLE LOCATION: E 342+00
DATE:

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3055

PROJECT and STATE: AZ, RWCD R-5

FIELD SAMPLE NO.: 37E

DEPTH: 6'-7'

SAMPLE LOCATION: E 229+00

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

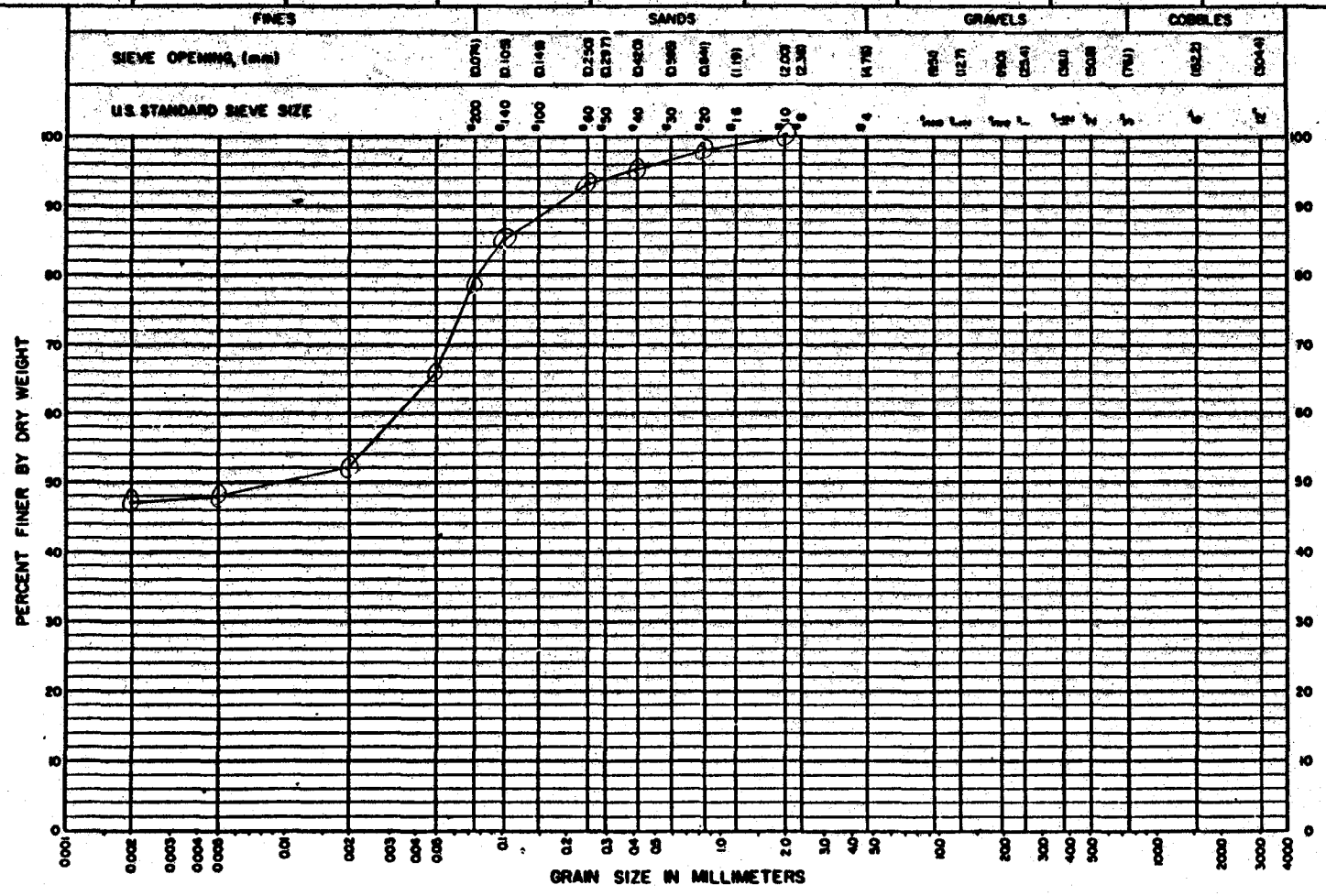
DATE

SYMBOL: CH

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{20}	D_{30}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

FILE CODE ENG-22

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3857

PROJECT and STATE: Az, RWCD R-5

FIELD SAMPLE NO.: 38.1

DEPTH: 4.5'-5.5'

GEOLOGIC ORIGIN

SAMPLE LOCATION: E 224400

TYPE OF SAMPLE

TESTED AT

APPROVED BY

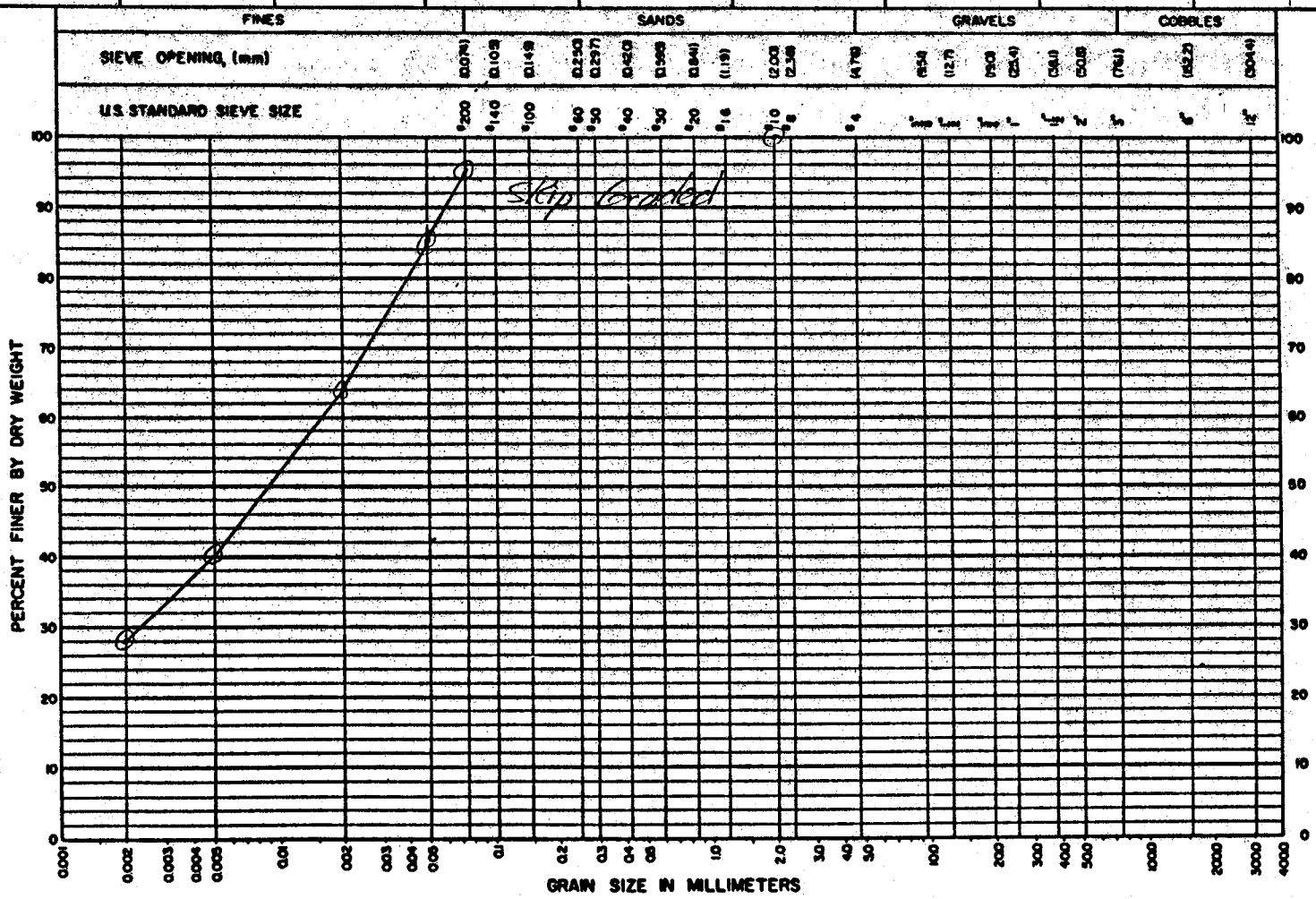
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

GRAIN SIZE DISTRIBUTIONS
(Larger Gradations)

Grain Size Distributions
(Larger Gradations)

FILE CODE ENG-22

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO 2981

PROJECT and STATE: AZ, Rwcd R-5

FIELD SAMPLE NO: 14

DEPTH: 11.5'-13'

SAMPLE LOCATION: 2 47B+38.5

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

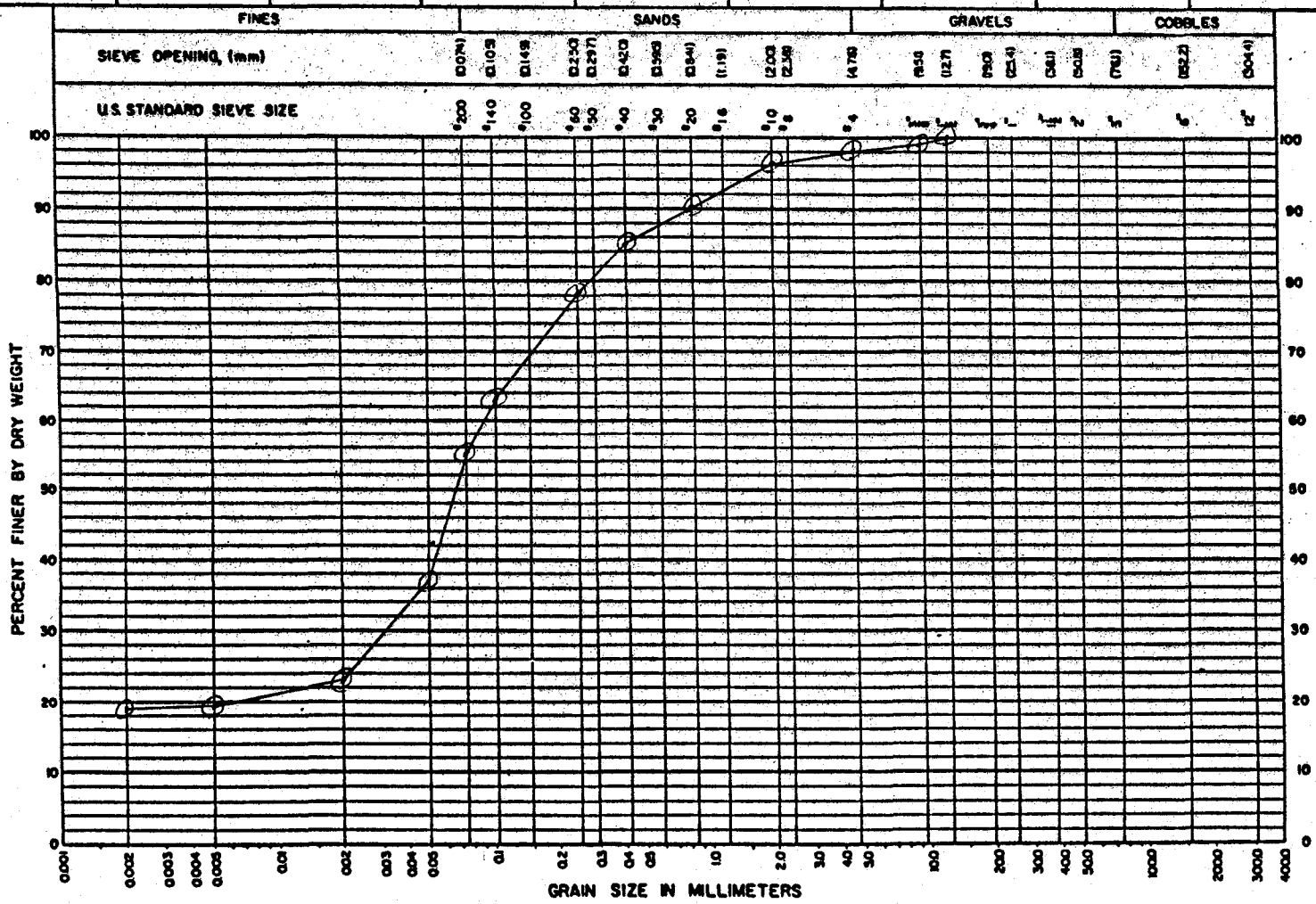
DATE

SYMBOL: CL-ML

DESCRIPTION: Lower Graduation

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

FILE CODE ENG-22

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 2998

PROJECT and STATE: AZ, Rucd R-5

FIELD SAMPLE NO.: 4,3

DEPTH: 18-11.5'

SAMPLE LOCATION: 2 455+38

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

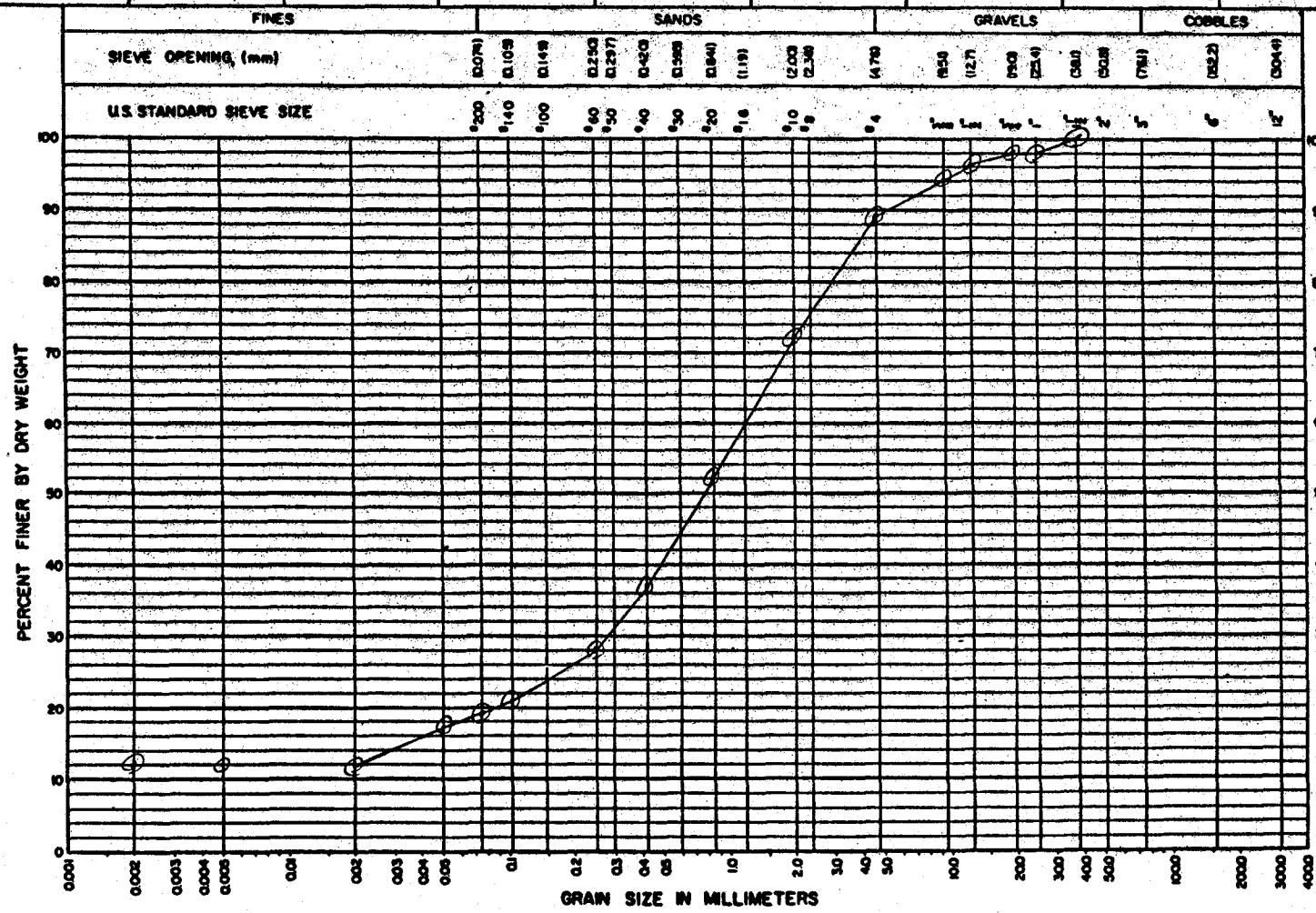
DATE

SYMBOL: SC

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

FILE CODE ENG-22

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO 2990

PROJECT and STATE: AZ, RWCD R-5

FIELD SAMPLE NO.: 5.2

DEPTH: 10.5'-12.5'

SAMPLE LOCATION: E 449700

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

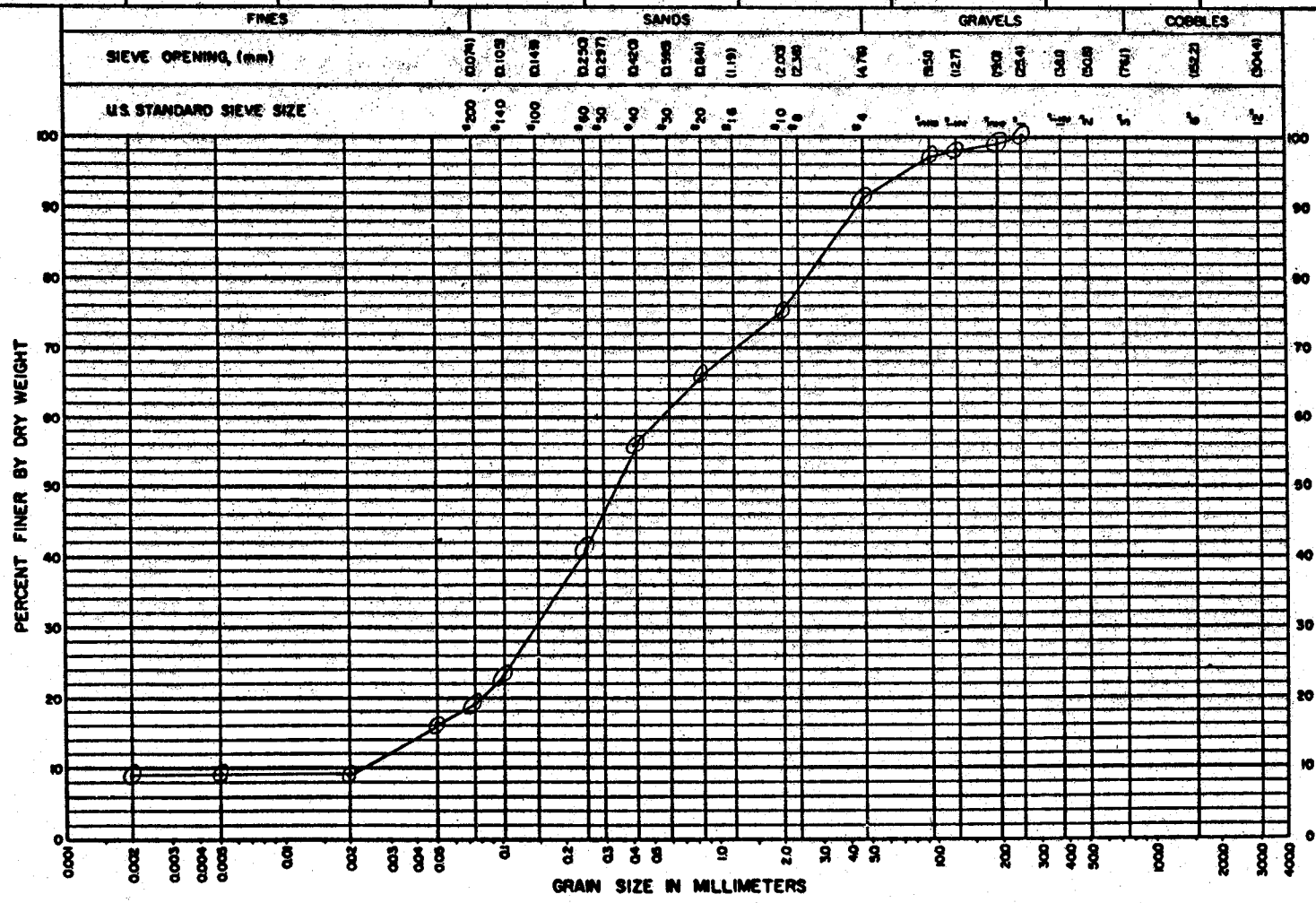
DATE

SYMBOL: SC

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3000

PROJECT and STATE: AZ, RWCD R5

FIELD SAMPLE NO.: 8.4

DEPTH: 9'-11'

SAMPLE LOCATION: 2 428+29

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

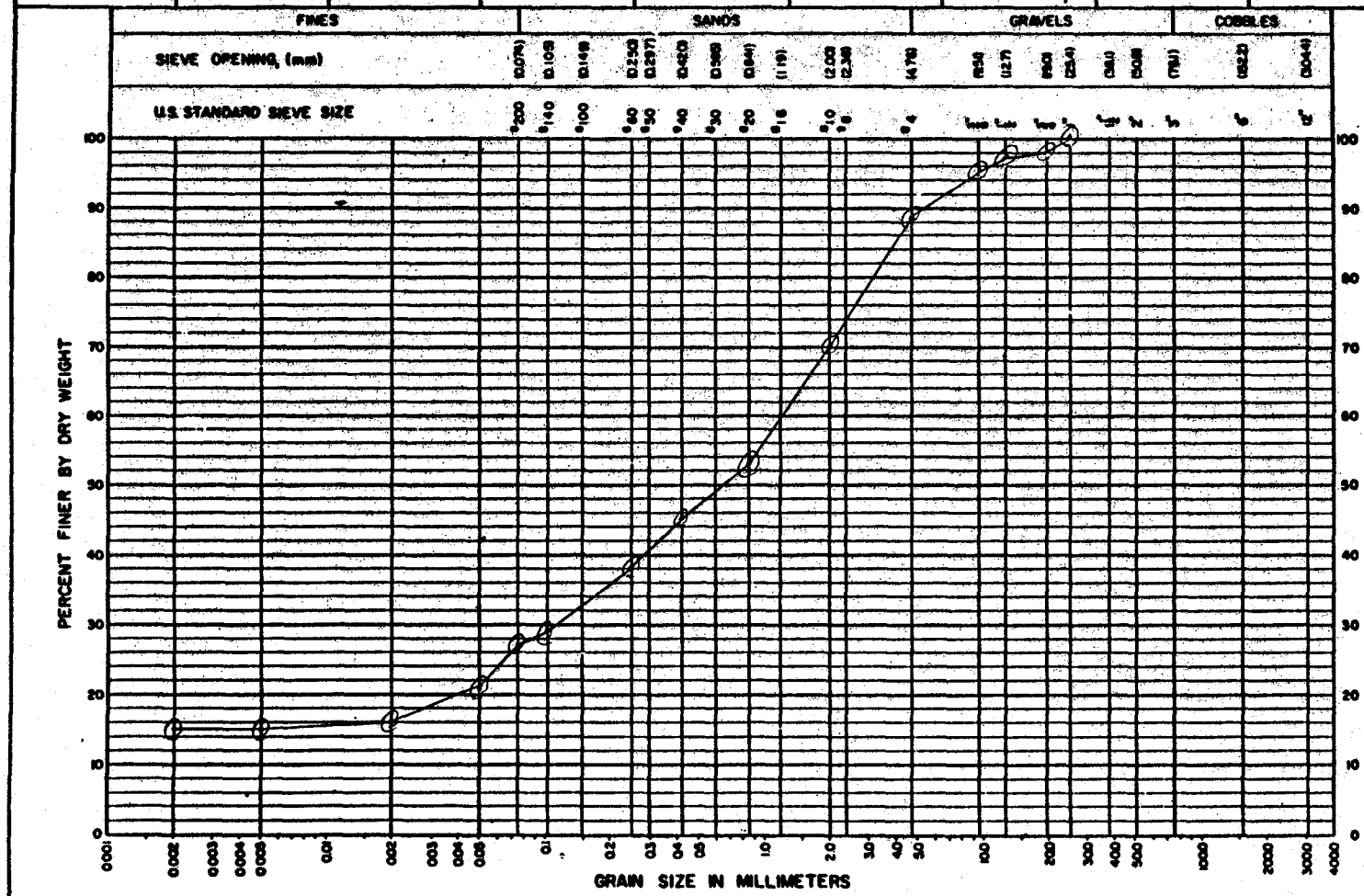
DATE

SYMBOL: SC

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3019

PROJECT and STATE: NZ, RWCD Reach 5

FIELD SAMPLE NO.: 18.2

DEPTH: 7'-9'

SAMPLE LOCATION: E 36+00

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

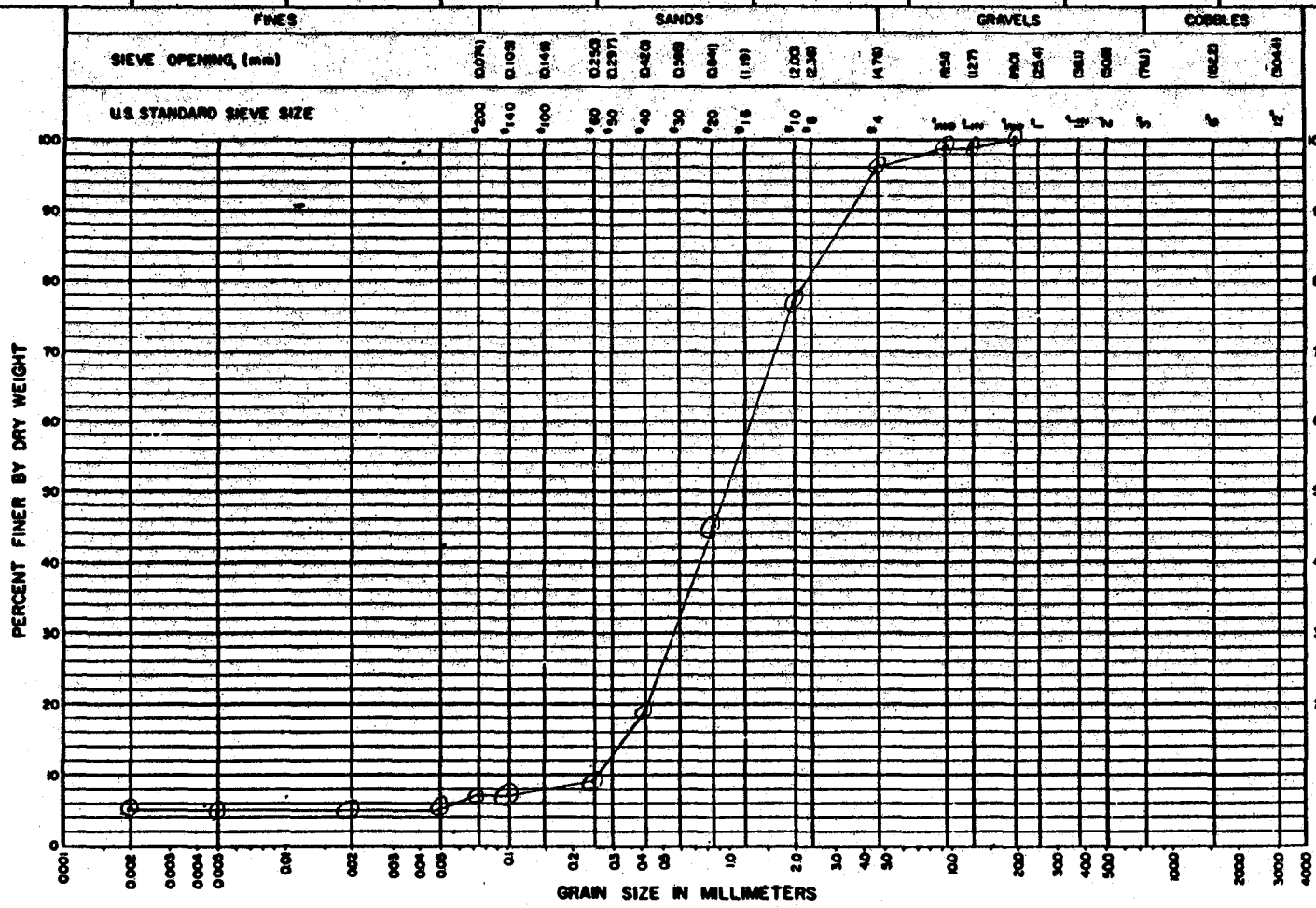
DATE

SYMBOL: SP, SC-SM

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. _____

PROJECT and STATE: AZ Pinal R-5

FIELD SAMPLE NO.: 21

DEPTH: 10'-11.5'

SAMPLE LOCATION: E 348400

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

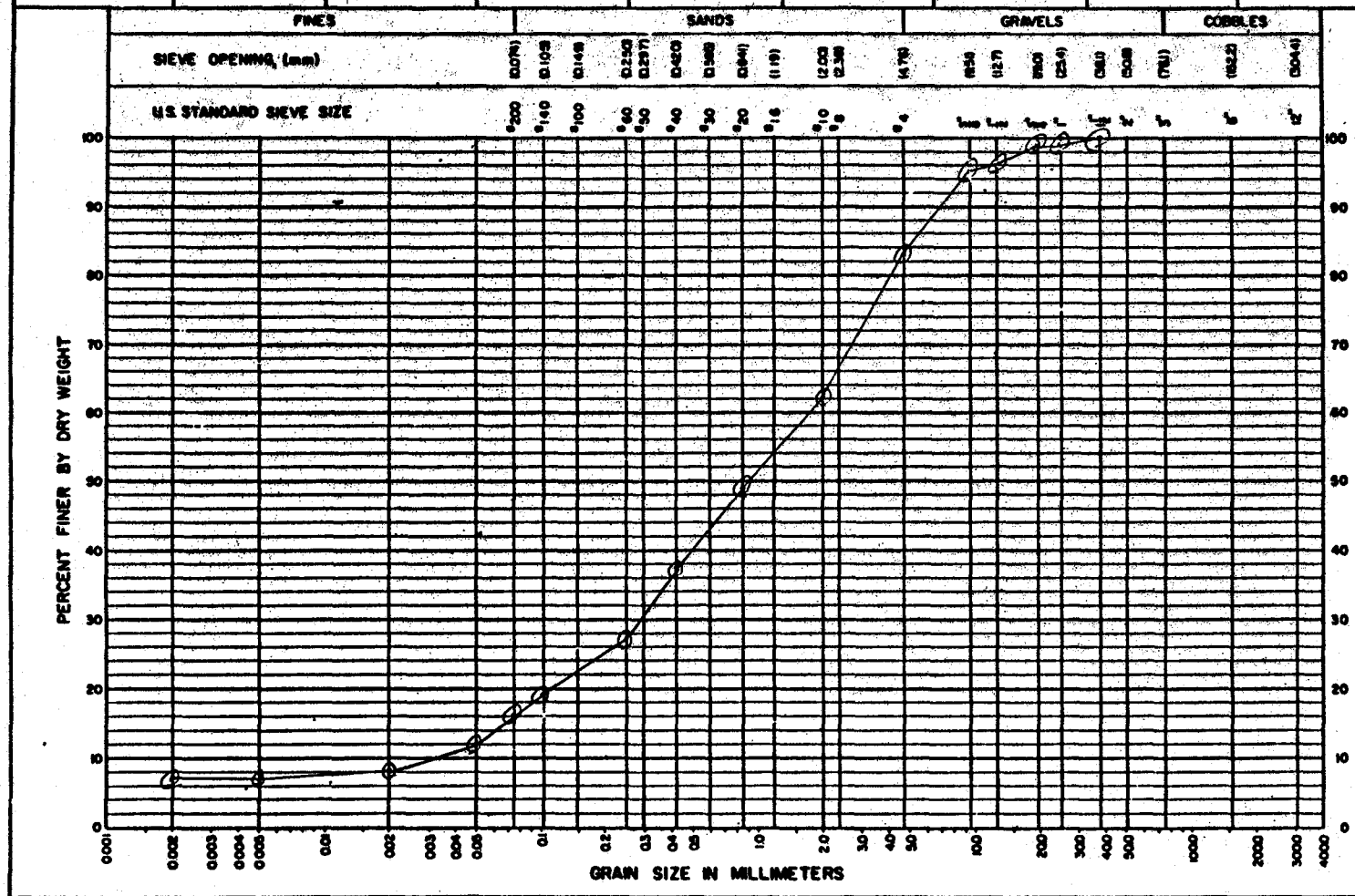
DATE

SYMBOL: SC-SM

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3047

PROJECT and STATE: AZ, Pima Co. R-5

FIELD SAMPLE NO.: 34-3

DEPTH: 6.5' - 7.5'

SAMPLE LOCATION: Q 25 T 10

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

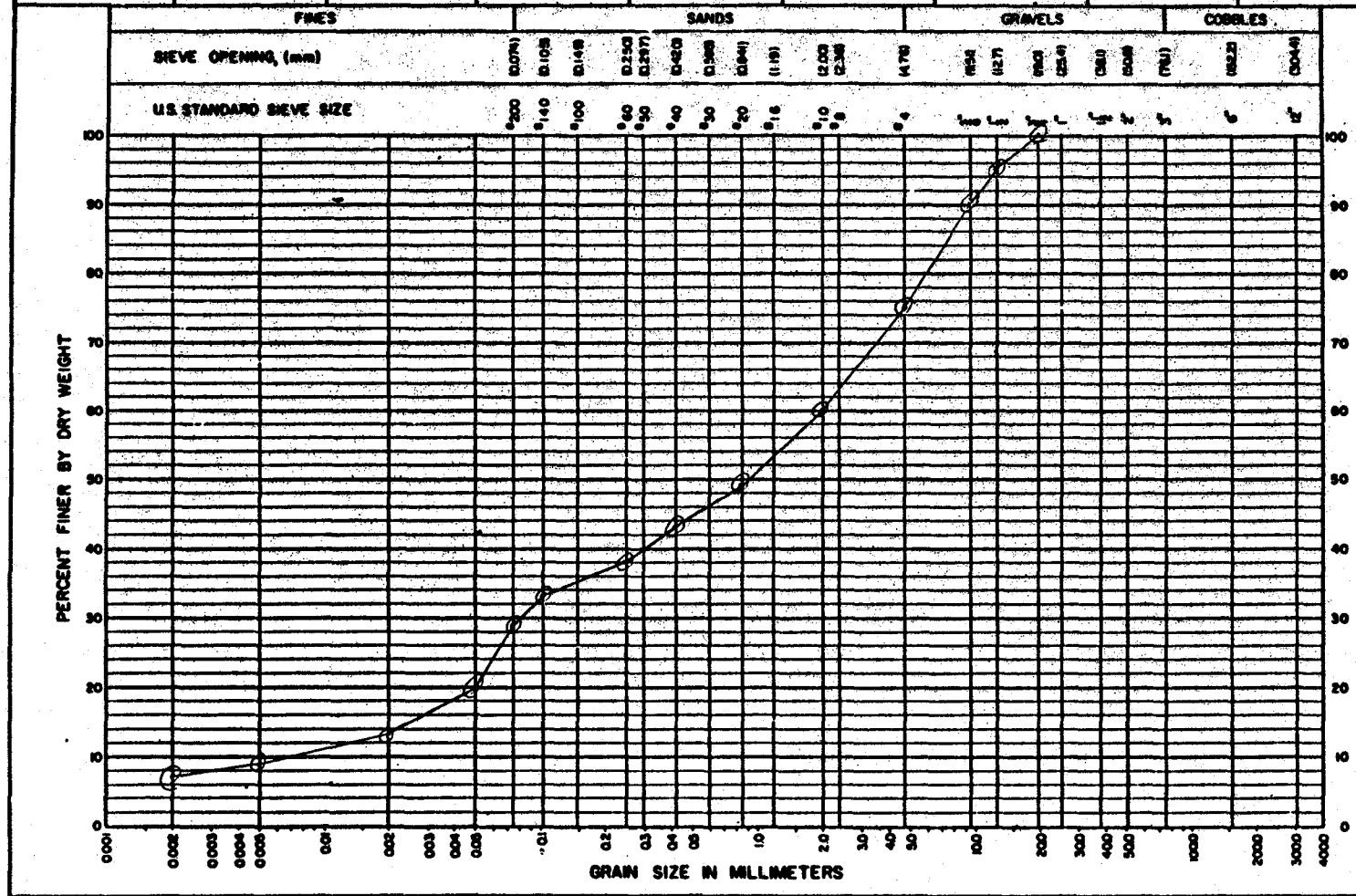
DATE

SYMBOL: SM

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

GRAIN SIZE DISTRIBUTIONS
(High Consolidation)

Grain Size Distributions

~~(Consolidation Considerations)~~

(High Consolidation)

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

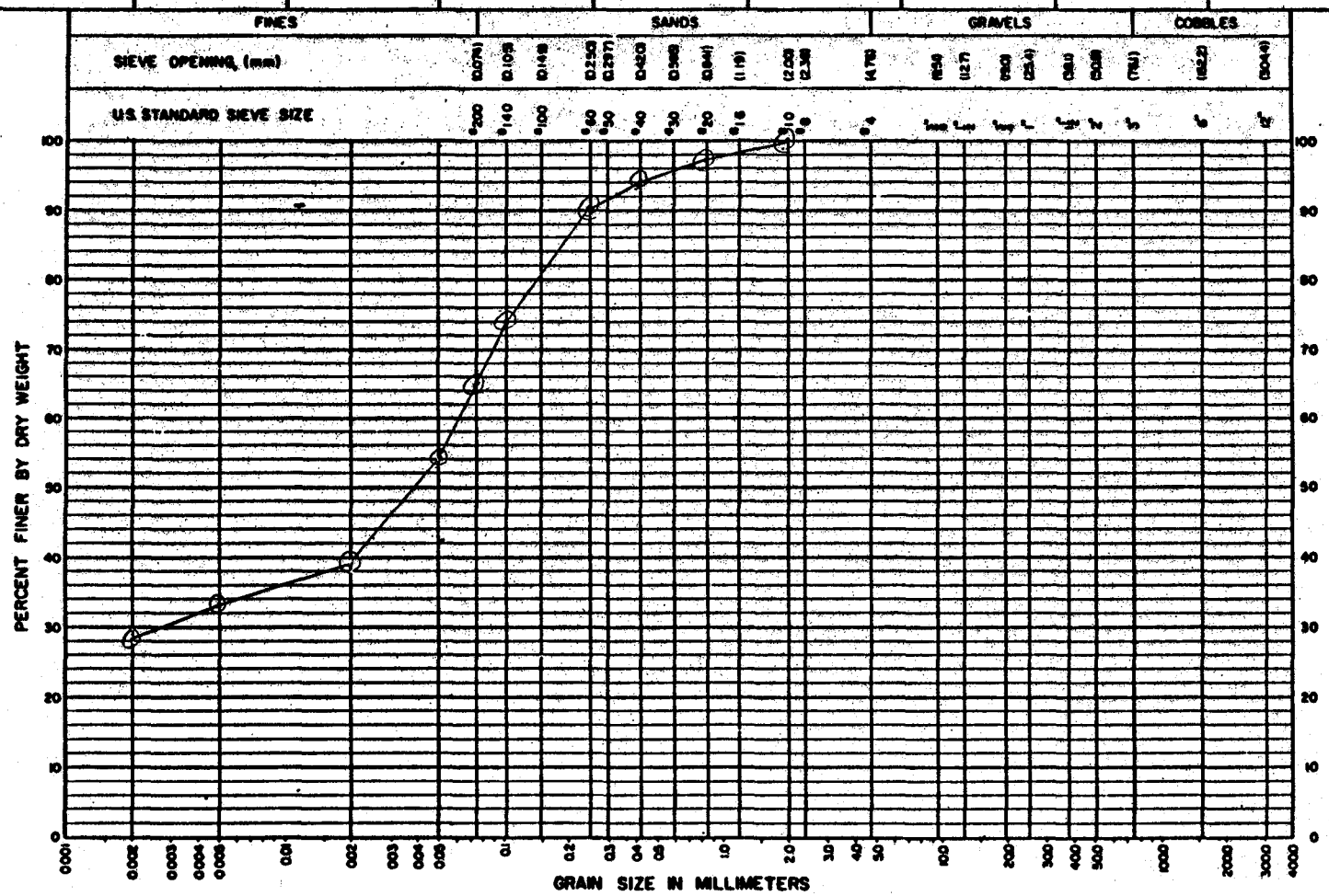
LABORATORY NO. 2295

PROJECT and STATE: Ft. Riley, KS
SAMPLE LOCATION: E 436400
FIELD SAMPLE NO.: 72
DEPTH: 6'-7'
GEOLOGIC ORIGIN:
TYPE OF SAMPLE:
TESTED AT:
APPROVED BY:
DATE:

SYMBOL: CL
DESCRIPTION: Consolidation Consolidation

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

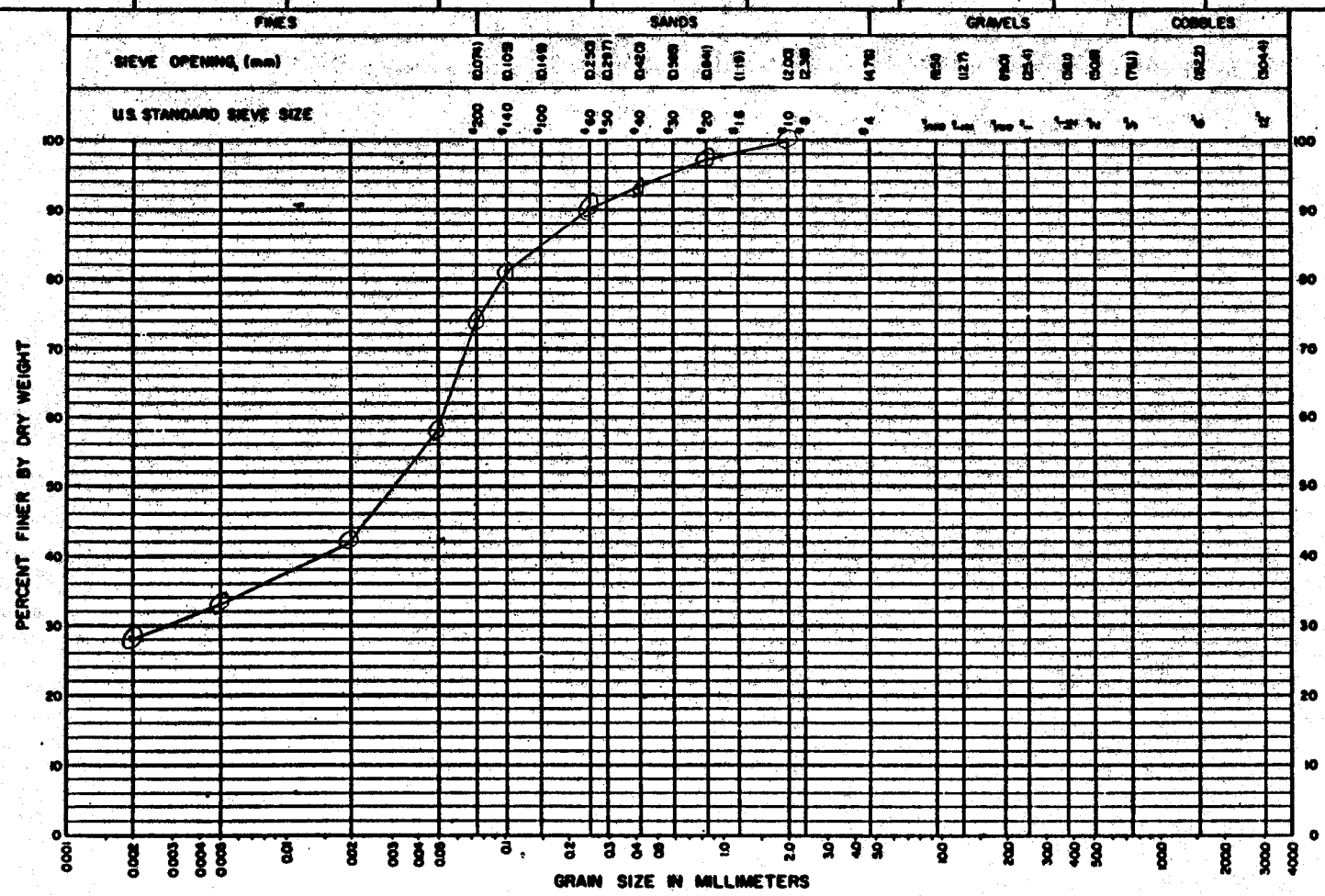
SOIL CLASSIFICATION

LABORATORY NO. 3012

PROJECT and STATE	Rwd R-5
FIELD SAMPLE NO.	152
DEPTH	6-7
SAMPLE LOCATION	E 38+00
TYPE OF SAMPLE	
TESTED AT	
GEOLOGIC ORIGIN	
APPROVED BY	
DATE	
SYMBOL	CL
DESCRIPTION	

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 8013

PROJECT and STATE: AZ, RWCD R-5

SAMPLE LOCATION: E 3 84700

FIELD SAMPLE NO.: 15-3

DEPTH: 9'-10'

GEOLOGIC ORIGIN

TYPE OF SAMPLE

TESTED AT

APPROVED BY

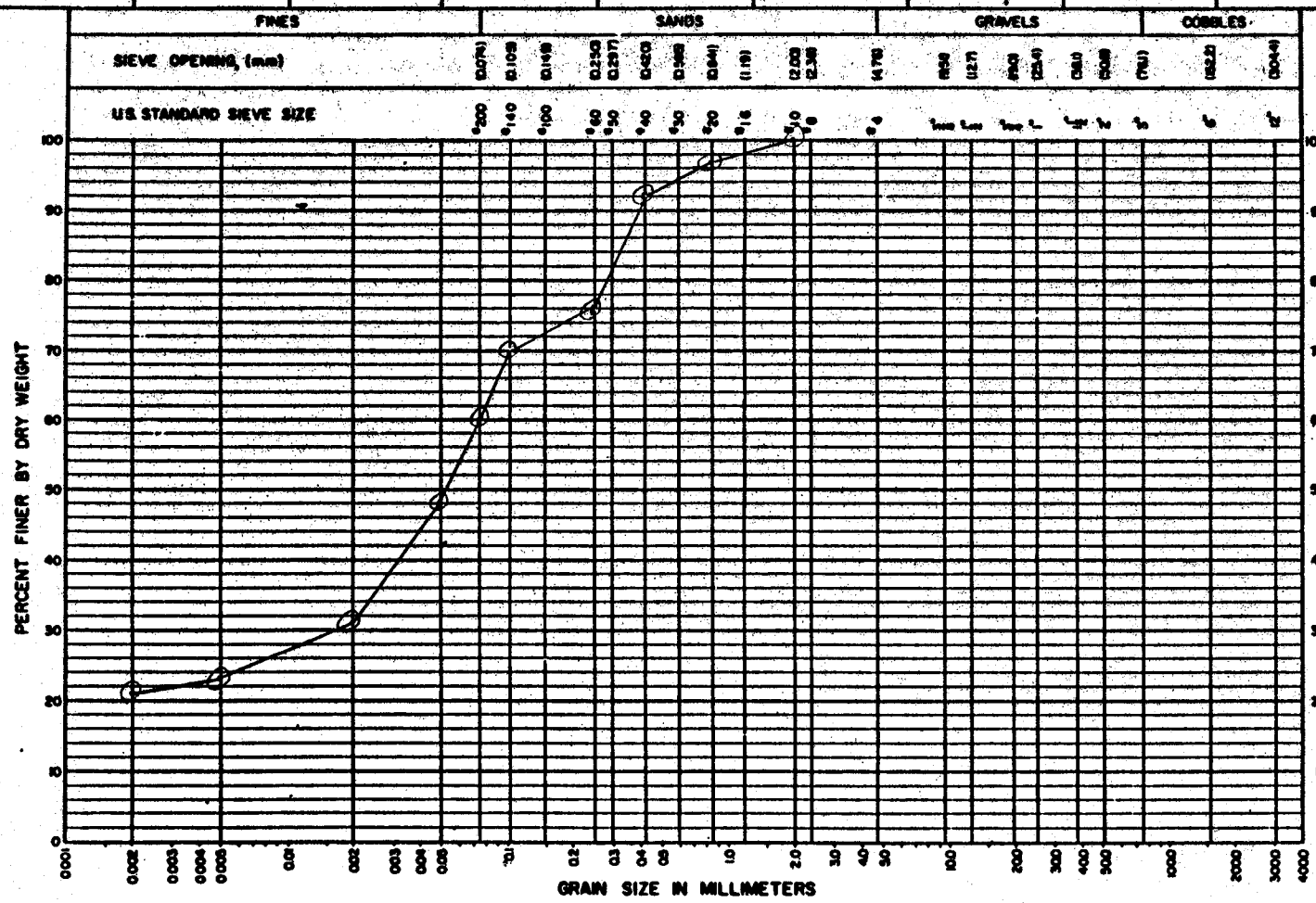
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 8020

PROJECT and STATE: NZ Bucd P-5

FIELD SAMPLE NO.: 183

DEPTH: 4'-5'

SAMPLE LOCATION: B 366700

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

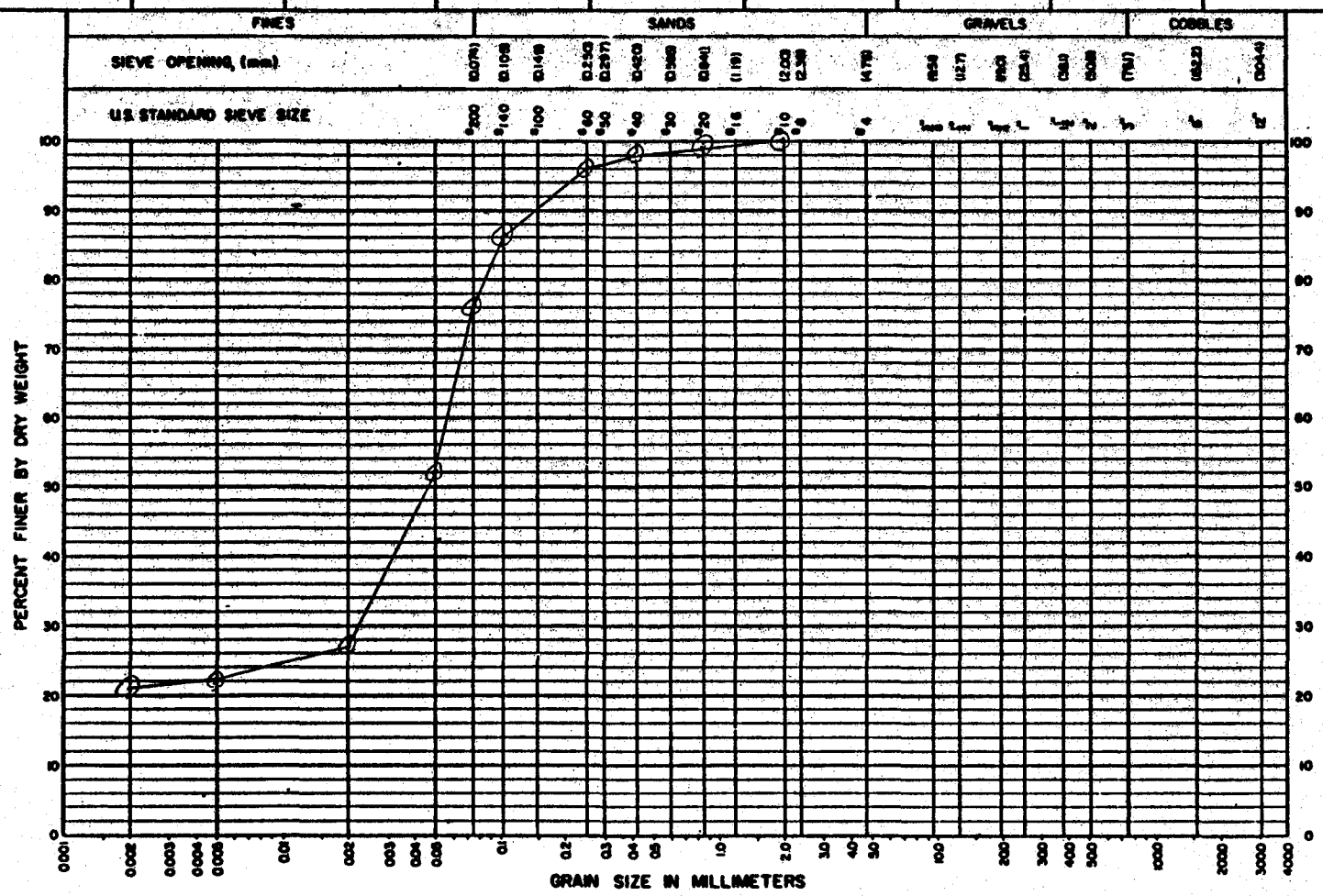
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3032

PROJECT and STATE: Az, EWCD R-5

FIELD SAMPLE NO.: 28.1 "A"

DEPTH: 2'-3'

SAMPLE LOCATION: E 299400

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

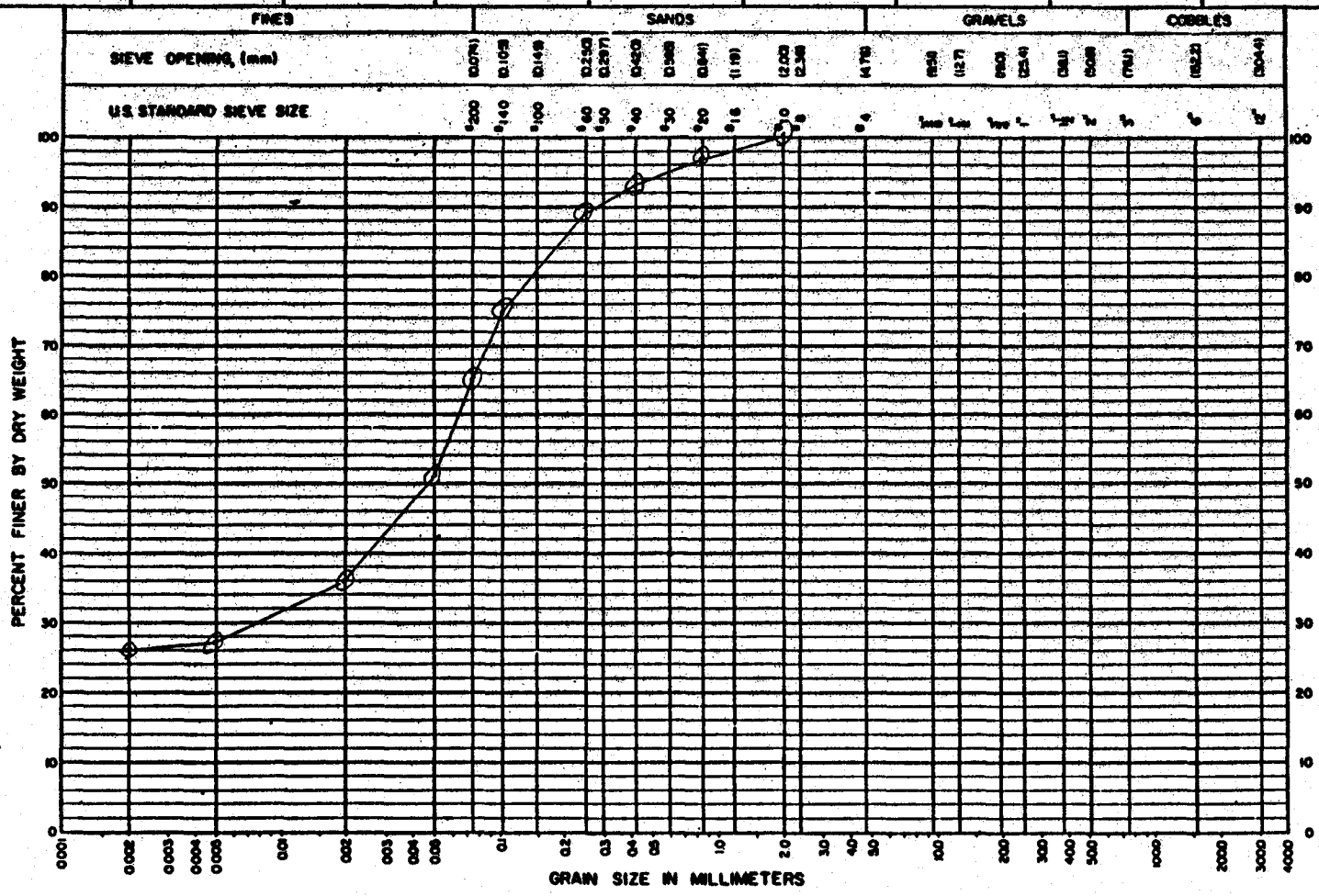
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 8032

PROJECT and STATE: AZ

FIELD SAMPLE NO.: 281 "B"

DEPTH: 2-3'

SAMPLE LOCATION: 2 299 400

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

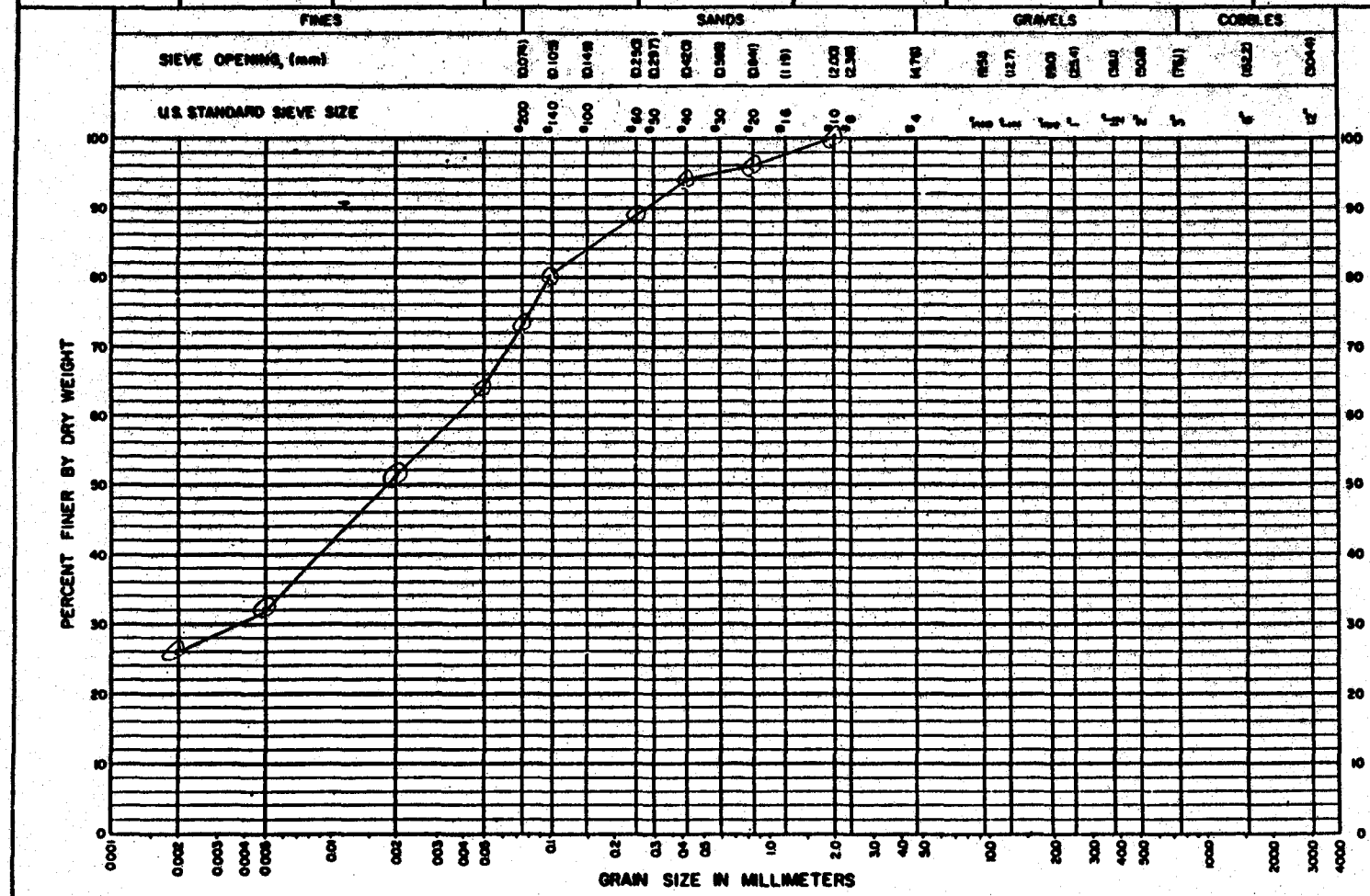
DATE

SYMBOL: CL

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

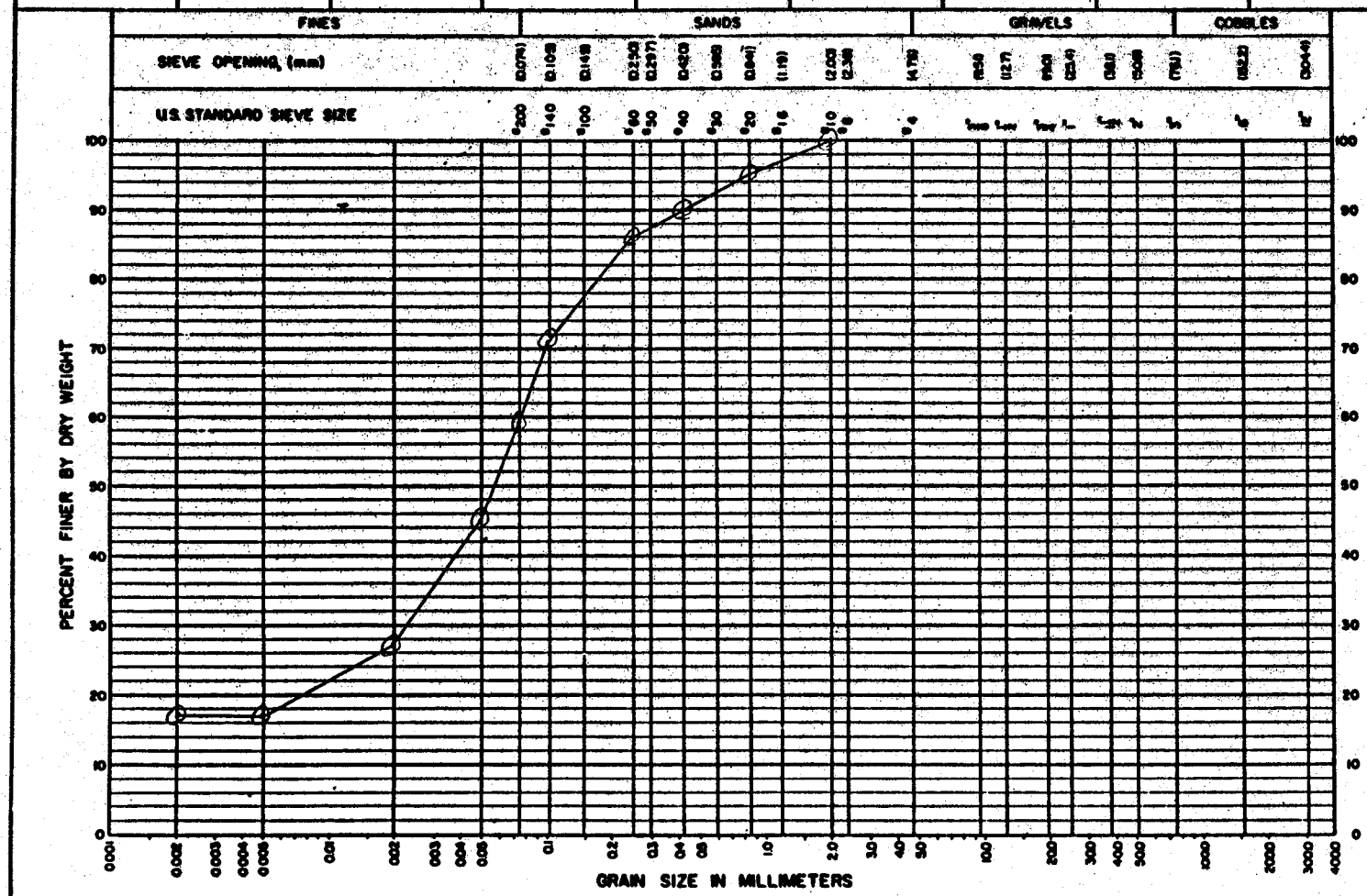
LABORATORY NO. 3041

PROJECT and STATE: AZ, RWCD R-5
FIELD SAMPLE NO.: 3/3
DEPTH: 5'-6'
SAMPLE LOCATION: E 28/+00
TYPE OF SAMPLE
TESTED AT
GEOLOGIC ORIGIN
APPROVED BY
DATE

SYMBOL: ML
DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 3042

PROJECT and STATE: AZ, RWCD R5

FIELD SAMPLE NO.: 3, 4

DEPTH: 8'-8.5'

SAMPLE LOCATION: E 28/100

TYPE OF SAMPLE

TESTED AT

GEOLOGIC ORIGIN

APPROVED BY

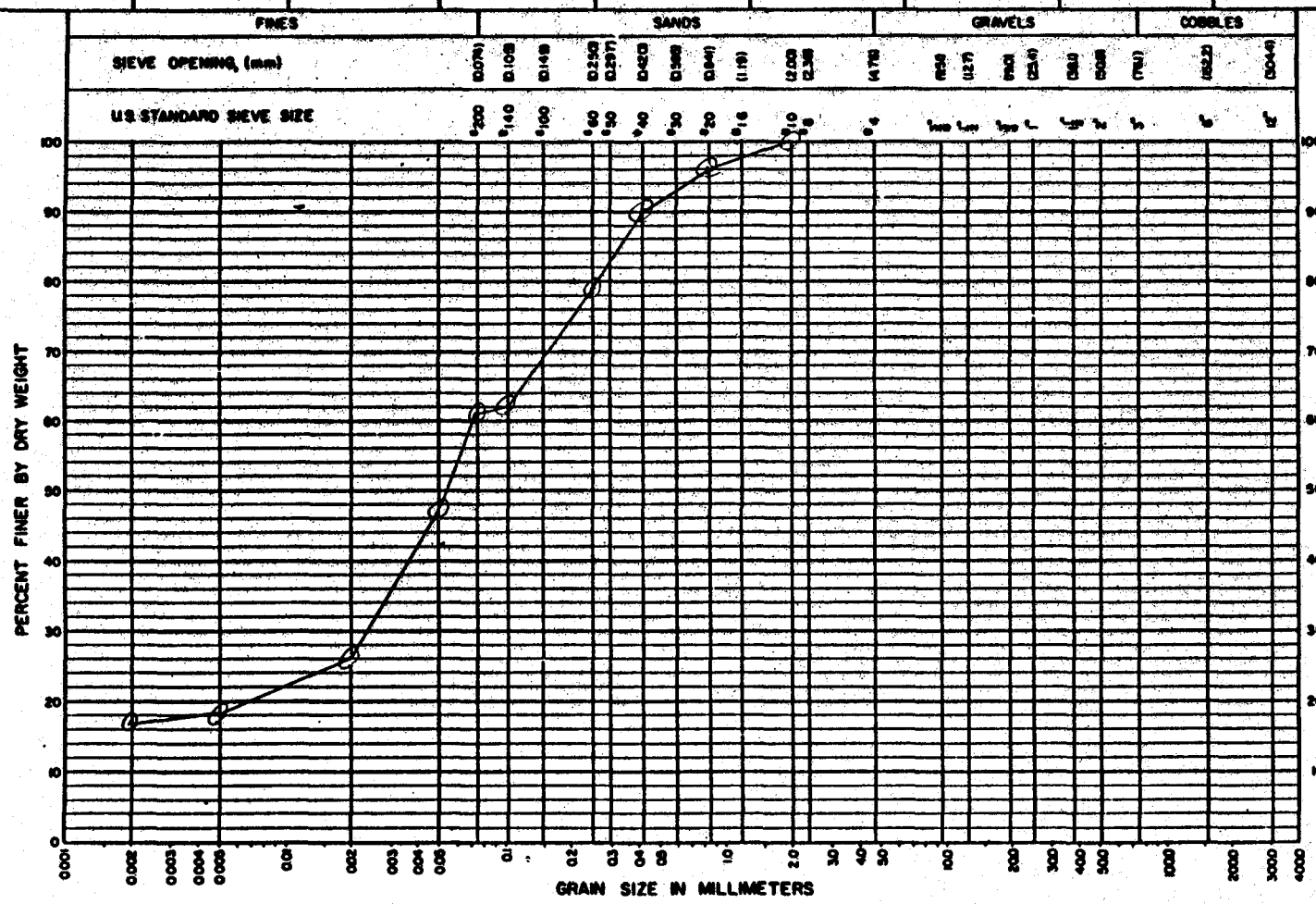
DATE

SYMBOL: CL-ML

DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 8044

PROJECT and STATE: NZ, Rwcd R-5

FIELD SAMPLE NO.: 33

DEPTH: 7'-8'

GEOLOGIC ORIGIN:

SAMPLE LOCATION: E262740

TYPE OF SAMPLE:

TESTED AT:

APPROVED BY:

DATE:

SYMBOL: CL

DESCRIPTION:

GRAIN SIZE DISTRIBUTION

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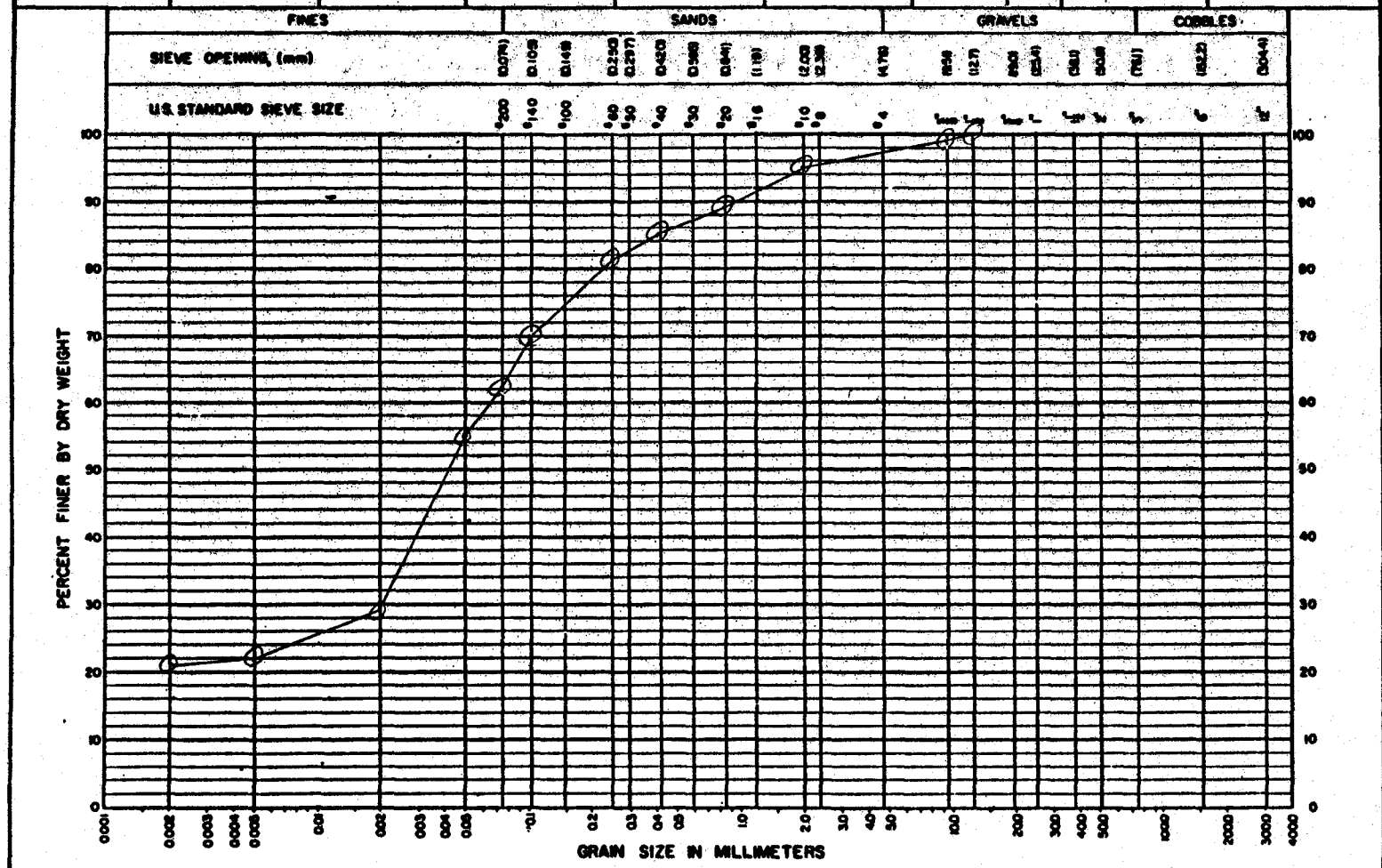


SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS:

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

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 30576

PROJECT and STATE: AZ, RWCD R-5

FIELD SAMPLE NO.: 37.3

DEPTH: 9'-10.5'

GEOLOGIC ORIGIN:

SAMPLE LOCATION: E 279400

TYPE OF SAMPLE:

TESTED AT:

APPROVED BY:

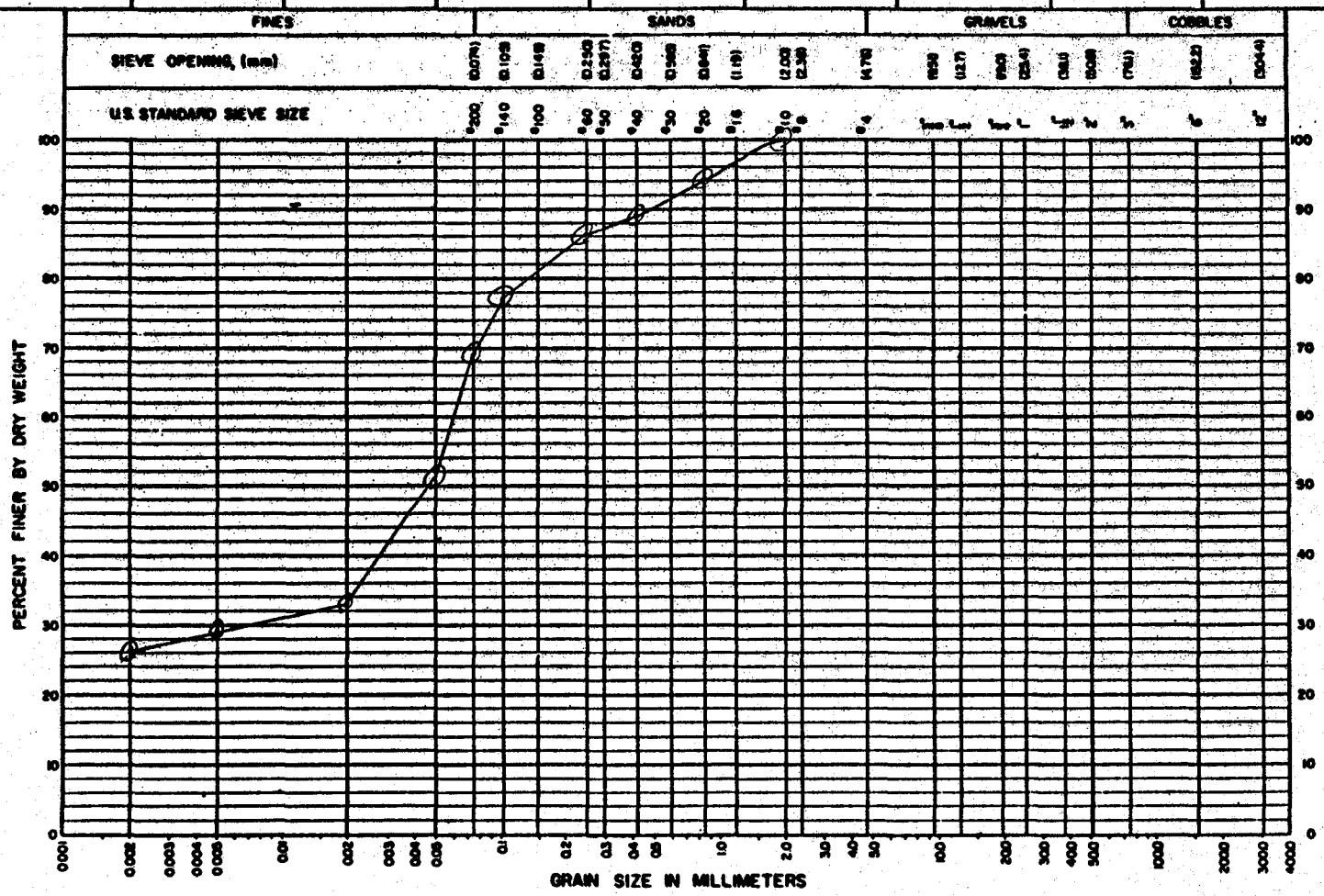
DATE:

SYMBOL: CL

DESCRIPTION:

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{20}	D_{30}	D_{60}	D_{85}	D_{MAX}	C_u	C_c



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

REMARKS:

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

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

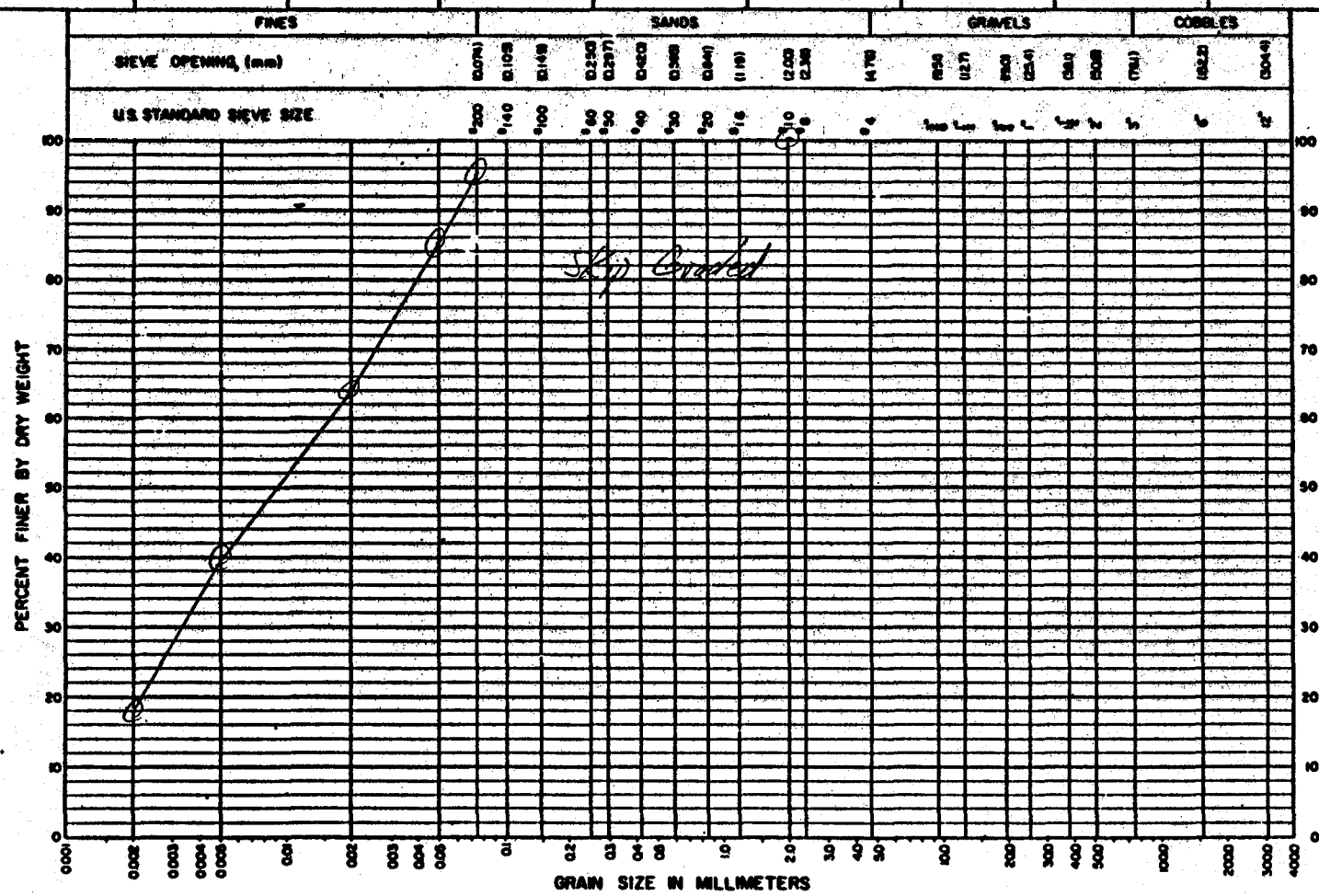
LABORATORY NO. 3057

PROJECT and STATE: NZ, Powell R-5
FIELD SAMPLE NO.: 8B1
DEPTH: 4.5'-5.5'
SAMPLE LOCATION: E 224+00
TYPE OF SAMPLE
GEOLOGIC ORIGIN
TESTED AT
APPROVED BY
DATE

SYMBOL: CL
DESCRIPTION

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{20}	D_{30}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c



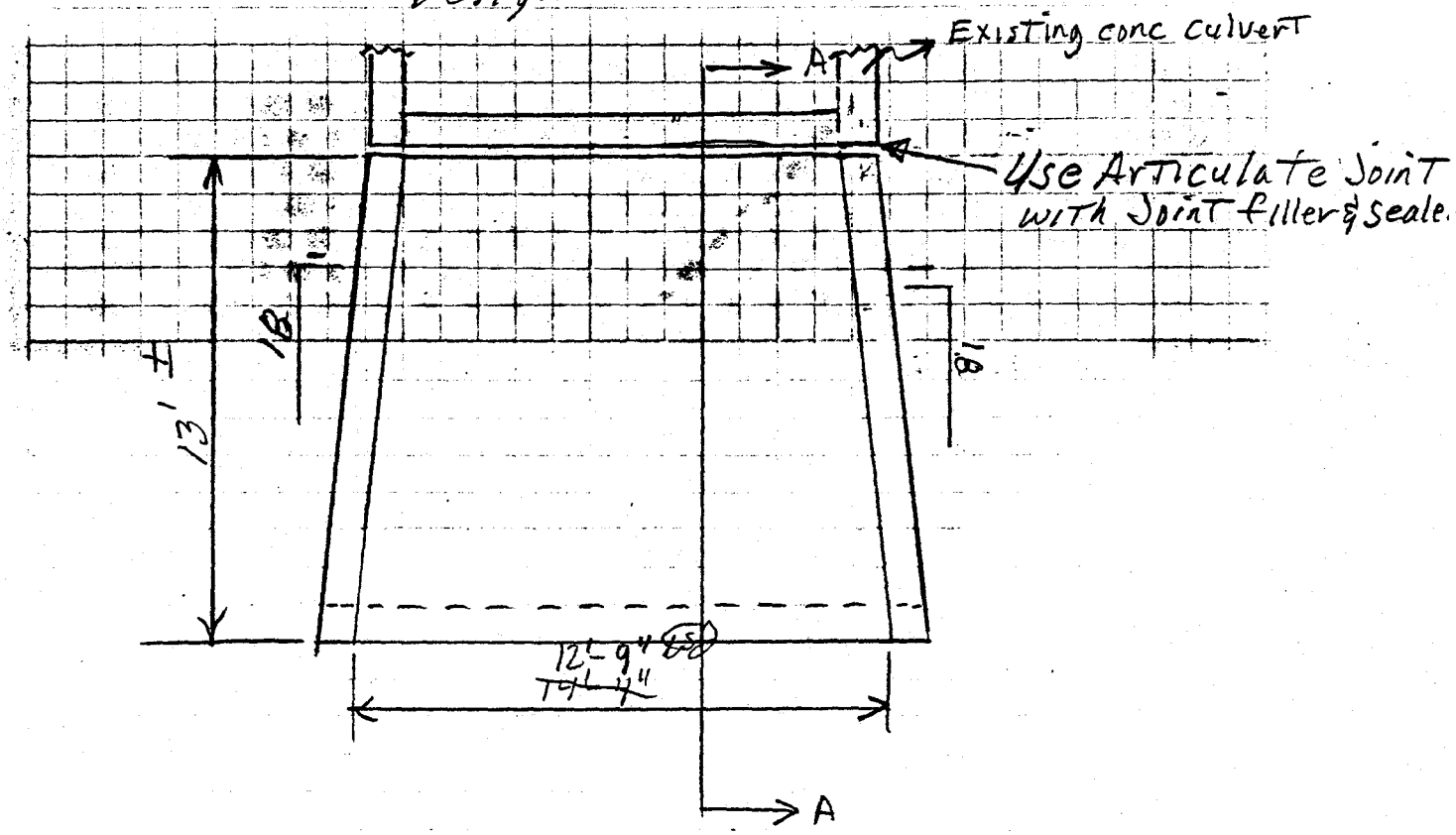
SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

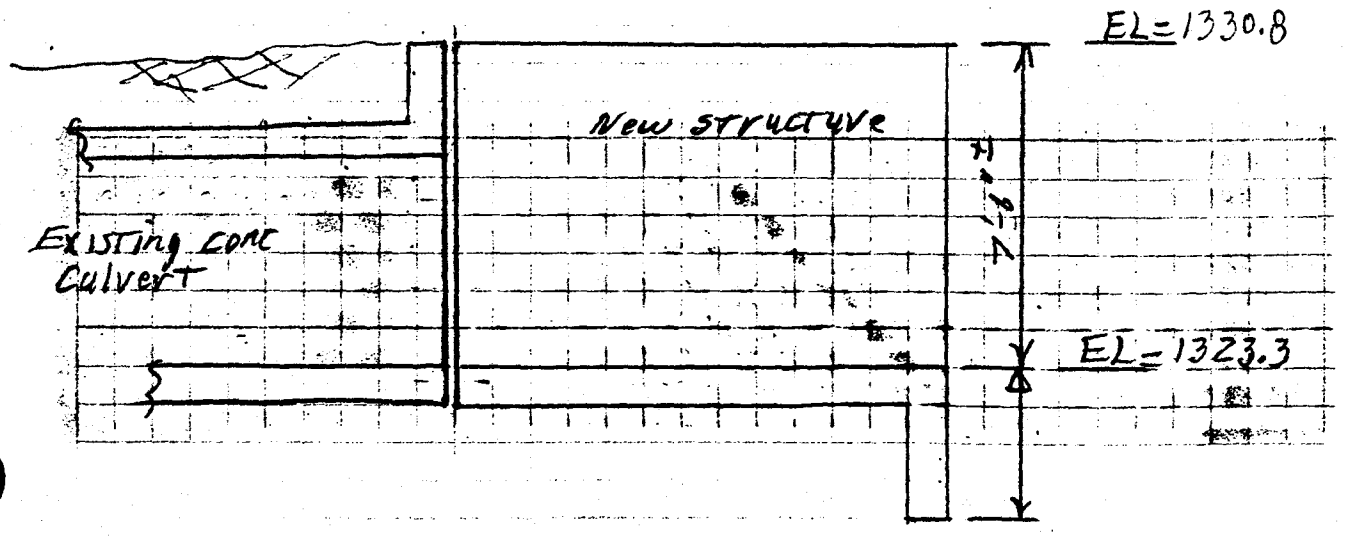
REMARKS:

WARNER ROAD TURNOUT STRUCTURE OUTLET

Warner Road turnout structure
Outlet

Arizona RWCD REACH 5
Tom Jayo 11-14-86 D8 11/86
Warner Road Irrig Canal Outlet 1 9
Design





SEC A-A

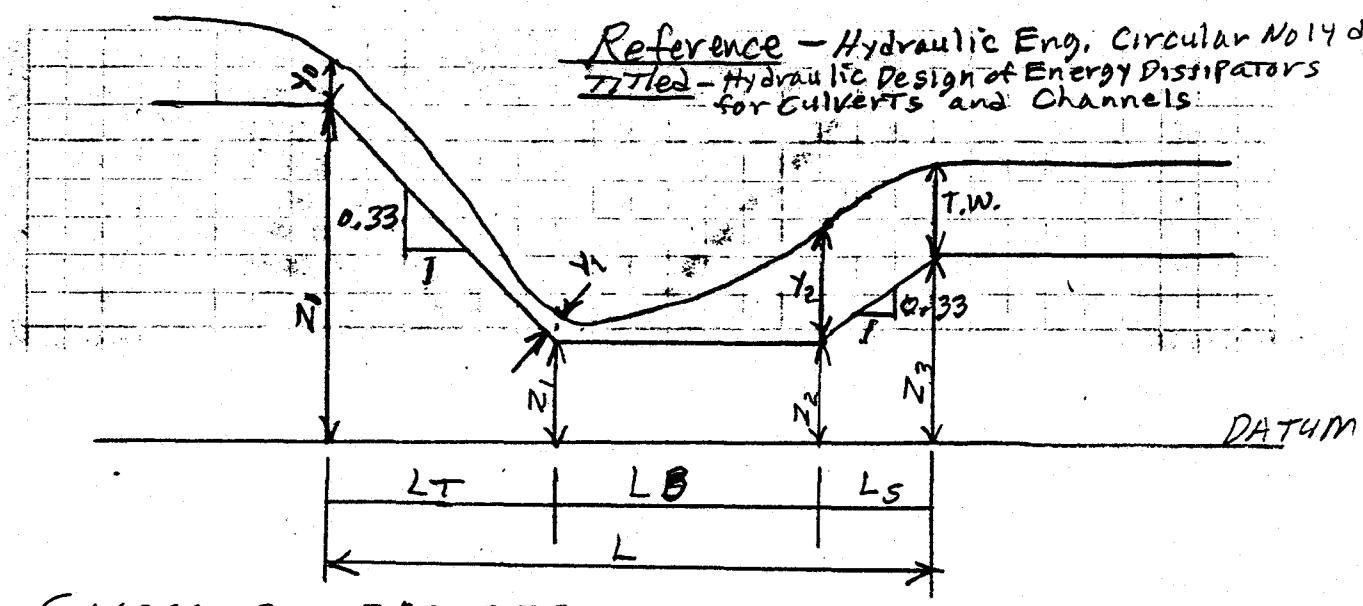
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		RWCD REACH 5		
BY Tom Jayo	DATE 11-17-86	CHECKED BY DSP	DATE 11/86	JOB NO.
SUBJECT Warner Road Irrig Canal Outlet				SHEET 2 OF 9

Grouted Rock Drop

Reference – Hydraulic Eng. Circular No 14 dated 12, Titled – Hydraulic Design of Energy Dissipators for Culverts and Channels



Given: $Q = 280$ CFS

$Z_0 - Z_3 = 1323.3 - 1319.1 = 4.2$ FT

Find Y_0 & V_0

$Y_0 = Y_c$ (critical depth

From Page III-8, Fig III-3, $Y_c = 0.315 \sqrt[3]{\left(\frac{Q}{B}\right)^2}$

$Y_c = 0.315 \sqrt[3]{\left(\frac{280}{14.33}\right)^2} =$

$Y_c = 2.29$ FT $= Y_0$

$B = 14.33$ per outlet configuration given

Find V_0

$V_0 = \frac{Q}{A} = \frac{280}{2.29(14.33)} = 8.53$ FT/sec

Assume $Z_0 - Z_1 = 6.2$ FT.

Find Y_1, V_1

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

$L_T = 3(Z_0 - Z_1) = 3(6.2) = 18.6$ FT

$W_B = 14.33 + \frac{L_T}{10}(2) = 14.33 + \frac{18.6}{5} = 18.05$

COMPUTATION SHEET
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BY Tom Joyo	DATE 11-17-86	CHECKED BY	DATE 11/86	JOB NO.
SUBJECT Wavner Road Grouted Rock Drop				SHEET 3 OF 9

Design -

$$ZBO = Y_1 (18.05)\left[64.4(6.2 + 2.29 - Y_1) + (8.53)^2\right]^{1/2}$$

$$\left(\frac{ZBO}{18.05}\right)^2 = Y_1\left[619.52 - 64.4 Y_1\right]$$

$$64.4 Y_1^3 - 619.52 Y^2 + 240.64 = 0$$

$$Y_1^3 - 9.62 Y^2 + 3.74 = 0$$

$$Y_1 = 0.65 \text{ FT} \quad (\text{By Trial})$$

$$V_1 = \frac{Q}{A} = \frac{280}{18.05(0.65) + 3(0.65)^2} = 21.54 \text{ FT/sec}$$

Find Fr_1

$$Fr_1 = \frac{V_1}{\sqrt{g Y_1}} = \frac{21.54}{\sqrt{32.2(0.65)}} = 4.71$$

Find Y_2

$$Y_2 = C_1 Y_1 \left[\frac{\sqrt{1 + 8 Fr_1^2} - 1}{2}\right] \qquad C_1 = 1.0 \text{ Page IV-B-9}$$

$$Y_2 = 1(0.65)\left[\frac{\sqrt{1 + 8(4.71)^2} - 1}{2}\right] = 4.02 \text{ FT}$$

$$T.W. \geq Y_2 - (Z_3 - Z_2)$$
$$\geq 4.02 - 2$$
$$\geq 2.02$$

Tail water depth per Don Parlos' Analysis see sheet 4 dated 11-19-86

$$= \underline{1.7 \text{ FT}}$$

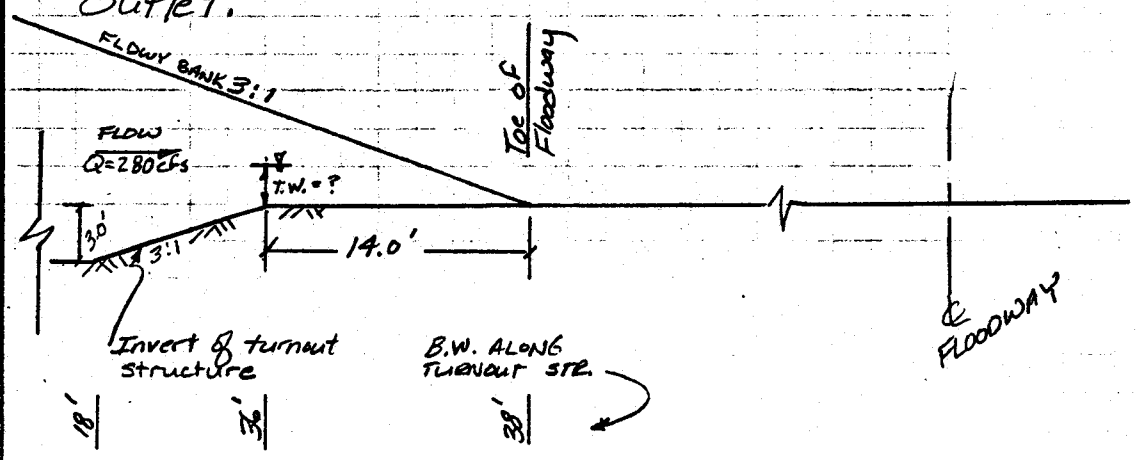
T.W. < 2.0' required for Jump therefore lower basin by 1 foot -

Az RWCD Reach-5

DE Paulus 11-19-86 T. Jayo 11-21-86

Turnout Structure @ Warner Rd. 4 9

A. Determine Tailwater depth at structure Outlet.



1. Use Manings Eqn. to figure D_N in the Floodway for:
   $Q = 280$ cfs
   $S = 0.0003$
   $n = 0.02$
   $B.W. = 140'$
   $Z = 3:1$

   $D_N = 1.3$ ft ✓

2. Figure critical depth @ end of turnout str.
   $Q = 280$ cfs
   $B.W. = 38.0'$
   $Z = 3:1$

   $Y_c = 1.2$ ft ✓

∴ Assume a Broad Crested Weir with critical depth at the toe of the Flwy.

For rectangular section of broad crested weir } $H = T.W. \approx \frac{3}{2} Y_c \approx 1.5(1.2) = 1.8$,

-or- $q = \frac{2}{3} H \sqrt{\frac{2}{3} g H}$

$$\frac{280}{36} = \frac{2}{3} H \sqrt{\frac{2}{3}(32.2) H}$$

$$136.2 = H^2 (21.5) H$$

$$H^3 = 6.33 \qquad H = 1.9 \text{ ft}$$

-or- Weir equation for Trap. section
$Q = 3.1 L H^{3/2} + 3.1 Z H^{5/2}$ solve for $H = \underline{1.7 \text{ ft}}$ ✓

see p-8

AZ RWCD Reach 5

DE Paulus 11-19-86 T. JAYD 11-22-86

Turnout Structure @ Warner Rd. 5 9-

∴ USE T.W. = 1.7 ft for sequent depth design of hydraulic jump

USE T.W. = 2.0 ft (+ Freeboard) for capacity

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Grouted Rock Drop Cond.

Go back to

Find $Y_1 V_1$ with $Z_0 - Z_1 = 7.2$ FT

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

$$L_T \approx 3(Z_0 - Z_1) = 3(7.2) = 21.6 \text{ use } 22 \text{ FT}$$

$$W_B = 14.33 + \frac{L_T}{3F_r}(2) = 14.33 + \frac{22}{3F_r}(2) = 14.33 + \frac{14.67}{5.94} = 16.8 \text{ FT}$$

$$280 = Y_1(22)\left[64.4(7.2 + 2.29 - Y_1) + (8.53)^2\right]^{\frac{1}{2}}$$

$$\left(\frac{280}{22}\right)^2 = (Y_1)^2\left[683.92 - 64.4Y_1\right] = 161.98$$

$$-64.4Y_1^3 + 683.92Y_1^2 = 161.98$$

$$Y_1^3 - 10.62Y_1^2 + 2.52 = 0$$

$Y_1 = 0.5$ (By trial),

$$V_1 = \frac{Q}{A} = \frac{280}{22(0.5) + 3(0.5)^2} = 23.83 \text{ FT/sec}$$

Find Fr_1

$$Fr_1 = \frac{V_1}{\sqrt{gY_1}} = \frac{23.83}{\sqrt{32.2(0.5)}} = 5.94$$

Side Flare $= 3(Fr_1) = 3(5.94) = 17.82$/FT use 18 FT

Find Y_2

$$Y_2 = C_1 Y_1 \left[\frac{\sqrt{1 + 8Fr_1^2} - 1}{2}\right]$$

($C_1 = 1.0$ Page IV-B-9 for hydraulic jump)

$$Y_2 = 1(0.5)\left[\frac{\sqrt{1 + 8(5.94)^2} - 1}{2}\right] = 3.96$$

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Grouted Rock Drop Cond

$T.W. \geq Y_2 - (Z_3 - Z_2)$

$\geq 3.96 - 3.0$

$T.W. \geq 0.96$ OK since T.W. = 1.7 FT from Don Pablos Analysis (see sheet 4).

Therefore $Z_0 - Z_1 = 7.2$ FT OK

Dimensions of Drop

$L_T = (Z_0 - Z_1)/S_T = \frac{7.2}{1/3} = 21.6$ FT use 22 FT

$L_S = (Z_3 - Z_2)/S_T = \frac{3}{1/3} = 9$ FT

$L_B = f(Y_1, Fr_1)$ see Fig VI-11 (assuming rect section)

$Fr_1 = 5.94$
$Y_1 = 0.5$

$\frac{L_B}{Y_1} = 48$

$L_B = 0.5(48) = 24$ FT

total Length = 22 + 24 + 9 = 55 FT within about 9' of channel toe

$W_1 = 12.75 + \frac{22}{18}(2) = 15.24$

$W_2 = 12.75 + \left(\frac{22+24}{18}\right)2 = 17.85'$

$W_3 = W_2 + 9(2) = 17.85 + 18 = 35.85$

↳ see bottom sheet 8 for allowable flare of 1:1 for 9'

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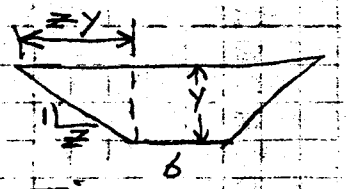
SUBJECT Warner Road Irrig Canal Outlet			SHEET 8 OF 9

Grouted Rock Drop (Cond)

Check Dimensions of Drop with trapezoidal section

$$Z = \frac{b}{2Y} = \frac{16}{3(4)} = \frac{16}{12} = 1.33$$



From Figure VI-12 for trapezoidal sections

$$\frac{L_j}{Y_1} = 200 \text{ @ } F_{r_1} = 5, \quad L_j = 200\left(\tfrac{1}{2}\right) = 100'$$

T.W. needed = 4.0'

T.W. actual = 1.7 + 3.0 = 4.7

The reverse circulation that occurs within the hydraulic jump of trapezoidal channel cross sections actually increases the amount of energy dissipation, however it prevents the formation of a stable jump and converts the downstream flow into an oscillating jet.

Therefore assume jump length for a rectangular section and design for enough freeboard within the grouted area to provide protection from waves and extend the outlet protection into the flood way.

Per Don Paulus

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19.4

Grouted Rock Drop Design

Check velocities exiting basin at STA 1+55 after flaring sides out on 45° exit width = 35.86' use 36'

Water depth = 1.7 FT

$V = \frac{Q}{A} = \frac{280}{1.7(36)+3(1.7)^2} = 4.0$ FT/sec - still too high

$3F_r = 3\left(\frac{4.0}{\sqrt{32.2\,(A)}}\right) = \frac{3(V)}{\sqrt{32.2\left(\frac{69.87}{4.2}\right)}} = \underline{2.8}$ - Ref #EC-14

Flare remaining section - from STA 1+55 to 1+73 on 2:1 flare - or 26.57°

V @ 1+73 $= \frac{280}{1.3(36+49)} = 4.0$ FT/sec with grouted rock riprap ending 4 FT beyond Floodway bottom toe.

Surround grouted rock riprap with 12 FT of gravel out beyond grouted rock riprap on all sides.

Flow length now becomes - 54 + 12 + 12 = 78'

V @ 1+85 $= \frac{280}{1.3(78')} = \underline{2.76}$ FT/sec okey -

Plan on 1 foot of gravel out 12 ft on all sides of grouted rock riprap.

WARNER ROAD TURNOUT STRUCTURE

Warner Road turnout structure

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12		RWCD REACH-5		
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Turnout Structure				

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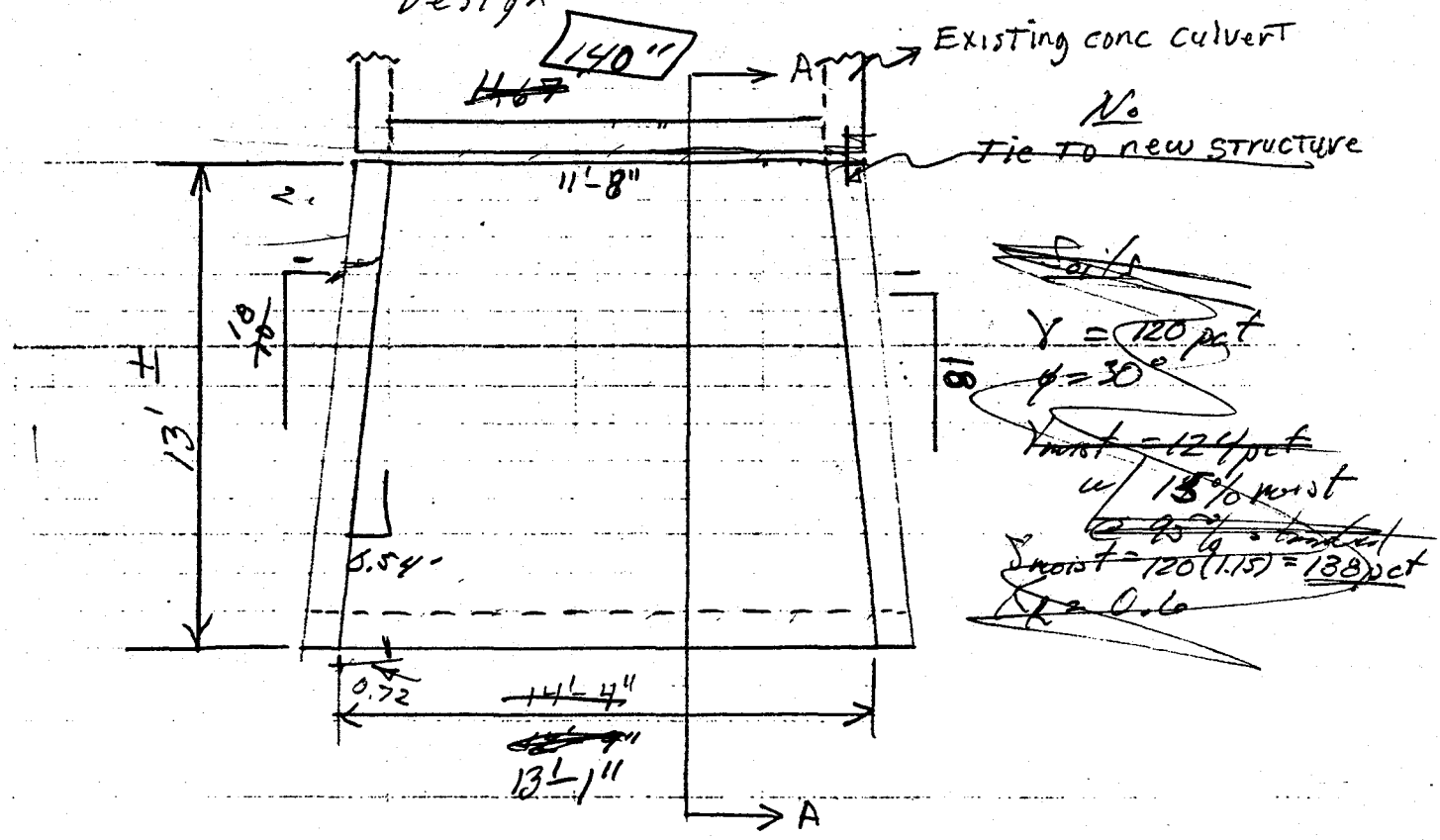
Pages	
2	Also See p 1 of 9 Worner Rd. Canal outlet for layout
3	1. Setup problem with given soil parameters
3-4	2. Cutoff at toe of structure and investigate floatation of Concrete Structure.
5-7	3. Design Retaining Walls
8	4. Design Slab
9	5. Design Cut-off
10-12	6. Steel Details
13	7. Check Need for Drain All
13-14	8. Re-Check on Slab to account for Uplift Pressures.
15	9. Tapered wall detail

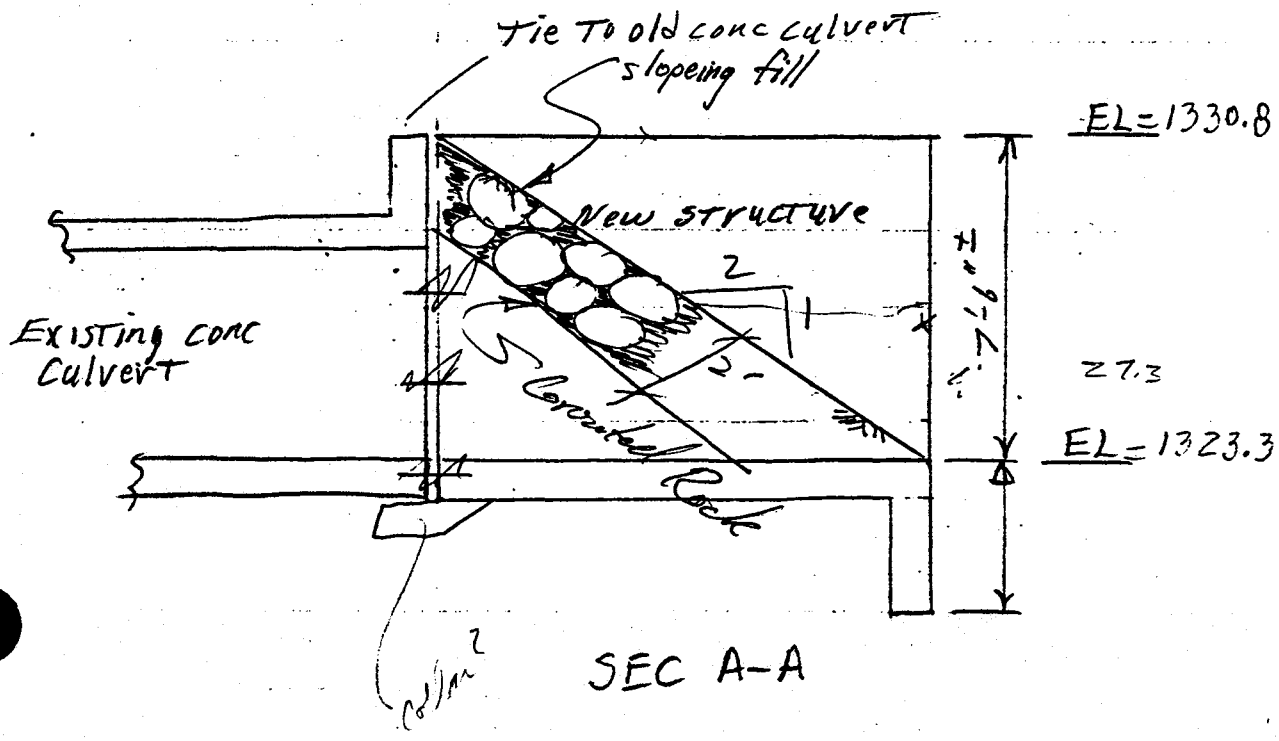
Arizona RWCD REACH 5

Tom Jayo 11-14-86

Warner Road Irrig Canal Outlet : sht 2 of 15

Design





SEC A-A

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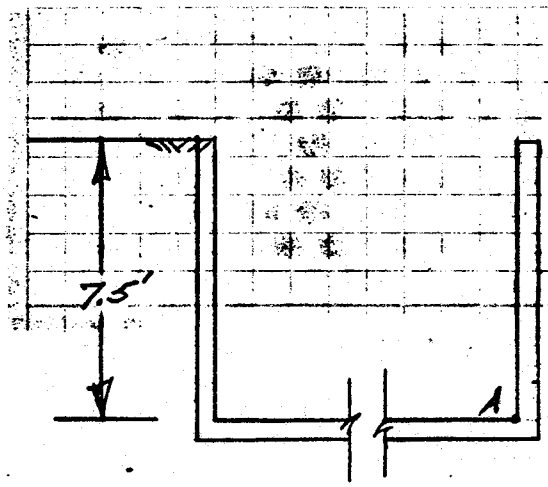


GIVEN:

- Sta. 436+00	- Sta. 384+00
$\gamma_d = 100$ pcf	$\gamma_d = 118.5$
$w = 21.5\%$ (opt.)	$w = 12.5\%$ (opt.)
$\phi = 31°$	$\phi = 35°$
$G_s = 2.63$	$G_s = 2.66$
$K_R = 0.58$	$K_R = 0.44$
$e = 0.641$	$e = 0.401$
$w_{sat.} = 24.4\%$	$w_{sat.} = 15.1\%$
$\gamma_{moist.} = 121.5$ pcf	$\gamma_{moist} = 133.3$ pcf

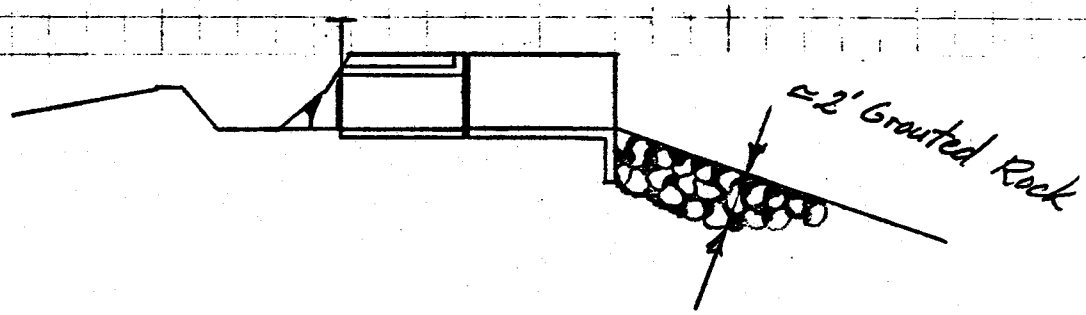
Cut-off at toe of wall.

Considerations:

a. May remain under moist conditions due to seepage through canal lining and gates.

b. Excavation @ toe of slab for the placement of grouted rock

c. Contraction and expansion of concrete may induce loads to Cut-off wall.



Response to a:

Uplift will be looked at with the possibility of using drainfill and outlets.

Response to b:

Need a minimum of 2.5' cutoff to avoid under mining the toe.

Response to c:

$\epsilon = 0.00055/100°F$ (Expansion Coef. for Concrete, AISC 8th. Ed., page 6-7)

$L = 13'$

Assume $\Delta T = 45°F$

$$\Delta L = 0.00055\left(\frac{45}{100}\right)13'(12''/ft) = \underline{0.039''}$$

$$\sigma = \epsilon E = \tfrac{1}{2}\left(\frac{0.039''}{13'(12'')}\right)57{,}000\sqrt{4000}$$

$= 446.1$ psi - stress due to temp. expansion of concrete.

∴ Construction joint at box culvert will allow the expansion of the concrete slab and also the Temp & Shrinkage steel will stabilize slab.

~ Token cutoff wall shall only need Temp & Shrinkage reinforcement.

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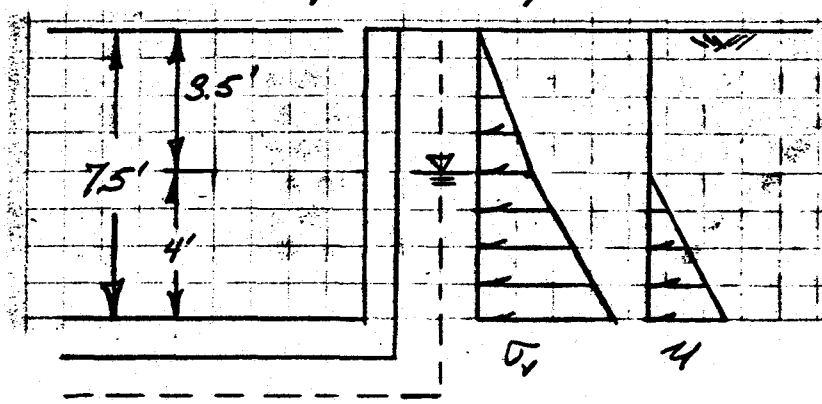
SUBJECT Turnout Structure				SHEET 5 OF 15

~ Design Retaining Wall



*Note: Will design for soil conditions at station 384+00
$\gamma_{moist.} = 133.5$ pcf
$K_R = 0.44$
$\gamma_{sat.} = 136.4$ pcf

@ 3.5' depth

$\sigma_v = 3.5(133.5) = 467.25$ psf

@ 7.5' depth

$\sigma_v = 467.25 + 4(136.4) = 1{,}012.85$ psf

Hydrostatic Pressure

@ 7.5' depth

$u = 4(62.4) = 249.6$ psf

~ Apply K_R factor

$\bar{\sigma}_v = \sigma_v - u = 763.25$ psf (@ 7.5' depth)

$\bar{\sigma}_h = K_R \bar{\sigma}_v = 0.44(763.25) = 335.8$ psf

@ 3.5' depth

$\bar{\sigma}_h = 0.44(467.25) = 205.6$ psf

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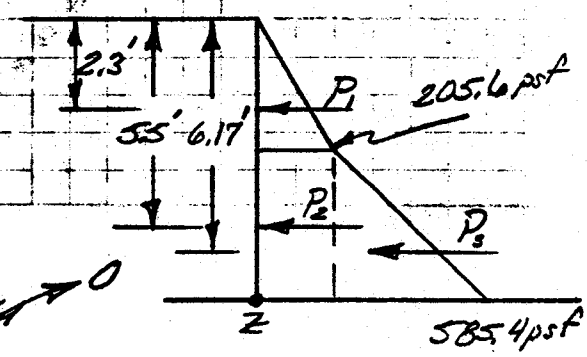
~ Design Press, (σ_h)

@ 0.0'

$\sigma_h = 0.0$ psf

@ 3.5'

$\sigma_h = \underline{205.6}$ psf + ~~74~~ → 0



@ 7.5'

$\sigma_h = 335.8 + 249.6 = \underline{585.4 \text{ psf}}$

$P_1 = \frac{1}{2}(205.6)\,3.5' = \underline{359.8 \text{ Lbs/ft}}$

$P_2 = 205.6(4') = \underline{822.4 \text{ Lbs/ft}}$

$P_3 = (585.4 - 205.6)\,4'\,(\frac{1}{2}) = \underline{759.6 \text{ Lb/ft}}$

M_z +)

$M_z = [-P_1(7.5-2.3) - P_2(7.5-5.5') - P_3(7.5-6.17)]$

$= 359.8(5.2) - 822.4(2') - 759.6(1.33')$

$= 4{,}526.0$ Lb-ft/ft

$= \underline{54.31 \text{ K-in/ft}}$

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i) $M_n = 1.8 M_z$

ii) $\phi M_u = M_n$

iii) $M_u = M_n / 0.9$

$$\therefore M_u = \frac{1.8 M_z}{0.9} = 2.0 M_z$$

$$\boxed{M_u = 108.6 \text{ K-in/ft}}$$

```
fy= 60.0ksi
f'c= 4.0ksi
mn= 108.60k-in./ft
d= 7.0in
0= as^2 -9.52as +2.46
as=0.27sq.in/ft
```

```
*-AS-*

fy= 40.0ksi
f'c= 4.0ksi
mn= 108.60k-in./ft
d= 8.0in
0= as^2 -16.33as +5.54
as=0.35sq.in/ft

fy= 40.0ksi
f'c= 4.0ksi
mn= 108.60k-in./ft
d= 7.5in
0= as^2 -15.31as +5.54
as=0.37sq.in/ft

fy= 40.0ksi
f'c= 4.0ksi
mn= 108.60k-in./ft
d= 7.0in
0= as^2 -14.29as +5.54
as=0.40sq.in/ft
```

USE:

- 10" Wall with

#5 @ 9" O.C. ($A_s = 0.41 in^2/ft$)

TEMP & SHRINK

$A_s = \rho b d = 0.002(10)12 = 0.24 in^2/ft$

USE #4 @ 9" O.C.

STATE AZ		PROJECT RWCD Reach-5		
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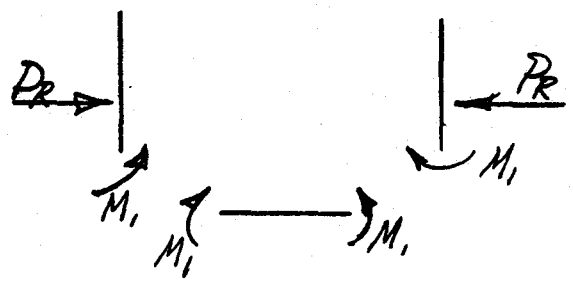
Design Slab (Monolithic with walls)

USE 12" slab thickness with
#5 @ 9" O.C.



*Note: Uplift is equal to zero.

Summary:

Normally the moment @ the ℄ would be decreased due to uplift pressures caused by walls deflecting inward and by saturated ground conditions.
~ Two assumptions were made:

1.) Wall deflections would be very small since wall height is small and strength in wall is twice that required.
2.) Moment constant along length of slab.

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Design Cut-off

Temp & Shrinkage

$A_s = \rho bd = 0.001(6)12 = 0.072 in^2/ft$

USE: #4 @ 18" O.C. ($A_s = 0.13 in^2/ft$)

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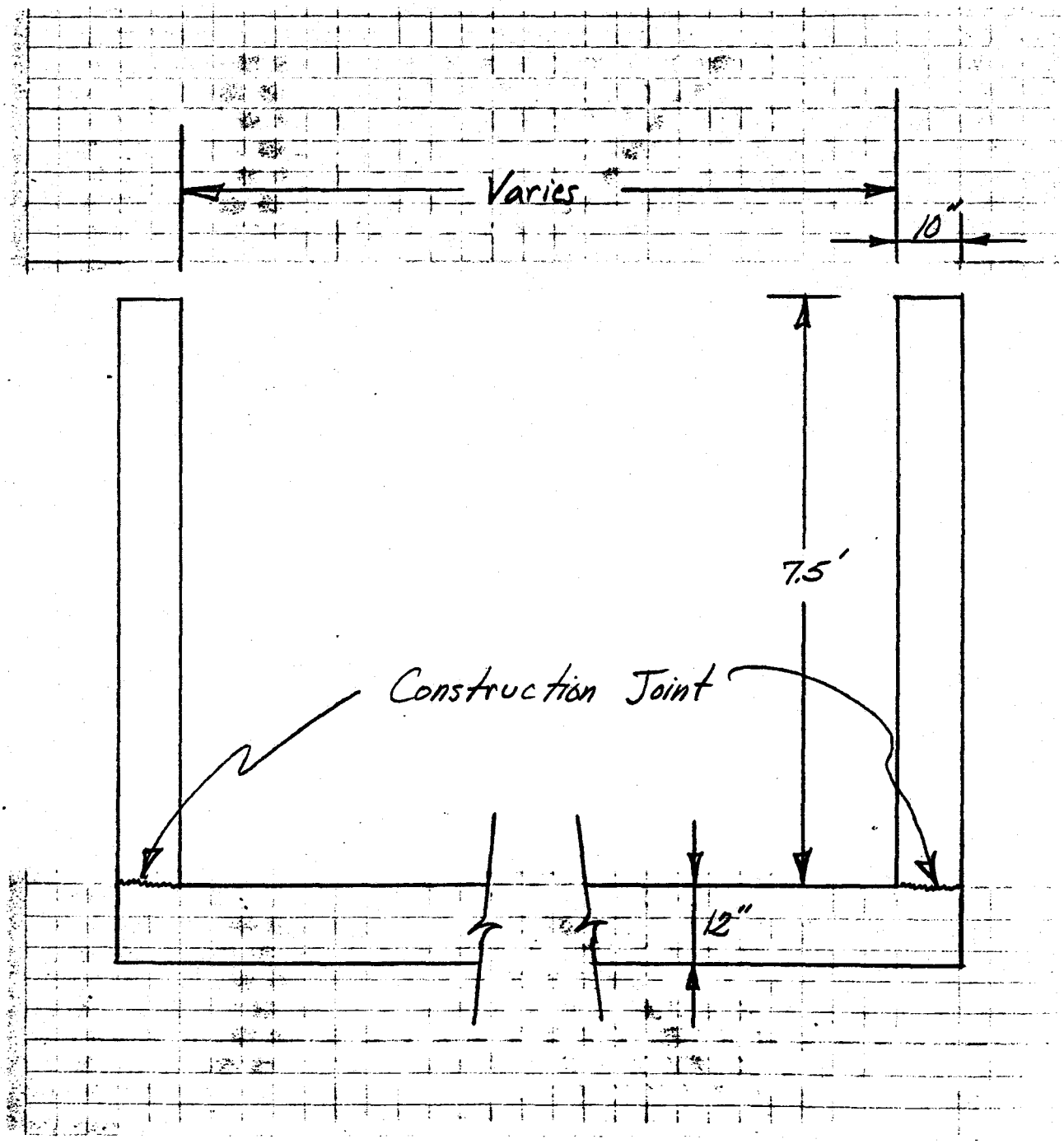
SUBJECT Turnout Str.				SHEET 10 OF 15



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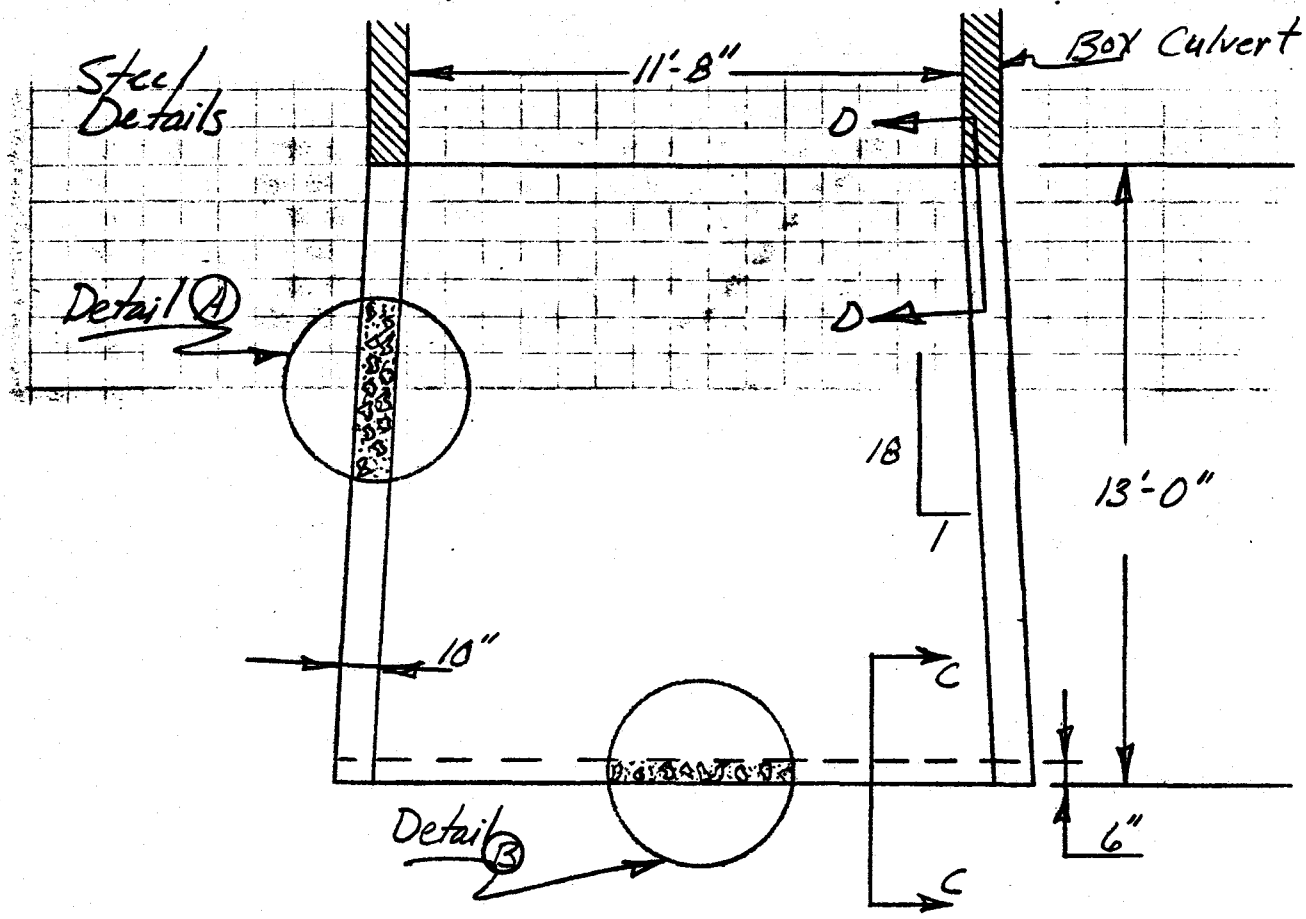
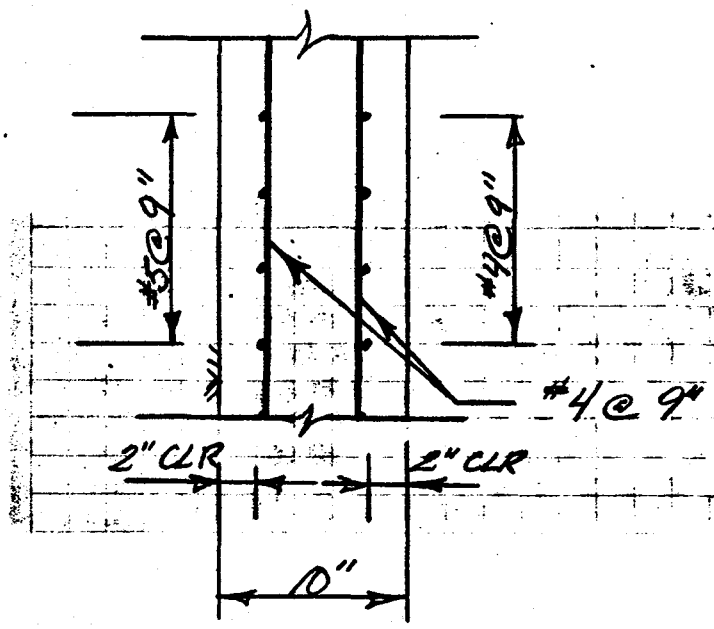
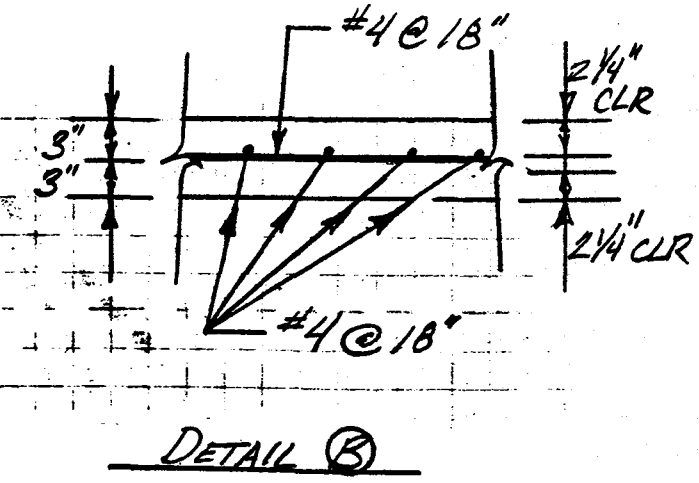




DETAIL (A)



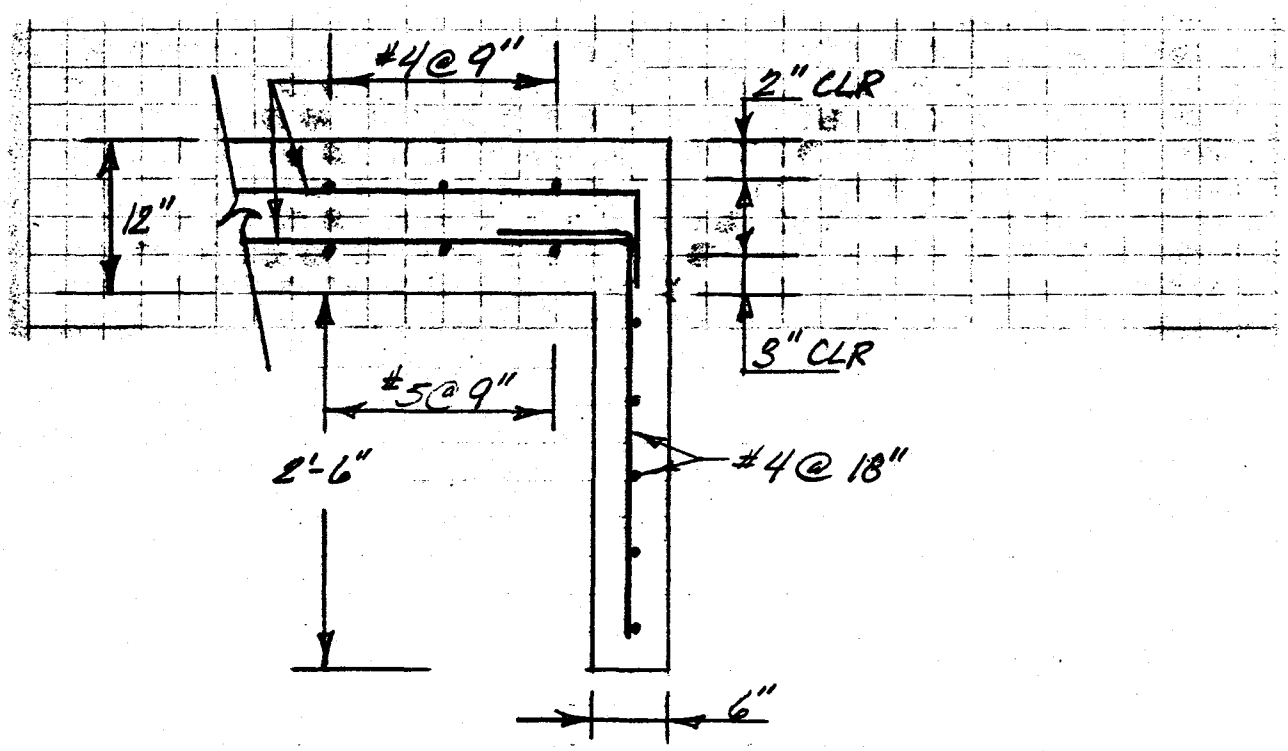
DETAIL (B)

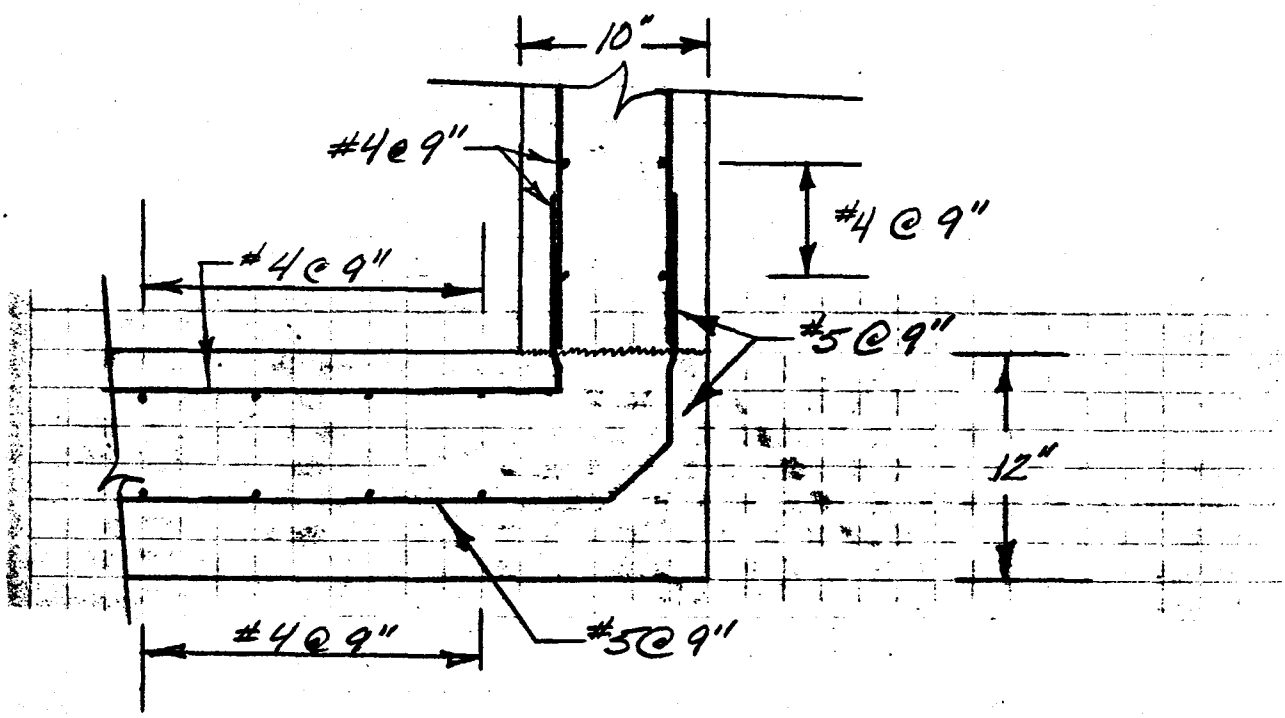
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY TCC	DATE 11-24-86	CHECKED BY DEP	DATE 12/86	JOB NO.
SUBJECT Turnout Str.				SHEET 12 OF 15

DETAIL C-C



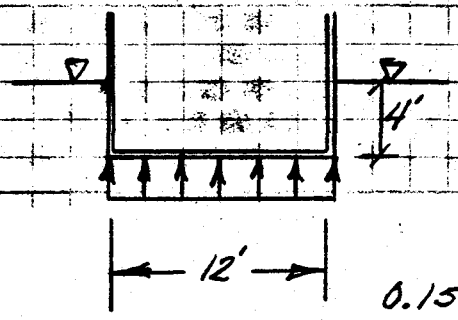


DETAIL D-D

STATE		PROJECT		
AZ		RWCD Reach-5		
BY	DATE	CHECKED BY	DATE	JOB NO.
ICC	11-25-96	DCS	12/96	
SUBJECT				SHEET 13 OF 15
Turnout Structure				

Check Need For Drains

*Refer to detail on pg. 6



~ uplift press = 4'(12') 62.4/1000
= 3K/ft width

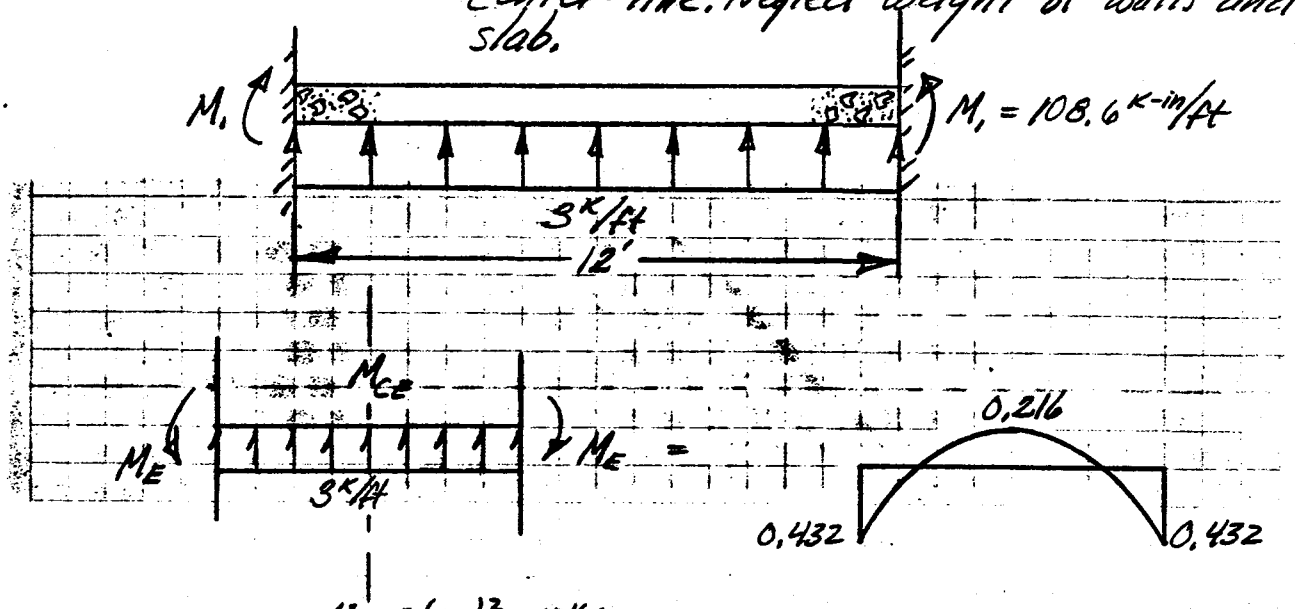
~ Wt. of Outlet Structure:

$0.150\left[12'(1') + \frac{10}{12}(7.5')2\right] = \underline{3.68\ K/ft}$ (Concrete)

∴ Wt. of structure exceeds uplift pressures. OK

~ Re-Check slab w/ Uplift

Problem: Find direction and magnitude of moment @ center-line. Neglect weight of walls and slab.



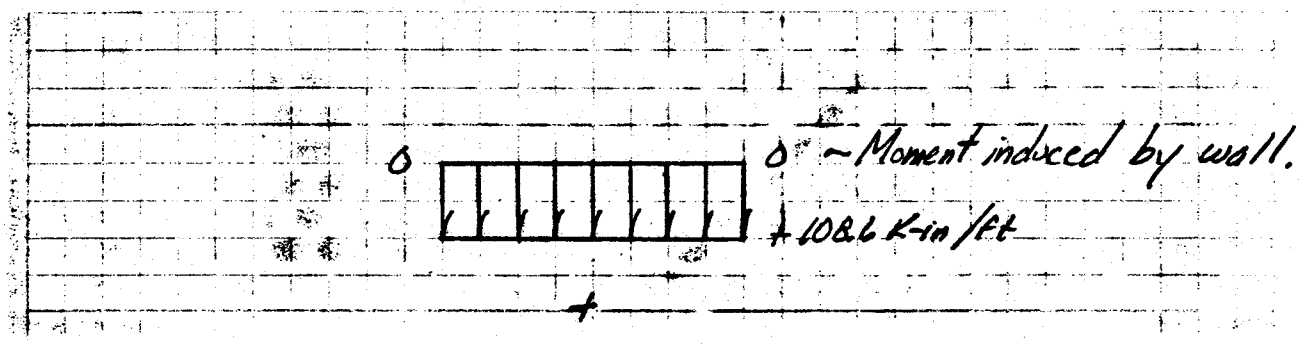
$$M_{CE} = \frac{wl^2}{24} = \frac{3(12)^2}{24} \times 12''/1000^K = 0.216\ K\text{-}in/ft$$

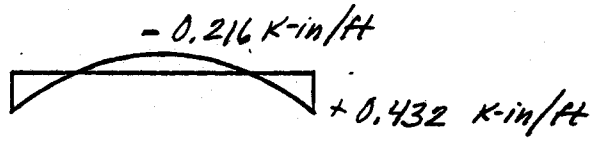
$$M_E = \frac{wl^2}{12} = \frac{3(12)^2}{12} \times 12''/1000^K = 0.432\ K\text{-}in/ft$$

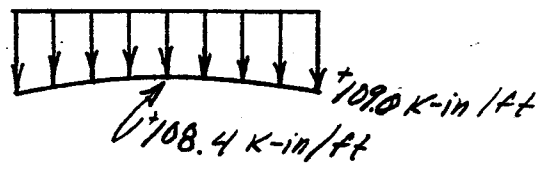
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE 11-25-86	CHECKED BY DSP	DATE 12186	JOB NO.
SUBJECT Turnout Structure				SHEET 14 OF 15







OK

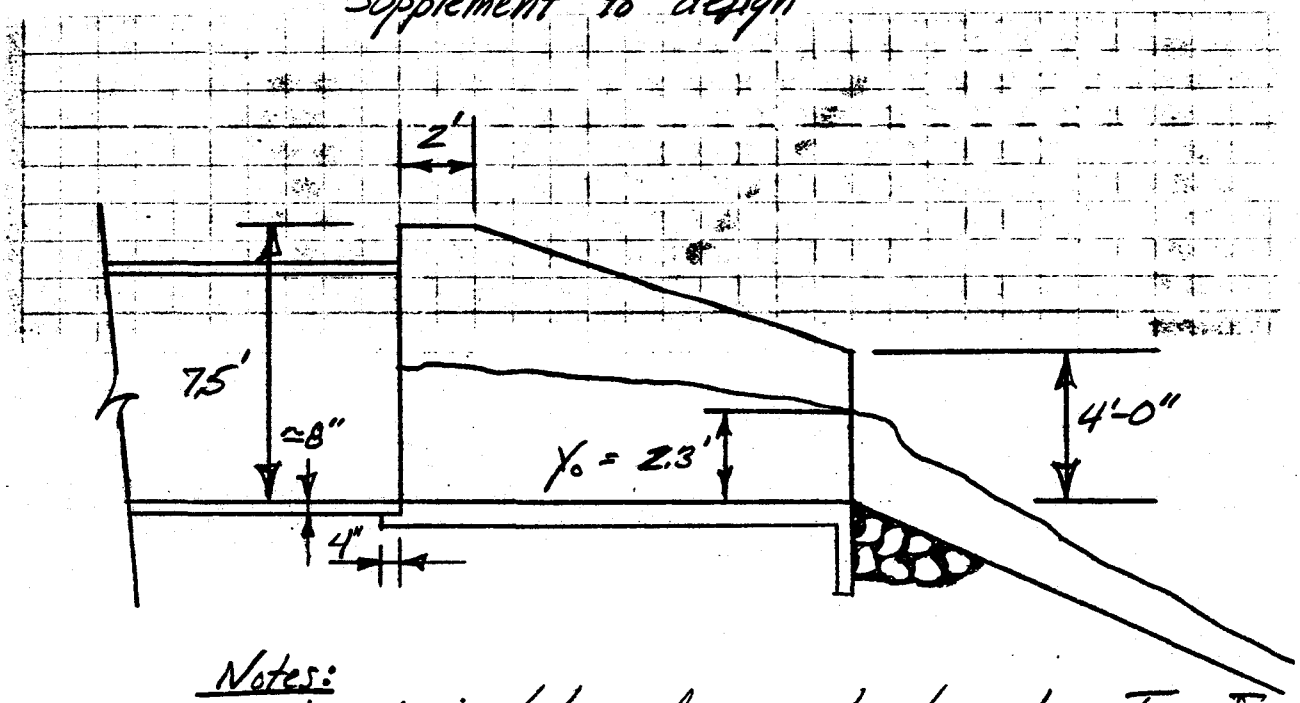
```
*-AS-*

fy= 40.0ksi
f'c= 4.0ksi
mn= 109.00k-in./ft
d= 7.0in
0= as↑2 -14.29as +5.56
as=0.40sq.in/ft
```

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE 12-2-86	CHECKED BY DJB	DATE 12/86	JOB NO.
SUBJECT Turnout Structure				SHEET 15 OF 15

Supplement to design



Notes:

1. Y_o is taken from work done by Tom Jaye on the Warner Road Irrig. Canal Outlet dated 11-17-86.

2. Slab is keyed under box culvert to further stabilize structure against uplift. Key will require no reinforcement.

COMPUTATION SHEET
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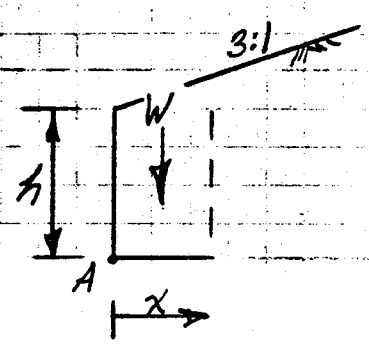
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE 7-14-87	CHECKED BY DGB	DATE 7/87	JOB NO.
SUBJECT Turnout structure				SHEET 1 OF 3

~ Design Wing Walls.



$\gamma_m = 133.5$ pcf
$K_R = 0.44$
$F = 1.32$

$P = \frac{1}{2} F K_R \gamma h^2 = 38.77 h^2$

$M = \frac{1}{6} K_R F \gamma h^3 = 12.92 h^3$

h	P(lb)	M(lb-ft)
4	620	827
3	349	349
2	155	103

Weight $= w \times h \times x \times \gamma$
$= 1' \times h \times x \times 133.5$
$= 133.5 h x$

$\Sigma M_A = 0 \circlearrowleft +$

$W(x/2) - P(h/3) = 0$

$133.5 h x (x/2) = P(h/3)$

$x^2 = P\left(\frac{h}{3}\right) 2 \left(\frac{1}{133.5 h}\right) = \frac{2P}{3(133.5)}$

$x^2 = \frac{2(38.77 h^2)}{3(133.5)} = 0.1936 h^2$

$\boxed{x = 0.44 h}$

h	x
4	1.76
3	1.32
2	0.88

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD R-5		
BY ICC	DATE 1-14-87	CHECKED BY DSB	DATE 1/87	JOB NO.
SUBJECT TURNOUT STRUCTURE				SHEET 2 OF 3

$$M_n = 2\,(827\ \text{lb-ft}) \times \frac{12}{1000} = \underline{\underline{19.85\ \text{K-in}}}$$

```
*-AS-*

fy= 40.0ksi
f'c= 4.0ksi
mn= 19.85k-in./ft
d= 3.0in
0= as^2 -6.12as +1.01
as=0.17sq.in/ft
```

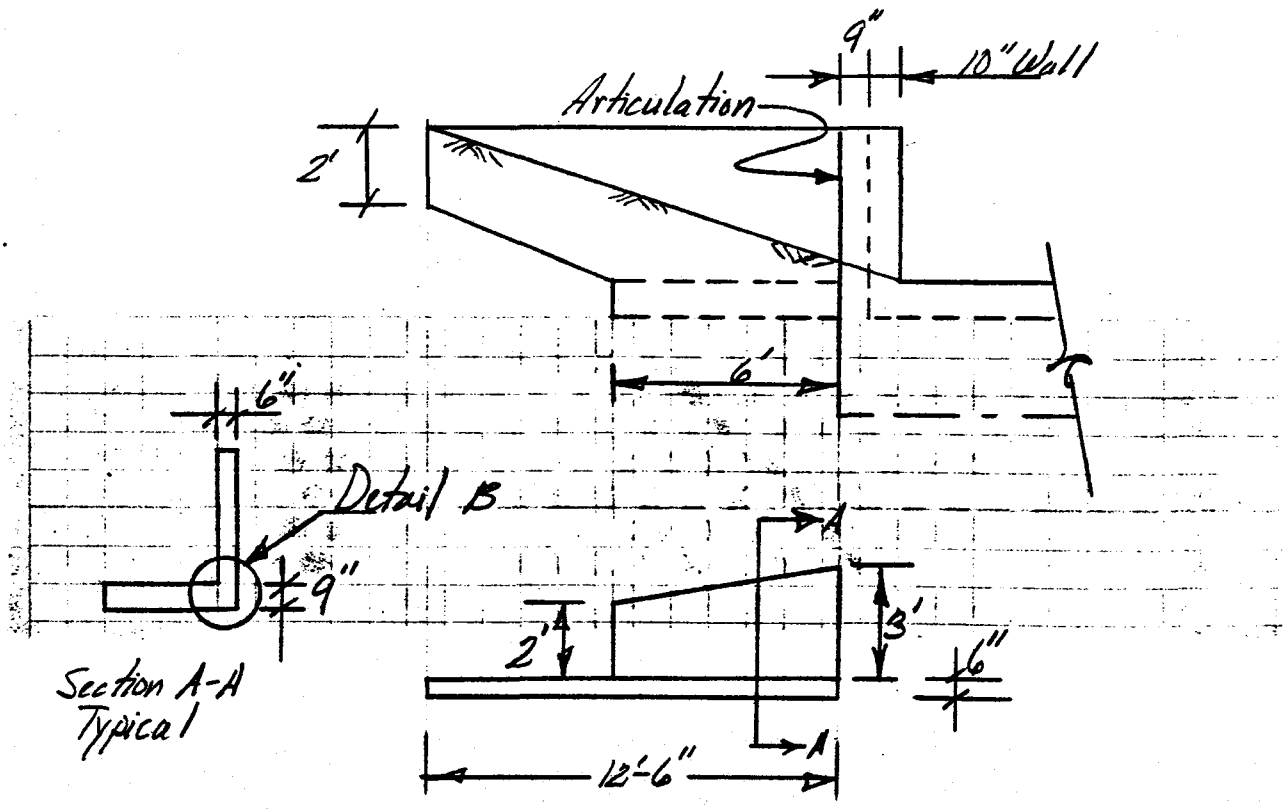
$A_s = 0.17\,in^2$

$\underline{\underline{\#4 @ 12''\ O.C.\quad (A_s = 0.20\,in^2)}}$

T & S

$A_s = \rho bd = 0.003(6)12 = \underline{\underline{0.22\,in^2}} \simeq 0.20\,in^2$

OK

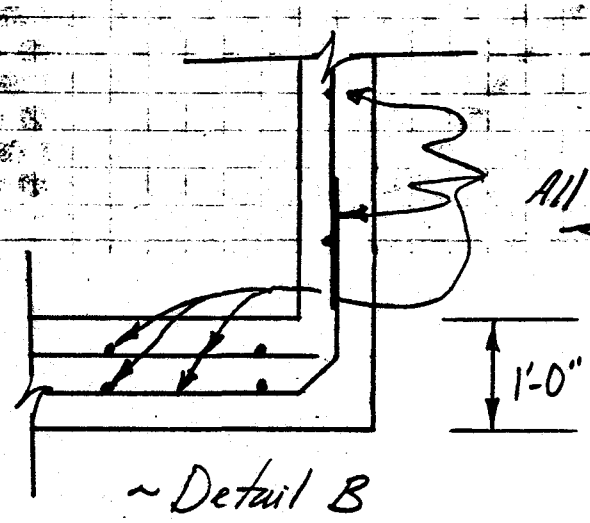


COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD R-5		
BY ICC	DATE 1-14-87	CHECKED BY DGP	DATE 1/87	JOB NO.
SUBJECT TURNOUT STRUCTURE				SHEET 3 OF 3

Steel Details



COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE 3-10-87	CHECKED BY	DATE	JOB NO.
SUBJECT Reinforced Concrete - Steel details				SHEET 1 OF 1

GIVEN:

$f_y = 60ksi$
$f'_c = 4ksi$

Class B

References:
1) ACI 318-83
2) NEN 6
3) Manual of Standard Practice - CRSI 23rd Ed.

Splice #5 - 19"
Splice #4 - 16"

90° Hook #5 - 10"
#4 - 8"

PIPE DESIGN 42" CMP

Pipe Design 42" CMP

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE 1-27-87	CHECKED BY DSF	DATE 2/87	JOB NO.
SUBJECT Design of 42"ϕ CMP at entrance to Leisure World.				SHEET 1 OF 5

Reference: Handbook of Steel Drainage & Highway Construction Products. Third Ed. 1983.

Pages 116-117

Given:

Pipe = 48"ϕ
LL = H20
γ = 120 pcf
Height of fill = 5'

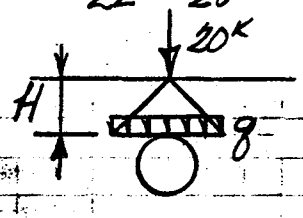
Find:

Wall thickness and type of corrugation

Solution:

1. 95% standard proctor.

2. DL = γh = 120 (5) = 600 psf
LL = 20K



$$q = \frac{P}{(1.75H)^2} \quad \text{(NEH-6, ES-25)}$$

$$= \frac{20{,}000}{(1.75(5))^2} = \underline{261.2 \text{ psf}}$$

$$P_v = DL + LL = 600 + 261 = \underline{861 \text{ psf}}$$

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
AZ		RWCD Reach-5		
BY ICC	DATE 2-3-87	CHECKED BY DB	DATE 2/87	JOB NO.
SUBJECT Design of 42" CMP				SHEET 2 OF 5

conti:

3. RING COMPRESSION

$C = P_v \times \frac{S}{2}$

$S = 42''/12 = 3.5'$

$C = 861 \times \frac{3.5}{2} = 1{,}507$ lb/ft

Can use:

i) 2 × 1/2
ii) 2-2/3 × 1/2
iii) 3 × 1

4. Allowable Wall stress:

$\phi = 3.5'$ & 95% standard & 2 2/3" × 1/2"

$f_c = \underline{26 ksi}$ from fig 3-6 on page 105.

5. Cross-sectional Area

$A = \frac{C}{f_c} = \frac{1507}{26{,}000} = \underline{0.06 \text{ in}^2/\text{ft}}$

From Table 3-2, specify thickness = 0.034 min.

(2 2/3 × 1/2 Corrugation + 0.034mm thickness = = 0.387 in²/ft of width)

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE 2-3-87	CHECKED BY DJP	DATE 2/87	JOB NO.
SUBJECT Design of 42" CMP				SHEET 3 OF 5

6. Handling Stiffness

$$FF = \frac{D^2}{EI} < 0.0433$$

$D = 42''$

$E = 30 \times 10^6$ psi
$I = 0.0112$ in^4/ft

$$FF = \frac{42^2}{30(10)^6(0.0112)} = 0.005 < 0.0433 \quad \underline{OK}$$

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCP Reach-5		
BY ICC	DATE 2-3-87	CHECKED BY DGP	DATE 2/87	JOB NO.
SUBJECT Design 42" CMP				SHEET 4 OF 5

Results come from Tech Note, W-22.

~ This program does not take into account the corrugations in the pipe, (i.e. the moment of inertia used here is smaller than it actually is).

∴ The computed deflection is conservative.

EXTERNAL
PIPE LOAD
AND
VERTICAL
DEFLECTION

```
 * INPUT DATA *
FILL DEPTH=5.00 FT
PIPE O.D.=42.000 IN.
SOIL UN.WT.=120.00 LB/CF
POINT LOAD=20,000.00 LBS
SOIL MOD.=1,000.00 PSI
E=30,000,000.00 PSI
WALL THIK.=0.0520 IN.
IMPACT FACT=1.20

 RESULTS AT 5.0 FT.
 TOP OF PIPE DEPTH
LL=1,401.38 LB/FT
DL=2,100.00 LB/FT
TL=3,501.38 LB/FT
V. DEF=0.60 IN.
% DEF=1.42%
```

```
 * INPUT DATA *
FILL DEPTH=2.00 FT
PIPE O.D.=42.000 IN.
SOIL UN.WT.=120.00 LB/CF
POINT LOAD=20,000.00 LBS
SOIL MOD.=1,000.00 PSI
E=30,000.00 PSI
WALL THIK.=0.0520 IN.
IMPACT FACT=1.20

 RESULTS AT 2.0 FT.
 TOP OF PIPE DEPTH
LL=6,776.63 LB/FT
DL=840.00 LB/FT
TL=7,616.63 LB/FT
V. DEF=1.30 IN.
% DEF=3.10%
```

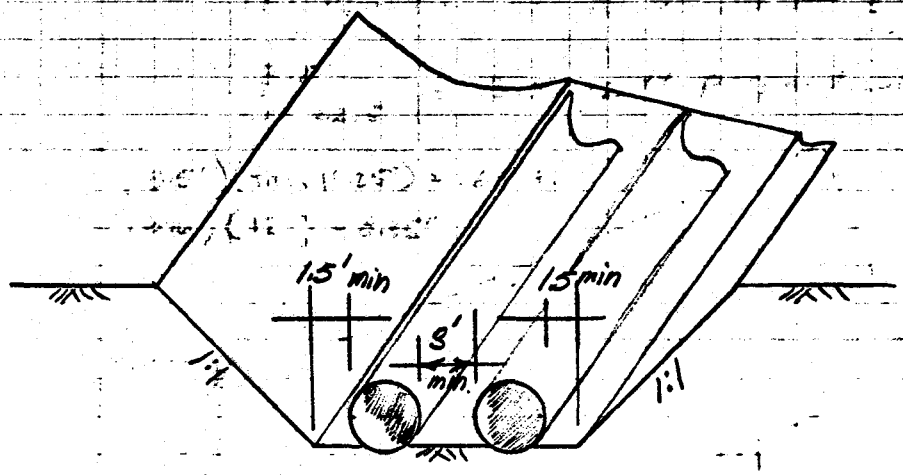
Conclusion:

By any method of design, the specified 42"ϕ × 2 2/3" × 1/2" CMP will be more than sufficient for its intended use.

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD Reach-5		
BY ICC	DATE	CHECKED BY	DATE 12/87	JOB NO.
SUBJECT Design of 42"ϕ CMP				SHEET 5 OF 5



Specs:

1) 95% Standard Proctor
2) USE same coating as spec'ed by Tom Jayo

TELEPHONE CONVERSATION

Project: RWCD Reach-5

Contact: Chuck - Representative for ARMCO-CMP

Date: 3-4-87 Time: 9:15AM

Caller Ilde Chavez

RE:

A. If it is possible to weld rebar onto the CMP.

B.

C.

D.

CONCLUSIONS:

He stated he could foresee no problems. He also said that any type of electrode could be used as long as the welder concentrated the heat of the rod on the rebar instead of the CMP.

ELLIOT ROAD SYPHON
(Installation Design)

Elliot Road Syphon
(Installation Design)

Arizona RWCD REACH 5

Tom Jayo 11-6-86 DP 11/86

ELLIOT RD SYPHON DESIGN (Installation Design) 1 7

Objective - 8'-7" x 6'-4" Sypon inlet box will have its west side excavated in order to install the 36 in syphon pipe. An analysis is needed to check the following:

1. Determine the amount of excavation needed on east side of box to resist overturning and sliding of the box

2. Determine the forces acting on the foundation and see if soils have enough bearing to resist settlement.

Procedure:

1. Area will be drained since floodway will be excavated prior to starting on syphon.

2. Earth loadings will be made for a moist condition and at rest.

3. It is assumed that box will tip at the west bottom of floor.

4. Using soil mechanics lab data for Direct Shear and Max dry density determine ϕ and max dry density. Judgement used for ave value since we do not have values at syphon site.

5. Determine Coefficient, K Fig 2.12 of Eng Design Stds for West States in order to compute P force acting by earth load against box.

6. Using Earth forces and box weight resisting earth forces determine overturning safety factor.

7. Check Sliding -

8. Check to see if soil beneath box will settle from Box loading + earth loading acting on east side of box.

A2 RWCD REACH 5

Tom Dayo 11-6-86 DSB 11/86

ELLIOT ROAD SYPHON DESIGN 2 7

Soils information - From Soil Mechanics Report - Lab Data

FLD Sample	STA #	Classification	Specific Gravity	Depth	ϕ
38.1	224+00	CL	2.69	4.5-5.5	21°
37.3	229+00	CL	2.65	9.0-10.5	30°
37.2	229+00	CH	2.68	6.0-7.0	25°
37.1	229+00	SC-SM	2.66	2.0-3.0	27°
33.1	262+00	CL	2.67	7.0-8.0	27.5°
31.4	281+00	CL-ML	2.65	8.0-8.5	23.5
31.3	281+00	ML	2.65	5.0-6.0	25.5°
28.1	299+00	CL	2.65	2.0-3.0	27.5°
28.1	299+00	CL	2.65	2.0-3.0	22.5°
22.2	342+00	CL	2.65	8.0-9.0	23.5° ✓
20.1	354+30	CL	2.66	8.0-9.0	24.0° ✓
19.1	360+00	CL	2.67	8.0-9.0	33.5 ✓
18.3	366+00	CL	2.66	4.0-5.0	24.5
15.1	384+00	CL	2.66	9.0-10.0	34.5 ✓
15.2	384+00	CL	2.65	6.0-7.0	36
15.1	384+00	CL	2.63	3.0-4.0	31.5
10.1	414+00	SC	2.64	6.0-7.0	26.5 ✓
10.1	414+00	CL	2.65	3.0-4.0	37.5
7.2	436+00	CL	2.64	6.0-7.0	32
7.1	436+00	CL	2.63	2.0-3.0	30.5

Use $\phi = 30°$ for design purposes -

Compaction - information

FLD Sample	STA	classification	Depth	Max Dry Density	OPT Moisture	Field moist
29.2	293+00	CL	7 to 10	107.5	19 ✓	
30.1	287+00	CL	2-4	118.0	13	
30.2	287+00	CL	6-10	112.0	15.5	
31.1	291+00	CL-ML	3-6	117.5	12.5	
31.2	281+00	CL	9-11	109.5	16.6	
35.1	250+00	CL	8.5-10	104.0	19.5 ✓	
36.2	244+00	CL	3-5	115.5	13.5	
40.2	213+00	SM	8-12	126.5	9.0 ✓	

See sheet 2A

Use 120 lb/ft³ max dry density

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		RWCD REACH 5		
BY Tom Jayo	DATE 11-18-86	CHECKED BY DSB	DATE 11/86	JOB NO.
SUBJECT Soils Information - From Soil Mechanics Report				SHEET 2A OF 7

LAB DATA

FLD Sample	STA		% Nat Moisture
40.1	213+00	4-8	2.9
40.2	213+00	8-12	1.3
38.1	224+00	4.5-5.5	2.69
37.3	224+00	9-10.5	2.65
37.2	229+00	6-7	2.66
37.1	229+00	2-3	2.66
36.2	244+00	3-5	2.8
35.1	250+00	8.5-10	3.6
32.1	275+00	2.5-5	2.8
31.2	281+00	9-11	9.9
31.1	281+00	3-6	5.4
30.2	287+00	6'-10'	11.8
30.1	287+00	2'-4'	12.8
29.2	293+00	7'-10'	16.9
29.1	293+00	3'-6'	3.0
28.3	299+00	7'-10'	14.1 ✓
28.2	299+00	3'-5'	13.6
26.4	310+00	7'-10'	16.6
26.3	310+00	5'-5.5'	4.7
26.2	310+00	3'-5'	9.5
26.1	310+00	2'-3'	5.6
25.1	317+00	6'-7'	8.8
23.1	336+00	7'-10'	13.0
22.1	342+00	8'-10'	16.0 ✓
21.1	348+00	10'-11.5'	5.1
18.2	366+00	7'-9'	5.0
18.1	366+00	2'-4'	7.0
15.4	384+00	11'-12'	9.7
15.3	384+00	9'-10'	18.8 ✓
15.2	384+00	6'-7'	12.5
15.1	384+00	3'-4'	13.7
14.2	390+00	3'-5'	8.2
14.1	390+00	1'-2.5'	5.2
11.1	408+00	1'-3'	3.6
10.4	414+00	7'-10'	5.1
10.1	414+00	3'-6'	6.8
9.1	420+00	10'-12'	5.7
8.4	428+29	9'-11	5.9
8.3	428+29	8'-9'	11.0
8.2	428+29	6'-7'	4.5
8.1	428+29	4'-5'	10.2
7.3	436+00	0'-1'	4.5

FLD Sample No	STA		% Nat. Moisture
3.4	462+73	9'-10'	7.2
3.3	462+73	7'-8'	3.4
3.2	462+73	5'-6'	11.1
1.4	478+38	11.5-13	4.1
1.3	478+38	10.5-11.5	8.4
1.2	478+38	8'-10'	5.4
1.1	478+38	5'-6'	7.1

Ave = $\frac{364.98}{49}$ = 7.45 %

Max = 18.8 % ✓

next high = 16 %

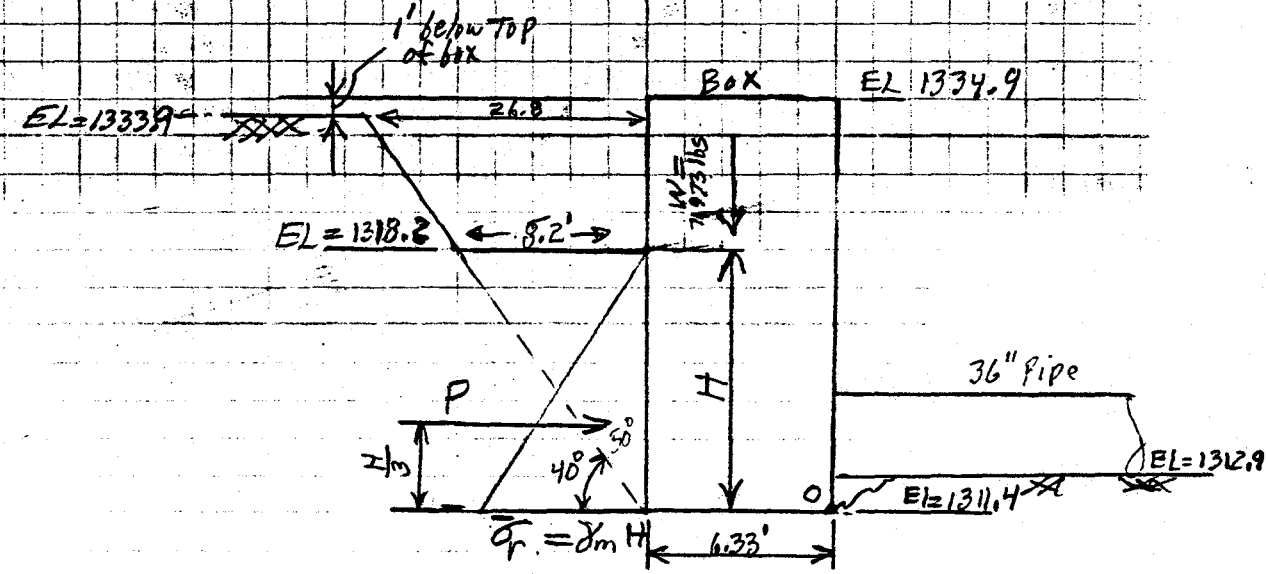
next high = 14.1 %

Arizona RWCD REACH 5
Tom Dayo 11-6-86 DSP 11/86
ELLIOT ROAD SYPHON DESIGN 3 7

Determine K from Fig 2.12 Eng Design STDS (Far West States)

For $\theta = 30°$, and at rest condition,

$K = 0.6$



Assume 15% moisture present in in place soil and 90% compaction
max dry density = 120 lb/FT³ ±

$\gamma_m = 0.90(120)(1.15) = 124.2$ lb/FT³

$\gamma_m H = 124.2(22.5 - 15.7) = 844.6$ lb/FT²

$P = \frac{K \gamma_m H^2}{2} = \frac{0.6(124.2)(6.8)^2}{2} = 1723$ lbs/FT

$\frac{H}{3} = \frac{6.8}{3} = 2.27$ FT

$M_o = 1723(2.27) = 3905$ lb-FT/FT

Arizona RWCD REACH 5
Tom Joyo 11-6-86 DB 11/86
ELLIOT RD SYPHON DESIGN 4 7

Box size = 8'-7" x 6'-4" ~ Area = 54.31 FT^2

Box vol = $\left[8.58(2) + \overset{\text{walls}}{5(2)}\right] \frac{8}{12}(23.5) + \overset{\text{Floor}}{8.58(6.33)(1)} = 479.82 \text{ FT}^3$

WT = 479.82(150) = 71,972.71 lbs.

lbs/ft^2 on bottom of box = $\frac{71,972.71}{54.31}$ = 1325.22 lb/FT^2

WT/1 FT width = 6.33(1325.22) = 8,388.64 lbs

$M_o = 8388.64\left(\frac{6.33}{2}\right) = 26,550.05$ lb/FT per FT

Safety factor against overturning = S

$$S = \frac{26,550}{3905} = \underline{\underline{6.8}}$$

No advantage was taken of friction of the in place soil along the sides of the box. Also the west side of the box on north side of pipe trench will have a rectangular section of soil that resists overturning. (See sketch) Sheet 8

Check Sliding.

Box cannot slide since there will be a section of soil on west side of box over 6' high and 2.42 wide that will prevent sliding. Box will want to rotate clockwise but soil on south side of box at bottom 11 feet will prevent this. Therefore box is safe from sliding. see sketch sheet 8.

5,67

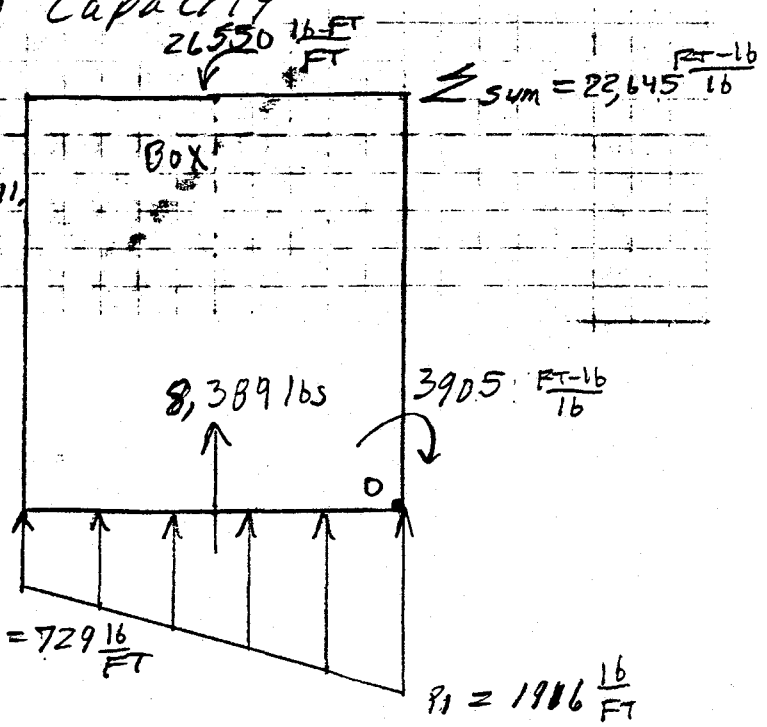
Check Soil Bearing

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-19-86	CHECKED BY DS	DATE 11/86	JOB NO.
SUBJECT ELLIOT RD SYPHON DESIGN				SHEET 5 OF 7

Check on Soil Bearing Capacity



Use

$P_{1,2} = \frac{V}{A}\left(1 \pm 6\frac{e}{J}\right)$ P-4.12 of NEH 11

$P_1 = \frac{8389}{6.33}\left(1 + \frac{6(e)}{6.33}\right)$

$a = \frac{\Sigma M_o}{\Sigma F_v} = \frac{22645}{8389} = 2.7$

$e = \frac{\ell}{2} - a = \frac{6.33}{2} - 2.7 = 0.47$

$P_1 = \frac{8389}{6.33}\left(1 + \frac{6(0.47)}{6.33}\right) = 1916 \frac{lb}{FT}$

$P_2 = \frac{8389}{6.33}\left(1 - \frac{6(0.47)}{6.33}\right) = 729 \frac{lb}{FT}$

Allowable soil bearing pressure = $2000 lb/FT^2 > 1916 \frac{lb}{FT^2}$ ok
(assuming Soft Clay)

COMPUTATION SHEET
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SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	RWCD REACH 5		
BY Tom Dayo / DATE 11-19-86	CHECKED BY DR	DATE 11/86	JOB NO.
SUBJECT ELLIOT ROAD SYPHON DESIGN			SHEET 6 OF 7

NOTE Sheets 6 & 7 used to work from allowable bearing to get value of H. They are not needed once H has been determined. This method was used to save on trial & error calc.

Work from allowable bearing capacity = 2000 lb/FT² for soft clay with some moisture

Assume resultant vertical force = V acts in middle third of base say 2.7 FT in from west side.

WT of box provides 1,325 lb/FT² unit wt on base

Use $P_{1,2} = \frac{V}{A}\left(1 \pm \frac{6e}{d}\right)$ Page 4.12 of NEH - Sec 11

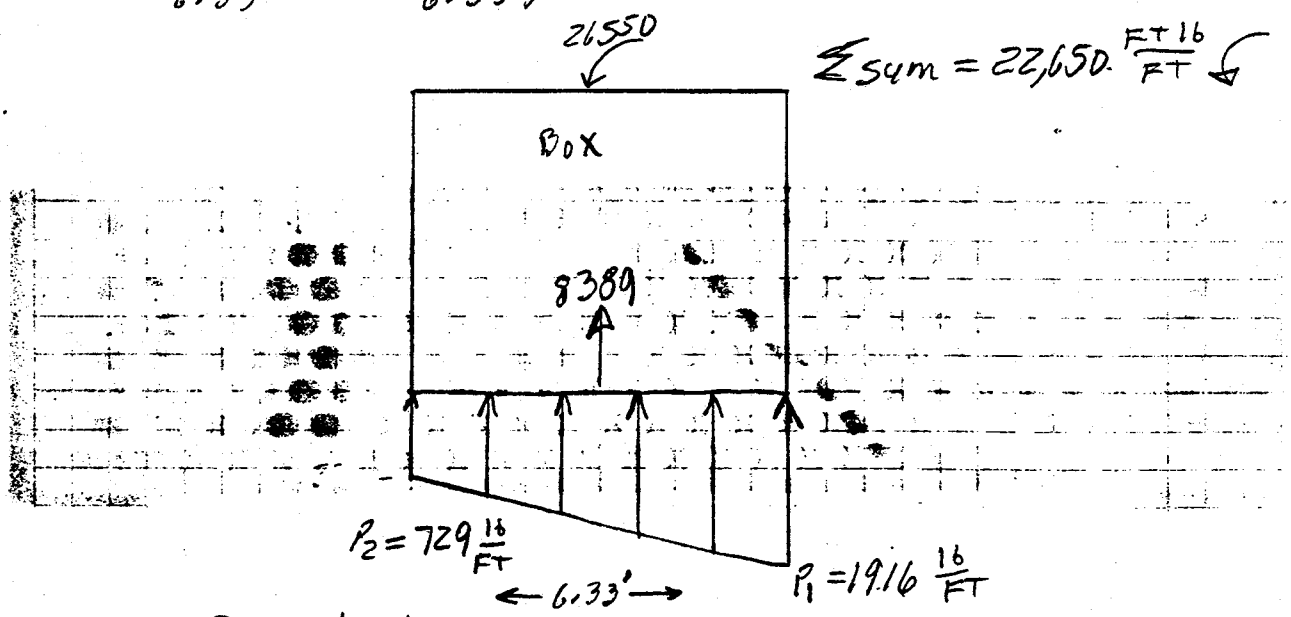
$e = \frac{l}{2} - a =$

$= \frac{l}{2} - 2.7 = \frac{6.33}{2} - 2.7 = 0.47$

$a = \frac{\Sigma M_0}{\Sigma F_V} = \frac{\Sigma M_0}{8389}$, $\Sigma M_0 = a(8389) = 2.7\,(8389) = 22{,}650 \frac{FT\,lb}{FT}$

$P_1 = \frac{8389}{6.33}\left(1 + \frac{6(0.47)}{6.33}\right) = 1916 \frac{lb}{FT}$

$P_2 = \frac{8389}{6.33}\left(1 - \frac{6(0.47)}{6.33}\right) = 729 \frac{lb}{FT}$



Moment from backfill on east side of box =

$= 26550 - 22{,}650 = 3900 \cdot \frac{FT\text{-}lb}{FT}$ allowable to keep foundation pressures within limits.

COMPUTATION SHEET
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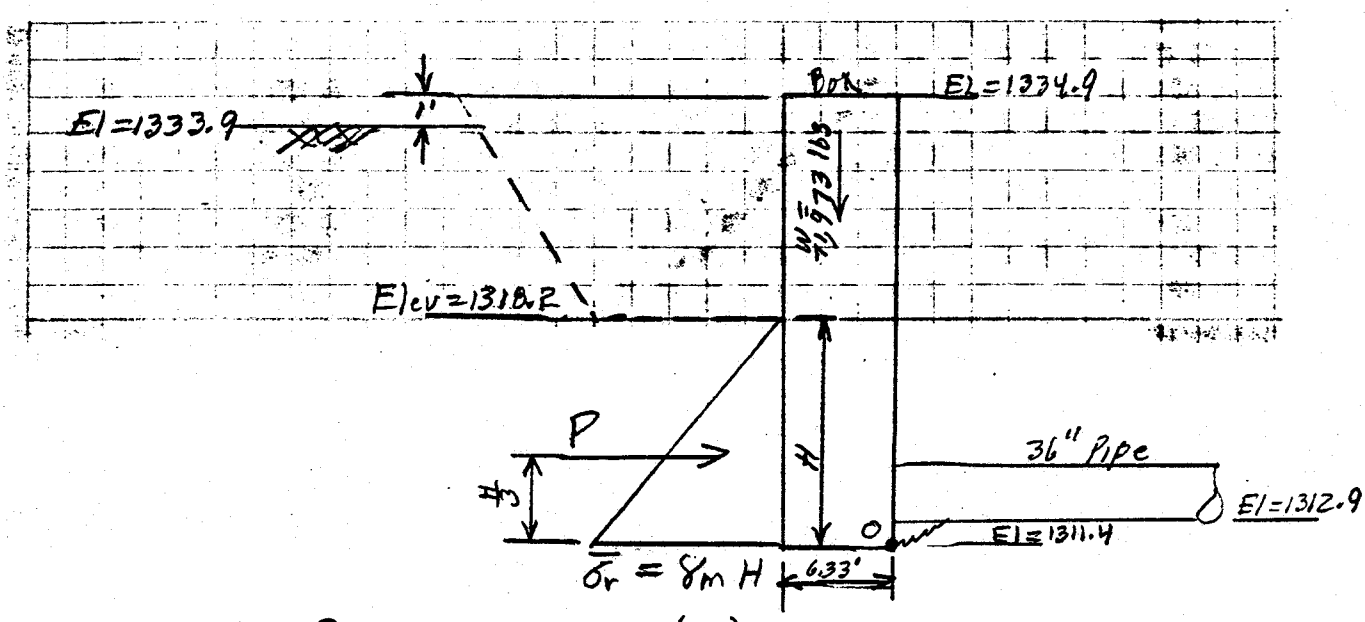
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-19-86	CHECKED BY	DATE 11/86	JOB NO.
SUBJECT ELLIOT ROAD SYPHON DESIGN				SHEET 7 OF 7



M_o caused by $P = 3900 = P\left(\frac{H}{3}\right)$

$$P = \frac{K \gamma_m H^2}{2} = \frac{0.6(124.2)(H)^2}{2} = 37.26 H^2$$

$PH = 11,700$,

$H = \frac{11,700}{P}$,

Subst. $P = 37.26(H)^2 = 37.26\left(\frac{11,700}{P}\right)^2 = \frac{(37.26)(136,890,000)}{P^2}$

$P^3 = 5,100,521,400$

$P = 1721$ lbs/FT

$H = \frac{11,700}{P} = \frac{11,700}{1721} = 6.8$ FT

ELLIOT ROAD SYPHON
(Pipe Design)

Elliot Road Syphon
(Pipe Design)

COMPUTATION SHEET
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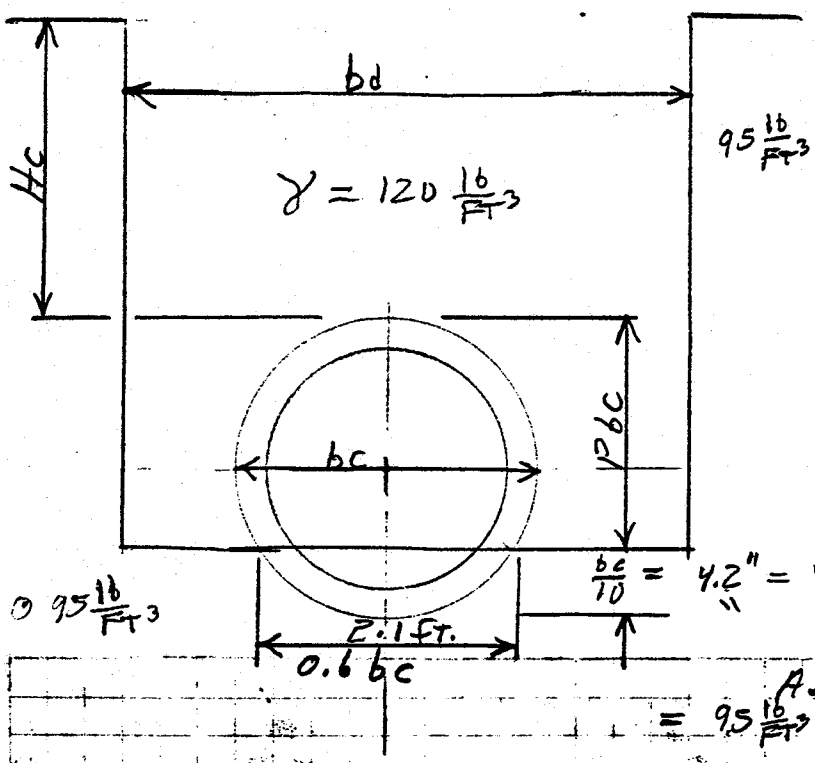
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
AZ		RWCD REACH 5		
BY Tom Jayo	DATE 10-30-86	CHECKED BY JSB	DATE 11-13-86	JOB NO.
SUBJECT ELLIOT SYPHON DESIGN (Pipe Design)				SHEET 1 OF 7

Given: trench condition - top of pipe
Fill = 1331.2 - 1316.1 = 15.1 ft. max Fill -
pipe size predetermined by FCD & others. = 36"
Use Technical Release 5 ~ SCS

Find: type pipe to use
strength pipe required -



bc = 42" assume 3" wall thickness
bd = 78" ~ 18" each side of pipe - Compacti
Hc = 15.1 max
Pbc = 37.8 in

$P = \frac{Pbc}{bc} = \frac{37.8}{42} = 0.90$

$\psi = \frac{\psi bc}{bc} = \frac{4.2}{42} = 0.1$

$\frac{bc}{10} = 4.2" = \psi bc$ Per page 3-73 for class C ordinary bedding ~ TR-5

$= 95 \frac{lb}{ft^3}$ Assume foundation material & back fill material = $= \gamma = 120$ lb/ft³

$\phi = 30°$

type C - ordinary bedding
Lf = 1.5
See sheet 3-73
except back fill with compacted earth instead of fine granular material.

From table ES 114 page 3-43 & $\phi = 30°$

$K = 0.33$, $\mu = 0.577$

$K\mu = 0.19$

S = safety factor = 1 for R/C pipe

COMPUTATION SHEET
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STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Joyce	DATE 11-3-86	CHECKED BY DSP	DATE 11-18-86	JOB NO.
SUBJECT ELLIOT SYPHON DESIGN.				SHEET 2 OF 7

Follow procedure in ES-113 page 3-37

Find δ - From ES-115 page 3-47 case c applies since the material is very deep

$b = b_c = 3.5$ FT (ES 114, Page 3-41)

$\frac{K\mu}{K_f \mu_f} = 1$ assume ϕ for back fill & foundation equal

$\frac{\gamma_f}{\gamma} = \frac{95}{120} = 0.79$

$\left[\frac{\gamma_f}{\gamma} \cdot \frac{E}{E_f}\right] = 1$ since this parameter does not greatly affect the value of δ page 3-42 ~ TR-5

$$\delta = \frac{1 + \left[\frac{\gamma_f}{\gamma} \frac{E}{E_f}\right] \frac{\psi}{P}}{1 + \left[\frac{\gamma_f}{\gamma} \frac{E}{E_f}\right] \frac{K\mu}{K_f \mu_f}} = \frac{1 + 1\left(\frac{0.1}{0.9}\right)}{1 + 1(1)} = 0.56$$

Check whether classification is ditch conduit using (ES-117, page 3-59)

$\frac{H_c}{b_c} = \frac{1331.2 - 1316.1}{3.5} = 4.31$, $2K\mu \frac{H_c}{b_c} = 2(0.19)(4.31) = 1.64$

$\delta P = 0.56(0.9) = 0.5$, $2K\mu\delta P = 2(0.19)(0.5) = 0.19$

$\frac{b_d}{b_c} = \frac{6.5}{3.5} = 1.86$

$\frac{b_d'}{b_c} = 2.11$

$1.86 < 2.11$

Since $\frac{b_d}{b_c} < \frac{b_d'}{b_c}$, the conduit is classed as a ditch conduit

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-3-86	CHECKED BY DJ	DATE 11-18-86	JOB NO.
SUBJECT ELLIOT SYPHON DESIGN				SHEET 3 OF 7

Obtain C_d from ES-118, page 3-61

$\frac{H_c}{b_d} = \frac{15.1}{6.5} = 2.32$, $K_H = 0.19$

$C_d = 1.55$

$L_f = 1.5$ from ES 120, page 3-73. Type C

Solve for $w_c = C_d \gamma b_d^2 = 1.55(120)(6.5)^2 = 7858.5$ lbs/ft.

Let $w_c = R_d$. Solve for R_{eb} required

$R_{eb} = \frac{S R_d}{L_f} = \frac{4)(7858.5)}{1.5} = 5239$ lbs/ft (For R./c Pipe)

$R_{eb} = \frac{1.5(7858.5)}{1.5} = 7858.5$ lbs/ft (for other types of pipes)

From ES-119 pages 3-67

Class IV pipe with wall B is required - OD = 3.667 FT
with $R_{eb} = 6000$ lbs/ft > 5239

Class III will not work - $R_{eb} = 4050$ lbs/FT < 5239

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-3-86	CHECKED BY DEP	DATE 11/86	JOB NO.
SUBJECT ELLIOT SYPHON DESIGN				SHEET 4 OF 7

Check using American Conc. Pipe Association, dated Mar 1968

trench conduit – $W_d = C_d W (B_d)^2$ where

W_d = backfill load lbs/FT
C_d = load coeff. for trench cond.
W = unit wt. of matl. = 120 lb/FT³ (assumed)
B_d = trench width = 78" for 36" pipe
H = backfill above pipe = 15.1 FT

For $\frac{H}{B_d} = \frac{15.1}{6.5} = 2.32$, & $K\mu = K\mu' = 0.13$

From Table 1

$C_d = 1.75$

$W_d = 1.75(120)(6.5)^2 = 8872.5$ lbs → backfill load

Live load – insignificant for $H > 12'$ ∴ ≈ 100 lbs ±

impact factor = 0

TOTAL Load = 8872 lbs – use Load factor = 1.5

The required 0.01-inch crack D-load strength $= \frac{8872}{3(1.5)} = 1971$ lb/FT

Use C-76 Class IV pipe with D-load = 2000 lb/FT

COMPUTATION SHEET
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SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD REACH 5		
BY Tom Joyo	DATE 11-4-86	CHECKED BY DB	DATE 11/86	JOB NO.
SUBJECT ELLIOT RD- SYPHON DESIGN				SHEET 5 OF 7

Check Design for lowest fill + live load-

Fill = 1320.4 − 1316.1 = 4.3 Feet
remaining items same as sheet 1

$b_c = 42'' = 3.5'$
$b_d = 78'' = 6.5'$
$H_c = 4.3$ FT.

$\gamma = 120$ lb/FT^3
$\phi = 30°$

$P_{bc} = 37.8$ in
$P = \frac{P_{bc}}{b_c} = \frac{37.8}{42} = 0.9$

$\psi = \frac{\psi b_c}{b_c} = \frac{4.2}{42} = 0.1$

$K = 0.33$, $\mu = 0.577$
$K\mu = 0.19$
$S = 1$ for R/C pipe

Check whether classification is ditch conduit using (ES-117, page 3-59)

$\frac{H_c}{b_c} = \frac{4.3}{3.5} = 1.23$, $2K\mu \frac{H_c}{b_c} = 2(0.19)(1.23) = 0.47$

$\delta P = 0.56(0.9) = 0.5$, $2K\mu\delta P = 2(0.19)(0.5) = 0.19$

$\frac{b_d}{b_c} = \frac{6.5}{3.5} = 1.86$

$\frac{b_d'}{b_c} = 1.45$

Since $\frac{b_d}{b_c} > \frac{b_d'}{b_c}$, the conduit is classed as a positive projecting conduit-

Subclassify - ES-117, sheet 1

$\frac{H_e}{b_c} = 1.48 > \frac{H_c}{b_c}$ 1.23 there for we have complete condition

Find - C_p from ES-118 sheet 2

$$C_p = \frac{e^{2K\mu(H_c/b_c)} - 1}{2K\mu} = \frac{e^{0.47} - 1}{0.38} = 1.58$$

COMPUTATION SHEET
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-4-86	CHECKED BY DJ	DATE 11/86	JOB NO.
SUBJECT ELLIOT RD SYPHON DESIGN				SHEET 6 OF 7

X_p from ES-120 sheet 4 of 5, $= 0.840$

T from ES-121 $= P X_a \left[\frac{H_c}{b_c} + \frac{P}{2}\right] = 0.9(0.66)\left[1.23 + \frac{0.9}{2}\right] = 1$

X_a from ES 120 $= 0.66$

$T = 1$

Solve for $F_{sr} = C_p X_p - KT$

$F_{sr} = 1.58(0.84) - 0.33(1) = 1.0$

Select Pipe, ES-119.

Try C-76- class III

$SYF_{sp} = 473.1$ for wall A-

$F_{sp} = \frac{473.1}{1(120)} = 3.94 > F_{sr} > 1$ ∴ ok

$SYF_{sr} = 1(120)(1) = 120$

A class II pipe is okey with $SYF_{sp} = 350.4$ considering earth load only-

Check Live Load - using EngTech Note 1-

using std DWG NO. 7-2-23069 sht 15 of 15

$P = 0.48 \frac{P b_c}{Z^2} = 0.48 \frac{(20{,}000)(3.5)}{(4.3)^2} = 1817$ lb/FT

divide by bedding factor $= 1.5$

$\frac{1817}{1.5} = 1211$ lb/FT

$R_{eb} = \frac{SYF_{sp}(b_c)^2}{1.431} = \frac{1(120)(1)(3.5)^2}{1.431} = 1028$ lb/FT

Total dead + live load $= 1211 + 1028 = 2239$ lb/FT

Class II has $R_{eb} = 3000$ lbs/FT > 2239 ∴ okey for center portion of syphon

COMPUTATION SHEET
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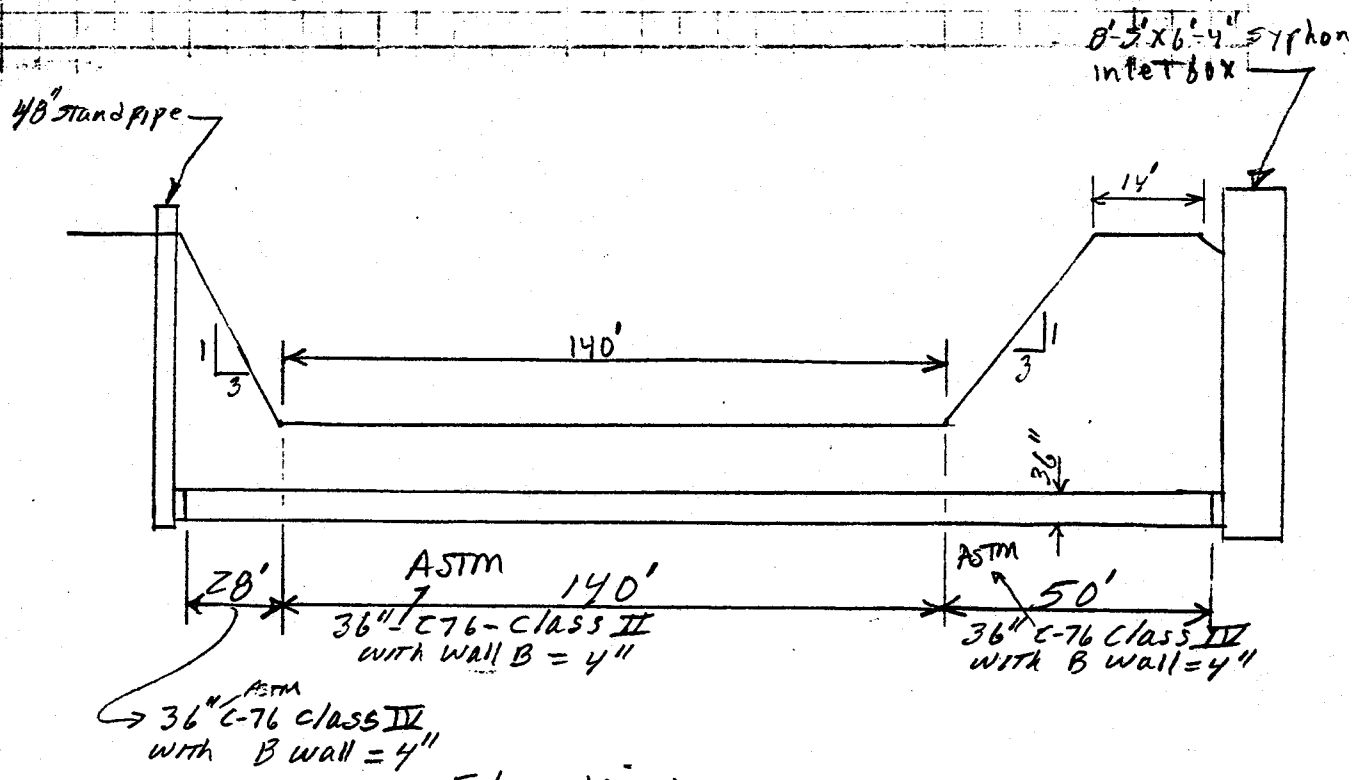
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Dayo	DATE 11-4-86	CHECKED BY DSB	DATE 11/86	JOB NO.
SUBJECT ELLIOT RD SYPHON DESIGN				SHEET 7 OF 7

Summary - A R/C pipe - C-76 class IV will be required to withstand the higher fills at 0 & m roads at both ends of pipe.



Elev. View
looking upstream -

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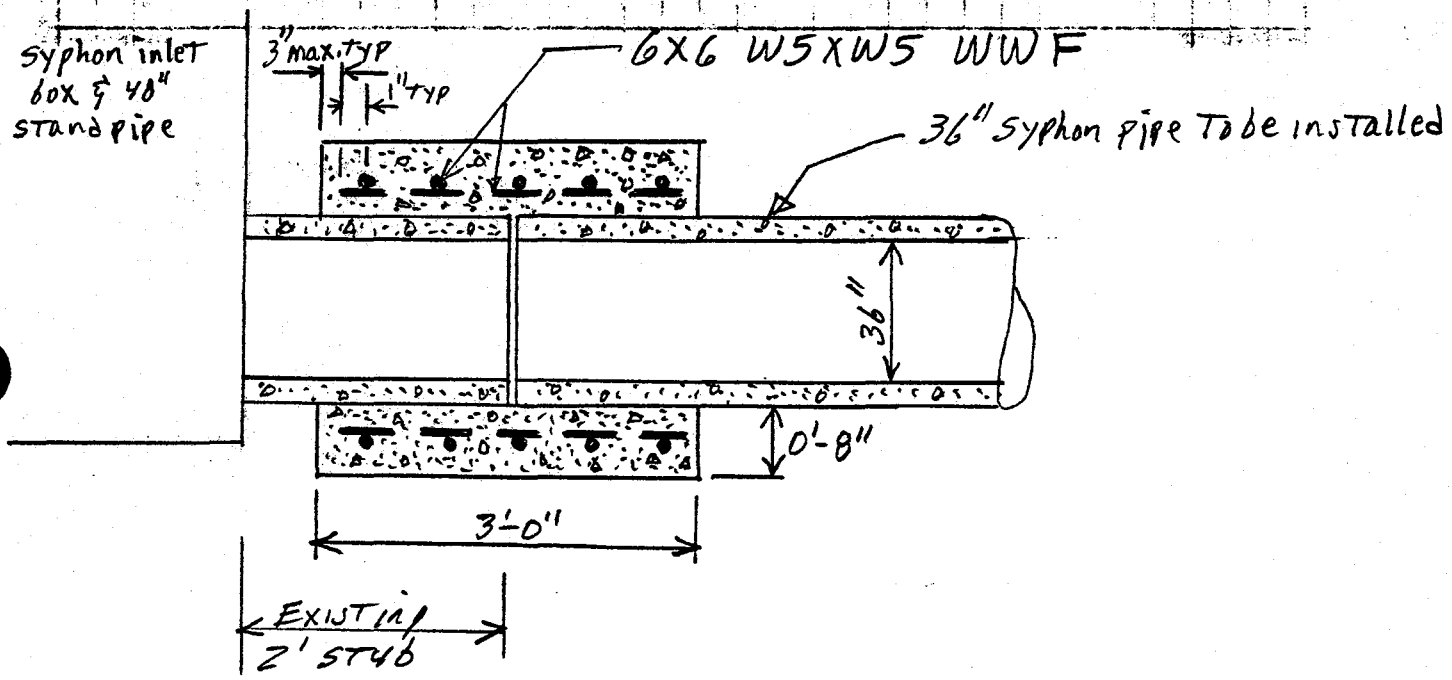
SOIL CONSERVATION SERVICE

STATE #2		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 11-19-86	CHECKED BY	DATE	JOB NO.
SUBJECT ELLIOT ROAD SYPHON DESIGN-				SHEET 1 OF 1

Connection Design - existing 2FT STUB TO proposed 36 in syphon -

Assume both protruding ends at present are bell ends will need minimum of 1 collar and possibly 2 if new pipe does not match existing pipe manufacturer.



CONCRETE PIPE COLLAR

Specifications

1. The diameter of the circular ties shall be the outside diameter of the pipe plus 8 inches.
2. Concrete collars shall be finished smooth and flush with the inside surface of the pipe
3. All concrete shall be 2500 PSI at 28 days.

Note - Set Plans up for 2 collars one at each end of syphon

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SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 3-9-87	CHECKED BY	DATE	JOB NO.
SUBJECT Elliot Road Syphon				SHEET 1 OF

1. Check internal pressure of C-76 Class IV pipe-

I called Mervil at Hydro Conduit on 3-9-87 and asked him what the C-76 pipe was designed for on internal pressure.

He said it was designed for 25 feet of gravity head. Its not suppose to leak at 25 feet of head.

Since Elliot road syphon system will be operating under 20 feet ± of head it should be satisfactory

Tom Jayo

2. Checked 48" manhole wall thickness on west side of Flood way.

Danny at Smith Pre Cast said all 48" manholes are 5 inches thick. This is pretty much std. for the industry. Therefore we will go with 5" in spec.

Tom Jayo

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Changed To 18"

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SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD - REACH 5		
BY Tom Jayo	DATE 11-18-86	CHECKED BY DJ	DATE 11/86	JOB NO.
SUBJECT ELLIOT ROAD - Design of ~~24"~~ RC Pipe				SHEET 1 OF

out of 8'-7" x 6'-4" Syphon Inlet Box (overflow Pipe)

Elliot Rd Bridge ℄ elev = 1336.1 (east end)
" " " shoulder elev. = 1335.6
O&M Road elev. = 1331.2
top of 8x6 syphon box elev = 1334.9

Given: invert elev = 1326.9
pipe size = 24 in
cover - use 3' min

Fillover pipe to elev 1332.2 or 1' above embankment elev.

Embankment will be built then trench will be excavated

Using Technical Note Eng No 1 dated Jan 16, 1974
For $\xi = 0.7$, $b_c = 1.13d$
$\gamma = 120$ lb/ft³ S = Safety factor = 1 per TR-5 page 3-42 ES-114 (For R/C pipe only)

From STD DWG No 7-L-23070 Sht 11 of 12 for cohesive soils and Type C bedding

External Crush load = 450 lbs/ft

Live Load
Using STD DWG No 7-L-23069 sheet 11 of 15 for 3 ft of cover & 15,000 lb point load possible during construction,
Live Load = 2100 lbs/ft

Convert to three-edge bearing by dividing by bedding factor

$$= \frac{2100}{1.5} = 1400 \text{ lbs/ft}$$

TOTAL External load = 1400 + 450 = 1850 lbs/ft
Try 24" C-76 class II pipe
max loading for Class II for 0.01" crack = 2000 lbs/ft

$$\text{Safety factor} = \frac{2000}{1850} = 1.08 > 1.0 \text{ allowed}$$

per TR-5 page 3-42 for C-76 reinforced concrete pipe -

OK - Use 24" C-76 class II pipe

Re route O&M road around east side of 8x6 syphon box since there is not enough room on west side for road.

COMPUTATION SHEET
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SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT RWCD REACH 5		
BY Tom Jayo	DATE 2-20-87	CHECKED BY	DATE	JOB NO.
SUBJECT 18" Syphon Overflow Pipe -				SHEET 1 OF

Readjustment of Dimensions & slope due to 2.5 to 1 to 3 to 1 transition through area.

℄ STA 18" syphon overflow = 382+27.06

℄ STA Elliot Road Syphon = 382+30.56

℄ STA ℄ Elliot Road = 382+30.56 − 54.0 = 381+76.56

STA START of slope transition
South side of bridge = 381+76.56 + 25.0 = 382+01.56

Length START of transition to ℄ 18" syphon overflow

$$= \begin{array}{r} 382+27.06 \\ -\ 382+01.56 \\ \hline 25.50 \text{ FT} \end{array}$$

overall transition change = 11.75(3) − 11.75(2.5) = 5.88 FT

change per foot = $\frac{5.88}{50}$ = 0.1175 FT/FT

change in 24.5 FT = 0.1175(24.5) = 2.8788 FT

Length from channel toe to berm = 35.25 − 2.88 = 32.37 FT
(left side)

$$\text{slope} = \frac{32.37}{11.75} = 2.75 \text{ to } 1$$

New Pipe Length (18" overflow)

Toe channel to inlet toe X = 35.25 + 16.6 (per orig drg.) = 51.85

New horiz slope dist. = 2.75(11.75) = 32.31

New Berm dist = 51.85 − 32.31 = 19.5 FT

Slope dist − $y = 9.341 - \frac{x}{2.75}$ → EQU-1

$y = -0.01646X$ → EQU-2 (based on 0.4' drop in 24.3 orig length)

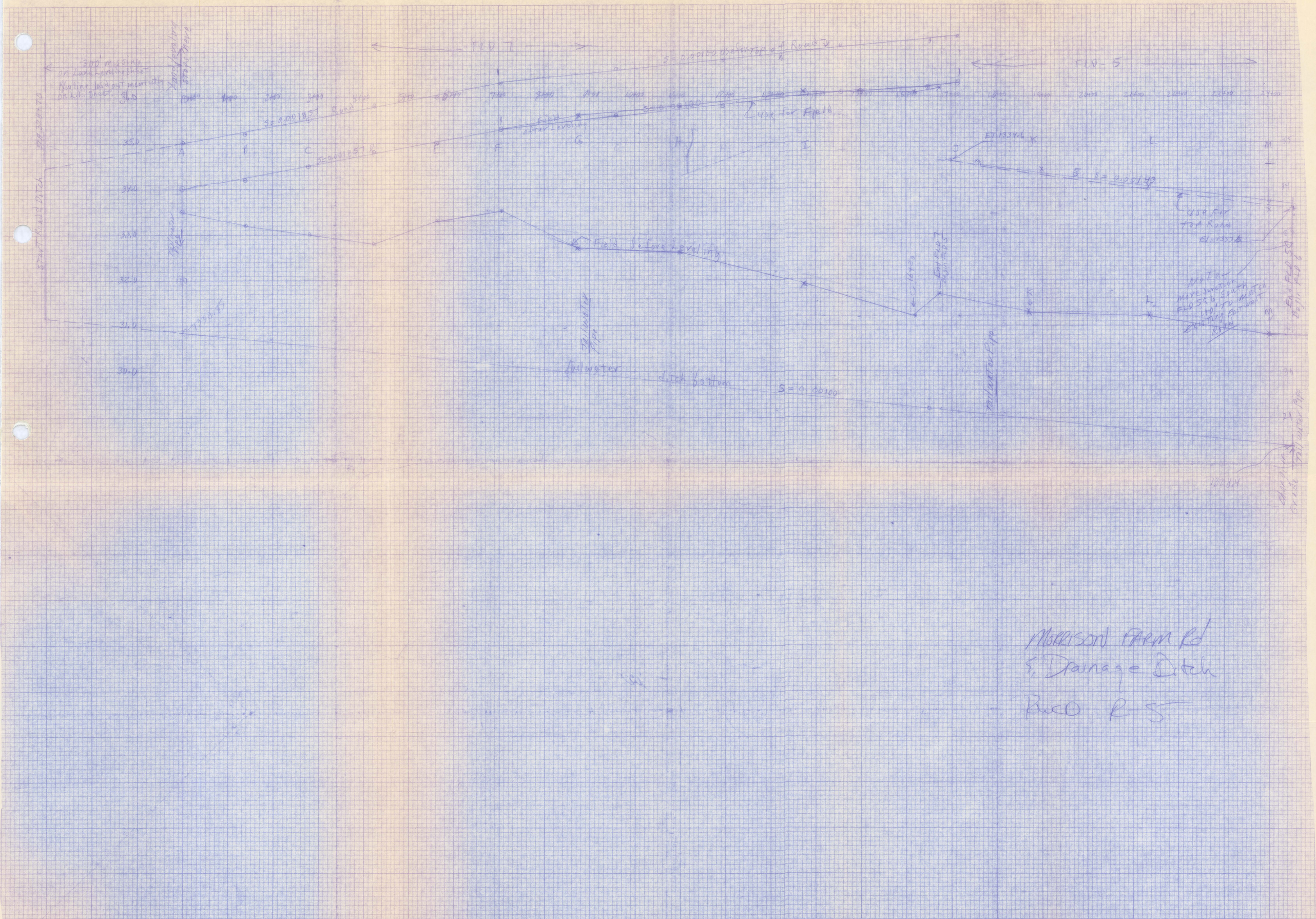
Solving for X − X = 26.9 FT

26.9 − 19.5 = 7.4' length along slope −

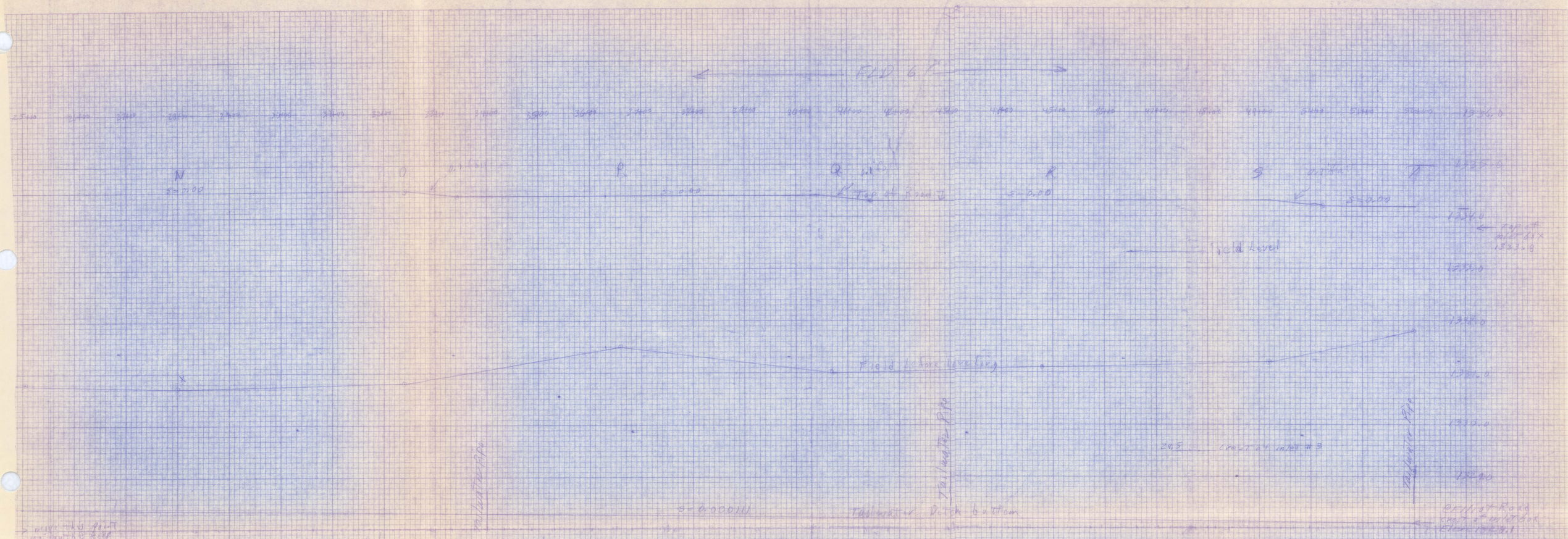
TOTAL Pipe Length = 26.9 FT use 27'-6" to allow pipe to enter existing box 8"

Landleveling

LANDLEVELING



"PERFECT" CROSS SECTION
10 X 10 = ONE INCH
EUGENE DIETZGEN CO.
PRINTED IN U.S.A.



RWCD REACH 5
Morrison Farm Road
& Tailwater Ditch Design
between Grandview Rd & Elliott Rd
3-10-87 TJD

CONSTRUCTION SPECIFICATION

2. CLEARING AND GRUBBING

1. SCOPE

The work shall consist of the clearing and grubbing of designated areas by removal and disposal of trees, snags, logs, stumps, shrubs and rubbish.

2. MARKING

The limits of the areas to be cleared and grubbed will be marked by means of stakes, flags, tree markings or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

3. REMOVAL

All trees not marked for preservation and all snags, logs, brush, stumps, shrubs and rubbish shall be removed from within the limits of the marked areas. Unless otherwise specified, all stumps, roots and root clusters having a diameter of one inch or larger shall be grubbed out to a depth of at least two feet below subgrade elevation for concrete structures and one foot below the ground surface at embankment sites and other designated areas.

4. DISPOSAL

All materials removed from the cleared and grubbed areas shall be burned or buried at location shown on the drawings or as specified in Section 6 of this specification.

5. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the cleared and grubbed area will be measured to the nearest 0.1 acre. Payment for clearing and grubbing will be made for the total area within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools and all other items necessary and incidental to the completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

OCD

6. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 1, Clearing and Grubbing

1. This item shall consist of clearing and grubbing all areas shown on the drawings and staked in the field.

2. If refuse materials are disposed of by burying, they shall be buried a minimum of 24 inches below the existing ground surface in waste area Number 1 shown on the drawings and as staked in the field. When disposal is complete, the waste area shall be smoothed and graded to blend into the surrounding terrain.

3. Refuse materials are to be no larger than 2' - 0" in width or diameter and no longer than 2' - 0".

4. If material removed from the cleared and grubbed area is to be burned, burning must be carried out in accordance with Maricopa County Health department regulations.

5. Measurement and payment will include compensation for Subsidiary Item, Structure Removal and Removal of Water.

CONSTRUCTION SPECIFICATION

3. STRUCTURE REMOVAL

1. SCOPE

The work shall consist of the removal, salvage and disposal of structures (including fences) from the designated areas.

2. MARKING

The limits of the areas from which structures must be removed will be marked by means of stakes, flags or other suitable methods. Structures to be preserved in place or salvaged will be designated by special markings.

3. REMOVAL

Within the areas so marked all visible structures and attachments and all buried structures located and identified by survey stakes shall be removed to the specified extent and depth.

4. SALVAGE

Structures that are designated to be salvaged shall be carefully removed and neatly placed in the specified storage areas. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly match marked with paint prior to disassembly. All pins, nuts, bolts, washers, plates and other loose parts shall be marked or tagged to indicate their proper locations in the structure and shall be fastened to the appropriate structural member or packed in suitable containers. Materials from fences designated to be salvaged shall be placed outside the work area on the property from which they were removed. Wire shall be rolled into uniform rolls of convenient size. Posts and rails shall be neatly piled.

5. DISPOSAL OF REFUSE MATERIALS

Refuse materials resulting from structure removal shall be burned or buried at locations shown on the drawings or as specified in Section 7 of the specification.

6. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

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7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Structure Removal

(1) This item shall consist of removing and disposing of all items as shown on the drawings and marked for removal. This item shall also consist of salvaging the two existing 42-inch flap gates, extruded metal platform, fence cable, 42-inch ARMCO slide gate, 36-inch gate, frame and trash guard, and seven (7) farm road tail water pipes. All salvaged items except those belonging to Foresight Developers will be stored in contractors yard.

(2) Superstitution Spring Golf Club maintenance personnel will remove or abandon the existing irrigation and landscaping north of Guadalupe Road. Contact Steve Eastham of Foresight Developers, 890-5650 two weeks prior to start of construction in that area.

(3) Removal and salvage of two-42-inch flap gates and extruded metal platform at southwest corner of Guadalupe bridge, and cable in fence north of Guadalupe Road bridge will be coordinated through Foresight Developers 1517 South Power Road, Phone number 890-5650, contact persons are Stephen Eastham or Jay Ahrens.

(4) Refuse materials shall be buried a minimum of 24 inches below the existing ground surface in waste area No. 1 as shown on the drawings. When disposal is complete, the waste area shall be smoothed and graded to blend into the surrounding terrain.

(5) Waste materials are to be no larger than 2'-0" in width or diameter and no longer than 2'-0".

(6) No separate payment will be made for this item. Compensation for this work will be included in the payment for Bid Item 1, Clearing and Grubbing.

CONSTRUCTION SPECIFICATION

5. POLLUTION CONTROL

1. Scope

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air during construction operations in accordance with these specifications.

2. MATERIALS

All materials furnished shall meet the requirements of the Material Specifications listed in Section 8 of this specification.

3. EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

The work and measures shall include but not be limited to the following, as shown on the drawings or as specified in Section 8 of this specification.

Staging of Earthwork Activities - The excavation and moving of soil materials shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.

Seeding - Seedings to protect disturbed areas shall be used as specified on the drawings or in Section 8 of this specification.

Mulching - Mulching shall be used to provide temporary protection to soil surfaces from erosion.

Diversions - Diversions shall be used to divert water away from work areas and/or to collect runoff from work areas for treatment and safe disposition.

Stream Crossings - Stream crossings shall be used where fording of streams by equipment is necessary.

Sediment Basins - Sediment basins shall be used to settle and filter out sediment from eroding areas to protect properties and streams below the construction site.

Straw Bale Filters - Straw bale filters shall be used to trap sediment from areas of limited runoff. Bales are temporary and shall be removed when permanent measures are installed.

Waterways - Waterways shall be used for the safe disposal of runoff from fields, diversions and other structures or measures.

4. CHEMICAL POLLUTION

The Contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to be used to dispose of chemical pollutants (such as drained lubricating or transmission oils, greases, soaps, asphalt, etc.) produced as a by-product of the project's work. At the completion of the construction work, sumps shall be voided without causing pollution as specified in Section 8 of this specification.

Sanitary facilities such as pit toilets, chemical toilets, or septic tanks shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources. At the completion of construction work, facilities shall be disposed of without causing pollution as specified in Section 8 of this specification.

5. AIR POLLUTION

Local and state regulations concerning the burning of brush or slash or disposal of other materials shall be adhered to.

Fire prevention measures shall be taken to prevent the start or the spreading of fires which result from project work. Fire breaks or guards shall be constructed at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated fully suppress dust.

6. MAINTENANCE, REMOVAL ,AND RESTORATION

All pollution control measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. All temporary measures shall be removed and the site restored to as nearly to original conditions as practicable.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in Section 8 of this specification.

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8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Pollution Control

(1) This item shall consist of all work and materials required to control or reduce pollution.

(2) This specification shall apply to all construction activities within the Floodway Right-of-Way and construction easements, within the designated waste areas, and along approved haul roads between the designated waste area and construction limits shown on the drawings.

(3) The contractor is required to adhere to all applicable local, state and federal laws and regulations pertaining to the control of pollution as may result from construction of this project. These laws and regulations include but are not limited to:

(a) The "Policy on construction and related activities in water" adopted April 13, 1977, by the Water Quality Control Council of Arizona.

(b) The Clean Air Act (42 U.S.C. 1857 et seq. as amended by Pub. L. 91-604) Section 114, and Section 308 of the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq., as amended by Pub. L. 92-500) relating to inspection, monitoring, entry, reports, and information as well as the other requirements of these sections.

(4) The Contractor is responsible for maintaining air, water, and vegetative quality within the work area. Methods include:

(a) Establishing turn areas, haul roads, work site access roads, temporary building sites, and equipment yards in approved locations, and staging earthwork activities to prevent contamination of air and water, to minimize destruction of existing vegetation, and to minimize erosion.

(b) Operating mechanized equipment at the job site in a manner that will avoid destruction or removal of trees and shrubs unless necessary for construction of the measure.

(5) No separate payment will be made for this item. Compensation for this work will be inlcuded in the payment for Bid Item 4, Water, and Bid Item 5, Channel Excavation.

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CONSTRUCTION SPECIFICATION

7. ENGINEERING CONSTRUCTION SURVEYS

1. SCOPE

The work consists of performing all surveys required for (1) layout of the work, (2) construction control, and (3) quantity surveys for progress payment estimates from baselines and bench marks established by the Government. It includes furnishing all the necessary equipment, labor, and materials. Not included is work required for making the original and final surveys for computing quantities.

2. EQUIPMENT AND MATERIALS

Equipment used for all construction surveys shall be of a quality and condition that provides the specified accuracy. The equipment shall be maintained in good working order and good adjustment. Records of calibration tests and adjustments shall be maintained and be available for inspection by the Government.

Materials include all the necessary field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and other accessories required for layout and construction control of all of the work.

3. QUALITY OF WORK

Surveys shall be certified by a Land Surveyor or Engineer licensed by the State. The work shall be performed to the accuracy and detail appropriate for the location and type of job. Daily quantities of earthwork may be estimated from load count or equivalent measurement (within 25 percent ±); measurement for progress payments should be accurate within 10 percent ±/

Notes, sketches, and other data shall be complete, recorded neatly, and organized in a manner that will allow reproduction of copies for job documentation.

Differential leveling shall be third order with such precision that the error of closure (in feet) shall not exceed plus or minus 0.1 times the square root of the distance (in miles). The elevations of bench marks and temporary bench marks shall be determined and recorded to the nearest 0.01 foot.

Transit traverses shall be third order with such precision that; (1) the linear error of closure shall not exceed one foot in 3,000 feet, and (2) the angular error of closure shall not exceed 1.0 minute times the square root of the number of angles turned.

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Surveys will be reviewed periodically and randomly checked by the Government to assure that the specified quality is being maintained.

4. PRIMARY CONTROL

The base lines and bench marks for primary control, which are necessary to establish the lines and grades needed for construction, will be established by the Government. They will be shown on the drawings and located on the ground before construction.

The base lines and benchmarks shall be used as the origin of all surveys needed to establish lines and grades for construction.

5. CONSTRUCTION SURVEY AND MEASUREMENT RECORDS

All survey data will be recorded in fully identified, bound field notebooks. Pages shall be numbered consecutively. The required books shall be turned over to and become the property of the Government, prior to acceptance of the work or any part of this work. All entries shall be legible, reproducible, and follow the format in Soil Conservation Service TR-62, "Engineering Layout, Notes, Staking and Calculations." The bound field note books shall be available at all times during the progress of the work for examination and use by the Government. Copies of field book notes shall be made available to the Contracting Officer upon request. Electronically generated survey data and computations shall be bound, paginated, and referenced in the bound field notebook containing the survey control in a manner that will make all of the information intelligible and permanent. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, the weather (if field work), the individual or individuals who performed and checked the work and sketches and other information pertinent to the work.

6. STAKING

The location and marking of all stakes shall be as shown in Soil Conservation Service TR-62 as supplemented below.

a. Clearing and grubbing - The boundary of the clearing and grubbing areas shall be staked or flagged at 200-foot intervals or less if needed to clearly mark the limits of work.

b. Excavation - Cut stakes shall be placed on the centerline at the intersection of the planned side slopes and natural ground line. All slope stakes shall be marked with the required cut, horizontal distance, and slope ratio. Offset reference stakes and hubs shall be placed at full stations, on at least one side of the proposed excavation.

c. Earth Fill - Fill stakes shall be placed on the centerline and at the toes of the planned slopes and shall be marked with the fill, horizontal distance, constructed slope ratio, and stationing. Offset reference stakes and hubs shall be provided as a minimum on both sides of the fill at full stations.

Earthwork slope stakes shall be placed as a minimum at full stations, break in the original ground surface, and at other intermediate stations as necessary to insure accurate location of construction. Slope stakes and cross sections shall be at right angles to the centerline. Distances shall be measured horizontally; rod readings shall be taken vertically and recorded to the nearest 0.1 foot.

7. MEASUREMENT AND PAYMENT

Payment will be made as the work proceeds, after receipt of invoices from the contractor showing (contractor or subcontractor) surveying costs and cost of supplies. If the total of incremental payments is less than the contract lump sum for surveys, the balance will be included in the final contract payment. Total payment will be the contract lump sum price for surveys, regardless of actual cost to the contractor.

Payment will not be made under this item for the purchase cost of materials and equipment having a residual value.

Payment of the contract lump sum price for surveys will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the item to which they are made subsidiary are identified in Section 8 of this specification.

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8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 2, Survey

1. This item shall consist of furnishing personnel, equipment, materials and performing surveys required for:

   a. Construction Layout
   b. Computation of Quantities
   c. "As-Built" Construction Drawings

2. Section 1, Scope, the last sentence does not apply.

3. The contractor shall provide the contracting officer a statement of qualifications, including specific experience of each of the survey personnel assigned to the job.

4. The contractor shall provide the contracting officer a schedule of surveys to be performed each month.

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CONSTRUCTION SPECIFICATION

8. MOBILIZATION

1. SCOPE

The work shall consist of the mobilization of the Contractor's forces and equipment necessary for performing the work required under the contract. Mobilization will not be considered as work in fulfilling the contract requirement for commencement of work.

Mobilization shall include the cost for transportation of personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary facilities as the site not covered in specific bid items, and other pereparatory work at the site. The cost of the entire amount of premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable shall be paid upon request when evidence of full payment to the surety has been provided to the Contracting Officer.

Work done under this specification shall not include mobilization for any specific item of work for which payment for mobilization is provided elsewhere in the contract.

The specification covers mobilization for work required by the contract at the time of award. If additional mobilization costs are incurred during performance of the contract as a result of changed or added items of work for which the Contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

2. PAYMENT

Payment will be made as the work proceeds, after presentation of invoices by the Contractor showing his own mobilization costs and evidence of the charges of suppliers, subcontractos, and others for mobilization work performed by them. If the total of such payments is less than the contract lump sum for mobilization, the unpaid balance will be included in the price final contract payment. Total payment will be the lump sum contract price for mobilization, regardless of actual cost to the Contractor.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

Payment of the lump sum contract price for mobilization will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to completion of the work.

3. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 3, Mobilization

(1) This item consists of the mobilization of the contractor's equipment and forces for construction of the Floodway and appurtenances.

CONSTRUCTION SPECIFICATION

10. WATER FOR CONSTRUCTION

1. Scope

The work shall consist of furnishing, transporting, and using water for construction purposes in accord with the applicable specifications.

2. FACILITIES AND EQUIPMENT

The Contractor shall build and maintain such access and haul roads as are needed, and shall furnish, operate, and maintain all pumps, piping, tanks, and other facilities needed to load, transport, and use the water as specified.

These facilities shall be equipped with meters, tanks, or other devices by which the volume of water supplied can be measured.

3. DUST ABATEMENT AND HAUL ROAD MAINTENANCE

Water for dust abatement and haul road maintenance shall be applied to haul roads and other dust-producing areas as needed to prevent excessive dust and to maintain the roads in good condition for efficient operation while they are in use.

4. EARTHFILL, DRAINFILL, ROCKFILL

Water for earthfill, drainfill, or rockfill shall be used in the fill materials as specified in the applicable construction specifications.

5. CONCRETE, MORTAR, GROUT

Water used in mixing or curing concrete, pneumatically applied mortar, or other portland cement mortar or grout shall meet the requirements of the applicable construction specifications and shall be used in conformance with those specifications. Payment for water used in these items is covered by the applicable concrete, mortar, or grout specification.

6. MEASUREMENT AND PAYMENT

For water items for which specific unit prices are established in the contract, the volume of water furnished and used in accordance with the specifications will be measured to the nearest 1000 gallons.

Except as otherwise specified, the measurement for payment will include all water needed at the construction site to perform the work required under the contract in accordance with the specifications but will not

include water wasted or used in excess of the amount needed. It will not include water used in concrete which is mixed elsewhere and transported to the site.

Payment for water will be made at the contract unit price. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to furnishing, transporting, and using the water.

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7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 4, Water

(1) This item shall consist of furnishing and applying all water necessary for performance of the work described in this contract.

(2) Water may be obtained from the Roosevelt Water Conservation District, Higley, Arizona (Mike Leonard Telephone 963-3414).

(3) Measurement and payment will be based on metered quantity of water. Accuracy of meters shall be checked and certified to plus or minus 2 percent of actual flow within normal flow range. Certification shall be submitted to the Contracting Officer prior to their use.

CONSTRUCTION SPECIFICATION

11. REMOVAL OF WATER

1. Scope

The work shall consist of the removal of surface water and ground water as needed to perform the required construction in accordance with the specifications. It shall include (1) building and maintaining all necessary temporary impounding works, channels, and diversions, (2) furnishing, installing and operating all necessary pumps, piping and other facilities and equipment, and (3) removing all such temporary works and equipment after they have served their purposes.

2. DIVERTING SURFACE WATER

The Contractor shall build, maintain and operate all cofferdams, channels, flumes, sumps, and other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site and away from the construction work while construction is in progress. Unless otherwise specified, a diversion must discharge into the same natural drainage way in which its headworks are located.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, his plan for diverting surface water before beginning the construction work for which the diversion is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

3. DEWATERING THE CONSTRUCTION SITE

Foundations, cutoff trenches and other parts of the construction site shall be dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction work. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps, casings, wellpoints, and other equipment needed to perform the dewatering as specified. Dewatering methods that cause a loss of fines from foundation areas will not be permitted.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, his plan for dewatering before beginning the construction work for which the dewatering is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

4. DEWATERING BORROW AREAS

Unless otherwise specified in Section 8, the Contractor shall maintain the borrow areas in drainable condition or otherwise provide for timely and effective removal of surface and ground waters that accumulate within the

borrow areas from any source. Borrow material shall be processed as necessary to achieve proper and uniform moisture content for placement.

If pumping to dewater borrow areas is included as an item of work in the bid schedule, each pump used for this purpose shall be equipped with a water meter in the discharge line. Accuracy of the meters shall be such that the measured quantity of water is within 3 percent, plus or minus, of the true quantity. Means shall be provided by the Contractor to check the accuracy of the water meters when requested by the Contracting Officer.

5. EROSION AND POLLUTION CONTROL

Removal of water from the construction site, including the borrow areas shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized.

6. REMOVAL OF TEMPORARY WORKS

After the temporary works have served their purposes, the Contractor shall remove them or level and grade them to the extent required to present a sightly appearance and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.

Except as otherwise specified, pipes and casings shall be removed from temporary wells and the wells shall be filled to ground level with gravel or other material approved by the Contracting Officer.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Removal of Water

(1) This item shall consist of all removal or diversion of surface and ground water from the construction area shown on the drawings.

(2) The diversion or dewatering plans submitted to the contracting officer for approval shall be specific to each structure site or section of work. Any diversions or dikes proposed in the existing floodway shall incorporate "fuse" or breakaway sections or otherwise be capable of rapid removal in the event of unusual surface water flows during construction.

(3) As a result of any storm water runoff through the upper reaches of the existing floodway and through the Leisure World complex, Foresight Developers will be pumping water into the floodway south of Guadalupe Road as needed to maintain designed lake elevations. The rate of discharge will be approximately 140 cfs. Contact person for coordinating and scheduling pumping during storm periods is Stephen Eastham, phone number 890-5650.

(4) No separate payment will be made for the removal of water. Compensation for this work will be included in the payment for Bid Item 1, Clearing and Grubbing; Bid Item 5, Channel Excavation; Bid Item 6, Structure Excavation; Bid Item 7, Trench Excavation; Bid Item 8 earthfill; Bid Item 9 Structure Backfill; and Bid Item 10 Concrete, Class 4000.

CONSTRUCTION SPECIFICATION

21. EXCAVATION

1. SCOPE

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials.

2. CLASSIFICATION

Excavation will be classified as common excavation or rock excavation in accordance with the following definitions or will be designated as unclassified.

Common excavation shall be defined as the excavation of all materials that can be excavated, transported, and unloaded by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded on to hauling equipment by means of excavators having a rated capacity of one cubic yard and equipped with attachments (such as shovel, bucket, backhoe, dragline or clam shell) appropriate to the character of the materials and the site conditions.

Rock excavation shall be defined as the excavation of all hard, compacted or cemented materials the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than one cubic yard in volume encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation.

Excavation will be classified according to the above definitions by the Engineer, based on his judgment of the character of the materials and the site conditions.

The presence of isolated boulders or rock fragments larger than one cubic yard in size will not in itself be sufficient cause to change the classification of the surrounding material.

For the purpose of this classification, the following definitions shall apply:

Heavy ripping equipment shall be defined as a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a tractor having a power rating of 200-300 net horsepower (at the flywheel).

Wheel tractor-scraper shall be defined as a self-loading (not elevating) and unloading scraper having a struck bowl capacity of 12-20 yards.

Pusher tractor shall be defined as a track type tractor having a power rating of 200-300 net horsepower (at the flywheel) equipped with appropriate attachments.

3. UNCLASSIFIED EXCAVATION

Items designated as "Unclassified Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed. When excavation is unclassified, none of the definitions or classifications stated in Section 2 of this specification shall apply.

4. BLASTING

The transportation, handling, storage, and use of dynamite and other explosives shall be directed and supervised by a person of proven experience and ability in blasting operations.

Blasting shall be done in such a way as to prevent damage to the work or unnecessary fracturing of the foundation and shall conform to any special requirements in Section 12 of this specification.

5. USE OF EXCAVATED MATERIALS

To the extent they are needed, all suitable materials from the specified excavations shall be used in the construction of required permanent earthfill or rockfill. The suitablity of materials for specific purposes will be determined by the Engineer. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

6. DISPOSAL OF WASTE MATERIALS

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

7. BRACING AND SHORING

Excavated surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workers, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. The Contractor shall furnish, place and subsequently remove such supporting installations.

8. STRUCTURE AND TRENCH EXCAVATION

Structure or trench excavation shall be completed to the specified elevations and to sufficient length and width to include allowance for forms, bracing and supports, as necessary, before any concrete or

earthfill is placed or any piles are driven within the limits of the excavation.

9. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fills, additional materials shall be obtained from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas shall be as directed by the Engineer.

Borrow pits shall be excavated and finally dressed in a manner to eliminate steep or unstable side slopes or other hazardous or unsightly conditions.

10. OVEREXCAVATION

Excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete made of materials and mix proportions approved by the Engineer. Concrete that will be exposed to the atmosphere when construction is completed shall contain not less than 6 sacks of cement per cubic yard of concrete. Concrete that will be permanently covered shall contain not less than 4.5 sacks of cement per cubic yard. The concrete shall be placed and cured as specified by the Engineer.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved compacated earthfill, except that, if the earth is to become the subgrade for riprap, rockfill, sand or gravel bedding or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding or drainfill.

11. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Regardless of quantities excavated, the measurement for payment will be made to the specified pay limits, except that excavation outside the specified lines and grades directed by the Engineer to remove unsuitable material will be included. Excavation required because unsuitable conditions result from the Contractor's improper construction operations, as determined by the Contracting Officer, will not be included for measurement and payment.

The pay limits shall be defined as follows:

a. The upper limit shall be the original ground surface as it existed prior to the start of construction operations except that where

excavation is performed within areas designated for previous excavation or fill the upper limit shall be the modified ground surface resulting from the specified previous excavation or fill.

b. The lower and lateral limits shall be the true surface of the completed excavation as directed by the Engineer.

Payment for each type and class of excavation will be made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to the performance of the work, except that extra payment for backfilling overexcavation will be made in accordance with the following provisions:

Payment for backfilling overexcavation, as specified in Section 10 of this specification, will be made only if the excavation outside specified lines and grades is directed by the Engineer to remove unsuitable material and if the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 12 of this specification.

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12. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 5, Channel Excavation

(1) This item shall consist of common excavation required to construct the floodway and appurtenances for which channel excavation is shown on the drawings.

(2) Suitable materials resulting from this excavation and not required for Bid Item 9, Structure Backfill, and Bid Item 8 Earthfill, shall be wasted in the waste areas shown on the drawings, and as specified in Subsidiary Item Waste Disposal.

(3) Measurement and payment will include compensation for Subsidiary Items, Pollution Control; Removal of Water; and Waste Disposal. Section 11 b. shall apply unless shown otherwise on the drawings.

b. Bid Item 6, Structure Excavation

(1) This item shall consist of common excavation for the installation of those items for which structure excavation is shown on the drawings.

(2) Measurement and payment will include compensation for subsidiary Item removal of water.

c. Bid Item 7, Trench Excavation

(1) This item shall consist of common excavation for the installation of those items for which trench excavation is shown on the drawings.

(2) Measurement and payment will include compensation for subsidiary item, Removal of Water.

d. Subsidiary Item, Pipe Excavation

(1) This item shall consist of the common excavation required for installation of those items for which pipe excavation is shown on the drawings.

(2) No separate payment will be made for pipe excavation. Compensation for pipe excavation will be included in Bid Item 13, Maintenance Road Drain, and Bid Item 15, Farm Tailwater Drain.

CONSTRUCTION SPECIFICATION

23. EARTHFILL

1. SCOPE

The work shall consist of the construction of earth embankments and other earthfills required by the drawings and specifications.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing and disposition of materials in the various fills shall be subject to approval by the Engineer.

Fill materials shall contain no sod, brush, roots or other perishable materials. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to compaction of the fill.

The types of materials used in the various fills shall be as listed and described in the specifications and drawings.

3. FOUNDATION PREPARATION

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable materials or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earthfill, and the surface materials of the foundation shall be compacted and bonded with the first layer of earthfill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of two inches in depth normal to the slope and shall be at such a moisture content that the earthfill can be compacted against them to effect a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose materials by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

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4. PLACEMENT

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Engineer. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exeed the maximum thickness specified. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of fill compacted by manually directed power tampers.

Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earthfill in dams, levees and other structures designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

a. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

b. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

c. The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of approximately 2 percent shall be maintained to insure effective drainage, and except as otherwise specified for drainfill or sectional zones.

d. Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of stream flow during construction are specifically authorized in the contract.

e. Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in place shall be stripped of all material not meeting the requirements of this specification, and shall be scarified, moistened and recompacted when the new fill is placed against it as needed to insure a good bond with the new fill and to obtain the specified moisture content and density in the junction of the in place and new fills.

5. CONTROL OF MOISTURE CONTENT

During placement and compaction of fill, the moisture content of the materials being placed shall be maintained within the specified range.

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary. Uniform moisture distribution shall be obtained by disking.

Material that is too wet when deposited on the fill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacated fill or a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

6. COMPACTION

Earthfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction. Each layer of fill shall be compacted as necessary to make the density of the fill matrix not less than the minimum density specified. The fill matrix is defined as the protion of the fill material finer than the maximum particle size used in the compaction test method specified.

Class B comapction. Each layer of fill shall be compacted to a mass density not less than the minimum density specified.

Class C compaction. Each layer of fill shall be compacted by the specified number of passes of the type and weight of roller or other equipment specified, or by an approved equivalent method. Each pass shall consist of at least one passage of the roller wheel or drum over the entire surface of the layer.

Fill adjacent to strutures shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping or manually directed power tampers or plate vibrators. Unless otherwise specified, heavy equipment including backhoe mounted power tampers, or vibrating compactors and manually directed vibrating rollers, shall not be operated within 2 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist will not be permitted.

The passage of heavy equipment will not be allowed: (1) over cast-in-place conduits prior to 14 days after placement of the concrete; (2) over cradled or bedded precast conduits prior to 7 days after placement of the concrete cradle or bedding; or (3) over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 2 feet, whichever is greater.

Compacting of fill adjacent to structures shall not be started until the concrete has attained the strength specified in Section 10 for this purpose. The strength will be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determing when a structure may be put into service.

When the required strength of the concrete is not specified as described above, compaction of fill adjacent to structures shall not be started until the following time intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (Impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and spillway risers, cast-in-place (with inside forms in place)	7 days
Conduits and spillway risers, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Cantilever outlets bents (Backfilled) (both sides simultaneously)	3 days

7. REWORKING OR REMOVAL AND REPLACEMENT OF DEFECTIVE FILL

Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

8. TESTING

During the course of the work, the Engineer will perform such tests as are required to identify materials, to determine compaction characteristics, to determine moisture content, and to determine density of fill in place. These tests performed by the Engineer will be used to verify that the fills conform to the requirements of the specifications. Such tests are not intended to provide the Contractor with the information required by him for the proper execution of the work and their performance shall not relieve the Contractor of the necessity to perform tests for that purpose.

Densities of fill requiring Class A compaction will be determined by the Engineer in accordance with ASTM Method D 1556, D 2167, D 2922 or D 2937 except that the volume and moist weight of included rock particles larger than those used in the compaction test method specified for the type of fill will be determined and deducted from the volume and moist weight of the total sample prior to computation of density or if using the nuclear gauge, added to the specified density to bring it to the measure of equivalent compostion for comparision. The density so computed will be used to determine the percent compaction of the fill matrix. Unless Otherwise specified, moisture content will be determined by one of the following methods: ASTM Method D-2216, D-3017.

9. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill within the specified zone boundaries and pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified, no deduction in volume will be made for embedded conduits and appurtenances.

The pay limits shall be as defined below, with the further provision that earthfill required to fill voids resulting from over excavation of the foundation, outside the specified lines and grades, will be included in the measurement for payment only where such overexcavation

is directed by the Engineer to remove unsuitable material and where the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

The pay limits shall be as designated on the drawings.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subisdiary. Such items and the items to which they are made subsidiary are identified in Section 10 of this specification.

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10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 8, Earthfill

(1) This item shall consist of placing and compacting all required earthfill shown on the drawings.

(2) Material included in the earthfill shall:

(a) Consist of suitable CL, ML, SC, or SM material (Unified Soil Classification System) obtained from the required excavations.

(b) Have a plasticity index no greater than 15.

(3) In Section 6, Compaction, Class A shall apply. The fill matrix shall be compacted to at least 95 percent of the maximum density obtained in compaction tests of the fill materials performed by method A, ASTM D698 (Standard Proctor Test) or Rapid Compaction Test (Test No. S-6) SCS National Engineering Handbook, Section 19.

(4) The maximum size of rock fragments incorporated in the fill shall be six (6) inches.

(5) The maximum thickness of a layer before compaction shall be nine (9) inches.

(6) The moisture content of the material incorporated in the fill shall be maintained within the range of three (3) percentage points below to one (1) percentage point above the optimum moisture content.

(7) Measurement and payment will include compensation for Subsidiary Item, Removal of Water.

b. Bid Item 9, Structure Backfill

(1) This item shall consist of placing and compacting all required structure backfill shown on the drawings.

(2) Structure backfill material shall:

(a) Consist of suitable CL, ML, SC, or SM material (Unified Soil Classification System) obtained from the required excavations.

(b) Contain a minimum of 15 percent passing the #200 sieve

when determined on a dry weight basis, in accordance with ASTM D 1140.

(c) Have a plasticity Index no greater than 15.

(3) In Section 6, Compaction, Class A shall apply. The fill matrix shall be compacted to at least 95 percent of the maximum density obtained in Method A, ASTM D 698 (Standard Proctor Test) or the Rapid Compaction Test (Test No. S-6) SCS National Engineering Handbook, Section 19.

(4) The maximum size of rock fragments incorporated in the fill shall be two (2) inches.

(5) The maximum thickness of a layer before compaction shall be six (6) inches.

(6) The moisture content of the material incorporated in the fill shall be maintained within the range of three (3) percentage points below to one (1) percentage point above the optimum moisture content.

(7) Measurement and payment will include the reduction in volume for embedded conduits and appurtenances and compensation for Subsidiary Item, Removal of Water.

c. Subsidiary Item, Pipe Backfill

(1) This item shall consist of placing and compacting all required pipe backfill shown on the drawings.

(2) Pipe backfill material shall:

(a) Consist of suitable CL, ML's, SC's, and SM's (Unified Soil Classfication System) obtained from the required excavation.

(b) Have a Plasticity index no greater than 15.

(c) Contain a minimum of 15 percent passing the #200 sieve when determined on a dry weight basis, in accordance with ASTM D 1140.

(3) In Section 6, Compaction, Class A shall apply. The fill matrix shall be compacted to at least 95 percent of the maximum density obtained in Method A, ASTM D 698 (Standard Proctor Test); or the Rapid Compaction test (test No. S-6) SCS National Engineering Handbook, Section 19.

(4) The maximum size of rock fragments incorporated in the fill shall be two (2) inches.

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(5) The maximum thickness of a layer before compaction shall be six (6) inches.

(6) The moisture content of the material incorporated in the fill shall be maintained within the range of three (3) percentage points below to one (1) percentage point above the optimum moisture content.

(7) No separate payment will be made for pipe backfill. Compensation for this item will be included in the payment for Bid Item 13, Maintenance Road Drain, and Bid Item 15, Farm Tailwater Drain.

d. Subsidiary Item, Waste Disposal

(1) This Item shall consist of transporting, placing or stock piling all waste in the waste sites shown on the drawings.

(2) Waste material shall consist of all surplus or unsuitable material resulting from the required excavations.

(3) Section 6, Compaction, does not apply to this item.

(4) No special moisture content for waste material will be required.

(5) Waste material for all waste sites shall be placed in layers not to exceed two (2) feet in depth. Full coverage of the waste area shall be obtained before the next 2 foot layer is placed. Waste material will be placed according to the typical sections and profiles shown on the drawings. The finished surface in these areas shall not vary from the average grade more than: (a) 0.5 foot plus or minus for waste sites 1 & 2 (b) 0.3 foot plus or minus for waste site 3 (c) 0.2 foot plus or minus for waste areas adjoining the west floodway berm.

A leveling plan will be available to the Contractor showing detailed fill depths for waste site No. 3.

(6) Final grades for waste area No. 3 and the waste areas adjoining the west floodway berm shall be obtained prior to the completion of the job.

(7) No separate payment will be made for waste disposal. Compensation for this work will be included in the payment for bid Item 5, Channel Excavation.

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CONSTRUCTION SPECIFICATION

24. DRAINFILL

1. SCOPE

The work shall consist of furnishing, placing and compacting drainfill required in the construction of structure drainage systems.

2. MATERIALS

Drainfill materials shall conform to the requirements of Material Specification 521. At least 30 days prior to the delivery of the materials to the site the Contractor shall inform the Contracting Officer in writing of the source from which he intends to obtain them. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing.

3. BASE PREPARATION

Foundation surfaces and trenches shall be clean and free of organic matter, loose soil, foreign substance, and standing water when the drainfill is placed. Earth surfaces upon or against which drainfill will be placed shall not be scarified.

4. PLACEMENT

Drainfill shall not be placed until the subgrade has been inspected and approved by the Engineer. Drainfill shall shall not be placed over or around pipe or drain tile until the installation of the pipe or tile has been inspected and approved.

Drainfill shall be placed uniformly in layers not more than 12 inches deep before compaction. When compaction is accomplished by manually controlled equipment, the layers shall be not more than 8 inches deep. The material shall be placed in a manner to avoid segregation of particle sizes and to insure the continuity and integrity of all zones. No foreign materials shall be allowed to become intermixed with or otherwise contaminate the drainfill.

Traffic shall not be allowed to cross over drains at random. Equipment crossovers shall be maintained, and the number and location of such crossovers shall be established and approved prior to the beginning of drainfill placement. Each crossover shall be cleaned of all contaminating materials and shall be inspected and approved by the Engineer before additional drainfill is placed.

Any damage to the foundation surface or the sides or bottoms of trenches occurring during placement of drainfill shall be repaired before drainfill placement is continued.

The upper surface of drainfill constructed concurrently with adjacent zones of earthfill shall be maintained at an elevation of at least one foot above the upper surface or the adjacent fill.

Drainfill over or around pipe or drain tile shall be placed in manner to avoid any displacement in line on grade of the pipe or tile.

Drainfill shall not be placed adjacent to structures until the concrete has attained the strength specified in Section 9 of this specification. The strength shall be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determining when a structure may be put in service.

When the required strength of the concrete is not specified as described above, placement of drainfill adjacent to structures shall not be started until the following item intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and galleries, cast-in-place (with inside forms in place)	7 days
Conduits and galleries, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Cantilever outlet bents backfilled on both sides simultaneously	3 days

5. CONTROL OF MOISTURE

The moisture content of drainfill materials shall be controlled as specified in Section 9. When the addition of water is required, it shall be applied in such a way as to avoid excessive wetting to adjacent earth fill. Except as specified in Section 9, control of moisture content will not be required.

6. COMPACTION

Drainfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction. Each layer of drainfill shall be compacted to a relative density of not less than 70 percent as determined by ASTM Method D-4254.

Class I compaction. Each layer of drainfill shall be compacted by at least 2 passes, over the entire surface, of a steel-drum vibrating roller weighing not less than 5 tons and exerting a vertical vibrating force of not less than 20,000 pounds at least 1200 times per minute, or by an approved equivalent method.

Class II compaction. Each layer of drainfill shall be compacted by one of the following methods or by an approved equivalent method:

a. At least 2 passes, over the entire surface,of a pnuematic-tired roller exerting a pressure of not less than 75 pounds per square inch. A pass is defined as at least one complete coverage of the roller wheel, tire or drum over the entire surface of the layer.

b. At least 4 passes, over the entire surface, of the track of a crawler-type tractor weighing not less than 20 tons.

c. Controlled movement of the hauling equipment so that the entire surface is traversed by not less than one tread track of the loaded equipment.

Class III compaction. No compaction will be required beyond that resulting from the placing and spreading operations.

When compaction other than Class III compaction is specified materials placed in trenches or other locations inaccessible to heavy equipment shall be compacted by means of manually controlled pneumatic or vibrating tampers or by approved equivalent methods.

Heavy equipment shall not be operated within 2 feet of any structure. Vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from cranes or hoists will not be permitted.

7. TESTING

The Engineer will perform such tests as are required to verify that the drainfill materials and the drainfill in place meet the requirements of the specifications. These tests are not intented to provide the Contractor with information he needs to assure that the materials and

workmanship meet the requirements of the specifications, and their performance will not relieve the Contractor of the responsibility of performing his own tests for that purpose.

8. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of drainfill within the neat lines shown on the drawings will be measured and computed to the nearest cubic yard. Where the Engineer directs placement of drainfill outside the neat lines to replace unsuitable foundation material, the volume of such drainfill will be included, but only to the extent that the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Payment for drainfill will be made at the contract unit price for each type of drainfill, complete in place. Except as otherwise specified in Section 9, such payment will consititute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 9 of this specification.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Drainfill

(1) This item shall consist of furnishing and placing drainfill around the Maintenance Road Drain conduits as described in this specification and shown on the drawings.

(2) The drain fill shall meet the following gradation:

Sieve Size	% Passing
1-1/2	100
3/4	90-100
3/8	80-100
No. 4	65-100
No. 10	47-95
No. 20	26-70
No. 40	16-56
No. 60	5-40
No. 200	0-5

(3) Drainfill shall be placed in horizontal layers not to exceed 18-inches.

(4) Material passing the #40 sieve shall be non-plastic according to ASTM D-4318.

(5) The drainfill material shall contain sufficient moisture to permit placing without segregation.

(6) In Section 6, Compaction, drainfill shall be compacted by a manually controlled vibratory tamper. Each layer shall be compacted by at least two (2) passes over the entire surface.

(7) No separate payment will be made for Drainfill. Compensation will be included in Bid Item 13, Maintenance Road Drain.

CONSTRUCTION SPECIFICATION

31. CONCRETE

1. SCOPE

The work shall consist of furnishing, forming, placing, finishing and curing portland cement concrete as required to build the structures designated in Section 26 of this specification.

2. MATERIALS

Portland cement shall conform to the requirements of Material Specification 531 for the specified type. One brand only of any type of cement shall be used in any single structure as defined in Section 26.

Aggregates shall conform to the requirements of Material Specification 522 unless otherwise specified. The grading of coarse aggregates shall be as specified in Section 26.

Water used in mixing or curing concrete shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter or other deleterious substances.

Air entraining admixtures shall conform to the requirements of Material Specification 532. If air-entraining cement is used, any additional air-entraining admixture shall be of the same type as that in the cement.

Pozzolan shall conform to ASTM C618, Class F, except the loss of ignition shall not exceed 3.0 percent.

Water-reducing, set-retarding admixture shall conform to the requirements of Material Specification 533.

Shear plates shall conform to the requirements of Material Specification 581 for structural quality or commercial or merchant quality steel. Structural quality shall be used if specifically designated in the drawings or specifications.

Preformed expansion joint filler shall conform to the requirements of Material Specification 535.

Waterstops shall conform to the requirements of Material Specifications 537 and 538 for the specified kinds.

Curing compound shall conform to the requirements of Material Specification 534.

3. CLASSES OF CONCRETE

Concrete shall be classified according to the required compressive strength. The strength of the concrete at 28 days shall equal or exceed the Minimum Compressive Strength at 28 days tabulated below for the class of concrete specified.

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

4. AIR CONTENT AND CONSISTENCY

The air content (by volume) of the concrete at the time of placement shall be:

Maximum Size Aggregate	Air Content (%)
3/8 inch to 1/2 inch	6 to 9
Over 1/2 inch to 1 inch	5 to 8
Over 1 inch to 2-1/2 inches	4 to 7

The consistency of the concrete shall be such as to allow it to be worked into place without segregation or excessive laitance. Unless otherwise specified, the slump shall be:

Type of Structure	Slump (inches)
Massive sections, pavements, footings	2 ± 1/2
Heavy beams, thick slabs, thick walls (over 12 in.)	3 ± 1/2
Colums, light beams, thin slabs, thin walls (12 in. or less)	4 ± 1

5. DESIGN OF THE CONCRETE MIX

The Contractor will be responsible for the design of the concrete mixtures. At least 5 days prior to any placement of concrete he shall furnish the Contracting Officer a statement of the materials and mix proportions (including admixtures, if any) he intends to use for each specified class of concrete. The statement shall include evidence satisfactory to the Contracting Officer that the materials and proportions selected will produce concrete of the quality, consistency and strength specified.

The materials and proportions so stated shall constitute the "job mix". After a job mix has been designated, neither the source, character or grading of the aggregates nor the type or brand or quantity of cement or admixture shall be changed without prior notice to the Contracting Officer and establishment of a new job mix supported by evidence, as required for the initial job mix, that the proposed new materials and mix proportions will produce concrete of the quality, consistency, and strength specified.

When specified, a water-reducing, set-retarding admixture shall be used. When conditions are such that the temperature of the concrete at the time of placement is consistently above 75° F, a water-reducing , set-retarding admixture may be used, at the option of the Contractor. The cement content shall be the same as that required in the mix without the admixture.

The use of calcium chloride or other accelerators or antifreeze compounds will not be allowed.

Before placing concrete containing a water-reducing, set-retarding admixture, the Contractor shall furnish test results satisfactory to the Contracting Officer showing that its performance in the job mix meets the requirements of Material Specification 533, Section 4.

When specified, mixes that include fly ash as a partial substitution for portland cement shall be based on absolute volume with a maximum substitution of 20 percent.

6. INSPECTING AND TESTING

During the course of the work, the Engineer will perform such tests as are required to assure the concrete meets the contract requirements. Tests performed by the Engineer are not for the purpose of providing the Contractor with the information required for proper work execution and performance and shall not relieve the Contractor of the necessity to perform tests for that purpose.

The following tests will be performed by the methods indicated:

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

1/ Test of a portion of a batch may be made on samples representative of that portion for any of the following purposes:

(1) Determining uniformity of the batch.

(2) Checking compliance with requirements for slump and air content when the batch is discharged over an extended period of time.

(3) Checking compliance of the concrete with the specifications when the whole amount being placed in a small structure, or a distinct portion of a larger structure, is less than a full batch.

2/ For each strength test of specimens made according to ASTM Designation C 39 or C684, three (3) standard test specimens shall be made. The test result shall be the average of the strength of the three (3) specimens, except that if one (1) specimen in the test shows manifest evidence of improper sampling, molding or testing, it shall be discarded and the strengths of the remaining two (2) specimens shall be averaged. Should more than one (1) specimen representing a test show such defects, the entire test shall be discarded.

The Engineer shall have free entry to the plant and equipment furnishing concrete under the contract. Proper facilities shall be provided for the Engineer to inspect materials, equipment and processes, to obtain samples of the concrete. All tests and inspections will be conducted so as not to interfere unnecessarily with the manufacture and delivery of the concrete.

7. HANDLING AND MEASUREMENT OF MATERIALS

Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size will be avoided and that various sizes will not become intermixed before proportioning. Methods of handling and transporting aggregates shall be such as to avoid contamination, excessive breakage, segregation or degradation, or intermingling of various sizes.

Scales for weighing aggregates and cement shall be beam type or springless dial type. They shall be accurate within 1 percent under operating conditions. All exposed fulcrums, clevises and similar working parts of scales shall be kept clean.

The quantities of cement and aggregates in each batch of concrete, as

indicated by the scales, shall be within the following percentage of the required batch weights:

Cement	plus or minus 1.0 percent
Aggregates	plus or minus 2.0 percent

Measuring tanks for mixing water shall be of adequate capacity to furnish the maximum amount of mixing water required per batch and shall be equipped with outside taps and valves to provide for checking their calibration unless other means are provided for readily and accurately determining the amount of water in the tank.

Except as otherwise provided in Section 8, cement and aggregates shall be measured as follows:

Cement shall be measured by weight or in bags of 94 lbs. each. When cement is measured by weight, it shall be weighed on a scale separate from that used for other materials, and in a hopper entirely free and independent of the hopper used for weighing the aggregates. When cement is measured in bags, no fraction of a bag shall be used unless weighed.

Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight corrected by the weight of surface moisture it contains.

Mixing water shall consist of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates and water introduced in the form of admixtures. The added water shall be measured by weight or volume to an accuracy of 1 percent of the required total mixing water. Added ice shall be measured by weight. Wash water shall not be used as a portion of the mixing water for succeeding batches.

Dry admixtures shall be measured by weight, and paste or liquid admixtures by weight or volume, within a limit of accuracy of 3 percent.

8. MIXERS AND MIXING

Mixers and mixing shall be in accordance with recommended standards set forth in ACI 304, some specific interpretations of which are stated below.

Concrete may be furnished by batch mixing at the site of the work or by ready-mix methods.

Mixers shall be capable of thoroughly mixing the concrete ingredients into a uniform mass within the specified mixing time and of discharging the mix without segregation. Each mixer or agitator shall bear a manufacturer's rating plate indicating the rated capacity and recommended speeds of rotation, and shall be operated in accordance with these recommendations.

Concrete shall be uniform and thoroughly mixed when delivered to the forms. Variations in slump of more than 1 inch within a batch will be considered evidence of inadequate mixing and shall be corrected by changing batching procedures, increasing mixing time, changing mixers or other means. Mixing time shall be within the limits specified below unless the Contractor demonstrates by mixer performance tests that adequate uniformity is obtained by different times of mixing.

No mixing water in excess of the amount called for by the job mix shall be added to the concrete during mixing or hauling or after arrival at the delivery point. If less water than the design maximum water-cement ratio has been incorporated in the batch, water to compensate for up to a one (1) inch loss in slump may be added, up to the design maximum water cement ratio. Withholding some of the mixing water until the concrete arrives on the job, then adding the remaining water and turning the mixer 30 revolutions at mixing speed may overcome transporting conditions. When loss of slump or workability cannot be offset by these measures, complete mixing shall be performed on the job using centrally dry batched materials, or by on site batching and mixing.

Batch mixing at the site. For concrete mixed at the site of the work with paving mixers or stationary construction mixers, the time of mixing after all cement and aggregates are in the mixer drum shall be not less than 1-1/2 minutes. The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates and all mixing water shall be introduced into the drum before one-fourth of the mixing time has elapsed.

Control shall be provided to insure that the batch cannot be discharged until the required time has elapsed.

If truck mixers are used, the requirements below for truck mixers and truck-mixed concrete shall apply.

Volumetric batching and continuous mixing at the site. Volumetric batching and continuous mixing at the construction site will be permitted. The batching and mixing equipment shall conform to the requirements of ASTM Specification C 685 and shall be demonstrated prior to placement of concrete, by tests with the job mix, to produce concrete meeting the specified proportioning and uniformity requirements. Concrete made by this method shall be produced,

inspected, and documented in conformance with Sections 6, 7, 8, 13, and 14 of ASTM Specification C 685.

Ready-mixed concrete. Ready-mixed concrete shall be mixed and delivered to the site of the work by one of the following methods:

a. Truck-mixed concrete--Mixed completely in a truck mixer.

b. Shrink-mixed concrete--Mixed partially in a stationary mixer, and the mixing completed in a truck mixer.

c. Central-mixed concrete.--Completely in a stationary mixer and the mixed concete transported to the point of delivery in a truck agitator or in a truck mixer operating at agitating speed or in nonagitating equipment.

Truck mixers and agitators shall be equipped with revolution counters by which the number of revolutions of the drum or blades may be readily verified.

When ready-mixed concrete is furnished, the Contractor shall furnish the Engineer a statement-of-delivery ticket showing the time of loading, the revolution counter reading at the time of loading and the quantities of materials used for each load of concrete.

Truck-mixed concrete. When concrete is mixed in a truck mixer loaded to its maximum capacity, the number of revolutions of the drum or blades at mixing speed shall be not less than 70 nor more than 100. If the batch is at least 1/2 cubic yard less than maximum capacity, the number of revolutions at mixing speed may be reduced to not less than 50. Mixing in excess of 100 revolutions shall be at the speed designated by the manufacturer of the equipment as agitating speed. The mixing operation shall begin within 30 minutes after the cement has been added to the aggregates and the water shall be added during mixing. When mixing is begun during or immediately after charging, a portion of the mixing water shall be added ahead of, or with, the other ingredients.

Shrink-mixed concrete. When concrete is partially mixed at a central plant and the mixing is completed in a truck mixer, the mixing time in the central plant mixer shall be the minimum required to intermingle the ingredients and shall be not less than 30 seconds. The mixing shall be completed in a truck mixer and the number of revolutions of the drum or blades at mixing speed shall be not less than 50 nor more than 100. Mixing in excess of 100 revolutions shall be at the speed designated by the manufacturer of the equipment as agitating speed.

Central-mixed concrete. For central-mixed concrete, mixing in the stationary mixer shall meet the same requirements as batch mixing at the site.

When an agitator, or truck mixer used as an agitator, transports concrete that has been completely mixed in a stationary mixer, mixing during transportation shall be at the speed designated by the manufacturer of the equipment as agitating speed.

The use of nonagitating equipment to transport concrete to the site of the work will be permitted only if the consistency and uniformity of the concrete as discharged at the point of delivery meet the requirments of this specification. Bodies of nonagitating hauling equipment shall be so constructed that leakage of the concrete mix, or any part thereof will not occur. Concrete hauled in open-top vehicles shall be protected from rain, and from more than 20 minutes exposure to the sun when the air temperature is above 75°F.

9. FORMS

Forms shall be of wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags or other irregularities. Forms shall be coated with a nonstaining form oil before being set into place.

Metal ties or anchorages within the forms shall be equipped with cones, she-bolts or other devices that permit their removal to a depth of at least one inch without injury to the concrete. Ties designed to break off below the surface of the concrete shall not be used without cones.

All edges that will be exposed shall be chamfered, unless finished with molding tools as specified in Section 20.

10. PREPARATION OF FORMS AND SUBGRADE

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. Any form release agent on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed.

Rock surfaces shall be cleaned by air-water cutting, wet sand blasting or wire brush scrubbing, as necessary, and shall be wetted immediately prior to placement of concrete. Earth surfaces shall be firm and damp. Placement of concrete on mud, dried earth, uncompacated fill or frozen subgrade will not be permitted. All ice, snow and frost shall be removed and the temperature of all surfaces to be in contact with the new concrete shall be no colder than 40°F.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Weepholes in walls or slabs shall be formed with nonferrous materials.

11. CONVEYING

Concrete shall be delivered to the site and discharged into the forms within 1-1/2 hours after the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85°F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

The Engineer may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the forms as rapidly as practicable, by methods that will prevent segregation of the aggregates or loss of mortar.

12. PLACING

Concrete shall not be placed until the subgrade, forms and steel reinforcement have been inspected and approved.

The Contractor shall have all equipment and materials required for curing available at the site ready for use before placement of concrete begins.

No concrete shall be placed except in the presence of the Engineer. The Contractor shall give reasonable notice to the Engineer each time he intends to place concrete. Such notice shall be far enough in advance to give the Engineer adequate time to inspect the subgrade, forms, steel reinforcement and other preparations for compliance with specifications. Other preparations include but are not limited to the concrete batching plant, mixing and delivery equipment and system, placing and finishing equipment and system, schedule of work, work force and heating or cooling facilities as applicable. All deficiencies are to be corrected before concrete is delivered for placing.

The concrete shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The depositing of concrete shall be regulated so that the concrete can be consolidated with a minimum of lateral movement.

Concrete shall not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation.

13. LAYERS

Unless otherwise specified, slab concrete shall be placed to design thickness in one continuous layer. Formed concrete shall be placed in horizontal layers not more than 20 inches thick. Hoppers and chutes, pipes or "elephant trunks" shall be used as necessary to prevent splashing of mortar on the forms and reinforcing steel above the layer being placed.

Successive layers shall be placed at a fast enough rate to prevent the formation of "cold joints". If the surface of a layer of concrete in place sets to the degree that it will not flow and merge with the succeeding layer when vibrated, the Contractor shall discontinue placing concrete and shall make a construction joint according to the procedure specified in Section 15.

If placing is discontinued when an incomplete layer is in place, the unfinished end of the layer shall be formed by a vertical bulkhead.

14. CONSOLIDATING

Unless otherwise specified, concrete shall be consolidated with internal type mechanical vibrators capable of transmitting vibration to the concrete at frequencies not less than 6000 impulses per minute.

The location, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface.

The Contractor shall provide a sufficient number of vibrators to properly consolidate the concrete immediately after it is placed in the work. Vibration shall be applied to the freshly deposited concrete by slowly inserting and removing the vibrator at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibily effective. The vibrator shall extend into the previously placed layer of fresh concrete, at all points, to insure effective bond between layers.

Vibration shall not be applied directly to the reinforcement steel or the forms nor to concrete that has hardened to the degree that it does not become plastic when vibrated.

The use of vibrators to transport concrete in the forms or conveying equipment will not be permitted.

Vibration shall be supplemented by spading and hand tamping as necessary to insure smooth and dense concrete along form surfaces, in corners and around embedded items.

15. CONSTRUCTION JOINTS

Construction joints shall be made at the locations shown on the drawings. If construction joints are needed which are not shown on the drawings, they shall be placed in locations approved by the Engineer.

Where a feather edge would be produced at a construction joint, as in the top surface of a sloping wall, an insert form shall be used so that the resulting edge thickness on either side of the joint is not less than 6 inches.

In walls and columns as each lift is completed, the top surfaces shall be immediately and carefully protected from any condition that might adversely affect the hardening of the concrete.

Steel tying and form construction adjacent to concrete in place shall not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms shall be retightened. New concrete shall not be placed until the hardened concrete has cured at least 12 hours.

Surfaces of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings, stains, or debris by washing and scrubbing with a wire brush or wire broom or by other means approved by the Engineer. The surfaces shall be kept moist for at least one hour prior to placement of new concrete. The new concrete shall be placed directly on the cleaned and washed surface.

16. EXPANSION AND CONTRACTION JOINTS

Expansion and contraction joints shall be made only at locations shown on the drawings.

Exposed concrete edges at expansion and contraction joints shall be carefully tooled or chamfered, and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

When open joints or weakened plane "dummy" joints are specified, the joints shall be constructed by the insertion and subsequent removal of a wood strip, metal plate or other suitable template in such a manner that the corners of the concrete will not be chipped or broken. The edges of the concrete at the joints shall be finished with an edging tool prior to removal of the joint strips.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

17. WATERSTOPS

Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in metal watershops shall be brazed or welded. Joints in rubber or plastic waterstops shall be cemented, welded or vulcanized as recommended by the manufacturer.

18. REMOVAL OF FORMS

Forms shall be removed only when the Engineer is present and shall not be removed without his approval. Forms shall be removed in such a way as to prevent damage to the concrete. Supports shall be removed in a manner that will permit the concrete to take the stresses due to its own weight uniformly and gradually.

Forms shall not be removed sooner than the following minimum times after the concrete is placed. These periods represent the cumulative number of days and fractions of days, not necessarily consecutive, during which the temperature of the air adjacent to the concrete is above 50°F.

Element	Time
Beams, arches - supporting forms and shoring	14 days
Conduits, deck slabs - supporting (inside) forms and shoring	7 days
Conduits (outside forms), sides of beams, small structures	24 hours
Columns, walls, spillway riser - with side or vertical load	7 days
Columns, walls, spillway riser - with no side or vertical load.	7 days
Concrete supporting more than 30 feet of wall in place above it	7 days
Concrete supporting 20 to 30 feet of wall in place above it 1/	3 days
Concrete supporting not more than 20 feet of wall in place above it 1/	24 hours

1/ Age of stripped concrete shall be at least 7 days before any load is applied other than the weight of the column or wall, forms and scaffolds for succeeding lifts.

19. FINISHING FORMED SURFACES

All concrete surfaces shall be true and even, and shall be free from open or rough spaces, depressions or projections.

Immediately after the removal of forms:

All bulges, fins, form marks or other irregularities which in the judgment of the Engineer will adversely affect the appearance or the function of the structure shall be removed. All form bolts and ties shall be removed to a depth at least 1 inch below the surface of the concrete. The cavities produced by form ties and all other holes of similar size and depth shall be thoroughly cleaned and, after the interior surfaces have been kept continuously wet for at least 3 hours, shall be carefully packed with a dry patching mortar mixed not richer than 1 part cement to 3 parts sand. Patching mortar shall be mixed in advance and allowed to stand without addition of water until it has reached the stiffest consistency that will permit placing. Manipulation of the mortar with a trowel during this period shall be performed as required to insure the proper consistency.

Holes left by form bolts or straps which pass through the wall shall be filled solid with mortar.

Patching mortar shall be thoroughly compacted into place to form a dense, well-bonded unit, and the in-place mortar shall be sound and free from shrinkage cracks.

All repaired areas shall be cured as specified in Section 21.

20. FINISHING UNFORMED SURFACES

All exposed surfaces of the concrete shall be accurately screeded to grade and then float finished, unless specified otherwise.

After placing and consolidating the concrete, all exposed surfaces shall be accurately struck off to grade. Following strike-off, the surfaces shall be immediately smoothed by darbying or bull floating before any free water has bled to the surface. The concrete will then be allowed to rest until the bleed water and water sheen has left the surface and the concrete has stiffened to where it will sustain foot pressure with only about 1/4 inch (6mm) indentation. At this time all joints and edges that will be exposed to view that are not chamfered shall be finished with edging and/or molding tools. After edging and hand-jointing is complete, all exposed surfaces shall be floated with wood or magnesium floats. The floating should work the concrete no more than necessary to remove screed, edger and jointer marks and produce a compact surface, uniform in texture.

Joints and edges on unformed surfaces shall be chamfered or finished with molding tools.

21. CURING

Concrete shall be cured in accordance with the recommended practice of ACI 308, of which some specific interpretations are set forth below.

Concrete shall be prevented from drying for a period of at least 7 days after it is placed. Exposed surfaces and concrete formed in absorbtive wood forms shall be kept continually wet during the entire curing period or until the forms have been removed. After forms have been removed, the exposed surface shall be kept continuously wet until patching and repair are complete and until the curing period is completed or until a curing compound is applied.

Moisture can be maintained by sprinkling, flooding or fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand or an approved material. Water and/or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

Except as otherwise specified in Section 26, curing compound may be used for exposed surfaces or formed surfaces after patching and repair have been completed. Unless otherwise specified, the curing compound shall be white pigmented and conform to ASTM C 309 Type 2, Class A or B. If surface coatings are to be applied to concrete where curing compound is used, Type 2, Class B shall be used and allowed to age a minimum of 30 days prior to the application of the coating. Clear curing compound (Type 1) or clear with fugitive dye (Type 1-D) may only be used when specified in Section 26.

Curing compound shall be thoroughly mixed before applying and agitated during application. It shall be applied using a continously agitating pressure sprayer at a uniform rate of not less than one gallon per 150 square feet of surface. It shall form a uniform continuous, adherent film that shall not check, crack or peel and shall be free from pinholes or other imperfections.

All surfaces covered with curing compound shall be continuously protected from damage to the protective film during the required curing period.

Surfaces subjected to heavy rainfall or running water within 3 hours after the compound has been applied, or surfaces damaged by subsequent construction operations during the curing period shall be resprayed in the same manner as for the original application.

Unless otherwise specified in Section 26, curing compound shall not be applied to construction joints or other areas that are to receive additional concrete, paint or other material that require a positive bond.

Water for curing shall be clean and free from any substances that will cause discoloration of the concrete.

22. REMOVAL, REPLACEMENT OR REPAIR

When concrete is honeycombed, damaged or otherwise defective, the Contractor shall remove and replace the structure or structural member containing the defective concrete, or correct or repair the defective parts. The Contracting Officer will determine the required extent of removal, replacement or repair and advise the Contractor, in writing, of this determination.

Prior to starting repair work the Contractor shall obtain the Contracting Officer's approval of his plan for making the repair. The appropriate methods described in Chapter VII of the Concrete Manual, Bureau of Reclamation, U.S. Department of the Interior, shall be used as the primary reference for repairs. If approved in writing by the Contracting Officer, proprietary compounds for adhesion or as patching ingredients may be used. Such compounds shall be used in accordance with the manufacturer's recommendations.

Approval of the Contractor's repair plan shall not be considered a waiver of the Contracting Officer's right to require complete removal of defective work if the completed repair does not produce concrete of the required quality and appearance..

Repair work shall be performed only when the Engineer is present.

Repair of formed surfaces shall be started within 24 hours after removal of the forms.

Curing as specified in Section 21 shall be applied to repaired areas immediately after the repairs are completed.

23. CONCRETING IN COLD WEATHER

Concreting in cold weather shall be performed in accordance with ACI 306 Recommended Practice for Cold Weather Concreting, of which some specific interpretations are set forth below.

When the atmospheric temperature may be expected to drop below 40°F at the time concrete is delivered to the work site, during placement, or at any time during the curing period, the following provisions also shall apply:

a. The temperature of the concrete at time of placing shall not be less than 50°F nor more than 90°F. The temperature of neither aggregates nor mixing water shall be more than 140°F just prior to mixing with the cement.

b. When the minimum daily atmospheric temperature is less than 40°F, concrete structures shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the concrete shall be maintained at not less than 50°F nor more than 90°F for the duration of the curing period.

c. Methods of insulating, housing and heating the structure shall conform to "Recommended Practice for Cold Weather Concreting" ACI Standard 306.

d. When dry heat is used to protect concrete, means of maintaining an ambient humidity of at least 40 percent shall be provided unless the concrete has been coated with curing compound as specified in Section 21 or is covered tightly with an approved impervious material.

24. CONCRETING IN HOT WEATHER

Concreting in Hot Weather shall be in accordance with the recommended practice of ACI 305, of which some specific interpretations are set forth below.

For the purpose of the specification, hot weather is defined as any combination of high temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

When climatic or other conditions are such that the temperature of the concrete may reasonably be expected to exceed 90°F at the time of delivery at the work site, during placement, or during the first 24 hours after placement, the following provisions shall apply;

a. The Contractor shall maintain the temperature of the concrete below 90°F during mixing, conveying, and placing.

b. The concrete shall be placed in the work immediately after mixing. Truck mixing shall be delayed only until time enough remains to accomplish it before the concrete is placed.

c. Exposed concrete surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or other means to maintain adequate moisture during the time between placement and finishing, and after finishing.

d. Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay.

e. Formed surfaces shall be kept completely and continuously wet for the duration of curing period (prior to, during and after form

removal) or until curing compound is applied as specified in subsection g, below.

f. Concrete surfaces, especially flatwork placed with large areas of surface, shall be covered as soon as the concrete has sufficiently hardened and shall be kept continuously wet for at least 72 hours of the curing period. This protective method may be continued for the required curing period or until curing compound as specified in (g) below is applied:

g. Moist curing may be discontinued before the end of the curing period if white pigmented curing compound is applied immediately, following the procedures specified in Section 21.

h. In extreme conditions it may be necessary to (1) restrict placement to late afternoon or evening (2) restrict the depth of layers to assure coverage of the previous layer while it will still respond readily to vibration, (3) suspend placement until conditions improve, and (4) remove forms, repair, patch and reapply wet curing by small areas at a time.

25. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, concrete will be measured to the neat lines or pay limits shown on the drawings, and the volume of concrete will be computed to the nearest 0.1 cubic yard. No deduction in volume will be made for chamfers, rounded or beveled edges, or for any void or embedded item that is less than five cubic feet in volume. Where concrete is placed against the sides or bottom of an excavation without intervening forms, drainfill, or bedding, the volume of concrete required to fill voids resulting from over excavation outside the neat lines or pay limits will be included in the measurement for payment where such over excavation is directed by the Engineer to remove unsuitable foundation material; but only to the extent that the unsuitable condition is not a result of the Contractor's improper construction operations, as determined by the Contracting Officer.

Payment for each item of concrete will be made at the contract unit price for that item. The payment for concrete will constitute full compensation for all labor, materials, equipment, transportation, tools, forms, falsework, bracing and all other items necessary and incidental to completion of the concrete work, such as joint fillers, waterstops, dowels or dowel assemblies and shear plates, but not including reinforcing steel or other items listed for payment elsewhere in the contract.

Measurement and payment for furnishing and placing reinforcing steel will be made as specified in Construction Specification 34.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 26 of this specification.

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26. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 10, Concrete, Class 4000

(1) This item shall consist of furnishing forming, and placing all concrete to construct the Warner Road Turnout Structure.

(2) Concrete shall be class 4000.

(3) Coarse aggregate shall be size No. 57 in accordance with ASTM C-33.

(4) Performed expansion joint filler shall conform to Material Specification 535 and ASTM D 1752, Type I.

(5) Joint sealing compound shall be Type II, Class A conforming to Material Specification 536 and Federal Specification TT-S-227.

(6) In Section 19, all patched or formed surfaces that will be exposed shall have a rubbed finish. Surfaces for which a rubbed finish is specified shall be rubbed with a medium coarse carburundum stone, using water for lubrication and cleaning. The rubbing shall be started as soon as possible after the forms are removed, patching is finished, and the patching mortar has set thoroughly.

(7) Concrete for Bid Item 10 shall be integrally colored. The cured concrete color shall blend with the natural earth tones at the site and may be produced using Davis Colors' Harvest Goldenrod additive produced by pigment #5084, at a rate of 2-lbs. per sack of cement or similar quality products produced by Colorful Admixtures or L.M. Scofield. The Contractor shall provide a cured trial test sample on an unexposed footing or slab to verify the color.

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

(8) Curing compound shall contain a fugitive dye conforming to Material Specification 534, and ASTM C-309, Type I-D, Class B.

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(9) Cement shall be Type II, IIA, or IP(MS).

(10) If IP(MS) is used Pozzolan shall not exceed 20 percent based on absolute volume and the R Factor ($R = \frac{Ca\ O_5)}{Fe_2\ O_3}$ shall be less than 1.5.

(11) Waterstops shall be Class II, Type B, D or E, size designation 20 with a center bulb diameter of not less than one inch. All splices except straight butt splices shall be factory made. Straight butt splices shall be made according to the Manufacturer's recommendations.

(12) Measurement and Payment shall include compensation for Subsidiary Item, Removal of Water.

b. Subsidiary Item, Concrete Class 2500

(1) This item shall consist of furnishing, forming, and placing all concrete required to construct the maintenance road drain inlet base slabs, tail water inlet structures, anchor posts for traffic control signs and identification markers, plugs for existing pipes, and concrete collars.

(2) Concrete shall be Class 2500, and Cement shall be Type II, IIA, or IP (MS).

(3) If IP(MS) is used Pozzolan shall not exceed 20 percent based on absolute volume and the R Factor ($R = \frac{Ca\ O_5)}{Fe_2\ O_3}$ shall be less than 1.5.

(4) Coarse aggregate shall be size No. 57 in accordance with ASTM C-33.

(5) Curing compound shall be type 2 conforming to material specification 534 and ASTM C-309.

(6) No separate payment will be made for concrete class 2500. Compensation will be included in Bid Item 13, Maintenance Road Drain; Bid Item 15, Farm Tailwater Drain; and Bid Item 18, Identification Marker.

CONSTRUCTION SPECIFICATION

34. STEEL REINFORCEMENT

1. SCOPE

The work shall consist of furnishing and placing steel reinforcement for reinforced concrete or pneumatically applied mortar.

2. MATERIALS

Steel reinforcement shall conform to the requirements of Material Specification 539. Before reinforcement is placed, the surfaces of the bars and fabric and any metal supports shall be cleaned to remove any loose, flaky rust, mill scale, oil, grease or other coatings or foreign substances. After placement, the reinfor cement shall be maintained in a clean condition until it is completely embedded in the concrete.

3. BAR SCHEDULE, LISTS AND DIAGRAMS

Any supplemental bar schedules, bar lists or bar-bending diagrams required to accomplish the fabrication and placement of reinforcement shall be provided by the Contractor. Prior to placement of reinforcement, the Contractor shall furnish four prints or copies of any such lists or diagrams to the Contracting Officer. Acceptance of the reinforcement will not be based on approval of these lists or diagrams but will be based on inspection of the reinforcement after it has been placed.

4. BENDING

Reinforcement shall be cut and bent in compliance with the requirements of the American Concrete Institute Standard 315. Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks, cracks or improper bends will be rejected.

5. SPLICING BAR REINFORCEMENT

Splices of reinforcement shall be limited to those locations shown on the drawings. Splice lengths shall be determined prior to fabrication and meet the requirements of ACI Standard 318 "Building Code Requirements for Reinforced Concrete" based upon design information contained in Section 10 of this specification. Bar placement drawings and schedules shall be provided for approval prior to fabrication. The drawings shall show all splice locations, layouts, and lap distances.

6. SPLICING WELDED WIRE FABRIC

Unless otherwise specified, welded wire fabric shall be spliced in the following manner:

a. Adjacent sections shall be spliced end to end (longitudinal lap) by overlapping a minimum of one full mesh plus 2 inches plus the length of the two end overhangs. The splice length is measured from the end of the longitudinal wires in one piece of fabric to the end of the longitudinal wires in the lapped piece of fabric.

b. Adjacent sections shall be spliced side to side (transverse lap) a minimum of one full mesh plus 2 inches. The splice length shall be measured from the centerline of the first longitudinal wire in one piece of fabric to the centerline of the first longitudinal wire in the lapped piece of fabric.

7. PLACING

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. Tack welding of bars will not be permitted. Metal chairs, metal handers, metal spacers and concrete chairs may be used to support the reinforcement. Metal handers, spacers and ties shall be placed in such a manner that they will not be exposed in the finished concrete surface. The legs of metal chairs or side form spacers that may be exposed on any face of slabs, walls, beams or other concrete surfaces shall have a protective coating or finish by means of hot dip galvanizing, epoxy coating, plastic coating, or by stainless steel. Metal chairs and spacers not fully covered by a protective coating or finish shall have a minimum cover of 3/4 inch of concrete over the unprotected metal portion except for those with plastic coatings may have a minimum cover of 1/2 inch of concrete over the unprotected metal portion. Precast concrete chairs shall be manufactured of the same class of concrete as that specified for the structure and shall have tie wires securely anchored in the chair or a V-shaped groove at least 3/4 inch in depth molded into the upper surface to receive the steel bar at the point of support. Precast concrete chairs shall be moist at the time concrete is placed.

High density of structural plastic repar accessories, designed to insure maximum concrete bond, may be substituted for metal or concrete accessories in spacer applications as approved by the Contracting Officer. Exposure of plastic rebair accessories at the finished concrete surface shall be kept to a minimum. Plastic rebar accessories, if used, shall be staggered along adjacent parallel bars and shall be placed at intervals no closer than 12 inches. Plastic rebar accessories shall not be used in concrete sections 6 inches or less in thickness.

Reforcement shall not be placed until the prepared site has been inspected and approved by the Engineer. After placement of the reinforcement, concrete shall not be placed until the reinforcement has been inspected and approved by the Engineer.

8. STORAGE

Steel reinforcement stored at the work site shall be placed above the ground surface on platforms, skids or other supports and protected from mechanical damage or corrosion.

9. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the weight of reinforcement placed in the concrete in accordance with the drawings will be determined to the nearest pound by computation from the placing drawings. Measurement of hooks and bends will be based on the requirements of ACI Standard 315. Computation of weights of reinforcement will be based on the unit weights established in Tables 34-1 and 34-2. Computation of weights for welded wire fabric not shown in Table 34-2 shall be based on ACI Standard 315. The area of welded wire fabric reinforcement placed in the concrete in accordance with the drawings will be determined to the nearest square foot by computation from the placing drawings with no allowance for laps. The weight of steel reinforcing in extra splices of extra length splices approved for the convenience of the Contractor or the weight of supports and ties will not be included in the measurement for payment.

Payment for furnishing and placing reinforcing steel will be made at the contract unit price. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the completion of the work including preparing and furnishing bar schedules, lists or diagrams; furnishing and attaching ties and supports; and furnishing, transporting, storing, cutting, bending, cleaning and securing all reinforcements.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items to which they are made subsidiary are identified in Section 10 of this specification.

TABLE 34-1. STANDARD REINFORCING BARS

Bar Size No.	Wt. (lb./ft).
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.670
9	3.400
10	4.303
11	5.313
14	7.65
18	13.60

TABLE 34-2. RECTANGULAR WELDED WIRE FABRIC 1/

Style Designation By Steel Wire Gauge	By W-Number	Weight, lb. Per 100 Sq. Ft.
6 x 6 - 10 x 10	6 x 6 - WI.4 x W1.4	21
6 x 6 - 8 x 8	6 x 6 - W2.1 x W2.1	30
6 x 6 - 6 x 6	6 x 6 - W2.9 x W2.9	42
6 x 6 - 4 x 4	6 x 6 - W4.0 x W4.0	58
4 x 4 - 10 x 10	4 x 4 - W1.4 x W1.4	31
4 x 4 - 8 x 8	4 x 4 - W2.1 x W2.1	44
4 x 4 - 6 x 6	4 x 4 - W2.9 x W2.9	62
4 x 4 - 4 x 4	4 x 4 - W4.0 x W4.0	85
4 x 12 - 8 x 12	4 x 12 - W2.1 x W0.9 2/	25
4 x 12 - 7 x 11	4 x 12 - W2.5 x W1.1 2/	31

1/ Style designation is defined in ACI Standard 315 of the American Concrete Institute.

2/ Welded smooth wire fabric with wires smaller than Size WI.4 is manufactured from galvanized wire.

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10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 11, Steel Reinforcement

(1) This item shall consist of furnishing and installing all steel reinforcement required for the construction of the Warner Road turnout structure.

(2) Steel bars shall be grade 40 or grade 60.

(3) Section 3, Bar Schedule, Lists and Diagrams; the Contractor shall provide the required information 15 working days prior to placement of the steel reinforcement.

b. Subsidiary Item, Tailwater Inlet Structure Steel Reinforcement

(1) This item shall consist of furnishing and installing all the steel reinforcement required to construct the tailwater inlet structures.

(2) Steel bars shall be grade 40 or grade 60.

(3) Section 3, Bar Schedule, Lists and Diagrams; the Contractor shall provide the required information 15 working days prior to placement of the steel reinforcement.

(4) No separate payment will be made for tailwater inlet structure for Steel Reinforcement. Compensation will be included in Bid Item 15, Farm Tailwater Drain.

c. Subsidiary Item, Concrete Collar Steel Reinforcement

(1) This item shall consist of furnishing and installing all the steel reinforcement required to construct the concrete collars around the pipes shown on the drawings.

(2) Reinforcement shall be rectangular welded wire fabric 6 x 6 - W5.0 x W5.0.

(3) No separate payment will be made for concrete collar steel reinforcement. Compensation will be included in Bid Item 12, 36-inch RCP.

CONSTRUCTION SPECIFICATION

42. CONCRETE PIPE CONDUITS AND DRAINS

1. SCOPE

The work shall consist of furnishing and installing concrete pipe or concrete drain tile and the necessary fittings as shown on the drawings.

2. MATERIALS

Reinforced concrete pressure pipe shall conform to the requirements of Material Specification 541 for the type and strength specified.

Concrete culvert pipe shall conform to the requirements of Material Specification 542 for the kind of pipe specified.

Concrete irrigation pipe, drainage pipe and drain tile shall conform to the requirements of Material Specification 543 for the kind of pipe or tile specified.

Pipe fittings shall conform to the requirements of the applicable pipe specifications.

Sealing compound for filling rubber gasket joints shall conform to the requirements of Material Specification 536.

Hot-pour joint sealer shall conform to the requirements of Material Specification 536.

Performed sealing compound shall conform to the requirements of Material Specification 536.

Joint packing shall be commercial grade oakum.

Preformed expansion joint filler shall conform to the requirements of Material Specification 535.

3. LAYING AND BEDDING

Pipe and tile shall be laid to the line and grade shown on the drawings. Pipe shall be laid with the bell or groove at the upstream end of each section.

a. Concrete Cradles or Bedding. Pipe to be cradled or bedded on concrete shall be set to the specified line and grade and temporarily supported on precast concrete blocks or wedges until the cradle or bedding concrete is placed. Concrete blocks or wedges used to temporarily support the pipe during placement of bedding or cradle shall be of a class of concrete equal to or better than that used in the bedding or cradle.

b. Earth, Sand, or Gravel Bedding. The pipe shall be firmly and uniformly bedded throughout its entire length to the depth and in the manner specified on the drawings. The pipe shall be loaded sufficiently during backfilling around the sides to prevent its being lifted from the bedding.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about a vertical centerline. Perforations shall be clear of any obstructions when the pipe is laid.

Elliptical pipe and pipe with elliptical or quadrant reinforcement shall be layed so that the vertical axis, as indicated by markings on the pipe, is in a vertical position.

4. JOINTS

Pipe joints shall conform to the details shown on the drawings and to the requirements of Section 5 and 6 of this specification applicable to the type of joint specified. Except where unsealed joints are indicated, pipe joints shall be sound and watertight at the pressure specified.

5. JOINTING BELL AND SPIGOT PIPE

a. Rubber Gasket Joint, Pressure Pipe. Just before the joint is connected the connecting surfaces of the spigot and the bell or coupling band, sleeve or collar shall be thoroughly cleaned and dried, and the rubber gasket and the inside surface of bell or coupling band, sleeve or collar shall be lubricated with a light film of soft vegetable soap compound (flax soap). The rubber gasket shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the pipe.

The joint shall be connected by means of a pulling or jacking force so applied to the pipe that the spigot enters squarely into the bell.

When the spigot has been seated to within seated 1/2 inch of its final position, the position of the gasket in the joint shall be checked around the entire circumference of the pipe by means of metal feeler gauge. In any case where the gasket is found to be displaced, the joint shall be disengaged and properly reconnected. After the position of the gasket has been checked, the spigot shall be completely pulled into the bell and the section of the pipe shall be adjusted to line and grade.

b. Rubber Gasket Joints, Sewer and Culvert Pipe or Irrigation Pipe. The pipe shall be joined in accordance with the gasket manufacturer's recommendations except as otherwise specified.

c. Mastic Sealed Joints. At the time of assembly the inside surfaces of the bell and the outside surfaces of the spigot shall be clean, dry and primed as recommended by the manufacturer of the sealing compound. A closely twisted gasket of joint packing of the diameter required to support the spigot at the proper grade and to make the joint concentric shall be made in one piece of sufficient length to pass around the pipe and lap at the top. The gasket shall be laid in the bell throughout the lower third of the circumference. The end of the spigot shall be laid in the bell throughout the lower third of the circumference. The end of the spigot shall be laid on the gasket and the spigot shall be fully inserted into the bell so that the pipe sections are closely fitted and aligned. The gasket then shall be lapped at the top of the pipe and thoroughly packed into the annular space between the bell and the spigot.

(1) Hot-Pour Joint Sealer. The sealing compound shall be heated to within the temperature range recommended by the manufacturer and shall not be overheated or subjected to prolonged heating. After the joint is assembled, with the pipe in its final location, a suitable joint runner shall be placed around the joint with an opening left at the top. Molten sealing compound shall be poured into the joint as rapidly as possible without entrapping air until the annular space between bell and spigot is completely filled. After the compound hasset, the runner may be removed. Alternate joints may be poured before the pipe is lowered into the trench. In this case, the joint shall be poured with the pipe in a vertical position without the use of the runner. The compound shall have thoroughly set before the piep is placed in the trench, and the pipe be handled so as to cause no deformation of the joint during placement.

(2) Cold-Applied Sealing Compound. The annular space between bell and spigot shall be completely filled with the sealing compound. The compound shall be mixed on the job in accordance with the manufacturer's recommendations and in relatively small quantities so that setting will not be appreciable before application.

(3) Preformed Sealing Compound. Joint packing will not be required, except as recommended by the manufacturer of the sealing compound. Preformed strips or bands of the sealing compound shall be applied to the bell and spigot prior to assembly of the joint in accordance with the manufacturer's recommendations. Any compound extruded from the interior side of the joint during assembly shall be trimmed even with the interior surface of the pipe.

d. Cement Mortar Sealed Joints. Cement mortar for joints shall consist of one part by weight of portland cement and two parts by weight of fine sand with enough water added to produce a workable consistency. At the time of assembly the inside surface of the bell and the outside surface of the spigot shall be clean and moist.

(1) With Packing. A closely twisted gasket of joint packing of the diameter required to support the spigot at the proper grade and to make the joint concentric shall be made in one piece of sufficient length to pass around the pipe and lap at the top. The gasket shall be saturated with neat cement grout, laid in the bell throughout the lower third of the circumference and covered with mortar. The end of the spigot shall be fully inserted into the bell so that the pipe sections are closely fitted and aligned. A small amount of mortar shall be placed in the annular space throughout the upper two-thirds of the circumference. The gasket then shall be lapped at the top of the pipe and thoroughly packed into the annular space between the bell and the spigot. The remainder of the annular space then shall be filled completely with mortar and beveled off at an angle of approximately forty-five (45) degrees with the outside of the bell. If the mortar is not sufficiently stiff to prevent appreciable slump before setting,the outside of the joint thus made shall be wrapped with cheesecloth. After the mortar has set slightly,the joint shall be wiped inside the pipe. In pipe too small for a man to work inside, wiping may be done by dragging an approved swab through the pipe as the work progresses.

(2) Without Packing. The lower portion of the bell shall be filled with stiff mortar of sufficient thickness to make the inner surface of the abutting sections flush. TThe spigot end of the pipe to be joined shall be fully inserted into the bell so that the sections are closely fitted and aligned. The remaining annular space between the bell and spigot shall then be filled mortar and the mortar neatly beveled off at an angle of approximately forty-five (45) degrees with the outside of the bell. After the mortar has set slightly, the joint shall be wiped inside the pipe. In pipe too small for a man to work inside, wiping may be done by dragging an approved swab through the pipe as the work progresses.

(e) Unsealed Joints. When unsealed joints are specified, they shall conform to the details shown on the drawings.

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6. JOINING TONGUE AND GROOVE PIPE

a. Cement Mortar Sealed Joint. Mortar shall be as specified for bell and spigot joints. The tongue end of the section being placed

shall be covered with mortar and firmly pressed into the groove of the laid section in such manner that the tongue fits snugly and truly in the groove and that mortar is squeezed out both on the interior and exterior of the joint. Care shall be taken that no mortar falls from the groove end during the abutting operation. Immediately after the pipe sections have been abutted, exposed external surface mortar shall be pressed into the joint and any excess mortar removed, after which the interior surface of the joint shall be carefully pointed and brushed smooth, and all surplus mortar removed.

b. Mastic Sealed Joints. Strips or bands of preformed sealing compound shall be applied to the tongue and groove prior to assembly of the joint in accordance with the manufacturer's recommendations. Any compound extruded from the interior side of the joint during assembly shall be trimmed even with the interior surface of the pipe.

c. Rubber Gasket Joints. The pipe shall be joined in accordance with the gasket manufacturer's recommendations except as otherwise specified.

d. Unsealed Joints. When unsealed joints are specified, they shall conform to the details

7. BANDING

When external mortar bands are specified, they shall conform to the details shown on the drawings.

8. CURING MORTAR JOINTS AND BANDS

The external surfaces of mortar joints shall be covered with moist earth, sand, canvas, burlap or other approved materials and shall be kept moist for 10 days or until the pipe is backfilled.

Water shall not be turned into the conduit within 24 hours after the joints are finished. Hydrostatic pressure shall not be applied to the conduit prior to 14 days after the joints are finished.

9. PRESSURE TESTING

Prior to the placement of concrete or earth fill around the conduit,the conduit shall be tested at the specified test pressure for a period of

at least 2 hours. Any leaks shall be repaired and the conduit shall be retested. The procedure shall be repeated until the conduit is watertight.

The pipe joints shall show no leakage. Damp spots developing on the surface of the pipe will not be considered as leaks.

10. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the quantity of each kind, size, and class of pipe or tile will be determined to the nearest 0.1 foot by measurement of the laid length along the invert centerline of the conduit. Payment for each kind, size, and class of pipe or tile will be made at the contract unit price for that kind, size, and class. Such payment will constitute full compensaiton for furnishing, transporting and installing the pipe or tile complete in place.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 11 of this specification.

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11. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 12, 36-inch RCP

(1) This item shall consist of furnishing and installing all reinforced concrete pipe and concrete collars and sealing the existing 36-inch RCP joints at the existing manhole and existing box structure for the Elliot Road Syphon at approximate Station 382+31.

(2) The pipe shall be installed to the lines and grade shown on the drawings.

(3) The pipe shall be 36-inch inside diameter bell and spigot with rubber gasket joint per material specification 542 and ASTM C-76 Class IV wall B, as shown on the drawings.

(4) Test pressure shall be 5.7 psi. This is equivalent to filling the syphon system to the outlet irrigation elevation of the 36-inch RCP pipe.

(5) Measurement and payment shall include compensation for subsidiary items, 18-inch over flow pipe, 48-inch manhole pipe, concrete collar steel reinforcement, and concrete class 2500.

b. Subsidiary Item, 18-inch overflow pipe

(1) This item shall consist of furnishing and installing the 18-inch overflow pipe at the existing Elliot Road Syphon inlet box at approximate Station 382+27.

(2) The pipe shall be installed to the lines and grade shown on the drawings.

(3) The pipe shall be 18-inch inside diameter bell and spigot with rubber gasket joint per Material Specification 542 and ASTM C-76 Class II wall B, as shown on the drawings.

(4) Section 9, pressure testing, will not apply.

(5) No separate payment will be made for 18-inch overflow pipe. Compensation for this item will be included in the payment for Bid Item 12, 36-inch RCP.

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c. Subsidiary Item, 48-inch Manhole Pipe

(1) This item shall consist of furnishing and installing a 4-foot section of precast 48-inch manhole for the Elliot Road syphon at a approximate station 382+31± as shown on the drawings and removing and replacing the existing manhole sections with watertight seals.

(2) The pipe will replace an existing section that is scheduled to be removed and disposed of.

(3) Watertight seals shall be Butyl Resin concrete sealant as shown on the drawings.

(4) Section 2, materials, shall not apply. Pipe shall conform to the requirements of ASTM Specification C478 precast reinforced concrete manhole sections, and shall have a wall thickness of 5-inches.

(5) Pressure testing of the 48-inch manhole shall be by maintaining a water elevation equal to the outlet irrigating elevation of the 36-inch RCP syphon for the specified time.

(6) The manhole section shall be connected as recommended by the manufacturer, and will include manhole steps.

(7) No separate payment will be made for the 48-inch manhole pipe, compensation for this item will be included in the payment for Bid Item 12, 36-inch RCP.

CONSTRUCTION SPECIFICATION

51. CORRUGATED METAL PIPE CONDUITS

1. SCOPE

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

2. MATERIALS

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

3. LAYING AND BEDDING THE PIPE

Unless otherwise specified, the pipe shall be installed in accordance with the manufacturer's recommendations. The pipe shall be laid with the outside laps of circumferential joints pointing upstream and with longitudinal laps at the sides at about the veritical midheight of the pipe. Field welding of corrugated galvanized iron or steel pipe will not be permitted. Unless otherwise specified, the pipe sections shall be joined with standard coupling bands. The pipe shall be firmly and uniformly bedded throughout its entire length to the depth and in the manner specified on the drawings.

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

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

4. STRUTTING

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

5. HANDLING THE PIPE

The Contractor shall furnish such equipment as is necessary to place the pipe without damaging the pipe or coatings. The pipe shall be transported and handled in such a manner as to prevent bruising, scaling, or breaking of the spelter coating or bituminous coating.

6. REPAIR OF DAMAGED COATINGS

Any damage to the zinc coating shall be repaired by thoroughly wire brushing the damaged area, removing all loose and cracked coating, removing all dirt and greasy material with solvent, and painting with two coats of one of the following paint options.

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

Normal exterior or interior atmospheric exposure:

(a) Zinc dust - zinc oxide primer, Federal Specification TT-P-641, Type I or Type II,

(b) Single package, moisture cured urethane primer in silver metallic color, or

(c) Zinc-rich cold galvanizing compound, brush, or aerosol application.

Submergence in water exposure:

(a) Zinc dust-zinc oxide primer, Federal Specification TT-P-641, Type III.

(b) Zinc dust paint, Military Specification MIL-P-21035,

(c) Zinc Dust Chlorinated Rubber, Federal Specification TT-P-1046a, or

(d) Epoxy-Polyamid, Department of Defense Specification DOD-P-15145 B.

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

Breaks or scuffs in bituminous coatings that are less than 36 square inches in area shall be repaired by the application of two coats of hot asphaltic paint or a coating of cold-applied bituminous mastic. The repair coating shall be at least 0.05 inches thick after hardening and shall bond securely and permanently to the pipe. The material shall meet the physical requirements for bituminous coatings contained in the references cited in Material Specifications 551 and 552. Whenever individual breaks exceed 36 square inches in area or when the total area of breaks exceeds 0.5 percent of the total surface area of the pipe, the pipe will be rejected.

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

7. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract the quantity of each type, class, size and guage of pipe will be determined to the nearest 0.1 foot by measurement of the laid length of pipe along the centerline of the pipe. Payment for each type, class, size and gauge of pipe will be made at the contract unit price for that type, class, size and gauge of pipe. Such payment will constitute full compensation for furnishing, transporting and installing the pipe and fittings and all other items necessary and incidental to the completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

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8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 13, Maintenance Road Drains

(1) This item shall consist of furnishing and installing all Maintenance Road Drains which includes the CMP pipe, the CMP drop shaft, inlet base slab, drainfill, fabricated steel trash racks and animal guards, pipe excavation, and pipe backfill, as shown on the drawings.

(2) Material Specification 551 shall apply.

(3) The CMP pipe shall be 18 inch diameter, 14 guage, Class I or Class II, Shape 1, Series A or B and Bituminus coating A, in accordance with Federal Specification WW-P-405.

(4) The CMP drop shaft shall be 24-inch diameter, 14 gage, Class I or Class II, Shape 1, Series A or B and Bituminus coating A, in accordance with Federal Specification WW-P-405.

(5) Section 7, Measurement and Payment, the following method shall apply. The quantity of pipe and other material will not be measured for payment. Payment for each Maintenance Road Drain will be made at the contract unit price for one Maintenance Road Drain installed. Payment for each will include compensation for all material, labor, equipment, tools, and Subsidiary Items; Concrete Class 2500 Pipe Excavation, Pipe Backfill, Drainfill, and Metal Fabrication.

b. Bid Item 14, 42-inch CMP Outlet

(1) This item shall conisist of furnishing and installing two (2) 42-inch diameter corrugated metal pipes, including the 22.5 degree bends, to the two existing 42-inch diameter corrugated metal pipes, and extending them to the floodway as shown on the drawings. The work shall also consist of installing the animal guards within the pipe as shown on the drawings.

(2) The pipe and fittings shall be a minimum of 14 gage, Class I, Shape 1, Series A or B, and Bituminus coating A in accordance with Federal Specification WW-P-405.

(3) Material Specification 551 shall apply.

(4) The pipe miter cut shall be performed in the field.

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(5) Measurement and Payment will include compensation for Subsidiary Item, Metal Fabrication.

c. Bid Item 15, Farm Tailwater Drain

(1) This item shall consist of furnishing and installing all Farm Tailwater Drains which includes the CMP pipe, tailwater inlet structures, pipe excavation, pipe backfill, and metal fabricated channel guides as shown on the drawings.

(2) In Section 2, Materials Specification 551 shall apply.

(3) The CMP pipe shall be 18-inch diameter, 14 gage, Class 1, shape 1, series A coating A in accordance with Federal Specification WW-P-405.

(5) In Section 7, Measurement and Payment, the following method shall apply. The quanitity of pipe and other material will not be measured for payment. Payment for each Farm Tailwater Drain will be made at the contract unit price for one Farm Tailwater Drain. Payment for each will include compensation for all material,labor, equipment, tools, and Subsidiary Items; Concrete Class 2500, Tailwater Inlet Structure Steel Reinforcement, Pipe Excavation, Pipe Backfill and Metal Fabrication.

d. Bid Item 16, Aluminum Arch Pipe

(1) This item shall consists of furnishing and installing the 18-inch by 24-inch Aluminum Arch Pipe animal guard and inlet elbow located south of Guadalupe Road and exiting into side inlet number 1 at approximate Station 10+17.

(2) Section 2, Mateirals, will not apply. Pipe shall be 14 gage and meet AASHTO Designation M196 Type II Corrugated Aluminum Alloy Culverts and Underdrains.

(3) Pipe shall be bituminous coated per Federal Specification WW-P-402, coating A.

(4) Measurement and Payment will include compensation for Subsidiary Item, Metal Fabrication.

CONSTRUCTION SPECIFICATION

62. GROUTED ROCK RIPRAP

1. SCOPE

The work shall consist of furnishing, transporting, and placing rock and concrete grout in the construction of grouted rock riprap sections.

2. MATERIALS

Rock for grouted rock riprap shall conform to the requirements of Material Specification 523, or if so specified shall be obtained from designated sources. It shall be free from dirt, clay, sand, rock fines, and other materials not meeting the required gradation limits.

At least 30 days prior to delivery of rock from other than designated sources, the Contractor shall designate, in writing, the source from which he intends to obtain the rock and information satisfactory to the Contracting Office that the material meets the requirements of the contract. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock shall be as specified in Section 13 of this specification.

Rock from designated sources shall be excavated, selected and processed as necessary to meet the quality and grading requirements in Section 13 of this specification. The rock shall conform to the specified grading limits when installed in the riprap.

Filter or bedding materials when required, shall unless otherwise specified, conform to the requirements of the Material Specification 521.

Portland cement shall conform to the requirements of Mateiral Specification 531 for the specified type.

Pozzolan. Unless otherwise specified in Secion 13 of this specification, pozzolans conforming to Specification ASTM C-618 Class F in amounts not to exceed 20 percent, based on absolute volume, may be substituted for an equivalent amount of portland cement in the grout mixture.

Aggregates shall conform to the requirements of Material Specification 522, except that the grading for coarse aggregate shall be as specified in the construction details.

Water shall be clean and free from injurious amounts of oils, acid, alkali, organic matter or other deleterious substances.

Air-entraining admixtures shall conform to the requirements of Material Specification 532.

Curing compound shall conform to the requirements of Material Specification 534.

Other admixtures, when required, shall be as specified in the construction details.

3. SUBGRADE PREPARATION

Riprap or filter shall not be placed until the subgrade surfaces have been inspected and approved by the Engineer.

4. FILTER LAYERS OR BEDDING

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

5. PLACING ROCK

The rock shall be placed on the surfaces and to the depths specified in such a manner as to avoid displacement of the underlying materials. The rock may be equipment or hand placed as necessary to produce a surface in which the tops of the individual rocks do not vary more than the specified deviation from the neat lines shown on the drawings. Double decking of thin, flat rocks to bring the surface up to the required grade will not be permitted.

6. DESIGN OF THE GROUT MIX

The mix proportions for the grout mix shall be as specified in the construction details. During the course of the work the Engineer will require adjustment of the mix proportions whenever necessary. After the mix has been designated, it shall not be changed without the approval of the Engineer.

7. HANDLING AND MEASUREMENT OF MATERIAL

Materials shall be stockpiled and batched by methods that will prevent segregation or contamination of aggregates and insure accurate proportioning of the ingredients of the mix.

Except as otherwise provided in Section 11, cement and aggregates shall be measured as follows:

Cement shall be measured by weight or in bags of 94 pounds each. When cement is measured in bags, no fraction of a bag shall be used unless weighed.

Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight plus the weight of surface moisture it contains.

Water shall be measured, by volume or by weight, to an accuracy within one percent of the total quantity of water required for the batch.

Admixtures shall be measured within a limit of accuracy of ± 3 percent.

8. MIXERS AND MIXING

The mixer, when loaded to capacity, shall be capable of combining the ingredients of the grout mix into a thoroughly mixed and uniform mass and of discharging it with a satisfactory degree of uniformity.

Mixer shall be operated within the limits of the manufacturer's guaranteed capacity and speed of rotation.

The time of mixing after all cement and aggregates are in the mixer drum shall be not less than one minute for mixers having a capacity of one cubic yard or less. For mixers of larger capacities, the minimum time shall be increased fifteen seconds for each cubic yard or fraction thereof of additional capacity. The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate, and all mixing water shall be introduced into the drum before one-fourth of the mixing time has elapsed.

When ready-mixed grout mix is furnished, the Contrator shall furnish to the Engineer a delivery ticket showing the time of loading and the quantities of materials used for each load of grout mix.

No mixing water in excess of the amount called for by the job mix shall be added to the grout mix during mixing or hauling or after arrival at the delivery point.

9. CONVEYING AND PLACING

The grout mix shall be delivered to the site and placed within 1-1/2 hours after the introductin of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. The Engineer may allow a longer time, provided the setting time of the concrete is

increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the final placement as rapidly as practicable by methods that will prevent segregation of the aggregates or loss of mortar.

Grout mix shall not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation.

The grout mix shall not be placed until the rock riprap has been inspected and approved by the Engineer.

Rock to be grouted shall be kept wet for at least 2 hours immediately prior to grouting.

The rock riprap shall be flushed with water to remove the fines from the rock prior to placing the grout. The rock shall be kept moist just ahead of the actual placing, but the grout shall not be placed in standing or flowing water. Grout placed on inverts or other nearly level areas may be placed in one course. On slopes, the grout shall be placed in two (2) courses in successive lateral strips approximately ten (10) feet in width starting at the toe of the slope and progressing to the top. The grout shall be delivered to the place of final deposit by approved means and discharged directly on the surface of the rock, using a splash plate of metal or wood to prevent displacement of the rock directly under the discharge. The flow of grout shall be directed with brooms, spades or baffles to prevent it from flowing excessively along the same path and to assure that all intermittent spaces are filled. Sufficient barring shall be done to loosen tight pockets or rock and otherwise aid the penetration of grout so that all voids shall be filled and the grout fully penetrates the rock blanket. All brooming on slopes shall be uphill and after the grout has stiffened, the entire surface shall be rebroomed to eliminate runs and to fill voids caused by sloughing.

After completion of any strip or panel, no workman or other load shall be permitted on the grouted surface for a period of twenty-four (24) hours. The grouted surface shall be protected from injurious action by the sun, rain, flowing water and mechanical injury.

10. CURING AND PROTECTION

The surface of treatment materials shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied as specified below. Moisture shall be maintained by sprinkling, flooding or fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand or other approved material. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

The grouted rock may be coated with an approved curing compound in lieu of continued application of moisture. The compound shall be sprayed on the moist concrete surfaces as soon as free water has disappeared, but shall not be applied to any surface until finishing of that surface is completed. The compound shall be applied at a uniform rate of not less than one gallon per 150 square feet of surface and shall form a continuous adherent membrane over the entire surface. Curing compound shall not be applied to surfaces requiring bond to subsequently placed concrete. If the membrane is damaged during the curing period, the damaged area shall be resprayed at the rate of application specified above.

Grout mix shall not be placed when the daily minimum temperature is less than 40°F unless facilities are provided to insure that the temperature of the materials is maintained at not less than 50°F nor more than 90°F during placement and the curing period. Grout mix shall not be placed on frozen surfaces. When freezing conditions prevail, rock to be grouted must be covered and heated to a range of 50°F to 90°F for at least 24 hours prior to placing treatment materials.

11. INSPECTING AND TESTING FRESH GROUT

The Engineer will inspect and test grout during the course of the work. Sampling of fresh grout will be done by the methods prescribed in ASTM Designation C 172. The volume of each batch will be determined by the methods prescribed in ASTM Designation C 138. The Engineer shall have free entry to all parts of the Contractor's plant and equipment which concern mixing and placing the grout while work on the contract is being performed. Proper facilities shall be provided for the Engineer to inspect materials and processes used in mixing and placing the grout as well as for securing samples of the grout mix. All tests and inspections shall be so conducted as not to interfere unnecessarily with the mixing and placing of the grout.

When ready-mixed grout is furnished, the Contractor shall furnish to the Engineer a statement-of-delivery ticket for each batch delivered to the job site. The ticket shall show the total weights in pounds of cement, water, and fine and coarse aggregates, amount of air-entraining agent, time of loading, and the revolution counter reading at the time of batching.

12. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of grouted rock riprap, including filter layers or bedding, will be determined from the specified thickness shown on the drawings and the area on which acceptable placement has been made. Payment for grouted rock riprap will be made at the contract unit price. Such payment will be considered full compensation for all

labor, materials, equipment and all other items necessary and incidental to the completion of the grouted rock riprap and filter layers or bedding.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in he payment for the itme of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 13 of this specification.

13. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 17, Grouted Rock Riprap

(1) This is item shall consist of furnishing and placing of all grouted rock riprap as shown on the drawings.

(2) The rock shall be graded as follows:

Particle Size (inch)	Percent Passing (By Dry WT).
12	100
9	40-85
6	10-50
3	0-5

(3) In section 6, Design of the grout Mix, the contractor shall be responsible for proportioning the mix. The grout shall consist of portland cement, fine and coarse aggregate, water, and an air entraining agent. The cement content shall be 5 1/2 bags per cubic yard of concrete. The maximum nominal size of coarse aggregate shall be 3/4 inch. The slump shall be within the range of 6 to 10 inches. The air content (by volume) of the grout mixture at the time of placement shall be five(5) to seven(7) percent. At least five(5) days prior to placement of grout, the contractor shall furnish the Engineer with a statement of the mix proportions for approval.

(4) Cement shall be type II or IIA

(5) The grout mix shall be integrally colored. The colored grout shall blend with the natural earth tones at the site and may be produced using Davis Colors' Harvest Goldenrod additive at two(2) pounds per sack of cement or similar quality products produced by Colorful Admixtures or L.M. Scofield. The color tone of the grout mix shall be approved by the Engineer prior to full production.

CONSTRUCTION SPECIFICATION

81. METAL FABRICATION AND INSTALLATION

1. SCOPE

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

2. MATERIALS

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

3. FABRICATION

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

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

4. ERECTION

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

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

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

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

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

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

5. PROTECTIVE COATINGS

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

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

6. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

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7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Metal Fabrication

(1) This item shall consist of providing and fabricating the steel trash racks and animal guards for the Maintenance Road Drains, metal fabricated channel guides for the tailwater inlet structure, animal guards for the 42-inch CMP outlet and 18-inch by 24-inch Aluminum arch pipe, and the Identification Marker

(2) Steel for trash rack fabrication, and animal guards shall consist of a minimum grade 60 rebar and size as specified in the drawings.

(3) All welding electrodes shall conform to AWS A5.1 or A5.5 E70XX.

(4) Field welding shall only be permitted as approved by the Contracting Officer.

(5) All fabricated parts shall be galvinized.

(6) No separate payment will be made for metal fabrication. Compensation for this work will be included in payment for Bid Item 13, Maintenance Road Drains; Bid Item 14, 42-inch CMP outlet, Bid Item 15, Farm Tailwater Drain; Bid Item 16, Aluminum Arch Pipe; and in Bid Item 19, Identification Marker.

CONSTRUCTION SPECIFICATION

82. CLEANING AND PAINTING METALWORK

1. SCOPE

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

2. PAINTS

For the purposes of this specification paints shall be designated by types as defined below:

Type 1 paint shall conform to the requirements of Federal Specification TT-P-86, Type IV, Red Lead Base Paint.

Type 2 paint shall conform to the requirements of Military Specification MIL-P-23377D, Int. Amend. 2, Epoxy Chromate Metal Primer.

Type 3 paint shall conform to the requirements to Federal Specification TT-P-86, Type II, or Type III, Red Lead Base Paint.

Type 4 paint shall conform to the requirements of Federal Specification TT-P-86, Type I, Read Lead Base Paint.

Type 5 paint shall conform to the requirements of Federal Specification TT-P-636, Synthetic Primer.

Type 6 paint shall conform to the requirements of Military Specification MIL-C-22750D Amend. 1, Epoxy-Polyamide.

Type 7 paint shall conform to the requirements of Federal Specification TT-E-489, Class A, Alkyd Gloss Enamel.

Type 8 paint shall conform to the requirements of Federal Specification TT-E-529, Alkyd Semi Gloss Enamel.

Type 9 paint shall conform to the requirements of Federal Specification TT-P-641, Type I or Type II, Zinc Dust-Zinc Oxide Primer.

Type 10 paint shall be a single package moisture cured urethane primer in a silver metallic color.

Type 11 paint shall conform to the requirements of Federal Specification TT-P-641, Type III Zinc Dust-Zinc Oxide Primer; Federal Specification TT-P-1046a, Zinc Dust Chlorinated Rubber; or Zinc Dust Paint meeting the requirements of Military Specification MIL-P-21035.

Type 12 paint shall conform to the requirements of Department of Defense Specification DOD-P-15145B, Epoxy-Polyamide.

Type 13 paint shall conform to the requirements of Material Specification 583. The paint shall be mixed at the time of use.

Paints of Types 1, 3, and 5 may be thinned with mineral spirits as necessary for proper application but the amount of thinner used shall not exceed one pint per gallon of paint. Other paints may be thinned in accordance with the manufacturer's instructions only if such thinning is approved by the Engineer.

When tinting is required, it shall be accomplished by the addition of pigment-in-oil tinting colors conforming to the requirements of Federal Specification TT-P-381.

Mineral spirits shall conform to the requirements of Federal Specification TT-T-291, Grade 1, Light Thinner.

3. SURFACE PREPARATION

Surfaces to be painted shall be thoroughly cleaned prior to the application of the paint. For the purposes of this specification methods of surface preparation shall be designated as defined below:

Method 1 (near white blast) surface preparation shall consist of the removal of all grease and oil by means of steam cleaning or solvent cleaning methods and removal of all dirt, rust, mill scale and other coatings by means of sandblasting, grit blasting or pickling. The finished surface shall uniformly expose the base metal and shall present an etched, but not polished or peened, appearance. Not more than 5 percent of the surface may exhibit very light shadows, light streaks, or slight discolorations caused by rust stain, mill scale oxides, or slight, tight residues of paint or coating.

Method 2 (hand tool clean) surface preparation shall consist of the removal of all grease and oil by means of steam cleaning or solvent cleaning and the removal of all dirt, surface rust and loose scale by means of wire brushing, flame cleaning, use of rotary abrading tools or light sandblasting.

Method 3 (acid clean) surface preparation shall consist of the treatment of the surface with a dilute acid solution. The surface shall be thoroughly wetted with a dilute (about 5 percent strength) phosphoric acid solution. After the acid has dried, the surface shall be thoroughly rinsed with clear water and allowed to dry. Dirt, grease and oil shall be removed from the surface by solvent cleaning prior to the acid treatment.

Cleaning solvent shall be mineral spirits. Cleaning cloths and solvents shall be discarded before they become contaminated to the extent that a greasy film would remain on the surface being cleaned.

The final cleaning and wiping shall be done with clean solvent and clean cloths. Grit blasting shall be accomplished using compressed air blast nozzles and grit made of steel, malleable iron or cast iron crushed shot. Abrasives used shall have a maximum particle size that will pass the No. 16 sieve (U.S. Standard) and a minimum size that will be retained on the No. 50 sieve (U.S. Standard). The equipment used for sandblasting shall be equipped with adequate separators and traps to insure that the compressed air shall be free of detrimental amounts of water and oil. Blast cleaned surfaces shall be brushed, blown or vacuum cleaned to remove any trace of blast products or abrasives prior to painting.

Surfaces that are not to be painted immediately after cleaning shall be treated with one brush coat of metal conditioner conforming to the requirements of Military Specificaiton MIL-M-10578, except that surfaces cleaned by pickling in phosphoric acid solution shall not require such treatment.

Surfaces shall be thoroughly dry when paint is applied.

No field coats of paint shall be applied until the prepared surfaces have been inspected and approved by the Engineer.

4. PAINT SYSTEMS

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

Paint System A shall consist of the preparation of the surfaces to be painted by Method 1 and the application of two priming coats of Type 1 or Type 2 paint and two or more top coats of Type 6 paint as necessary to provide a total dry paint film thickness of 6 mils.

Paint System B shall consist of the preparation of the surfaces to be painted by Method 1 and the application of one priming coat of Type 1 or Type 2 paint and two top coats of Type 6 paint.

Paint System C shall consist of the preparation of the surfaces to be painted by Method 2 and the application of one priming coat of Type 3, Type 4 or Type 5 paint and two top coats of Type 7 or Type 8 paint.

Paint System D shall consist of the preparation of the surfaces to be painted by Method 2 and the application of one priming coat of Type 3 or 5 paint and two top coats of Type 7 paint.

Paint System E shall consist of the preparation of the surfaces to be painted by Method 2 and the application of one priming coat of Type 3 or Type 5 paint and two top coats of Type 8 paint.

Paint System F shall consist of the preparation of the surfaces to be painted by Method 3 and the application of two coats of Type 9 or 10 paint.

Paint System G shall consist of the preparation of the surfaces to be painted by Method 3 and the application of two coats of Type 11 or 12 paint.

Paint System H shall consist of the preparation of the surfaces to be painted by Method 1 and the application of four or more coats of Type 1 paint as necessary to provide total dry paint film thickness of 6 mils.

Paint System I shall consist of the preparation of the surfaces to be painted by Method 1 and the application of two or more coats of Type II paint as neccessary to provide a total dry paint film thickness of at least 16 mils.

5. APPLICATION OF PAINT

Surfaces shall be painted immediately after preparation (or within two days after preparation and treatment with metal conditioner) with at least one coat of the type of priming paint required by the specified paint system. Surfaces not required to be painted shall be protected against contamination and damage during the cleaning and painting operation.

Paints shall be thoroughly mixed at the time of application.

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

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

The drying time between coats shall be prescribed by the manufacturer of the paint but not less than that required for the paint film to dry through. The elapsed time between the application of the first and second prime coats of Paint System A shall not exceed 60 hours. In the application of Paint System I, if, for any reason, the first dries hard

before the second coat is applied or the elapsed time between coats exceeds 48 hours, the method of application must be modified in any of the following ways: (1) the first coat must be wiped down with MIBK with the application of the second coat following the wipedown by not more than 6 feet; or (2) the first coat must be lightly brush blasted or given a fog coat of the paint before application of the full second coat; or (3) a special bonding additive supplied by the paint manufacturer must be mixed with the paint applied in the second coat.

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

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

Except for Paint System I, the first coat of each two-coat system shall be tinted for contrast. The first coat of red-lead paint shall be tinted by the addition of 3 ounces per gallon of 1B black pigment. The first coat of machinery paint shall be tinted off color with 3 ounces per gallon of a pigment suitable to the color of the paint.

6. ATMOSPHERIC CONDITIONS

Paint shall not be applied with the temperature of the item to be painted or if the surrounding air is less than 50°F. For Paint System I, the temperature of the coated surface must be maintained at not less than 50°F for 6 hours after the application of each coat. Painting shall be done only when the humidity and temperature of the surrounding air and the temperature of the metal surfaces are such that evaporation rather than condensation will result during the period of time required for application and drying. Surfaces protected from adverse atmospheric conditions by special cover, heating or ventilation shall remain so protected until the paint is dry.

7. TESTS

Acceptance of dry paint film thickness for Paint Systems A, H, and I will be based on the measurement of wet paint film thickness by means of an Elcometer or other suitable film thickness gauge. Other testing instruments employed by the Engineer may include an inspedtor thickness guage (dry film thickess) and a pin-hole detector.

8. PAYMENT

For items of work for which specific lump sum prices are established in the contract, payment for painting metalwork will be at the contract lump sum price. Such payment will consititute full compensation for furnishing, preparing and applying all materials and for the cleaning,

painting and coating of metal work including labor, tools, equipment and all other items necesary and incidental to the completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 9 of this specification.

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9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Cleaning and Painting Metal Work

(1) This item shall consist of painting the identification marker.

(2) Paint system E shall apply to the identification marker. The two topcoats of paint on the identification marker shall be white and the letters painted dark green.

(3) No separate payment will be made for cleaning and painting metal work. Compensation for this work will be included in Bid Item 18, Identification Marker.

CONSTRUCTION SPECIFICATION

93. IDENTIFICATION MARKERS OR PLAQUES

1. SCOPE

The work shall consist of furnishing and installing identification markers or plaques at the designated locations.

2. MATERIALS

The markers or plaques shall be constructed of the specified materials, and shall meet all requirements for lettering, painting, finishing, and related items as shown on the drawings or as specified in Section 6 of this specification.

3. CONSTRUCTION METHODS

The markers or plaques shall be installed at locations and in the manner or condition specified.

4. MONUMENTS

Unless otherwise specified the markers or plaques shall be mounted on concrete monuments or on existing structures. The monuments shall be of the type, kind, and size and located as specified.

5. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, payment for each type, kind, and size of marker or plaque complete in place, will be made at the contract unit price for that type, kind, and size.

For items of work for which specific lump prices are established in the contract, payment for identification markers or plaques will be made at the contract lump sum price.

Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subisdiary. Such items and the items to which they are made subsidiary are identified in Section 6 of this specification.

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6. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 18, Identification Marker

(1) This item shall include the fabrication and installation of the identification signs including anchor posts, as shown on the drawings.

(2) Painting shall be in accordance with construction specification 82.

(3) Measurement and payment shall include compensation for subsidiary items, concrete class 2500, cleaning and painting metalwork, and traffic control device.

b. Subsidiary Item, Traffic Control Device

(1) This item shall consist of furnishing two standard reflective signs, with steel posts, and concrete anchor posts as described in this specification and shown on the drawings.

(2) Single perforated posts shall be 2" x 2" square tube frabricated from 0.105-inch U.S.S. gauge cold-rolled sheet carbon steel conforming to the requirements of ASTM A 366. Bolts, nuts and washers shall conform to the requirements of ASTM A 307, Grade A.

(3) Posts shall be galvanized in accordance with Material Specification 582 or in accordance with ASTM A525, coating designation G-90. Bolts, nuts and washers shall be zinc coated in accordance with the requirements of ASTM A 153 or cadmium plated in accordance with the requirements of ASTM A 165.

(4) No separate payment will be made for traffic Control Device. Compensation will be included in Bid Item 18, Identification Marker.

CONSTRUCTION SPECIFICATION

94. CONTRACTOR INSPECTION

1. Scope

The work shall consist of providing all equipment, materials, labor and services necessary to ensure that the specified quality is maintained on all work performed. The Contractor shall be responsible for the day-to-day quality control.

2. Equipment and Materials

Equipment for materials testing shall be of the quality and condition required to meet the test specifications cited in the contract references. Equipment shall be in good condition and properly adjusted. Calibration of equipment shall be done at the frequency specified in Section 8. Records of equipment calibration tests shall be available to the government at all times. Nuclear devices shall be operated and maintained by qualified operators and as prescribed by applicable state and federal regulations.

Materials include but shall not be limited to: sand for density tests, bound field books and forms for record-keeping, concrete specimen molds, and all other equipment and materials prescribed by the test procedures referenced in the contract.

The quality of materials used in quality control testing and the equipment employed shall: meet the appropriate standards specified and the standards of the industry, be appropriate for its intended use, and provide the accuracy specified by the contract requirements unless otherwise specified in Section 8 of this specification.

3. Inspection Personnel

Inspections and materials testing shall be accomplished by qualified personnel: a licensed engineering firm, testing laboratory, certified inspection technicians, or licensed and experienced personnel from the contractor's organization. The contractor's written inspection plan shall identify the names and qualifications, training, and experience of all quality control personnel who will actually be performing the inspection and quality control work.

4. Inspection System

The Contractor shall develop and conduct an inspection system adequate to maintain quality control of all work performed and materials and equipment used. The inspection system established shall be based upon a plan and implemented by the necessary mobilization of personnel, equipment and materials. Inspection shall include the initial work needed to verify

adequacy of completed work and provide controls for any corrective work. The inspection system and records to substantiate daily conduct of the system shall be kept by the Contractor and are subject to review by the Contracting Officer, at any time.

The Contrctor's inspection system shall cover all aspects of quality control and shall specifically address any testing and inspection requirements detailed in Section 8 of this specification. The planned inspection system shall also identify the Contractor's primary quality control manager and provide an organizational listing of the individual quality control personnel and their specific duties, experience and qualifications.

If the government's quality assurance inspections indicate that the contractor's inspection system is not adequate or is not producing the desired results, corrective actions shall be taken by the Contractor in both the inspection system, its plan and the work. The Contracting Officer may direct that changes be made in the inspection system including, but not limited to, the removal of unsatisfactory quality control personnel.

5. Pre-Construction Conference

After the contract is awarded and before construction operations are started the Contractor shall meet with the Contracting Officer and discuss the contractor's inspection plan. The meeting shall develop a mutual understanding regarding inspection details including the form of documentation to be used for recording the quality control operations, inspections, management procedures and the interrelationship of Contractor and government inspection efforts. The finalized plan will be approved by the Contracting Officer and it shall become a part of the contract.

6. Records

The inspection records shall be kept daily and shall document both acceptable and deficient features of the work. They shall include complete records of required material tests, submittal and approval of shop drawings, manufacturer's recommendation and certifications, and a complete record of materials delivery, quality examination, certification and storage. Tests performed by the Contractor (including sub contractors) shall be a part of the record. All records shall be on forms acceptable to the Contracting Officer and shall be legible, properly dated and identified as to the responsible tester, the material or item tested, and its location of placement in the structure. In addition, these records shall include factual evidence that required activities or tests have been performed, including but not limited to the following:

1. Type and number of control activities and tests involved and the location (elevation, station and offset) of the work tested.

2. Result of control activities or tests.

3. Method of testing used (e.g. citation of reference specification).

4. Nature of defects, cause for rejection, etc.

5. Proposed remedial action.

6. Corrective actions taken and quality control testing.

7. Measurement and Payment

For items of work for which lump sum prices are established in the contract, payment for contractor inspection will be made at the contract lump sum price. such payment shall constitute full compensation for all labor, materials, equipment, transportation and all other items necessary and incidental to completion of the work. Progress estimates for payment of this bid item will be based on the percent completion of all contract items (dollar value) used in preparing the regular progress payments.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary are identified in Section 8 of this specification.

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8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 19, Contractor Inspection

1. This item shall consist of furnishing the personnel, equipment and material required by the Contractor to perform the testing and inspection that is necessary to implement an inspection system that will insure the specified quality is being maintained for:

   (a) Channel Excavation, Structure Excavation, and Trench Excavation.
   (b) Earthfill, Structure Backfill, and Pipe Backfill.
   (c) Grouted Rock Riprap.
   (d) Concrete Class 2,500 and Class 4,000.
   (e) Steel Reinforcement.
   (f) Drainfill and Gravel Cover.
   (g) All Concrete Pipe and CMP.

2. The moisture-density determinations required for the quality control of earth fill, structure backfill and pipe backfill shall be performed in accordance with Method A, ASTM D 698 (Standard Proctor Test) or Test No. S-6 (Rapid Compaction Control Method) as described in Section 19 of the SCS National Engineering Handbook.

3. Prior to establishing fill production operations, it shall be demonstrated and verified by test results that the proposed equipment fleet is capable of producing fill of the quality specified.

4. For production operations the initial moisture-density test frequency shall be one (1) test per 2,000 cubic yards of compacted earthfill and one (1) test per each 500 cubic yards of compacted structure backfill and pipe backfill. When approved by the Contracting Officer, the testing frequency may be modified as the job progresses, provided the quality of the fill is consistant or when the testing frequency is not compatible with the daily production.

5. The plasticity and classification of the fill material shall be determined whenever a significant difference in fill material is encountered or 25,000 cubic yards, whichever occurs first.

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6. The gradation of drainfill and gravel cover shall be determined in accordance with ASTM C 136 and C 117. The testing plan shall include those tests and inspections required during the processing or importation operation to verify that the processed material is within the specified limits. During placement operations one (1) sieve analysis of the in-place drainfill will be performed, and for each 500 cubic yards of placed gravel cover. Sieve analysis will be performed at more frequent intervals whenever the tested in-place material does not meet the gradation requirements, or visual inspections indicate the need to increase the frequency.

7. A sufficient number of tests shall be performed during the processing of the rock being supplied for the grouted rock riprap to insure that the rock meets the specified gradation before delivery. A minimum of two (2) tests will be performed at the site. Rock having the specified gradation shall be placed in a specific location for use as a visual reference. The grout shall have a minimum of one (1) slump test and one (1) air content test performed for every one hundred (100) cubic yards of grout delivered to the site or once a day, whichever results in the greater number of tests. Five sets of cylinders will be made to monitor strength.

8. The quality control for concrete Class 4000 and Class 2500 shall include the sampling and testing of fresh concrete for the purpose of determining the air content, temperature, slump, and the molding of compression test specimens. Minimum testing shall include 4 standard compression tests and one (1) air content test per day of concrete placement, and temperature and slump tests for every truckload. When approved by the Contracting Officer these test frequencies may be modified to fit job conditions. Inspection will be per Construction Specification 31, Drawings, and SCS reference, NEH Section 19.

9. The placing of steel reinforcement shall be monitored by quality control personnel. Prior to scheduling the delivery of concrete, a certification that all bars are the correct size and positioned as specified shall be given to the Contracting Officer.

10. The installation of all concrete pipe and CMP pipe shall be monitored by quality control personnel for proper size, quality, and installation.

11. Testing equipment shall be calibrated after it is delivered to the site and whenever erratic or unreasonable test results are being obtained.

The sand used for testing fill densities shall be calibrated whenever there is a change in the humidity or lot of sand.

12. Suitable lab facilities will be set up at the site and will be used exclusively for testing purposes.

13. The Contractor shall designate an experienced quality control manager and inspection staff whose primary responsibility will be implementing the inspection system. The manager shall be on site during major construction activities and will not be involved in directing production oriented activities unless it pertains to achieving the specified quality for the work being performed.

14. The names and qualifications of proposed quality control personnel shall be submitted to the Contracting Officer for review and approval prior to the pre-construction conference. Any changes in quality control personnel will require the approval of the Contracting Officer.

15. Copies of all test results and inspection reports (visual inspections of earthwork and concrete form works, steel placement verifications, concrete placement, etc.), required by the approved inspection plan shall be submitted to the Contracting Officer within 24 hours of when the test or inspection report is completed and certified.

CONSTRUCTION SPECIFICATION

202. GRAVEL COVER

1. SCOPE

The work shall consist of the construction of gravel cover over slopes or on other areas that are subject to erosion.

2. MATERIALS

Gravel shall meet the requirements of Section 8 of this specification or be obtained from designated sources as shown on the drawings. Gravel from designated sources shall be excavated, selected, handled, and processed as necessary to meet the quality and grading requirements specified.

3. SUBGRADE PREPARATION

The subgrade surfaces shall be the neat lines and grades shown on the drawings.

Gravel cover shall not be placed until the subgrade surfaces have been inspected and approved by the Engineer.

4. PLACEMENT

The gravel cover shall be placed by equipment on the surfaces and to the depths specified in Section 8 of this specification. The cover shall be constructed to the full coarse thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. The gravel shall be delivered and placed in a manner that will ensure that the cover in-place shall be reasonably homogeneous and the fractions well distributed.

Hand placing of gravel cover shall be required to the extent necessary to prevent damage to the permanent works.

The gravel cover may be placed in sequence with the placement of earth fill zones of the embankment or after completion of the embankment. If sequential placement is used, it is emphasized that the Contractor shall complete the earthwork to the required cross-sectional line and grade prior to gravel cover placement. Contamination of earth fill zones by gravel cover placement operations will not be allowed. Surfaces of the completed gravel cover shall be finished reasonably free of mounds, dips, or windrows to the lines and grades specified.

5. COMPACTION AND MOISTURE REQUIREMENTS

No compaction will be required beyond that resulting from the placing and spreading operations unless otherwise specified in Section 8 of this

specification. Moisture control shall be that necessary to control dust during borrow and placing operations.

6. TESTING AND MEASUREMENTS

The Engineer will perform such tests and measurements as are required to verify that the gravel material and work meet the requirements of this specification. These tests are not intended to provide the Contractor with the information he needs to assure that the materials and workmanship meet the requirements of this specifications, and their performance will not relieve the Contractor of the responsibility of performing his own tests for the purpose.

7. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of the gravel will be measured within the specified pay limits and computed to the nearest cubic yard by the method of average cross-sectional end areas. Such payment will be considered full compensation for all labor, materials, equipment, and all other items necessary and incidental to the placement of the gravel.

Compensation for any items of work described in the contract but not listed in the Bid Schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

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6. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 20, Gravel Cover

(1) This item shall consist of furnishing and installing the gravel cover to the depth and locations as shown on the plans.

(2) The gravel cover shall be a 50/50 mix of coarse and fine aggregate with gradations in accordance to ASTM C-33. Coarse aggregate shall be size No. 57.

(3) At least 30 days prior to delivery of the gravel, the Contractor shall designate, in writing, the source from which he intends to obtain the rock, and information satisfactory to the Contracting Officer that the material meets the requirements of the contract. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing.

MATERIAL SPECIFICATION

521. AGGREGATES FOR DRAINFILL AND FILTERS

1. SCOPE

This specification covers the quality of mineral aggregates for the construction of drainfill and filters.

2. QUALITY

Drainfill and filter aggregates shall be sand, gravel or crushed stone or mixtures thereof. They shall be composed of clean, hard, durable mineral particles free from organic matter, clay balls, soft particles or other substances that would interfere with their free-draining properties.

Aggregates of crushed limestone shall be thoroughly washed and screened. Course aggregate containing crushed limestone shall have not more than 3 percent by weight of particles finer than the No. 4 sieve. Crushed limestone shall not be used for fine aggregates except in combination with other materials such that not more than 5 percent of the portion finer than the No. 4 sieve shall be crushed limestone.

Aggregates shall be tested for soundness according to ASTM Method C 88, and shall have a weighted average loss in five cycles of not more than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

3. GRADING

Drainfill and filter aggregates shall conform to the specified grading limits after being placed in the work, and after being compacted if compaction is specified. Grading shall be determined by ASTM Method C 136. The percentage of material finer than the No. 200 sieve shall be determined by the method in ASTM Designation C 117.

4. STORING AND HANDLING

Drainfill and filter aggregates shall be stored and handled by methods that prevent segregation of particle sizes or contamination by mixing with other materials.

MATERIAL SPECIFICATION

522. AGGREGATE FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of fine aggregate and coarse aggregate for use in the manufacture of portland cement concrete.

2. QUALITY

Aggregate shall conform to the requirements of ASTM Specification C-33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when: (1) the specified alternate conditions of acceptance can be proved prior to the use of the aggregates on the job and within a period of time such that no work under the contract will be delayed by the requirements of such proof; or, (2) the specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

3. REACTIVITY WITH ALKALIES

The potential reactivity of aggregates with the alkalies in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM Designation C 289, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM Specification C 33, Appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used, except under one of the following conditions:

a. Applicable test results of mortar bar tests, made according to ASTM Method C 227, are available which indicate an expansion of less than 0.10 percent at six months in mortar bars made with cement containing not less than 0.8 percent alkalies expressed as sodium oxide; or

b. Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with "low alkali" cement, containing less than 0.60 percent alkalies expressed as sodium oxide.

4. STORING AND HANDLING

Aggregate of each class and size shall be stored and handled by methods that prevent segregation of particles sizes or contamination by intermixing with other materials.

MATERIAL SPECIFICATION

523. ROCK FOR RIPRAP

1. SCOPE

This specification covers the quality of rock to be used in the construction of rock riprap.

2. QUALITY

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Except as provided below, the rock shall have the following properties:

a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5.

b. Absorption not more than 2 percent.

c. Soundness: Weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

The bulk specific gravity and absorption shall be determined by ASTM Method C 127. The test for soundness shall be performed by ASTM Method C 88 for coarse aggregate modified as follows:

The test sample shall not be separated into fractions. It shall consist of 5000 ± 300 grams of rock fragments, reasonably uniform in size and shape and weighing approximately 100 grams each, obtained by breaking the rock and selecting fragments of the required size.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more pieces.

The report shall show the percentage loss of weight and the results of the qualitative examination.

Rock that fails to meet the requirements stated in a, b, and c above, may be accepted only if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

3. GRADING

The rock shall conform to the specified grading limits after it has been placed in the riprap.

MATERIAL SPECIFICATION

531. PORTLAND CEMENT

1. SCOPE

This specification covers the quality of portland cements.

2. QUALITY

Portland cement shall conform to the requirements of ASTM Specification C 150 for the specified types of cement, except that, when Type I portland cement is specified, Type IS portland blast-furnace slag cement or Type IP portland-pozzolan cement conforming to the requirements of ASTM Specification C 595 may be used unless prohibited in the specifications.

If air-entraining cement is to be used, the Contractor shall furnish the manufacturer's written statement giving the source, amount and brand name of the air-entraining addition.

3. STORAGE AT THE CONSTRUCTION SITE

Cement shall be stored in such a manner as to be protected from weather, dampness or other destructive agencies. Cement that is partially hydrated or otherwise damaged will be rejected.

MATERIAL SPECIFICATION

532. AIR-ENTRAINING ADMIXTURES (FOR CONCRETE)

1. SCOPE

This specification covers the quality of air-entraining admixtures for concrete.

2. QUALITY

Air-entraining admixtures shall conform to the requirements of ASTM Specification C 260, except that the relative durability factor in the freezing and thawing test shall be not less than 95.

MATERIAL SPECIFICATION

533. WATER-REDUCING AND SET-RETARDING ADMIXTURES FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of water-reducing and set-retarding admixtures for portland cement concrete.

2. QUALITY

Water-reducing and set-retarding admixtures shall conform to the requirements of ASTM Specification C 494, except that resistance to freezing and thawing shall be determined in all cases, and the minimum relative durability factor shall be 95.

3. TYPES

Admixtures shall be Type A, Water-Reducing or Type D, Water-Reducing and Retarding, as defined in ASTM Specification C 494.

4. PERFORMANCE IN THE JOB MIX

When added in the manner and amount recommended by the manufacturer to the concrete used on the job, with no change in the cement content or proportions of the aggregates, admixtures shall have the following effects:

Type A or Type D: The water content at the required slump shall be at least 5 percent less with the admixture than without. The air content shall remain within the range specified, but shall not exceed 8 percent in any case.

Type D: The time of initial setting, determined as prescribed in ASTM C 494, shall be from 1 to 3 hours longer with the admixture than without.

MATERIAL SPECIFICATION

534. CURING COMPOUND (FOR CONCRETE)

1. SCOPE

This specification covers the quality of liquid membrane-forming compounds suitable for spraying on concrete surfaces to retard the loss of water during the curing process.

2. QUALITY

The curing compound shall meet the requirements of ASTM Specification C 309.

Unless otherwise specified the compound shall be Type 2.

3. DELIVERY AND STORAGE

All curing compound shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner to prevent damage to the containers and to protect water-emulsion types from freezing.

MATERIAL SPECIFICATION

535. PREFORMED EXPANSION JOINT FILLER

1. SCOPE

This specification covers the quality of preformed expansion joint fillers for concrete.

2. QUALITY

Preformed expansion joint filler shall conform to the requirements of ASTM Specification D 1752, Type I, Type II or Type III, unless bituminous type is specified. Bituminous type preformed expansion joint filler shall conform to the requirements of ASTM Specification D 994, or D 1751.

MATERIAL SPECIFICATION

536. SEALING COMPOUND FOR JOINTS IN CONCRETE AND CONCRETE PIPE

1. SCOPE

This specification covers the quality of sealing compound for filling joints in concrete pipe and concrete structures.

2. TYPE

The compound shall be a cold-application mastic, single component or multiple component type.

The single component type shall be a ready-mixed nondrying compound furnished in troweling consistency or in preformed rope or strip form.

The multiple component type shall be composed of two or more substances that are to be mixed prior to application.

3. QUALITY

Sealing compound shall conform to the requirements of one of the following specifications:

ASTM Specification D 1850; Concrete Joint Sealer, Cold-Application Type. Penetration, determined as specified in ASTM D 1850, shall be not greater than 120.

Federal Specification SS-S-210A; Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

ASTM Specification D-1190 concrete joint sealer, hot poured elastic type.

Federal Specification TT-S-227; Sealing Compound: Elastomeric Type Multi-Component (for Caulking, Sealing, and Glazing in Buildings and other Structures), Type II.

The compound shall be capable of being applied at a temperature of 70°F and shall be of such nature that it will adhere to dry, dust free concrete when applied either directly or over a suitable primer. After curing it shall be a resilient, adhesive material that is capable of filling joints and firm enough to prevent the entry of subsequently placed concrete or of earth during the bedding, cradling, or backfilling operations.

4. COMPOSITION AND PROPERTIES

The compound, if used for pipe having rubber gaskets, shall have a composition such that it will not cause deterioration of the rubber gaskets.

MATERIAL SPECIFICATION

537. NON-METALLIC WATERSTOPS

1. SCOPE

This specification covers non-metallic waterstops for use in joints of concrete structures.

2. CLASSIFICATION

a. Classes. Non-metallic waterstops shall be of the following classes, as specified:

Class I shall be made of either natural or synthetic rubber.

Class II shall be made of vinyl chloride polymer or copolymer.

b. Types. Non-metallic waterstops may be either split or solid and shall conform to the following types, as specified (see Figure 1):

Type A shall have ribbed anchor flanges and a smooth web. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type B shall have ribbed anchor flanges and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to at least one-half the web thickness and (2) the inside diameter (D) specified in the contract. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type C shall have a single, circular, bulb-type anchor flange at each edge and a smooth web.

Type D shall have a single, circular, bulb-type anchor flange at each edge and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to at least one-half the thickness of the web and (2) the inside diameter (D) specified in the contract.

Type E shall have ribbed anchor flanges and a web molded or extruded in the form of a round or U-shaped bulb of the dimensions specified in the contract. The web bulb shall be connected at the open end of the "U" by a thin membrane (having a thickness of not less than 1/64-inch or more than 1/5 the web thickness) designed to: (1) prevent infiltration of wet concrete into the bulb and (2) tear when expansion of the joint occurs. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges. Auxiliary positioning or nailing flanges may be provided so long as they do not interfere with the functioning of the web bulb.

Type F shall have ribbed anchor flanges with at least two extra heavy ribs (designed to resist displacement of the waterstop during placement of concrete) on each flange and a smooth web having a positioning or nailing flange attached at the center.

Type G shall be of special design conforming to the details shown on the drawings.

c. Sizes. Waterstops of Types A through F shall be of the sizes listed herein, as specified (see Table 1). Type G waterstops shall have the dimensions shown on the drawings.

3. PHYSICAL REQUIREMENTS

The extruded or molded materials shall exhibit the properties specified herein when tested by the methods specified in Section 4 of this specification.

a. Class I Waterstops

(1) The hardness (Shore A durometer) shall be not less than 60.

(2) The specific gravity shall be not more than 1.2.

(3) The tensile strength shall be not less than 2500 pounds per square inch.

(4) The ultimate elongation shall be not less than 450 percent.

(5) The compression set shall be not more than 30 percent.

(6) The water absorption (by weight) shall be not more than 5 percent.

(7) The decrease in tensile strength and ultimate elongation after aging shall be not more than 20 percent.

(8) There shall be no sign of failure due to brittleness at a temperature of minus 35°F.

b. Class II Waterstops

(1) The hardness (Shore A durometer) shall be not less than 60.

(2) The specific gravity shall be not more than 1.4.

(3) The tensile strength shall be not less than 1400 pounds per square inch.

(4) The ultimate elongation of the web shall be not less than 280 percent and that of the flanges shall be not less than 200 percent.

(5) There shall be no sign of failure due to flange brittleness at a temperature of 0°F nor of web brittleness at a temperature of minus 35°F.

(6) The decrease in either tensile strength or ultimate elongation after accelerated extraction shall be not greater than 15 percent.

(7) As a result of the effects of alkalies:

(a) After immersion for 7 days, the sample shall exhibit no loss of weight and not more than 0.25 percent increase in weight, and the hardness (Shore A) of the treated sample shall differ from that of the untreated sample by not more than plus 5 points or minus 5 points.

(b) After immersion for 30 days, the sample shall exhibit no loss of weight and not more than 0.40 percent increase in weight, and the dimensions of the treated sample shall not differ from those of the untreated sample by more than one percent.

4. TEST METHODS

Testing shall be done by the methods cited herein. All cited test methods are included in Federal Test Method Standard No. 601.

a. Hardness shall be determined by Method 3021.

b. Specific gravity shall be determined by Method 14011.

c. Tensile strength shall be determined by Method 4111.

d. Ultimate elongation shall be determined by Method 4121.

e. Compression set shall be determined by Method 3311.

f. Water absorption shall be determined by Method 6631.

g. Tensile strength and ultimate elongation after aging shall be determined by Method 7111.

h. Brittleness shall be determined by Method 5311-1.

i. Accelerated extraction shall be accomplished by Method 6111 under the following conditions:

(1) Samples shall be not less than 1/16-inch nor more than 1/8-inch in thickness;

(2) The immersion medium shall be a solution made by dissolving 5 grams of chemically pure sodium hydroxide and 5 grams of chemically pure potassium hydroxide in one liter of distilled water;

(3) The samples shall be immersed in the medium for 14 days at a temperature of 145° ± 5°F;

(4) During the immersion period, air shall be gently bubbled through the medium from a 1/4-inch glass tube at a rate of about one bubble per second;

(5) Fresh medium shall be substituted every day;

(6) Samples need not be dipped in acetone.

j. The effects of alkalies shall be determined by Method 6251 under the following conditions:

(1) Sample shall be not more than 1/4-inch in thickness;

(2) The immersion medium shall be as described in (i), above;

(3) Fresh medium shall be substituted every 7 days.

(4) The samples shall be immersed in the medium for a period of 30 days;

(5) Samples need not be dipped in acetone.

5. CONDITION

Waterstops shall be extruded or molded in such a manner that the material is dense and homogeneous throughout and free from voids, tears, thins, indentations, or other imperfections. Unless otherwise specified, waterstops shall be symmetrical in shape and uniform in dimensions and shall be furnished in continuous strips at least 50 feet long. Factory splices shall have a tensile strength equal to at least one-half that of the unspliced section.

6. PACKAGING AND STORING

Waterstops shall be packaged and stored by methods that will protect them from prolonged exposure to direct sunlight or excessive heat.

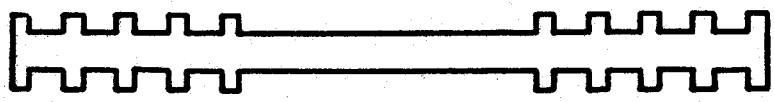
TABLE 1. SIZES OF WATERSTOPS

Size Designation	Web Thickness (T) (Inches)	Width (W) (Inches)
1	1/16	5 1/4
2	3/32	3 3/4
3	3/32	4
4	3/32	5 1/4
5	3/32	6
6	1/8	4
7	1/8	5 1/4
8	1/8	6
9	5/32	4
10	5/32	4 1/2
11	5/32	9
12	3/16	4
13	3/16	5
14	3/16	6
15	3/16	9
16	1/4	6
17	1/4	9
18	3/8	5
19	3/8	6
20	3/8	9
21	1/2	6
22	1/2	9
23	1/2	12

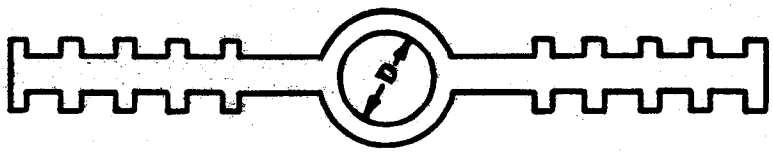
FIGURE 1

TYPES OF NON-METALLIC WATERSTOPS

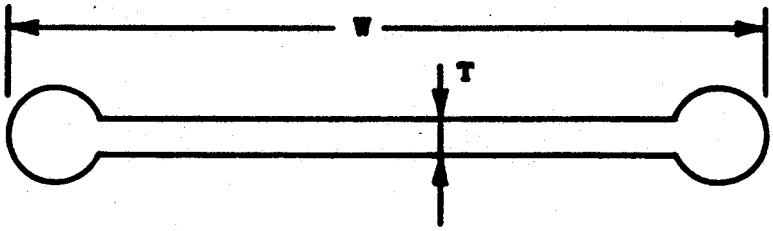
TYPE A



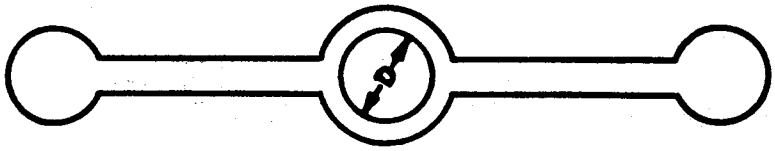
TYPE B



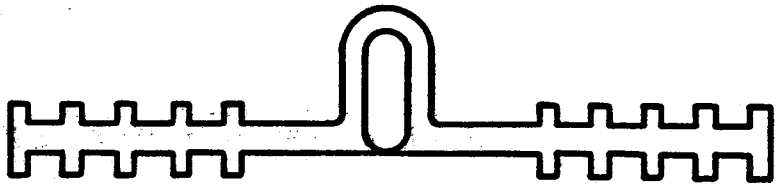
TYPE C



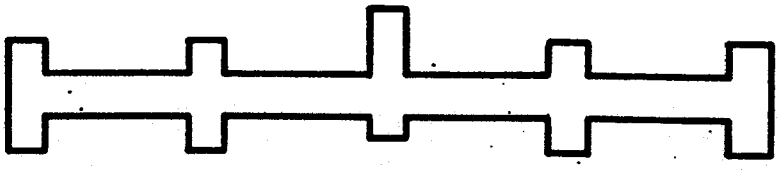
TYPE D



TYPE E



TYPE F



MATERIAL SPECIFICATION

539. STEEL REINFORCEMENT (FOR CONCRETE)

1. SCOPE

This specification covers the quality of steel reinforcement for reinforced concrete.

2. QUALITY

All reinforcement shall be free from rust, oil grease, paint or other deleterious matter.

Steel bars for concrete reinforcement requiring bends shall be deformed billet-steel bars conforming to ASTM Specification A 615, Grade 40 or Grade 60.

Straight steel bars shall be deformed bars conforming to one of the following specifications:

Deformed Billet-Steel Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 615.

Rail-Steel Deformed Bars for Concrete Reinforcement (Grade 50 or Grade 60) - ASTM Designation A 616.

Axle-Steel Deformed Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 617.

Fabricated steel bar mats shall conform to the requirements of ASTM Specification A 184.

Welded steel wire fabric reinforcement shall conform to the requirements of ASTM Specification A 185.

Welded deformed steel wire fabric for concrete reinforcement shall conform to the requirements of ASTM Specification A 497.

Cold-drawn steel wire reinforcement shall conform to the requirements of ASTM Specification A 82.

Deformed steel wire for concrete reinforcement shall conform to the requirements of ASTM Specification A 496.

3. DIMENSIONS OF WELDED WIRE FABRIC

Gauges, spacing and arrangement of wires in welded steel wire fabric shall be as defined in ACI Standard 315 of the American Concrete Institute for the specified style designations.

4. STORAGE

Steel reinforcement stored at the site of the work shall be stored above the ground surface on platforms, skids or other supports and shall be protected from mechanical injury and corrosion.

MATERIAL SPECIFICATION

542. CONCRETE CULVERT PIPE

1. SCOPE

This specification covers the quality of nonreinforced and reinforced concrete culvert pipe.

2. NONREINFORCED PIPE

Nonreinforced concrete culvert pipe shall conform to the requirements of ASTM Specification C 14 for the class of pipe specified.

3. REINFORCED PIPE

a. Round pipe. Round reinforced concrete culvert pipe shall conform to the requirements of ASTM Specification C 76 or ASTM C 655 for the class of pipe specified.

b. Arch pipe. Reinforced concrete arch culvert pipe shall conform to the requirements of ASTM Specifications C 506 for the class of pipe specified.

c. Elliptical Pipe. Reinforced concrete elliptical culvert pipe shall conform to the requirements of ASTM Specification C 507 for the class of pipe specified.

4. REINFORCED BOX SECTIONS

Reinforced concrete box sections shall be manufactured meeting the requirements of ASTM Specifications C 789 or C 850 based on the design specified.

5. RUBBER GASKET JOINTS

When rubber gasket joints are specified, the joints and gaskets shall conform to the requirements of ASTM Specification C 443.

MATERIAL SPECIFICATION

551. ZINC-COATED IRON OR STEEL CORRUGATED PIPE

1. SCOPE

This specification covers the quality of zinc-coated iron or steel corrugated pipe and fittings.

2. PIPE

Zinc-coated iron or steel corrugated pipe and fittings shall conform to the requirements of Federal Specification WW-P-405 for the specified classes and shapes of pipe, and to the following additional requirements:

a. Unless otherwise specified, circumferential shop riveted seams shall have a maximum rivet spacing of 6 inches, except that 6 rivets will be sufficient for 12-inch diameter pipe;

b. When close riveted pipe is specified: (1) the pipe shall be fabricated so that the rivet spacing in the circumferential seams shall not exceed 3 inches, except that 12 rivets will be sufficient to secure the circumferential seams in 12-inch pipe, and (2) in those portions of the longitudinal seams that will be covered by the coupling bands the rivets shall have finished flat heads or the rivets and holes shall be omitted and the seams shall be connected by welding to provide a minimum of obstruction to the seating of the coupling bands.

c. Double riveting or double spot welding for pipe less than 42 inches in diameter may be required. When double riveting or double spot welding is specified, the riveting or welding shall be done in the manner specified for pipe 42 inches or greater in diameter.

3. COATINGS

Coatings shall conform to the requirements of Federal Specification WW-P-405 for the specified types of coatings.

MATERIAL SPECIFICATION

552. ALUMINUM CORRUGATED PIPE

1. SCOPE

This specification covers the quality of aluminum corrugated pipe and fittings.

2. PIPE

Aluminum corrugated pipe and fittings shall conform to the requirements of Federal Specification WW-P-402 for the specified classes and shapes of pipe, and to the following additional requirements:

a. When close riveted pipe is specified: (1) the pipe shall be fabricated so that the rivet spacing in the circumferential seams shall not exceed 3 inches, except that 12 rivets will be sufficient to secure the circumferential seams in 12-inch pipe; and (2) in those portions of the longitudinal seams that will be covered by the coupling bands the rivets shall have finished flat heads or the rivets and holes shall be omitted and the seams shall be connected by welding to provide a minimum of obstruction to the seating of the coupling bands.

b. Double riveting of pipe less than 42 inches in diameter or double spot welding of pipe less than 30 inches in diameter may be required.

When double riveting or double spot welding is specified, the riveting or welding shall be done in the manner specified for pipe of greater diameter.

3. COATINGS

Coatings shall conform to the requirements of Federal Specification WW-P-402 for the specified types of coatings.

MATERIAL SPECIFICATION

581. METAL

1. SCOPE

This specification covers the quality of steel and aluminum alloys.

2. STRUCTURAL STEEL

Structural steel shall conform to the requirements of ASTM Specification A 36.

High-strength low-alloy structural steel shall conform to ASTM Specification A 242 or A 588.

Carbon steel plates of structural quality to be bent or formed cold shall conform to ASTM Specification A 283, Grade C.

Carbon steel sheets of structural quality shall conform to ASTM Specification A 570, Grade D or A 611, Grade D.

Carbon steel strip of structural quality shall conform to ASTM Specification A 570, Grade C.

3. COMMERCIAL OR MERCHANT QUALITY STEEL

Commercial or merchant quality steel shall conform to the requirements of the applicable ASTM specifications listed below:

Product	ASTM Specification
Carbon steel bars	A 575, Grade M 1015 to Grade M 1031
Carbon steel sheets	A 569
Carbon steel strip	A 569
Zinc-coated carbon steel sheets	A 526

4. ALUMINUM ALLOY

Aluminum alloy products shall conform to the requirements of the applicable ASTM specifications listed below. Unless otherwise specified, alloy 6061-T6 shall be used.

Product	ASTM Specification
Standard structural shape	B 308
Extruded structural pipe and tube	B 429

Extruded bars, rods, shapes and tube	B 221
Drawn seamless tubes	B 210
Rolled or cold-finished bars, rods and wire	B 211
Sheet and plate	B 209

5. Bolts

Steel bolts shall conform to the requirements of ASTM Specification A 307. If high-strength bolts are specified they shall conform to the requirements of ASTM Specification A 325.

When galvanized or zinc-coated bolts are specified, the zinc coating shall conform to the requirements of ASTM Specification A 153; except that bolts 1/2 inch or less in diameter may be coated with electrodeposited zinc or cadmium coating conforming to the requirements of ASTM Specification A 164, Type RS, or ASTM Specification A 165, Type TS, unless otherwise specified.

6. RIVETS

Unless otherwise specified, steel rivets shall conform to the requirements of ASTM Specification A 502, Grade 1. Unless otherwise specified, aluminum alloy rivets shall be Alloy 606-T6 conforming to the requirements of ASTM Specification B 316.

7. WELDING ELECTRODES

Steel welding electrodes shall conform to the requirements of American Welding Society specification AWS A5.1. "Specification for Mild Steel Covered Arc-Welding Electrodes," except that they shall be uniformly and heavily coated (not washed) and shall be of such a nature that the coating will not chip or peel while being used with the maximum amperage specified by the manufacturer.

Aluminum welding electrodes shall conform to the requirements of American Welding Society specification AWS A5.10, "Specification for Aluminum and Aluminum-Alloy Welding Rods and Bare Electrodes."

MATERIAL SPECIFICATION

582. GALVANIZING

1. SCOPE

This specification covers the quality of zinc coatings applied to iron and steel products.

2. QUALITY

Zinc coatings shall conform to the requirements of ASTM Specification A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products or as otherwise specified in the items of work and construction details of the Construction Specification.

ASTM A 123 covers both fabricated and unfabricated products e.g., assembled steel products, structural steel fabrications, large tubes already bent or welded before galvanizing, and wire work fabricated from uncoated steel wire. It also covers steel forgings and iron castings incorporated into pieces fabricated before galvanizing or which are too large to be centrifuged (or otherwise handled to removed excess galvanizing bath metal). Items to be centrifuged or otherwise handled to remove excess zinc shall meet the requirements of ASTM A 153, except: Bolts, screws and other fasteners 1/2 inch or less in diameter may be coated with electrodeposited zinc or cadmium coating conforming to the requirements of ASTM Specification A 165, Type TS, or ASTM Specification B 633, Service Condition SC-3 unless otherwise specified.

MATERIAL SPECIFICATION

583. COAL TAR-EPOXY PAINT (FORMULA C-200)

1. SCOPE

This specification covers the quality of a coal tar polyamide epoxy paint suitable for use on structural steel or concrete. (Note: Coatings compounded from coal tar and epoxy resins are the subject of U.S. Patent No. 2,765,288 held by the U.S.S. Chemicals, a Division of United States Steel Corporation, Pittsburgh, Pennsylvania, 15230.)

2. COMPOSITION AND PROCESSING

a. Composition. The paint shall be a two-component system containing the pitch, filler and catalyst in one component and the resin in another. the components shall contain the following types and proportions of ingredients:

(1) COMPONENT A

Ingredient	% by Wt.	Gallons (absolute) in 38.5 lb. batch
Coal Tar Pitch	35.0	1.28
Polyamide Resin	11.5	0.55
Magnesium Silicate	31.0	0.51
Xylene	18.7	1.00
Ethyl Alcohol (95%-denatured)	1.0	0.06
Gelling Agent	1.5	0.04
Catalyst	1.3	0.06
	100.0	3.50 gallons

(2) COMPONENT B

Epoxy Resin (100% nonvolatile)	9.7 pounds	1.0 gallon

b. Processing. Magnesium silicate and gelling agent shall be thoroughly dispersed in Component A by means of grinding equipment capable of developing substantial shear values. Gellant shall be mixed with an equal weight of magnesium silicate and then dampened by stirring-in all of the alcohol; the resultant mixture shall be added to and thoroughly dispersed into Component A. (The viscosity of Component A will be markedly influenced by the degree of dispersion of gellant and magnesium silicate.)

c. Quality of Ingredients. Ingredient materials shall exhibit the following properties:

(1) Coal Tar Pitch. Coal tar pitch shall have the following characteristics:

	Minimum	Maximum
B & R softening point, degree C (Method ASTM D 36)	70	75.0
Ash, percent by weight (Method ASTM D 3176)		0.5
Benzene insolubles, percent by weight (Method ASTM D 367)		18.0
Volatiles, percent by weight		
Under 250 degrees C		0.0
Under 300 degrees C		5.0

(2) The Gellant. The gellant or thixotropic-producing additive for coal tar-epoxy paint shall be an organic derivative of magnesium montmorillonite for use in low polarity hydrocarbons. It shall be a creamy white powder having a bulking value of 15 ±0.2 lbs. per gallon and water content of 3.0% maximum (Bentone 38, National Lead Company has these properties.)

(3) The Catalyst. The catalyst shall be 3, 4, 6 Tri-(Dimethylamino methyl) phenol. (DMP-30, Rohm and Haas Company, is such a chemical.)

(4) Epoxy Resin. Epoxy resin shall be a diepoxide condensation product of bisphenol A and epichlorohydrin with terminal epoxide group with the following properties:

	Minimum	Maximum
Nonvolatile content	99	
Epoxide equivalent	180	200
Color, Gardner		5
Specific Gravity 25°C/25°C	1.15	1.18
Viscosity, 25°C, Brookfield, Poises	100	160

(5) Polyamide Resin. Polyamide resin shall be a condensation product of dimerized fatty acid and polyamines with the following characteristics:

Amine Value	330-360

Color, Gardner	12 maximum
Specific Gravity 25°C/25°C	0.96-0.98
Viscosity, Poises, 75°C, Brookfield	7-9
Nonvolatile content, percent	97

(6) Xylene. Xylene shall conform to Federal Specification TT-X-916b, "Xylene (for use in organic coatings)."

(7) Ethyl Alcohol. Ethyl alcohol (95% denatured) shall conform to Federal Specification O-E-760c, "Ethyl Alcohol (Ethanol); Denatured Alcohol; Proprietary Solvents and Special Industrial Solvents," Type III or IV.

(8) Magnesim Silicate. Magnesium silicate shall conform to ASTM Specification D 605, "Magnesium Silicate Pigment."

3. PHYSICAL REQUIREMENTS

When tested by the methods described in Section 4:

a. Component A shall exhibit the following properties:

(1) Viscosity, poises (Brookfield)	160 maximum
(2) Nonvolatile residue, percent	78 minimum

b. The mixed paint shall exhibit the following properties:

(1) Sag, 12 mil wet film	None
(2) Pot life at 77° ± 3°F. hours	4 minimum

c. The cured film shall exhibit the following properties:

(1) Penetration, 200 grams, 5 seconds, 77°F, hundredth centimeter units	3 maximum
(2) Odor after 48 hours curing	Pass test
(3) Flexibility on 1/2-inch mandrel	Pass test
(4) Adhesion	No delamination

4. TEST METHODS

a. Viscosity of Component A. Fill a container having a diameter and a height of not less than 3 and 3-3/4 inches respectively to a depth of not less than 3 inches with a representative

sample of Component A. Set up a Model RVT or RVF-100 Brookfield Synochro-Electric Viscometer with a No. 7 spindle and with guard removed. Bring the sample to a temperature of 25°C and stir vigorously for 2 minutes with a stiff spatula. Immediately after stirring lower the viscometer until the spindle is immersed until 1/2 of the "neck" mark is covered. Run the viscometer at 100 r.p.m. for 1 minute and take a reading of the position of the pointer on the dial. If the dial reading is 40 or less, the viscosity shall be considered to be 160 Poises or less. If the reading is over 40, immediately start the motor and take additional readings at 1-minute intervals. If no readings of 40 or less are obtained out of 10 readings, taken at 1-minute intervals, the viscosity of the material shall be considered to be over 160 Poises.

b. Nonvolatile Content of Component A. Place a short length of stiff wire such as a partially-straightened paper clip into a small disposable aluminum dish of about 2 inches diameter and weigh to the nearest 0.1 milligram. As rapidly as possible, place between 2 and 3 grams of Component A into the dish and weigh immediately to the nearest 0.1 milligram. After weighing, spread the material over the bottom of the dish. Heat the dish, wire and contents in a well-ventilated convection-type oven maintained at 105°± 2°C, for 3 hours. After the material has been in the oven for a few minutes, and periodically thereafter, stir the material. Cool in a desicator, weigh to the nearest 0.1 milligram and calculate the percentage nonvolatile.

c. Sag Test of Coal Tar-Epoxy Paint. Prepare approximately one pint of the material by thoroughly mixing 100 ml. of Component B into 350 ml. of Component A. Determine its viscosity immediately after mixing, using the same procedure as for Component A above but employing a No. 6 spindle. If the material produces a scale reading of more than 80, at 100 r.p.m. after 5 readings taken at 1-minute intervals, reduce the viscosity by adding xylene in small increments until a reading not greater than 80 is obtained. Press a strip of 1-inch masking tape across the full width of a solvent cleaned 3" x 6" cold-rolled steel panel. The tape should be parallel to and centered on the shorter axis of the panel. Within 30 minutes after mixing, apply the material to the panel to a wet film thickness of at least 12 mils as determined by an Interchemical wet film thickness gauge. The application may be made with a doctor blade having a gap of approximately 25 mils or by brush. Immediately after applying the material, carefully remove the masking tape and stand the panel in a vertical position with the bare strip horizontal. Examine the panel after four hours. Sagging or running of the coating into the bare area shall constitute failure of the material to pass the sag test.

d. Penetration Test on Coal Tar-Epoxy Film. Select and solvent spray-clean two 3" x 6" steel panels in accordance with Method 2011 of Federal Test Method Standard 141. Draw down, in accordance with Method 2161, a coat of the paint mixed (including any thinning) for the sag test. Allow the film to dry 18 to 24 hours in a horizontal position at 77° ± 3°F and at a relative humidity of not over 60%. Apply a second coat over and at right angles to the first, using freshly mixed paint prepared identically to that used for the first coat. The draw-down applicator(s) shall be such as to provide a total dry-film thickness for the two coats of 23 ± 3 mils and the coats shall be of approximately equal thickness. Allow the second coat to dry in a horizontal position for 120 hours at 77° ± 3°F. After 72 hours of curing, and daily thereafter, clamp the panel onto the table of a penetrometer (ASTM D5) so that the needle is over an area which is within the prescribed thickness range (as measured by ASTM Method D 1186) and determine the penetration, using a total load of 200 grams applied for 5 seconds at 77°F. The average of the 3 lowest out of 5 penetration readings, all taken within a 1 centimeter square, shall not exceed 3/100 of a centimeter after 120 hours of curing.

e. Flexibility of Coal Tar-Epoxy Film. Sandblast 3 steel panels (similar to those used in the penetration test) at low pressure with clean, 30 to 50 mesh, non-metallic abrasive until a uniform, gray-white surface, with well developed anchor pattern, is achieved. (Note: It may be necessary to blast both sides of panel, in stages, to avoid warping.) Blowoff dust with a clean air blast. Immediately after recoating of the penetration test panel, apply 10 to 12 mils (wet thickness as determined with an Interchemical gage) of the same material to the flexibility test panels in accordance with Method 2161, Federal Test Method Standard No. 141. Allow the film to cure in the horizontal position for 120 hours at 77° ± 3°F or for a period equal to that required to reach a penetration of 3/100 centimeter on the penetration test panel, whichever occurs first. With film side up, and in a time interval of approximately 1 second, bend each of the flexibility panels double over a 1/2-inch diameter mandrel. Cracks in any of the panels visible to the naked eye shall constitute failure except that edge cracks extending no further than 1/2-inch or small local fissures emanating from air bubbles, craters and similar imperfections shall be disregarded.

f. Adhesion of Coal Tar-Epoxy Film. Test the adhesion of the coating on an unbroken area of the flexibility panel with a sharp knife after the panel has cured 120 hours. It shall strongly resist being removed from the metal. Also, test the intercoat adhesion of the film on a penetration panel after 120 hours curing, with a knife. Any delamination of the two coats shall constitute failure.

g. Pot Life Test of Coal Tar-Epoxy Paint. Mix 100 ml. of Compound "B" into 350ml. of Component "A" both of which have been brought to a temperature of 77° ± 3°F before mixing. Pour the material into a pint tin can, seal tightly and maintain at 77° ± 3°F. Examine the material in four hours from the time it was mixed. For its pot life to be considered satisfactory, the mixed material must still be in a fluid condition and when thinned with no more than 100 ml. of xylene shall be lump-free and brushable.

h. Odor of Dried Coal Tar-Epoxy Film. Examine the paint film or one of the flexibility panels for odor after it has been cured for 48 hours. The film shall be free of any odor except for a faint odor of xylene.

5. PACKAGING

Three and one-half gallons of Component A shall be packaged in a standard 5-gallon container with a lug-type, removable lid. Component B shall be packaged to the full mark in a one-gallon, friction-lid container. In addition to other labelling requirements, each of the 5-gallon containers shall bear instructions for properly mixing the two components immediately prior to use.

Section 6 – Bid Schedule and Cost Estimate

BID SCHEDULE

RWCD FLOODWAY REACH -5

Item No.	Work or Material	Spec. No.	Quantity	Unit	Unit Price	Amount
1.	Clearing and Grubbing	2		Acres	$_____	$_____
2.	Survey	7	1	L.S.	$XXXX	$_____
3.	Mobilization	8	1	L.S.	$XXXX	$_____
4.	Water	10		M.G.	$_____	$_____
5.	Channel Excavation	21		Cu.Yd.	$_____	$_____
6.	Structure Excavation	21		Cu.Yd.	$_____	$_____
7.	Trench Excavation	21		Cu.Yd.	$_____	$_____
8.	Earthfill	23		Cu.Yd.	$_____	$_____
9.	Structure Backfill	23		Cu.Yd.	$_____	$_____
10.	Concrete Class 4000	31		Cu.Yd.	$_____	$_____
11.	Steel Reinforcement	34		Lbs.	$_____	$_____
12.	36-inch RCP	42		L.F.	$_____	$_____
13.	Maintenance Road Drain	51		Each	$_____	$_____
14.	42-inch CMP Outlet	51		L.F.	$_____	$_____
15.	Farm Tailwater Drain	51		Each	$_____	$_____
16.	Aluminum Arch Pipe	51		L.F.	$_____	$_____
17.	Grouted Rock Riprap	62		Cu.Yd.	$_____	$_____
18.	Identification Marker	93	2	Each	$_____	$_____
19.	Contractor Inspection	94	1	L.S.	$ XXX	$_____
20.	Gravel Cover	202		Cu.Yd.	$_____	$_____
				TOTAL	$_____	

OPERATION AND MAINTENANCE PLAN

RWCD FLOODWAY, REACH-5

This plan applies to the RWCD Floodway, Reach-5 along with all associated works of improvement. The sponsors, Flood Control District of Maricopa County, will be responsible for the features covered under this plan.

GENERAL

This reach of the floodway is the fifth of six planned and extends from approximately Ray Road to Guadalupe Road.

While no improvements in this reach require control or operation, maintenance will be essential for this project to function as intended over its design life. The program established here will help ensure that excessive erosion, sedimentation or destruction of the floodway or appurtenances will not occur. In addition, a regular program of inspection and maintenance will point out areas that need to be monitored closely.

Identified maintenance items are listed below:

MAINTENANCE

Main Floodway: Little erosion or deposition should occur within the floodway due to transporting storm runoff. However, because of localized areas of dispersive soils, which exist throughout this reach, bank rilling or jugging may occur from the direct impact of rainfall.

Make repairs of eroded areas by replacing lost material with compacted earth, or other suitable erosion resistant material, in accordance with the original construction specifications. SCS assistance is available in determining the extent of repair needed or the suitability of differing materials.

Make repairs of deposits of loose material by removing to obtain designed grades and cross sections. Loose deposited materials shall not be used within the floodway unless tested to meet the earthfill criteria in the construction specifications.

Remove or destroy woody vegetation within the flow area of the floodway, collection ditches or side inlet basins. Also remove trash or other objects that will impede flows in these areas.

Inspect the grouted riprap channel lining for uplift and cracking. Report any evidence of uplift to the SCS for further review. Cracks should be filled with a flexible sealant.

Side Inlets and Collection Systems: Inspect the grouted riprap for uplift and cracking. Report any evidence of uplift to the SCS for further review. Cracks should be repaired with an epoxy filler.

Inspect upstream of the weir for extensive cracking and/or jug holes which could lead to possible seepage failures. Contact SCS to help determine the repair needed.

Remove accumulations of debris, sediment, or vegetation from the side inlets, basins or side collection ditches to ensure the discharge capabilities of the side inlets.

Inspect the gravel protection within the side inlet basins for localized erosion. Extend the width and/or depth of the gravel protection as needed to stabilize the eroded area.

Pipe Inlets: Inspect for cracks and jug holes along the length of the pipe which could lead to possible seepage failure. Remove existing soils in these areas to the extent needed and replace with earthfill according to the criteria in the construction specifications. **Caution: do not disturb the drainfill diaphragm.**

Remove debris and sediment from the pipe inlet on a regular periodic basis and following significant rains that may cause a collection of debris and sediment at the inlets.

Turnout Structure and Outlet: Inspect the joint between the RWCD Canal culvert structure and the installed outlet structure for structural cracks to the culvert and separation of the joint sealer from the concrete. Notify the RWCD of any deterioration of their structure. Add joint sealer as necessary.

Inspect the concrete of the installed structure for cracking, spalling, etc., which might affect its integrity. Make repairs as needed.

Inspect the grouted rock for uplift and cracking. Report any evidence of uplift to the SCS for further review. Cracks should be repaired with an expoxy filler.

If possible notify the SCS during the operation of the turnout structure.

Vegetation: As stated in the appropriate sections above, woody vegetation should be removed or destroyed. If grasses are established maintain the height of the grass to six inches.

State O & M Handbook: The SCS National Operation and Maintenance Manual and the SCS State of Arizona Watersheds Operation and Maintenance Handbook are herein part of this Operation and Maintenance Plan.

SECTION 8 - Inspection Plan

GOVERNMENT
INSPECTION PLAN
for
RWCD FLOODWAY, REACH-5

GENERAL

The project is located six miles east of Gilbert, Arizona and will be constructed under Government contract which is expected to be awarded September, 1987. The following major items of work will require inspection during the construction:

1. Channel Excavation - 790,000 cubic yards.
2. Earthfill - 118,000 cubic yards.
3. Grouted rock riprap 10,000 cubic yards.
4. 36-inch reinforced concrete pipe syphon 170 feet.
5. 11 CMP inlet structures.

ITEMS OF WORK TO BE INSPECTED

It is anticipated that the degree of inspection (periodic or continuous) as per NEM, PART 512, Subpart D, will be provided for the following work to be performed under the construction contract. The need for continous inspection will depend on the intensity of the Contractor's Inspection System, which will be evaluated as the construction progresses.

Periodic Inspection	Continuous Inspection
Channel Excavation	Earthfill
Clearing and Grubbing	Structure Backfill
Structure Removal 1/	Pipe Backfill
Pollution Control	Drainfill Placement
Mobilization 2/	Concrete Placement
Water	Concrete Pipe Installation
Removal of Water & Diverting Surface Water	CMP Installation
Structure Excavation	Gravel Cover Placement
Trench Excavation	Grouted Rock Riprap Installation
Waste Disposal	
Waste Grading	
Metal Fabrication and Installation	
Surveys	
Reinforcing Steel Placement	
Contractor Inspection	

A materials testing program will be implemented to verify contract compliance using the reference tests for each segment of the construction. The inspection and testing program will be coordinated with the Contractor's Inspection System to compliment and enhance the project inspection effort and to substantiate the Contractor's test results.

All testing will be performed in accordance with the applicable Construction Specifications and NEH Section 19, unless stated otherwise.

1/ May require continous inspection during the removal of concrete structure east of Power Road Bridge, 36 inch gate and pipe at Elliot Road, syphon and abandoned gates outletting from Roosevelt Canal.

2/ Consists of checking equipment for safety and performance.

I. Earthwork

A. Excavation; Channel, Structure, and Trench

1. There are 790,000 cubic yards of channel excavation, and 11,000 cubic yards of structure excavation, trench excavation and pipe excavation for the installation of 11 maintenance road drains, the two (2) 42 inch CMP, the 36 inch reinforced concrete syphon, the 18 inch overflow pipe, the 7 farm tailwater drains, and an 18" x 24" arch drainage pipe. No specific material testing is required. Periodic inspections will be required to evaluate the soils encountered for their suitability as earthfill and occassional testing will be performed by the laboratory crew for identification, dispersiveness, etc.

B. Earthfill, Structure Backfill, Pipe Backfill and Waste Disposal

1. There are 118,000 cubic yards of earthfill, 1,000 cubic yards of structure backfill and an undertermined quantity for pipe backfill and spoil disposal. All of the fill items except spoil disposal will be tested for compaction, moisture, plasticity index, and classified according to the unified classification system. It will require a full time inspector and materials testing technician during the initial placement of earthfill and backfill to monitor the Contractor's quality control. If it is determined that the Contractor's Inspection System is reliable, full time inspections will not be necessary.

2. The initial test frequency for compaction and moisture will be 2,000± cubic yards per test. The test frequency may be changed as the job progresses depending on the reliability of the Contractor's Inspection System.

3. The tests for the plasticity and classification of earthfill will be performed whenever a significant difference in material is encountered or 25,000 cubic yards, whichever occurs first.

4. The testing program will require approximately 65 compaction and moisture tests and a minimum of 5 each for plasticity index and classification.

5. Fill material will be monitored for dispersion properties. Dispersion tests will be conducted whenever the fill material is suspected of being dispersive in nature. As a minimum one test shall be conducted for each side inlet and maintenance road drain and one every 1,000 feet in the channel bottom.

II. Concrete

A. The work will consist of placing approximately 17 cubic yards of concrete and 8,000 lbs. of reinforcing steel required to construct the Warner Road turnout structure and seven tailwater drain inlets, and a minor quantity to construct other miscellaneous items. It will require a full time concrete inspector and a materials testing technician during placement operation.

B. The test frequency will be as follows:

1. Strength and air entrainment - one set of cylinders and one air test per day.

2. Slump, temperature, etc. - each truck, if practical.

III. Grouted Rock Riprap

A. There are approximately 10,000 cubic yards of grouted rock riprap which will require full time inspection during placement. Acceptance will be based on the Contractor's test date submittals. The rock will be evaluated by the Engineer and a specific area of placement that is acceptable will be used as a visual reference for the rest of the rock placed.

IV. Contractor Surveys

A. Random x - sections of the original ground line will be taken at intervals not to exceed 800 feet and will be used to spot check the Contractor's qualilty control as the survey work progresses. The SCS survey party chief will observe the contractor survey crew's performance for one or two days during the initial survey work and then at random intervals as the surveys progress to verify their ability, and for assurance that the staking is compatible with SCS standards. Random survey spot checks by SCS survey personnel will be made to determine if the slope and reference stakes are within the tolerances specified or expected.

V. Contractor Inspection

A. The Contractor will be required to submit test data and the results to the Engineer within 24 hours of the report completion and certification. The data and results will be reviewed for completeness, errors and evaluated to determine if they are reasonable.

B. The SCS inspection team will periodically observe the Contractor's testing to verify that proper procedures are followed and that the testing is in compliance with the appropriate ASTM's.

C. The Contractor's inspection system will be constantly monitored for assurance that the approved inspection plan is being implemented.

TIMING OF INSPECTIONS

It is anticipated that the notice to proceed will be received October 6, 1987 and the performance time has been calculated to be 229 calendar days. The construction sequence as shown below is based on the work being performed by an average contractor, the completion dates will be adjusted after the low bidder has submitted his construction schedule.

Item	Calendar Days	Weather Days	Start Date	Completion Date
Notice to Proceed			10-06-87	05-21-88
Mobilization	20	3	10-06-87	10-28-87
Clearing & Grubbing (1st Mile)	7	1	10-29-87	11-05-87
Prewet (1st Mile)	27	9	11-06-87	12-11-87
Excavation & Earthfill	107	35	12-12-87	05-01-88
Grouted Rock Riprap	5		Intermittent	05-06-88
Side Inlets	5		Intermittent	05-11-88
Clean Up	10		05-12-88	05-21-88
	181	48		

The clearing and grubbing, prewet, structure backfill, pipe backfill, etc., will continue as the job progresses.

SKILLS NEEDED FOR CONTRACT ADMINISTRATION AND INSPECTION

PROJECT ENGINEER, GS-9/11

Skills Needed

Must be able to manage and schedule project staff effectively.

Must be familiar with and understand the philosophy and critical elements of the design.

Must be knowledgeable of quality assurance testing and inspections required for the works of improvement.

Must be able to maintain open communications with contractor.

Must be knowledgeable of OSHA safety requirements, and the SCS Supplement.

Training Required

Have two years or more of field experience in construction inspection and contract administration. Have completed Contract Administration for Construction Contracts training course.

Have unified soil classification.

Has completed Management Level II.

CHIEF INSPECTOR, GS-7/8

Skills Needed

Must be able to communicate effectively with the Contractor's field supervisory personnel.

Understand basic staking and construction layout.

Know the principles of earthwork inspection.

Know the principles of concrete and steel reinforcement inspection.

Have a sufficient working knowledge of geology to be able to determine if subsurface conditions are those described in the geologic investigation.

Perform quantity computations.

Ability to maintain records.

Supervise technicians assigned to the project.

Knowledge of OSHA safety requirements and the SCS Supplement.

Training Required

A minimum of two construction contracts as lead inspector of a critical element of the work being constructed.

Have four years of construction experience.

Worked on one or more contracts as a concrete inspector and earth inspector. Completed the SCS Construction Inspection training course

Know testing procedures.

EARTH/CONCRETE INSPECTOR, GS-5/7

Skills Needed

Must have knowledge and be experienced in the placing, sampling and testing of concrete and earthfills.

Must be able to determine if reinforcing steel has been properly placed, tied and supported.

Must be knowledgeable of the forming and vibration of concrete.

Have a knowledge of grouted rock riprap installations.

Have a knowledge of OSHA Safety Requirements and the SCS Supplement.

Training Required

Have a minimum of two years construction experience.

Have completed the SCS Construction Inspection training.

Interpretation of plans and specifications.

Have spent a minimum of one month in the field testing lab.

SURVEY PARTY CHIEF, GS-6/7

Skills Needed

Have the ability to determine survey controls required for the construction of various elements of a project. Must be able to communicate with the contractor's survey crew and to evaluate their ability and effectiveness.

Coordinate SCS surveys with the Contractor's surveyors to verify compliance.

Be capable of checking field notes for accuracy and completeness.

Training Required

Has worked as a instrument man for two years. Has completed the SCS Construction Inspection training course. Interpertation of plans and specifications. Math through trig. or equivalent experience.

SURVEY RODMAN, GS-5/6

Skills Needed

The ability to perform as a rodman or chainman and other routine survey duties as directed by the survey party chief.

Be able to determine distances, grades, etc., and interpret construction drawings.

Training Required

Worked as a rodman or chainman for two years of more. Enough math to perform simple calculations as needed for construction layout.

MATERIALS TESTING TECHNICIAN, GS-5/6/7

Skills Needed

Knowledge of earthwork testing such as compaction, moisture determination, sieve analysis, unified classification system, etc.

Knowledge of concrete testing such as slump, air, strength, aggregate, etc.

Knowledge of OSHA safety requirements.

Training Required

Work a minimum of two years as the primary lab technician on construction projects.

Computation of test results and reports.

Tolerance of testing equipment.

Test procedures required for testing earthwork, concrete, bedding, and rock riprap.

Completed the SCS Construction Inspectionl Training course.

ESTIMATED STAFF HOURS REQUIRED TO COMPLETE THE CONTRACT

	Regular Time
Project Engineer	1300 Hours
Chief Inspector	1300 Hours
Earth/Concrete Inspector	1300 Hours
Materials Testing Technician	1300 Hours
Survey Party Chief	350 Hours
Survey Rodman	300 Hours

Not included in the above hours is the estimated overtime. Overtime is not considered a problem and will be authorized as required to adequatly inspect the construction activities. The overtime on past project in Arizona has been in the range of 5% to 10% of the regular time.

PROJECT TESTING EQUIPMENT, FACILITIES AND PERSONNEL

The Chandler Construction Office will provide the necessary office space and a mobile lab trailer which is fully equipped to perform the required soil and concrete testing is available for use on this project. All testing equipment is according to ASTM Standards and will be serviced and calibrated prior to the start of construction.

Project personnel have not been selected as of this date, but prior to advertising qualified personnel will be assigned and this plan admended accordingly.

APPROVAL OF CO-DETERMINERS

State Conservation Engineer Date

Contracting Officer Date

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1969 O—361-109

STATE	PROJECT		
Arizona	RWCD Floodway, Reach 5		
BY / DATE	CHECKED BY / DATE	JOB NO.	
FCC / 3-20-87			
SUBJECT: Performance Time		SHEET 1 OF 20	

GIVEN:

Clearing & Grubbing
Excavation:
site #1 = 590,000 yd³
site #2 = 247,000 yd³
site #3 = 264,000 yd³
Earthfill
Grouted Rock

Assumptions:

1) Total Performance Time will be based on the following path:
a) Moving all excess excavation material to spoil areas.
b) Mobilization
c) Clearing and Grubbing first (1) mile stretch.
d) Prewet first ½ mile
e) Finish work on Grouted side inlets
f) Clean-up.
g) Weather

2) Spread operation shall consist of:

4 - 631D = Scrapers - struck - 21 yd³, heaped - 31 yd³
2 - Push Dozers when noted.

3) Use a load factor of 0.8 on struck capacity
- accounts for type of material not achieving full capacity on every load

$$\text{Use } 0.8\left[\frac{21+31}{2}\right] = 21 \text{ yd}^3$$

4.) Use 50min effective work hour.

Reference
- Caterpillar Performance Handbook (13th Ed)
- Performance Time Calcs by DEP (RWCD Reach 3)
- Calculations by J.W. & J.L.S. - Pass Mountain & Sig. Butte
- Calculations by Don P. - RWCD Reach 4

COMPUTATION SHEET
SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
AZ	RWCD Floodway, Reach 5		
BY: ICC	DATE: 3-20-87	CHECKED BY	DATE / JOB NO.

SUBJECT: PERFORMANCE TIME

SHEET 2 OF 20

Solution:

Check to see if spoil between Warner Rd and Guadalupe Rd can be put into spoil sites 2 & 3.

Site #2 : Approx. Capacity = 247,000 yds^3
Site #3 : Approx. Capacity = 264,000 yds^3
511,000 yds^3

* Warner Rd. is @ Sta. 435+00

From Mass Diagram dated January 9, 1987, find @ what station the spoil equals 511,000 yds^3.

Sta. 425+0 510,168 Spoil
511,000 Spoil
Sta. 426+0 514,238 Spoil

$$\frac{100'}{4,070} = \frac{x}{832} \Rightarrow x = 20.44'$$

Approx. Sta. 425 + 20 = 511,000 yds^3

Assume: Spoil between Sta. 323+00 and Sta. 425+20 goes into spoil sites #2 & 3.

Spoil between Sta. 425+20 and 486+34 goes into spoil site #1.

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1969 O—364-105

STATE AZ | PROJECT RWCD Floodway, Reach-5

BY ICC | DATE 3-23-87 | CHECKED BY | DATE | JOB NO.

SUBJECT PERFORMANCE TIME | SHEET 3 OF 20

~ Solve for the performance time necessary to spoil between sta. 323+00 and sta. 425+20

Short haul distances will be common since the spoil area parallels the floodway.

TABLE #1

Spoil Area	Vol.	Sta. to Sta.	Spoil From Mass Diag.
#3	264,000	323+00, 376+50	264,000
#2	247,000	376+50, 425+20	247,000
#1	590,000	425+20, 486+34	158,162

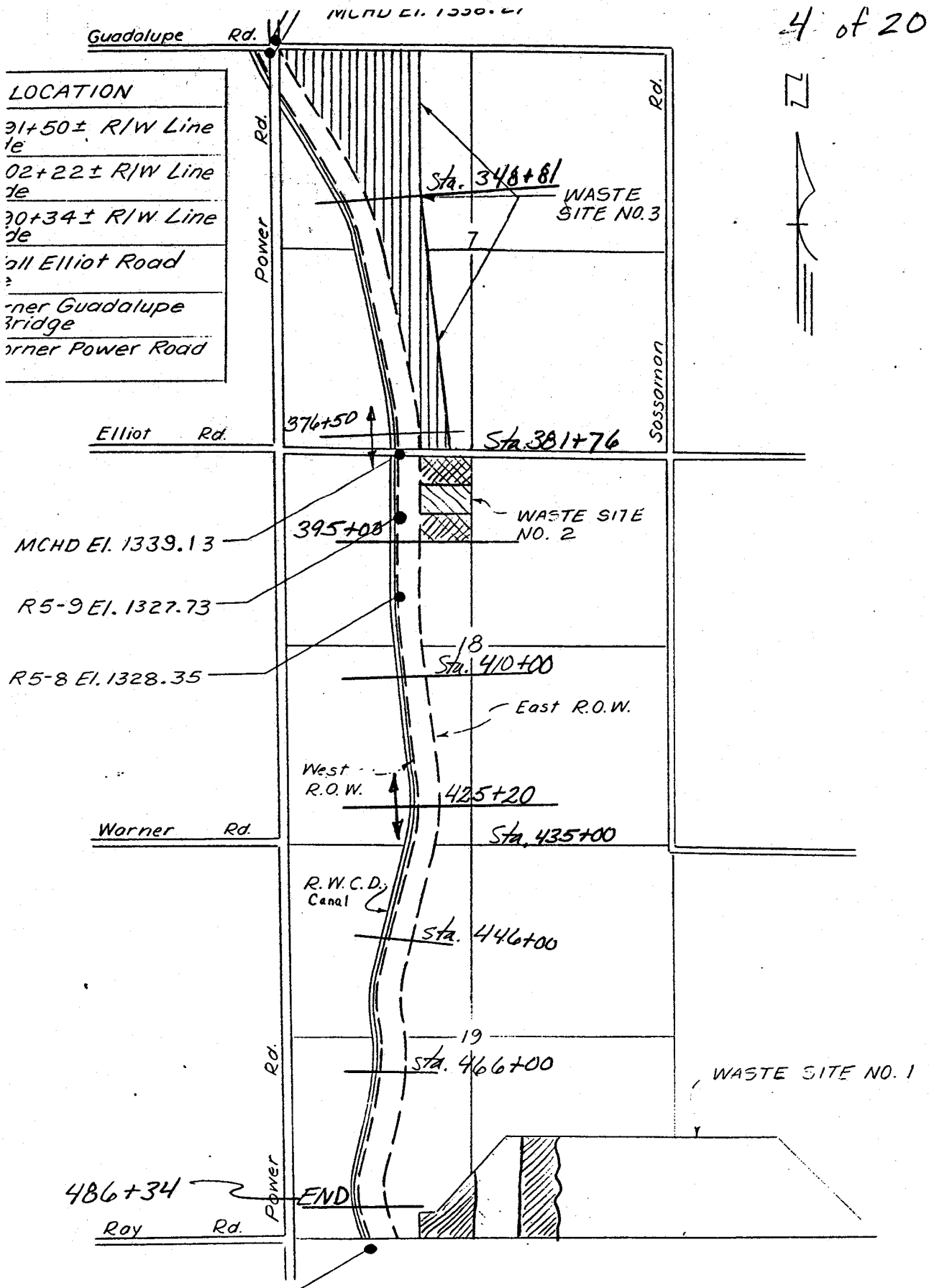
~ For spoil between sta. 323+00 to sta. 376+50, break reach into 2 separate lengths and figure cycle time for each.

~ For spoil between sta. 376+50 to sta. 425+20, break reach into 3 separate lengths and figure cycle time for each.

Note: HERE-AFTER, Assume total excavation will be going to spoil even though part of the excavation will be going toward earthfill.

Note: Pushcat takes 1.1 min/load

∴ 3 Scrapers - 3.3 min - minimum cycle time (MCT)
∴ 4 Scrapers - 4.4 min. - minimum cycle time (MCT)



WASTE SITE AREAS
(Not to Scale)

ximum Fill height (above ing ground) for Waste Sites

te	Height	Approx. Volume
1	3'-0"	590,000 Cu. yds.
2	10'-0"	[illegible]

LOCATION MAP
RWCD FLOODWAY REACH 5

Taken from Mass Diagram: 1-9-87

Station	Cut	Fill	Mass
325+00	0	0	0
325+20	1292	118	1174
326+00	4877	644	5407
326+33	2063	301	7169
326+60	1754	269	8654
327+00	2722	419	10957
327+46	3344	442	13859
328+00	4058	435	17482
328+68	2201	235	19448
329+00	1954	229	21173
329+31	2135	262	23046
330+00	4903	834	27115
331+00	5624	1004	31735
332+00	4780	335	36180
332+63	3550	153	39577
333+00	2289	132	41734
334+00	5944	555	47123
335+00	5499	649	51973
336+00	5490	630	56833
337+00	5529	587	61775
338+00	5586	509	66852
339+00	5615	506	71961
340+00	5579	558	76982
341+00	5572	527	82027
342+00	5648	485	87190
343+00	5661	471	92380
344+00	5461	477	97364
345+00	5257	487	102134
346+00	5160	519	106775
347+00	5064	506	111333
348+00	5145	436	116042
348+80	4327	293	120076
net	134083	14007	
349+00	1040	63	121053
350+00	5513	315	126251
351+00	5586	279	131558
352+00	5651	271	136938
353+00	5641	333	142246
353+63	3576	252	145570
354+00	2111	137	147544
355+00	5731	336	152939
356+00	5775	347	158367
357+00	5626	381	163612
358+00	5585	374	168823
359+00	5743	322	174244
360+00	5627	373	179498
361+00	5507	457	184548
362+00	5492	446	189594
363+00	5540	428	194706
364+00	5630	429	199907

365+00	5693	411	205189
366+00	5720	401	210508
367+00	5609	421	215696
368+00	5529	435	220790
369+00	5554	452	225892
370+00	5588	475	231005
371+00	5472	438	236039
372+00	5434	335	241138
373+00	5537	228	246447
374+00	5584	194	251837
375+00	5685	209	257313
376+00	5786	203	262896
377+00	5861	173	268584
377+03	178	5	268757
net	158604	9923	
378+00	5814	137	274434
379+00	6072	102	280404
380+00	6198	107	286495
380+71	4274	169	290600
381+00	1476	49	292027
381+47	2369	16	294380
381+73	1148	23	295505
382+00	1179	40	296644
382+80	3751	267	300128
383+00	1182	51	301259
384+00	6559	53	307765
385+00	6186	95	313856
386+00	6021	109	319768
387+00	5998	109	325657
388+00	6042	120	331579
389+00	5976	117	337438
390+00	5881	114	343205
391+00	5823	145	348883
392+00	5734	164	354453
393+00	5578	192	359839
394+00	5287	284	364842
395+00	5040	339	369543
net	103588	2802	
396+00	4978	372	374149
397+00	5015	362	378802
398+00	5105	312	383595
399+00	5054	324	388325
400+00	4977	334	392968
401+00	5046	340	397674
401+24	1244	76	398842
402+00	3948	217	402573
403+00	5223	276	407525
403+19	1003	52	408476
404+00	4296	223	412549
405+00	5421	293	417677
406+00	5424	391	422710
407+00	5357	546	427521

407+56	3007	361	430167
408+00	2336	290	432213
409+00	5183	624	436772
410+00	5210	635	441347
net	77832	6028	
411+00	5221	662	445906
412+00	5168	631	450443
413+00	5345	619	455169
414+00	5441	644	459966
415+00	5469	668	464767
416+00	5403	690	469480
417+00	5385	701	474164
418+00	5465	719	478910
419+00	5382	717	483575
420+00	5084	759	487900
421+00	5029	798	492131
422+00	5298	759	496670
423+00	5403	707	501366
424+00	5327	768	505925
425+00	5124	895	510154
425+20	994	148	511000
net	80538	10885	
426+00	3975	751	514224
427+00	5067	844	518447
428+00	5293	768	522972
428+48	2517	364	525125
429+00	2629	412	527342
430+00	5049	789	531602
431+00	5044	818	535828
432+00	5118	805	540141
432+40	2076	315	541902
433+00	3107	490	544519
434+00	5060	887	548692
435+00	4463	1005	552150
436+00	4157	1073	555234
437+00	4172	1011	558395
438+00	4380	963	561812
439+00	4474	999	565287
440+00	4340	1018	568609
441+00	4393	1018	571984
442+00	4267	1026	575225
443+00	4296	1044	578477
444+00	4488	1048	581917
445+00	4306	1163	585060
446+00	4079	1243	587896
net	96750	19854	
447+00	3936	1264	590568
448+00	3785	1313	593040
449+00	3802	1324	595518
450+00	3777	1377	597918

451+00	4013	1303	600628
451+92	3980	1099	603509
452+00	349	93	603765
453+00	4011	1100	606676
454+00	4082	1098	609660
455+00	4621	1005	613276
455+37	1758	315	614719
456+00	2865	552	617032
457+00	4436	928	620540
458+00	4535	942	624133
459+00	4516	976	627673
460+00	4499	993	631179
461+00	4527	1014	634692
462+00	4307	1004	637995
462+71	2956	706	640245
463+00	1249	298	641196
464+00	4447	1046	644597
465+00	4537	1067	648067
466+00	4251	977	651341
net	85239	21794	
467+00	3863	872	654332
468+00	3383	875	656840
469+00	2813	905	658748
470+00	1965	1191	659522
471+00	1146	1431	659237
472+00	846	1328	658755
473+00	906	1280	658381
474+00	1201	1543	658039
475+00	1538	2024	657553
476+00	1940	2282	657211
477+00	2796	2087	657920
478+00	3141	2133	658928
478+37	1092	865	659155
479+00	2051	1411	659795
480+00	3861	1966	661690
481+00	4413	1560	664543
482+00	4105	1566	667082
483+00	2708	1558	667932
484+00	1679	1927	667684
484+22	353	417	667620
485+00	1202	1300	667522
485+06	90	83	667529
486+34	2760	1138	669151
net	49852	32042	
GRAND TOTAL:	786486	117335	

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1969 O—364-109

STATE	PROJECT		
AZ	RWCD Reach 5		
BY ICC	DATE 3-23-87	CHECKED BY	DATE	JOB NO.

SUBJECT PERFORMANCE TIME

Sta. 323+00 to 348+80

$\frac{2,065 + 885}{2} = 1475'$ – Avg haul dist. one way.

Cycle Time: Loading – 0.6 min
Dumping – 0.3 min

Travel time loaded on 4% grade – 1.1 min.
Travel time empty on 0% grade – 0.7 min.
} Ref: Cat. Perf. page 247 & 248

2.7 min – USE 3.3 MCT & 3 Scrapers

Approx. Yardage: 134,083 yds³ (Total Excavation)

$\frac{50 \text{ min/hr}}{\text{scraper}} \times \frac{1 \text{ load}}{3.3 \text{ min}} \times \frac{8 \text{ hrs}}{\text{day}} \times \frac{21 \text{ yds}^3}{\text{load}} \times 3 \text{ scrapers} =$

= 7,636 yds³/day

$\frac{134,083}{7,636} = 17.6$ day → USE 18 days

COMPUTATION SHEET

SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1969 O—364-109

STATE	PROJECT		
AZ	RWCD Floodway, Reach 5		
BY ICC	DATE 3-23-87	CHECKED BY	DATE	JOB NO.

SUBJECT PERFORMANCE TIME

SHEET 10 OF 20

Sta. 349+00 to 377+03

$\frac{500 + 796}{2} = \underline{648}$ ' - Avg haul dist.

Cycle Time:

Loading - 0.6 min.
Dumping - 0.3 min.

Travel time loaded on 4% grade - 0.6 min

Travel time empty on 0% grade - 0.5 min.

2.0 min - USE 3.3 min.

Approx. Yardage: 158,604 yds^3

$\therefore \frac{158,604}{7,636} = 20.8$ days → USE 21 days

(See page 4 for computations on 10,667 yds^3/day)

COMPUTATION SHEET
SCS-ENG-5234 Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ | PROJECT RWCD FLOODWAY, REACH -5
BY ICC | DATE 3-23-87 | CHECKED BY | DATE | JOB NO.
SUBJECT PERFORMANCE TIME | SHEET 11 OF 20

Station 378+00 to 395+00

$\frac{1032 + 1475}{2} = \underline{1254'}$ - Avg. haul dist. one way.

Cycle Time:

Loading - 0.6 min.
Dumping - 0.3 min

Travel time loaded on 4% grade - 0.8 min.

Travel time empty on 0% grade - 0.5 min.

2.2 min. → WE 3.3 min

Approx. Yardage: 103,588 yds^3

$\therefore \frac{103,588}{7636} = 13.6 \rightarrow$ USE 14 Days

(See page 4 for computations)

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT	
AZ	RWCD Floodway, Reach 5	
BY ICC / DATE 3-23-87	CHECKED BY / DATE	JOB NO.

SUBJECT: PERFORMANCE TIME

SHEET 12 OF 20

Station 396+00 to 410+00

$\frac{1180 + 2802}{2} = \underline{1991}$ ' - Avg. haul dist. one way.

Cycle Time: Loading - 0.6 min.
Dumping - 0.3 min.

Travel time loaded on 4% grade - 1.3 min.

Travel time empty on 0% grade - 0.9 min.
3.1 min. → USE 3.3 min.

Approx. Yardage: 77,832 yds.^{3}

$\therefore \frac{77,832}{7,636} = 10.2 \rightarrow$ USE 10 Days

(See page 4 for computations)

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1969 O-364-16

STATE	PROJECT		
AZ	RWCD Floodway, Reach-5		
BY ICC	DATE 3-23-87	CHECKED BY	DATE	JOB NO.

SUBJECT PERFORMANCE TIME

SHEET 13 OF 20

Station 411+00 to 425+20

$\frac{2,655 + 3982}{2} = \underline{3,319}$ ' - Avg. haul dist. one way.

Cycle time: Loading - 0.6 min
Dumping - 0.3 min.

Travel time loaded on 4% grade - 2.0 min

Travel time empty on 0% grade - 1.3 min

4.2 min → USE 4.4 min w/ 4 Scrapers

Approx Yardage: 80,538 yds³

$: \frac{3.3}{4.4}(7636) = 5,727.0$ yds³/day

(see page 4 for computations)

$\frac{80538}{5,727} = 14.1$ → USE 14 days

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
AZ	RWCD Floodway, Reach 5		
BY ICC	DATE 3-23-87	CHECKED BY	DATE	JOB NO.

SUBJECT PERFORMANCE TIME

Station 446+00 to 426+00

$\frac{5309 + 6637}{2} = 5,973$ - Avg. haul dist. one way.

Cycle Time:

Loading - 0.6 min.
Dumping - 0.3 min.

Travel time loaded on 4% grade - 3.6 min.

Travel time empty on 0% grade - 2.3 min.
6.8 min. → USE 4.4 min.

Approx. Yardage: 96,750 yds³

$\therefore \frac{96750}{5727} = 16.9$ → USE 17 DAYS

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1969 O—364-109

STATE AZ PROJECT RWCD Floodway, Reach 5

BY ICC DATE 3-23-87 CHECKED BY DATE JOB NO.

SUBJECT PERFORMANCE TIME SHEET 15 OF 20

Station 466+00 to 447+00

$\frac{4,130 + 5,604}{2} = \underline{4,867'}$ - Avg. haul dist. one way.

Cycle Time =

Loading - 0.6 min
Dumping - 0.3 min

Travel time loaded on 4% grade - 3.0 min.

Travel time empty on 0% grade - 1.9 min.

5.8 → 4.4 min.

Approx. Yardage: 85,239 yds^3

$\therefore \frac{85,239}{5727} = 14.9 \rightarrow$ USE 15 DAYS

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
AZ	RWCD Floodway, Reach -5		
BY ICC	DATE 3-23-87	CHECKED BY	DATE	JOB NO.

SUBJECT Performance Time

SHEET 16 OF 20

Station 486+34 to 467+00

$\frac{2803 + 4129}{2} = 3466'$ - Avg. haul dist. one way

Cycle time:

Loading - 0.6 min
Dumping - 0.3 min

Travel Time loaded on 4% grade - 2.2 min.

Travel Time empty on 0% grade - 1.4 min.

4.5 min. → USE 4.4 min

Approx. Yardage : 49,852 yds^3

$\therefore \frac{49,852}{5727} = 8.7 \rightarrow$ USE 9 DAYS

Total Working Days = 18 + 21 + 14 + 10 + 14 + 17 + 15 + 9 =
= 118 working days

Calander Days = 7/5 (118) = 165 days

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

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT RWCD FLOODWAY, REACH 5		
BY ICC	DATE 2-26-87	CHECKED BY	DATE	JOB NO.
SUBJECT PERFORMANCE TIME				SHEET 17 OF 20

Side Inlets:

Finish up last two inlets:

	EXC.	Grout/Rock	Backfill
sta. 350+00	75 yds³	15 yds³	32 yds³
sta. 365+00	"	"	"
	150 yds³	30 yds³	64 yds³

Will compute time per structure:

- To excavate all of structure and lay pipe - 1 day
- To backfill pipe & install drainfill - 1/2 day
- To shape rock & grout - 1 day

Total - 2 1/2 days / inlet

2-Structures - 2 1/2 x 2 = 5 days (workdays)

∴ Calander Days = 7/5 (5) = 7 Days

Clearing & Grubbing

$\frac{420' \times 5280}{43560}$ = 51 Acres/mile

Assume Clear & Grub 10 Acres/Day

$\frac{51}{10}$ = 5 (Work Days)

7/5 (5) - 7 CD

COMPUTATION SHEET
SCS-ENG 523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ | PROJECT RWCD Floodway, Reach 5
BY ICC | DATE 3-24-87 | CHECKED BY | DATE | JOB NO.
SUBJECT PERFORMANCE TIME | SHEET 18 OF 20

Pre-Wet:

$= 122,544 \, yd^3$

Based on J.L. Sullivan calc's. (1-18-85) for Pass Mountain & Signal Butte.

Assume
Avg. Opt. = 15%
In place Moisture = 3%

Avg. $\gamma_d = 120$ pcf

$= 15 - 3 = 12\%$

$W_w = 120(0.12) = 14.4 \, lbs/ft^3 \times \frac{1}{8.33 \, lbs/gal} = \underline{1.73 \, gal/ft^3}$

$1.73 \times 27 = 46.7 \, gal/yd^3$

Assume 20% is loss due to evap, runoff, etc.,

Actually applied is $\frac{46.7}{0.8} = \underline{58.3 \, gal/yd^3}$

Quantity needed is $58.3(122,544) =$

$= 7,144,315$ gals

Assume water is applied @ 800 gpm

$7,144,315 \, gal \times \frac{min}{800 \, gal} \times \frac{1 \, hr}{60 \, min} \times \frac{1 \, day}{24 \, hr} = \underline{6.2 \, days}$

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1969 O—364-100

STATE	PROJECT		
AZ	RWCD Floodway, Reach-5		
BY TCC	DATE 3-24-87	CHECKED BY	DATE / JOB NO.

SUBJECT Performance Time

SHEET 19 OF 20

Assume 6 days to set up & 4 days to break down.

Use 10 days for Curing

Total is = 6 + 4 + 7 + 10 = 27 days

Weathe Days:

Number of days with rainfall greater than 0.2" on the average from 1979 to 1987 are as follows:

Oct. -1
Nov. -2
Dec. -4
Jan. -3
Feb -2
Mar. -3
April -1
May -1
June -0
July -3

~ add 2 days per (1) day of rain for curing.

Total time: 20 + 2(20) = 60 CD

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
AZ	RWCD Floodway, Reach 5		
BY ICC	DATE 3-24-87	CHECKED BY	DATE / JOB NO.

SUBJECT PERFORMANCE TIME

SHEET 20 OF 20

The following scenario will be used to compute the total performance time required to complete the required work.

1.) Mobilization - 20 calendar days (CD).
2.) Clearing & Grubbing - Note: The contractor may opt, under this phase to also excavate a small conveyance channel from beginning to end to transport water pumped by Leisure World. - 7 CD

3.) Pre-Wet & Curing first mile: - 27 CD

4.) Excavation - Note: Earthfill is assumed to run concurrently. - 165 CD

5) Finish Side Inlets - 7 CD

6.) Weather - 51

7.) Clean-Up - 10 CD

Total P.T. = 20 + 7 + 27 + 165 + 7 + 60 + 10 =
~ 296 CD

Start Oct - 1
Oct - 31
Nov. - 30
Dec - 31
Jan - 31
Feb - 28
Mar. - 31
Apr. - 30
May - 31
June - 30
END July - 23 ←
296 CD