Gordon Cook

File

Sediment Pond Size Calcs

Vol. of runoff is : 2.46 ac.ft.

Yearly sediment Vol is : 1.37 ac.ft / 3.83 ac.ft 22.8 ac x .06 ft sed/yr = 1.37 ac.ft.

Pond must contain 3.83 ac.ft.

assume upper pond full to bottom of spillway (no decant device)

Present dimensions upper pond 90' x 50' x 2 (2:1) = 18000 ft³ (freeboard left in bottom of pond)

" " Lower " 90 x 53 x 8 (2:1) = 76320 ft³ (bottom to spillway elev.)

Present capacity = 2.165 ac ft

~~Design pond to~~

~~100' long x 50' wide x 9' high ← upper cell~~ 100 x 50 x 6 > 2.44 ac.ft.

~~90' x 53' x 8' ← Lower cell~~ 90 x 53 x 16

~~This design will allow for adequate storage of sediment and design flow event and will also insure efficient sediment trap detention in the upper cell.~~

① enlarge pond to hold 3.83 ac. ft.

or

② submit maps and calcs which delineate and list areas w/in 22 acre "dist area".

Peak Input

Disturbed Area : 22.9 acres – From Plate 3-1 submitted 8/18/86
CN : 90.0
100y/24h P : 3.2
10y/24h P : 2.0
Slope length : 2950

Watershed	Acres	Storm	R/O depth (in)	Qp (cfs)	Ac-ft
Disturbed	22.9	10y/24h	1.09	22.15	2.08
	22.9	100y/24h	2.168	43.64	4.14
Undisturbed	74.9	10y/24h	.0606	.56	.378
	74.9	100y/24h	.408	10.89	2.55

Sed Pond Capacity (see notes 7/17/86)

Upper Cell – .746 ac.ft.

Lower Cell – .805 ac.ft.
Total cap. available → 1.55 ac.ft. → to bottom of Emergency Spillway

Capacity needed
2.08
+ .378
2.458 ac.ft. (runoff)
+ 4.12 ac-ft sed (22.9 x .06 x 3yr = 4.12)

need 1ac.ft. to achieve full containment.

Assumptions:

Upper Cell is full to bottom of spillway, sideslopes are uniform @ 2:1

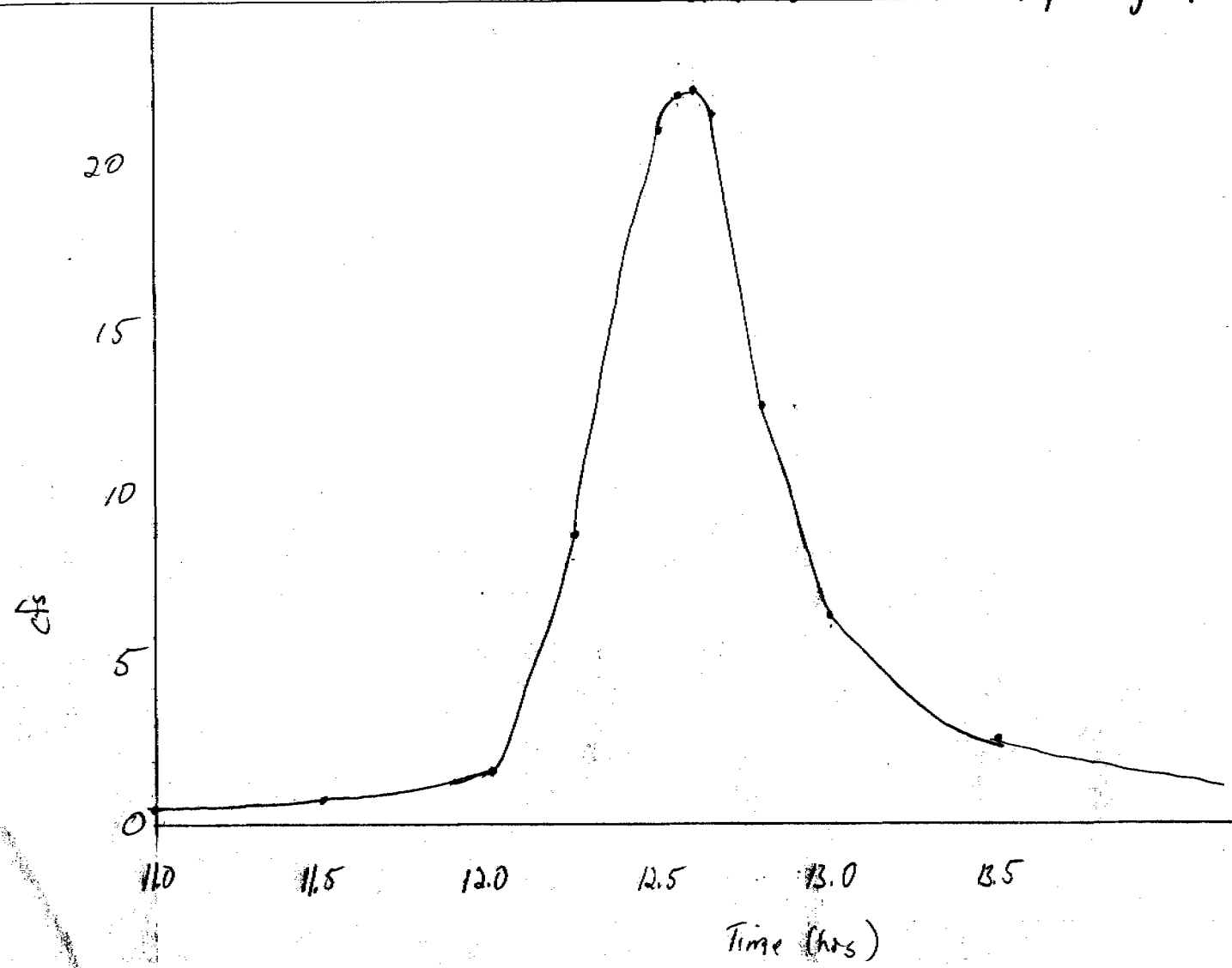
Volume in upper cell would be

Increase pond volume in each cell by 0.5 ac.ft.

$\frac{.5}{.746} = 67$ or 67% $\frac{.5}{.805} = 62\%$

②

Sed. Pond Inflow Hydrograph



BC 3 of 6

8/19

Upper pond full 2' H x 2:1 slope

Upper Cell Vol. = 90 x 50 x 4 = 18,000 ft³ x $\frac{1ac}{43,560 ft^2}$ = .4132 ac ft

Lower Cell Vol = 90 x 53 x 16 = 1.75 ac ft.
55 x 18

Total is 2.165 ac ft., therefore resize Lower pond to

90 x 55 x 9(2) = 2.04 ac. ft.
.4132 ac ft
2.459 ac ft. ✗

Lower Pond Cell Dimensions 90 x 55 x 9

Culvert Spillway Specs.

Assumptions: ignore decant Holes – Barf. 236
18" riser + barrel

$Q = CLH^{3/2}$ $Q = C' a\sqrt{2gH}$ $Q_p = \frac{a(2gH')^{1/2}}{(1+K_e+K_b+K_c L)^{1/2}}$

C = 3.43 L = 4(7) a = 1.77 ft² C = .61

$Q = 5.43(H+9.1)^{1/2}$

pipe dia

$H' = H + 10 - (.6)(1.5)$
$H' = H + 9.1$
$K_e = 1$
$K_b = .5$
$K_c = .07$
$L = 61.88'$

Head	Weir	orifice	Pipe
0.1	.5098	2.74	16.47
.3	2.649	4.75	16.65
.5	5.6996	6.13	16.82
.8	11.535	7.75	
1.0	16.12	8.66	
1.5	29.62	10.61	
2.0	45.59	12.25	18.09

Design Flow is 22.15 cfs

24" riser x 18" barrel
a = 3.14

.1	4.86
.3	8.42
.5	
.8	
1.0	15.37
1.5	
2.0	21.74

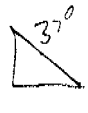
18.09 is < Qd of 22.15 cfs.

21.74
+ 1.0 cfs from decant holes
22.74 therefore use 24" riser + 24" barrel

Emergency Spillway - Drop Chute

Design Q = 43.64 disturbed
10.89 undisturbed
54.53 cfs.

Combination of principle & emergency spillways will accomodate 109.6 cfs (7/18/86) utilizing 18" CMP
∴ 109.6 > 54.53 spillway will work.



Drop chute -

Check with Trap Q program

Q = 54.53 cfs
S = 50% (2:1)
n = .035
BW = 4.0'
SS = 1.5:1
d = .603' = 7.2"
v = 18.43 fps

42-381 50 SHEETS 5 SQUARE
42-382 100 SHEETS 5 SQUARE
42-389 200 SHEETS 5 SQUARE
NATIONAL MADE IN U.S.A.

7/16/86 BCCC 3 & 6

USLE

From submittal $A = 5.32$ (see Kaiser worksheet 6/30/86 for methodology)

8ac x 1mi² / 640ac

$D = .59$ $y = DA \Rightarrow y = 3.14$ tons 1ac-yr x 7.96ac = 24.99 tons/yr

$V_s = 598.5\ ft^3/yr \times \frac{1ac}{43560\ ft^2} = .014$ ac-ft/yr x 3 = .04

From submittal

$.04 < .06$ ∴ pond will handle volume

From PSIAC .45 af/mi² = y

undisturbed
Area = 74.9ac

$74.9ac \times \frac{1mi^2}{640ac} \times \frac{.45af}{mi^2} = .05$ ac ft sed to ponds

$.05 \times 3yr = .15 + .18$ ac ft = .33 ac.ft.

From submittal disturbed y

+

+ 1.13 ac ft runoff

+ .03 ac ft. direct rainfall on ponds

1.49 ac-ft.

+ .52 ac-ft diff for UDD to ponds

2.01 ac-ft.

I computed .92 - .40 ← hea compute.

Culvert Sizing (Barf pg 518) on D-1

24" CMP $Q = 10.6$ cfs

$L = 75'$

S_o = est. .04

$Index = \frac{L}{100(S_o)} = 18.75$

Headwater Depth from

7/17/86 BCCC 346

Pond

Area 1
(Bottom C-1)

Contour elev.	2 Interval	3 Area (ft^2)	4 Ave Area	(2x4) Vol.
0	4	.073 ac (.07 ac)	.083 ac	.332 ac-ft
4	4	.093	.1035	.414 ac ft
8	4	.114		

Σ = .746 ac-ft.

Area 2
(C-2)

Contour elev.	interval	Area (ac)	Ave Area	Vol
0		.081		
	6		.0955	.573 ac-ft
10 y 24h Spillway elev. → 6		.110		
	2		.116	.232 ac-ft
8 - bottom of Em spillway		.122		

Σ = .805

grand total = 1.551 ac-ft.

Principal Spillway Calcs.

Perforations:

$Q = C_c C_v A_o (2gh)^{1/2}$

$Q = 0.$ / hole x 15 holes

$= .2051$ cfs

$C_c = .62$
$C_v = .95$
$A_o = .7854 d^2 = .0164 ft^2$
$g = 32.2$ ft/s
$h = 7'$ - from plate 7-4a

$A_o = \frac{1}{2}\pi r^2$

18" CMP - Weir Control

$Q = C L H^{1.5}$
$Q = 6.8$ cfs

$H = 2'$
L = circumference of 1.5' pipe = 3.1416 d
= 4.71'
$C = .51$

see Summers analysis on next page

7/18/86 BCCC 3 & 6

Emergency Spillway (Barf 275)

$b = 4'$ $H_{ec,r} = 1.35$ rectangular spillway

~~Q = 155 = 10.28~~

$Q' = .544\, g^{.5} (H_{ec,r})^{1.5}\, b$

$Q' = 99.39$ cfs

$Q = Q' \left[\frac{1.5b + zH_{ec,z}}{150}\right] = 199.39 \left[\frac{1.5(4) + 2(1.35)}{150}\right]$

$Q = 5.76$ (not acceptable) Design $Q = 35.58$

Stage Discharge pg 284 (Barf)

$b = 4'$
$L = 25'$
$z = 2$
$n = .04$

$H_{ec}^1 = H_p - 1$
$Q^2 = Q' = .544\, g^{.5} (H_{ec,r})^{1.5}\, b$
$Head^3 = H_p + 2$

① Head above emergency spill H_p	② Total Head, H_{ec}	③ Discharge in spillway rectangular	4 Head above prin. spillway	5 Q in principal spillway	(3+5) Total Q
0	0	0	2	10.23	10.23
1.5	.5	99.4	3.5	10.23	109.64

> 35.58 design Q ∴ structure will work

Planimeter program Date: 07-15-1986 Time: 16:33:22

Region 1 (MAP SCALE: 1 inch= 1920 feet)

area		total
SQ. MILES:	0.034	0.034
ACRES:	22.057	22.057
SQ. FEET:	960,823.300	960,823.300
SQ. YARDS:	106,758.200	106,758.200
MAP INCH:	0.261	0.261
SQ. METERS:	89,263.410	89,263.410

perimeter		total
MILES:	0.940	0.940
YARDS	1,653.827	1,653.827
FEET:	4,961.482	4,961.482
METERS:	1,512.186	1,512.186
INCH:	2.584	2.584

Region 2 (MAP SCALE: 1 inch= 1920 feet)

area		total
SQ. MILES:	0.117	0.152
ACRES:	74.925	96.982
SQ. FEET:	3,263,732.000	4,224,556.000
SQ. YARDS:	362,636.900	469,395.100
MAP INCH:	0.885	1.146
SQ. METERS:	303,210.600	392,474.000

perimeter		total
MILES:	1.646	2.586
YARDS	2,896.697	4,550.525
FEET:	8,690.091	13,651.570
METERS:	2,648.611	4,160.797
INCH:	4.526	7.110

Region 3 (MAP SCALE: 1 inch= 1920 feet)

area		total
SQ. MILES:	0.998	1.150
ACRES:	638.969	735.951
SQ. FEET:	27,833,470.000	32,058,030.000
SQ. YARDS:	3,092,608.000	3,562,003.000
MAP INCH:	7.550	8.696
SQ. METERS:	2,585,814.000	2,978,288.000

perimeter		total
MILES:	3.997	6.583
YARDS	7,034.805	11,585.330
FEET:	21,104.420	34,755.990
METERS:	6,432.313	10,593.110
INCH:	10.992	18.102

Region 1 (MAP SCALE: 1 inch= 2000 feet)

AREA		total	PERIMETER		total
SQ. MILES:	0.487	0.487	MILES:	2.926	2.926
ACRES:	311.740	311.740	YARDS	5,149.647	5,149.647
SQ. FEET:	13,579,390.000	13,579,390.000	FEET:	15,448.940	15,448.940
SQ. YARDS:	1,508,821.000	1,508,821.000	METERS:	4,708.608	4,708.608
SQ IN(map)	3.395	3.395	INCHES (map):	7.724	7.724
SQ. METER:	1,261,567.000	1,261,567.000			

Runoff Vol = 10.4 ac-ft.

$$10.4\ ac\text{-}ft \times \frac{43560\ ft^2}{ac} \times \frac{60s}{1m} \times \frac{60m}{h} \times \frac{24h}{1day} = 5.24\ cfs$$

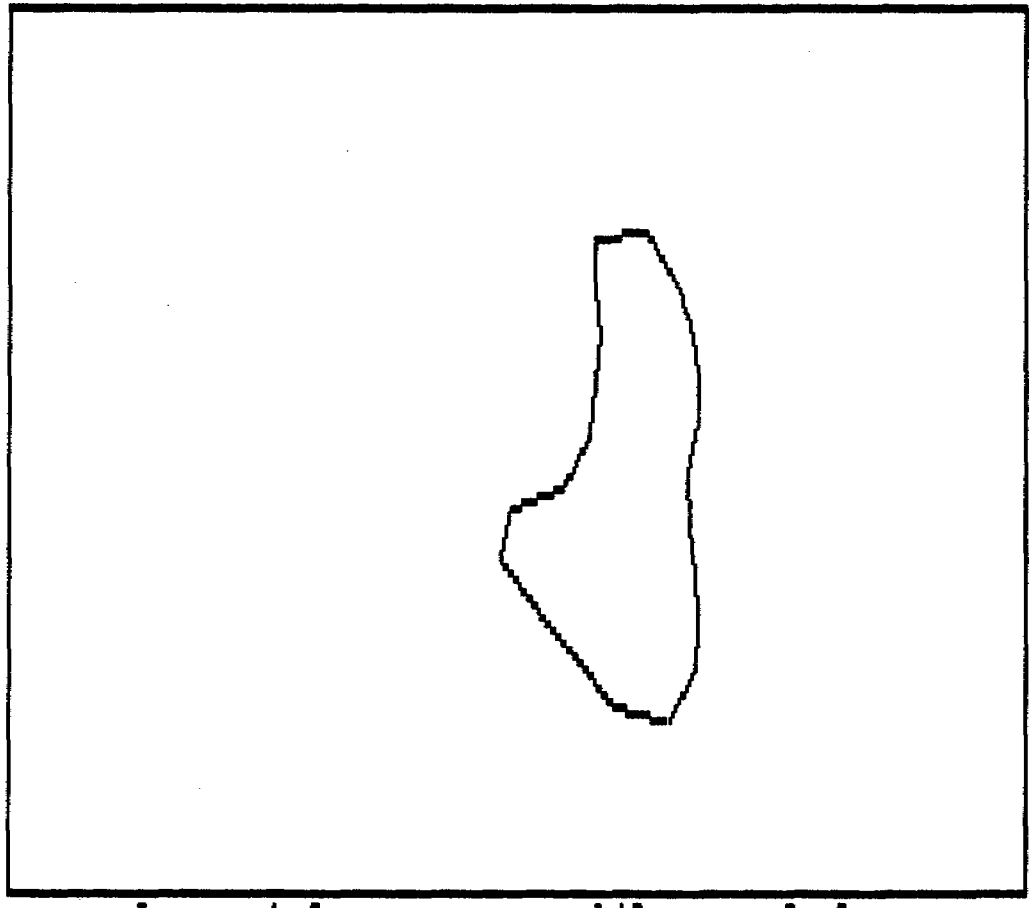
L = 6500

.162

311 Ac

3.2 in.

37.86 cfs



place stylus on menu either marked
DIGITIZE ANOTHER AREA or QUIT
press (*) to keep or (#) to reject

AREA 1	
Area	
SQUARE MILES	0.033
ACRES:	20.97
SQ. YARDS:	101,495.60
SQ. FEET:	913,460.40
SQ. METERS:	84,863.25
SQUARE INCHES (map):	0.25
Perimeter	
MILES:	0.90
YARDS:	1,577.77
FEET:	4,733.32
METERS:	1,442.64
MAP INCHES:	2.47
TOTALS	
ACRES:	20.97
SQ. FEET:	913,460.40
SQ. INCHES (map):	0.25
feet:	4,733.32
inches (map):	2.47

Scale 1 inch = 1920 Feet Map digitizing area (2.054 x 1.895)

Planimeter program Date: 07-17-1986 Time: 10:00:51

Cell # 2

Region 1 (MAP SCALE: 1 inch= 20 feet)

AREA		total	PERIMETER		total
SQ. MILES:	0.000	0.000	MILES:	0.045	0.045
ACRES:	0.081	0.081	YARDS	78.562	78.562
SQ. FEET:	3,532.051	3,532.051	FEET:	235.686	235.686
SQ. YARDS:	392.450	392.450	METERS:	71.834	71.834
SQ IN(map)	8.830	8.830	INCHES (map):	11.784	11.784
SQ. METER:	328.138	328.138			

Region 2 (MAP SCALE: 1 inch= 20 feet)

AREA		total	PERIMETER		total
SQ. MILES:	0.000	0.000	MILES:	0.051	0.096
ACRES:	0.110	0.191	YARDS	90.199	168.761
SQ. FEET:	4,780.820	8,312.870	FEET:	270.596	506.282
SQ. YARDS:	531.202	923.652	METERS:	82.474	154.307
SQ IN(map)	11.952	20.782	INCHES (map):	13.530	25.314
SQ. METER:	444.153	772.291			

Region 3 (MAP SCALE: 1 inch= 20 feet)

AREA		total	PERIMETER		total
SQ. MILES:	0.000	0.000	MILES:	0.054	0.149
ACRES:	0.122	0.312	YARDS	94.181	262.942
SQ. FEET:	5,292.595	13,605.470	FEET:	282.543	788.826
SQ. YARDS:	588.066	1,511.718	METERS:	86.115	240.422
SQ IN(map)	13.231	34.014	INCHES (map):	14.127	39.441
SQ. METER:	491.698	1,263.989			

Planimeter program Date: 07-17-1986 Time: 09:48:25

Cell #1

Region 1 (MAP SCALE: 1 inch= 20 feet)

AREA		total	PERIMETER		total
SQ. MILES:	0.000	0.000	MILES:	0.042	0.042
ACRES:	0.073	0.073	YARDS	74.752	74.752
SQ. FEET:	3,167.808	3,167.808	FEET:	224.255	224.255
SQ. YARDS:	351.979	351.979	METERS:	68.350	68.350
SQ IN(map)	7.920	7.920	INCHES (map):	11.213	11.213
SQ. METER:	294.299	294.299			

Region 2 (MAP SCALE: 1 inch= 20 feet)

AREA		total	PERIMETER		total
SQ. MILES:	0.000	0.000	MILES:	0.047	0.090
ACRES:	0.093	0.166	YARDS	83.020	157.772
SQ. FEET:	4,050.605	7,218.412	FEET:	249.060	473.315
SQ. YARDS:	450.067	802.046	METERS:	75.910	144.260
SQ IN(map)	10.127	18.046	INCHES (map):	12.453	23.666
SQ. METER:	376.313	670.612			

Region 3 (MAP SCALE: 1 inch= 20 feet)

AREA		total	PERIMETER		total
SQ. MILES:	0.000	0.000	MILES:	0.052	0.141
ACRES:	0.114	0.280	YARDS	90.855	248.627
SQ. FEET:	4,960.589	12,179.000	FEET:	272.565	745.880
SQ. YARDS:	551.177	1,353.222	METERS:	83.074	227.333
SQ IN(map)	12.401	30.448	INCHES (map):	13.628	37.294
SQ. METER:	460.854	1,131.466			

8/19

INPUT SUMMARY
FOR W.S.: BCUN

STORM: 100y WATERSHED:

DISTRIBUTION = SCS TYPE 2 LAND SLOPE = 18.5000 PCT
CURVE NUMBER = 60.00
PRECIP.DEPTH = 3.20 IN CHANNEL LENGTH = 4950.00 FT
TIME OF CONC. = .7663 HR
DURATION = 24.00 HR AREA = 74.90 AC
NUMBER OF LINES = 250 D = .1021 HR

OUTPUT SUMMARY

RUNOFF DEPTH = .4083 IN
INITIAL ABSTRACTION = 1.3333 IN
PEAK FLOW = 10.89 CFS (.1442 IPH)
AT T = 13.07 HRS

8/19

INPUT SUMMARY
FOR W.S.: BCUN10

STORM: 10y WATERSHED:

DISTRIBUTION = SCS TYPE 2
LAND SLOPE = 18.5000 PCT
CURVE NUMBER = 60.00
PRECIP.DEPTH = 2.00 IN
CHANNEL LENGTH = 4950.00 FT
TIME OF CONC. = .7663 HR
DURATION = 24.00 HR
AREA = 74.90 AC
NUMBER OF LINES = 250
D = .1021 HR

OUTPUT SUMMARY

RUNOFF DEPTH = .0606 IN
INITIAL ABSTRACTION = 1.3333 IN
PEAK FLOW = .56 CFS (.0075 IPH)
AT T = 14.10 HRS

INPUT SUMMARY
FOR W.S.: BCD

STORM: 10 y WATERSHED:

DISTRIBUTION = SCS TYPE 2
PRECIP.DEPTH = 2.00 IN
DURATION = 24.00 HR
NUMBER OF LINES = 574

LAND SLOPE = 7.5000 PCT
CURVE NUMBER = 90.00
CHANNEL LENGTH = 2950.00 FT
TIME OF CONC. = .3225 HR
AREA = 22.90 AC
D = .0430 HR

OUTPUT SUMMARY

RUNOFF DEPTH = 1.0940 IN
INITIAL ABSTRACTION = .2222 IN
PEAK FLOW = 22.15 CFS (.9596 IPH)
AT T = 12.60 HRS

INPUT SUMMARY
FOR W.S.: BCD100

STORM: 100 Y WATERSHED:

DISTRIBUTION = SCS TYPE 2 LAND SLOPE = 7.5000 PCT
CURVE NUMBER = 90.00
PRECIP.DEPTH = 3.20 IN CHANNEL LENGTH = 2950.00 FT
TIME OF CONC. = .3225 HR
DURATION = 24.00 HR AREA = 22.90 AC
NUMBER OF LINES = 574 D = .0430 HR

OUTPUT SUMMARY

RUNOFF DEPTH = 2.1685 IN
INITIAL ABSTRACTION = .2222 IN
PEAK FLOW = 43.64 CFS (1.8900 IPH)
AT T = 12.55 HRS

Planimeter program Date: 08-19-1986 Time: 10:18:07 BC 3+6

Region 1 (MAP SCALE: 1 inch= 50 feet)

AREA		total
SQ. MILES:	0.036	0.036
ACRES:	~~22.906~~	~~22.906~~
SQ. FEET:	997,791.900	997,791.900
SQ. YARDS:	110,865.800	110,865.800
SQ IN(map)	399.117	399.117
SQ. METER:	92,697.900	92,697.900

PERIMETER		total
MILES:	1.169	1.169
YARDS	2,057.663	2,057.663
FEET:	6,172.990	6,172.990
METERS:	1,881.436	1,881.436
INCHES (map):	123.460	123.460

Plate 3-1 8/19

Sediment Pond Size Calcs

Vol. of runoff is : 2.46 ac.ft.

Yearly sediment Vol is : 1.37 ac.ft / 3.83 ac.ft 22.8 ac x .06 ft sed/yr = 1.37 ac.ft

Pond must contain 3.83 ac.ft.

assume upper pond full to bottom of spillway (no decant device)

Present dimensions upper pond 90' x 50' x 2 (2:1) = 18000 ft³ (freeboard left in full pond)

" " Lower " 90 x 53 x 8 (2:1) = 76320 ft³ (bottom to spillway elev.)

Present capacity = 2.165 ac ft

~~Design pond to~~

~~100' long x 50' wide x 9' high ← upper cell~~ 100 x 50 x 6 > 2.44 ac.ft.

~~90' x 53' x 8' ← Lower cell~~ 90 x 53 x 16

~~This design will allow for adequate storage of sediment and design flow event and will also insure efficient sediment ~~trap~~ detention in the upper cell.~~

① enlarge pond to hold 3.83 ac.ft.

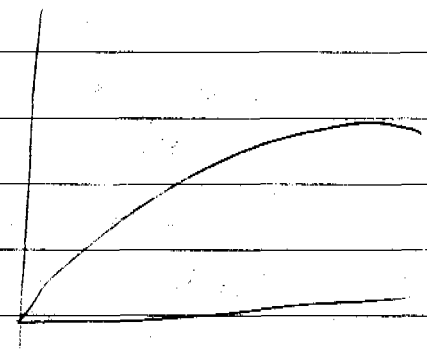
or

② submit maps and calcs which delineate undist areas w/in 22 acre "dist area".

Principal Spillway

(*) 3 eq. that define spillway flow

1) weir
2) orifice
3) pipe



Ht riser = 7516 - 7510 = 6'

Dia riser = 18" = 1.5'

K_e calc = 3.832
H_o 9.25
L = 64.88'
K_c = .5
K_b = .5

C_o = 0.51

Head	weir	orifice	pipe
0.1	0.486	2.287	17.07
0.3	2.548	3.961	17.27
0.5	5.504	5.114	17.47
0.8	11.206	6.469	17.76
1.0	15.724	7.232	17.96
1.5	29.195	8.85	18.43
2.0	45.362	10.23	18.89

approx

design flow is 10.28 cfs.

6/11 BCCC 346 ①

Check S.F. on rip rap for road fold

$\tau_o = \frac{21\tau}{\gamma(SG-1)D_{50}}$ $\tau = \gamma d S$ d = depth flow, S = channel slope

$= \frac{21\gamma d S}{\gamma(SG-1)D_{50}}$

Trap Q
$d = 1.0'$
$S = .05$
$D_{50} = 1.83 - 1.0''$
$SG = 2.65$

$= \frac{21(1)(.05)}{(1.65)(.83)}$

$= .7667$

$SF = \frac{\cos(2.9)\tan(39°)}{\sin(2.9) + (.7667)(\tan 39°)}$ $\frac{.8087}{.6715} = 1.2$

8" rip rap 8" rip rap

$N_b = .95$

$SF = \frac{.8087}{.8199} = .986 = 1.0$

Drop Structure Design for R-3 reach From OSM Design Manual (pg 6.45)

Channel Slope .12 length is 75' ∴ rise is 9.0'

static equilibrium slope is:

10" rip rap

$S = \frac{.047(G_s-1)D_{50}}{R}$ $D_{50} = 16''$, $G_s = 2.65$

$S = .146$ $R = \left(\frac{Vn}{1.49\sqrt{S}}\right)^{1.5}$

From MRD
$V = 10.26$
$n = .04$
$S = .12$

Solve for K (pg 6.45) to determine R $R = .709$

$K = \left[\frac{Qn}{0.323\sqrt{(G_s-1)D_{50}}}\right]^6$

$Q = 135$
$n = .04$
$D_{50} = 1.33'$

$K = [11.28]^6$

.4785

$K = 2,059,940$ R from graph 6.10c 14' base width $= .61$

$\approx 0^6$

Channel slope is < than computed static slope with a rip rap D50 of 16", therefore eqns says a drop structure is not needed for stability of the rip rap on the 18% grade of R-3 – but energy dissipation should be utilized at the bottom of ~~the~~ R-3 to protect R-4.

for R-3 & R-5 * Energy dissipator design from Small Canal Structures (BOR pub.) pg 32.1

Stilling Basin

1. Theoretical velocity

$V = \sqrt{2gh}$ $h = 9.0'$

$g = 32.2$

$V = 24.07$ fps

2. Area of flow

$A = Q/V = 5.61 ft^2$

3. depth of flow

$d = \sqrt{A} = 2.37$ ft

4. Froude #

$F = \frac{V}{\sqrt{gd}} = 2.7$

5. $\frac{w}{d}$ Ratio = from fig 6-10 = 5.1

6. Minimum width of basin

$W = d \times \frac{w}{d} = 13.77$ ft

7. Baffled Outlet design width

Use $W = 14$ ft (inside width after placement of f.b & r.t.)

8. Basin invert a distance t below ground surface

$t = \frac{1}{2}(W) = 3.5$ feet

use 3.0 feet depth ~~of~~ after filter blanket and rip rap placement

Erosion Protection for Baffled Outlet
p 322 Small Canal Structures (BOR, pub)

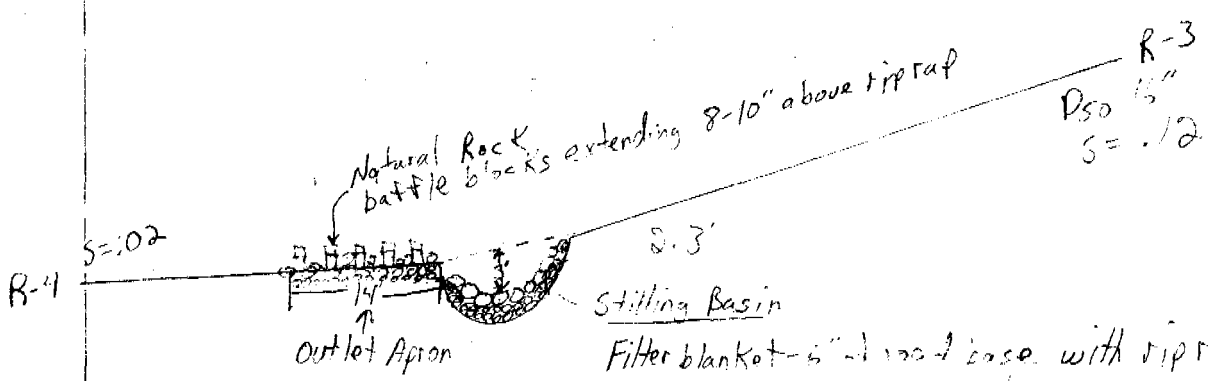
1. Required Rock diameter

$\frac{W}{20} = \frac{14}{20} = .70' \sim 9''$ for d_{50} + road base filter 6"

Vol of .70' rock is $\frac{\pi \text{ dia}^3}{6} = .18\ ft^3$

? 2. Length of Protection is W, = 14ft ~~use 15ft~~
check against 5 (depth of downstream flow) ⇒ 6.3'
1.26'

3. Depth of protection is $\frac{W}{6} = 2.3$ feet
road base @ 6" + d_{50} of 9" = 15" ∴ change
d_{50} to 12", design will be adequate since 12"
rock is ~~greater~~ larger than required see #1 preceding
Vol of 12" rock w 6" of road base is .45 ft^3 ∴ this will enough
Vol (.45 > .7)



Filter blanket - 6" of road base with riprap
d_{50} of 12", excavate basin at least 5' before placement of protection
width of basin 14 ft. after riprap placement.

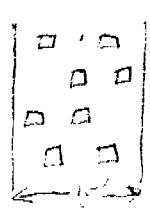
Outlet Apron

Length : 14'
Width : 15'
Filter depth : 6" of road base
rip rap : d_{50} 12"

* depth of flow in basin 2.4'

alternate Not'l rock baffles

Plan View



3/20/86 Beaver Creek 3 & 6

Diversion Ditch D-1

Velocity Calc from Trap Q

Q = 17.79 cfs
Slope = .075
n = .038
Side Slope = 1:1
Bottom Width = 1.5'
Velocity =

Q from Trap Q = 18.62 cfs
Slope = .075
n = .038
Side slope = 1:1
Bottom Width = 1.5'
Depth-Calculated = 1'
Area = 2.5
WP = 4.33
V = 7.4

Using 7.7 cfs = Q from Peak Program

Q = 7.7 cfs
Slope = .075
n = .038
Side Slope = 1:1
Bottom Width = 1.5'
V = 5.86 calc
Depth = 0.62 - calc
Area = 1.31 - calc
WP = 3.25

Contributing Watershed

Calibrate Planimeter to 1 section

Planimeter
7.5
7.6
7.83
Av = 7.64 = 640 acres

Complete Undisturbed & Disturbed
.90
1.13
.90
1.57
.90
Ave = 1.08

Contributing Acreage to Ponds

$\frac{640 ac}{7.64 revs} \times 1.08 revs = 90.47$ acres

3/20/86 Beaver Creek 3 & 6

Channel Length from Watershed Divide to Ponds.

Fig 7-4

assume 2.75" = 1 mile on 7-4

Channel Length

2.13
2.08
2.08
2.10
2.05
2.09

$\frac{5,280'}{2.75''} \times 2.09'' = 4,012.8'$

Peak Inputs

Slope 50' contours

assume - USE 7.5% in canyon bottom

Canyon side slope = $\frac{500'}{1,020.1'}$ = 0.49
+0.075
+0.378
Ave S = .3143

$\frac{1}{2}'' = \frac{1}{32} = \frac{17}{32}$

$\frac{17}{32}'' = .5313$

Channel Length = 4,012.8'

Area Acres = 90.47

Weighted CN = 7.96 acres @ 90 = 11.4% area
82.51 acres @ 60 = 88.6% area

CN x %
10.26
53.16
63.42

Use 63

Disturbed Area

2,160

Undisturbed Area

Channel L = 4012 - 2,160 = 1852

82.51 ac.

CN = 65

3/20/86

Beaver Creek 3&6

Peak Inputs

Assume 2.75" = 5,280' on Fig 7-4

Undisturbed Area

Channel length = 1852'

Land Slope $\frac{.49 + .378}{2} = .434 = 43.4\%$

Acres = 90.47 - 7.96 = 82.51 acres

CN = 65 - More Outcrop present

Peak Flow = 41.73 cfs for 10y, 24h. storm @ 2.0 in precip.

Disturbed Area

Channel length = 2160'

Land Slope = 7.5%

Acres = 7.96

CN = 90

From Trap Q
SS = 2:1
BW = 2'
n = .03
CS = .075
V = 6.36

Q = 8.09

Peak = 8.09 cfs for 10y 24h storm @ 2.0" precip.

Diversion Ditch D-1 from Trap Q

Soils from CH. 8 Sandy loam = Mannings n = .030
Q = 12.82
V = 8.01

How will Ditch be designed to allow overland flow into ditch

3/24/86

BC 3 & 6

Curve Number for D-1 watershed

Hydrologic Soil Group	Land Cover	Class Condition	CN	Acres	% of Area	CN x %
C due to slope	OAK	good	53	40.5	46.3	24.54
C	Sagebrush - Grass	good (porous soils)	53	30.1	34.4	18.23
C	Doug Fir	good	74	8.9	10.2	7.55
D	Bare	poor	90	7.96	9.1	8.19
						58.51

79.5 Undisturbed
7.96 Disturbed

Total Acres = 87.46

CN = 58

USE their CN = 60

Sediment Yield for Undisturbed PSIAC method

Factors	Sediment Yield Level	Rating
Surface Geology	Interbedded SS & Sh	6
Soils	MiE unit, water erosion hazard is high	10
Climate	Infrequent convective storms	5
Runoff	Moderate Volume of runoff / unit area	5
Topography	Steep upland Slopes 40 - 50%	10
Ground Cover	Total Veg Cover 30 - 40%	0

3/25/86 BC 3 & 6

R-2

Safety Factor Calc for road ford rip rap

Baof. pg. 188 -

Assumptions

$D_{50} = 10'' = .83'$

$Q = 135$

Calc

$n = .0395 (.83)^{.17}$

$n = .038$

Trap Q Calcs

In

SS = 2:1

BW = 15'

CS = .05

Out

D = .99 = 1.0'

Area = 16.9

W.P. = 19.45

V = 7.98

Checking for stability Using eqns 3.33 & 3.28

$\tau = \gamma D S = (62.4)(1.0')(.05)$

$\tau = 3.12$

$n_b = \frac{21\tau}{\gamma(SG-1)D_{50}} = \frac{21(3.12)}{62.4(2.65-1)(.83)} = 0.079$

10"

.7667

.945

1.1055

.8548

.66

$\phi = 34°$

$\theta = 2.9°$

1.2 6/9

1.19 = SF

$SF = \frac{\cos(2.9°)\ \tan(39°)}{\sin(2.9°) + (.078)(\tan 39°)} = \frac{.6736}{.103}$

SF = 6

.5851 (.7667) .0526

.5667

1.4

$(\ )^{1/2} = \sqrt{\ }$

Mannings n justification

$n = .0395 D_{50}^{1/6}$

$.038 = .0395 D_{50}^{1/6}$

$D_{50}^{1/2}$

$\left(\frac{.038}{.0395}\right)^6 = D_{50}$

$D_{50} = .79'$

3/27/86 BC 346

Rip Rap Sizing for R-3, R-5

T. Suchoski Method

① $n = .04$

normal depth = .79 ft

hydraulic radius = $R = A/P = \frac{13.65 ft^2}{18.55 ft} = 0.71 ft$ $n = .04$

② Calc D_{50} from EPA eqn (1976) from fig 1-19

$$D_{50} = [118\ Q (S_b)^{1/6?} (R/P)]^{.4}$$

Q = Design Flow

S_b = Channel Slope = .12

R = hyd. radius

P = wetted perimeter

$$D_{50} = [118\ (135)\ (.12)^{2.167} (.71/18.55)]^{.4} = 2.07'$$

.0101

③ Check assumed n with n calculated

$$n_c = .0395\ (D_{50})^{.167} \qquad D_{50} = 16'' = 1.333'$$

$n_c = .044$

Try w $n = .044$ $A/P = \frac{13.99}{18.75} = R = .75$

normal depth = .838

$$D_{50} = [(118)(135)(.12)^{2.167} (\tfrac{.75}{18.75})]^{.4}$$

$D_{50} = 2.1'$

Check against OSM SSM

Using Fig 5.4 trap channel 2:1 SS 15 ft bw $Q = 135$

D_{50} @ $S = .10 = .77$

D_{50} @ $S = .25 = 1.45'$

interpolate for 12% slope

$$\frac{12\% - 10\%}{25 - 10} (1.45 - .77) + .77 = 1.02' \quad \text{use } 1.25'$$

Design Rip Rap is 1.33 w/ SF of 1.0 use $D_{50} = 1.33'$

3/27/86

BC3+6

Pond Sizing Calcs

From PSIAC $SY_{100} = 0.45\ AF/mi^2$

Size Ponds for Vol + SY

Sediment Yield not too important because they commit to cleaning the ponds @ 60% sediment levels (pg 7-23)

Size Spillways

Spillway Q 35.58 cfs ? due to routing?

Spillway Size

Assume Pond (↗ Water level) is at spillway bottom when design storm ~~is~~ occurs

10y/24 ~~pass~~ design ~~storm~~ Peak is 10.28 cfs
100y/24 is 35.58 cfs

Filter blanket is it possible on the chute

Assume 35.58 hits first spillway

From p 229 Barf - Side Contracted Weir $Q = 3.1 b^{1.02} H^{1.47}$
b = width

$4' = b \quad Q = 35.6$ cfs

$$35/3.1(4)^{1.02} = H^{1.47}$$

$$2.745 = H^{1.47}$$

$$(2.745)^{2/3} = 1.96 = H$$

Pond Spillway is 4' wide by 2' deep assuming full 35.6 cfs hits spillway will just barely pass the flow - should handle it.

Ask for section view + calcs for both pond outlets.

3/27/86 BC 3 & 6

Filter Blanket Design

From DOT Hydraulic Eng Circ # 11, June 1967

is filter required

$D_{50} = 1.33 \times 2 = D_{100}$

$\frac{D_{15}\text{ (riprap)}}{D_{85}\text{ (strmbank)}} = \frac{.399'}{.142} = 2.80 > 5$ no $D_{15\,rr} = D_{100} \times .15 = .399' = D_{15}$

.35 mm =

35 m 3500

.00035

Assume D_{50} Strmbed = 2" = .167'

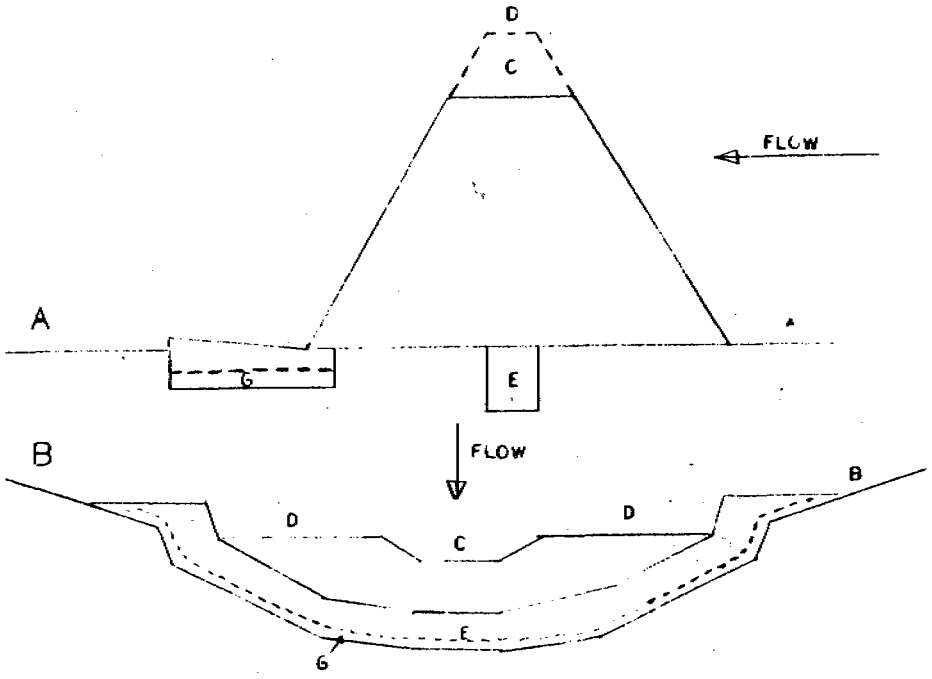
$D_{85} = .142'$

If D_{50} Strmbed Material = 2"
won't need a filter

Try $D_{50sb} = 1'' = .083' \times .85 = .07$

$\frac{D_{15rr}}{D_{85sb}} = \frac{.399}{.07} = 5.6 > 5$ need a filter

CROSS-SECTIONAL VIEW OF LOOSE ROCK CHECK DAM



Construction Plans for a Loose-Rock Check Dam

1. Section of the dam parallel to the centerline of the gully.
2. Section of the dam at the cross section of the gully.

A = original gully bottom; B = original gully cross section;

C = spillway; D = crest of free board; E = excavation for key;

F = excavation for apron; G = filter blanket.

IMPORTANT CONSIDERATIONS

1. A well-graded distribution of angular rock from 6-24 inches must be used. The angle of rest for this angular rock should correspond to a slope ratio not less than 1.5 to 1.0. The structure shall be 24-30 inches high. The angular rock shall be placed so as to form an 18-inch wide by 5-inch deep notch in the center of the creek channel to form a centralized spillway.

2. The keyway must be 24 inches wide and deep and excavated into the streambed and banks. The keyway into the banks must be 36 inches deep.

3. The apron section must be 10 feet long and placed with an adverse slope of six inches over the 10 foot length. A filter blanket (two inch minus material, six inches deep) must be placed under aprons. Riprap side slope protection measures for the length of the apron and two feet above the gabion crest must be included. The angle of rest for the 6-24 inch well-graded material used to construct the gabion must be strictly adhered to.

LOOSE ROCK CHECK DAM

DIV. OIL, GAS & MINING

APPROVED: TOM MUNSON	SCALE: NA
DRAWN: TM	DATE: 11-1-85

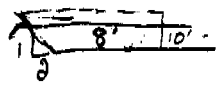
4/8/86

- BC 3&6 Pond Siz Calculations -

1. Calculate Volume in Ponds from Plate 7-4
2. Calculate Sediment Volume for ? event
3. Calculate Runoff Volume for " "

Pond Size 1st Cell From Plate 7-4 depth from bottom to spillway (2:1 Slope)

Pond Capacity to Overflow Spillway = 90' x 50' x 16' - 8 x 2



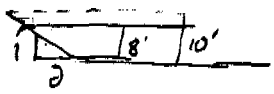
8' x 2:1 = 10'

Elev bot Pond = 7515
100y spill Elev = 7523

= 72,000 ft³

2nd Cell

Pond Capacity to Emergency Spillway = 90 X 53 x 16



= 76,320 ft³

Elev bottom 7510
100y Spill 7518

Volume R/O to Pond

Precip (P) = 2.0" 10y / 24h

$Q = \frac{(P - .2S)^2}{P + .8S}$ = inches $S = \frac{1000}{CN} - 10 = 6.6$ CN = 60

$Q = .0632''/12'' = .0053' \times 80ac \times 43560 \frac{ft^2}{ac} = 18,469 ft^3$ (Acreage to ponds)

From MUSLE (MUSLE in Barf)

$Y = 95 (Q \times q_{pi})^{0.56} K LS CP$ (From Peak Flow Program) Q = .424 ac-ft (From Peak) q_{pi} = 10.32

$Y = 95 (.424 \times 10.32)^{.56} (.22)(4.79)(.50)(.75)$ K = .22, LS = 4.79, CP = .50, P = .75

Y = 85.8 Tons

$V_s = \frac{(85.8 \text{ Tons})(2000 \text{ lbs/Ton})}{(75 \text{ lbs/ft}^3)(43,560 \text{ ft}^2/\text{ac})} =$

V_s = .0525 ac ft.

Assume Sed is always sub

PS 459 P_s = 100 - 50 = 50
P_m 56 - 20 = 30
P_c = = 20

70 sand silt clay

W = (26)(.20) + (70)(.30) + (97)(.50) = 75 lbs/ft³

#s entering pond .0525 ac ft
#water " " .1240 ac ft

Pond Capacity = cell 1 + 2 = 3,405 ac ft

∴ ponds will hold Vol of sed & water

Site Visit

✓ PSIAC inputs ✓

✓ Manning's n for Diversion Ditch (.03 – .038) ✓

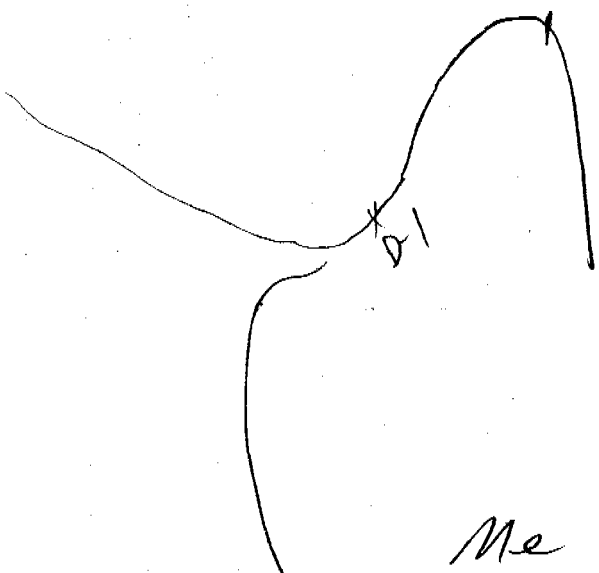
✓ Slope in various areas of D-1 ✓

✓ Dimensions of drainages to the west of portals & main drainage ✓

15' = DW

Left Fork reconstruction

- Cross-section of channel.
- Culvert (UP+L 24") ??



Talk to John – when will other comments will go back to Dan. wants to do all at once
might ✓ other people comments & see if there's a conflict

3/26/86 BC 3 & 6

Changes in the MRP

1. Install loose rock check dams on drainages at #3 portal (2, one to the north
   a. Use TM design

2. Install loose rock check dam on drainage to the north of #6 mine portal
   a. see 1(a)

3. -

4. Change n to .035 for Channel Reach 1, 4, & D-1

5. Install rip rap & stilling basin at drainage to the south of #3 portal or LRCD

6. Install loose rock check dams (well graded keys) according to TM design in R-1, R-3, R-4.

7. Change R-3 to a straighter shot into the meander & install a LRCD in straight section

8. May want culvert (w outlet protection depending on slope) at D-1 road crossing & UP&L access.

9. Drawing for D-1 shows a 1.0' BW - Table 7-6 shows BW = 1.5 - lets Design for 1.5

10. Typical X-sect for left fork reconstruction
    a. design methodology added to (Table 7-6)

11. ~~A verbage about diversions to stream channel diversions for 100 yr/24h - pg 7-25a~~ at Plate 31-A

12. pg 7-25a - pond overflows d_{50} = 12", Fig 7-5 shows d_{min} = 12" / channel outlet protection? shouldn't it be pond - - - or diversion ditch

13. p. 7-25a + pond overflows concrete or rip rap which?

14. p 7-25b drop statement about non-erosive velocities

15. Channel depths according to Plate 7-3 show 2'/statement on p7-25b says 1.5'

16. On reaches with rip rap (Table 7-6) add the filter blanket & coarse gravel requirements

17. Section view of pond outlet w structures & length of stilling basin.

18. Pond Inlet - What will be the slope here, Plate 31-A shows rip rap in D-1 if needed will also need filter blanket & description, well graded, up the sides & d_{50}.

19. R3, R5 - verbage about excavating the channel so as to accomplish the design specs with the rip rap. follow OSM steep Slope methodology

√ Plate 7-3 shows 2' + 15' after rr

20. Commit to filter blanket under all rip rap where the D_{50} of the streambed material is < 1". Commit to filter blanket being at least 9" in depth and of a particle size distribution of 3" minus road base.

21. ~~Sed~~ pg 7-23 refers to sediment marker on fig 7-2 change to plate 7-4

3/25/86 RC 3+6

Sediment Yield for Undisturbed Area
PSIAC Method (cont)

Factors	Sediment Yield Level	Rating
Land Use	Somewhat Overgrazed Steep areas not as much	5
Upland Erosion	Some rills at head of drainage small + veged, Some gully in channel	4
Channel Erosion + Sediment Transport	Well vegetated, Fair amount graded rock in channel	0
		45

Site Visit

45 = Classification 4 = Sediment Yield of .2-.5 ac ft/mi²

.7 use ~ 0.45 AF/mi²

Undisturbed Drainage to ponds Area = 0.45 AF/mi²

3/25/86

BC 3-6

Area calc for Northern Undisturbed Drainage to Diversion Ditch D-1.

Planimeter

Scale 1" = 500' from Veg Map

4.47
4.04 Ave = 3.95
3.60
3.70

22.7 acres

Ridge top to #6 entrance

Channel Length = 1000'
Slope = 65.6%

.82 cfs

Area Calc for Southern Undisturbed Drainage to Ponds

Planimeter

8.11
8.00 Ave = 8.47
8.88
8.88

48.6 acres

Ridge top to #3 entrance

Channel length = 1000'
Slope = 66.9%

Total Acres = 71.3 acres
- 7.96 Disturbed
63.34

Weighted Curve Number

	% of Area	% x CN
63.34 @ 60	88.8	53.3
7.96 @ 90	11.2	10.1
		63 use

Run Peak for Both Areas Using CN=63

① Determine Peak & Velocity where steep slopes meet Disturbed area

② Determine Peak for Undisturbed Area Ditch
A. 7.96 acres
B. CN = 90
C. Slope = 25
D. Channel length = 2,950 ft.

From MRP

INPUT SUMMARY
FOR W.S.: 8CUDN

STORM: WATERSHED:

DISTRIBUTION = SCS TYPE 2
PRECIP.DEPTH = 2.00 IN
DURATION = 24.00 HR
NUMBER OF LINES = 1732

LAND SLOPE = 65.6000 PCT
CURVE NUMBER = 63.00 *
CHANNEL LENGTH = 1000.00 FT
TIME OF CONC. = .1048 HR
AREA = 22.70 AC *
D = .0139 HR

OUTPUT SUMMARY

RUNOFF DEPTH = .1004 IN
INITIAL ABSTRACTION = 1.1746 IN
PEAK FLOW = .82 CFS (.0358 IPH)
AT T = 12.57 HRS

Velocity Calc from Trap Q

2:1 SS
1.5' BW
.030 n
.656 Slope
.82 = Q
6.65 = V

qpi = .82
+7.70
+1.76
10.3

INPUT SUMMARY
FOR W.S.: BCDD

STORM: WATERSHED:

DISTRIBUTION = SCS TYPE 2
PRECIP.DEPTH = 2.00 IN
DURATION = 24.00 HR
NUMBER OF LINES = 574

LAND SLOPE = 7.5000 PCT
CURVE NUMBER = 90.00
CHANNEL LENGTH = 2950.00 FT
TIME OF CONC. = .3225 HR
AREA = 7.96 AC
D = .0430 HR

OUTPUT SUMMARY

RUNOFF DEPTH = 1.0940 IN
INITIAL ABSTRACTION = .2222 IN
PEAK FLOW = 7.70 CFS (.9596 IPH)
AT T = 12.60 HRS

Velocity Calc from Trap Q
2:1 SS
1.5' BW
.030 n
.075 Slope
7.7 cfs
6.4 = V

BCDD Q = 7.7
BCUDS Q = 1.76
BCUDN Q = .82
10.28 Trap Q

INPUT SUMMARY
FOR W.S.: BCUNS

STORM: WATERSHED:

DISTRIBUTION = SCS TYPE 2
PRECIP.DEPTH = 2.00 IN
DURATION = 24.00 HR
NUMBER OF LINES = 1749

LAND SLOPE = 66.9000 PCT
CURVE NUMBER = 63.00
CHANNEL LENGTH = 1000.00 FT
TIME OF CONC. = .1038 HR
AREA = 48.60 AC
D = .0138 HR

OUTPUT SUMMARY

RUNOFF DEPTH = .1004 IN
INITIAL ABSTRACTION = 1.1746 IN
PEAK FLOW = 1.76 CFS (.0359 IPH)
AT T = 12.55 HRS

Velocity Calc from Trap Q

2:1 SS
1.5 BW
.030 n
.669 slope
1.76 = Q
V = 8.74

Data Documents SS-338-1478-F1

INPUT SUMMARY
FOR W.S.: BCD 7

STORM: WATERSHED:

DISTRIBUTION = SCS TYPE 2 LAND SLOPE = 7.5000 PCT
CURVE NUMBER = 90.00
PRECIP.DEPTH = 2.00 IN CHANNEL LENGTH = 2160.00 FT
TIME OF CONC. = .2513 HR
DURATION = 24.00 HR AREA = 7.96 AC
NUMBER OF LINES = 732 D = .0335 HR

OUTPUT SUMMARY

RUNOFF DEPTH = 1.0940 IN
INITIAL ABSTRACTION = .2222 IN
PEAK FLOW = 8.09 CFS (1.0089 IPH)
AT T = 12.53 HRS

INPUT SUMMARY
FOR W.S.: BCUD

STORM: WATERSHED:

DISTRIBUTION = SCS TYPE 2
LAND SLOPE = 43.4000 PCT
CURVE NUMBER = 65.00
PRECIP.DEPTH = 2.00 IN
CHANNEL LENGTH = 1852.00 FT
TIME OF CONC. = .2004 HR
DURATION = 24.00 HR
AREA = 82.51 AC
NUMBER OF LINES = 913
D = .0267 HR

OUTPUT SUMMARY

RUNOFF DEPTH = .1345 IN
INITIAL ABSTRACTION = 1.0769 IN
PEAK FLOW = 4.73 CFS (.0569 IPH)
AT T = 12.61 HRS

.1345 in = .0112 ft x 82.5 ac = .92 ac ft

COAL CREEK DRAINAGE
GORDON CR. 3+6

Scale 1" = 2000'

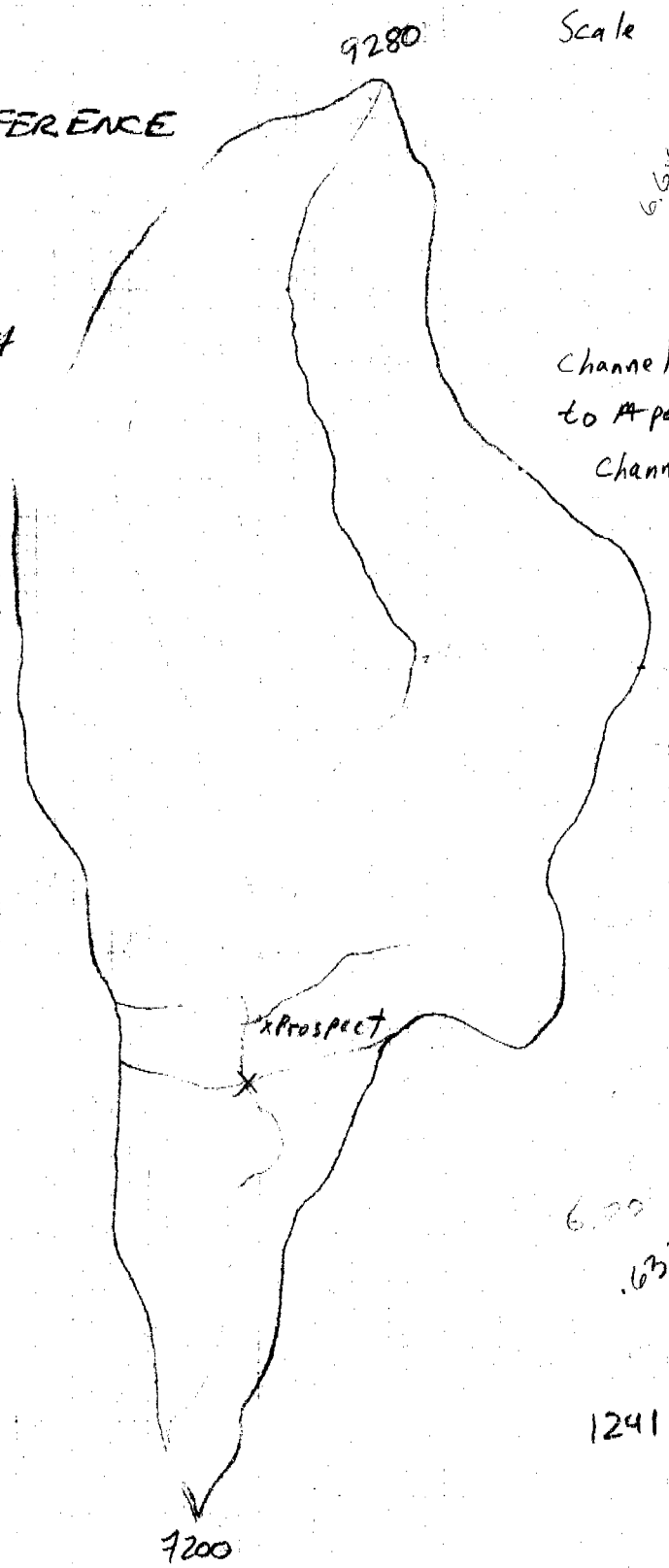
ELEVATION DIFFERENCE

9280
7200
2080 FT.

CHANNEL LENGTH

8 1/2"
17,000'

$\frac{2080}{17000} = \frac{646}{5280}$



.6097 AC

Channel 5.8" from divide to ponds
Channel length to ponds 11,600'

.502 AC

1112.0 AC ABOVE THE MINE

.632 AC

1241.5 AC TOTAL DRAINAGE

DAMES & MOORE

PLATE

REVISIONS BY ____ DATE ____

FILE ____

BY Thompson DATE 11/21/85
CHECKED BY ____

946.7 (REV. 6-61)

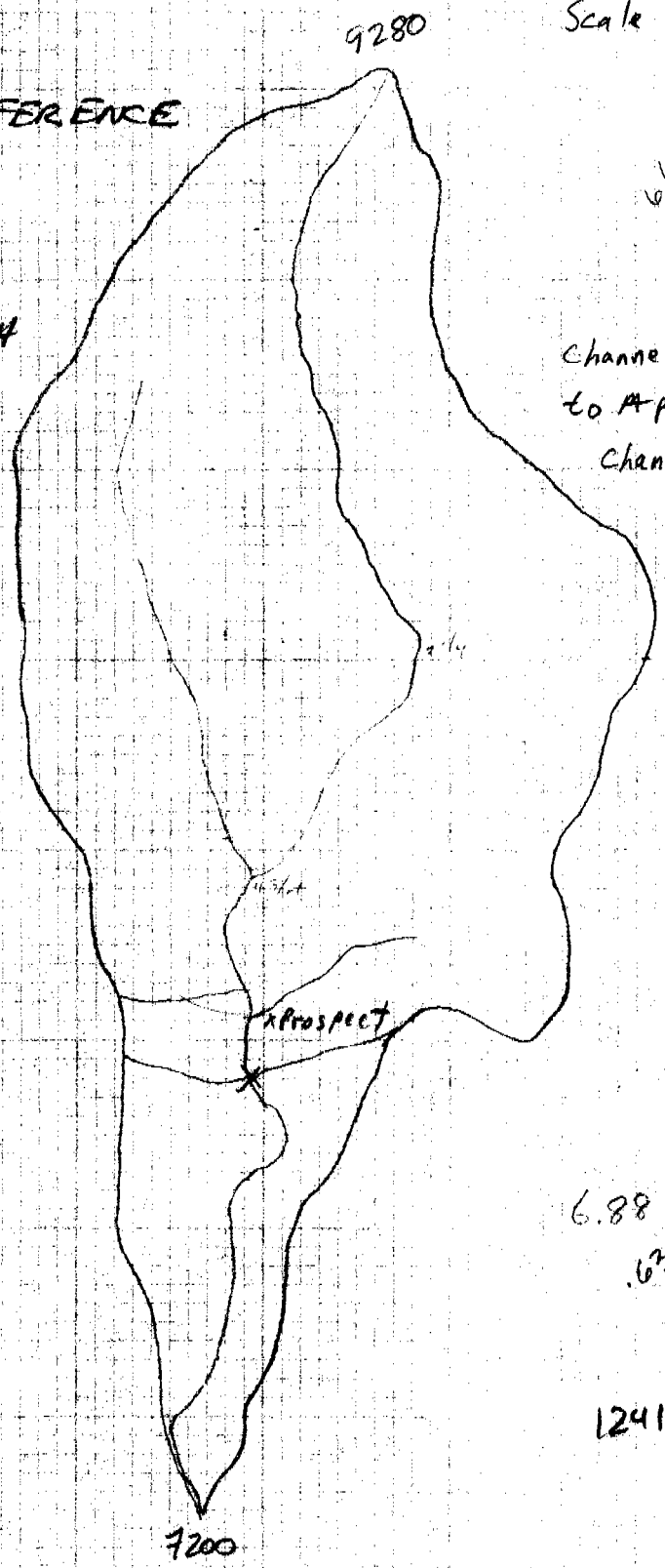
COAL CREEK DRAINAGE
GORDON CR. 3+6

Scale 1" = 2000'

ELEVATION DIFFERENCE
9280
7200
2080 FT.

CHANNEL LENGTH
8 1/2"
17,000'

$\frac{2080}{17000} = \frac{646}{5280}$



6.64
.6097 AC

Channel 5.8" from divide to A ponds
Channel length to ponds 11,600'

5.47
.502 AC

1112.0 AC ABOVE THE MINE

6.88
.632 AC

1241.5 AC TOTAL DRAINAGE

REVISIONS BY ____ DATE ____

FILE ____

BY I. MUNSON DATE 11/21/85
CHECKED BY ____

946.7 (REV. 6-61)

DAMES & MOORE

PLATE

Gordon Creek 3 & 6 (~~Small~~ Tech assistance to operator)

CN#- Veg for undisturbed area is oak, aspen, mixed conifer
Oak Shrub - 40.9%

MJF
Hydro

- "Peak" Computor ~~calcs~~

Area - 896 ac
CN - -68- 55
100y 24h - 3.2 inches
slope - 16.2%
Slope Length - 10,500'

Inputs

TC - 1.2153 hrs.
D - .1620 hr

.25 DRO
Runoff depth - 0.7325 in
Peak Flow - 226.8 96.25
at T = 13.45 hrs.

Outputs

CN-55 ~ Big Storms in August & September
correction factor of .73 bumped up to 55
.75

#2 w CN 55
Tc = 1.6956 RO .2508
? D = .226
Q = 39.9 cfs

#3 CN = 68
TC = 1.2153 > Same as 1st run