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POWER LINE DAM

Hydrology & Hydraulics & Structure Design

713

A310.707

SCS-344a 5-57
Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

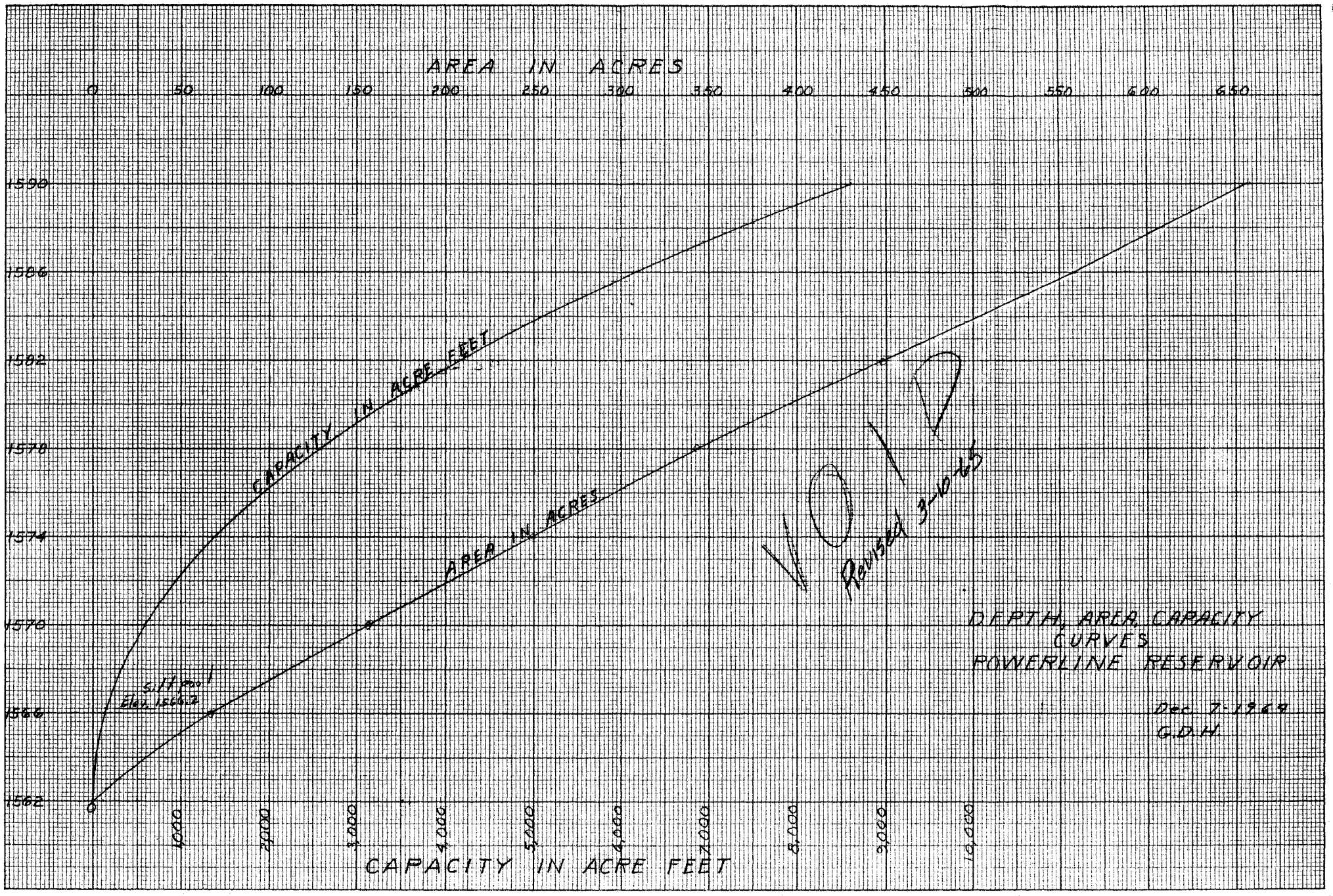
P

Power Line Dam & Floodway

Planimetered with large planimeter D.H.H. 11-6-64

1. Elev	2. Planimeter Area	3. (2) x 10.71 = Area in Ac.	4. Average end Area	5. Ac. Ft. (4) x diff in Elev.	6. Acc. Ac. ft.			
1562	0	0						
1566	6.27	67.15	33.575	134.3	134.3			
1570	14.64	156.79	111.970	447.88	582.18			
1574	23.26	249.11	202.950	811.80	1,393.98			
1578	32.07	343.47	296.290	1,185.16	2,579.14			
1582	41.84	448.11	395.790	1,583.16	9,162.3			
1586	52.14	558.42	503.265	2,013.06	6,175.36			
1590	61.31	656.63	607.525	2,430.10	8,605.46			

Revised 3-10-65


AREA IN ACRES
0
50
100
150
200
250
300
350
400
450
500
550
600
650
1590
1586
1582
1578
1574
1570
1566
1562
CAPACITY IN ACRE-FEET
AREA IN ACRES
S.M. Pool
Elev. 1564.2
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
CAPACITY IN ACRE FEET
Revised 3-10-65
DEPTH, AREA, CAPACITY
CURVES
POWERLINE RESERVOIR
Dec 7-1964
G.D.H.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Power Line Dam & Floodway
Depth - Capacity Calculations
Planimetered with large planimeter P.M.W. 3-9-65

1. Elev.	2. Planimeter Area	3. (2) x 10.71 = Area in Ac.	4. Average end Area	5. Ac. Ft. (4) x diff. in Elev.	6. Acc. Ac. Ft.			
1564	0	0						
1566	3.68	39.44	19.72	39.44	39.44			
1568.2	8.28	88.68	64.06	140.93	180.37			
1570	12.05	129.08	~~84.26~~	~~337.04~~	~~376.48~~			
			108.88	195.98	376.48			
1574	20.67	221.40	175.24	700.96	1,077.44			
1578	29.48	315.76	268.58	1,074.32	2,151.76			
1582	39.25	420.40	368.08	1,472.32	3624.08			
1583.3	42.60	456.25	438.33	569.83	4,193.91			
1586	~~49.55~~	~~530.71~~	~~475.55~~	~~1,902.20~~	~~5,526.28~~			
			493.48	1,332.90	5,526.28			
1590	58.72	628.92	579.81	2,319.24	7,845.52			

Arizona Powerline Dam
Watt 3-30-65

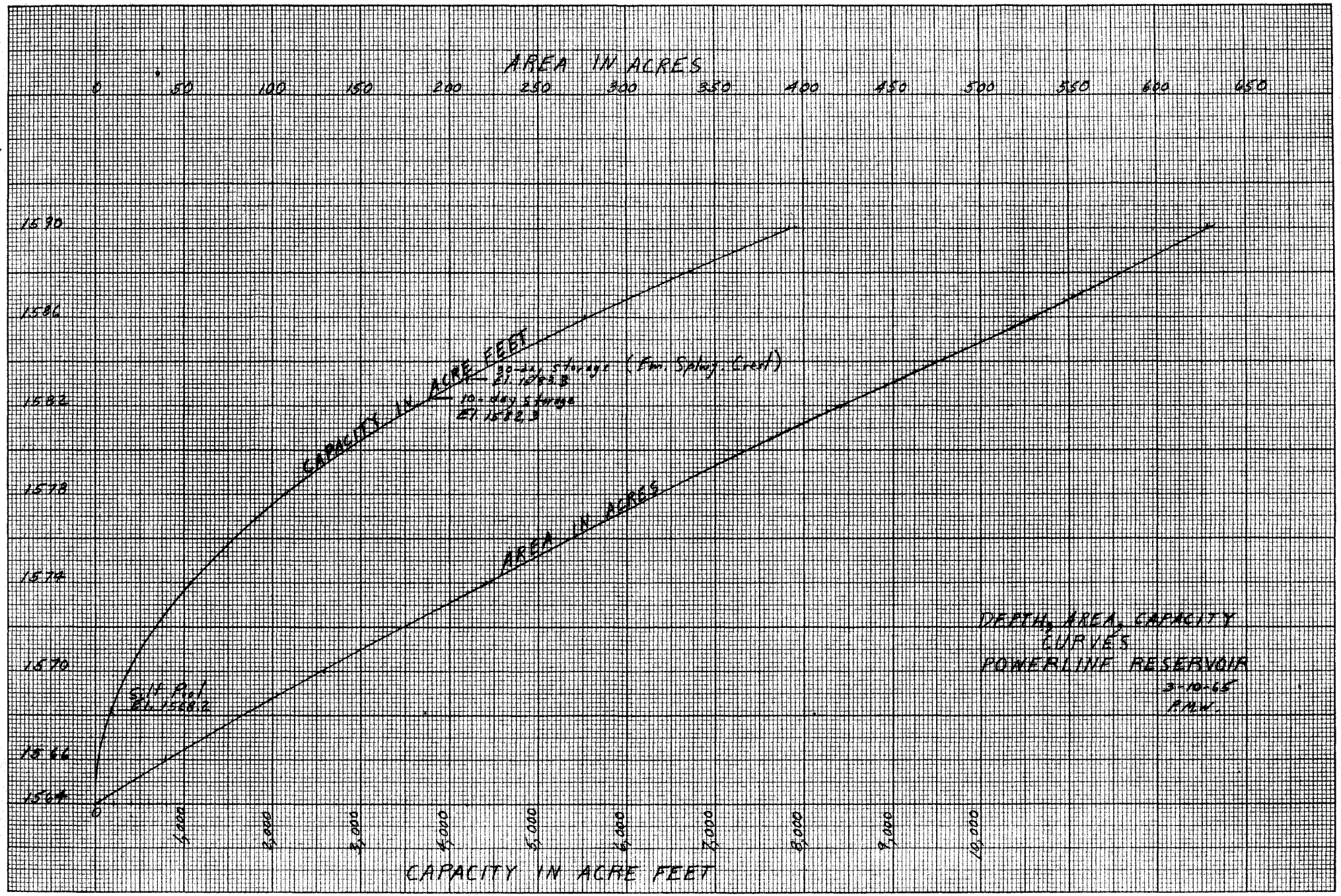
Comparison of Depth Capacity Curve of Original & Revised Location

Capacity	Org Elev	Revised Elev	Diff in WS Elev
1000	72.3	73.6	1.3
2000	76.2	77.5	1.3
3000	79.2	80.4	1.2
4000	81.7	82.8	1.1
5000	83.8	84.9	1.1
6000	85.7	86.8	1.1
8000	89.1	90.2	1.1

Elev for 4021 flood storage & 175 Ac Ft silt storage

Revised Location = 1583.3 = Crest Emg Sp
Original = 1582.2 = " " "
Diff = 1.1

Because the depth capacity curves so closely parrallel each other we will use the same size & depth of emergency spillway as determined in the original flood Routing Freeboard Hydrograph is routed from storage starting at 3667 above which storage curves are parrallel


AREA IN ACRES
0
50
100
150
200
250
300
350
400
450
500
550
600
650
1590
1586
1582
1578
1574
1570
1566
1564
CAPACITY IN ACRE FEET
30-day storage (Em. Splwy. Crest)
El. 1583.3
10-day storage
El. 1582.3
AREA IN ACRES
Silt Pool
El. 1568.2
DEPTH, AREA, CAPACITY
CURVES
POWERLINE RESERVOIR
3-10-65
P.M.W.
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
CAPACITY IN ACRE FEET

P

Arizona Power Line

D.N.H. 11-8-64

Power Line Drainage Area in Sq. Miles 1 1

Power Line Drainage Area incl. Weekes Wash 49.59 sq m

Weekes Wash only 11.20 sq m

Subdrainage in northern part of Power Line Drainage 1.96 sq m

49.59

Power Line Drainage Area minus Weekes Wash, minus Subdrainage in northern part of Power Line Drainage 36.43 sq m

Area deducted by relocation of Powerline Dam 11.7 sq. m

Previous Powerline Drainage Area = 49.9 sq. mi.
Relocated Powerline Dam Drainage Area = 49.6

Net difference = −0.3 sq. mi.

Arizona — Powerline Dam - Maricopa County Watershed

PMW 11-13-64

Revised Hydrology for the Dam 1

Refer to Soil Cover Map with new Location of Powerline Dam shown on it.
See pages 50 and 51 of the Hydrology Documentation.

Determination of Curve Numbers for area above Powerline Dam: D.A. = 49.6 sq. mi.

Unit No.	D.A.	Weighted Curve Number	D.A. x Wtd. C.N.
4	2.34	84.75	198.31
6	6.00	79.4	476.40
7	10.90	83.0	904.70
8	6.44	83.5	537.74
9	10.83	81.6	883.73
10	1.43	84.75	121.19
12	7.00	83.75	586.25
13	3.80	84.25	320.15
14	0.86	80.0	68.80

Composite Curve Number = $\frac{4092.27}{49.6} = 82.51$ say 83

Compute Rainfall

Point precipitation, 6 hr., P = 4.10"

See page 47 of Hydrology Documentation.

Time	Ratio to 6th hr.			Areal Precip. Corr.		Rainfall
2 hr.	0.76	x 4.10	= 3.12	x 0.66	=	2.02
4 hr.	0.89	x 4.10	= 3.65	x 0.66	=	2.40
6	1.00	x 4.10	= 4.10	x 0.66	=	2.71
12	1.23	x 4.10	= 5.04	x 0.66	=	3.31
24	1.53	x 4.10	= 6.27	x 0.66	=	4.15

Arizona — Powerline Dam – Maricopa County Watershed

PMW 11-16-64

Revised Hydrology for the Dam

2

Compute Runoff Volume from Rainfall

Time (hrs)	Rainfall (inches)	Sub-Runoff (inches)		Transmission Loss Factor		Runoff Volume
2 hr	2.02	0.71	×	0.66	=	0.47
4	2.40	0.98	×	0.66	=	0.65
6	2.71	1.22	×	0.66	=	0.80
12	3.31	1.70	×	0.66	=	1.12
24	4.15	2.41	×	0.66	=	1.59

Volume – Duration:

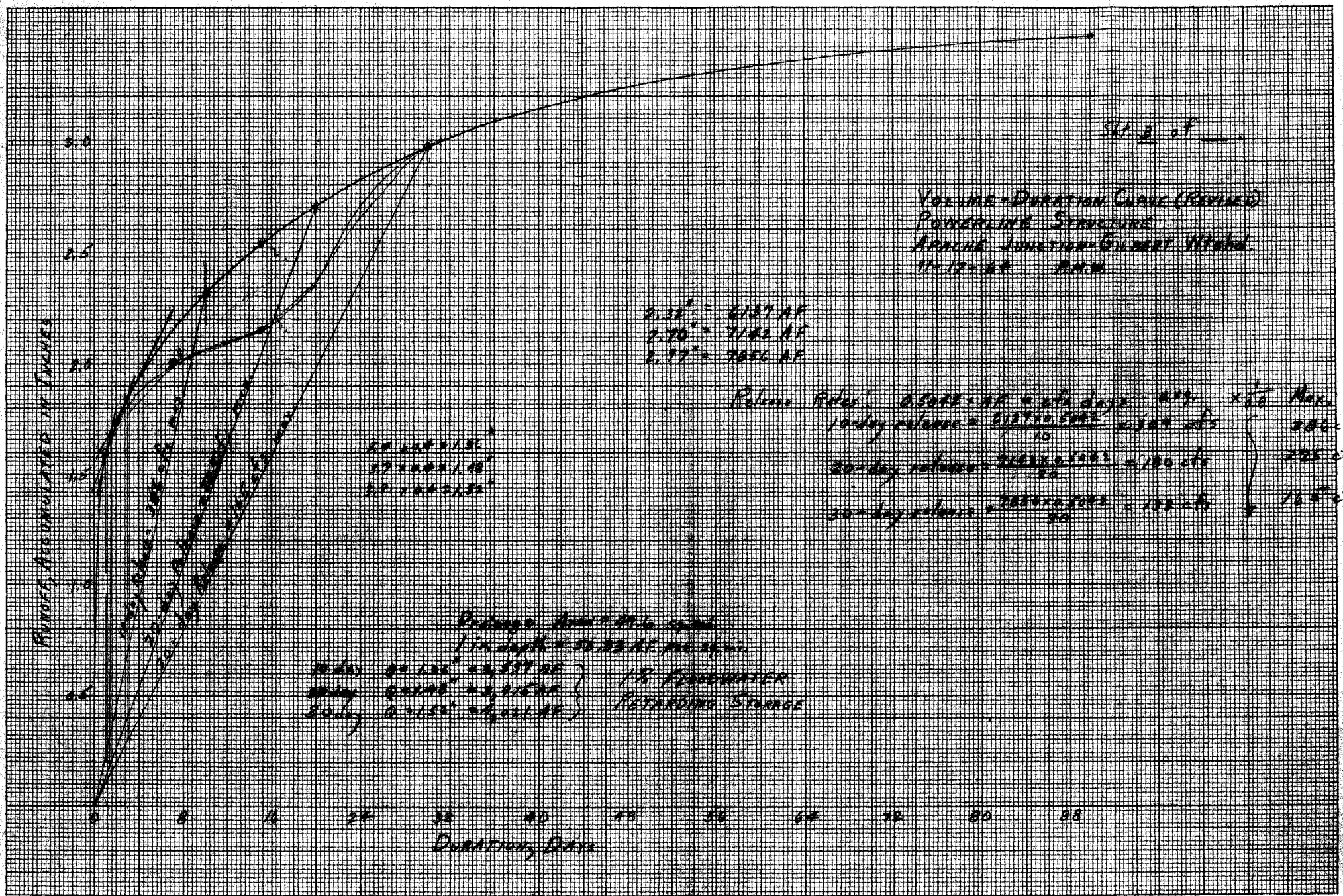
24 hour Runoff Volume = 1.59 inches.

Time	Runoff Ratio	Accumulated Runoff, inches
24 hrs.	1.00	1.59
2 days	1.09	1.73
7 days	1.25	1.99
15 days	1.49	2.37
30 days	1.87	2.97
90 days	2.18	3.47

Plot values on Graph as a curve, Sheet 3.

$T_p = T_c = 1.88$

$$Q_p = \frac{484 \times 49.6 \times 10.80}{1.88} = 10,215$$



Sht. 3 of ___
VOLUME-DURATION CURVE (REVISED)
POWERLINE STRUCTURE
APACHE JUNCTION-GILBERT Wtshd.
11-17-64 P.M.W.
2.32" = 6137 AF
2.70" = 7142 AF
2.97" = 7856 AF
Release Rates: 0.5042 × AF = cfs days avg. × 1/0.8 Max.
10-day release = 6137 × 0.5042 / 10 = 309 cfs
20-day release = 7142 × 0.5042 / 20 = 180 cfs
30-day release = 7856 × 0.5042 / 30 = 132 cfs
286 cfs
225 cfs
165 cfs
Drainage Area = 49.6 sq. mi.
1 in. depth = 53.33 AF per sq. mi.
10 day Q = 1.36" = 3,597 AF
20 day Q = 1.48" = 3,916 AF
30 day Q = 1.52" = 4,021 AF
1% FLOODWATER RETARDING STORAGE
RUNOFF, ACCUMULATED IN INCHES
DURATION, DAYS
0
8
16
24
32
40
48
56
64
72
80
88
0.5
1.0
1.5
2.0
2.5
3.0

Arizona Powerline Dam - Maricopa County Watershed
PMW 11-18-64
Revised Hydrology for the Dam 4

Time of Concentration: Chapter 21 of Hydrology

From page 108 of Hydrology Documentation, time of concentration $t_c = 1.88$ hrs. for new location of Powerline Dam.

SCS-319
6-58

11-23-64

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Em. Splwy.

Design HYDROGRAPH COMPUTATION
Revised from Planning Hydrograph for new location

Sht. 5 of ___.

WATERSHED OR PROJECT East Maricopa Wtsh.d. STATE Arizona

STRUCTURE SITE OR SUBAREA Powerline Retarding Dam

DR. AREA 49.6 SQ. MI. T_c 1.88 HR. RUNOFF CONDITION NO. II

RUNOFF CURVE NO. 83 . STORM DISTRIB. CURVE A . HYDROGRAPH FAMILY NO. 3

STORM DURATION 6 HR. RAINFALL: POINT 3.5 IN. Dorrok 0.88 AREAL 2.03 IN.

Q 0.75 IN. COMPUTED T_p 1.32 HR. T_o 5.72 HR.

(T_q / T_p): COMPUTED 4.33 ; USED 4.0 . REVISED T_p 1.43 .

$q_p = \frac{484\ A}{REV.\ T_p}$ = 16,788 CFS. Qq_p = 12,591 CFS.

t(COLUMN) = (t/T_p) REV. T_p. q(COLUMN) = (q_c/q_p) Qq_p.

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21			41		
2	0.66	441	22			42		
3	1.31	1977	23			43		
4	1.97	3488	24			44		
5	2.63	4104	25	$\Delta t = 0.6578$		45		
6	3.29	4193	26	$\Sigma q = 36,982$		46		
7	3.95	4092	27			47		
8	4.60	3979	28	$Q = \frac{(0.6578)(36,982)}{645\ (49.6)}$		48		
9	5.26	3865	29			49		
10	5.92	3752	30	Q = 0.76 in.		50		
11	6.58	3148	31			51		
12	7.24	1939	32	% error = $\frac{0.01}{0.75}$ =		52		
13	7.89	1007	33	→ 1.3%		53		
14	8.55	504	34			54		
15	9.21	227	35			55		
16	9.87	139	36			56		
17	10.52	76	37			57		
18	11.18	38	38			58		
19	11.84	13	39			59		
20	12.50	0	40			60		

EM 27
P
class b
0.75 × 4 = 3.00
class c
4.00
NVJ 3.5" = 3.5
24,327 / 31,992

SCS-319
6-58

11-23-64

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Em. Spl wy.

Freeboard HYDROGRAPH COMPUTATION
Revised from Planning Hydrograph for new location

Sht. 6 of —.

WATERSHED OR PROJECT East Maricopa Wtshd. STATE Arizona

STRUCTURE SITE OR SUBAREA Powerline Retarding Dam

DR. AREA 49.6 SQ. MI. T_c 1.88 HR. RUNOFF CONDITION NO. II

RUNOFF CURVE NO. 83 . STORM DISTRIB. CURVE A . HYDROGRAPH FAMILY NO. 2

STORM DURATION 6 HR. RAINFALL: POINT 7.5 IN. Darrah 0.58 AREAL 4.35 IN.

Q 2.6 IN. COMPUTED T_p 1.32 HR. T_o 5.85 HR..

(T_o / T_p): COMPUTED 4.43 : USED 4.0 . REVISED T_p 1.46 .

$q_p = \frac{484\ A}{REV.\ T_p}$ = 16,443 CFS. Qq_p = 42,751 CFS.

t(COLUMN) = (t/T_p) REV. T_p. q(COLUMN) = (q_c/q_p) Qq_p.

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	11.39	86	41		
2	0.57	1796	22	11.96	43	42		
3	1.14	8037	23	12.53	0	43		
4	1.71	14,236	24			44		
5	2.28	16,160	25			45		
6	2.85	15,647	26			46		
7	3.42	14,663	27	$\Delta t = 0.5694$		47		
8	3.99	13,595	28	$\Sigma q = 148,644$		48		
9	4.55	12,526	29			49		
10	5.12	11,500	30	$Q = \frac{(0.5694)(148,644)}{645\ (49.6)}$ 31,992		50		
11	5.69	10,816	31	$Q = 2.646$ in.		51		
12	6.26	9,961	32			52		
13	6.83	7,994	33	% error = $\frac{0.046}{2.6}$ =		53		
14	7.40	5,087	34	→ 1.7%		54		
15	7.97	2,907	35			55		
16	8.54	1,667	36			56		
17	9.11	940	37			57		
18	9.68	513	38			58		
19	10.25	299	39			59		
20	10.82	171	40			60		

P
EM27
class (b)
1.25 / 4 / 5.00
class (c)
2.5 / 4 / 10.0
84,638 / 31,992

Arizona Powerline Dam

PMW 12-1-64

Principal Spillway Depth-Discharge Curve Computations 7

The Principal Spillway Discharge is directly proportional to the square root of the head on the pipe. That is,

$$Q = K H^{1/2}$$

The 1% storm results in an emergency spillway crest elevation of. (Refer to Depth-Capacity curve and Volume-Duration Curve);

10-day release = Em. Splwy. El. 1581.1

30-day release = Em. Splwy. El. 1582.2

The Principal Spillway release rates are:

Q, 10-day release = 386 cfs

Q, 30-day release = 165 cfs

The Corresponding Discharge Curves are:

10-day release, $Q = 386$ cfs

$H = 81.1 - 63 = 18.1$ ft.

$$K = \frac{386}{\sqrt{18.1}} = 90.7$$

$$\therefore \underline{Q = 90.7 H^{1/2}} \quad (10\text{-day})$$

30-day release, $Q = 165$ cfs

$H = 19.2$ ft.

$$K = \frac{165}{\sqrt{19.2}} = 37.6$$

$$\therefore \underline{Q = 37.6 H^{1/2}} \quad (30\text{-day})$$

This is close enough for routing the 6-hr storm thru the emergency spillway.

Arizona Powerline Dam

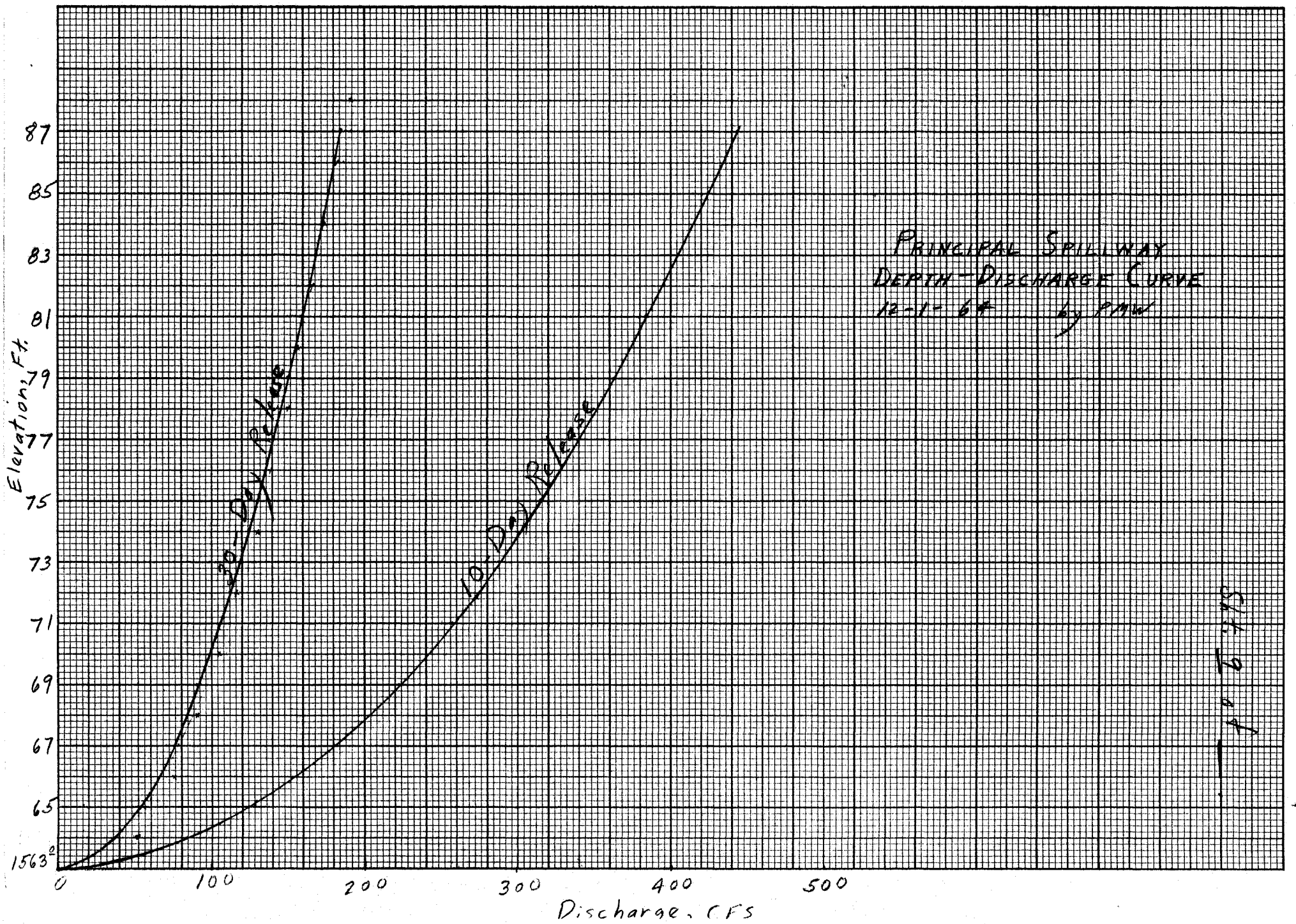
pmw 12-1-64

Principal Spillway Depth-Discharge Curve 8

Elev. top of pr. splwy. conduit = 1563

10-day release $Q = 90.7\ H^{1/2}$				30-day release $Q = 37.6\ H^{1/2}$			
H	$H^{1/2}$	Q	Elev.	H	$H^{1/2}$	Q	Elev.
2	1.41	128	1565	2	1.41	53	1565
4	2.0	181	67	4	2.0	75	67
6	2.45	222	69	6	2.45	92	69
8	2.83	257	71	8	2.83	106	71
10	3.16	287	73	10	3.16	119	73
12	3.46	314	75	12	3.46	130	75
14	3.74	339	77	14	3.74	141	77
16	4.0	363	79	16	4.0	150	79
18	4.24	384	81	18	4.24	159	81
20	4.47	405	83	20	4.47	168	83
22	4.69	425	1585	22	4.69	176	1585
24	4.90	444	87	24	4.90	184	87
26	5.10	463	89	26	5.10	192	89

K&E 10 X 10 TO THE ⅛ INCH KEUFFEL & ESSER CO. 359-11 MADE IN U. S. A.



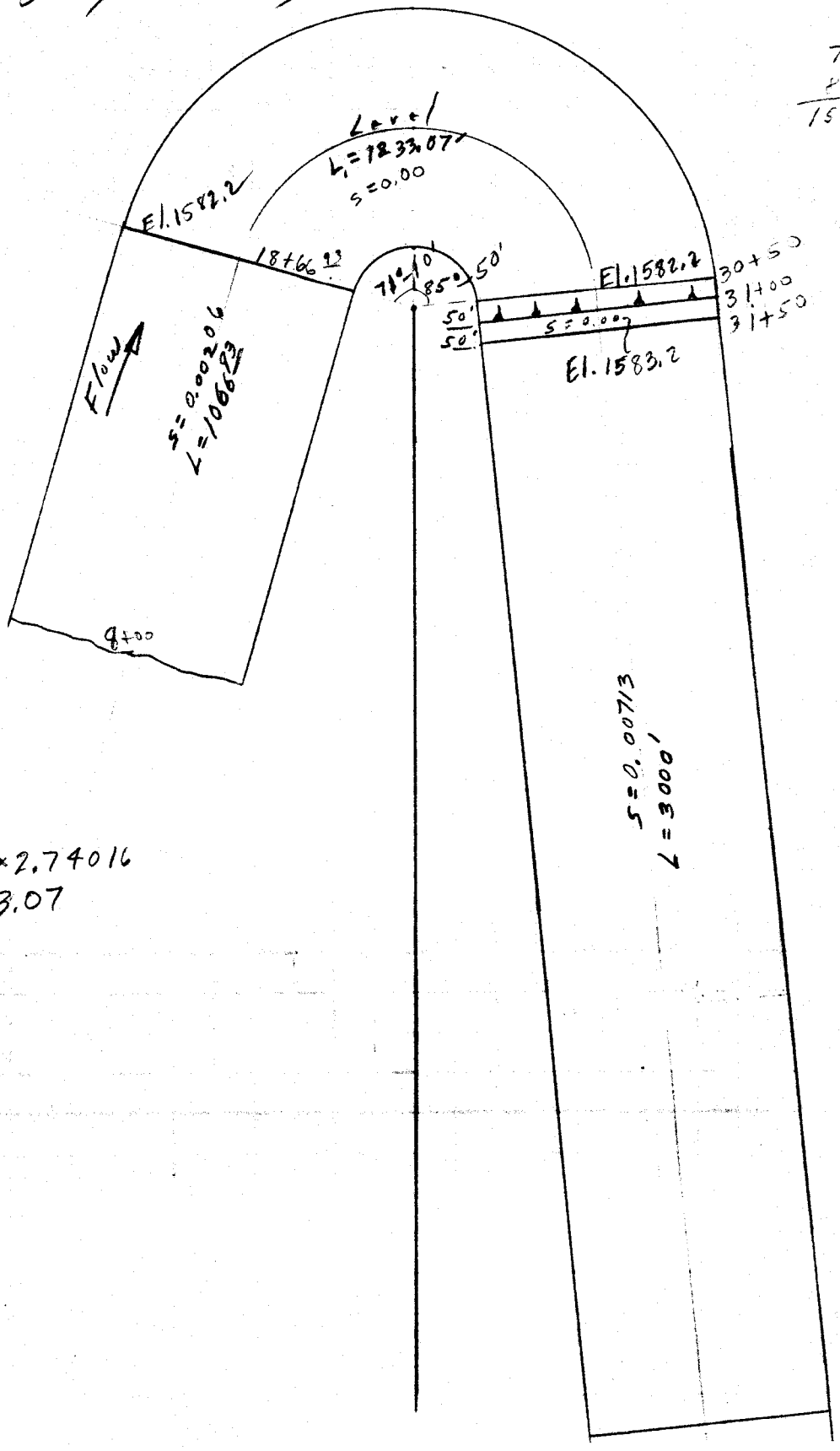
Arizona Powerline Dam

PMW 12-2-64

Emergency Spillway Plan

10

71° 10'
+ 85° 50'
157 0



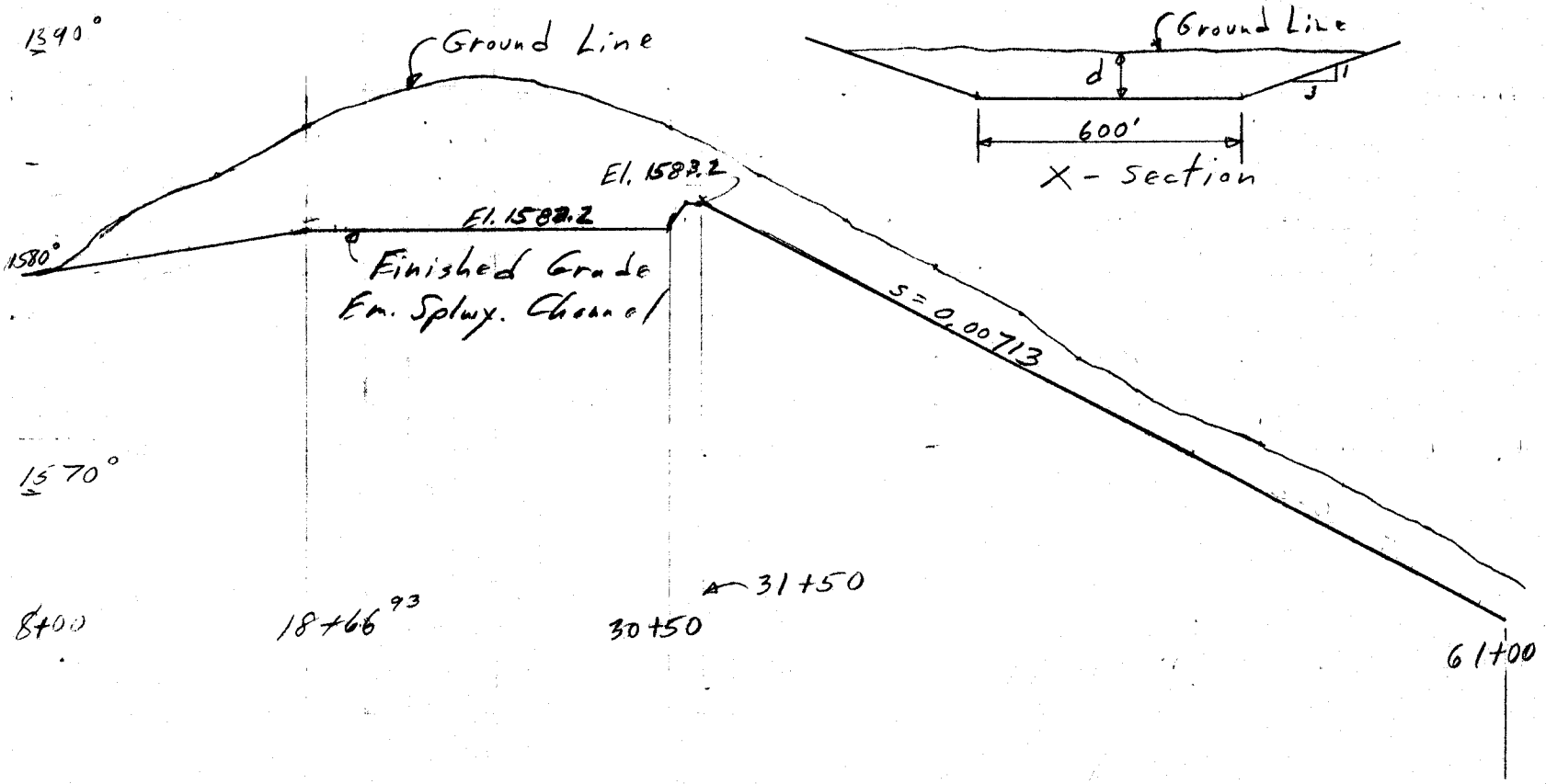
$L_1 = R\theta$

$= 450 \times 2.74016$

$L_1 = 1233.07$

Horiz. Scale: 1" = 600 ft.
Vert. Scale: 1" = 8'

Arizona
PMW 12-2-64
Emergency Spillway Profile & Cross-section
Powerline Dam



11

P

Arizona — Powerline Dam - Maricopa County Watershed

PMW 12-4-64

Em. Spdwy Water-surface Profiles - Using Watt's U-curves 12

$d = 0.5$ ($\frac{q^2}{2g} = 0.026$) Sta.	d	$d = 1.0$ ($\frac{q^2}{2g} = 0.262$) Sta.	d	$d = 1.5$ ($\frac{q^2}{2g} = 1.01$) Sta.	d
23+40	0.5	23+40	1.0	23+40	1.5
22+90	0.75	22+90	1.36	22+90	1.82
22+40	1.85	22+40	2.53	22+40	3.13
10+40	2.00	10+40	3.05	10+40	3.75
10+00	2.02	10+00	3.05	10+00	3.77
8+00	2.45	8+00	3.50	8+00	4.25
6+00	2.90	6+00	3.92	6+00	4.70
4+00	3.33	4+00	4.35	4+00	5.14
2+00	3.75	2+00	4.75	2+00	5.56
0+00	4.15	0+00	5.15	0+00	5.97

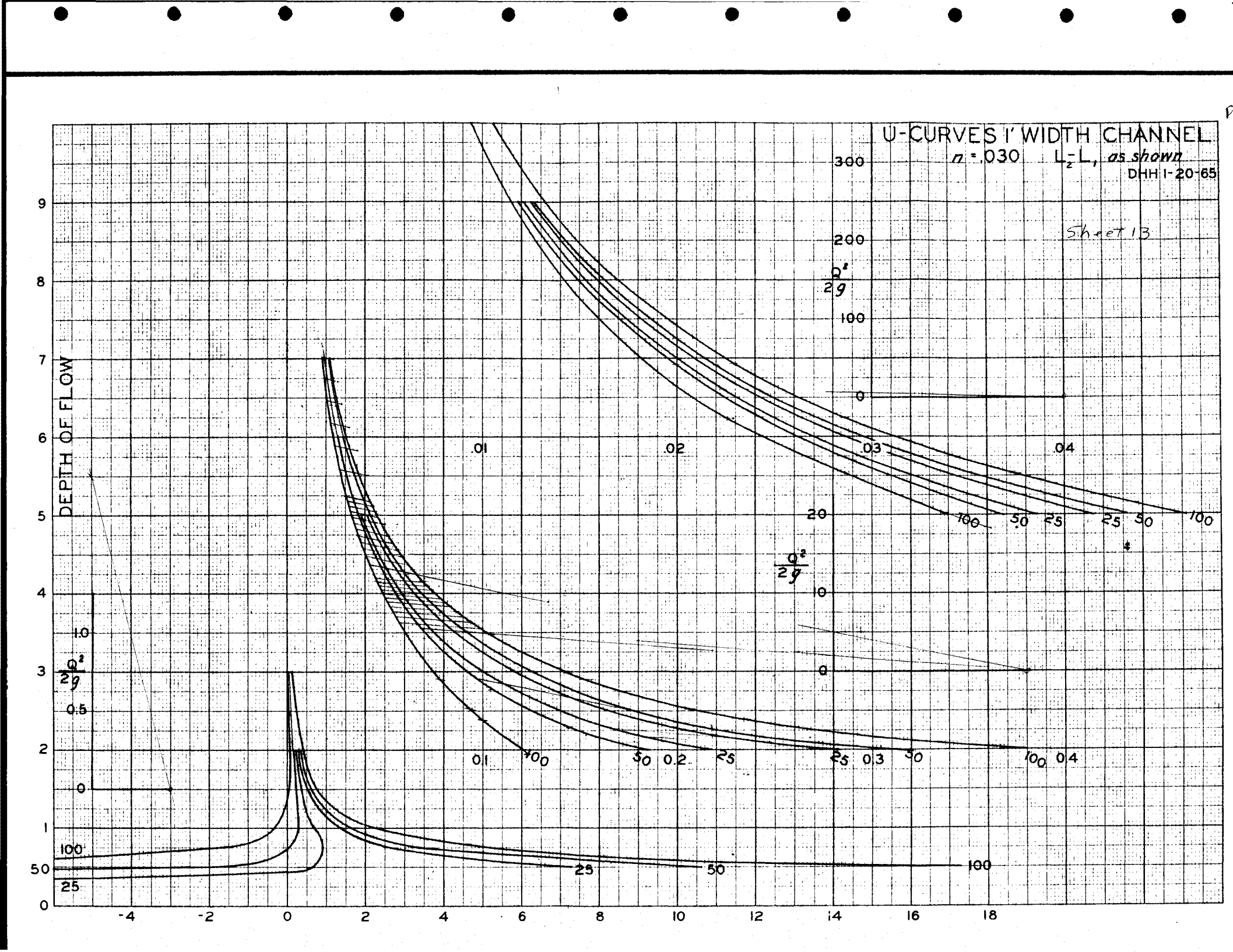
1240

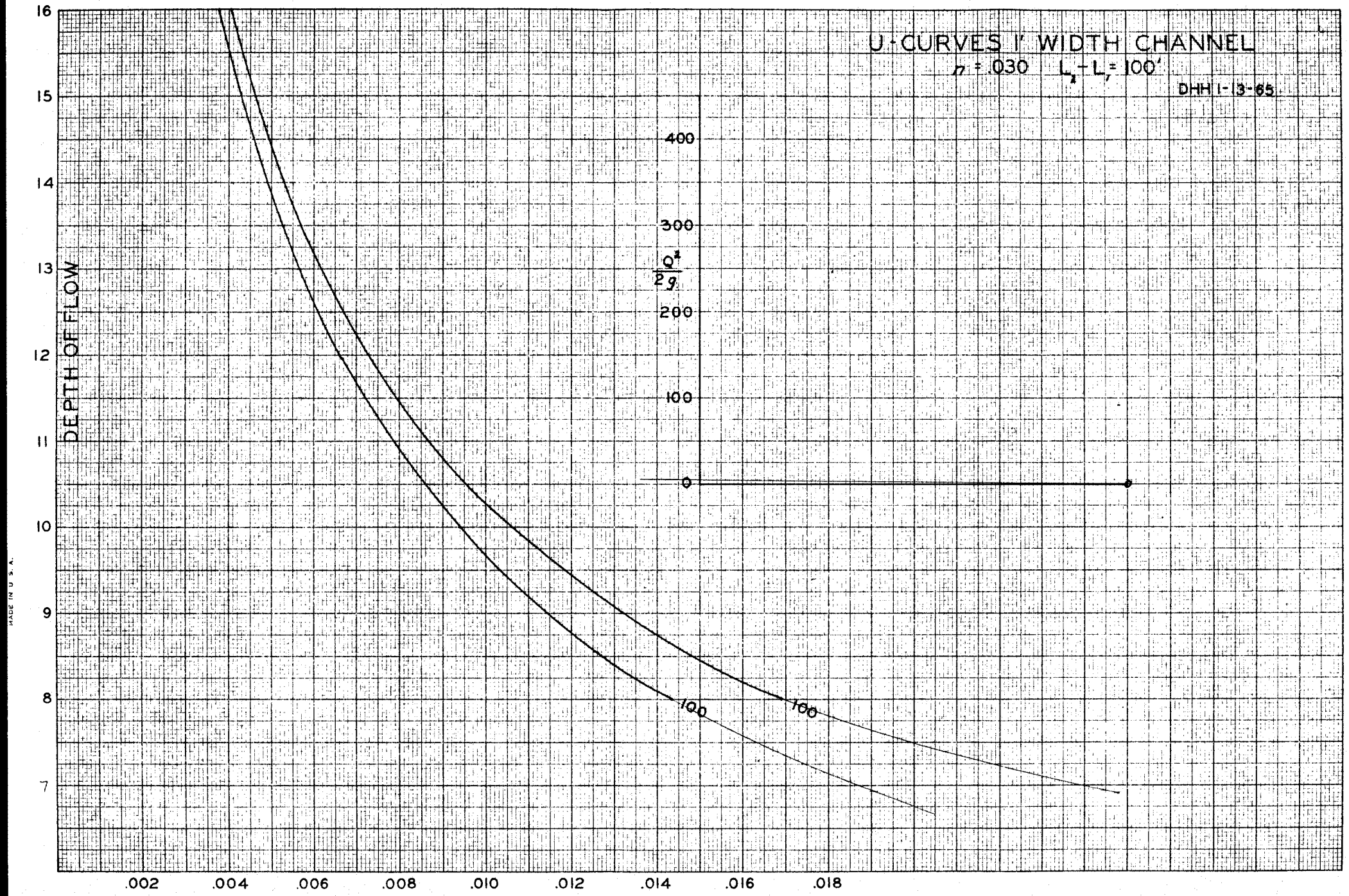
Use for w.s. Elev. in pool → 4+00

($\frac{q^2}{2g} = 2.65$) $d = 2.0$ Sta.	d	$d = 3.0$ ($\frac{q^2}{2g} = 10.21$) Sta.	d	($\frac{q^2}{2g} = 26.71$) $d = 4.0$ Sta.	d	($\frac{q^2}{2g} = 56.18$) $d = 5.0$ Sta.	d
23+40	2.0	23+40	3.0	23+40	4.0	23+40	5.0
22+90	2.47	22+90	3.57	22+90	4.60	22+90	
22+40	3.84	22+40	5.12	22+40	6.38	22+40	
10+40	4.60	10+40	6.27	10+40	7.87	10+40	
10+00	4.62	10+00	6.28	10+00	7.90	10+00	
8+00	5.12	8+00	6.86	8+00	8.76	8+00	
6+00	5.61	6+00	7.39	6+00	9.25	6+00	
4+00	6.06	4+00	7.89	4+00	9.76	4+00	
2+00	6.51	2+00	8.37	2+00		2+00	
0+00	6.95	0+00	8.83	0+00		0+00	

Use for w.s. Elev. in pool → 4+00

44 46


U-CURVES 1' WIDTH CHANNEL
n = .030 L₂-L₁ as shown
DHH 1-20-65
Sheet 13
DEPTH OF FLOW
Q²/2g
300
200
100
0
20
10
0
1.0
0.5
0
100
50
25
.01
.02
.03
.04
.1
.2
.3
.4
25
50
100
9
8
7
6
5
4
3
2
1
0
-4
-2
0
2
4
6
8
10
12
14
16
18


U-CURVES 1' WIDTH CHANNEL
n = .030 L2 - L1 = 100'
DHH 1-13-65
DEPTH OF FLOW
16
15
14
13
12
11
10
9
8
7
400
300
Q²/2g
200
100
0
100
100
.002
.004
.006
.008
.010
.012
.014
.016
.018

Arizona Powerline Dam

PMW 12-2-64

Emergency Spillway Rating Curve 14

downstream slope = 0.00689

$b = 600'$ $SS = 3:1$ $n = 0.030$

assume $(r = d)$ [Use Table 90, King's]

d	nv	V	$Q/b = q$	d_c	hv
0.5	0.0777	2.59	1.30	0.37	0.10
1.0	0.1234	4.11	4.11	0.70	0.26
1.5	0.1617	5.39	8.08	1.28	0.45
2.0	0.1959	6.53	13.06	1.75	0.66
3.0	0.2567	8.55	25.65	2.73	1.13
4.0	0.3110	10.37	41.48	3.78	1.67
5.0	0.3608	12.03	60.15	4.82	2.25

Em. Splwy. El. 1581.1

d	Q/b	$q^2/2g$	d adj.	Sta.	Remaining v	Remaining hv	Total d	Elev. Bott.	Pool Elev.
0.5	1.30	0.0262	3.33	4+00	0.39	0	3.33	1578.9	1582.23
1.0	4.11	0.2623	4.35	4+00	0.94	0.01	4.36	1578.9	1583.26
1.5	8.08	1.0138	5.14	4+00	1.57	0.04	5.18	1578.9	1584.08
2.0	13.06	2.65	6.06	4+00	2.15	0.07	6.13	1578.9	1585.03
3.0	25.65	10.21	7.89	4+00	3.25	0.16	8.05	1578.9	1586.95
4.0	41.48	26.71	9.76	4+00	4.25	0.28	10.04	1578.9	1588.94
5.0	60.15	56.18							

Rating Curve for Emergency Spillway (Em. Splwy. El. 1582.2)

10-Day Release (Em. Splwy El. 1581.1) Elevation	Q	30-Day Release Elevation	Q
1582.23	780	1583.33	780
83.26	2,466	84.36	2,466
84.08	4,848	85.18	4,848
85.03	7,836	86.13	7,836
86.95	15,390	88.05	15,390
88.94	24,888	90.04	24,888

Arizona Powerline Dam P

PMW 12-7-64

Elevation Base for Flood Routing 16

For a 10-day release, the starting elevation would be the crest of the principal spillway; in other words, use the elevation of the silt pool. Reason - after 10 days of drawdown the reservoir would be empty.
The drainage area being about the same as the work plan provision, use a silt storage of 175 Acre-ft. The corresponding elevation from the Stage-Storage Curve is 1566.2.

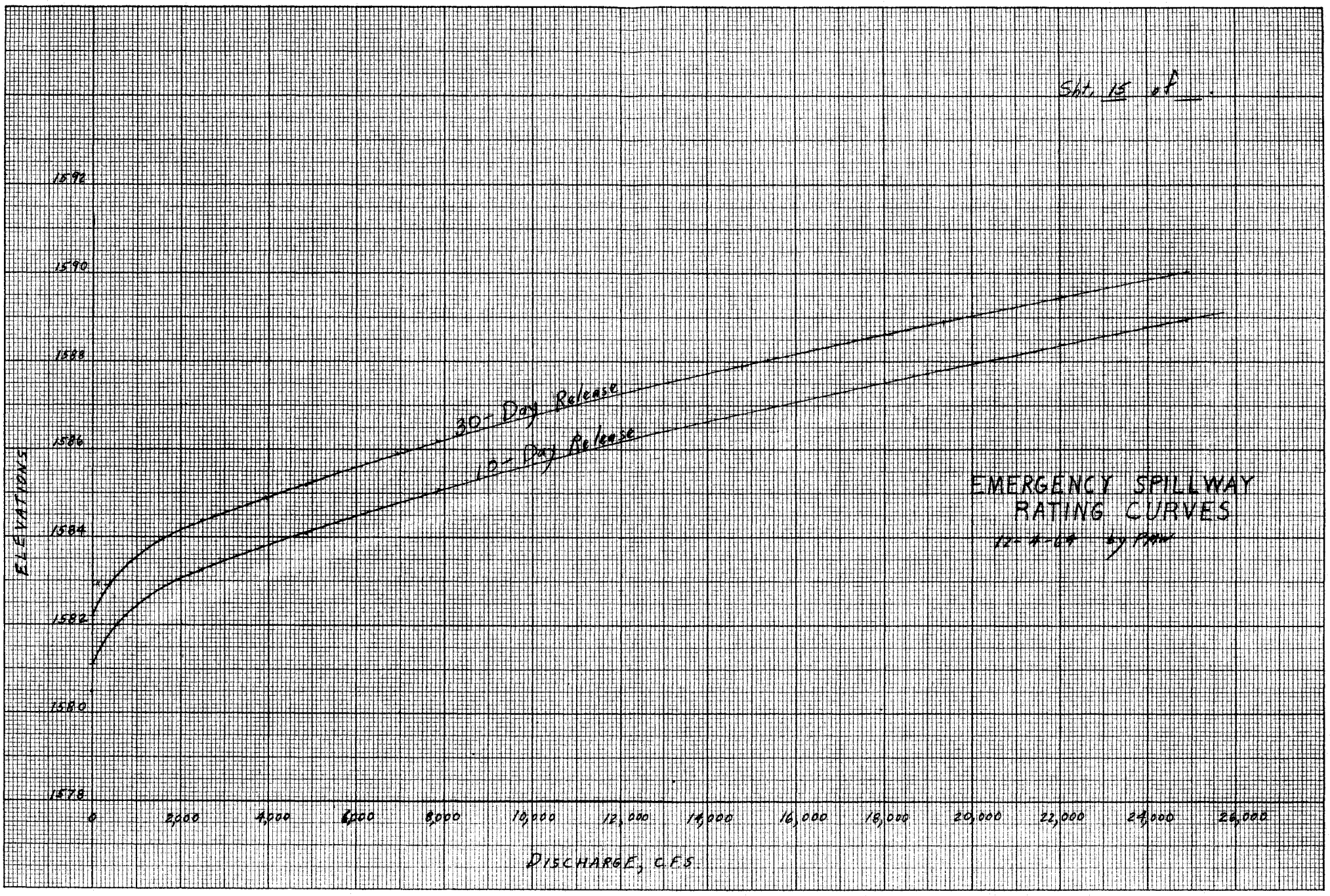
For a 30-day release, the starting elevation would be the elevation after 10 days of drawdown. From the Volume-Duration Curve, the storage after 10 days of drawdown would be: 1.32 in. × 49.6 mi.² × 533 AF/mi.²

or

10-day drawdown storage = 3492 A.F.
silt storage = 175 AF
Total storage = 3667 A.F.

Corresponding elevation from the Stage-Storage Curve is 1580.8.

Sht. 15 of ___.


EMERGENCY SPILLWAY
RATING CURVES
12-4-64 by PMM
30-Day Release
10-Day Release
ELEVATIONS
1592
1590
1588
1586
1584
1582
1580
1578
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
24,000
26,000
DISCHARGE, C.F.S.

Arizona Powerline Dam P

PMW 12-7-64

Combined Depth-Discharge Curves - 17
Emergency and Principal Spillways

10-day Release

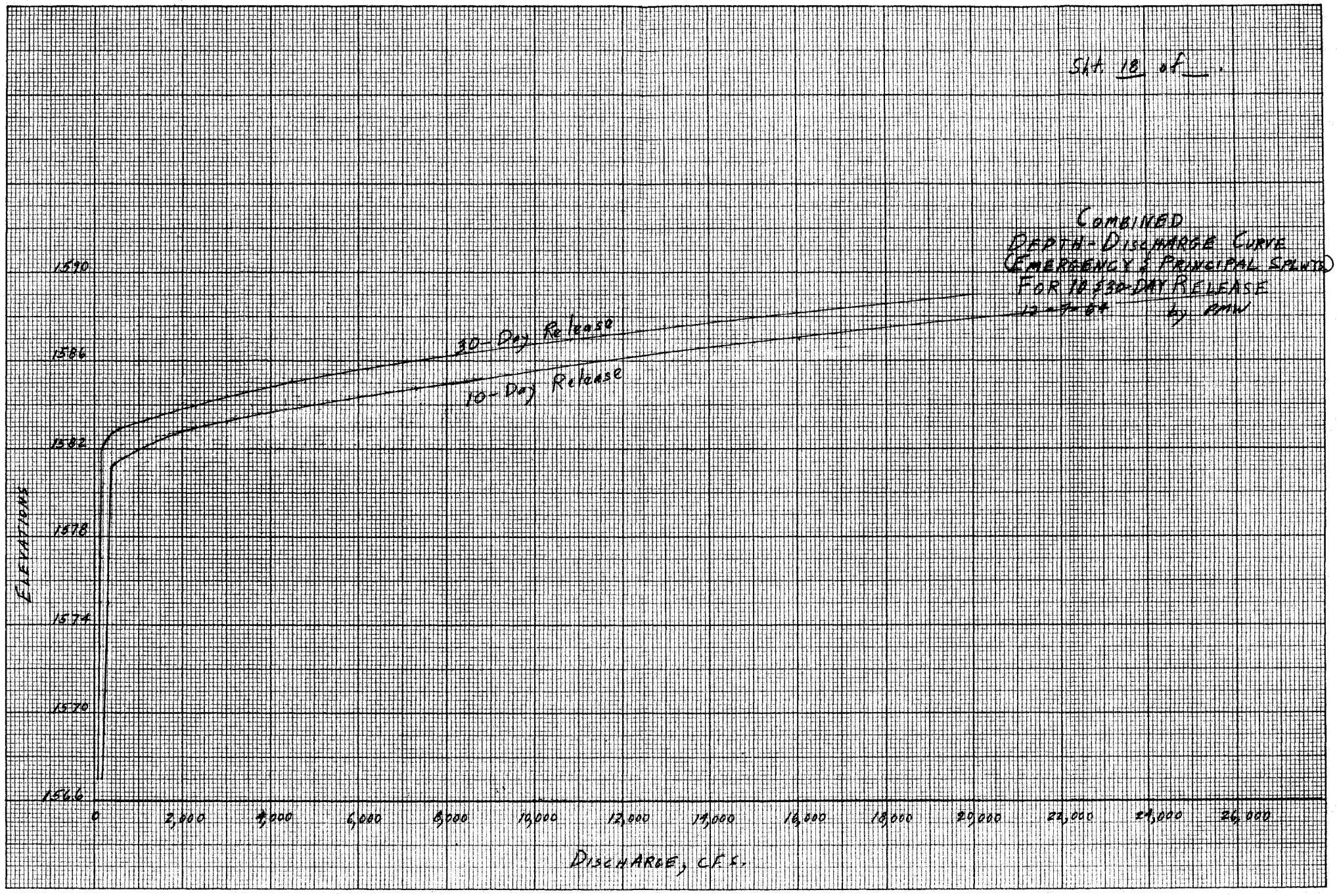
Elev.	Pr. Splwy. Q	Em. Splwy. Q	Combined Q
1567	181	—	181
69	222	—	222
71	257	—	257
73	283	—	283
75	314	—	314
77	339	—	339
79	363	—	363
81	384	—	384
83	405	1,900	2,305
85	425	7,700	8,125
87	444	15,600	16,044
89	463	25,100	25,563
91			

30-day Release

Elev.	Pr. Splwy. Q	Em. Splwy. Q	Combined Q
1567	75	—	75
69	92	—	92
71	106	—	106
73	119	—	119
75	130	—	130
77	141	—	141
79	150	—	150
81	159	—	159
83	168	500	668
85	176	4,250	4,426
87	184	10,900	11,084
89	192	19,900	20,092
91			

Sht 18 of ___.

COMBINED
DEPTH-DISCHARGE CURVE
EMERGENCY & PRINCIPAL SPILLWAYS
FOR 10 & 30-DAY RELEASE
12-7-64 by RMW



Arizona Powerline Dam P

PMW 12-7-64

Storage - Discharge Curve 19

10-Day Release A.F. × 12.1 = cfs-hrs

Elev.	Storage A.F.	(cfs-hrs) Storage	Discharge cfs	Elevation
1566.2	175	2,117	175	1566.2
68	330	3,993	200	68
70	582	7,042	240	70
72	950	11,495	280	72
74	1,394	16,867	300	74
76	1,940	23,474	320	76
78	2,579	31,206	350	78
80	3,320	40,172	380	80
81	3,740	45,254	390	81
82	4,162	50,360	1,000	82
84	5,100	61,710	5,000	84
86	6,175	74,718	11,500	86
88	7,330	88,693	20,500	88
90	8,605			90

(Em. Splwy. Crest)

Volume of Storage below El. 1581.1 = 3772 AF = 45,641 cfs-hrs
Volume of Storage below El. 1566.2 = 175 AF = 2,117 cfs-hrs
Available Storage between crests = 3597 AF = 43,524 cfs-hrs

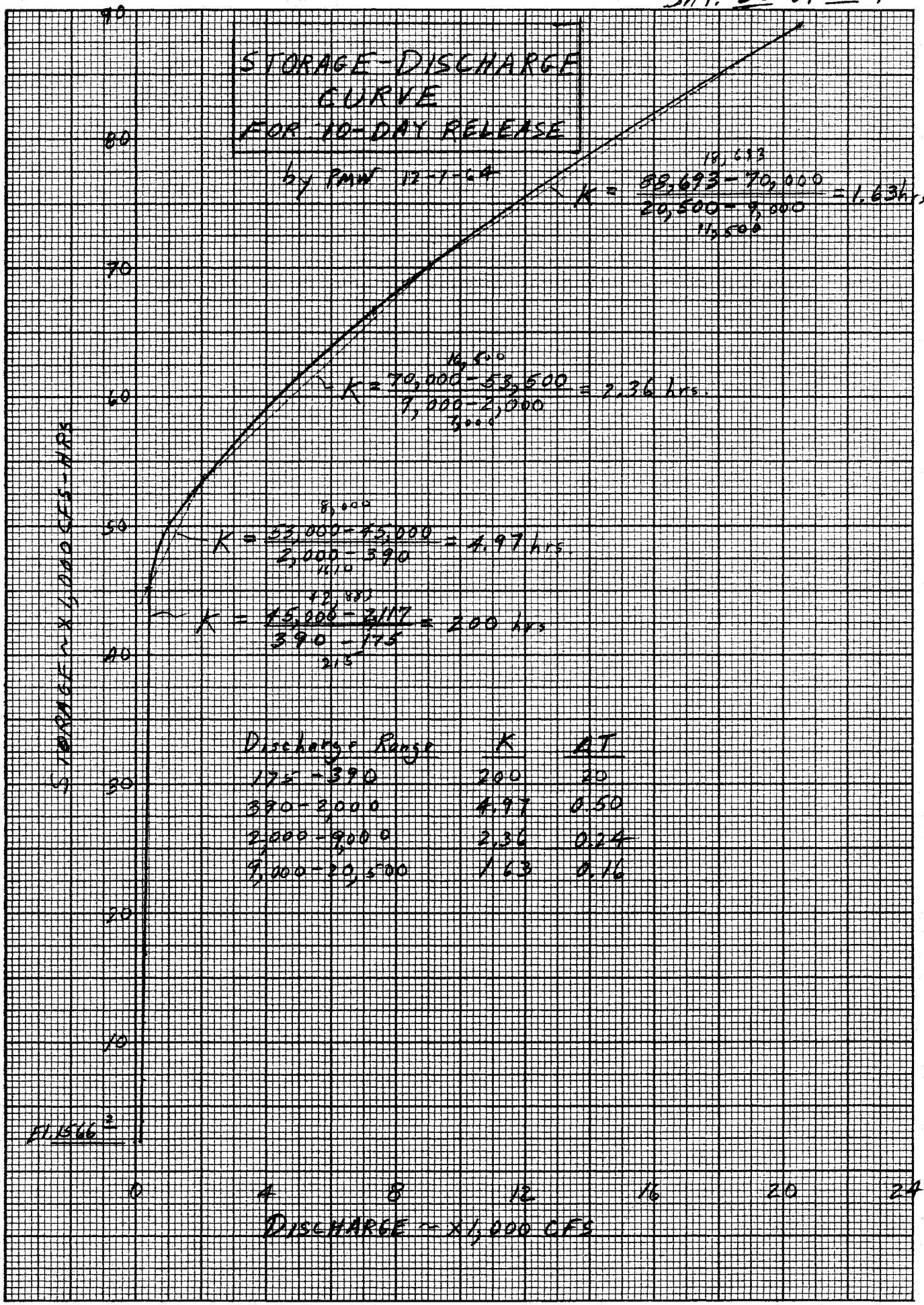
To find Time required to accomplish this volume of Storage, Refer to Murphy's Curves, "Mass Inflow Coordinates" from Hydrograph Family 2, Storm Distribution Curve A.

$T_o/T_p = 4.0$.

Constant (K) = 53.33 × 49.6 × 2.6 × 12.1 = 83,217 cfs-hrs
Line 7 = 83,217 × 0.425 = 35,367
" 8 = " × 0.520 = 43,272
Line 8 on the Freeboard Hydrograph yields 3.99 hrs. Therefore, the storage required would be close to that Time Lapse.

STORAGE-DISCHARGE CURVE FOR 10-DAY RELEASE

by PMW 12-7-64



$$K = \frac{88,693 - 70,000}{20,500 - 9,000} = 1.63 \text{ hrs.}$$

$$K = \frac{70,000 - 53,500}{9,000 - 2,000} = 2.36 \text{ hrs.}$$

$$K = \frac{53,000 - 45,000}{2,000 - 590} = 4.97 \text{ hrs.}$$

$$K = \frac{45,000 - 7,117}{390 - 175} = 200 \text{ hrs}$$

Discharge Range	K	Δ T
175 - 390	200	20
390 - 2,000	4.97	0.50
2,000 - 9,000	2.36	0.24
9,000 - 20,500	1.63	0.16

Fl. 1566

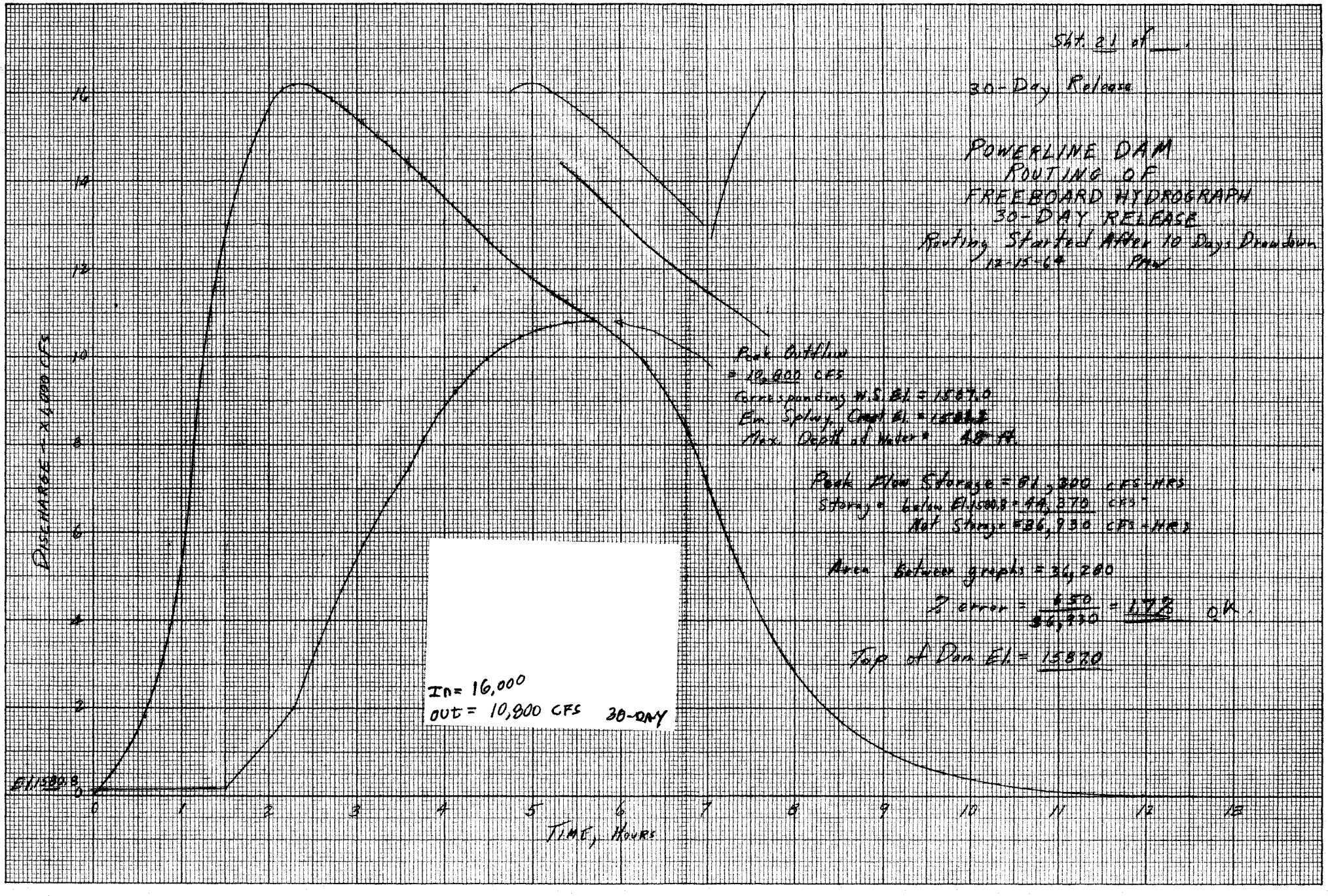
K&E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.

Sht. 21 of ___.

30-Day Release

POWERLINE DAM
ROUTING OF
FREEBOARD HYDROGRAPH
30-DAY RELEASE

Routing Started After 10 Days Drawdown
12-15-64 Proj



Peak Outflow
= 10,800 CFS
Corresponding W.S. El. = 1587.0
Em. Spillway Crest El. = 1580.8
Max. Depth of Water = 6.2 Ft.

Peak Flow Storage = 61,300 cfs-hrs
Storage below El. 1580.8 = 44,870 cfs-hrs
Net Storage = 26,930 cfs-hrs

Area between graphs = 34,280

Σ error = $\frac{6,350}{26,930}$ = 17% OK.

Top of Dam El. = 1587.0

In = 16,000
Out = 10,800 CFS 30-DAY

Arizona Powerline Dam

PMW 12-11-64

Storage - Discharge Curve 22

Refer to Sheet 17 for discharges. Also see stage-storage curve for dam.

30-Day Release A.F. x 12.1 = cfs-hrs

Elev.	Storage A.F.	Storage cfs-hrs.	Discharge cfs	Elevation
1580.8	3,667	44,370	158	1580.8
82	4,162	50,360	164	82
84	5,100	61,710	2,350	84
86	6,175	74,718	7,300	86
88	7,330	88,693	15,300	88
90				90

(Em. Splwy. Crest)

Volume of Storage below El. 1582.2 = 4,196 AF = 50,772 cfs-hrs
Volume of storage below El. 1580.8 = 3667 AF = 44,370 cfs-hrs
Available Storage below Em. Splwy. crest = 529 AF = 6,402 cfs-hrs

Refer to Murphy's Tables as explained on sht. 19 of calculations

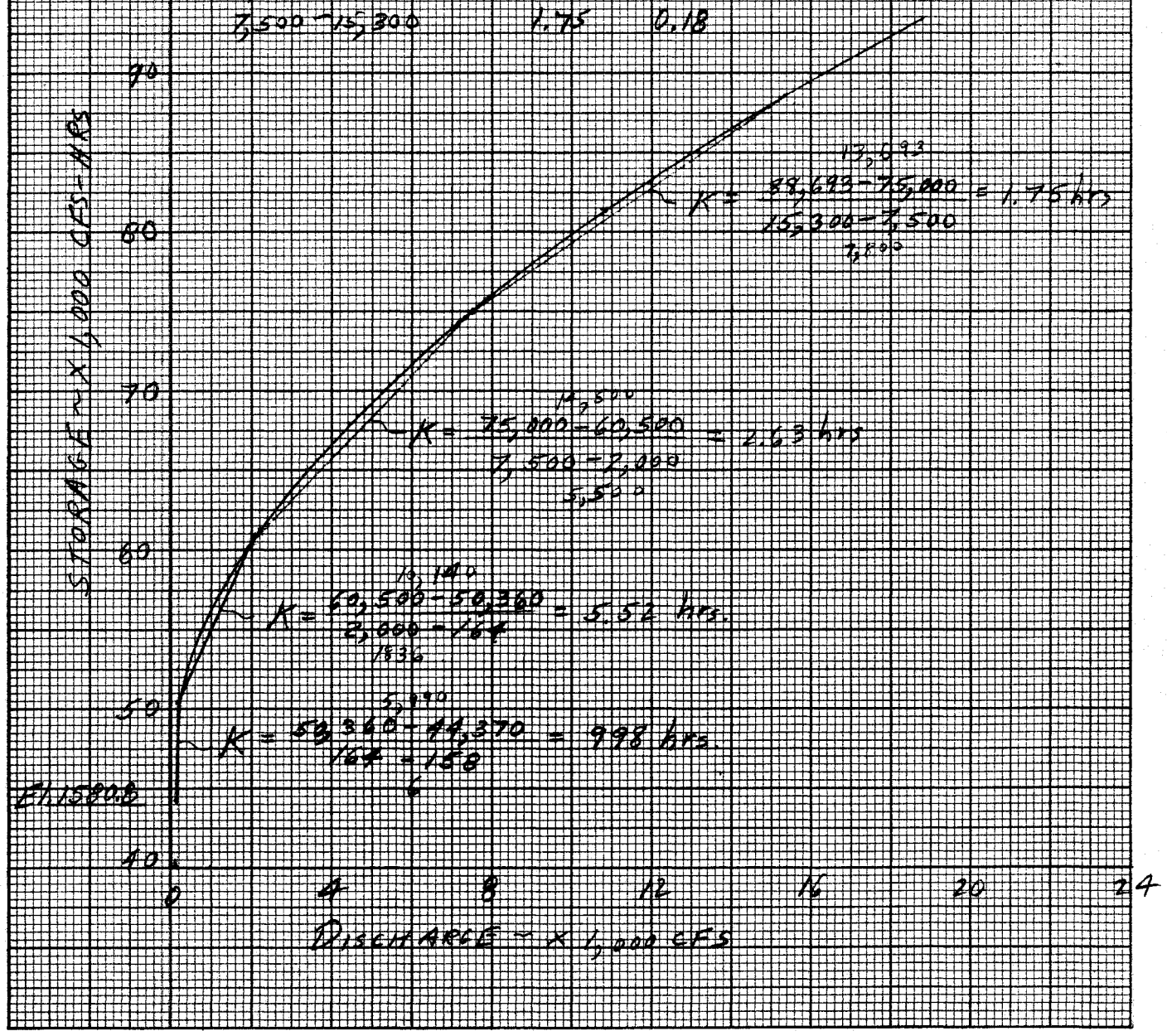
K = 83,217 cfs-hrs.

Line 3 = 83,217 x 0.039 = 3,245 Time = 1.14 hrs Try 1.30 hrs.
Line 4 = 83,217 x 0.114 = 9,487 Time = 1.71 hrs

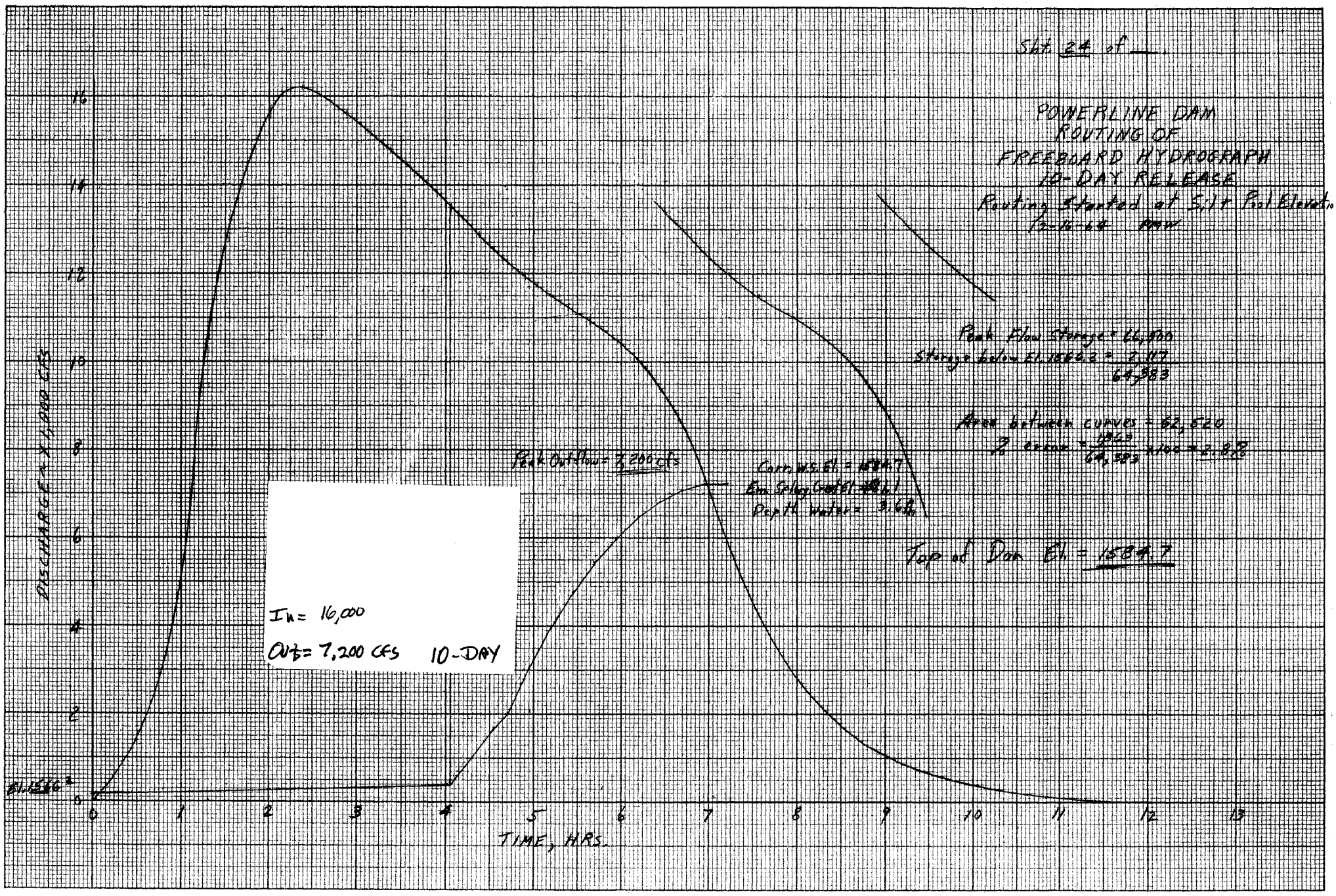
STORAGE-DISCHARGE CURVE
FOR 30-DAY RELEASE

12-15-64 by PMW

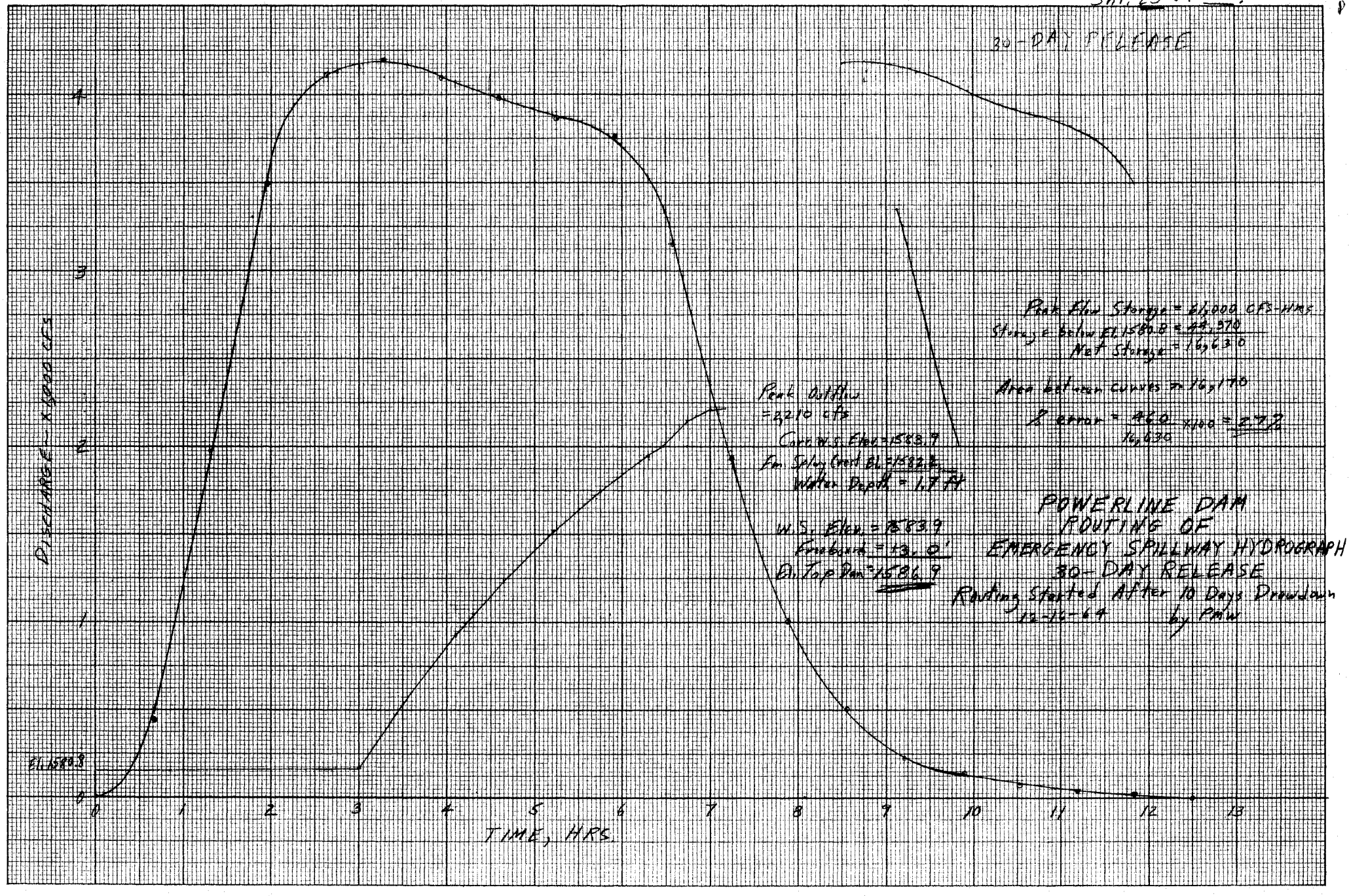
Discharge Range	K	ΔT
158 - 164 cfs	998	99.8
164 - 2,000	5.52	0.55
2,000 - 7,500	2.63	0.26
7,500 - 15,300	1.75	0.18



K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.


Sht. 24 of ___
POWERLINE DAM
ROUTING OF
FREEBOARD HYDROGRAPH
10-DAY RELEASE
Routing Started at Silt Pool Elevation
12-16-64 RMW
Peak Flow Storage = 66,500
Storage below El. 1566.3 = 2,117
64,383
Area between curves = 62,520
% error = 1863 / 64,383 x 100 = 2.8%
Peak Outflow = 7,200 cfs
Corr. W.S. El. = 1584.7
Em. Spillway Crest El. = 1581.1
Depth Water = 3.6 ft
Top of Dam El. = 1584.7
In = 16,000
Out = 7,200 CFS 10-DAY
DISCHARGE ~ X 1,000 CFS
TIME, HRS.
El. 1566.3
0
2
4
6
8
10
12
14
16
1
3
5
7
9
11
13

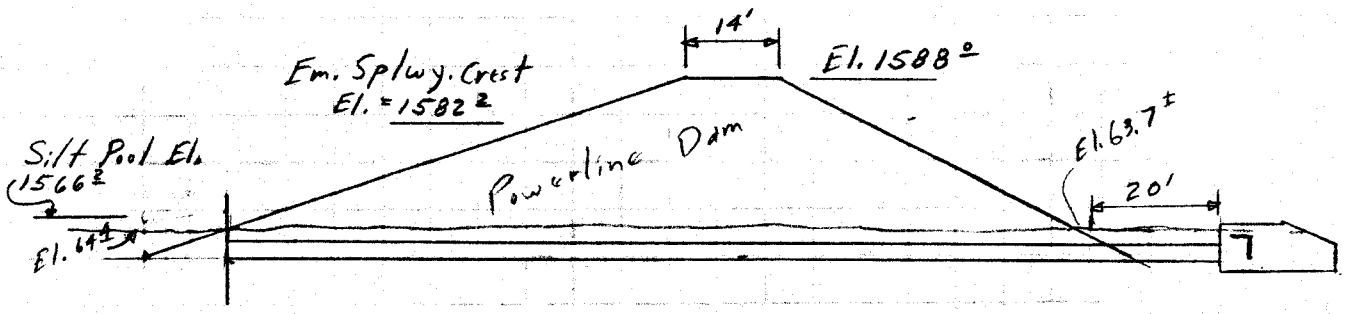
Sht. 25 of ___.


30-DAY RELEASE
Peak Flow Storage = 61,000 CFS-HRS
Storage below El. 1580.8 = 44,370
Net Storage = 16,630
Area between curves = 16,170
% error = 460 / 16,630 x100 = 2.7%
Peak Outflow
= 2,210 cfs
Corr. W.S. Elev. = 1583.9
Fm. Spillway Crest El. = 1582.2
Water Depth = 1.7 ft
W.S. Elev. = 1583.9
Freeboard = +3.0'
El. Top Dam = 1586.9
POWERLINE DAM
ROUTING OF
EMERGENCY SPILLWAY HYDROGRAPH
30-DAY RELEASE
Routing Started After 10 Days Drawdown
12-16-64
by PMW
DISCHARGE - x1,000 CFS
El. 1580.8
TIME, HRS.
0
1
2
3
4
5
6
7
8
9
10
11
12
13

Arizona Powerline Dam

PMW 1-27-65

Principal Spillway Design 1



Silt Pool Elevation = 1566 ±

Assume the Inlet structure to be built to the top of the silt pool.

Required trash rack area = $\frac{165}{1.0}$ = 165 sq. ft.

For a 16' height of trashrack, the required perimeter is $\frac{165}{16}$ = 10.3'

Make the riser 3' x 9'.

Area of Riser = 27 ft² = a_R

Riser entrance loss

Let V_R = velocity in riser
V_p = velocity in pipe
a_R = area of riser
a_p = area of pipe

$\frac{V_R^2}{V_p^2} = \frac{a_p^2}{a_R^2}$ Try 36" ∅ outlet pipe. a_p = 7.07 ft²

Riser entrance loss = $0.5 \frac{V_R^2}{2g} = 0.5 \left(\frac{7.07}{27}\right)^2 \frac{V_p^2}{2g} = 0.034 \frac{V^2}{2g}$

Bend Loss = $0.10 \frac{V^2}{2g}$

Pipe Entrance loss = = $0.200 \frac{V^2}{2g}$

Friction Loss = 0.00428 x 154 = $0.660 \frac{V^2}{2g}$

Velocity Head = = $1.00 \frac{V^2}{2g}$

Total H = $1.894 \frac{V^2}{2g}$

$Q = \frac{(7.07)(8.03)}{\sqrt{1.894}} H^{\frac{1}{2}} = 40.2 H^{\frac{1}{2}}$ 1.01

Arizona Powerline Dam

PMW 1-28-65

Principal Spillway Design

2

Try a 30" ∅ outlet pipe $a_p = 4.91\ ft^2$

$$\frac{a_p^2}{a_R^2} = \left(\frac{4.91}{27}\right)^2 = 0.0332$$

Riser entrance loss $= 0.5(0.0332)\frac{V^2}{2g} = 0.016\frac{V^2}{2g}$

Bend loss $= 0.52(0.0332)\frac{V^2}{2g}$	=	0.017
Pipe entrance loss	=	0.20
Friction Loss $= 0.00546 \times 154$	=	0.84
Velocity head loss	=	1.00
Total H	=	$2.073\frac{V^2}{2g}$

$$Q = \frac{(4.91)(8.03)}{\sqrt{2.073}}H^{1/2} = 27.4\,H^{1/2}$$ (1.4) Too small!!

Try 33" ∅ pipe $a_p = 5.94\ ft^2$

$$\frac{a_p^2}{a_R^2} = \left(\frac{5.94}{27}\right)^2 = 0.048$$

Riser entrance loss $= 0.5(0.048)\frac{V^2}{2g} = 0.024\frac{V^2}{2g}$

Bend Loss

Pipe entrance loss = 0.20

Friction loss:

$$K_p = \frac{5087\,(0.010)^2}{(33)^{4/3}} = 0.00480$$ (105.8)

Friction loss $= 0.00480 \times 154$ =	0.74
Velocity Head Loss =	1.00
	1.964

$$Q = \frac{(5.94)(8.03)}{\sqrt{1.964}} = 34.0H^{1/2}$$ (1.4)

Arizona Powerline Dam

PMW 1-29-65

Principal Spillway Design 3

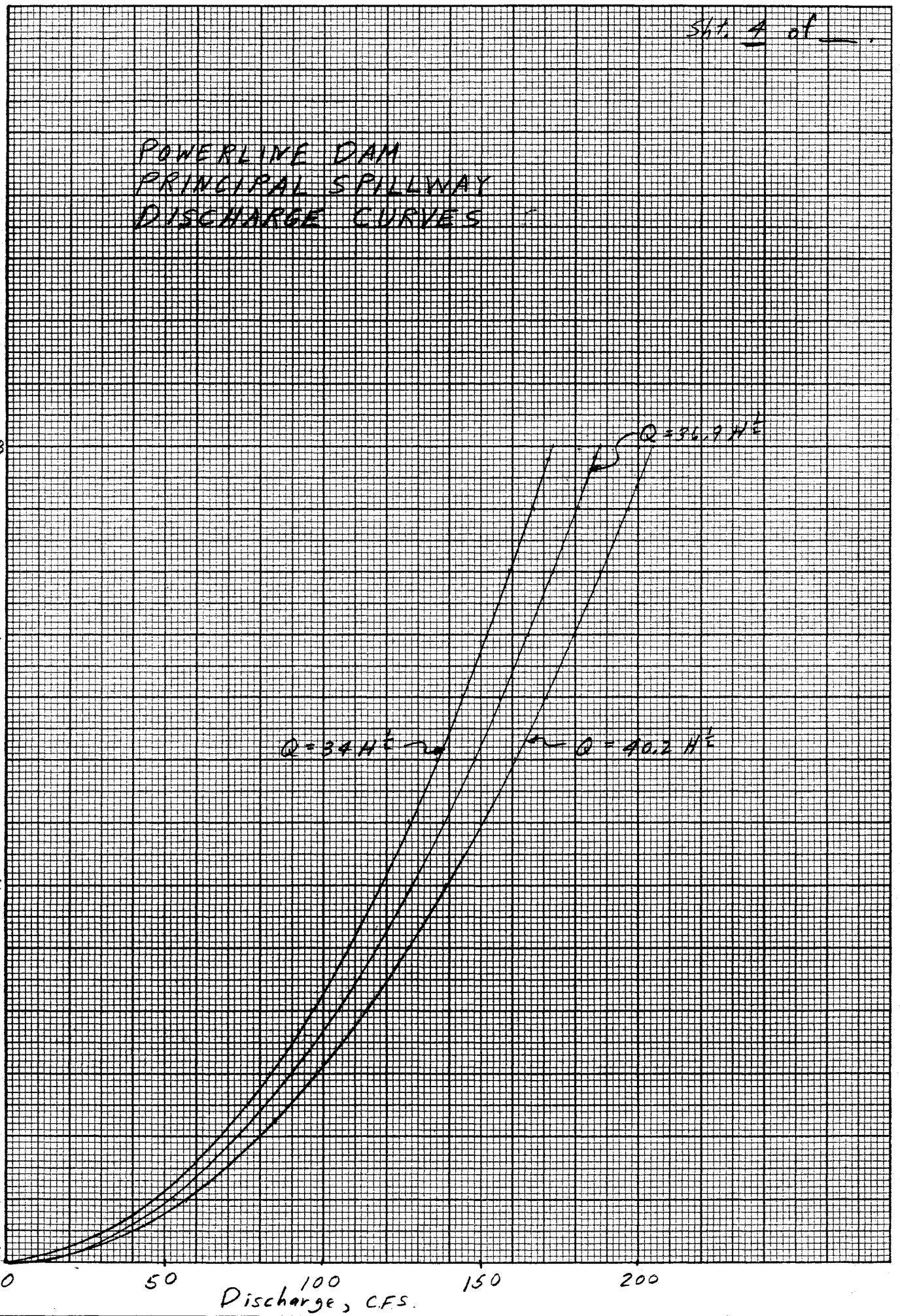
Desired Discharge Formula for Principal Spillway (Top of pipe at outlet = 1562.0) is $\therefore K = \frac{16.5}{\sqrt{20.2}} = \frac{16.5}{4.47} = 36.9 \quad \therefore Q = 36.9\, H^{\frac{1}{2}}$

Comparison of 33"ø and 36"ø outlet pipes yield the following discharge relationships:

Head		Flood Routing	33"ø pipe	36"ø pipe	Elevation
H	$H^{\frac{1}{2}}$	$Q = 36.9\, H^{\frac{1}{2}}$	$Q = 34\, H^{\frac{1}{2}}$	$Q = 40.2\, H^{\frac{1}{2}}$	
2	1.41	53	48	57	1564
4	2.0	74	68	81	66
6	2.45	90	83	98	68
8	2.83	105	96	114	70
10	3.16	117	108	127	72
12	3.46	128	118	139	74
14	3.74	138	127	150	76
16	4.0	148	136	161	78
18	4.24	156	144	171	80
20	4.47	165	152	180	82
22	4.69	173	159	188	84
24	4.90	181	167	197	86
26	5.10	188	173	205	1588

Sht. 4 of ___.

POWERLINE DAM
PRINCIPAL SPILLWAY
DISCHARGE CURVES



K&E 10 X 10 TO THE ½ INCH KEUFFEL & ESSER CO. MADE IN U.S.A. 359-11

Arizona Powerline Dam

PMW 1-29-65

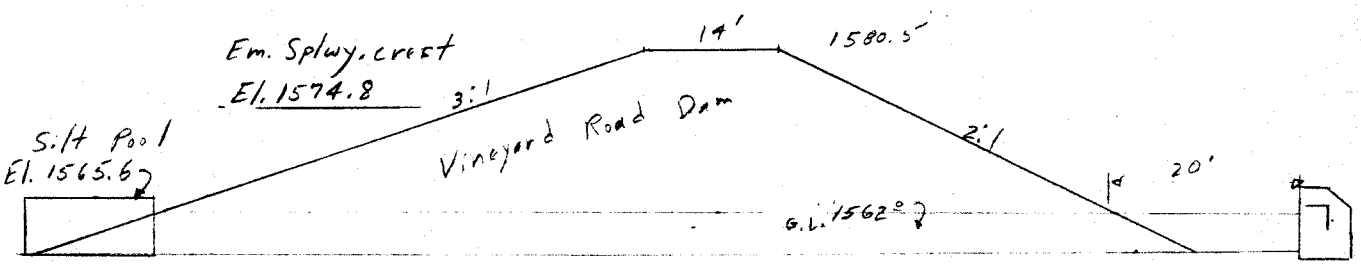
Principal Spillway Design 6

Check the discharge of the principal spillway conduit on Vineyard Road Dam to see what the combined discharges would be.

El. invert @ outlet end = 1559.3

Use Maximum Release Rate = 327 cfs

Try 54"ϕ outlet pipe Assume Top of Dam = 1580.5 (including 1'-0" for settlement)



Silt Pool Elevation = 1565.6

Assume the Inlet structure to be built to the top of the silt pool.

Required trashrack area = $\frac{327}{1.0} = 327 ft^2$

For a 9.2' height of trashrack, the required perimeter is $\frac{327}{9.2} = 35.5'$.

Using a 54"ϕ outlet pipe, make the riser 4'-6" x 13'-6".

Area of riser = 60.7 ft.²

$$\frac{a_p^2}{a_R^2} = \left(\frac{15.9}{60.7}\right)^2 = 0.0685$$

Riser entrance loss = $0.5\frac{V_R^2}{2g} = 0.5(0.0685)\frac{V_p^2}{2g} = 0.034\, V^2/2g$

Pipe entrance loss = 0.200

Friction Loss = 0.00249 x 120' = 0.299

Velocity Head = 1.000

Total H = 1.533

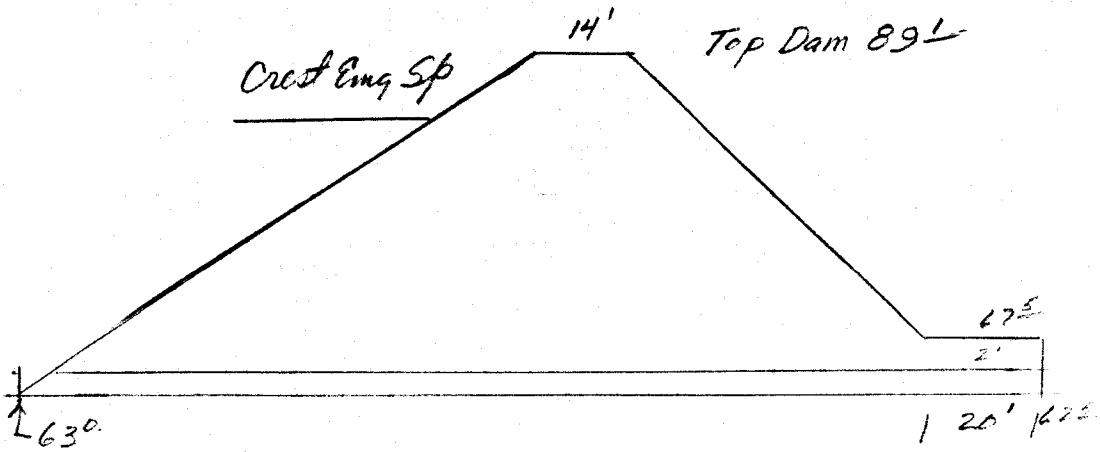
$$Q = \frac{(15.9)(8.03)}{\sqrt{1.533}} = 103.4\, H^{\frac{1}{2}}$$

1.236

Arizona Powerline Dam

3-31-65

Discharge Outlet of Powerline Dam as Designed



89 - 63 = 27 89 - 67.5 = 21.5

3 × 27 + 2 × 21.5 + 14 + 20 = 157.5 Call 160'

For n = .010 36" Pipe K = .00428

Friction loss =	$.00428 \times 160 \times V^2/2g$ =	.685
Entrance loss =	$.10\ V^2/2g$	.100
Velocity head =	$1.00\ V^2/2g$	1.000
	Total	$1.785\ V^2/2g$

$$Q = 8.02 A\sqrt{\frac{H}{K}} = \frac{8.02 \times 7.07}{\sqrt{1.785}}\sqrt{H} = 42.4\sqrt{H}$$

Arizona Powerline Dam
Watt 3-31-65
Principal Spillway Depth Discharge
Curve As Designed
$Q = 41.4\sqrt{H}$ Top Outlet Pipe 65

W.S. Elev	Head	$\sqrt{H}$	Q
67	1.5	1.22	50.7
70	4.5	2.12	88.0
74	8.5	2.92	121.2
76	10.5	3.24	134.0
80	14.5	3.81	158
83.3	17.8	4.22	174
85	19.3	4.39	182
88.1	22.6	4.75	197

Arizona — Powerline Dam

PMW 3-24-65

Emergency Spillway Rating Curve

$b = 600'$ $ss = 3:1$ $n = 0.030$ downstream slope = 0.00713

Use unit width ($b = 1'$), $r = d$

Use Table 90, King's

d	n v	V	$Q/b = q$	d_c	h_v
0.5	0.0789	2.63	1.32	0.38	0.11
1.0	0.1252	4.17	4.17	0.83	0.27
1.5	0.1641	5.47	8.20	1.28	0.46
2.0	0.1988	6.63	13.26	1.72	0.68
3.0	0.2604	8.68	26.04	2.75	1.17
4.0	0.3155	10.52	42.08	3.80	1.72
5.0	0.3663	12.21	61.05	4.90	2.32

30-day

d	Q/b	$\frac{q^2}{2g}$	d_c	sta.	Remaining V	Remaining h_v	Total d	Elev. Bott.	Pool Elev.
0.5	1.32	0.027	2.91	13+50	0.45	0	2.91	1581.14	1584.05
1.0	4.17	0.27	4.06		1.03	0.02	4.08		85.22
1.5	8.20	1.05	4.94		1.66	0.04	4.98		86.12
2.0	13.26	2.73	5.81		2.28	0.08	5.89		87.03
3.0	26.04	10.54	7.63		3.41	0.18	7.81		88.95
4.0	42.08	27.53	9.33		4.51	0.32	9.65		90.79
5.0	61.05	57.96	10.88		5.61	0.49	11.37		92.51

Rating Curve for Emergency Spillway

10-day Release

Elev.	Q
1583.15	792
84.32	2,502
85.22	
86.13	
88.05	
89.89	
91.61	

30-day Release

Elev.	Q
1584.05	
85.22	
86.12	
87.03	
88.95	
90.79	
92.51	

Arizona — Powerline Dam

PMW 3-25-65

Em. Splwy, W.S. Profiles - Using Watt's U-curves

$d = 0.5$, $\frac{v^2}{2g} = 0.027$		$d = 1.0$, $\frac{v^2}{2g} = 0.262$		$d = 1.5$, $\frac{v^2}{2g} = 1.01$		$d = 2.0$, $\frac{v^2}{2g} = 2.65$	
sta.	d	sta.	d	sta.	d	sta.	d
31+50	0.5	31+50	1.0	31+50	1.5	31+50	2.0
31+00	0.65	31+00	1.35	31+00	1.95	31+00	2.45
30+50	1.72	30+50	2.52	30+50	3.23	30+50	3.80
18+50	1.88	18+50	2.96	18+50	3.83	18+50	4.64
13+50	2.91	13+50	4.06	13+50	4.94	13+50	5.81

$d = 3.0$, $\frac{v^2}{2g} = 10.21$		$d = 4.0$, $\frac{v^2}{2g} = 26.71$		$d = 5.0$, $\frac{v^2}{2g} = 56.18$	
Sta.	d	Sta.	d	Sta.	d
31+50	3.0	31+50	4.0	31+50	5.0
31+00	3.57	31+00	4.77	31+00	5.92
30+50	5.12	30+50	6.42	30+50	7.72
18+50	6.37	18+50	7.97	18+50	9.40
13+50	7.63	13+50	9.33	13+50	10.88

Arizona Powerline Dam

PMW 3-23-65

Emergency Spillway W.S. Profile

Check on effect of Outlet Channel on Capacity, if any.

Compute uniform depth for 600' wide channel

slope = 0.007 $n = 0.030$ $Q = 10,800$

$q = \frac{10,800}{600} = 18$ cfs/ft

$(0.007)^{\frac{1}{2}} = 0.08367$

$D^{5/3} = \frac{Qn}{S^{\frac{1}{2}}(1.486)}$

$D^{5/3} = \frac{18(0.030)}{(0.08367)(1.486)} = 4.34$

$D = 2.41'$ actual $D = 2.41 + 4.5 = 6.91'$ @ Sta. 61+00

Use Watt's U-curves and profile of Em. Splwy.

$\frac{Q^2}{2g} = \frac{324}{64.3} = 5.04$

Sta.	D	Elevation
61+00	6.91	69.46
60+50	6.92	69.47
59+50	6.24	69.45
58+50	5.53	69.45
57+50	4.83	69.46
56+50	4.15	69.49
55+50	3.47	69.52
54+50	2.90	69.66
53+50	2.52	69.99
52+50	2.39	70.57
51+50	2.39	
50+50	etc.	

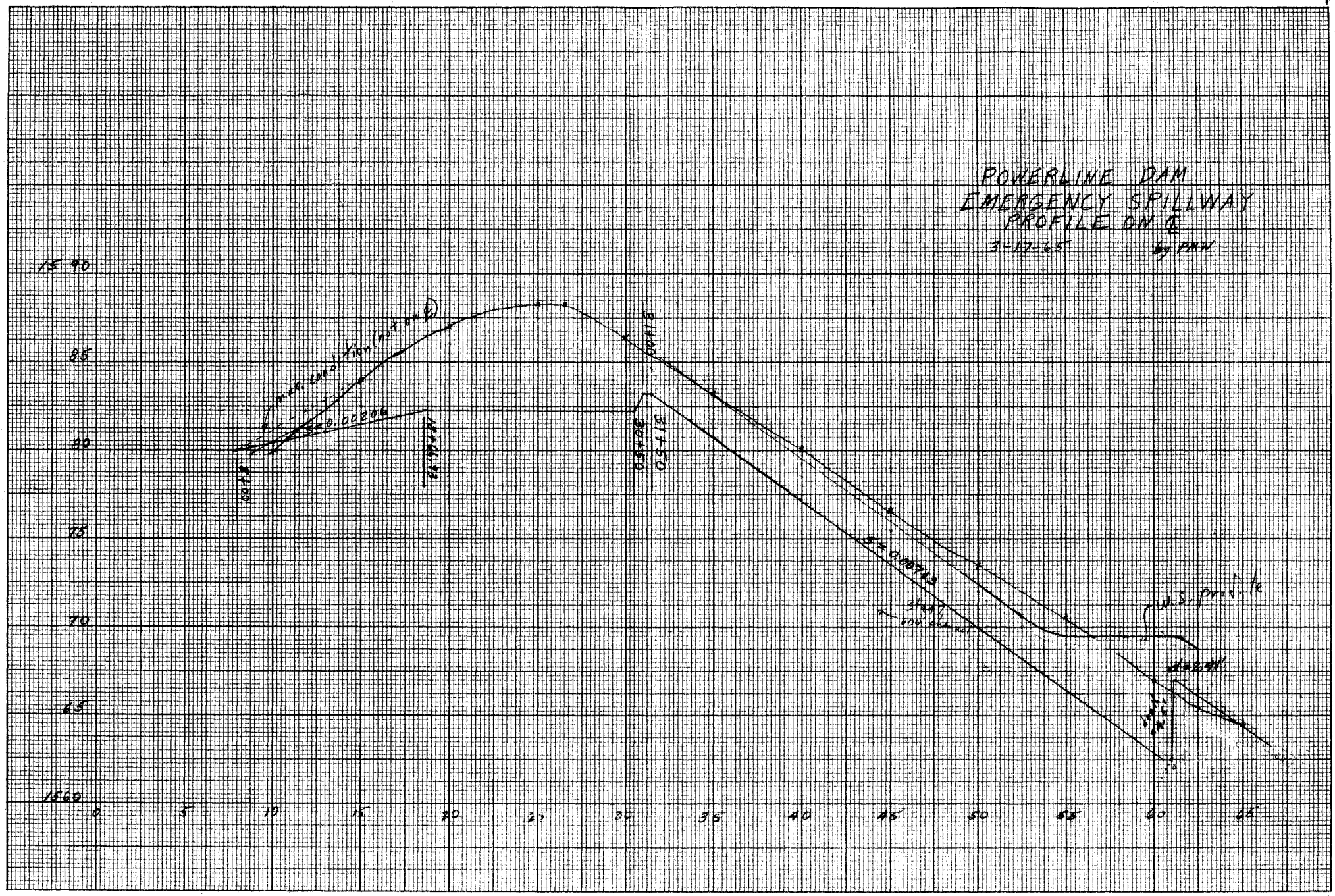
Compute uniform depth for 600' wide channel

slope = 0.00713 $n = 0.030$ $Q = 10,800$ cfs, $q = 18$ cfs/ft

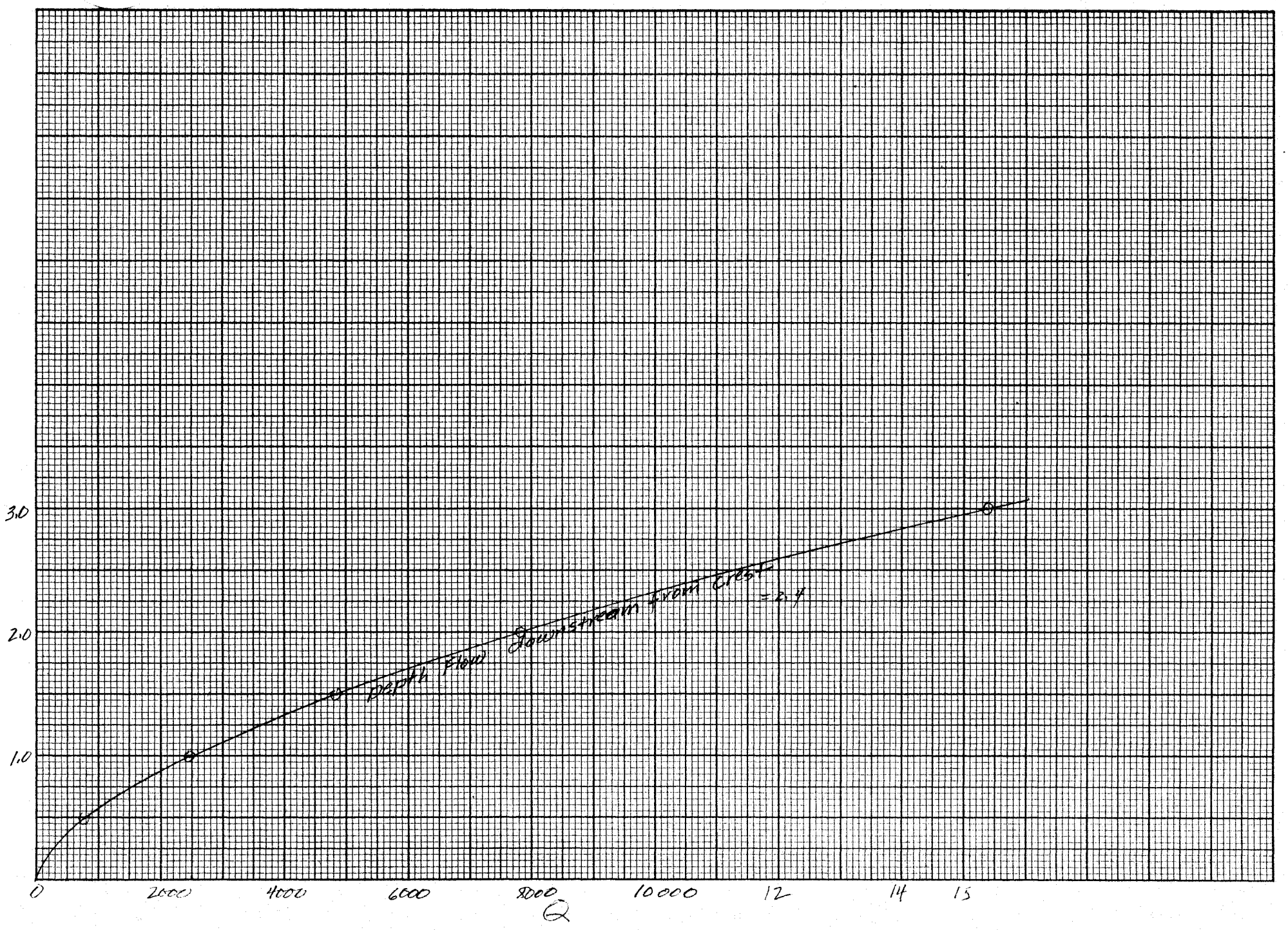
$(0.00713)^{\frac{1}{2}} = 0.08444$

$D^{5/3} = \frac{18(0.030)}{(0.08444)(1.486)} = 4.31$

$D = 2.39'$


POWERLINE DAM
EMERGENCY SPILLWAY
PROFILE ON ℄
3-17-65
by PMW
1590
85
80
75
70
65
1560
0
5
10
15
20
25
30
35
40
45
50
55
60
65
max. condition (not on ℄)
S=0.00206
31+00
30+50
31+50
S=0.08743
W.S. profile

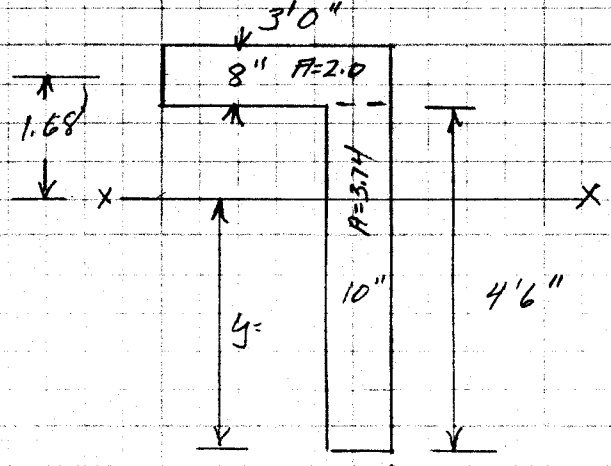
K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U. S. A.



STATE Arizona PROJECT Powerline Dam JOB NO. P

Watt 4-2-65

Moment of Inertia of Impact Wall SHEET 4 OF 20



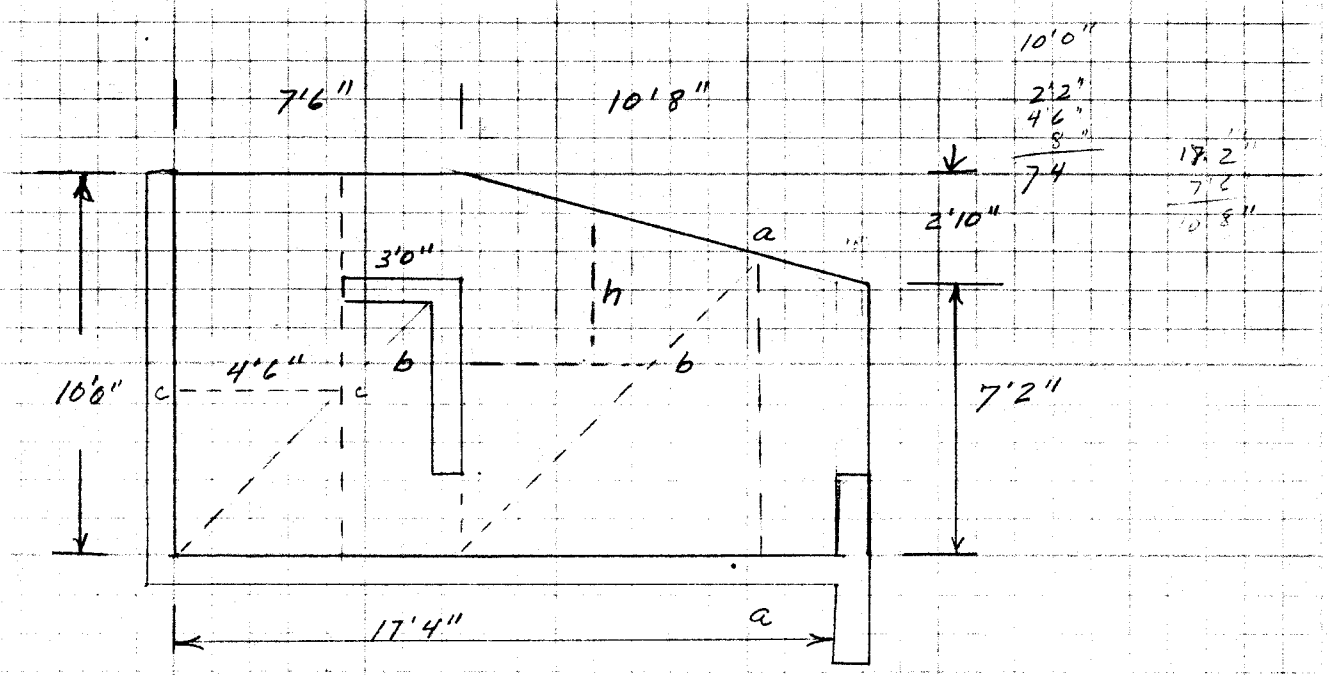
$$y = \frac{3.74 \times 2.25 + 2.0 \times 4.83}{5.74} = 3.15$$

$$I_{x-x} = \underset{3.03}{3.74(3.15-2.25)^2} + \frac{\overset{6.30}{4.5^3} \times .83}{12} + \underset{5.64}{2.0 \times 1.68^2} + \frac{\overset{.07}{.67^3} \times 3.0}{12}$$

$$= 15.04$$

Wt of Wall per ft

$$2.0 + 3.74 \times 150 = 861 \#/\text{lin ft}$$



Max Vert steel = Sec a-a H = 8'

Earth Pressure = 40 #/ft³

$$M = \frac{wl^3}{6} = \frac{40 \times 5^3}{6} = \underline{\underline{3.41}} \text{ Kip ft.}$$

Max Horizontal M b-b

$l = 9 - h \qquad w = 40h$

$$M = \frac{wl^2}{2} = \frac{40h(9-h)^2}{2} = 20h(81 + 18h + h^2)$$

$$\frac{dM}{dh} = 3h^2 - 36h + 81 = 0$$

$$= h^2 - 12h + 27 \qquad h = \frac{+12 \pm \sqrt{12^2 - 4 \times 27}}{2} = \frac{12 \pm 6}{2}$$

$$= 3$$

$$M = 20 \times 3(9-3)^2 = \underline{\underline{2160}} \text{ ft lbs}$$

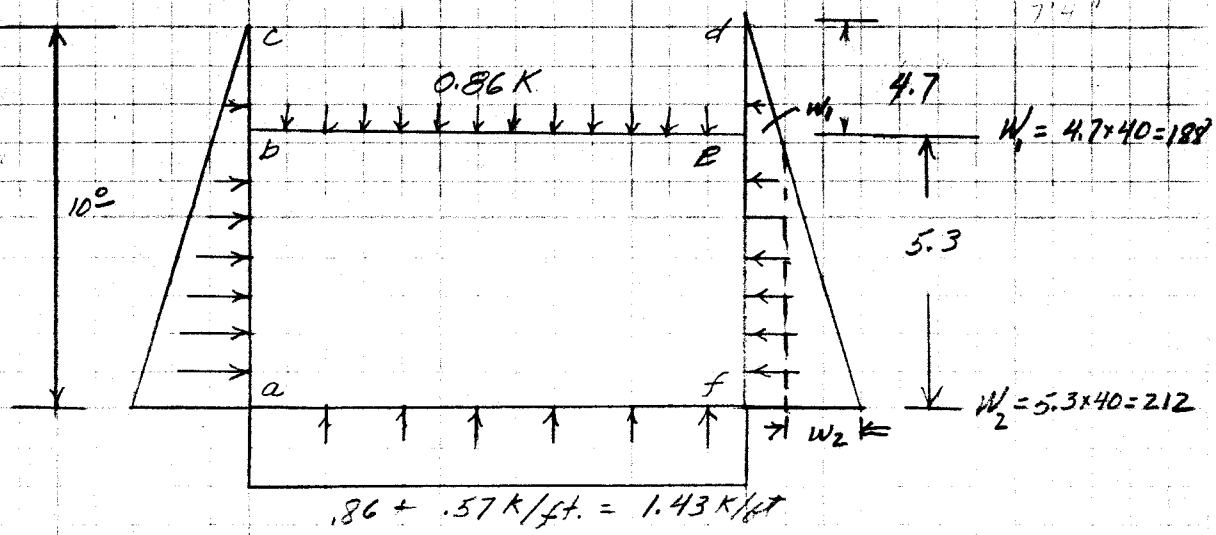
$$M_{cc} = (10.0 - 4.5)\, 40 \times \frac{4.5^2}{2} = \underline{\underline{2230}} \text{ ft lbs}$$

Arizona
Watt 4-2-65

Powerline Dam

SHEET 6 OF 20

2 2
4 6
0 8
6 16
7'-4"



Wt of walls $.33(3.0) \times 10.0 \times .150 \times 2 \times \frac{1}{13} = .57$ K/ft

Soil type 2 $H/H = 0$ Use 40 #/cuft Equiv Pressure

Sheet 7-L-15498.

$I_{ab} = I_{ef} = \frac{3.0 \times .83^3}{12} = .143$

$I_{af} = \frac{3.0 \times .83^3}{12} = .143$

$I_{be} = 15.04$

$K_{ab} = \frac{I}{L} = \frac{.143}{5.3} = .027$

$K_{af} = \frac{I}{L} = \frac{.143}{13} = .011$

$K_{be} = \frac{15.04}{13} = 1.06$

Distribution Factors

@ b be - .98
ab - .02

@ a ab - .71
af - .29

STATE		PROJECT		
Arizona		Powerline Dam		
BY	DATE	CHECKED BY	DATE	JOB NO.
Watt	4-14-65			
SUBJECT				SHEET 7 OF 20

$$M_c = \frac{wl^3}{6} = \frac{.040 \times 4.7^3 \times 3}{6} = .2080 \text{ ft-kip}$$

Sides

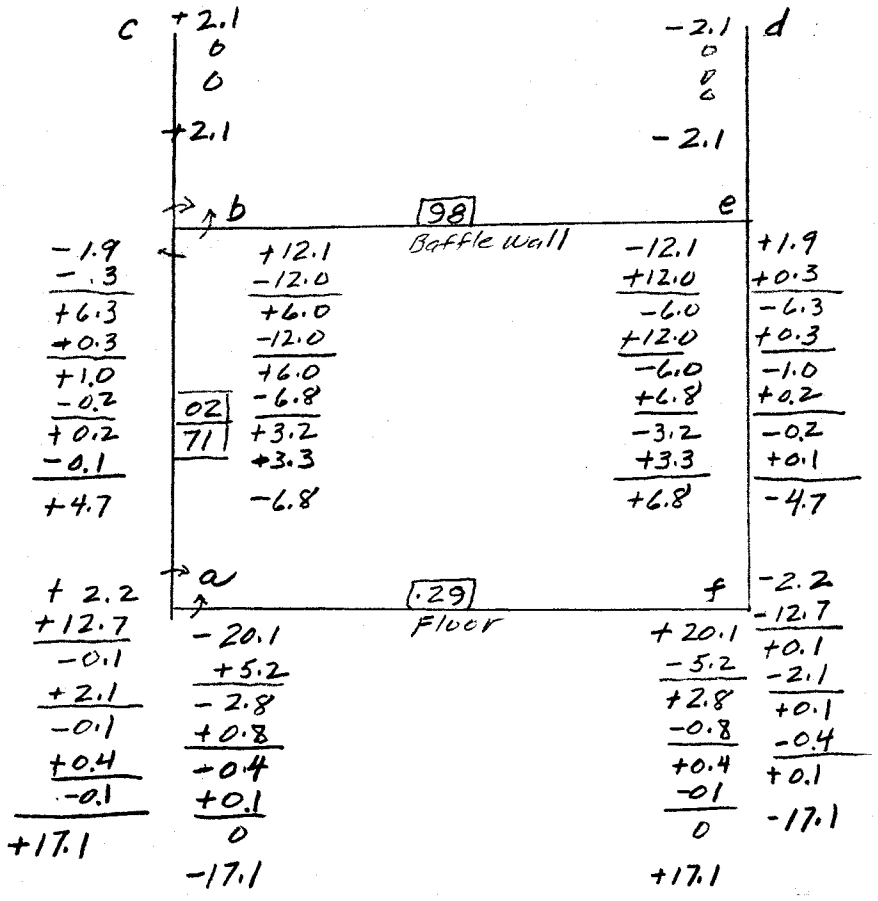
$$M_e = \frac{.188 \times 3 \times 5.3^2}{12} + \frac{3 \times .212 \times 5.3^2}{30} = 1.92 \text{ k-ft}$$

$$M_f = \frac{.188 \times 3 \times 5.3^2}{12} + \frac{3 \times .212 \times 5.3^2}{20} = 222 \text{ k-ft}$$

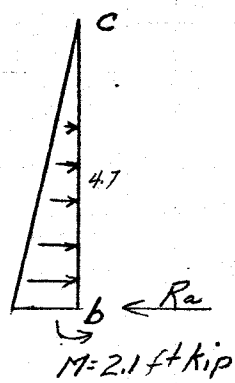
Btm

$$M_{af} = \frac{1.43 \times 13^2}{12} = 20.1$$

Top $M_{be} = \frac{.86 \times 13^2}{12} = 12.1$

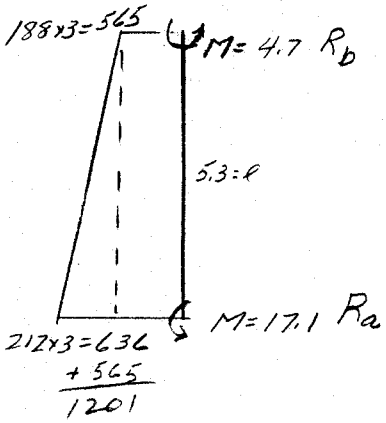

c
+2.1
0
0
+2.1
d
-2.1
0
0
-2.1
b
98
Baffle Wall
e
-1.9
-.3
+6.3
+0.3
+1.0
-0.2
+0.2
-0.1
+4.7
+12.1
-12.0
+6.0
-12.0
+6.0
02
-6.8
71
+3.2
+3.3
-6.8
-12.1
+12.0
-6.0
+12.0
-6.0
+6.8
-3.2
+3.3
+6.8
+1.9
+0.3
-6.3
+0.3
-1.0
+0.2
-0.2
+0.1
-4.7
a
129
Floor
f
+2.2
+12.7
-0.1
+2.1
-0.1
+0.4
-0.1
+17.1
-20.1
+5.2
-2.8
+0.8
-0.4
+0.1
0
-17.1
+20.1
-5.2
+2.8
-0.8
+0.4
-01
0
+17.1
-2.2
-12.7
+0.1
-2.1
+0.1
-0.4
+0.1
-17.1

STATE Arizona		PROJECT Powerline Dam		P
BY Watt	DATE 4-14-65	CHECKED BY	DATE	JOB NO.
SUBJECT				SHEET 9 OF 20



$M = 2.1$ ft kip

$$R_a = \frac{.040 \times 4.7 \times 4.7}{2} \times 3 = 1.32\ K$$



$$5.3\,R_b = \frac{.565 \times 5.3^2}{2} + \frac{.636 \times 5.3^2}{6} \quad \begin{matrix} 7.93 \\ \\ \end{matrix} \quad \begin{matrix} 2.98 \\ \\ \end{matrix} \quad = 17.1 - 4.7$$

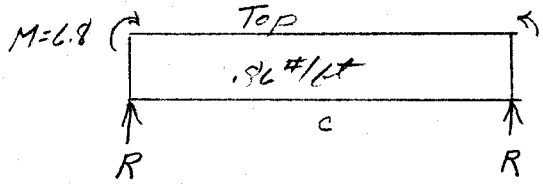
$$R_b = -2.05\ K$$

$$5.3\,R_a = 7.93 + 2 \times 2.98 + 17.1 + 4.7$$

$$R_a = 6.73$$

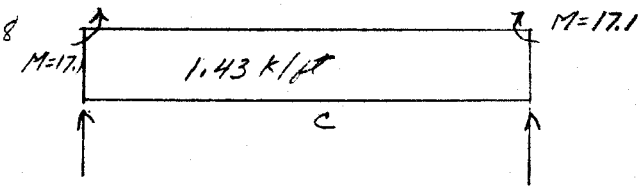
$$6.73 - 2.05 = \frac{(1.201 + .565)}{2} 5.3$$

$$4.68 = 4.68 \quad OK$$



$$R = .86 \times \frac{13}{2} = 5.59$$

$$M_c = 6.8 + \frac{5.59 \times 13}{4} = 25.0\ k\ lbs$$



$$R = 1.43 \times \frac{13}{2} = 9.3$$

$$M_c = \frac{9.3 \times 13}{4} - 17.1 = 13.1$$

$$M_x = 17.1 - 9.3x + \frac{1.43x^2}{2} = 0$$

$$x^2 - 13.0x + 23.9 = 0$$

$$x = \frac{13 \pm \sqrt{169 - 95.6}}{2} = 2.21'$$

$$x^2 - 13.0x + 23.9 = -7.5$$

$$x = \frac{13 \pm \sqrt{169 + 125.6}}{2}$$

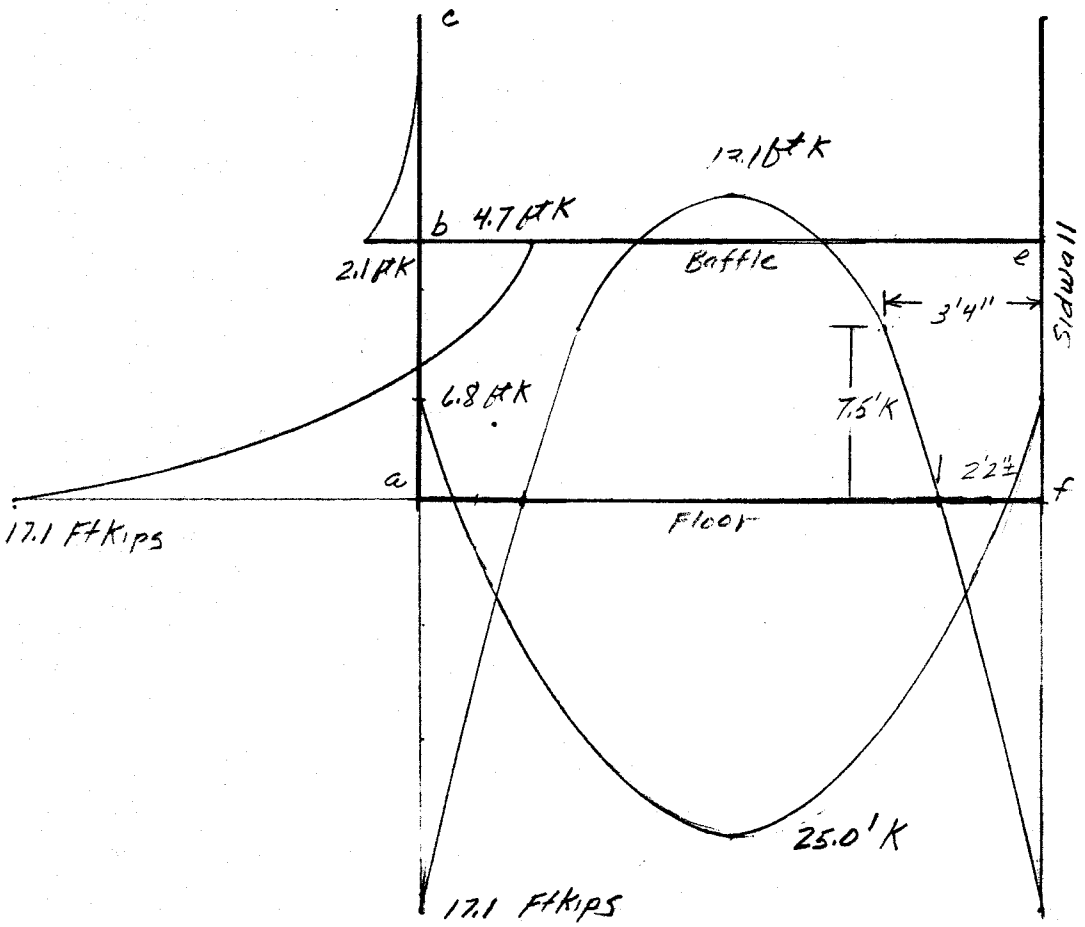
$$x = \frac{13.2 \pm 6.6}{2} = 3.3$$

COMPUTATION SHEET
SCS-522A REV 5-58

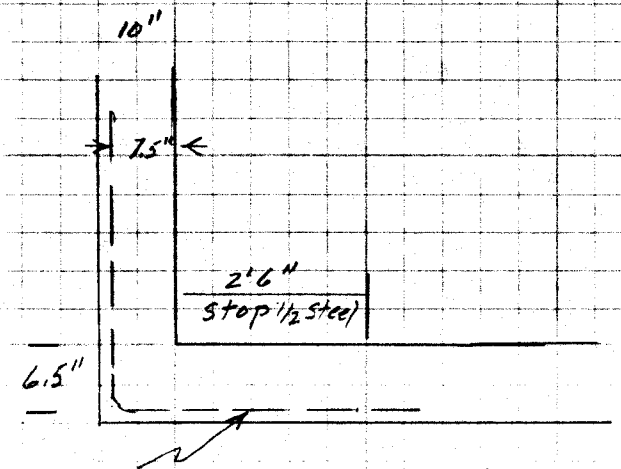
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO: 1960 O - 543250

STATE Arizona		PROJECT Powerline Dam		8
BY Watt	DATE 4-14-65	CHECKED BY	DATE	JOB NO.
SUBJECT Moments for 3' width				SHEET 10 OF 20



STATE Arizona PROJECT Powerline Channel P
BY Watt DATE 4-15-65 CHECKED BY DATE JOB NO.
SUBJECT Impact Basin SHEET 11 OF 20



No 5 @ 6" to 2'6" (see sheet 9)
5 @ 12" across

Corner floor & Sidewall

Moment/ft = $\frac{17.1}{3}$ = 5.7

For 10" wall d = 6 1/2" (on Floor

A_s = 0.60 No's 5 @ 6"

$v = \frac{6.7 \times 8}{7 \times 12 \times 7.5}$ = 85# ok Sidwall

$v = \frac{5.6 \times 8}{7 \times 12 \times 6.5}$ = 82 #/in.2 Floor

Center of Floor

$M = \frac{13.1}{3}$ = 4.4 ft K

A_s = 0.46 No 5 @ 8"
No 4 @ 5"

Point on sidewall where No 5 @ 12" are adequate

At section a-a (sheet 5)

M for No 5 @ 12" = 3.6 ft kip Sec a-a ok

By Sec at Baffle (Sheet 9)

17.1
3.6
13.5

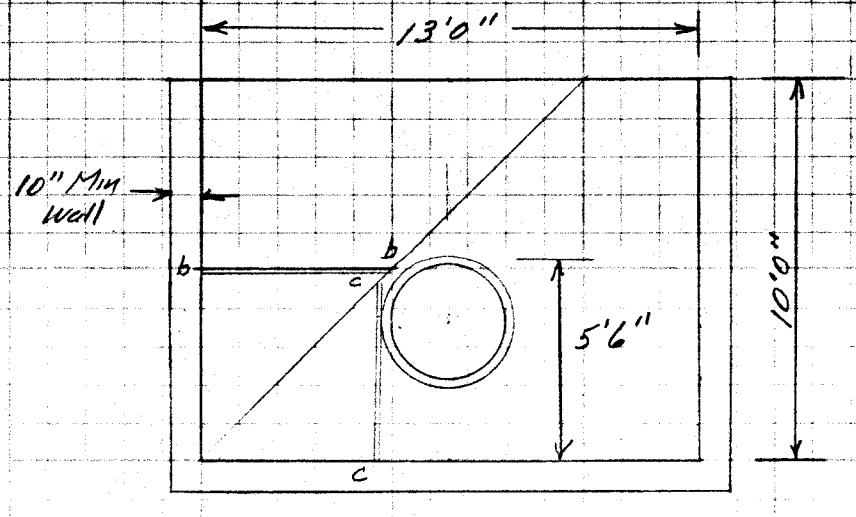
$M_x = 17.1 - 6.73x + \frac{1000x^2}{2}$ (approx) = 3.6

$x^2 - 13.46x + 27 = 0$

x = 2.31 Cut 1/2 steel at 2.5'

STATE Arizona PROJECT Powerline Channel P
BY Watt DATE 4-15-64 CHECKED BY DATE JOB NO.
SUBJECT Impact Basin SHEET 12 OF 20

Design of Headwall



Earth Load 40 #/Cu.ft.

Horozontal Moment
For strip just above pipe

Load = 4.5 × 40 = 160 #/lin ft

Fixed horizontal beam

$M = \frac{.160 \times 14^2}{12} = 2.61$ ft K

At center $= \frac{.160 \times 14^2}{24} = 1.30$ ft K If Simple Beam = 3.9 ft K

Cantilever at side of pipe (b-b)

$M = \frac{5 \times 040 \times 5^2}{2} = 2.50$ K ft

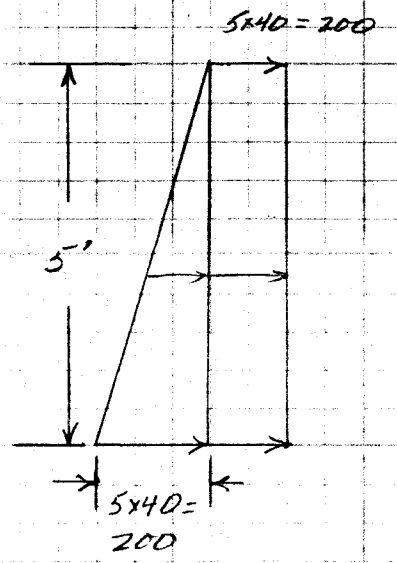
Horozontal Steel $R_s = .22$

#4 @ 10" Outside Steel

#4 @ 10" Inside Steel
Min Steel

Arizona Powerline Dam P
Watt 4-16-65
Impact Basin
SHEET 13 OF 20

Design of Headwall Section C-C



Cantilever

$M = \frac{.200 \times 5^2}{2} + \frac{.200 \times 5^2}{6} = 2.5 + .83 = 3.33 \text{ ft-k/ft}$

$d = 6.5$ btm $= 7.5$ wall

$F_S = 0.34$

Use #4 @ 6" 2' up wall & along floor
Cut out 1/2 of steel for remainder.

Toewall

Floor is designed transversely so toe wall will have little load use Min steel #4@12"

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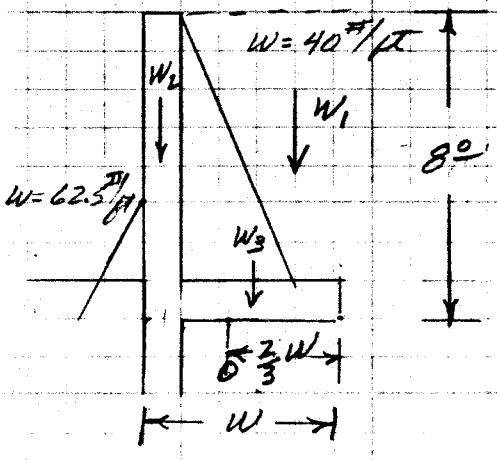
SOIL CONSERVATION SERVICE

P

Arizona — Powerline Dam
Watt 4-16-65
Impact Basin

Wing Wall design

Wt of Earth = 110#/cuft
Fluid Pressure = 40#/cuft



ΣM_o

$+ 110 \times 7.16 (W - .83)\left(\frac{2}{3}W - \frac{W-.83}{2}\right)$

$- 8 \times .83 \times 150 \left(\frac{W}{3} - .41\right)$

$4W - 3W + 2.50$

$+ 150 \times .83 (W - .83)\left(\frac{2}{3}W - \frac{W-.83}{2}\right)$

$- \frac{40 \times 8^3}{6} + \frac{62.5 \times 3^3}{6}$

$912.1 (W - .83)\left(\frac{W + 2.50}{6}\right) - 996\left(\frac{W - 1.24}{3}\right) - 3413 + 281 = 0$

$152.0 (W^2 + 1.67W - 2.08) - 332W + 412.1 - 3413 + 281 = 0$

$152W^2 - 78.16W - 3036.1$

$W^2 - .514W - 19.97 = 0$

$W = \frac{.514 + 8.95}{2} = 4.73 \text{ ft}$

Check $+ 110 \times 7.16 \times 3.9 \times 1.21 =$
$+ 150 \times .83 \times 3.9 \times 1.21 =$ } $+4304$
$- 996 \times 1.17 = -1165$
$- 3413 = -3413$
$+281 = +281$
$= 7.0 K$

Make W = 4'10"

$\text{Pressure} = \frac{\Sigma F_y \times 2}{W} = \frac{(912 \times 3.9 + 966)\,2}{4.75} = 950 \times 2 = 1900 \text{ \#/ft}^2$ OK

COMPUTATION SHEET
SCS-533A REV 5-58

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P

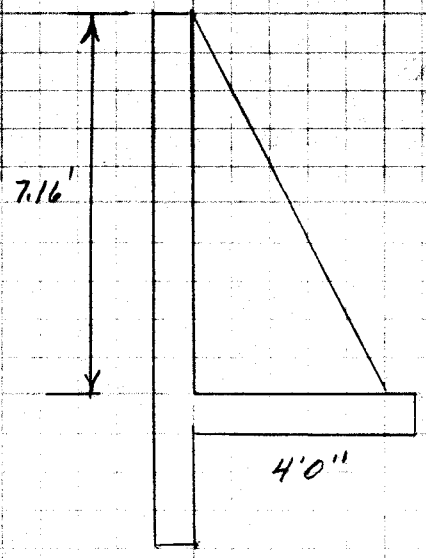
STATE Arizona PROJECT Powerline Dam

BY Watt DATE 4-16-64 CHECKED BY DATE JOB NO

SUBJECT Impact Basin

SHEET 15 OF 20

Wing Wall



$M = \frac{.040 \times 7.16^3}{6} = 2.45$

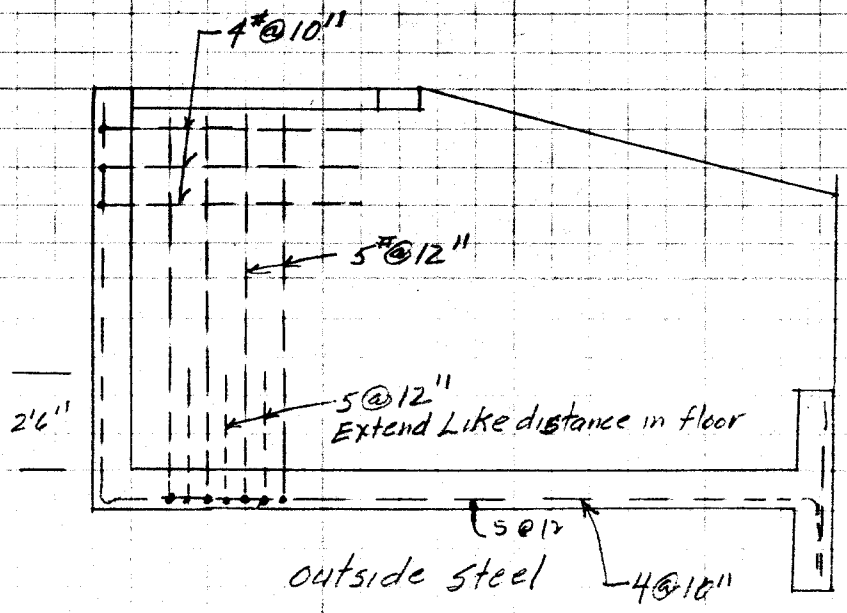
For 10" wall

Min steel #4 @ 12" ←

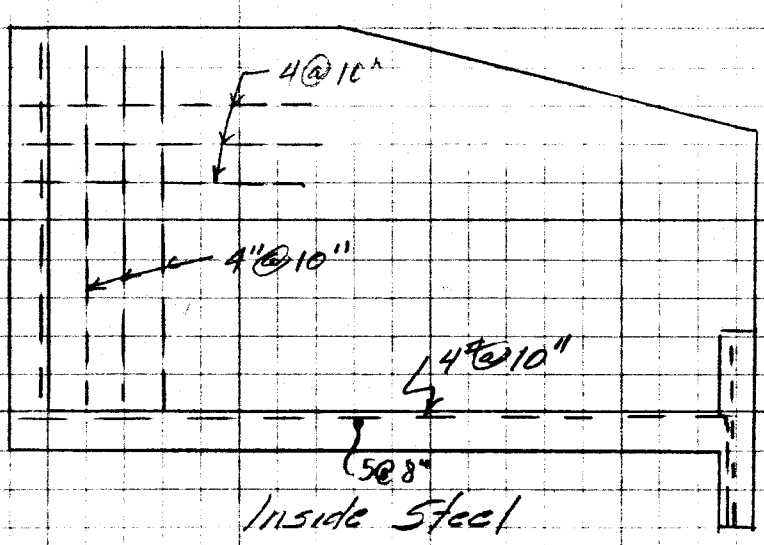
Shear

$\frac{7.16^2 \times 40 \times .}{2 \cdot 7.5 \times 12 \times .9} = 13^{\#}$ ok

Arizona Powerline Dam
Watt 4-16-65
Impact Basin



Toe use No 4#@16"



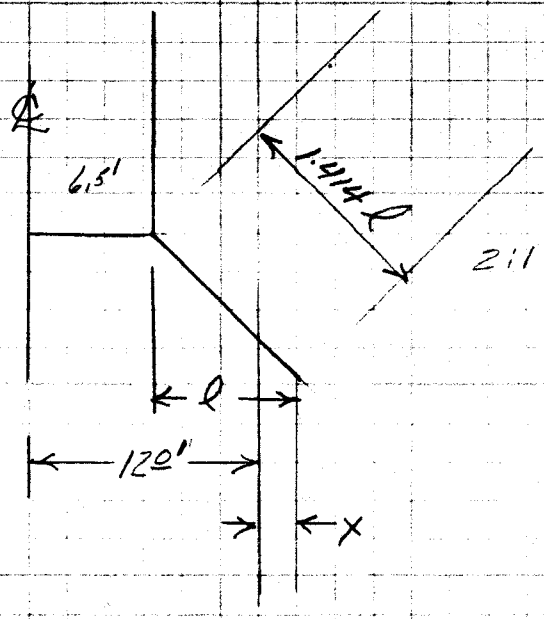
Toe use No 4@10"

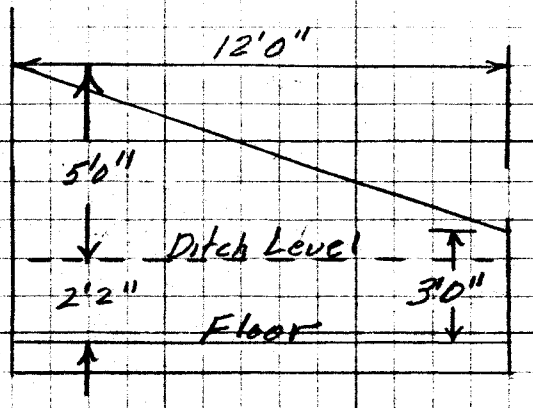
P

Arizona Powerline Dam
Watt 4-16-64
Wing Wall Dimensions

SHEET 17 OF 20

Dimensions so Rip Rap can be placed on 2:1 slope behind wing.



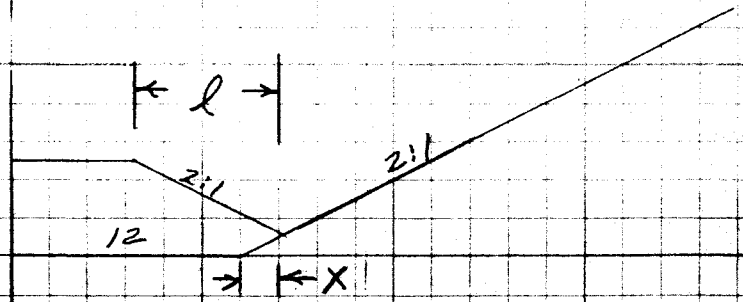


$12/2.82 = 4.25$

$5.00 - 4.25 = .75'$

$2'2" + 9 = 2'11"$

Call 3'



$6.5 + \ell = 12 + X$

$\frac{\ell}{2} + \frac{X}{2} = 5$

$6.5 + \ell = 12 + (10 - \ell)$

$2\ell = 22 - 6.5 = 15.5$

$\ell = 7.75$

$1.414\ell = 10.96$

Slope = $2 \times 1.414 = 2.82$

COMPUTATION SHEET
SCS-523A REV 5-58

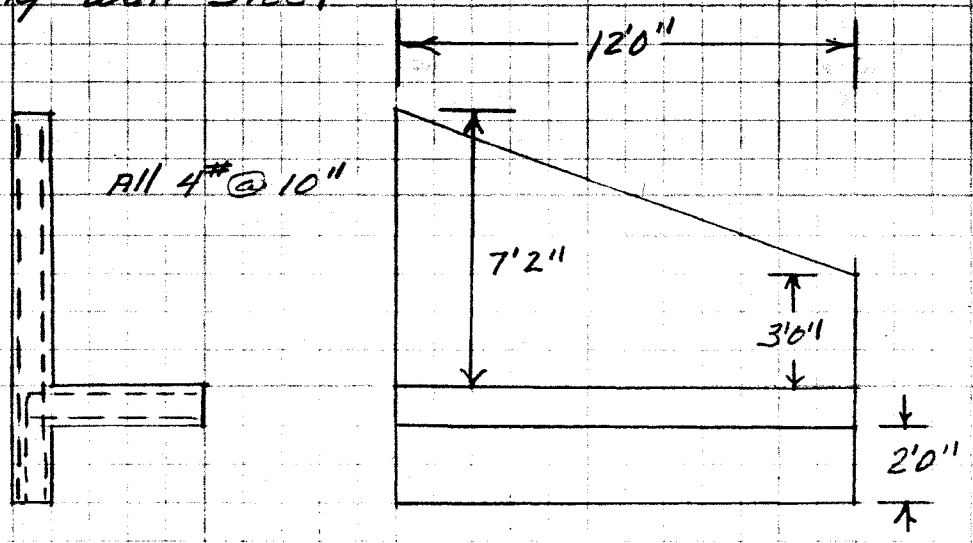
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Dam 9

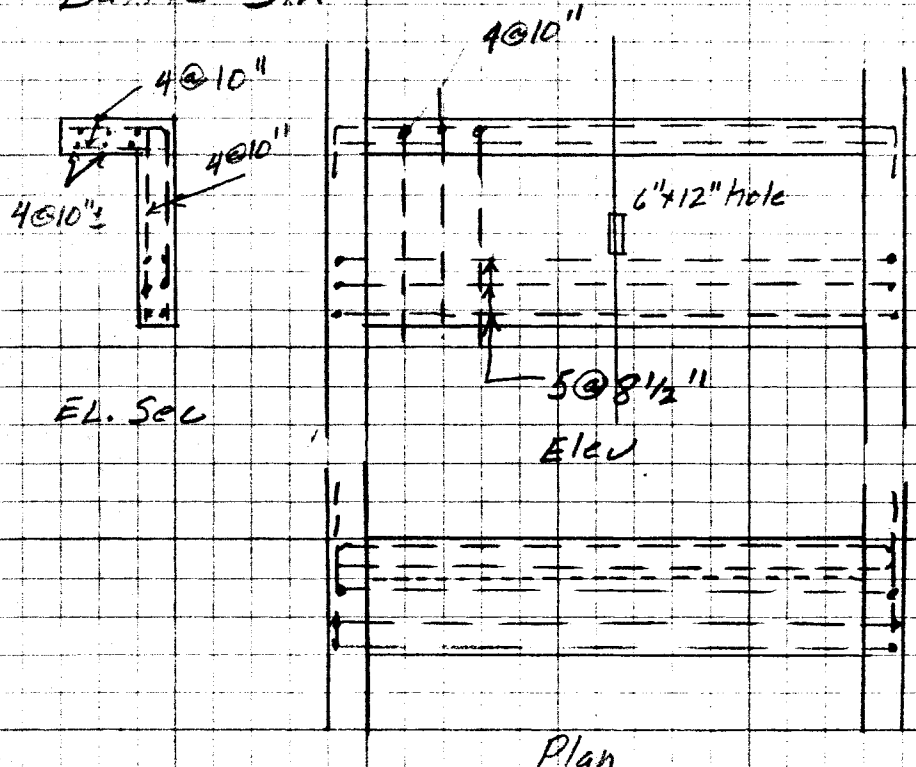
BY Watt DATE 4-16-65 CHECKED BY DATE JOB NO.

SUBJECT Impact Basin SHEET 19 OF 20

Wing Wall Steel



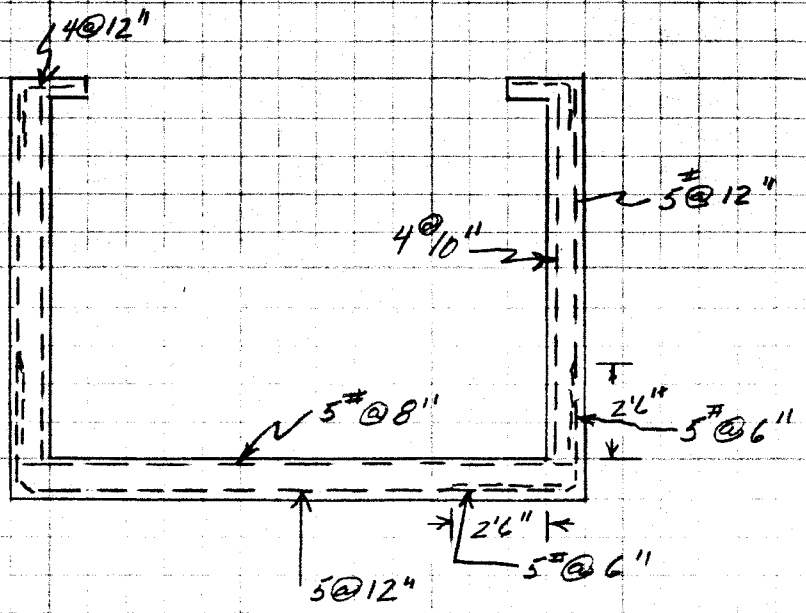
Baffle Str.

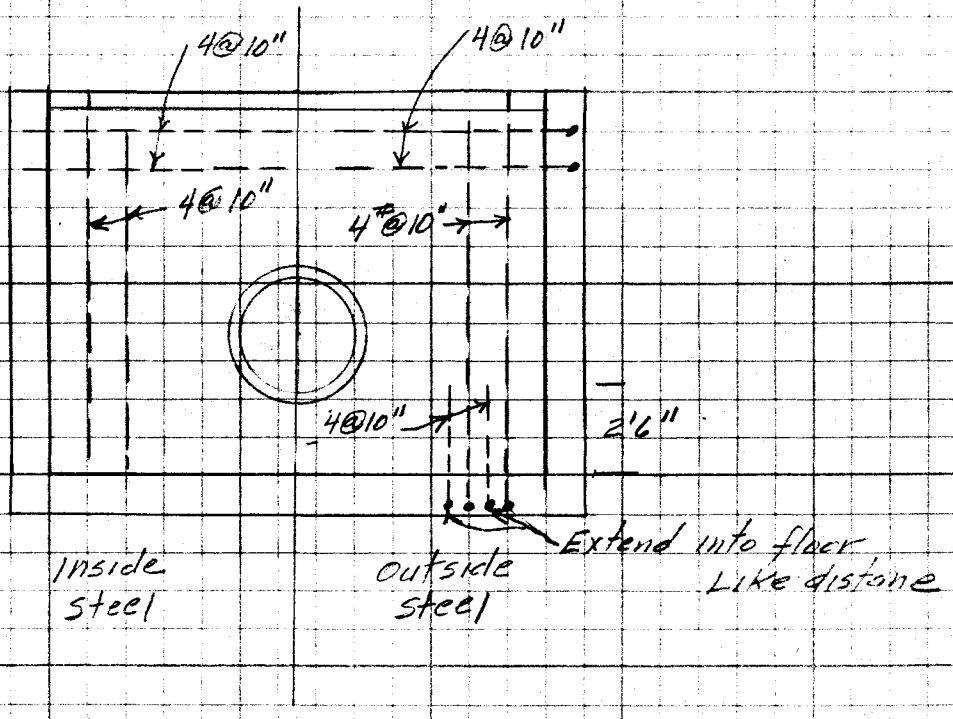


COMPUTATION SHEET
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SCS-523A REV 5-58

P

STATE Arizona PROJECT Powerline Dam
BY Watt DATE 4-16-65 CHECKED BY DATE JOB NO
SUBJECT Impact Basin
SHEET 20 OF 20





Size Pipe for Stock Water Outlet

6" Pipe 10ga

$d = 5.731"$ $A = .179$

$$K_p = \frac{5087}{5.731^{4/3}} \times .013^2 = \frac{5087 \times .013^2}{10.25} = .0839$$

8" Pipe 10ga

$d = 7.73$ $A = .326$

$$K_p = \frac{5087 \times .000169}{15.29} = .0562$$

	6" Pipe		8" Pipe	
K_e	1.24	$V^2/2g$	1.24	$V^2/2g$
K_f	8.81		5.90	
h_v	1.00		1.00	
Total	11.05		8.14	$V^2/2g$

$$11.05\, V^2/2g = H = \frac{2gH}{11.05} = \frac{Q^2}{A^2}$$

$$Q = \frac{8.02 \times A\sqrt{H}}{11.05^{1/2}} = .432\sqrt{H} \quad 6" \text{ pipe}$$

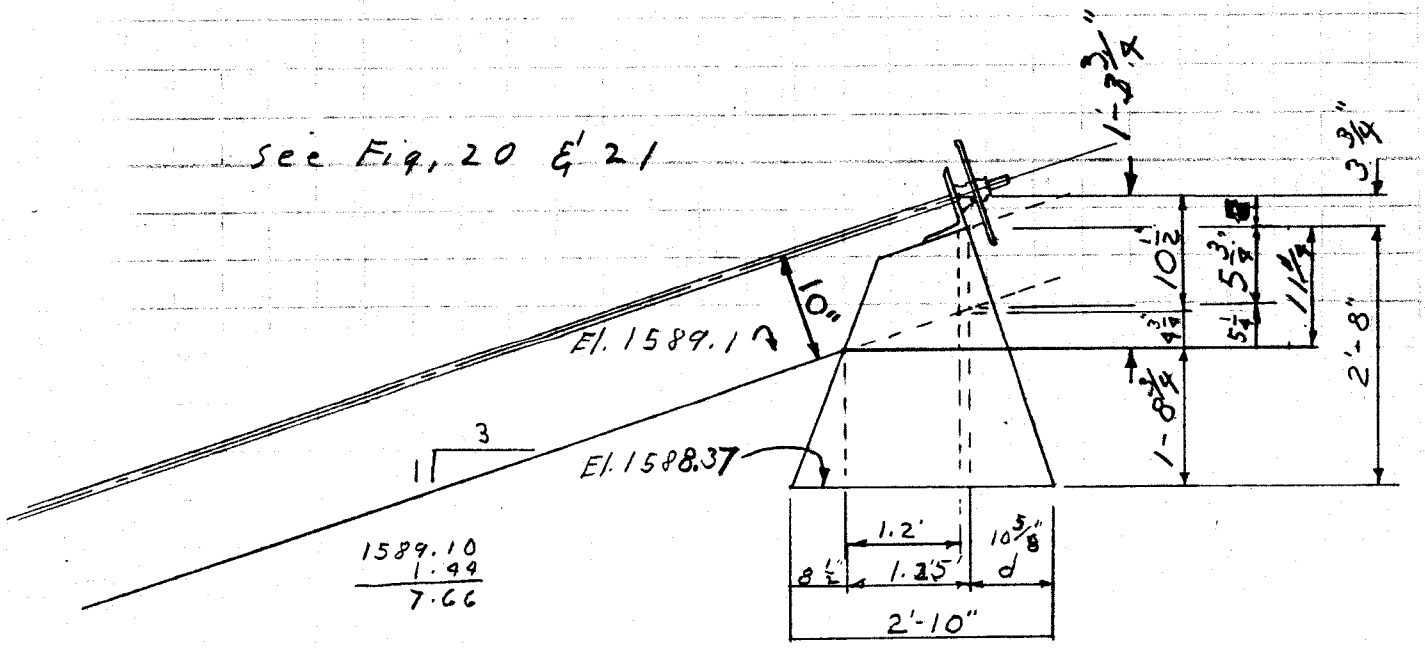
$$Q = \frac{8.02 \times .326\sqrt{H}}{8.14^{1/2}} = .916\sqrt{H} \quad 8" \text{ Pipe}$$

H	$H^{1/2}$	Q-6"	$Q^{8"}$
1	1	.432	.916
2	1.41	.609	1.29
4	2	.864	1.83
6	2.45	1.06	2.24

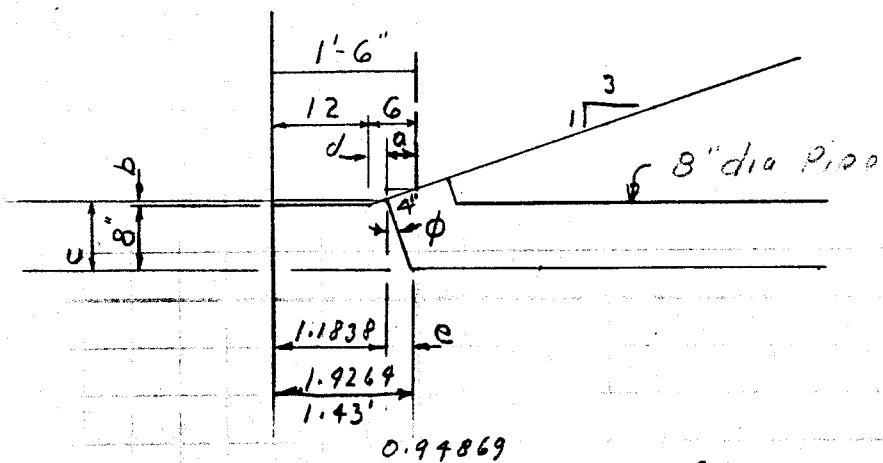
Arizona Powerline Dam

GOH 3-30-66

Details of Gate Lift Pedestal



$d = 2.66667 \times 0.33333 = 0.88889$



$\tan \phi = \frac{1}{3} = 0.33333$

$= 18°26''$

0.94869

$a = 0.33333 \cos. 18°26' = 0.31623$

$d = 0.50 - 0.31623 = 0.18377$

$\frac{1}{3} = \frac{b}{0.18377}$, $b = 0.06125$

$c = 0.66667 + 0.06125 = 0.72792$

$e = 0.72792 \tan 18°26'' = 0.24264$

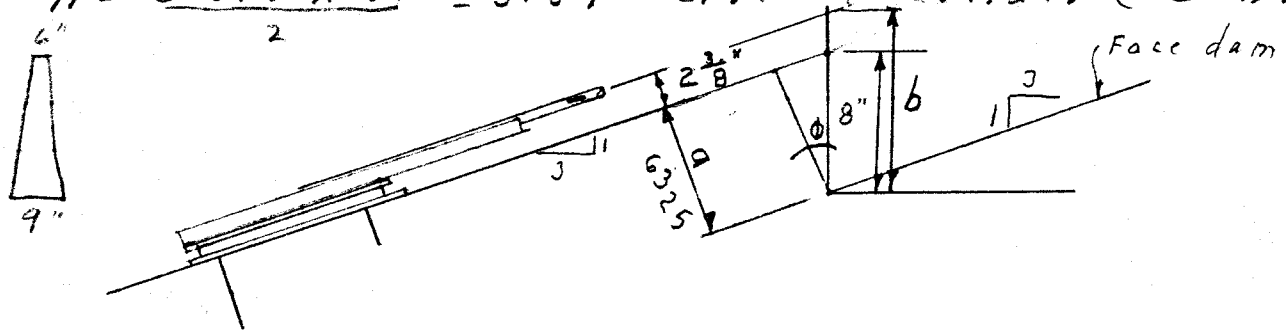
Arizona Powerline Dam

G.D.H. 3-30-66

Details of stock pond diversion

Use standard Intake structure (7-N-20465 A-1)
8" dia C.M. Pipe 14 ga. asbestos bonded asphalt coated.
use P.W.D Basin 7-N-20463 (A-1)
use 1" dia. black iron gate stem, except lift threaded section, use stainless steel.
use 14" dia handwheel with bronze lift nut.
Use Gate Lift Pedestal "B" of Fig 20
Use adjustable stem guide Fig-18 (without Vent pipe)
use gate stem pedestal Fig-22 (@ 10' spacings)
use Armco Model 50-10C slide gate, Flange back.
Number of cutoff collars =

$n = \frac{0.075 \times 89}{2} = 3.34$ use 4 collars @ 20' sp.

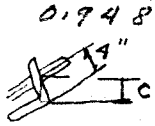


$\tan\phi = \frac{1}{3} = 0.33333 = 18^\circ 26'$

$a = 0.666667 \cos 18^\circ 26' = 0.632\cancel{46}$ (0.94869)
$+ \; 0.1979$
8304 use .833333

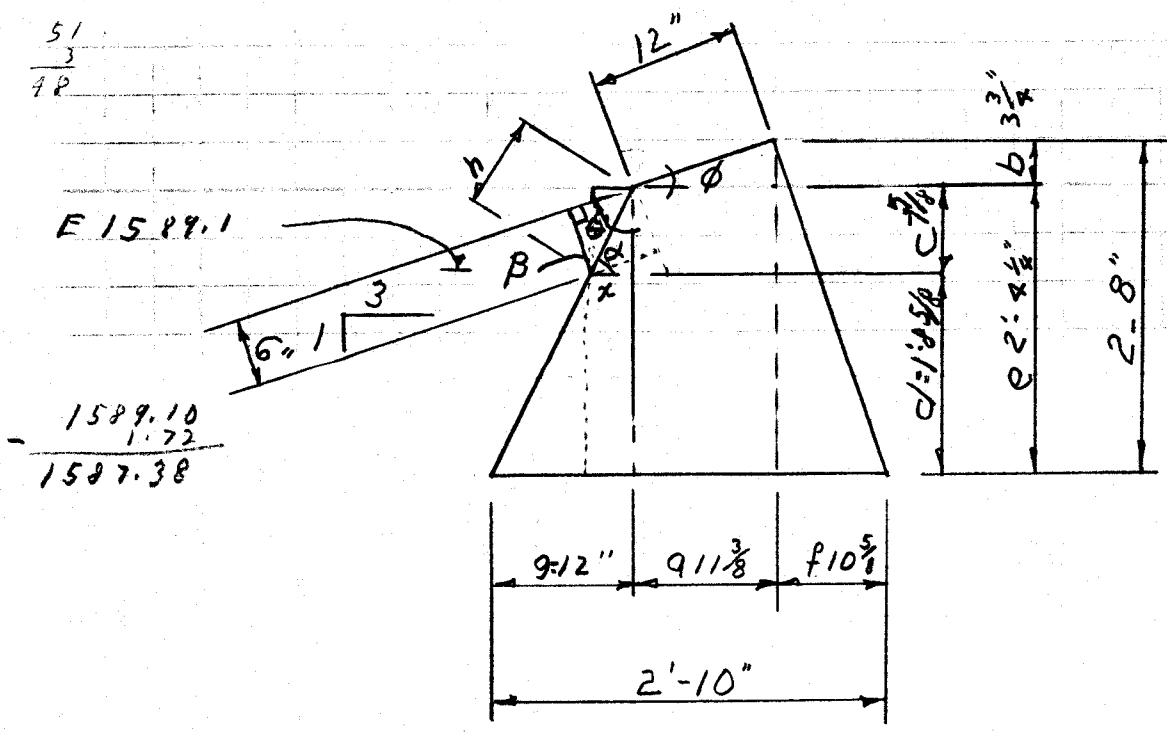
Set ℄ of stem guides at 0.83333 up and normal to face of dam

$b = \frac{0.833333}{\cos 18^\circ 26'} = 0.8784 = 0.875 = 10\frac{1}{2}"$
0.94869



$c = 0.33333 \cos 18^\circ 26' = 0.31623$ use $3\frac{3}{4}$ (0.94869)

51
3
48



1589.10
− 1.72
1587.38

$\tan\phi = \frac{1}{3} = 0.33333 = 18°26'6"$

$a = 1.0 \cos 18°26'6" = 11\frac{3}{8}$ (.948683)

$b = 1.0 \sin 18°26'6" = 3\frac{3}{4}"$ (3162286)

$e = 2'-8" - 0'-3\frac{3}{4}" = 2'-4\frac{1}{4}"$

$f = 2.66667 \tan 18°26'6" = 0.888888 = 10\frac{5}{8}" = 0.8854$ (.3333333)

$g = 2.833333 - (0.8854 + 0.9487) = 1'-0"$

$\tan\alpha = \frac{1}{2.3542} = 0.4247727 = 23°0'52"$

$\theta = 90° - (23°0'52" + 18°26'6") = 48°33'02"$

$\beta = 180° - (48°33'02" + 90) = 41°26'52"$

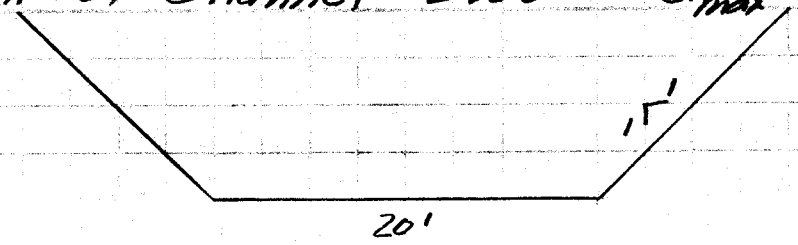
$h = \frac{0.5}{\cos 41°26'52"} = 0.667058$ (.749559)

$C = 0.667058 \cos 18°26'06" = 0.63283$ use $7\frac{5}{8}$ .6354 (.948683)

20/63

Arizona Powerline Dam
Watt 7-21-66
Cost to temporarily divert
Powerline Dam Outlet into
Siphon Draw

Length of Channel 2700' Q_{max} = 180 C.F.S.



$n = .03$ $S = .001$ $Q = 180$

$$K = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{180 \times .03}{2950 \times .03162} = .0579$$

$\frac{D}{b} = .143$ $D = 20 \times .143 = 2.86$ $V =$

$A = 65.4$ $V = 2.75$ $R = 2.33$

$$\text{Earth} = \frac{65.4}{27} \times 2700 = 6540 \text{ cuyd}$$

$6540 \times 30¢ = \$1962$

No compaction No shaping.

For $S = .002$ $K = \frac{180 \times .03}{2950 \times .04472} = .0409$

$\frac{d}{b} = .116$ $d = 20 \times .116 = 2.32$

$A = 2.32 \times 20 + 2.32^2 = 51.7$ $V = 3.5'/\text{sec}$

Arizona Powerline Dam.
Watt 10-24-66
Hydrology High School Diversion

Drainage Area High School Diversion

$\frac{6.85}{} \times .143 = 0.98$ Call 1.0 sq. mi.

Length = 12,000 ft

For V S=.005 R=.75 V = 2.5 ft/sec

$T_c = T_p = \frac{12000}{2.5 \times 3600} = 1.3$ hr

For 100 yr 1 hr Storm 2.7 inches

For Curve No 80 $Q_p = 1.1$

$Q = \frac{1.1 \times 1.0 \times 4.84}{1.3} = 410$ CFS

For 50 yr 1 hr Storm = 2.3 Q = .74

$Q = \frac{0.74 \times 1.0 \times 484}{1.3} = 211$ CFS

Design Channel for 210 CFS

For 1st 1500' Drainage Area = 0.455 sq mi L = 12000
Q = 100 CFS

Arizona
Watt 10-24-66

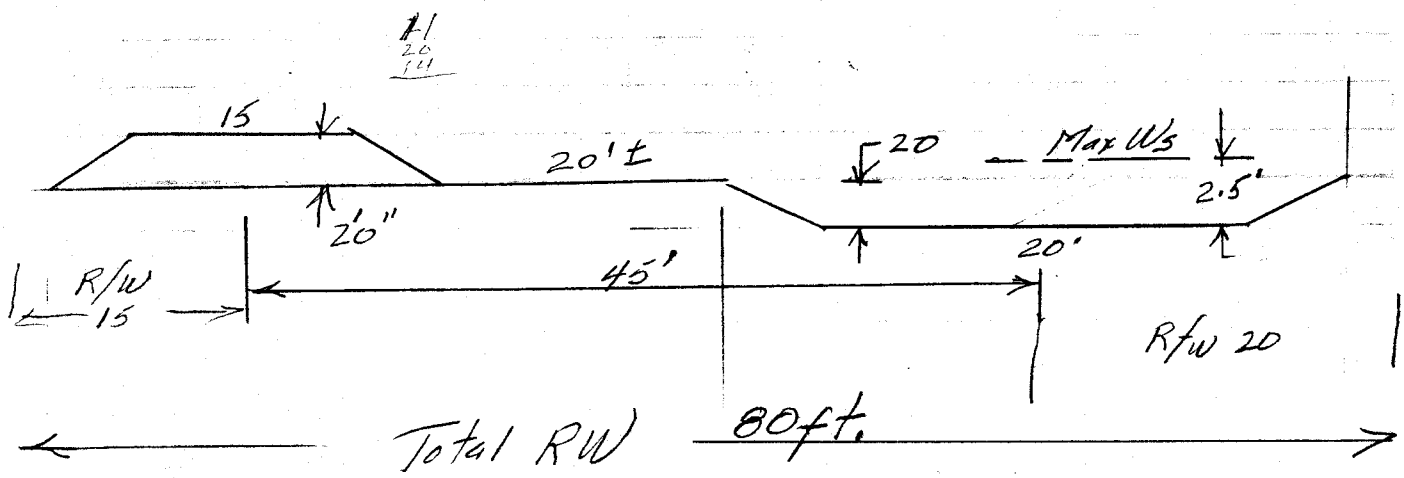
Channel $d = 2$ $n = .03$ $S = .002$ S.S. = 2:1

$Q = 210$ $K = \frac{210 \times .03}{2^{8/3} S^{1/2}} = .992$ (6.35)

S	$S^{1/2}$	K'	D/b	b
.0015	.03873	25.61	.058	34.5
.002	.04472	22.18	.0695	28.8
.003	.05477	18.11	.0865	23.1
.004	.06325	15.68	.010	20.0
.005	.07071	14.03	.0113	17.7
.006	.07746	12.81	.0126	16.0

$d = 2.5$ $K = \frac{.547}{S^{1/2}}$

S	$S^{1/2}$	K	D/b	b
.0015	.03873	14.12	.113	22
.002	.04472	12.25	.132	19
.003	.05477	9.98	.166	15
.004	.06325	8.65	.183	13.7
.005	.07071	7.74	.208	12.0
.006	.07746	7.07	.230	11.0



Arizona
Watt
Hydraulics High School Diversion

For Channel 20' Wide 2:1 5.5, Q=210 CFS

$n = .030$ $K' = \frac{210 \times .03}{20^{8/3} \times S^{1/2}} = \frac{6.3}{(2950)} = 0.00213$

S	$S^{1/2}$	K'	P/b	D	A	V
.0015	.0387	.00551	.132	2.64	66.7	3.1
.002	.0447	0.0477	.122	2.44	60.7	3.4
.003	.0548	0.0388	.108	2.16	52.5	4.0
.004	.0633	0.0336	.100	2.00	48.0	4.4
.005	.0707	0.0301	.093	1.86	43.1	4.9
.006	.0775	0.0275	.089	1.78	42.0	5.0

For 100 C.F.S.

S	K'	P/b	D	A	V
.0015	.0262	.086	1.72	40.3	2.5
.002	.0227	.079	1.58	36.6	2.7
.003	.0185	.070	1.40	31.9	3.1
.004	.160	.065	1.30	29.4	3.4
.005	.0143	.061	1.22	27.4	3.7
.006	.0131	.057	1.14	25.4	3.9

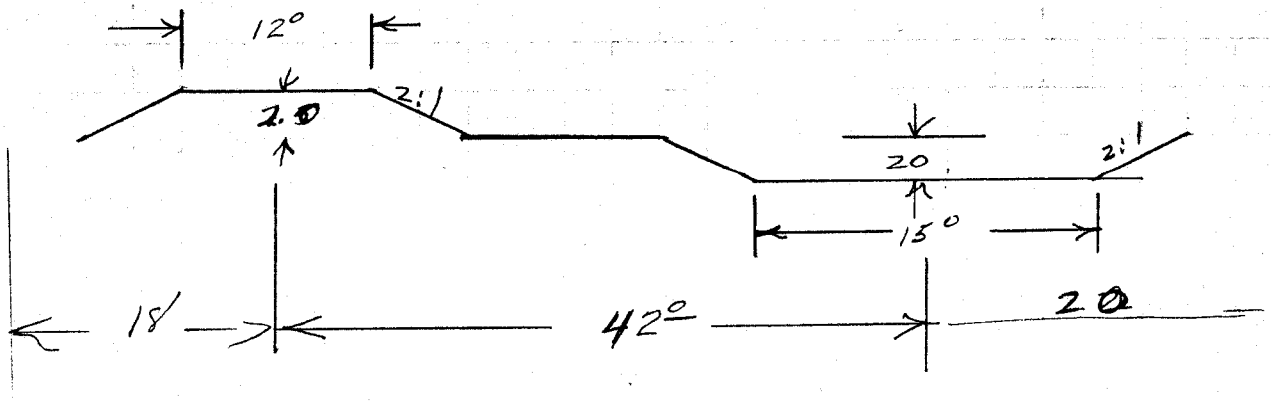
For 100 CFS b = 15'

$K' = .00219/S^{1/2}$

S			
.0015	.0565	.134	2.01
.002	.0489	.123	1.84
.003	.0399	.110	1.65
.004	.0346	.101	1.52
.005	.0309	.095	1.42
.006	.0282	.090	1.35

Size Channel 1st 1500 ft.

11.5
=
31.5



Arizona
Watt
Est Cost Diversion

Excavation $\frac{20 \times 2 \times 2 \times 4 \times 5300}{27} = 9418$

Fill $\frac{15 \times 2 \times 8}{27} \times 5300 = 7457$

9500 Excavation @ 20¢ = 1900
7500 Fill @ 35¢ 2625
$4525

Clearing 10 acres @ $60 600

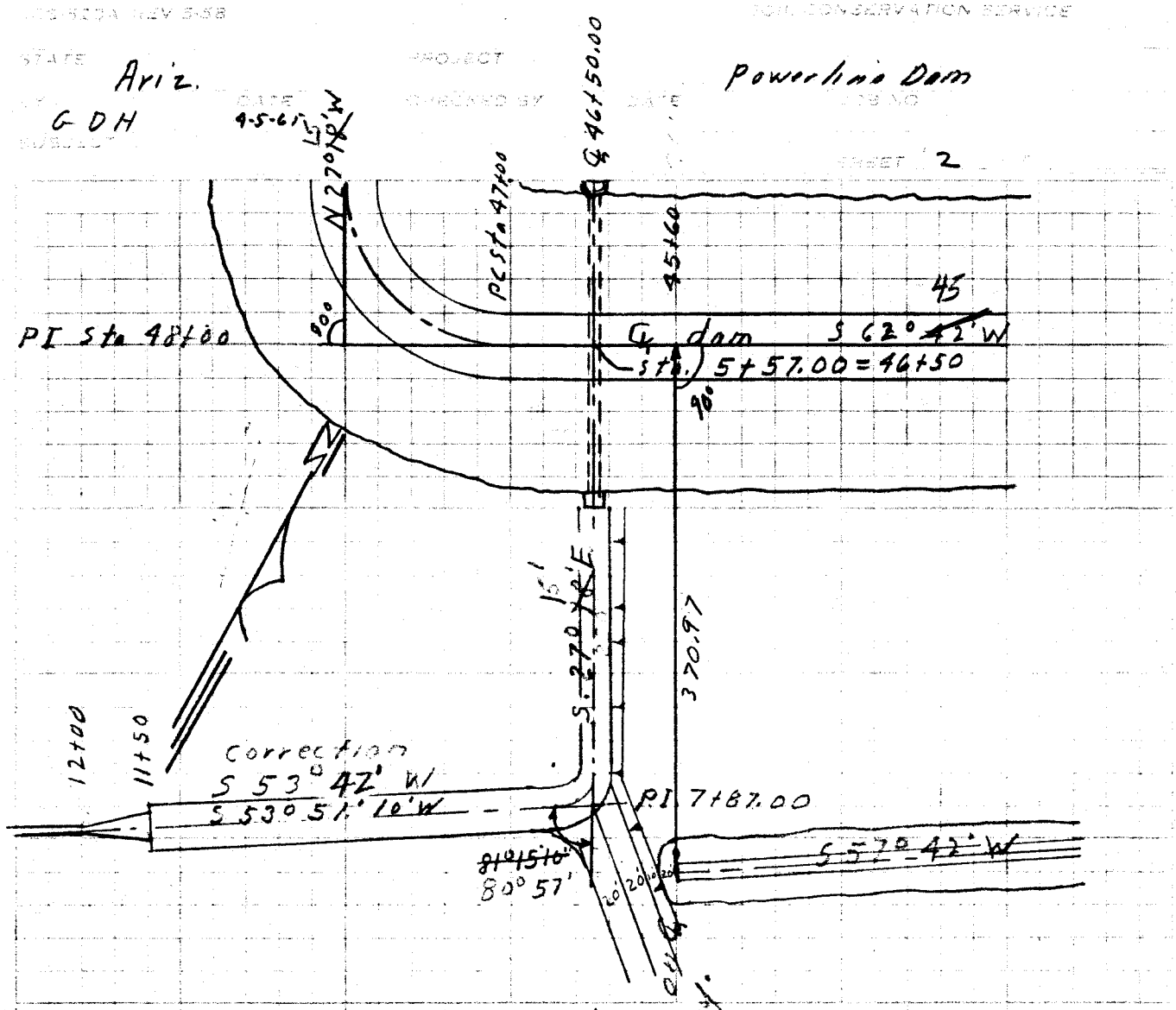
Total $5125

COMPUTATION SHEET
SCS-SEDA REV 5-58

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Ariz.
BY GDH
DATE 4-5-61
SUBJECT

PROJECT Powerline Dam
CHECKED BY
DATE
JOB NO
SHEET 2



Inside Curve Data

Δ = ~~81° 15' 10"~~ 80° 57'

R = 50

T = 42.~~38~~ 67

$\frac{1}{2}\Delta$ = 40° ~~27'~~ 28' ~~25"~~ 30"

tan = 0.~~85790~~ 0.85333

T = R tan $\frac{1}{2}\Delta$

T

t = 50 x .~~84750~~ 85333 = 42.~~38'~~ 67'

~~74 x 84750 = 62.72'~~

~~Outside Curve~~

~~Δ = 81° 15' 10"~~

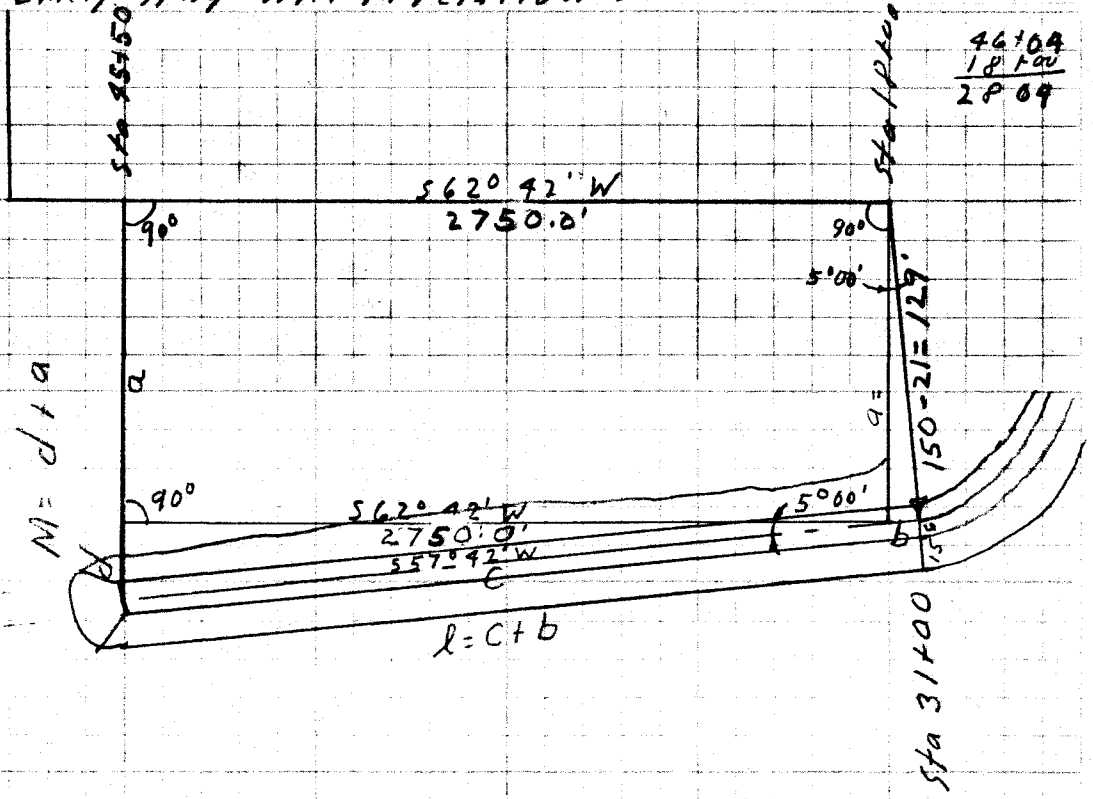
~~R = 74~~

~~T = 62.72'~~

Sta. 59+26 of emerg. spwy.

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

STATE Arizona PROJECT Powerline Dam
BY GDH DATE 4-5-65 CHECKED BY D.A.H DATE 5-10-65 JOB NO.
SUBJECT Locating end Emerg. Spwy dike in relation to ℄ dam. SHEET 3 OF



$a = \frac{129}{\cos 5°00'}$ - - - - - - - - - = 129.49336
0.99619

$b = 129 \tan 5°0'$ (0.08749) - - - - = 11.28621

$c = \frac{2750.0}{\cos 5°00'}$ - - - - - - = 2,760.5176
0.99619

$d = 2750.0 \tan 5°0'$ (0.08749) - - - = 240.5975

$l = c + b = 2,760.5176 + 11.28621 = 2771.80$

$M = d + a = 240.5975 + 129.49336 = 370.91'$

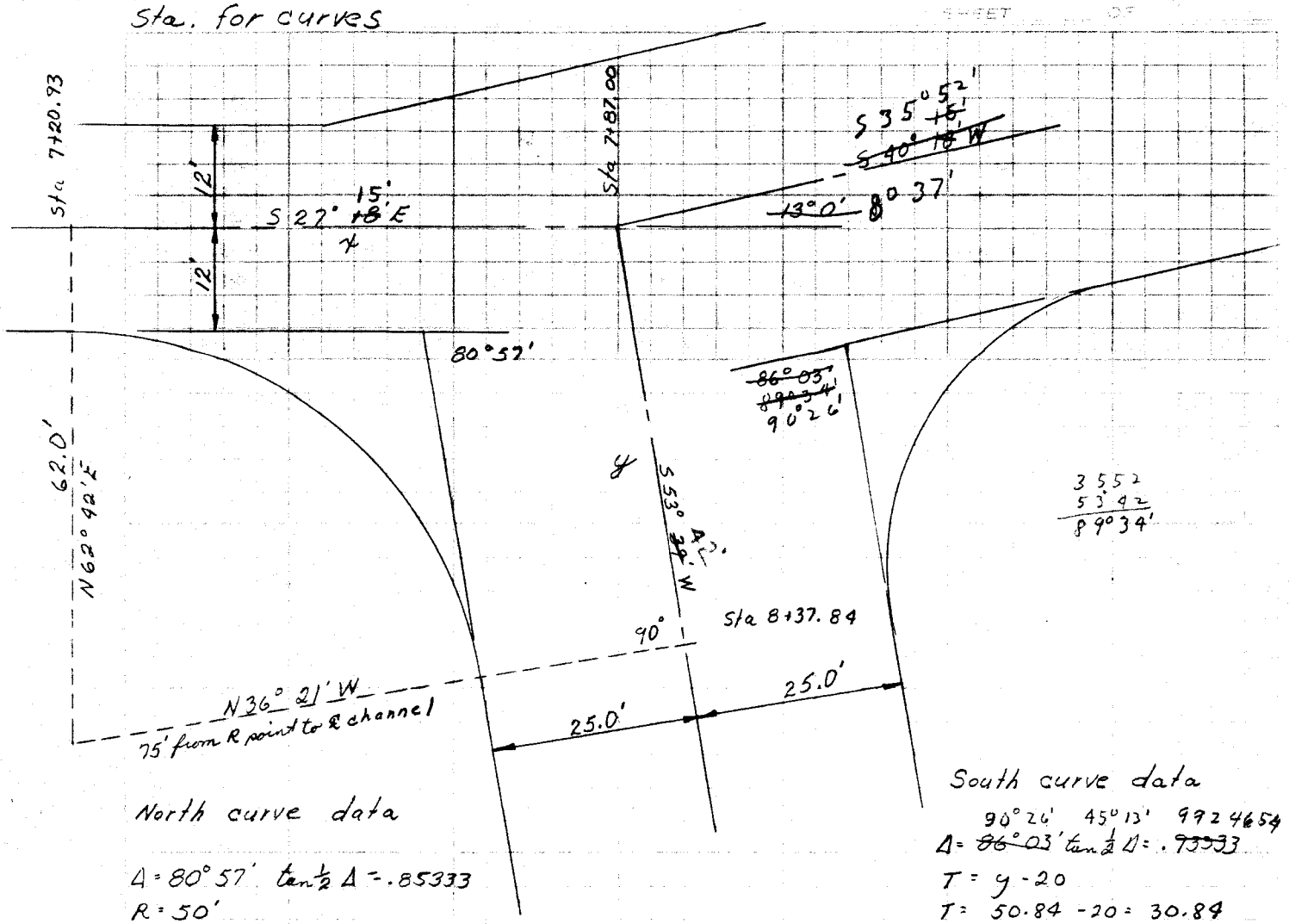
Sta. along ℄ emerg. spwy. = 31+00 + 27+71.80 = 58+71.80

STATE Arizona

PROJECT Powerline Prin. Spillway Outlet

D.H.H. 5-10-65

Sta. for curves



North curve data

$\Delta = 80° 57'$ $\tan \frac{1}{2}\Delta = .85333$

$R = 50'$

$T = 50.0 \times .85333 = 42.67'$

South curve data

$90° 26'$ $45° 13'$ $.9924654$

$\Delta = 86° 03'$ $\tan \frac{1}{2}\Delta = .73333$

$T = y - 20$

$T = 50.84 - 20 = 30.84$

$R = \frac{30.84}{.93333} = \frac{31.07'}{33.04}$

.9924654

Computing sandy distances, consider the ℄ line as South

Bearing	Dist.	Cos	Sin	N	S	E	W
South	x 66.07	1.00			66.06912		
S 80° 57' W	x 50.84	.15730	.98755		7.99713		50.2025
N 9° 03 W	75.0'	.98755	.15730	74.06625			11.79750
East	62.0'		1.00			62.0	
Substitute in correct Bearings							
S 27° 18' E	66.07	.88862	.45865		58.71112	30.30301	
S 53° 39' W	50.84	.59272	.80541		30.13388		40.94704
N 36° 21' W	75.0	.80541	.59272	60.40575			44.45400
N 62° 42' E	62.0	.45865	.88862	28.4363		55.09414	
				88.8420	88.84500	85.34745	85.40104

Arizona Powerline Dam

GDH 3-15-64 ~~Wall~~

Emergency Spillway Layout.

$\Delta = 151°00'$ ✓

$R = 450'$ ✓

$T = 1,740.02'$ ✓

$L = 1,185.95$ ✓

$D = 12°44'$ ✓

3.8667131

$T = 450 \tan 75°30' = 1,740.02$

$L = \frac{3.14159 \times 450 \times 151}{180} = 1,185.95'$

$D = \frac{5729.58}{450} = 12.7324$

station 31+00.00

11+85.95

19+14.05

66°

85

151

Solving for stationing @ ℄ of dam

$\Delta = 66°00'$

$R = 450'$

$L = \frac{3.14159 \times 450' \times 66°}{180°} = 518.36$ ✓

Sta = 19+14.05

5+18.36

24+32.41 ✓

Arizona Powerline Dam

GDH 3-12-65 D.H.H 3-15-65

Realignment of ℄ 2 3

See sheet 3 of 3 for curve data, sheet 1 of 3 for dist.

sta. 0+00	
+	47 00
1st P.C. - - -	47+00
+	1 00
PI - - - -	48+00
+Lc - 100 (157.08-100)=	57.08
PT- - - -	48+57.08
+2,979.39 - 200 +	27+79.39
2nd PC - - - -	76+36.47
+	1 00.00
P.I.- - - -	77+36.47
+Lc-100=(192.57-100) +	92.57
P.T. - - -	78+29.04
+3,386.00 - 200 +	31 86.00
3rd P.C. - -	110+15.04
+	100.00
P.I. - - - -	111+15 04
+Lc-100=(178.46-100) +	78.46
P.T.- - - -	111+93.50
+4,786.38 - 100	4686.38
End - -	158+79.88

161+39.62
158+79.88
2 59.74

Arizona Powerline Dam

GDH 11-30-64 D.H.H. 12-1-64

Dam Curve Data & Stationing 3 3

Sta 50+00 PI Curve I

$\Delta = 90°$
$T = 100'$
$R = 100'$
$L = 157.08$
$D = 57°18'$

$L = \frac{3.14159 \times 100 \times 90}{180} = 157.08'$

$D = \frac{5729.58}{100} = 57.2958° = 57°18'$

Curve II

$\Delta = 38°07'$ $(19°03'30")$
$R = 289.46$
$T = 100$
$L = 192.57$
$D = 19°48'$

$R = \frac{T}{\tan \frac{1}{2}\Delta} = \frac{100}{.345465} = 289.46'$

$D = \frac{5729.58}{289.4649} = 19.7937° = 19°48'$

$L = \frac{3.14159 \times 289.46^{49} \times 38.1167}{180} = 192.57'$

Curve III

$\Delta = 64°26'$ $(32°13')$
$R = 158.69$
$T = 100$
$L = 178.46$
$D = 36°06'$

$R = \frac{100}{.63014} = 158.69$

$D = \frac{5729.58}{158.69489} = 36.1044° = 36°6'$

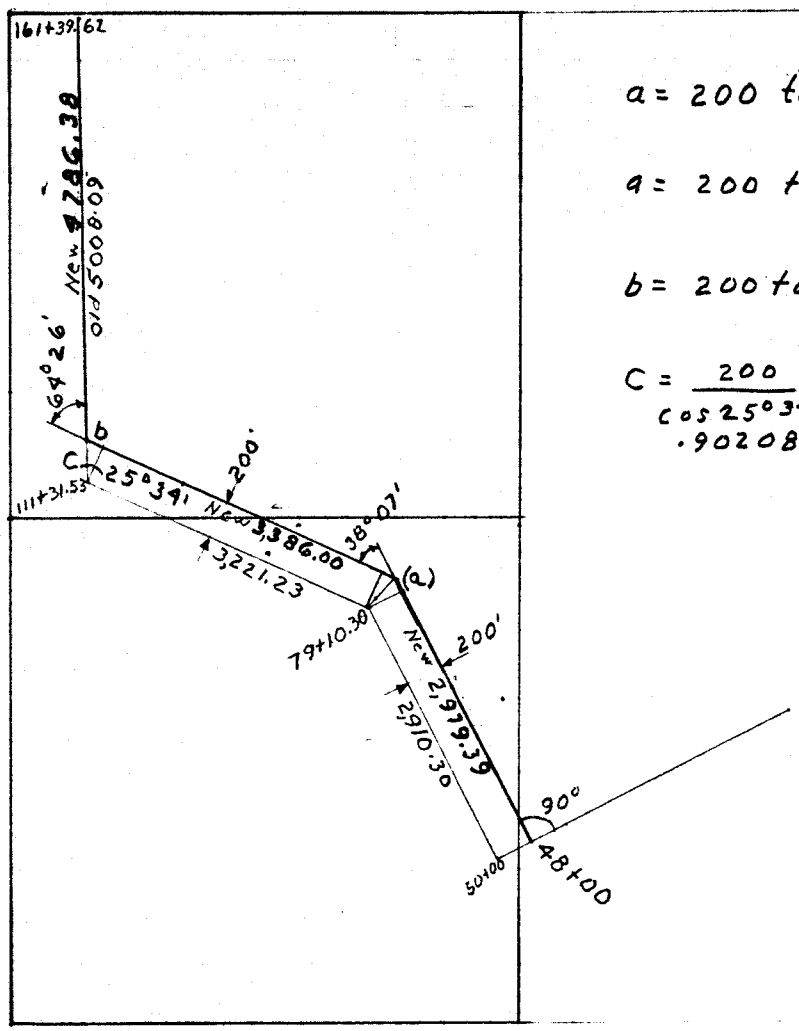
$L = \frac{3.14159 \times 158.69489 \times 64.433333}{180} = 178.46$

Arizona Powerline Dam

GDH 3-11-65 DHH 3-15-67

Realignment of Powerline Dam ℄ 1 3

89°60'
64°26'
25°34'



$a = 200 \tan \frac{38°07'}{2}$

.345465

$a = 200 \tan 19°03'30" = 69.09'$

.47840

$b = 200 \tan 25°34' = 95.68'$

$C = \frac{200}{\cos 25°34'} = 221.71'$

.90208

New Dist. P.I. to P.I.

2,910.30	69.09	5,008.09
+ 69.09	3221.23	− 221.71
2,979.39	95.68	4,786.38
	3,386.00	

Arizona Powerline & Vineyard Road Dam's.

G.D.H. 1-7-65 D.H.H. 1-8-65

Dam ℄ alignment

Original Stations	∡ angle	Bearings	New Stations
161+39.62			End. 160+67.73
		S 0° 56'E	
111+31.53	R 64°26'		P.I. 110+81.18
		S 65° 22'E	
78+67.38	L 38°07'		P.I. 78+67.38
		S 27°15'E	
50+00	R 90°00'		Pl. 50+00
		N 62° 45'E	
0+00	R 64°52'		Begin 0+00
		S 52° 23'E	
9/10 1/4 cor.	R 120°46'		
		S 68° 23'W	
P.I.	L 11° 23'		
		S 57° 00'W	
251+48.42	L 90° 00'		Pl. 251+16.82
		S 33° 00'E	
214+72.30	R 13° 29'		Pl. 214+41.62
		S 19° 31'E	
188+25.50	L 10°06'		Pl. 187+95.34
		S 29°37'E	
147+93.60	R 25°42'		Pl. 147+66.80
		S 3° 55'E	
128+00	L 18° 30'		Pl. 127+74.94
		S 22° 25'E	
101+09.20	R 12°59'		Pl. 100+85.00
		S 9° 26'E	
67+50.23	L 12°53'		PI 67+26.88
		S 22° 19'E	
40+00	L 67°02'		PI 40+00
		S 89°21'E	
20+00	R 75°19'		
		S 14° 02'E	Begin 20+00

Powerline Dam

Vineyard Road Dam

These comp on powerline are OK for closure but void for sta. (Dam ℄ Moved)

34 | 35
3 | 2

Arizona Powerline Dam

GDH 12-1-64 D.H.H. 12-1-64

Sta. Correction due to Curves

		Tan. Dist.	Length Curve	P.I to P.I. - 2T	Correction @ P.T.	original Sta	New Sta.
- Begin						0+00	
I	P.C.	-100'		+5,000			49+00
	P.I.	+100	- - -	- - - - -	- - -	(50+00)	50+00
	P.T.		P.C.+157.08		-42.92		50+57.08
II	P.C.			+2,710.30	-42.92		77+67.38
	P.I.	+100				(79+10.30)	78+67.38
	P.T.		Pc+192.57		-50.35		79+59.95
III	P.C			+3,021.23	-50.35		109+81.18
	P.I	+100				(111+31.53)	110+81.18
	P.T		PC.+178.46		-71.89		111+59.64
End				+4,908.09	-71.89	(161+37.02)	160+67.73

Note: For bearings of ℄ of Powerline Dam see Vineyard Road computations. The two dams are tied together. G.D.H. 1-7-65

Station Void

3-11-65

G.D.H.

OPTIONAL FORM NO. 10
5010-103

UNITED STATES GOVERNMENT

Memorandum

TO : Mr. T. Geter
Const. Mgt. Eng.

DATE: 10-29-64

FROM : Dick Wenberg
P.E.

survey notes placed in book
2006 11-2-64 R.J.W.

SUBJECT: Surveys - Apache Jct. - Gilbert Watershed

I tried to call you today regarding the enclosed channel alignment notes. The bearings at each end where I have information varies from +0°03' to -0°03', and from ¼ Cor Sec 20-29 ~~E~~ West the alignment is much different than you indicated it should be. I would prefer having the applicable G.L.O. maps to rough check such ~~it~~ information prior to sending it ino I talked to swenson yesterday about acquiring A one-man raft or equiv. for RWCD x-sect. I believe you have looked into this before. Let me know what you think about this.

Dick

12
10

179 60
92°33'
23

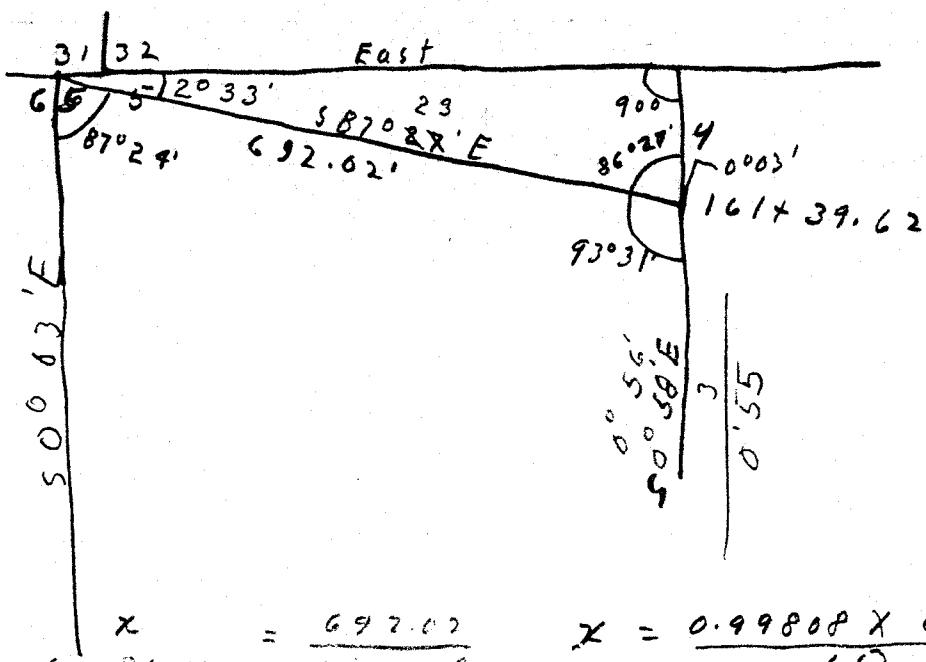
8960
8727
92°33
9

8627
9331
17958

179 59 60
93 30 30
86 29 30

86 30
90 00
17630

179.60
17630
30

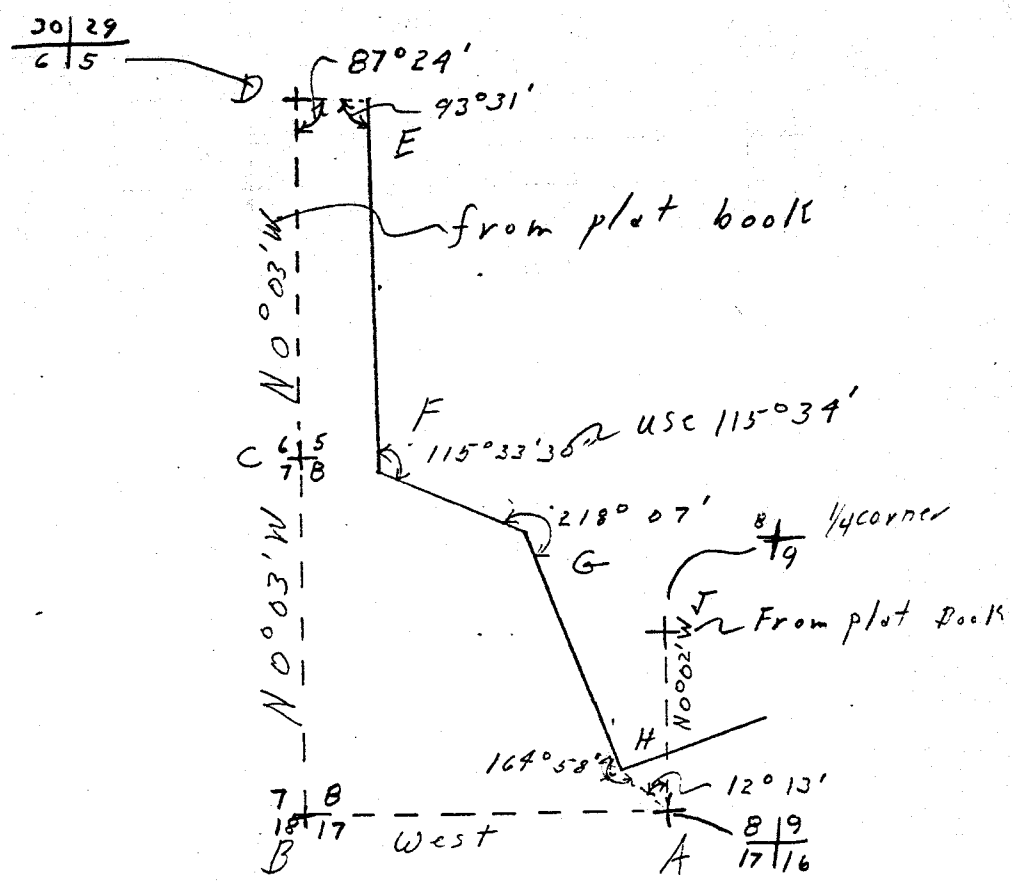


$$\frac{x}{\sin 86°27'} = \frac{692.02}{\sin 90°} \qquad x = \frac{0.99808 \times 692.02}{1.0} = 690.69$$

$$\frac{y}{\sin 2°33'} = \frac{692.02}{\sin 90°00'} \qquad y = \frac{0.04449 \times 692.02}{1.0} = 30.79'$$

1560
1787
883
2

Arizona Apache Jct.- Gilbert
R.D.W. 10-5-64 Power line Str. 1 2
traverse closure



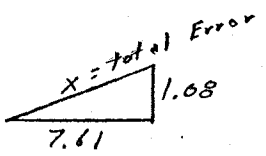
B - D		N 0° 03' W
D	87° 24'	
D - E		S 87° 27' E
E	93° 31'	
E - F		S 0° 58' E
F	115° 33" or 34"	
F - G		S 65° 25' E or S 65° 24' E
G	38° 07'	
G - H		S 27° 18' E or S 27° 17' E
H	164° 58' or 15° 02'	
H - A		S 12° 16' E or S 12° 15' E
A	12° 13'	
A - J		N 0° 03' W or N 0° 02' W ch

XERO COPY XERO COPY XERO COPY

Arizona R.D.W. 10-5-64 Apache Jct. – Gilbert Powerline Str. 2 2

Traverse closure

Line	Bearing	Dist	Cosine	+ Lat	− Lat	Sine	+ Dep.	− Dep.
A-B	West *	5,283.96 *	0.0	—	—	1.0	—	5,283.96
B-C	N 0°03'W *	5,280.0 *	1.0	5,280.0	—	.00087	—	4.59
C-D	N 0°03'W *	4,891.92 *	1.0	4,891.92	—	.00087	—	4.26
D-E	S 87°27'E	692.02	.04449	—	30.79	.99901	691.33	—
E-F	S 0°58'E	5,008.09	.99986	—	5,007.39	.01687	84.49	—
F-G	S 65°24'E	3,221.23	.41628	—	1,340.93	.90924	2,928.87	—
G-H	S 27°17'E	2,910.30	.88875	—	2,586.53	.45839	1,334.05	—
H-A	S 12°15'E	1,233.28	.97723	—	1,205.20	.21218	261.68	—
Total		28,520.8		10,171.92	10,170.84		5,300.42	5,292.81
				−10,170.84			5,292.81	
			Error	+1.08'			+7.61'	



$x = \sqrt{(1.08)^2 + (7.61)^2} = \sqrt{1.17 + 57.91} = \sqrt{59.08}$

$x = 7.69$ ft

1 : 3,709

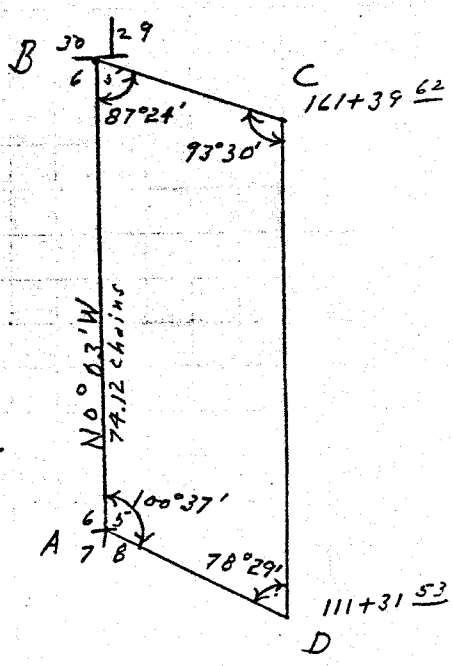
* From Plat Map

Arizona — Apache Jct. - Gilbert Powerline Str.

R. D. W. 10-5-64

traverse closure

A - B		N 0°03'W
B	87°24'	
B - C		S 87°27' E
C	93°30' a 86°30	
C - D		S 0°57'E
D	78°29'	
D - A		N 79°26 W
A	100°37' a 79°23'	
A - B		N 0° 03' W OK.



Line	Bearing	Dist	Cos.	Lat	Sine	Dep.
A - B	N 0°03'W	4,891.92	1.0	+4,891.92	.00087	- 4.26
B - C	S 87°27'E	692.02	.04449	- 30.79	.99901	+ 691.33
C - D	S 0°57'E	5,008.09	.99986	- 5,007.39	.01658	+ 83.03
D - A	N 79°26'W	784.43	.18338	+ 143.85	.98304	- 771.13
		11,376.46		- 2.41		- 1.03'

$$\text{Error} = \sqrt{(2.41)^2 + (1.03)^2} = \sqrt{5.81 + 1.06} = \sqrt{6.87}$$

$$= 2.62 \text{ ft.}$$

$$\frac{1}{X} = \frac{2.62}{11,376.46}$$

$X = 11,376.46 \div 2.62 = 4,342$ or 1: 4,342

XERO COPY XERO COPY

Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Project _____ Checked By _____ Date _____

By _____ Date _____ Sheet _____ of _____

Stations	Δ	Bearings	Length in Feet	cos	sin	Latitudes North	Latitudes South	Departures East	Departures West	Bal. Latitudes North	Bal. Latitudes South	Bal. Departures East	Bal. Departures West		
50 to 0		N	5,000			5,000									
0 to 9/10	115° 08'	N 69° 52' E	1,389.10	.42473	.90532	589.99		1,257.58							
9/10 to P1	59° 15'	S 5° 37' W	669.60	.99520	.09787		666.39		65.53						
P1 to 286+00	191° 23'	S 5° 46' E	1914.88	.99494	.10048		1407.72	192.17							
286 to 251+48.42	180°	S 5° 46' E	3451.58	.99494	.10048		3434.12	346.81							
251+48.42 to 50	87° 04	S 87° 10' W	~~1680.50~~ 1680.50	.04993	.99878		83.07		1,678.45						
						5589.99	5591.30	1,746.56	1743.98						
			13,605.66				1.31	2.58							
										1/4,707					
							8.3725								
							2.89								
sin 17° 30' / 632.30		sin 125° 30' / x													
38625 / 632.30	.81912 / x	x = 1,680.88													

COMPUTATION SHEET

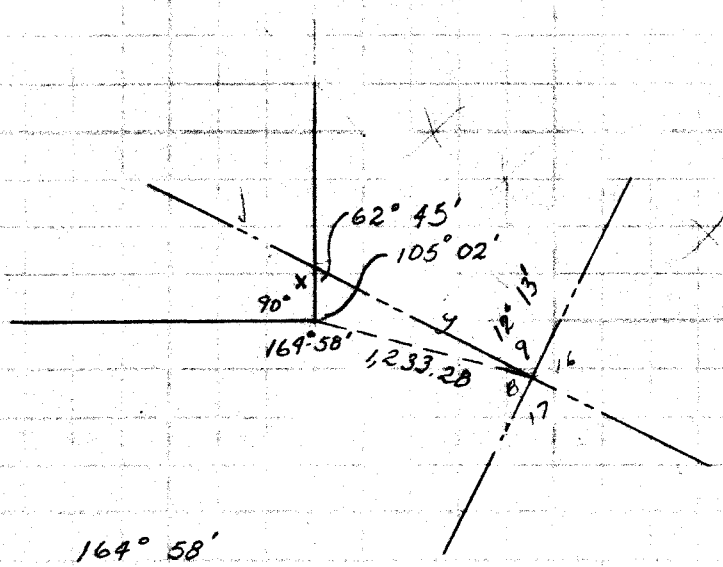
SCS-522A REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona PROJECT Powerline Dam

BY D.H.H DATE 12-2-64 CHECKED BY DATE JOB NO.

SUBJECT Section $\frac{8}{17}\frac{9}{16}$ location SHEET 1 OF 3



105° 02'
12° 13'
117° 15'

179° 60'
117° 15'
62° 45'

164° 58'
90°
254° 58'

359° 60'
254° 58'
105° 02'

$\frac{\sin 12° 13'}{x} \quad \frac{\sin 62° 45'}{1,233.28}$

$\frac{.21161 \times 1,233.28}{.88902} = x$

$x = 293.55$

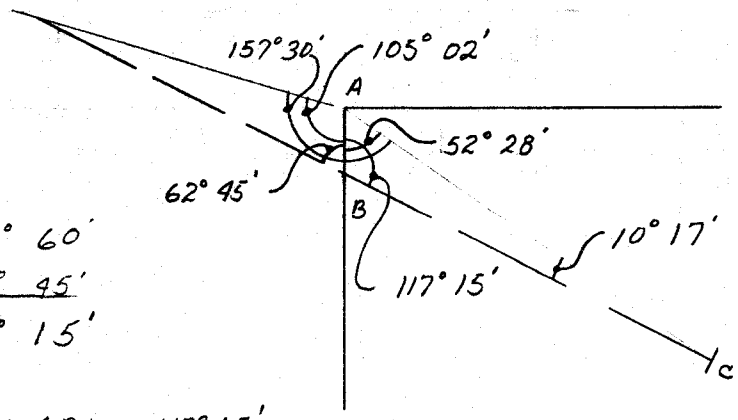
$\frac{\sin 62° 45'}{1,233.28} \quad \frac{\sin 105° 02'}{y}$

$\frac{.88902}{1,233.28} \quad \frac{.96578}{y} \qquad y = 1,339.76$

Arizona Powerline Dam

D.H.H. 12-2-64

1/4 corner 8/9 location 2 3



179° 60'
169° 43'
10° 17'

179° 60'
62° 45'
117° 15'

52° 28'
117° 15'
¼ corner 169° 43'

∠ ABC = 117° 15'

∠ BAC = 52° 28

AB = 293.55'

$$\frac{\sin 10^\circ 17'}{293.55} \qquad \frac{\sin 52^\circ 28'}{BC}$$

$$\frac{293.55 \times .79300}{.17852} = BC$$

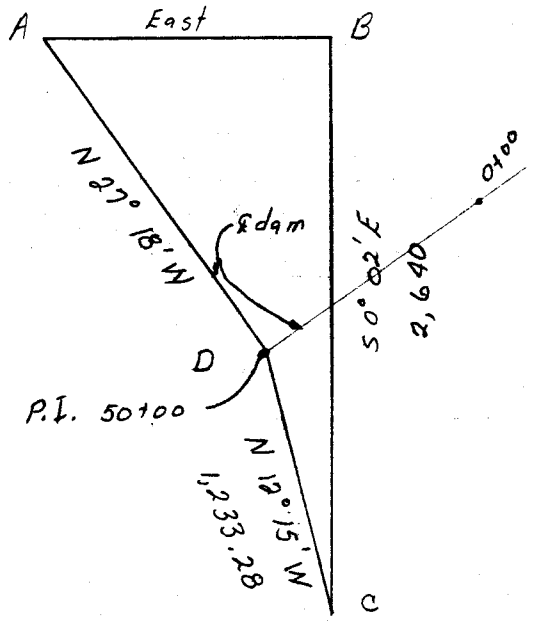
BC = 1,303.97

Arizona — Powerline Dam

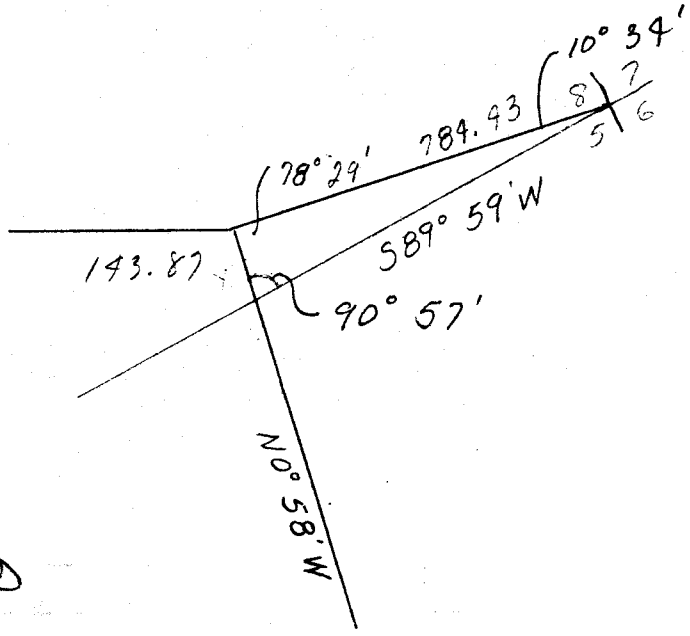
D.H.H. 12-2-64

Location 1/4 corner on ℄ of dam

Sta	Bearing	Length	cos	sin	North	South	3 East	3 West
AB	East	*1,000.70					*1,000.70	
BC	S 0° 02'E	2,640.00	1.00000	.00058		2,640.00	1.531	
CD	N 12° 15'W	1,233.28	.97723	.21218	1,205.198			261.677
DA	N 27° 18'W	*1,619.64	.88862	.45865	*1,439.802			*790.554



Sta	Bearing	Length	cos	sin	North	South	East	West



89° 59'
0° 58'
89° 117'

90° 57'

90° 57'
78° 29'
168° 86'

169° 26'

179° 60'
169 26'
10° 34'

$$\frac{\sin 10° 34'}{X} \qquad \frac{\sin 90° 57'}{784.43}$$

$$X = \frac{.18338 \times 784.43}{.99986} = 143.87$$

Beginning 0+00

Old & New P.I = 50+00

New P.C = 49+00

New P.T = 50+57.08

79+10.30
50+00.00
29+10.30
-2+00.00
27+10.30

(50+57.08)+27+10.30

New P.C = 77+67.38

50+57.08
27+10.30
77+67.38

= 77+67.38+192.57

77+67.38
1+92.57
79+59.95

New PT = 79+59.95

New P.I 78+67.38

111+31.53
79+10.30
32+21.23
-2+00.00
30+21.23

79+59.95
30+21.23
New P.C. 109+81.18

109+81.18
1+78.46
New P.T. 111+59.64

New P.I 110+81.18

161+39.62
111+31.53
50+68.09
-1+00.00
49+08.09

End. 160+67.73