007/018#2

FILE COPY

October 21, 1987

TO: File

FROM: Kent Wheeler, Reclamation Hydrologist KW

RE: Technical Review of Stipulation Response from Soldier Creek Coal Co. (received Aug. 3, 1987), ACT/007/018, Folder No. 2, Carbon County, Utah

SUMMARY

This response was directed towards three stipulations to Soldier Creeks five year permit. The three stipulations were:

1) UMC 817.43-(1 and 2)-DC

These stipulations dealt with the diversion ditches that conveyed flow to and around the sediment pond. The applicant has to show that the diversion ditches are adequately sized and stable. Approval to use a 10yr - 6hr design storm event had been previously granted by DOGM administration with the following stipulation. If this design storm event has not been approved for use in the regulations by the Mid-Term Permit Review the applicant will have to show that the diversion can convey the design storm that is in the regulations at that time.

2) UMC 817.46-(1)-DC

This stipulation required the applicant to show that the sediment pond complies with the performance standards as set forth in this section of the regulations. The 10yr - 24 hr storm event had to be contained and the 25yr - 6hr storm had to be passed by the primary and emergency spillway. Since the sediment pond uses a decant device the design flows must be entirely conveyed by the emergency spillway.

ANALYSIS

See attached notes for the actual calculations.

DESIGN EVENTS

	Precip Event	DOGM values	APPLICANTS used
Diversion Ditches	10yr - 6hr precip	1.52 in	1.52 in
Emergency Spillway	25yr - 6hr precip	1.61 in*	1.76 in
Pond Containment	10yr - 24hr precip	2.08 in	2.08 in

* Value from NOAA Rainfall Intensity Atlas

WATERSHED INFORMATION TABLE
Salient information for the diversion ditchs and sediment pond designs.

DRAINAGE 1 and 2	DOGM	Applicants
Area (acres)	135	128
Hydraulic Length (ft)	3800	4080
Slope (%)	73	74
T_c (hr)	0.21	0.21
CN	75	75
Q_p (10yr-6hr)(cfs)	10.8	6.69

DRAINAGE 3	DOGM	Applicants
Area (acres)	6.5	6.8
Hydraulic Length (ft)	850	860
Slope (%)	107	80
T_c (hr)	0.05	0.05
CN	75	75
Q_p (10yr-6hr)(cfs)	0.82	0.97
Q_p (25yr-6hr)(cfs)	1.07	N.A.

DRAINAGE 4	DOGM	Applicants
Area (acres)	9.1	9.4
Hydraulic Length (ft)	900	855
Slope (%)	97	84
T_c (hr)	0.06	0.06
CN	75	75
Q_p (10yr-6hr)(cfs)	1.10	1.35
Q_p (25yr-6hr)(cfs)	1.45	N.A.

DRAINAGE 5	DOGM	Applicants
Area (acres)	3.1	3.0
Hydraulic Length (ft)	600	525
Slope (%)	72	63
T_c (hr)	0.05	0.04
CN	75	75
Q_p (10yr-6hr)(cfs)	0.39	0.43
Q_p (25yr-6hr)(cfs)	0.51	N.A.

DRAINAGE 6	DOGM	Applicants
Area (acres)	2.3	2.1
Hydraulic Length (ft)	850	860
Slope (%)	5	2.8
T_c (hr)	0.15	0.15
CN	88	88
Q_p (10yr-6hr)(cfs)	1.23	1.13
Q_p (25yr-6hr)(cfs)	1.37	N.A.

DRAINAGE 7	DOGM	Applicants
Area (acres)	3.5	3.2
Hydraulic Length (ft)	1350	1325
Slope (%)	39	12
T_c (hr)	0.08	0.10
CN	90	90
Q_p (10yr-6hr)(cfs)	2.30	2.23
Q_p (25yr-6hr)(cfs)	2.56	N.A.

DRAINAGE 8	DOGM	Applicants
Area (acres)	0.9	0.9
Hydraulic Length (ft)	300	220
Slope (%)	70	52
T_c (hr)	0.02	0.02
CN	80	75
Q_p (10yr-6hr)(cfs)	0.25	0.12
Q_p (25yr-6hr)(cfs)	0.30	N.A.

DRAINAGE 9	DOGM	Applicants
Area (acres)	1.5	1.4
Hydraulic Length (ft)	1100	1200
Slope (%)	3	3
T_c (hr)	0.14	0.17
CN	90	90
Q_p (10yr-6hr)(cfs)	0.95	0.89
Q_p (25yr-6hr)(cfs)	1.05	N.A.

DRAINAGE 10	DOGM	Applicants
Area (acres)	0.4	0.5
Hydraulic Length (ft)	50	100
Slope (%)	40	43
T_c (hr)	0.01	0.02
CN	75	75
Q_p (10yr-6hr)(cfs)	N.A.	N.A.
Q_p (25yr-6hr)(cfs)	0.07	N.A.

SEDIMENT POND DESIGNS

	DOGM values used	APPLICANTS values used
Sediment Storage ac-ft	0.76	0.71*
R.O. Containment Vol. ac-ft	1.47	1.43
Total Containment ac-ft	2.23	2.14
Q_p (25yr - 6hr) (cfs)	8.40	10.39
Available Head	1.10	1.10
Head Required	0.95	1.50

* Since the sediment pond has excess dead storage, the cleanout elevation was increased to 6647.8 ft allowing 0.76 ac-ft of sediment to be stored before cleanout. This still maintains the required 2 ft of elevation between the top of the sediment and the decant pipe elevation. The pond can still easily contain the 10yr - 24hr precipitation event and the increased sediment volume.

The slope, area, and hydraulic lengths in the WATERSHED INFORMATION TABLE was derived from Drawing D-213 and Figure 8 in the Vaughn Hansen report. Time of Concentration, CN, were checked using the applicants methods and the peak flows were generated using the SCS TR-55 methodology. As is shown on the Watershed Information Table the applicant and the Divisions values are similar, the main differences are in the calculated slope with the applicant often having significantly flatter slopes.

The drainage system is shown on Drawing E-026, it consists of four types of lined channels. These channels are shown in Drawing B-134. The applicant routed all flows through the drainage system using the SEDIMONT II hydrology program. Since the drainage area and channel lengths are so small the Division felt that the changes due to routing were within acceptable error and therefore did not route its calculated flows. The designs show that the diversions are capable of passing the 10yr - 6hr storm event with the required 0.3 ft of freeboard (see attached calculations) without routing the flows.

Since the applicants flatter slopes did not change the peak flows enough to affect the carrying capacity of the drainage system, they will be acceptable for this submittal, however future submittals may be affected by the flatter slope calculations. These slope values should be checked before being used for other calculations.

A Stage-Volume curve was generated using Drawing D-202 and the elevations of the spillway, height of the riser, length of culverts, and H' were taken from Drawing B-127. A Stage-Discharge Curve was derived from data found on these two drawings. The applicant has calculated that the 25yr - 6hr peak flows to the sediment pond are 10.39 cfs. Using the Stage Discharge from the sediment pond the pond is not capable of passing the 25yr - 6hr storm event and have the necessary 1.0 ft of freeboard. However the applicant uses precipitation data from Soldier Creek Summit, this is a conservative estimate when compared to the NOAA Rainfall Intensity Atlas for the Soldier Creek Canyon area. The division calculated the peak flows (8.4 cfs) using the NOAA Atlas and found that the emergency spillway could pass the expected peak flows with the necessary freeboard (see attached calculations).

RECOMMENDATIONS

The applicant has shown that all of the diversion ditches and the sediment pond meets the criteria established as permanent performance standards in the respective sections of UMC 817.43 and UMC 817.46. Therefore, the Division finds that the applicant has adequately addressed Stipulations UMC 817.43 (1 and 2)-DC and UMC 817.46 (1)-DC of the current five year permit.

cc: J. Leatherwood
S. Linner
R. Summers
1239R-73

Watershed # 1 + 2

See Attached Computer Prints for Area + Slope

AREA - ACRES 135
Sq ft 5,891900

Slope = $\frac{21,588 \times 200}{5891900}$ = 0.73 - 73%

Hy Length - 3800

CN - 75 S = 3.3

$T_c = \frac{L}{0.6}$ = 0.21

$L = \frac{(\text{hy Len})^{0.8} (S+1)^{0.7}}{1900 \sqrt{\text{Slope}}}$

Precip
10 yr - 6 hr - 1.52 in

$Q_{P_{10-6}}$ 10.8 cfs

Watershed #3

AREA - ACRES - 6.5
Sq ft - 283,867

Slope - $\frac{6,099 \times 50}{283,867}$ = 1.07 107%

Hy Length 850 ft

$\frac{(220.56)(2.78)}{1900 \sqrt{107}}$ = 0.03

CN - 75 S = 3.3

T_c = 0.05 hr

$L = \frac{(850)^{.8} (4.3)^{.7}}{1900 \sqrt{107}}$

Precip 10 yr - 6 hr 1.52 in
Soldier Summit ★ 25 yr - 6 hr 1.61 in
10 yr - 24 hr 2.07 in

★ from NOAA ATLAS

Qp 10 yr - 6 hr 0.82 cfs
25 yr - 6 h 1.07 cfs

Runoff
10 yr - 24 hr 0.42 in

Watershed #4

AREA - ACRE - 9.1
sq.ft. - 394471

Slope - $\frac{7677 \times 50}{394,471} = 0.97 - 97\%$

Hy Length 900 ft

CN - 75 S = 3.3

Tc = 0.06

Precip 10yr-6hr 1.52 in
★ 25yr-6hr 1.61 in ★ from NOAA ATLAS
10yr-24hr 2.08 in

Qp 10yr-6hr 1.1 cfs
25yr-6hr 1.95 cfs

2.0
1.5
2.1
0.7
1.9

Runoff 10yr-24hr 0.42 in

Watershed #5

AREA - ACRES - 3.1
sqft - 135,628

Slope $\frac{1,957 \times 50}{135628} = 0.72 - 72\%$

Hy Length - 600 ft

CN - 75 S = 3.3

Tc = 0.05

Precip 10yr-6hr 1.52 in
★ 25yr-6hr 1.61 in ★ From NOAA ATLAS
10yr-24hr 2.08 in

Qp 10yr-6hr = 0.39 cfs
25yr-6hr = 0.51 cfs

Runoff 10yr-24hr - 0.42 in

Watershed #6

Area Acres - 2.3
Sq ft - 98,140

Slope 6740 - 6700 = $\frac{40 \text{ ft}}{850 \text{ ft}}$ = 0.05 - 5%

Hy Length 850

CN - 88 S = 1.1

Tc = 0.15 hr

3.5
2.3
1.5
7.3

Precip 10 yr - 6 hr 1.52 in
★ 25 yr - 6 hr 1.61 in ★ From NOAA Atlas
10 yr - 24 hr 2.08 in

Qp 10 yr - 6 hr 1.23 cfs
25 yr - 6 hr 1.37 cfs

Runoff 10 yr - 24 hr 1.16

Watershed #7

Area - Acres - 3.5
Sq ft - 150,543

Slope $\frac{1,183 \times 50}{150,543}$ = 0.39 - 39%

Hy Length - 1350

CN - 90 S = 1.1

Tc = 0.08

Precip 10 yr - 6 hr 1.52 in
★ 25 yr - 6 hr 1.61 in ★ From NOAA Atlas
10 yr - 24 hr 2.08 in

Qp 10 yr - 6 hr 2.3 cfs
25 yr - 6 hr 2.56 cfs

Runoff 10 yr - 24 hr - 1.16 in

Watershed #8

Area - Acres - 0.9
Sq ft - 37184

Slope $\frac{519 \times 50}{37184} = 0.70$ or 70%

Hy Length - 300 ft

CN - 80 - 30% Disturbed - 70% Undisturbed - S = 2.5

T_c - 0.02 hr

Precip 10 yr - 6 hr 1.52 in
★ 25 yr - 6 hr 1.61 in ★ From NOAA Atlas
10 yr - 24 hr 2.08 in

Qp 10 yr - 6 hr - 0.25 cfs
25 yr - 6 hr - 0.30 cfs

Runoff 10 yr - 24 hr - 0.61

Watershed #9

Area - Acres - 1.5
Sq ft - 64858

Slope - $\frac{30}{1100} = 0.03$ or 3% 6710-6680

Hy length = 1100 ft

CN - 90 S = 1.1

T_c - 0.14 hr

Precip 10 yr - 6 hr 1.52 in
25 yr - 6 hr 1.61 in
10 yr - 24 hr 2.08 in

Qp 10 y - 6 hr - 0.95 cfs
25 yr - 6 hr - 1.05 cfs

Runoff 10 yr - 24 hr - 1.16 in

Watershed 10

Area 0.4 Ac
Slope 90 %
Hy Length 50
CN 75
T_c 0.01
Qp 25-6 0.07 cfs

Drainage Design

Undisturbed Drainage

Must pass - 10.8 cfs

Length of culvert 1250 ft

Slope 6765 - 6700 = 65 ft in 1250

= 5%

HW Required using inlet control 0.6 D

Using Pipeflow equation

$$Q = \frac{a(2gH')^{\frac{1}{2}}}{(1 + K_e + K_b + K_c L)^{\frac{1}{2}}} = \frac{4.91\sqrt{(2(32.2)\,65)}}{\sqrt{(1 + 1 + 0.6 + (0.0341)1250)}}$$

K_b - 90° + 10° ~ 0.6 = 317.59

= 47 cfs

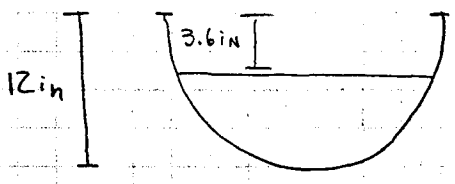
∴ the pipe is satisfactory sized

Sizing Capacity for Half Round Culvert

Assume NO Routing - Watersheds 4 + 6

HALF ROUND Culvert 1.1 cfs + 1.45 cfs = 2.56 cfs

3.



AREA

AREA of 24 in culvert

3.14 ft

AREA of ½ Round

1.57 ft

WETTED Perimeter

circumference of 24 in culvert

$2\pi r = 2(3.14)1$
$= 6.28$

circumference of ½ Round

$6.28/2 = 3.14$

total Length of Freeboard

0.6

WETTED PERIMETER

$3.14 - 0.6 = 2.54$ ft

AREA of freeboard

.3 ft x 2 ft = 0.6 ft

AREA of channel

1.57 ft − 0.6 ft = 0.97 ft

Mannings

$$Q = A\left(\frac{1.49}{n}\right)R^{2/3}S^{\frac{1}{2}}$$

$n = 0.025$

$$R = \frac{0.97 ft^2}{2.54 ft} = 0.38 ft$$

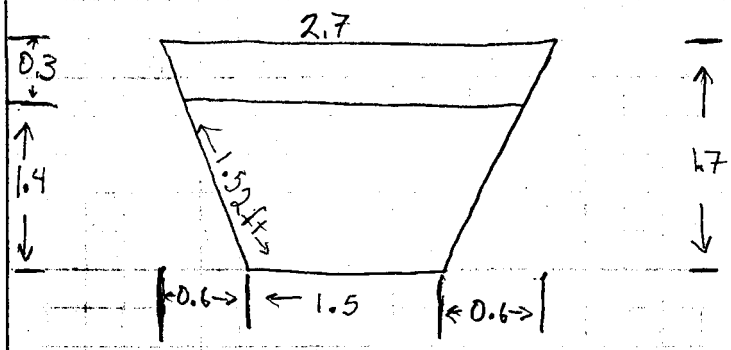
$A = 0.97$ ft

$S = 0.017$ minimum slope from Exhibit Fig 4.2-2

$$Q = 0.97\left(\frac{1.49}{0.025}\right)(0.38)^{0.66}(0.017)^{0.5}$$

$Q_{MAX} = 4.0$ cfs

Sizing Capacity for Concrete + Cobblestone Ditch



X-Sectional Area

$2.1 \text{ ft} \times 1.4 \text{ ft} = 2.94 \text{ ft}$

WETTED Perimeter

$1.52 + 1.52 + 1.5 = 4.54$

$$R = \frac{2.94}{4.54} = 0.65$$

$A = 2.94$

S_{min} = Above WS #3 $= \frac{1.2}{60} = 0.02$

S_{min} = Below WS #3 $= \frac{2.5}{100} = 0.03$

$n = 0.025$

$$Q = A\left(\frac{1.49}{n}\right) R^{2/3} S^{\frac{1}{2}}$$

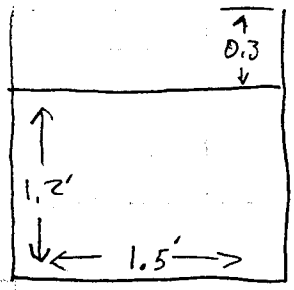
Above WS#3 $Q_{max} = 18.65$ cfs

Below WS#3 $Q_{max} = 22.84$ cfs

UnRouted Peak Discharge Above WS #3 = 2.55 cfs
∴ Accept Design

Unrouted Peak Discharge below WS#3 = 6.06
Σ WS # 4, 6, 7, 3, 5 =
∴ Accept Design

Sizing Capacity for Concrete Ditch



Cross Sectional Area

$1.2 \times 1.5 = 1.80$

Wetted Perimeter

$1.2 + 1.2 + 1.5 = 3.9'$

$R = \frac{1.8}{3.9}$ 0.46'

$A = 1.8'$

S_{min} = Above WS #3 $= \frac{2'}{125'} = 0.02$

S_{min} = below WS #3 $\frac{3}{125} = 0.02$

S_{min} = ON WS #3 Ditch $= \frac{4.5}{125'} = 0.04$

$n = 0.014$

Above WS#3 $Q =$ 16.23 cfs

Below WS#3 $Q =$ 16.23 cfs

WS#3 Ditch $Q =$ 22.95 cfs

Unrouted Peak Discharge Above WS #3 = 2.55 cfs ∴ Accept design

Unrouted Peak Discharge below WS # 3 = 6.06 cfs ∴ Accept design

Unrouted Peak Discharge ON WS #3 = 0.82 cfs ∴ Accept design

Sed Pond Drainage,
Sizing Capacity for County Road Drainage

Ran on Computer

Assumptions

1 ft bottom width

Sideslope 2.5 H ; 1 Vertical $\frac{1}{2.5} = 0.40$

UnRouted -> Q_{MAX} WS #9 = 0.95 cfs

$Slope_{MAX} = \frac{4'}{75'} = 0.05$

$Slope_{min} = \frac{5}{250} = 0.02$

$n = 0.035$

Max slope -> Velocity MAX = 2.76 ft/sec

Min slope -> Depth MAX = 0.28 ft

∴ Accept Design

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

Sizing Capacity for Culverts Reporting to Pond

$$Q = \frac{a\sqrt{(2gH')}}{\sqrt{(1 + K_e + K_b + K_c L)}}$$

$K_b = 0.4$ (60° bend)

$K_e = 1$ standard

$K_c = 0.0341$

$L = 325'$

$H' =$ Assume = slope = 6697 − 6670 = 27'

$g = 32.2$

$A = \pi r^2 = 3.14'$ $r = 1$

Using Pipe flow equation

$$Q = \frac{3.14\sqrt{64.4(27)}}{\sqrt{(1 + 1 + 0.4 + 0.0341(325))}}$$

$\frac{130.93}{3.67} = 35.66$ cfs

Using Inlet control Diagram

Assume $HW = 1.0D$

Pipe diameter 24 in

$Q_p = 12$ cfs ∴ Accept design

County Road Culvert

Inlet Control Diagram → 5.5 cfs ∴ Accept design

12 in Culverts

Inlet Control Diagram 2 cfs ∴ Accept Design

Sediment Pond Design

Drainage Area	Acres	Disturbed Drainage Area
WS # 3 =	6.5	
WS # 4 =	9.1	
WS # 5 =	3.1	
WS # 6 =	2.3	2.3
WS # 7 =	3.5	3.5
WS # 8 =	0.9	0.3
WS # 9 =	1.5	1.5
Total	26.9 Acres	7.6

Runoff 10yr-24hr

	in	Convert to /12	ft	x	Area		
W.S. # 3	0.46 in		0.038				
WS # 4	0.46 in		0.038		18.7 AC	=	0.71 AC-ft
WS # 5	0.46 in		0.038				
WS # 6	1.16 in		0.097				
WS # 7	1.16 in		0.097		5.8 AC	=	0.56 AC-ft
WS # 8	0.61 in		0.051		0.9 AC	=	0.05
WS # 9	1.16 in		0.097		1.5 AC	=	0.15
							1.47 AC-ft

Total Containment Volume

1.47 Ac-ft of Water
0.76 Ac-ft of Sed
2.13 Ac-ft total containment necessary

2 3
1.07
1.45
0.51
1.37
2.56
0.30
1.05
8.31

Peak Flow From 25 yr -6 hr Event

Used 1.61 in of precip 25yr-6hr from NOAA Atlas

⟷ Division – 8.31 cfs Unrouted

Applicants – 10.39 cfs Routed – (SEDCAD)

Sediment Pond Design - see computer printout

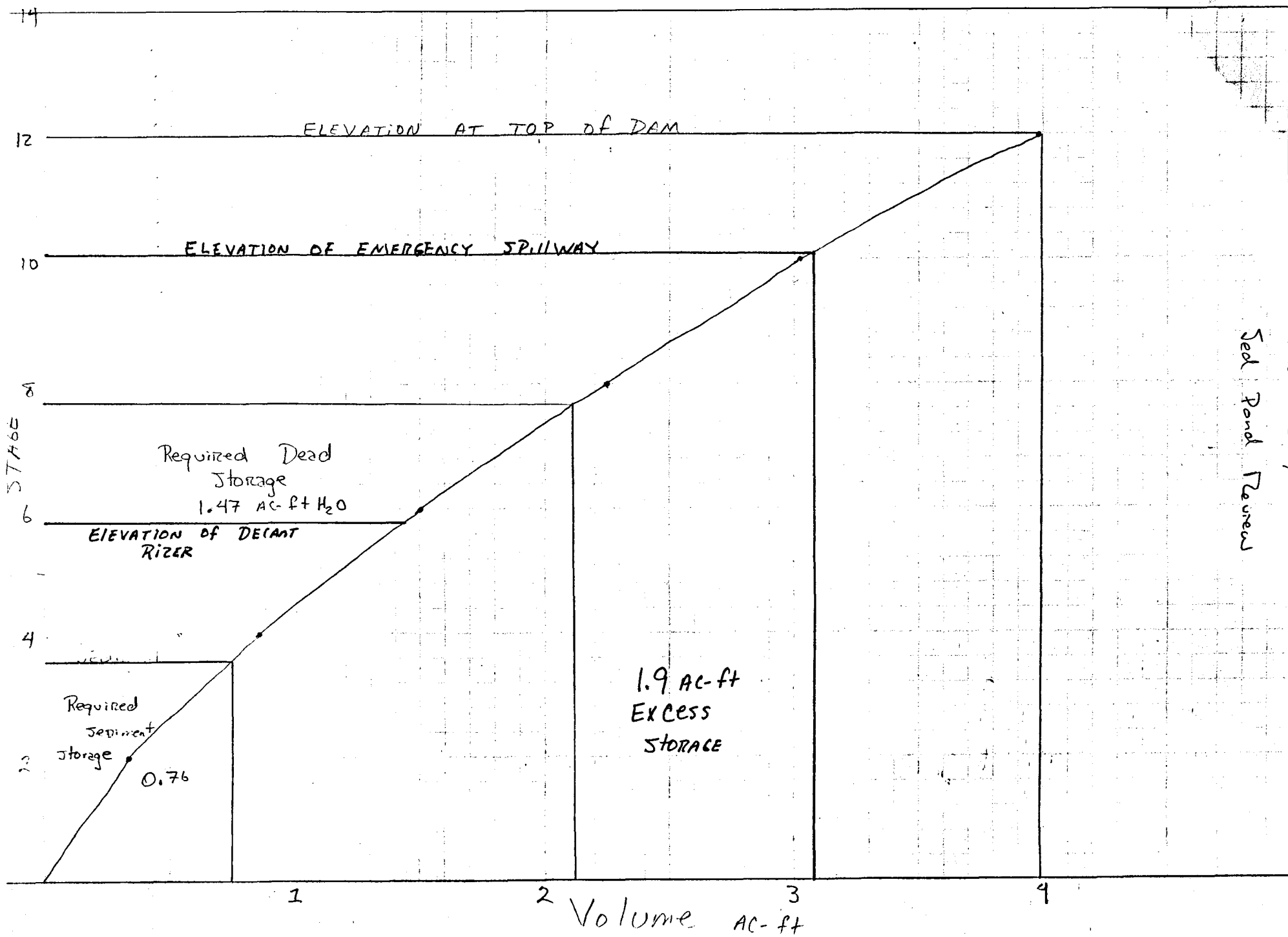
Area of Pond

Volume of 6644 to 6646

							Total
AREA 1	2ft	$\frac{0.078 AC + 0.243 AC}{2}$	x	2ft =	0.32	AC-ft	0.32 AC-f
AREA 2	4ft	$\frac{0.243 + 0.288}{2}$	x	2 =	0.53	AC-ft	0.85 AC-f
AREA 3	6ft	$\frac{0.288 + 0.336}{2}$	x	2 =	0.65	AC-ft	1.5 AC-f
AREA 4	8ft	$\frac{0.336 + 0.380}{2}$	x	2 =	0.75	AC-ft	2.25 AC-f
AREA 5	10ft	$\frac{0.380 + 0.431}{2}$	x	2 =	0.81	AC-ft	3.06
AREA 6	12ft	$\frac{0.431 + 0.485}{2}$	x	2 =	0.92	AC-ft	3.98

Total Pond Volume 3.98 AC-ft

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



Soldier Canyon
Sed Pond Review

Stage - Discharge for Soldier Canyon Sedimend Pond

Wier Flow

H (ft)	Q (cfs)	WIER COEF.
0.10	0.49	3.27
0.20	1.38	3.28
0.30	2.54	3.28
0.40	3.92	3.29
0.50	5.48	3.29
0.60	7.21	3.29
0.70	9.11	3.30
0.80	11.13	3.30

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

L = circumfrence of pipe

$L = 2\pi r$

$L = 4.71$ ft

Pipe diameter 18 in CMP

$C = 3.27 + 0.4\, H/W$

W = hieqth of Riser

W = 10 ft

Orifice Flow

$Q = C' A \sqrt{2gH}$

$C' = 0.6$

$A = \pi r^2$

$= 1.77\ ft^2$

$g = 32.2$

H (ft)	Q (cfs)
0.5	6.02
0.6	6.59
0.7	7.12
0.8	7.61
0.9	8.07
1.0	8.51
1.1	8.92
1.2	9.32
1.3	9.72
1.4	10.08

H (ft)	Q (cfs)
1.5	10.43
1.6	10.78
1.7	11.11
1.8	11.43
1.9	11.75
2.0	12.05

Pipe Flow

$$Q = \frac{a\sqrt{2gH'}}{\sqrt{1 + K_e + K_b + K_c L}} = \frac{14.2\sqrt{H'}}{3.13} = 4.54\sqrt{H'}$$

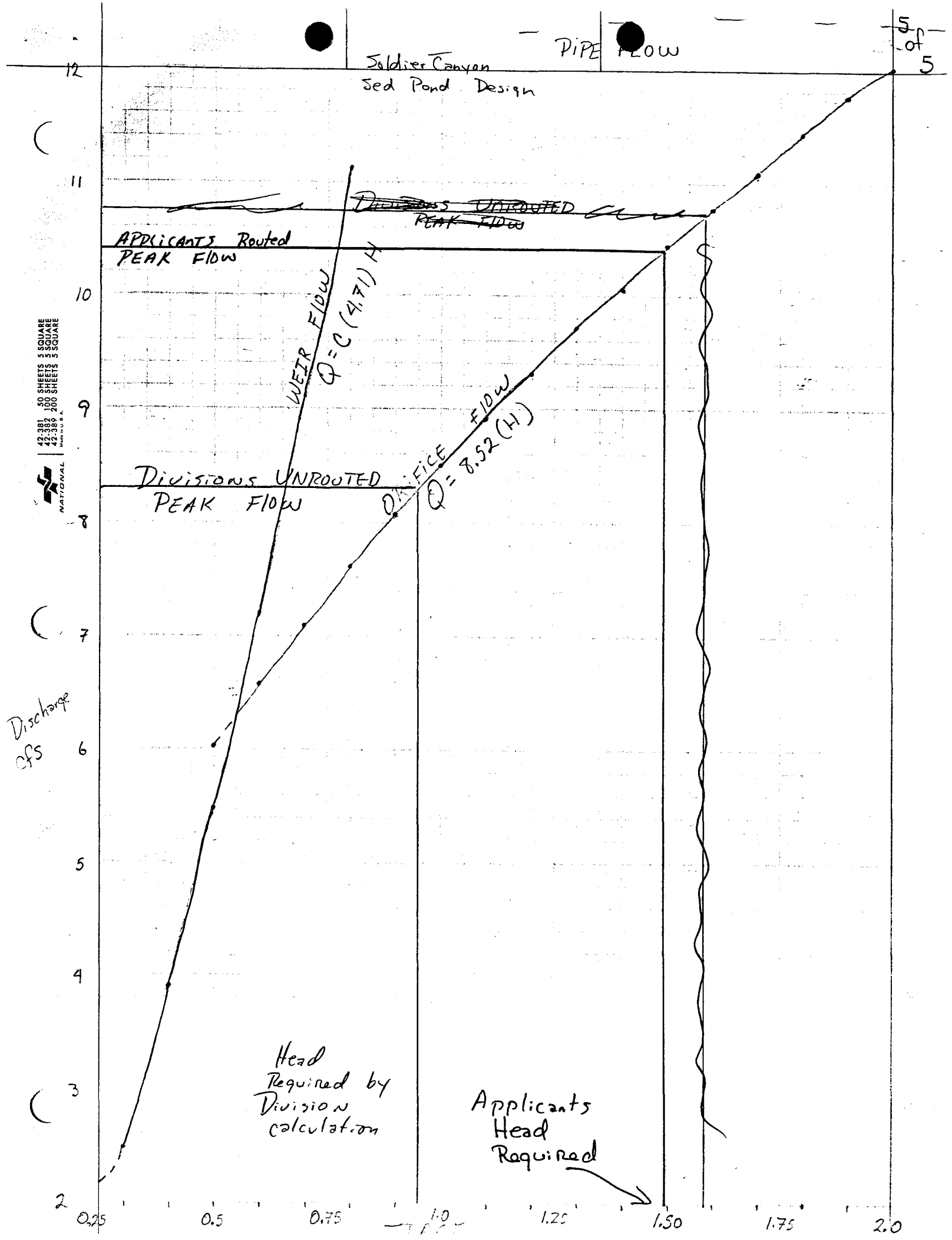
$K_e = 1.0$

$K_b = 0.5$

$K_c = 0.0674$

$L = 107$

H (ft)	H' (ft) (9.4 + H)	Q cfs
1.0	10.4	14.64
1.5	10.9	14.99
1.8	11.2	15.20
2.0	11.4	15.33

PIPE FLOW

Soldier Canyon
Sed Pond Design