RWCD Floodway Reach 2 Extension Final Design

Soil Conservation Service

1983

United States Department of Agriculture

Soil Conservation Service

West National Technical Center
511 N. W. Broadway, Rm. 510
Portland, Oregon 97209

Subject: ENG - Design Assistance, RWCD Floodway Reach 2 Extension, Williams Chandler Watershed, Arizona

Date: April 15, 1983

To: Ralph Arrington, State Conservation Engineer, SCS, Phoenix, Arizona

We have completed and co-approved the design of RWCD Floodway, Reach 2 Extension, as requested in letter from Verne Bathurst to Charles Lemon dated March 8, 1983.

Attached are the following:

1. Three copies of the Design Report.

2. One original copy and two color coded copies of the Construction Specifications including bid schedule.

3. Two copies of Design Computations including estimate of quantities.

4. One set of original Construction Drawings.

5. One set of blueline Construction Drawings.

We have signed the cover sheet and added your signature as authorized by Remote Message Transmittal dated April 14, 1983.

We have not prepared a cost estimate for the work. We believe that your staff being close to the work in progress on Reach 2 is better prepared for developing a cost estimate. There are a couple of items that should be noted:

1. The quantities are based on the work ending at STA 982+50. This overlaps Reach 2 work and will require an adjustment in Reach 2 quantities or the Reach 2 Extension quantities.

2. The estimate for quantity of water was based on the estimate for Reach 2. It seems high and should be checked against actual usage for Reach 2.

If there are any questions concerning other aspects of the design or drawings and specifications, please give us a call.

Gordon W. Strang for
JACK C. STEVENSON
Head, Engineering Staff

cc:
Verne Bathurst, State Conservationist, SCS, Phoenix, Arizona
Donald E. Wallin, Head, Design Unit Engineering, WNTC, Portland, Oregon

Attachments

DESIGN REPORT

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Design Unit
Portland, Oregon
April 10, 1983

DESIGN REPORT

Job : RWCD Floodway Reach 2 Extension
Project : Williams-Chandler W.P.P.
Location : Maricopa and Pinal Counties, Arizona
Authority: WF-08
Phase : Final Design

Summary: The design, construction drawings, and specifications for this job were prepared by the WNTC Design Staff at the request of the Arizona State Conservationist.

Description of Job: The job includes: extension of the RWCD Floodway upstream from the current beginning of RWCD Reach 2 and covering the work between STA 976+000 and STA 982+50, an excavated basin for collection of bedload sediment from the Hunt Highway diversion, a dip crossing for access across the RWCD Floodway at Hunt Highway, a temporary entrance structure between the existing flood channel and the enlarged floodway, a 24 inch diameter R/C sediment basin drain, a grouted rock weir inlet to the floodway from the basin, grouted rock structures at the two inlets to the sediment basin, and construction of channels connecting the basin and the Hunt Highway diversion channels.

Design Objectives

1. Provide for economic removal of bedload sediment from the Hunt Highway diversion before its entry to the RWCD Floodway.

2. Provide a low cost, low maintenance junction of the Hunt Highway diversion with the RWCD Floodway.

3. Provide a dip crossing at the Hunt Highway which aligns with existing access roads, requires minimal additional right-of-way, and does not interfere with the existing RWCD canal.

Basis for Design

1. TR-25, NEH 5, TR5
2. NEM
3. U. S. Army Corps of Engineers
   Chart for "Stone Stability-Velocity vs. Stone Dia."
   Hydraulic Design Chart 712-1.
4. Chow, "Open Channel Hydraulics"
5. Design Report RWCD Floodway Reach 2
6. Construction Drawings and Specifications RWCD Floodway Reach 2
7. Construction Drawings and Specifications RWCD Floodway Reach 1

8. RWCD Floodway Hydrology Studies, 11/76 and 5/77
9. Geologic Investigation Report - RWCD Floodway Reach 3
10. Topographic Survey, SCS Arizona, 2/83

Location and Layout

Considerations in the location and layout of the work were:

Floodway - follows the preliminary design grade and alignment shown on RWCD Floodway Reach 2 and Reach 3 photo base maps (1"=100 ft. scale).

Sediment Basin - located within the 300' x 400' R/W area adjacent to the 330' floodway R/W width a shown on the RWCD Floodwlay Reach 2 drawings.

Basin Inlet Channels - located to provide a smooth transition from the existing channels to the sediment basin with minimal additional right-of-way needed.

Dip Crossings - aligns with existing roadways.

Entrance - located in close proximity upstream of the dip crossing.

Hydrology

Peak design flows determined in the RWCD Floodway hydrology studies of November 1975 and May 1976 by Bartels and McArthur were used. These are the same flows used for design of Reach 2. Peak 100-year design flow in the RWCD Floodway at this location is 8700 cfs, including the routed flow of 600 cfs contributed by the Hunt Highway diversion. The Hunt Highway diversion peak 100 year design flow of 2250 cfs occurs in these studies with virtually no flow in RWCD floodway from the reaches above the Hunt Highway.

Sedimentation Design

The need for a basin to remove sediment at the Hunt Highway diversion was established in the RWCD Floodway Reach 2 Geologic Investigation report and supported by visual observation of the amount of loose cohesionless material available for transport in the diversion channels.

A value of 1 ac. ft. of bedload sediment was used for design. This was selected as a reasonable, conservative value based on the sediment quantities predicted in the above report for a 100-year event in the side drainages along the Santan front adjacent to this site. Considering the time required to make a more rigorous determination of sediment quantity and the uncertainty of even a more rigorously obtained value, further studies were not made.

The basin was dimensioned to keep average velocity at peak design flow under 2 ft/sec with an assumed 1 ft depth of sediment accumulation.

Velocity in the constructed inlet channels is approximately 10 ft/s at peak design flows. This is the same as in the existing diversion channels. The velocity is maintained at this high level to limit sediment deposition in the basin inlet channels. Some deposition is likely to occur, however, at lesser flows due to backwater effect from the basin pool.

Sediment should be removed from both the lower inlet channels and basin when significant deposition occurs.

Hydraulic Design

A. Floodway - The 500 foot floodway extension is designed to the same grade (s=0.0003 ft/ft) and cross section (b=200, z=3) as the adjacent Reach 2 floodway channel. Design Q is 8700 cfs downstream of the sediment basin outlet. Design flow depth is 9.41 feet and design channel depth is 11 feet, providing freeboard equal to 17% of flow depth.

No channel lining will be required in the extended floodway. Geologic investigations show material in the excavated flow area of the floodway extension to have erosion resistance equal to that of adjacent unlined Reach 2 floodway channel. Portions of the constructed channel will require compacted earthfill to meet the design cross section.

B. Floodway Inlet at STA 980+75 - The loose and grouted rock weir, chute, and apron carry flow from the sediment basin to the floodway.

The weir section has 10:1 side slopes for vehicle travel. The 150 feet width compromises between the lesser erosion potential in the floodway of a wider weir and the lesser material cost of a narrower weir.

Maximum velocity in the chute is 17 ft/sec. A submerged hydraulic jump will occur at the chute toe for tailwater depth in the RWCD floodway equal to normal depth for Q=2250 cfs, the design weir flow. Rock and grouted rock are used as shown on the drawings to protect areas of expected high velocity flow. Some local scour adjacent to the apron should be expected during flows approaching design values.

Velocity at the upstream side of the weir crest is approximately 5 ft/sec at design flows. Protection of the adverse slope approaching this point for this velocity was considered unnecessary.

Momentum methods were used to check effect on flow depth in the floodway for peak Q in the floodway with routed flow of 600 cfs in the inlet: floodway flow depth was increased by 0.10 feet.

C. Basin Inlet Structures - Rock and grouted rock structures were used at the channel inlets to the debris basin. These are of similar design to the side inlets used in RWCD Reach 2. Experience with the Reach 2 structures led to the addition of grouted rock cutoffs at the upstream end. To reduce piping potential under the rock.

D. Basin Inlets Channels - Inlet channels 1 and 2 were assumed to each carry one-half of the 100 year, 2250 cfs flow. Channel slope of 0.009 ft/ft is maintained. The outside transition curves are protected with rock riprap. Channel 3 will carry the approximate bankfull flow of 30 cfs.

E. Basin Outlet Structure - A 24 inch dia. R/C, ASTM C76, pipe with concrete box inlet was selected for the basin outlet to provide long life and access for maintenance. Hydraulic capacity did not control the design. Flow will be

essentially non-pressure. The conduit is placed on a 0.022 ft/ft grade, providing for flushing of sediment in the pipe.

The box crest is at EL 1293.0 and the basin invert is at EL 1291.0. Drainage below EL 1293.0 is provided though 4" PVC perforated drains placed in a berm of drain fill and rock riprap as shown on the drawings. The basin outlet is located in the SW corner of the basin away from likely heavier sediment deposition. The pipe outlets into the RWCD channel in grouted rock riprap.

F. Entrance - The temporary rock riprap floodway entrance is essentially the same design as proposed for RWCD Reach 2, modified to provide smooth transition from the existing flood channel alignment.

Structural Design

A. Rock and Grouted Rock: The rock sections and thicknesses used are consistent with those used on RWCD Floodway Reach 2: The gradations are identical to those used on Reach 2.

B. Dip Crossing: Dip crossing details are adapted directly from Reach 1 and Reach 2 crossings.

C. Basin Outlet Box: Temperature steel provides sufficient reinforcement.

Construction

Considerations During Construction:

1. Spoil Disposal: The area between the sediment basin and the dip crossing and between the RWCD Floodway and RWCD canal will be filled with spoil to the minimum elevations shown on the drawings. Additional spoil may be placed in these locations at the direction of the Engineer.

2. Floodway Channel: The project engineer will need to verify that the material in the excavated floodway is the erosion resistant material indicated on soil logs and that no compacted earth lining is needed.

Specifications:

Specifications were adapted from those prepared for the Reach 2 contract. Bid items are numbered following the Reach 2 sequence. Dip crossing items were added to Schedule 2, the remainder to schedule 1.

David D. Thackery
Submitted

Leland M. Barber
Recommended

Leland M. Barber
Approved
Acting for DEW

4-15-83
Date

HYDROLOGY, SOILS, SÉDIMENTATION

ARIZONA
D.T 4/15/83
COMPUTATIONS

RWCD REACH 2 EXT.

1/210

COMPUTATIONS - CONTENTS

HYDROLOGY

SOILS

SEDIMENTATION

SIDE INLET

BASIN PROPORTIONS

BASIN INLET CHANNEL

BASIN OUTLET

LAYOUT

SURVEYS

DETAILS

QUANTITY COMPUTATIONS

ARIZONA RWCD REACH 2 EXTENSION 2/210

D.T. 2/23/83

JUNCTION @ HUNT HIGHWAY 1

PROBLEM: NEED DESIGN FOR JUNCTION AND DEBRIS BASIN AT JUNCTION OF HUNT HIGHWAY SIDE DRAINAGE AND RWCD FLOODWAY

ANALYSIS: 1. SUMMARIZE DESIGN FLOWS: ✓

2. SOILS: VERIFY THAT SOILS U.S. OF HUNT HWY (RLH3) ARE SIMILAR TO THOSE IN (RLH2): IE SAME CHANNEL TREATMENT, (IE NO LINING REQUIRED). ✓

3. SURVEYS: PLOT WHEN AVAIL. ✓

4. DEBRIS BASIN: ✓
   - SEDIMENT CAP:
   - HYDRAULIC PROPORTION:
   - LAYOUT

5. JUNCTION: ✓
   - HYDRAULIC ANAL.
   - CHANNEL PROTECTION

6. DETAIL LAYOUT: ✓
   - BERMS, RAMPS, ETC
   - CURVE DATA, ALIGNMENT
   - ROW
   - DRAWING SHEET LAYOUT

7. SPECIFICATIONS ✓

8. QUANTITIES ✓

SOLUTIONS:

1. DESIGN FLOWS:

CASE 1

RWCD DESIGN FLOW	8700	CFS ✓
HUNT HWY DR.*	600	CFS ✓

CASE 2

RWCD FLOW HUNT HWY DR**	2250	CFS ✓

FLOW FROM RWCD FLOODWAY REACHES ABOVE HUNT HIGHWAY AT REACH IN HUNT HIGHWAY DIVERSION IS NEGLIGIBLE.

*RWCD FLOODWAY "FINAL EIS" p.15
- 8100 CFS ABOVE
- 600 CFS BELOW

*p.418-430 "HYDROLOGY STUDIES" AN Bartels 11/76

ARIZONA RWCD REACH 2 EXTENSION 4/210

D. Throckmorton 2/23/83 3/83

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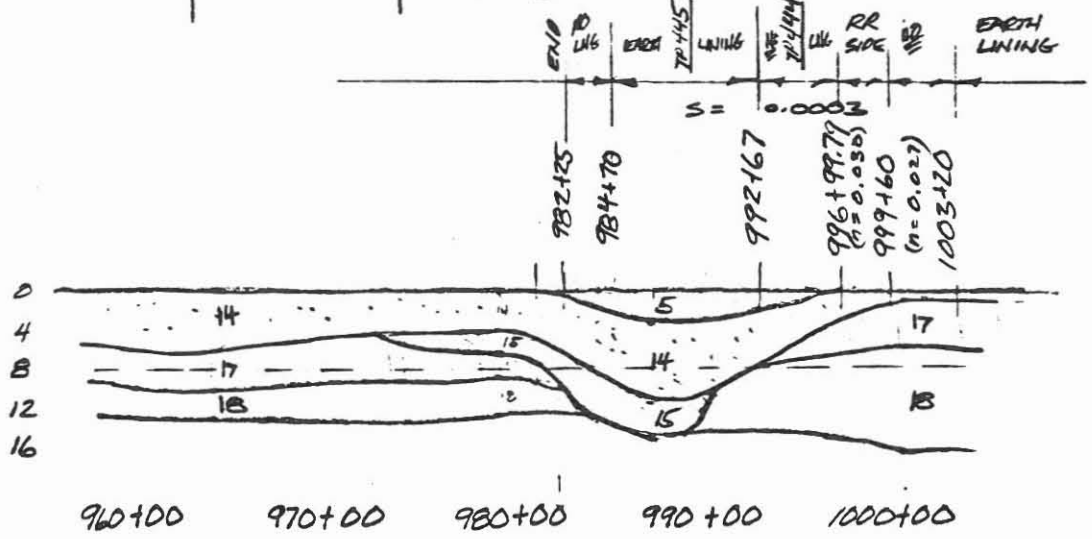
2. SOILS

PIT	STA	DESCRIPTION
2427	1008+00	0-1', #5; 1-5.5', #14; 5.5-17, #15
2428	987+00	0-3', #5; 3-11.5', #14; 11.5-15, #15
2433	979+25	0-4', #14; 4-6', #15; 6-9', #17; 9-13', #18
2434	964+20	0-6', #14; 6-10', #17; 10-13, #18

SEE SH 162/283

HYDRAULICS REF RWCD RCH2 p 41/283



5	LOOSE SAND
14	f-cs SAND, MOD CMT, V. SILTY-CLAYEY
17	f-cs SAND, MOD-WK CMT, w/CL LAYERS
18	SILTSTONE - CALICHE
15	SILT - SAND, SLIGHT - MOD CEM.

CONCLUSION: THE GEOLOGIC PROFILE IN THE RWCD FLOODWAY REACH 3 GEOLOGIC INVESTIGATION REPORT APPEARS SOMEWHAT DIFFERENT FROM THAT ABOVE: THE CONCLUSION, HOWEVER, IS THAT THE CHANNEL EXTENSION FROM STA 972+00 TO 983+00 WILL NOT REQUIRE A COMPACTED EARTH LINING.

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RWCD REACH 2 EXTENSION
3/83

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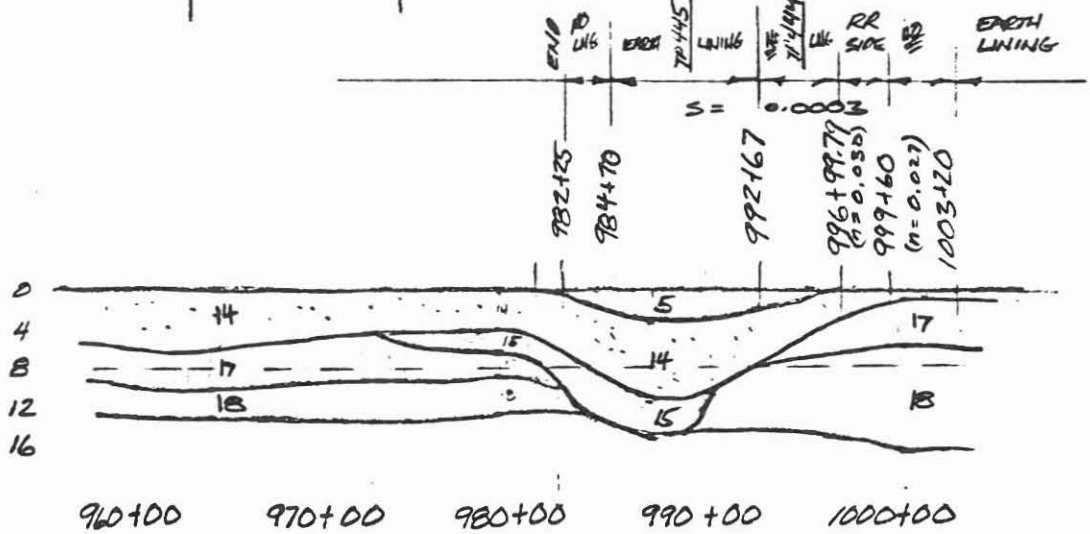

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CONCLUSION: THE GEOLOGIC PROFILE IN THE RWCD FLOODWAY/REACH 3 GEOLOGIC INVESTIGATION REPORT APPEARS SOMEWHAT DIFFERENT FROM THAT ABOVE: THE CONCLUSION, HOWEVER, IS THAT THE CHANNEL EXTENSION FROM STA 976+00 TO 991+00 WILL NOT REQUIRE A COMPACTED EARTH LINING.

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JMF 3/83

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DESIGN REPORT & DESIGN CALCULATIONS RWCD REACH 2

MAY 29, 1982

SEDIMENT

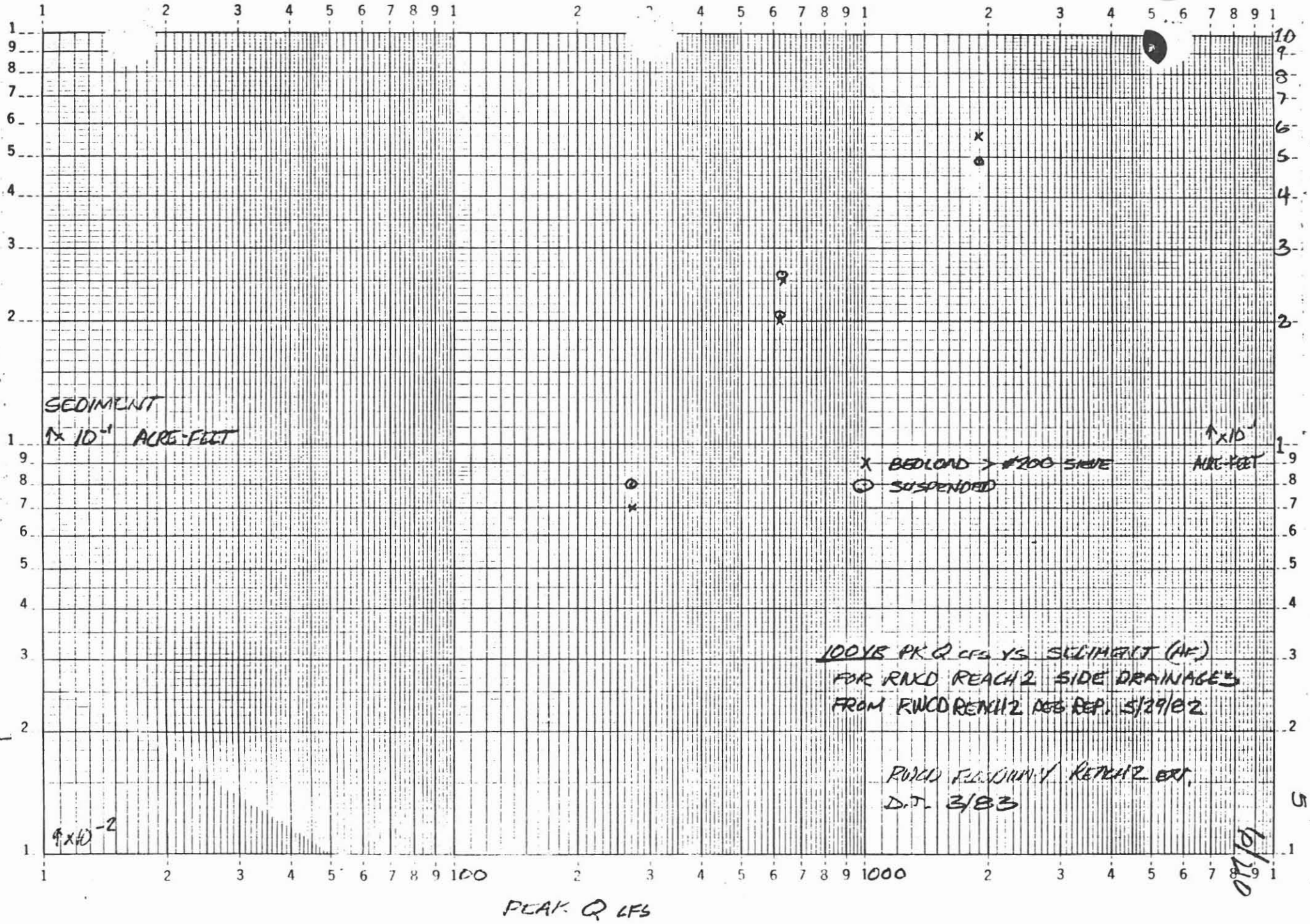
- LITTLE BASIC INFORMATION IS AVAILABLE
- ATTEMPT TO EXTRAPOLATE SEDIMENT QUANTITIES COMPUTED FOR SIDE DRAINAGES TO RWCD RCH 2 REF DES. REP. p. 135/283 & 267/283:

FROM P 267 — P 135

WATERSHED:						SEDIMENT (A-F)					
DA	STA	STA	AREA MI²	CN	TC HR	24		10		100	
						SUS	B>20	SUS	B	SUS	B
1	980	1030	3.25	81	0.9	0.15	0.13	0.32	0.27	0.49	0.41
						0.03	0.03	0.05	0.05	0.07	0.08
					Σ	0.18	0.16	0.37	0.32	0.56	0.49
2	1030	1060	0.34	76	0.31	0.03	0.03	0.05	0.05	0.07	0.08
3	1060	1090	0.62	80	0.28	0.06	0.06	0.13	0.14	0.20	0.21
4	1095	1120	0.66	83	0.44	0.07	0.08	0.16	0.17	0.25	0.26

PEAK FLOWS p 28-32/283:

DA	Q_{100}	Q_{50}	Q_{25}	Q_{10}
	(CFS)			
1	1990	1589	1204	728
2	271	209	151	83
3	621	495	374	225
4	635	515	399	254


SEDIMENT
1 x 10^-1 ACRE-FEET
1 x 10^-2
1 x 10^-1 ACRE-FEET
X BEDLOAD > #200 SIEVE
O SUSPENDED
100YR PK Q CFS VS SEDIMENT (AF)
FOR RWCD REACH 2 SIDE DRAINAGES
FROM RWCD REACH 2 DEB DEP. 5/29/82
RWCD FLOODWAY REACH 2 EXT.
D.T. 3/83
PEAK Q CFS

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RWCD REACH 2 EXTENSION
YMW 3/83

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RWCD FLOOD/ "HYDROLOGY STUDIES"
R.M. Bartels
R.P. McArthur
Nov. 1976
P418, 430

WORK PLAN HYDROLOGY: USED FOR DESIGN (ATT. NO. 3)
HUNT HWY. DRAINAGE

SECTION	DA	Q_{100}	Q_{25}	Q_{10}
184	13.8	2249	1244	707

SEDIMENT (CONT.)

CONCLUSION:

BASED ON PLOT OF DATA:

- DESIGN SEDIMENT VOLUMES CAN REASONABLY ESTIMATED (CONSIDERING THE ASSUMPTIONS REQUIRED IN MAKING SUCH ESTIMATES) AS FOLLOWS:

  BEDLOAD 100 YR EV. 1A-F
  SUSP 1A-F

- ~~SIZE OF THE BASIN WILL BE LIMITED TO THE EXISTING AVAILABLE R.O.W.; CHECK TRAP EFFICIENCY OF TRIAL STRUCTURE TO DETERMINE AMT. OF SEDIMENT RETAINED.~~

NOT NEEDED. BEDLOAD ONLY IS TO BE TRAPPED.

- NOTE THAT REACH 2 DRAINAGES #1 - #4 HAVE NO SEDIMENT TRAPS AND IN TOTAL CONTRIBUTE MORE THAN THE AMOUNT OF SEDIMENT ESTIMATED ABOVE FROM THE HUNT HWY. DIV.

HYDRAULIC DESIGN

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RWCD REACH 2 ART. 1

PROBLEM: DESIGN OVERFLOW WEIR

ANALYSIS: 1. – TRY WEIR L = 150 FT. ; Z = 10 (ACCESS RD. RAMP)
– TRY WEIR ELEV. = 1294.67

2. CHECK EFFECT ON W.S.P. IN CHANNEL FOR Q_{SIDE} = 2250 CFS, 1125 CFS, AND 600 CFS. BY MOMENTUM METHODS AS OUTLINED IN CHOW.

3. CHECK CROSS CHANNEL VELOCITIES BY MOMENTUM METHODS. SOLUTIONS WILL BE APPROXIMATE.

4. DETERMINE EXTENT OF PROTECTION (ROCK – GROUTED ROCK) REQUIRED.

5. ADJUST WEIR DIMENSIONS AS REQUIRED.

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RWCD REACH 2 ~~EXT.~~

FLOW OVER TRAPEZOIDAL WEIR
(KINGS 4th ED p 4-15)

$$Q = CLH^{3/2} + CZH^{5/2} = CH^{3/2}(L + ZH)$$

HP97 PROG

KEYS

H→Q	L	Z	C	
A	B	C	D	E

PROGRAM

LBL A	LBL B	LBL C	LBL D
↑	STO B	STO C	STO D
↑	RTN	RTN	RTN
RCL C	GTO A	GTO A	GTO A
~~RCL~~			
~~X~~			
×			
RCL B			
+			
RCL D			
×			
$\sqrt{x}$			
1.5			
y^x			
RTN			

REG

A	
B	L
C	Z
D	C
E	
01	
02	
03	

EXAMPLE: $L = 150$
$Z = 10$
$H = 2$
$C = 3.0$

$$Q = 3(150)(2)^{3/2} + 3(10)(2)^{5/2} = 3(2)^{3/2}(150 + (10)2)$$

$$= 1272.8 + 169.7$$

$$= 1442.5 \qquad = 1442.5$$

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3/1/83

RIVER REACH 2 EXT.

WEIR FLOW PER KING'S HYD.:

$$Q = CLH^{3/2} + CZH^{3/2} = CH^{3/2}(L + ZH)$$

FOR $Q = 2250$ CFS, $Z = 10$, $C = 3.0$

L (FT)	H (FT)
100	3.19
150	2.63
175	2.42
200	2.25
225	2.10
240	2.02
260	1.99

L = 150

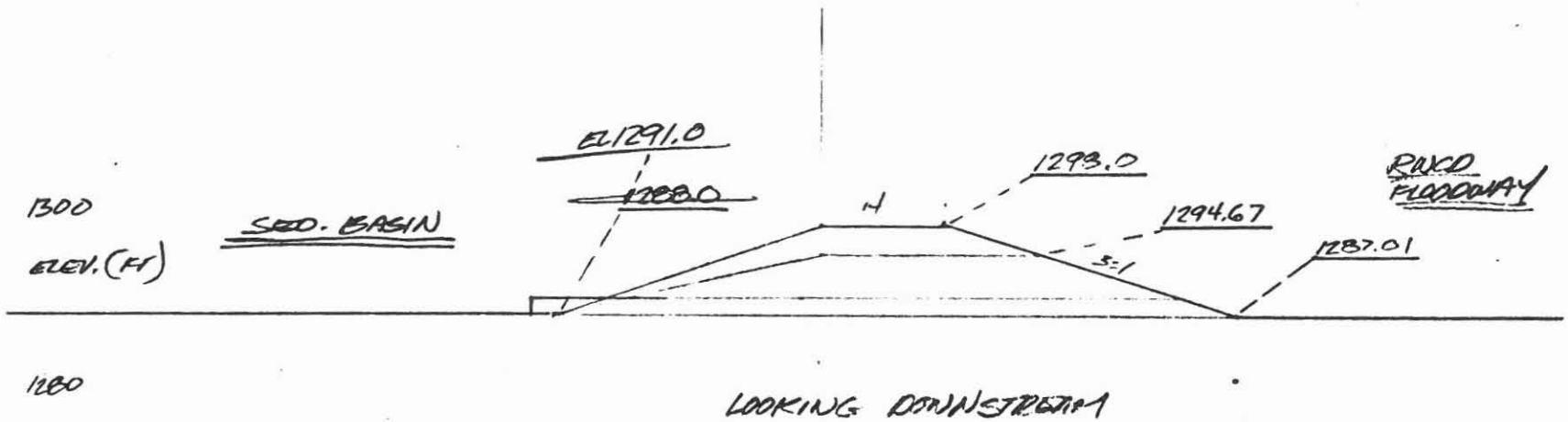
H (FT)	Q (CFS)
0.50	164
0.75	307
1.00	480
1.25	681
1.50	909
1.75	1163
2.00	1442
2.25	1747
2.50	2075
2.63	2255

AR12.

D.T.

3/9/83

RWCD REACH 2 EXT.



11/210

SOLUTION:

1. CHECK THE INCREASE IN FLOW DEPTH IN THE FLOODWAY DUE TO SIDE FLOW FROM THE BASIN WITH PEAK IN CHANNEL BY MOM. PRINCIPLE.

RWCD $n = 0.027$
$B = 20$
$Z = 3$
$S_o = 0.0003$
$d_{WSD} = 9.3$ FT : W.S. EL. ≈ 1296.3

BELOW WEIR $Q_{DS} = 8700$ CFS ✓

ABOVE WEIR $Q_{US} = 8100$ ✓

WEIR

TRIAL EL = 1294.67
DEPTH = 1296.3 − 1294.67 = 1.63 FT
L_{TOP} = 150 + 2(1.63)10 = 182.6 FT

CH. INV

STA	EL
981+66.3	1287.00
981+50	1287.01
981+25	1287.01
981+00	1287.02
980+75	1287.03
980+50	1287.04
980+25	1287.04
980+00	1287.05
980+16.3	1287.05

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RWCD REACH 2 EXT

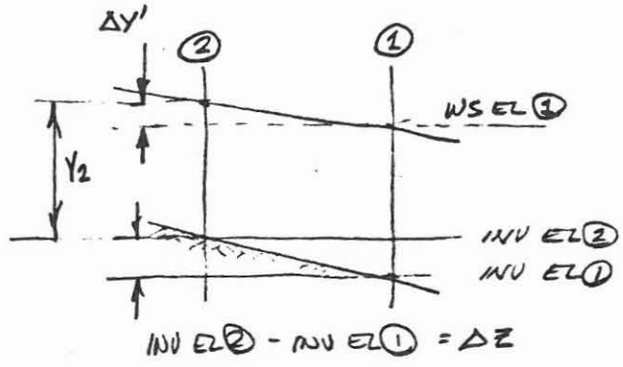
FOLLOW CHOW p. 342-346:

$$\Delta y' = \frac{\alpha Q_1 (V_1 + V_2)}{g(Q_1 + Q_2)} \left(\Delta V + \frac{V_2}{Q_1} \Delta Q \right) + S_f \Delta X$$

INPUT: Q_1, V_1, b_1, Z_1, α_1, y_1, ΔX, ΔQ, ΔY, ΔZ

FIND: $\Delta y' \rightarrow \Delta y'$ SOLN. CHECK

y_2 = WS EL$_1$ + ΔY − (INV. EL 2 − INV. EL 2)
= $y_1 + \Delta Y - \Delta Z$



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RWCD REACH 2 EXT

EQUATIONS:

1. $U = Q/A$

2. $S_{f_{V_1+V_2/2}} = \left(\frac{n\bar{V}}{1.486 R^{2/3}}\right)^2$

$V = \frac{V_1+V_2}{2}$

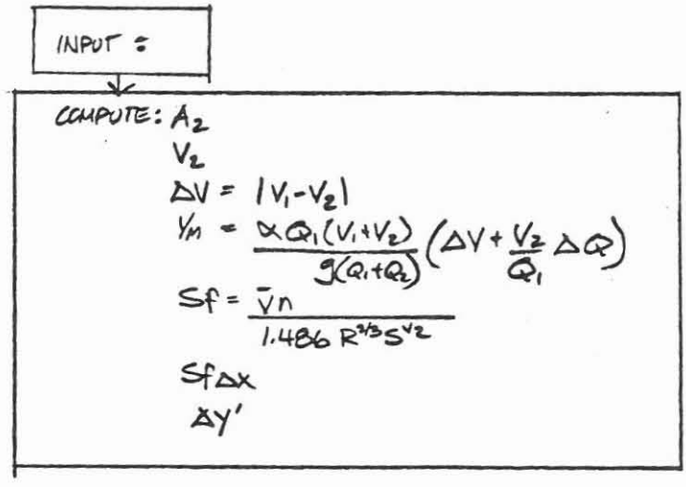
$A = bd + zd^2$

$P = b + 2d\sqrt{z^2+1}$

$R = A/P$

$d = \frac{Y_1+Y_2}{2}$

FLOWCHART:



WNTC
D.T

3/2/83

RWCD REACH 2 EXT.

SUBROUTINES

```
* LBL 01 (Y→AREA)
  ↑
  ↑
  RCL 6
   X
  RCL 7
   X
   +
  RTN

* LBL 02 (Y→P)
  RCL 6
   x²
   1
   +
   √
   X
   2
   X
  RCL 7
   +
  RTN

* LBL 03 (Y→R)
  GSB 1
   ⇄
  GSB 2
   ÷
  RTN

* LBL 04 (Y→Sf)
  RCL C
  RCL 2
   +
   2
   ÷
  GSB 3
   2
   ↑
   3
   ÷
   y^x
  1.49
   X
  RCL E
   ⇄
   ÷
  RCL A
  RCL B
   +
   2
   ÷
   X
   x²
  RTN

* LBL B
  RCL C
  PRTX
  RTN
```

SUBROUTINES

01	Y→AREA
02	Y→P
03	Y→R
04	Y→Sf
05	

REGISTERS

		GIVEN	SIGN
A	V_2		
B	Y_M		
C	Y_2		
D	Sf		
E	n	**	
0	Y_1	*	
1	ΔZ	*	POS-INC
2	ΔY		POS-INC
3	ΔQ	*	POS-DEC
4	ΔX	*	POS
5	α	**	
6	z	**	
7	b	**	
8	V_1	*	
9	Q_1	*	
I			

NNTC
D. Thadoray 3/2/83

RWCD REACH 2 GRT.

16/21

MAIN

```
LBL A
STO 2
RCL 0
RCL 1
-          COMPUTE
+          V2
STO C
GSB 1      A2
RCL 9      Q1
RCL 3      ΔQ
-          Q2
R↓
÷          Q2/T2 V2
STO A
RCL 8
-
ABS        ΔV
RCL A      V2
RCL 9      Q1
÷
RCL 3      ΔQ
×
+          ΔV + (V2/Q1) ΔQ
32.2
÷
RCL 5      α
×
RCL 9      Q1
×
RCL A      V2
RCL 8      V1
+          V1 + V2
×
RCL 9      Q1
2
×
RCL 3
-          Q1 + Q2
÷
STO B      Ym'
RCL 0
RCL C
+
2
÷          Y̅
GSB 4
STO D      Sf
RCL 4      X
RCL B
+
PRT SP
RCL 2
PRT X
R↓
PRT X
RTN
GTO A
```

ARIZONA
D.T.

3/3/83

RWCD REACH2 EXT.

17/210

001	*LBLA	21 11
002	STO2	35 02
003	RCL0	36 00
004	RCL1	36 01
005	-	-45
006	+	-55
007	STOC	35 13
008	GSB1	23 01
009	RCL9	36 09
010	RCL3	36 03
011	-	-45
012	X⇄Y	-41
013	÷	-24
014	STOA	35 11
015	RCL0	36 00
016	GSB1	23 01
017	RCL9	36 09
018	X⇄Y	-41
019	÷	-24
020	STO8	35 08
021	RCLA	36 11
022	-	-45
023	ABS	16 31
024	RCLA	36 11
025	RCL9	36 09
026	÷	-24
027	RCL3	36 03
028	x	-35
029	+	-55
030	3	03
031	2	02
032	.	-62
033	2	02
034	÷	-24
035	RCL5	36 05
036	x	-35
037	RCL9	36 09
038	x	-35
039	RCLA	36 11
040	RCL8	36 08
041	+	-55
042	x	-35
043	RCL9	36 09
044	2	02
045	x	-35
046	RCL3	36 03
047	-	-45
048	÷	-24
049	STO5	35 12
050	RCLC	36 00
051	RCLC	36 13
052	+	-55
053	2	02
054	÷	-24
055	GSB4	23 04
056	STOD	35 14
057	RCL4	36 04
058	x	-35
059	RCLB	36 12
060	+	-55
061	SPC	16-11
062	RCL2	36 02
063	PRTX	-14
064	X⇄Y	-41
065	PRTX	-14
066	RTN	24
067	GTOA	22 11
068	*LBL1	21 01
069	ENT↑	-21
070	ENT↑	-21
071	ENT↑	-21
072	RCL6	36 06
073	x	-35
074	RCL7	36 07
075	+	-55
076	x	-35
077	RTN	24
078	*LBL2	21 02
079	RCL6	36 06
080	X²	53
081	1	01
082	+	-55
083	√X	54
084	x	-35
085	2	02
086	x	-35
087	RCL7	36 07
088	+	-55
089	RTN	24
090	*LBL3	21 03
091	GSB1	23 01
092	X⇄Y	-41
093	GSB2	23 02
094	÷	-24
095	RTN	24
096	*LBL4	21 04
097	RCLC	36 13
098	RCLA	36 00
099	-	-55
100	1	02
101	÷	-24
102	GSB3	23 03
103	2	02
104	ENT↑	-21
105	3	03
106	÷	-24
107	Yˣ	31
108	1	01
109	.	-62
110	4	04
111	8	08
112	6	06
113	x	-35
114	RCLE	36 15
115	X⇄Y	-41
116	÷	-24
117	RCLA	36 11
118	RCL8	36 08
119	+	-55
120	2	02
121	÷	-24
122	x	-35
123	X²	53
124	RTN	24
125	R/S	51
126	*LBLB	21 12
127	RCLC	36 13
128	PRTX	-14
129	RTN	24
130	GTOA	22 11
131	R/S	51

WNTC
D.T. 3/2/83

RWCD REACH 2 EXT.

OPERATION:

1. INITIALIZE

			SIDEWEIR FOR SUBCR COMP. (U.S.) - SIGN -
	[n STO E]		
*	Y1 STO	0	
	ΔZ STO	1	+
	ΔQ STO	3	+
	ΔY STO	4	+
	[α STO	5	
	Z STO	6	
	D STO	7]	
*	Q1 STO	9	

2. KEY EST. ΔY' | +

3. HIT A GIVES ΔY'

4. COMPARE AND TRY NEW EST. IF NECESSARY.

WNTC
D. Theodore 3/2/83

RWCD REACH 2 EXT

EXAMPLE:

$Q = 8700$
$Y_1 = 9.3$ FT
$A_1 = bd + zd^2 = 200(9.3) + 3(9.3)^2 = 21$
$V_1 = 4.10$ FT/S
$\alpha_1 = 1.2$

LENGTH OF W.S. AT TOP OF WEIR
$L_T \approx 182.6$ FT
$\Delta X = 16.3$
$\Delta Z = 0.01$
$\Delta Q = 29.25$ ($Q_{SIDE} = 600$ CFS : USE EQ. $L = 150$ ft
$Q/FT = 3.61$: $Q_{ENTER} = 3.61 \times 150 = 541.19$
END $Q = (600 - 541.19)/2 = 29.40$)

$\Delta Y' = 0.02$

1. $Y_2 = Y_1 - \Delta_Z + \Delta Y'$
$= 9.30 - 0.01 + 0.02$
$= 9.31$

2. $A_2 = 200(9.31) + 3(9.31)^2$
$= 2122.03$

3. $V_2 = \dfrac{8700 - 29.4}{2122.03}$
$= 4.086$ FT/S

4. $\Delta V = 4.10 - 4.086$
$= 0.014$

5. $Y_M = \dfrac{\alpha Q_1 (V_1 + V_2)}{g(Q_1 + Q_2)} \left(\Delta V + \dfrac{V_2}{Q_1} \Delta Q\right)$

$= \dfrac{1.2(8700(4.086 + 4.10))}{32.2(8700(2) - 29.25)} \left(0.0174 \dfrac{4.086}{8700}(29.25)\right)$

$= (0.1529) \quad (0.03243)$

$= 0.004959$

6. $S_f = \left(\frac{n\bar{V}}{1.486\,R^{2/3}}\right)^2$

$= \left(\frac{0.027(4.093)}{1.486\,(8.193)^{2/3}}\right)^2$

$S_f = 0.0003348$

$\bar{V} = 4.093$ FT/S

$\bar{Y} = 9.305$

$A = 200(9.305) + 3(9.3$
$= 2120.75$

$P = b + 2d\sqrt{z^2+1}$
$= 200 + 2(9.305)(\sqrt{3^2+}$
$= 258.85$

$R = 8.193$

7. $S_f \Delta x = 0.00034(16.3)$
$= 0.00546$

8. $Y' = Y_m' + S_f \Delta X$

$= 0.004959 + 0.00546$
$Y' = 0.01042$

OK
Z

ARIZONA D.T

3/3/83

P.W.G. REACH 2 EXT

JMK

$n = 0.030$ $\alpha = 1.20$

$b = 200$ $S = 0.0003$

$z = 3$

STATION	REG 4 ΔX	INV EL	REG 1 ΔZ	REG 9 Q	REG 3 ΔQ	REG 0 Y	ΔY'
981+66.3		1287.00		8700		9.30	
981+50	16.3		0.00489	8670.75	29.25	9.307	0.01145
981+25	25		0.00750	[8580.50]	90.25	9.323	0.0243
981+00				8490.25		9.340	0.0238
980+75				8400.00		9.355	0.0232
980+50				8309.75		9.371	0.0227
980+25				8219.50		9.385	0.0222
980+00				8129.25		9.400	0.0218
980+16.3	16.3		0.00489	8100.00	29.25	9.405	0.00984

→ ∴ DESIGN FLOW DEPTH D.S. OF WEIR = 9.41 ✓

— CHECK F.B. W/ DESIGN DEPTH = 11 FT. ; FB = 11/9.41 = 1.17 17% F.B. OK JMK
THIS IS SLIGHTLY LESS THAN 20%.

— USE DESIGN DEPTH WITH FB = 11 FT. ✓

****** WATER SURFACE PROFILE ******

JOB: RWCD REACH 2-EXTENSION
BY: D. THACKERAY
DATE: 3/83

Q= 2,250.00 N= 0.035 B= 150.00 Z= 10.00 S= 0.000000
Dc= 1.890 Vc= 7.05 Sc=0.013607
ALPHA=1.10 K=0.00

No.	Station (ARBITRARY)	Inv-El	WS-El	D	V	He	Sf	F
1 TOP OF CHUTE	-1+00.00	1294.67	1296.67	2.000	6.62	2.680	0.011198	0.914
2	1+01.00	1294.67	1296.72	2.054	6.42	2.695	0.010216	0.877
3	1+02.00	1294.67	1296.76	2.093	6.29	2.707	0.009574	0.851
4	1+03.00	1294.67	1296.79	2.125	6.18	2.719	0.009087	0.831
5	1+04.00	1294.67	1296.82	2.152	6.09	2.729	0.008692	0.814
6	1+05.00	1294.67	1296.85	2.177	6.02	2.739	0.008359	0.800
7	1+06.00	1294.67	1296.87	2.199	5.95	2.749	0.008071	0.787
8	1+08.00	1294.67	1296.91	2.239	5.83	2.766	0.007590	0.766
9	1+10.00	1294.67	1296.94	2.273	5.73	2.783	0.007198	0.747
10	1+12.00	1294.67	1296.97	2.304	5.64	2.799	0.006868	0.731
11	1+14.00	1294.67	1297.00	2.332	5.57	2.813	0.006584	0.717
12	1+18.00	1294.67	1297.05	2.383	5.43	2.841	0.006112	0.693
13	1+22.00	1294.67	1297.10	2.427	5.32	2.867	0.005733	0.673
14 U.S. END	1+28.00	1294.67	1297.16	2.486	5.18	2.902	0.005277	0.648
15 OF WEIR	1+34.00	1294.67	1297.21	2.538	5.06	2.935	0.004914	0.628
16	1+40.00	1294.67	1297.25	2.584	4.95	2.965	0.004614	0.610
17	1+50.00	1294.67	1297.32	2.653	4.81	3.011	0.004212	0.585
18	1+60.00	1294.67	1297.38	2.713	4.68	3.053	0.003893	0.564

ENTER NEXT STATION

≡ HWSP RUN UPSTREAM FROM THE WEIR CREST
TO CHECK VELOCITIES,
⟶ the computation depth was assumed to be 2.0 ft at the weir crest
⟶ Note that He will bring depth of pool to ≈ EL 1294.67 + 3.0 = 1297.67 ft.

22/20

ARIZONA
D. Thackeray 3/8/83

RWCD REACH 2 EXT.
JNV 3/83

PROBLEM: NEED TO DECIDE EXTENT OF ROCK & GROUTED ROCK CHANNEL PROTECTION NEEDED DOWN SIDE WEIR.

ANALYSIS: 1. DETERMINE CRITICAL DEPTH FOR FLOWS IN SIDE WEIR

2. COMPUTE WSP DOWN CHUTE ASSUMING CHANNEL TO BE INFINITELY WIDE. THAT IS R = BOTTOM WIDTH; R = DEPTH. USE DIRECT STEP. CHECK LOCATION OF HYDRAULIC JUMP ACCROSS CHANNEL ASSUMING DEPTH EQUALS NORMAL DEPTH FOR THE RWCD FLOW. NEGLECT THE DYNAMIC FORCE.

THIS SOLUTION IS APPROXIMATE ONLY BUT WILL PROVIDE SOME PRELIMINARY DESIGN.

ARIZONA
D. Thackeray 3/8/83

RWCD REACH 2 ~~EXT.~~
LMK 3/83

SOLUTION:

1. CRITICAL DEPTH: CHECK Q = 2250 CFS.

PREL COMP

A = 2.63 FT

TOP WIDTH = 150 + 2(2.63)10 = 202.6 FT

USE EQUIVALENT WIDTH = $\frac{A}{d} = \frac{150(2.63) + (2.63)^2 10}{2.63}$ ✓

= 176.3 FT

USE $q = \frac{2250}{176.3} = 12.76$ cfs/ft ✓

TEC #27

d_c

B = 150
z = 10
α = 1.0
Q_c = 2250 CFS
d_c = 1.83 FT ✓

d_{crit}

B = 1
z = 0
α = 1
Q = 1
d = 1.72 ft

USE d = 1.72 AS INITIAL DEPTH ✓

ARIZONA RWCD REACH 2 EXT.

Dillingham 3/8/83

```
LBL A
STO A
RCL 0
RCL D
x²
×
64.4
÷
STO 5   [K]
RCL B
GSB 1
STO 6   E1
RCL B
GSB 2
STO 3   SF1
*LBL E
RCL A
GSB 1
STO 7   E2
RCL A
GSB 2
STO 4   SF2
RCL 3
+
2
÷       S̄F
RCL C   S0
⇄
−       S0-S̄F
RCL 6
RCL 7
−       ΔE
ABS
⇄
÷       ΔX
PRT SP
RCL A
PRT X   <PRT SP.
↓
PRT X
RTN
GTO E
```

```
LBL 1   Y→E
↑
Yx
x²
RCL 5
×
+
RTN
LBL 2   Y→SP
RCL E
RCL D
×
1.496
÷
⇄
5
↑
3
÷
Yx÷
x²÷
RTN

LBL B
RCL B
STO A
RTN
GTO A
```

ARIZONA
D. Trachoney 3/8/83

ROUGH REACH 2 EXT.

2. DIRECT STEP:

$$\Delta X = \frac{\Delta E}{S_o - S_f} \qquad E = y + \alpha \frac{V^2}{2g}$$

FOR WIDE CH:
$R \simeq y$

$$S_f = \frac{n^2 V^2}{2.22 R^{4/3}}$$

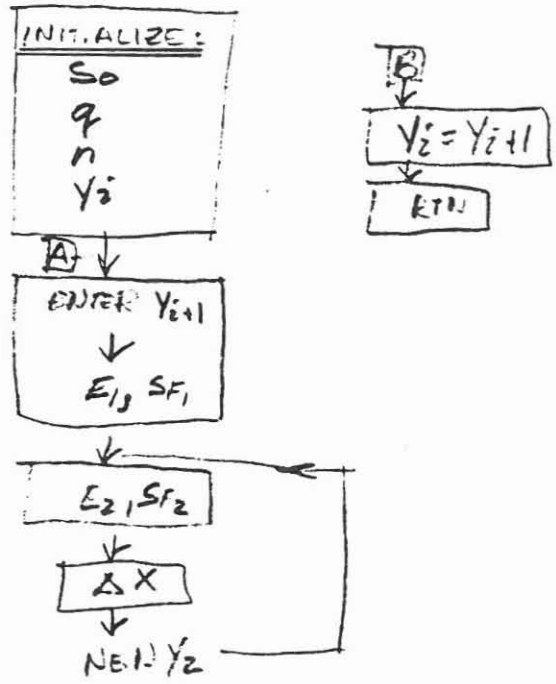
UNIT WIDTH:
$D = 1;\ A = y;\ V = \frac{q}{y}$

$$\Delta E = E_2 - E_1$$

THEN: $S_f = \frac{n^2 (q/y)^2}{2.22\, y^{4/3}} = \frac{n^2 q^2}{2.22 (y^{10/3})} = \left(\frac{n q}{1.486\, y^{5/3}}\right)^2$

$$E = y + \frac{\alpha q^2}{2g}\left(\frac{1}{y}\right)^2 = y + K\frac{1}{y^2} \quad : K = \frac{\alpha q^2}{2g}$$

PROGRAM:



REG

A	Y_2
B	Y_1
C	S_o
D	q
E	n
F	α
G	V_1
H	V_2
I	S_{f1}
J	S_{f2}
K	K
L	E_1
M	E_2
N	
O	
P	
Q	
R	
S	
T	
U	
V	
W	
X	
Y	
Z	
I	UREG

INITIAL VALUES

ARIZONA
D.T. 3/8/83

RWCD REACH 2 ~~EXT.~~

EXAMPLE:

$q = 12.76$
$n = 0.035$
$S_o = 0.3333$
$\alpha = 1.2$

$Y_1 = 1.72$
$Y_2 = 1.60$

FIND: $E_1 = y + \alpha \frac{V^2}{2g}$

$= 1.72 + 1.2(12.76/1.72)^2/64.4$

$= 1.72 + 1.02551$

$E1 = 2.74551$

$S_{f1} = \left(\frac{nq}{1.486 Y_1^{5/3}}\right)^2$

$= \left(\frac{0.035(12.76)}{1.486(1.72)^{5/3}}\right)^2$

$S_{f1} = 0.01482$

$E2 = 1.60 + 1.2(12.76/1.60)^2/64.4$

$= 1.60 + 1.1851$
$= 2.7851$

$S_{f2} = \left(\frac{0.035(12.76)}{1.486(1.60)^{5/3}}\right)^2$

$S_{f2} = 0.01885$

ARIZ
DT 3/8/83 RUXDRCH2 CT.

$$\Delta E = 2.7851 - 2.74551$$
$$= 0.03959$$

$$\Delta X = \frac{\Delta E}{S_o - \bar{S}_f}$$

$$= \frac{0.03959}{0.3333 - \left(\frac{0.01482 + 0.01885}{2}\right)}$$

$$= \frac{0.03959}{0.31667}$$

$$\Delta X = \underline{\underline{0.125 \text{ FT}}}$$ OK

ARIZONA D.T. 3/3/83 RIVER REACH 2 EXT. LMS 3/83

$q = 12.76$ cfs/ft
$n = 0.035$
$\alpha = 1.2$

TRIAL WEIR EL. 1294.67
CH. INVERT EL. 1287.03
$H = 7.64$ FT $L = 22.92$ FT

CHOW p.13

FROUDE # $= \frac{V}{\sqrt{gL}}$

$V = q/D$
$L = D$

$F = \frac{q/D}{\sqrt{gD}}$

$F = \frac{q}{\sqrt{g}}(D)^{-3/2}$

	Y1	So	ΔX	DIST	
WEIR CR.	1.72	0.3333	0.125	0	F = 1.00
	1.60		0.203		V = 7.42
	1.50		0.324		
	1.40		0.491		
	1.30		0.730		
	1.20		1.089		
	1.10		0.742		
	1.05		0.929		
	1.00		1.184		
	0.95		1.549		
	0.90		2.107		
	0.85		3.058		
	0.80		5.006		
	0.75		1.482		
	0.74		1.759		
	0.73		2.150		
TOE OF SL.	0.72			22.928	V = 17.7 ft/s
		0.000			
	0.73		0.565		F = 3.61
	0.74		0.566	1.1	
	0.75		0.567	1.7	
	0.80		2.834	4.5	
	0.90		5.622	10.2	
	1.00		5.595	15.7	F = 2.25
	1.10		5.466	21.2	
	1.20		5.229	26.4	
	1.30		4.874	31.3	
	1.40		4.391	35.7	
	1.50		3.769	39.5	
	1.60		2.997	42.5	
	1.70		2.062	44.5	F = 1.01

ARIZONA D.T 3/8/83 RNCD REACH 2 EXT LMS 3/83

CHECK SPECIFIC FORCE:

$$F = \bar{p}A + Q\rho V \qquad \bar{p} = \frac{\gamma y}{2}$$

$$= \frac{\gamma}{2} y (y)(1) + q \rho q/y \qquad A = y \times 1$$

$$= \frac{\gamma}{2} y^2 + q^2 \rho / y \qquad Q = q$$

$$= \gamma\left(\tfrac{1}{2} y^2 + q^2/gy\right) \qquad V = q/y$$

$$\rho = \gamma/g$$

DIVIDING BY γ: $F/\gamma = (\tfrac{1}{2} y^2 + q^2/gy)$

$q = 12.76$ $\qquad F/\gamma = y^2/2 + K/y$ $\qquad K = q^2/g$

$$\left[= \frac{(12.76)^2}{32.2} = 5.06 \text{ FOR EG} \right]$$

y	$y^2/2$	K/y	F/γ
0.5	0.13	10.11	10.24
0.6	0.18	8.43	8.61
0.7	0.25	7.22	7.47
0.8	0.32	6.32	6.64
0.9	0.41	5.62	6.02
1.0	0.50	5.06	5.56
1.1	0.61	4.60	5.20
1.2	0.72	4.21	4.93
1.3	0.85	3.89	4.73
1.4	0.98	3.61	4.59
1.5	1.13	3.37	4.50
1.6	1.28	3.16	4.44
1.7	1.45	2.97	4.42
2.2	2.42	2.30	4.72
2.6	3.38	1.94	5.32
3.0	4.50	1.69	6.19
4.0	8.00	1.26	9.26
5.0	12.50	1.01	13.51
6.0	18.00	0.84	18.84

$\bar{V}_{D=4'} = 3.2$ FPS

- IT APPEARS THE JUMP WILL BE SUBMERGED AT THE SLOPE TOE FOR TAILWATER DEPTHS GREATER THAN 4.0 FT.

- NORMAL DEPTH IN RNCD FOR $Q = 2250$, $n = 0.035$, $S = 0.0003$, $b = 200$; $z = 3$, $d = 5.1$ FT

ARIZONA RWCD REACH 2 EXT
D.T. 3/9/83 LHW 3/83

CONCLUSION:

(Hwp.398)

- A HYDRAULIC JUMP WILL OCCUR AT THE BASE OF THE CHUTE SLOPE. ✓
- FROUDE # (F) FOR THE JUMP EXAMINED IS 3.6 - IN THE UNDULAR RANGE. ✓
- USE A GROUTED ROCK APRON EXTENDING 20' FROM THE SLOPE TOE: EXTEND A 15' ROCK SECTION BEYOND. ✓

ARIZ.
D.T. 3/27/83 RWCD RCH2 EXT. 4/83

PROBLEM: CHECK GRADATION OF ROCK RR.

ANALYSIS: 1. USE CORPS ROCK CHARTS.; HIGH TURBULENCE; LOW TURBULE
FLOW $\gamma_s = 165$ LB/FT^3 =

SOLUTION:

V	HIGH TURB. D_{50}	LOW TURB. D_{50}
6.5	0.54	
8	0.82	0.5
9	1.05	0.6
10	1.25	0.67
12	1.85	0.95
14	2.50	1.30
17	3.70	1.90

RWCD RCH2 ROCK

SID ITEM 20

SIZE (IN)	% PASSING
15	100
12	75 - 100
9	60 - 85
6	25 - 40
4	10 - 25
3	0 - 10

$D_{50} \approx 8$ in $= .67$ FT

OK FOR INLET CHANNEL

ARIZONA D.T. 4/83 RWCD REACH 2 EXT. 4/83

BASIN DESIGN SUMMARY:

INVERT EL	1291.0
DESIGN W.S. EL	1297.7
DESIGN WATER DEPTH	6.7 FT
BOTTOM DIM	192 FT W X 236 FT L
FLOW AREA (D=6.7)	1420 FT²
FLOW V (Q=2250 CFS)	1.58 FT/S
FLOW AREA W 1' SED	1243 FT²
V (Q=2250 CFS) 1' SED	1.81 FT/S
VOL @ D=6.7 FT	8.37 AF

ARIZONA D.T 3/24/03 DWCD REACH 2 EXT YML 4/03

34/21

PROBLEM: BASIN INLET CHANNEL LAYOUT REVISION

ANALYSIS: 1. KEEP VELOCITY IN THE INLET CHANNEL APPROXIMATELY THE SAME AS IN THE EXISTING CHANNEL FOR DESIGN Q = 2250 CFS.

2. TRY INVERT EL. AT BASIN INLET = EL 1293.5 & TRY S = 0.009, b = 50, Z = 3

FROM TEK PROG. FOR IRREG. CH. SECTION

3. BY SLOPE-AREA METHOD BANKFULL CAPACITY OF CHANNEL #1 AND CHANNEL #2 IS FOR EACH APPROX 1/2 THE Q_{100} OF 2250 CFS OR 1250 CFS EACH: VELOCITY IS APPROX. 10 FT/S.

4. DESIGN WS IN THE BASIN IS APPROX EL 1297.3 FOR Q = 2250 CFS.

5. AS AN APPROXIMATION CHECK NORMAL DEPTH FOR:

A.	B.
Q = 2250 CFS	Q = 1225
n = 0.035	n = 0.035
S = 0.009	S = 0.009
B = 50	B = 25
Z = 3	Z = 3

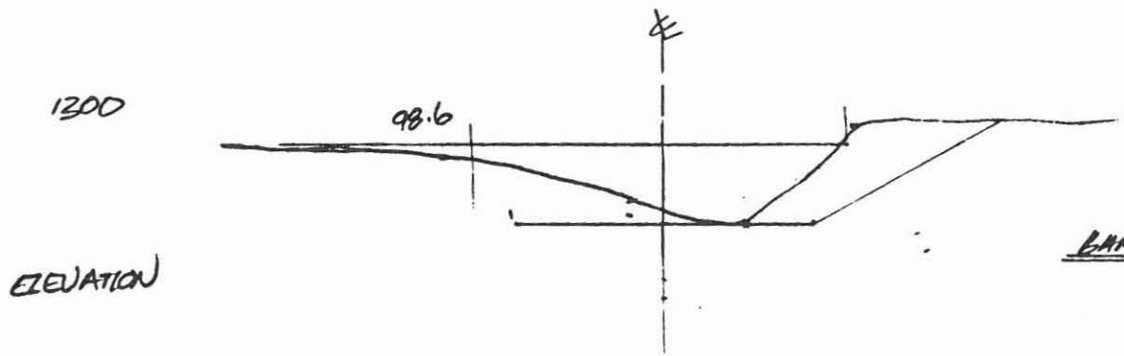
SOLUTION:

A.	B.
1. A: DEPTH = 4.03	DEPTH = 4.00
A = 250	A = 147.8
V = 9.0 FT/S	V = 8.3 FT/S

OR - USE THIS CONFIGURATION

- FOR FLOWS LESS THAN DESIGN FLOWS THE INLET CHANNEL WILL BE SUBMERGED. DEPOSITION OF SEDIMENT IN THE BASIN INLET SHOULD BE EXPECTED.

✓ YML



SECTION CHANNEL #3 AT STA 13+00

BANK FULL CAP:

$A \approx 14(2)(1/2) = 14\ ft^2$
$P \approx 15$
$R \approx 14/15 \approx 1$
$S = 0.005$; $n = 0.035$
$V = \frac{R^{2/3} S^{1/2}}{n} \approx \frac{1(0.005)^{1/2}}{0.035}$
$V = 2\ ft/s$
$Q = 2(14) \approx 28\ cfs$

USE STD SIDE INLET
RUCD RCH12 p45/50
- W=10 d=1

ADIZ
D.T.

3/29/83

RIKD REACH 2 EXT.

3/9

✓

SED BASIN INLET CHANNEL:

MAIN CHANNEL

DESC	STA	ELEV.
TOE	10+07.5	1291.0
CREST	10+00	1293.5
BEGIN MAIN	9+40	1294.04

CH #1

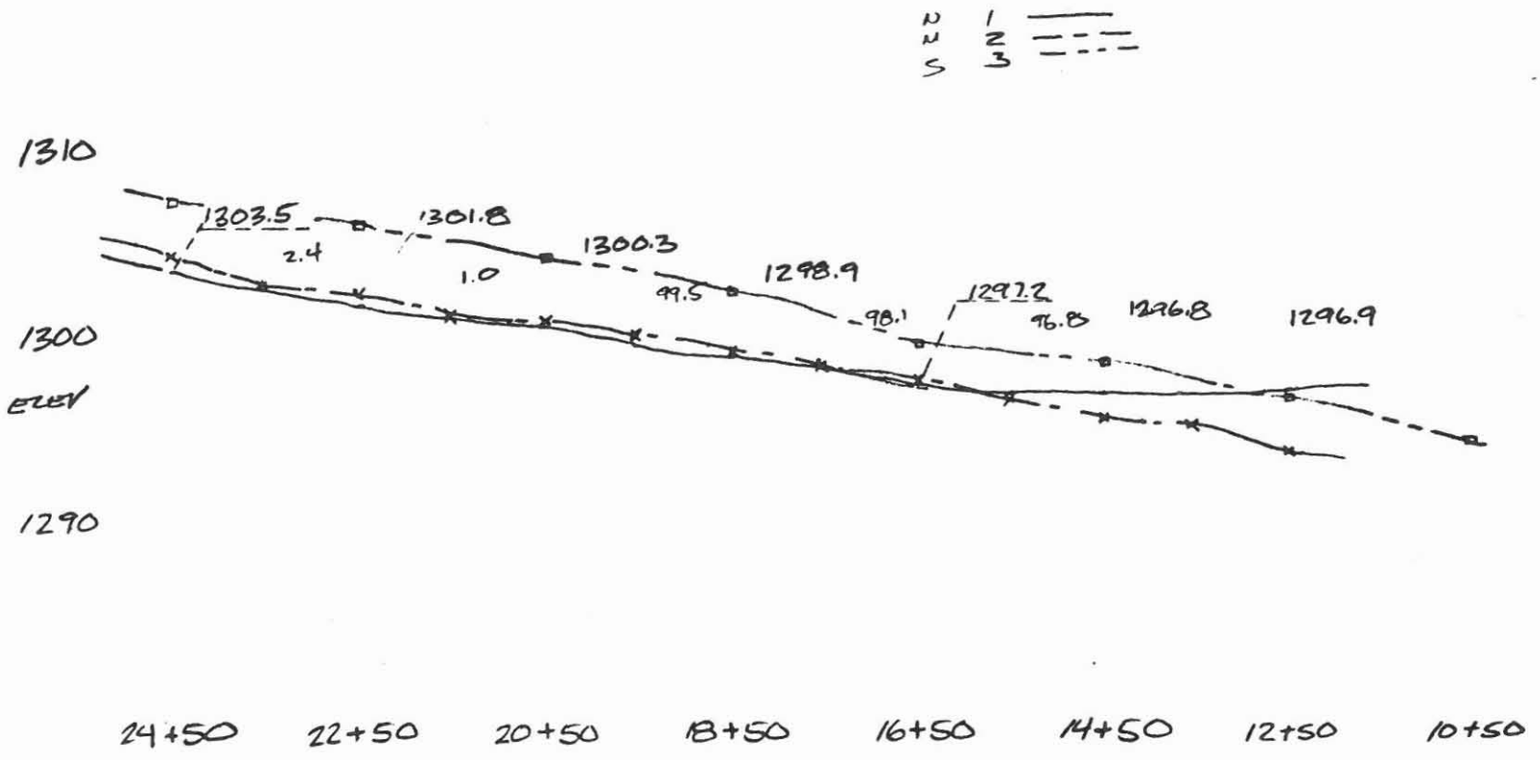
END	CH#1	9+40	1294.04	=
	PT	8+50	1294.85	
BEGIN PROJ	PC	7+20.80	1296.01	

CH #2

END CH2	PT	9+40	1294.04
BEGIN CH#2		8+10.80	1295.20

ARIZ D.T. 3/10/83 RWCO REACH 2 BOT. JAW

PROFILE - SIDE DRAINAGE - MONT HIGHWAY DIV.



MONT HWY. TOPOG.

AVE GR. CH2 ≈ $\frac{1302.1 - 1293.5}{1000} = 0.0086$

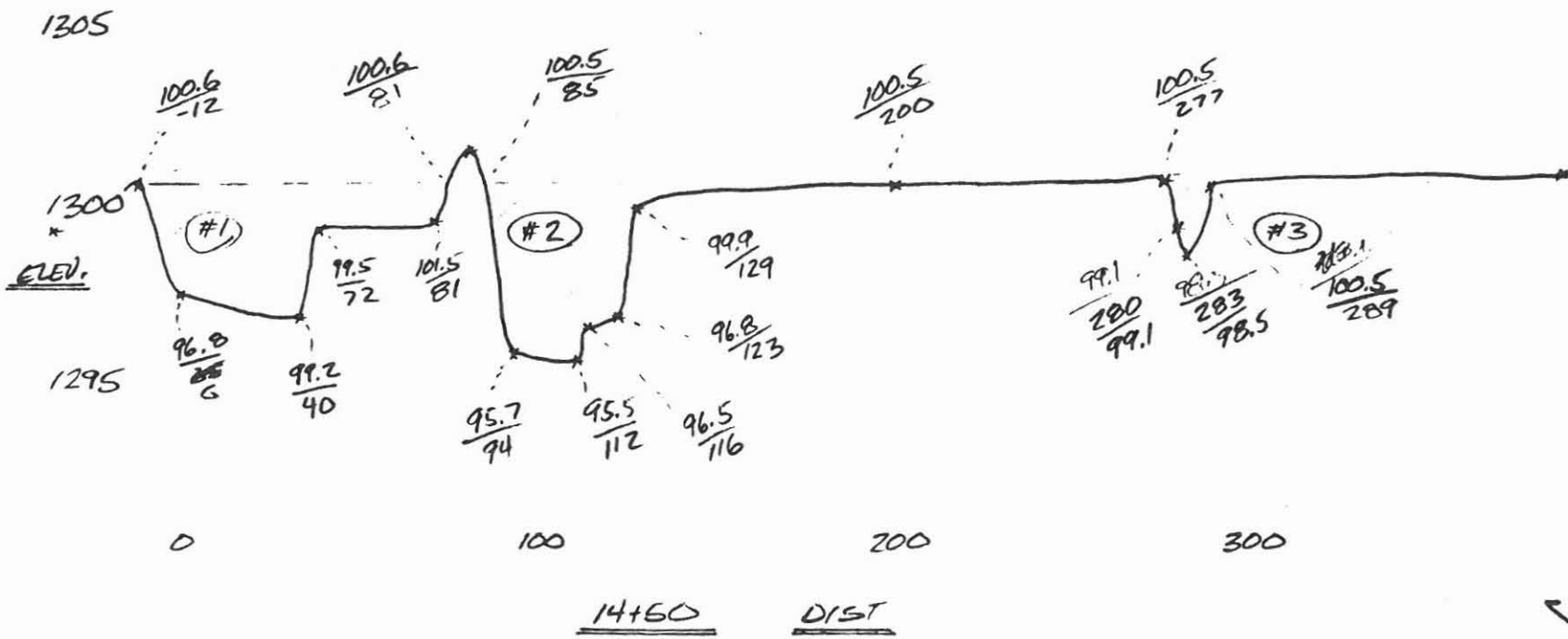
37/2

AD12
O.T.

3/11/83

X-SEC HWY HIGHWAY DIV.

RUCO REPACH'R EST.



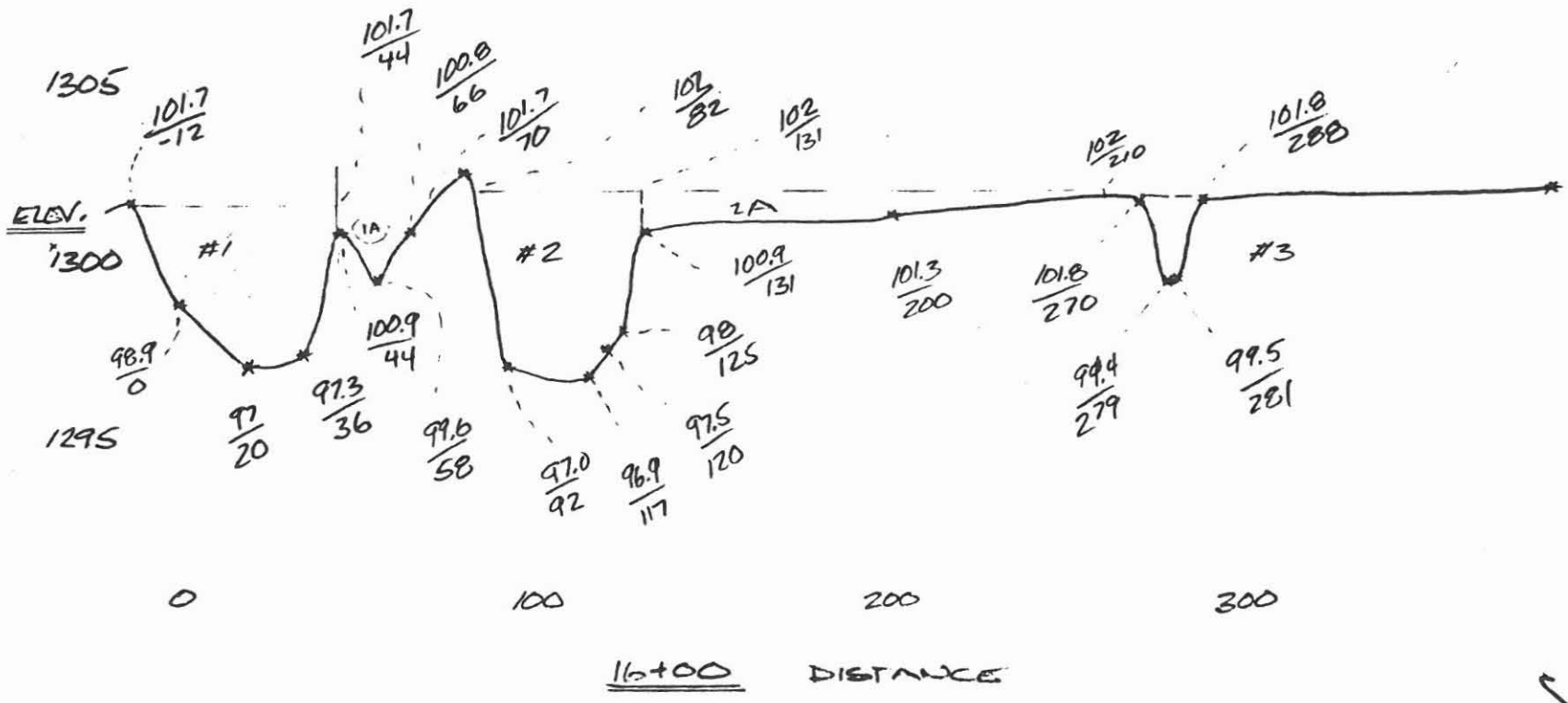
38/210

ARIZ
D.T.

3/11/83

X-SEC. HUNT HIGHWAY DIV.

RWCD REACH 2 EXT.

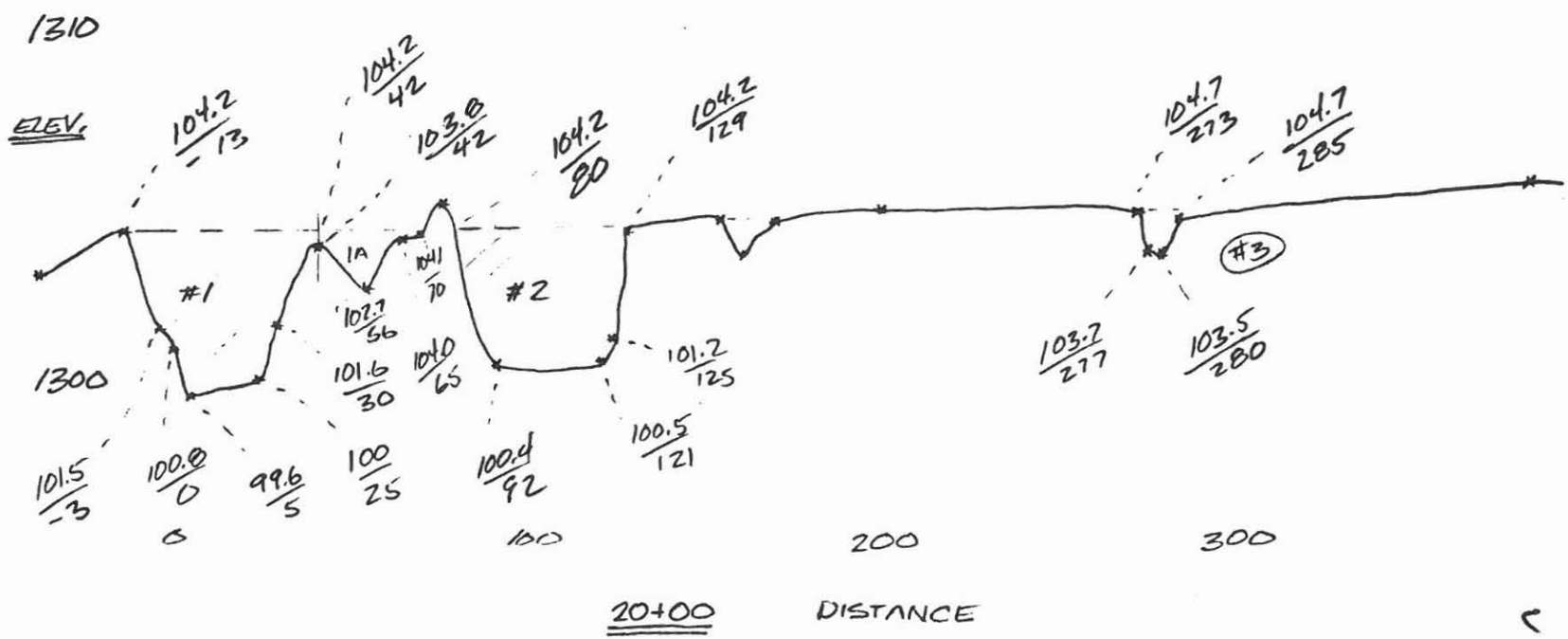


39/210

ARIZ.
D.T.

3/11/83
X-SEC HWY HIGHWAY DIV.

RWCD REACH 2 EXT

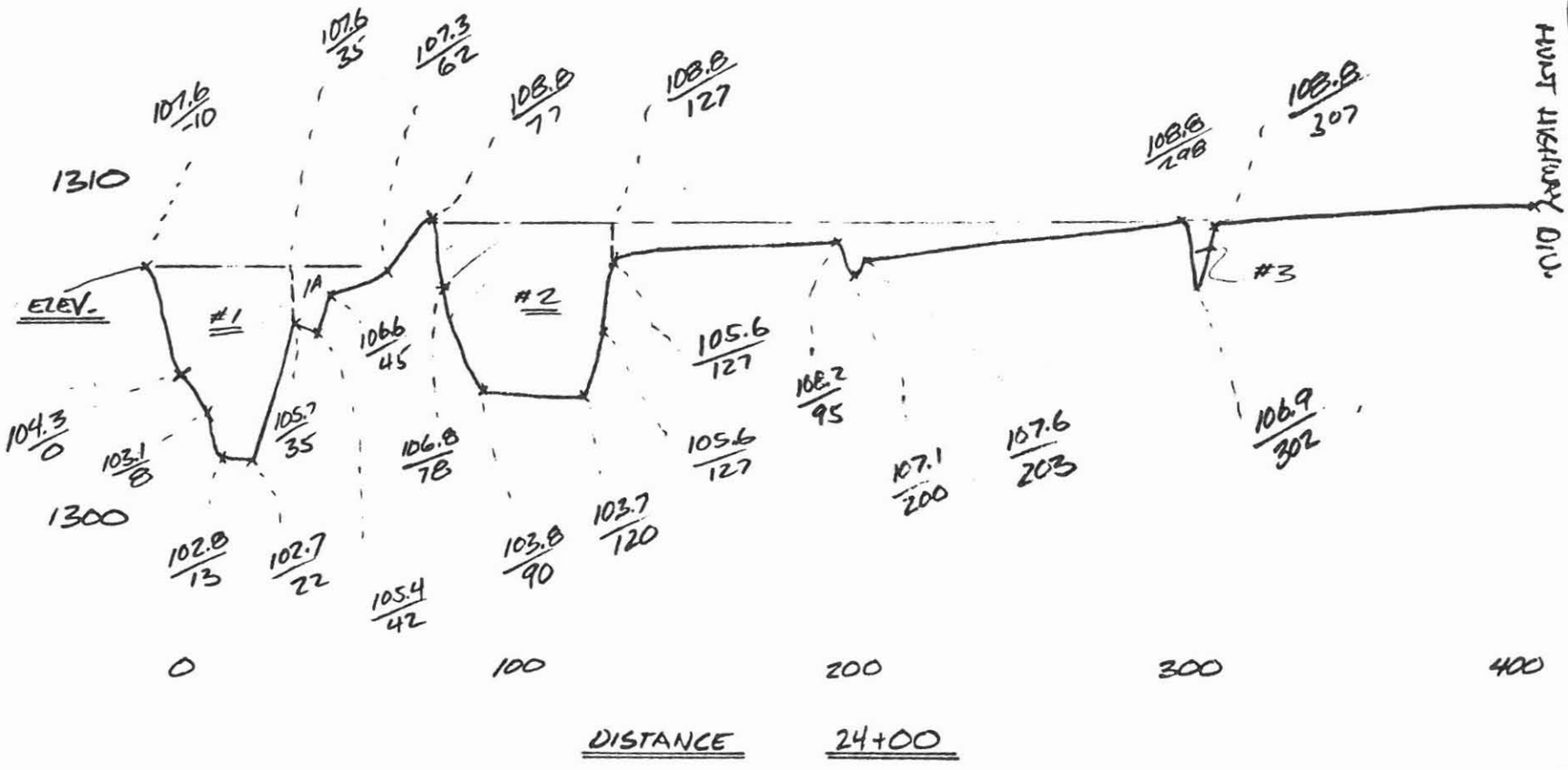


2 of 2

ABIZ.
O.T.

3/10/83
X-SEC HWY HIGHWAY DIV.

RWCD REACH 2 EXT



41

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	
0.00	102.7	0.0	0.0	0.0	0.0	0.0
0.25	103.0	0.5	4.0	0.1	0.1	0.6
0.50	103.2	2.0	7.9	0.2	0.8	3.9
0.75	103.5	4.4	11.9	0.4	2.3	11.4
1.00	103.7	7.9	15.9	0.5	4.9	24.5
1.25	104.0	12.3	19.9	0.6	9.0	44.5
1.50	104.2	18.0	28.2	0.6	13.3	66.0

DO YOU WANT A GRAPH?

20+00
#1A

DWD BERNIZ-EST. 42/210
ADOT.
HOUT HIGHWAY DIV.
BATING SLOPE AREA
n=0.03
S=0.01
STA 20+00
Alt. 1A

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	
0.00	99.6	0.0	0.0	0.0	0.0	0.0
0.50	100.1	6.5	22.5	0.3	2.9	14.2
1.00	100.6	18.6	26.3	0.7	14.8	73.7
1.50	101.1	32.6	30.1	1.1	34.4	170.7
2.00	101.6	48.4	33.9	1.4	61.4	304.7
2.50	102.1	66.2	38.6	1.7	94.9	471.6
3.00	102.6	86.3	43.2	2.0	136.9	679.8
3.50	103.1	108.7	47.9	2.3	187.8	932.5
4.00	103.6	133.4	52.6	2.5	248.2	1232.6
4.50	104.1	160.2	56.0	2.9	323.0	1604.4

DO YOU WANT A GRAPH?

20+00

#1

BUCD RECEIVED OCT. 4 '91
210
ABIB.
HOUST HIGHWAY DIV.
RATING
SLOPE - AREA
n=0.03
S=0.01
STA 20+00
CH 1

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	
0.00	98.5	0.0	0.0	0.0	0.0	0.0
0.25	98.8	0.3	2.1	0.1	0.1	0.3
0.50	99.0	1.0	4.1	0.2	0.4	1.9
0.75	99.3	2.2	5.8	0.4	1.2	5.8
1.00	99.5	3.8	7.2	0.5	2.5	12.2
1.25	99.8	5.6	8.5	0.7	4.3	21.3
1.50	100.0	7.8	9.9	0.8	6.7	33.3
1.75	100.3	10.4	11.3	0.9	9.8	48.5
2.00	100.5	13.2	12.7	1.0	13.5	67.3

DO YOU WANT A GRAPH?

#3

14+50

RUN BEACH 2 EXT 4/1/20
ABR2
HUNT HIGHWAY DIV.
RATIO
SLOPE-AREA
n = 0.03
S = 0.01
STA 14+50
CH#3

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	
0.00	96.8	0.0	0.0	0.0	0.0	0.0
1.00	97.8	9.9	20.0	0.5	6.2	30.8
2.00	98.8	39.6	40.0	1.0	39.4	195.7
3.00	99.8	100.8	83.4	1.2	114.4	568.2
4.00	100.8	187.4	90.9	2.1	303.7	1508.6

DO YOU WANT A GRAPH?Y

ES

↓ SYNTAX ERROR
ES

#1
14+50

45/90
BUD BEACH 2 EST
ARIZ.
HUNT HIGHWAY DIV.
RATING
SLOPE-AREA
N=0.03
S=0.01
STA 14+50
CH #1

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	95.5	0.0	0.0	0.0	0.0	0.0
0.50	96.0	7.8	20.7	0.4	4.1	20.1
1.00	96.5	18.8	23.8	0.8	16.1	79.7
1.50	97.0	33.3	32.3	1.0	33.9	168.5
2.00	97.5	49.7	34.5	1.4	63.3	314.6
2.50	98.0	67.0	36.6	1.8	100.2	497.8
3.00	98.5	85.3	38.8	2.2	144.3	716.6
3.50	99.0	104.5	40.9	2.6	195.4	970.4
4.00	99.5	124.7	43.1	2.9	253.5	1258.9
4.50	100.0	146.5	56.9	2.6	275.4	1367.6
5.00	100.5	189.0	117.1	1.6	260.0	1291.3

DO YOU WANT A GRAPH?

14+50 #2

RWCD BEACH 2 EXT 4/6/20
AR12
HIGHT HIGHWAY DIV.
RATING
SLOPE-AREA
n=0.03
S=0.01
STA 14+50
CH #2

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	100.4	0.0	0.0	0.0	0.0	0.0
0.50	100.9	13.6	31.6	0.4	7.8	38.6
1.00	101.4	30.0	34.5	0.9	27.4	135.9
1.50	101.9	47.7	37.3	1.3	56.2	279.3
2.00	102.4	66.8	40.2	1.7	93.7	465.5
2.50	102.9	87.1	43.0	2.0	139.6	693.3
3.00	103.4	108.9	45.8	2.4	193.8	962.5
3.50	103.9	131.9	48.7	2.7	256.4	1273.2

DO YOU WANT A GRAPH?

20+00
#2

RIVER REACH 2 47/20
ARIZ
HUNT HIGHWAY DIV.
RATING
SLOPE - AREA
n=0.03
S=0.01
STA 20+00
CH #2

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	103.5	0.0	0.0	0.0	0.0	0.0
0.25	103.8	0.6	4.3	0.1	0.2	0.8
0.50	104.0	1.9	6.4	0.3	0.8	4.2
0.75	104.3	3.7	8.5	0.4	2.2	10.7
1.00	104.5	6.1	10.6	0.6	4.2	20.8

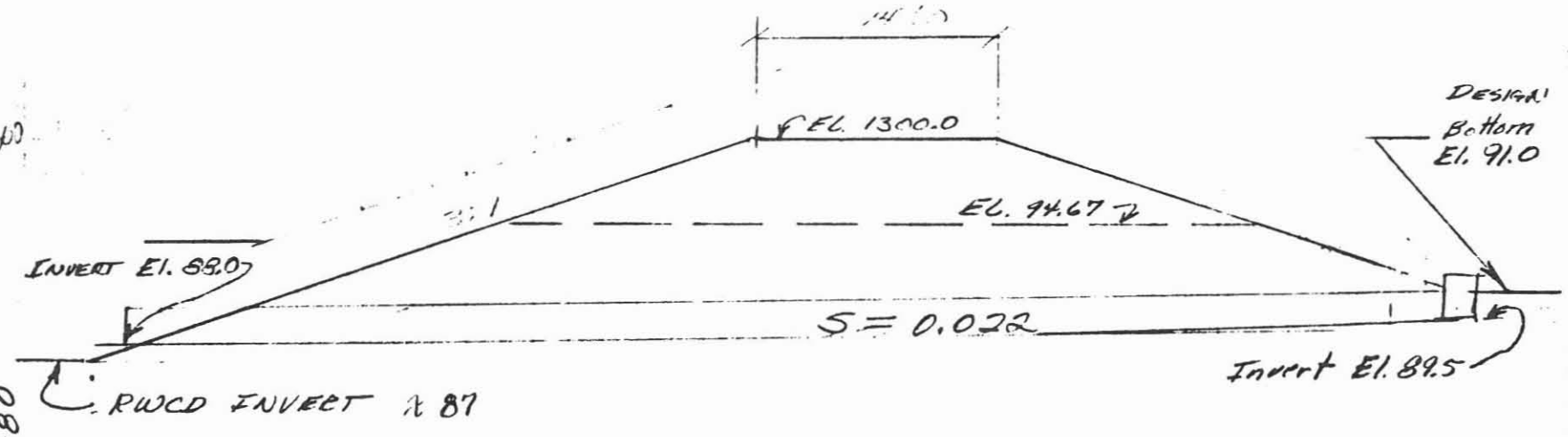
DO YOU WANT A GRAPH?

0+00
#3

RUCD RESEARCH 2 ~~EXT~~ 4E/210
AREA
HUNT HIGHWAY DIV.
RATING
SL-A
n=0.03
S=0.01
STA 20+00
CH #3

49/210

AZ. RWCD - R-2 Ext.
LMS 3/83 DT. 4/12/83
SED. BASIN OUTLET, STA 981+80



Requirements
1. Self Cleaning — partial flow velocity to sufficient to move silt size* particles
2. Large enough for maintenance (minimum 24 inch dia.)
3. 100 yr. life — Concrete
4. Non-pressure flow — (C76 PIPE)
5. Trash guard, — Concrete riser with Trash rack
6. Ext. strength to support earth load
~~load plus~~ (vehicle wt. not a factor because of fill depth)
7. Outlet a minimum of 1.0 foot above channel invert.

* Use min. velocity of 4 fps for 1/4 depth flow

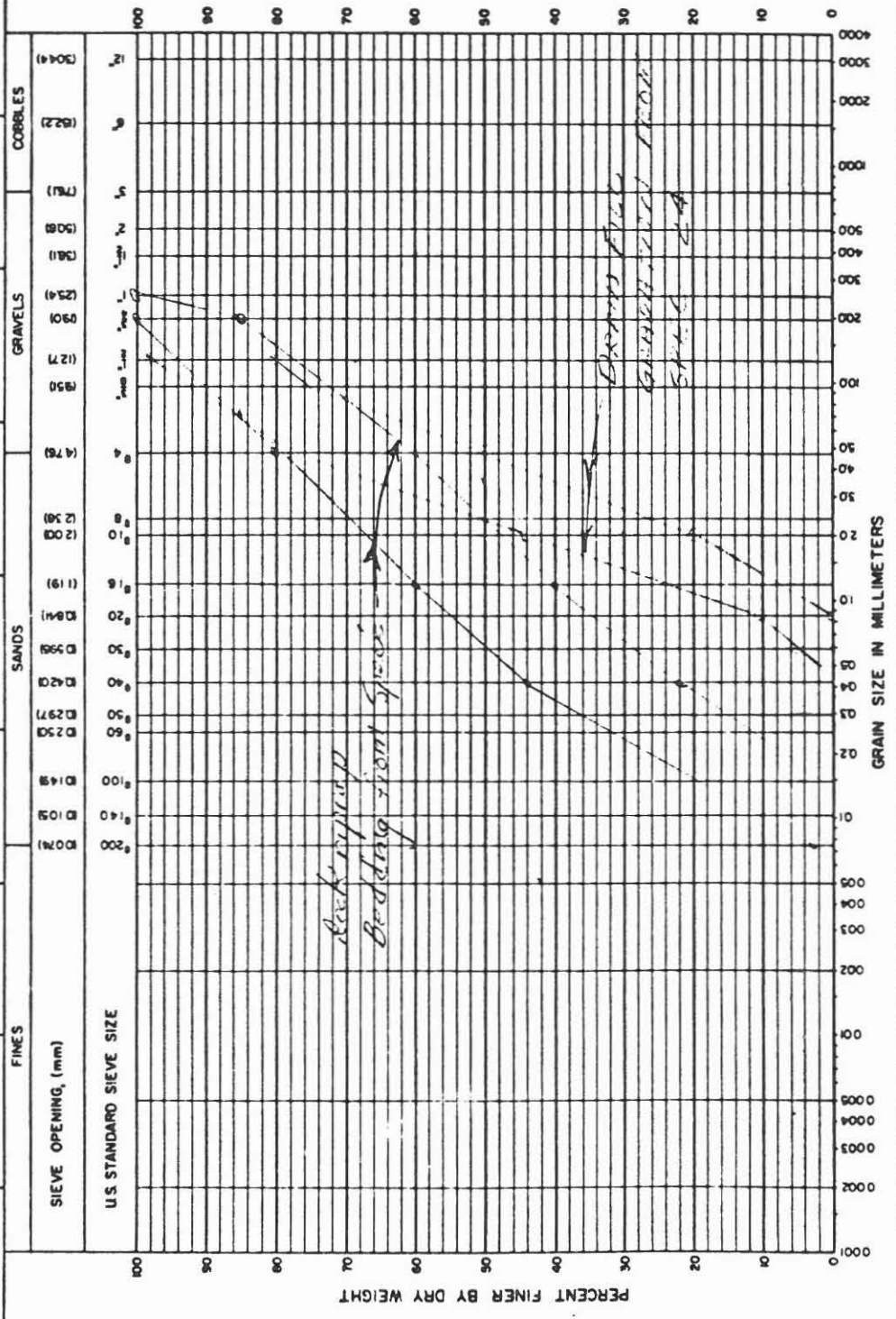
SCS-ENG-353 (REV. 3-70)
FILE CODE ENG-22

LABORATORY NO 50/210

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: AZ. - PWCD-R2			SAMPLE LOCATION
FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
SYMBOL	DESCRIPTION: Bedding and drainfill gradations from Reach 2 specs.		

GRAIN SIZE DISTRIBUTION



UNDISTURBED CONDITION		
MOISTURE	%	
DRY UNIT WEIGHT	g/cc	pcf

SOLUBLE SALTS	%
SHRINKAGE LIMIT	%

ATTERBERG LIMITS	NATURAL MOISTURE		AIR DRY		OVEN DRY	
	LL	PI	LL	PI	LL	PI

SPECIFIC GRAVITY (G_s)	(-) #4	(+) #4

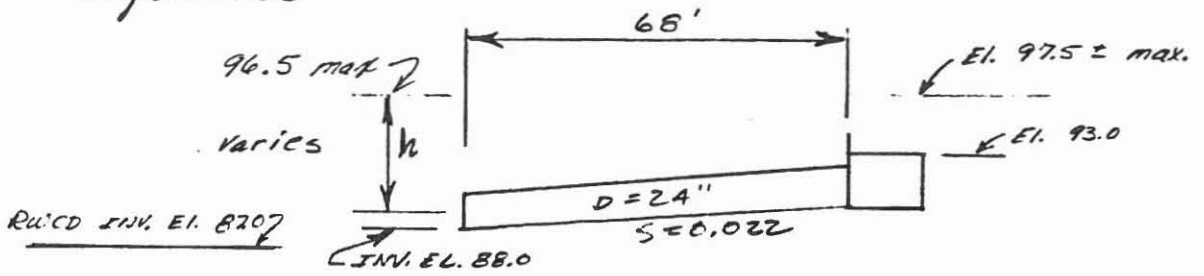
REMARKS:

AZ RWCD - R-2 Ext

LMS 3/83 DT 4/12/83

Sed. Basin Outlet - STA. 9E1+80

Hydraulics

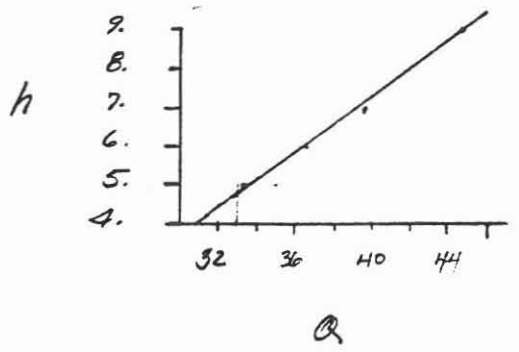


ASSUME : INLET LOSS $K_e = 1.0$

$n = 0.013$

$K_p = 0.0124$

$$Q = A\left[\frac{2gh}{K_e + K_o + K_p L}\right]^{1/2} = 14.94\sqrt{h}$$



Discharge for pipe flowing flow with grade = 0.022

NEH - 5 Full Pipe Flow Charts

$Q = 33.5$

Pressure flow could occur during periods of high intensity rainfall over the local drainage area and little runoff from the upper watershed. These periods would be infrequent and pressure flow would probably not exceed 2' ±.

⟹ C-76 pipe is satisfactory.

AE RWCD R-2 Ext.
LMS 3/83 DT 4/12/83

Determine discharge-velocity values for 24" concrete pipe ($n = 0.013$) flowing partly full

Partially full flow – Reference HEC-14

$d/D = 0.25$ $(d = 0.5')$

$A/D^2 = (0.1535)(4) = 0.61$ "

$Q = 30.97\ S^{1/2}$

S	Q	A	V
0.005	2.2	0.61	3.58
0.01	3.1	"	5.10
0.015	3.8	"	6.2

$d/D = 0.5$ $(d = 1.0')$

$A/D^2 = (0.3927)(4) = 1.57$ "

$Q = 113.3\ S^{1/2}$

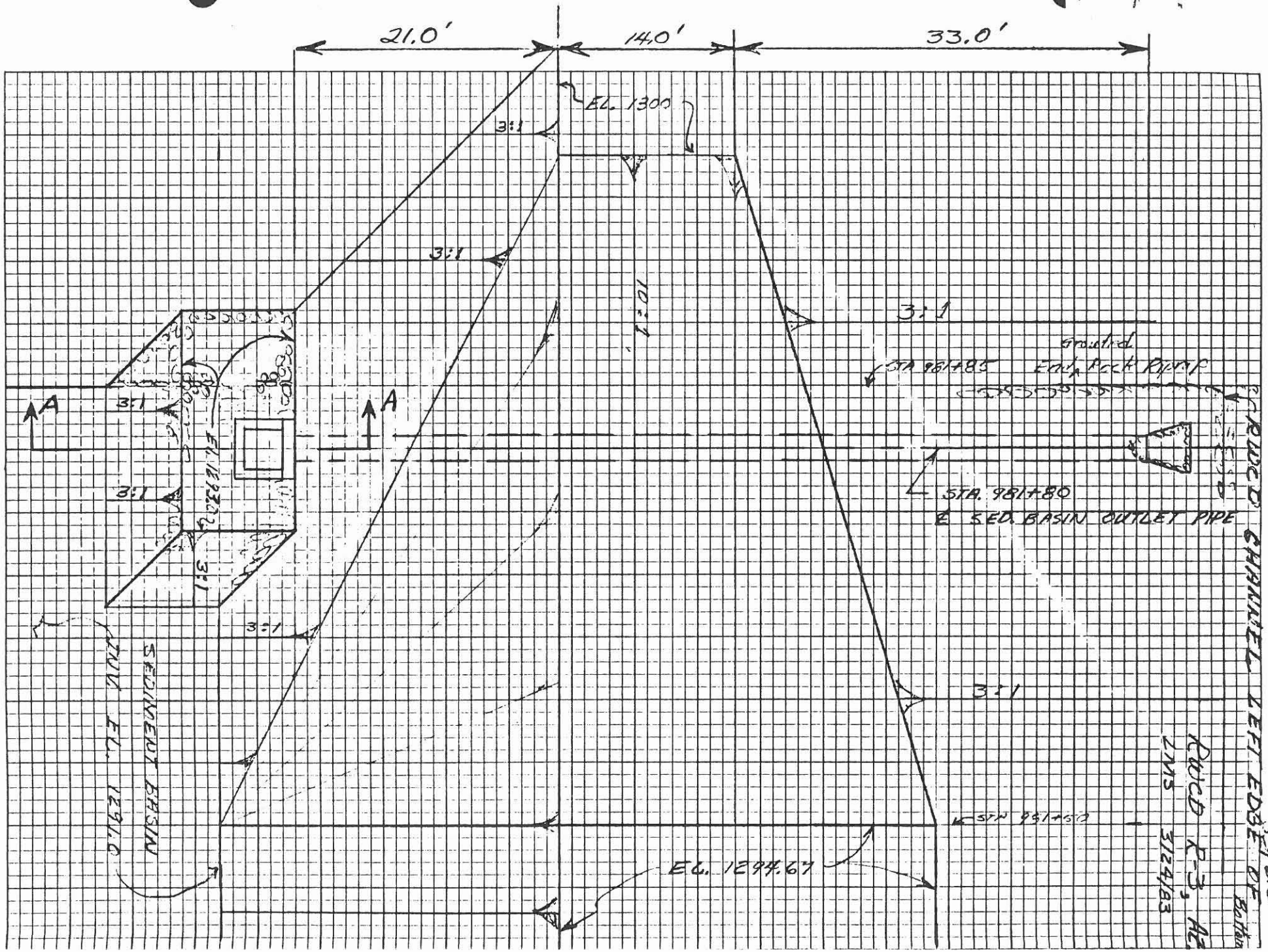
S	Q	A	V
.005	8.0	1.57	5.1
0.01	11.3	"	7.2
0.015	13.9	"	8.9

⇒ Use min slope of 0.01 feet/ft to provide self scouring velocities at low discharge

$S = 0.022$ $Q \geq 30$ CFS for full pipe flow

K+E 5 X 5 TO 1/2 INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 0862

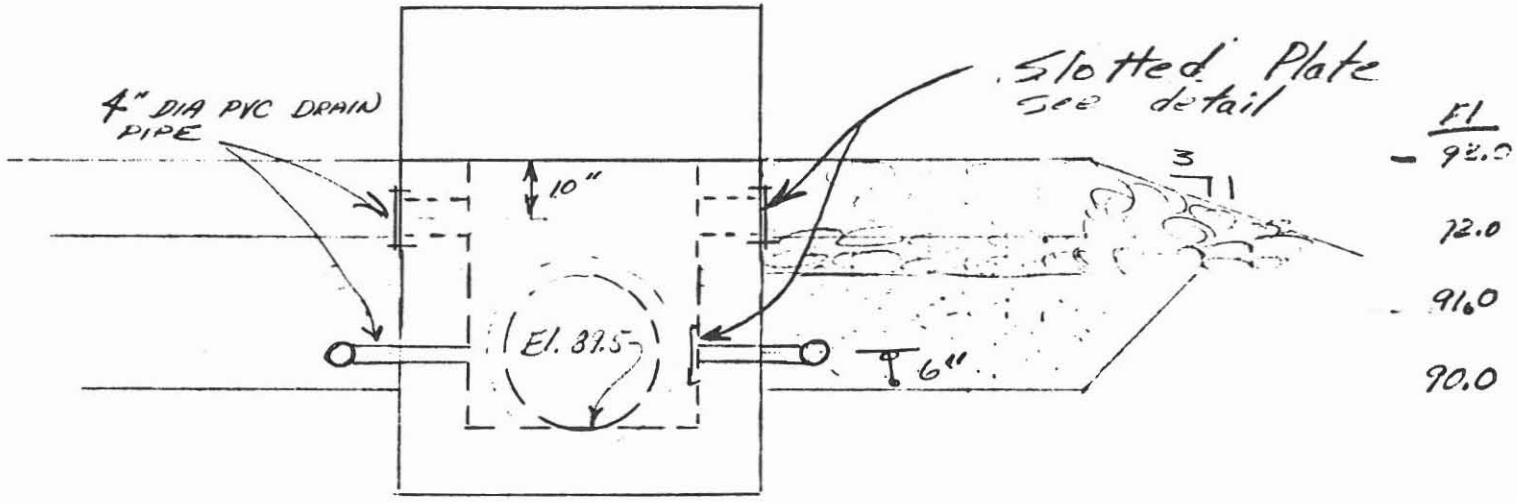


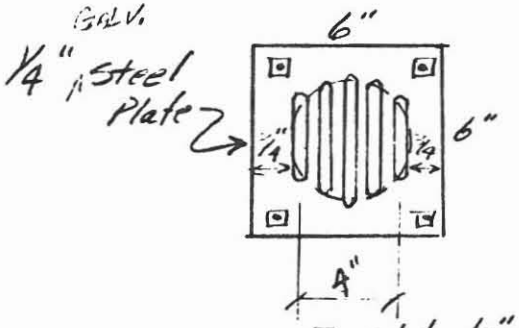
54/210

FIELD BEACH EXTENSION

ARE 4/83

BASIN OUTLET



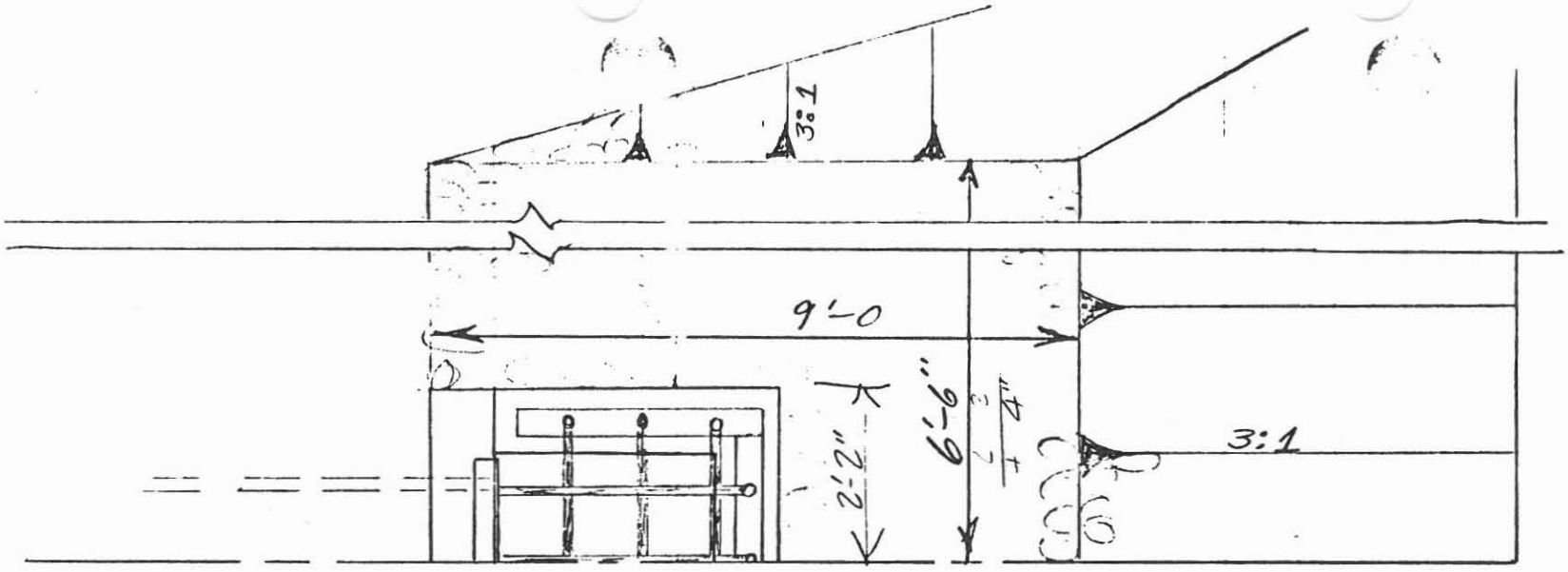


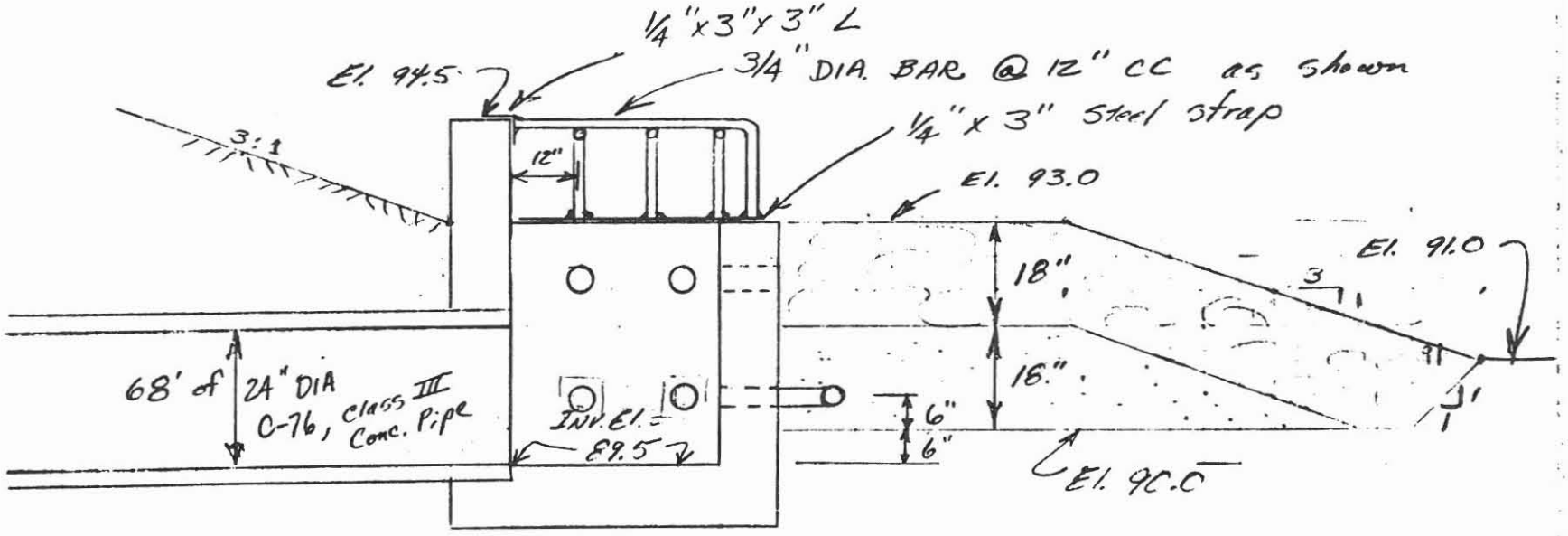
5 slots, 1/2" wide
DRAIN Cover Plate
or
Manufactured equil.
as approved by
12 required

⟹ Rock riprap
Gradation used for Reach 2
is satisfactory $D_{100} \leq 15"$

Rock riprap bedding (Reach 2)
D_{10} = #60 — #140 .25 mm — 0.1 mm
Could have low perm rate

⟹ Use Drain Fill Gradation (R-2 Specs.)
$D_{85} \geq 7.5$ mm
D_{10} 0.85 — 1.3 mm





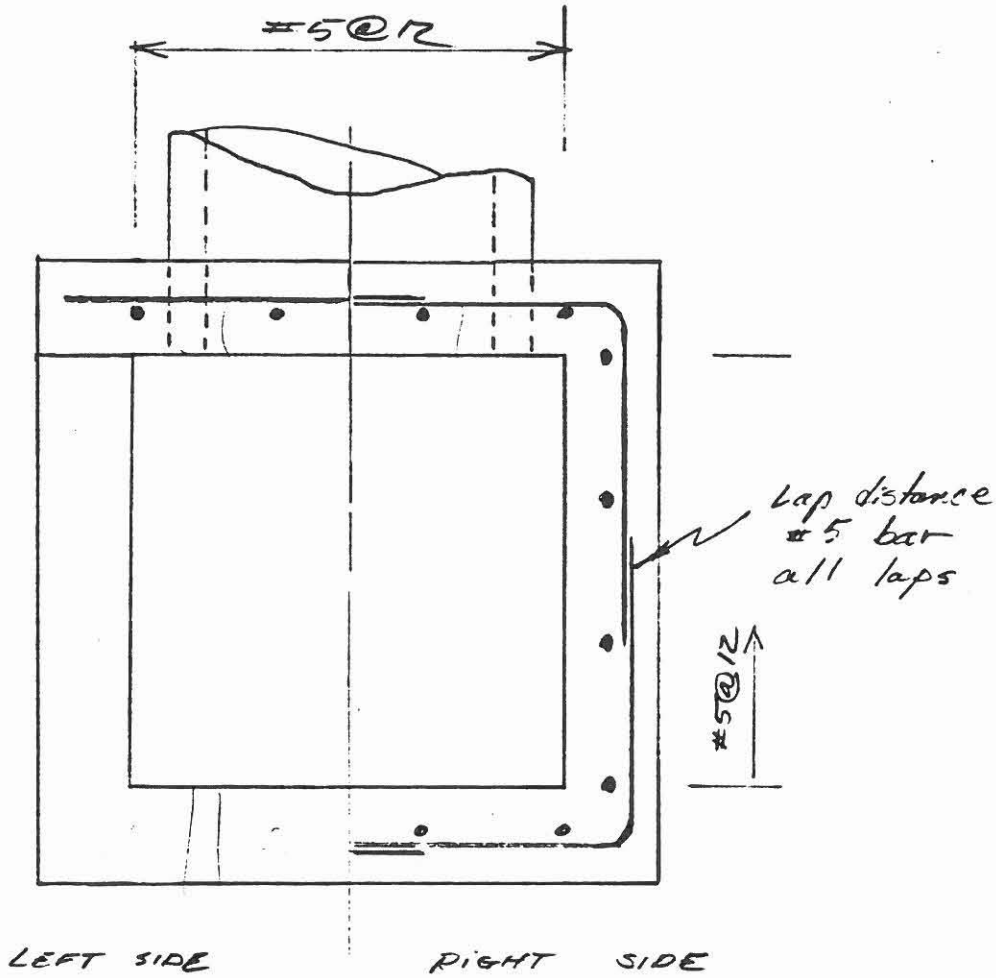
SECTION A-A

Design: By inspection use 6" walls & floor, #5 @ 12, both directions, single grid. Emis.

Ar RWCD - R2 Ext.

LMS 4/4/83

Sed. Basin Outlet Str.



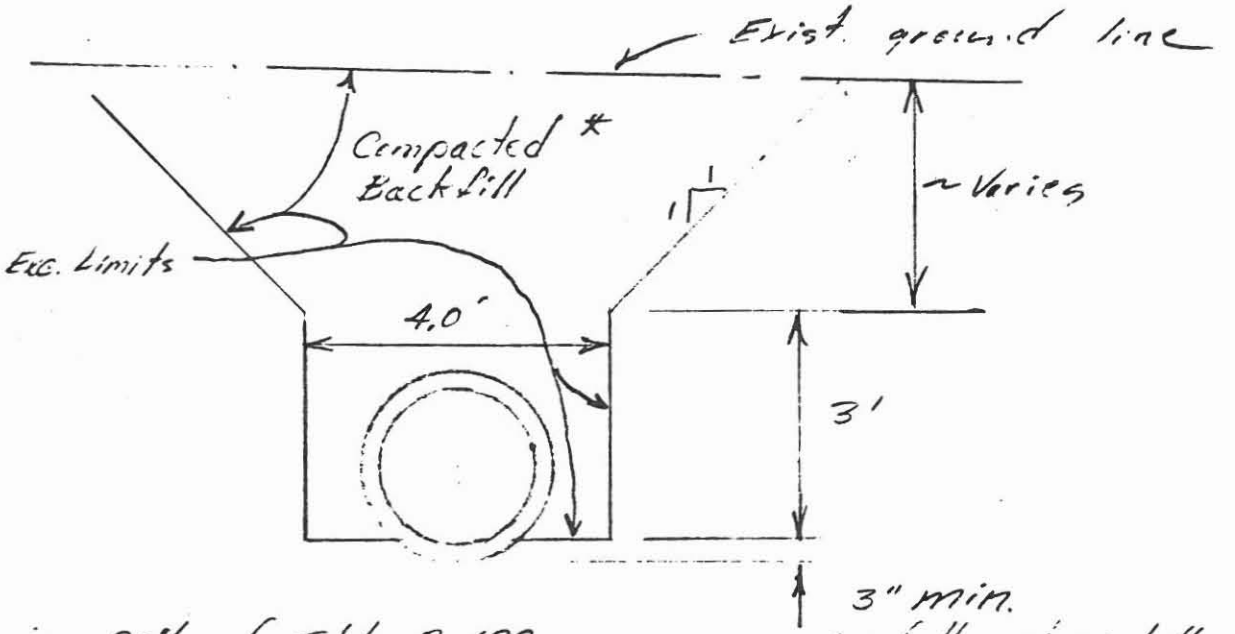
SEC. A-A

AZ. RWCD R-2 Ext.

LMS 3/53

Side Inlet STA. 981+80 (Sediment Basin outlet)

Pipe trench excavation



* 90% of Std. D-698 within 3% of Opt. Moisture.

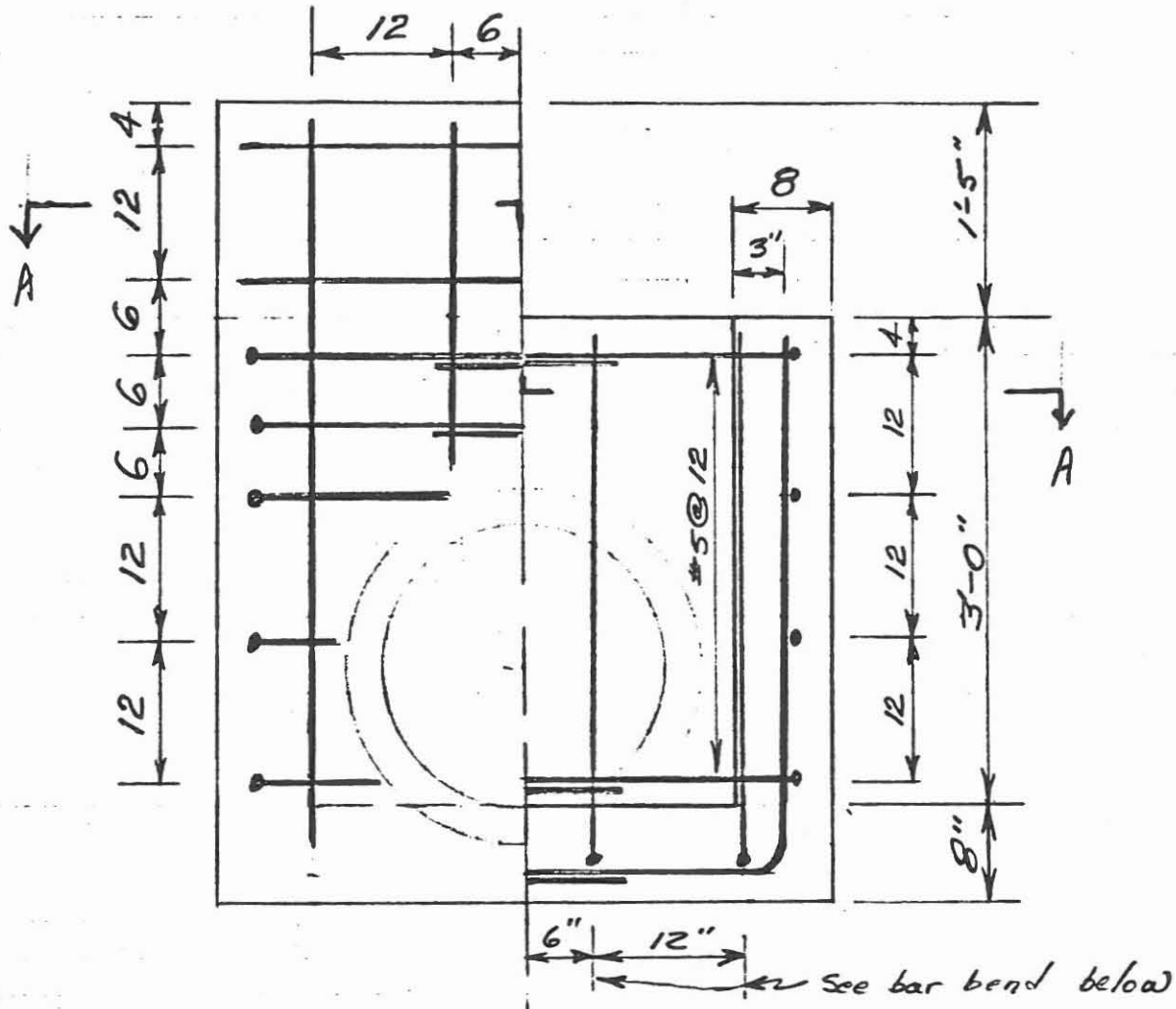
Carefully shape bottom of trench to fit pipe

Pipe: N/C C-76, Class III, Wall A or B

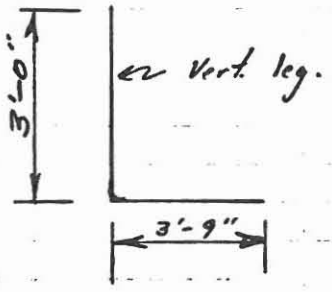
68' required.

Form grouted rock basin at outlet of pipe.

Az RWCD R-2 Ext.
LMS 1/4/83
Sed. Basin outlet Str.

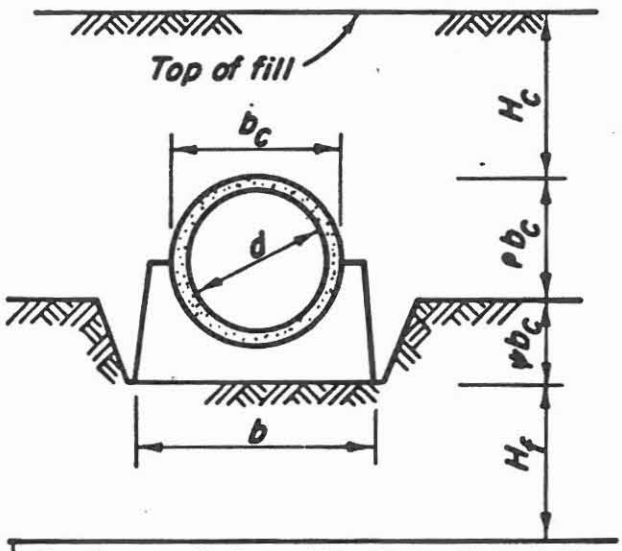


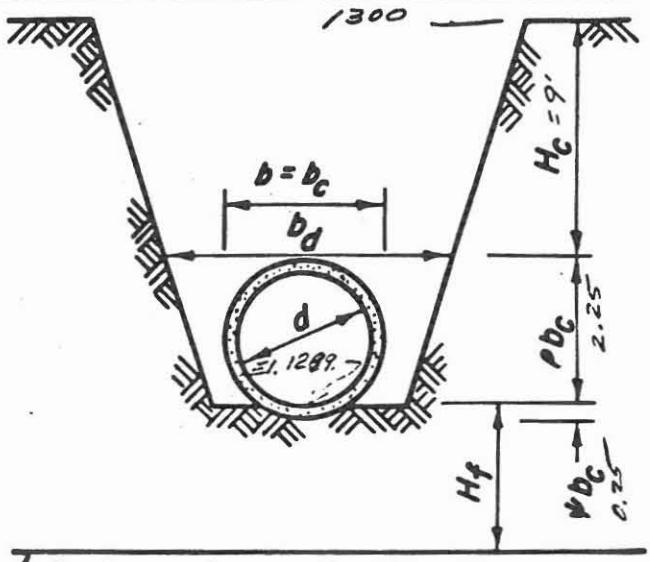
LEFT SIDE & DOWNSTREAM END | RIGHT SIDE & UPSTREAM END



UNDERGROUND CONDUIT LOADING WORK SHEET

State ARIZONA Project RWCD REACH 3
Subject SIDE INLET 981+80 (Sediment Basin Outlet) Job
By LMS Date 3/83 Checked _____ Date _____ Sheet 1 of 2





1. KNOWN AND ASSUMED VALUES

b_c = 2.5' ϕ = 20°
b = 2.5' γ = 120
ρb_c = 2.25' H_f = 10' *
ψb_c = 0.25' ϕ_f = 20° *
H_c = 9.0' γ_f = 125 *
d = 2.0' E = *
b_d = 4.0' E_f = *

Cradle Type = _____
Bedding Type = _____

☐ Yielding Foundation
☐ Non-Yielding Foundation

* Not required for non-yielding foundation

2. ES-114 SHEET 3

K = .49 K_f = .49
μ = .36 μ_f = .36
$K\mu$ = 0.18 $K_f\mu_f$ = .18

3. PROJECTION RATIO

$$\rho = \frac{\rho b_c}{b_c} = \frac{(2.25)}{(2.5)} = 0.9$$

4. SETTLEMENT RATIO ES-115

Case d $\left[\frac{\gamma_f E}{\gamma E_f}\right]$ = 1
δ = 0.56
$\delta\rho$ = (0.56) (0.9) = 0.56

5. ES-117 SHEET 1

$$\frac{H_e}{b_c} = 1.5$$

6.

$$\frac{H_c}{b_c} = \frac{(9)}{(2.5)} = 3.6$$

$$2K\mu\frac{H_c}{b_c} = 2(0.18)(3.6) = 1.3$$

$$2K\mu\delta\rho = 2(0.18)(0.56) = 0.10$$

$$\frac{b_d}{b_c} = \frac{(4.0)}{(2.5)} = 1.6$$

7. ES-117 SHEET 2

$$\frac{b'_d}{b_c} = 1.95$$

☐ Positive Projecting $\frac{b_d}{b_c} > \frac{b'_d}{b_c}$

☒ Ditch $\frac{b_d}{b_c} \leq \frac{b'_d}{b_c}$

UNDERGROUND CONDUIT LOADING WORK SHEET

State AZ Project RWCD - R-2 Extension
Subject Pipe outlet for Sediment Basin Job #
By LMS Date 3/83 Checked _____ Date _____ Sheet 2 of 2

POSITIVE PROJECTING CONDUITS

☐ Complete Condition $\frac{H_c}{b_c} \leq \frac{H_e}{b_c}$

☐ Incomplete Condition $\frac{H_c}{b_c} > \frac{H_e}{b_c}$

ES-118 SHEET 2 or 3

$2K\mu C_p$ _____

LOAD COEFFICIENT

$C_p = \frac{2K\mu C_p}{2K\mu} = \frac{(\quad)}{(\quad)} =$ _____

ES-120

$X_p =$ _____

ES-121
SHEET 1 FOR CRADLES
SHEET 2 FOR BEDDING

$T =$ _____

STRENGTH FACTOR

$F_{sr} = C_p X_p - KT$

$F_{sr} = (\quad)(\quad) - (\quad)(\quad)$

$F_{sr} = (\quad) - (\quad) =$ _____

3 EDGE BEARING STRENGTH REQ'D

$R_{eb} = \frac{s \gamma F_{sr}}{1.431} (b_c)^2$

$R_{eb} = \frac{(\quad)(\quad)(\quad)(\quad)^2}{1.431}$

$R_{eb} = \frac{(\quad)}{1.431} =$ _____ lb/ft

DITCH CONDUITS

$\frac{H_c}{b_d} = \frac{(9)}{(4.0)} = 2.25$

LOAD COEFFICIENT

ES-118 SHEET 1

$C_d = 1.55$

LOAD FACTOR

ES-120 SHEET 1

$L_f = 1.5$

VERTICAL LOAD

$W_c = C_d \gamma (b_d)^2$

$= (1.55)(120)(4)^2 = 2976$

3 EDGE BEARING STRENGTH REQ'D

$R_{eb} = \frac{s W_c}{L_f}$

$R_{eb} = \frac{(1.33)(2976)}{(1.5)}$

$R_{eb} = \frac{(\quad)}{(\quad)} = 2639$ lb/ft

"D" LOAD REQUIREMENT

"D" LOAD $= \frac{R_{eb}}{d}$ C-76 Class III Pipe, Wall A or C K

"D" LOAD $= \frac{(\quad)}{(\quad)} = 1319$

LAYOUT, SURVEYS, DETAILS.

ARIZONA RNCD REACH 3

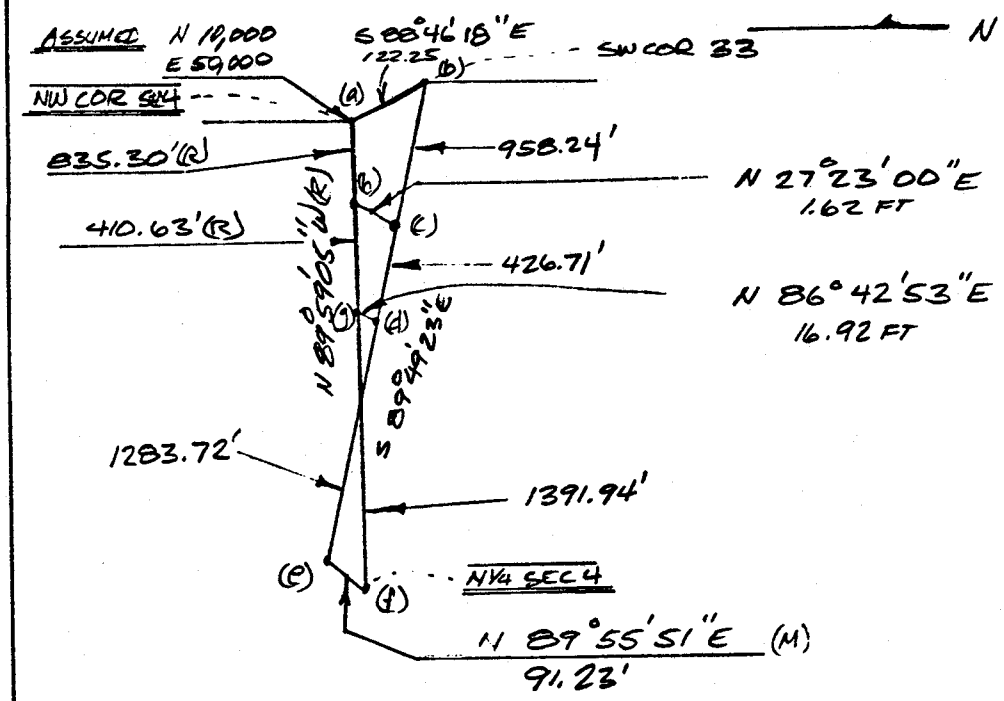
D. Thackeray 1/27/83 LNV

CHECK SURVEYS

1

PROBLEM: CHECK ADAM, HAMLYN, ANDERSON ROW SURVEY TIE TO SECTION LINE(S) 4-33:

USE HP97 SURVEY PAC:



BY INVERSE (f) - (a)

BRG N 89°52'49"W
DIST 2637.67

- CTS SURV

RECORD BRG

N 89°59'05"W
DIST 2637.87

62/20

ARIZONA
D. Mackay 1/26/83
CHECK SURVEYS

RWCD REACH 3
JMK 3/83

2

	1.0000	***
(a)	10000.0000	***
	50000.0000	***
	271.1342	***
	122.2500	***
	2.0000	***
	10002.6207	***
(b)	49877.7781	***
	90.1037	***
	958.2400	***
	3.0000	***
	9995.6614	***
(c)	50836.0135	***
	90.1037	***
	426.7100	***
	4.0000	***
	9998.3436	***
(d)	51262.7215	***
	90.1037	***
	1283.7200	***
	5.0000	***
	9994.3791	***
(e)	52546.4354	***
	89.5551	***
	91.2300	***
	6.0000	***
	9994.4892	***
(f)	52637.6653	***

INVERSE	AZIMUTH 270.0711	***
(f)-(a)	DIST 2637.6711	***
(a)	7.0000	***
	10000.0000	***
	50000.0000	***
	2637.8700	***
	1.0000	***
(f)	9994.4890	***
	52637.6700	***
AZ FROM INV. ABOVE	270.0711	***
	1391.9400	***
	2.0000	***
	9997.3975	***
(g)	51245.7330	***
	270.0711	***
	410.6300	***
	3.0000	***
	9998.2556	***
(h)	50835.1039	***
	270.0711	***
	835.3000	***
	4.0000	***
	10000.0010	***
(a)	49999.8058	***

ARIZONA RWCD REACH 3

D. Thackeray 1/20/83 [illegible] 3/83

CHECK SURVEYS

3

TRY USING INVERSED BRG FOR LINE (f) – (g):

STA	N	E	BRG	DIST.
f	9994.489	52637.67	N 89°52'49"W	1391.94
g	9997.398	51245.73	"	410.63
h	9993.256	50835.103	"	835.30
a	10,000.001	49999.806		

INVERSE:

		INVERSE		REC. & MEAS	
STA	STA	BRG	DIST.	BRG.	DIST.
g	d	N 86°48'45"E	17.01	N 86°42'53"	16.92
n	c	N 32°54'15"E	1.67	N 27°23'20"	1.62

COORD.

STA		N	E
h	TRAV.*	9998.26	50835.10
	SS	9998.22	50835.27
g	TRAV.*	9997.40	51245.73
	SS	9997.37	51245.90

* USING INV. BRG.

ARIZONA REACH 3

D.T 3/4/83 JMW 3/83

1 6

PROBLEM: TRY TO RELATE R.O.W. SURVEY BY A.H.A. ENG INC. TO ALIGNMENT SURVEY BY CTS ENG INC. IN VICINITY OF HUNT HIGHWAY SO THAT THE NORTH BOUNDARY OF SECTION 4, WHICH WAS USED AS A BASELINE FOR 2/83 SURVEY OF TOPOG ALONG HUNT HIGHWAY, CAN BE RELATED TO THE PROPOSED FLOODWAY ℄. NO ANGLE AT PT# 918 FROM THE FLOODWAY ℄ TO THE TOPOG BASELINE WAS GIVEN.

ANALYSIS:

1. START AT NEAREST POINT DEFINITELY COMMON TO BOTH SURVEYS: THE W. FLOOD CHANNEL ROW INT. w/ N-S MID LINE OF SECTION 33. ✓

2. USE AN ARBITRARY COORDINATE SYTEM AT THIS POINT AND COMPUTE COORD. OF PTS ON EACH SURVEY. ✓

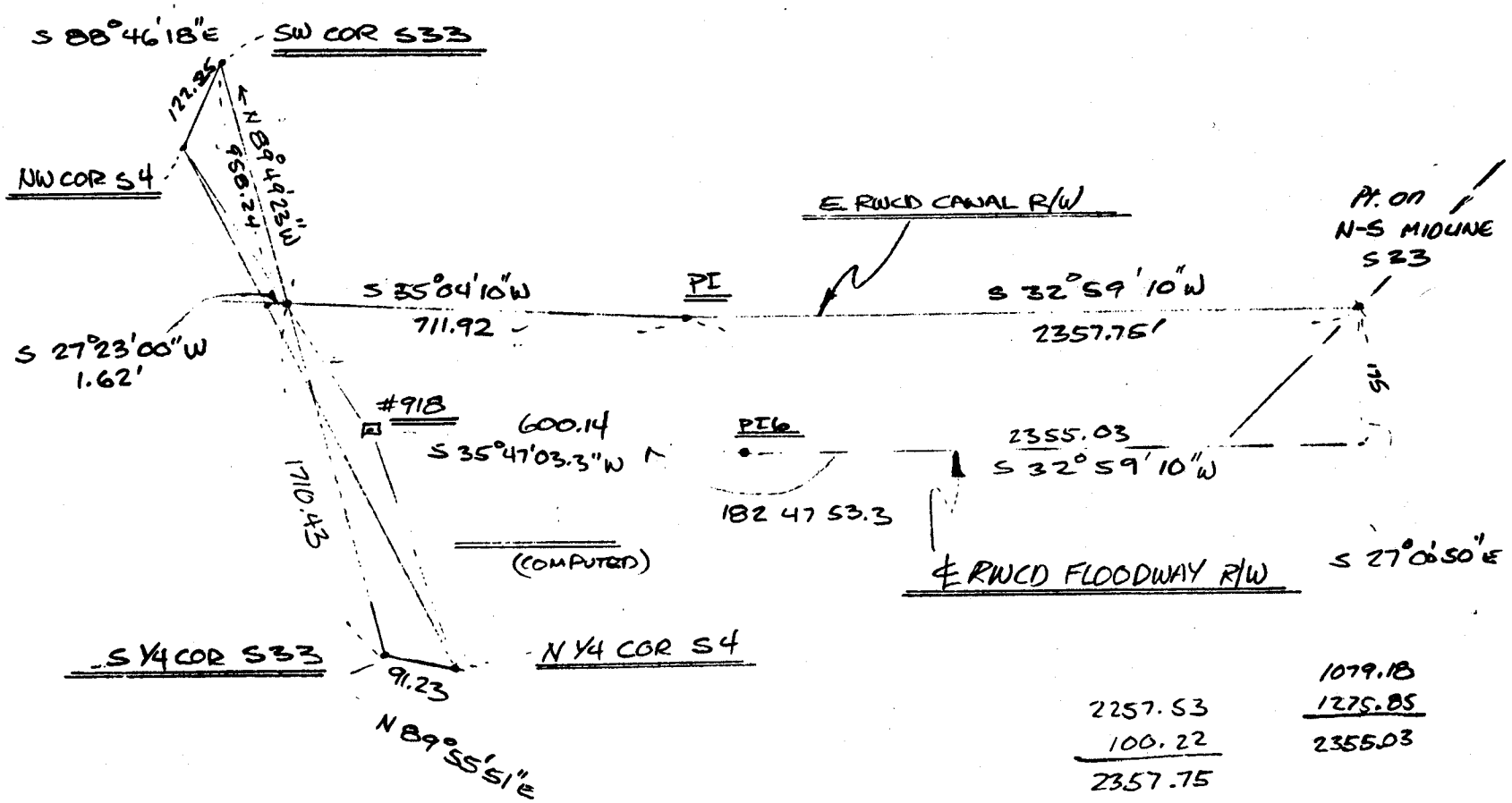
3. INVERSE LINES AS NEEDED TO OBTAIN BEARINGS. ✓

ARIZONA DT

3/4/83

RWCD BEACH HWY

3/83



2257.53	1079.18
100.22	1275.85
2357.75	2355.03

2 6

65/210

66/210

ARIZONA RWCD REACH 3

D.T 3/15/83

3 6

RWCD RCH 3
3/15

	1.0000	***
MID LN 33	100000.0000	***
	50000.0000	***
	212.5910	***
	2357.7500	***
DE	2.0000	***
	98022.3133	***
	48716.3567	***
	215.0410	***
	711.9200	***
SLN 33	3.0000	***
	97439.6379	***
	48307.3096	***
	270.1037	***
	958.2400	***
SLN 33	4.0000	***
	97442.5972	***
	47349.0742	***
	91.1342	***
	122.2500	***
NW 4	5.0000	***
	97439.9765	***
	47471.2961	***

RWCD RCH 3
3/15

	1.0000	***
SLN 33	97439.6400	***
	48307.3100	***
	96.1037	***
	1716.4300	***
S¼ 33	2.0000	
	97434.3578	
	50017.7318	
	89.5551	
	91.2300	
N¼ 4	3.0000	
	97434.4679	
	50108.9618	

RWCD RCH 3
3/15

	1.0000	***
MID LN 33	100000.0000	***
	50000.0000	***
	122.5910	***
	175.0000	***
OS	2.0000	***
	99904.7238	***
	50146.7905	***
	212.5910	***
	2355.0300	***
PJ 6	3.0000	***
	97925.3185	***
	48864.6280	***
	215.4703	***
	600.1400	***
#918	4.0000	***
	97442.4702	***
	48513.7053	***

67/210

ARIZONA RWCD REACH 3

D.T 3/15/83

4 6

RWCD 3
3/15

	1.0000	***
#918	97442.4700	***
	48513.7100	***
	269.5147	***
	1042.4130	***
	2.0000	***
NW 4	97439.9800	***
	47471.3000	***

	1.0000	***
	97442.4700	***
#918	48513.7100	***
	90.1714	***
	1595.2701	***
	2.0000	***
N1/4 4	97434.4700	***
	50108.9600	***

	1.0000	***
NW 4	97439.9800	***
	47471.3000	***
	90.0711	***
	2637.6658	***
	2.0000	***
NW 4	97434.4700	***
	50108.9600	***

ARIZONA RWCD REACH 3

D.T. 3/15/83 3/83

5 6

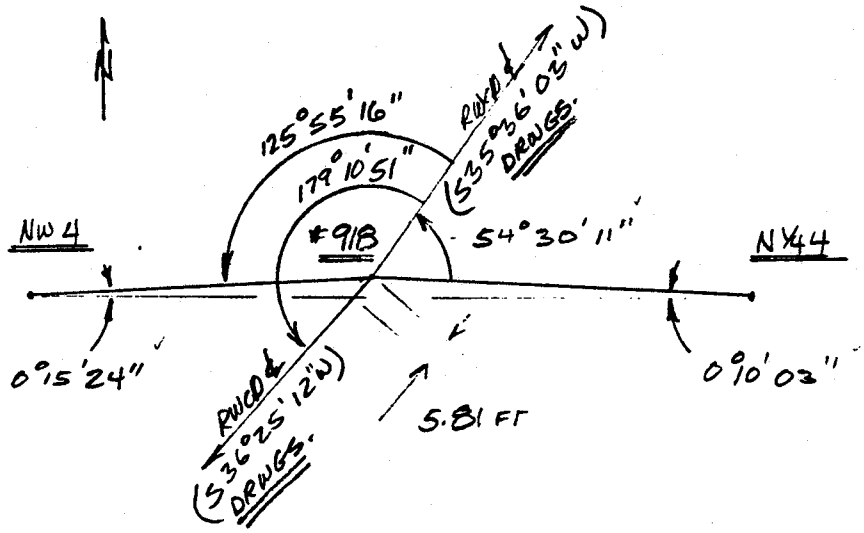
** NOTE: ALL BEARINGS ARE PER R/W SURVEY. **
- R/W BEARINGS ARE ≈ 0°11'00" RIGHT OF CONSTRUCTION DRAWING BEARINGS.

POINT	N	E	BEARING	DIST
TRAVERSE	SOLVE FOR:	SOLVE FOR:		
MID LN 33	100,000.00	50,000.00	S 32 59 10 W[3]	2357.75
PI			S 35 04 10 W[3]	711.92
S LN S33			N 89 49 23 W[4]	958.24
SVC 33			S 88 46 18 E[2]	122.25
NW COR 4	97,439.98	47,471.30		
S LN 33	97439.64	48 307.31	S 89 49 23 E[2]	1710.43
S 1/4 33	97434.36	50 017.73	N 89 55 51 E[1]	91.23
N 1/4 4	97434.47	50 108.96		
MID LN 33	100,000	50,000	S 57 00 50 E[2]	175.00
OS	99,904.72	50,146.79	S 32 59 10 W[3]	2355.03
PI 6	97,929.32	48,864.63	S 35 47 03.3 W[3]	600.14
918	97,442.47	48,513.71		
INVERSE			SOLVE FOR:	SOLVE FOR:
918	97 442.47	48,513.71	(269°51'47")	1042.41
NW COR 4	97 439.98	47 471.30	S 89°51'47" W	
918	97 442.47	48,513.71	(90°17'14")	1595.27
N 1/4 4	97 434.47	50 108.96	S 89 42 46 E	
NW COR 4	97 439.98	47 471.30	(90°07'11")	2637.67
N 1/4 4	97 434.47	50 108.96	S 89 52 49 E	

ARIZONA D.T. 3/15/83 RWCD REACH 3 YNK / 3/83

6 6

CHECK INTERSECTION OF RWCD & W'N LINE SECTION 4 BY INTERSECTION:



INTER SECTION

#918		
97 442.47	97442.4700	T
48 513.71	48513.7100	Z
S 36°36'12"W³	5.8060	Y
	216.3612	X
NW 4		
97 439.98	97439.9800	T
47 471.30	47471.3000	Z
S 89°52'49"E²	1038.9503	Y
	90.0711	X
	97437.8091	***
	48510.2481	***

ADIZ RWCD REACH 2 EST1

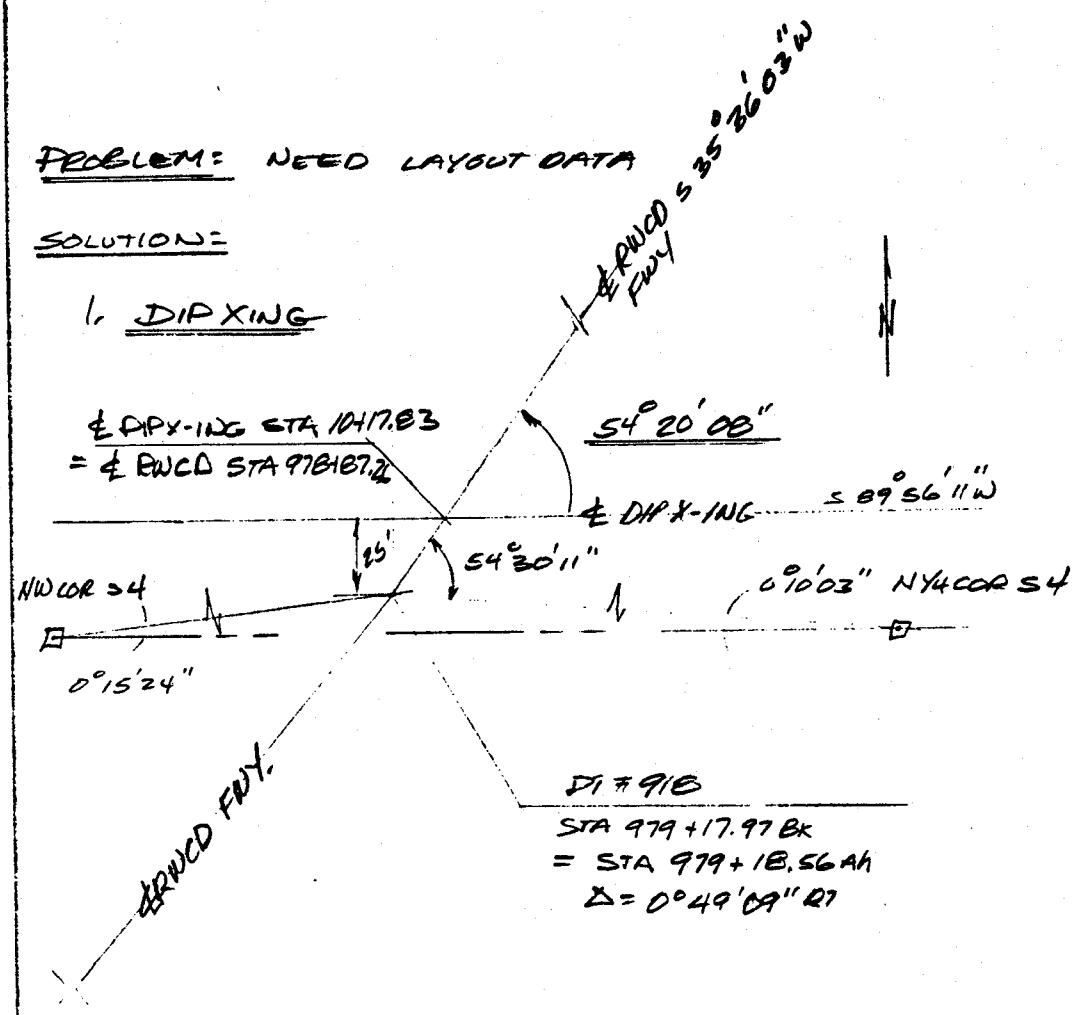
D.T. 3/17/83 JMA 3/83

LAYOUT

PROBLEM: NEED LAYOUT DATA

SOLUTION:

1. DIP XING



℄ RWCD STA DIP X-ING ℄ = 979+17.97 − 25/sin(54°30'11")
= 979+17.97 − 30.71
= STA 978+87.26

℄ DIPXING STA @ RWCD ℄ = 10+00 + 25/tan(54°30'11")
= 10+00 + 17.83
= 10+17.83

ARIZ.

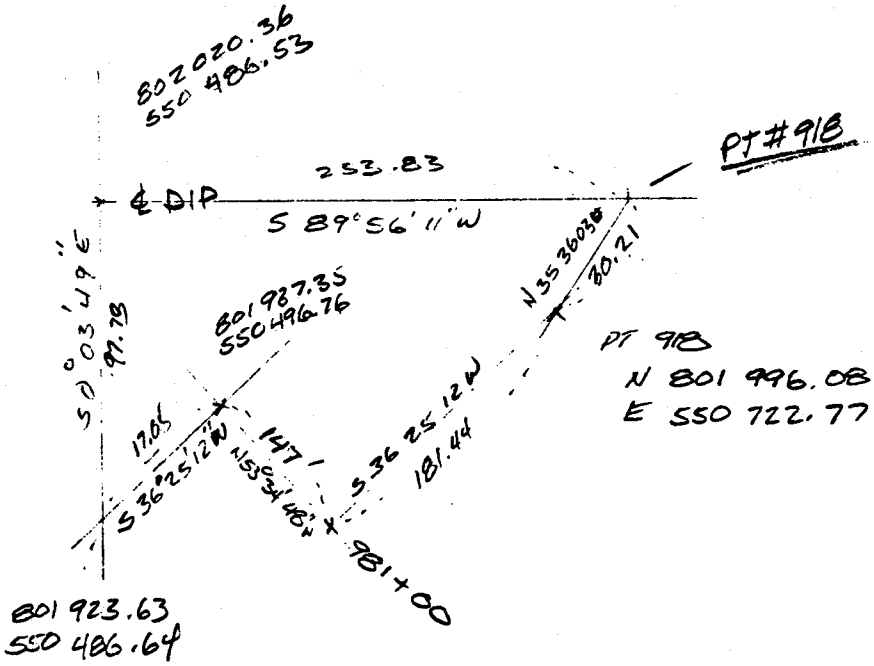
D.T.

3/22/83

RWCD REACH 3

PROBLEM: MISC DIP LAYOUT

USE COORD SYST. ON DRWGS

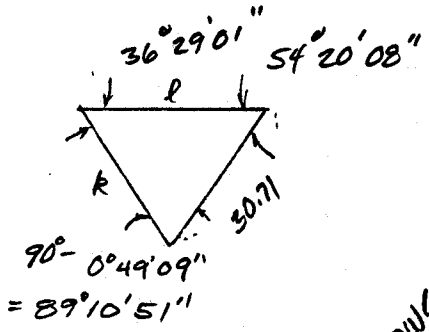


ARIZ

D.T.

RWCD REACH 3

3/17/83



$l = \sin 89\,10\,51 \left(\frac{30.71}{\sin 36°29'01"}\right)$

$= 51.64$

$k = \sin 54°20'08" \left(\frac{30.71}{\sin 36°29'01"}\right)$

$= 41.96$

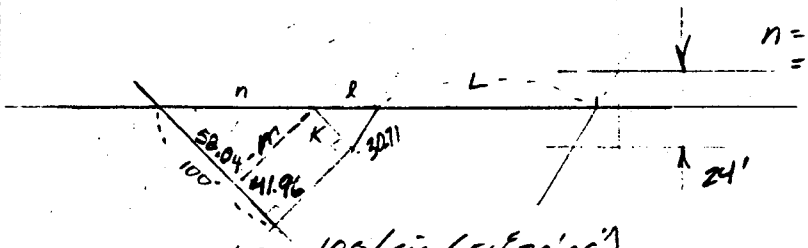
$m = 58.03 / \tan 53°30'59"$

$= 42.92$

$n = 58.03 / \sin 53\,30\,59$

$= 72.17$

℄ RWCD



$L = 100 / \sin(54°20'08")$

$\underline{L = 123.09}$

END VC STA = 10+17.83 - (m+l)

= 10+17.83 - (72.17+51.64) = 8+94.02

TOE LINE EAST = 10+17.83 + 123.09

= 11+40.92

PVC EAST STA = 11+40.92 + 12/TAN(54°20'08")

= 11+40.92 + 8.61

= 11+49.53

ARIZ RWCD REACH 3

D.T 3/16/83

PROBLEM: NEED VERTICAL CURVE FOR DIP X-INS

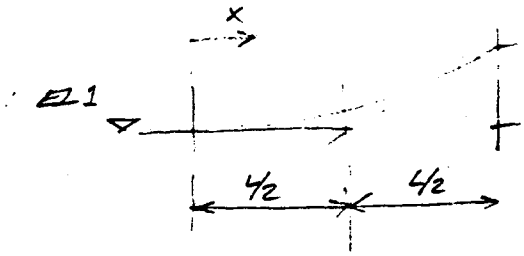
ANAL: 1. TRY L = 20 FT ; 21.44 USED FOR REACH 1 ✓

2. EQUATIONS:

$$ax^2 + bx + c = EL$$ ✓

C = EL STA 1
X = STA X - STA 0
B = GRADE 1
L = LENGTH OF CURVE

G1 = 0
G2 = 10%



$H = G2 \times L/2 = 0.10(10) = 1\,FT$

$$ax^2 + bx + EL1 = EL$$

AT X = L:

$$ax^2 + \cancel{b}^{0}x + EL1 = H + EL1$$

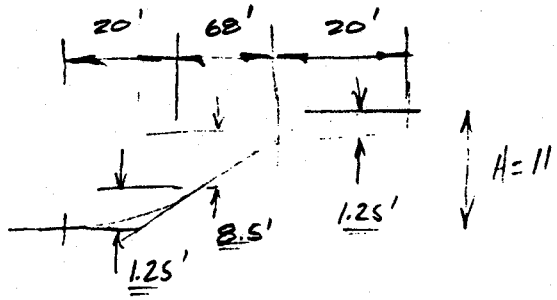
$$a(20)^2 = 1$$

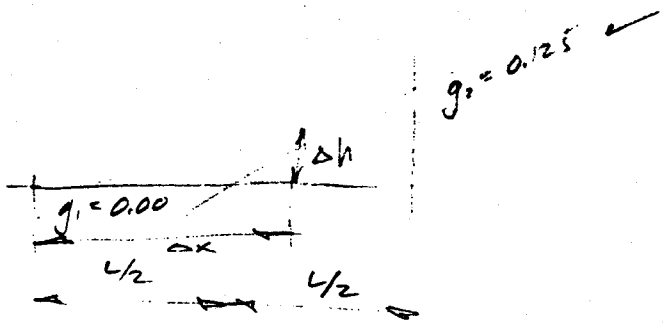
$$a = 1/40$$

THEN EL = 0.02 (STA - STA1) + EL1

ARIZ
D.T. 3/16/83 RWCD REACH 3 4/83

REVISE VC:





$\Delta h = a x^2$

$a = \frac{\Delta h}{x^2}$

@ $x = L = 20$, $\Delta h = 1.25$:

$a = \frac{1.25}{20^2} = 0.003125$

Δx	Δh
0	0
5	0.078
10	0.313
15	0.703
20	1.25

11 ea

75/210

ARIZ RWCD DEACH3

D.T. 3/21/83

℄ DIP X-ING ORIG. GROUND.

STA	ELEV.
5+00	91.0
5+50	91.0
6+00	91.0
6+50	91.4
7+00	93.0
7+50	97.6
8+00	1302.0
8+50	94.5
9+00	90.0
9+50	94.0
10+00	94.0
10+50	95.8
11+00	97.3
11+50	97.6
12+00	98.0
12+50	98.7
13+00	98.9
13+50	99.0
14+00	98.0
14+50	99.8

76/210

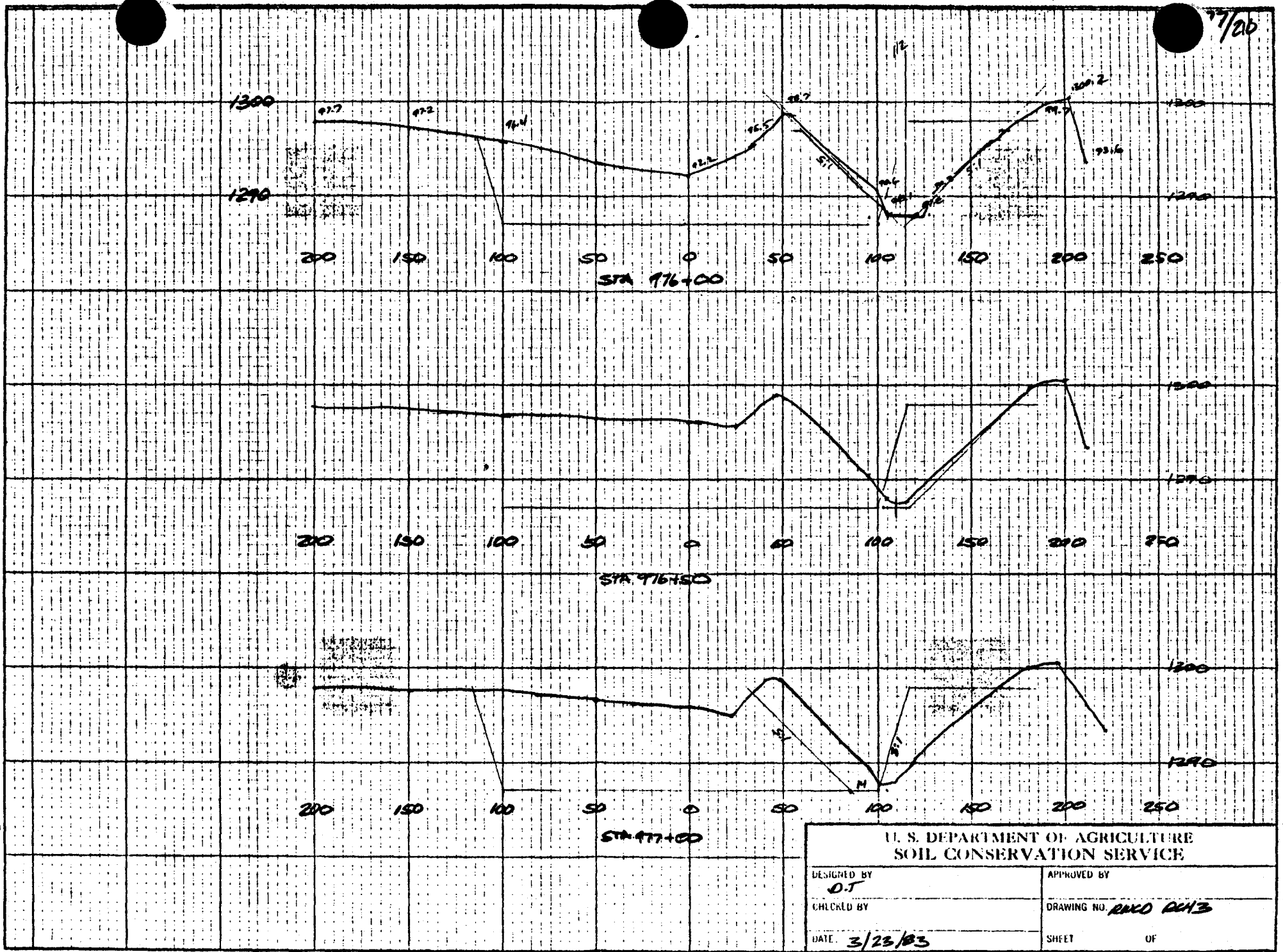
ARIZ.
D.T.

RWCD REACH 3

3/21/83

RWCD FLOODWAY
CHANNEL INVERT & DIKE EL

STA	INVERT	DIKE RT.	DIKE LT.
976+00	1287.17	1298.17	1298.17
976+50	1287.16	1298.16	1298.16
977+00	1287.14	1298.14	1298.14
977+50	1287.13	1298.13	1298.13
978+00	1287.11		1298.11
978+87.76	1287.08		1298.08
979+18	1287.07		1298.07
980+00	1287.05		1298.05
980+75	1287.03		1298.03
981+50	1287.01		1298.01
982+50	1286.98		1297.98
982+00	1286.99		
980+50	1287.04		1298.04
981+00	1287.02		

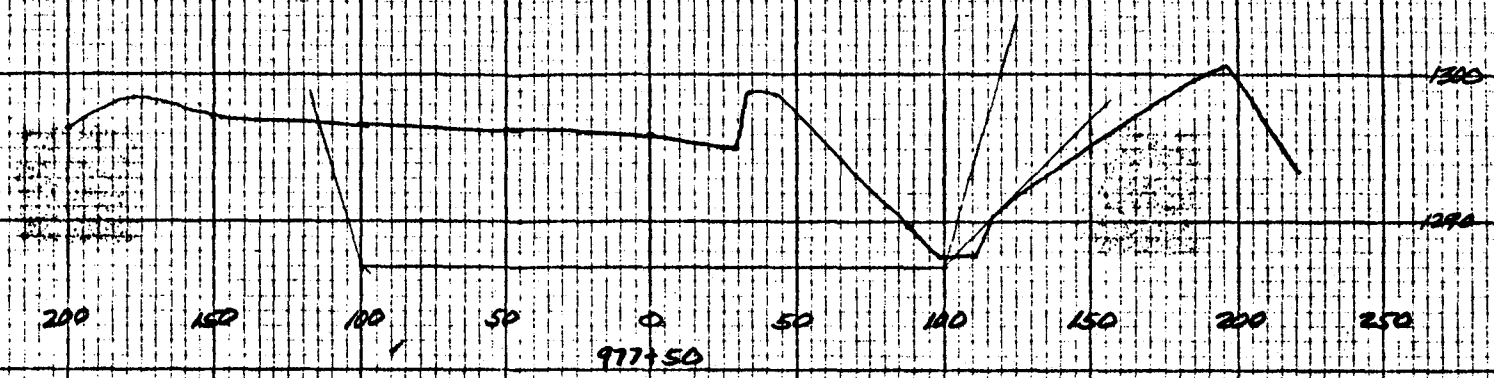


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED BY D.T	APPROVED BY
CHECKED BY	DRAWING NO. RWCD RCH3
DATE 3/23/83	SHEET OF

SCS-ENG-315A Rev. 12-69

8/20



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED BY D.T	APPROVED BY
CHECKED BY	DRAWING NO. DWCD RCH3
DATE:	SHEET OF

506

RWCD
R-2
EXTENSION

LIETZ
SINCE 1882

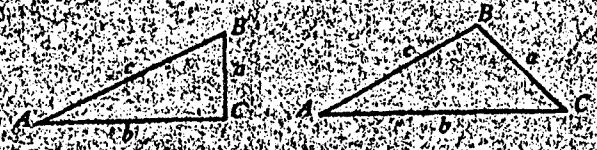
LIETZ
SINCE 1882

ECONOMY FIELD BOOK

No. 8152-05

79/20

FORMULAE FOR SOLVING RIGHT TRIANGLES



$\text{Sin}\,A = \frac{a}{c} = \text{Cos}\,B \qquad \text{Cot}\,A = \frac{b}{a} = \text{Tan}\,B$

$\text{Cos}\,A = \frac{b}{c} = \text{Sin}\,B \qquad \text{Sec}\,A = \frac{c}{b} = \text{Cosec}\,B$

$\text{Tan}\,A = \frac{a}{b} = \text{Cot}\,B \qquad \text{Cosec}\,A = \frac{c}{a} = \text{Sec}\,B$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A,\ a = c \sin A,\ b = c \cos A$
A, b	B, a, c	$B = 90° - A,\ a = b \tan A,\ c = \frac{b}{\cos A}$
A, a	B, b, c	$B = 90° - A,\ b = a \cot A,\ c = \frac{a}{\sin A}$
a, c	A, B, b	$\sin A = \frac{a}{c},\ \cos B = \frac{a}{c},\ b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b},\ \cot B = \frac{a}{b},\ c = \sqrt{a^2+b^2}$

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a},\ c = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C,\ c = \frac{a \sin C}{\sin A}$
a, b, c	Area	side $\frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

MADE IN U.S.A.

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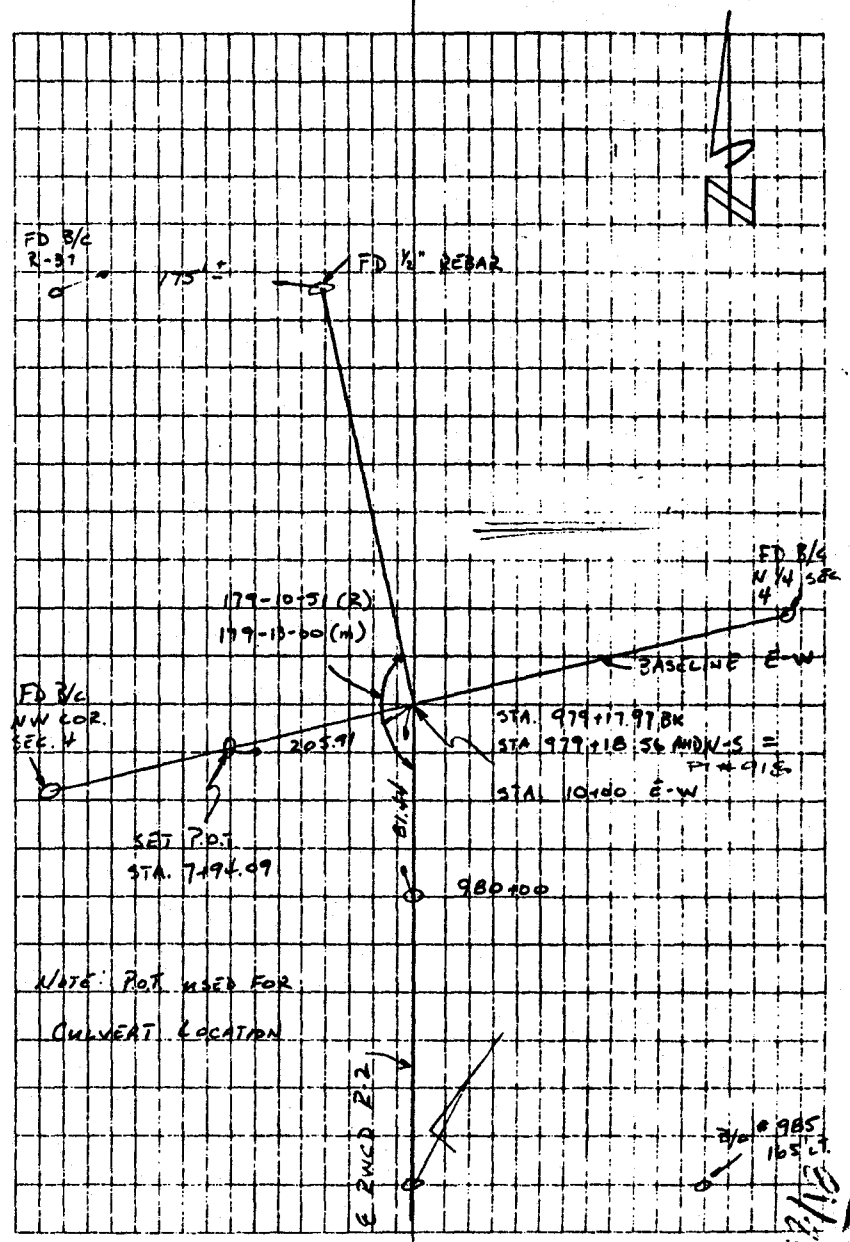
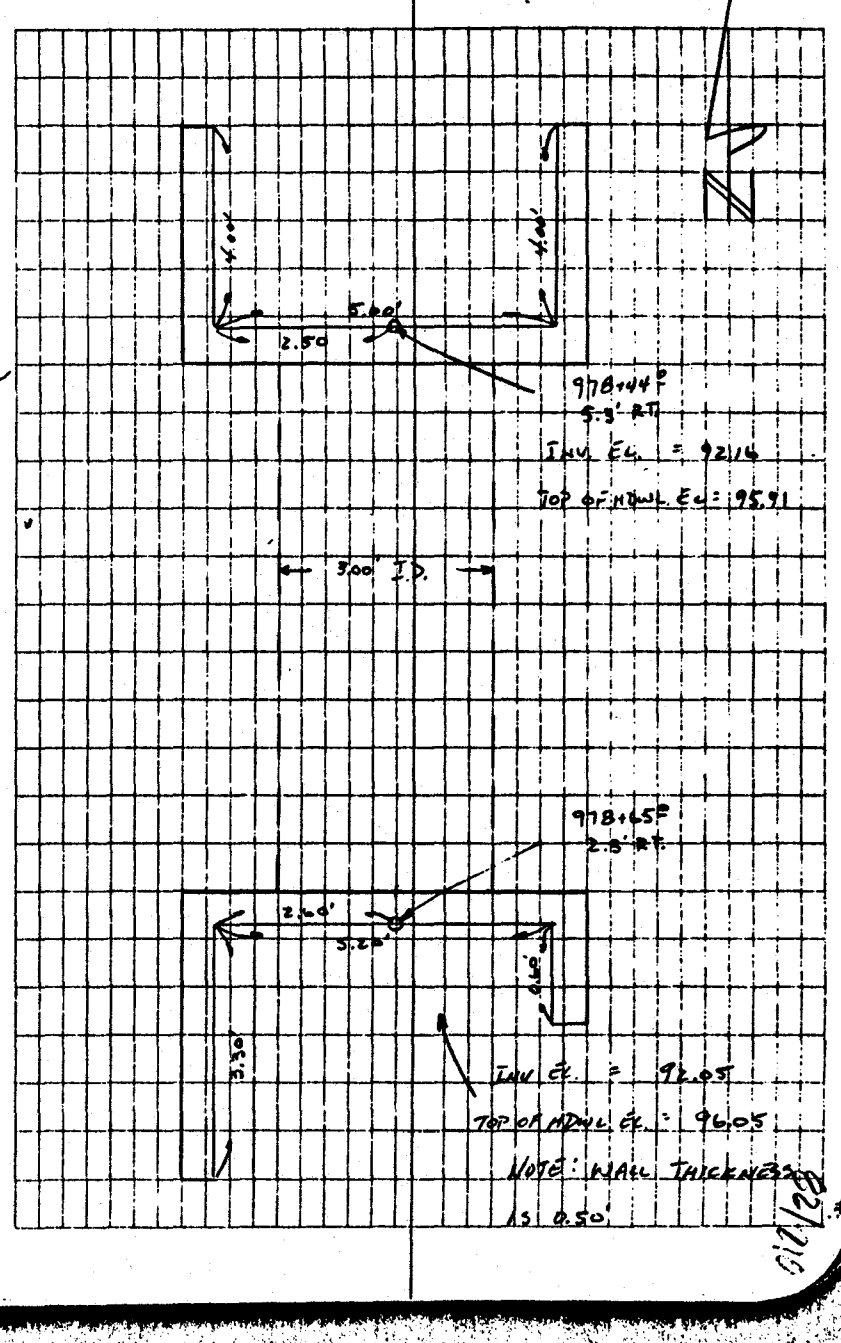
831 CB

HOR. CONTROL &
BASELINE FOR X-SECTIONS
2-21-83
R. PECHA
M. SMITH
D. RICHISON

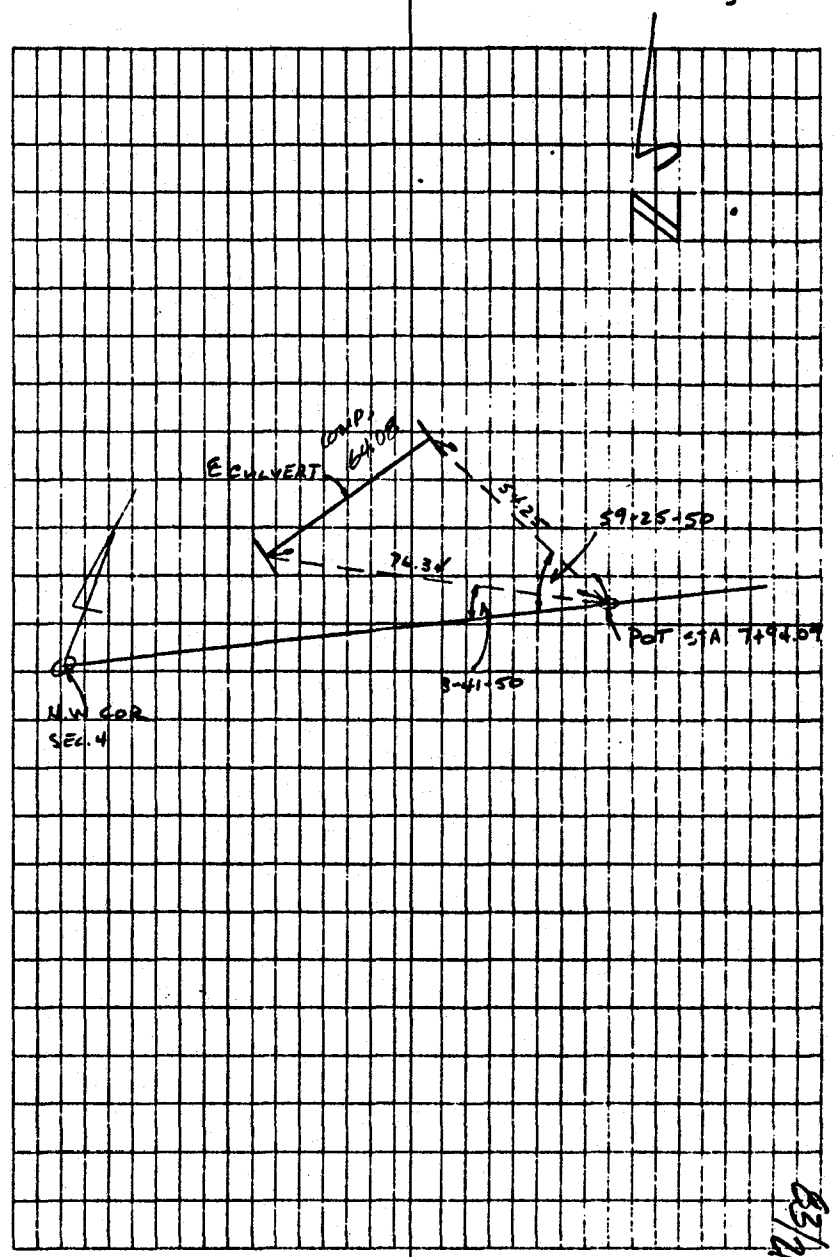


CULVERT ALONG N-5
BASELINE
2-23-83
R PECHA
M. SMITH
J. RICHISON

2



CULVERT LOCATION
FROM P.O.T.
2-21-83
R. PECHA
M. SMITH
J. RICHISON



83/210

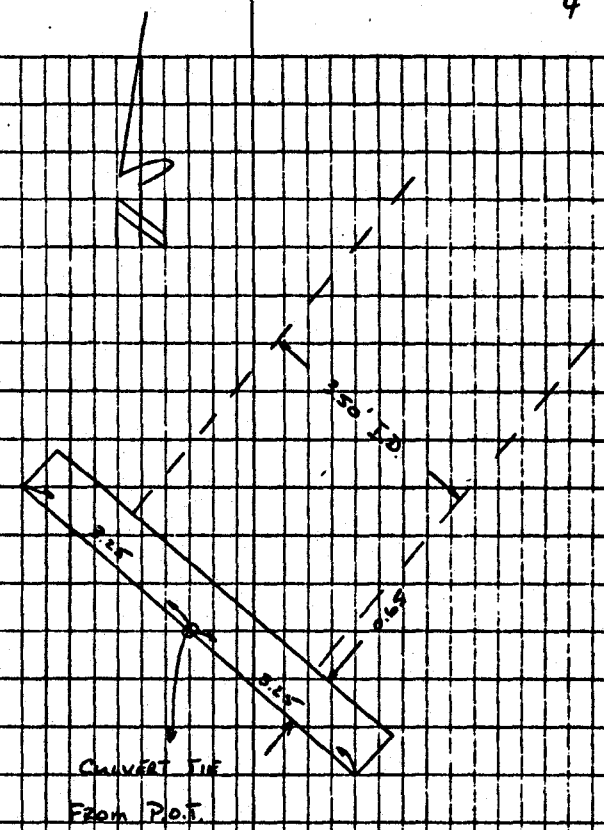
DN. STREAM HDWL.

2-21-83

R. PECHA

M. SMITH

J. RICHISON



INV. ELEV. = 1288.22

TOP HDWL. ELEV. = 1293.57

84/20

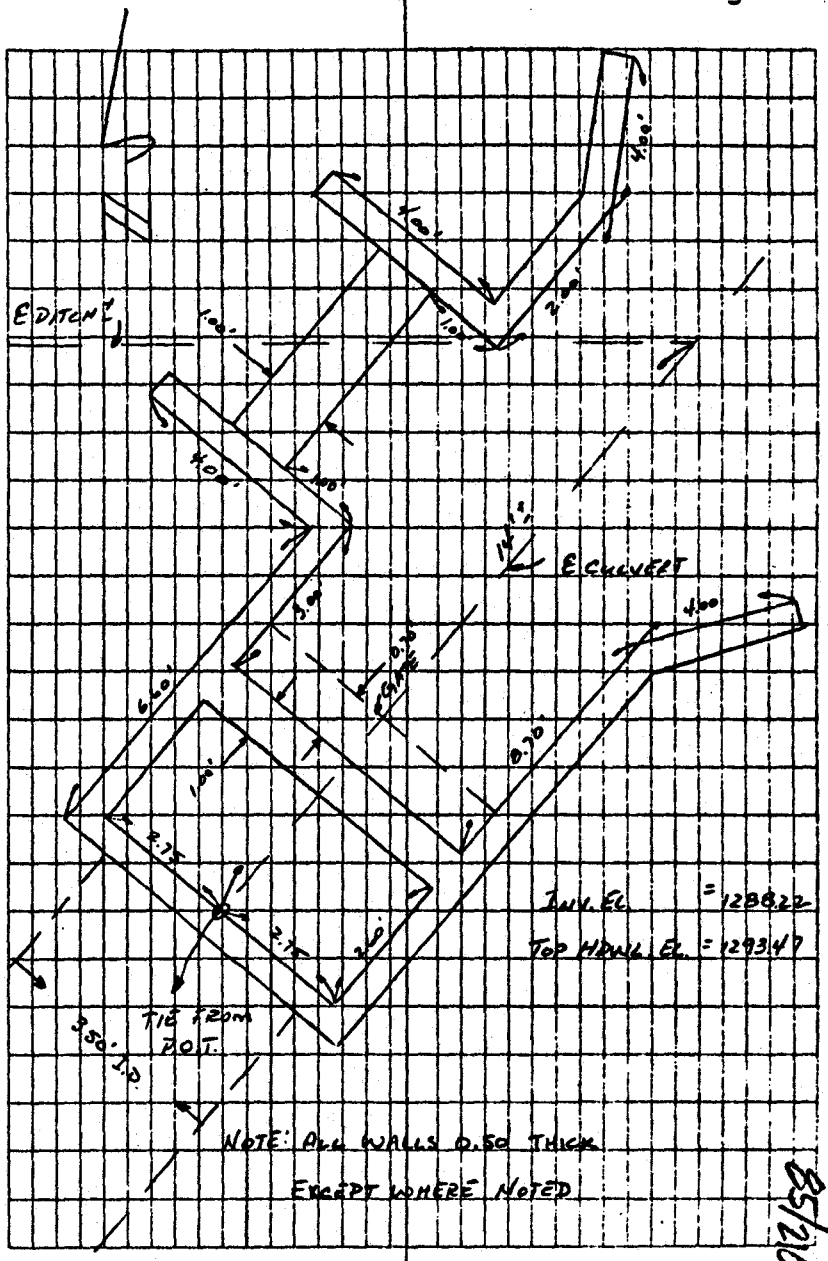
UP STREAM HWDL. & BOX

2-21-83

R. PECHA

M. SMITH

J RICHISON



85/210

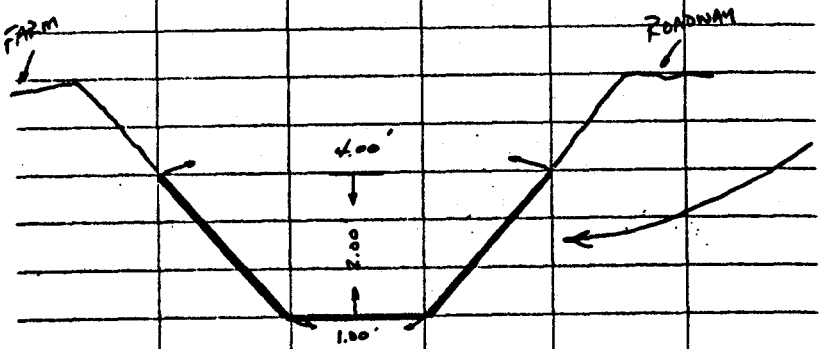
X-SECTIONS

2-22-82

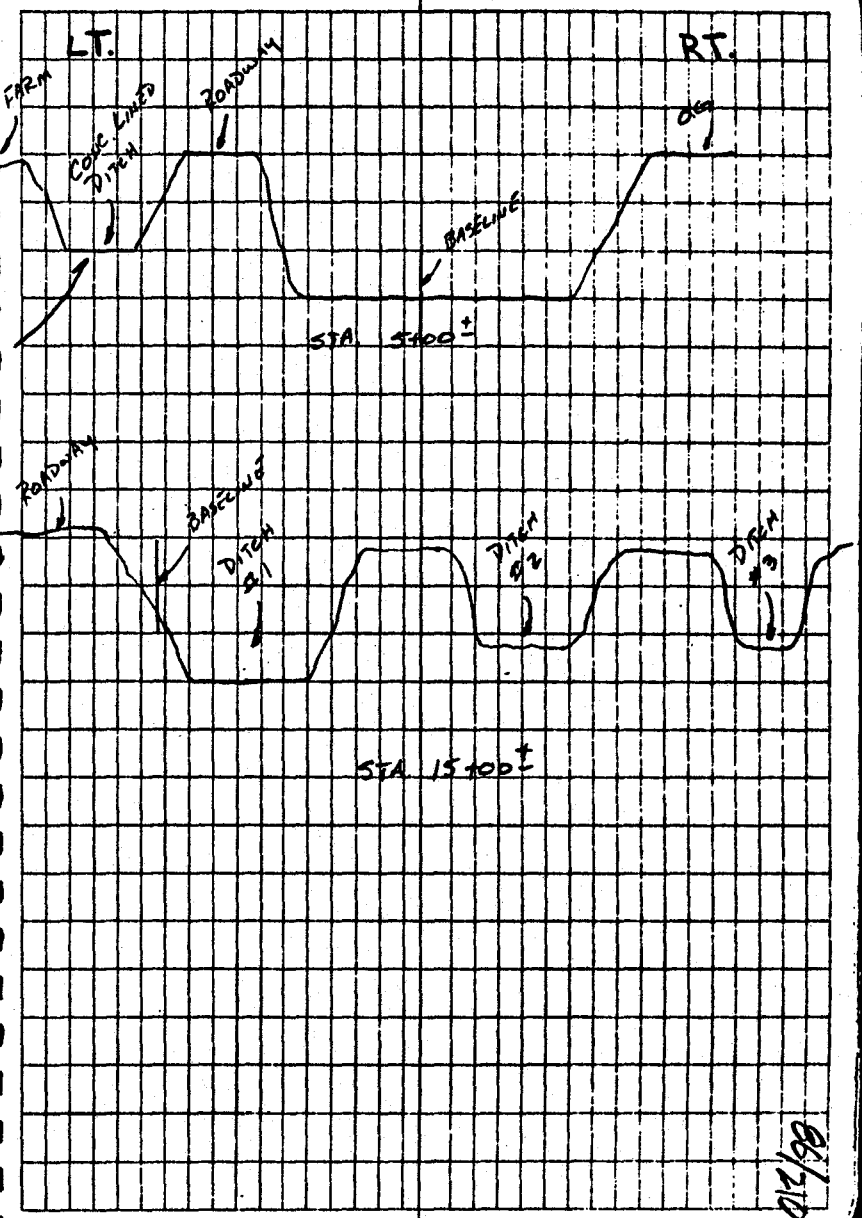
R. PECHA

M. SMITH

J. RICHISON



TYP. DITCH CONC. LINED



STA.	DIST. LT.	DIST. RT.	MI	—	ELEV	DESCRIPTION
5+00	0		1306.7	19.6	87.1	E
		5		20.6	86.1	G.B.
		10		19.5	87.2	G.B
		26		17.7	89.0	G.B
		32		14.8	91.9	TOE
		37		14.0	92.7	TOP
	6			19.0	87.7	TOP
	21			17.9	88.8	TOE
	29			16.1	90.6	TOP
	51			15.4	91.3	TOP
	57		1306.65	18.28	88.37	E CONC DITCH
	62			16.3	90.4	TOP
	100			16.5	90.2	O.G
	110			16.4	90.3	O.G

87/210

STA	DIST. LT.	DIST. RT.	HI	-	ELEV	DESCRIPTION
5+50	0		1306.7	19.3	87.4	℄
		5		19.8	86.9	G.B.
		24		18.2	88.5	TOE
		30		14.6	92.1	G.B.
		33		14.4	92.3	TOP
	18			19.2	87.5	TOE
	29			15.7	91.0	TOP
	51			15.3	91.4	TOP
	57		1306.65	18.25	88.40	℄ CONC. DITCH
	62			16.2	90.5	TOP
	100			16.3	90.4	O.G.
	110			16.1	90.6	O.G.

STA	DIST. LT.	DIST. RT.	HI	-	ELEV	DESCRIPTION
6+00	0		1306.7	18.6	88.1	℄
		19		18.0	88.7	TOE
		30		14.3	92.4	TOP
	4			18.9	87.8	TOP
	5			19.6	87.1	TOE
	8			18.7	88.0	TOP
	25			17.8	88.9	TOE
	30			16.1	90.6	TOP
	51			14.9	91.8	TOP
	57		1306.65	18.22	88.43	℄ CONC DITCH
	63			15.9	90.8	TOP
	100			15.9	90.8	O.G.
	110			16.0	90.7	O.G.

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV.	DESCRIPTION
6+50	0		1306.7	19.2	87.5	℄
		3		18.3	88.4	TOP
		22		16.4	90.3	TOE
		26		14.0	92.7	G.B
		33		13.5	93.2	TOP
	4			18.3	88.4	TOP
	22			17.1	89.6	TOE
	29			15.3	91.4	TOP
	51			14.2	92.5	TOP
	57		1306.65	18.13	88.52	℄ CONC. DITCH
	63			15.3	91.4	TOP
	100			15.5	91.2	O.G.
	110			15.7	91.0	O.G

STA.	DIST. LT.	DIST. RT	HI	-	ELEV	DESCRIPTION
7+00	0		1306.7	18.2	88.5	E
		3		18.6	88.1	TOE
		5		18.1	88.6	TOP
		19		17.4	89.3	TOE
		33		15.0	91.7	EOB
		37		12.7	94.0	TOP
	3			17.7	89.0	TOP
	11			17.5	89.2	TOE
	22			13.9	92.8	TOP
	48			13.4	93.3	TOP
	57		1306.65	18.08	88.57	E DOWN DITCH
	63			15.2	91.5	TOP
	100			15.3	91.4	O.G.
	110			15.5	91.2	O.G.

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV.	DESCRIPTION
7+50	0		1306.7	7.9	98.8	E
		42		7.6	99.1	OG
		64		8.7	98.0	OG
		100		12.3	94.4	OG
	19			10.5	96.2	TOE
	28			9.2	97.5	G.B
	45			9.5	97.2	TOP
	59		1306.65	17.17	89.48	BOTTOM STRUCTURE (TBR)
	80			12.7	94.0	TOP
	100			13.4	93.3	O.G.
	125			13.4	93.3	O.G.

92/320

STA.	DIST. LT.	DIST. RT.	H.I.	-	ELEV.	DESCRIPTION
8+00	0		1306.7	4.7	1302.0	℄
		12		4.8	1301.9	TOP
		50		9.1	97.6	G.B.
		74		9.7	97.0	TOP
		148		17.4	89.3	TOE
		200		17.5	89.2	TOE
		270		14.0	92.7	TOP
	62			6.4	1300.3	TOP
	93			11.1	95.6	G.B.
	100			11.4	95.3	G.B.
	120		1306.65	16.95	89.70	℄ CONC. DITCH
	141			12.8	93.9	TOP
	200			14.0	92.7	O.G.

92/210

STA	DIST. LT.	DIST. RT.	HI	-	ELEV.	DESCRIPTION
8+50	0		1306.7	12.2	94.5	E
		56		17.0	89.7	TOP
		65		19.2	87.5	TOE
		89		19.0	87.7	TOE
		100		17.2	89.5	G.B
		110		15.7	91.0	TOP
		136		14.7	92.0	G.B.
		200		11.7	95.0	O.G.
	32			10.6	96.1	G.B
	61			7.0	99.7	TOP
	100			6.6	1300.1	G.B.
	143			6.0	1300.7	TOP
	178			11.4	95.3	G.B.
?(	200'		130465	14.85	89.80	E CONC DITCH
	230			13.2	93.5	TOP
	280			14.4	92.3	O.G.
	300			14.5	92.2	O.G

94/210

STA.	DIST. LT.	DIST RT.	MI	—	ELEV.	DESCRIPTION
9+00	0		1306.7	18.9	87.8	℄
		4		18.0	88.7	G.B.
		39		15.2	91.5	G.B
		50		14.6	92.1	G.B.
		63		12.0	94.7	TOP
		81		12.6	94.1	TOP
		89		18.0	88.7	TOE
		97		17.8	88.9	TOE
		105		13.2	93.5	TOP
		115		10.8	95.9	TOP
		200		11.2	95.5	O.G.
	22			18.9	87.8	TOE
	40			17.1	89.6	G.B
	96			11.8	94.9	G.B
	118			11.8	94.9	G.B.
	127			10.6	96.1	G.B.
	159			6.7	1300.0	TOP
	200			6.1	1300.6	O.G.

DITCH #2

STA.	DIST. LT.	DIST RT.	MS	—	ELEV.	DESCRIPTION
9+50	0		1306.7	11.6	95.1	E
		81		10.4	96.3	TOP
		85		12.6	94.1	G.B.
		93		14.4	92.3	G.B.
		96		17.0	89.7	TOE #2
		104		17.2	89.5	TOE
		107		13.2	93.5	TOP
		121		12.2	94.5	G.B
		133		9.9	96.8	TOP
		156		8.7	98.0	TOP
		198		11.6	95.1	TOE
		235		10.8	95.9	G.B.
		278		11.2	95.5	E DITCH #3
		378		10.4	96.3	O.G.
	9			11.8	94.9	TOP
	16			17.5	89.2	E DITCH #1
	23			12.2	94.5	TOP
	53			14.4	92.3	G.B.
	62			16.6	90.1	G.B.
	89			17.3	89.4	G.B.
	100			19.1	87.6	TOE
	127			19.1	87.6	TOE
	141			17.6	89.1	G.B.
	200'			13.6	93.1	O.G.

01/2/96

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV.	DESCRIPTION
10+00	0		1306.7	12.6	94.1	E TOP
		6		11.7	95.0	TOP
		18		12.2	94.5	TOP
		21		13.2	93.5	TOE
		26		11.9	94.8	TOP
		48		11.2	95.5	TOE
		79		8.6	98.1	TOP
		~~94~~ 86		12.5	94.2	TOE
		98		16.0	90.7	TOE #2
		102		15.7	91.0	TOE
		107		14.1	92.6	G.B
		125		11.2	95.5	TOP
		193		11.5	95.2	G.B.
		200		10.6	96.1	G.B
		245		10.1	96.6	TOP
		264		12.1	94.6	E #3
		284		10.2	96.5	TOP
		384		9.7	97.0	O.G.
	6			14.7	92.0	TOE
	11			12.7	94.0	TOP
	40			9.5	97.2	TOP
	61			9.0	97.7	G.B
	69			11.1	95.6	G.B
	91			14.1	92.6	G.B.

97/20

STA.	DIST. CT.		HI	-	ELEV.	DESCRIPTION
10+00 (CONT)	100		1306.7	15.3	91.4	G.S.
	122			16.7	90.0	TOP
	131			19.5	87.2	TOE
	147			18.9	87.8	TOE
	157			16.6	90.1	G.S.
	200			12.7	94.0	O.G.

STA.	DIST. LT.	DIST RT.	HI	-	ELEV	DESCRIPTION
10+50	0		1306.7	11.2	95.5	E
		4		11.5	95.2	TOP
		8		12.5	94.2	TOE #1
		25		12.9	93.8	TOE
		30		11.1	95.6	TOP
		48		10.0	96.7	G.B
		56		10.7	96.0	G.B
		76		10.1	96.6	TOP
		88		13.8	92.9	G.B.
		94		13.0	93.7	G.B
		108		15.3	91.4	TOE #2
		111		12.8	93.9	TOP G.B
		122		11.2	95.5	TOP
		162		11.4	95.3	G.B
		186		9.5	97.2	G.B.
		200		10.0	96.7	G.B
		261		9.8	96.9	TOP
		270		12.6	94.1	TOE
		272		12.5	94.2	TOE
		275		10.8	95.9	TOP
		300		9.5	97.2	OG.
		400		9.7	97.0	OG.
	26			10.9	95.8	TOE
	36			9.3	97.4	TOP
	100			11.0	95.7	OG

9/26

STA.	DIST LT.	DIST. RT.	HI	—	ELEV	DESCRIPTION
11+00	0		1306.7	10.8	95.9	℄ TOP
		9		12.7	94.0	TOE #1
		35		12.0	94.7	TOE
		38		11.1	95.6	G.B
		43		9.4	97.3	TOP
		77		9.3	97.4	TOP
		84		12.3	94.4	G.B.
		96		13.6	93.1	G.B.
		100		14.9	91.8	TOE #2
		107		14.6	92.1	TOE
		111		13.6	93.1	G.B
		119		11.4	95.3	TOP
		168		9.5	97.2	O.G
		200		9.3	97.4	O.G.
		244		9.0	97.7	TOP
		258		10.8	95.9	G.B.
		270		10.6	96.1	G.B.
		274		12.0	94.7	TOE #3
		276		12.0	94.7	TOE
		282		9.4	97.3	TOP
		382		8.8	97.9	O.G
	26			9.4	97.3	EDGE ROAD
	41			10.1	96.6	EDGE ROAD
	100			10.6	96.1	O.G.

ab/ab

STA.	DIST. LT.	DIST RT.	MI	—	ELEV.	DESCRIPTION
11+50	0		1306.7	12.3	94.4	℄ #1
		24		11.4	95.3	TOE
		34		9.3	97.4	TOP
		48		10.7	96.0	TOE
		83		11.3	95.4	TOP
		90		12.2	94.5	TOP
		94		14.0	92.7	TOE #2
		102		13.8	92.9	TOE
		108		12.4	94.3	TOP
		116		13.2	93.5	TOE
		129		9.5	97.2	TOP
		167		9.7	97.0	G.B.
		200		9.0	97.7	O.G.
		255		8.2	98.5	TOP
		260		9.5	97.2	TOE
		265		8.6	98.1	TOP
		270		11.4	95.3	TOE #3
		272		11.6	95.1	TOE
		277		10.2	96.5	G.B.
		287		8.9	97.8	TOP
		387		8.3	98.4	O.G.
	5			12.3	94.4	TOE #1
	13			10.1	96.6	TOP
	21			9.1	97.6	EDGE ROAD
	42			10.0	96.7	EDGE ROAD
	100			10.1	96.6	

M/240

STA	DIST. LT.	DIST. RT.	MI	-	ELEV.	DESCRIPTION
12+00	0		1306.7	11.7	95.0	E #1
		43		11.4	95.3	TOE
		53		10.2	96.5	TOP
		82		8.5	98.2	TOP
		95		13.3	93.4	TOE
		106		13.3	93.4	TOE #2
		110		12.0	94.7	TOP
		122		12.5	94.2	TOE
		133		9.0	97.7	TOP
		200		8.8	97.9	O.G.
		270		8.3	98.4	TOP
		275		10.1	96.6	TOE
		284		9.3	97.4	G.B.
		288		11.2	95.5	TOE
		289		11.2	95.5	TOE
		291		9.6	97.1	TOP
		300		8.4	98.3	O.G.
		400		8.0	98.7	O.G.
	2			11.2	95.5	TOE #1
	12			8.2	98.5	TOP
	20			8.4	98.3	EDGE ROAD
	39			9.5	97.2	EDGE ROAD
	100			9.6	97.1	O.G.

10/21/10

STA.	DIST LT.	DIST. RT.	HI	—	ELEV	DESCRIPTION
12+50	0		1307.2	10.9	96.3	EI #1 TOE
		45		10.3	96.9	O.G.
		90		11.2	96.0	TOP
		93		13.0	94.2	TOE #2
		108		13.3	93.9	TOE
		111		12.5	94.7	TOP
		121		12.3	94.9	TOE
		136		9.1	98.1	TOP
		200		8.7	98.5	O.G.
		274		8.6	98.6	TOP
		281		10.5	96.7	TOE #3
		283		10.6	96.6	TOE
		287		8.3	98.9	TOP
		387		8.0	99.2	O.G.
	18			8.3	98.9	TOP E/R
	31			9.0	98.2	E/R
	100			9.8	97.4	O.G.

1/24/90

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV.	DESCRIPTION
13+00	0		1307.2	9.9	97.3	@ TOE #1
		38		10.5	96.7	TOE
		41		8.8	98.4	TOP
		82		8.3	98.9	TOP
		95		12.1	95.1	TOE
		120		12.4	94.8	TOE #2
		131		10.4	96.8	TOP
		165		8.4	98.8	TOP
		200		8.2	99.0	O.G.
		278		8.6	98.6	TOP
		283		9.7	97.5	TOE #3
		286		10.3	96.9	TOE
		289		7.7	99.5	TOP
		389		7.4	99.8	O.G.
	3			9.3	97.9	TOP
	11			9.6	97.6	TOE
	18			8.1	99.1	TOP E/P
	34			8.8	98.4	E/P
	100			9.8	97.4	O.G.

1044-210

STA.	DIST. LT.	DIST RT.	HI	-	ELEV	DESCRIPTION
13+50	0		1307.2	10.7	96.5	℄ TOE #1
		30		11.4	95.8	TOE
		37		8.2	99.0	TOP
		70		8.5	98.7	TOE
		80		6.4	1300.8	TOP
		98		12.2	95.0	TOE
		120		12.1	95.1	TOE #2
		129		8.0	99.2	TOP
		200		7.7	99.5	O.G.
		276		7.7	99.5	TOP
		280		9.9	97.3	TOE
		283		9.5	97.7	TOE #3
		290		7.3	99.9	TOP
		390		7.3	99.9	O.G.
	9			7.9	99.3	TOP E/R
	35			8.7	98.5	E/R
	100			9.5	97.7	O.G.

ms/pw

STA.	DIST. LT.	DIST RT.	HI	-	ELEV.	DESCRIPTION
14+00	0		1307.2	9.9	97.3	℄ TOE #1
		35		10.4	96.8	TOE
		41		8.2	99.0	TOP
		69		8.7	98.5	TOE
		80		6.4	1300.8	TOP
		97		11.9	95.3	TOE #2
		116		11.9	95.3	TOE
		119		11.0	96.2	G.B.
		128		7.6	99.6	TOP
		200		7.3	99.9	O.G.
		278		6.7	1300.5	TOP
		284		8.8	98.4	TOE
				~~7.5~~	~~97.9~~	~~TOP~~ #3
		287		9.3	97.9	TOE
		294		7.4	99.8	TOP
		394		6.7	1300.5	O.G.
	11			7.0	1300.2	TOP E/R
	35			8.5	98.7	E/R
	100			9.0	98.2	O.G.

10/4/78

STA	DIST. LT.	DIST. RT.	HI	-	ELEV.	DESCRIPTION
14+50	0		1307.2	9.8	97.4	℄ TOE #1
		35		10.4	96.8	TOE
		40		8.0	99.2	TOP
		72		7.7	99.5	TOE
		81		5.7	1301.5	TOP
		94		11.5	95.7	TOE #2
		112		11.7	95.5	TOE
		116		10.7	96.5	TOP
		123		10.4	96.8	TOE
		129		7.3	99.9	TOP
		200		6.8	1300.4	O.G.
		277		6.7	1300.5	TOP
		280		8.1	99.1	TOE #3
		283		8.7	98.5	TOE
		289		6.8	1300.4	TOP
		389		6.4	1300.8	O.G.
	12			6.6	1300.6	TOP E/R
	36			8.1	99.1	E/R
	100			8.7	98.5	

10/7/90

STA.	DIST. LT.	DIST. RT.	HI	–	ELEV.	DESCRIPTION
15+00	0		1307.2	9.1	98.1	℄ TOE #1
		18		10.7	96.5	℄
		35		10.2	97.0	TOE
		39		7.7	99.5	TOP
		49		8.8	98.4	G.B
		62		7.8	99.4	TOE
		82		5.3	1301.9	TOP
		94		10.9	96.3	TOE #2
		116		11.2	96.0	TOE
		118		10.4	96.8	TOP
		122		10.2	97.0	TOE
		124		7.1	1300.1	TOP
		200		6.5	1300.7	O.G.
		259		6.0	1301.2	TOP
		267		6.6	1300.6	TOE
		276		5.9	1301.3	TOP
		281		8.0	99.2	TOE #3
		283		8.6	98.6	TOE
		288		5.9	1301.3	TOP
		388		5.8	1301.4	O.G.
	12			6.4	1300.8	TOP E/R #1
	36			7.7	99.5	E/R
	100			8.1	99.1	O.G.

1881/210

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV
15+50	0		1307.2	8.6	98.6
		19		10.4	96.8
		35		10.4	96.8
		42		6.9	1300.3
		57		8.0	99.2
		80		5.5	1301.7
		94		10.7	96.5
		115		10.7	96.5
		118		10.1	97.1
		127		6.7	1300.5
		137		6.8	1300.4
		140		9.1	98.1
		144		6.7	1300.5
		200		5.7	1301.5
		271		6.2	1301.0
		277		7.6	99.6
		280		8.2	99.0
		286		6.9	1300.3
		386		5.3	1301.9
	13			6.0	1301.2
	36			7.3	99.9
	100			8.0	99.2

DESCRIPTION
℄
℄ #1
TOE
TOP
TOE
TOP
TOE
TOE #2
TOP
TOP
TOP
TOE
TOP
O.G.
TOP
TOE #3
TOE
TOP
O.G.
TOP E/R
E/R
O.G.

10/7/80

STA.	DIST. LT.	DIST RT.	HI	-	ELEV	DESCRIPTION
16+00	0		1307.2	8.3	98.9	℄ TOE #1
		20		10.2	97.0	℄
		36		9.9	97.3	TOE
		44		6.3	1300.9	TOP
		58		7.6	99.6	G.P.
		66		6.4	1300.8	TOP
		80		4.8	1302.4	TOP
		92		10.2	97.0	TOE
		117		10.3	96.9	TOE #2
		120		9.7	97.5	TOP
		125		9.2	98.0	TOE
		131		6.3	1300.9	TOP
		200		5.9	1301.3	O.G.
		270		5.4	1301.8	TOP
		279		7.8	99.4	TOE #3
		281		7.7	99.5	TOE
		288		5.4	1301.8	TOP
		388		5.1	1302.1	O.G.
	12			5.5	1301.7	TOP E/R
	36			6.9	1300.3	E/R
	100'			7.6	99.6	O.G.

110/20

STA.	DIST. LT.	DIST. RT.	HI	—	ELEV.	DESCRIPTION
16+50	0		1307.2	8.1	99.1	℄
		17		10.0	97.2	℄ #1
		34		9.5	97.7	TOE
		43		6.0	1301.2	TOP
		58		7.2	1300.0	TOE
		72		6.0	1301.2	TOE
		81		4.3	1302.9	TOP
		94		9.5	97.7	TOE
		116		9.6	97.6	TOE #2
		117		9.3	97.9	G.R.
		122		9.0	98.2	TOE
		132		5.8	1301.4	TOP
		200		5.9	1301.3	O.G.
		271		4.7	1302.5	TOP
		277		7.4	99.8	TOE #3
		280		7.6	99.6	TOE
		287		5.0	1302.2	TOP
		307		4.4	1302.8	O.G.
	3			7.7	99.5	TOE #1
	11			5.1	1302.1	TOP E/R
	36			6.6	1300.6	E/R
	100			7.1	1300.1	O.G.

505

RWCD
R-2
EXTENSION

LIETZ
SINCE 1882

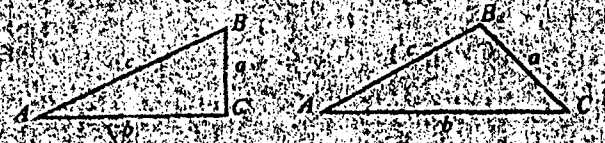
LIETZ
SINCE 1882

ECONOMY FIELD BOOK

No. 8152-05

112/210

FORMULAE FOR SOLVING RIGHT TRIANGLES



$$\sin A = \frac{a}{c} = \cos B; \quad \cot A = \frac{b}{a} = \tan B$$

$$\cos A = \frac{b}{c} = \sin B; \quad \sec A = \frac{c}{b} = \operatorname{cosec} B$$

$$\tan A = \frac{a}{b} = \cot B; \quad \operatorname{cosec} A = \frac{c}{a} = \sec B$$

Given	Required	Solution
c, A	B, a, b	$B = 90° - A;\ a = c \sin A;\ b = c \cos A$
A, b	B, a, c	$B = 90° - A;\ a = b \tan A;\ c = \frac{b}{\cos A}$
A, a	B, b, c	$B = 90° - A;\ b = a \cot A;\ c = \frac{a}{\sin A}$
a, c	A, B, b	$\sin A = \frac{a}{c};\ \cos B = \frac{a}{c};\ b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b};\ \cot B = \frac{a}{b};\ c = \sqrt{a^2+b^2}$

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, B, b	B, C, c	$\sin B = \frac{b \sin A}{a};\ C = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C;\ c = \frac{a \sin C}{\sin A}$
a, b, c	Area	$\text{side} = \frac{a+b+c}{2};\ \text{area} = \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	$\text{area} = \frac{bc \sin A}{2}$
A, B, C, a	Area	$\text{area} = \frac{a^2 \sin B \sin C}{2 \sin A}$

MADE IN U.S.A.

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11/3/26

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV	DESCRIPTION
18+00	0		1307.4	8.3	1299.1	E
		10		8.9	1298.5	E #1
		26		8.8	1298.6	TOE
		37		5.6	1301.8	TOP
		58		5.7	1301.7	TOE
		67		5.3	1302.1	TOE
		78		3.6	1303.8	TOP
		87		7.3	1300.1	G.B.
		94		8.7	1298.7	TOE #2
		112		8.1	1299.3	TOE
		126		6.5	1300.9	G.B.
		128		4.7	1302.7	TOP
		139		5.6	1301.8	TOP
		142		6.6	1300.8	TOE
		148		5.0	1302.4	TOP
		200		4.5	1302.9	O.G.
		263		4.2	1303.2	TOP
		271		6.1	1301.3	TOE #3
		273		6.1	1301.3	TOE
		278		4.2	1303.2	TOP
		378		3.6	1303.8	O.G.
	4			7.9	1299.5	G.B.
	13			5.0	1302.4	TOP. E/2
	36			5.9	1301.5	E/2
	100			6.4	1301.0	O.G.

114120

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV	DESCRIPTION
18+50	0		1307.4	8.0	1299.4	℄
		17		8.5	1298.9	℄ #1
		28		8.2	1299.2	TOE
		31		7.3	1300.1	G.B.
		42		5.0	1302.4	TOP
		57		5.5	1301.9	G.B.
		69		4.7	1302.7	TOE
		80		3.1	1304.3	TOP
		92		8.0	1299.4	TOE #2
		113		8.2	1299.2	TOE
		122		7.2	1300.2	G.B.
		130		4.5	1302.9	TOP
		142		4.4	1303.0	TOP
		151		5.8	1301.6	TOE
		164		3.9	1303.5	TOP
		200		3.9	1303.5	O.G.
		261		3.5	1303.9	TOP
		267		5.1	1302.3	TOE #3
		271		5.7	1301.7	TOE
		280		3.6	1303.8	TOP
		380		3.0	1304.4	O.G.
	3			7.5	1299.9	TOE
	13			4.7	1302.7	TOP E/R
	37			5.7	1301.7	E/R
	100			5.7	1301.7	O.G.

115/240

STA	DIST. LT	DIST. RT.	MI	-	ELEV.	DESCRIPTION
19+00	0		1307.4	7.5	1299.9	E
		23		8.4	1299.0	E #1
		29		7.3	1300.1	TOE
		36		6.1	1301.3	TOP
		42		4.4	1303.0	TOP
		55		5.4	1302.0	TOE
		66		4.5	1302.9	TOE
		79		2.2	1305.2	TOP
		89		7.5	1299.9	TOE
		113		7.9	1299.5	#2 TOE
		118		7.0	1300.4	TOP
		125		7.1	1300.3	TOE
		129		4.1	1303.3	TOP
		151		3.9	1303.5	TOP
		157		4.9	1302.5	TOE
		162		4.2	1303.2	TOP
		200		4.2	1303.2	D.G.
		268		2.7	1304.7	TOP
		273		4.2	1303.2	TOE #3
		277		4.6	1302.8	TOE
		282		3.2	1304.2	TOP
		382		2.4	1305.0	D.G.
	3			7.2	1300.2	G.B.
	14			4.3	1303.1	TOP C/P
	37			5.3	~~1302.1~~	E/R
	100			5.7	1301.7	O.P.

STA	DIST. LT.	DIST. RT.	MI	-	ELEV	DESCRIPTION
19+50	0		1307.4	7.2	1300.2	E
		18		7.9	1299.5	E ⊿
		27		7.9	1299.5	TOE
		34		~~7.7~~ 5.9	1301.5	G.B.
		42		4.8	1302.6	TOP
		55		4.9	1302.5	G.B.
		62		4.2	1303.2	TOE
		77		2.0	1305.4	TOP
		88		7.4	1300.0	TOE
		118		7.4	1300.0	TOE ⊿2
		123		6.6	1300.8	G.B.
		129		3.8	1303.6	TOP
		156		3.3	1304.1	TOP
		161		4.7	1302.7	TOE
		164		3.5	1303.9	TOP
		200		3.5	1303.9	O.G.
		272		3.1	1304.3	TOP
		276		4.3	1303.1	TOE
		279		4.3	1303.1	TOE
		283		3.1	1304.3	TOP
		383		2.2	1305.2	O.G.
	2			6.8	1300.6	G.B.
	13			3.7	1303.7	TOP E/R
	37			4.7	1302.7	E/R
	100			5.2	1302.2	O.G.

11/20

STA.	DIST. LT	DIST. RT.	H I	-	ELEV	DESCRIPTION
20+00	0		1313.8	13.0	1300.8	℄
		5		14.2	1299.6	℄ #1
		25		13.0	1300.0	TOE
		30		12.2	1301.6	G.B.
		42		10.0	1303.8	TOP
		56		11.1	1302.7	G.B.
		65		9.8	1304.0	TOP
		70		9.7	1304.1	TOE
		77		8.0	1305.8	TOP
		92		13.4	1300.4	TOE #2
		121		13.3	1300.5	TOE
		125		12.6	1301.2	G.B.
		129		9.6	1304.2	TOP
		155		9.2	1304.6	TOP
		161		10.2	1303.6	TOE
		170		9.3	1304.5	TOP
		200		8.9	1304.9	O.G.
		275		9.1	1304.7	TOP
		277		10.1	1303.7	TOE #3
		280		10.3	1303.5	TOE
		286		9.3	1304.5	TOP
		386		8.2	1305.6	O.G.
	3			12.3	1301.5	TOE
	13			9.6	1304.2	TOP E/R
	37			10.8	1303.0	E/R
	110			11.0	1302.8	O.G.

118-120

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV		DESCRIPTION
20+52	0		1313.8	12.7	1301.1	℄	
		4		13.5	1300.3	TOE	#1
		25		13.5	1300.3	TOE	
		29		12.9	1300.9	G.B	
		37		9.5	1304.3	TOP	
		56		10.6	1303.2	TOE	
		68		9.7	1304.1	TOE	
		80		7.3	1306.5	TOP	
		91		12.5	1301.3	TOE	#2
		123		12.9	1300.9	TOE	
		126		11.5	1302.3	G.B	
		131		9.0	1304.8	TOP	
		159		8.8	1305.0	TOP	
		163		9.8	1304.0	TOE	
		170		8.6	1305.2	TOP	
		200		8.5	1305.3	O.G.	
		273		8.0	1305.8	TOP	
		277		9.4	1304.4	TOE	#3
		281		9.6	1304.2	TOE	
		286		8.6	1305.2	TOP	
		386		7.1	1306.7	O.G	
	2			12.2	1301.6	TOE	
	13			9.1	1304.7	TOP	E/R
	36			10.3	1303.5	E/R	
	100			10.7	1303.1	O.G	

179/120

STA.	DIST. LT.	DIST RT.	MI	-	ELEV	DESCRIPTION
21+00	0		1313.8	12.1	1301.7	E
		6		13.3	1300.5	TOE
		25		12.9	1300.9	TOE #1
		36		9.1	1304.7	TOP
		53		10.1	1303.7	G.B.
		57		10.2	1303.6	TOE
		61		9.2	1304.6	TOP
		69		9.2	1304.6	TOE
		80		7.7	1306.1	TOP
		95		12.5	1301.3	TOE
		118		12.3	1301.5	TOE
		126		11.6	1302.2	G.B.
		131		8.6	1305.2	TOP
		159		8.3	1305.5	TOP
		165		9.3	1304.5	TOE
		171		8.4	1305.4	TOP
		200		8.1	1305.7	O.G.
		272		7.5	1306.3	TOP
		277		8.8	1305.0	TOE
		280		9.5	1304.3	TOE #3
		286		8.1	1305.7	TOP
		386		7.1	1306.7	O.G.
	2			11.5	1302.3	TOE
	13			8.7	1305.1	E/R TOP
	37			9.9	1303.9	E/R
	100			10.3	1303.5	O.G.

120/240

	DIST. LT.	DIST. RT.	MI	-	ELEV	DESCRIPTION
21+50			1313.8	11.7	1302.1	E
		10		12.8	1301.0	E #1
		25		12.7	1301.1	TOE
		36		9.0	1304.8	TOP
		51		9.5	1304.3	TOE
		64		9.1	1304.7	TOE
		80		6.4	1307.4	TOP
		95		12.0	1301.8	TOE
		122		12.0	1301.8	#2 TOE
		130		8.5	1305.3	TOP
		162		8.2	1305.6	TOP
		170		9.0	1304.8	TOE
		177		8.5	1305.3	TOP
		200		8.0	1305.8	O.G.
		273		7.0	1306.8	TOP
		278		8.0	1305.8	TOE #3
		282		8.7	1305.1	TOE
		288		7.3	1306.5	TOP
		388		6.3	1307.5	O.G.
	2			11.1	1302.7	TOE
	13			8.3	1305.5	TOP E/R
	37			9.6	1304.2	E/R
	100			9.8	1304.0	O.G.

12/20

STA	DIST LT	DIST RT	MI	-	ELEV	DESCRIPTION
22+00	0		1313.8	11.6	1302.2	℄
		10		12.2	1301.6	℄ #1
		26		12.5	1301.3	TOE
		29		11.6	1302.4	G.B
		33		11.1	1302.7	TOE
		42		8.3	1305.5	TOP
		50		9.0	1304.8	TOE
		68		8.2	1305.6	TOE
		77		6.6	1307.2	TOP
		81		9.6	1304.4	TOE
		97		12.0	1301.8	TOE
		122		11.8	1302.0	TOE #2
		124		11.2	1302.6	G.B.
		131		7.9	1305.9	TOP
		167		7.4	1306.4	TOP
		172		8.7	1305.1	TOE
		177		7.4	1306.4	TOP
		200		7.2	1306.6	O.G.
		270		7.0	1306.8	TOP
		278		8.4	1305.4	TOE #3
		282		8.1	1305.7	TOE
		287		7.1	1306.7	TOP
		387		6.3	1307.5	O.G.
	2			11.1	1302.7	TOE
	12			7.8	1306.0	TOP ℄2
	36			9.0	1304.8	E/R
	100			9.5	1304.3	O.G.

12/20

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV	DESCRIPTION
22+50	0		1313.8	11.2	1302.6	℄
		16		12.0	1301.8	⅊ #1
		25		12.0	1301.8	TOE
		31		10.9	1302.9	G.B.
		40		7.9	1305.9	TOP
		52		8.7	1305.1	TOE
		69		7.7	1306.1	TOE
		76		6.7	1307.1	TOP
		82		9.6	1304.2	G.B
		95		11.0	1302.8	TOE #2
		120		11.5	1302.3	TOE
		125		10.9	1302.9	G.B
		135		7.7	1306.1	TOP
		171		7.1	1306.7	TOP
		177		7.9	1305.9	TOE
		182		7.5	1306.3	TOP
		200		7.1	1306.7	O.G.
		274		6.5	1307.3	TOP
		278		7.4	1306.4	TOE #3
		283		7.8	1306.0	TOE
		289		6.7	1307.1	TOP
		389		5.8	1308.0	O.G.
	2			10.6	1303.2	TOE
	12			7.3	1306.5	TOP E/R
	34			8.6	1305.2	E/R
	100			9.1	1304.7	O.G.

123/240

STA	DIST. CT	DIST. PT.	MI	—	ELEV	DESCRIPTION
23+00	0		1313.8	10.9	1302.9	℄
		16		11.6	1302.2	℄ #1
		27		11.4	1302.4	TOE
		40		9.0	1304.8	G.B.
		44		7.5	1306.3	TOP
		56		8.3	1305.5	G.B
		64		7.3	1306.5	TOE
		74		7.1	1306.7	TOE
		79		5.9	1307.9	TOP
		89		9.6	1304.2	TOE #2
		98		11.1	1302.7	TOE
		126		11.0	1302.8	TOE
		132		9.5	1304.3	TOP
		137		8.8	1305.0	TOE
		140		6.7	1307.1	TOP
		184		7.6	1306.2	G.B.
		192		6.6	1307.2	TOP
		200		6.8	1307.0	O.G.
		277		6.0	1307.8	TOP
		285		7.6	1306.2	TOE #3
		288		7.7	1306.1	TOE
		294		6.2	1307.6	TOP
		394		5.4	1308.4	O.G.
	7			7.1	1306.7	TOP E/R
	37			8.3	1305.5	E/R
	100?			8.7	1305.1	O.G.

124/210

STA.	DIST. LT.	DIST. RT.	HI	-	ELEV.	DESCRIPTION
23+50	0		1313.8	10.0	1303.8	℄
		20		11.4	1302.4	℄ #1
		24		11.2	1302.6	TOE
		35		8.7	1305.1	G.B.
		38		8.6	1305.2	G.B.
		42		7.3	1306.5	TOP
		55		7.9	1305.9	TOE
		76		5.2	1308.6	TOP
		84		9.0	1304.8	G.B.
		94		10.5	1303.3	TOE
		126		10.5	1303.3	TOE #2
		131		6.6	1307.2	G.B. TOP
		186		6.7	1307.1	TOP
		193		7.3	1306.5	TOE
		200		6.4	1307.4	TOP
		282		5.9	1307.9	TOP
		291		7.4	1306.4	TOE #3
		300		5.8	1308.0	TOP
		400		4.7	1309.1	O.G.
	11			6.7	1307.1	TOP E/R
	37			7.8	1306.0	E/R
	100			8.5	1305.3	O.G.

125/210

STA.	DIST. LT	DIST. RT.	HI	-	ELEV	DESCRIPTION
24+00	0		1313.8	9.5	1304.3	E
		8		10.7	1303.1	TOE #1
		13		11.0	1302.8	E
		22		11.1	1302.7	TOE
		35		8.1	1305.7	TOP
		42		8.4	1305.4	TOE
		45		7.2	1306.6	TOP
		62		6.5	1307.3	G.B.
		76		4.9	1308.9	TOP
		78		7.0	1306.8	TOE
		90		10.0	1303.8	TOE #2
		120		10.1	1303.7	TOE
		127		8.2	1305.6	G.B
		129		6.1	1307.7	TOP
		195		5.6	1308.2	TOP
		200		6.7	1307.1	TOE
		203		6.2	1307.6	TOP
		290		5.0	1308.8	TOP
		302		6.9	1306.9	TOE #3
		307		5.1	1308.7	TOP
		407		4.5	1309.3	O.G.
	10			6.2	1307.6	TOP E/R
	37			7.5	1306.3	E/R
	100			8.2	1305.6	O.G.

126/210

STA.	DIST. LT	DIST. RT	HI	—	ELEV	DESCRIPTION
24+50	0		1313.8	9.0	1304.8	E
		3		9.7	1304.1	TOE
		25		10.3	1303.5	TOE #1
		30		9.1	1304.7	TOP
		33		8.7	1305.1	TOE
		36		7.4	1306.4	TOP
		60		6.5	1307.3	TOE
		77		4.3	1309.5	TOP
		80		6.9	1306.9	G.B.
		90		9.4	1304.4	TOE
		126		9.0	1304.8	TOE #2
		130		5.7	1308.1	TOP
		200		5.0	1308.8	TOP
		209		6.3	1307.5	TOE
		213		5.4	1308.4	TOP
		294		4.7	1309.1	TOP
		300		6.4	1307.4	TOE
		306		5.0	1308.8	TOP
		406		4.0	1309.8	O.G.
	9			5.5	1308.3	TOP E/R
	34			6.7	1307.1	E/R
	100			7.7	1306.1	O.G.

121/240

STA.	DIST. LT.	DIST. RT	MI	-	ELEV.	DESCRIPTION
25+00	0		1313.8	7.9	1305.9	E
		3		9.0	1304.8	TOE #1
		26		9.9	1303.9	TOE
		41		6.2	1307.6	TOP
		67		5.7	1308.1	TOE
		74		4.0	1309.8	TOP
		79		7.1	1306.7	G.B
		92		9.6	1304.2	TOE #2
		122		8.6	1305.2	TOE
		126		5.4	1308.4	TOP
		200		5.0	1308.8	O.G.
		206		4.5	1309.3	TOP
		214		5.7	1308.1	TOE
		217		4.8	1309.0	TOP
		287		4.4	1309.4	TOP
		293		5.8	1308.0	TOE #3
		303		4.2	1309.6	TOP
		403		3.6	1310.2	O.G.
	10			5.0	1308.8	TOP E/R
	37			6.4	1307.4	E/R
	100			7.5	1306.3	O.G.

127A/210

X - Sections

2/24/82

STA - 973+50 - 979 +17.97 BK

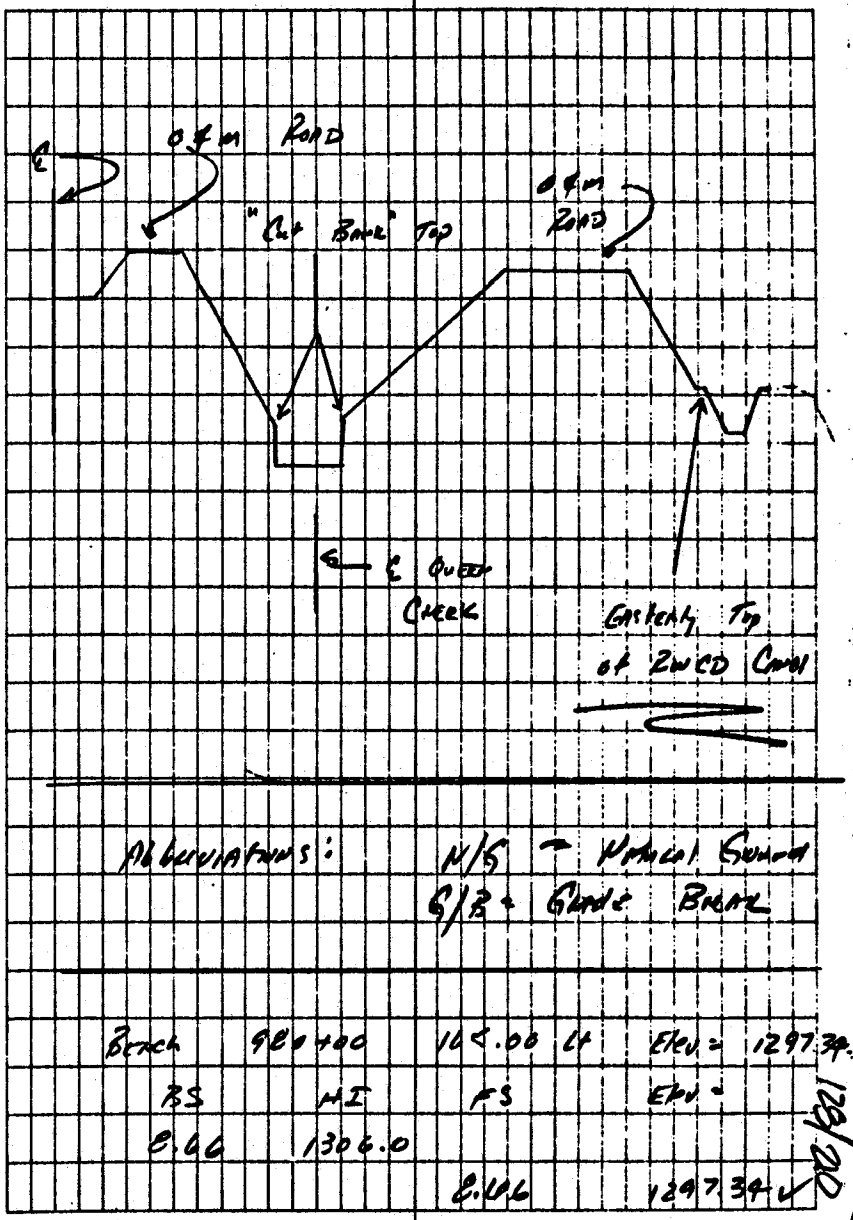
RWCD Extension

J. Custer

J. Richison

D. Massey

Typical X-Section Right



Abbreviations: N/G - Natural Ground

G/B - Grade Break

Bench	980+00	16<.00 LT	Elev =	1297.34
BS	HI	FS	Elev =	
0.66	1306.0			
		0.06	1297.34 ✓	

1284.00

STA	Dist Up	Dist Rt	HI	—	Elev	Description
973+50	0		1306.0	10.4	1295.6	℄
		49		10.3	1295.7	Toe
		68		7.8	1298.2	Top 0 Km
		76		8.0	1298.0	Top 0 Km
		109		14.7	1291.3	Top C/Brk
		124		18.5	1287.5	Invert
		134		17.7	1288.3	"
		142		16.1	1289.9	Top C/Brk
		163		11.4	1294.6	G/B
		199		6.1	1299.9	Top 0 Km
		209		5.8	1300.2	Top 0 Km
		225		12.2	1293.8	Top Concrete Cutw - Edge
	50			9.7	1296.3	N/G
	100			9.1	1296.9	N/G
	150			8.5	1297.5	N/G
	200			7.7	1298.3	N/G
	250			7.3	1298.7	N/G
	300			6.6	1299.4	N/G

STA	Dist Lt	Dist Rt	HI	—	Elev.	Description
974+00	0		1306.0	10.1	1295.9	℄
		49		10.1	1295.9	Toe
		67		7.6	1298.4	Top 0 Km
		75		7.9	1298.1	Top 0 Km
		110		14.9	1291.1	Top C/Back
		121		18.0	1288.0	Thickness
		136		17.8	1288.2	Thickness
		146		16.0	1290.0	Top C/Back
		165		11.4	1294.6	C/B
		199		6.0	1300.0	Top 0 Km
		209		6.0	1300.0	"
		225		12.3	1293.7	Top Concrete Canal PACD East
	50			9.6	1296.4	N/B
	72			9.4	1296.6	"
	100			9.0	1297.0	"
	150			8.2	1297.8	"
	200			7.9	1298.1	"
	250			7.1	1298.9	"
	300			6.7	1299.3	"

130/310

STA	Dist Lt	Dist Rt	HI	–	Elev.	Description
974+50	0		1306.0	10.5	1295.5	℄
		43		10.3	1295.7	TOC
		61		7.4	1298.6	Top 0 Km
		68		7.8	1298.2	Top 0 Km
		110		15.6	1290.4	Top C/Brk
		121		18.5	1287.5	Target
		132		17.6	1288.4	"
		141		15.8	1290.2	Top C/Brk
		161		11.4	1294.6	A/B
		192		5.9	1300.1	Top 0 Km
		208		5.6	1300.4	Top 0 Km
		224		12.3	1293.7	Top Concrete Canal Pipe Cut
	50			9.8	1296.2	N/B
	100			9.2	1296.8	"
	150			9.0	1297.0	"
	200			8.1	1297.9	"
	250			7.7	1298.3	"
	300			6.9	1299.1	"

134/210

STA	Dist Lt	Dist Rt	HI	—	Elev.	Description
975+00	0		1306.0	10.5	1295.5	℄
		39		10.4	1295.6	TOC
		57		7.5	1298.5	Top of Ditch
		65		7.7	1298.3	Top of Ditch
		105		15.7	1290.3	Top Cut Back
		117		18.4	1287.6	Toe
		126		18.4	1287.6	"
		139		15.5	1290.5	Top Cut Back
		189		6.2	1299.8	Top of Ditch
		206		5.7	1300.3	Top of Ditch
		224		12.4	1293.6	Top Concrete Canal Pavd Edge
	50			10.0	1296.0	W/S
	100			9.2	1296.8	"
	150			8.6	1297.4	"
	200			8.0	1298.0	"
	250			7.7	1298.3	"
	300			6.9	1299.4	"

STA	Dist Lt	Dist Rt	HI	-	Elev.	Description
975+50	0		1306.0	10.6	1295.4	℄
		37		10.5	1295.5	Toe
		53		7.5	1298.5	Top 0 4m
		60		7.5	1298.5	Top 0 4m
		100		15.4	1290.6	Top Cut Break
		110		18.0	1288.0	Invert
		124		18.0	1288.0	"
		185		6.4	1299.6	Top 0 4m
		204		5.7	1300.3	Top 0 4m
		224		12.4	1293.6	Top Cut Break Chnl RW CD East
	50			10.0	1296.0	N/G
	100			9.6	1296.4	"
	150			8.6	1297.4	"
	200			8.1	1297.9	"
	250			7.2	1298.8	"
	300			6.9	1299.0	"

STA	Dist Lt	Dist Rt	HI	—	Elev.	Description
976+00	0		1306.0	10.8	1292.2	℄
		34		10.5	1295.5	Toe
		51		7.3	1298.7	Top 0 Km
		59		7.4	1298.6	Top 0 Km
		100		15.4	1290.6	Top C/B
		110		17.9	1288.1	Toe
		123		18.2	1287.8	"
		130		15.8	1290.2	Top C/Bank
		188		6.3	1299.7	Top 0 Km
		205		5.8	1300.2	Top 0 Km
		226		12.4	1293.6	Top Concrete Canal Road East
	50			10.1	1295.9	N/G
	100			9.6	1296.4	"
	150			8.8	1297.2	"
	200			8.3	1297.7	"
	250			7.7	1298.3	"
	300			7.0	1299.0	"

134/20

STA	DIST LT	DIST RT	H.I	—	Elev.	Description
976+50	0		1306.0	10.0	1296.0	℄
		26		10.4	1295.6	TOE
		45		7.1	1298.9	Top 0 Km
		51		7.4	1298.6	Top 0 Km
		95		15.7	1290.3	Top C/Bank
		105		18.0	1288.0	Toe Ent
		115		18.5	1287.5	"
		181		6.1	1299.9	Top 0 Km
		200		5.6	1300.4	Top 0 Km
		223		12.5	1293.5	Top Concrete Canal Pavcd East
	50			9.6	1296.4	N/G
	100			9.1	1296.9	"
	150			8.5	1297.5	"
	200			8.3	1297.7	"
	250			7.7	1298.3	"
	300			7.4	1298.6	"

135/240

STA	DIST LT.	DIST RT	HI	—	ELEV.
977+00	0		1306.0	10.1	1295.9
		23		11.1	1294.9
		41		7.3	1298.7
		48		7.3	1298.7
		95		16.8	1289.2
		101		18.5	1287.5
		109		18.3	1287.7
		120		15.8	1290.2
		179		6.0	1300.0
		195		5.6	1300.4
		222		12.5	1293.5
	50			9.5	1296.5
	100			8.4	1297.6
	150			8.7	1297.3
	200			8.3	1297.7
	250			6.9	1299.1
	280			6.8	1299.2
	300			10.0	1296.0

DESCRIPTION

℄

TOC

Top 0.4m

Top 0.4m

Top C/Brk

Invert 9 C.

"

Top C/Brk

Top 0.4m

"

Top Concrete Canal Rmcd. Ests

N/G

"

"

"

"

"

"

136120

Sta	Dist Lt	Dist Rt	HI	–	Elev.	Description
977+50	0		1306.0	10.0	1296.0	℄
		19		11.0	1295.0	Toe
		34		7.2	1298.8	Top 0.4m
		43		7.3	1298.7	Top 0.4m
		88		16.3	1289.7	Top C/Brk
		98		18.4	1287.6	Toe QC
		111		18.2	1287.8	" QC
		117		15.7	1290.3	Top C/Brk
		171		6.3	1299.7	Top 0.4m
		195		5.5	1300.5	"
		221		12.5	1293.5	Top Concrete Canal Rnco East
	50			9.7	1296.3	N/G
	100			9.3	1296.7	"
	150			6.7	1297.3	"
	165			7.6	1298.4	"
	200			9.6	1296.4	"
	239			12.5	1293.5	"
	261			13.3	1292.7	"
	270			9.4	1296.6	"
	300			7.9	1298.1	"

137/20

STA	DIST LT	DIST RT	HI	-	ELEV.	DESCRIPTION
978+00	0		1306.0	10.5	1295.5	℄
		12		10.3	1295.7	TOE
		28		7.4	1298.6	TOP 0 [illegible]
		41		7.2	1298.8	"
		88		16.5	1289.5	TOP C/BANK
		95		18.4	1287.6	INVERT
		108		18.0	1288.0	"
		111		16.2	1289.8	TOP C/BANK
		171		5.9	1300.1	TOP [illegible]
		192		5.2	1300.8	"
		219		12.6	1293.4	TOP CHANNEL CANAL RWCD EMT
	50			10.0	1296.0	N/G
	100			8.8	1297.2	"
	128			8.0	1298.0	"
	143			10.8	1295.2	"
	193			11.7	1294.3	"
	237			8.5	1297.5	"
	272			9.1	1296.9	"
	300			10.4	1295.6	"

138/210

STA	DIST LT	DIST RT	HI	—	ELEV.	DESCRIPTION
978+50	0		1306.0	9.1	1296.9	℄
		37		7.5	1298.5	℄/BREAK
		60		12.8	1293.2	TOP
		79		15.4	1290.6	TOP ℄/BANK
		95		18.5	1287.5	INVERT
		105		18.6	1287.4	"
		110		16.5	1289.5	TOP CROSS-ROAD
		136		12.6	1293.4	TOP " "
		174		5.8	1300.2	TOP 0 km
		196		5.1	1300.9	TOP 0 km
		222		12.7	1293.3	TOP CONCRETE CANAL ROAD EAST
	40			9.0	1297.0	H/G
	94			11.8	1294.2	"
	100			11.9	1294.1	"
	130			11.0	1295.0	"
	146			8.9	1297.1	"
	206			7.9	1298.1	"
	220			12.6	1293.4	"
	235			12.5	1293.5	"
	267			11.2	1294.8	"
	276			7.7	1298.3	"
	300			7.6	1298.4	"

1391/20

STA	DIST LT	DIST RT	HI	—	ELEV.	DESCRIPTION
979+17.97	BL 0		1306.0	11.9	1294.1	℄
		4		15.4	1290.6	G/Break
		10		12.3	1293.7	G/Break
		40		10.9	1295.1	G/Break
		90		18.5	1287.5	Inlet
		105		18.4	1287.6	"
		114		16.4	1289.6	G/Break
		138		13.3	1292.7	Top Cross - Pipe
		154		12.3	1293.7	" " "
		184		5.9	1300.1	Top 0.8 m
		210		5.2	1300.8	Top 0.4 m
		235		12.7	1293.3	Top Curb Cont Pavd Edge
	36			12.1	1293.9	W/G
	60			9.2	1296.8	"
	84			8.6	1297.4	"
	100			12.5	1293.5	"
	116			14.4	1291.6	"
	128			14.1	1291.9	"
	141			10.9	1295.1	"
	200			8.7	1297.3	"
	250			8.3	1297.7	"
	300			7.8	1298.2	"

1481/210

Level Loop for Establishing
Canal Invert Grades &
Drop Structure Details

J. Cluster
J. Richison
2/25/83

141/210

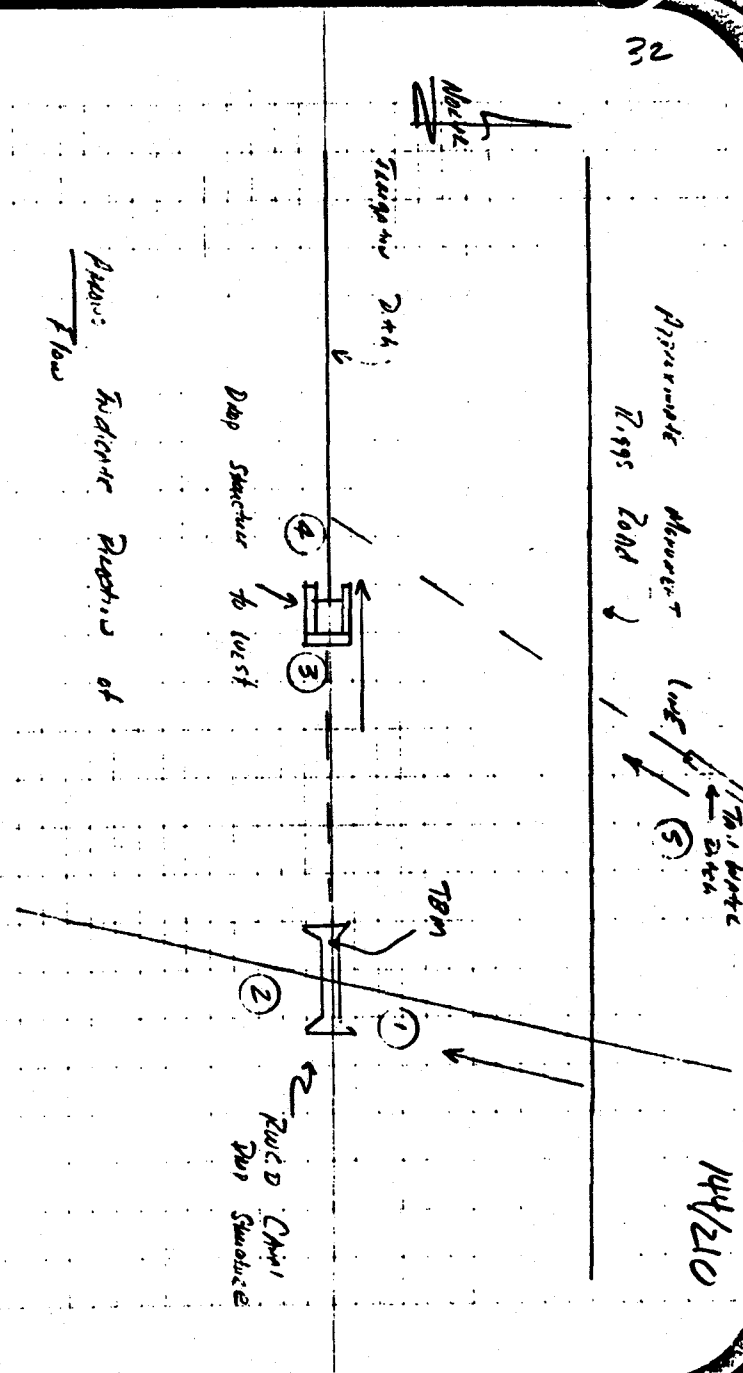
B.S	H.I	F.S.	Elev.	Adjusted
			1297.34	
5.76	1303.10			
		7.26	1295.84	
5.80	1301.64			
		4.90	1296.74	
5.84	1302.58			
		5.48	1297.10	
6.00	1303.10			
		7.18	1295.92	1295.90
7.31	1303.23			
		6.13	1297.10	
5.36	1302.46			
		6.12	1296.34	
5.10	1301.44			
		5.60	1295.84	
7.14	1303.03			
		5.66	1297.37	
48.36		48.33		

Description						
Station	980	400	RwCD	B.C	165°	Left
P.O.W	B.C	At	RwCD	& Corner	Sec	33
P.O.B						

Page 20

BS	HI	FS	Elev	Adjusted	Description
			1295.90		B.C AT RWCD ROW & Center Sec 33
11.53	1307.43				
		5.90	1301.53		
6.59	1308.12				
		5.69	1302.43		
5.26	1307.69				
		8.63	1299.06	1299.04	Chiseled 'X' Painted White on West
8.85	1307.91				Side of Stoplog Blockout - Top of
		4.22	1303.69		Concrete Rings Road Location
3.91	1307.60				
		4.52	1303.08		
4.47	1307.55				
		5.00	1302.55		
4.37	1306.92				
		10.98	1295.94		P.O.B
44.98		44.94			

143/210



144/210

	Invert	Angles	Drop Structure	
	At	Rings	Rod	
BS	HI	FS	El	
			1299.04	See previous page
4.94	1303.99			
		① 11.76	1292.23	Cwcd Nozzle
		② 11.53	1292.41	Cwcd Corner
		③ 10.47	1293.52	West Drop
		④ 13.99	1290.00	West Drop
		⑤ 3.52	1294.47	Tail water Ditch
		4.94 ✓	1299.04	T.O.B

145/216

BS	HI	FS	ELEV
			1292.90
8.42	1304.32		
		5.98*	1298.34
	(1)	10.66	1293.66
	(2)	11.64	1292.68
	(3)	11.64	1292.68
	(4)	12.24	1292.08
	(5)	12.09	1292.23
		8.42 ✓	1295.90

* TBM on Structure = Chiseled "X" on ZWCD Drop Structure on Southwest Wingwall - Top.

STA	DIST. LT.	DIST. RT.	HI	–	ELEV.	DESCRIPTION
17+00	0		1307.2	8.0	99.2	E
		14		9.6	97.6	RE #1
		34		9.2	98.0	TOE
		39		7.5	99.7	TOE
		43		5.6	1301.6	TOP
		57		6.7	1300.5	TOE
		66		5.5	1301.7	TOP
		73		4.9	1302.3	TOE
		79		3.7	1303.5	TOP
		87		7.0	1300.2	TOE
		93		9.5	97.7	TOE #2
		119		8.6	98.6	TOE
		131		5.2	1302.0	TOP
		147		5.0	1302.2	TOP
		152		7.4	99.8	TOE
		156		5.5	1301.7	TOP
		200		5.3	1301.9	O.G.
		271		4.7	1302.5	TOP
		275		7.0	1300.2	TOE #3
		278		7.3	99.9	TOE
		283		4.9	1302.3	TOP
		383		4.0	1303.2	O.G.
	2			7.6	99.6	TOE #1
	11			4.9	1302.3	TOP E/R
	36			6.2	1301.0	E/R
	100			7.0	1300.2	O.G.

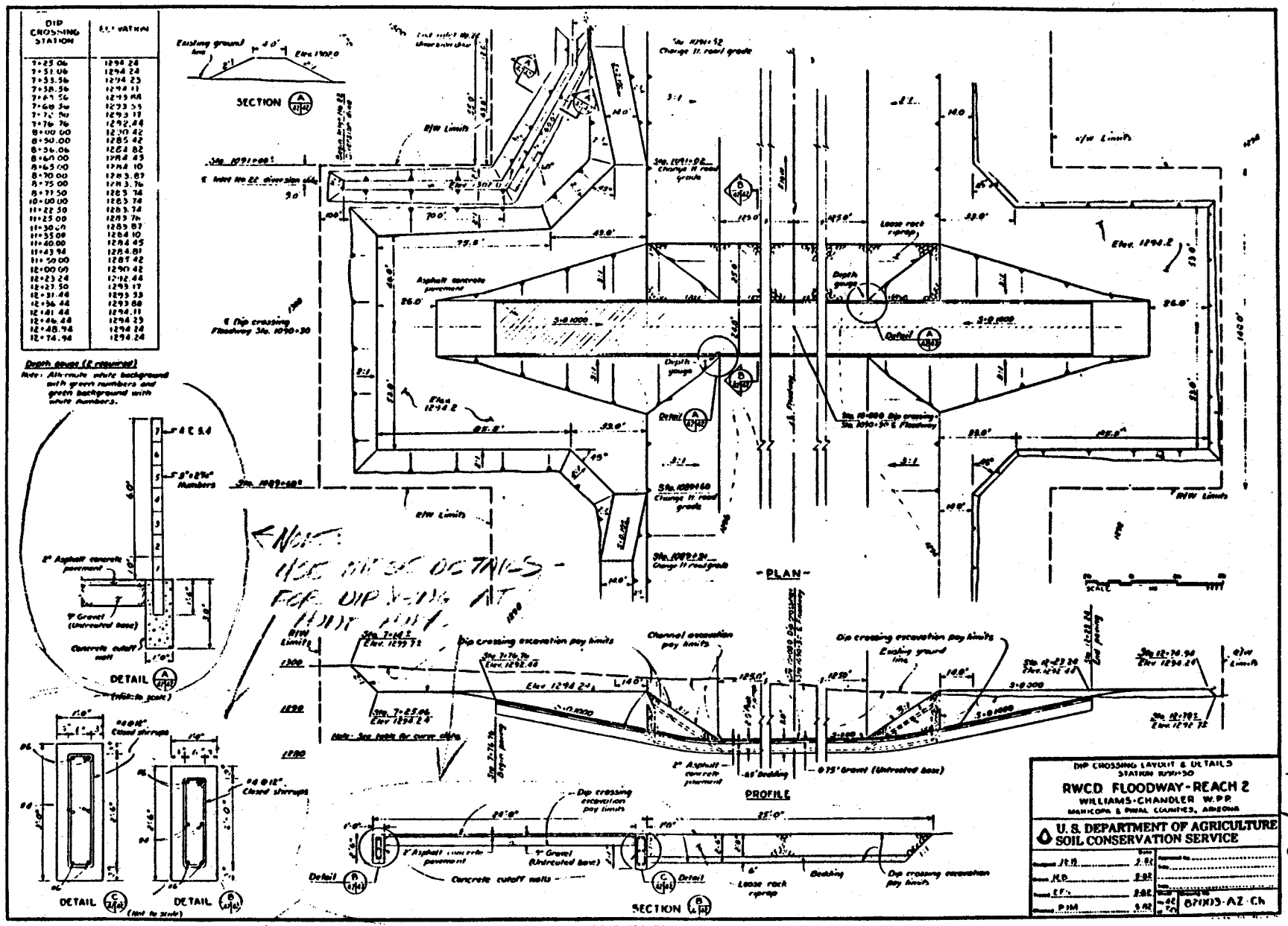
OK 1/4/94

STA.	DIST. LT.	DIST. RT.	HI	–	ELEV.	DESCRIPTION
17+50	0		1307.2	8.1	99.1	E
		12		9.1	98.1	TE #1
		28		9.0	98.2	TOE
		41		5.8	1301.4	TOP
		57		6.2	1301.0	G.B
		68		5.5	1301.7	TOE
		76		3.2	1304.0	TOP
		87		7.3	99.9	TOE
		92		8.9	98.3	TOE #2
		117		8.5	98.7	TOE
		126		6.9	1300.3	TOP
		128		8.3	98.9	TOE
		131		8.2	99.0	TOE
		136		5.8	1301.4	TOP
		149		4.7	1302.5	TOP
		200		4.7	1302.5	O.G.
		266		4.4	1302.8	TOP
		272		6.6	1300.6	TOE #3
		274		6.1	1301.1	TOE
		281		4.4	1302.8	TOP
		381		3.8	1303.4	O.G.
	4			7.7	99.5	TOE #1
	12			5.0	1302.2	TOP E/P
	37			6.0	1301.2	E/P
	100			6.5	1300.7	O.G.

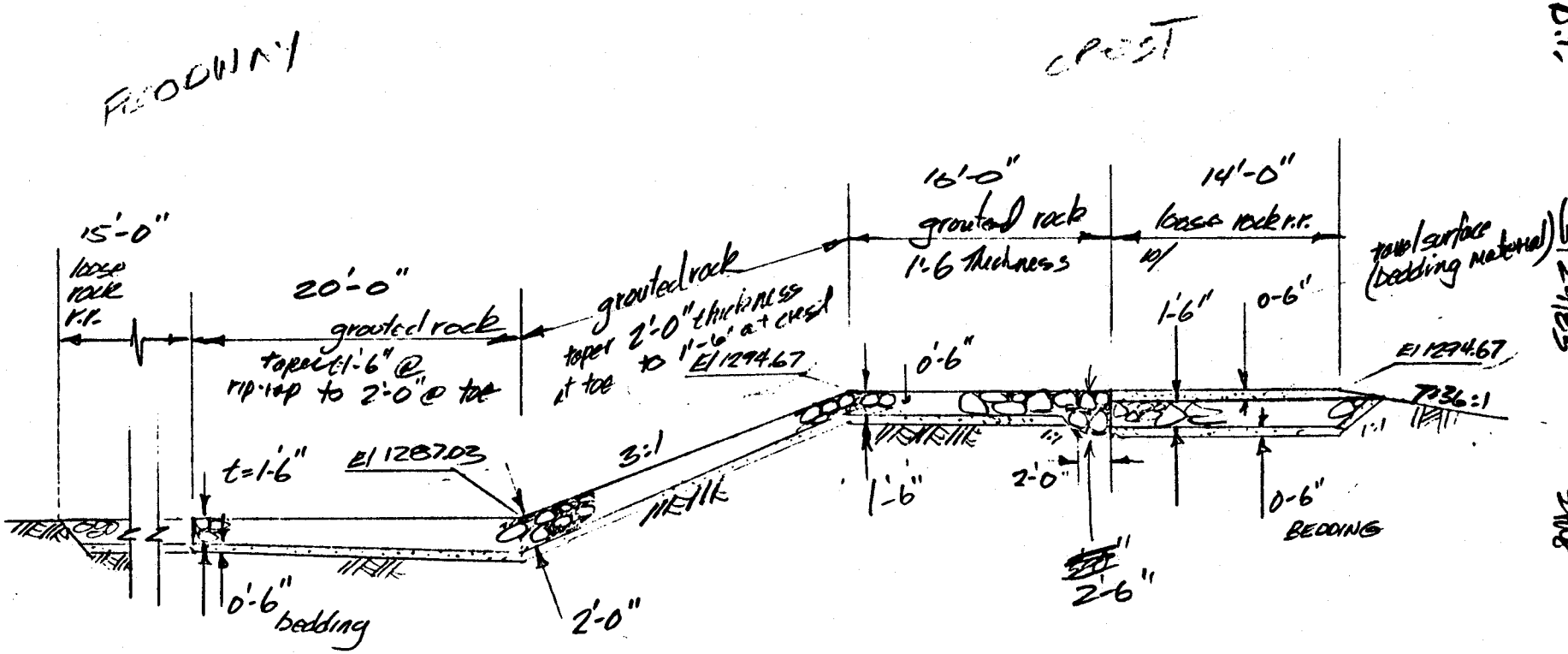
147/240

Continuation - Book 505

DIP CROSSING STATION	ELEVATION
7+25.06	1294.24
7+31.06	1294.24
7+53.56	1294.23
7+58.56	1294.11
7+65.56	1293.88
7+68.56	1293.53
7+71.56	1293.13
7+76.76	1292.44
8+00.00	1230.42
8+50.00	1285.42
8+56.06	1284.82
8+60.00	1284.43
8+65.00	1284.10
8+70.00	1283.87
8+75.00	1283.76
8+77.50	1283.74
10+00.00	1283.74
11+22.50	1283.74
11+25.00	1283.76
11+30.00	1283.87
11+35.00	1284.10
11+40.00	1284.45
11+43.94	1284.81
11+50.00	1287.42
12+00.00	1290.42
12+23.24	1292.44
12+27.50	1293.17
12+31.44	1293.53
12+36.44	1293.88
12+41.44	1294.11
12+46.44	1294.23
12+48.94	1294.24
12+74.94	1294.24



148/20



SECTION ON ℄ SIDE INLET RWCD STA 980+75

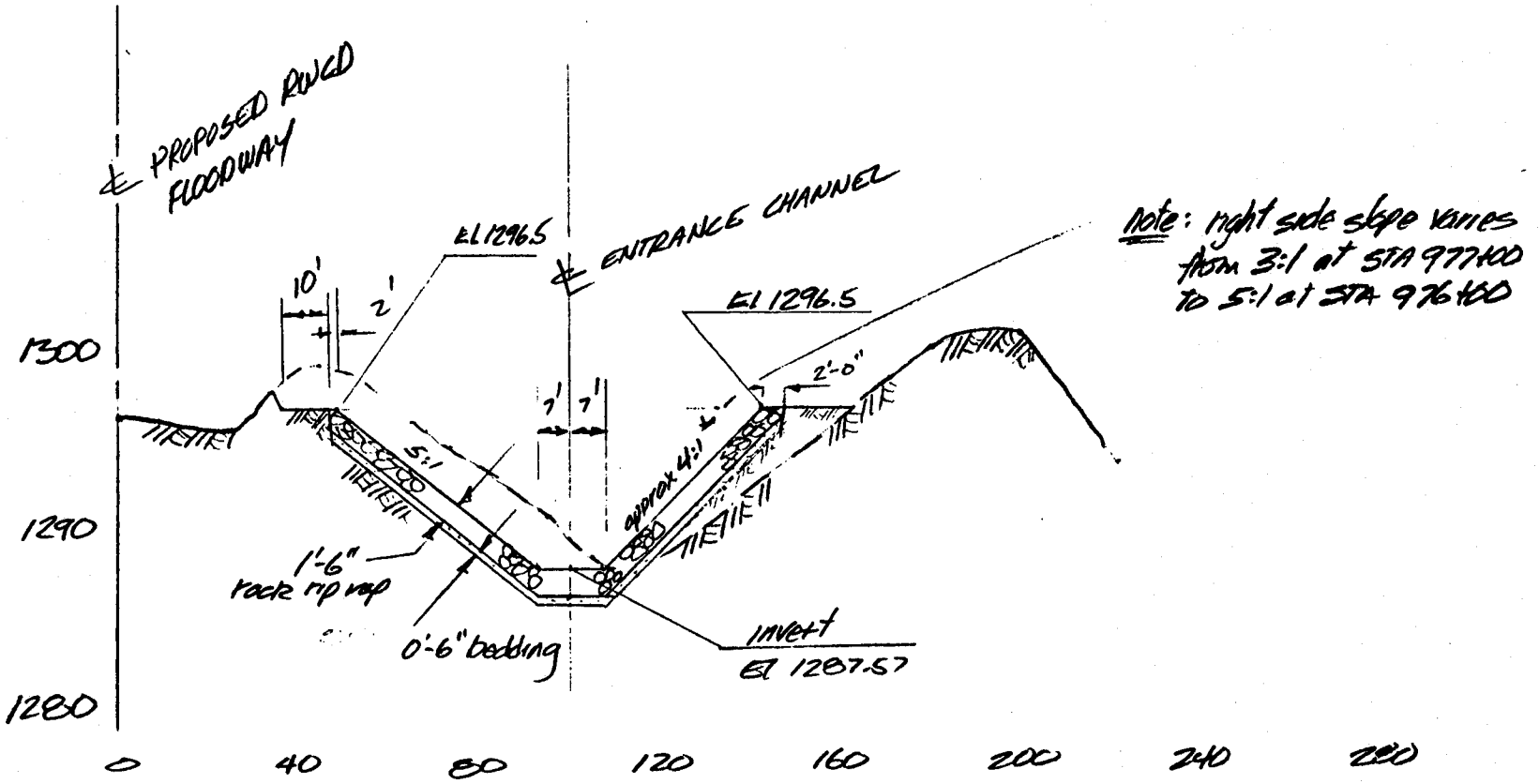
(LOOKING UPSTREAM)

REVERSE FF

AMZ.
D.T.
6/29/83

RWCD REACH 2 EXT
4/83

149



SECTION J-J RWCD ENTRANCE CHANNEL - RWCD STA 976+50

LOOKING DOWNSTREAM

ARIZONA D.T.

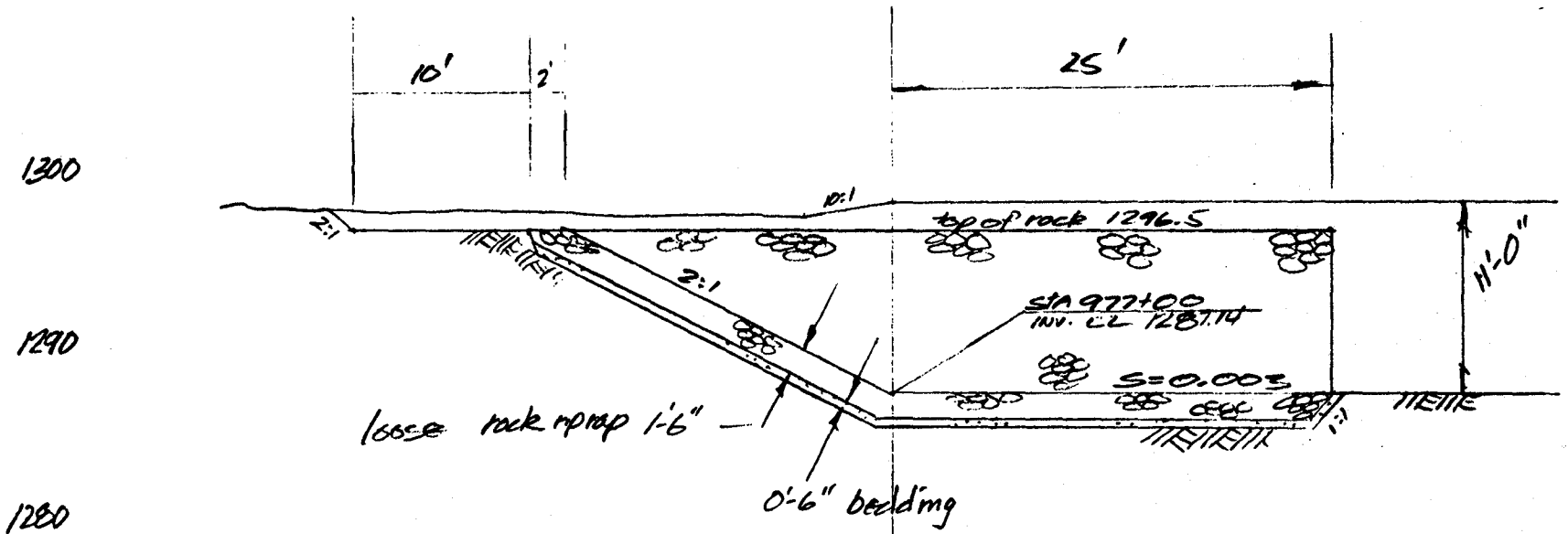
3/30/83

RWCD BERTHA EXT

PMF

A-169

150/210



SECTION K-K RWCD ENTRANCE CHANNEL

ARIZONA D.T.

5/30/83

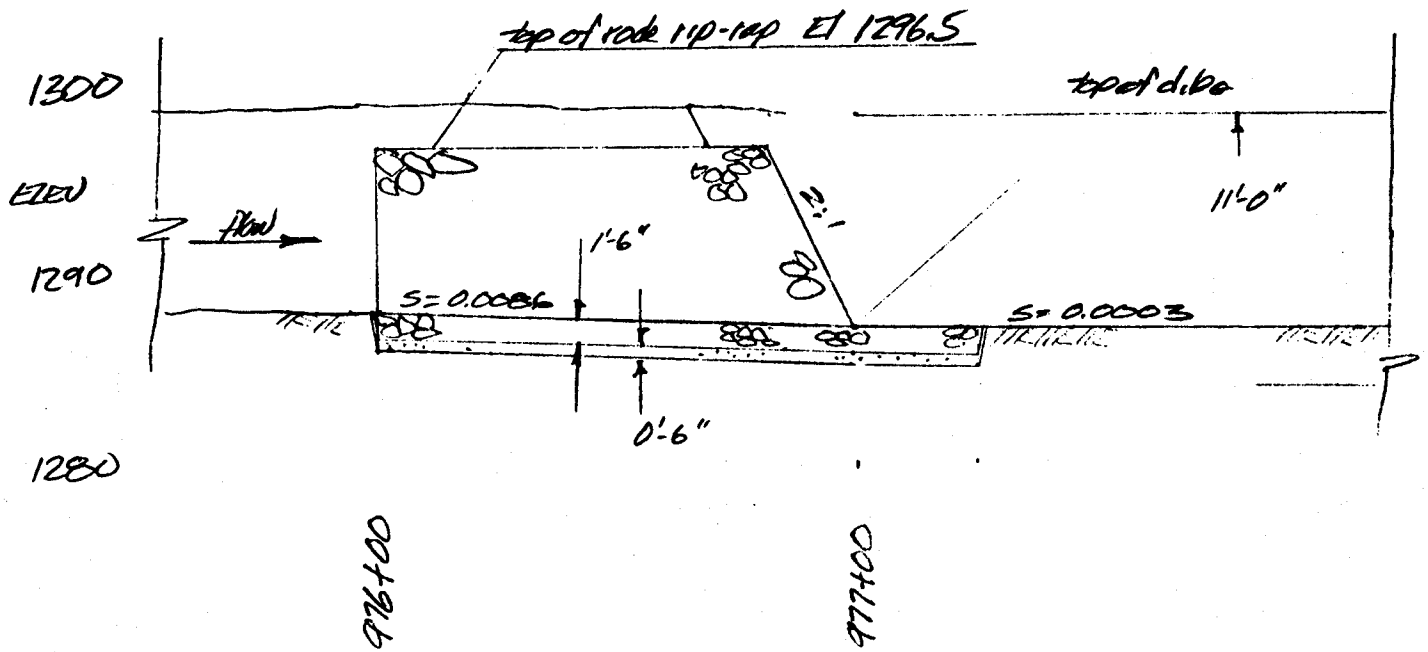
RWCD REACH 2 EXT.

151/210

ARIZONA D.T.

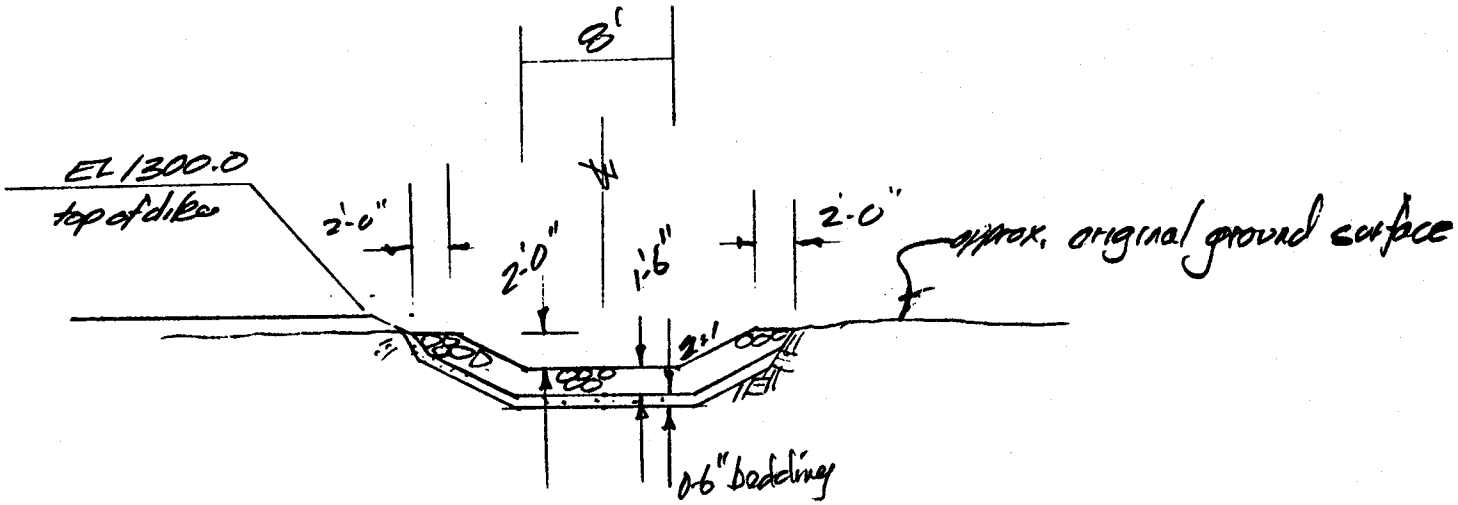
3/29/83

RIVER RESTAURANT

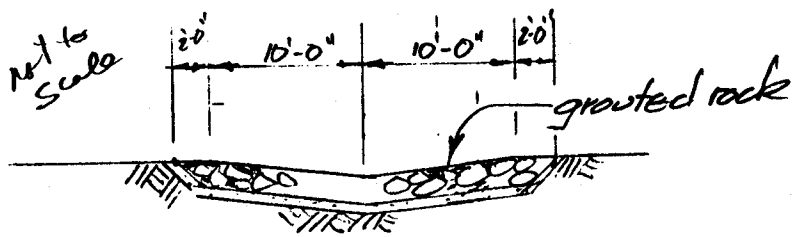


PROFILE ON ℄ RIVER FLOODWAY ENTRANCE CHANNEL

152/210



SECTION E-E ON ℄ SIDE INLET CH #3



SECTION E'-E' ON ℄ SIDE INLET CH. #3

LOOKING DOWNSTREAM

NRIZ.
D.T.

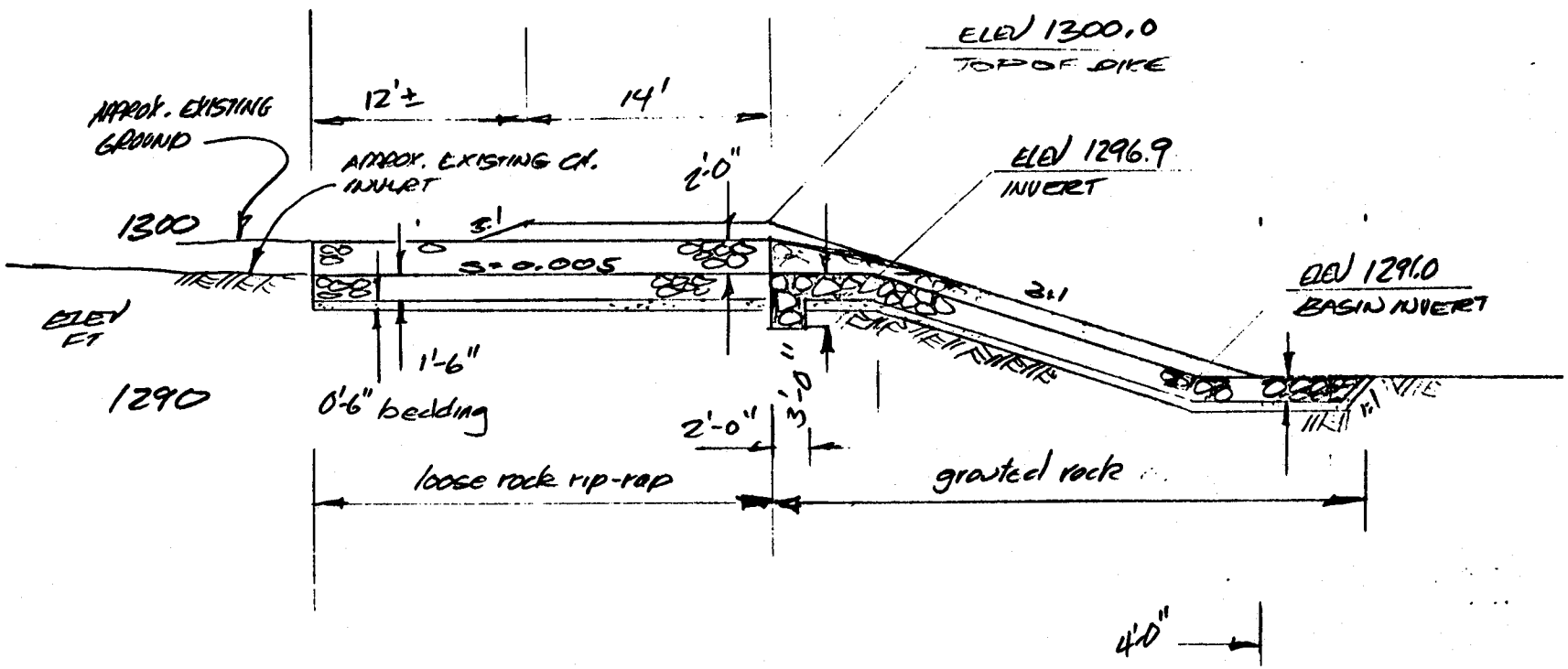
3/30/

PWCD REACH 12 EXT.

Jmb

A/67

153/210



PROFILE ON ℄ CHANNEL #3 INLET TO BASIN

D-D

ADD D.T.

3/30/83

RWCD DETAIL 2 EXT

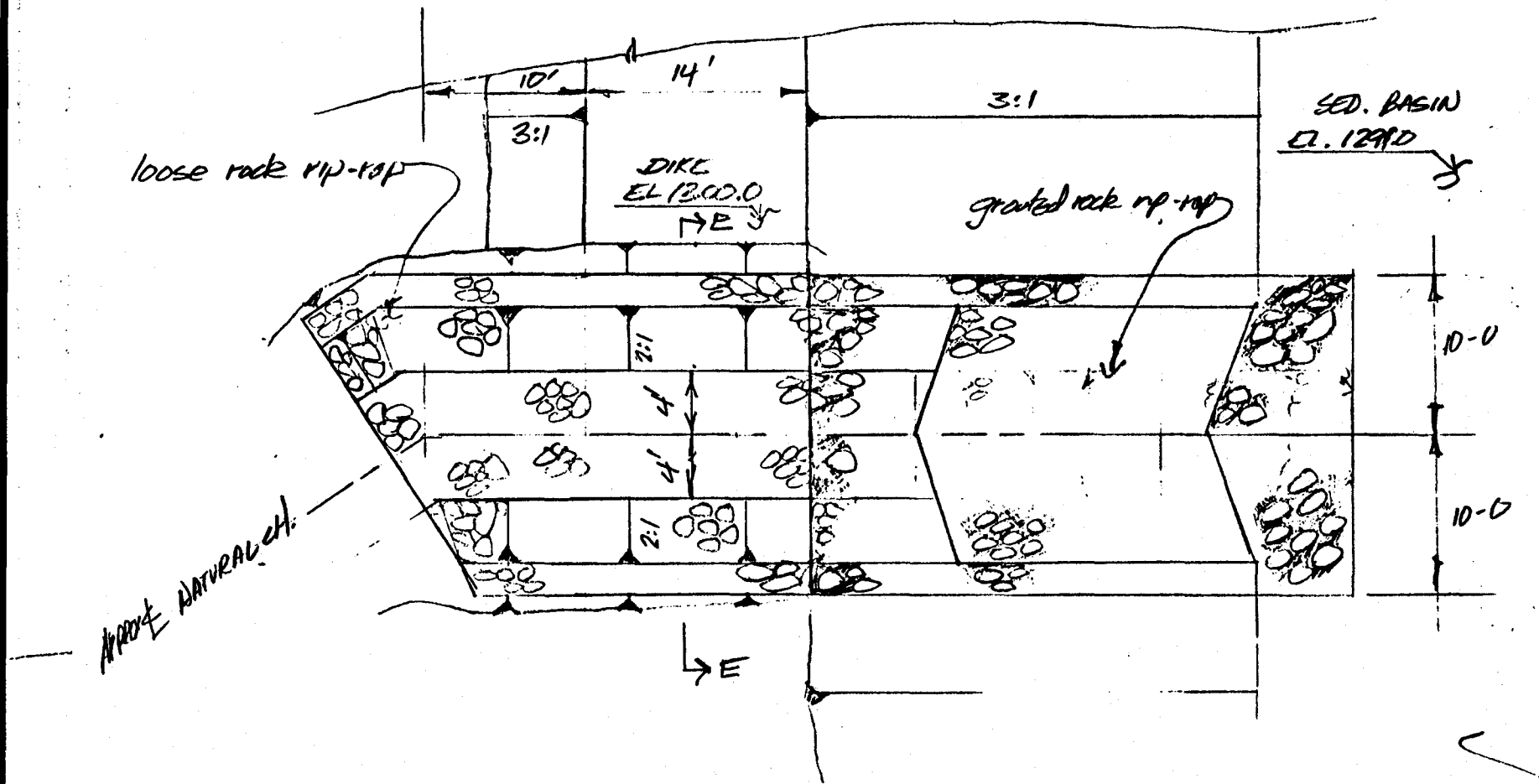
15¢/210

ARIZONA D.T.

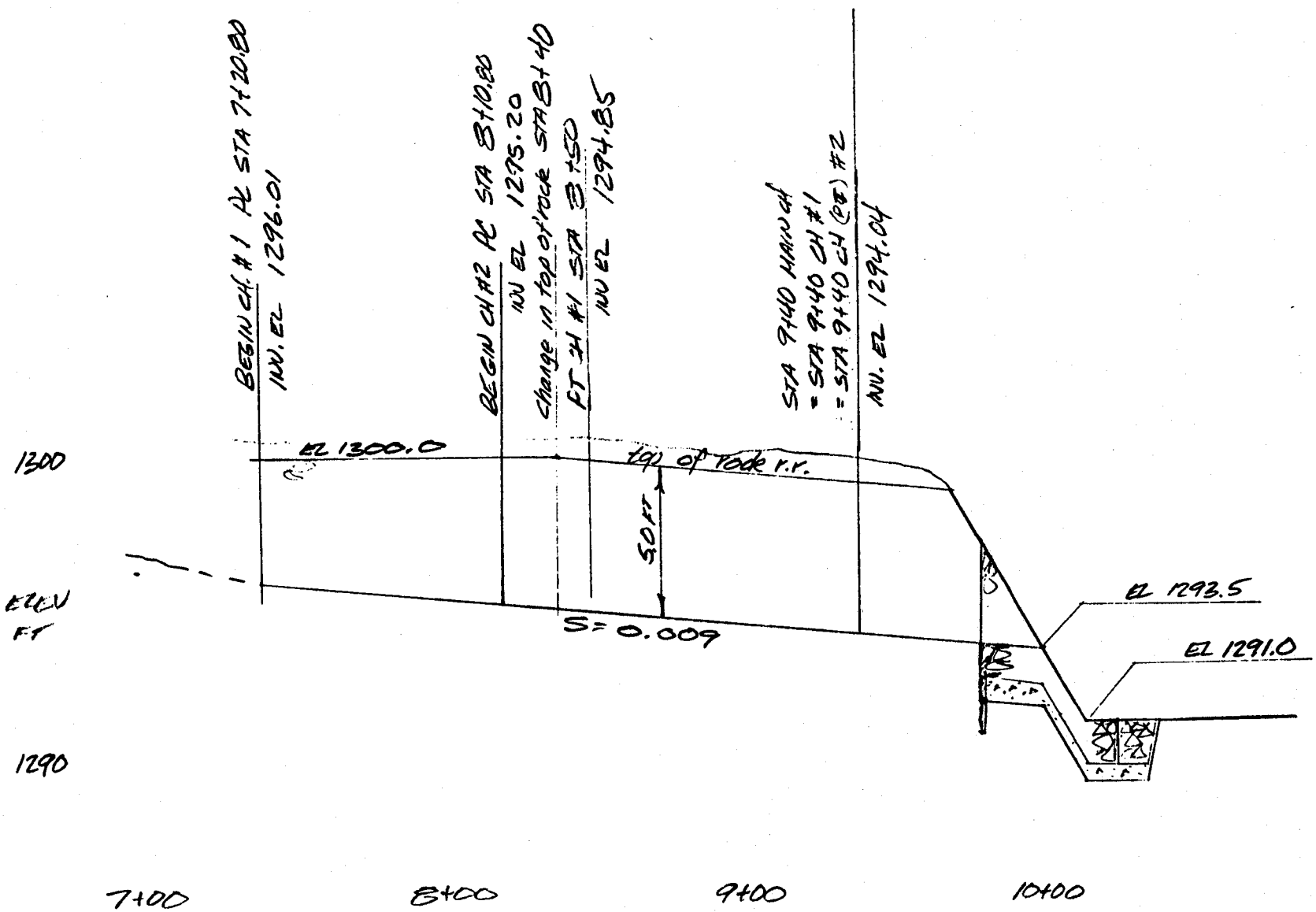
3/29/83

RIVER BEACH 2 EXT.

155/210



PLAN SIDE INLET CHANNEL #3



PROFILE ON ℄ SED. BASIN INLET CH.
MAIN CH, CH #1, CH #2

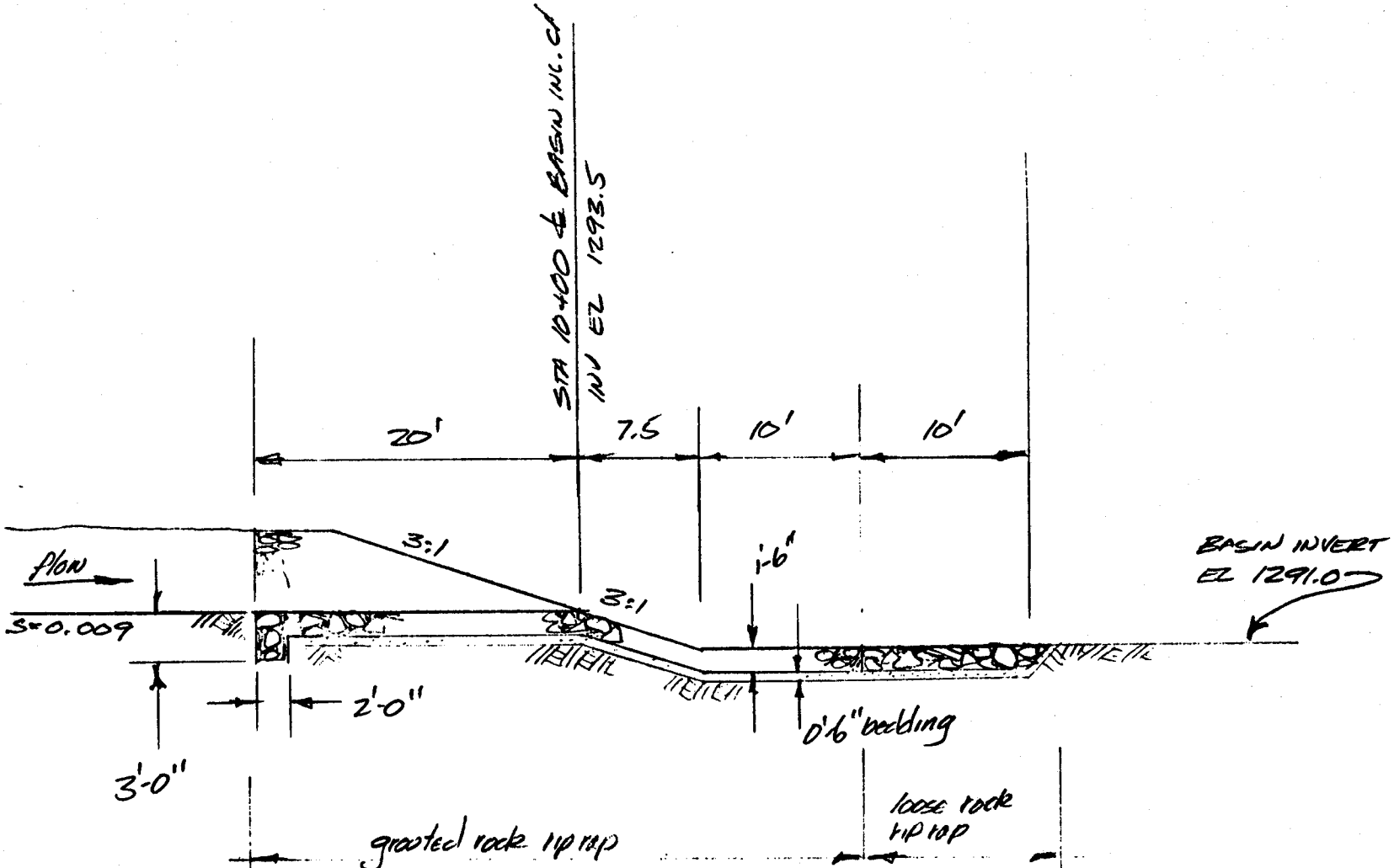
AB12.
O.I.

3/29/03

ROLLO RETAIN. EXT.
JH

A/B

156/210



SECTION ON ℄ BASIN INLET C-C

ADZ.
D.T.

2/29/93

RWCD RIVERSIDE EXT

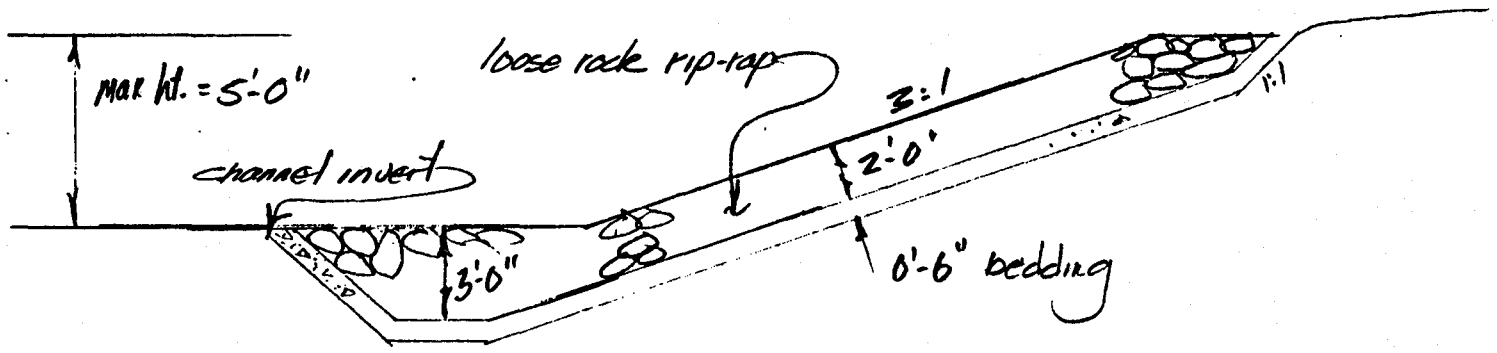
A/93

157/210

AR12
D.T.

2/29/83

RWCD REACH 2 EXT.



TYPICAL SECTION
ROCK RIP-RAP SED BASIN INLET CH.

A-A

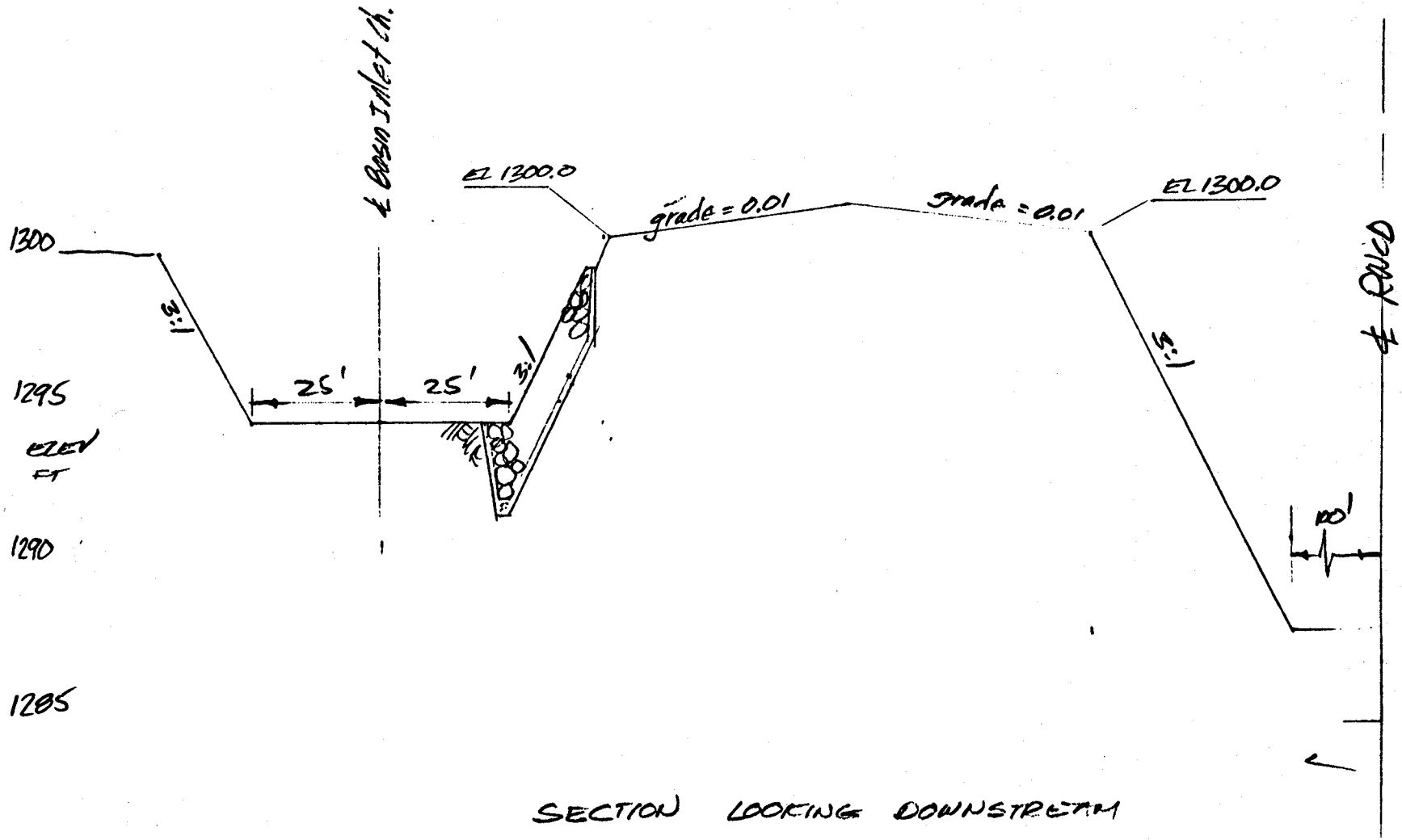
158/210

ARIZ. D.T.

3/29/83

ROUTE REALIGN EXT.

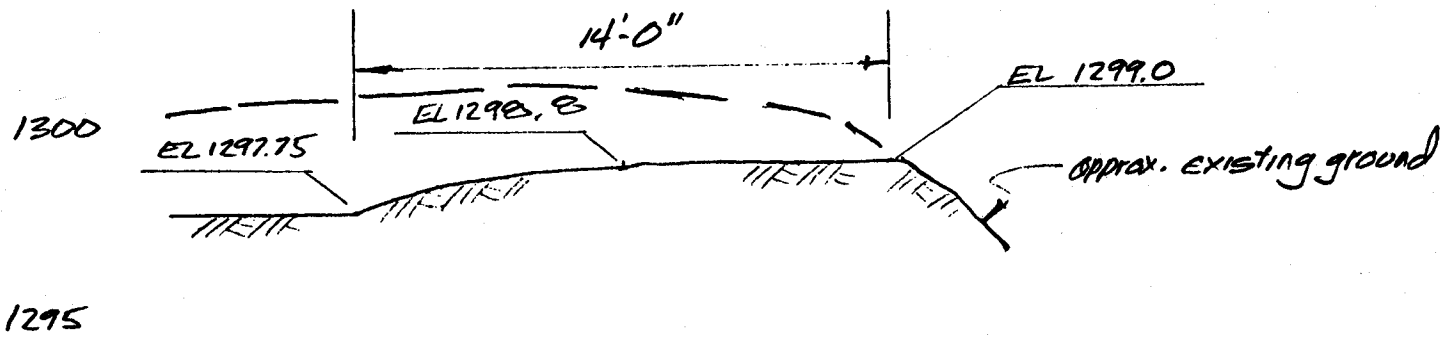
159/210



SECTION LOOKING DOWNSTREAM

STA 9+40 BASIN INLET = STA 778+58.31 RWCD FWY

B-K



SECTION G3 LOOKING DOWNSTREAM

AB12
D.T.

4/11/83

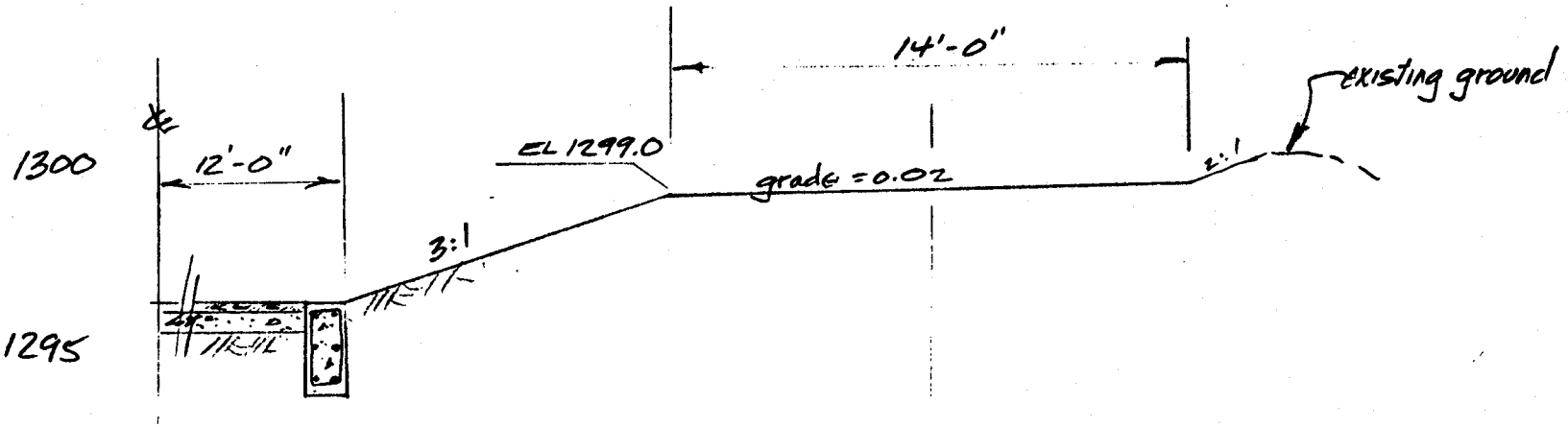
RUKO RETRCH'Z EXT.

1600/210

ARIZ.
D.T.

3/31/63

BUCO REACH 2 EXT.

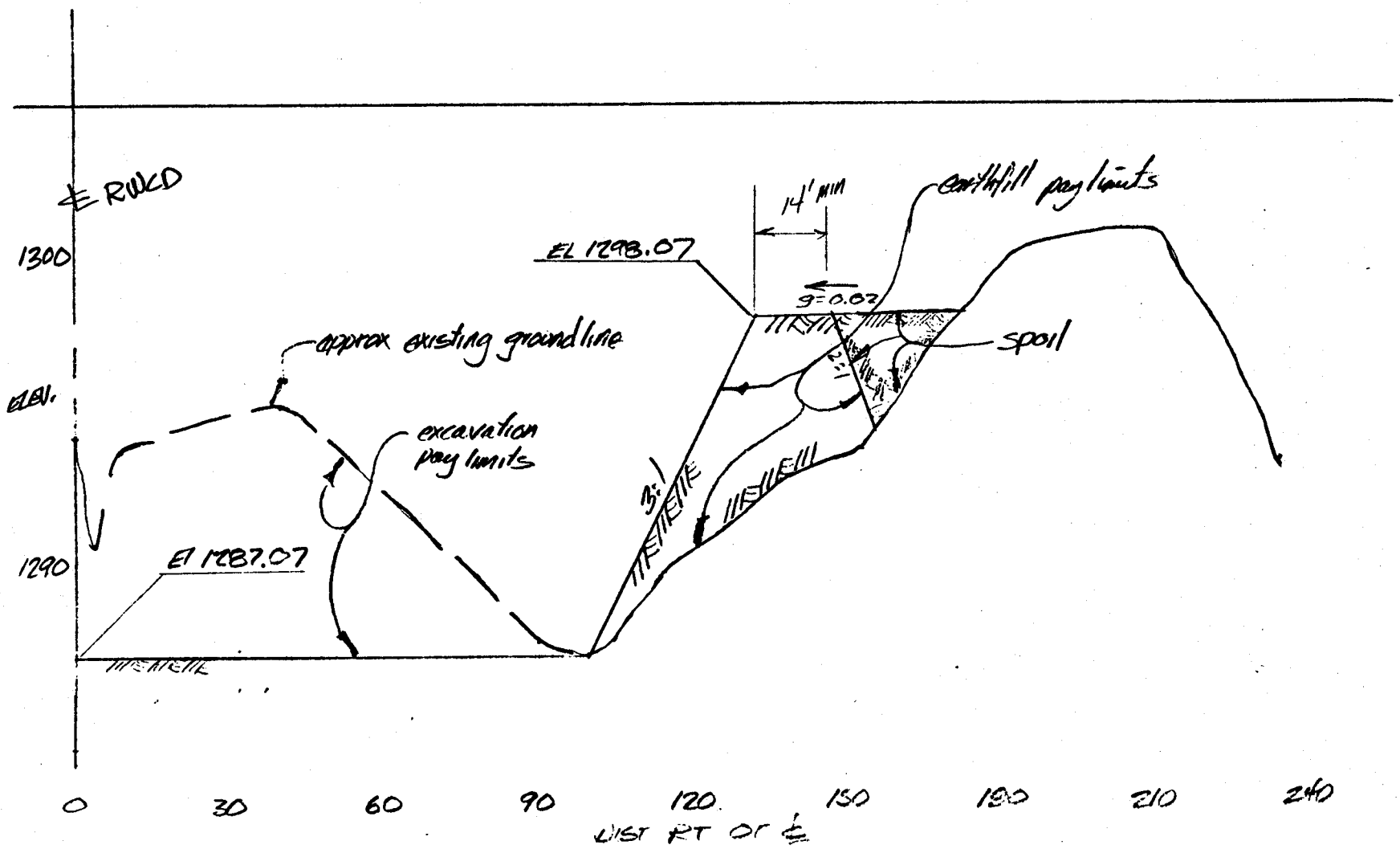


STA 8+11 DIP X-ING

SECTION G2 LOOKING DOWNSTREAM

A163

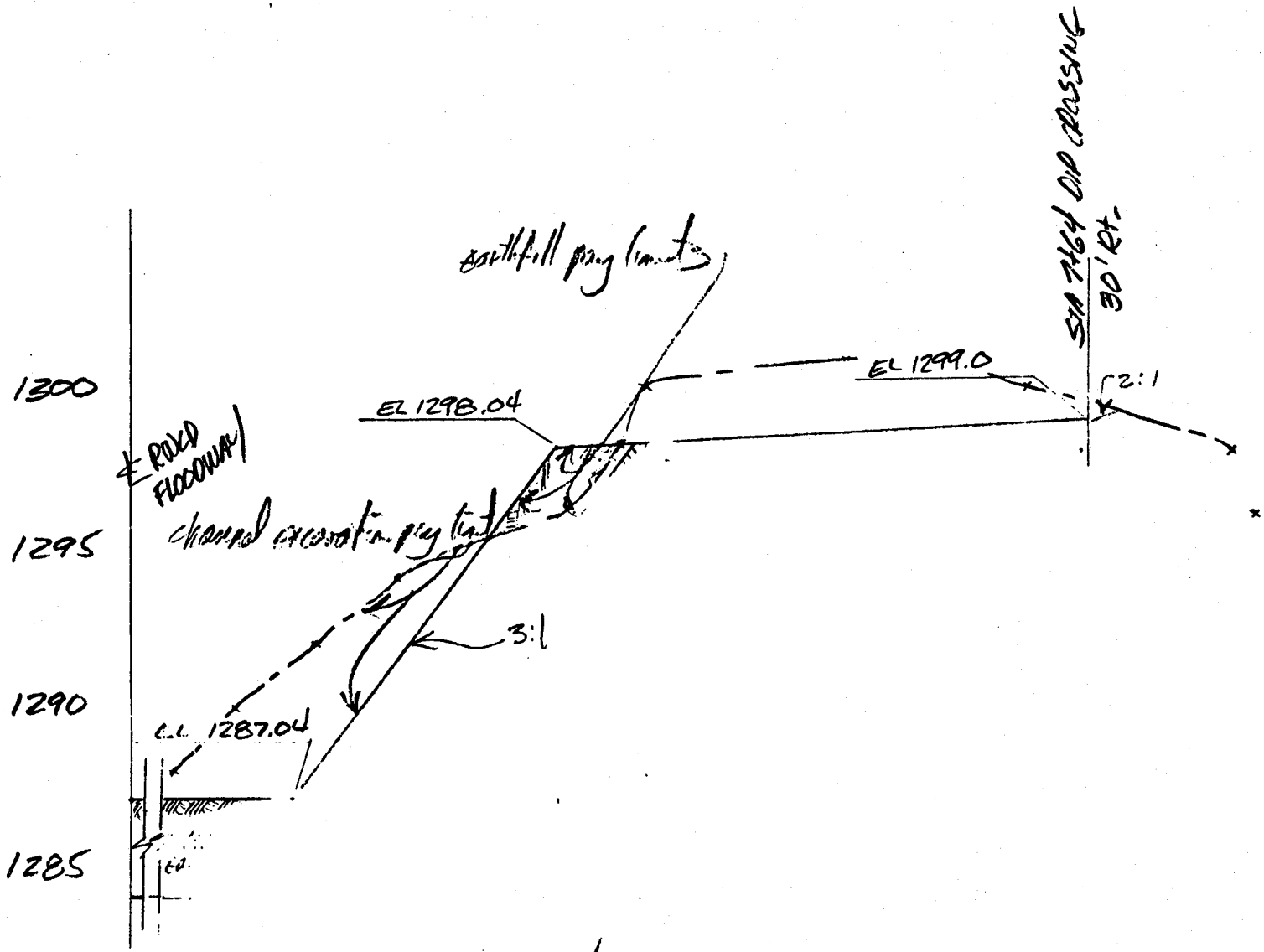
161/210



SECTION G1 STA 979+17 LOOKING DOWNSTREAM

RDE. D. Hardesty 8/20/83 RWCD RETICHE etc. JMF A/B3

162/210



SECTION ~~A-A~~ N

LOOKING DOWNSTREAM

AE12.
O.T.

3/31/03

ROAD RAISE EXT.

1-2/210

QUANTITY COMPUTATIONS

COMPUTATION SHEET
SCS-ENG-522A
Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO. 1978—O 725-733

STATE: AZ
PROJECT: RWLD REACH 2 EXTENSION
BY: MHE
DATE: 4-20-83
CHECKED BY:
DATE:
JOB. NO.
SUBJECT: ESTIMATED QUANTITIES
SHEET ____ OF ____

This summary modifies "Quantities Summary" sheet 164/210 in the design folder for the extension. Quantities calculated in the design folder began @ Sta 982+50. The change reflected below moves the beginning sta to 981+80.

WORK OR MATERIAL	UNIT	QUANTITY
CLEARING & GRUBBING.	ACRES	7
WATER	M. GAL.	5,525
CHANNEL EXCAV, COMMON	C.Y.	28,000
BASIN EXCAV, COMMON	C.Y.	14,510
STRUCTURE EXCAV, COMMON	C.Y	2,332
STRUCTURE BACKFILL	C.Y.	31
EARTHFILL	C.Y.	5,547
DRAINFILL	C.Y	9
24-IN. DIA R/C PIPE, C76 Class III	L.F.	64
LOOSE ROCK RIP-RAP	C.Y.	1664
GROUTED ROCK RIP-RAP	C.Y.	1314
SURVEYS	L.S.	XXXX

COMPUTATION SHEET
SCS-ENG-522A
Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
GPO 1978-0-725-733

STATE	PROJECT		
AZ	RWLD REACH 2 EXTENSION		
BY MHE	DATE 4-20-83	CHECKED BY	DATE	JOB. NO.
SUBJECT Quantities			SHEET ___ OF ___

QUANTIES IN DESIGN FOLDER ARE STA 982+50 NORTH THEREFORE, CALCULATE QUANTITIES OF EXCAVATION & EARTHFILL IN THAT AREA WHICH ARE ALREADY CONSTRUCTED.

EXCAVATION:

Computer quantity calcs run 4/15/83 @ Sta 983+00

Sta 982+50 ~ 1560± ft²

50'

2888 c.y.³

Sta 982+00 ~ 1560± ft²

20'

578 c.y.³

Sta 981+80 ~ 0.± ft²

[3466 c.y.³]

From Quantity Calcs. Quantity = 31,471 c.y.³
subtract = 3466
28,005 c.y.³

Clearing & Grubbing:

Subtract: Station 982+50 to Sta 981+80 @ 330' wide.

$= \frac{70 \times 330}{43,560} = 0.53$ Ac.

Change to [7 Ac]

Earthfill

subtract Sta 982+50 (45 ft²) to Sta 981+80 (29) ft²

$\frac{45+29}{2} \times \frac{70}{27} = 96$ c.y.

Change to [5547 c.y.]

ARIZONA RINCO REACH 2 EXT.

D.T. 4/14/83

QUANTITIES SUMMARY

BID SCHEDULE NO. 1

ITEM	WORK OR MATERIAL	SPEC NO	QUANTITY	UNIT
25	CLEARING & GRUBBING	2	~~8~~ 7 Ac.	ACRES
26	WATER	10	5,525	M GAL
27	CHANNEL EXCAV, COMMON	21	~~31,471~~ 28,000	CY
28	BASIN EXCAV, COMMON	21	14,510	CY
29	STRUCTURE EXCAV. COMMON	21	2,332	CY
30	STRUCTURE BACKFILL	23	31	CY
31	EARTHFILL	23	~~5,643~~ 5,547	CY
32	DRAINFILL	24	9	CY
33	24-IN DIA R/C PIPE, C76CIII	42	64	LF
34	LOOSE ROCK RIP-RAP	61	1664	CY
35	GROUTED ROCK RIP-RAP	62	1314	CY
36	SURVEYS	~~8~~ 401	XXXX	L.S

165/210

ARIZONA D.T. 4/14/83 RWCO REACH 2 EXT

BID SCHEDULE NO. 2 DIP CROSSING

ITEM	WORK OR MATERIAL	SPEC NO	QUANTITY	UNIT
11	DIP CROSSING EXCAV., COM	21	951	C.Y.
12	STRUCTURE EXCAV., COM.	21	427	C.Y.
13	STRUCTURE BACKFILL	23	72	C.Y.
14	CONCRETE CLASS 4000X	31	98	C.Y.
15	CEMENT	31	147	BBL.
16	STEEL REINFORCEMENT	34	10,100	lb.
17	LOOSE ROCK RIP RAP	61	760	C.Y.
18	ASPHALT CONCRETE PVMT	400	1,076	S.Y.

ARIZONA RWCD REACH 2 EXT.
P.T. 4/12/83

QUANTITIES

1. CLEARING AND GROUBBING:

AREA = L x W = [(982+50)-(976+00)] 330'

CHANNEL = 214 500

BASIN ≈ 300 x 400 = 120,000

TOTAL = 334 500 FT²

USE AREA = 7.7 ACRES = 8

2 WATER:

PRORATE FROM AMT PROVIDED FOR REACH 2:

L = 121650 - 98100 = 23 550 LF.

$\frac{GAL}{LF} = \frac{200\,000 \text{ MGAL}}{23\,550 \text{ LF}} = 8.5 \text{ MGAL/FT}$

L = 98250 - 97600 = 650

H_2O = 8.5 M GAL/FT (650) = 5525 M GAL

PRORATE ON BASIS OF CLEARING & GROUBBING AREA:

$H_2O = 200{,}000 \text{ M Gal} \left(\frac{7.7}{169}\right) = 9112 \text{ M gal}$

USE 8000 M-Gal

ARIZONA D.T.

DWCD REACH 2 EXT.

4/13/83

STRUCTURE EXCAVATION

OUTLET PIPE $V = \frac{60\ (7(4) + 4^2)}{27} = 98$ cy

BOX $V = \frac{17 \times 17 \times 1 + (9 \times 9) 1.2}{27} = 14$ cy

INLET STRUCTURE

$V =$ ROCK + GROUTED ROCK

$= \frac{11328 + 26170 + 7406}{27}$

$= 1663$ cy

BASIN INLET $V =$ ROCK + GROUTED ROCK

$= 294 + 139$ cy $= 433$ cy

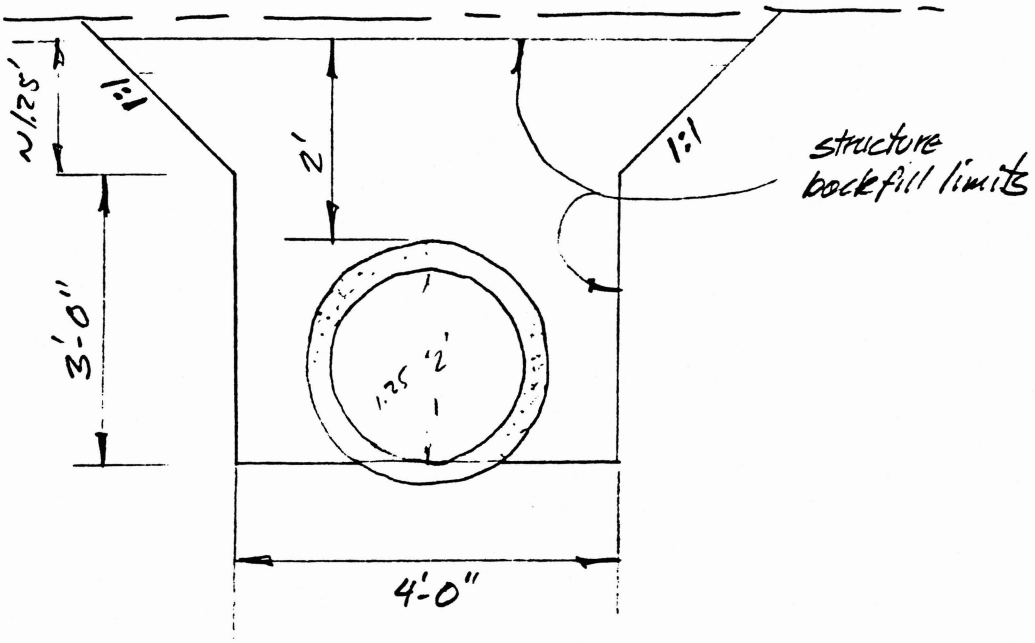
SIDE INLET CH#3

$V = \frac{6(20)2 + 22(20)2.5 + 72(28)}{27} = 124$ cy

→ TOTAL 2332 cy

ARIZONA D.T. 4/13/83 RUXD REACH 2 EXT

STRUCTURE BACKFILL



$$A \approx 3 \times 4 + 1.25^2 + 4(1.25) - 1.25^2\pi$$

$$= 12 + 1.56 + 5 - 4.91$$

$$\underline{\underline{A = 13.65\ ft^2}}$$

$$V \approx \frac{\overset{64}{\cancel{60}}(13.65)}{27} = \underline{\underline{\overset{32}{\cancel{31}}\ cy}}$$

ARIZONA
D.T.

4/13/83

RWCD REACH 2 EXT

DRAIN FILL (AROUND INLET BOX)

$$VOL \approx \left(12 \times 14 - 4.33 \times 4.33\right)\frac{1.5}{27} = \underline{\cancel{8.3}\ 9\ cy}$$

ROCK RIP-RAP (AROUND INLET BOX)

$$V \approx \left(15 \times 21 - 4.33^2\right)\frac{1.5}{27} = \underline{11\ cy}$$

ARIZ
D. Theodoray 4/14/83
QUANTITIES

RWCD REACH 2 EXT.

EXCAVATION SUMMARY:

CHANNEL EXCAVATION, COMMON:

LOCATION	VOL (CY)
RWCD (976+00 to 982+50)	31 471 cy.

BASIN EXCAVATION, COMMON

LOCATION	VOL
BASIN	13 093
BASIN ABOVE 9+00	1417
TOTAL	14 510 cy

ARIZONA
O. Thackeray 4/14/83

RWCD REACH 2 EXT

171/210

EXCAVATION, BASIN, INLET CHANNELS (ABOVE 9400)

CHANNEL #1	1028
CHANNEL #2	389
TOTAL	1417 cy

ARIZONA D.T. 4/12/83 RWCD REACH 2 EXT

BASIN EXCAVATION

STA 9+00 TO BEGINNING OF CONSTRUCTION:

SECTIONS

CHANNEL #1

STA	EL/℄ DIST		
7+20.80	98/-20	93/16	
7+50	98/-18	98/23	
8+00	1300/42	98/6	98/63
8+50	1300/25	98/46	
9+00	96/-14	94/12.5	96/35

CHANNEL #2

STA	EL/℄ DIST					
8+10.80	98/-23	96/-16	96/10	98/13	1300/17	1300/29
8+50	98/-20	96/-17	96/17	98/22	1300/24	1300/33
9+00	98/-4	96/4	96/20 END			

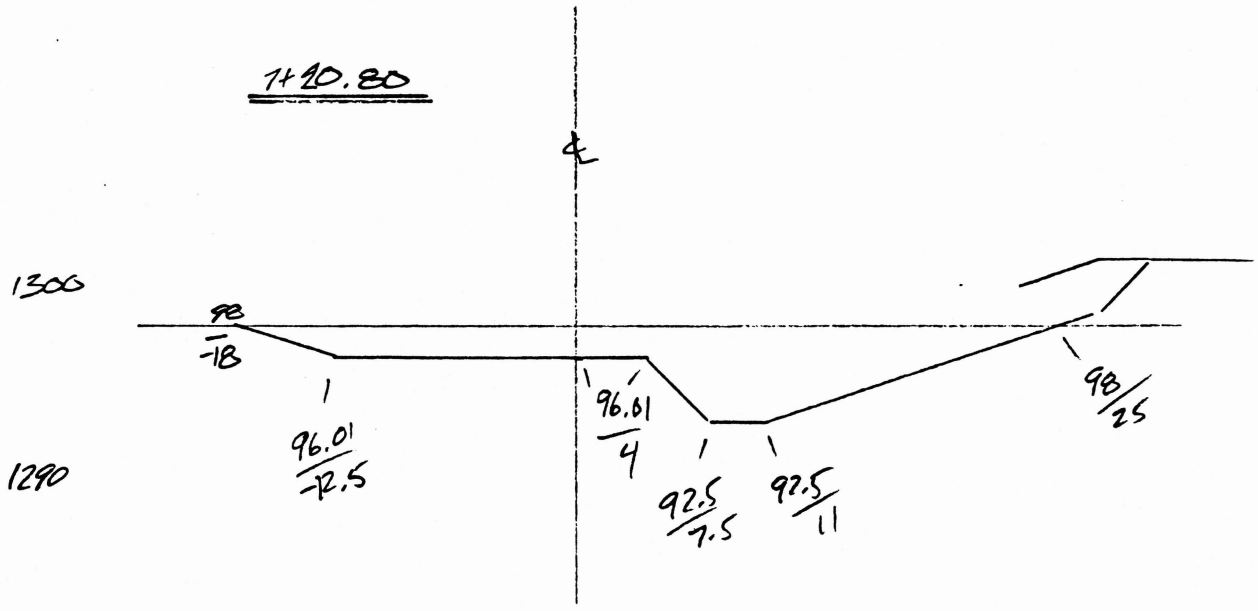
ARIZONA
D.T.

4/13/83

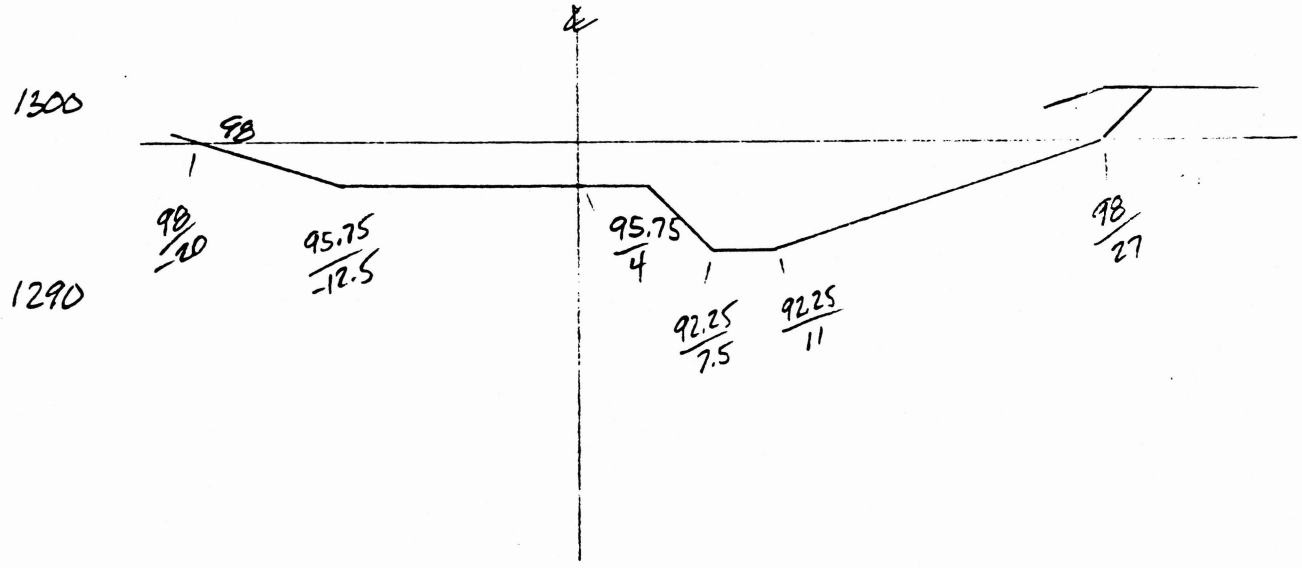
RUNCO BEACH EXT

CHANNEL #1

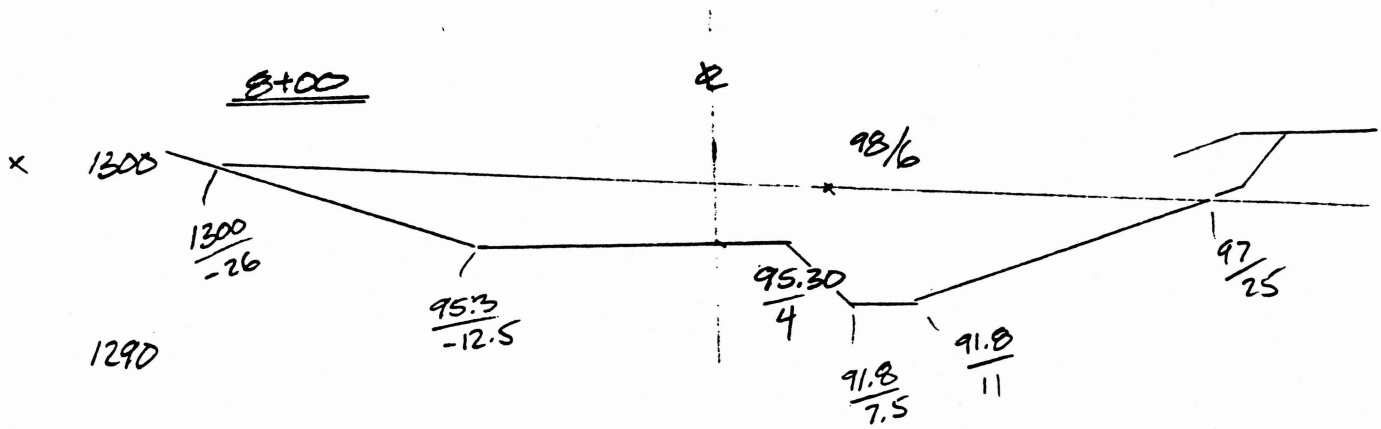
7+20.80

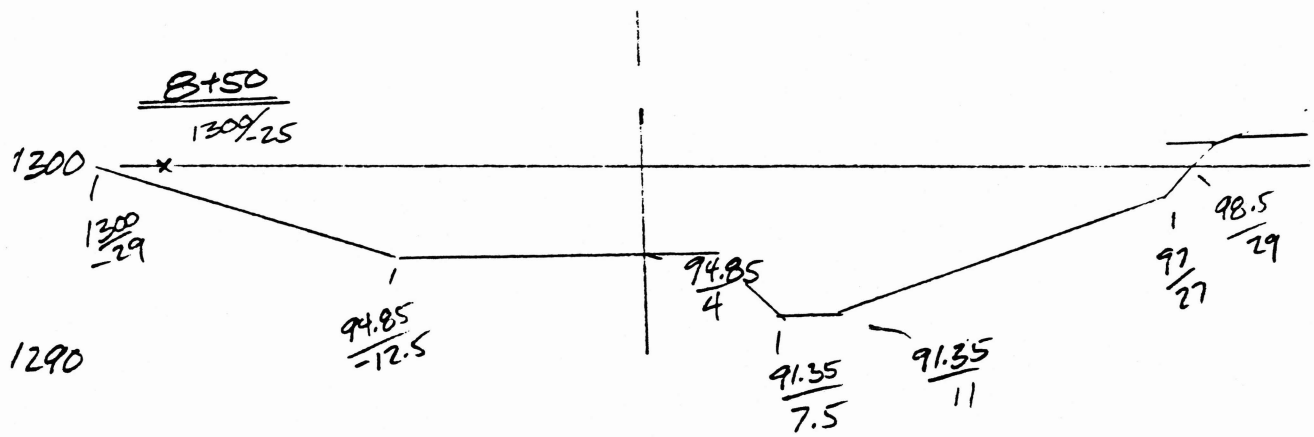


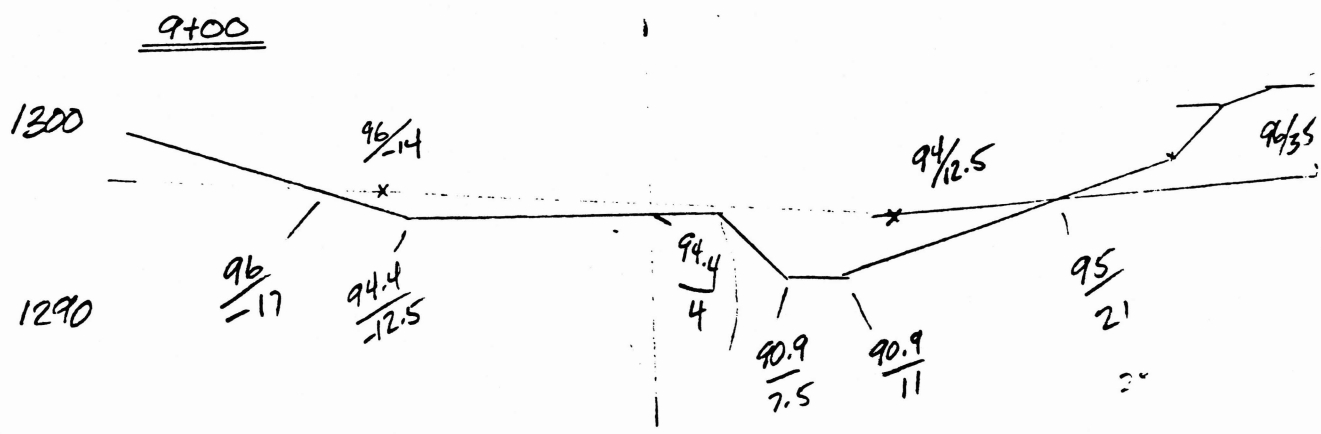
7+50



ARIZONA RWCD REACH 2 EXT
D. Thackeray 4/14/83





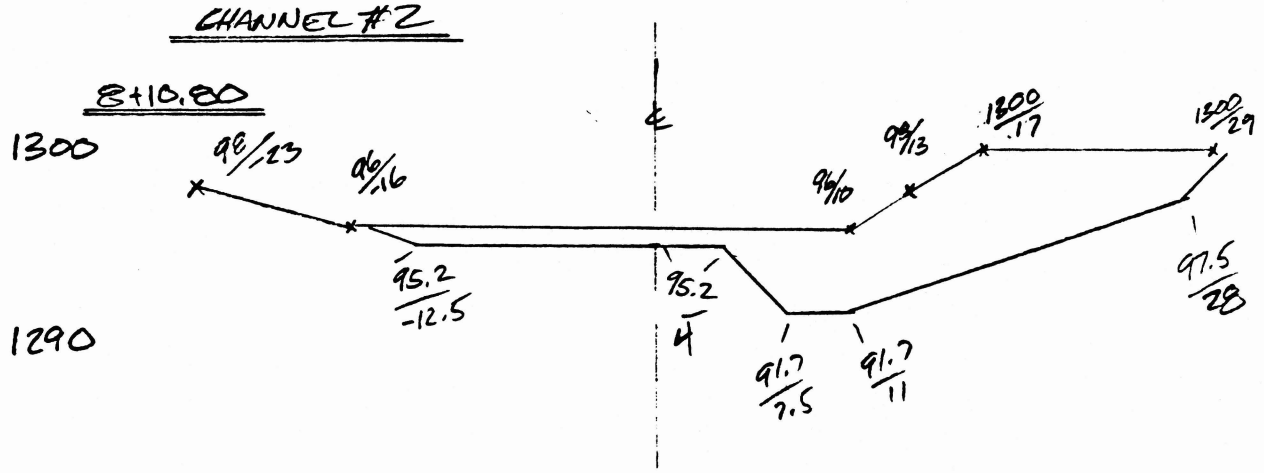


ARIZONA RWCD REACH 2 EXT. 175/210

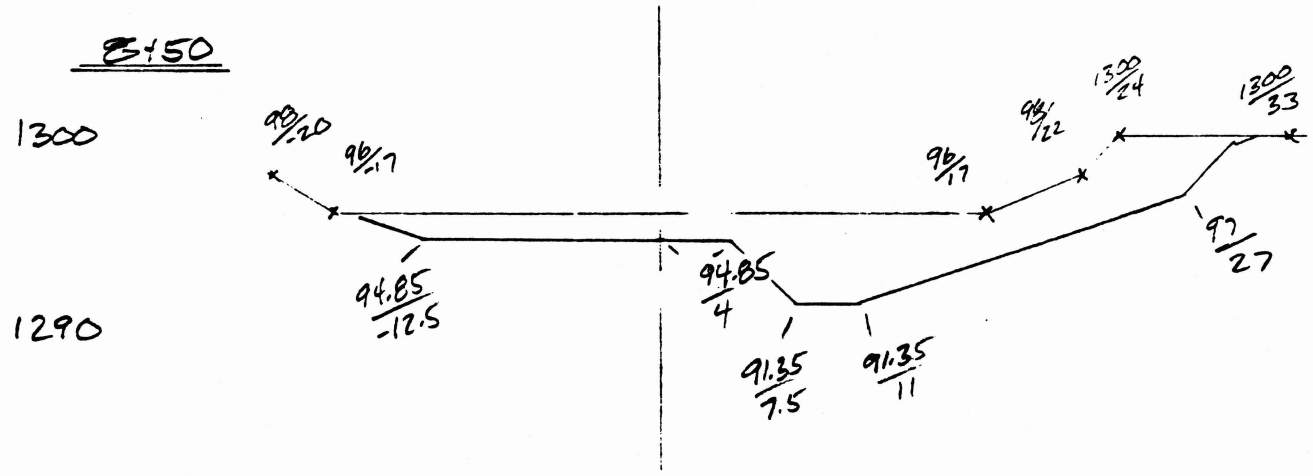
D.T. 4/14/83

CHANNEL #2

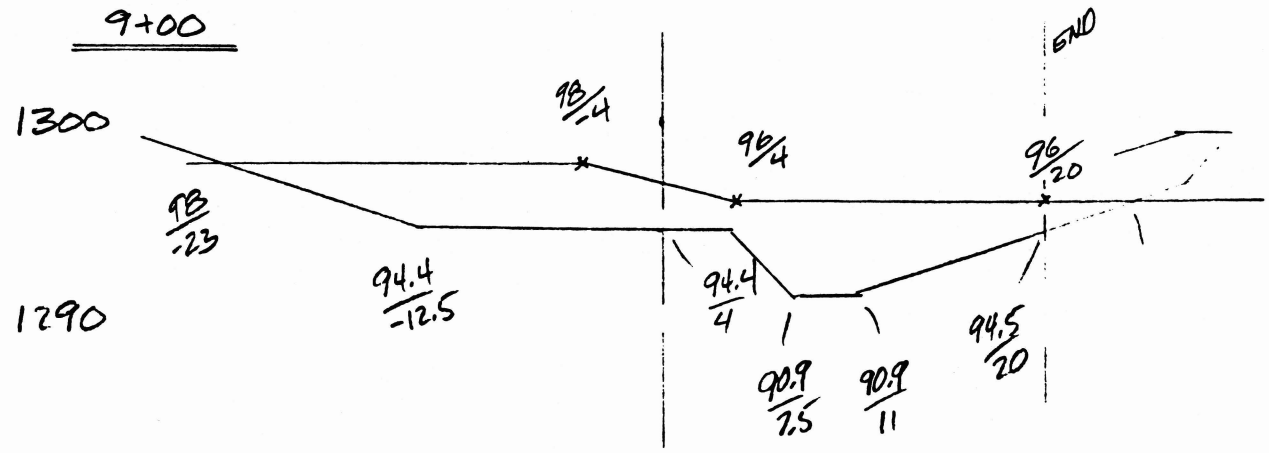
8+10.80



8+50



9+00

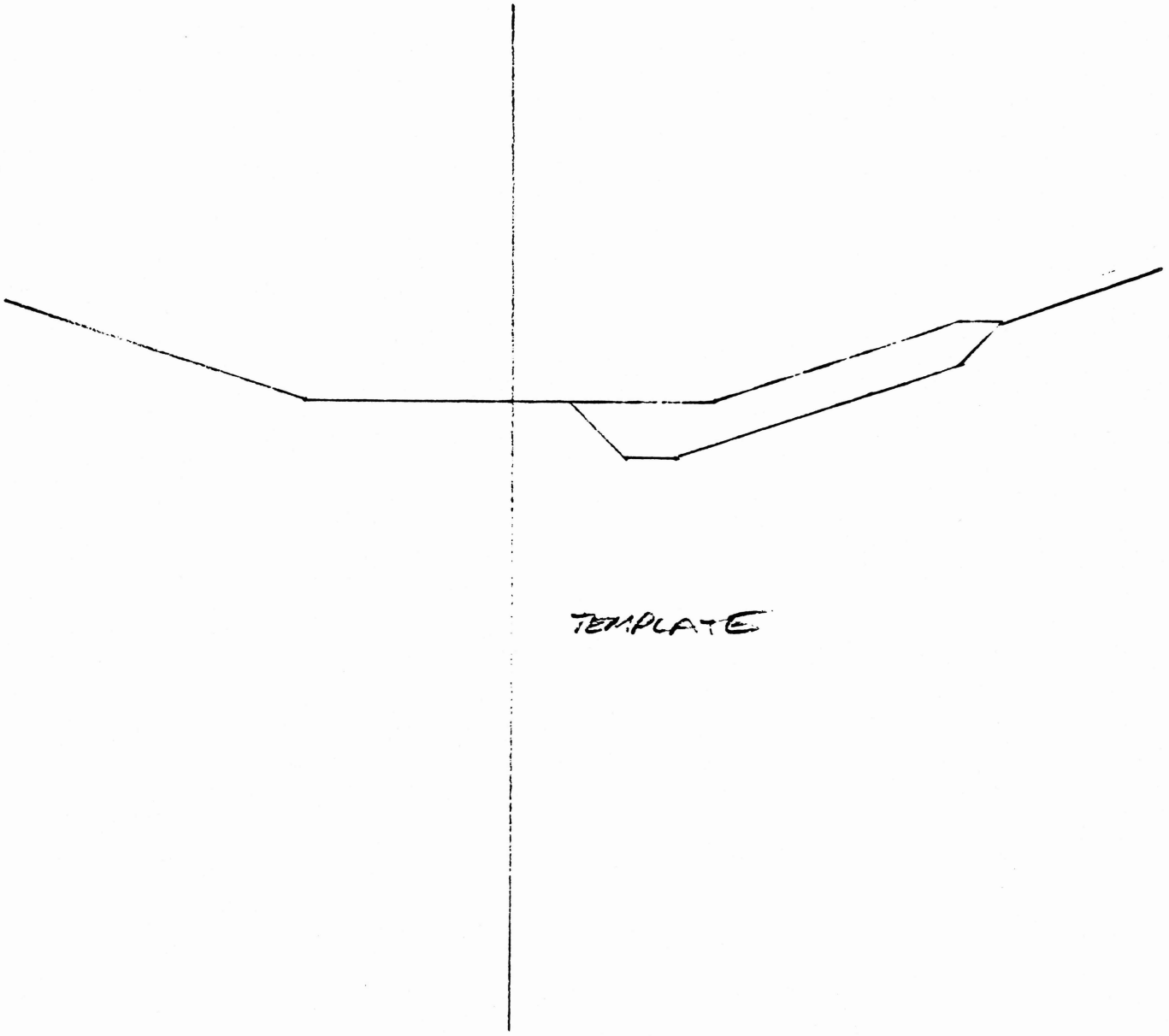


ARIZONA
D.T.

4/14/83

RWCO REACH 2 EXT

176/210



ARIZONA RWCD REACH 2 EXT
D. Thackeray 4/14/83
QUANTITIES EXCAV. BASIN

CHANNEL #1

	96.01	***
	-12.50	***
	98.00	***
	-18.00	***
	98.00	***
	25.00	***
	92.50	***
	11.00	***
	92.50	***
	7.50	***
	96.01	***
	4.00	***
	96.01	***
	-12.50	***
7+20.80	1.00	***
L	0.00	T
A	109.17	Z
ΔV	0.00	Y
V	0.00	X

	95.75	***
	-12.50	***
	98.00	***
	-20.00	***
	98.00	***
	27.00	***
	92.25	***
	11.00	***
	92.25	***
	7.50	***
	95.75	***
	4.00	***
	95.75	***
	-12.50	***
7+50	2.00	***
L	29.20	T
A	125.69	Z
ΔV	126.99	Y
V	126.99	X

	95.30	***
	-12.50	***
	1300.00	***
	-26.00	***
	95.30	***
	-12.50	***
	100.00	***
	-26.00	***
	98.00	***
	6.00	***
	97.00	***
	25.00	***
	91.80	***
	11.00	***
	91.80	***
	7.50	***
	95.30	***
	4.00	***
	95.30	***
	-12.50	***
	100.00	***
	-26.00	***
	95.30	***
	-12.50	***
8+00	3.00	***
L	50.00	T
A	159.45	Z
ΔV	264.02	Y
V	391.01	X

ARIZONA RWCD REACH 2 EXT 178/210

D.T. 4/14/83

QUANTITIES EXCAV. BASIN

CHANNEL #1

	94.85	***		94.40	***
	-12.50	***		-12.50	***
	100.00	***		96.00	***
	-29.00	***		-17.00	***
	100.00	***		96.00	***
	-25.00	***		-14.00	***
	98.50	***		94.00	***
	29.00	***		12.50	***
	97.00	***		95.00	***
	27.00	***		21.00	***
	91.35	***		90.90	***
	11.00	***		11.00	***
	91.35	***		90.90	***
	7.50	***		7.50	***
	94.85	***		94.40	***
	4.00	***		4.00	***
	94.85	***		94.40	***
	-12.50	***		-12.50	***
8+50	4.00	***	9+00	5.00	***
L	50.00	T	L	50.00	T
A	239.09	Z	A	50.83	Z
ΔV	369.02	Y	ΔV	268.44	Y
V	760.03	X	V	1026.46	X

ARIZONA
D. Thackeray 4/14/03
QUANTITIES

RWCD BENCH 2 EXT

EXCAV, BASIN

179/210

CHANNEL #2

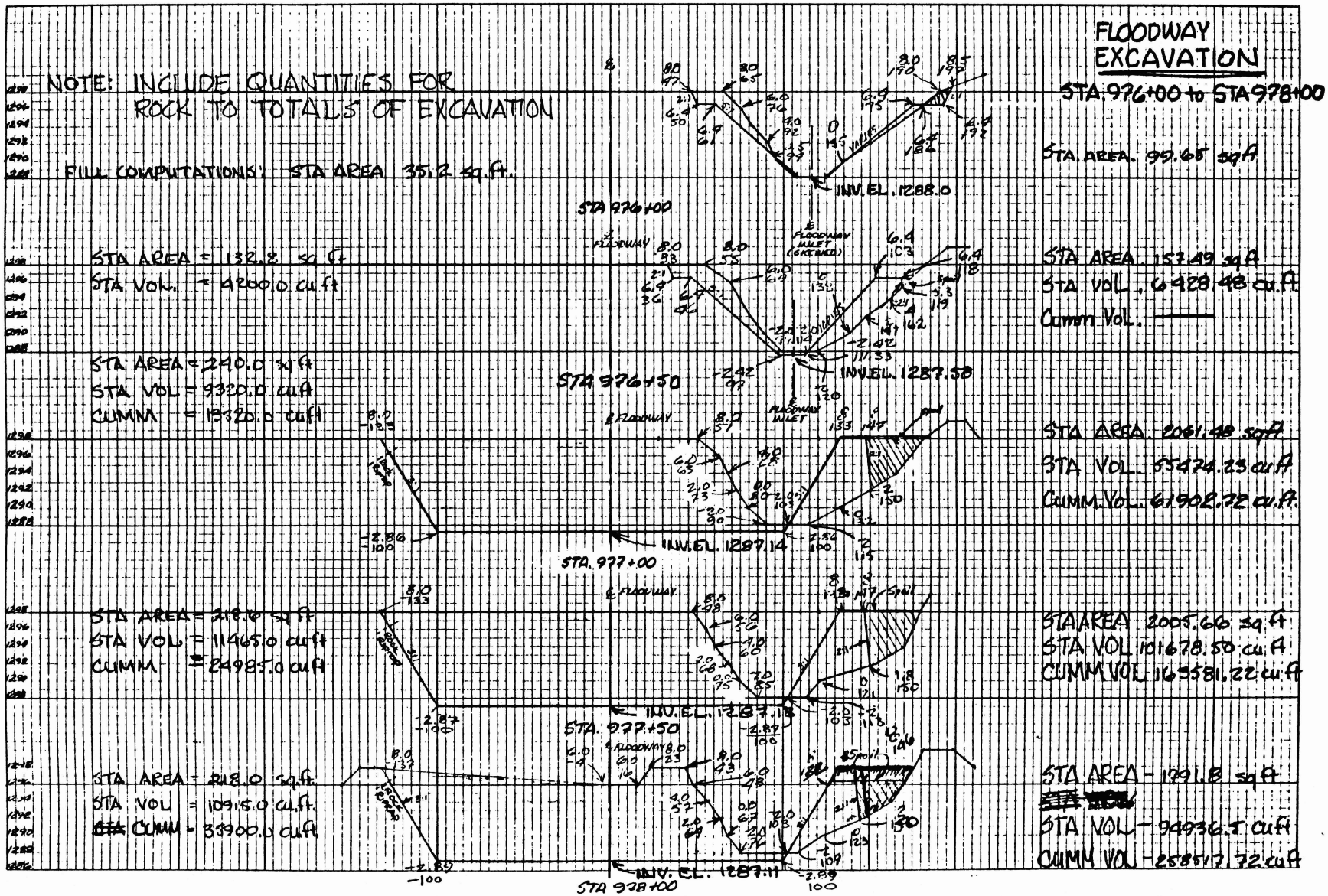
	95.20	***		94.85	***		94.40	***
	-12.50	***		-12.50	***		-12.50	***
	96.00	***		96.00	***		98.00	***
	-16.00	***		-17.00	***		-23.00	***
	96.00	***		96.00	***		98.00	***
	10.00	***		17.00	***		-4.00	***
	98.00	***		98.00	***		96.00	***
	13.00	***		22.00	***		4.00	***
	100.00	***		100.00	***		96.00	***
	29.00	***		24.00	***		20.00	***
	98.00	***		100.00	***		94.50	***
	13.00	***		33.00	***		20.00	***
	100.00	***		97.00	***		90.90	***
	17.00	***		27.00	***		11.00	***
	100.00	***		91.35	***		90.90	***
	29.00	***		11.00	***		7.50	***
	97.50	***		91.35	***		94.40	***
	28.00	***		7.50	***		4.00	***
	91.70	***		94.85	***		94.40	***
	11.00	***		4.00	***		-12.50	***
	91.70	***		94.85	***	9+00	3.00	***
	7.50	***		-12.50	***			
						L	50.00	T
	95.20	***	8+50	2.00	***	A	129.58	Z
	4.00	***				ΔV	221.08	Y
			L	39.20	T	Vg	389.36	X
	95.20	***	A	109.19	Z			
	-12.50	***	ΔV	168.28	Y			
			Vg	168.26	X			
8+10.80	1.00	***						
L	0.00	T						
A	122.63	Z						
ΔV	0.00	Y						
V	0.00	X						

FLOODWAY EXCAVATION

STA. 976+00 to STA 978+00

NOTE: INCLUDE QUANTITIES FOR ROCK TO TOTALS OF EXCAVATION

FILL COMPUTATIONS: STA AREA 35.2 sq.ft.



STA AREA = 132.8 sq ft
STA VOL. = 4200.0 cu ft

STA AREA = 240.0 sq ft
STA VOL = 9320.0 cu ft
CUMM = 13520.0 cu ft

STA AREA = 218.0 sq ft
STA VOL = 11465.0 cu ft
CUMM = 24985.0 cu ft

STA AREA = 218.0 sq.ft.
STA VOL = 10915.0 cu.ft.
~~STA~~ CUMM = 35900.0 cu ft

STA. AREA. 95.65 sq ft

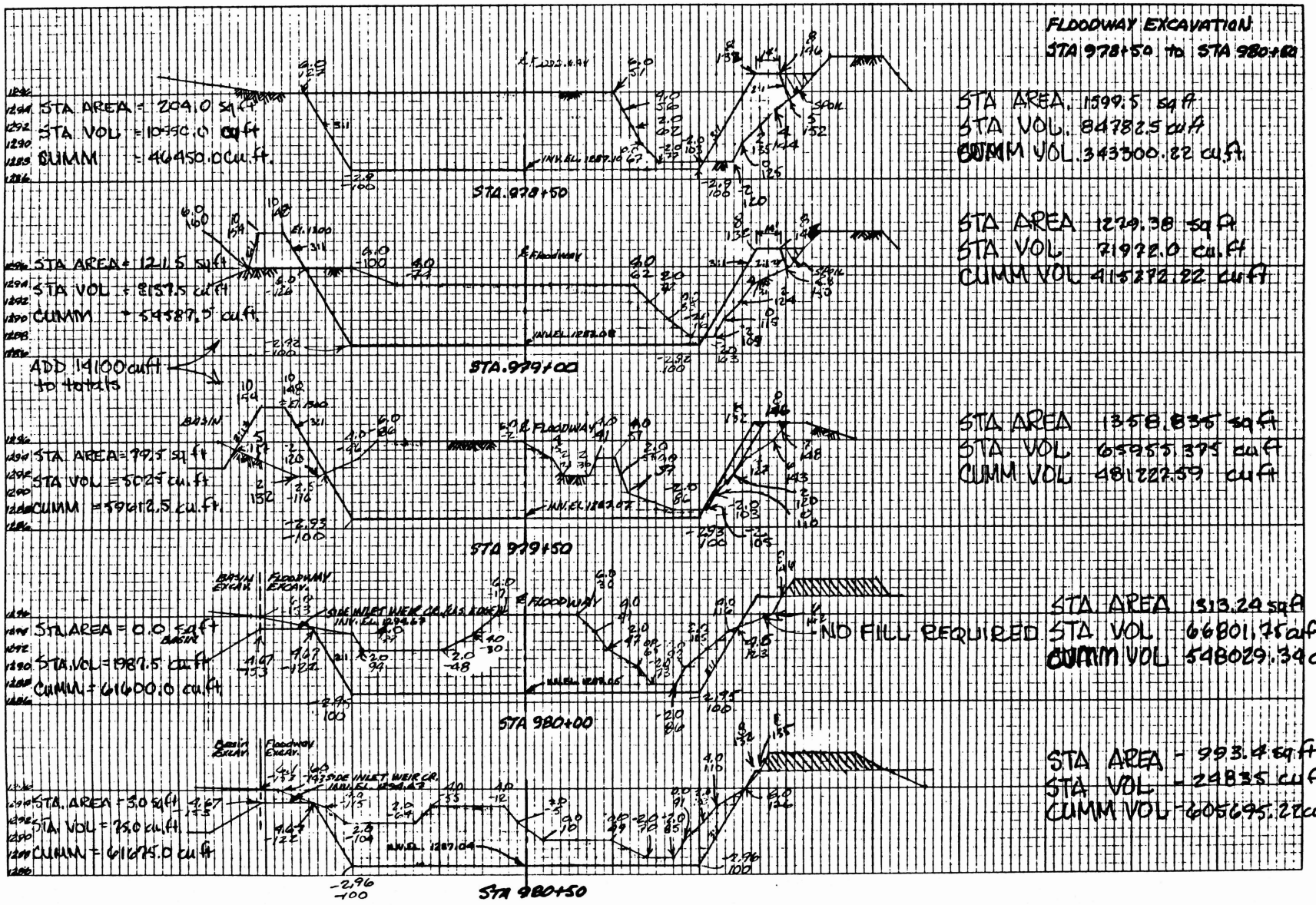
STA AREA. 157.49 sq ft
STA VOL. 6428.48 cu ft
Cumm Vol. ——

STA AREA. 2061.48 sq ft
STA VOL. 55474.23 cu ft
CUMM. VOL. 61902.72 cu ft.

STA AREA 2005.66 sq ft
STA VOL 101678.50 cu ft
CUMM VOL 163581.22 cu ft

STA AREA - 1791.8 sq ft
~~STA~~
STA VOL - 94936.5 cu ft
CUMM VOL - 258517.72 cu ft

47 0700
K+E 10 X 10 TO THE INCH • 10 X 15 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

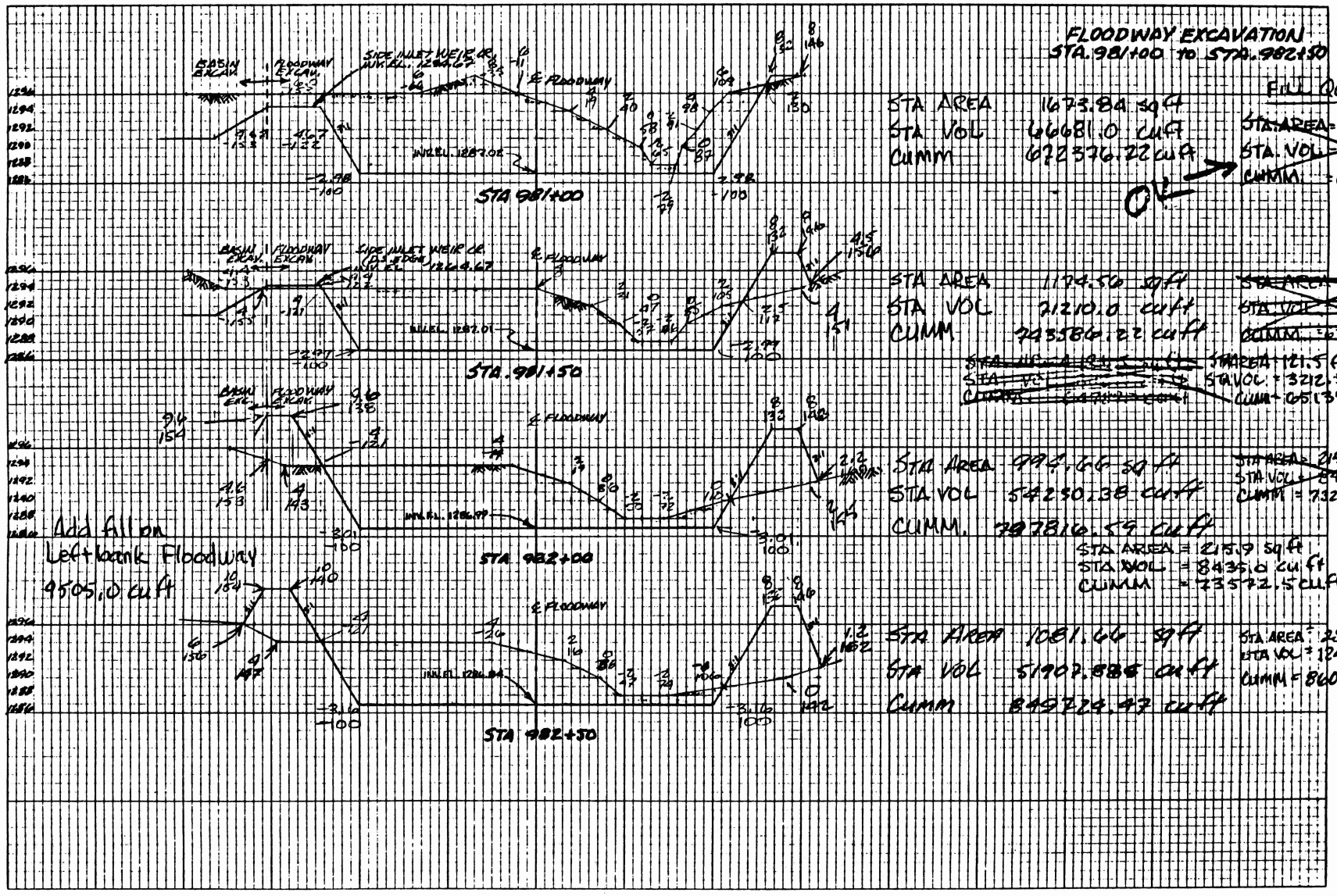


47 0700

K+E 10 X 10 TO THE INCH • 10 X 15 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

181/20

FLOODWAY EXCAVATION
STA. 981+00 to STA. 982+50



STA AREA	1673.84 sq ft	
STA VOL	66681.0 cu ft	
CUMM	672376.22 cu ft	

OK

Full Quantities

STA AREA = 7.0 sq ft
STA VOL = 2580.0 cu ft
CUMM = 61925.0 cu ft.

STA AREA	1174.56 sq ft	
STA VOL	71210.0 cu ft	
CUMM	743586.22 cu ft	

~~STA AREA = 121.5~~
~~STA VOL = 3212.5~~
~~CUMM = 65137.5~~

STA AREA = 121.5 ft²
STA VOL = 3212.5 ft³
CUMM = 65137.5 ft³

STA AREA	994.66 sq ft	
STA VOL	54250.38 cu ft	
CUMM.	797816.59 cu ft	

~~STA AREA = 215.9 sq ft~~
~~STA VOL = 8435 cu ft~~
~~CUMM = 73222.5 cu ft~~

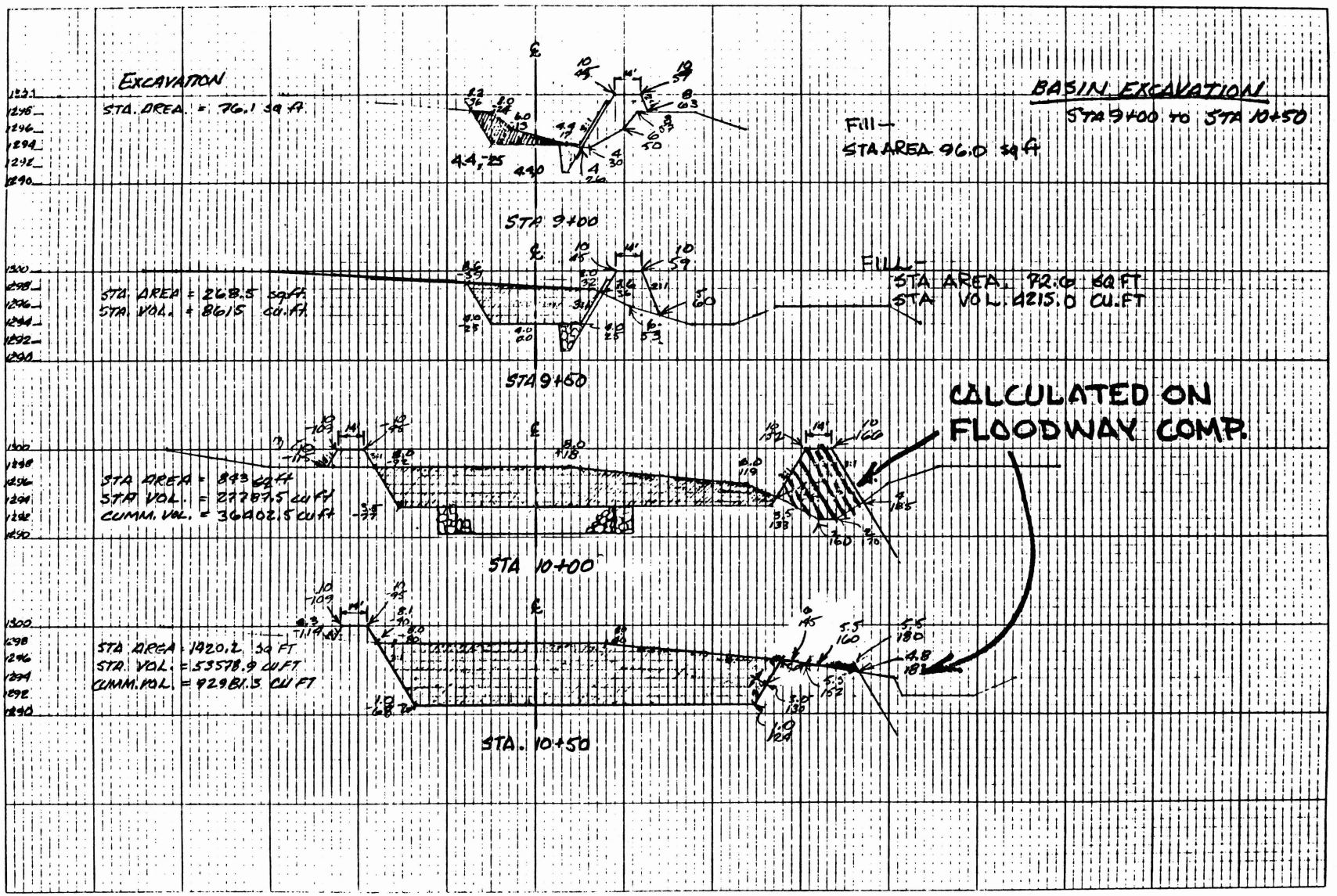
STA AREA = 215.9 sq ft
STA VOL = 8435.0 cu ft
CUMM = 73222.5 cu ft

Add fill on Left bank Floodway 9505.0 cu ft

STA AREA	1081.66 sq ft	
STA VOL	51907.88 cu ft	
CUMM	849724.47 cu ft	

STA AREA = 292.6 ft²
STA VOL = 12462.5 ft³
CUMM = 86035.0 ft³

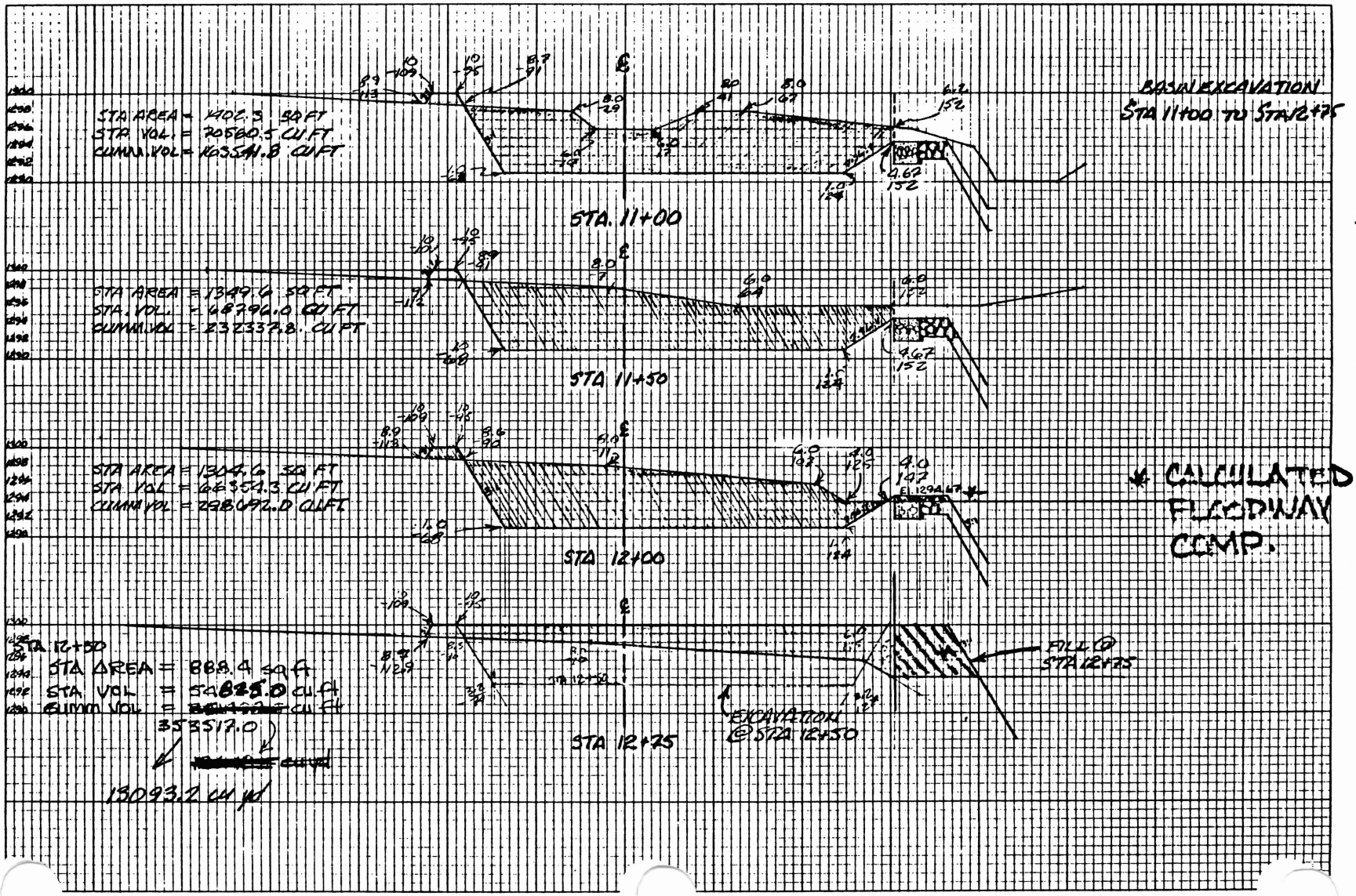
K+E 10 X 10 TO THE INCH 47 0700 10 X 15 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



47 0700

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

183/210


BASIN EXCAVATION
STA 11+00 TO STA 12+75
STA AREA = 1402.3 SQ FT
STA VOL. = 70580.5 CU FT
CUMM. VOL = 103544.8 CU FT
STA. 11+00
STA AREA = 1349.6 SQ FT
STA. VOL. = 68796.0 CU FT
CUMM. VOL = 232337.8 CU FT
STA 11+50
STA AREA = 1344.6 SQ FT
STA VOL = 66351.3 CU FT
CUMM VOL = 298692.0 CU FT
STA 12+00
CALCULATED ON FLOODWAY COMP.
STA 12+50
STA AREA = 888.4 sq ft
STA VOL = 54825.0 cu ft
CUMM VOL = cu ft
353517.0
13093.2 cu yd
STA 12+75
EXCAVATION @ STA 12+50
FILL @ STA 12+75

184/210

ARIZ
D.T

4/4/83

RWCD REACH 2 EXT

185/210

EARTHFILL SUMMARY:

LOCATION	VOL (CY)
RWCD	3539
BASIN 9+00 +	149
E FWY, S DIP	213
FWY - INLET N BAS	320
S. DIKE	809
BASIN E	390
BASIN W	223
TOTAL	5643 cy

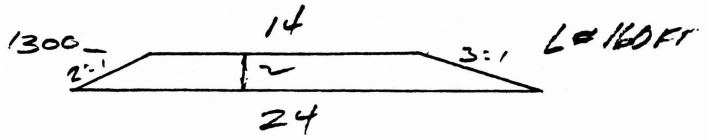
ARIZ RDXD REACH 2 EXT

D.T. 4/14/83

EARTHFILL (MISC):

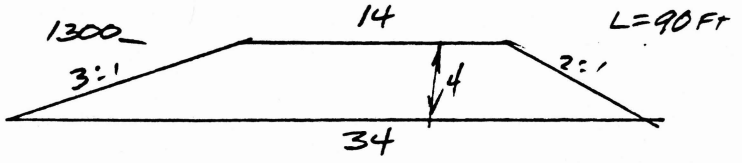
E OF RDXD FWY, S OF DIP:

APPROX =



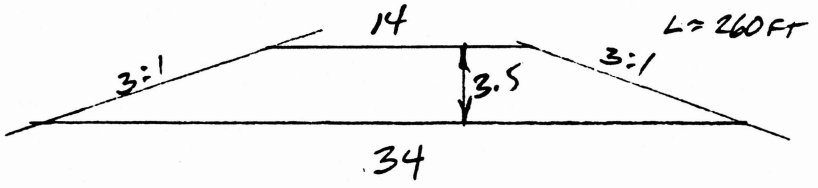
$$V = \frac{2(18)160}{27} = \underline{213\,cy}$$

BETWEEN RDXD & BASIN CHANNEL, N OF BASIN



$$V = \frac{4(24)90}{27} = \underline{320\,cy}$$

S. BASIN DIKE



$$V = \frac{3.5(24)260}{27} = \underline{309\,cy}$$

ABOVE STA 9+00

$$V = \underline{149\,cy}$$

ARIZONA RWCD REACH 2 EXT

D.T. 4/14/83

QUANTITIES EARTH FILL ABOVE 9+00

FILL

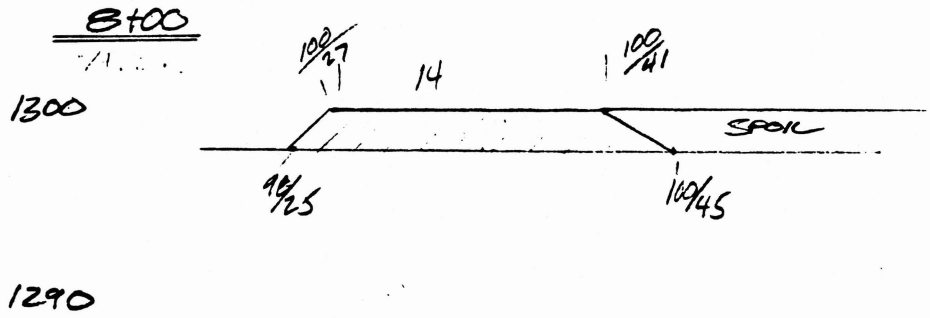
	0.00	***		98.50	***		95.00	***
	0.00	***		29.00	***		21.00	***
	1.00	***		100.00	***		96.50	***
				31.50	***		27.00	***
	0.00	T						
	0.00	Z		100.00	***		100.00	***
	0.00	Y		45.50	***		30.00	***
	0.00	X						
				98.00	***		100.00	***
				49.50	***		44.00	***
	98.00	***						
	25.00	***		98.00	***		98.50	***
				45.00	***		47.00	***
	100.00	***						
	27.00	***		98.50	***		98.00	***
				29.00	***		44.00	***
	100.00	***						
	41.00	***		3.00	***		96.00	*
							35.00	*
	100.00	***	L	50.00	T			
	45.00	***	A	31.13	Z		95.00	***
			ΔU	45.49	Y		21.00	***
	98.00	***	V	62.15	X			
	25.00	***					-62.25	***
							50.00	***
	2.00	***						
							95.00	***
L	50.00	T					21.00	***
A	18.00	Z						
ΔV	16.67	Y					4.00	***
V	16.67	X						
						L	50.00	T
						A	62.25	Z
						ΔU	86.46	Y
						V	148.61	X

ARIZONA
D. Thackeray 4/14/23

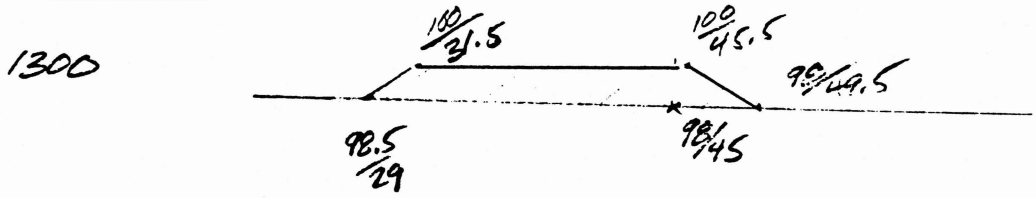
RUXD REACH 2 EXT

EARTHFILL AREAS (STA 9+00)

8+00



8+50

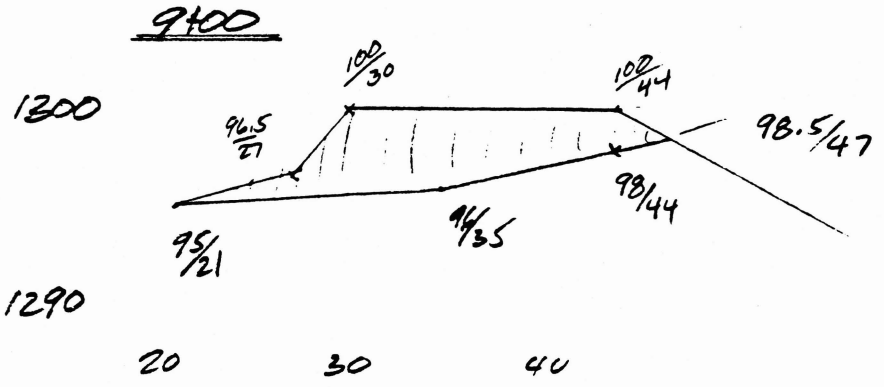


30 40

ARIZONA
O. Thadoray 4/14/83

RWCO REACH 2 EXT

137/210



ARIZONA D.T.

4/12/83

RWCD REACH 2 EXT

SUMMARY

LOOSE ROCK RIP RAP

SITE	VOL FT³	VOL CY
CHANNEL #1	19229.7	712.21
CHANNEL #2	6569.7	243.32
SIDE INL #3	881	32.63
BASIN INL	3760	139.26
ENTRANCE	2856	105.78
BASIN OUTLET	—	11.00
SIDE INL. RWCD	11328	419.56
TOTAL		1664 cy

GROUTED ROCK RIP-RAP

SITE	VOL FT³	VOL CY
SIDE INLET CH. #3	1366.4	50.60
BASIN INL.	7938	294.00
SIDE INL.	26169.5	969.24
TOTAL		1314 cy

ARIZONA RWCD REACH 2 EXT.

JFA 4/6/83

QUANTITY COMPUTATION - CHANNEL #2

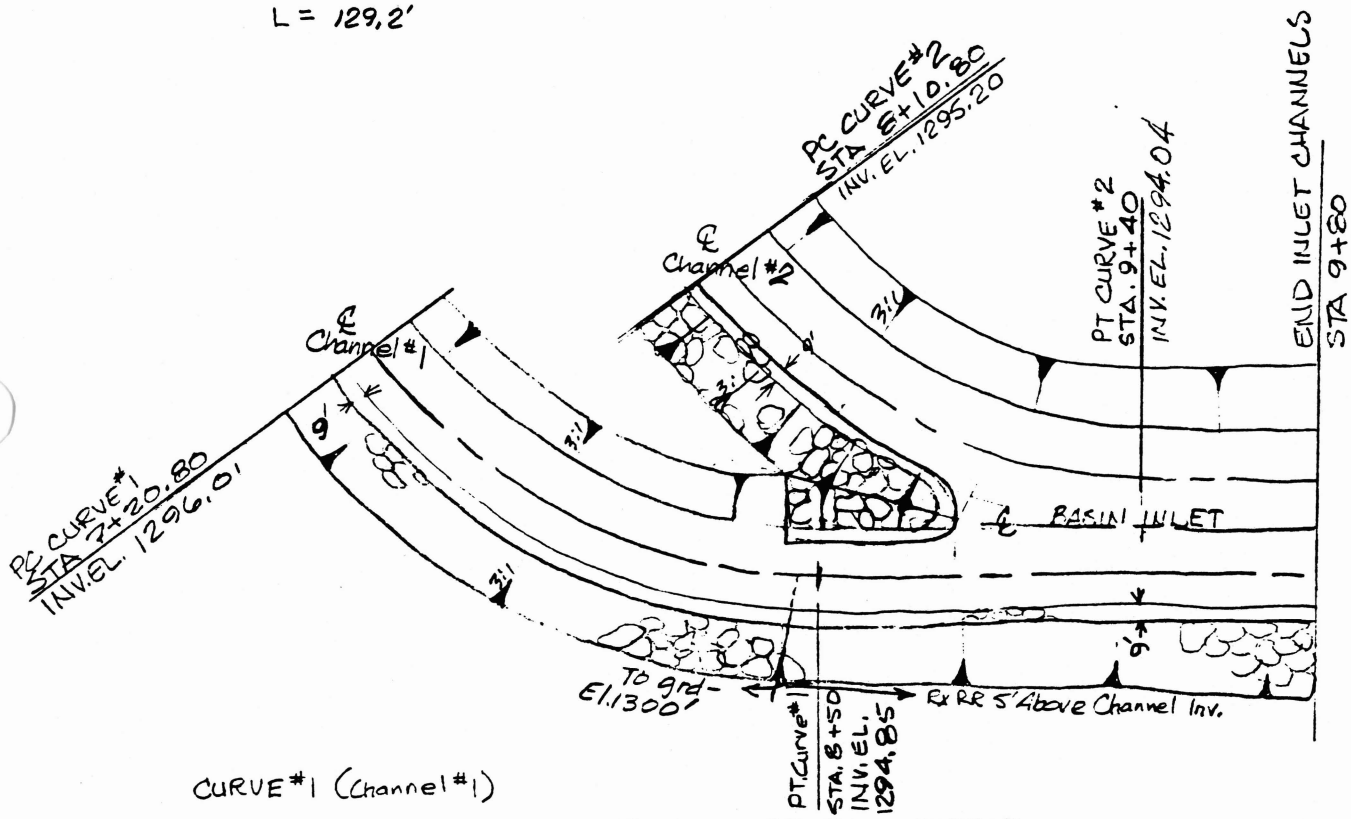
Curve # 2 (Channel #2)

$\Delta = 53°38'37''$

$R = 138'$

$L = 129.2'$

TOTAL LOOSE ROCK RIPRAP
NORTHSIDE CHANNEL #2. = 6569.67 ft³



CURVE #1 (Channel #1)

$\Delta = 53°38'37''$

$R = 138'$

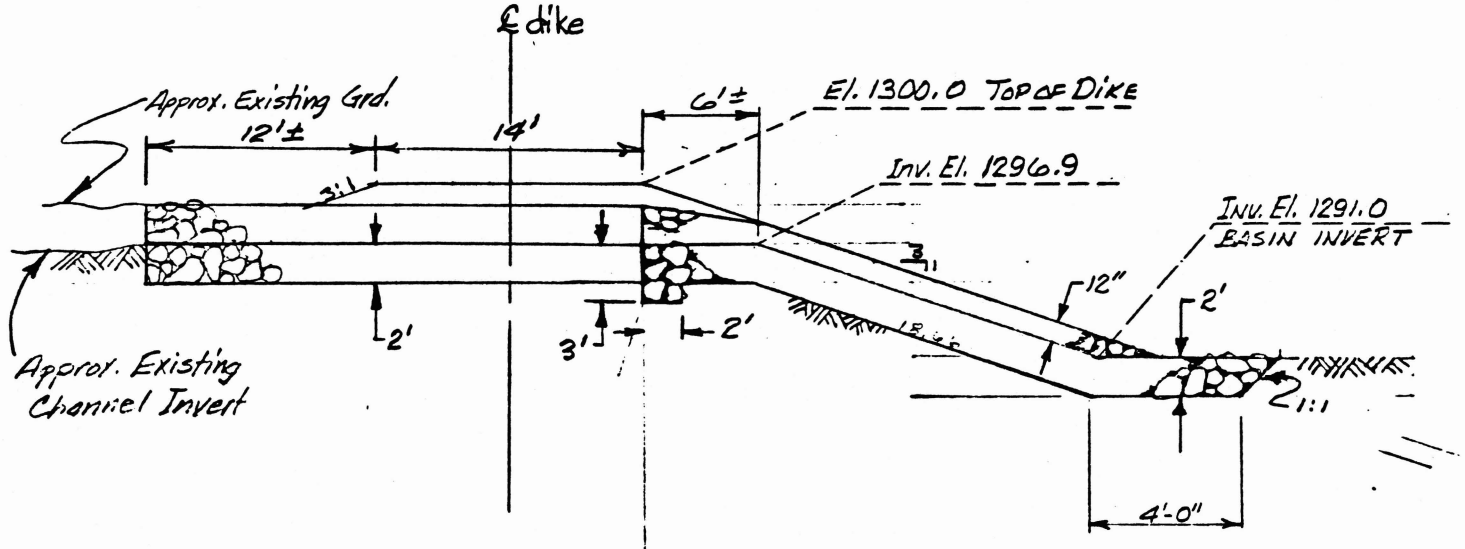
$L = 129.2'$

TOTAL LOOSE ROCK RIPRAP
ALONG NORTH SIDE OF CHANNEL #1 = 19229.7 ft³

ARIZONA RWCD REACH 2 EXT.

JFA 4/5/93

QUANTITY COMPUTATIONS — Side Inlet Channel #3



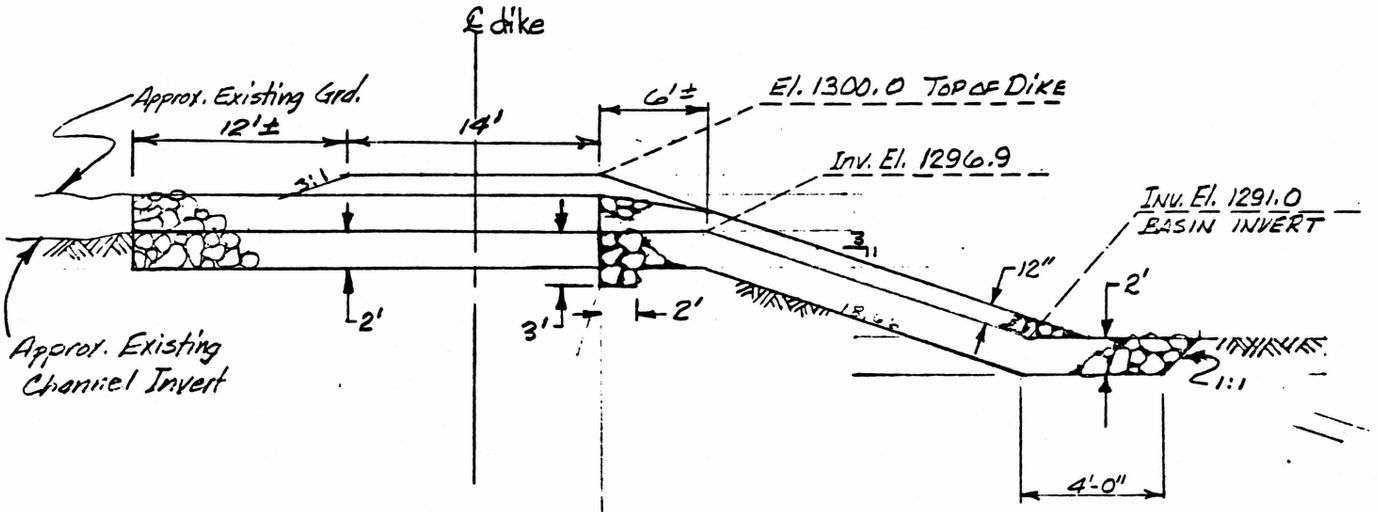
LOOSE ROCK RIPRAP - 881.1 ft³

GROUTED ROCK RIPRAP - 1366.4 ft³

ARIZONA RWCD REACH 2 EXT.

JFA 4/5/93

QUANTITY COMPUTATIONS — Side Inlet Channel #3



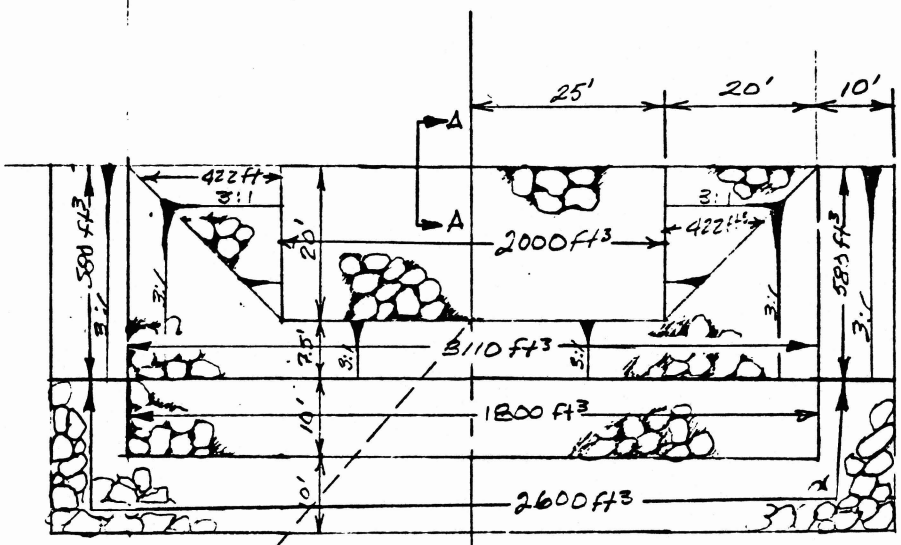
LOOSE ROCK RIPRAP - 881.1 ft^3

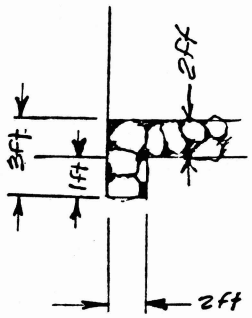
GROUTED ROCK RIPRAP - 1366.4 ft^3

ARIZONA RWCD REACH 2 EXT.

JFA 4/5/83

QUANTITY COMPUTATIONS - BASIN INLET





PROFILE OF KEY SECTION A-A (+184.9 ft³)

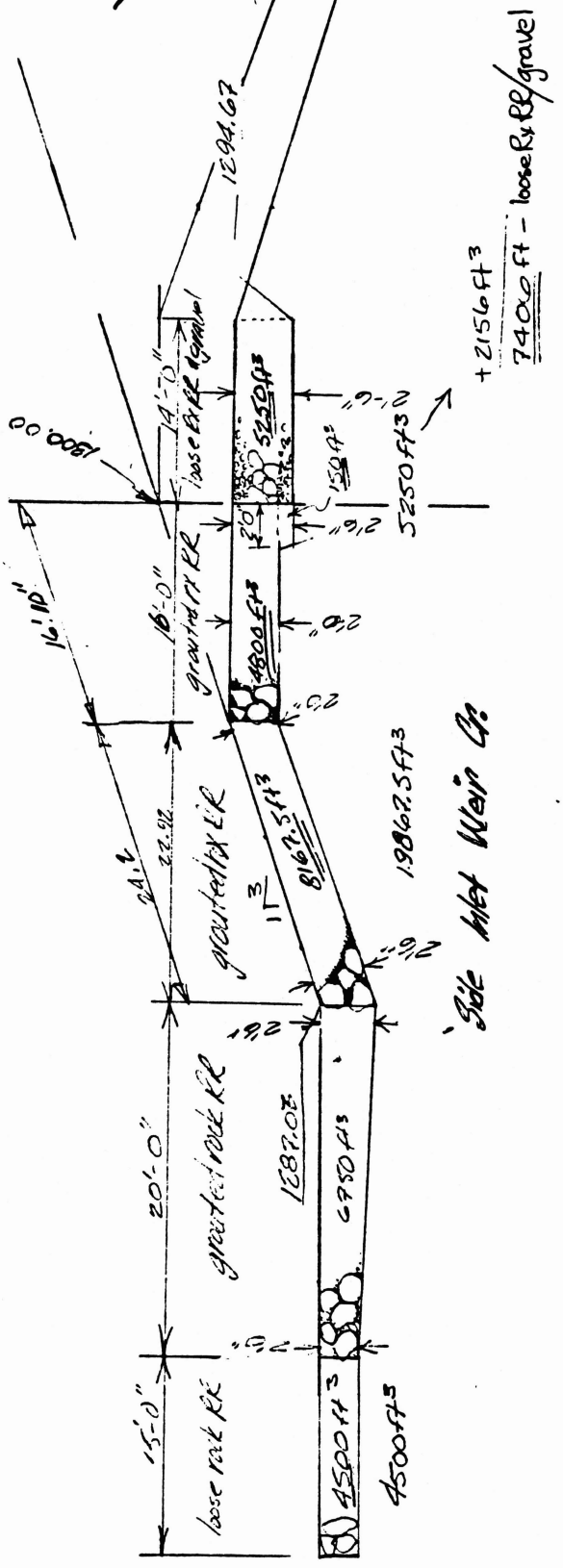
℄ BASIN INLET
STA 10+00
INV. EL. 1293.5

grouted Rx RR – 7939 ft³ (294 yd³)
Loose Rx RR – 3760 ft³ (139.26 yd³)

ARIZONA
JFA 4/4/83

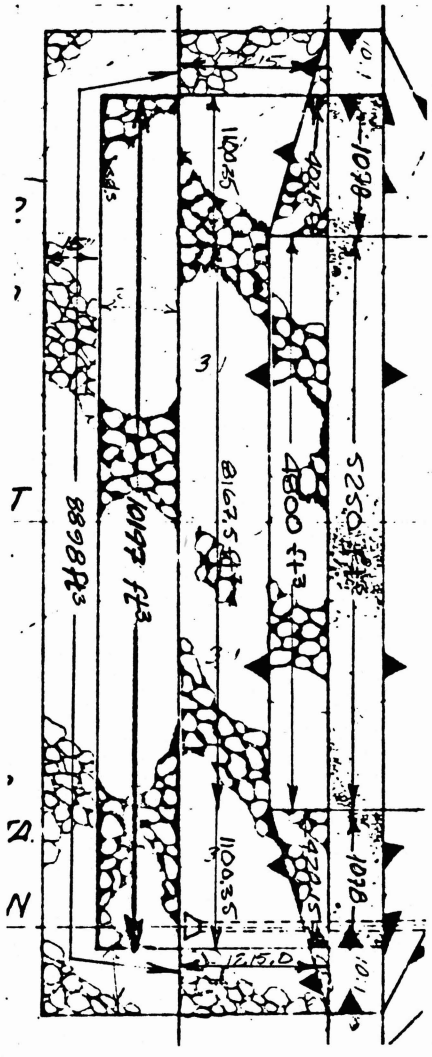
RWCD REACH 2 EXT

Quantity Comp on Side Inlet



gravel & Loose Rx RR. - 7406 ft³
grouted Rx RR - 5604.3 - weir cr.
10268.2 - slope
10197 - RWCD
26169.5 ft³ total

loose Rx RR - 11328 ft³

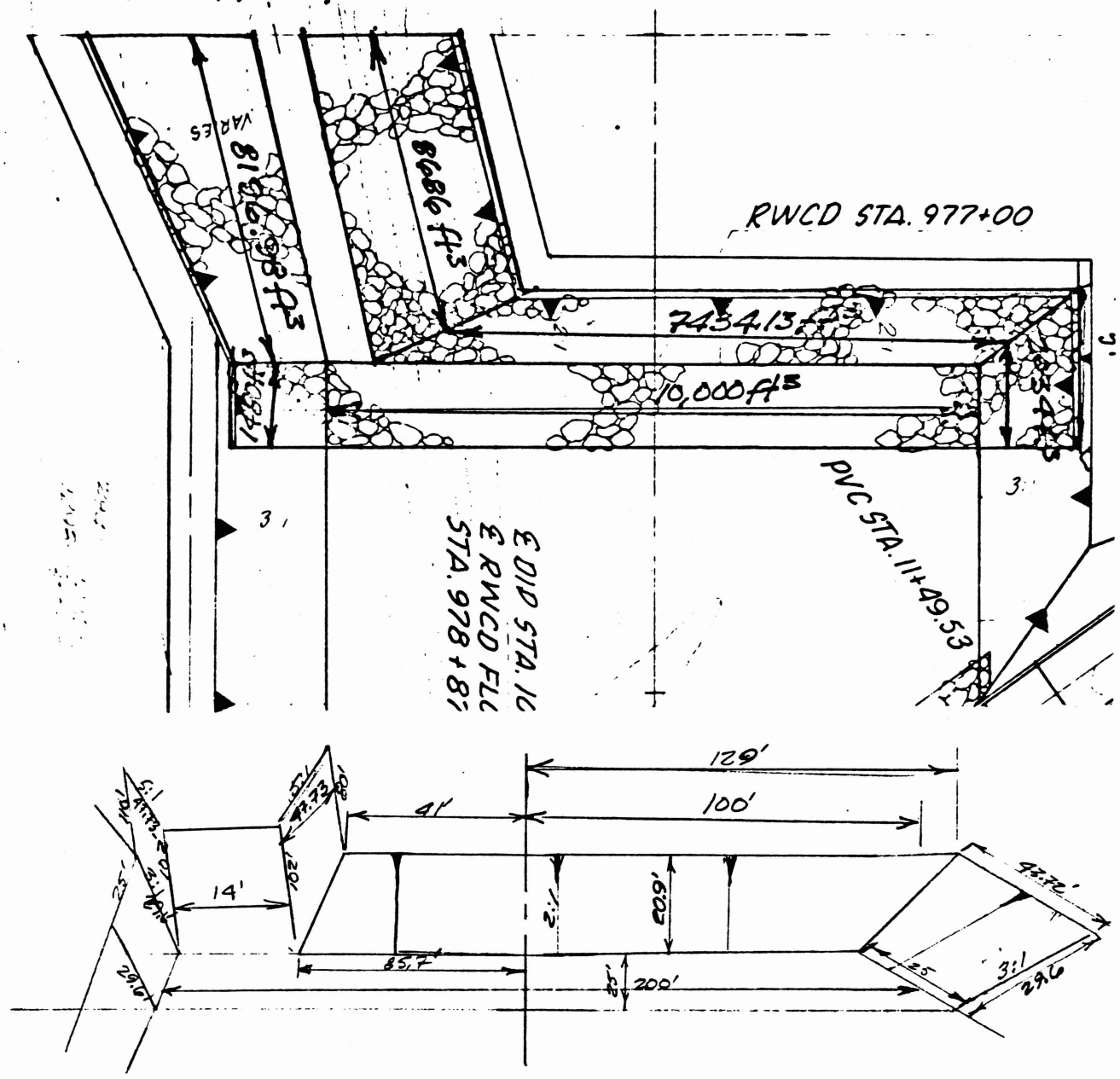


ARIZONA
JFA

RWCD REACH 2 EXT.

4/1/83

Quantity Computations



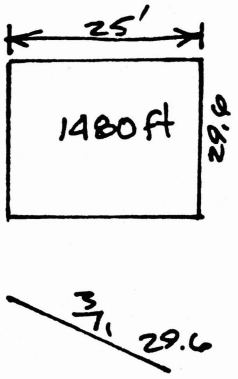
36,351 ft total not including channel (2856) entrance.

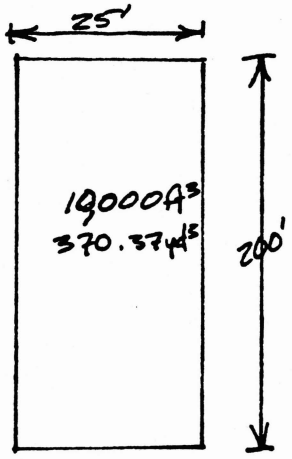
ARIZ. RUXCO REACH 2 EXT. 196/210

JA 4/1/83

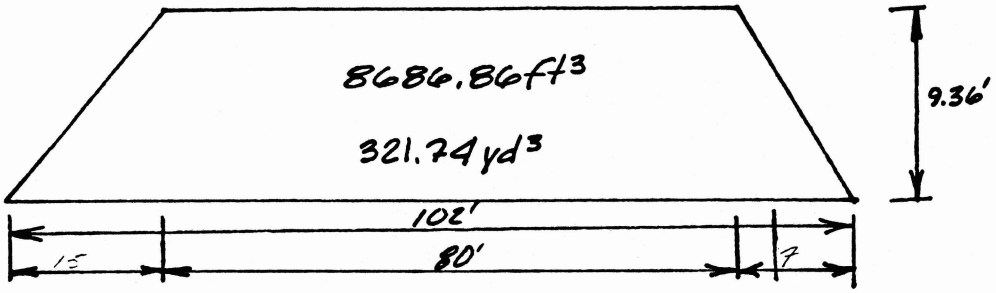
QUANTITY COMPUTATIONS

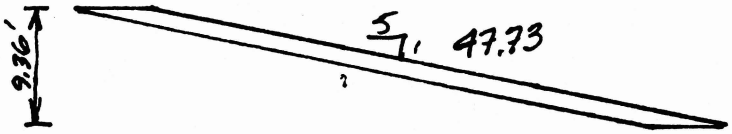
Right Bank



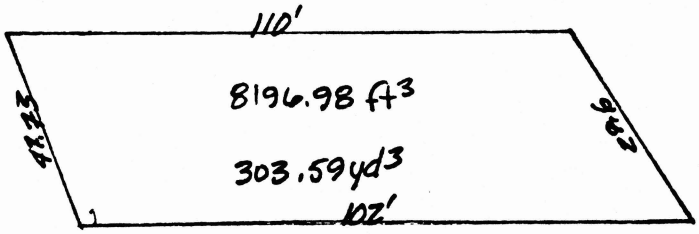


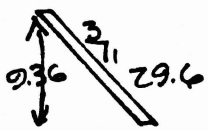
LEFT BANK ~~INLET~~
RWCD ENTRANCE

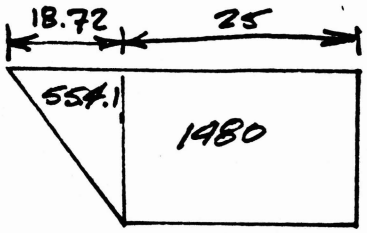




RIGHT BANK ~~INLET~~
RWCD ENTRANCE

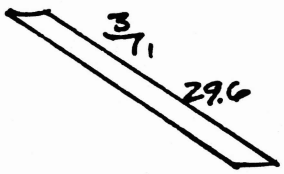


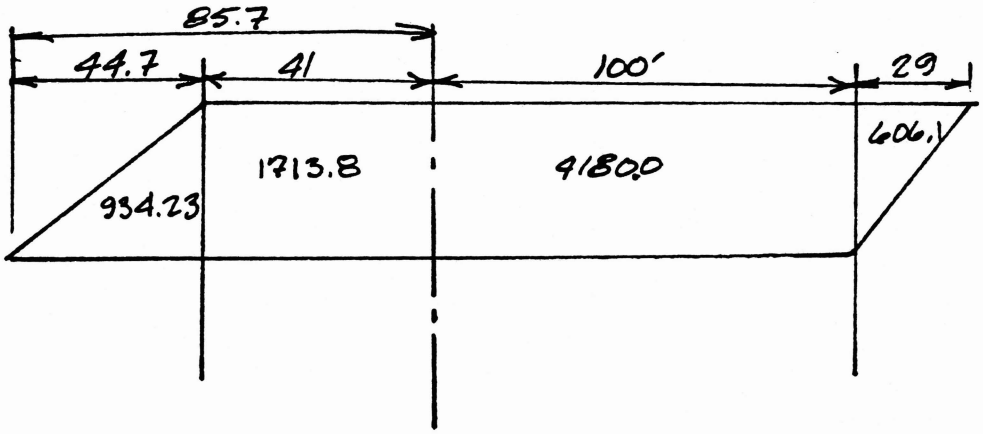


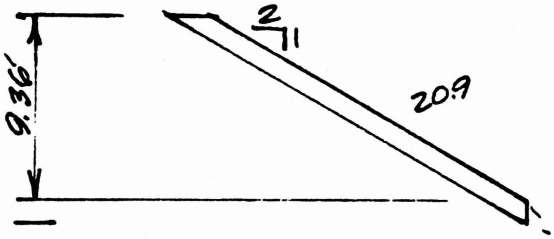


LEFT BANK

2034.1 ft3
75.3 yd3







~~7434.13~~
7434.13 ft3
275.39 yd3

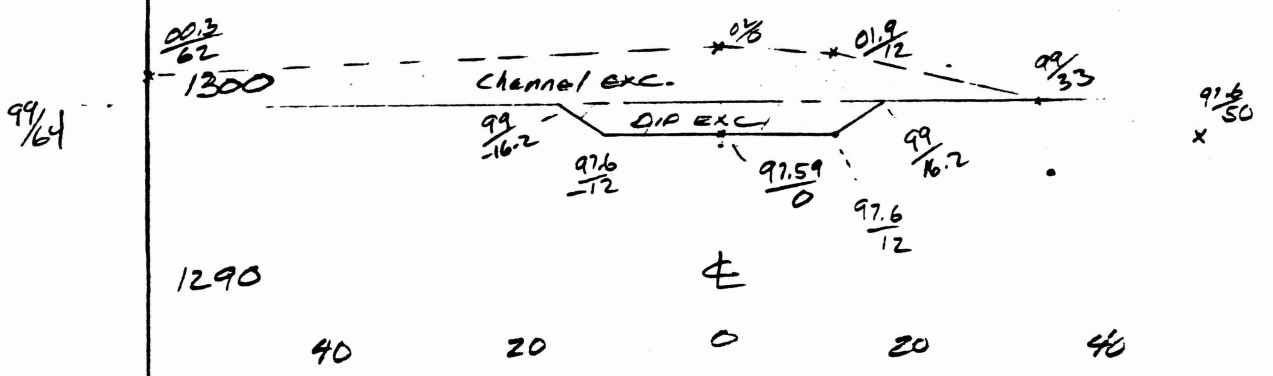
ARIZONA D.T. 4/12/83 RWCD REACH 2 EXT. 179/210

QUANTITIES DIP CROSSING

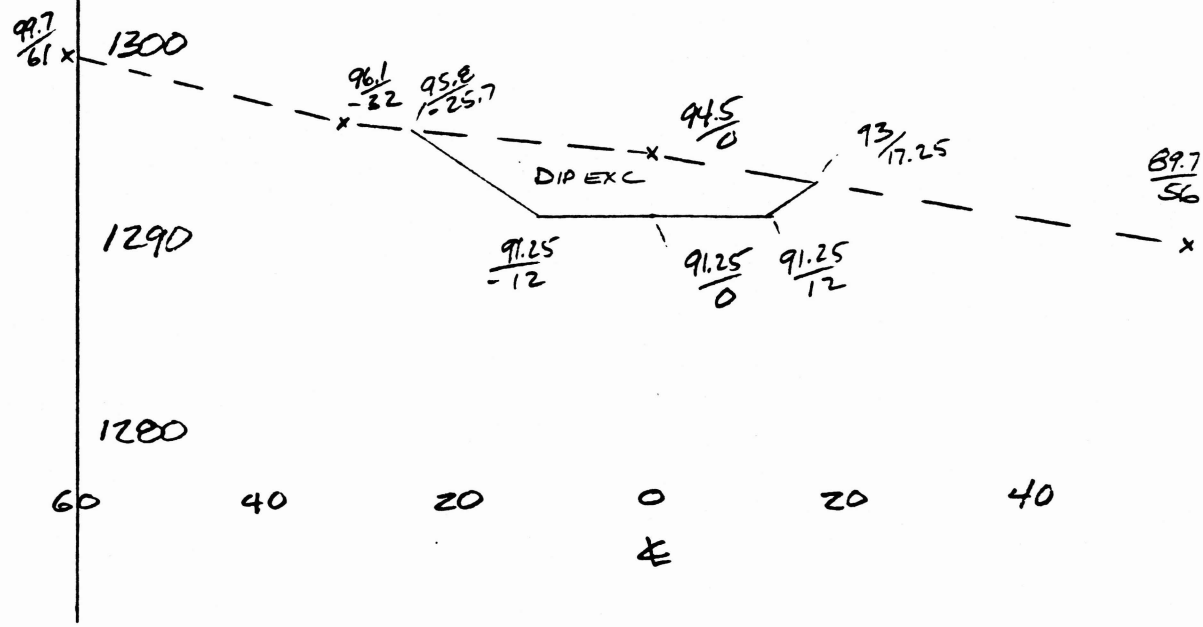
1. EXCAVATION COMMON:

SECTIONS: 7+80 A=0

8+00



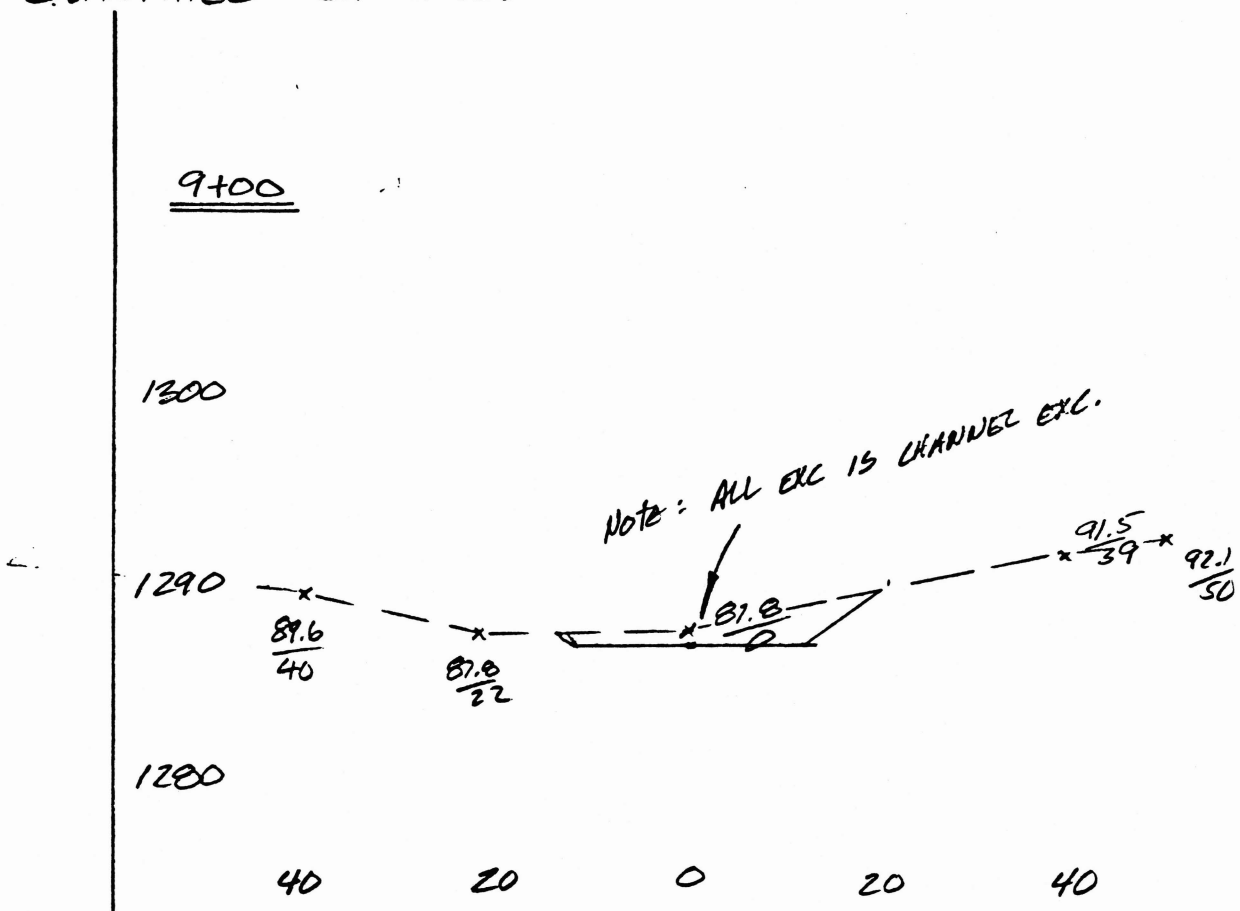
8+50



ARIZONA RUXD REACH 2 EXT 200/210

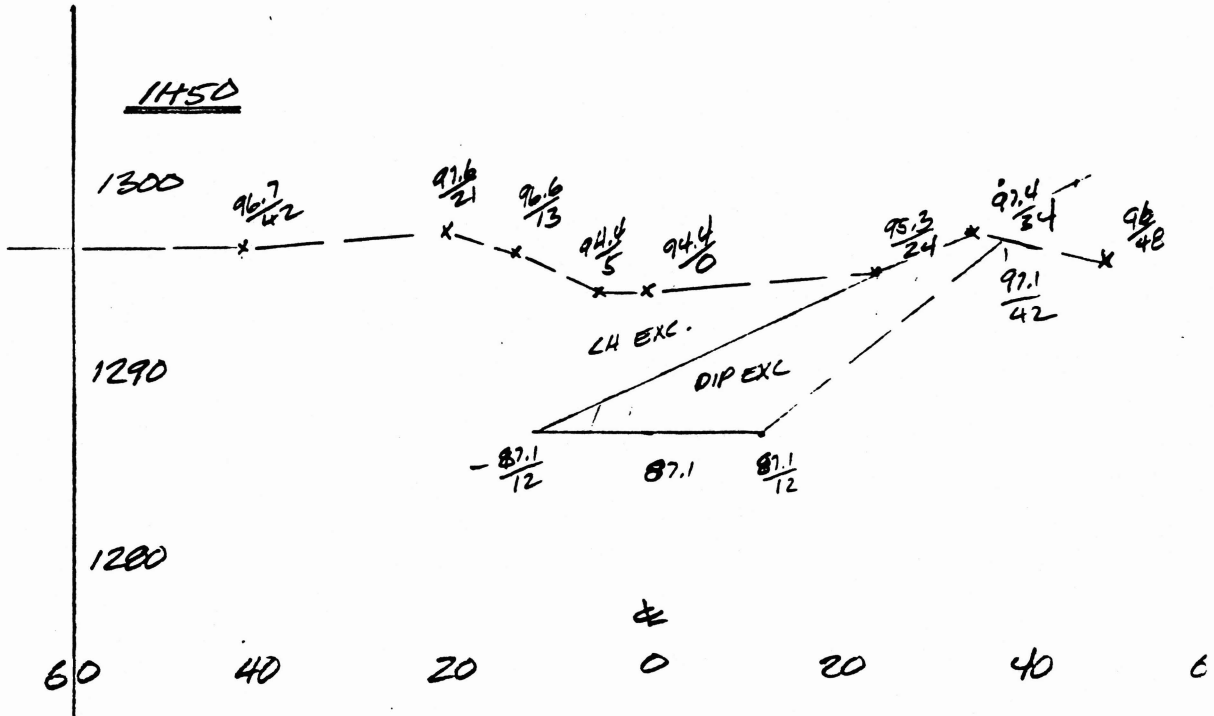
D.T. 4/13/83

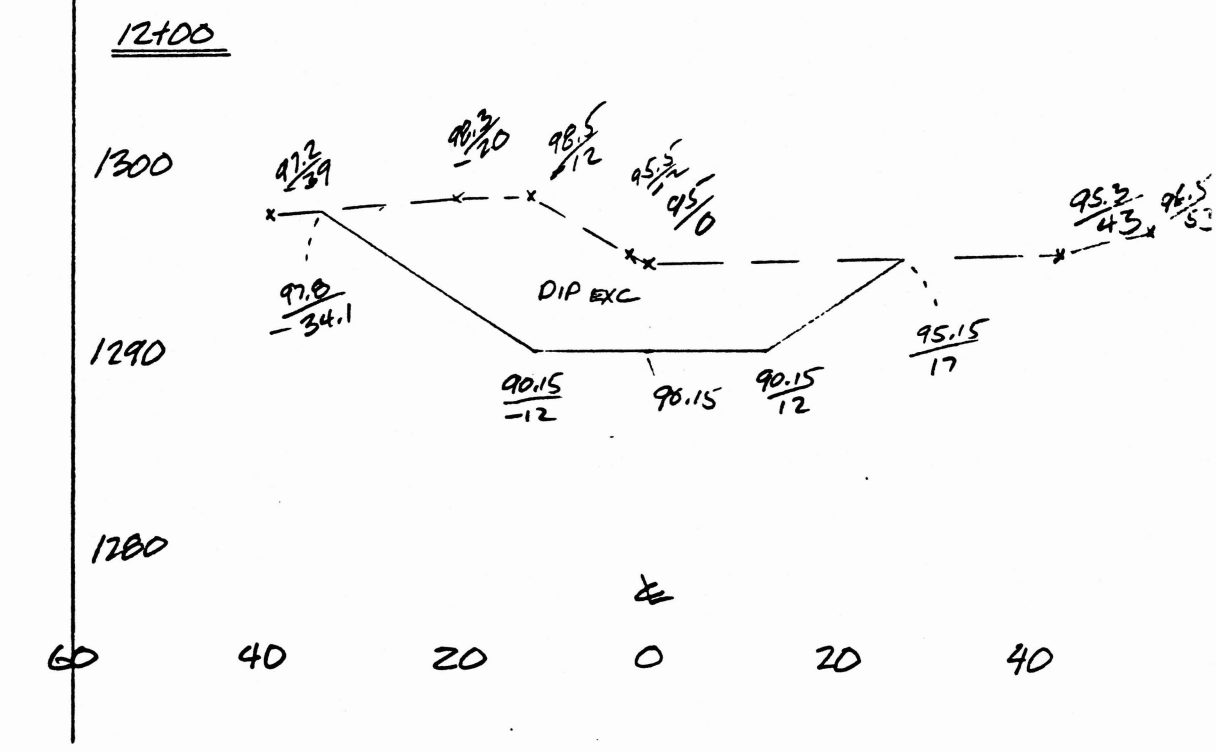
QUANTITIES DIP CROSSING



ARIZONA RWCO REACH 2 EXT. 201/210

D. Thackeray 4/13/83

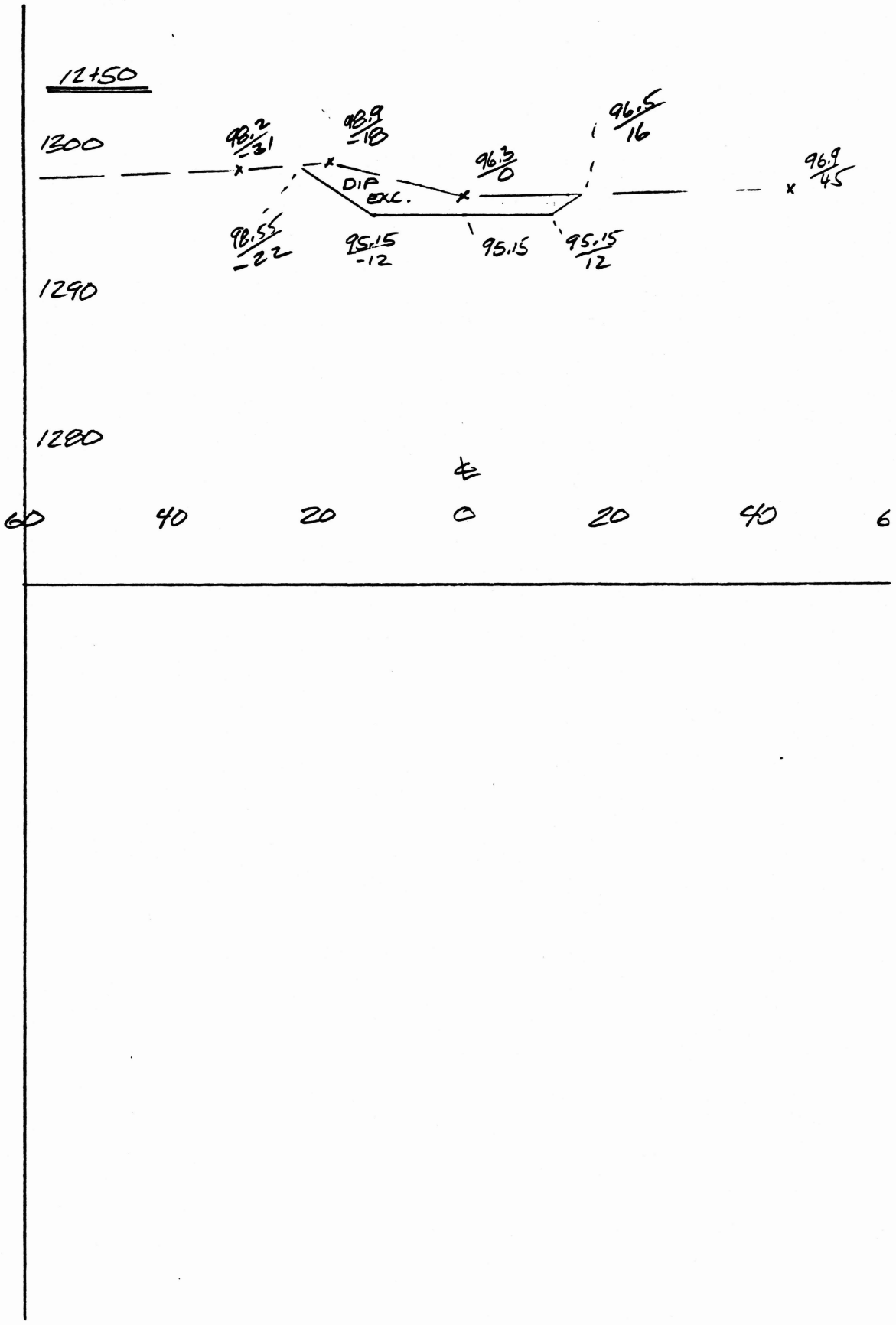




ARIZONA
O. Thackeray 4/13/83

RWCD REACH 2 EXT.

202/210



ARIZONA
O. Thackeray 4/13/23

ROXCO REACH 2 EXT.

11+40	1.00	***
	0.00	T
	0.00	Z
	0.00	Y
	0.00	X
	87.10	***
	-12.00	***
	95.30	***
	24.00	***
	97.40	***
	34.00	***
	97.10	***
	42.00	***
	87.10	***
	12.00	***
	87.10	***
	-12.00	***
11+50	2.00	***
D	10.00	T
A	171.30	Z
V	31.72	Y
ΔV	31.72	X

	90.15	***
	-12.00	***
	97.80	***
	-34.10	***
	97.20	***
	-39.00	***
	98.30	***
	-20.00	***
	96.50	***
	-12.00	***
	95.50	***
	-2.00	***
	95.00	***
	0.00	***
	95.15	***
	17.00	***
	90.15	***
	12.00	***
	90.15	***
	-12.00	***
12+00	3.00	***
D	50.00	T
A	239.78	Z
V	380.63	Y
ΔV	412.35	X

	95.15	***
	-12.00	***
	98.55	***
	-22.00	***
	98.20	***
	-31.00	***
	98.90	***
	-18.00	***
	96.30	***
	0.00	***
	96.50	***
	16.00	***
	95.15	***
	12.00	***
	95.15	***
	-12.00	***
12+50	4.00	***
D	50.00	T
A	59.58	Z
V	277.18	Y
ΔV	689.53	X
12+60	5.00	***
D	10.00	T
A	0.00	Z
V	11.03	Y
ΔV	700.56	X

ARIZONA
D. Theodora 4/12/83

ROUCD REACH 2 EXT

	1.00	***
7+80	0.00	T
	0.00	Z
	0.00	Y
	0.00	X
	97.60	***
	-12.00	***
	99.00	***
	-16.20	***
	99.00	***
	16.20	***
	97.60	***
	12.00	***
	97.60	***
	-12.00	***
8+00	2.00	***
D	20.00	T
A	39.48	Z
V	14.62	Y
ΔV	14.62	X

	91.25	***
	-12.00	***
	95.80	***
	-25.70	***
	94.50	***
	0.00	***
	93.00	***
	17.25	***
	91.25	***
	12.00	***
	91.25	***
	0.00	***
	91.25	***
	-12.00	***
8+50	3.00	***
D	50.00	T
A	107.59	Z
V	136.18	Y
ΔV	150.80	X
9+00	4.00	***
D	50.00	T
A	0.00	Z
V	99.62	Y
ΔV	250.43	X

ARIZONA RWCD REACH 2 EXT 205/210

D. Thackeray 4/13/83

QUANTITIES – DIP CROSSING

STATION	A (FT²)	L (FT)	ΔV (CY)	ΣV (CY)
7+80	0	20	14.62	14.62
8+00	39.48	50	136.18	150.80
8+50	107.59	50	99.62	250.43
9+00	0			
11+40	0	10	31.72	31.72
11+50	171.30	50	380.63	412.35
12+00	239.78	50	277.18	689.53
12+50	59.58	10	11.03	700.56
12+60	0			

TOTAL DIP X-ING EXCAV 951 cy

3. CONCRETE CLASS 4000X:

$L = 440.51$

$A = 2(3 \times 1) = 6 ft^2$

$V = \frac{440.51(6)}{27} = 98 cy$

4. CEMENT:

PRORATE FROM REACH 2

$\frac{132 bbl}{88 cy} = 1.5 bbl/cy$

$98 cy \times 1.5 bbl/cy = 147 bbl$

5. STEEL REINFORCEMENT:

LONGITUDINAL BARS:

bar	NO.	A/bar/ft	Σ A/ft	wt/ft*	L	WT
#4	2	0.1964	0.3927			
#6	4	0.4418	1.7672			
Σ			2.1599	7.42	881	6540#

* lb/ft × $\frac{495 pcf}{144 in^2}$ = 3.44 lb/in²-ft

ties: #4 - 880
$\ell = 6 ft$; $A = 0.1964$

$Wt = 880(6)\left(\frac{0.1964}{144}\right)(495) = 3565 \#$

TOTAL WT = 10 105 # ≈ 10 100 #

2. STRUCTURE EXCAVATION (COLUMN)

USE TANGENT LENGTH:

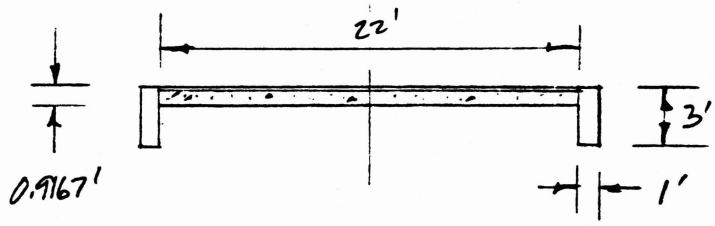
		L (HORIZ)
BEGIN PAVEMENT	8 + 11.14	73.08
PVI	8 + 84.02	275.51
PVI	11 + 59.53	90.90
END PAVEMENT	12 + 50.43	

$$\text{tan length} = \frac{1}{\cos(\tan^{-1} 0.125)}(73.08) = 73.65$$

$$\text{tan length} = \frac{1}{\cos(\tan^{-1} 0.1)}(90.90) = 91.35$$

275.51

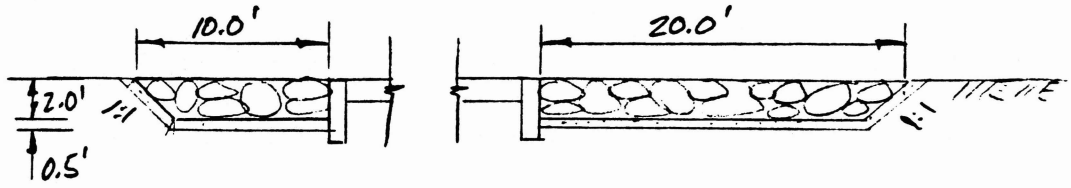
LENGTH 440.51



$$A = 24(3) - 22(2.0833) = \underline{26.16740 \text{ ft}^2}$$

$$\text{VOL} = \frac{440.51(26.1674)}{27} = \underline{427 \text{ cy}}$$

6. LOOSE ROCK RIP-RAP:



$A_1 = (10.71 + 8.21)\ 2.5/2 = 23.65\ ft^2$

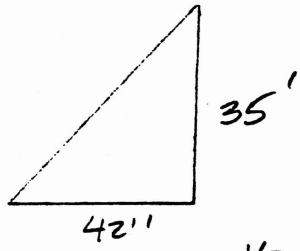
$A_2 = (20.71 + 18.21)\ 2.5/2 = 48.65\ ft^2$

$\Sigma = 72.30\ ft^2$

VOL BOTTOM = 246.2 ft (72.30)(1/27)

= 659.3 cy ~ 660

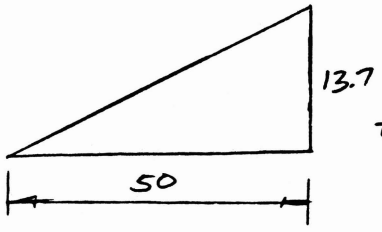
WEST SLOPE:



t = 2.5'

$V = \frac{42(35)2.5}{27(2)}$

V = 68.1 cy



t = 2.5

$V = \frac{50(13.7)2.5}{27(2)}$

V = 31.7 cy

ΣV = 99.8 cy

TOTAL 760 C.Y.

ARIZONA
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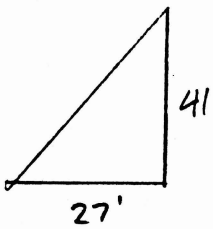
RNKD REACH EXT

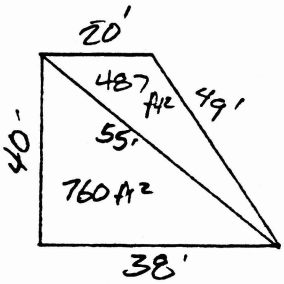
AP 47 STD
PAC
SC 07A

EAST END:



$t = 2.5$

$$V = \frac{41(27)2.5}{54} = 51.25\,cy$$



$t = 2.5$

$$V = \frac{(487 + 760)2.5}{27} = 115.46\,cy$$

EAST TOTAL = 166.71 cy

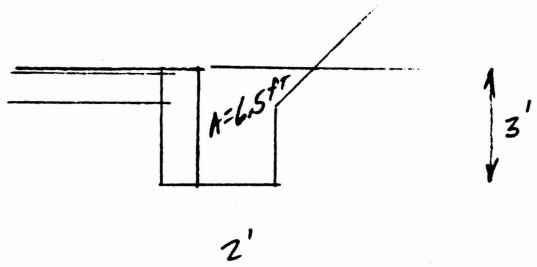
TOTAL LOOSE ROCK RR

BOTTOM	659.3
WEST	99.8
EAST	166.7
TOTAL	925.8 cy

7. ASPHALT CONCRETE PAVEMENT:

$$\text{AREA} = \frac{22\text{FT} \times 440.5\text{FT}}{9\text{FT}^2/\text{SQ YD}} = \underline{1076 \text{ SQ YD}}$$

8. STRUCTURE BACKFILL:



$$V \approx \frac{6.5\text{FT}^2(300)}{27} = \underline{72 \text{ cy}}$$

BID SCHEDULE AND SPECIFICATIONS

BID SCHEDULE NO. 1
WILLIAMS-CHANDLER, WPP, ARIZONA
RWCD FLOODWAY - REACH 2 EXTENSION

Item	Work or Material	Spec. No.	Quantity	Unit	Unit Price	Amount
25.	Clearing and Grubbing	2		Acres	$_____	$_____
26.	Water	10		M.Gal.	$_____	$_____
27.	Channel Excavation, Common	21		C. Y.	$_____	$_____
28.	Basin Excavation, Common	21		C. Y.	$_____	$_____
29.	Structure Excavation, Common	21		C. Y.	$_____	$_____
30.	Structure Backfill	23		C. Y.	$_____	$_____
31.	Earth Fill	23		C. Y.	$_____	$_____
32.	Drain Fill	24		C. Y.	$_____	$_____
33.	24-Inch Diameter Reinforced Concrete Pipe, Cl. III	42		L. F.	$_____	$_____
34.	Loose Rock Riprap	61		C. Y.	$_____	$_____
35.	Grouted Rock Riprap	62		C. Y.	$_____	$_____
36.	Surveys	8		L. S.	$_____	$_____

BID SCHEDULE NO. 2
WILLIAMS-CHANDLER, WPP, ARIZONA
RWCD FLOODWAY - REACH 2 EXTENSION
DIP CROSSING AND QUEEN CREEK EARTHFILL

Item	Work or Material	Spec. No.	Quantity	Unit	Unit Price	Amount
11.	Dip Crossing Excavation, Common	21		C. Y.	$_____	$_____
12.	Structure Excavation, Common	21		C. Y.	$_____	$_____
13.	Structure Backfill Common	23		C. Y.	$_____	$_____
14.	Concrete, Class 4000X Common	31		C. Y.	$_____	$_____
15.	Cement	31		Bbls.	$_____	$_____
16.	Steel Reinforcement	34		Lbs.	$_____	$_____
17.	Loose Rock Riprap	61		C. Y.	$_____	$_____
18.	Asphalt Concrete Pavement	400		S. Y.	$_____	$_____
				TOTAL	$_____	$_____

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 15 Clearing and Grubbing

(1) This item shall consist of clearing and grubbing of all areas shown on the drawings and staked in the field.

(2) If waste materials are disposed of by burying, they shall be buried a minimum of 18 inches below the existing ground surface in the waste disposal areas shown on the drawings. When disposal is complete, the waste disposal areas shall be smoothed and graded to blend into the surrounding terrain.

(3) If materials removed from the cleared and grubbed area are to be burned, burning must be carried out in accordance with Pinal County Health Department regulations.

(4) Measurement and payment will be by Method 1.

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 26, Water

(1) This item shall consist of furnishing and applying all water necessary for performance of the work described.

(2) Water may be obtained from the Roosevelt Water Conservation District Higley, Arizona (Grant Ward Telephone 963-3414).

(3) Measurement and payment shall be in accordance with Section 6.

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, Removal of Water

(1) This item shall consist of the removal of surface and ground water from the construction area shown on the drawings.

(2) No advance plan of dewatering will be required.

(3) No separate payment will be made for the removal of water. Compensation for this work will be included in the payment for Bid Items 11, 12, 13, 14, and 17.

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 27, Earth Channel Excavation, Common

(1) This item shall consist of all excavation required to construct:

(a) The floodway, including entrance channel, between Stations 976+00± and 982+50±, as shown on the drawings.

(b) Stripping of the top 6 inches below original ground surface on surfaces where earth fill is to be placed in construction of the floodway.

(2) In Section 5, Use of Excavated Material, Method 1 shall apply. Suitable materials resulting from this excavation and not required for Bid Item 30, Structure Backfill, and Bid Item 31, Earth Fill, will be spoiled in the areas shown on the drawings.

(3) In Section 6, Disposal of Waste Material, Method 1 shall apply.

(4) Measurement and payment will be by Method 2, and will include compensation for Subsidiary Item, Removal of Water, and Subsidiary Item, Spoil Disposal.

b. Bid Item 28, Basin Excavation, Common

(1) This item shall consist of all excavation required for construction of the Sediment Basin and basin inlet channel as shown on the drawings, including stripping of the top 6 inches below original ground surface on surfaces where earth fill is to be placed in construction of the basin or basin inlet channels.

(2) In Section 5, Use of Excavated Material, Method 1 shall apply.

(3) In Section 6, Disposal of Waste Materials, Method 1 shall apply.

(4) Measurement and payment will be by Method 2.

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, Removal of Water

(1) This item shall consist of the removal of surface and ground water from the construction area shown on the drawings.

(2) No advance plan of dewatering will be required.

(3) No separate payment will be made for the removal of water. Compensation for this work will be included in the payment for Bid Items 27, 28, 29, 30, and 31.

c. Bid Item 29, Structure Excavation, Common

(1) This item shall consist of all excavation required for the installation of the sediment basin outlet structure and pipe, the side inlet at RWCD STA 980+75, the basin inlet structure and side inlet structure for channel #3, as shown on the drawings.

(2) In Section 5, Use of Excavated Materials, Method 1 shall apply.

(3) In Section 6, Disposal of Waste Materials, Method 1 shall apply.

(4) Measurement and payment will be by Method 1, and will include compensation for Subsidiary Item, Removal of Water.

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 11, Dip Crossing Excavation, Common

(1) This item shall consist of all excavation between Station 976+75± and Station 981+00±, centerline Floodway, in excess of specified channel excavation required to construct the Dip Crossing, except structure excavation for the concrete cutoff walls, as shown on the drawings and staked in the field.

(2) In Section 5, Use of Excavated Materials, Method 1 shall apply.

(3) In Section 6, Disposal of Waste Materials, Method 1 shall apply.

(4) Measurement and payment will be by Method 2 and will include compensation for Subsidiary Item, Removal of Water.

b. Bid Item 12, Structure Excavation, Common

(1) This item shall consist of all excavation required to construct concrete cutoff walls for the Dip Crossing as shown on the drawings and staked in the field.

(2) In Section 5, Use of Excavated Materials, Method 1 shall apply.

(3) In Section 6, Disposal of Waste Materials, Method 1 shall apply.

(4) Measurement and payment will be by Method 4 and will include compensation for Subsidiary Item, Removal of Water.

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 30, Structure Backfill

(1) This item shall consist of placing and compacting backfill around the sediment basin outlet pipe.

(2) Backfill material shall consist of suitable CL's, ML's, SC's and SM's (Unified Soil Classification System) obtained from the required excavation as approved by the Engineer. The material shall contain a minimum of 15 percent passing the #200 sieve when determined on a dryweight 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) S.C.S. National Engineering Handbook, Section 19.

(4) The maximum size of rock fragments incorporated in the fill shall be three (3) 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 be by Methods 4 and 7, and will include compensation for Subsidiary Item, Removal of Water. Deduction in volume will be made for embedded conduit and appurtenances.

b. Bid Item 31, Earth Fill

(1) This item shall consist of placing and compacting all earth fill required to construct the floodway between Stations 976+00± and 982+50±, the sediment basin dikes, and fill adjacent to the basin inlet channel.

(2) Fill material shall consist of suitable CL's, ML's, SC's, and SM's (Unified Soil Classification System) obtained from the required excavation, as approved by the Engineer.

(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 D 698 (Standard Proctor Test) or Rapid Compaction. Test (Test No. S-6) S.C.S. 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 be by Methods 1 and 7, and will include compensation for Subsidiary Item, Removal of Water.

c. Subsidiary Item, Spoil Disposal

(1) This item shall consist of placing or stockpiling all spoil in the spoil disposal areas, as shown on the drawings.

(2) Spoil material shall consist of all material resulting from the required excavations not needed to construct the floodway or basin dikes.

(3) Section 6, Compaction, does not apply to this item.

(4) Spoil material shall be placed in layers not to exceed two (2) feet in depth.

(5) The finished surface shall not vary more than one half (0.5) foot, plus or minus, from the average grade.

(6) Spoil shall be placed in the area between the dip crossing and the basin to the minimum elevation shown on the drawings, and in the area between the RWCD Flooding and the RWCD Canal as shown on the drawings. Excess spoil may be placed in these areas as directed by the engineer or shall, at the direction of the engineer, be placed in the spoil disposal areas shown on the RWCD Flooding Reach 2 drawings.

(7) Fill slopes resulting from the deposition of spoil in the disposal areas shown on the Reach 2 drawings shall not be steeper than 2:1 on the east and west sides and 4:1 on the north and south ends.

(8) No special moisture content of spoil material will be required.

(9) No separate payment will be made for spoil disposal. Compensation for this work will be included in the payment for Bid Item 27, Channel Excavation, Common and Bid Item 28, Basin Excavation, Common.

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 13, Structure Backfill

(1) This item shall consist of placing and compacting backfill around the concrete cutoff walls for the Dip Crossing, as shown on the drawings.

(2) Backfill material shall consist of suitable CL's, ML's, SC's and SM's (Unified Soil Classification System) obtained from the required excavation as approved by the Engineer. The material shall 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 compaction tests of the fill materials performed by Method A, ASTM D 698 (Standard Proctor Test), or Rapid Compaction Test (Test No. S-6) S.C.S. National Engineering Handbook, Section 19.

(4) The maximum size of rock fragments incorporated in the fill shall be three (3) 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 be by Methods 4 and 7 and will include compensation for Subsidiary Item, Removal of Water.

b. Subsidiary Item, Spoil Disposal

(1) This shall consist of placing and smoothing all spoil placed in the spoil disposal areas.

(2) Spoil material shall consist of all material resulting from the required excavations not needed to construct the floodway and Dip Crossing.

(3) Section 6, Compaction, does not apply to this item.

(4) The maximum thickness of each layer before smoothing the surface shall not exceed two (2) feet.

(5) The finished surface shall not vary more than one-half (0.5) foot, plus or minus, from the average grade.

(6) Fill slopes resulting from the deposition of spoil in the disposal areas shown on the Reach 2 drawings shall not be steeper than 2:1 on the east and west sides and 4:1 on the north and south ends.

(7) Spoil shall be placed in the area between the dip crossing and the basin to the minimum elevations shown on the drawings and in the area between the RWCD canal and RWCD Floodway as shown on the drawings. Excess spoil may be placed in these areas as directed by the engineer or shall, at the direction of the engineer, be placed in the spoil disposal areas shown on the RWCD Floodway Reach 2 drawings.

(8) No special moisture content of spoil material will be required.

(9) No separate payment will be made for spoil disposal. Compensation for this work will be included in the payment for Bid Item 11, Dip Crossing Excavation, Common.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 32, Drain Fill

(1) This item shall consist of furnishing and placing the drain fill materials in the locations shown on the drawings.

(2) In Section 2, Materials, Method 1 shall apply.

(3) The gradation of the drain fill shall meet the following requirements:

Sieve Size	Percent Passing (Dry Weight Basis)
2"	100
1"	90 - 100
1/2"	80 - 98
3/8"	70 - 95
#4	50 - 78
#10	12 - 44
#20	0 - 14
#30	0 - 9
#200	0 - 3

(4) Drain fill shall be placed in horizontal layers not to exceed 18 inches deep.

(5) In Section 6, Compaction, Class III shall apply.

(6) The moisture content shall be maintained in a range, as determined by the engineer, that will minimize segregation.

(7) The material passing the #200 sieve shall be non-plastic.

(8) Measurement and payment will be in accordance with Section 8.

26. 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, Concrete, Class 3000

(1) This item shall consist of furnishing, forming and placing all items required to construct the basin outlet structure.

(2) In Section 3, Classes of Concrete, and Section 5, Design of the Concrete Mix, Method 1 shall apply. Concrete shall be Class 3000.

(3) Coarse aggregate shall be size No. 67, in accordance with ASTM C 33.

(4) Cement shall be Type II or IIA.

(5) In Section 15, Construction Joints, Method 1 shall apply.

(6) In Section 18, Removal of Forms, Method 1 shall apply.

(7) Curing compound shall be Type 2 conforming to Material Specification 534 and ASTM C 309.

(8) No separate payment will be made for Class 3000 concrete. Compensation for this work will be included in the payment for Bid Item 33, 24-inch Diameter Reinforced Concrete Pipe, Class III.

26. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 5, Concrete, Class 4000X

(1) This item shall consist of furnishing, forming and placing all concrete required to construct the Dip Crossing.

(2) In Section 3, Classes of Concrete, and Section 5, Design of the Concrete Mix, Method 2 shall apply. Concrete shall be Class 4000X.

(3) Coarse aggregate shall be size No. 67, in accordance with ASTM C 33.

(4) In Section 15, Construction Joints, Method 1 shall apply.

(5) In Section 18, Removal of Forms, Method 1 shall apply.

(6) All exposed surfaces shall be finished in the following manner:

Upon patching and pointing all holes as directed in Section 19, the surface shall be promptle covered with polyethylene film, wet burlap or wet cotton mats. If polyethylene film is used, the film shall be help securely to the surface by means of weights, adhesive or other suitable means. only white polyethylene film for covering will be acceptable. When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on the surfaces sufficiently green to work up such lather; otherwise a thin grout composed of one (1) part cement and one (1) part of fine sand may be sued to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be left on the finished surface. A portion of the required cement for the grout shall be white, as required to match the color of the surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform texture.

(7) Curing compound shall be Type 2 conforming to Material Specification, ASTM C 309.

(8) Measurement and payment will be by Method 2 and will include compensation for Subsidiary Item, Cleaning and Painting Metal Work.

b. Bid Item 6, Cement

(1) This item shall consist of furnishing and handling all cement required to construct the concrete items in Bid Item 14.

(2) Cement shall be Type II or IIA.

(3) Measurement and payment will be by Method 2.

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, Steel Reinforcement

(1) This item shall consist of furnishing and installing all steel reinforcement required in the construction of the basin outlet structure.

(2) No separate payment will be made for steel reinforcement. Compensation for this work will be included in payment for Bid Item 33, 24-inch Diameter Reinforced Concrete Pipe, Class III.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 16, Steel Reinforcement

(1) This item shall consist of furnishing and installing all steel reinforcement required in the construction of reinforced concrete for the dip crossing.

(2) Measurement and payment will be by Method 1.

11. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and construction details are:

a. Bid Item 33, 24-inch Diamenter Reinforced Concrete Pipe, Class III

(1) This item shall consist of furnishing and installing all pipe for the basin outlet at RWCD Floodway STA 981+80+, as shown on the drawings.

(2) Pipe shall conform to the requirements of Material Specification 542 and ASTM C 76. The pipe shall be Class III.

(3) Pipe shall be furnished with bell and spigot joints equipped with endless "o" ring type gaskets of circular cross-section.

(4) Cement shall be Type II.

(5) In Section 5, Joining Bell and Spigot Pipe, Method 1 shall apply.

(6) In Section 9, Pressure Testing, Method 1 shall apply.

(7) Measurement and payment will be by Method 1 and will include payment for subsidiary items concrete, Class 3000; Metalwork, and cleaning and painting metalwork.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 34, Loose Rock Riprap

(1) This item shall consist of furnishing and placing all loose rock riprap, including bedding, in the floodway, and inlets as follows:

(a) Floodway

Station 976+00 to Station 977+25
Station 979+45± to Station 982+04±

(b) Side inlet at RWCD Floodway Station 980+75, including bedding material placed over the side inlet weir as shown on the drawings.

(c) The side inlet for Channel #3.

(d) The basin inlet structure.

(e) The basin inlet channel.

(2) The rock shall be graded as follows:

Particle Size (inch)	Percent Passing (by Dry Wt.)
15	100
12	75 - 100
9	60 - 85
6	25 - 40
4	10 - 25
3	0 - 10

(3) Rock shall be either hand or equipment placed.

(4) Bedding beneath riprap shall be graded as follows:

U. S. Sieve Size	Percent Passing (by Dry Wt.)
1"	100
3/4"	85 - 100
#4	60 - 80
#16	40 - 60
#40	22 - 44
#200	0 - 3

Size No. 67 blended with fine aggregates in accordance with ASTM C 33 meets these requirements.

(5) Measurement and payment will be by Method 1.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 34, Loose Rock Riprap

(1) This item shall consist of furnishing and placing all loose rock riprap, including bedding, in the floodway, and inlets as follows:

(a) Floodway

Station 976+00 to Station 977+25
Station 979+45± to Station 982+04±

(b) Side inlet at RWCD Floodway Station 980+75, including bedding material placed over the side inlet weir as shown on the drawings.

(c) The side inlet for Channel #3.

(d) The basin inlet structure.

(e) The basin inlet channel.

(2) The rock shall be graded as follows:

Particle Size (inch)	Percent Passing (by Dry Wt.)
15	100
12	75 - 100
9	60 - 85
6	25 - 40
4	10 - 25
3	0 - 10

(3) Rock shall be either hand or equipment placed.

(4) Bedding beneath riprap shall be graded as follows:

U. S. Sieve Size	Percent Passing (by Dry Wt.)
1"	100
3/4"	85 - 100
#4	60 - 80
#16	40 - 60
#40	22 - 44
#200	0 - 3

Size No. 67 blended with fine aggregates in accordance with ASTM C 33 meets these requirements.

(5) Measurement and payment will be by Method 1.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 17, Loose Rock Riprap

(1) This item shall consist of furnishing and placing of loose rock riprap, including bedding, adjacent to the Dip Crossing At Hunt Highway, as shown on the drawings and staked in the field.

(2) The rock shall be graded as follows:

Particle Size (inches)	Percent Passing (by Dry Weight)
15	100
12	75 - 100
9	60 - 85
6	25 - 40
4	10 - 25
<3	0 - 10

(3) Rock shall be either hand or equipment placed.

(4) Bedding beneath riprap shall be graded as follows:

US Sieve Size	Percent Passing (by Dry Weight)
1"	100
3/4"	85 - 100
#4	60 - 80
#16	40 - 60
#40	22 - 44
#200	0 - 3

Size No. 67 blended with fine aggregates in accordance with ASTM C 33 meets these requirements.

(5) Measurement and payment will be by Method 1 and shall include compensation for Subsidiary Item, Removal of Water.

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 35, Grouted Rock Riprap

(1) This item shall consist of the furnishing and placing of grouted rock riprap and bedding at the side inlet at RWCD Floodway Station 980+75, the side inlet for Ch. #3, and the basin inlet structure, as shown on the drawings and staked in the field.

(2) The rock shall be graded as follows:

Particle Size (inch)	Percent Passing (by Dry Weight)
15	100
12	75 - 100
9	60 - 85
6	25 - 40
4	10 - 25
3	0 - 10

(3) Rock shall be either hand or equipment placed.

(4) Bedding beneath riprap shall be graded as follows:

U. S. Sieve Size	Percent Passing (by Dry Weight)
1"	100
3/4"	85 - 100
#4	60 - 100
#16	40 - 60
#40	22 - 44
#200	0 - 3

Size No. 67 blended with fine aggregates in accordance with ASTM C 33 meets these requirements.

(5) 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.

(6) Cement shall be Type II of IIA.

(7) Measurement and payment will be by Method 1.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Metal Work

(1) This item shall consist of fabricating and installing the basin outlet trash rack and drain grates as shown on drawings.

(2) The trash rack and drain grates shall be fabricated of structural steel conforming to the requirements of ASTM A 36.

(3) The trash rack and drain grates shall be painted in the manner specified in Construction Specification 82.

(4) Equal quality manufactured drain grates may be substituted witb approval of engineer.

(5) No separate payment will be made for this item. Compensation will be included in Bid Item 33, 24-inch Diameter Reinforced Concrete Pipe, Class III.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Metal Work

(1) This item shall consist of the fabrication and installation of depth gauges as shown on the drawings and directed by the Engineer.

(2) Painting shall be in accordance with Construction Specification 82.

(3) No separate payment will be made for metal work. Compensation for this work will be included in the payment for Bid Item 14, Reinforced Concrete Clss 4000X.

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 Items, Cleaning and Painting Metal Work

(1) This item shall consist of cleaning and painting the basin outlet trash rack and drain grates as shown on the drawings.

(2) In Section 3, Surface Preparation, Method 2 shall apply.

(3) In Section 4, Painting Systems, Paint System C shall apply for the trash rack and drain grate in Bid Item 33, except that Type 4 paint shall be used in place of Type 2 or 3 paint for the priming coat.

(4) No separate payment will be made for this item. Compensation will be included in Bid Item 33, 24-inch Diameter Reinforced Concrete Pipe, Class III.

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 cleaning and painting the depth guages.

(2) In Section 3, Surface Preparation, Method 2 shall apply.

(3) In Section 4, Paint Systems E (except that Type 4 paint shall be used in place of Type 2 paint for the priming coat) shall apply. The two top coats of enamel paint on the depth guages shall alternate white background with green numbers, and green background with white numbers.

(4) No separate payment will be made for cleaning and painting. Compensation for this work will be included in the payment for Bid Item 14, Concrete, Class 4000X.

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 18, Asphalt Concrete Pavement

(1) This item shall consist of furnishing and installing the asphalt concrete pavement, including the untreated base and preservative seal for the following work:

(a) The dip crossing between Station 976+75± and Station 981+00± centerline floodway.

(2) Payment will be made in accordance with Section 7.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 36, Surveys

(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) The Contractor shall provide the Government Representative a statement of qualifications, including specific experience of each of the survey personnel assigned to the job.

(3) The Contractor shall provide the Government Representative schedule of surveys to be performed each month.

(4) In Section 5, Construction Surveys and Measurements, all entries in the bound field notebooks shall follow the format shown on pages 2-40 and 2-42 of the Soil Conservation Service National Engineering Handbook, Section 19.

(5) In Section 6, Staking, the location and marking of stakes shall follow the format shown on pages 2-13, 2-15, 2-17 and 2-20 of the Soil Conservation Service National Engineering Handbook, Section 19.

(6) Payment will be in accordance with Section 8.