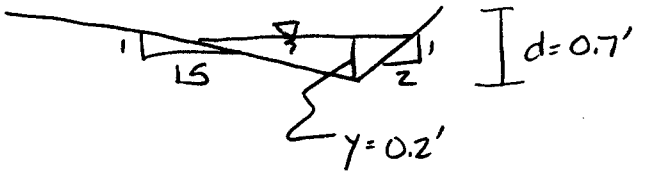
UPPER SECTION - CROSS SECTION (18% Grade)



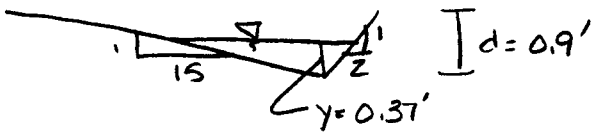
REMAINING SECTION OF DITCH (BELOW 18% GRADE)

SLOPE VARIES BETWEEN 2% AND 10% WITH 1 30% RIPRAPPED SECTION

FOR 2-10% SLOPES : Q=2.6 cfs (See Sheet 7)

$M_1 = 1.5$ $b=0$
$M_2 = 2$ $\eta = 0.03$ $V = 4.1 < 5$ ok

NO LINING REQ'd



30% RIPRAP SECTION Q=2.6

From Sheet 8; $y = 0.22'$, $V = 8.1$ fps > 5.0 LINING REQ'd
$b = 1.0'$

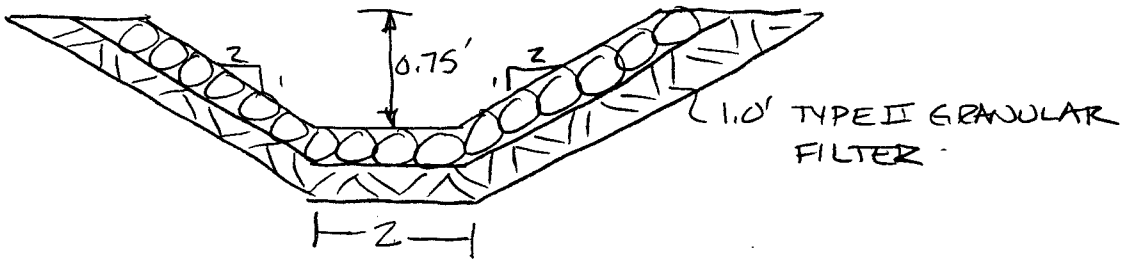
EXTRAPOLATING FROM "DESIGN OF STABLE CHANNELS WITH FLEXIBLE LININGS" FED. HIGHWAY ADM - OCT 75 - SEE SHEET 9

GIVES $D_{50} \sim 1.0'$ $\eta = .0395(D_{50})^{1/6} \sim 0.04$

IF CHANNEL IS WIDENED TO 2.0' (Sheet 10)

$y = 0.19'$ AND $D_{50} = 0.75'$ USE $B = 2.0'$

USE 1.0' TYPE II GRANULAR FILTER AS PER "URBAN STORM DRAINAGE CRITERIA MANUAL" - VOL 2 - MARCH 1969 (T615-4)



Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	05-May-89
Project No.:	007.11.100	Time:	08:33 AM
Channel Section:	Lower D-37	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	2.60	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.10	ft/ft
	Freeboard:	0.50	feet
CALCULATION:	Depth (Min. Flow):	0.37	feet
(Channel Depth)	Qn/1.49(S)1/2=	0.371	
	A(R)2/3=	0.371	
	Required Depth:	0.87	feet
	Area:	1.16	ft2
	Perimeter:	6.37	feet
	Hydraulic Radius:	0.18	feet
	Velocity:	2.25	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION:	Depth (Max. Flow):	0.27	feet
(Velocity Check)	Qn/1.49(S)1/2=	0.166	
	A(R)2/3=	0.166	
	Required Depth:	0.77	feet
	Area:	0.63	ft2
	Perimeter:	4.71	feet
	Hydraulic Radius:	0.13	feet
	Velocity:	4.10	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	15.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.10	ft/ft
	Channel Depth:	0.87	feet
	Riprap:	Not Needed	

Comment:

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company — Date: 05-May-89
Project No.: 007.11.100 — Time: 08:47 AM
Channel Section: Lower D-37 — Computed: DEH

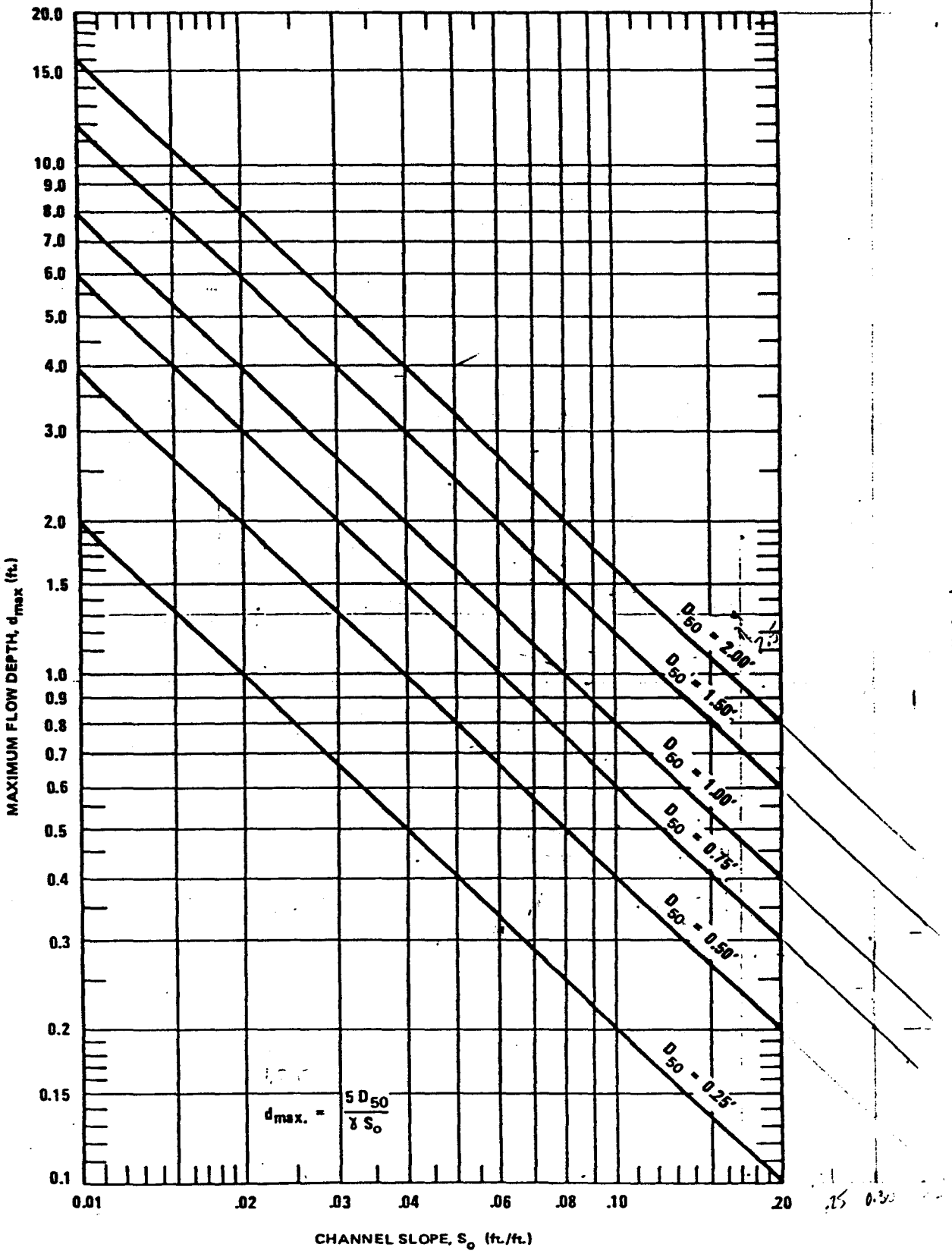
			UNITS
GENERAL CRITERIA:	Design Flow:	2.60	cfs
	Bottom Width:	1.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.30	ft/ft
	Max. Bottom Slope:	0.30	ft/ft
	Freeboard:	0.50	feet
CALCULATION:	Depth (Min. Flow):	0.22	feet
(Channel Depth)	Qn/1.49(S)1/2=	0.096	
	A(R)2/3=	0.096	
	Required Depth:	0.72	feet
	Area:	0.32	ft2
	Perimeter:	2.00	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	8.06	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION:	Depth (Max. Flow):	0.22	feet
(Velocity Check)	Qn/1.49(S)1/2=	0.096	
	A(R)2/3=	0.096	
	Required Depth:	0.72	feet
	Area:	0.32	ft2
	Perimeter:	2.00	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	8.06	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	1.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.30	ft/ft
	Max. Bottom Slope:	0.30	ft/ft
	Channel Depth:	0.72	feet
	Riprap:	Required	

Comment:

9/11

Chart 27



MAXIMUM PERMISSIBLE DEPTH OF FLOW (d_{max})
FOR CHANNELS LINED WITH ROCK RIPRAP

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

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Co.	Date:	12-Jul-89
Project No.:	007.11.100	Time:	03:13 PM
Channel Section:	Lower D-37	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	2.60	cfs
	Bottom Width:	2.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.040	
	Min. Bottom Slope:	0.300	ft/ft
	Max. Bottom Slope:	0.300	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.19	feet
	Qn/1.49(S)1/2=	0.128	
	A(R)2/3=	0.127	
	Required Depth:	0.69	feet
	Area:	0.44	ft2
	Perimeter:	2.83	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	5.93	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.19	feet
	Qn/1.49(S)1/2=	0.128	
	A(R)2/3=	0.127	
	Required Depth:	0.69	feet
	Area:	0.44	ft2
	Perimeter:	2.83	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	5.93	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	2.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	30.0	%
	Max. Bottom Slope:	30.0	%
	Min Channel Depth:	0.69	feet
	Riprap (Min S):	Required	
	Riprap (Max S):	Required	

HANSEN ALLEN & LUCE INC

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE: D-37
PROJECT NO.: 007.11.100

SHEET 11 OF 11
COMPUTED: DEH
CHECKED:
DATE: 5 MAY 89

RIPRAP GRADATION (From Drainage Criteria Manual) Table 5-1

RIPRAP TYPE L

INTERMEDIATE ROCK DIMENSION (INCHES)	% SMALLER THAN GIVEN SIZE BY WEIGHT
15	70-100
12	50-70
9	35-50
3	2-10

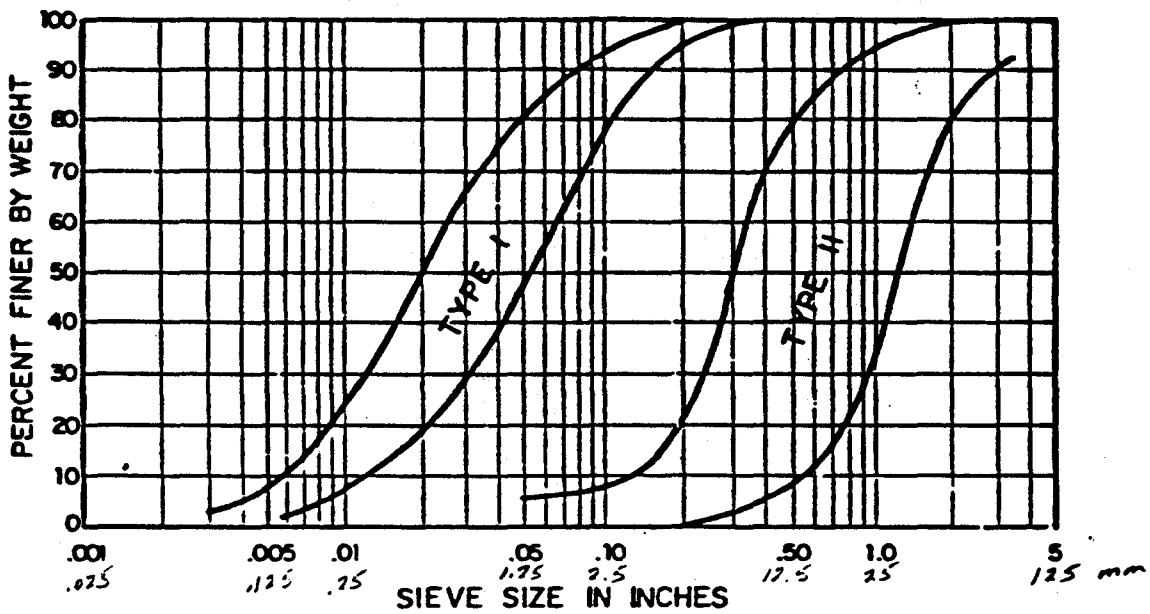


FIGURE 5-2. GRADATION CURVES FOR GRANULAR BEDDING

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED DEH
CHECKED
DATE 10/30/89

D-38

Total Area = 0.3 acres (Disturbed)

CN = 90

Precipitation = 1.55 inches (10yr, 6hr)

Hydraulic Length = 175 feet

$$\text{Slope} = \frac{(150)\,25(100)}{43560\,(0.3)} = 28.7\%$$

Calculated Runoff $Q_{TOT} = 0.22$ cfs

No ditch Design Anticipated. - USE GENERAL DESIGN

$b = 0,\ d \geq 7.0',\ m = 2$

Slope (Lower Section) ~ 3/80 = 0.038 $\quad \frac{Qn}{1.49 S^{1/2}} = 0.023$

Y	$AR^{2/3}$
0.2	0.016
0.22	0.021
0.23	0.023 ⇒ A = 0.106, V = 2.08 < 5 fps ∝

No Lining Req'd

PROJECT : Valley Camp Coal - D-38 Runoff Calculation

AREA= .3 ACRES
AVERAGE BASIN SLOPE= 27.7 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 175. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0117 HOURS QPCFS= 19.43 CFS QPIN=64.2234 INCHES
C3=316.5573 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2199	.0000	.0000	.0	.00
1.55	.2234	.0000	.0000	19.4	.00
1.56	.2269	.0000	.0000	5.6	.00
1.57	.2305	.0000	.0000	.6	.00
1.58	.2340	.0001	.0000	.0	.00
2.42	.8428	.2224	.0081	.0	.21
2.44	.8566	.2306	.0081	.0	.21
2.45	.8704	.2388	.0082	.0	.21
2.46	.8841	.2471	.0083	.0	.21
2.47	.8979	.2555	.0084	.0	.21
2.48	.9116	.2640	.0085	.0	.22
2.50	.9254	.2725	.0086	.0	.22
2.51	.9325	.2770	.0044	.0	.14
2.52	.9362	.2793	.0023	.0	.08
2.53	.9399	.2817	.0023	.0	.06
2.54	.9436	.2840	.0023	.0	.06
2.56	.9474	.2864	.0024	.0	.06
2.57	.9511	.2887	.0024	.0	.06

HYDROGRAPH PEAK= .22 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .02 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-39A, D-39B
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/9/89

D-39A, D-39B (Convenience Ditches)

Total Area = 253 * 0.00702 = 1.8 acres

CN = 70 (25% Oak/Aspen)

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 450 feet

$$\text{slope} = \frac{(.1100)(25)(100)}{(1.78)\,43{,}560} = 35.5\%$$

Run-Off Calculation: $Q_{TOT} = 0.06$ cfs

Convenience Ditches -

Slope ~ 1.5% $b=0,\ m=2,\ n=0.03$ $\frac{Qn}{1.49S^{1/2}} = 0.010$

y	$AR^{2/3}$
0.1	0.003
0.15	0.007
0.2	0.016
0.17	0.010 ⇒

A = 0.058
V = 1.04 < 5 ✓

No Lining Req'd

PROJECT : Valley Camp Coal - D-39A, D-39B Runoff Calculations

AREA= 1.8 ACRES
AVERAGE BASIN SLOPE= 35.5 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0417 HOURS QPCFS= 32.61 CFS QPIN=17.9644 INCHES
C3= 88.5466 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.42	.8406	.0000	.0000	.0	.00
2.44	.8646	.0000	.0000	16.0	.00
2.46	.8885	.0002	.0002	32.6	.00
2.48	.9125	.0007	.0005	23.0	.01
2.51	.9317	.0013	.0006	10.5	.03
2.53	.9382	.0015	.0002	3.8	.04
2.55	.9447	.0018	.0002	1.2	.03
2.57	.9512	.0020	.0003	.3	.03
2.59	.9576	.0023	.0003	.0	.02
3.36	1.1747	.0219	.0007	.0	.06
3.38	1.1799	.0226	.0007	.0	.06
3.40	1.1851	.0233	.0007	.0	.06
3.42	1.1902	.0240	.0007	.0	.06
3.45	1.1954	.0247	.0007	.0	.06
3.47	1.2006	.0255	.0007	.0	.06
3.49	1.2058	.0262	.0007	.0	.06
3.51	1.2103	.0269	.0007	.0	.06
3.53	1.2139	.0274	.0005	.0	.06
3.55	1.2175	.0279	.0005	.0	.05
3.57	1.2210	.0285	.0005	.0	.05
3.59	1.2246	.0290	.0005	.0	.05
3.61	1.2281	.0296	.0005	.0	.05

HYDROGRAPH PEAK= .06 cfs
TIME TO PEAK= 3.49 Hours
RUNOFF VOLUME= .01 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-42
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/8/89

D-42 (Convenience Ditch)

Total Area = 99 * 0.00702 = 0.7 ac

CN = 90 (disturbed)

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 275'

$$\text{Slope} = \frac{(450)(25)(100)}{43{,}560\,(0.7)} = 36.9\%$$

Run-off Calculation: $Q_{TOT} = 0.51$ cfs

Convenience Ditch -

Slope = 5/140 = 0.036 $\quad b=0,\ m=2,\ n=0.03$

$$\frac{Qn}{1.49S^{1/2}} = 0.054$$

y	$AR^{2/3}$
0.2	0.016
0.3	0.047
0.32	0.056

A = 0.205

⇒ V = 2.5 < 5 ok

No Lining Req'd

PROJECT : Valley Camp Coal - D-42 Runoff Calculations

AREA= .7 ACRES
AVERAGE BASIN SLOPE= 36.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 275. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0145 HOURS QPCFS= 36.45 CFS QPIN=51.6334 INCHES
C3=254.5012 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2201	.0000	.0000	.0	.00
1.55	.2244	.0000	.0000	36.4	.00
1.57	.2287	.0000	.0000	11.8	.00
1.58	.2330	.0001	.0000	1.3	.00
1.60	.2372	.0002	.0000	.0	.00
2.41	.8233	.2110	.0096	.0	.47
2.42	.8400	.2207	.0097	.0	.48
2.44	.8566	.2306	.0098	.0	.49
2.45	.8732	.2405	.0100	.0	.49
2.46	.8899	.2506	.0101	.0	.50
2.48	.9065	.2608	.0102	.0	.50
2.49	.9231	.2711	.0103	.0	.51
2.51	.9326	.2771	.0060	.0	.35
2.52	.9371	.2799	.0028	.0	.19
2.54	.9416	.2827	.0028	.0	.15
2.55	.9461	.2856	.0028	.0	.14
2.57	.9506	.2884	.0029	.0	.14
2.58	.9551	.2913	.0029	.0	.14

HYDROGRAPH PEAK= .51 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .04 Acre-Feet

D-44A DESIGN

CN determination shown on D-44B sheets $P_{10yr-6Hr} = 1.55$ in

AREA: $R_{DG} = 434$ $A = 434 * 0.0035 = 1.52$ ac : TOTAL
0.53 : DISTURBED CN = 90
0.99 : UNDISTURBED CN = 70

Undist. Area is Approx 25% Oak/Aspen Complex

Area	CN	$Q_{10yr-6hr}$
0.53	90	0.723
0.99	70	0.096
1.52		$\bar{Q} = 0.315$

$\bar{CN} = 80$

HYD. LENGTH ~ 510'

WATERSHED SLOPE: $\frac{\text{Cont L} * \text{Cont Int} * 100}{\text{Area} * 43560}$

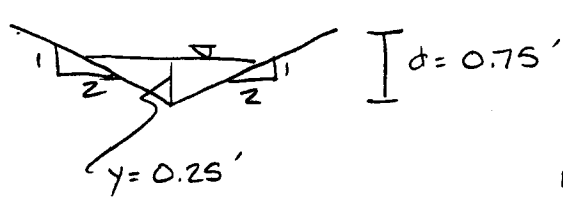
$= \frac{800 * 25 * 100}{1.52 * 43560} = 30.2\%$

RUNOFF PREDICTION:

$Q = 0.43$ cfs

CHANNEL DESIGN:

$S_{min} = 10\%$ $b = 0$
$S_{max} = 10\%$ $M_1 = M_2 = 2$



NO LINING REQ'd

PROJECT : Valley Camp Coal - Ditch D-44A Runoff Calculation

AREA= 1.5 ACRES
AVERAGE BASIN SLOPE= 30.2 PERCENT
CURVE NUMBER= 80.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 510. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0375 HOURS QPCFS= 30.66 CFS QPIN=20.0051 INCHES
C3= 98.6053 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.12	.4921	.0000	.0000	.0	.00
2.14	.5136	.0000	.0000	15.0	.00
2.16	.5351	.0005	.0004	30.7	.00
2.17	.5566	.0013	.0008	21.6	.03
2.19	.5781	.0024	.0011	9.9	.05
2.21	.5996	.0038	.0014	3.5	.08
2.23	.6211	.0056	.0018	1.1	.10
2.25	.6426	.0077	.0021	.3	.13
2.27	.6641	.0101	.0024	.0	.16
2.40	.8146	.0352	.0044	.0	.33
2.42	.8361	.0398	.0047	.0	.35
2.44	.8576	.0447	.0049	.0	.37
2.46	.8791	.0499	.0052	.0	.39
2.47	.9006	.0553	.0054	.0	.41
2.49	.9221	.0610	.0056	.0	.43
2.51	.9337	.0641	.0031	.0	.41
2.53	.9395	.0657	.0016	.0	.32
2.55	.9453	.0673	.0016	.0	.22
2.57	.9511	.0690	.0016	.0	.17
2.59	.9569	.0706	.0016	.0	.14

HYDROGRAPH PEAK= .43 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .04 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	04-May-89
Project No.:	007.11.100	Time:	04:08 PM
Channel Section:	D-44A	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.43	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.10	ft/ft
	Max. Bottom Slope:	0.10	ft/ft
	Freeboard:	0.50	feet
CALCULATION:	Depth (Min. Flow):	0.25	feet
(Channel Depth)	Qn/1.49(S)1/2=	0.027	
	A(R)2/3=	0.027	
	Required Depth:	0.75	feet
	Area:	0.12	ft2
	Perimeter:	1.10	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	3.58	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION:	Depth (Max. Flow):	0.25	feet
(Velocity Check)	Qn/1.49(S)1/2=	0.027	
	A(R)2/3=	0.027	
	Required Depth:	0.75	feet
	Area:	0.12	ft2
	Perimeter:	1.10	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	3.58	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.10	ft/ft
	Max. Bottom Slope:	0.10	ft/ft
	Channel Depth:	0.75	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE INC

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE: RUNOFF HYDROLOGY - BELINA MINE AREA
PROJECT NO.: 007.11.100

SHEET 1 OF 4
COMPUTED: DEH
CHECKED:
DATE: 4 MAY 89

DITCH 44B

START W/ UPPER SMALL DITCHES TO WEST

DITCH D-44B - Includes a portion of ASCA 6 plus some undisturbed area,

MAP SCALE 1:100' RDG = 408 for 1.44 ac RATIO = 0.0035

Tributary Area = 506 * .0035 = 1.8 ac
Disturbed " = 78 = 0.3 ac
Undisturbed " = 1.5 ac

USING CONSISTENT CURVE NUMBERS AS DEVELOPED IN OUR FEB 89 SED. POND REPORT.

SAGE/GRASS AREAS, SOIL GROUP C, DENSITY 25%; CN = 75
OAK/ASPEN AREAS, SOIL GROUP C, DENSITY 25%; CN = 70
OAK/ASPEN AREAS, SOIL GROUP C, DENSITY 90%; CN = 40 *

* TAKEN FROM FIG 9.5 NEH 4; PG 9.11

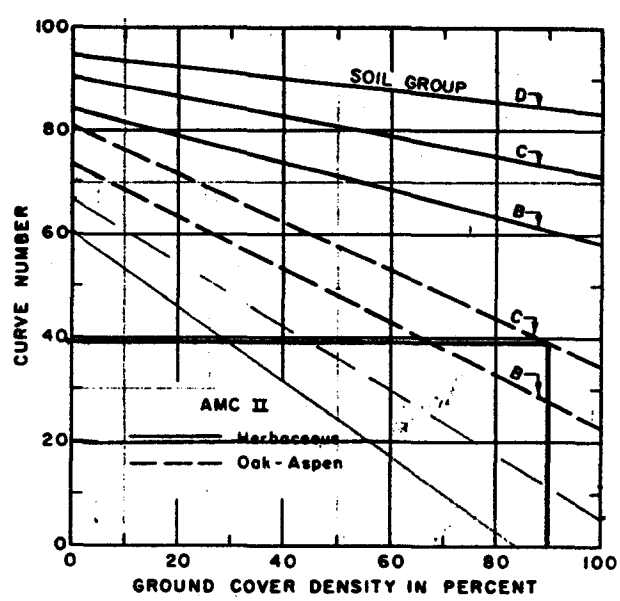


Figure 9.5.--Graph for estimating runoff curve numbers of forest-range complexes in western United States: herbaceous and oak-aspen complexes.

DISTURBED AREAS CN = 90

RECLAIMED AREAS CN = 85
PAVED AREAS CN = 98

CN	S	CN	S
98	0.204	75	3.333
90	1.111	70	4.286
85	1.765	40	15.000

DITCH D-44B

Area	CN	Runoff Depth (in) 10YR-6HR
0.3	90	0.723
1.5	40	0.155
1.8		$\bar{Q} = 0.25$

$\overline{CN} = 77.8$

$P_{10YR-6HR} = 1.55$ in - Hand Calc for Example of procedure

$$Q_{in} = \frac{(P-.2S)^2}{P+.8S} \quad \text{where } S = \frac{1000}{CN} - 10$$

$$P^2 - .4PS + .04S^2 = PQ + .8QS$$
$$0.04S^2 - .4S(P+2Q) - PQ + P^2 = 0 \qquad \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$b = -0.4(P+2Q) = -0.82$
$a = 0.04 = 0.04$
$c = P(P-Q) = 2.015$

$$S = \left[+0.82 \pm \sqrt{(-.82)^2 - 4(.04)2.015}\right] 0.08 = \frac{.82 \pm .592}{.08} = 17.65;\ 2.85$$

$$CN = \frac{1000}{S+10} = \frac{1000}{12.9} = 77.8 \quad \alpha$$

Hydraulic Length: 710 ft

Ave Slope: Measured from Map $\sim \frac{(900)25(100)}{43560\,(1.8)} = 28.7\%$

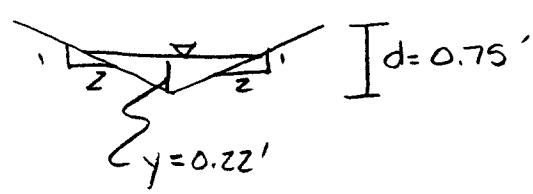
Hydro Results give $Q = 0.37$ cfs

Try Trap. Channel design:

$b = 0;\ m_1 = m_2 = 2,\ n = .03,\ Q = 0.4$

$S_{min} = 17\%$
$S_{max} = 21\%$ from Printout $V = 4.54 < 5 - \alpha$

NO LINING REQ'd



PROJECT : Valley Camp Coal - D-44B Runoff Calculation

AREA= 1.8 ACRES
AVERAGE BASIN SLOPE= 28.7 PERCENT
CURVE NUMBER= 77.8
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 710. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0536 HOURS QPCFS= 25.40 CFS QPIN=13.9920 INCHES
C3= 68.9665 ITERATIONS= 3 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.18	.5678	.0000	.0000	.0	.00
2.20	.5831	.0000	.0000	2.4	.00
2.21	.5985	.0003	.0002	12.4	.00
2.22	.6139	.0006	.0004	22.1	.00
2.24	.6293	.0012	.0005	25.4	.01
2.25	.6446	.0019	.0007	23.0	.02
2.26	.6600	.0027	.0008	17.9	.04
2.28	.6754	.0037	.0010	12.6	.05
2.29	.6907	.0048	.0011	8.2	.07
2.30	.7061	.0061	.0013	5.0	.09
2.32	.7215	.0076	.0014	2.9	.11
2.33	.7368	.0091	.0016	1.7	.13
2.35	.7522	.0109	.0017	.9	.15
2.36	.7676	.0127	.0019	.5	.17
2.37	.7830	.0147	.0020	.3	.19
2.39	.7983	.0168	.0021	.1	.21
2.40	.8137	.0191	.0023	.0	.23
2.41	.8291	.0215	.0024	.0	.25
2.43	.8444	.0240	.0025	.0	.27
2.44	.8598	.0266	.0026	.0	.29
2.45	.8752	.0294	.0028	.0	.30
2.47	.8905	.0322	.0029	.0	.32
2.48	.9059	.0352	.0030	.0	.34
2.49	.9213	.0384	.0031	.0	.35
2.51	.9318	.0406	.0022	.0	.37
2.52	.9360	.0414	.0009	.0	.37
2.53	.9401	.0423	.0009	.0	.34
2.55	.9443	.0432	.0009	.0	.30
2.56	.9484	.0442	.0009	.0	.25
2.57	.9526	.0451	.0009	.0	.21
2.59	.9567	.0460	.0009	.0	.18
2.60	.9609	.0469	.0009	.0	.16

HYDROGRAPH PEAK= .37 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .04 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	04-May-89
Project No.:	007.11.100	Time:	03:38 PM
Channel Section:	D-44B	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.40	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.17	ft/ft
	Max. Bottom Slope:	0.21	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.22	feet
	Qn/1.49(S)1/2=	0.020	
	A(R)2/3=	0.020	
	Required Depth:	0.72	feet
	Area:	0.09	ft2
	Perimeter:	0.97	feet
	Hydraulic Radius:	0.10	feet
	Velocity:	4.25	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.21	feet
	Qn/1.49(S)1/2=	0.018	
	A(R)2/3=	0.018	
	Required Depth:	0.71	feet
	Area:	0.09	ft2
	Perimeter:	0.94	feet
	Hydraulic Radius:	0.09	feet
	Velocity:	4.54	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.17	ft/ft
	Max. Bottom Slope:	0.21	ft/ft
	Channel Depth:	0.72	feet
	Riprap:	Not Needed	

Comment:

Undisturbed Area Ditches

I- Undisturbed Area Runoff Channels

A- Drainage Basin Characteristics

Channel	Basin Area (acres)	Hydraulic Length ft	Watershed Slope %
UDA-1	6.7	700	27
UDA-2	14.7	1900	37
UDA-3	8.1	1500	32
UDA-4	5.5	1250	31
UDA-5	7.2	1100	28

$$\text{Watershed Slope} = \frac{L_c * CI}{DA} * 100$$

L_c = length of Contour lines
CI = Contour Interval in feet.
DA = Drainage Area

Channel	L_c ft	CI ft	DA ft^2	Slope %
UDA-1	1000	80	291,852	27
UDA-2	11,900	20	640,332	37
UDA-3	5,600	20	352,836	32
UDA-4	3750	20	239,580	31
UDA-5	4400	20	313,632	28

B- Curve Number

Use CN = 75 for sage-grass cover
CN = 70 for Aspen or Forest Cover
} See Calculations 9/18/88 for justification.

Channel	Area Sage-Grass ac	Area Aspen or Forest ac
UDA-1	6.7	0
UDA-2	1.4	13.3
UDA-3	8.1	0
UDA-4	0	5.5
UDA-5	0	7.2

HANSEN ALLEN & LUCE INC

CLIENT: Valley Camp
PROJECT: Hydrology - Surface Facilities
FEATURE: Runoff & Peak Flow Projections
PROJECT NO.:

SHEET 2 OF 17
COMPUTED: DMA
CHECKED:
DATE: 1/18/89

Weighted Curve #'s based on runoff volume.

Channel	Area ac	CN	10-yr 24-hr Runoff Depth in	Wt. CN based on Wt. Q
UAD-1	6.7	75	0.62	75
	0	70	0.43	
			WT Q = 0.62	
UAD-2	1.4	75	0.62	
	13.3	70	0.43	70.5 Use 71
			WT Q = 0.45	
UAD-3	8.1	75	0.62	
	0.0	70	0.43	75
			WTQ = 0.62	
UAD-4	0	75	0.62	
	5.5	70	0.43	70
			WTQ = 0.43	
UAD-5	0	75	0.62	
	7.2	70	0.43	70
			WTQ = 0.43	

10-yr 24-hr Precip = 2.45 inches

10-yr 6-hr Precip = 1.55 inches.

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Hydrology - Surface Facilities
FEATURE Runoff; Peak Flow Projections
PROJECT NO.

SHEET 3 OF 17
COMPUTED EMA
CHECKED
DATE 1/18/89

C- Peak Discharge Summary

Estimated Peak Discharge for Undisturbed Area Bypass Channels from 10-year, 24-hour and 10-year, 6-hour Precipitation Events.

CHANNEL	PEAK FLOW 10-YEAR, 24-HOUR (cfs)	PEAK FLOW 10-YEAR, 6-HOUR (cfs)
UD-1	4.5	.84
UD-2	6.4	.57
UD-3	5.1	.85
UD-4	2.3	.19
UD-5	3.0	.25

See Attached Printouts for Hydrograph output data.

PROJECT : VALLEY CAMP 10-YR, 24-HR PEAK FLOW CHANNEL ~~UD-1~~ UDD-1

AREA= 6.7 ACRES
AVERAGE BASIN SLOPE= 27.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 2.45 INCHES
STORM DURATION= 24.0 HOURS
HYDRAULIC LENGTH= 700. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0593 HOURS QPCFS= 85.42 CFS QPIN=12.6436 INCHES
C3= 62.3202 ITERATIONS= 8 SCS 24-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
11.38	.6649	.0000	.0000	.0	.00
11.40	.6704	.0000	.0000	26.7	.00
11.42	.6758	.0000	.0000	78.6	.00
11.45	.6813	.0000	.0000	79.8	.00
11.47	.6868	.0001	.0000	52.5	.00
11.50	.6923	.0002	.0000	27.2	.01
11.52	.7290	.0011	.0009	12.1	.04
11.54	.7733	.0033	.0022	4.9	.14
11.57	.8177	.0065	.0032	1.8	.34
11.59	.8620	.0108	.0043	.6	.59
11.61	.9063	.0161	.0053	.2	.87
11.64	.9506	.0223	.0062	.0	1.16
11.85	1.3494	.1161	.0134	.0	3.38
11.88	1.3938	.1302	.0141	.0	3.59
11.90	1.4381	.1450	.0148	.0	3.79
11.92	1.4824	.1604	.0154	.0	3.98
11.95	1.5267	.1764	.0160	.0	4.17
11.97	1.5710	.1930	.0166	.0	4.35
12.00	1.6153	.2102	.0172	.0	4.52
12.02	1.6310	.2164	.0062	.0	4.38
12.04	1.6394	.2198	.0034	.0	3.55
12.07	1.6478	.2231	.0034	.0	2.51
12.09	1.6562	.2265	.0034	.0	1.74
12.11	1.6646	.2299	.0034	.0	1.30
12.14	1.6730	.2334	.0034	.0	1.10

HYDROGRAPH PEAK= 4.52 cfs
TIME TO PEAK= 12.00 Hours
RUNOFF VOLUME= .35 Acre-Feet

PROJECT : VALLEY CAMP 10-YR, 6-HR PEAK FLOW CHANNEL ~~UD-1~~ UDD-1

AREA= 6.7 ACRES
AVERAGE BASIN SLOPE= 27.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 700. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0593 HOURS QPCFS= 85.42 CFS QPIN=12.6436 INCHES
C3= 62.3202 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.26	.6559	.0000	.0000	.0	.00
2.28	.6832	.0000	.0000	26.7	.00
2.31	.7105	.0006	.0005	78.6	.02
2.33	.7378	.0015	.0009	79.8	.07
2.36	.7651	.0028	.0013	52.5	.15
2.38	.7924	.0046	.0017	27.2	.25
2.40	.8197	.0067	.0021	12.1	.36
2.43	.8470	.0093	.0025	4.9	.48
2.45	.8743	.0122	.0029	1.8	.59
2.48	.9016	.0155	.0033	.6	.70
2.50	.9289	.0191	.0037	.2	.81
2.52	.9371	.0203	.0012	.0	.84
2.55	.9444	.0214	.0011	.0	.71
2.57	.9518	.0225	.0011	.0	.54
2.59	.9592	.0236	.0011	.0	.42
2.62	.9666	.0248	.0012	.0	.36
2.64	.9740	.0259	.0012	.0	.34
2.67	.9813	.0271	.0012	.0	.33

HYDROGRAPH PEAK= .84 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .10 Acre-Feet

6/17

PROJECT : VALLEY CAMP 10-YR, 24-HR PEAK FLOW CHANNEL ~~UD-2~~ UDD-2

AREA= 14.7 ACRES
AVERAGE BASIN SLOPE= 37.0 PERCENT
CURVE NUMBER= 71.0
DESIGN STORM= 2.45 INCHES
STORM DURATION= 24.0 HOURS
HYDRAULIC LENGTH= 1900. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1260 HOURS QPCFS= 88.25 CFS QPIN= 5.9534 INCHES
C3= 29.3443 ITERATIONS= 8 SCS 24-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
11.56	.8133	.0000	.0000	.0	.00
11.59	.8602	.0005	.0005	4.4	.00
11.61	.9071	.0019	.0015	27.4	.02
11.64	.9540	.0045	.0025	58.6	.08
11.67	1.0010	.0079	.0035	81.0	.21
11.69	1.0479	.0124	.0044	88.2	.42
11.72	1.0948	.0177	.0053	82.7	.72
11.74	1.1417	.0239	.0062	69.8	1.09
11.77	1.1886	.0310	.0071	54.6	1.52
11.79	1.2355	.0389	.0079	40.3	1.98
11.82	1.2824	.0476	.0087	28.4	2.46
11.84	1.3293	.0571	.0095	19.3	2.96
11.87	1.3763	.0674	.0103	12.7	3.46
11.89	1.4232	.0784	.0110	8.1	3.95
11.92	1.4701	.0901	.0117	5.1	4.43
11.94	1.5170	.1024	.0124	3.2	4.91
11.97	1.5639	.1155	.0131	1.9	5.37
11.99	1.6108	.1292	.0137	1.1	5.82
12.02	1.6307	.1352	.0060	.7	6.22
12.04	1.6396	.1379	.0027	.4	6.40
12.07	1.6485	.1407	.0027	.2	6.21
12.09	1.6573	.1434	.0028	.1	5.69
12.12	1.6662	.1462	.0028	.0	4.98
12.14	1.6751	.1490	.0028	.0	4.22
12.17	1.6840	.1518	.0028	.0	3.54
12.19	1.6929	.1547	.0029	.0	2.98

HYDROGRAPH PEAK= 6.40 cfs
TIME TO PEAK= 12.04 Hours
RUNOFF VOLUME= .57 Acre-Feet

PROJECT : VALLEY CAMP 10-YR, 6-HR PEAK FLOW CHANNEL ~~UD-2~~ UDD-2

AREA= 14.7 ACRES
AVERAGE BASIN SLOPE= 37.0 PERCENT
CURVE NUMBER= 71.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1900. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1260 HOURS QPCFS= 88.25 CFS QPIN= 5.9534 INCHES
C3= 29.3443 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.39	.8078	.0000	.0000	.0	.00
2.42	.8367	.0000	.0000	4.4	.00
2.44	.8656	.0006	.0005	27.4	.00
2.47	.8945	.0014	.0009	58.6	.02
2.49	.9234	.0027	.0013	81.0	.07
2.52	.9360	.0034	.0007	88.2	.14
2.54	.9438	.0038	.0005	82.7	.22
2.57	.9517	.0043	.0005	69.8	.28
2.60	.9595	.0048	.0005	54.6	.32
2.62	.9673	.0053	.0005	40.3	.33
2.65	.9751	.0059	.0006	28.4	.34
2.67	.9829	.0065	.0006	19.3	.34
2.70	.9907	.0071	.0006	12.7	.33
2.72	.9985	.0077	.0006	8.1	.33
2.75	1.0063	.0084	.0007	5.1	.33
2.77	1.0141	.0091	.0007	3.2	.34
2.80	1.0220	.0098	.0007	1.9	.35
2.82	1.0298	.0105	.0007	1.1	.36
2.85	1.0376	.0113	.0008	.7	.37
2.87	1.0454	.0121	.0008	.4	.39
2.90	1.0532	.0129	.0008	.2	.40
2.92	1.0610	.0138	.0008	.1	.42
2.95	1.0688	.0146	.0009	.0	.43
3.38	1.1783	.0294	.0010	.0	.52
3.40	1.1845	.0304	.0010	.0	.53
3.43	1.1908	.0314	.0010	.0	.54
3.45	1.1970	.0324	.0010	.0	.55
3.48	1.2033	.0334	.0010	.0	.56
3.50	1.2094	.0344	.0010	.0	.57
3.53	1.2136	.0351	.0007	.0	.57
3.55	1.2179	.0359	.0007	.0	.57
3.58	1.2222	.0366	.0007	.0	.56
3.60	1.2265	.0373	.0007	.0	.54
3.63	1.2308	.0381	.0008	.0	.52

PROJECT : VALLEY CAMP 10-YR, 6-HR PEAK FLOW CHANNEL ~~UD-2~~ UDD-2
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
3.65	1.2351	.0388	.0008	.0	.50
3.68	1.2394	.0396	.0008	.0	.48

HYDROGRAPH PEAK= .57 cfs
TIME TO PEAK= 3.53 Hours
RUNOFF VOLUME= .14 Acre-Feet

PROJECT : VALLEY CAMP 10-YR, 24-HR PEAK FLOW CHANNEL ~~UD-3~~ UDD-3

AREA= 8.1 ACRES
AVERAGE BASIN SLOPE= 32.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 2.45 INCHES
STORM DURATION= 24.0 HOURS
HYDRAULIC LENGTH= 1500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1002 HOURS QPCFS= 61.10 CFS QPIN= 7.4811 INCHES
C3= 36.8746 ITERATIONS= 8 SCS 24-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
11.37	.6630	.0000	.0000	.0	.00
11.39	.6676	.0000	.0000	3.1	.00
11.41	.6722	.0000	.0000	19.0	.00
11.43	.6768	.0000	.0000	40.6	.00
11.45	.6815	.0000	.0000	56.1	.00
11.47	.6861	.0001	.0000	61.1	.00
11.49	.6907	.0002	.0000	57.2	.00
11.51	.7093	.0005	.0004	48.3	.00
11.53	.7466	.0019	.0013	37.8	.02
11.55	.7839	.0040	.0021	27.9	.06
11.57	.8213	.0069	.0029	19.7	.13
11.59	.8586	.0105	.0036	13.3	.26
11.61	.8959	.0148	.0043	8.8	.42
11.63	.9333	.0197	.0050	5.6	.63
11.65	.9706	.0254	.0057	3.5	.87
11.67	1.0079	.0317	.0063	2.2	1.12
11.69	1.0453	.0386	.0069	1.3	1.38
11.71	1.0826	.0461	.0075	.8	1.65
11.73	1.1199	.0543	.0081	.5	1.92
11.75	1.1573	.0629	.0087	.3	2.19
11.77	1.1946	.0722	.0092	.2	2.45
11.79	1.2319	.0820	.0098	.0	2.70
11.37	.6630	.0000	.0000	.0	.00
11.39	.6676	.0000	.0000	3.1	.00
11.41	.6722	.0000	.0000	19.0	.00
11.43	.6768	.0000	.0000	40.6	.00
11.45	.6815	.0000	.0000	56.1	.00
11.47	.6861	.0001	.0000	61.1	.00
11.49	.6907	.0002	.0000	57.2	.00
11.51	.7093	.0005	.0004	48.3	.00
11.53	.7466	.0019	.0013	37.8	.02
11.55	.7839	.0040	.0021	27.9	.06
11.57	.8213	.0069	.0029	19.7	.13
11.59	.8586	.0105	.0036	13.3	.26
11.61	.8959	.0148	.0043	8.8	.42

PROJECT : VALLEY CAMP 10-YR, 24-HR PEAK FLOW CHANNEL ~~UD-3~~ UDD-3
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
11.63	.9333	.0197	.0050	5.6	.63
11.65	.9706	.0254	.0057	3.5	.87
11.67	1.0079	.0317	.0063	2.2	1.12
11.69	1.0453	.0386	.0069	1.3	1.38
11.71	1.0826	.0461	.0075	.8	1.65
11.73	1.1199	.0543	.0081	.5	1.92
11.75	1.1573	.0629	.0087	.3	2.19
11.77	1.1946	.0722	.0092	.2	2.45
11.79	1.2319	.0820	.0098	.0	2.70
11.81	1.2693	.0923	.0103	.0	2.95
11.83	1.3066	.1031	.0108	.0	3.19
11.85	1.3439	.1144	.0113	.0	3.43
11.87	1.3813	.1262	.0118	.0	3.66
11.89	1.4186	.1384	.0122	.0	3.88
11.91	1.4559	.1511	.0127	.0	4.09
11.93	1.4933	.1642	.0131	.0	4.30
11.95	1.5306	.1778	.0136	.0	4.51
11.97	1.5679	.1918	.0140	.0	4.71
11.99	1.6053	.2062	.0144	.0	4.90
12.01	1.6278	.2151	.0089	.0	5.07
12.03	1.6349	.2179	.0028	.0	5.12
12.05	1.6420	.2208	.0028	.0	4.93
12.07	1.6490	.2236	.0028	.0	4.51
12.09	1.6561	.2265	.0029	.0	3.93
12.11	1.6632	.2293	.0029	.0	3.32
12.13	1.6702	.2322	.0029	.0	2.76
12.15	1.6773	.2351	.0029	.0	2.30

HYDROGRAPH PEAK= 5.12 cfs
TIME TO PEAK= 12.03 Hours
RUNOFF VOLUME= .42 Acre-Feet

PROJECT : VALLEY CAMP 10-YR, 6-HR PEAK FLOW CHANNEL ~~UD-3~~ UDD-3

AREA= 8.1 ACRES
AVERAGE BASIN SLOPE= 32.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1002 HOURS QPCFS= 61.10 CFS QPIN= 7.4811 INCHES
C3= 36.8746 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.27	.6612	.0000	.0000	.0	.00
2.29	.6842	.0000	.0000	3.1	.00
2.31	.7072	.0005	.0004	19.0	.00
2.33	.7301	.0012	.0007	40.6	.01
2.35	.7531	.0022	.0010	56.1	.04
2.37	.7761	.0035	.0013	61.1	.08
2.39	.7991	.0051	.0016	57.2	.14
2.41	.8221	.0069	.0019	48.3	.21
2.43	.8451	.0091	.0021	37.8	.30
2.45	.8681	.0115	.0024	27.9	.40
2.47	.8911	.0142	.0027	19.7	.50
2.49	.9141	.0171	.0029	13.3	.61
2.51	.9319	.0196	.0025	8.8	.72
2.53	.9381	.0204	.0009	5.6	.81
2.55	.9444	.0214	.0009	3.5	.85
2.57	.9506	.0223	.0009	2.2	.84
2.59	.9568	.0232	.0009	1.3	.78
2.61	.9630	.0242	.0010	.8	.71
2.63	.9692	.0252	.0010	.5	.63
2.65	.9754	.0262	.0010	.3	.57
2.67	.9816	.0272	.0010	.2	.51
2.69	.9879	.0282	.0010	.0	.48

HYDROGRAPH PEAK= .85 cfs
TIME TO PEAK= 2.55 Hours
RUNOFF VOLUME= .12 Acre-Feet

PROJECT : VALLEY CAMP 10-YR, 24-HR PEAK FLOW CHANNEL ~~UD-4~~ UDD-4

AREA= 5.5 ACRES
AVERAGE BASIN SLOPE= 31.0 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 2.45 INCHES
STORM DURATION= 24.0 HOURS
HYDRAULIC LENGTH= 1250. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1012 HOURS QPCFS= 41.12 CFS QPIN= 7.4135 INCHES
C3= 36.5410 ITERATIONS= 8 SCS 24-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
11.57	.8296	.0000	.0000	.0	.00
11.59	.8673	.0000	.0000	2.1	.00
11.61	.9050	.0005	.0005	12.8	.00
11.63	.9426	.0017	.0011	27.3	.00
11.65	.9803	.0034	.0018	37.7	.03
11.67	1.0180	.0058	.0024	41.1	.08
11.69	1.0556	.0088	.0030	38.5	.15
11.71	1.0933	.0123	.0035	32.5	.24
11.73	1.1310	.0164	.0041	25.4	.36
11.76	1.1687	.0211	.0047	18.8	.49
11.78	1.2063	.0263	.0052	13.2	.63
11.80	1.2440	.0320	.0057	9.0	.77
11.82	1.2817	.0383	.0062	5.9	.92
11.84	1.3194	.0450	.0067	3.8	1.07
11.86	1.3570	.0522	.0072	2.4	1.22
11.88	1.3947	.0599	.0077	1.5	1.36
11.90	1.4324	.0681	.0082	.9	1.51
11.92	1.4701	.0767	.0086	.5	1.65
11.94	1.5077	.0857	.0091	.3	1.78
11.96	1.5454	.0952	.0095	.2	1.92
11.98	1.5831	.1052	.0099	.1	2.05
12.00	1.6208	.1155	.0103	.0	2.18
12.02	1.6308	.1183	.0028	.0	2.29
12.04	1.6379	.1203	.0020	.0	2.31
12.06	1.6451	.1224	.0020	.0	2.20
12.08	1.6522	.1244	.0021	.0	1.98
12.10	1.6594	.1265	.0021	.0	1.71
12.12	1.6665	.1286	.0021	.0	1.44
12.14	1.6736	.1307	.0021	.0	1.20
12.16	1.6808	.1328	.0021	.0	1.01

HYDROGRAPH PEAK= 2.31 cfs
TIME TO PEAK= 12.04 Hours
RUNOFF VOLUME= .20 Acre-Feet

PROJECT : VALLEY CAMP 10-YR 6-HR PEAK FLOW CHANNEL ~~UD-4~~ UDD-4

AREA= 5.5 ACRES
AVERAGE BASIN SLOPE= 31.0 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1250. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1012 HOURS QPCFS= 41.12 CFS QPIN= 7.4135 INCHES
C3= 36.5410 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.43	.8473	.0000	.0000	.0	.00
2.45	.8705	.0000	.0000	2.1	.00
2.47	.8937	.0003	.0003	12.8	.00
2.49	.9169	.0008	.0005	27.3	.00
2.51	.9327	.0013	.0005	37.7	.02
2.53	.9390	.0015	.0002	41.1	.03
2.55	.9453	.0018	.0002	38.5	.05
2.57	.9516	.0020	.0003	32.5	.06
2.59	.9578	.0023	.0003	25.4	.07
2.61	.9641	.0026	.0003	18.8	.07
2.63	.9704	.0029	.0003	13.2	.07
2.65	.9766	.0032	.0003	9.0	.08
2.67	.9829	.0036	.0003	5.9	.08
2.69	.9892	.0039	.0004	3.8	.08
2.71	.9955	.0043	.0004	2.4	.08
2.73	1.0017	.0047	.0004	1.5	.09
2.75	1.0080	.0051	.0004	.9	.09
2.77	1.0143	.0056	.0004	.5	.09
2.79	1.0206	.0060	.0004	.3	.10
2.81	1.0268	.0065	.0005	.2	.10
2.83	1.0331	.0069	.0005	.1	.11
2.85	1.0394	.0074	.0005	.0	.11
3.40	1.1840	.0232	.0007	.0	.17
3.42	1.1890	.0238	.0007	.0	.18
3.44	1.1940	.0245	.0007	.0	.18
3.46	1.1990	.0253	.0007	.0	.18
3.48	1.2040	.0260	.0007	.0	.18
3.50	1.2090	.0267	.0007	.0	.19
3.52	1.2125	.0272	.0005	.0	.19
3.54	1.2159	.0277	.0005	.0	.19
3.56	1.2194	.0282	.0005	.0	.18
3.58	1.2228	.0288	.0005	.0	.18
3.60	1.2263	.0293	.0005	.0	.17
3.62	1.2297	.0298	.0005	.0	.16

PROJECT : VALLEY CAMP 10-YR 6-HR PEAK FLOW CHANNEL ~~UD-4~~ UDD-4
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
3.64	1.2332	.0303	.0005	.0	.16

HYDROGRAPH PEAK= .19 cfs
TIME TO PEAK= 3.52 Hours
RUNOFF VOLUME= .04 Acre-Feet

PROJECT : VALLEY CAMP 10-YR, 24-HR PEAK FLOW CHANNEL ~~UD-5~~ UDD-5

AREA= 7.2 ACRES
AVERAGE BASIN SLOPE= 28.0 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 2.45 INCHES
STORM DURATION= 24.0 HOURS
HYDRAULIC LENGTH= 1100. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0961 HOURS QPCFS= 56.66 CFS QPIN= 7.8043 INCHES
C3= 38.4674 ITERATIONS= 8 SCS 24-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
11.57	.8239	.0000	.0000	.0	.00
11.59	.8596	.0000	.0000	2.8	.00
11.61	.8954	.0003	.0003	17.6	.00
11.63	.9312	.0013	.0009	37.6	.00
11.65	.9670	.0027	.0015	52.0	.03
11.67	1.0028	.0048	.0020	56.7	.08
11.69	1.0386	.0074	.0026	53.1	.17
11.70	1.0744	.0105	.0031	44.8	.28
11.72	1.1101	.0141	.0036	35.0	.42
11.74	1.1459	.0182	.0041	25.9	.57
11.76	1.1817	.0229	.0046	18.2	.75
11.78	1.2175	.0280	.0051	12.4	.93
11.80	1.2533	.0335	.0056	8.2	1.11
11.82	1.2891	.0395	.0060	5.2	1.30
11.84	1.3249	.0460	.0065	3.3	1.48
11.86	1.3607	.0529	.0069	2.0	1.67
11.88	1.3964	.0603	.0073	1.2	1.85
11.90	1.4322	.0680	.0078	.7	2.03
11.92	1.4680	.0762	.0082	.4	2.20
11.94	1.5038	.0848	.0086	.3	2.37
11.95	1.5396	.0937	.0090	.1	2.54
11.97	1.5754	.1031	.0093	.0	2.70
11.99	1.6112	.1128	.0097	.0	2.86
12.01	1.6286	.1177	.0049	.0	3.00
12.03	1.6354	.1196	.0019	.0	3.05
12.05	1.6422	.1215	.0019	.0	2.95
12.07	1.6490	.1235	.0019	.0	2.69
12.09	1.6558	.1254	.0020	.0	2.35
12.11	1.6625	.1274	.0020	.0	1.99
12.13	1.6693	.1294	.0020	.0	1.66
12.15	1.6761	.1314	.0020	.0	1.39

HYDROGRAPH PEAK= 3.05 cfs
TIME TO PEAK= 12.03 Hours
RUNOFF VOLUME= .26 Acre-Feet

PROJECT : VALLEY CAMP 10-YR, 6-HR PEAK FLOW CHANNEL ~~UD-5~~ UDD-5

AREA= 7.2 ACRES
AVERAGE BASIN SLOPE= 28.0 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1100. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0961 HOURS QPCFS= 56.66 CFS QPIN= 7.8043 INCHES
C3= 38.4674 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.42	.8401	.0000	.0000	.0	.00
2.44	.8622	.0000	.0000	2.8	.00
2.46	.8842	.0002	.0002	17.6	.00
2.48	.9063	.0006	.0004	37.6	.00
2.50	.9283	.0012	.0006	52.0	.02
2.52	.9355	.0014	.0002	56.7	.03
2.54	.9415	.0016	.0002	53.1	.06
2.56	.9474	.0019	.0002	44.8	.08
2.58	.9534	.0021	.0003	35.0	.09
2.59	.9593	.0024	.0003	25.9	.09
2.61	.9653	.0027	.0003	18.2	.10
2.63	.9713	.0030	.0003	12.4	.10
2.65	.9772	.0033	.0003	8.2	.10
2.67	.9832	.0036	.0003	5.2	.10
2.69	.9891	.0039	.0003	3.3	.11
2.71	.9951	.0043	.0004	2.0	.11
2.73	1.0010	.0047	.0004	1.2	.11
2.75	1.0070	.0051	.0004	.7	.12
2.77	1.0130	.0055	.0004	.4	.12
2.79	1.0189	.0059	.0004	.3	.13
2.81	1.0249	.0063	.0004	.1	.13
2.83	1.0308	.0068	.0004	.0	.14
3.40	1.1847	.0233	.0006	.0	.23
3.42	1.1894	.0239	.0007	.0	.23
3.44	1.1942	.0246	.0007	.0	.23
3.46	1.1990	.0252	.0007	.0	.24
3.48	1.2037	.0259	.0007	.0	.24
3.50	1.2085	.0266	.0007	.0	.24
3.52	1.2119	.0271	.0005	.0	.25
3.54	1.2152	.0276	.0005	.0	.25
3.56	1.2185	.0281	.0005	.0	.24
3.57	1.2218	.0286	.0005	.0	.23
3.59	1.2250	.0291	.0005	.0	.22
3.61	1.2283	.0296	.0005	.0	.21

PROJECT : VALLEY CAMP 10-YR, 6-HR PEAK FLOW CHANNEL ~~UD-5~~ UDD-5
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
3.63	1.2316	.0301	.0005	.0	.21

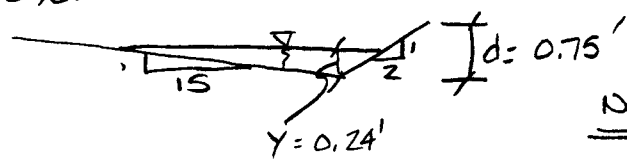
HYDROGRAPH PEAK= .25 cfs
TIME TO PEAK= 3.52 Hours
RUNOFF VOLUME= .06 Acre-Feet

UDD-1

ALL DESIGNS TO BE COMPLETED ACCORDING TO 30CFR REQUIREMENT OF A 10-YR-6HR EVENT AND AS PENDING IN NEW UTAH REG'S.

COMPUTER CALC'S SHOWN ON ATTACHED SHEETS (SHEET 2)

$S_{min} = 2\%$ $\eta = .03$ $M_1 = 15$ freeboard = 0.5'
$S_{max} = 20\%$ (field) $b = 0$ $M_2 = 2$
30% (off Map)
$Q_{design} = 0.84$ cfs



NO LINING REQ'd

UDD-2

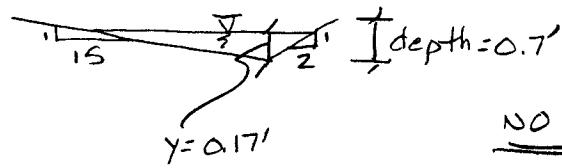
$Q_{design} = 0.57$ cfs

Try Triangular Section. $b = 0$ $S_{min} = 7\%$ > from Mapping
$\eta = .03$ $S_{max} = 23\%$ <
$M_1 = M_2 = 2$ freeboard = 0.5'

Velocity Check on Sheet 3 Shows vel > 5.0'

Change to Road Style design - (SHEET 3)

$b = 0$ $\eta = .03$
$M_1 = 15$ $S_{min} = 0.07$
$M_2 = 2$ $S_{max} = 0.23$

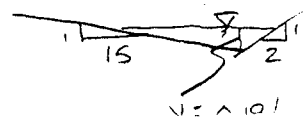


NO LINING REQ'd

UDD-3 $Q_{design} = 0.85$ cfs

$S_{min} = 7\%$ > from Mapping $b = 0$ freeboard = 0.5'
$S_{max} = 20\%$ < $M_1 = 15$
$M_2 = 2$

Use Road Style Design (SHEET 4)



NO LINING REQ'd

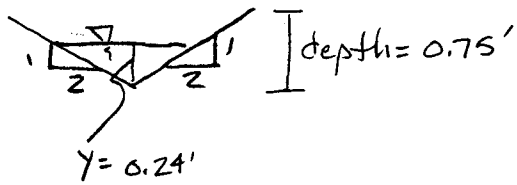
UDD-4

Qdesign = 0.19 cfs

$b = 0$
$M_1 = M_2 = 2$

$S_{min} = 2\%$, $S_{max} = 13\%$ } From Mapping

USE DITCH STYLE DESIGN (SHEET 6)



NO LINING REQ'd

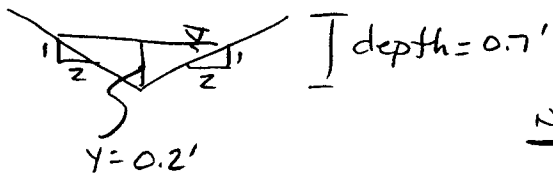
UDD-5

Qdesign = 0.25 cfs

$b = 0$
$M_1 = M_2 = 2$

$S_{min} = 12\%$, $S_{max} = 25\%$ } From Mapping

USE DITCH STYLE DESIGN (SHEET 7)



NO LINING REQ'd

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	03-May-89
Project No.:	007.11.100	Time:	10:13 AM
Channel Section:	UDD-1 - Trial 1	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.84	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/mi
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.30	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.24	feet
	Qn/1.49(S)1/2=	0.120	
	A(R)2/3=	0.119	
	Required Depth:	0.74	feet
	Area:	0.49	ft2
	Perimeter:	4.16	feet
	Hydraulic Radius:	0.12	feet
	Velocity:	1.70	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.15	feet
	Qn/1.49(S)1/2=	0.031	
	A(R)2/3=	0.031	
	Required Depth:	0.65	feet
	Area:	0.18	ft2
	Perimeter:	2.50	feet
	Hydraulic Radius:	0.07	feet
	Velocity:	4.70	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	15.0	1/mi
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.30	ft/ft
	Channel Depth:	0.74	feet
	Riprap:	Not Needed	

Comment:

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company — Date: 02-May-89
Project No.: 007.11.100 — Time: 02:39 PM
Channel Section: UDD-2 - Trail 2 — Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.57	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.07	ft/ft
	Max. Bottom Slope:	0.23	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.17	feet
	Qn/1.49(S)1/2=	0.043	
	A(R)2/3=	0.043	
	Required Depth:	0.67	feet
	Area:	0.23	ft2
	Perimeter:	2.85	feet
	Hydraulic Radius:	0.08	feet
	Velocity:	2.46	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.13	feet
	Qn/1.49(S)1/2=	0.024	
	A(R)2/3=	0.023	
	Required Depth:	0.63	feet
	Area:	0.14	ft2
	Perimeter:	2.25	feet
	Hydraulic Radius:	0.06	feet
	Velocity:	3.97	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:

Side Slope 1:	15.0	1/m1
Side Slope 2:	2.0	1/m2
Min. Bottom Slope:	0.07	ft/ft
Max. Bottom Slope:	0.23	ft/ft
Channel Depth:	0.7	feet
Riprap:	Not Needed	

Comment: Channel Velocities < 5.0 fsp.
Design OK

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company — Date: 02-May-89
Project No.: 007.11.100 — Time: 03:33 PM
Channel Section: UDD-3 - Trial 1 — Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.85	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.07	ft/ft
	Max. Bottom Slope:	0.20	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.19	feet
	Qn/1.49(S)1/2=	0.065	
	A(R)2/3=	0.065	
	Required Depth:	0.69	feet
	Area:	0.31	ft2
	Perimeter:	3.32	feet
	Hydraulic Radius:	0.09	feet
	Velocity:	2.71	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.16	feet
	Qn/1.49(S)1/2=	0.038	
	A(R)2/3=	0.038	
	Required Depth:	0.66	feet
	Area:	0.21	ft2
	Perimeter:	2.71	feet
	Hydraulic Radius:	0.08	feet
	Velocity:	4.06	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	15.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.07	ft/ft
	Max. Bottom Slope:	0.20	ft/ft
	Channel Depth:	0.69	feet
	Riprap:	Not Needed	

Comment: Build channel on existing scar

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company — Date: 02-May-89
Project No.: 007.11.100 — Time: 03:41 PM
Channel Section: UDD-4 - Trial 1 — Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.19	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.13	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.24	feet
	Qn/1.49(S)1/2=	0.027	
	A(R)2/3=	0.027	
	Required Depth:	0.74	feet
	Area:	0.12	ft2
	Perimeter:	1.08	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	1.62	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.18	feet
	Qn/1.49(S)1/2=	0.011	
	A(R)2/3=	0.011	
	Required Depth:	0.68	feet
	Area:	0.06	ft2
	Perimeter:	0.78	feet
	Hydraulic Radius:	0.08	feet
	Velocity:	3.10	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.13	ft/ft
	Channel Depth:	0.74	feet
	Riprap:	Not Needed	

Comment:

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	02-May-89
Project No.:	007.11.100	Time:	03:56 PM
Channel Section:	UDD-5 - Trial 1	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.25	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.12	ft/ft
	Max. Bottom Slope:	0.25	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.20	feet
	Qn/1.49(S)1/2=	0.015	
	A(R)2/3=	0.015	
	Required Depth:	0.70	feet
	Area:	0.08	ft2
	Perimeter:	0.87	feet
	Hydraulic Radius:	0.09	feet
	Velocity:	3.29	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.17	feet
	Qn/1.49(S)1/2=	0.010	
	A(R)2/3=	0.010	
	Required Depth:	0.67	feet
	Area:	0.06	ft2
	Perimeter:	0.76	feet
	Hydraulic Radius:	0.08	feet
	Velocity:	4.33	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.12	ft/ft
	Max. Bottom Slope:	0.25	ft/ft
	Channel Depth:	0.70	feet
	Riprap:	Not Needed	

Comment:

Culverts

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-1-32
PROJECT NO. 007.11-100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/18/89

C-1-32 Tributary Area → Ditch D-1

$Q_{TOT} = 3.9$ cfs (10 yr, 6 hr)

check pipe flow

32" CMP
$n = 0.024$
$S = 25\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 132.0$ cfs OK

Since $Q_{allow} >> Q_{TOT}$ pipe flow not limiting
OK

check Inlet Control

HW depth = 5.2'

$\frac{HW}{D} = 1.9$ Using Chart 5 assume projecting entrance

$Q_{HW} \approx 45.0$ cfs

Since $Q_{HW} > Q_{TOT}$ inlet control limit does not
OK

Check Reqmt for Riprap

$\frac{Qn}{1.49 S^{1/2}} = 0.126$

y	$AR^{2/3}$
0.2	0.041
0.3	0.096
0.35	0.132 → V = 10.6 fps > 5

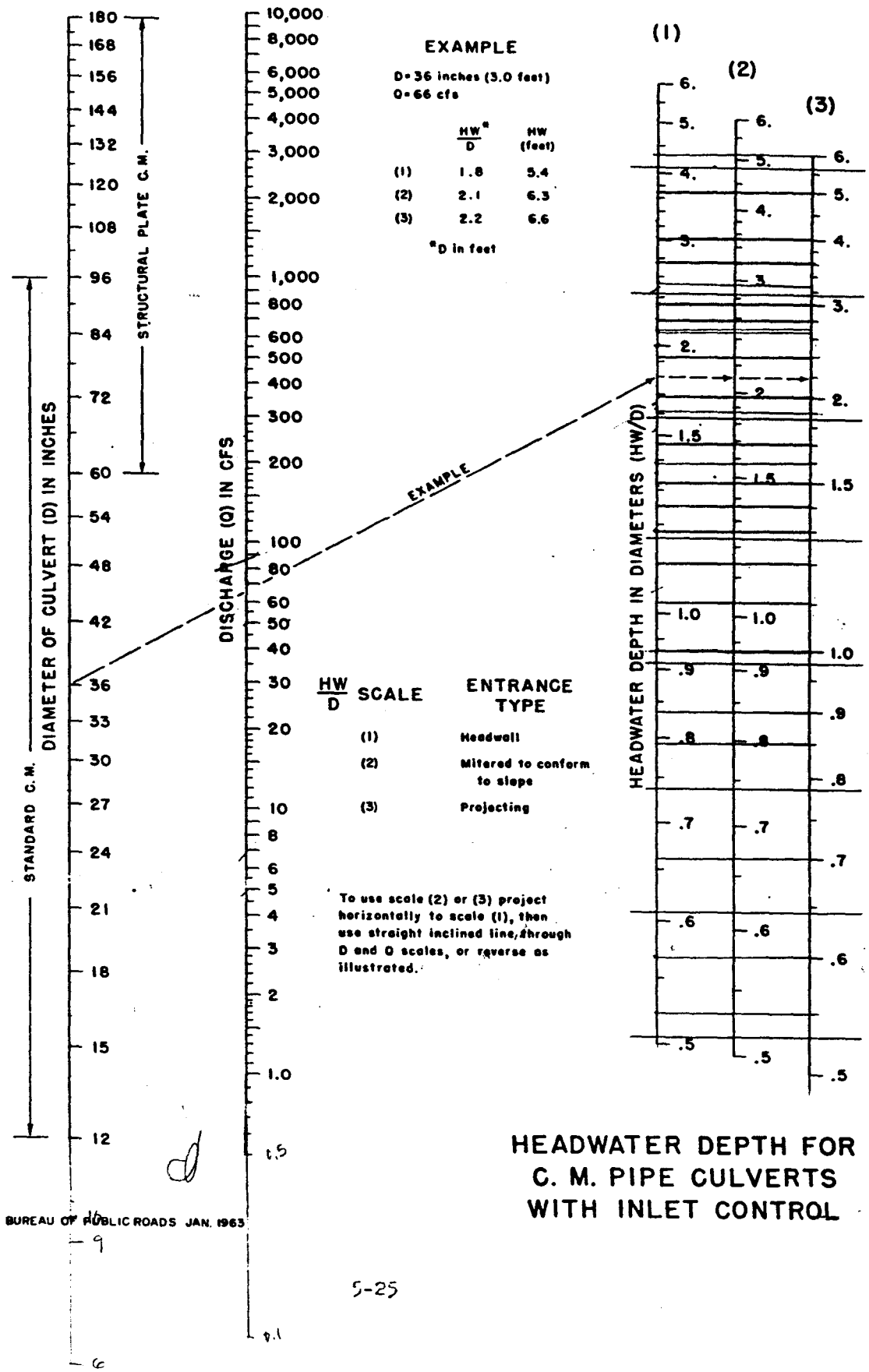
USE EPA, 1976 Rock RIPRAP OUTLET - "Erosion & Sediment Control, Surface Mining in the Eastern U.S., Vol 2. - Design", EPA, OCT 1976, pp 35-40.

TW depth ≤ 0.5 dia - Chart 1-15.

$d_{50} = 0.2$ ft, L is off graph, Use 10' Length

2/2

CHART 5



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED DEH
CHECKED
DATE 10/30/89

C-2-18

This culvert drains very little area and is used for the draining of a small area sometimes used for storage of equipment. Since there is no identifiable tributary area, no calculations are made. By inspection the culvert has more than adequate capacity.

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-3-18
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/18/89

C-3-18

Tributary Flow - D-3

$Q_{TOT} = 2.61$ cfs

Check Pipe Flow

18" CMP
$n = 0.024$
$S = 3\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 9.86$ cfs OK

Since $Q_{allow} > Q_{TOT}$ pipe flow not limiting

Check Inlet Control

HW depth = 0.9' $\frac{HW}{D} = 2.7$

Using Chart 5 - Assume projecting entrance

$Q_{HW} = 12.5$ cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.243 \Rightarrow y = 0.53$, $V = 4.67 < 5$ fps OK - No Lining Req'd

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-4-42
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/19/89

C-4-42 (Permanent structure – Under Railroad Control upon Reclamation)

Total Area = 63 * 1.401 = 88 acres
90% Cover Oak/Aspen = 69 acres CN = 70
25% Cover Sage/Grass = 19 acres CN = 75

CN	A	Q
70	69	0.34
75	19	0.51

$\overline{Q} = 0.38$ $\overline{CN} = 71.2$

Precipitation = 2.25 inches (100 yr, 6 hr)

hydraulic length = 4,000 feet

$$\text{slope} = \frac{(16{,}000)(80)(100)}{43{,}560\,(88)} = 33.4\%$$

Calculated Runoff $Q_{TOT} = 16.6$ cfs

Check Pipe Flow

- 42" CMP
- $n = 0.024$
- $S = 3\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 94.39$ cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe Flow not limiting

Check Inlet Control

- HW depth = 6.5' $\frac{HW}{D} = 1.86$

Use Chart 5 – assume projecting entrance

$Q_{HW} = 90$ cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet control not limiting

Riprap Check $\frac{Qn}{1.49 S^{1/2}} = 0.368$, $y = 0.49$, $V = 4.84 < 5.0$ fps OK

(NO LINING REQ'D)

PROJECT : Valley Camp Coal. 007.11.200 Culvert C-4-42

AREA= 88.0 ACRES
AVERAGE BASIN SLOPE= 33.4 PERCENT
CURVE NUMBER= 71.2
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 4000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .2392 HOURS QPCFS= 278.21 CFS QPIN= 3.1352 INCHES
C3= 15.4535 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.15	.7721	.0000	.0000	.0	.00
2.20	.8517	.0004	.0004	14.0	.00
2.25	.9314	.0036	.0031	86.4	.08
2.30	1.0110	.0096	.0060	184.7	.44
2.34	1.0907	.0183	.0087	255.4	1.34
2.39	1.1703	.0296	.0113	278.2	2.95
2.44	1.2500	.0434	.0137	260.6	5.31
2.49	1.3296	.0594	.0160	220.0	8.32
2.54	1.3660	.0674	.0081	172.1	11.68
2.58	1.3876	.0724	.0050	127.0	14.57
2.63	1.4091	.0775	.0051	89.5	16.24
2.68	1.4306	.0828	.0053	60.8	16.58
2.73	1.4521	.0882	.0054	40.0	15.98
2.77	1.4737	.0938	.0056	25.7	14.92
2.82	1.4952	.0995	.0057	16.1	13.77
2.87	1.5167	.1054	.0059	9.9	12.78
2.92	1.5383	.1114	.0060	6.0	12.04
2.97	1.5598	.1175	.0061	3.6	11.54
3.01	1.5801	.1235	.0059	2.1	11.26
3.06	1.5973	.1286	.0051	1.2	11.11
3.11	1.6145	.1338	.0052	.7	10.98
3.16	1.6317	.1391	.0053	.4	10.81
3.21	1.6489	.1444	.0054	.2	10.62
3.25	1.6662	.1499	.0055	.1	10.43
3.30	1.6834	.1554	.0055	.0	10.29

HYDROGRAPH PEAK= 16.58 cfs
TIME TO PEAK= 2.68 Hours
RUNOFF VOLUME= 2.77 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-5-18
PROJECT NO. 007.11-100

SHEET 1 OF 1
COMPUTED paul
CHECKED
DATE 5/18/89

C-5-18

Tributary Flow D-5A, D-5B

$Q_{5A} + Q_{5B} = (0.43 + 2.16)$ cfs

$Q_{TOT} = 2.59$ cfs

Check pipe characteristics

- 18" cast Iron
- $n = 0.014$
- $S = 3\%$

$Q_{allow} = \frac{1.49}{n} AR^{2/3} S^{1/2}$

$Q_{allow} = 16.89$ cfs ok

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting

Check Inlet Control

- HW depth = 2.3'

$\frac{HW}{D} = 1.5$ assume projecting entrance or type A

Select most limiting solution using either chart 5 or 7

Chart 5 ⇒ $Q_5 = 9.0$ cfs

Chart 7 ⇒ $Q_7 = 10.5$ cfs

$Q_{HW} = 9.0$ cfs

Since $Q_{HW} > Q_{TOT}$ Inlet control not limiting

Riprap Check $\frac{Qn}{1.49 S^{1/2}} = 0.141$, $y = 0.4'$, $V = 0.85$ fps < 7.7 (Denver Criteria)

No Lining Required

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-6-18
PROJECT NO. 007-11-100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/18/89

C-6-18

Tributary Flow (C-5-18) 2.59 cfs
(D-6) 0.82 cfs
Small Area - Negligable
3.41 cfs

Check pipe flow

- 18" CMP
- $n = 0.024$
- $S = 2.5\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 9.0$ cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting

Check Inlet Control

HW depth = 4.1 feet $\frac{HW}{D} = \frac{4.1}{1.5} = 2.7$

Use Chart 5 - Assume projecting entrance

$Q_{HW} = 13.0$ cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.347$, $y = 0.64$, $V = 4.74$ fps < 5.0 OK

NO LINING REQ'd

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED DEH
CHECKED
DATE 10/30/89

C-7-24

Tributary Areas Ditch D-7A $Q = 0.57$
D-7B $Q = 1.27$
$Q_{TOT} = 1.84$ cfs

Check pipe flow:

- 24" CMP
- $n = 0.024$
- $S = 5\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 27.4$ cfs >> Q_{TOT} ok

Pipe Flow not limiting

Check Inlet flow

- HW = 2.8'

$\frac{HW}{D} = 1.4$

Using Chart 5 - assume projecting Inlet

$Q_{HW} = 16.5$ cfs >> Q_{TOT} ok

Inlet Control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.133$, $y = 0.35$, $V = 4.98$ because $Q < 2$ cfs it does not appear on Fig 1-15, EPA, 76

∴ NO LINING REQ'D

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-8-18
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/18/89

C-8-18

Tributary Flows

D-8 = 1.17 cfs
D-9A,9B = 0.07
Q_{TOT} = 1.24 cfs

Check Pipe Flow

- 18" CMP
- n = 0.024
- S = 4%

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

Q_{allow} = 11.4 cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting

Check Inlet Control

HW depth = 2.30

$\frac{HW}{D} = 1.5$

Use Chart 5
assume projecting entrance

Q_{HW} = 9.0 cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet Control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.100$, y = 0.35', v = 3.96 < 5.0 fps OK

NO LINING REQ'D

ALSO Q < 2 cfs, EPA Chart

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CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED DEH
CHECKED
DATE 6/30/89

C-9-15

Tributary Ditches D-9A, D-9B } $Q_{TOT} = 0.07$ cfs

Check Pipe Flow

- 15" CMP
- $n = 0.024$
- $S = 0.001$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 1.1$ cfs $> Q_{TOT}$ ✓

Pipe flow not limiting

Check Inlet Control

from Chart 5 - Projecting Inlet

- $HW = 1.25$

$\frac{HW}{D} = 1.0$

$Q_{HW} = 3.5$ cfs $> Q_{TOT}$ ✓

Inlet Control not limiting

Riprap Check

$Q < 0.1$ cfs - NO LINING REQ'd (Eyeball Inspection)

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-10-18
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/18/89

C-10-18

Tributary Area Ditch D-10

$Q_{TOT} = 1.18$ cfs

Check Pipe flow

- 18" CMP
- $n = 0.024$
- $S = 10\%$

$Q_{allow} = \frac{1.49}{n} AR^{2/3} S^{1/2}$

$Q_{allow} = 18.0$ cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting

Check Inlet Control

- HW depth = 2.3 feet

$\frac{HW}{D} = \frac{2.3}{1.5} = 1.5$ Use chart 5 - assume projecting entrance

$Q_{HW} = 9.0$ cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet control not limiting

Riprap Check

EPA Chart, $Q < 2$ cfs, NO LINING REQ'd (Fig 1-15)

$\frac{Qn}{1.49 S^{1/2}} = 0.0100$, $y = 0.26$, $V = 5.8 < 7.7$ (Denver Criteria)

No Lining Req'd

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-11-12
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/18/89

C-11-12

Tributary Area = 940 * .000875 = 0.8 ac
disturbed = 840 * .000875 = 0.7 ac
paved = = 0.1 ac

CN	A	Q
90	0.7	0.72
98	0.1	1.33

$\overline{Q} = 0.80$ $\overline{CN} = 91.3$

P = 1.55 inches (10 yr, 6 hr)

hydraulic length = 300'

$slope = \frac{(1425)(5)(100)}{43,560(0.8)} = 20.4\%$

Calculated Runoff $Q_{TOT} = 0.64$ cfs

Check Pipe flow

- 12" CMP
- n = 0.024
- S = 8%

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 5.5$ cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting

Check Inlet Control

HW = 16.0 ft (Seems high - Use 1.0')

$\frac{HW}{D} = 1$

$Q_{HW} = 2.0$ cfs OK

Inlet Control not limiting

Riprap Check

$\frac{Q_{10}}{1.49 S^{1/2}} = 0.036$, y = 0.23, v = 4.7 fps < 5.0 OK
NO LINING REQ'd

PROJECT : Valley Camp Coal - C-11-12 Runoff Calculation

AREA= .8 ACRES
AVERAGE BASIN SLOPE= 20.4 PERCENT
CURVE NUMBER= 91.3
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 300. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0198 HOURS QPCFS= 30.51 CFS QPIN=37.8167 INCHES
C3=186.3984 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.1890	.0000	.0000	.0	.00
1.41	.1932	.0000	.0000	30.5	.00
1.43	.1966	.0000	.0000	9.9	.00
1.45	.1999	.0000	.0000	1.1	.00
1.47	.2033	.0002	.0000	.0	.00
2.39	.7878	.2301	.0140	.0	.58
2.40	.8105	.2443	.0143	.0	.59
2.42	.8332	.2588	.0145	.0	.60
2.44	.8559	.2735	.0147	.0	.61
2.46	.8786	.2885	.0149	.0	.62
2.47	.9013	.3036	.0152	.0	.63
2.49	.9240	.3190	.0154	.0	.64
2.51	.9345	.3262	.0072	.0	.39
2.53	.9407	.3304	.0042	.0	.22
2.55	.9468	.3346	.0042	.0	.18
2.57	.9529	.3388	.0042	.0	.18
2.59	.9591	.3431	.0043	.0	.18
2.61	.9652	.3473	.0043	.0	.18

HYDROGRAPH PEAK= .64 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .05 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-12-24
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/18/89

C-12-24

Tributary Area = D-12A, D-12B

$Q_{D-12A} + Q_{D-12B} = 0.19 + 0.74$

$Q_{TOT} = 0.93$ cfs

Check Pipe Flow

- 24" CMP
- $n = 0.024$
- $S = 2\%$

$Q_{allow} = \frac{1.49}{n} AR^{2/3} S^{1/2}$

$Q_{allow} = 17.3$ cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting

Check Inlet Control

HW depth = 4.0'

$\frac{HW}{D} = 2.0$ Use chart 5 - Assume projecting entrance

$Q_{HW} = 22.0$ cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.106$, $y = 0.31$, $V = 3$ fps < 5.0 OK

NO LINING REQ'd

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED DEH
CHECKED
DATE 6/30/89

C-13-24

Tributary Ditch D-13A $Q_{TOT} = 0.60$ cfs

Check Pipe Flow

- 24" CMP
- $n = 0.024$
- $S = 30\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 67.1$ cfs >> Q_{TOT} ok

Pipe Flow Not Limiting

Check Inlet Conditions

- $HW = 3.0'$

$\frac{HW}{D} = 1.5$

From Chart 5-
Assume projecting Inlet

$Q_{HW} = 18$ cfs >> Q_{TOT} ok

Inlet Control Not Limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.018$, $y = 0.14'$, $V = 0.21$ fps < 7.7 (Denver Criteria)

NO LINING REQUIRED

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-14-42
PROJECT NO. 007.11.100

SHEET 1 OF 4
COMPUTED Paul
CHECKED
DATE 5/18/89

C-14-42 (Permanent structure - Portion beneath Railroad to remain under RR Control. Design shown in Reclamation Plan)

Tributary Area = 173 * 1.401 = 242 Acres
90% Cover Oak/Aspen = 123 ac
25% Cover Sage/Grass = 119 ac

Ground cover taken by assuming that all North facing, and south facing slopes are characteristic.

North facing - 90% Oak/Aspen CN = 70
South facing - 25% Sage/Grass CN = 75

CN	A	Q
70	123	0.34
75	119	0.51

$\bar{Q} = 0.42$ $\bar{CN} = 72.5$

Precipitation = 2.25" (100yr, 6hr)

hydraulic length = 5000 feet

$$\text{slope} = \frac{(10{,}000)(400)(100)}{43{,}560\,(242)} = 37.9\%$$

Calculated Run-Off $Q_{TOT} = 52.3$ cfs

Check Pipe Flow

- D = 42"
- n = 0.024
- S = 3% min

$$Q_{allow} = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

$Q_{allow} = 94.4$ cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe Flow not limiting

Check Inlet Control

HW depth = 6.5' $\frac{HW}{D} = 1.86$ assume proj. entrance

from Chart 5

$Q_{HW} = 90.0$ cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet Control not limiting

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.200

SHEET 2 OF 4
COMPUTED DEF
CHECKED
DATE 8/14/90

C-14-42 - (Continued)

Riprap Check

According to EPA, Fig 1-15,

$d_{50} \sim 0.5$ ft

$L \sim 10$ ft

PROJECT : Valley Camp Coal. 007.11.200 Culvert C-14-42

AREA= 242.0 ACRES
AVERAGE BASIN SLOPE= 37.9 PERCENT
CURVE NUMBER= 72.5
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 5000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .2590 HOURS QPCFS= 706.62 CFS QPIN= 2.8957 INCHES
C3= 14.2729 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.12	.7236	.0000	.0000	.0	.00
2.18	.8098	.0007	.0007	35.5	.02
2.23	.8961	.0048	.0041	219.5	.30
2.28	.9823	.0125	.0077	469.1	1.50
2.33	1.0685	.0234	.0110	648.7	4.44
2.38	1.1548	.0375	.0141	706.6	9.65
2.43	1.2410	.0544	.0170	661.9	17.15
2.49	1.3273	.0741	.0197	558.7	26.64
2.54	1.3672	.0841	.0100	437.0	37.16
2.59	1.3905	.0902	.0061	322.5	46.14
2.64	1.4138	.0965	.0063	227.3	51.27
2.69	1.4371	.1029	.0064	154.3	52.25
2.75	1.4604	.1096	.0066	101.6	50.25
2.80	1.4837	.1164	.0068	65.2	46.80
2.85	1.5070	.1233	.0070	41.0	43.12
2.90	1.5303	.1305	.0071	25.2	39.93
2.95	1.5536	.1378	.0073	15.3	37.51
3.00	1.5766	.1451	.0073	9.1	35.89
3.06	1.5952	.1512	.0061	5.4	34.88
3.11	1.6139	.1574	.0062	3.1	34.13
3.16	1.6325	.1636	.0063	1.8	33.37
3.21	1.6512	.1700	.0064	1.0	32.60
3.26	1.6698	.1765	.0065	.6	31.89
3.32	1.6885	.1831	.0066	.3	31.33
3.37	1.7071	.1897	.0067	.2	30.97
3.42	1.7257	.1965	.0068	.1	30.79
3.47	1.7444	.2033	.0069	.0	30.79

HYDROGRAPH PEAK= 52.25 cfs
TIME TO PEAK= 2.69 Hours
RUNOFF VOLUME= 8.42 Acre-Feet

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-15-24
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/18/89

C-15-24

Tributary Flow = D-15

$Q_{TOT} = 1.57$ cfs

Check Pipe Flow

- 24" CMP
- $n = 0.024$
- $S = 5\%$

$Q_{allow} = \frac{1.49}{n} AR^{2/3} S^{1/2}$

$Q_{allow} = 27.4$ cfs OK

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting

Check Inlet Control

- HW depth = 3.2' $\frac{HW}{D} = 1.6$

Use Chart 5 Assume projecting entrance

$Q_{HW} = 18.5$ cfs OK

Since $Q_{HW} > Q_{TOT}$ Inlet Control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.113$, $y = 0.32$, $V = 4.8$ fps < 5.0

NO LINING REQ'd

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED DEH
CHECKED
DATE 10/30/89

C-16-24

Tributary Culvert C-15-24 Q_{TOT} = 1.57 cfs

Check Pipe Flow

- 24" CMP
- $n = 0.024$
- $S = 10\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q_{allow} = 38.7 cfs >> Q_{TOT} ok

Pipe Flow not limiting

Check Inlet Conditions

- HW = 1.0'

$\frac{HW}{D} = 0.5$

From Chart 5
Assuming projecting Inlet

Q_{HW} = 3.8 cfs > Q_{TOT} ok

Inlet Conditions not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.080$, $y = 0.28$, $v = 5.87$ fps > 5.0

Q < 2 cfs off EPA Chart - No Lining Req'd

However, if erosion becomes a problem, the following riprap could be installed.

d_{50} = 0.5' (min)
L = 5'

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED DEH
CHECKED
DATE 6/30/89

C-17-21 + C-18-21

Tributary Ditches D18A, D18B } $Q_{TOT} = 0.59 + 0.47 = 1.06$ cfs

Check Pipe Flow

- 21" CMP
- $n = 0.024$
- $S = 1\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 8.6$ cfs $> Q_{TOT}$ ✓

Pipe Flow not limiting

Check Inlet Conditions

- $HW = 1.75'$

$\frac{HW}{D} = 1.0$

From Chart 5
Assume projecting Inlet

$Q_{HW} = 8$ cfs $> Q_{TOT}$ ✓

Inlet Conditions not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.171$, $y = 0.42$, $V = 2.4$ fps < 5.0

NO LINING REQ'd

C-19-48, C-20-48

Total Acreage = 1060 * 1.401 = 1485 acres
90% Cover Oak/Aspen = 761 acres
25% Cover Sage/Grass = 724 acres

CN	AREA	Q
70	761	0.096
75	724	0.185

$\overline{CN} = 72.6$

$\bar{Q} = 0.14$

Precipitation = 1.55 in (10yr, 6Hr)

Hyd. Length = 16,600 ft

$$\text{Slope} = \frac{(63,500)(400)(100)}{43,560\ (1485)} = 39.3\%$$

from "Hydro" Q = 60.7 cfs

Culvert Analyses

C-19-48

Inlet Control HW depth = 8.5'

HW/D = 8.5/4 = 2.1 Assuming Projecting Inlet from Chart 5

Q_{MAX} = 130 cfs > 60.7 cfs ✓

Pipe Flow

S = 6%, n = 0.024,

$$Q_{max} = \frac{1.49}{n} A R^{2/3} S^{1/2} = 190.6\text{ cfs} > 60.7\text{ cfs} \quad ✓$$

C-20-48

Inlet Control HW depth = 9.0'

HW/D = 9.0/4 = 2.25 Q_{max} = 140 cfs > 60.7 cfs ✓

Pipe Flow

$S = 4\%$, $n = 0.024$

$Q_{max} = \frac{1.49}{n} A R^{2/3} S^{1/2} = 155.6\,cfs > 60.7\,cfs$ ok

EVALUATE EROSION POTENTIAL

Check Pipe Velocities

C-19-48 $\frac{Qn}{1.49 S^{1/2}} = 3.99$

Y	$AR^{2/3}$	
1.55	3.995 ⇒	A = 4.50, V = 13.5 f/s

C-20-48 $\frac{Qn}{1.49 S^{1/2}} = 4.89$

Y	$AR^{2/3}$	
1.7	4.727	A = 5.25
1.74	4.928 ⇒	V = 11.5 f/s

Flows are Supercritical at Outlet

Check Channel Velocities -

Below C-19-48

$S = 5\%$, $b = 5$, $m_1 = 0.5$, $m_2 = 2.5$

			UNITS				
Design Flow	:	60.70	cfs	Q-1.49AR(2/3)S(1/2)/n =		0.000	Accuracy
Bottom Width	:	5.0	feet				
Side Slope1	:	0.5	1/m1	Required Depth	:	1.61	feet
Side Slope2	:	2.5	1/m2	Area	:	7.39	ft2
Friction Factor	:			Perimeter	:	9.23	feet
Assumed D50	:	1.00	feet	Hydraulic Radius	:	0.80	feet
Calc n Value	:	0.040		Velocity	:	8.21	ft/sec
Used	:	0.035		Riprap Ck (V<5?)	:	Required	
Min. Bottom Slope	:	0.050	ft/ft				
Max. Bottom Slope	:	0.050	ft/ft				
Freeboard	:	0.50	feet				
Depth (Min. S):		1.11	feet				

$Fr^2 = \frac{Q^2 B}{g A^3} = \frac{(60.7)^2\, 3.58}{32.2\,(7.39)^3} = 1.02$

$B = D \sin\beta$ $\beta = \cos^{-1}(1 - 2y/D)$

$\beta = \cos^{-1}(1 - 2(1.11)/4) = 1.11$

$B = 4(\sin 1.11) = 3.58'$

Normal flow will scour channel bottom.

PROJECT : Valley Camp Coal. 007.11.200 Culverts C-19-48, C-20-48

AREA= 1485.0 ACRES
AVERAGE BASIN SLOPE= 39.3 PERCENT
CURVE NUMBER= 72.6
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 16600. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .6624 HOURS QPCFS= 1695.40 CFS QPIN= 1.1322 INCHES
C3= 5.5807 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.25	.6457	.0000	.0000	.0	.00
2.38	.7977	.0005	.0005	85.1	.04
2.52	.9353	.0082	.0078	526.6	.91
2.65	.9764	.0123	.0040	1125.5	4.97
2.78	1.0174	.0171	.0048	1556.4	12.02
2.91	1.0585	.0226	.0055	1695.4	20.44
3.05	1.0967	.0284	.0058	1588.2	29.02
3.18	1.1295	.0338	.0054	1340.6	37.03
3.31	1.1624	.0397	.0059	1048.5	43.95
3.44	1.1952	.0460	.0063	773.7	49.69
3.58	1.2221	.0515	.0055	545.3	54.40
3.71	1.2447	.0563	.0048	370.3	57.93
3.84	1.2673	.0613	.0050	243.9	59.98
3.97	1.2899	.0664	.0052	156.5	60.71
4.11	1.3108	.0714	.0050	98.3	60.60
4.24	1.3313	.0764	.0050	60.6	60.04
4.37	1.3519	.0816	.0052	36.7	59.34
4.50	1.3723	.0868	.0053	21.9	58.74
4.64	1.3887	.0912	.0043	12.9	58.29
4.77	1.4051	.0956	.0044	7.5	57.71
4.90	1.4216	.1001	.0045	4.4	56.81
5.03	1.4380	.1047	.0046	2.5	55.71
5.17	1.4544	.1094	.0047	1.4	54.65
5.30	1.4708	.1142	.0048	.8	53.83
5.43	1.4873	.1190	.0049	.4	53.33
5.56	1.5027	.1237	.0046	.2	53.16
5.70	1.5171	.1281	.0044	.1	53.13
5.83	1.5315	.1325	.0045	.0	53.01

HYDROGRAPH PEAK= 60.71 cfs
TIME TO PEAK= 3.97 Hours
RUNOFF VOLUME= 16.96 Acre-Feet

Below C-20-48 $S = 10\%$, $b = 5$, $m_1 = 0.6$, $m_2 = 2.0$

			UNITS
Design Flow	:	60.70	cfs
Bottom Width	:	5.0	feet
Side Slope1	:	0.6	1/m1
Side Slope2	:	2.0	1/m2
Friction Factor	:		
Assumed D50	:	1.00	feet
Calc n Value	:	0.040	
Used	:	0.040	
Min. Bottom Slope	:	0.100	ft/ft
Max. Bottom Slope	:	0.100	ft/ft
Freeboard	:	0.50	feet
Depth (Min. S):		0.99	feet

Q-1.49AR(2/3)S(1/2)/n =		0.000	Accuracy
Required Depth	:	1.49	feet
Area	:	6.26	ft2
Perimeter	:	8.38	feet
Hydraulic Radius	:	0.75	feet
Velocity	:	9.70	ft/sec
Riprap Ck (V(5?)	:	Required	

$\beta = \cos^{-1}(1 - 2(.9)/4) = 0.99$

$B = 4\sin(.99) = 3.34$

$Fr^2 = \frac{(60.7)^2\, 3.34}{32.2\,(6.26)^3} = 1.56$

Supercritical - will scour bottom naturally - bed should be naturally armored

DETERMINE ROCK SIZE

C-19-48 (Using Denver Storm drainage Criteria Manual)

$Q/D^{2.5}$ Use De for D since supercritical

$De = \frac{1}{2}(D + Yn) = \frac{1}{2}(4 + 1.55) = 2.78$

$Q/D^{2.5} = 60.7/(2.78)^{2.5} = 4.71 < 6.0$ ∴ Use fig 5.7

$Q/D^{1.5} = 60.7/(2.78)^{1.5} = 13.10$

$Yt = 1.11'$ $Yt/D_2 = 1.11/2.78 = 0.40$

from Fig 5-7, use Type H, (borderline M to H)

Length of placement $L = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - w\right)$

from Fig 5-9, $\frac{1}{2\tan\theta} = 2.8$ $L = 2.8\left(\frac{7.39}{1.11} - 4\right) = 7.4'$

Carry D50 = 18" for 8' downstream

C-20-48

$D_a = \frac{1}{2}(4+1.74) = 2.87$

$Q/D^{2.5} = 60.7/(2.87)^{2.5} = 4.35 < 6.0$ ∝ Use fig 5.7

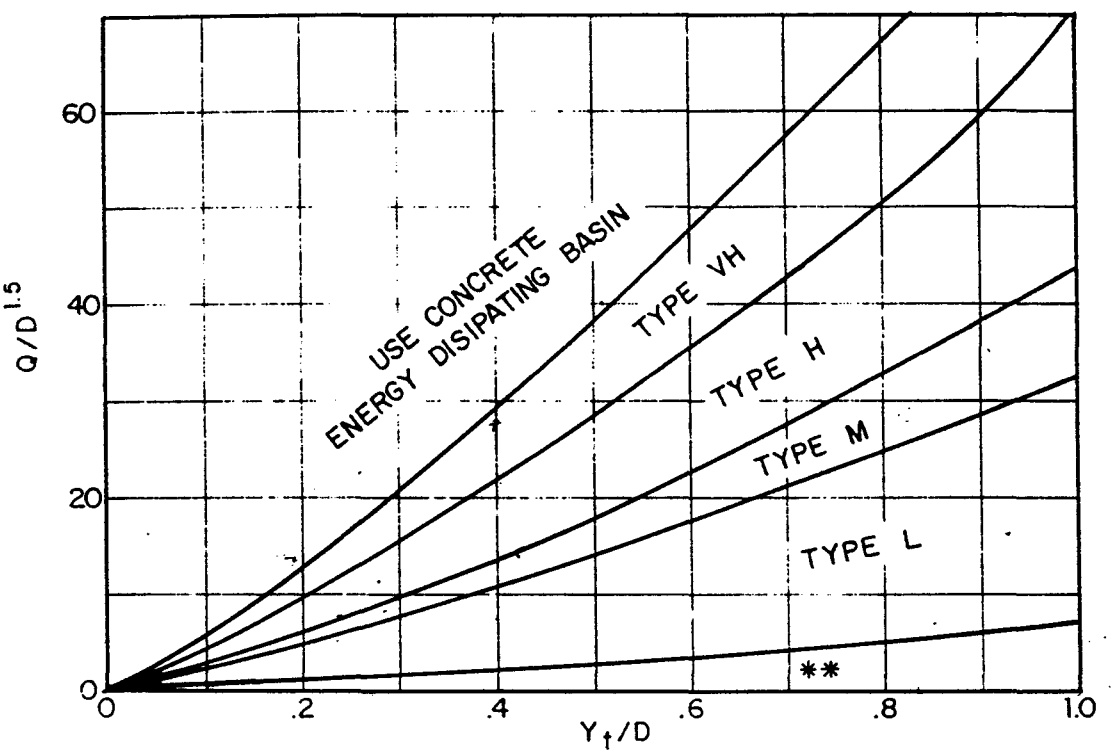
$Q/D^{1.5} = 60.7\,(2.87)^{1.5} = 12.48$

$Y_t/D_a = 0.99/2.87 = 0.34$

from Fig 5-7. Use type H Riprap - $D_{50} = 18''$

from Fig 5-7, $\frac{1}{2\tan\theta} = 2.3$ $\quad L = 2.3\left(\frac{6.26}{0.99} - 4\right) = 5.34'$

Carry $D_{50} = 18''$ for 6' downstream



Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

FIGURE 5-7. RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET.

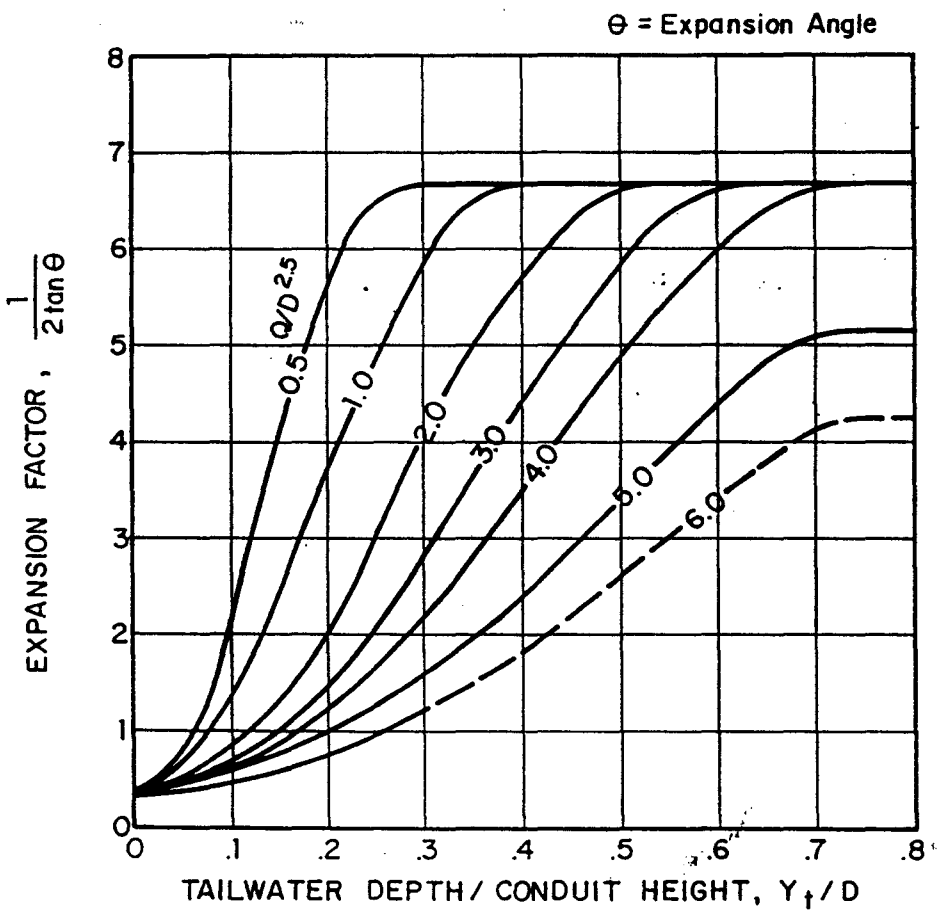


FIGURE 5-9. EXPANSION FACTOR FOR CIRCULAR CONDUITS

C-21-48 1F TEMPORARY STRUCTURE

FLOW TRIBUTARY

TOTAL AREA = 1479 * 1.401 = 2072 ac

90% OAK ASPEN	645	904
25% SAGE GRASS	834	1168

ASSUMING THAT NORTH & SOUTH FACING SLOPES ARE CHARACTERISTICALLY:

NORTH FACING 90% COVER OAK/ASPEN (CN = 70)
SOUTH FACING 25% COVER SAGE/GRASS (CN = 75)

CN	A	Q
70	904	0.10
75	1168	0.19
		$\bar{Q} = 0.15$

$\overline{CN} = 73$

PRECIPITATION = 1.55 inches (10 YR, 6 HR)

HYD. LENGTH = 12,000 ft

SLOPE = $\frac{(78{,}000)(400)(100)}{43{,}560\ (2072)} = 34.6\%$ $Q = 92.6$ cfs

CHECK PIPE FLOW

- D = 48"
- $\eta = 0.024$
- $S = 1\%$

$Q = \frac{1.49}{\eta} A R^{2/3} S^{1/2} = 77.81$ cfs < 92.6 - Add Avail Head (33'-4=29' Available)

$S_f = \frac{29 + 0.01(250)}{250} = 0.126$

$Q = \frac{1.49}{\eta} A R^{2/3} (.126)^{1/2} = 276$ cfs >> 92.6 ✓

CHECK INLET FLOW (USING "HYDRAULICS CHARTS FOR THE SELECTION OF HIGHWAY CULVERTS")

PIPE LENGTH = 250 ft
HW DEPTH = 33 ft HW/D = 8.25 HW/D = 6.0 (Max Shown on Chart)

Q = 215 cfs - ✓
for HW/D = 6.0

PIPE IS ADEQUATE

PROJECT : Valley Camp Coal - C-21-~~52~~ 48 Runoff Calculation - TEMPORARY STRUCTURE

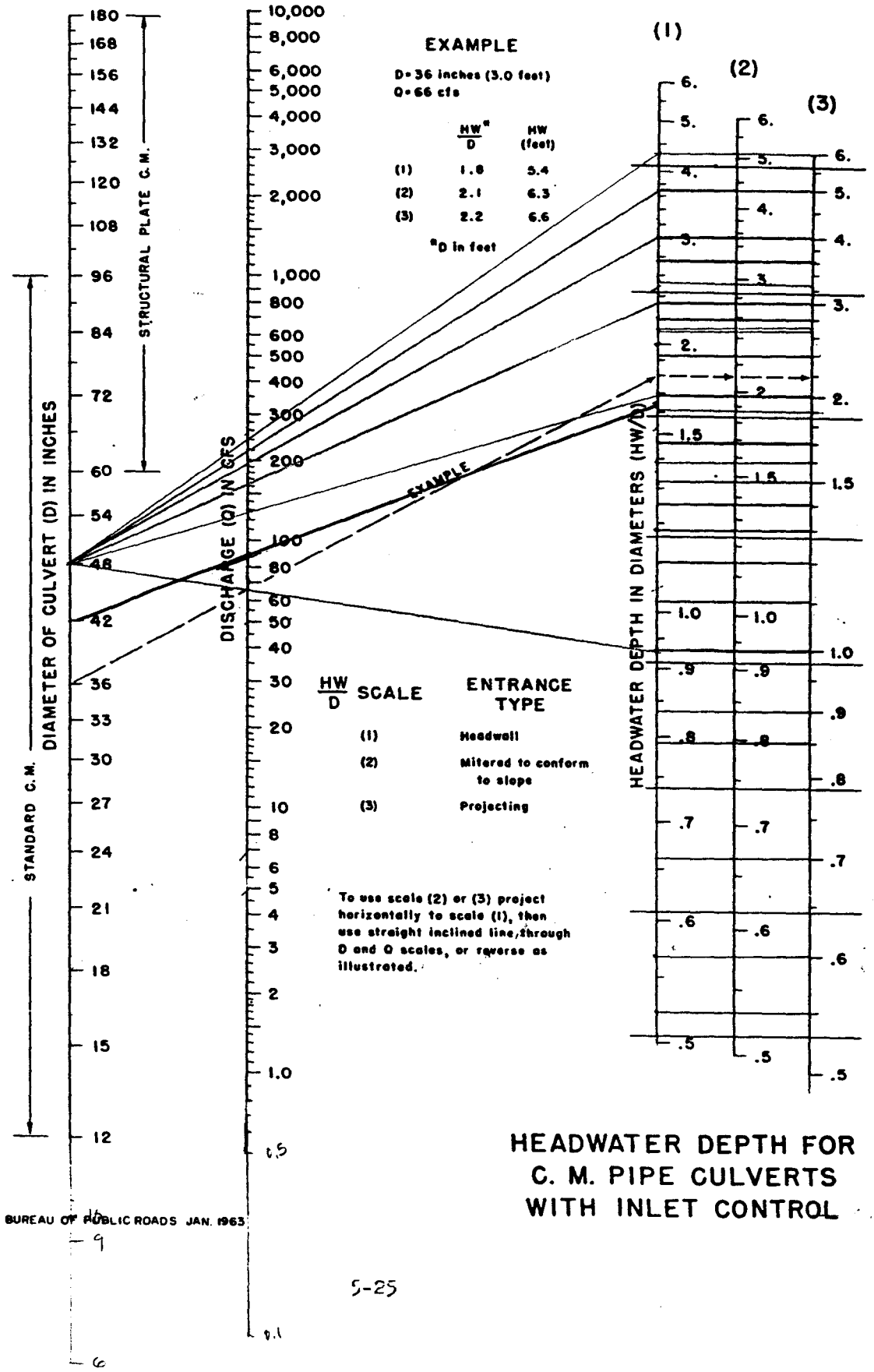
AREA= 2072.0 ACRES
AVERAGE BASIN SLOPE= 34.6 PERCENT
CURVE NUMBER= 73.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 12000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .5385 HOURS QPCFS= 2909.81 CFS QPIN= 1.3927 INCHES
C3= 6.8646 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.26	.6567	.0000	.0000	.0	.00
2.37	.7802	.0004	.0004	146.0	.06
2.48	.9038	.0070	.0065	903.8	1.35
2.58	.9563	.0120	.0050	1931.7	7.48
2.69	.9897	.0158	.0038	2671.2	18.87
2.80	1.0231	.0202	.0043	2909.8	32.51
2.91	1.0565	.0250	.0048	2725.7	45.63
3.02	1.0889	.0301	.0051	2300.8	57.15
3.12	1.1156	.0347	.0046	1799.6	66.87
3.23	1.1423	.0395	.0048	1327.9	74.59
3.34	1.1690	.0446	.0051	935.9	80.44
3.45	1.1957	.0500	.0054	635.6	84.97
3.55	1.2182	.0548	.0048	418.6	88.70
3.66	1.2366	.0588	.0040	268.7	91.43
3.77	1.2550	.0630	.0042	168.7	92.56
3.88	1.2733	.0673	.0043	103.9	92.13
3.98	1.2917	.0717	.0044	63.0	90.73
4.09	1.3086	.0758	.0042	37.6	89.06
4.20	1.3253	.0800	.0042	22.2	87.45
4.31	1.3420	.0843	.0043	12.9	86.02
4.42	1.3587	.0887	.0044	7.5	84.91
4.52	1.3747	.0930	.0043	4.3	84.21
4.63	1.3880	.0967	.0037	2.4	83.75
4.74	1.4014	.1004	.0037	1.4	83.00
4.85	1.4147	.1042	.0038	.8	81.73
4.95	1.4281	.1080	.0038	.4	80.14
5.06	1.4414	.1119	.0039	.2	78.58
5.17	1.4548	.1158	.0039	.1	77.31
5.28	1.4681	.1199	.0040	.0	76.47

HYDROGRAPH PEAK= 92.56 cfs
TIME TO PEAK= 3.77 Hours
RUNOFF VOLUME= 24.68 Acre-Feet

CHART 5



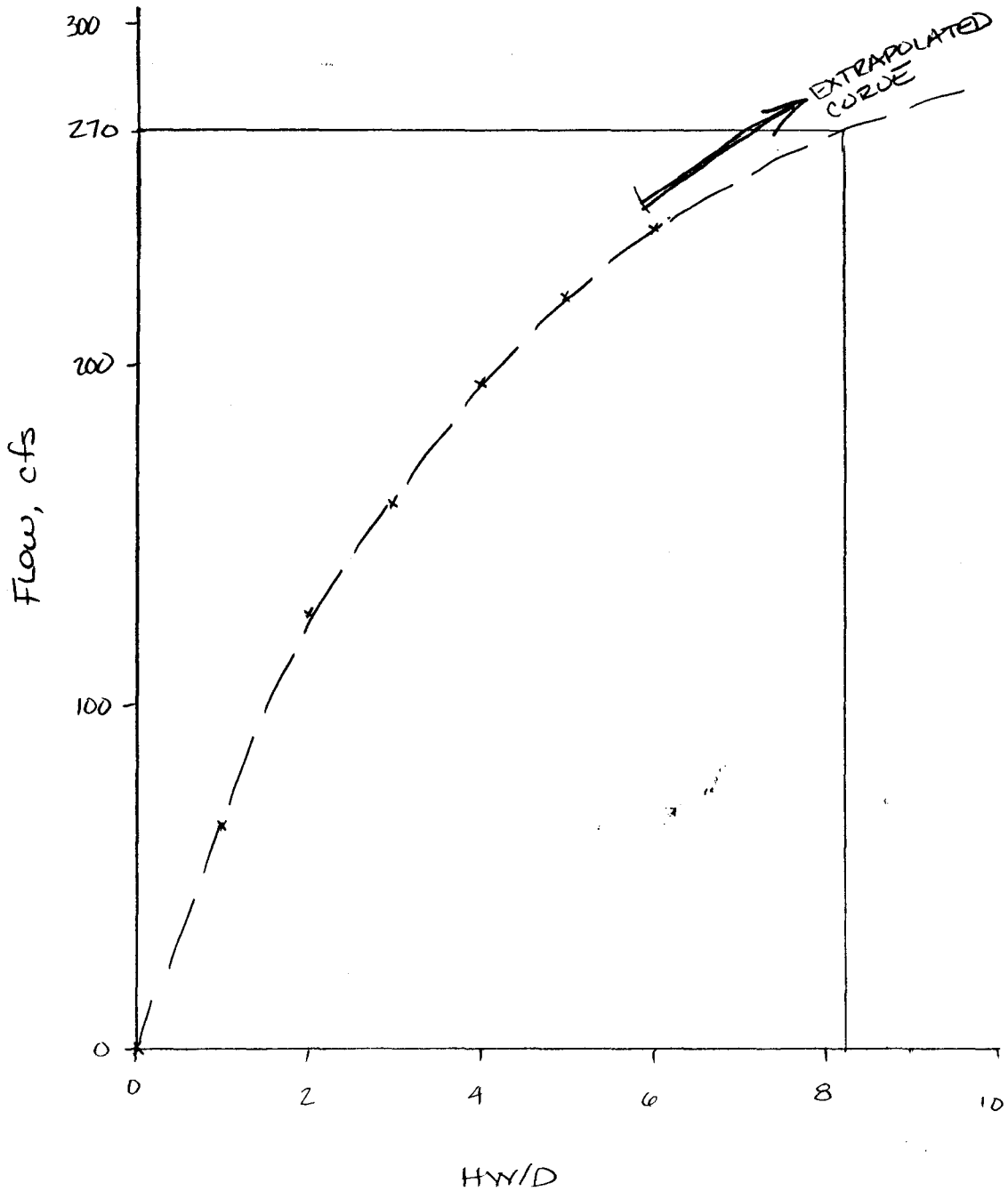
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

HANSEN ALLEN & LUCE inc

CLIENT VALLEY CAMP
PROJECT PERMIT
FEATURE
PROJECT NO. 007.11.200

SHEET 4 OF 7
COMPUTED DEH
CHECKED
DATE 3AUG90

FLOW UNDER INLET CONDITIONS



C-21-48 IF PERMANENT STRUCTURE

Precip = 2.25 in (100 yr, 6 hr)

Q = 330.8 cfs Neither Pipe nor Inlet Conditions will allow his amount of flow.

Extrapolating Inlet flow Curve gives @

$HW/D_{max} = 8.25$ gives $Q \sim 270$ cfs

Pipe flow$_{max}$ is 276 cfs > 270 Inlet Control Governs

Excess flow must go over road.

331 - 270 = 61 cfs.

Use broad crested weir to calculate flow depth. Dimensions are approximate.

From 1:100 Scale Mapping, available channel depth + width data is:

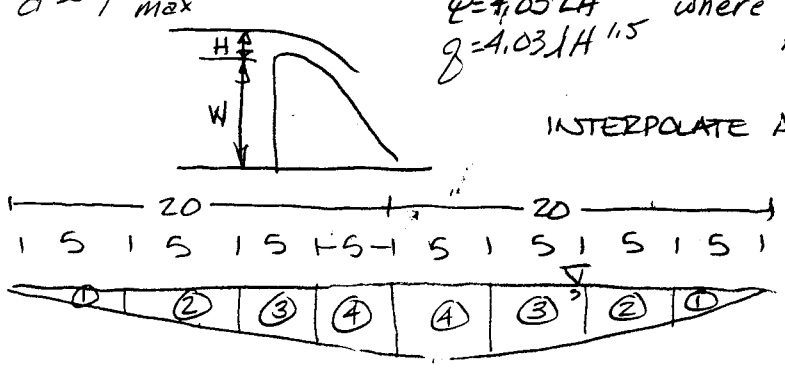
W ~ 40'
b ~ 0
d ~ 1' max

Weir will act much like a spillway. where

$Q = 4.03 LH^{1.5}$ where $\frac{W}{H} \geq 1.33$

$q = 4.03 H^{1.5}$

INTERPOLATE ANSWER



depth = 0.125 0.375 0.625 0.875

Calc q for 1/2 width

Area	Width	depth	q
1	5	.125	0.291
2	5	.375	4.627
3	5	.625	9.956
4	5	.875	16.493

Σ = 31.967 * 2 = 63.9 cfs ~ 61 cfs REQ'd

FLOW WILL PASS AT APPROX 1.0' DEPTH

270 + 63.9 = 333.9 cfs TOTAL > 330 cfs REQUIRED

PROJECT : Valley Camo Coal - C-21-48 Runoff Calculation - PERMANENT STRUCTURE

6/7

AREA= 2072.0 ACRES
AVERAGE BASIN SLOPE= 34.6 PERCENT
CURVE NUMBER= 73.0
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 12000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .5385 HOURS QPCFS= 2909.81 CFS QPIN= 1.3927 INCHES
C3= 6.8646 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.05	.5946	.0000	.0000	.0	.00
2.15	.7740	.0003	.0003	146.0	.05
2.26	.9533	.0117	.0113	903.8	1.94
2.37	1.1326	.0377	.0261	1931.7	14.66
2.48	1.3119	.0767	.0389	2671.2	52.00
2.58	1.3882	.0967	.0201	2909.8	119.69
2.69	1.4366	.1105	.0138	2725.7	198.86
2.80	1.4851	.1250	.0145	2300.8	264.83
2.91	1.5336	.1403	.0153	1799.6	306.57
3.02	1.5806	.1558	.0155	1327.9	326.21
3.12	1.6194	.1690	.0133	935.9	330.82
3.23	1.6582	.1827	.0137	635.6	326.11
3.34	1.6969	.1968	.0141	418.6	316.62
3.45	1.7357	.2113	.0145	268.7	306.03
3.55	1.7684	.2238	.0125	168.7	296.57
3.66	1.7951	.2343	.0104	103.9	287.74
3.77	1.8217	.2449	.0106	63.0	277.68
3.88	1.8484	.2557	.0108	37.6	266.00
3.98	1.8750	.2666	.0110	22.2	253.87
4.09	1.8996	.2769	.0103	12.9	242.66
4.20	1.9238	.2872	.0103	7.5	232.89
4.31	1.9481	.2976	.0104	4.3	224.62
4.42	1.9723	.3081	.0105	2.4	217.95
4.52	1.9955	.3183	.0102	1.4	212.88
4.63	2.0149	.3269	.0086	.8	208.86
4.74	2.0342	.3356	.0087	.4	204.56
4.85	2.0536	.3444	.0088	.2	199.35
4.95	2.0730	.3533	.0089	.1	193.65
5.06	2.0924	.3622	.0090	.0	188.22

HYDROGRAPH PEAK= 330.82 cfs
TIME TO PEAK= 3.12 Hours
RUNOFF VOLUME= 74.58 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT
FEATURE
PROJECT NO. 007.11.200

SHEET 7 OF 7
COMPUTED DEH
CHECKED
DATE 14 AUG 90

C-21-48 - (Continued)
RIPRAP CHECK

10yr-6hr Flow: Q = 926 cfs

from fig 1-15, EPA $d_{50} \sim 0.75'$
$L_a \sim 22'$ USE 25' *

100yr-6hr Flow: Q = 330 cfs

from fig 1-15, EPA $d_{50} \sim 2.5'$
$L_a \sim 57'$ USE 60'

Conform riprap to natural channel.

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-22-24
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED paul
CHECKED
DATE 5/19/89

C-22-24

Tributary Area = 16 * 1.401 = 22 Acres
90% Cover Oak/Aspen CN = 70 = 20 ac
25% Cover Sage/grass CN = 75 = 2 ac

CN	A	Q
70	20	0.10
75	2	0.19
		$\bar{Q}$ = 0.10

$\bar{CN}$ = 70.5

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 2,500 ft

$$\text{slope} = \frac{(6000)(80)(100)}{43{,}560\ (22)} = 50\%$$

Calculated Run-Off = Q_{TOT} = 0.79 cfs

Check Pipe Flow

- 24" CMP
- n = 0.024
- S = 5.7%

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q_{allow} = 29.3 cfs ok

Pipe flow not limiting

Check Inlet Control

- HW depth = 2.8'

$\frac{HW}{D}$ = 1.4 Use Chart 5 - assume proj. entrance

Q_{HW} = 17.0 cfs ok

Inlet control not limiting

Riprap Check $\frac{Qn}{1.49 S^{1/2}}$ = 0.054, y = 0.23, V = 3.9 < 5.0 ok

NO LINING REQD

PROJECT : Valley Camp Coal - C-22-24 Runoff Calculation

AREA= 22.0 ACRES
AVERAGE BASIN SLOPE= 50.0 PERCENT
CURVE NUMBER= 70.5
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1365 HOURS QPCFS= 121.60 CFS QPIN= 5.4813 INCHES
C3= 27.0175 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.41	.8246	.0000	.0000	.0	.00
2.44	.8560	.0000	.0000	6.1	.00
2.46	.8874	.0006	.0005	37.8	.00
2.49	.9187	.0016	.0010	80.7	.03
2.52	.9354	.0023	.0007	111.6	.09
2.54	.9439	.0027	.0004	121.6	.18
2.57	.9524	.0031	.0004	113.9	.25
2.60	.9609	.0036	.0005	96.1	.31
2.63	.9694	.0041	.0005	75.2	.35
2.65	.9779	.0046	.0005	55.5	.37
2.68	.9863	.0052	.0006	39.1	.39
2.71	.9948	.0057	.0006	26.6	.40
2.74	1.0033	.0064	.0006	17.5	.41
2.76	1.0118	.0070	.0007	11.2	.42
2.79	1.0203	.0077	.0007	7.0	.44
2.82	1.0288	.0084	.0007	4.3	.46
2.85	1.0372	.0092	.0007	2.6	.48
2.87	1.0457	.0099	.0008	1.6	.50
2.90	1.0542	.0107	.0008	.9	.52
2.93	1.0627	.0116	.0008	.5	.55
2.96	1.0712	.0124	.0009	.3	.57
2.98	1.0797	.0133	.0009	.2	.59
3.01	1.0875	.0142	.0009	.1	.62
3.04	1.0943	.0149	.0008	.0	.64
3.37	1.1757	.0254	.0010	.0	.71
3.39	1.1825	.0264	.0010	.0	.73
3.42	1.1893	.0274	.0010	.0	.74
3.45	1.1961	.0284	.0010	.0	.75
3.48	1.2029	.0294	.0010	.0	.77
3.50	1.2095	.0305	.0010	.0	.78
3.53	1.2141	.0312	.0007	.0	.79
3.54	1.2189	.0319	.0007	.0	.79
3.56	1.2238	.0327	.0008	.0	.78
3.57	1.2281	.0335	.0008	.0	.75

PROJECT : Valley Camp Coal - C-22-24 Runoff Calculation
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
3.64	1.2328	.0342	.0008	.0	.72
3.67	1.2375	.0350	.0008	.0	.70
3.69	1.2421	.0358	.0008	.0	.67

HYDROGRAPH PEAK= .79 cfs
TIME TO PEAK= 3.53 Hours
RUNOFF VOLUME= .19 Acre-Feet

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-23-24
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED PGH
CHECKED
DATE

C-23-24

Total Area = 16 + 1.401 = 22 acres
90% Cover Oak/Aspen (CN=70) = 20
25% Cover Sage/Grass (CN=75) = 2

CN	A	Q
70	20	0.10
75	2	0.19
		$\bar{Q}$=0.10

$\bar{CN}$ = 70.5

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 2,500 ft

$$\text{slope} = \frac{(6{,}000)(80)(100)}{43{,}560\ (22)} = 50\%$$

Calculated Runoff: Q_{TOT} = 0.79 cfs

Check Pipe Flow

- 24" CMP
- n = 0.024
- S = 8%

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q_{allow} = 34.66 cfs OK

Pipe flow not limiting

Check Inlet Control

HW depth = 3.5'

$\frac{HW}{D}$ = 1.75

Use Chart 5 - assume projecting entrance

Q_{HW} = 20.0 cfs OK

Inlet Control not limiting

Riprap Check $\frac{Qn}{1.49 S^{1/2}}$ = 0.046, y = 0.21, V = 4.6 fps < 5.0
NO LINING REQ'd

PROJECT : Valley Camp Coal - C-23-24 Runoff Calculation

AREA= 22.0 ACRES
AVERAGE BASIN SLOPE= 50.0 PERCENT
CURVE NUMBER= 70.5
DESIGN STORM= 1.35 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1368 HOURS QPCFS= 121.60 CFS QPIN= 5.4813 INCHES
C3= 27.0175 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.41	.8246	.0000	.0000	.0	.00
2.44	.8560	.0000	.0000	6.1	.00
2.46	.8874	.0006	.0005	37.8	.00
2.49	.9187	.0016	.0010	80.7	.03
2.52	.9354	.0023	.0007	111.6	.09
2.54	.9439	.0027	.0004	121.6	.18
2.57	.9524	.0031	.0004	113.9	.25
2.60	.9609	.0036	.0005	96.1	.31
2.63	.9694	.0041	.0005	75.2	.35
2.65	.9779	.0046	.0005	55.5	.37
2.68	.9863	.0052	.0006	39.1	.39
2.71	.9948	.0057	.0006	26.6	.40
2.74	1.0033	.0064	.0006	17.5	.41
2.76	1.0118	.0070	.0007	11.2	.42
2.79	1.0203	.0077	.0007	7.0	.44
2.82	1.0288	.0084	.0007	4.3	.46
2.85	1.0372	.0092	.0007	2.6	.48
2.87	1.0457	.0099	.0008	1.6	.50
2.90	1.0542	.0107	.0008	.9	.52
2.93	1.0627	.0116	.0008	.5	.55
2.96	1.0712	.0124	.0009	.3	.57
2.98	1.0797	.0133	.0009	.2	.59
3.01	1.0875	.0142	.0009	.1	.62
3.04	1.0943	.0149	.0008	.0	.64
3.37	1.1757	.0254	.0010	.0	.71
3.39	1.1825	.0264	.0010	.0	.73
3.42	1.1893	.0274	.0010	.0	.74
3.45	1.1961	.0284	.0010	.0	.75
3.48	1.2029	.0294	.0010	.0	.77
3.50	1.2095	.0305	.0010	.0	.78
3.53	1.2141	.0312	.0007	.0	.79
3.55	1.2188	.0319	.0007	.0	.79
3.58	1.2233	.0327	.0008	.0	.79
3.61	1.2281	.0335	.0008	.0	.79

PROJECT : Valley Camp Coal - C-23-24 Runoff Calculation
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
3.64	1.2328	.0342	.0008	.0	.72
3.67	1.2375	.0350	.0008	.0	.70
3.69	1.2421	.0358	.0008	.0	.67

HYDROGRAPH PEAK= .79 cfs
TIME TO PEAK= 3.53 Hours
RUNOFF VOLUME= .19 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-24-24
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/19/89

C-24-24

Tributary Area = 9*1.401 = 20 acres

CN = 75 (25% Cover Sage/Grass)

Precipitation = 1.55 inches (10 yr, 6hr)

hydraulic length = 2000 ft

$$\text{slope} = \frac{(4800)(80)(100)}{43{,}560\,(20)} = 44.1\%$$

Calculated Run-off: $Q_{TOT} \sim 2.04$ cfs

Check Pipe Flow

- 24" CMP
- n = 0.024
- S = 12%

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 42.45$ cfs OK

Pipe Flow not limiting

Check Inlet Control

- HW depth = 4.2'

$\frac{HW}{D} = 2.1$ Use Chart 5 assume projecting entrance

$Q_{HW} = 22.0$ cfs OK

Inlet control not limiting

Riprap Check $\frac{Qn}{1.49 S^{1/2}} = 0.095$, $y = 0.3'$, $V = 6.9$ f/s

Outlet off side hill, If erosion is severe, install riprap according to EPA,

from fig 1-15, $d_{50} \sim 0.25$ (Use 1.0' min d_{50} on hillslope for 10')

PROJECT : Valley Camp Coal - C-24-24 Runoff Calculation

AREA= 20.0 ACRES
AVERAGE BASIN SLOPE= 44.1 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1075 HOURS QPCFS= 140.71 CFS QPIN= 6.9769 INCHES
C3= 34.3891 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.26	.6517	.0000	.0000	.0	.00
2.28	.6764	.0000	.0000	7.1	.00
2.30	.7010	.0004	.0003	43.7	.00
2.32	.7257	.0010	.0007	93.4	.02
2.34	.7503	.0020	.0010	129.2	.07
2.36	.7750	.0034	.0014	140.7	.16
2.39	.7997	.0051	.0017	131.8	.30
2.41	.8243	.0071	.0020	111.3	.49
2.43	.8490	.0095	.0023	87.0	.71
2.45	.8736	.0121	.0026	64.2	.96
2.47	.8983	.0150	.0030	45.3	1.23
2.49	.9230	.0183	.0032	30.7	1.51
2.52	.9348	.0200	.0017	20.2	1.78
2.54	.9414	.0209	.0010	13.0	1.98
2.56	.9481	.0219	.0010	8.2	2.04
2.58	.9548	.0229	.0010	5.0	1.98
2.60	.9614	.0239	.0010	3.0	1.83
2.62	.9681	.0250	.0010	1.8	1.65
2.64	.9747	.0261	.0011	1.1	1.48
2.67	.9814	.0272	.0011	.6	1.33
2.69	.9881	.0283	.0011	.4	1.22
2.71	.9947	.0294	.0011	.2	1.15
2.73	1.0014	.0305	.0012	.1	1.10
2.75	1.0081	.0317	.0012	.0	1.07

HYDROGRAPH PEAK= 2.04 cfs
TIME TO PEAK= 2.56 Hours
RUNOFF VOLUME= .31 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-25-36
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/19/89

C-25-36

Tributary Area = 108 + 1.401 = 151 acres
90% Cover Oak/Aspen (CN=70) = 78
25% Cover Sage/Grass (CN=75) = 73

CN	A	Q
70	78	0.10
75	73	0.19

$\bar{Q} = 0.14$ $\bar{CN} = 72.7$

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 5,000 feet

$$\text{slope} = \frac{(6{,}500)(400)(100)}{43{,}560\ (151)} = 39.5\%$$

Calculated Run-Off: $Q_{TOT} = 17.0$ cfs

Check Pipe Flow

- 36" CMP
- n = 0.024
- S = 12%

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 125.15$ cfs OK

Pipe Flow not limiting

Check Inlet Control

- HW depth = 22'

$\frac{HW}{D} = 7.33$ Use Chart 5 - assume projecting entrance

Extrapolation yields a flow of 130 cfs

Inlet control not limiting

Riprap Check from EPA, fig 1-15, $d_{50} \sim 0.25'$ - USE $d_{50\,min} = 1.0'$ on hillslopes, Extend min of 10' downstream

PROJECT : Valley Camp Coal - C-25-36 Runoff Calculation

AREA= 151.0 ACRES
AVERAGE BASIN SLOPE= 39.5 PERCENT
CURVE NUMBER= 72.7
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 5000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .2523 HOURS QPCFS= 452.63 CFS QPIN= 2.9727 INCHES
C3= 14.6524 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.32	.7247	.0000	.0000	.0	.00
2.37	.7826	.0003	.0003	22.7	.00
2.42	.8405	.0021	.0018	140.6	.08
2.47	.8984	.0056	.0035	300.5	.41
2.52	.9371	.0088	.0032	415.5	1.22
2.57	.9527	.0103	.0015	452.6	2.41
2.62	.9684	.0119	.0016	424.0	3.60
2.67	.9840	.0136	.0017	357.9	4.49
2.72	.9997	.0154	.0018	279.9	5.05
2.78	1.0153	.0174	.0019	206.6	5.34
2.83	1.0309	.0194	.0020	145.6	5.49
2.88	1.0466	.0216	.0021	98.9	5.59
2.93	1.0622	.0238	.0023	65.1	5.69
2.98	1.0779	.0262	.0024	41.8	5.83
3.03	1.0918	.0284	.0022	26.2	6.01
3.08	1.1043	.0304	.0020	16.2	6.18
3.13	1.1168	.0325	.0021	9.8	6.31
3.18	1.1294	.0346	.0022	5.9	6.38
3.23	1.1419	.0368	.0022	3.5	6.42
3.28	1.1544	.0391	.0023	2.0	6.44
3.33	1.1669	.0415	.0023	1.2	6.48
3.38	1.1794	.0439	.0024	.7	6.55
3.43	1.1919	.0463	.0025	.4	6.64
3.48	1.2044	.0488	.0025	.2	6.76
3.53	1.2145	.0509	.0021	.1	6.88
3.58	1.2231	.0527	.0018	.0	6.96
3.63	1.2317	.0545	.0018	.0	6.92
3.68	1.2403	.0564	.0019	.0	6.77
3.73	1.2489	.0583	.0019	.0	6.56
3.78	1.2575	.0602	.0019	.0	6.34
3.83	1.2661	.0621	.0019	.0	6.16
3.89	1.2747	.0641	.0020	.0	6.02

HYDROGRAPH PEAK= 6.96 cfs
TIME TO PEAK= 3.58 Hours
RUNOFF VOLUME= 1.74 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE:
PROJECT NO.: 007.11.200

SHEET 1 OF 2
COMPUTED: DCH
CHECKED:
DATE: 3AUG90

C-26-24

Tributary Area = 4.8ac

CN = 75 (25% Sage Grass)

Precipitation = 1.55 inches (10yr, 6hr)

Hyd. Length = 1400 feet

$$\text{Slope} = \frac{4550(25)100}{43560(4.8)} = 54.4\%$$

Calculated Runoff: $Q_{TOT} = 0.57$ cfs

Check Pipe Flow

24" CMP
$n = 0.024$
$S = 18\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2} = 51.99 \text{ cfs}$$

51.99 >> 0.57 ok NOT LIMITING

Check Inlet Control

HW Depth = 4.0'

HW/D = 2.0 Use Chart 5, projecting Entrance

$Q_{HW} = 22$ cfs >> 0.57 ok

Inlet Control Not Limiting

Riprap Check $\frac{Qn}{1A^{1/2}S^{1/2}} = 0.022$, $y = 0.15'$, $V = 5.32'/s < 7.7$ (Denver Criteria)

Riprap Not Required

PROJECT : Valley Camp Coal - C-26-24 Runoff Calculation

AREA= 4.8 ACRES
AVERAGE BASIN SLOPE= 54.4 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1400. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0728 HOURS QPCFS= 49.89 CFS QPIN=10.3077 INCHES
C3= 50.8068 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.27	.6663	.0000	.0000	.0	.00
2.28	.6829	.0000	.0000	2.5	.00
2.30	.6996	.0003	.0002	15.5	.00
2.31	.7163	.0007	.0004	33.1	.00
2.33	.7330	.0013	.0006	45.8	.02
2.34	.7497	.0020	.0007	49.9	.04
2.36	.7664	.0029	.0009	46.7	.07
2.37	.7831	.0039	.0010	39.4	.10
2.39	.7998	.0051	.0012	30.9	.14
2.40	.8165	.0064	.0013	22.8	.18
2.42	.8332	.0079	.0015	16.0	.23
2.43	.8499	.0095	.0016	10.9	.28
2.44	.8665	.0113	.0018	7.2	.33
2.46	.8832	.0132	.0019	4.6	.38
2.47	.8999	.0153	.0020	2.9	.42
2.49	.9166	.0174	.0022	1.8	.47
2.50	.9309	.0194	.0020	1.1	.52
2.52	.9354	.0200	.0006	.6	.56
2.53	.9399	.0207	.0007	.4	.57
2.55	.9444	.0214	.0007	.2	.55
2.56	.9489	.0220	.0007	.1	.51
2.58	.9534	.0227	.0007	.0	.45
2.59	.9580	.0234	.0007	.0	.40
2.60	.9625	.0241	.0007	.0	.35
2.62	.9670	.0248	.0007	.0	.31

HYDROGRAPH PEAK= .57 cfs
TIME TO PEAK= 2.53 Hours
RUNOFF VOLUME= .07 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE:
PROJECT NO.: 007.11.200

SHEET 1 OF 1
COMPUTED: DEH
CHECKED:
DATE: 3AUG90

C-26A-24

Tributary Area = 9.2ac

CN = 75 (25% Sage/Grass)

Precipitation = 1.55 inches (10yr, 6Hr)

Hydraulic Length = 1780 ft

$$\text{Slope} = \frac{2630(80)100}{43560(9.2)} = 52.5\%$$

Calculated Runoff: $Q_{TOT} = 1.01 cfs$

Check Pipe Flow

- 24" CMP
- $n = 0.024$
- $S = 25\%$

$$Q_{allow} = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

$Q_{allow} = 61.4 cfs >> 1.01$ ok

Pipe Flow Not Limiting

Check Inlet Control

HW depth = 2.0 (Minimum, Actual is Greater)

HW/D = 1.0 Use Chart 5, projecting inlet

$Q_{HW} = 11 cfs >> 1.01 cfs$ ok

Inlet Control Not Limiting

Riprap Check $\frac{Qn}{1.49S^{1/2}} = 0.033$, $y = 0.18$, $V = 7.2 fps < 7.7$ (Denver Criteria)

NO LINING REQ'd

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-27-24
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED DEH
CHECKED
DATE 10/30/89

C-27-24

Tributary Area: Ditch UDD-2 Q = 0.57 cfs (See HA&L, 1989 Sed. Pond Report)

Check Pipe Flow

- 24" CMP
- $n = 0.024$
- $S = 43\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 80.6$ cfs ✓

Pipe flow not limiting

Check Inlet Control

- HW depth = 4.5'

$\frac{HW}{D} = 2.25$ Use Chart 5

Assume Projecting entrance

$Q_{HW} = 24$ cfs ✓

Inlet Control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.014$, $y = 0.12'$, $V = 7.4$ fps < 7.7 (Denver Criteria)

No Lining Req'd

C-28-24

Tributary Area: UDD-2 14.7ac ← from 1989 HA&L
Tributary Area 20.3ac Report on Sed. Ponds
35.0 ac

CN	A	Q
75	33.6	0.19
70	1.4	0.10
	35.0	

$\bar{Q} = 0.18$ $\bar{CN} = 74.8$

Slope from Tributary Area = $\frac{6800(80)100}{43560(20.3)} = 61.5\%$

Avg. Slope = $\frac{61.5(20.3)+37(14.7)}{35} = 51.2\%$

Precipitation = 1.55 inches (10yr, 6hr)

Hydraulic Length = 2350 feet

Calculated Runoff $Q_{TOT} = 3.3$ cfs

Check Pipe Flow

- 24" CMP
- $n = 0.024$
- $S = 30\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 67.12$ cfs ✓

Pipe Flow not limiting

Check Inlet Control

- HW depth = 8.5'

Use Chart 5 - Assume Projecting Inlet

$\frac{HW}{D} = 4.25$ $Q_{HW} = 35.0$ cfs Inlet control not limiting

Riprap Check $\frac{Qn}{1.49 S^{1/2}} = 0.097$, $y = 0.3'$, $V = 11.2$ fps

from EPA Fig 1-15, $d_{50} = 0.25'$ - Use $D_{50min} = 1.0'$, $L_a = 10'$

PROJECT : Valley Camp Coal - C-28-24 Runoff Calculation

AREA= 35.0 ACRES
AVERAGE BASIN SLOPE= 51.2 PERCENT
CURVE NUMBER= 74.8
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2350. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1142 HOURS QPCFS= 231.87 CFS QPIN= 6.5699 INCHES
C3= 32.3828 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.26	.6550	.0000	.0000	.0	.00
2.28	.6812	.0000	.0000	11.6	.00
2.31	.7074	.0003	.0003	72.0	.00
2.33	.7336	.0010	.0007	153.9	.03
2.35	.7597	.0021	.0011	212.9	.12
2.37	.7859	.0036	.0015	231.9	.28
2.40	.8121	.0055	.0018	217.2	.52
2.42	.8383	.0077	.0022	183.3	.85
2.44	.8645	.0102	.0026	143.4	1.25
2.47	.8907	.0131	.0029	105.8	1.71
2.49	.9169	.0164	.0032	74.6	2.19
2.51	.9335	.0186	.0022	50.6	2.69
2.53	.9406	.0196	.0010	33.4	3.09
2.56	.9477	.0206	.0010	21.4	3.30
2.58	.9548	.0216	.0010	13.4	3.27
2.60	.9618	.0227	.0011	8.3	3.07
2.63	.9689	.0238	.0011	5.0	2.80
2.65	.9760	.0249	.0011	3.0	2.52
2.67	.9831	.0260	.0011	1.8	2.28
2.69	.9901	.0272	.0012	1.0	2.10
2.72	.9972	.0283	.0012	.6	1.97
2.74	1.0043	.0295	.0012	.3	1.88
2.76	1.0114	.0307	.0012	.2	1.84
2.79	1.0185	.0320	.0012	.1	1.82
2.81	1.0255	.0333	.0013	.0	1.82

HYDROGRAPH PEAK= 3.30 cfs
TIME TO PEAK= 2.56 Hours
RUNOFF VOLUME= .53 Acre-Feet

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-29-16
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED PMT
CHECKED
DATE 5/9/89

C-29-16

Tributary Flow D-29A, D-29B

$Q_{TOT} = 1.14$ cfs

Check Pipe Flow

- 16" cast iron
- $n = 0.014$
- $S = 5\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 15.9$ cfs

Since $Q_{allow} > Q_{TOT}$ Culvert is acceptable OK

Check Inlet Control

HW depth = 16" $\frac{HW}{D} = 1$

Evaluate inlet based on 2 know charts from "Hydraulic Charts for the selection of Highway Culverts"

Chart 7 - assume type A $\Rightarrow Q_{HW_7} = 5$ cfs

Chart 5 - assume proj. entrance $Q_{HW_5} = 4.2$ cfs ← Select lower value

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting OK

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.048$, $y = 0.24$, $V = 6.7$ fps < 7.7 (Denver Criteria)

EPA fig 1-15 show data off Chart - $Q < 2$ cfs

Lining Not Required

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE Culvert Calculations
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/9/89

C-30-24

Receives flow from D-30

flow D-30 = 4.5 cfs = Q_{TOT}

Check Pipe Characteristics

- 24" CMP
- $n = 0.024$
- $S = 4\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 24.5$ cfs

since $Q_{allow} > Q_{TOT}$ Culvert is Acceptable

Check Inlet Control

HW depth = 48" $\frac{HW}{D} = 2$

assume projecting entrance - Based on Chart 5 of Federal Highway Administration

$Q_{HW_5} = 21.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ inlet control does not limit

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.362$, $y = 0.58'$, $V = 5.95$ fps > 5.0

Culvert discharges to Concrete ditch

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-31-18
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/9/89

C-31-18

Tributary Flow - D-31 1.48 cfs

Check Pipe Flow

- 18" CMP
- $n = 0.024$
- $S' = 18\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 24.14$ cfs

Since $Q_{allow} > Q_{TOT}$ Pipe Flow not limiting OK

Check Inlet Control

- HW depth = 21.6" $\frac{HW}{D} = 1.2$

from Chart 5 assume projecting entrance

$Q_{HW_5} = 7.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting OK

Riprap Check

Culvert discharges to Concrete ditch

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-32-36
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/9/89

C-32-36

Tributary Flow D-32A, D-32B

$Q_{TOT} = 0.58$ cfs

Check Pipe Flow

- 36" CMP
- $n = 0.024$
- $S = 4\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 72.26$ cfs

Since $Q_{allow} > Q_{TOT}$ Pipe Flow not limiting OK

Check Inlet Control

HW depth = 7.67' (drop box w/grate. Assume headwall entrance conditions to model inlet.)

$\frac{HW}{D} = 2.56$

from Chart 5 $Q_{HW_5} = 80.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet control not limiting OK

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.047$, $y = 0.19'$, $V = 3.1$ fps < 5.0 OK

NO LINING REQ'd

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE Culvert Analysis
PROJECT NO. 007.11-100

SHEET 1 OF 1
COMPUTED paul
CHECKED
DATE 5/9/89

C-33-24

Receives flow from D-33A, D-33B

flow D-33A = 5.36 cfs
D-33B = 6.6 cfs

Q_{TOT} = 11.96 cfs

Check Pipe Characteristics

- 24" CMP
- $n = 0.024$
- $S = 17\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q_{allow} = 50.5 cfs

Since $Q_{allow} > Q_{TOT}$ Culvert is Adequate OK

Check Inlet Control

HW depth = 48" $\frac{HW}{D} = 2.0$

using Chart 5 ⇒ Q_{HW_5} = 22.0 cfs
assume projecting entrance

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control does not limit OK

Riprap Check

Discharges directly to Pond 00AA. Energy adsorbed by water pool.

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE Culvert Analysis
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE

C-34-24

Receives flow from D-34A, D-34B

flow D-34A = 0.64 cfs
D-34B = 1.88 cfs

Q_{TOT} 2.52 cfs

Check culvert Characteristics

- 24" CMP
- $n = 0.024$
- $S = 30\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 67.17$ cfs

Since $Q_{allow} > Q_{TOT}$ Culvert is adequate

Check Inlet Control

HW depth = 4.3'

$$\frac{HW}{D} = \frac{4.3}{2} = 2.15$$

using Chart 5 $\Rightarrow$ $Q_{HW_5} = 22.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet control does not limit

Riprap Check

Discharges directly to Pond 004A - Energy absorbed by water pool.

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE Culvert Analysis
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/9/89

C-35-18

Receives flow from C-36-12 and D-35

C-36-12 has 1.06 cfs
D-35 has 3.00 cfs

$Q_{TOT} = 4.06$ cfs

Check Pipe Characteristics

- 18" Cast Iron
- $n = 0.014$
- $S = 4\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 16.89$ cfs

Since $Q_{allow} > Q_{TOT}$ Culvert is acceptable

Check Inlet Control

HW depth = $\frac{HW}{D} = 1.0$

assume projecting entrance

using Chart 5 $\Rightarrow Q_{HW_5} = 5.5$ cfs

using Chart 7 $\Rightarrow Q_{HW_7} = 6.5$ cfs

select limiting value

$Q_{HW_5} = 5.5$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet control not limiting

Riprap Check $\frac{Q \cdot n}{1.49 S^{1/2}} = 0.191$, $y = 0.47'$, $V = 8.6$ fps, $A = 0.47 ft^2$, $Y_t \sim 0.4'$

According to Denver Criteria Manual: Riprap Needed for $V > 5.5$ Erosive Soils
$V > 7.7$ Erosion Resistant Soils

As per EPA Fig 1-15, $L_a = 5$ ft, $D_{50} = 0.25'$

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Plymt
FEATURE C-36-12
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED RWF
CHECKED
DATE 5/9/89

C-36-12

Trib Flow D-36, C-38-6

D-36 ⇒ 0.70
C-38-6 ⇒ 0.36

1.06 cfs = Q_{TOT}

Check Pipe Flow

- 12" CMP
- n = 0.024
- S = 30%

$Q_{allow} = \frac{1.49}{n} AR^{2/3} S^{1/2}$

Q_{allow} = 10.57 cfs

Since $Q_{allow} > Q_{TOT}$ Pipe Flow not limiting OK

Check Inlet Control

HW depth = 2.2 feet $\frac{HW}{D} = 2.2$

assume projecting entrance

from Chart 5 ⇒ Q_{HW_5} = 4.0 cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting

Riprap Check

$\frac{Qn}{1A95^{1/2}} = 0.031$, y = 0.22', V = 8.3 fps > 7.7 (Denver Criteria)

d_{50} = 0.5' } As Per EPA, fig 1-15
L_a = 5'

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-37-18
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/9/89

C-37-18

Receives all flow from D-37

$Q_{TOT} = 2.6$ cfs

Check Pipe Characteristics

- 18" Cast Iron
- $n = 0.014$
- $S = 2\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 16.89$ cfs

Since $Q_{allow} > Q_{TOT}$ culvert acceptable

Check Inlet Control

HW depth = $\frac{HW}{D} = 1.0$

Check Chart 5 Assume projecting entrance

$Q_{HW_5} = 5.5$ cfs

Check Chart 7 Assume type A entrance

$Q_{HW_7} = 7.0$ cfs

Use limiting value $Q_{HW_5} = 5.5$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.173$, $y = 0.44'$, $V = 6.02' < 7.7$ (Denver Criteria)

No Lining Req'd

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE C-38-6
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED paul
CHECKED
DATE 5/8/89

C-38-6

Area tributary = 313 * 0.00702 = 2.2 acres

		Q		
CN = 70	A = 1.8	0.096	$\bar{Q}$ = 0.210	$\overline{CN}$ = 76.1
CN = 90	A = 0.4	0.723		

Precipitation = 1.55 inches (10 yr, 6 hr SCS)

hydraulic length = 570 feet

$$\text{Slope} = \frac{(1250)(25)(100)}{(2.2)43{,}560} = 32.6\%$$

Run-off Calculations $Q = 0.36$ cfs

Check Pipe Characteristics

- 6" CMP
- $n = 0.024$
- $S = 7\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 0.80$ cfs

since $Q_{allow} > Q_{TOT}$ culvert acceptable

Check Inlet Control

$HW = 18''$ $\frac{HW}{D} = 3.0$

based upon an extrapolation of Chart 5

$Q_{HW_5} \simeq 1.3$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet control not limiting

Riprap Check $\frac{Qn}{1A^{1/2}} = 0.022$, $y = 0.23'$, $V = 4.1$ fps < 7.7 ok

NO LINING REQ'd

PROJECT : Valley Camp Coal - C-38-6 Runoff Calculation

AREA= 2.2 ACRES
AVERAGE BASIN SLOPE= 32.6 PERCENT
CURVE NUMBER= 76.1
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 570. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0444 HOURS QPCFS= 37.50 CFS QPIN=16.9046 INCHES
C3= 83.3230 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.23	.6241	.0000	.0000	.0	.00
2.25	.6411	.0000	.0000	7.6	.00
2.26	.6580	.0003	.0002	28.7	.00
2.28	.6750	.0007	.0004	37.5	.01
2.29	.6919	.0013	.0006	31.7	.03
2.31	.7089	.0020	.0008	21.1	.05
2.32	.7259	.0030	.0009	12.1	.07
2.34	.7428	.0040	.0011	6.2	.09
2.35	.7598	.0053	.0013	3.0	.12
2.37	.7768	.0067	.0014	1.3	.14
2.38	.7937	.0083	.0016	.6	.17
2.40	.8107	.0100	.0017	.2	.19
2.41	.8277	.0119	.0019	.0	.22
2.43	.8446	.0140	.0020	.0	.24
2.44	.8616	.0162	.0022	.0	.26
2.46	.8786	.0185	.0023	.0	.29
2.47	.8955	.0210	.0025	.0	.31
2.48	.9125	.0236	.0026	.0	.33
2.50	.9294	.0264	.0028	.0	.35
2.51	.9344	.0272	.0008	.0	.36
2.53	.9390	.0280	.0008	.0	.32
2.54	.9436	.0288	.0008	.0	.26
2.56	.9482	.0296	.0008	.0	.20
2.57	.9528	.0304	.0008	.0	.16
2.59	.9574	.0312	.0008	.0	.14
2.60	.9619	.0321	.0008	.0	.13

HYDROGRAPH PEAK= .36 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .04 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE C-39-8
PROJECT NO. 007-11-100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/9/89

C-39-8

Tributary Flow D-39A, D-39B

$Q_{TOT} = 0.06$ cfs

Check Pipe Flow

- 8" CMP
- $n = 0.024$
- $S = 8\%$

$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q_{allow} = 1.85$ cfs

Since $Q_{allow} > Q_{TOT}$ Pipe Flow not limiting OK

Check Inlet Control

- HW depth = 1.9 feet $\frac{HW}{D} = 2.8$

Assume projecting entrance

From Chart 5 $Q_{HW_5} = 2.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting OK

Riprap Check

No lining Req'd - by Inspection

C-40-42 tributary area + culverts C-44-24, C-41-12

Trib. Area = 20 * 2.747 = 54.9 acres

CN = 70 (25% Oak/Aspen)

Precipitation = 1.55 inches (10 yr, 6 hr SCS)

Hydraulic length = 2,000 feet

$$\text{slope} = \frac{(8{,}500)(80)(100)}{(43{,}560)(54.9)} = 28.4\%$$

Run-Off Calculation: $Q = 1.81$ cfs $Q_{TOT} = 1.81 + 2.46 + 0.99$

$Q_{TOT} = 5.26$ cfs

Check Pipe Characteristics

- 42" CMP
- $n = 0.027$
- $S = 30\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 265.33$ cfs

since $Q_{allow} >> Q$ culvert adequate

* For a 100 yr, 6 hr event (Not required - CHECK ONLY! Structure not permanent)

Precip = 2.25 in $\Rightarrow Q = 10.88$ cfs

$Q_{TOT} = 10.88 + 14.82 + 1.37 + 0.99 \Rightarrow Q_{TOT} = 28.06$ cfs

Note. even under the 100 yr event

$Q_{allow} > Q$ culvert still adequate

Check Inlet Control

HW depth = 15' $\frac{HW}{D} = \frac{15}{3.5} = 4.3$

assume projecting entrance

Using Chart 5 $\Rightarrow Q_{HW_5} = 140.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control does not limit

Riprap Check from EPA, fig 1-15, $d_{50} = 0.5'$

USE $d_{50} = 1.0'$ $L_a = 10'$ min

PROJECT : Valley Camp Coal - Culvert C-40-42 Capacity Calculations

AREA= 54.9 ACRES
AVERAGE BASIN SLOPE= 28.4 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1539 HOURS QPCFS= 269.71 CFS QPIN= 4.8720 INCHES
C3= 24.0139 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.43	.8522	.0000	.0000	.0	.00
2.46	.8875	.0002	.0002	13.5	.00
2.49	.9229	.0010	.0008	83.8	.03
2.52	.9376	.0015	.0005	179.1	.11
2.56	.9472	.0019	.0004	247.6	.24
2.59	.9567	.0023	.0004	269.7	.37
2.62	.9662	.0027	.0004	252.6	.49
2.65	.9758	.0032	.0005	213.3	.58
2.68	.9853	.0037	.0005	166.8	.65
2.71	.9949	.0043	.0006	123.1	.71
2.74	1.0044	.0049	.0006	86.7	.77
2.77	1.0140	.0055	.0006	58.9	.82
2.80	1.0235	.0062	.0007	38.8	.88
2.83	1.0331	.0069	.0007	24.9	.94
2.86	1.0426	.0077	.0008	15.6	1.01
2.89	1.0521	.0085	.0008	9.6	1.07
2.92	1.0617	.0093	.0008	5.8	1.14
2.96	1.0712	.0102	.0009	3.5	1.20
2.99	1.0808	.0111	.0009	2.1	1.27
3.02	1.0893	.0119	.0008	1.2	1.33
3.05	1.0969	.0127	.0008	.7	1.39
3.08	1.1045	.0135	.0008	.4	1.43
3.11	1.1122	.0143	.0008	.2	1.45
3.14	1.1198	.0152	.0008	.1	1.46
3.17	1.1274	.0160	.0009	.0	1.47
2.43	.8522	.0000	.0000	.0	.00
2.46	.8875	.0002	.0002	13.5	.00
2.49	.9229	.0010	.0008	83.8	.03
2.52	.9376	.0015	.0005	179.1	.11
2.56	.9472	.0019	.0004	247.6	.24
2.59	.9567	.0023	.0004	269.7	.37
2.62	.9662	.0027	.0004	252.6	.49
2.65	.9758	.0032	.0005	213.3	.58
2.68	.9853	.0037	.0005	166.8	.65
2.71	.9949	.0043	.0006	123.1	.71

PROJECT : Valley Camp Coal - Culvert C-40-42 Capacity Calculations (Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.74	1.0044	.0049	.0006	86.7	.77
2.77	1.0140	.0055	.0006	58.9	.82
2.80	1.0235	.0062	.0007	38.8	.88
2.83	1.0331	.0069	.0007	24.9	.94
2.86	1.0426	.0077	.0008	15.6	1.01
2.89	1.0521	.0085	.0008	9.6	1.07
2.92	1.0617	.0093	.0008	5.8	1.14
2.96	1.0712	.0102	.0009	3.5	1.20
2.99	1.0808	.0111	.0009	2.1	1.27
3.02	1.0893	.0119	.0008	1.2	1.33
3.05	1.0969	.0127	.0008	.7	1.39
3.08	1.1045	.0135	.0008	.4	1.43
3.11	1.1122	.0143	.0008	.2	1.45
3.14	1.1198	.0152	.0008	.1	1.46
3.17	1.1274	.0160	.0009	.0	1.47
3.20	1.1351	.0169	.0009	.0	1.48
3.23	1.1427	.0178	.0009	.0	1.49
3.26	1.1503	.0188	.0009	.0	1.51
3.29	1.1580	.0197	.0010	.0	1.54
3.33	1.1656	.0207	.0010	.0	1.57
3.36	1.1732	.0217	.0010	.0	1.60
3.39	1.1809	.0227	.0010	.0	1.63
3.42	1.1885	.0238	.0010	.0	1.67
3.45	1.1961	.0248	.0011	.0	1.71
3.48	1.2038	.0259	.0011	.0	1.75
3.51	1.2107	.0269	.0010	.0	1.79
3.54	1.2159	.0277	.0008	.0	1.81
3.57	1.2212	.0285	.0008	.0	1.81
3.60	1.2264	.0293	.0008	.0	1.78
3.63	1.2317	.0301	.0008	.0	1.72
3.66	1.2369	.0309	.0008	.0	1.66
3.69	1.2422	.0317	.0008	.0	1.60
3.73	1.2474	.0326	.0008	.0	1.56

HYDROGRAPH PEAK= 1.81 cfs
TIME TO PEAK= 3.54 Hours
RUNOFF VOLUME= .44 Acre-Feet

PROJECT : Valley Camp Coal - Culvert C-40-42 (100 yr, 6 hour SCS)

AREA= 54.9 ACRES
AVERAGE BASIN SLOPE= 28.4 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1539 HOURS QPCFS= 269.71 CFS QPIN= 4.8720 INCHES
C3= 24.0139 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.19	.8270	.0000	.0000	.0	.00
2.22	.8783	.0001	.0001	13.5	.00
2.25	.9295	.0012	.0011	83.8	.02
2.28	.9808	.0035	.0023	179.1	.14
2.31	1.0321	.0069	.0034	247.6	.46
2.34	1.0833	.0113	.0045	269.7	1.05
2.37	1.1346	.0169	.0055	252.6	1.94
2.40	1.1858	.0234	.0065	213.3	3.10
2.43	1.2371	.0309	.0075	166.8	4.49
2.46	1.2884	.0394	.0085	123.1	6.03
2.49	1.3396	.0488	.0094	86.7	7.67
2.52	1.3610	.0530	.0042	58.9	9.29
2.56	1.3749	.0558	.0028	38.8	10.46
2.59	1.3888	.0587	.0029	24.9	10.88
2.62	1.4026	.0616	.0029	15.6	10.58
2.65	1.4165	.0646	.0030	9.6	9.81
2.68	1.4303	.0676	.0030	5.8	8.88
2.71	1.4442	.0707	.0031	3.5	7.98
2.74	1.4580	.0739	.0032	2.1	7.24
2.77	1.4719	.0771	.0032	1.2	6.68
2.80	1.4857	.0804	.0033	.7	6.30
2.83	1.4996	.0838	.0033	.4	6.07
2.86	1.5134	.0872	.0034	.2	5.95
2.89	1.5273	.0906	.0035	.1	5.90
2.92	1.5412	.0941	.0035	.0	5.92

HYDROGRAPH PEAK= 10.88 cfs
TIME TO PEAK= 2.59 Hours
RUNOFF VOLUME= 1.55 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE Culverts
PROJECT NO. 027-11-100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/9/89

C-41-12

Mine Discharge from concrete settling Ponds.

data based on records gathered by Vaughn Hansen Assoc from 9/77 to 10/83.

Max value measured. ⇒ 9/12/83 0.99 cfs = Q_{TOT}

Assume maximum value.

Check Pipe Characteristics

- 12" CMP
- $n = 0.024$
- $S = 17\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 7.96$ cfs

Since $Q_{allow} > Q$ Culvert is acceptable

Check Inlet Control

HW depth = 2.4' $\frac{HW}{D} = 2.4$

assume projecting entrance

Use Chart 5 ⇒ $Q_{HW_5} = 4.5$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.039$, $y = 0.24$, $V = 6.8$ fps < 7.7 (Denver Criteria)

No Lining Req'd

PROJECT : Valley Camp Coal - C-26A-24 Runoff Calculation

AREA= 9.2 ACRES
AVERAGE BASIN SLOPE= 52.5 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1780. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0898 HOURS QPCFS= 77.52 CFS QPIN= 8.3562 INCHES
C3= 41.1878 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.26	.6567	.0000	.0000	.0	.00
2.28	.6773	.0000	.0000	3.9	.00
2.30	.6979	.0003	.0003	24.1	.00
2.32	.7184	.0008	.0005	51.5	.00
2.33	.7390	.0015	.0007	71.2	.03
2.35	.7596	.0025	.0010	77.5	.07
2.37	.7802	.0037	.0012	72.6	.12
2.39	.8008	.0052	.0014	61.3	.20
2.41	.8214	.0069	.0017	47.9	.29
2.42	.8420	.0088	.0019	35.4	.38
2.44	.8626	.0109	.0021	24.9	.49
2.46	.8832	.0132	.0023	16.9	.60
2.48	.9037	.0157	.0025	11.2	.71
2.50	.9243	.0185	.0027	7.2	.82
2.51	.9340	.0199	.0014	4.5	.93
2.53	.9396	.0207	.0008	2.8	1.00
2.55	.9452	.0215	.0008	1.7	1.01
2.57	.9507	.0223	.0008	1.0	.96
2.58	.9563	.0232	.0008	.6	.88
2.60	.9619	.0240	.0009	.3	.78
2.62	.9674	.0249	.0009	.2	.69
2.64	.9730	.0258	.0009	.1	.62
2.66	.9785	.0267	.0009	.0	.56

HYDROGRAPH PEAK= 1.01 cfs
TIME TO PEAK= 2.55 Hours
RUNOFF VOLUME= .14 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camps
PROJECT Permit
FEATURE C-42-8
PROJECT NO. 007.11.100

SHEET 1 OF 1
COMPUTED Paul
CHECKED
DATE 5/8/89

C-42-8

Tributary Area D-42

$Q_{TOT} = 0.51$ cfs

Check Pipe Flow

- $n = 0.024$
- 8" CMP
- $S = 5\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 1.46$ cfs

Since $Q_{allow} > Q_{TOT}$ Pipe flow not limiting ok

Check Inlet Control

- HW depth = 2.67'

$$\frac{HW}{D} = \frac{2.67}{.67} = 4.0$$

assume projecting entrance

from Chart 5 ⇒ $Q_{HW_5} = 2.5$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting ok

Riprap Check

$\frac{Qn}{1.49 S^{1/2}} = 0.037$, $y = 0.27'$, $V = 3.85$ fps < 7.7 (Denver Criteria)

NO LINING REQ'd

C-43-8

Total Area = 184 * 0.00702 = 1.3 ac
Undist. Area = 57 * 0.00702 = 0.4 ac (25% Oak/Aspen)
Dist. Area = 130 * 0.00702 = 0.9 ac

CN	Area	Q
70	0.4	0.096
90	0.9	0.723

$\bar{Q} = 0.530$ $\bar{CN} = 86.1$

Precip = 1.55" (10 yr, 6 hr. SCS)

Hydraulic length = 325 feet

$$\text{slope} = \frac{(350)(25)(100)}{43{,}560\,(1.3)} = 24.3\%$$

Run-Off Calculation: $Q = 0.71$ cfs

Check Pipe Characteristics

8" CMP
$n = 0.024$
$S = 30\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 3.59$ cfs

since $Q_{allow} > Q$ culvert adequate

For a 100 year, 6 hour event - NOT REQUIRED, CHECK ONLY

$P = 2.25$ inches $\Rightarrow Q_{TOT} = 1.37$ cfs

since $Q_{allow} > Q_{TOT}$ culvert is acceptable

Check Inlet Control

HW depth = 2.17'

$$\frac{HW}{D} = \frac{2.17}{0.67} = 3.25$$

Use projecting entrance

Use Chart 5 $\Rightarrow Q_{HW_5} = 2.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT
FEATURE
PROJECT NO. 00711.200

SHEET 2 OF 4
COMPUTED DEH
CHECKED
DATE 14 Aug 90

C-43-8 - (Continued)

Riprap Check

$\frac{Qn}{1.49S^{1/2}} = 0.021$, $y = 0.21'$, $V = 7.5$ fps < 7.7 (Denver Criteria)

No Lining Reqd

PROJECT : Valley Camp Coal - Culvert C-43-8 Capacity Calculations

AREA= 1.3 ACRES
AVERAGE BASIN SLOPE= 24.3 PERCENT
CURVE NUMBER= 86.1
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 325. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0238 HOURS QPCFS= 41.38 CFS QPIN=31.5630 INCHES
C3=155.5737 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.88	.3212	.0000	.0000	.0	.00
1.90	.3282	.0000	.0000	41.4	.00
1.93	.3352	.0000	.0000	13.2	.00
1.95	.3422	.0002	.0001	1.5	.00
1.98	.3493	.0004	.0002	.1	.00
2.00	.3563	.0007	.0003	.0	.01
2.36	.7651	.0951	.0103	.0	.57
2.38	.7924	.1058	.0107	.0	.59
2.40	.8197	.1169	.0111	.0	.62
2.43	.8470	.1284	.0115	.0	.64
2.45	.8743	.1404	.0119	.0	.66
2.48	.9016	.1527	.0123	.0	.69
2.50	.9289	.1654	.0127	.0	.71
2.52	.9371	.1693	.0039	.0	.35
2.55	.9444	.1728	.0035	.0	.22
2.57	.9518	.1763	.0035	.0	.20
2.59	.9592	.1799	.0036	.0	.20
2.62	.9666	.1835	.0036	.0	.20
2.64	.9740	.1871	.0036	.0	.20

HYDROGRAPH PEAK= .71 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .06 Acre-Feet

PROJECT : Valley Camp Coal - Culvert C-43-8 (100 yr, 6 hour SCS)

AREA= 1.3 ACRES
AVERAGE BASIN SLOPE= 24.3 PERCENT
CURVE NUMBER= 86.2
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 325. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0237 HOURS QPCFS= 41.53 CFS QPIN=31.6773 INCHES
C3=156.1375 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.52	.3109	.0000	.0000	.0	.00
1.54	.3211	.0000	.0000	41.5	.00
1.56	.3312	.0000	.0000	13.3	.00
1.59	.3413	.0003	.0002	1.5	.00
1.61	.3515	.0006	.0003	.1	.02
1.64	.3616	.0010	.0004	.0	.02
2.35	1.0941	.2522	.0212	.0	1.19
2.37	1.1336	.2740	.0218	.0	1.22
2.39	1.1730	.2964	.0224	.0	1.25
2.42	1.2125	.3193	.0229	.0	1.28
2.44	1.2519	.3428	.0234	.0	1.31
2.46	1.2914	.3667	.0239	.0	1.34
2.49	1.3309	.3911	.0244	.0	1.37
2.51	1.3555	.4066	.0155	.0	1.00
2.54	1.3662	.4133	.0067	.0	.52
2.56	1.3768	.4201	.0068	.0	.40
2.58	1.3875	.4269	.0068	.0	.38
2.61	1.3982	.4338	.0068	.0	.39
2.63	1.4088	.4406	.0069	.0	.39

HYDROGRAPH PEAK= 1.37 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .11 Acre-Feet

C-44-24

Total Area = 27*(2.747) = 74.2 Acres (25% Oak/Aspen)

CN = 70 (25% Oak/Aspen)

Precipitation = 1.55 inches (10 year, 6 hr SCS)

Hydraulic length = 2,000 feet

$$\text{slope} = \frac{(12{,}200)(80)(100)}{43{,}560\ (74.2)} = 30.2\%$$

Run-Off Calculation: $Q = 2.46$ cfs

Check Pipe Characteristics

- 24" CMP
- $n = 0.024$
- $S = 8\%$

$$Q_{allow} = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$Q_{allow} = 34.66$ cfs

Since $Q_{allow} > Q$ culvert adequate

* For a 100 year, 6hr event - NOT REQ'd - CHECK ONLY

Precip = 2.25 inches $\Rightarrow Q_{TOT}$ 14.82 cfs

$Q_{TOT} = 14.82 + 1.37$ ← From C-43-8 $Q_{TOT} = 16.19$ cfs

Note: even under the 24 hr. conditions

$Q_{allow} > Q$ ∴ culvert acceptable

Check Inlet Control

HW depth = 6.3 feet $\frac{HW}{D} = \frac{6.3}{2.0} = 3.15$

Assume projecting entrance

Use Chart 5 $\Rightarrow Q_{HW_5} = 29.0$ cfs

Since $Q_{HW_5} > Q_{TOT}$ Inlet Control not limiting

C-44-2A -(Continued)

Riprap Check

$$\frac{Qn}{1.49S^{1/2}} = 0.140, \quad y = 0.36', \quad V = 6.4 \text{ fps} < 7.7 \text{ (Denver Criteria)}$$

PROJECT : Valley Camp Coal - Culvert C-44-24 Capacity Calculation

AREA= 74.2 ACRES
AVERAGE BASIN SLOPE= 30.2 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1493 HOURS QPCFS= 375.90 CFS QPIN= 5.0240 INCHES
C3= 24.7632 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.42	.8363	.0000	.0000	.0	.00
2.45	.8705	.0000	.0000	18.9	.00
2.48	.9048	.0005	.0005	116.8	.01
2.51	.9324	.0013	.0008	249.5	.08
2.54	.9417	.0016	.0003	345.1	.23
2.57	.9510	.0020	.0004	375.9	.42
2.60	.9602	.0024	.0004	352.1	.60
2.63	.9695	.0029	.0004	297.2	.74
2.66	.9787	.0034	.0005	232.5	.85
2.69	.9880	.0039	.0005	171.5	.93
2.72	.9972	.0044	.0006	120.9	1.00
2.75	1.0065	.0050	.0006	82.1	1.07
2.78	1.0157	.0057	.0006	54.1	1.14
2.81	1.0250	.0063	.0007	34.7	1.22
2.84	1.0343	.0070	.0007	21.8	1.30
2.87	1.0435	.0078	.0007	13.4	1.38
2.90	1.0528	.0085	.0008	8.1	1.47
2.93	1.0620	.0093	.0008	4.9	1.55
2.96	1.0713	.0102	.0008	2.9	1.64
2.99	1.0805	.0111	.0009	1.7	1.73
3.02	1.0888	.0119	.0008	1.0	1.81
3.05	1.0962	.0126	.0008	.6	1.89
3.08	1.1036	.0134	.0008	.3	1.94
3.10	1.1110	.0142	.0008	.2	1.97
3.13	1.1184	.0150	.0008	.0	1.98
3.37	1.1777	.0223	.0010	.0	2.20
3.40	1.1851	.0233	.0010	.0	2.24
3.43	1.1925	.0243	.0010	.0	2.29
3.46	1.1999	.0254	.0010	.0	2.35
3.49	1.2073	.0264	.0011	.0	2.40
3.52	1.2129	.0273	.0008	.0	2.44
3.55	1.2180	.0280	.0008	.0	2.46
3.58	1.2231	.0288	.0008	.0	2.44
3.61	1.2282	.0296	.0008	.0	2.37

PROJECT : Valley Camp Coal - Culvert C-44-24 Capacity Calculation
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
3.64	1.2333	.0303	.0008	.0	2.29
3.67	1.2384	.0311	.0008	.0	2.21
3.70	1.2435	.0319	.0008	.0	2.14
3.73	1.2485	.0328	.0008	.0	2.09

HYDROGRAPH PEAK= 2.46 cfs
TIME TO PEAK= 3.55 Hours
RUNOFF VOLUME= .59 Acre-Feet

PROJECT : Valley Camp Coal - Culvert C-44-24 (100 yr, 6 hour SCS)

AREA= 74.2 ACRES
AVERAGE BASIN SLOPE= 30.2 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1493 HOURS QPCFS= 375.90 CFS QPIN= 5.0240 INCHES
C3= 24.7632 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.18	.8163	.0000	.0000	.0	.00
2.21	.8660	.0000	.0000	18.9	.00
2.24	.9157	.0008	.0008	116.8	.02
2.27	.9654	.0027	.0019	249.5	.13
2.30	1.0152	.0056	.0029	345.1	.47
2.33	1.0649	.0096	.0040	375.9	1.16
2.36	1.1146	.0146	.0050	352.1	2.24
2.39	1.1643	.0205	.0060	297.2	3.69
2.42	1.2140	.0274	.0069	232.5	5.45
2.45	1.2637	.0352	.0078	171.5	7.43
2.48	1.3134	.0439	.0087	120.9	9.57
2.51	1.3535	.0515	.0076	82.1	11.76
2.54	1.3670	.0542	.0027	54.1	13.69
2.57	1.3804	.0569	.0027	34.7	14.78
2.60	1.3939	.0597	.0028	21.8	14.82
2.63	1.4073	.0626	.0029	13.4	14.02
2.66	1.4207	.0655	.0029	8.1	12.79
2.69	1.4342	.0685	.0030	4.9	11.49
2.72	1.4476	.0715	.0030	2.9	10.33
2.75	1.4610	.0746	.0031	1.7	9.42
2.78	1.4745	.0777	.0031	1.0	8.77
2.81	1.4879	.0809	.0032	.6	8.34
2.84	1.5013	.0842	.0033	.3	8.09
2.87	1.5148	.0875	.0033	.2	7.98
2.90	1.5282	.0908	.0034	.0	7.95

HYDROGRAPH PEAK= 14.82 cfs
TIME TO PEAK= 2.60 Hours
RUNOFF VOLUME= 2.10 Acre-Feet

ASCA's

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit Response
FEATURE
PROJECT NO. 007.11.200

SHEET 1 OF 2
COMPUTED DEH
CHECKED
DATE 2 NOV 89

SAE's

SAE's Changed to ASCA's according to new DOGM Policy clarification.

ASCA #3 is dropped - Area has been added to Pond 3

AREA OF ASCA #3 = 0.11 ac

TOTAL AREA CONTAINED BY PONDS = 62.83 ac

POND	AREA
001A	11.53
2A	7.12
3A	7.08
4A	37.10
	62.83 ac

$$Q(in) = \frac{(P-0.2S)^2}{P+0.8S}$$

$$CN = \frac{1000}{10+S}$$

TRIBUTARY AREA FOR ASCA's

ASCA #	AREA Paved	Disturbed	Sage/Grass	Forest	TOTAL
1	—	1.13	—	—	1.13
2	0.11	1.00	—	—	1.11
3	0.75	0.87	—	0.5	2.12
4	—	0.19	—	—	0.19
5	—	1.16	—	—	1.16
6	—	0.95	—	—	0.95

Curve Numbers:

PAVED	= 98
DISTURBED	= 90
SAGE/GRASS	= 75
FOREST	= 70

$P_{10YR-24HR} = 2.45$ in

VOL = Q * AREA
Q = Runoff Depth

ASCA #	Paved Area Q(in)	Vol(AF)	Dist. Area Q(in)	Vol(AF)	Sage/Grass Q(in)	Vol(AF)	Forest Area Q(in)	Vol(AF)	Runoff Vol (Ac-Ft)
1	2.22	—	1.49	0.14	—	—	—	—	0.14
2	2.22	0.02	1.49	0.12	—	—	—	—	0.14
3	2.22	0.14	1.49	0.11	—	—	0.43	0.02	0.27
4	2.22	—	1.49	0.02	—	—	—	—	0.02
5	2.22	—	1.49	0.14	—	—	—	—	0.14
6	2.22	—	1.49	0.12	—	—	—	—	0.12

HANSEN ALLEN & LUCE inc

CLIENT: VALLEY CAMP
PROJECT:
FEATURE:
PROJECT NO.: 007.11.200

SHEET 2 OF 2
COMPUTED: DEH
CHECKED:
DATE: 2 NOV 89

RUNOFF VOLUME INCLUDING TRIBUTARY AREAS

ASCA #	PAVED	DISTURBED	SAGE/GRASS	FOREST/ASPEN	TOTAL
1	—	1.13	—	—	1.13
2	0.60	1.00	—	—	1.60
3	0.75	0.87	—	0.50	2.12
4	—	0.19	—	0.37	0.56
5	—	1.16	—	—	1.16
6	—	0.95	1.00	1.34	3.29

ASCA #	PAVED		DISTURBED		SAGE/GRASS		FOREST/ASPEN		TOTAL RUNOFF VOLUME ac-ft
	Q (in)	Vol (ac-ft)	Q (in)	Vol (ac-ft)	Q (in)	Vol (ac-ft)	Q (in)	Vol (ac-ft)	
1	2.22	—	1.49	0.14	0.62	—	0.43	—	0.14
2	"	0.11	"	0.12	"	—	"	—	0.23
3	"	0.14	"	0.11	"	—	"	0.02	0.27
4	"	—	"	0.02	"	—	"	0.01	0.03
5	"	—	"	0.14	"	—	"	—	0.14
6	"	—	"	0.12	"	0.05	"	0.05	0.22

PERCENT AREA AS ASCA = $\frac{6.66 \text{ ac}}{62.83 \text{ ac}} * 100 = 10.6\%$

TOTAL POND RUNOFF VOLUME

POND #	10-YR, 24-Hr Volume (ac-ft)
001A	1.18
002A	0.94
003A	0.67
004A	3.15
TOTAL	5.94

ASCA Runoff Vol. as a % of Total Pond Runoff Vol = $\frac{0.83}{5.94} * 100 = 14.0\%$

APPENDIX 750

UPDES Discharge Permit

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

FILE COPY

Norman H. Bangerter
Governor

Suzanne Dandoy, M.D., M.P.H.
Executive Director

Route To	Initial	Date
Don	M	10/9
	D	
File		

October 14, 1986
538-6146

Mr. T. G. Whiteside
Valley Camp of Utah, Inc.
Scofield Route
Helper, Utah 84526

RE: Mine water treatment

Dear Mr. Whiteside:

We have reviewed Drawing Nos. B1-0027 and B4-0002 and information submitted 20 August and 17 September, 1986 for the referenced mine water treatment system.

Based upon our review, we have determined that the proposed alteration basically conforms with the State Wastewater Disposal Regulations.

Mine water is collected from the First East Mains and six worked out sections of the Belina No. 1 Mine. This entire area is sealed and provides settlement prior to discharge through pumps. The pumps are controlled by remote sensors. The sensors are located such that the pumps are turned off before the water level reaches the effluents pipes. Water from the First East sump is conveyed to the outlet of Filter Pond 005 where it is combined with treated water from Filter Pond 005 and discharged into Whiskey Creek.

Regular operation and maintenance observations of the pumps and sensors should be made. If the discharge fails to meet State or Federal discharge limitations additional improvements must be made.

Sincerely,

UTAH WATER POLLUTION CONTROL COMMITTEE

Don A. Ostler

for Calvin K. Sudweeks
Executive Secretary

Draft reviewed by SMC
DAO

DRA:jgh

cc: Oil, Gas & Mining
David Ariotti, Southeastern District Health Dept.

0070-43

Kenneth L. Alkema, Director • Division of Environmental Health

288 North 1460 West • P.O. Box 16690 • Salt Lake City, Utah 84116-0690 • (801) 538-6121

STATE OF UTAH
NATURAL RESOURCES
Oil, Gas & Mining

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
Dianne R. Nielson, Ph.D., Division Director

355 W. North Temple • 3 Triad Center • Suite 350 • Salt Lake City, UT 84180-1203 • 801-538-5340

October 15, 1986

Mr. Trevor G. Whiteside
Chief Engineer
Valley Camp of Utah, Inc.
Scofield Route
Helper, Utah 84526

Dear Mr. Whiteside:

Re: Approval of MRP Amendment, Modification of NPDES Permit, 6-inch Bypass Mine Water Discharge Line From Underground Abandoned Workings, Valley Camp of Utah, Inc., Belina Mine, ACT/007/001, Folder #4, Carbon County, Utah

On August 20, 1986 Valley Camp submitted a request to modify their existing NPDES Permit and construct a new 6" mine water discharge pipe from abandoned sections of the mine to the outlet of the Belina Mine filter pond (outfall No. 005). This request, although directed to the Environmental Protection Agency for formal approval, has been reviewed as a MRP permit amendment by the Division.

Currently, all mine water discharge, including both water from abandoned sections of the mine and working sections of the mine, is passed through the filter pond. The proposal requests to pass only water made in the active working sections of the mine through the filter pond and discharge water from the abandoned sections at the pond outlet. The system has been designed so that the monitoring and sampling station will include both discharges and be considered as only one discharge. This discharge will still be administered under the NPDES Permit and all effluent limitations will still apply. Therefore, the proposal is in line with the regulations and approval is hereby granted from the Division contingent upon approval from State Health and the Environmental Protection Agency.

Please contact me or David Cline, should you have any questions or need additional information.

Sincerely,

D. Wayne Hedberg

D. Wayne Hedberg
Permit Supervisor/
Reclamation Hydrologist

djh
cc: Allen Klein
Rob Waline, EPA
Marv Maxell, DEH
Dave Lof
Lowell Braxton
Dave Cline
Sue Linner

8992R/79

#70

Permit No. UT0022985
Minor Industrial

STATE OF UTAH
DIVISION OF WATER QUALITY
DEPARTMENT OF ENVIRONMENTAL QUALITY
SALT LAKE CITY, UTAH

AUTHORIZATION TO DISCHARGE UNDER THE

UTAH POLLUTANT DISCHARGE ELIMINATION SYSTEM
(UPDES)

In compliance with provisions of the Utah *Water Quality Act, Title 19, Chapter 5, Utah Code Annotated ("UCA") 1953, as amended* (the *"Act"*),

VALLEY CAMP OF UTAH

is hereby authorized to discharge from its facility located two (2) miles south of Scofield, Utah, with the outfalls located at latitude 39° 42′ 05″, longitude 111° 09′ 27″, and latitude 39° 41′ 54″, longitude 111° 09′ 25″, and latitude 39° 41′ 47″, longitude 111° 09′ 22″ and latitude 39° 39′ 55″, longitude 111° 10′ 18″, and latitude 39° 40′ 03″, longitude 111° 10′ 07″, to receiving waters named

WHISKEY CREEK and MUD CREEK

in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on

August 19, 1992

This permit and the authorization to discharge shall expire at midnight,

August 31, 1997

Signed this 19th day of August, 1992

Authorized Permitting Official
Executive Secretary
Utah Water Quality Board

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I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Definitions.

1. The "30-day (and monthly) average" is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

2. The "7-day (and weekly) average" is the arithmetic average of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. The 7-day and weekly averages are applicable only to those effluent characteristics for which there are 7-day average effluent limitations. The calendar week which begins on Sunday and ends on Saturday, shall be used for purposes of reporting self- monitoring data on discharge monitoring report forms. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for that calendar week shall be included in the data for the month that contains the Saturday.

3. "Daily Maximum" ("Daily Max.") is the maximum value allowable in any single sample or instantaneous measurement.

4. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

5. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

6. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

7. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

8. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

9. "Executive Secretary" means Executive Secretary of the Utah Water Quality Board.

10. "EPA" means the United States Environmental Protection Agency.

11. "Sludge" is any solid, semi-solid or liquid residue that contains materials removed during treatment. Sludge includes, but is not limited to, primary and secondary solids and sewage products.

12. The term "settleable solids" is that matter measured by the volumetric method specified below.

    Fill an Imhoff cone to the one-liter mark with a thoroughly mixed sample. Allow to settle undisturbed for 45 minutes. Gently stir along the inside surface of the cone with a stirring rod. allow to settle undisturbed for 15 minutes longer. Record the volume of settled material in the cone as milliliters per litter. Where a separation of settleable and floating material occurs, do not include the floating material in the reading.

B. Description of Discharge Point(s).

The authorization to discharge provided under this permit is limited to those outfalls specifically designated below as discharge locations. Discharges at any location not authorized under a UPDES permit is a violation of the *Act* and may be subject to penalties under the *Act*. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge may be subject to criminal penalties as provided under the *Act*.

Outfall Number	Location of Discharge Point(s)
001	A 18 inch discharge pipe located on the Northwest side of the North sediment pond. Located at latitude 39° 42′ 05″ and longitude 111° 09′ 27″, discharging to Mud Creek.
002	A 18 inch discharge pipe located on the West side of the middle sediment pond. Located at latitude 39° 41′ 54″ and longitude 111° 09′ 25″, discharging to Mud Creek.
003	A 18 inch discharge pipe located on the Southwest side of the South sediment pond. Located at latitude 39° 41′ 47″ and longitude 111° 09′ 22″, discharging to Mud Creek.

004	A 18 inch discharge pipe located on the Northeast side of the sediment pond. Located at latitude 39° 39′ 55″ and longitude 111° 10′ 18″, discharging to Whiskey Creek.
005	A 3 inch parshall flume located on the South side of the filter pond. Located at latitude 39° 40′ 03″ and longitude 111° 10′ 07″, discharging to Whiskey Creek.

C. Narrative Standard.

It shall be unlawful, and a violation of this permit, for the permittee to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste, or conditions which produce undesirable aquatic life or which produces objectionable tastes in edible aquatic organisms; or concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by bioassay or other tests performed in accordance with standard procedures.

D. Specific Limitations and Self-monitoring Requirements.

1. Effective immediately and lasting the duration of this permit, the permittee is authorized to discharge from Outfall 001, 002, 003, 004, and 005. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Limitations (Outfalls 001, 002, 003, 004, and 005)

Parameter	30-day Average	7-Day Average	Daily Maximum
Total Suspended Solids	25 mg/L	35 mg/L	70 mg/L
Total Dissolved Solids	700 mg/L	N.A.	1000 mg/L
Iron	N.A.	N.A.	1.0 mg/L
Oil and Grease	N.A.	N.A.	10 mg/L

The pH of the discharge shall not be less than 6.5 nor greater than 9.0 in any sample.

N.A. -- Not Applicable

In addition to these limitations, and in accordance with the Colorado River Basin Salinity Control Forum policy. The Total Dissolved Solids (TDS) from all the outfalls combined may not exceed one (1) ton per day

Effluent Limitation (summation of outfalls 001, 002, 003, 004 and 005)

Parameter	30-day Average	7-Day Average	Daily Maximum
Total Dissolved Solids	1000 lbs/day	N.A.	2000 lbs/day

40 CFR 434.63 entitles this facility to an alternate limits for Total Suspended Solids, and pH, for precipitation events The alternative permit limitations are:

Effluent Limitations

Parameter	30-day Average	7-Day Average	Daily Maximum
Total Settleable Solids	N.A.	N.A.	0.5 mL/L

The pH of the discharge shall not be less than 6.0 nor greater than 9.0 in any sample.

N.A. -- Not Applicable

In order to invoke this alternative, the conditions of 40 CFR 434.63(2) must be met.

Self-Monitoring Requirements (Outfalls 001, 002, 003, 004, and 005)

Parameter	Frequency	Sample Type	Units
Total Flow (a),(b)	Monthly	Estimated	MGD
Total Suspended Solids	Monthly	Grab	mg/L
Total Dissolved Solids	Monthly	Grab	mg/L
Iron	Monthly	Grab	mg/L
Oil and Grease	Monthly	Grab	mg/L
pH	Monthly	Grab	S.U.

(a) Flow measurements of effluent volume shall be made in such a manner that the permittee can affirmatively demonstrate that representative values are being obtained.

(b) If the rate of discharge is controlled, the rate and duration of discharge shall be reported.

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under *Part I* shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge. Sludge samples shall be collected at a location representative of the quality of sludge immediately prior to the use-disposal practice.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under *Utah Administrative Code ("UAC") R317-2- 10*, unless other test procedures have been specified in this permit.

C. Penalties for Tampering. The *Act* provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results. Monitoring results obtained during the previous month shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), post-marked no later than the 28th day of the month following the completed reporting period. The first report is due on **September 28, 1992**. If no discharge occurs during the reporting period, "no discharge" shall be reported. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with the requirements of *Signatory Requirements (see Part IV.G)*, and submitted to the Director, Division of Water Quality and to EPA at the following addresses:

original to: Department of Environmental Quality
Division of Water Quality
288 North 1460 West
PO Box 144870
Salt Lake City, Utah 84114-4870

copy to: United States Environmental Protection Agency Region VIII
Denver Place
999 18th Street, Suite 500
Denver, Colorado 80202-2466
Attention: Water Management Division
Compliance Branch (8WM-C)

E. Additional Monitoring by the Permittee. If the permittee monitors any parameter more frequently than required by this permit, using test procedures approved under *UAC R317-2-10* or as otherwise specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated. Only those parameters required by the permit need to be reported.

F. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

G. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time. A copy of this UPDES permit must be maintained on site during the duration of activity at the permitted location.

H. Twenty-four Hour Notice of Noncompliance Reporting.

1. The permittee shall (orally) report any noncompliance which may seriously endanger health or environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of circumstances. The report shall be made to the Division of Water Quality, (801) 538-6146, or 24 hour answering service (801) 536-4123.

2. The following occurrences of noncompliance shall be reported by telephone (801) 536-4123 as soon as possible but no later than 24 hours from the time the permittee becomes aware of the circumstances:

   a. Any noncompliance which may endanger health or the environment;

   b. Any unanticipated bypass which exceeds any effluent limitation in the permit (See *Part III.G, Bypass of Treatment Facilities.)*;

   c. Any upset which exceeds any effluent limitation in the permit (See *Part III.H, Upset Conditions.*); or,

d. Violation of a maximum daily discharge limitation for any of the pollutants listed in the permit.

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

a. A description of the noncompliance and its cause;

b. The period of noncompliance, including exact dates and times;

c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

e. Steps taken, if any, to mitigate the adverse impacts on the environment and human health during the noncompliance period.

4. The Executive Secretary may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Division of Water Quality, (801) 538-6146.

5. Reports shall be submitted to the addresses in *Part II.D, Reporting of Monitoring Results*.

I. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for *Part II.D* are submitted. The reports shall contain the information listed in *Part II.H.3*.

J. Inspection and Entry. The permittee shall allow the Executive Secretary, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the *Act*, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The *Act* provides that any person who violates a permit condition implementing provisions of the *Act* is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions of the Act is subject to a fine not exceeding $25,000 per day of violation; Any person convicted under *UCA 19-5-115(2)* a second time shall be punished by a fine not exceeding $50,000 per day. Except as provided at *Part III.G, Bypass of Treatment Facilities* and *Part III.H, Upset Conditions*, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

F. Removed Substances. Collected screening, grit, solids, sludges, or other pollutants removed in the course of treatment shall be buried or disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard. Sludge/digester supernatant and filter backwash shall not directly enter either the final effluent or waters of the state by any other direct route.

G. Bypass of Treatment Facilities.

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs 2 and 3 of this section. Return of removed substances, as described in *Part III.F*, to the discharge stream shall not be considered a bypass under the provisions of this paragraph.

2. Notice:

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten (10) days before the date of the bypass.

   b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required under *Part III.I, Twenty- four Hour Reporting*.

3. Prohibition of bypass.

   a. Bypass is prohibited and the Executive Secretary may take enforcement action against a permittee for a bypass, unless:

      (1) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage ;

      (2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

      (3) The permittee submitted notices as required under paragraph 2 of this section.

   b. The Executive Secretary may approve an anticipated bypass, after considering its adverse effects, if the Executive Secretary determines that it will meet the three conditions listed above in paragraph 3.a of this section.

H. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of paragraph 2. of this section are met. Executive Secretary's administrative determination regarding a claim of upset cannot be judiciously challenged by the permittee until such time as an action is initiated for noncompliance.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

   b. The permitted facility was at the time being properly operated;

   c. The permittee submitted notice of the upset as required under *Part II.I, Twenty-four Hour Notice of Noncompliance Reporting*; and,

   d. The permittee complied with any remedial measures required under *Part III.D, Duty to Mitigate.*

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

I. Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of *The Water Quality Act of 1987* for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

J. Changes in Discharge of Toxic Substances. Notification shall be provided to the Executive Secretary as soon as the permittee knows of, or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. One hundred micrograms per liter (100 ug/L);

b. Two hundred micrograms per liter (200 ug/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/L) for 2,4-dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

c. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with *UAC R317-8-3.4(7)* or (10); or,

d. The level established by the Executive Secretary in accordance with *UAC R317-8-4.2(6)*.

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

a. Five hundred micrograms per liter (500 ug/L);

b. One milligram per liter (1 mg/L) for antimony:

c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with *UAC R317-8-3.4(9)*; or,

d. The level established by the Executive Secretary in accordance with *UAC R317-8-4.2(6)*.

K. Industrial Pretreatment. Any wastewaters discharged to the sanitary sewer, either as a direct discharge or as a hauled waste, are subject to Federal, State and local pretreatment regulations. Pursuant to Section 307 of *The Water Quality Act of 1987*, the permittee shall comply with all applicable federal General Pretreatment Regulations promulgated at *40 CFR 403*, the State Pretreatment Requirements at *UAC R317-8-8*, and any specific local discharge limitations developed by the Publicly Owned Treatment Works (POTW) accepting the wastewaters.

In addition, in accordance with *40 CFR 403.12(p)(1)*, the permittee must notify the POTW, the EPA Regional Waste Management Director, and the State hazardous waste authorities, in writing, if they discharge any substance into a POTW which if otherwise disposed of would be considered a hazardous waste under *40 CFR 261*. This notification must include the name of the hazardous waste, the EPA hazardous waste number, and the type of discharge (continuous or batch).

IV. GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when the alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are not subject to effluent limitations in the permit. In addition, if there are any planned substantial changes to the permittee's existing sludge facilities or their manner of operation or to current sludge management practices of storage and disposal, the permittee shall give notice to the Executive Secretary of any planned changes at least 30 days prior to their implementation.

B. Anticipated Noncompliance. The permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Executive Secretary, and,

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph *IV.G.2* is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph *IV.G.2* must be submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The *Act* provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000.00 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential under *UAC R317-8-3.2*, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of Executive Secretary. As required by the *Act*, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability. Nothing in this permit shall be construed to preclude the permittee of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under the *Act*.

K. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability. The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Executive Secretary at least 20 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Executive Secretary does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

N. State Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by *UCA 19-5-117*.

O. Water Quality-Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. Water Quality Standards for the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. A final wasteload allocation is developed and approved by the State and/or EPA for incorporation in this permit.

3. A revision to the current Water Quality Management Plan is approved and adopted which calls for different effluent limitations than contained in this permit.

P. Toxicity Limitation -Reopener Provision.

This permit may be reopened and modified (following proper administrative procedures) to include Whole Effluent Toxicity (WET) testing, or any other conditions related to the control of toxicants if one or more of the following events occur:

1. Toxicity is detected during the life of the permit.

STATEMENT OF BASIS
PERMIT RENEWAL

VALLEY CAMP OF UTAH

UPDES No. UT0022985
MINOR INDUSTRIAL

FACILITY CONTACT:

Walter Wright
President and Chief Operating Officer
Scofield Route
Helper, Utah 84526
Phone: (801) 448-9413

STANDARD INDUSTRIAL CLASSIFICATION (SIC) CODE:

The SIC code for this facility is 1222 (Bituminous Coal Underground Mining).

DESCRIPTION OF FACILITY AND BACKGROUND INFORMATION;

Valley Camp of Utah owns and operates the Valcam loading facility and the Belina underground coal mine. The company began mining operations in 1977, with an average annual output of 750,000 tons. The mine is extracting coal via two (2) continuous miners. All of the mine water is piped to outfall 005. Outfalls 001, 002, and 003 discharge from the Valcam loading facility's disturbed area's settlement ponds. The loading facility is located approximately two (2) miles south of the town of Scofield, Carbon County. Outfall 001 is located at latitude 39° 42′ 05″ and longitude 111° 09′ 27″, discharging to Mud Creek. Outfall 002 is located at latitude 39° 41′ 54″ and longitude 111° 09′ 25″, discharging to Mud Creek. Outfall 003 is located at latitude 39° 41′ 47″ and longitude 111° 09′ 22″ discharging to Mud Creek. Outfalls 004, and 005 discharge from the Belina coal mine. The mine is located approximately six (6) miles south of the town of Scofield, Carbon County. Outfall 004 discharges from the mine's disturbed area's settlement pond. Outfall 005 is a concrete multi-media filter pond for all of the in-mine water. Outfall 004 is located at latitude 39° 39′ 55″ and longitude 111° 10′ 18″, discharging to Whiskey Creek a tributary of Mud Creek. Outfall 005 is located at latitude 39° 40′ 03″ and longitude 111° 10′ 07″, discharging to Whiskey Creek a tributary of Mud Creek. The mine is currently classified as a major discharging facility. In the past three years Valley Camp of Utah has averaged 0.134 MGD for their total discharge, given this fact the Division of Water Quality has petitioned EPA Region VIII to reclassify the mine as a minor discharging facility. The outcome of this petition is unknown at this time, however the permit is written with the assumption that this reclassification has taken place. As of July 1, 1992 Valley Camp of Utah was shutting down operations until a new coal contract can be secured.

DESCRIPTION OF DISCHARGE:

The facility has been reporting on a monthly basis. A summary of the last 12 submitted DMR's is listed on the next page.

Self-Monitoring Data (Outfall 001)

Date	Flow MGD	TSS mg/L	TDS mg/L	Fe mg/L	Oil & Grease mg/L	pH
6-91	No Discharge					
7-91	No Discharge					
8-91	No Discharge					
9-91	No Discharge					
10-91	No Discharge					
11-91	No Discharge					
12-91	No Discharge					
1-92	No Discharge					
2-92	No Discharge					
3-92	No Discharge					
4-92	No Discharge					
5-92	No Discharge					
average permitted	---	25	700	2.0	10.0	6.5-9.0

Self-Monitoring Data (Outfall 002)

Date	Flow MGD	TSS mg/L	TDS mg/L	Fe mg/L	Oil & Grease mg/L	pH
6-91	No Discharge					
7-91	No Discharge					
8-91	No Discharge					
9-91	No Discharge					
10-91	No Discharge					
11-91	No Discharge					
12-91	No Discharge					
1-92	No Discharge					
2-92	No Discharge					
3-92	No Discharge					
4-92	No Discharge					
5-92	No Discharge					
average permitted	---	25	700	2.0	10.0	6.5-9.0

Self-Monitoring Data (Outfall 003)

Date	Flow MGD	TSS mg/L	TDS mg/L	Fe mg/L	Oil & Grease mg/L	pH
6-91	No Discharge					
7-91	No Discharge					
8-91	No Discharge					
9-91	No Discharge					
10-91	No Discharge					
11-91	No Discharge					
12-91	No Discharge					
1-92	No Discharge					
2-92	No Discharge					
3-92	No Discharge					
4-92	No Discharge					
5-92	No Discharge					
average permitted	---	25	700	2.0	10.0	6.5-9.0

Self-Monitoring Data (Outfall 004)

Date	Flow MGD	TSS mg/L	TDS mg/L	Fe mg/L	Oil & Grease mg/L	pH
6-91	No Discharge					
7-91	No Discharge					
8-91	No Discharge					
9-91	No Discharge					
10-91	No Discharge					
11-91	No Discharge					
12-91	No Discharge					
1-92	No Discharge					
2-92	No Discharge					
3-92	No Discharge					
4-92	No Discharge					
5-92	No Discharge					
average permitted	---	25	700	2.0	10.0	6.5-9.0

Self-Monitoring Data (Outfall 005)

Date	Flow MGD	TSS mg/L	TDS mg/L	Fe mg/L	Oil & Grease mg/L	pH
6-91	0.13	1	182	0.50	0.5	7.7-7.9
7-91	0.14	1	158	0.30	1.9	7.7-7.8
8-91	No Discharge					
9-91	0.13	1	262	0.95	0.5	7.7-7.9
10-91	No Discharge					
11-91	No Discharge					
12-91	No Discharge					
1-92	No Discharge					
2-92	No Discharge					
3-92	No Discharge					
4-92	No Discharge					
5-92	No Discharge					
average	0.13	1	201	0.58	0.98	7.7-7.9
permitted	---	25	700	2.0	10.0	6.5-9.0

State-Monitoring Data Outfall 004
(grab samples)

Date	Flow MGD	TSS mg/L	TDS mg/L	Fe mg/L	Oil & Grease mg/L	pH
4-90	0.03	62	---	--	<5.0	8.3
5-90	0.05	48	---	--	<5.0	8.5
6-90	0.09	50	---	--	<5.0	8.3
average	0.05	53	---	--	<5.0	8.3-8.5
permitted	---	70	700	2.0	10.0	6.5-9.0

State-Monitoring Data Outfall 005
(grab samples)

Date	Flow MGD	TSS mg/L	TDS mg/L	Fe mg/L	Oil & Grease mg/L	pH
1-90	0.14	<3	---	--	<5.0	---
2-90	0.03	<3	---	--	<5.0	8.0
4-90	---	<3	---	--	<5.0	---
5-90	0.09	<3	---	--	<5.0	8.3
6-90	0.10	<3	---	--	<5.0	8.2
average	0.09	<3	---	--	<5.0	8.0-8.3
permitted	---	70	700	2.0	10.0	6.5-9.0

permit violations are in **BOLD**

USE CLASSIFICATION OF RECEIVING WATER:

Valley Camp of Utah discharges into Pleasant Valley Creek (Class 1C, 3A, 4) and Whiskey Creek (Class 1C, 3A, 4) a tributary of Pleasant Valley Creek.

Class 1C -- protected for domestic purposes with prior treatment by treatment processes as required by the Utah Department of Environmental Quality.

Class 3A -- protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.

Class 4 -- protected for agricultural uses including irrigation of crops and stockwatering.

EFFLUENT LIMITS:

The 30-day and 7-day limitations on total suspended solids (TSS) and pH limits are based on current Utah Secondary Treatment Standards. The daily maximum limit for TSS is a federal requirement found in 40 CFR 434.45. The concentration limits on total dissolved solids (TDS) are based on best professional judgement (BPJ). The mass limitations on TDS are based upon criteria established by the Colorado River Basin Salinity Control Forum. The iron limit is based upon the State's numeric criteria of a Class 3A water. The oil and grease limits are based upon on best professional judgement (BPJ). The permit limitations are:

Effluent Limitations (Outfalls 001, 002, 003, 004, and 005)

Parameter	30-day Average	7-Day Average	Daily Maximum
Total Suspended Solids	25 mg/L	35 mg/L	70 mg/L
Total Dissolved Solids	700 mg/L	N.A.	1000 mg/L
Iron	N.A.	N.A.	1.0 mg/L
Oil and Grease	N.A.	N.A.	10 mg/L

The pH of the discharge shall not be less than 6.5 nor greater than 9.0 in any sample.

N.A. -- Not Applicable

In addition to these limitations, and in accordance with the Colorado River Basin Salinity Control Forum policy. The total dissolved solids (TDS) from all the outfalls combined may not exceed one (1) ton per day

Effluent Limitation (summation of outfalls 001, 002, 003, 004 and 005)

Parameter	30-day Average	7-Day Average	Daily Maximum
Total Dissolved Solids	1000 lbs/day	N.A.	2000 lbs/day

40 CFR 434.63 entitles this facility to an alternate limits for Total Suspended Solids, and pH, for precipitation events The alternative permit limitations are:

Effluent Limitations

Parameter	30-day Average	7-Day Average	Daily Maximum
Total Settleable Solids	N.A.	N.A.	0.5 mL/L

The pH of the discharge shall not be less than 6.0 nor greater than 9.0 in any sample.

N.A. -- Not Applicable

In order to invoke this alternative, the conditions of 40 CFR 434.63(2) must be met.

SELF-MONITORING REQUIREMENTS:

The following self-monitoring requirements are based on the Utah Monitoring, Recording, and Reporting Frequency Guidelines as revised December 1, 1991. The requirements are:

Parameter	Frequency	Sample Type	Units
Total Flow (a),(b)	Monthly	Estimated	MGD
Total Suspended Solids	Monthly	Grab	mg/L
Total Dissolved Solids	Monthly	Grab	mg/L
Iron	Monthly	Grab	mg/L
Oil and Grease	Monthly	Grab	mg/L
pH	Monthly	Grab	S.U.

(a) Flow measurements of effluent volume shall be made in such a manner that the permittee can affirmatively demonstrate that representative values are being obtained.

(b) If the rate of discharge is controlled, the rate and duration of discharge shall be reported.

PRETREATMENT REQUIREMENTS:

Any wastewater that Valley Camp of Utah discharges to the sanitary sewer, either as a direct discharge or as a hauled waste, are subject to Federal, State and local pretreatment regulations. Pursuant to Section 307 of the Clean Water Act, the permittee shall comply with all applicable Federal General Pretreatment Regulations promulgated, found in 40 CFR 403, the State Pretreatment Requirements found in Utah Administrative Code (UAC) R317-8-8, and any specific local discharge limitations developed by the Publicly Owned Treatment Works (POTW) accepting the waste.

BIOMONITORING REQUIREMENTS:

As part of a nationwide effort to control toxics, biomonitoring requirements are being included in permits for facilities where effluent toxicity is an existing or potential concern. In Utah, this includes all major permittees, and significant minor permittees that are thought to have a potential to discharge toxics. Since Valley Camp of Utah has been conducting Whole Effluent Toxicity (WET) testing since 1988 with no indication of toxicity and is being reclassified as a minor facility, Valley Camp of Utah will not be required to conduct Whole Effluent Toxicity (WET) at this time. The permit will contain a reopener for the inclusion of WET testing event it becomes necessary. Authorization for requiring effluent biomonitoring is provided for in, Utah Administrative Code (UAC) R317-8-4.2 and R317-8-5.3.

SLUDGE DISPOSAL REQUIREMENTS:

The 1987 amendments to the Clean Water Act require EPA to establish toxic contaminate criteria for sludge use and disposal. These criteria are to be imposed through UPDES permits, or other permits, if appropriate, which includes requirements for the use and disposal of sludge that implements the regulations on toxic contaminate criteria. EPA proposed sludge regulations in the Federal Register February 6, 1989. Once these regulations are promulgated, it is anticipated that the State will proceed to adopt equivalent regulations. In lieu of this, the permit will contain a reopener to accommodate any new requirements that may result.

PERMIT DURATION:

It is recommended that the duration of the permit be five (5) years expiring on August 31, 1997.

Drafted by: State of Utah
Paul C. Krauth
Environmental Engineer
August 17, 1992

APPENDIX 760

Channel Reclamation Details

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

Valcam Loadout Area

RECLAIMED CHANNER RC-1

ADD ADDITIONAL AREA TO C-14-42 DATA

C-14-42 CHARACTERISTICS

A = 242.0 Ac
S = 37.9%
CN = 67.5
P = 2.25 (USE 2.3")
D = 6HR
H_L = 5000'
Q_P = 21.9cfs

ADDITIONAL AREA: CALIBRATE = $\frac{1.43ac}{407}$ = 0.00353

AREA ABOVE C-14-42 = 1.33ac
AREA BELOW C-14-42 = 1.83ac } 3.16ac
AREA USED FOR C-14-42 = 242.00ac
245.2ac

SLOPE:
CONTOUR LENGTH (Add'l. AREA) = 6070'
CONTOUR INTERVAL = 5'

$$S = \frac{6070 * 5 * 100}{3.16 * 43560} = 22.0\%$$

$$\text{AVG SLOPE} = \frac{22 * 3.16 + 37.9 * 242}{245.2} = 37.7\%$$

CURVE NUMBER:

		AREA	Q
RECLAIMED CN =	80	3.16	0.75
OAK / ASPEN =	40	123	0.03
SAGE/GRASS =	75	119	0.54
		$\bar{Q}$ =	0.29

CN = 67.4

H_L = 5000 + 1180 = 6180'

Q_{PEAK} = 23.0cfs

Channel Slopes Lower = 7.7% } USE S_{MAX} = 8%
Upper = 7.9% } S_{MIN} = 7.5%

D_{50} = 1.0' D_{MAX} = 1.75' USE TYPE II GRANULAR FILTER

PROJECT : Valley Camp of Utah, Inc. Reclaimed Channel RC-1; 100 Yr 6 Hr

AREA= 245.2 ACRES
AVERAGE BASIN SLOPE= 37.7 PERCENT
CURVE NUMBER= 67.4
DESIGN STORM= 2.30 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 6180. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .3531 HOURS QPCFS= 525.10 CFS QPIN= 2.1237 INCHES
C3= 10.4679 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.19	.8515	.0000	.0000	.0	.00
2.26	.9717	.0000	.0000	26.3	.00
2.33	1.0919	.0031	.0031	163.1	.08
2.40	1.2121	.0118	.0087	348.6	.74
2.47	1.3323	.0256	.0138	482.0	2.87
2.54	1.3996	.0355	.0099	525.1	7.04
2.61	1.4321	.0407	.0053	491.9	12.38
2.68	1.4646	.0463	.0056	415.2	17.19
2.75	1.4971	.0523	.0059	324.7	20.48
2.83	1.5296	.0585	.0063	239.6	22.22
2.90	1.5620	.0651	.0066	168.9	22.89
2.97	1.5945	.0720	.0069	114.7	23.02
3.04	1.6236	.0784	.0064	75.5	23.00
3.11	1.6496	.0843	.0059	48.5	22.94
3.18	1.6756	.0905	.0061	30.4	22.81
3.25	1.7016	.0968	.0063	18.8	22.62
3.32	1.7276	.1033	.0065	11.4	22.42
3.39	1.7536	.1099	.0067	6.8	22.29
3.46	1.7796	.1168	.0068	4.0	22.27
3.53	1.8019	.1228	.0060	2.3	22.37
3.60	1.8198	.1277	.0049	1.3	22.43
3.67	1.8377	.1327	.0050	.8	22.23
3.74	1.8555	.1378	.0051	.4	21.72
3.81	1.8734	.1430	.0052	.2	21.03
3.88	1.8913	.1482	.0052	.1	20.30
3.96	1.9092	.1535	.0053	.0	19.68

HYDROGRAPH PEAK= 23.02 cfs
TIME TO PEAK= 2.97 Hours
RUNOFF VOLUME= 5.80 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp of Utah, Inc. — Date: 26-Feb-90
Project No.: 007.12.100 — Time: 09:25 AM
Channel Section: Reclaimed Channel RC-1 — Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	23.00	cfs
	Bottom Width:	5.0	feet
	Side Slope1:	3.0	1/m1
	Side Slope2:	3.0	1/m2
	Friction Factor:		
	Assumed D50:	1.00	feet
	Calc n Value:	0.040	
	Used:	0.040	
	Min. Bottom Slope:	0.075	ft/ft
	Max. Bottom Slope:	0.080	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.58	feet
	Qn/1.49(S)1/2=	2.261	
	A(R)2/3=	2.263	
	Required Depth:	1.08	feet
	Area:	3.87	ft2
	Perimeter:	8.64	feet
	Hydraulic Radius:	0.45	feet
	Velocity:	5.95	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.57	feet
	Qn/1.49(S)1/2=	2.189	
	A(R)2/3=	2.192	
	Required Depth:	1.07	feet
	Area:	3.78	ft2
	Perimeter:	8.57	feet
	Hydraulic Radius:	0.44	feet
	Velocity:	6.08	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	5.0	feet
	Side Slope 1:	3.0	1/m1
	Side Slope 2:	3.0	1/m2
	Min. Bottom Slope:	7.5	%
	Max. Bottom Slope:	8.0	%
	Min Channel Depth:	1.08	feet
	Riprap (Min S):	Required	
	Riprap (Max S):	Required	

RIPRAP DESIGN - Using the RED BOOK (Applied Hydrology and for Disturbed Areas)

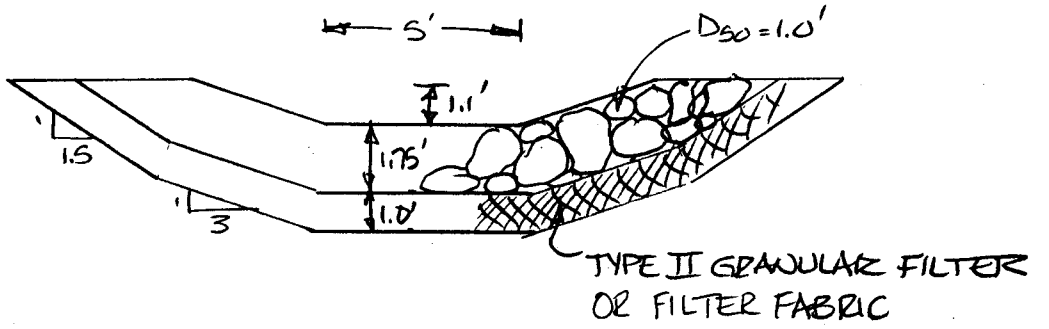
Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:25 AM
Channel Section: Reclaimed Channel RC-1 Computed:DEH

			UNITS
DESIGN CRITERIA:	Design Flow:	23.00	cfs
	Bottom Width:	5.00	feet
	Side Slope1:	3.00	1/m1
	Side Slope2:	3.00	1/m2
	Friction Factor:	0.04	
	Min. Bottom Slope:	0.08	ft/ft
	Max. Bottom Slope:	0.08	ft/ft
	Freeboard:	0.50	feet
	Depth (Min. S):	0.58	feet
	Depth (Max. S):	0.57	feet
	Angle Repose (Ar):	42	degrees

Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	Smin	Smax	
D50	1.00	1.00	feet
T	2.69	2.82	lb/ft2
Nb	0.55	0.58	
Tmax	2.05	2.14	lb/ft2
Ns	0.42	0.44	
m Critical	3.00	3.00	
A (m crit)	18.44	18.44	degrees
B	29.55	30.58	degrees
Nsp	0.32	0.34	
SFb	1.58	1.50	
SFs	1.51	1.47	

RC-1 X-SECTION



INLET SECTION

USE SAME AS BELINA EXCEPT

D_{50} = 1.0' ; S = 7.9%

OUTLET SECTION

USE SAME AS BELINA EXCEPT

D_{50} = 1.0' ; S = 7.7% ; MAX OUTLET BOTTOM WIDTH = 10'
FLATTEN SIDE SLOPES TO ZERO AT CHANNEL END

PIPE INLET

DESIGN INLET + OUTLET TO CARRY 100YR-6 HR EVENT

INLET D_{50} CAN USE SAME AS CHANNEL

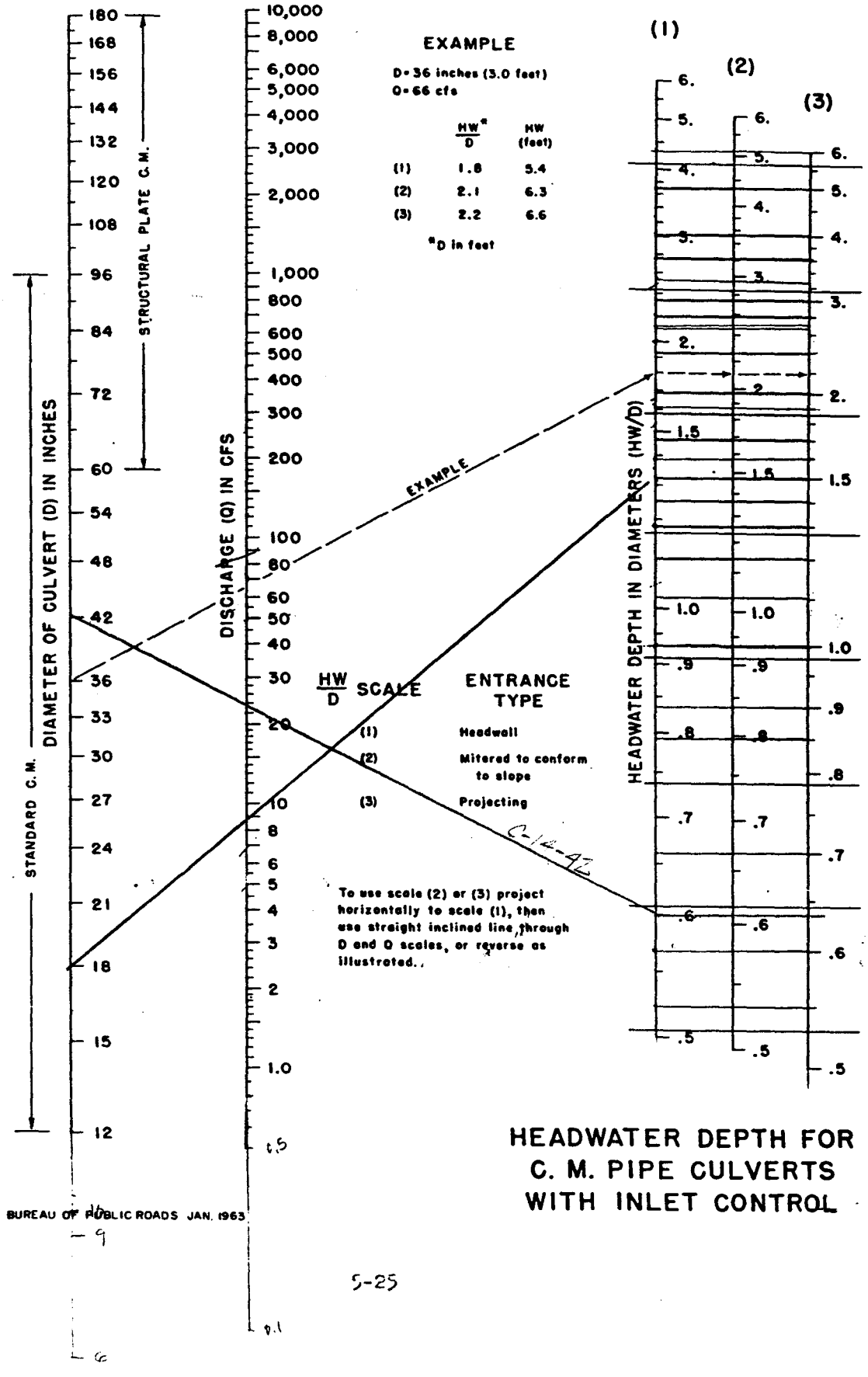
OUTLET D_{50} BASED UPON CULVERT VELOCITY CHARACTERISTICS.

INLET FLOW (CHART 5) SHOWS HW/d = 0.65

42 * 0.65 = 27.3" = 2.3' RAISE RIPRAP TO D = 3.0'

6/12

CHART 5



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

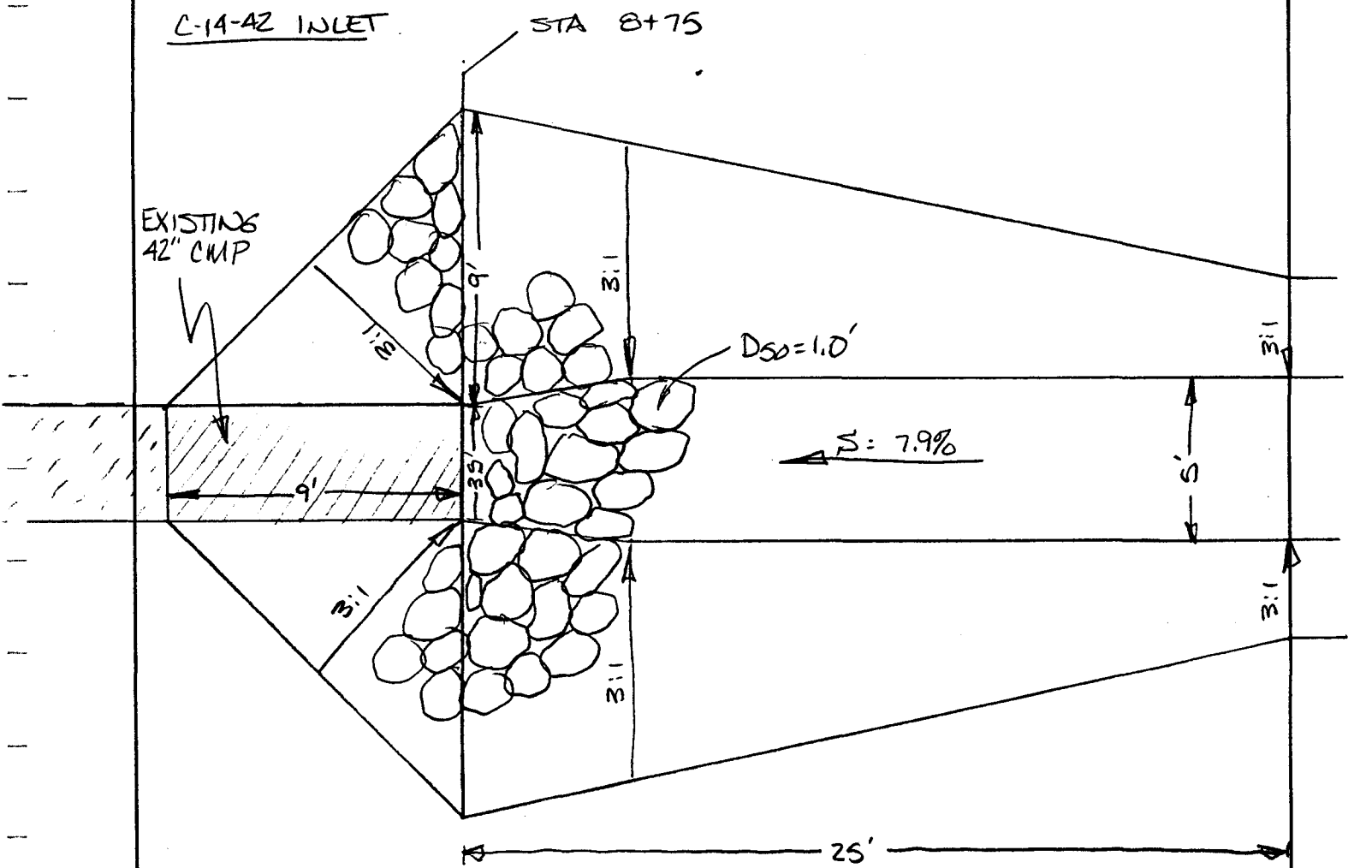
BUREAU OF PUBLIC ROADS JAN. 1963

HANSEN ALLEN & LUCE INC

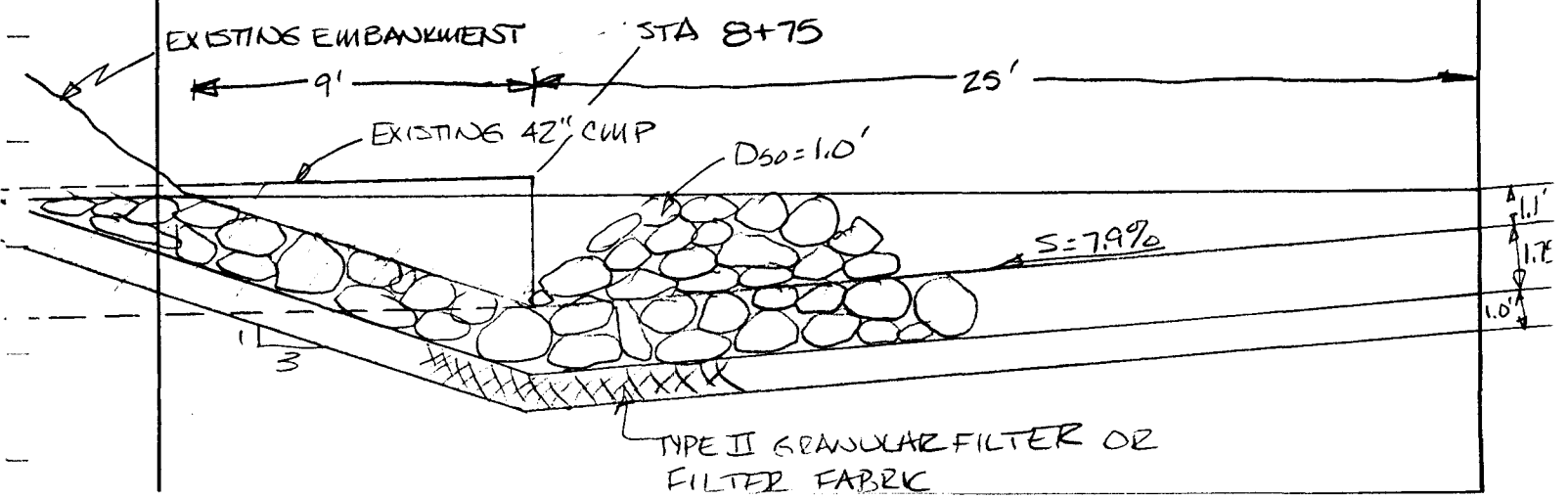
CLIENT: VALLEY CAMP
PROJECT: RECLAMATION
FEATURE:
PROJECT NO.: 007.12.100

SHEET 7 OF 12
COMPUTED: DBM
CHECKED:
DATE: 25 JAN 90

C-14-42 INLET



C-14-42 INLET



C-14-42 OUTLET

DESIGN USING TRAPEZOIDAL CHANNEL DESIGN WITH b = 3.5'

From design, $D_{50} = 1.25'$; Carry 15' downstream as channel width increases, then return D_{50} to 1.0'. Also take Channel depth from normal depth + 1.0' @ OUTLET to design depth.

Calc. y_n: $Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$ Assume $S = \frac{10}{120} * 100 = 8.3\%$

$\frac{Qn}{1.49 S^{1/2}} = 1.283$

Y	$AR^{2/3}$	
1.0	1.568	A = 1.96
0.9	1.275	→ V = 11.75
0.91	1.303	

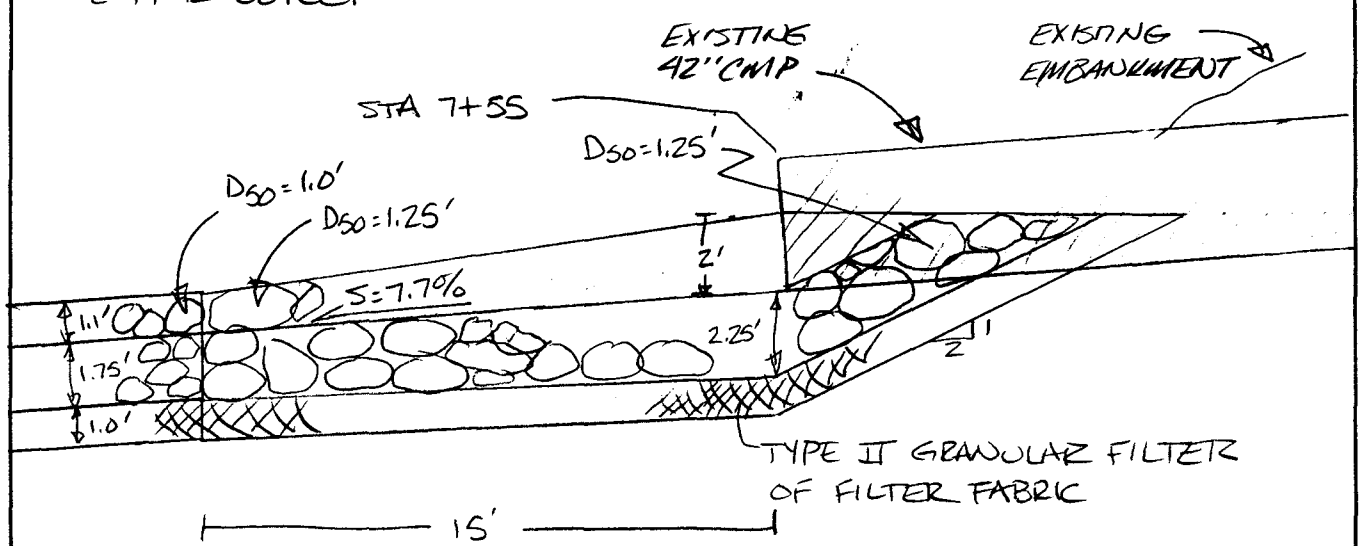
If S = 5% $\frac{Qn}{1.49 S^{1/2}} = 1.657$

Y	$AR^{2/3}$
1.1	1.885
1.05	1.724
1.01	1.596
1.02	1.629

Depth didn't change much, Start w/ Riprap depth = 2.0'

$D_{50} = 1.25'$, $D_{max} = 2.25'$
$D_{50} = 1.0'$, $D_{max} = 1.75'$

C-14-42 OUTLET



Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:27 AM
Channel Section: Channel RC-1; C-14-42 Outlet Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	23.00	cfs
	Bottom Width:	3.5	feet
	Side Slope1:	3.0	1/m1
	Side Slope2:	3.0	1/m2
	Friction Factor:		
	Assumed D50:	1.25	feet
	Calc n Value:	0.041	
	Used:	0.041	
	Min. Bottom Slope:	0.077	ft/ft
	Max. Bottom Slope:	0.077	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.68	feet
	Qn/1.49(S)1/2=	2.287	
	A(R)2/3=	2.286	
	Required Depth:	1.18	feet
	Area:	3.73	ft2
	Perimeter:	7.77	feet
	Hydraulic Radius:	0.48	feet
	Velocity:	6.17	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.68	feet
	Qn/1.49(S)1/2=	2.287	
	A(R)2/3=	2.286	
	Required Depth:	1.18	feet
	Area:	3.73	ft2
	Perimeter:	7.77	feet
	Hydraulic Radius:	0.48	feet
	Velocity:	6.17	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	3.5	feet
	Side Slope 1:	3.0	1/m1
	Side Slope 2:	3.0	1/m2
	Min. Bottom Slope:	7.7	%
	Max. Bottom Slope:	7.7	%
	Min Channel Depth:	1.18	feet
	Riprap (Min S):	Required	
	Riprap (Max S):	Required	

RIPRAP DESIGN - Using the RED BOOK (Applied Hydrology and for Disturbed Areas)

Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:27 AM
Channel Section: Channel RC-1; C-14-42 Outlet Computed:DEH

			UNITS
DESIGN CRITERIA:	Design Flow:	23.00	cfs
	Bottom Width:	3.50	feet
	Side Slope1:	3.00	1/m1
	Side Slope2:	3.00	1/m2
	Friction Factor:	0.04	
	Min. Bottom Slope:	0.08	ft/ft
	Max. Bottom Slope:	0.08	ft/ft
	Freeboard:	0.50	feet
	Depth (Min. S):	0.68	feet
	Depth (Max. S):	0.68	feet
	Angle Repose (Ar):	42	degrees

Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	Smin	Smax	
D50	1.25	1.25	feet
T	3.24	3.24	lb/ft2
Nb	0.53	0.53	
Tmax	2.46	2.46	lb/ft2
Ns	0.40	0.40	
m Critical	3.00	3.00	
A (m crit)	18.44	18.44	degrees
B	28.67	28.67	degrees
Nsp	0.31	0.31	
SFb	1.62	1.62	
SFs	1.53	1.53	

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PROJECT NO. 007.12.100

SHEET 11 OF 12
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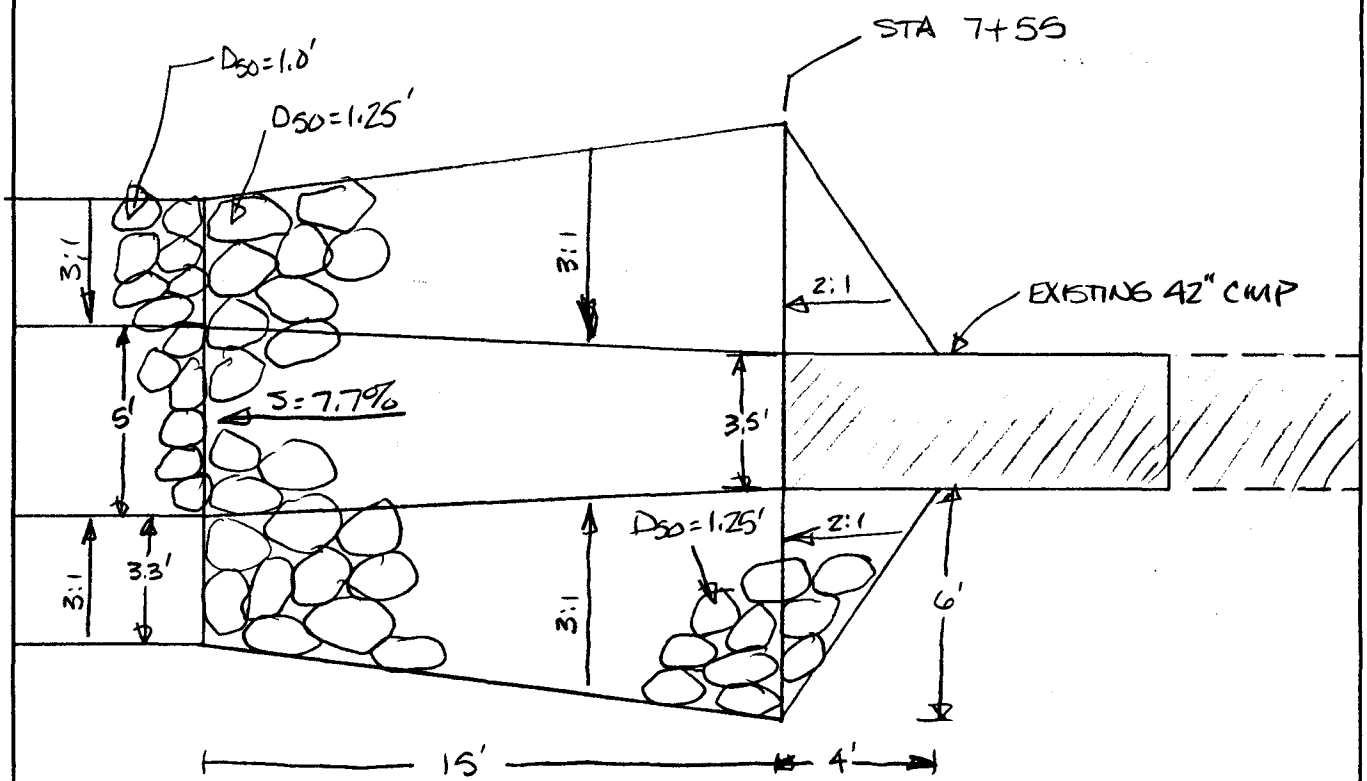
CHECKED
DATE 15 JAN 90

C-14-A2 OUTLET



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CLIENT VALLEY CAMP
PROJECT RECLAMATION
FEATURE
PROJECT NO. 007.12.100

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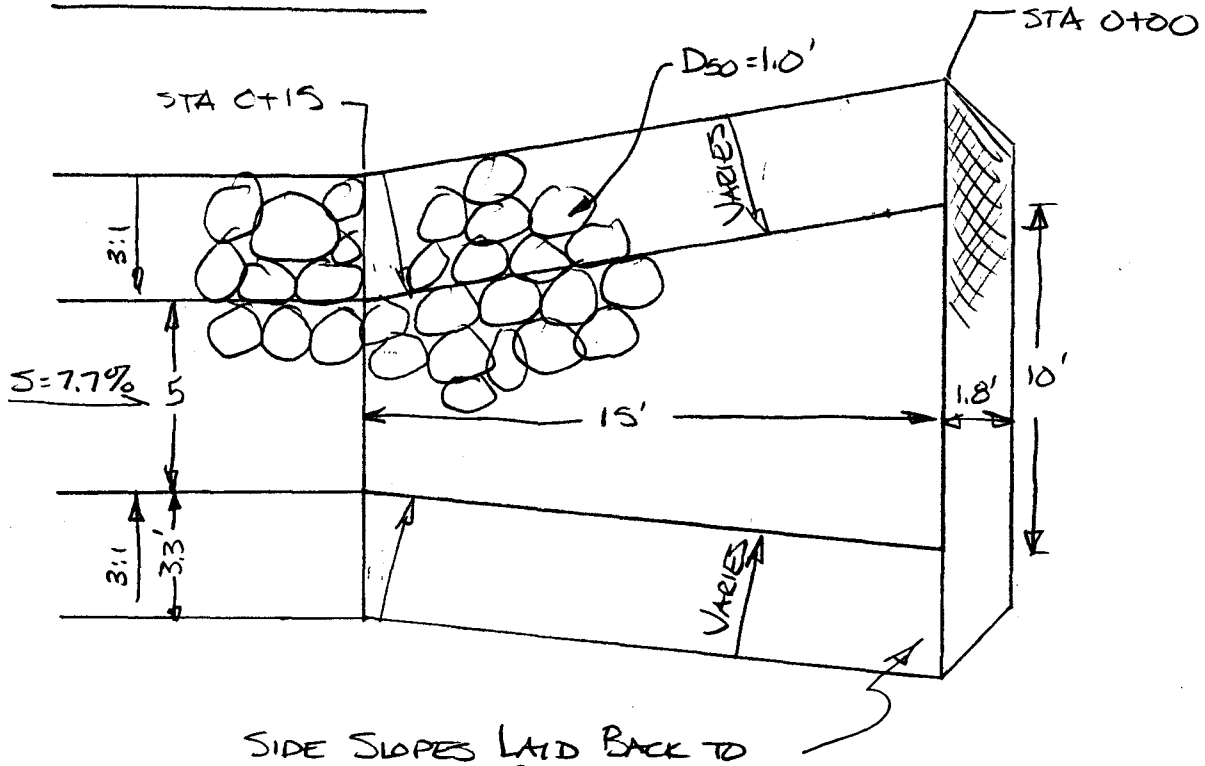
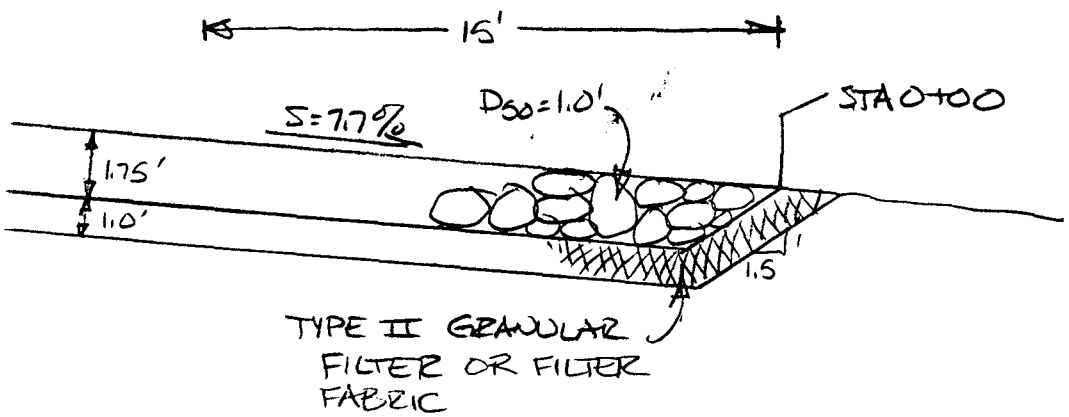
COMPUTED DEH
CHECKED
DATE 25 JAN 90

VALCAN RC-1 OUTLET



SIDE SLOPES LAID BACK TO MATCH LOCAL CONDITIONS - SIDE SLOPE VARIES BETWEEN STA 0+00 AND STA 0+15



TYPE II GRANULAR FILTER OR FILTER FABRIC

C-19-48, C-20-48

FROM CALCULATIONS PRESENTED IN "HYDROLOGIC CALCULATIONS" APPENDIX.

$A = 1485$ ac
$\overline{CN} = 72.6$
$H_L = 16{,}600$ ft
$S = 39.3\%$

Precipitation = 2.25 in (100 Yr, 6 Hr)

from "Hydro": $Q = 210$ cfs

CULVERT CHECK

210 cfs is greater than inlet capacity of either culvert.

Culvert	Inlet Capacity
C-19-48	130
C-20-48	140

∴ Must replace culverts

C-19-48

Inlet Control: HW = 8.5 ft

Try 54" CMP HW/D = 8.5/4.5 = 1.9

from Chart 5 Qmax = 160 cfs < 210 req'd

Try 66" CMP HW/D = 8.5/5.5 = 1.55

from Chart 5 Qmax = 230 cfs > 210 cfs Q

Pipe Control: Pipe length ≈ 60 ft, n = 0.027 (66" Dia)

Max friction Slope = (8.5-5.5)/60 + 0.06 (Pipe Slope) = 0.11

$Q = \frac{1.49}{n} A R^{2/3} S_f^{1/2} = 536$ cfs > 210 cfs Req'd

USE 66" Φ CMP

PROJECT : Valley Camp Coal - C-19-48, C-20-48 100Yr, 6Hr Runoff Calc

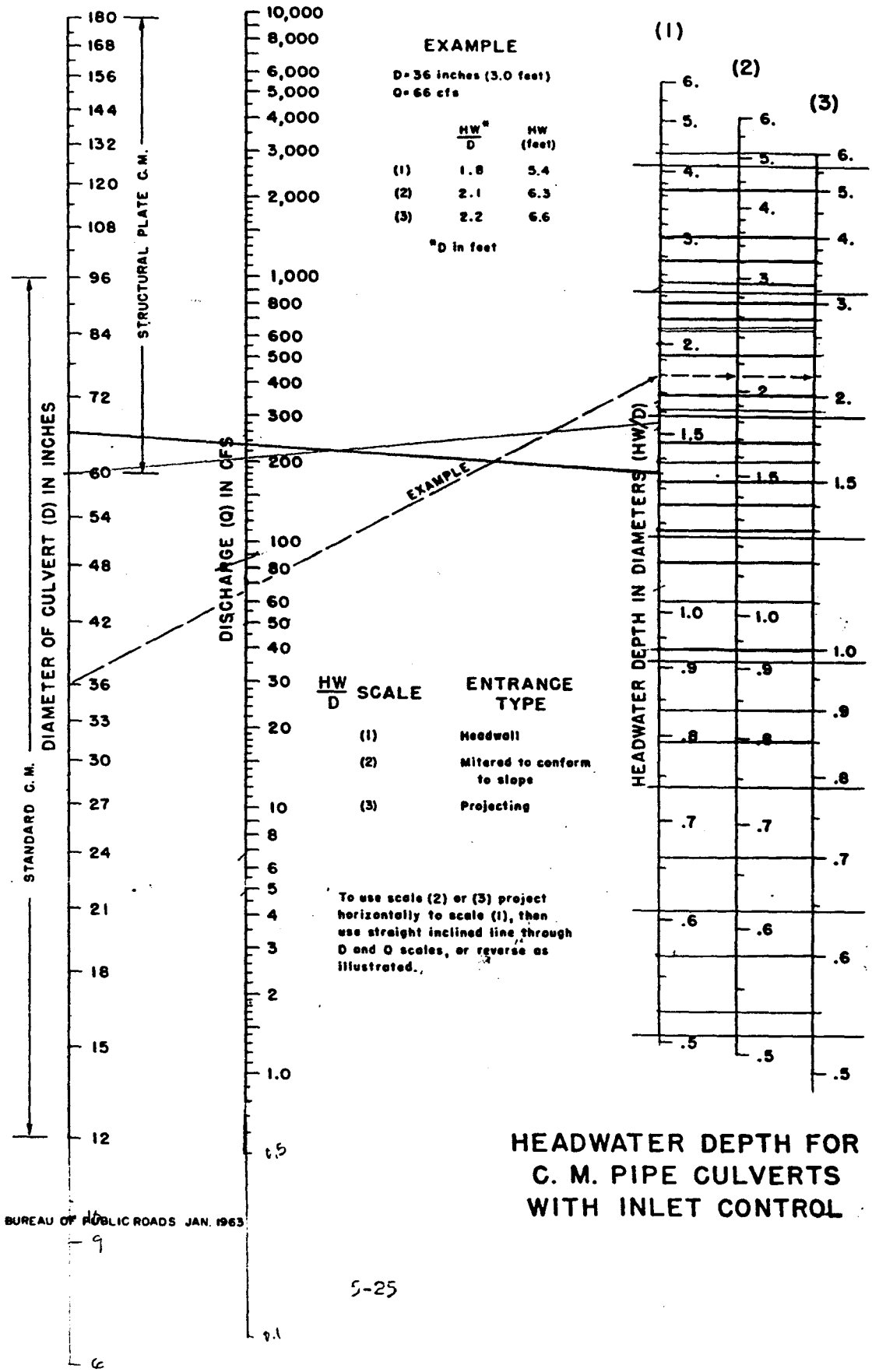
AREA= 1485.0 ACRES
AVERAGE BASIN SLOPE= 39.3 PERCENT
CURVE NUMBER= 72.6
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 16600. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .6624 HOURS QPCFS= 1695.40 CFS QPIN= 1.1322 INCHES
C3= 5.5807 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.12	.7168	.0000	.0000	.0	.00
2.25	.9373	.0084	.0084	85.1	.72
2.38	1.1579	.0389	.0305	526.6	7.03
2.52	1.3577	.0830	.0441	1125.5	29.28
2.65	1.4173	.0989	.0159	1556.4	72.00
2.78	1.4769	.1160	.0170	1695.4	121.21
2.91	1.5365	.1341	.0182	1588.2	162.15
3.05	1.5919	.1520	.0178	1340.6	189.52
3.18	1.6396	.1680	.0161	1048.5	204.46
3.31	1.6873	.1848	.0167	773.7	210.00
3.44	1.7350	.2021	.0173	545.3	209.74
3.58	1.7740	.2167	.0146	370.3	206.67
3.71	1.8068	.2293	.0126	243.9	201.79
3.84	1.8396	.2422	.0129	156.5	194.94
3.97	1.8724	.2553	.0131	98.3	186.62
4.11	1.9028	.2677	.0124	60.6	177.97
4.24	1.9326	.2801	.0124	36.7	169.80
4.37	1.9624	.2927	.0126	21.9	162.57
4.50	1.9920	.3054	.0127	12.9	156.63
4.64	2.0159	.3158	.0104	7.5	151.91
4.77	2.0397	.3263	.0105	4.4	147.51
4.90	2.0636	.3370	.0106	2.5	142.85
5.03	2.0874	.3477	.0108	1.4	138.12
5.17	2.1113	.3586	.0109	.8	133.79
5.30	2.1351	.3696	.0110	.4	130.26
5.43	2.1589	.3807	.0111	.2	127.70
5.56	2.1814	.3913	.0106	.1	126.04
5.70	2.2022	.4012	.0099	.0	124.84

HYDROGRAPH PEAK= 210.00 cfs
TIME TO PEAK= 3.31 Hours
RUNOFF VOLUME= 52.14 Acre-Feet

CHART 5



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

C-20-48

Allowable pipe diameter is limited by existance of gas pipeline from Alpine School Dstrict Facility to Valley Camp Office building. Provide two alternatives.

1) Design based on Round CMP
2) Design based on Arch CMP

ROUND CMP

Inlet Control $HW = 9.0$

Try 60" CMP $HW/D = 9.0/5.0 = 1.8$

from Chart 5, $Q_{max} = 210\,cfs = Req'd\ Q$ ok

Pipe Control Pipe Length = 20', $n = 0.024$

Max friction Slope $= (9.0-5)/20 + 0.04\,(\text{Pipe Slope}) = 0.24$

$Q = \frac{1.49}{n} A R^{2/3} S_f^{1/2} = 691\,cfs > 210\,cfs$ Req'd ok

If 60" CMP is too high, Try an Arch Culvert. (See Chart 6)

Try a 72"x44" cm Arch $HW/D = 9.0/(44/12) = 2.45$

$Q_{max} \sim 200\,cfs$ - Change to Mitered Entrance decreases entrance loss.

$\therefore Q_{max} = 205\,cfs \simeq Q$ Req'd (w/Mitered Entrance)

Installing a headwall provides required flow

$\therefore Q_{max} = 230\,cfs > 210\,cfs$ Req'd (w/Headwall)

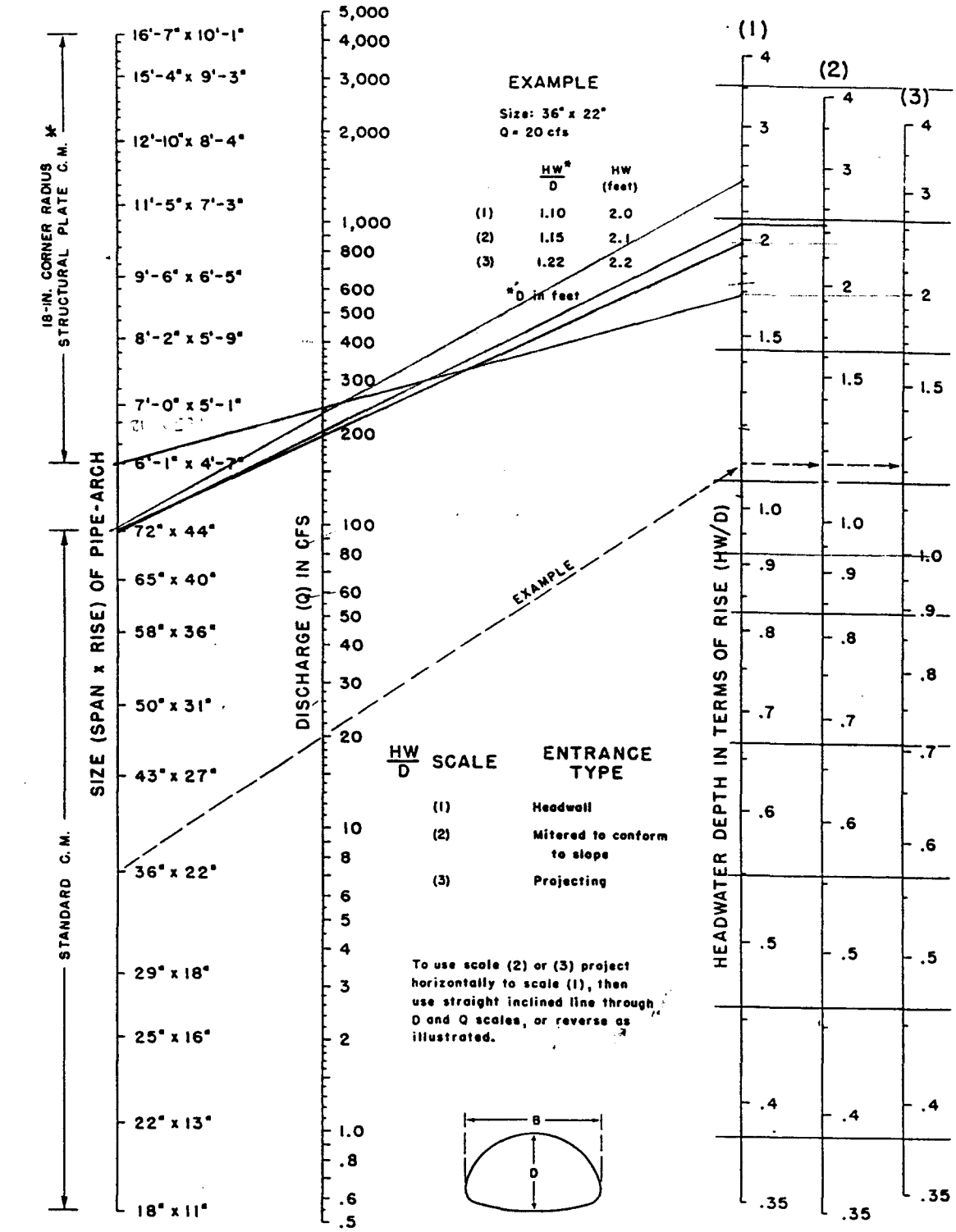
Or, if a 6'-1"x4'7" will fit upon excavation,

$HW/D = 9.0/4.58 = 2.0$

$Q_{max} = 240\,cfs > 210\,cfs$ Req'd

If round 60" CMP doesn't fit, try a 61"x47" Arch CMP. If it doesn't fit, use a 72"x44" Arch CMP with Headwall

CHART 6



*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

BUREAU OF PUBLIC ROADS JAN. 1963

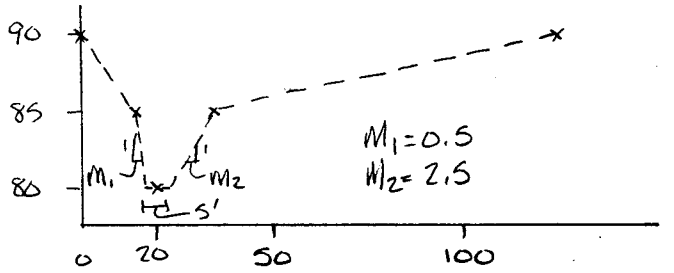
HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

PERMANENT EROSION PROTECTION

Evaluate Tailwater Conditions

below C-19-48 (from 1:100 Topo Map) b~5', S=5%, n=0.04

Channel Cross Section



X	Elev
0	90
15	85
20	80
35	85
125	90

TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client : Valely Camp of Utah Inc.
Project No. : 007.14.100
Channel Section: Channel Below C-19-48

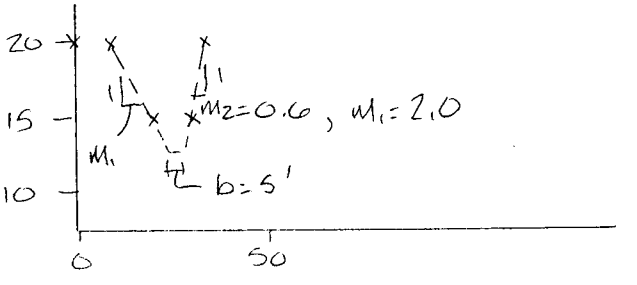
Date : 29-Dec-92
Time : 02:08 PM
Computed: DEH

				UNITS
GENERAL CRITERIA:	Design Flow	:	210.00	cfs
	Bottom Width	:	5.0	feet
	Side Slope1	:	0.5	1/m1
	Side Slope2	:	2.5	1/m2
	Friction Factor	:		
	Assumed D50	:	1.00	feet
	Calc n Value	:	0.040	
	Used	:	0.040	
	Min. Bottom Slope	:	0.050	ft/ft
	Max. Bottom Slope	:	0.050	ft/ft
	Freeboard	:	1.00	feet
CALCULATION: (Channel Depth)	Depth (Min. S):		2.34	feet

$T_w = 2.3' < 0.5$(Dia) of CMP (66") use Fig 1-15

below C-20-48 b=5', S=10%, n=0.04

X	Elev
0	20
10	20
20	15
30	15
33	20



TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client : Valely Camp of Utah Inc.
Project No. : 007.14.100
Channel Section: Channel Below C-20-48

Date : 29-Dec-92
Time : 02:16 PM
Computed: DEH

				UNITS
GENERAL CRITERIA:	Design Flow	:	210.00	cfs
	Bottom Width	:	5.0	feet
	Side Slope1	:	0.6	1/m1
	Side Slope2	:	2.0	1/m2
	Friction Factor	:		
	Assumed D50	:	1.00	feet
	Calc n Value	:	0.040	
	Used	:	0.040	
	Min. Bottom Slope	:	0.100	ft/ft
	Max. Bottom Slope	:	0.100	ft/ft
	Freeboard	:	1.00	feet
CALCULATION: (Channel Depth)	Depth (Min. S):		1.99	feet

Tw = 1.99' < 0.5(Dia) of CMP likely to be used - Use Fig 1-15

C-19-48 (66" CMP on Reclamation)

from Fig 1-15, Riprap Apron Length = 28'
D_{50} = 0.9 ft

C-20-48 (60", 6'1"x4'7", or 72"x44" on Reclamation)

	Culvert	Apron Length (ft)	D50 (ft)	Comment
From Fig 1-15	60" Round	34	1.1	—
	6'1"x4'7"	22	0.7	Based on a 72" Round CMP
	72"x44"	22	0.7	Based on a 72" Round CMP

Since riprap sizing is a function of velocity, recommend using dimensions compatable with a the 60" CMP for all three installation possibilities.

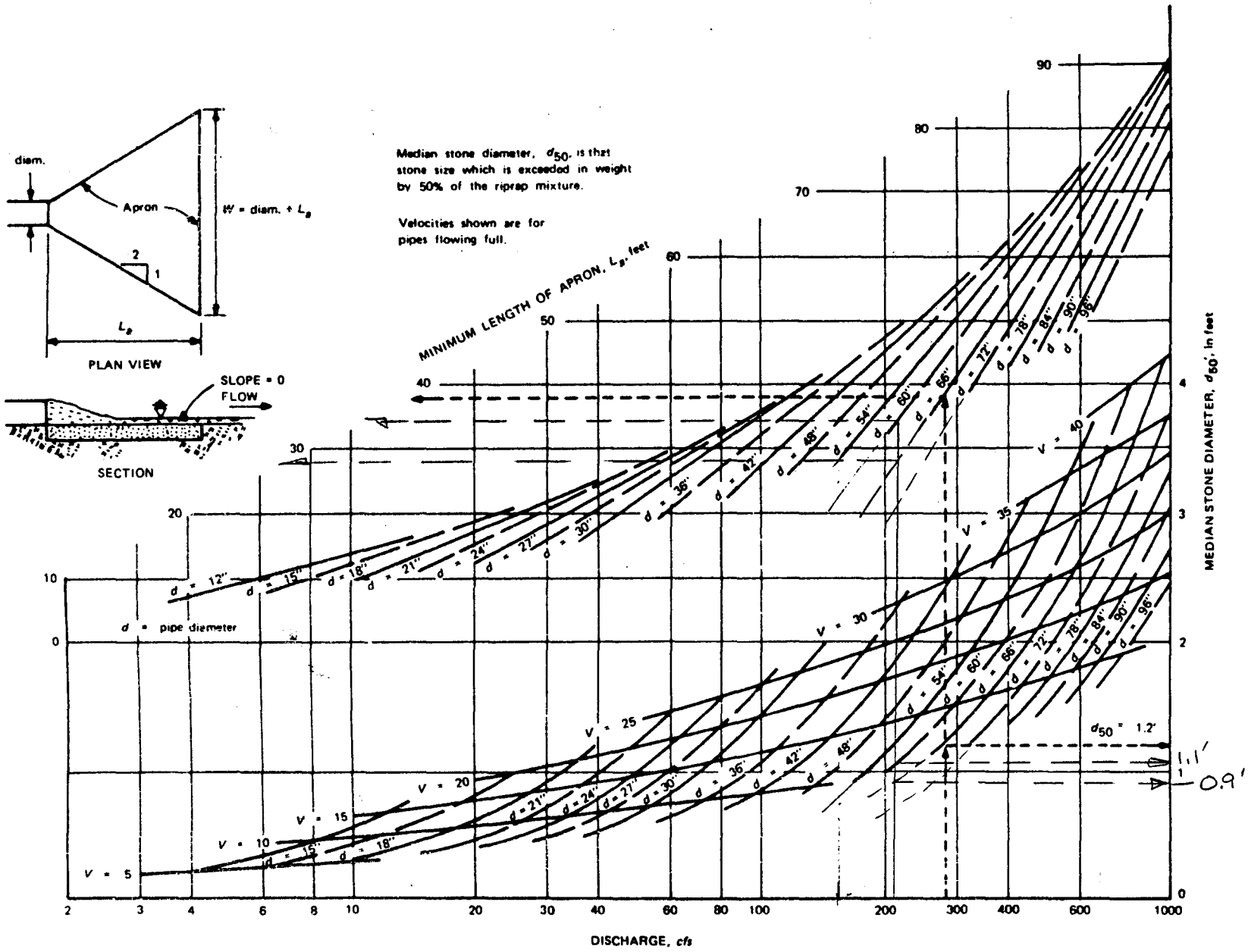


Figure I-15. Design of outlet protection – minimum tailwater condition ($T_W < 0.5$ diam.)[1]

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Eccles Canyon Area

PRELIMINARY CHANNEL DESIGN FOR CHANNEL AT C-21-48

IF CULVERT IS TO BE REMOVED (AT UDOT'S REQUEST) FULL DESIGN SHOULD BE COMPLETED. THESE CALCULATIONS SHOW FEASIBILITY.

APPROXIMATE DATA: Channel Slope: 5/120 = 0.042 (4.2%)
Channel Width: 10'
Channel Side Slope: m = 2

from Culvert design Sheets, $Q_{100yr,6Hr} = 330$ cfs. (100yr, 6Hr)

Assume: D_{50} Reqd = 1.0', then $\eta = 0.0395\, D^{1/6} \sim 0.04$

$$\frac{Qn}{1.49 S^{1/2}} = 43.34$$

y	$AR^{2/3}$
1.0	10.59
2.0	36.33
3.0	77.46
2.2	43.28 ⇒

A: 31.68
V: 10.42 fps

from Chart 27, "Flexible Linings $D_{50} \sim 1.25 - 1.50'$

Recalculate using corrected "η" value

$$\eta = 0.0395\,(1.5)^{1/6} = 0.042$$

$$\frac{Qn}{1.49 S^{1/2}} = 45.51$$

y	$AR^{2/3}$
2.3	46.99
2.2	43.28
2.25	45.16 ⇒

A = 32.63
V = 10.12 fps

DOESN'T CHANGE: $D_{50} = 1.50'$ $D_{max} = \frac{5 D_{50}}{S^{1/2}} = 2.9 \approx 3.0'$

FILTER BLANKET $\frac{D_{15}\,\text{filter}}{D_{85}\,\text{base}} < 5 < \frac{D_{15}\,\text{filter}}{D_{15}\,\text{base}} < 40$

[illegible]

SENSITIVITY [illegible]

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SHEET 2 OF 2
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CHECKED
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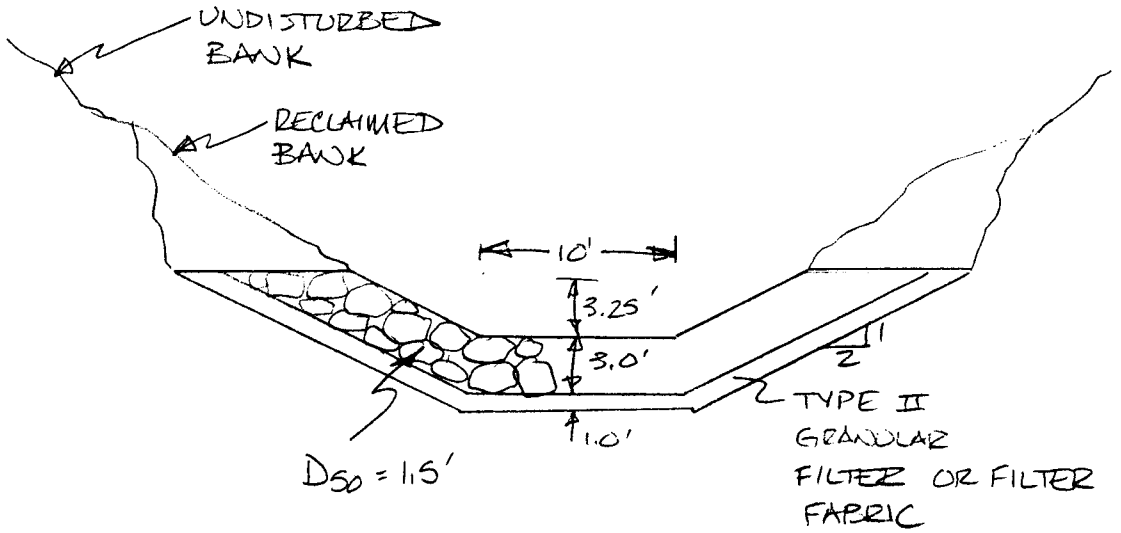
TYPICAL SECTION



NOTES:
- SIDES TO MATCH EXISTING EMBANKMENTS
- MEANDER CHANNEL TO MATCH NATURAL STREAM
- SHORT BENDS WILL REQUIRE CHECK OF DEPTH TO ACCOUNT FOR WAVE RUNUP.

Belina Haul Road Area

CHECK FOR CHANNEL DESIGN ON HAUL ROAD @ BOWL (C-25-36) RC-4

Find Slope: $\Delta H = 8595 - 8475 = 120'$
$\Delta X = 380'$

$$\frac{120}{380} * 100 = 31.6\%$$

USE DATA FROM CULVERT C-25-36 TO CALC. 100 YR-6HR EVENT

$A = 151\,ac - 11\,ac = 140\,ac$
$S = 39.5\%$
$CN = 72.7$
$P = 2.3\,in$
$D = 6\,HR$
$H_L = 5000'$

11 acres now travels along road, when reclaimed it will not enter drainage
$Q_{100\,YR-6HR} = 34.1\,cfs$

Check Trapezoidal Channel design Possibilities

Calculations show that a $b = 10'$, $D_{50} = 1.75'$ gives $SF_b = 0.84$ which is unacceptable

In conversations with Rick Summers at DOGM, it was agreed that the solution did not appear reasonable - (Using Redbook) (See Sheets 4 + 5)
We decided to change methodology, and use the OSM Steep Channel Riprap Design Criteria. Because of the unproven nature of this design, Hansen, Allen & Luce and any successors will not warrant the stability of this design. It is recommended that a review and check of alternate designs be completed prior to reclamation at which time new technologies might be available.

From Figure 5.4 (Sheet 6)

$D_{50} = 1.3'$ USE 1.5'

$d = 0.1'$ USE CHANNEL DEPTH OF 1.0'

RIPRAP FILTER "TYPE II - 1.0' THICK" or Filter Fabric

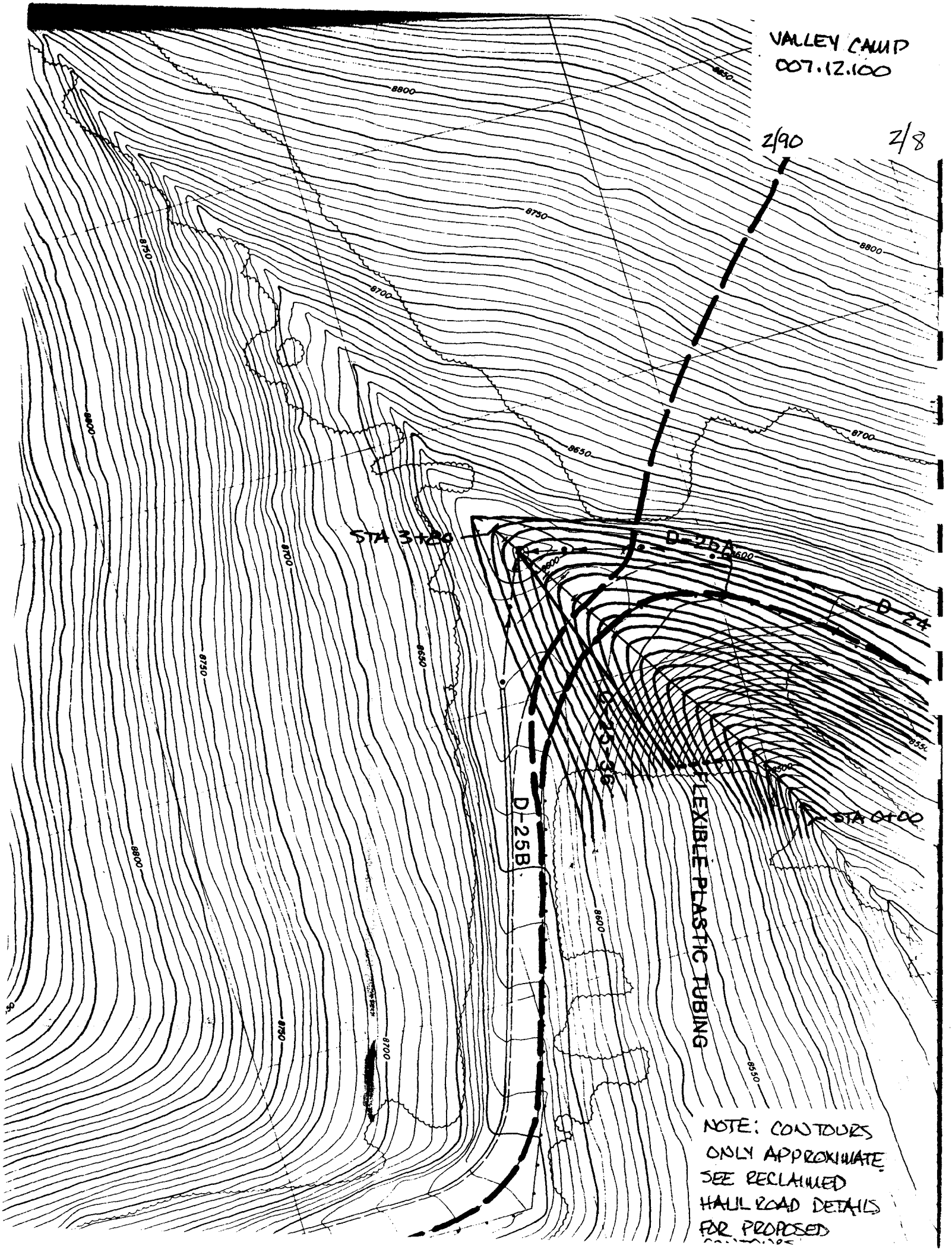
$D_{max} = 1.25 D_{50} = 1.88'$ USE 2.0'

$\frac{D_{50}}{D_{10-20}} = 2-3$ $D_{10-20} = \frac{D_{50}}{2-3}$ $D_{10-20} = 0.75 - 0.50'$

VALLEY CAMP
007.12.100

2/90

2/8



NOTE: CONTOURS ONLY APPROXIMATE SEE RECLAIMED HAUL ROAD DETAILS FOR PROPOSED

PROJECT : Valley Camp of Utah, Inc. Reclaimed Channel Replacing C-25-36

AREA= 140.0 ACRES
AVERAGE BASIN SLOPE= 39.5 PERCENT
CURVE NUMBER= 72.7
DESIGN STORM= 2.30 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 5000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .2523 HOURS QPCFS= 419.66 CFS QPIN= 2.9727 INCHES
C3= 14.6524 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.12	.7319	.0000	.0000	.0	.00
2.17	.8178	.0012	.0012	21.1	.02
2.22	.9037	.0060	.0048	130.4	.25
2.27	.9895	.0142	.0083	278.6	1.12
2.32	1.0754	.0258	.0116	385.2	3.11
2.37	1.1613	.0404	.0146	419.7	6.46
2.42	1.2472	.0579	.0175	393.1	11.15
2.47	1.3331	.0781	.0202	331.8	16.98
2.52	1.3905	.0931	.0150	259.5	23.45
2.57	1.4137	.0994	.0064	191.5	29.34
2.62	1.4369	.1059	.0065	135.0	33.06
2.67	1.4602	.1126	.0067	91.7	34.06
2.72	1.4834	.1195	.0069	60.4	32.94
2.78	1.5066	.1266	.0070	38.7	30.67
2.83	1.5298	.1338	.0072	24.3	28.10
2.88	1.5530	.1411	.0074	15.0	25.79
2.93	1.5762	.1487	.0075	9.1	23.98
2.98	1.5994	.1563	.0077	5.4	22.71
3.03	1.6201	.1633	.0070	3.2	21.91
3.08	1.6387	.1697	.0064	1.9	21.38
3.13	1.6572	.1762	.0065	1.1	20.92
3.18	1.6758	.1827	.0066	.6	20.44
3.23	1.6944	.1894	.0067	.3	19.97
3.28	1.7129	.1962	.0068	.2	19.56
3.33	1.7315	.2030	.0068	.1	19.26
3.38	1.7501	.2099	.0069	.0	19.07

HYDROGRAPH PEAK= 34.06 cfs
TIME TO PEAK= 2.67 Hours
RUNOFF VOLUME= 5.23 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:22 AM
Channel Section: Reclaimed Culvert C-25-36 Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	34.10	cfs
	Bottom Width:	10.0	feet
	Side Slope1:	3.0	1/m1
	Side Slope2:	3.0	1/m2
	Friction Factor:		
	Assumed D50:	1.75	feet
	Calc n Value:	0.043	
	Used:	0.043	
	Min. Bottom Slope:	0.316	ft/ft
	Max. Bottom Slope:	0.316	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.35	feet
	Qn/1.49(S)1/2=	1.755	
	A(R)2/3=	1.753	
	Required Depth:	0.85	feet
	Area:	3.81	ft2
	Perimeter:	12.18	feet
	Hydraulic Radius:	0.31	feet
	Velocity:	8.96	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.35	feet
	Qn/1.49(S)1/2=	1.755	
	A(R)2/3=	1.753	
	Required Depth:	0.85	feet
	Area:	3.81	ft2
	Perimeter:	12.18	feet
	Hydraulic Radius:	0.31	feet
	Velocity:	8.96	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	10.0	feet
	Side Slope 1:	3.0	1/m1
	Side Slope 2:	3.0	1/m2
	Min. Bottom Slope:	31.6	%
	Max. Bottom Slope:	31.6	%
	Min Channel Depth:	0.85	feet
	Riprap (Min S):	Required	
	Riprap (Max S):	Required	

RIPRAP DESIGN - Using the RED BOOK (Applied Hydrology and for Disturbed Areas)

Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:22 AM
Channel Section: Reclaimed Culvert C-25-36 Computed:DEH

DESIGN CRITERIA:			UNITS
	Design Flow:	34.10	cfs
	Bottom Width:	10.00	feet
	Side Slope1:	3.00	1/m1
	Side Slope2:	3.00	1/m2
	Friction Factor:	0.04	
	Min. Bottom Slope:	0.32	ft/ft
	Max. Bottom Slope:	0.32	ft/ft
	Freeboard:	0.50	feet
	Depth (Min. S):	0.35	feet
	Depth (Max. S):	0.35	feet
	Angle Repose (Ar):	42	degrees

Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	Smin	Smax	
D50	1.75	5.00	feet
T	6.80	6.80	lb/ft2
Nb	0.79	0.28	
Tmax	5.17	5.17	lb/ft2
Ns	0.60	0.21	
m Critical	3.00	3.00	
A (m crit)	18.44	18.44	degrees
B	33.02	14.71	degrees
Nsp	0.53	0.16	
SFb	0.84	1.53	
SFs	1.15	1.89	

UNREASONABLE SIZE

TOO LOW!

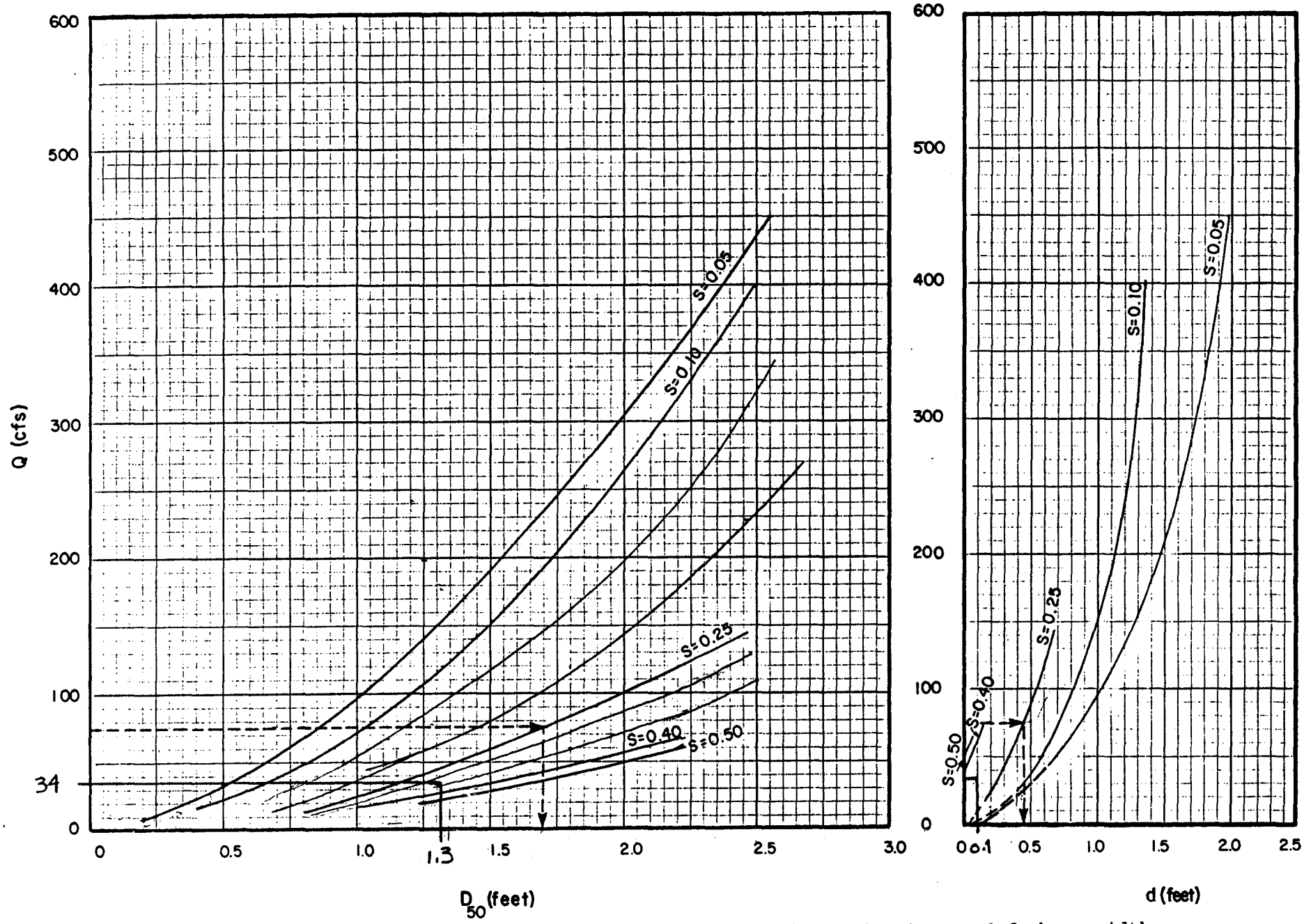
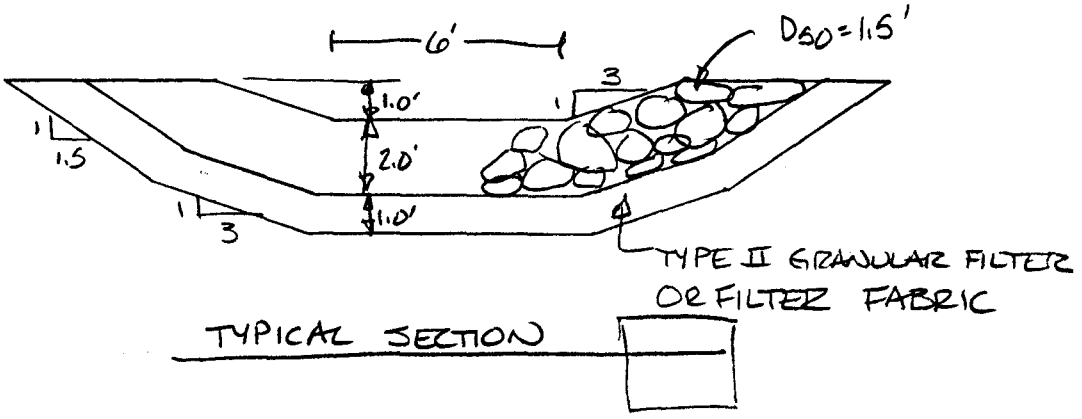


Figure 5.4. Steep slope riprap design, trapezoidal channels, 2:1 sideslopes, 6 ft base width.



TYPICAL SECTION

RIPRAP GRADATION (FROM FIGURES 1 - EXTRAPOLATED) PG 8

% PASSING BY WEIGHT	D_{50} (in)
70-100	24
50-70	20
35-50	18
2-10	5

USE INLET AND OUTLET DETAILS ALREADY DEVELOPED FOR OTHER CHANNELS.

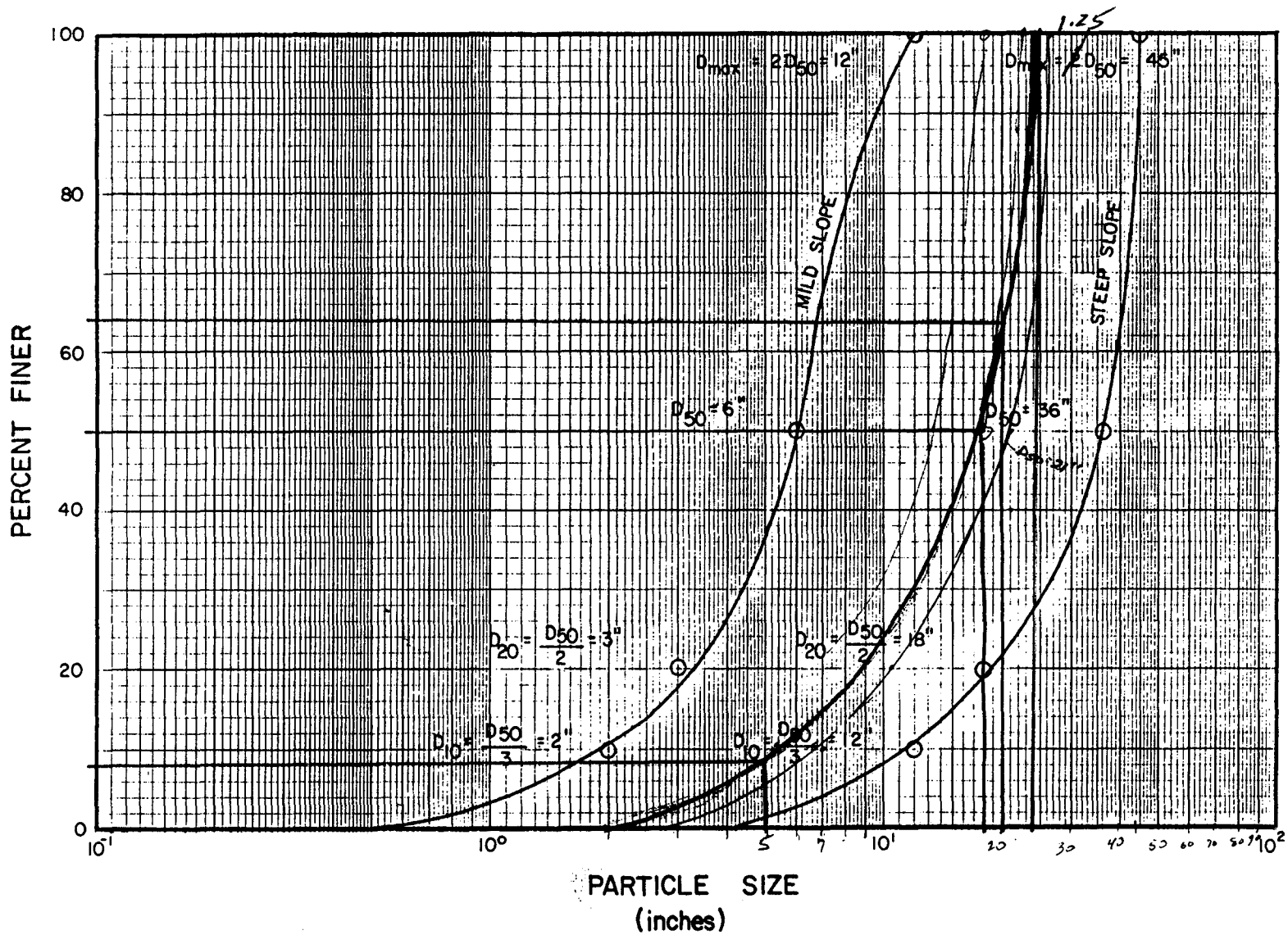


Figure 5.1. Definition sketch illustrating steep and mild slope riprap gradation based on recommended guidelines.

REVIEW OF RECLAMATION POTENTIALS AT CULVERTS ALONG HAUL ROAD.

Culverts Reviewed herein include: C-22-24
C-23-24
C-24-24
C-26-24
C-26A-24
C-28-24

(C-25-36 designed independently)

C-22-24

Culvert utilized to remove collected road drainage. Upon reclamation, all flow will be overland in the area. No surface channelization will be planned as part of the reclamation, therefore no additional design is required.

C-23-24

Same conditions apply at this culvert as were found at C-22-24.

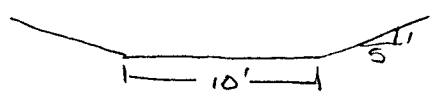
C-24-24

Upon reclamation the majority of area will experience overland flow. At this site however, some concentration of flow may exist.

Check 100yr-6hr flow potential

$Q_{100yr,6hr} = 1.2 cfs$

Simulate potential for erosion by using a 10' wide trapezoidal channel with 5:1 side slopes

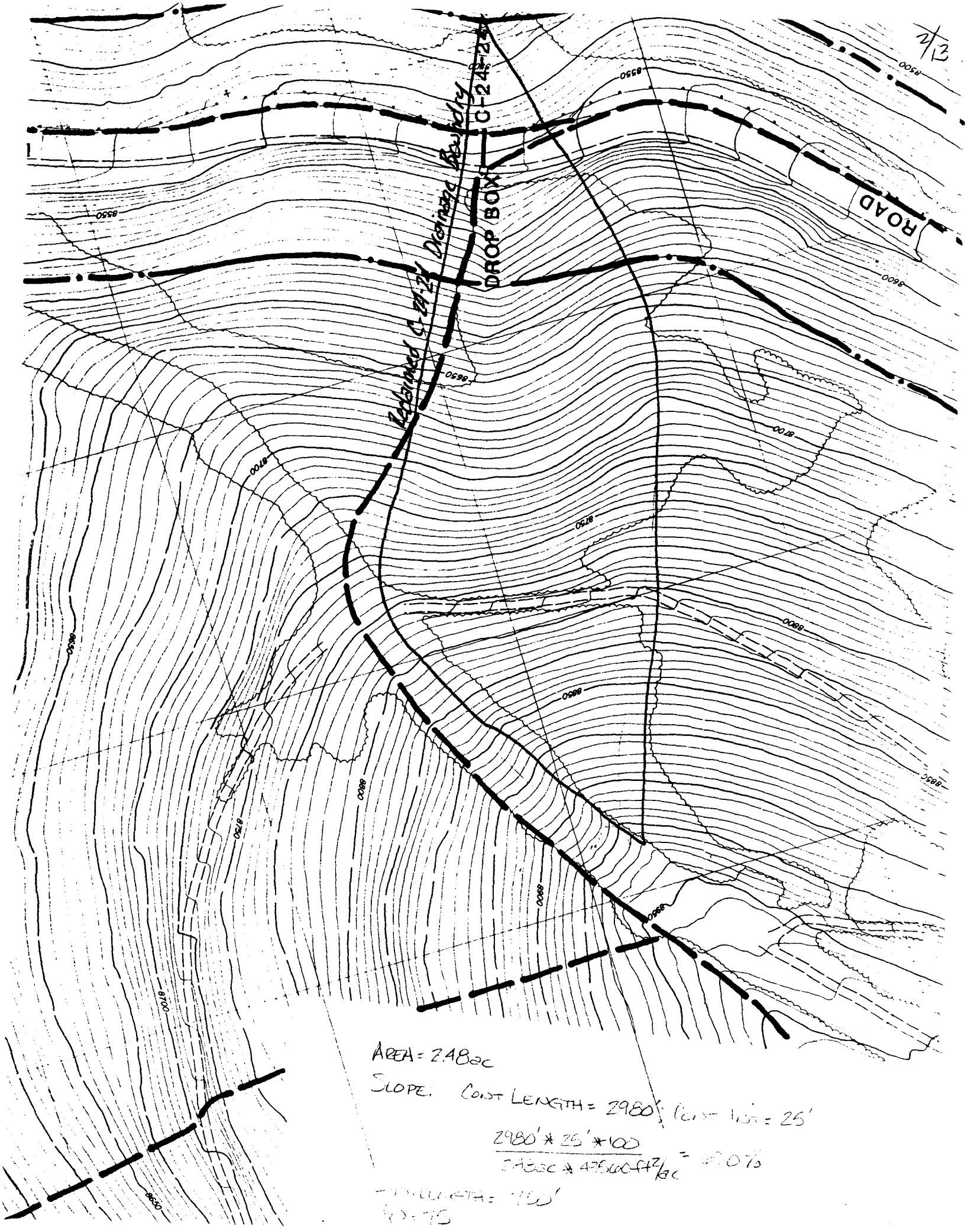


$n = 0.03$
$S = 0.54$

$\frac{Q_{100}}{1A^{5/3}} = 0.033$, $y \approx 0.03$, $V = 2.9 fps < 5.0$

For long term conditions, erosion will occur as a natural occurance. The design of specific erosion protection measures on this steep slope is impractical, nor do acceptable design methodologies exist.

Concrete is unacceptable due to 1) its relatively short life period and aesthetics, and 2) it would require


2/3
C-24-2
Drainage Boundary
Relocated C-24-2
DROP BOX
ROAD
8550
8600
8650
8700
8750
8800
8850
8900
8950
9000
9050
9100
9150
9200
9250
9300
9350
9400
9450
9500
AREA = 2.48ac
SLOPE. CONT LENGTH = 2980' CONT INT = 25'
2980' * 25' * 100
2.48ac * 43560ft²/ac = 48.0%

PROJECT : Valley Camp Coal - Reclaimed C-24-24 - 100 Yr. 6 Hr Runoff

AREA= 2.5 ACRES
AVERAGE BASIN SLOPE= 69.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 750. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0392 HOURS QPCFS= 47.83 CFS QPIN=19.1268 INCHES
C3= 94.2759 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.08	.6476	.0000	.0000	.0	.00
2.09	.6693	.0000	.0000	9.7	.00
2.10	.6911	.0002	.0002	36.6	.00
2.12	.7129	.0006	.0005	47.8	.01
2.13	.7346	.0014	.0007	40.4	.03
2.14	.7564	.0024	.0010	26.9	.07
2.16	.7782	.0036	.0013	15.4	.11
2.17	.7999	.0051	.0015	7.9	.15
2.18	.8217	.0069	.0018	3.8	.20
2.20	.8434	.0089	.0020	1.7	.25
2.21	.8652	.0112	.0023	.7	.30
2.22	.8870	.0137	.0025	.3	.35
2.23	.9087	.0164	.0027	.1	.39
2.25	.9305	.0193	.0030	.0	.44
2.42	1.2134	.0770	.0056	.0	.97
2.43	1.2352	.0828	.0058	.0	1.01
2.44	1.2569	.0888	.0060	.0	1.05
2.46	1.2787	.0949	.0061	.0	1.08
2.47	1.3004	.1012	.0063	.0	1.11
2.48	1.3222	.1077	.0065	.0	1.15
2.50	1.3440	.1144	.0066	.0	1.18
2.51	1.3542	.1176	.0032	.0	1.18
2.52	1.3601	.1194	.0018	.0	1.06
2.54	1.3660	.1213	.0019	.0	.87
2.55	1.3719	.1231	.0019	.0	.67
2.56	1.3778	.1250	.0019	.0	.53
2.57	1.3837	.1269	.0019	.0	.45

HYDROGRAPH PEAK= 1.18 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .11 Acre-Feet

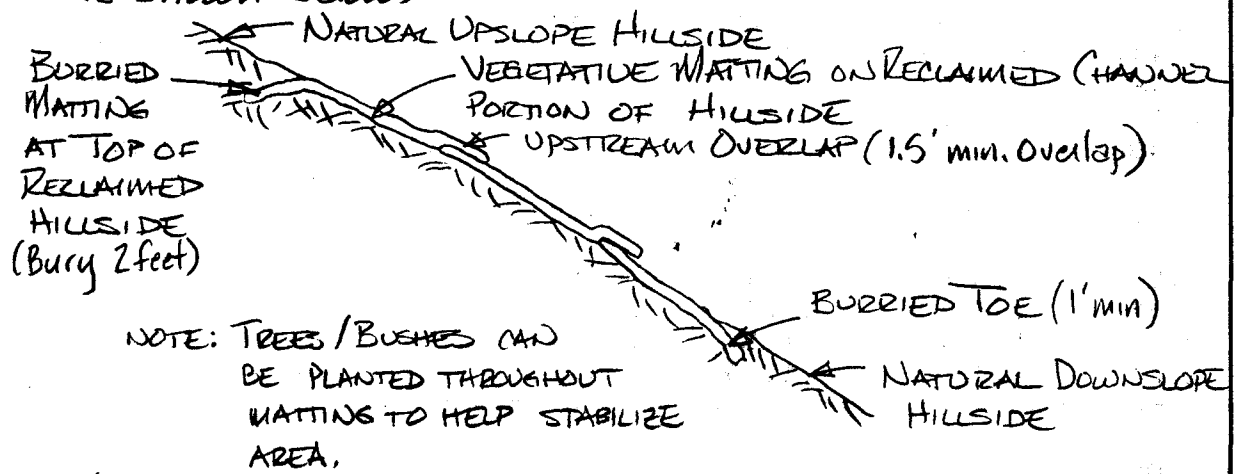
C-24-24 - Continued

that the concrete be extended to the bottom of Whisky Creek so that the energy could be dissipated.

Rock riprap is unstable on slopes found along the haul road. Designs of riprap are not meant to be applied to these conditions, and riprap used will likely not remain as a permanent structure.

The only feasible solution to protect against erosion may be to reclaim the area and install a vegetative matting along the intended flow path. New vegetative matting would help stabilize the soil along the flow path during the period of vegetation regrowth. The surrounding area is under a state of natural erosion. this method of reclamation may be the most reasonable option based upon 1) Current design methodologies, 2) current construction products, and 3) constructability. It is doubtful that any equipment could install properly a riprap channel on the local steep slopes because of the extended reach required both up and down slope from the reclaimed road.

A typical cross-section of a vegetative mat channel is shown below.



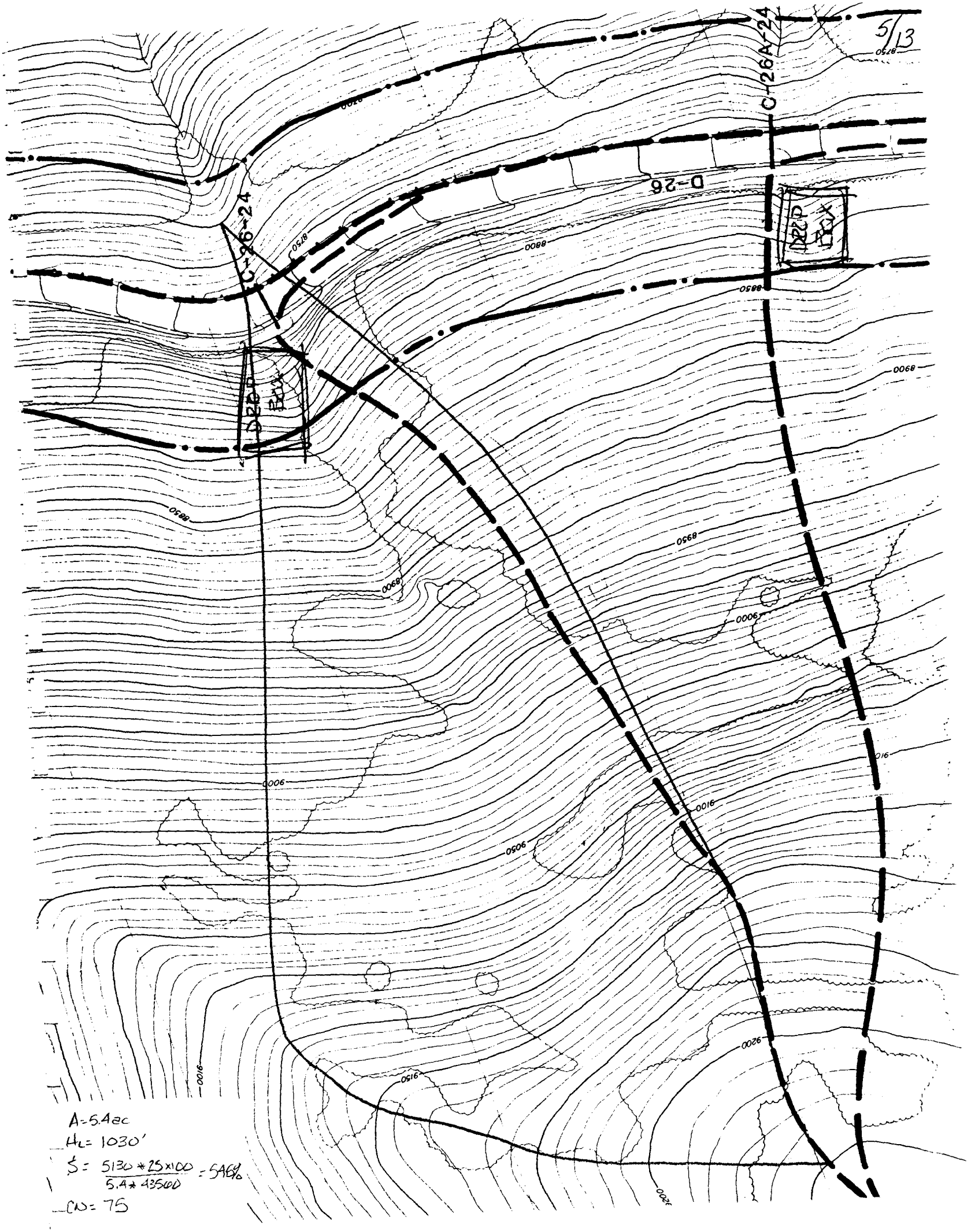
C-26-24

Same concerns as with C-24-24 apply here.

$Q_{100yr,6hr} = 2.5$ cfs Using $b = 10'$, $m = 5$ Trapezoidal Channel
$n = 0.03$, $S = 57\%$

$\frac{Qn}{1.49 S^{1/2}} = 0.066$, $y = 0.05'$, $V = 4.9$ fps

Use Matting solution used at C-24-24.



A=5.4ac

H_L= 1030'

$S = \frac{5130 * 25 \times 100}{5.4 * 43560} = 54.6\%$

CN= 75

PROJECT : Valley Camp Coal - Reclaimed C-26-24 - 100 Yr, 6 Hr Runoff

AREA= 5.4 ACRES
AVERAGE BASIN SLOPE= 54.5 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1030. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0569 HOURS QPCFS= 71.81 CFS QPIN=13.1885 INCHES
C3= 65.0060 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.08	.6442	.0000	.0000	.0	.00
2.09	.6679	.0000	.0000	6.8	.00
2.10	.6916	.0002	.0002	35.2	.00
2.12	.7153	.0007	.0005	62.5	.01
2.13	.7389	.0015	.0008	71.8	.04
2.15	.7626	.0027	.0012	65.0	.08
2.16	.7863	.0041	.0015	50.6	.15
2.18	.8100	.0059	.0018	35.5	.24
2.19	.8337	.0080	.0021	23.1	.34
2.20	.8573	.0103	.0023	14.2	.44
2.22	.8810	.0129	.0026	8.3	.55
2.23	.9047	.0159	.0029	4.7	.66
2.25	.9284	.0190	.0032	2.6	.78
2.26	.9520	.0225	.0035	1.4	.89
2.28	.9757	.0262	.0037	.7	.99
2.29	.9994	.0302	.0040	.4	1.10
2.30	1.0231	.0344	.0042	.2	1.21
2.32	1.0467	.0389	.0045	.0	1.31
2.43	1.2361	.0831	.0063	.0	2.07
2.45	1.2598	.0896	.0065	.0	2.15
2.46	1.2835	.0963	.0067	.0	2.24
2.47	1.3072	.1032	.0069	.0	2.32
2.49	1.3309	.1104	.0071	.0	2.40
2.50	1.3512	.1166	.0063	.0	2.48
2.52	1.3576	.1186	.0020	.0	2.49
2.53	1.3640	.1207	.0020	.0	2.34
2.55	1.3704	.1227	.0020	.0	2.06
2.56	1.3768	.1247	.0020	.0	1.73
2.57	1.3832	.1268	.0021	.0	1.43
2.59	1.3896	.1289	.0021	.0	1.20
2.60	1.3960	.1309	.0021	.0	1.04

HYDROGRAPH PEAK= 2.49 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .23 Acre-Feet

C-26A-24 Slight Channelization occurs immediately above culvert - Check flow Characteristics.

$Q_{100yr,6Hr} = 1.24$ cfs

Simulate using 10' Trapezoidal Channel.

$n = 0.03,\ b = 10,\ m = 5,\ S = 0.48$

$\frac{Qn}{1.49 S^{1/2}} = 0.04,\ y = 0.35',\ V = 3.5$ fps

Apply same concept as at C-24-24

Use Matting Solution as at C-24-24 and C-26-24.

C-27-24

Hillslope to be reclaimed without channel. Channel design not required. Regrade + Revegetate upon Phase II reclamation.

C-28-24 (Reclaimed Channel RC-4)

$Q_{100yr,6Hr} = 7.84$ cfs

Channel Slope ~ 0.27'/ft $\qquad n = 0.0395\, D_{50}^{1/6}$

Check design according to OSM procedure - Use $b = 6'$, $m = 2$

Assume $D_{50} = 0.75'$ $\qquad n = .0395(.75)^{1/6} = 0.04$

$\frac{Qn}{1.49 S^{1/2}} = 0.41,\ y = 0.2',\ V = 6.1$ fps

According to OSM procedure, Figure 5.4

DESIGN PARAMETERS

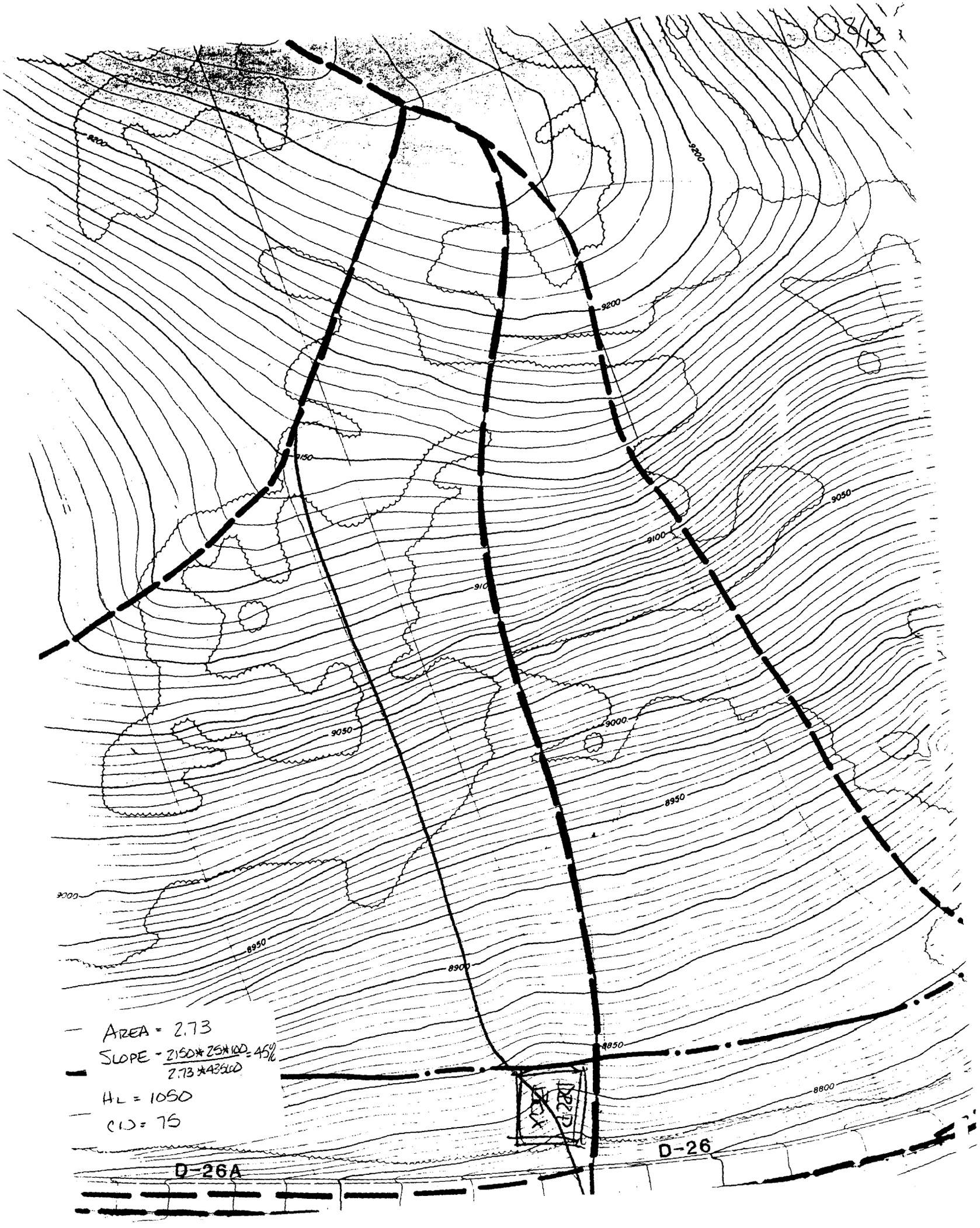
$D_{50} = 0.75'$

$D_{max} = 1.25 D_{50} = 0.94'$ USE 1.0' = Riprap Thickness

$D_{10-20} = D_{50}/(2 \text{ or } 3) = 0.25 - 0.38$ USE 0.25'

Use ≥ 0.5' freeboard. Total depth = 0.5 + 0.18 ⇒ 1.00' depth

Use 1.0' Type II granular Filter. Channel starts at Sta 0+00 at elev 8850 and extends to Sta 1+50 at elev 8890.


9200
9200
9200
9150
9050
9100
9050
9000
8950
9000
8950
8900
8850
8800
AREA = 2.73
SLOPE = 2150*25*100 / 2.73*43560 = 45%
HL = 1050
CN = 75
D-26A
D-26

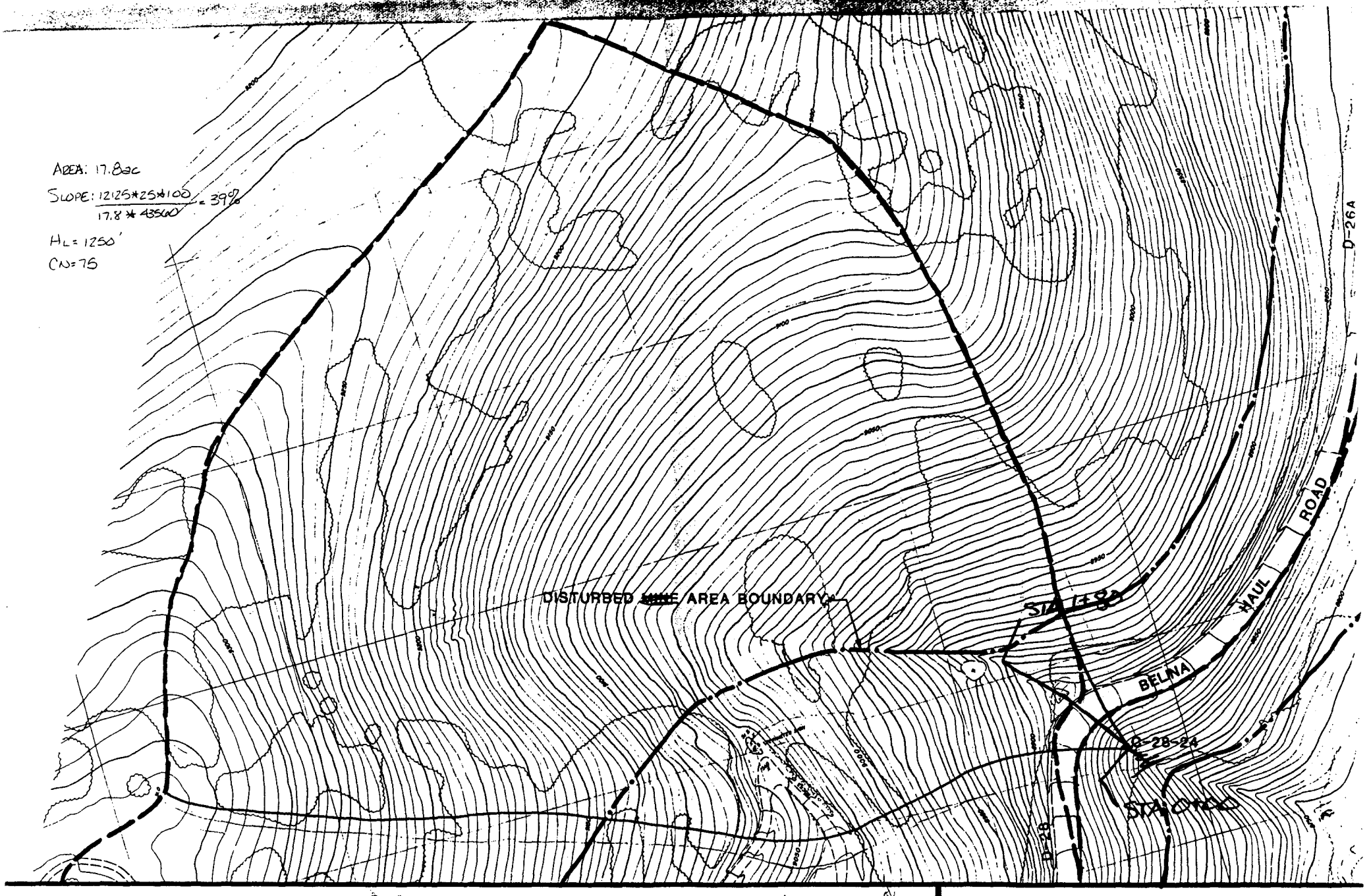
PROJECT : Valley Camp Coal - Reclaimed C-26A-24 - 100 Yr, 6 Hr Runoff

AREA= 2.7 ACRES
AVERAGE BASIN SLOPE= 45.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1050. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0636 HOURS QPCFS= 32.49 CFS QPIN=11.8011 INCHES
C3= 58.1674 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.08	.6533	.0000	.0000	.0	.00
2.10	.6798	.0000	.0000	3.1	.00
2.11	.7063	.0005	.0004	15.9	.00
2.13	.7327	.0013	.0008	28.3	.01
2.15	.7592	.0025	.0012	32.5	.03
2.16	.7856	.0041	.0016	29.4	.06
2.18	.8121	.0061	.0020	22.9	.11
2.19	.8385	.0084	.0023	16.1	.16
2.21	.8650	.0111	.0027	10.4	.22
2.22	.8915	.0142	.0031	6.4	.28
2.24	.9179	.0176	.0034	3.8	.34
2.26	.9444	.0214	.0037	2.1	.40
2.27	.9708	.0254	.0041	1.2	.46
2.29	.9973	.0298	.0044	.6	.52
2.30	1.0237	.0345	.0047	.3	.58
2.32	1.0502	.0396	.0050	.2	.64
2.34	1.0767	.0449	.0053	.0	.70
2.35	1.1031	.0505	.0056	.0	.75
2.37	1.1296	.0564	.0059	.0	.81
2.38	1.1560	.0626	.0062	.0	.86
2.40	1.1825	.0691	.0065	.0	.92
2.42	1.2089	.0759	.0068	.0	.97
2.43	1.2354	.0829	.0070	.0	1.02
2.45	1.2618	.0902	.0073	.0	1.07
2.46	1.2883	.0977	.0075	.0	1.12
2.48	1.3148	.1055	.0078	.0	1.16
2.49	1.3412	.1135	.0080	.0	1.21
2.51	1.3548	.1177	.0042	.0	1.24
2.53	1.3619	.1200	.0022	.0	1.22
2.54	1.3691	.1223	.0023	.0	1.11
2.56	1.3762	.1245	.0023	.0	.95
2.57	1.3834	.1268	.0023	.0	.79
2.59	1.3905	.1291	.0023	.0	.66
2.61	1.3977	.1315	.0023	.0	.56

HYDROGRAPH PEAK= 1.24 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .12 Acre-Feet



END:

HYDROLOGIC CERTIFICATION

VALLEY CAMP

10/3

PROJECT : Valley Camp Coal - Reclaimed C-28-24 - 100 Yr. 6 Hr Runoff

AREA= 17.8 ACRES
AVERAGE BASIN SLOPE= 39.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 2.25 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1250. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0785 HOURS QPCFS= 171.52 CFS QPIN= 9.5559 INCHES
C3= 47.1009 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.09	.6634	.0000	.0000	.0	.00
2.10	.6896	.0002	.0002	8.6	.00
2.12	.7157	.0007	.0006	53.3	.01
2.13	.7418	.0017	.0009	113.9	.06
2.15	.7680	.0030	.0013	157.5	.15
2.17	.7941	.0047	.0017	171.5	.31
2.18	.8202	.0068	.0021	160.7	.53
2.20	.8464	.0092	.0024	135.6	.81
2.21	.8725	.0120	.0028	106.1	1.13
2.23	.8986	.0151	.0031	78.3	1.48
2.24	.9248	.0185	.0035	55.2	1.86
2.26	.9509	.0223	.0038	37.5	2.24
2.28	.9770	.0264	.0041	24.7	2.63
2.29	1.0032	.0309	.0044	15.8	3.02
2.31	1.0293	.0356	.0047	9.9	3.41
2.32	1.0554	.0406	.0050	6.1	3.79
2.34	1.0816	.0459	.0053	3.7	4.16
2.35	1.1077	.0515	.0056	2.2	4.53
2.37	1.1338	.0574	.0059	1.3	4.89
2.39	1.1600	.0636	.0062	.8	5.25
2.40	1.1861	.0700	.0064	.4	5.60
2.42	1.2123	.0767	.0067	.3	5.94
2.43	1.2384	.0837	.0070	.1	6.27
2.45	1.2645	.0909	.0072	.0	6.59
2.46	1.2907	.0984	.0075	.0	6.91
2.48	1.3168	.1061	.0077	.0	7.23
2.50	1.3429	.1141	.0080	.0	7.53
2.51	1.3552	.1179	.0038	.0	7.80
2.53	1.3622	.1201	.0022	.0	7.84
2.54	1.3693	.1223	.0022	.0	7.53
2.56	1.3763	.1246	.0023	.0	6.90
2.57	1.3834	.1268	.0023	.0	6.11
2.59	1.3905	.1291	.0023	.0	5.29
2.61	1.3975	.1314	.0023	.0	4.57
2.62	1.4046	.1338	.0023	.0	3.99

PROJECT : Valley Camp Coal - Reclaimed C-28-24 - 100 Yr, 6 Hr Runoff
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS

HYDROGRAPH PEAK= 7.84 cfs
TIME TO PEAK= 2.53 Hours
RUNOFF VOLUME= .76 Acre-Feet

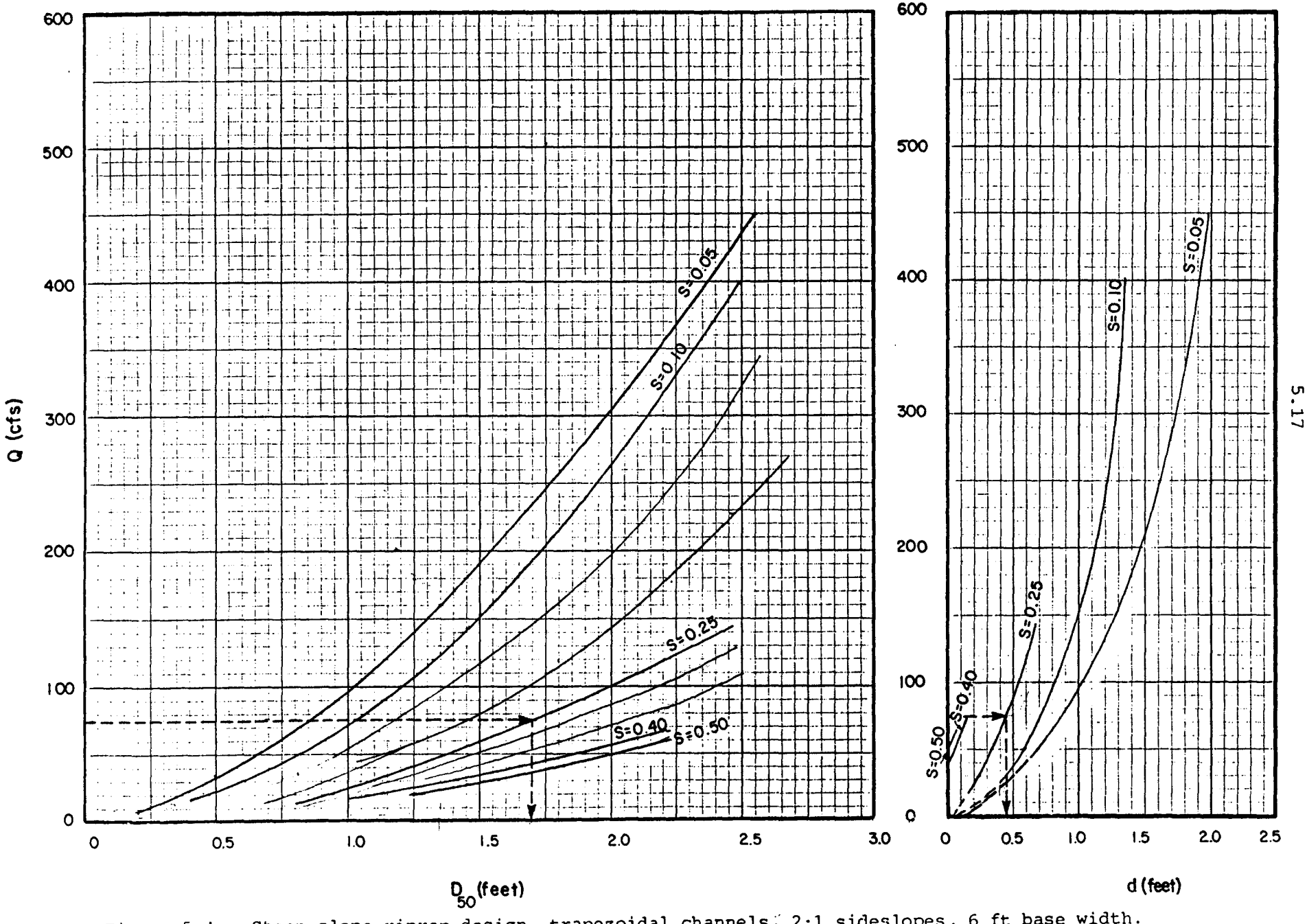


Figure 5.4. Steep slope riprap design, trapezoidal channels, 2:1 sideslopes, 6 ft base width.

Belina Mine Area

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Reclamation
FEATURE
PROJECT NO. 007.12.100

SHEET 1 OF 21.
COMPUTED DEH
CHECKED
DATE 10/12/89

Channel Reclamation - Belina Mine Area (Determine flow in Channel to Elev ~8750' below Pond 4)
Whiskey Creek

Complete Channel (- RC-2)

Rdg. 7½ Min. Topo Sec 30 T13S, R7E = 436

$$\text{Area} = \frac{\left(\frac{5000+5000}{2}\right) * \left(\frac{5260+5280}{2}\right)}{43560\ ft^2/ac} = 609.8\ ac$$

Rdg: Sec 30, Zeiog Copy = 450 Multiplier = 1.3651

Area = 356.4 ac

	Area	CN	% Cover
Pine Covered	193.7 ac	55	50*
Sage/Aspen Covered	122.0 ac	70	25
Disturbed/Reclaimed	40.7 ac	85	—
	356.4 ac		

* Conservative

100 yr - 6 Hr Precip = 2.3 in

Ave Slope: $\frac{\text{Cont. Length} * \text{Cont Int} * 100}{\text{Area} * 43560}$

Cont Length = 33.5 in * 2000'/in = 67,000 ft
Cont Int = 80 ft

$$\frac{67{,}000' * 80' * 100}{356.4\ ac * 43560\ ft^2/ac} = 34.5\%$$

Vol. Weighted Curve No.

CN	A	Q_i
55	193.7	0.05
70	122.0	0.36
85	40.7	1.02
		$\bar{Q}$ = 0.27

$\bar{CN}$ = 67.0

Hyd. Length = 5000'

$Q_{100yr-6hr}$ = 32.2 cfs

For Entire Channel - Break out Upper Portion Above Elev 8935

Upper Main Channel (RC-2)

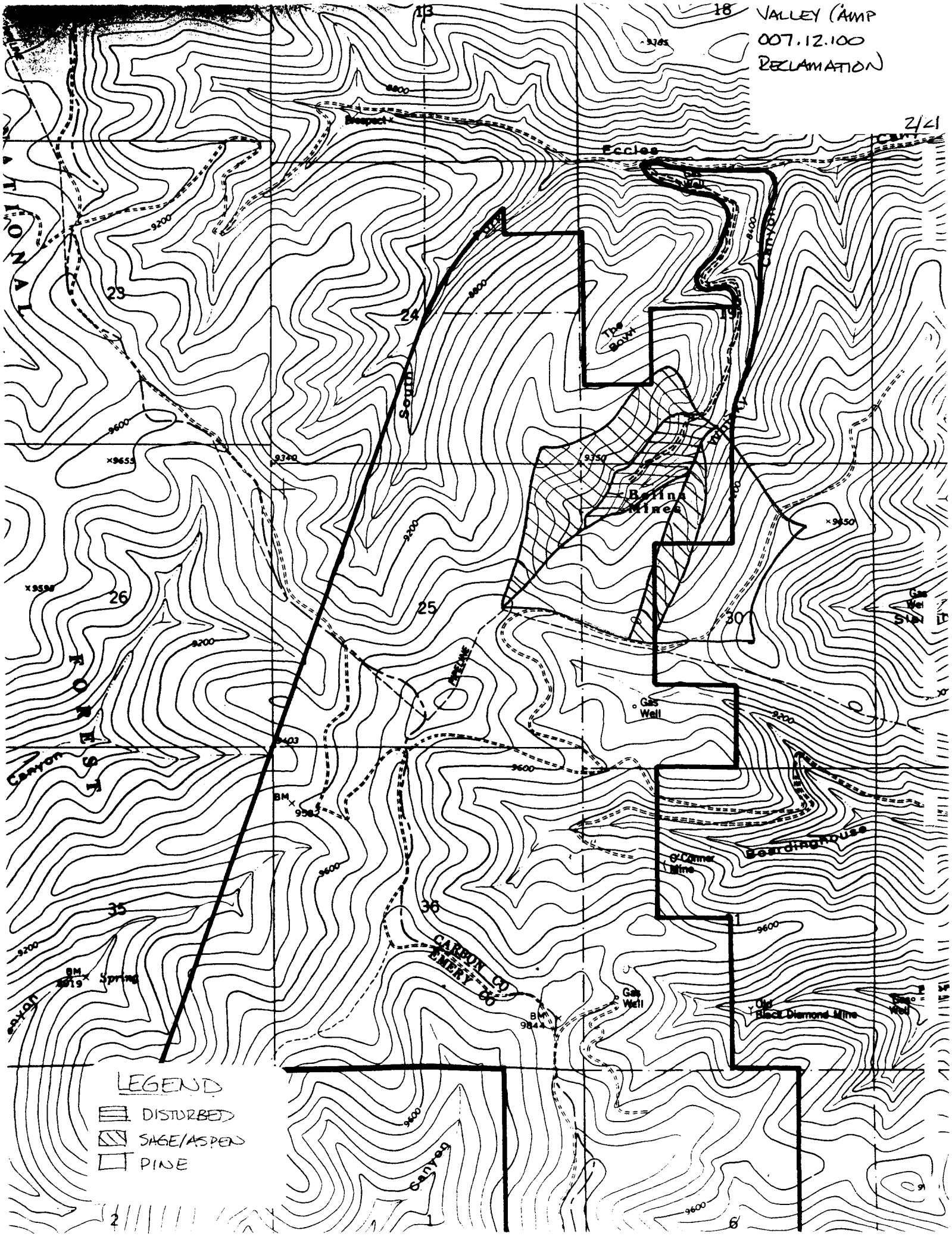
Upper Area = 134.5 ac

	Area	CN	Q_i
Pine Covered	77.0	55	0.05
Sage/Aspen	46.0	70	0.36
Dist/Reclaimed	11.5	85	1.02
			$\bar{Q}_1$ = 0.24

$\bar{CN}$ = [illegible]

VALLEY CAMP
007.12.100
RECLAMATION

2/4



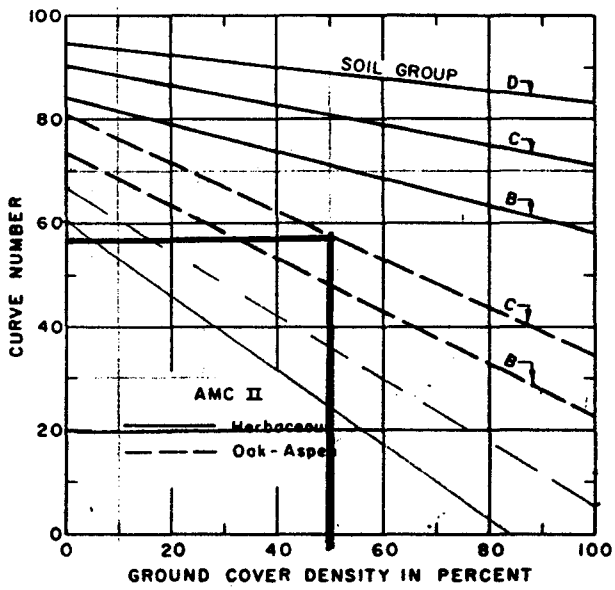


Figure 9.5.--Graph for estimating runoff curve numbers of forest-range complexes in western United States: herbaceous and oak-aspen complexes.

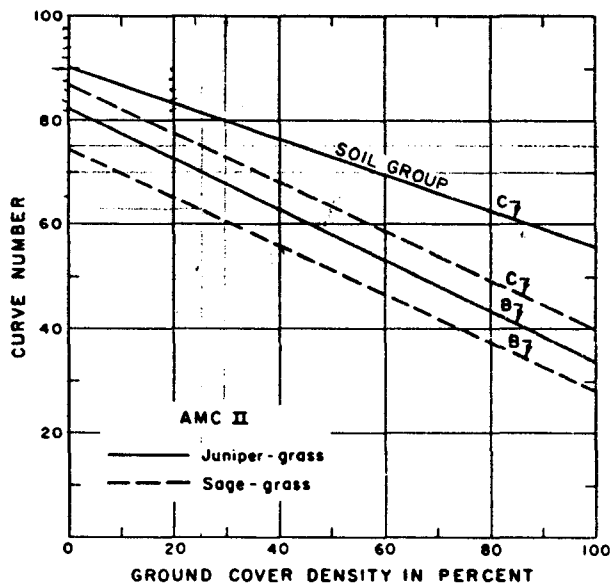


Figure 9.6.--Graph for estimating runoff curve numbers of forest-range complexes in western United States: juniper-grass and sage-grass complexes.

PROJECT : Valley Camp of Utah, Inc. Reclaimed Channel RC-2: 100 Yr 6 Hr

AREA= 356.4 ACRES
AVERAGE BASIN SLOPE= 34.5 PERCENT
CURVE NUMBER= 67.0
DESIGN STORM= 2.30 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 5000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

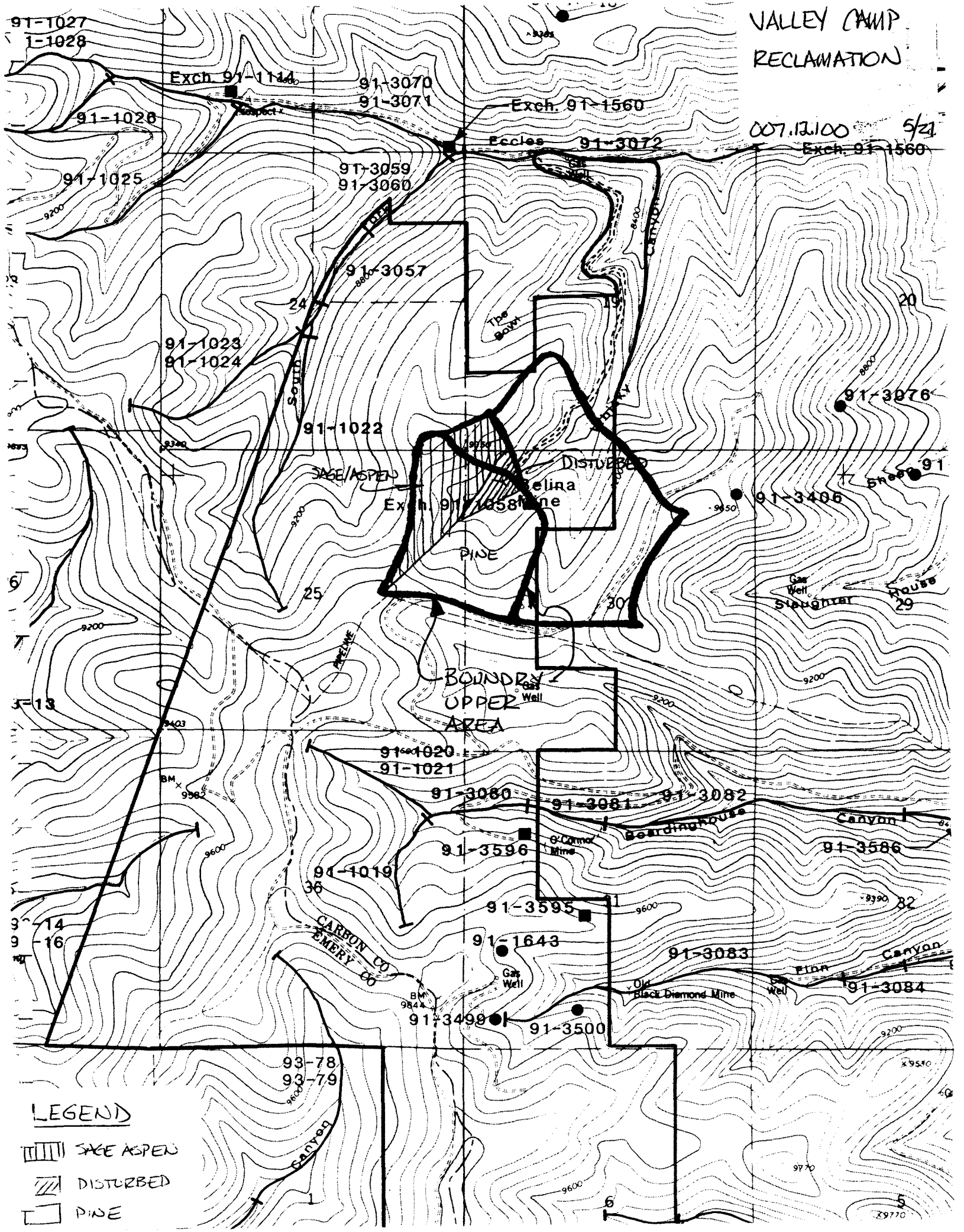
TP= .3149 HOURS QPCFS= 855.92 CFS QPIN= 2.3816 INCHES
C3= 11.7391 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.27	.9839	.0000	.0000	.0	.00
2.33	1.0911	.0022	.0022	42.9	.10
2.39	1.1983	.0088	.0066	265.9	.88
2.46	1.3055	.0196	.0107	568.2	3.49
2.52	1.3888	.0306	.0110	785.7	8.84
2.58	1.4178	.0349	.0044	855.9	16.32
2.65	1.4468	.0396	.0046	801.8	23.50
2.71	1.4757	.0445	.0049	676.8	28.57
2.77	1.5047	.0496	.0051	529.3	31.26
2.83	1.5337	.0550	.0054	390.6	32.20
2.90	1.5627	.0606	.0056	275.3	32.21
2.96	1.5916	.0665	.0059	187.0	31.95
3.02	1.6185	.0722	.0057	123.1	31.76
3.09	1.6417	.0772	.0051	79.0	31.72
3.15	1.6648	.0824	.0052	49.6	31.64
3.21	1.6880	.0878	.0054	30.6	31.46
3.27	1.7112	.0933	.0055	18.5	31.23
3.34	1.7344	.0989	.0056	11.1	31.05
3.40	1.7575	.1047	.0058	6.5	31.00
3.46	1.7807	.1107	.0059	3.8	31.12
3.53	1.8008	.1159	.0053	2.2	31.37
3.59	1.8167	.1201	.0042	1.3	31.54
3.65	1.8327	.1244	.0043	.7	31.31
3.72	1.8486	.1288	.0044	.4	30.63
3.78	1.8645	.1332	.0044	.2	29.65
3.84	1.8805	.1377	.0045	.1	28.61
3.90	1.8964	.1423	.0046	.0	27.70

HYDROGRAPH PEAK= 32.21 cfs
TIME TO PEAK= 2.90 Hours
RUNOFF VOLUME= 8.20 Acre-Feet

VALLEY CAMP
RECLAMATION

007.12.100 5/21



AVG SLOPE: $\frac{22500 * 80 * 100}{43560 * 134.5} = 30.72\%$

HYD. LENGTH = 1600 ft
P = 2.3 in

$Q_{100YR-6HR}$ = 13.4 cfs

SIDE CHANNEL - TO NORTH (RC-3)

	AREA	CN	Q_i
PINE COVERED	12.5	55	0.05
DIST/RECLAIMED	4.1	85	1.02
	16.6		

$\bar{Q}_i = 0.29$; $\overline{CN} = 67.5$

P = 2.3"
AVG. SLOPE ~ 31%
HYD. LENGTH = 900'

$Q_{100YR-6HR}$ = 3.1 cfs

RECLAIMED CHANNEL CHARACTERISTICS

	MIN SLOPE	MAX SLOPE
UPPER CHANNEL	3.6%*	33.0%
SIDE CHANNEL	6.3%*	100.0%**
LOWER CHANNEL	3.6%*	33.0%

* AT JUNCTION WITH SIDE CHANNEL
** AT EXTREME UPPER END

CHANGE GRADES TO ALLOW ACCEPTABLE RIPRAP D_{50} (SEE PG's 9+10)

ACCEPT MAX D_{50} = 1.75' - THIS GIVES D_{MAX} = 36" (3 ft)

PROJECT : Valley Camp of Utah, Inc. Reclaimed Upper Channel RC-2

AREA= 134.5 ACRES
AVERAGE BASIN SLOPE= 30.7 PERCENT
CURVE NUMBER= 65.6
DESIGN STORM= 2.30 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1600. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1392 HOURS QPCFS= 730.87 CFS QPIN= 5.3888 INCHES
C3= 26.5616 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.28	1.0097	.0000	.0000	.0	.00
2.31	1.0570	.0000	.0000	36.7	.00
2.34	1.1044	.0006	.0006	227.0	.02
2.37	1.1518	.0020	.0014	485.2	.19
2.39	1.1992	.0042	.0022	670.9	.68
2.42	1.2465	.0072	.0030	730.9	1.68
2.45	1.2939	.0109	.0038	684.6	3.25
2.48	1.3413	.0155	.0045	577.9	5.37
2.51	1.3823	.0199	.0045	452.0	7.93
2.53	1.3951	.0215	.0015	333.5	10.56
2.56	1.4079	.0230	.0016	235.1	12.51
2.59	1.4207	.0246	.0016	159.6	13.36
2.62	1.4336	.0263	.0017	105.1	13.26
2.64	1.4464	.0280	.0017	67.5	12.56
2.67	1.4592	.0298	.0018	42.4	11.65
2.70	1.4720	.0316	.0018	26.1	10.79
2.73	1.4848	.0335	.0019	15.8	10.10
2.76	1.4976	.0354	.0019	9.5	9.61
2.78	1.5104	.0373	.0020	5.6	9.32
2.81	1.5232	.0394	.0020	3.3	9.19
2.84	1.5360	.0414	.0021	1.9	9.19
2.87	1.5488	.0435	.0021	1.1	9.26
2.89	1.5616	.0457	.0022	.6	9.40
2.92	1.5744	.0479	.0022	.3	9.58
2.95	1.5872	.0501	.0023	.2	9.77
2.98	1.6000	.0524	.0023	.1	9.98
3.01	1.6122	.0547	.0022	.0	10.20

HYDROGRAPH PEAK= 13.36 cfs
TIME TO PEAK= 2.59 Hours
RUNOFF VOLUME= 2.69 Acre-Feet

PROJECT : Valley Camp of Utah, Inc. Reclaimed Channel RC-3; 100 Yr 6 Hr

AREA= 16.6 ACRES
AVERAGE BASIN SLOPE= 31.0 PERCENT
CURVE NUMBER= 67.5
DESIGN STORM= 2.30 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 900. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0832 HOURS QPCFS= 150.97 CFS QPIN= 9.0189 INCHES
C3= 44.4541 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.25	.9463	.0000	.0000	.0	.00
2.26	.9746	.0000	.0000	7.6	.00
2.28	1.0029	.0003	.0003	46.9	.00
2.30	1.0313	.0010	.0006	100.2	.02
2.31	1.0596	.0019	.0009	138.6	.07
2.33	1.0879	.0032	.0013	151.0	.16
2.34	1.1162	.0047	.0016	141.4	.30
2.36	1.1445	.0066	.0019	119.4	.49
2.38	1.1728	.0088	.0022	93.4	.71
2.39	1.2011	.0112	.0025	68.9	.95
2.41	1.2294	.0140	.0027	48.6	1.22
2.43	1.2577	.0170	.0030	33.0	1.50
2.44	1.2860	.0203	.0033	21.7	1.79
2.46	1.3143	.0239	.0036	13.9	2.07
2.48	1.3426	.0277	.0039	8.8	2.36
2.49	1.3709	.0319	.0041	5.4	2.65
2.51	1.3852	.0340	.0022	3.3	2.92
2.53	1.3928	.0352	.0012	2.0	3.09
2.54	1.4005	.0364	.0012	1.2	3.08
2.56	1.4081	.0377	.0012	.7	2.91
2.58	1.4158	.0389	.0012	.4	2.64
2.59	1.4235	.0402	.0013	.2	2.34
2.61	1.4311	.0415	.0013	.1	2.06
2.63	1.4388	.0428	.0013	.0	1.83

HYDROGRAPH PEAK= 3.09 cfs
TIME TO PEAK= 2.53 Hours
RUNOFF VOLUME= .40 Acre-Feet

FROM PRINTOUT (PG's 12-13) $S_{MAX} = 0.16$ TO PRODUCE $D_{MAX} = 1.75'$

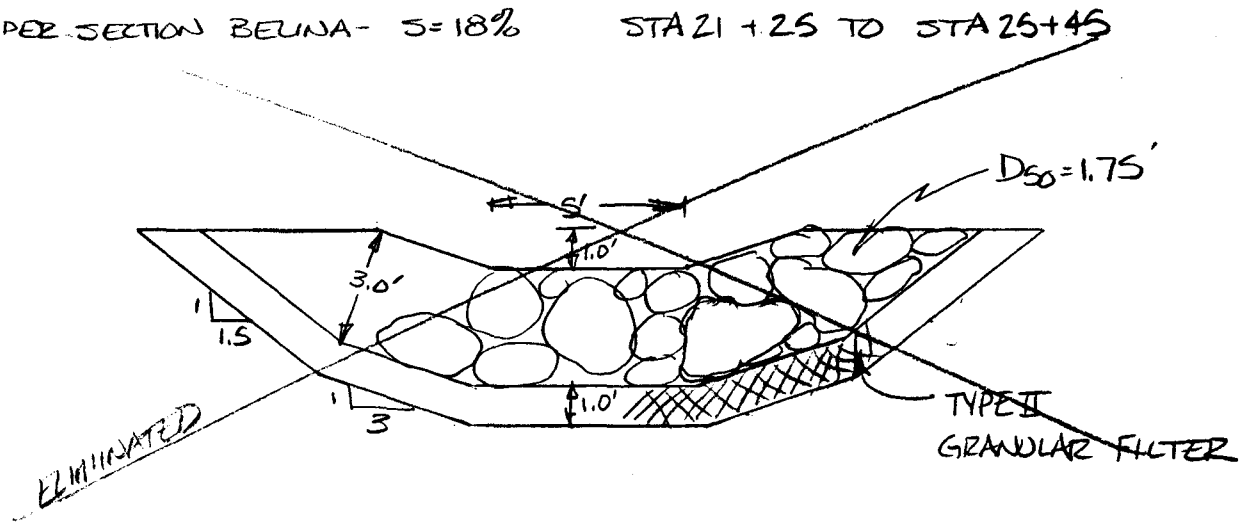
DRAW CONTOURS THROUGH STEEP AREAS WITH A $S_{MAX} = 16\%$

DESIGN CRITERIA

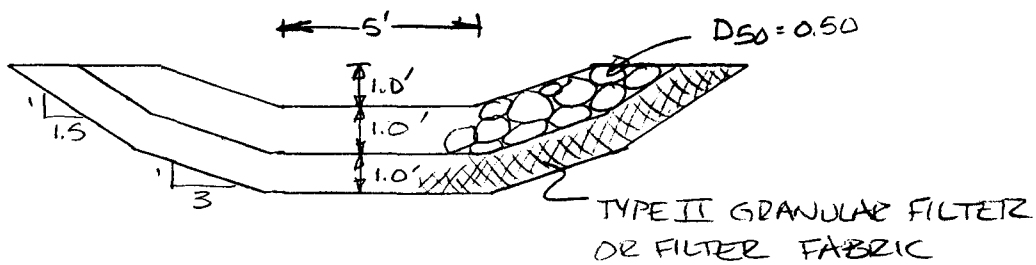
CHANNEL	Q (cfs)	b (ft)	m	S_{min} (%)	S_{max} (%)	d (ft)	D_{50} S_{min} (ft)	D_{50} S_{max} (ft)	D_{max} S_{min} (ft)	D_{max} S_{max} (ft)
UPPER	13.4	5	3	5.0	5.0	1.0	0.50	0.50	1.0	1.0
SIDE	3.1	5	3	32.0	32.0	0.75	1.75	1.75	3.0	3.0
LOWER	32.2	10	3	5.0	16.0	1.1	0.75	1.75	1.25	3.0

SHOW X-SECTIONS FOR CHANNELS

UPPER SECTION BELOW - S = 18% STA 21 + 25 TO STA 25+45



UPPER BELOW - S = 5.0 % STA 13+20 TO STA 17+95



Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp of Utah, Inc. — Date: 26-Feb-90
Project No.: 007.12.100 — Time: 09:36 AM
Channel Section: Channel RC-1; C-14-42 Outlet — Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	32.20	cfs
	Bottom Width:	10.0	feet
	Side Slope1:	3.0	1/m1
	Side Slope2:	3.0	1/m2
	Friction Factor:		
	Assumed D50:	1.75	feet
	Calc n Value:	0.043	
	Used:	0.043	
	Min. Bottom Slope:	0.050	ft/ft
	Max. Bottom Slope:	0.160	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.57	feet
	Qn/1.49(S)1/2=	4.167	
	A(R)2/3=	4.152	
	Required Depth:	1.07	feet
	Area:	6.67	ft2
	Perimeter:	13.60	feet
	Hydraulic Radius:	0.49	feet
	Velocity:	4.82	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.41	feet
	Qn/1.49(S)1/2=	2.329	
	A(R)2/3=	2.354	
	Required Depth:	0.91	feet
	Area:	4.60	ft2
	Perimeter:	12.59	feet
	Hydraulic Radius:	0.37	feet
	Velocity:	6.99	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	10.0	feet
	Side Slope 1:	3.0	1/m1
	Side Slope 2:	3.0	1/m2
	Min. Bottom Slope:	5.0	%
	Max. Bottom Slope:	16.0	%
	Min Channel Depth:	1.07	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Required	

RIPRAP DESIGN - Using the RED BOOK (Applied Hydrology and for Disturbed Areas)

Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:36 AM
Channel Section: Channel RC-1; C-14-42 Outlet Computed:DEH

			UNITS
DESIGN CRITERIA:	Design Flow:	32.20	cfs
	Bottom Width:	10.00	feet
	Side Slope1:	3.00	1/m1
	Side Slope2:	3.00	1/m2
	Friction Factor:	0.04	
	Min. Bottom Slope:	0.05	ft/ft
	Max. Bottom Slope:	0.16	ft/ft
	Freeboard:	0.50	feet
	Depth (Min. S):	0.57	feet
	Depth (Max. S):	0.41	feet
	Angle Repose (Ar):	42	degrees

Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	Smin	Smax	
D50	0.75	1.75	feet
T	1.78	4.09	lb/ft2
Nb	0.48	0.48	
Tmax	1.35	3.11	lb/ft2
Ns	0.37	0.36	
m Critical	3.00	3.00	
A (m crit)	18.44	18.44	degrees
B	26.99	25.23	degrees
Nsp	0.28	0.28	
SFb	1.85	1.51	
SFs	1.61	1.58	

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp of Utah, Inc.	Date:	26-Feb-90
Project No.:	007.12.100	Time:	09:29 AM
Channel Section:	Channel RC-1; C-14-42 Outlet	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	13.40	cfs
	Bottom Width:	5.0	feet
	Side Slope1:	3.0	1/m1
	Side Slope2:	3.0	1/m2
	Friction Factor:		
	Assumed D50:	0.50	feet
	Calc n Value:	0.035	
	Used:	0.035	
	Min. Bottom Slope:	0.050	ft/ft
	Max. Bottom Slope:	0.050	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.44	feet
	Qn/1.49(S)1/2=	1.411	
	A(R)2/3=	1.400	
	Required Depth:	0.94	feet
	Area:	2.78	ft2
	Perimeter:	7.78	feet
	Hydraulic Radius:	0.36	feet
	Velocity:	4.82	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.44	feet
	Qn/1.49(S)1/2=	1.411	
	A(R)2/3=	1.400	
	Required Depth:	0.94	feet
	Area:	2.78	ft2
	Perimeter:	7.78	feet
	Hydraulic Radius:	0.36	feet
	Velocity:	4.82	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	5.0	feet
	Side Slope 1:	3.0	1/m1
	Side Slope 2:	3.0	1/m2
	Min. Bottom Slope:	5.0	%
	Max. Bottom Slope:	5.0	%
	Min Channel Depth:	0.94	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

RIPRAP DESIGN - Using the RED BOOK (Applied Hydrology and for Disturbed Areas)

Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:29 AM
Channel Section: Channel RC-1: C-14-42 Outlet Computed:DEH

			UNITS
DESIGN CRITERIA:	Design Flow:	13.40	cfs
	Bottom Width:	5.00	feet
	Side Slope1:	3.00	1/m1
	Side Slope2:	3.00	1/m2
	Friction Factor:	0.04	
	Min. Bottom Slope:	0.05	ft/ft
	Max. Bottom Slope:	0.05	ft/ft
	Freeboard:	0.50	feet
	Depth (Min. S):	0.44	feet
	Depth (Max. S):	0.44	feet
	Angle Repose (Ar):	42	degrees

Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	Smin	Smax	
D50	0.50	0.50	feet
T	1.37	1.37	lb/ft2
Nb	0.56	0.56	
Tmax	1.04	1.04	lb/ft2
Ns	0.43	0.43	
m Critical	3.00	3.00	
A (m crit)	18.44	18.44	degrees
B	30.42	30.42	degrees
Nsp	0.33	0.33	
SFb	1.62	1.62	
SFs	1.50	1.50	

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:31 AM
Channel Section: Channel RC-1; C-14-42 Outlet Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	3.10	cfs
	Bottom Width:	5.0	feet
	Side Slope1:	3.0	1/m1
	Side Slope2:	3.0	1/m2
	Friction Factor:		
	Assumed D50:	1.75	feet
	Calc n Value:	0.043	
	Used:	0.043	
	Min. Bottom Slope:	0.320	ft/ft
	Max. Bottom Slope:	0.320	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.13	feet
	Qn/1.49(S)1/2=	0.159	
	A(R)2/3=	0.160	
	Required Depth:	0.63	feet
	Area:	0.67	ft2
	Perimeter:	5.79	feet
	Hydraulic Radius:	0.12	feet
	Velocity:	4.61	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.13	feet
	Qn/1.49(S)1/2=	0.159	
	A(R)2/3=	0.160	
	Required Depth:	0.63	feet
	Area:	0.67	ft2
	Perimeter:	5.79	feet
	Hydraulic Radius:	0.12	feet
	Velocity:	4.61	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	5.0	feet
	Side Slope 1:	3.0	1/m1
	Side Slope 2:	3.0	1/m2
	Min. Bottom Slope:	32.0	%
	Max. Bottom Slope:	32.0	%
	Min Channel Depth:	0.63	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

RIPRAP DESIGN - Using the RED BOOK (Applied Hydrology and for Disturbed Areas)

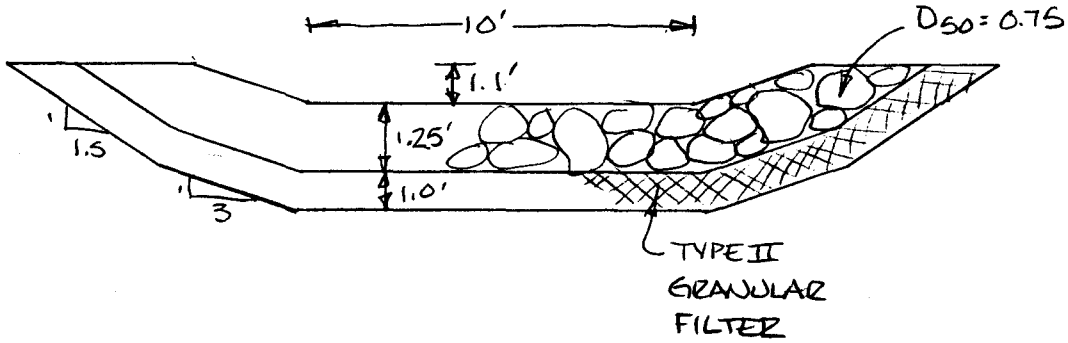
Client: Valley Camp of Utah, Inc. Date: 26-Feb-90
Project No.: 007.12.100 Time: 09:31 AM
Channel Section: Channel RC-1; C-14-42 Outlet Computed:DEH

			UNITS
DESIGN CRITERIA:	Design Flow:	3.10	cfs
	Bottom Width:	5.00	feet
	Side Slope1:	3.00	1/m1
	Side Slope2:	3.00	1/m2
	Friction Factor:	0.04	
	Min. Bottom Slope:	0.32	ft/ft
	Max. Bottom Slope:	0.32	ft/ft
	Freeboard:	0.50	feet
	Depth (Min. S):	0.13	feet
	Depth (Max. S):	0.13	feet
	Angle Repose (Ar):	42	degrees

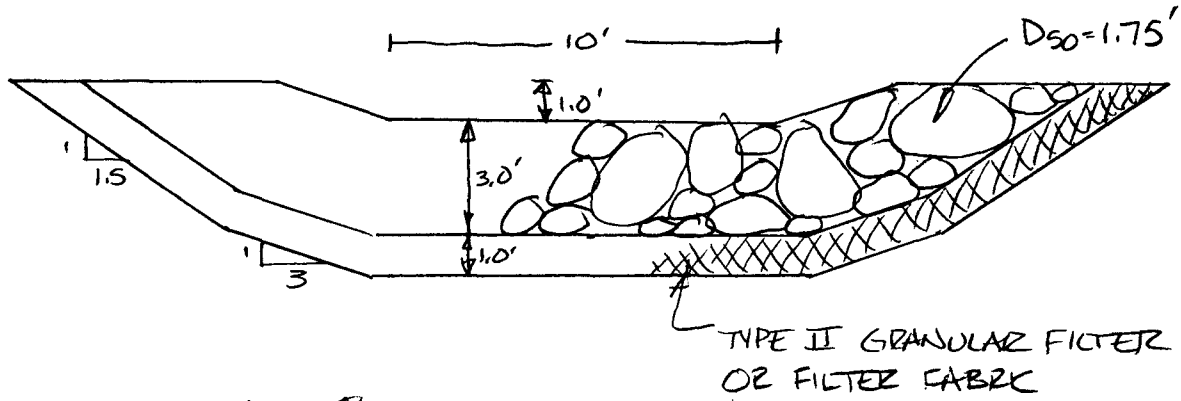
Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	Smin	Smax	
D50	1.75	1.75	feet
T	2.50	2.50	lb/ft2
Nb	0.29	0.29	
Tmax	1.90	1.90	lb/ft2
Ns	0.22	0.22	
m Critical	3.00	3.00	
A (m crit)	18.44	18.44	degrees
B	15.30	15.30	degrees
Nsp	0.17	0.17	
SFb	1.48	1.48	
SFs	1.86	1.86	

LOWER BELINA - S = 5.0% STA 11+00 TO STA 13+20



LOWER BELINA - S = 16% STA 0+00 TO STA 10+95



SIDE CHANNEL - S = 32% STA 0+00 TO STA 5+30

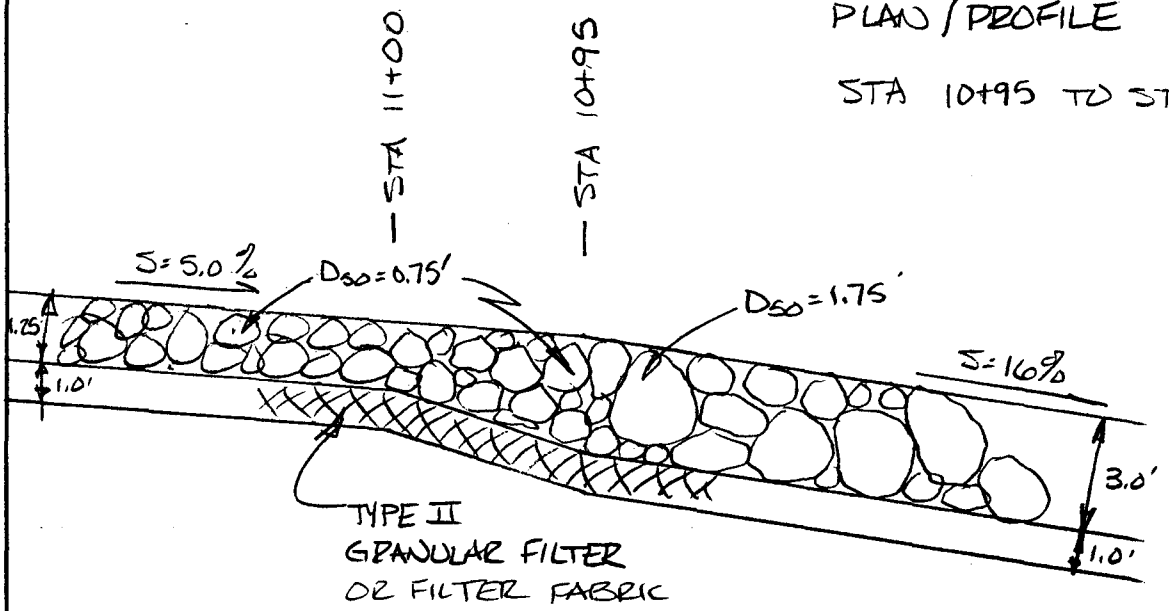
HANSEN ALLEN & LUCE inc

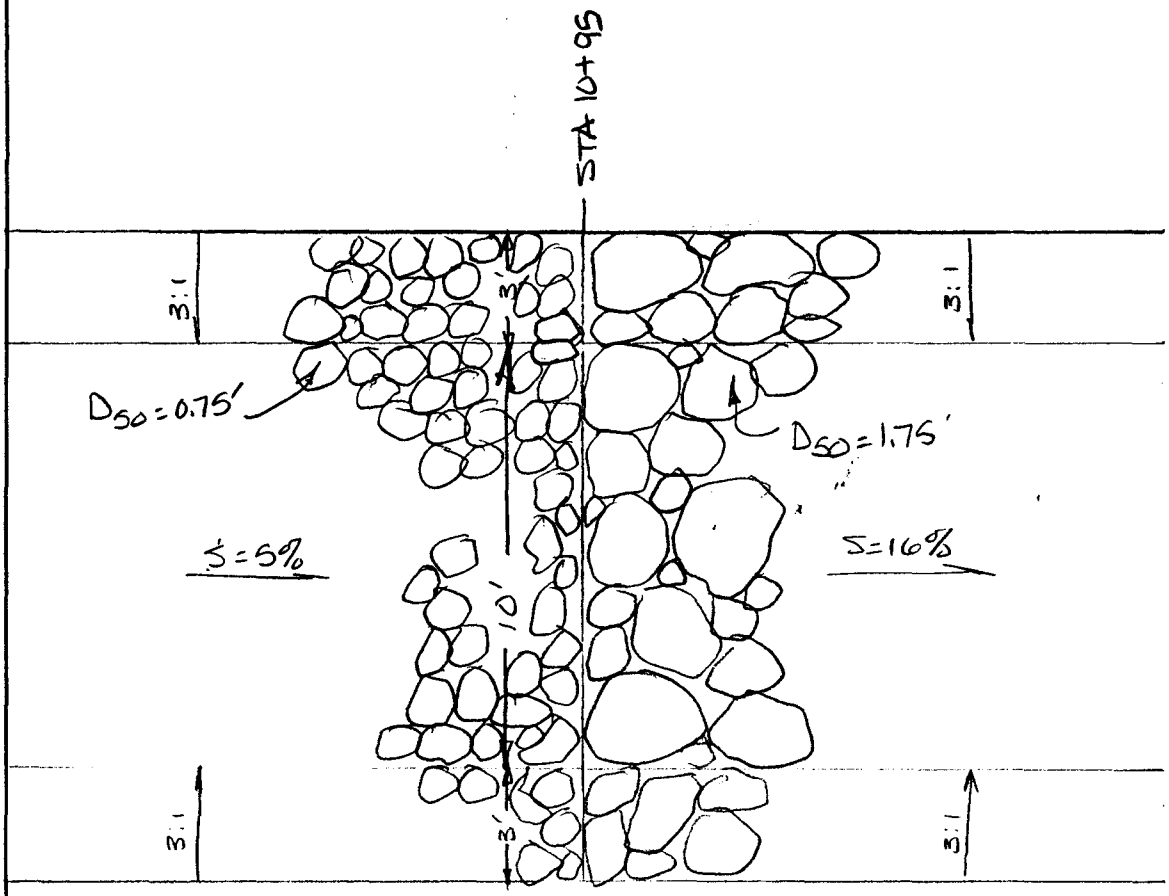
CLIENT VALLEY CAMP
PROJECT RECLAMATION
FEATURE
PROJECT NO. 007.12.100

SHEET 17 OF 21
COMPUTED DEH
CHECKED
DATE 22JAN90

PLAN / PROFILE

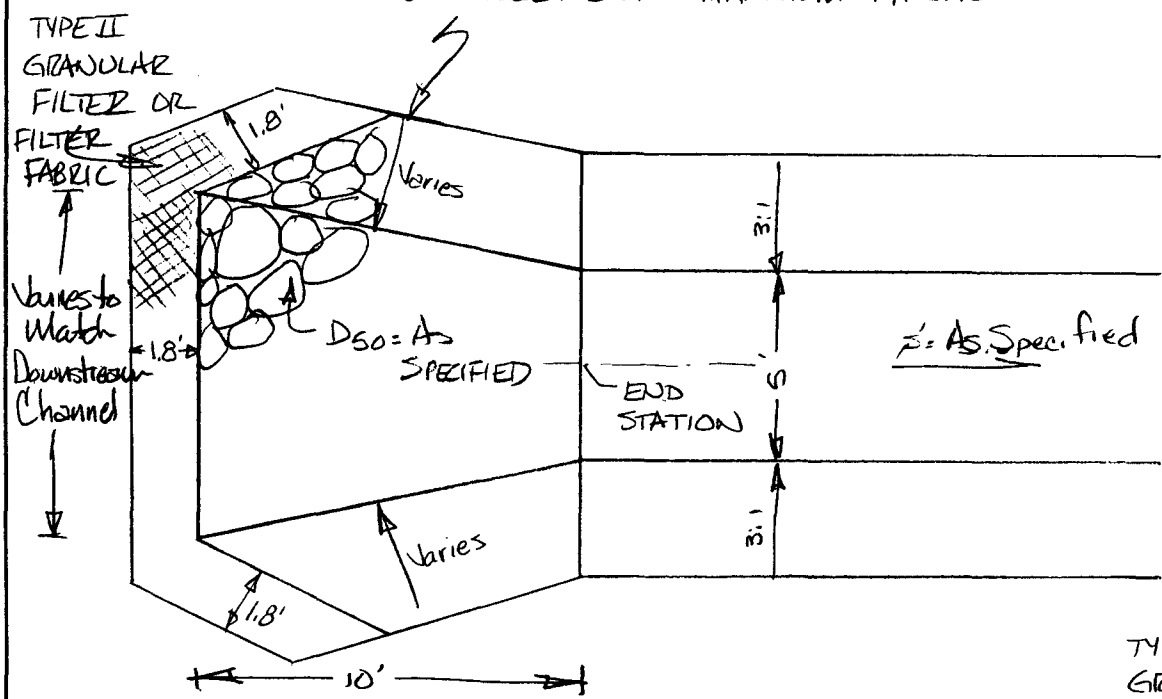
STA 10+95 TO STA 11+00

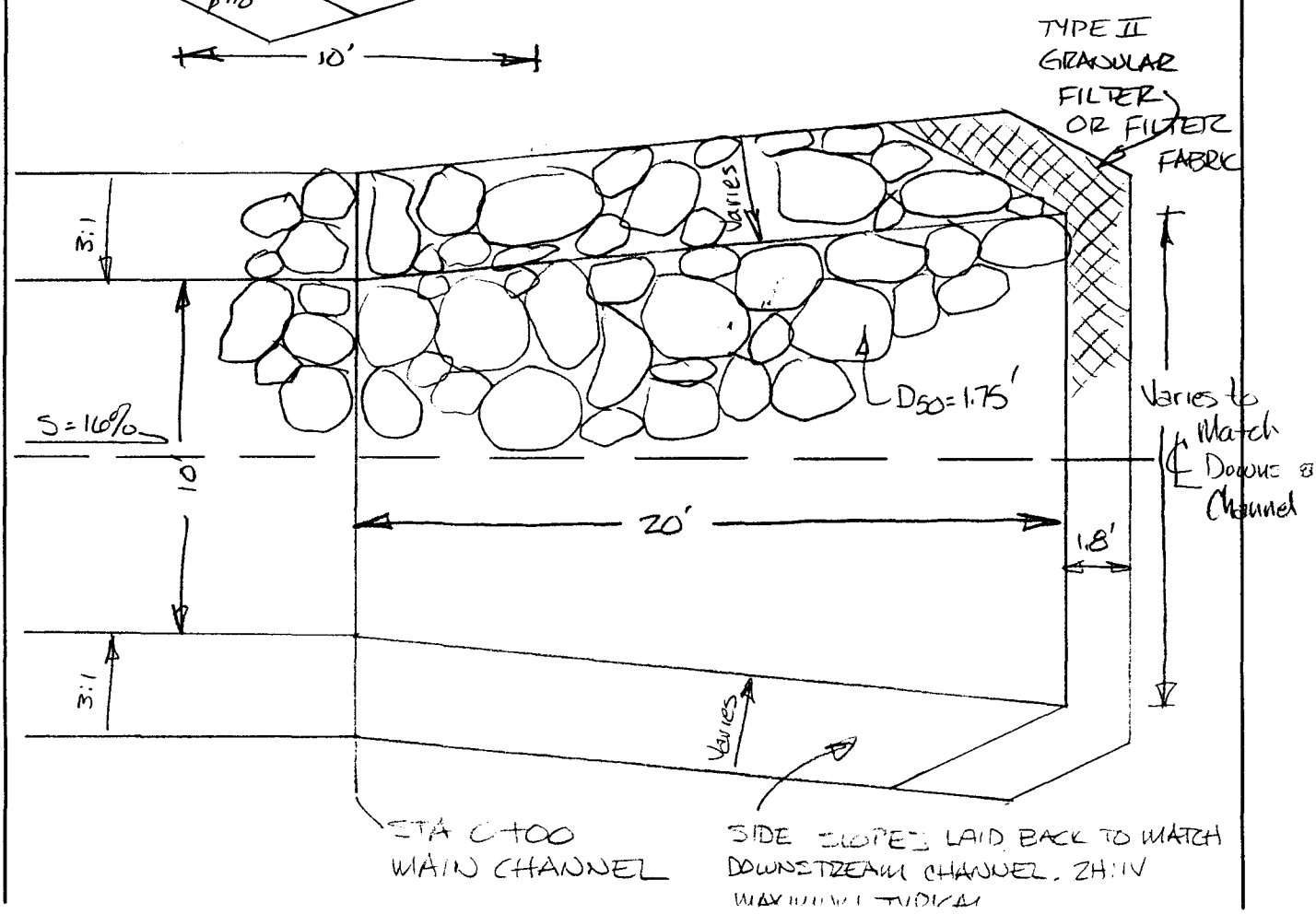




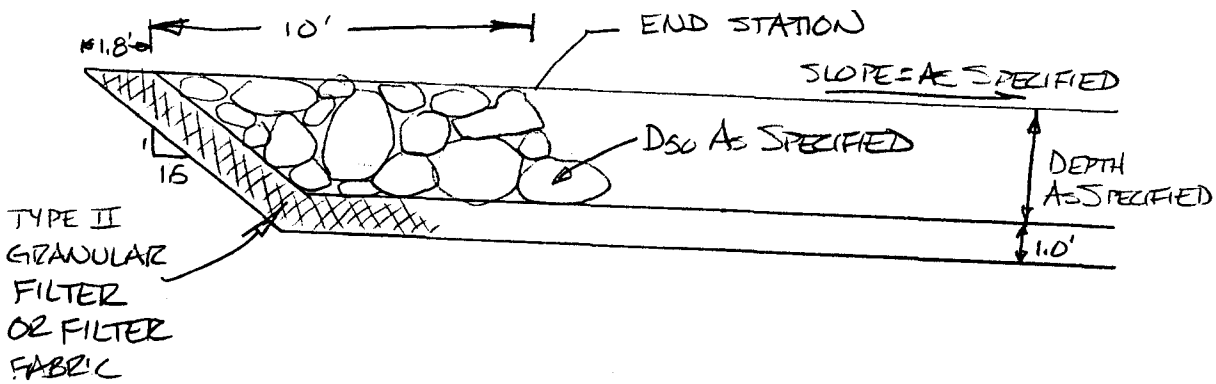
INLET DESIGN - UPPER CHANNEL (RIGHT & LEFT FORKS) STA 2S+4S
SIDE CHANNEL RIGHT STA 5+30
SIDE CHANNEL LEFT STA 0+60

SIDE SLOPES LAID BACK TO MATCH UPSTREAM CHANNEL. 2H:1V MAXIMUM TYPICAL

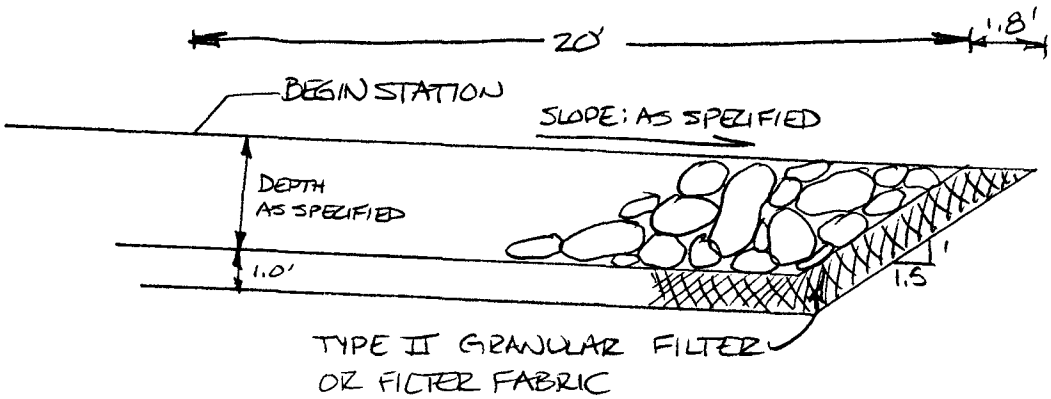




UPSTREAM INLET X-SECTION



DOWNSTREAM OUTLET SECTION

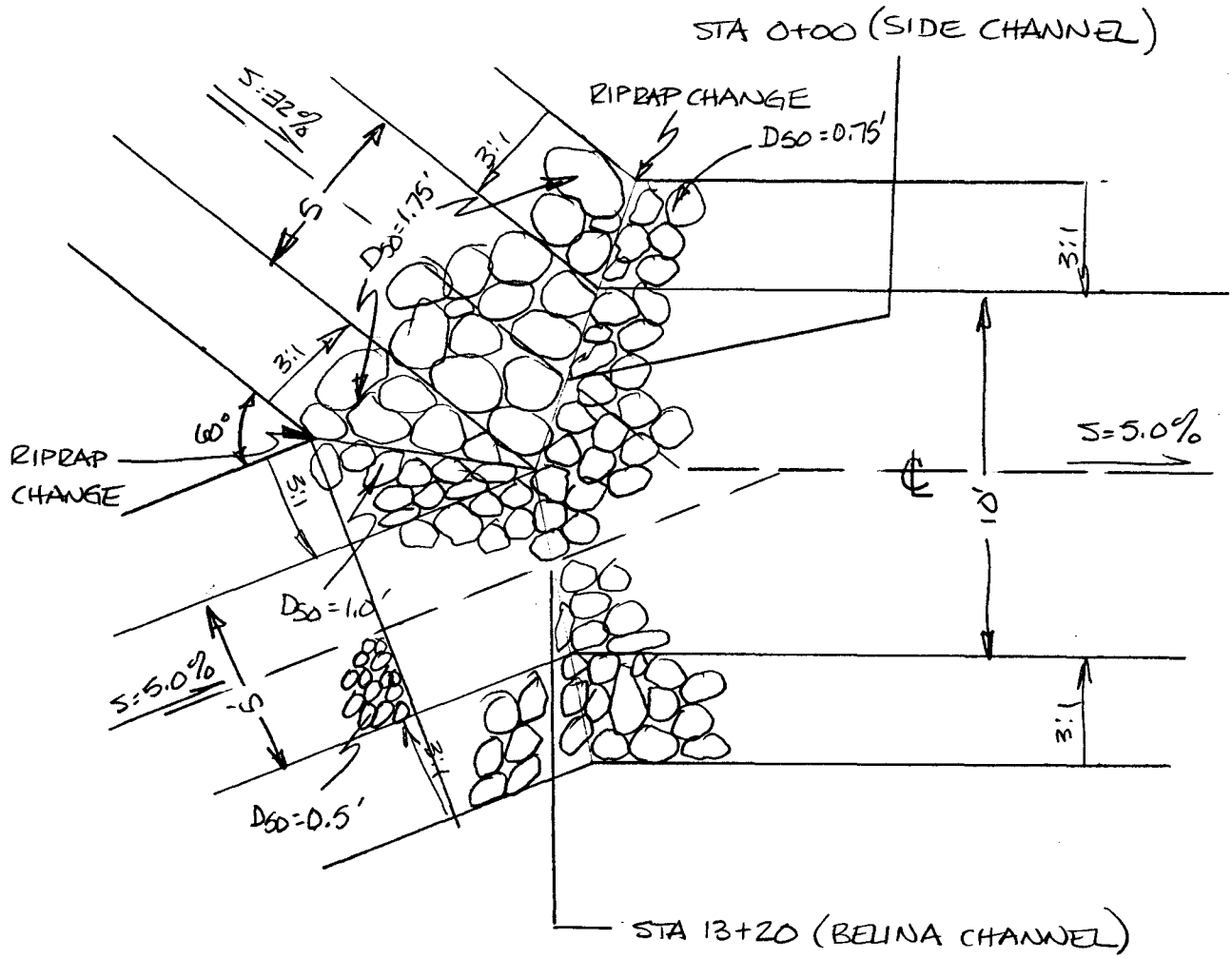


HANSEN ALLEN & LUCE inc

CLIENT VALLEY CAMP
PROJECT RECLAMATION
FEATURE
PROJECT NO. 007.12.100

SHEET 20 OF 21
COMPUTED VEH
CHECKED
DATE 22 JAN 90

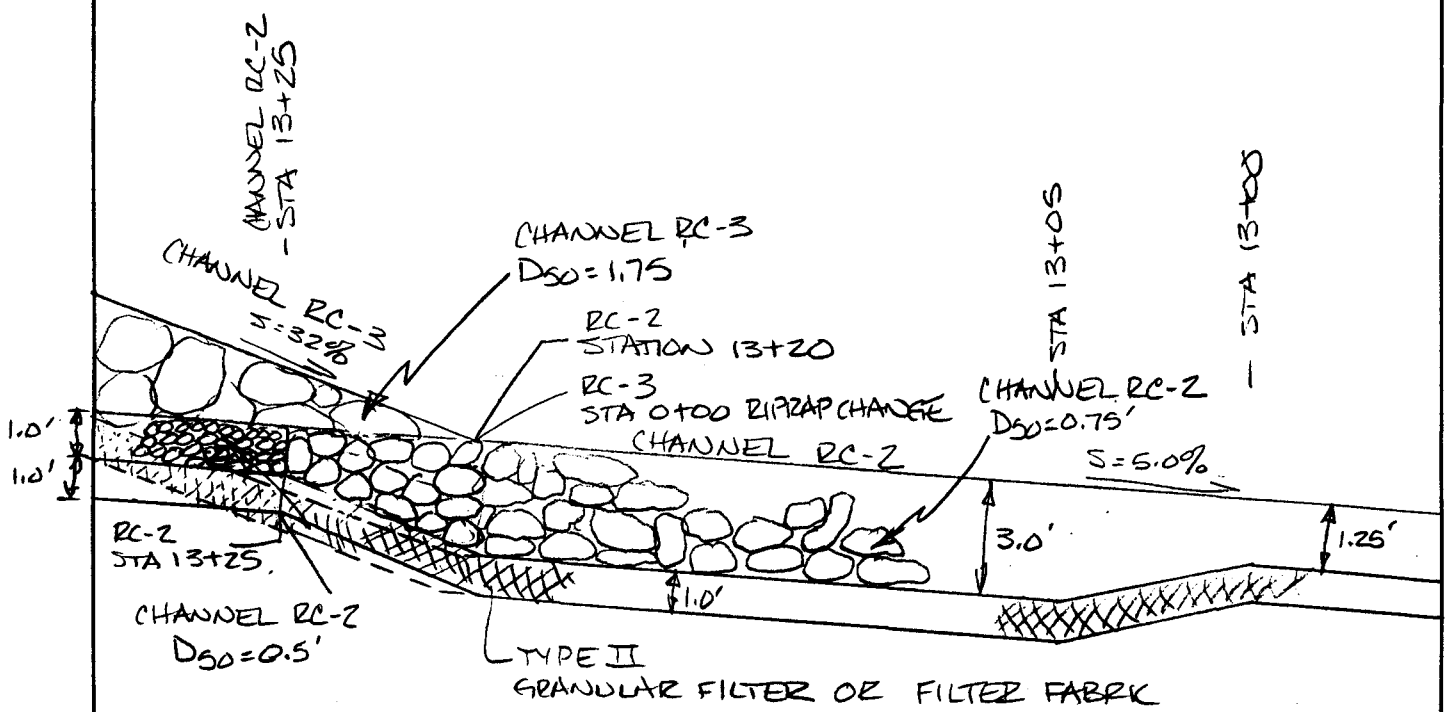
FORK - STA 13+20



HANSEN ALLEN & LUCE INC

CLIENT VALLEY CAMP
PROJECT RECLAMATION
FEATURE
PROJECT NO. 007.12.100

SHEET 21 OF 21
COMPUTED DEH
CHECKED
DATE 23 JAN 90



JUNCTION CHANNEL RC-2 AND RC-3

NOTE: RIPRAP UPSTREAM OF STATION 13+20 IN CHANNEL RC-2 HAS D_{50} = 0.50 FT. RIPRAP D_{50}=0.75' USED DOWNSTREAM

APPENDIX 820.100

Reclamation Agreement

Last Revised, July 1989
RECLAMATION AGREEMENT

Permit Number ACT/007/001
Date Permit Issued 8-24-84.
Effective Date of Agreement 11-30-89

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
(801) 538-5340

COAL RECLAMATION AGREEMENT

--ooOOoo--

For the purposes of this RECLAMATION AGREEMENT the terms below are defined as follows:

"PERMIT" (Mine Permit No.)	ACT/007/001 (County) Carbon
"MINE" (Name of Mine)	Belina Complex
"OPERATOR" (Company or Name)	Valley Camp of Utah, Inc.
(Address)	Scofield Route Helper, Utah 84526
"OPERATOR'S REGISTERED AGENT" (Name)	W. L. Wright, President & Chief Operating Officer
(Address)	Scofield Route Helper, Utah 84526
(Phone)	(801) 448-9456
"COMPANY OFFICERS":	James L. Litman, Vice President & Chief Executive Officer
"BOND TYPE" (Form of Bond)	Performance
"BOND" (Bond Amount-Dollars)	2.3 Million
(Year-Dollars)	1989
INSTITUTION (Bank or Agency)	FEDERAL INSURANCE COMPANY
POLICY OR ACCOUNT NUMBER	8099-56-50
"LIABILITY INSURANCE" (Exp.)	
(Insurance Company)	The Home Indemnity Company
"STATE":	Utah (Department of Natural Resources)
"DIVISION":	Division of Oil, Gas and Mining
"DIVISION DIRECTOR"	Dianne R. Nielson

EXHIBITS:

		Revision Dates		
"SURFACE DISTURBANCE"	Exhibit "A"			
"BONDING AGREEMENT"	Exhibit "B"			
"LIABILITY INSURANCE"	Exhibit "C"			
"STIPULATION TO CHANGE BOND"	Exhibit "D"			

RECLAMATION AGREEMENT

This RECLAMATION AGREEMENT (hereinafter referred to as "Agreement") is entered into by the Operator.

WHEREAS, on 8-24, 1984, the Division approved the Permit Application Package, hereinafter "PAP", submitted by Valley Camp of Utah, Inc., hereinafter "Operator"; and

WHEREAS, prior to issuance of a permit to conduct mining and reclamation operations on the property described in the PAP, hereinafter "Property", the Operator is obligated by Title 40-10-1, et seq., Utah Code Annotated (1953, as amended), hereinafter "Act", to file with the Division a bond ensuring the performance of the reclamation obligations in the manner and by the standards set forth in the PAP, the Act, and the State of Utah Division of Oil, Gas and Mining Rules pertaining to Coal Mining and Reclamation Activities, hereinafter "Rules"; and

WHEREAS, the Operator is ready and willing to file the bond in the amount and in a form acceptable to the Division and to perform all obligations imposed by the Division relating to the reclamation of the Property; and

WHEREAS, the Division is ready and willing to issue the subject a mining and reclamation permit upon acceptance and approval of the bond.

NOW, THEREFORE, the Division and the Operator agree as follows:

1. The provisions of the Act and the Rules are incorporated by reference herein and hereby made a part of this Agreement. Provisions of the Act or Rules shall supercede conflicting provisions of this Agreement.

2. The Operator shall provide a legal description of the property including the number of acres approved by the Division to be disturbed by surface mining and reclamation operations during the permit period. The description is attached as Exhibit "A", and is incorporated by reference and shall be referred to as the "Surface Disturbance".

3. The Operator shall provide a bond to the Division in the form and amount acceptable to the Division ensuring the performance of the reclamation obligations in the manner and by the standards set forth in the PAP, the Act and the Rules. Said bond is attached as Exhibit "B" and is incorporated by reference.

4. The Operator shall maintain in full force and effect the public liability insurance policy submitted as part of the permit application. The Division shall be listed as an additional insured on said policy.

5. In the event that the Surface Disturbance is increased through expansion of the coal mining and reclamation operations or decreased through partial reclamation, the Division shall adjust the bond as appropriate.

6. The Operator does hereby jointly and severally agree to indemnify and hold harmless the State of Utah and the Division from any claim, demand, liability, cost, charge, or suit initiated by a third party as a result of the Operator or Operator's agent or employees failure to abide by the terms and conditions of the approved PAP and this Agreement.

7. The terms and conditions of this Agreement are non-cancellable until such time as the Operator has satisfactorily, as determined by the Division, reclaimed the Surface Disturbance in accordance with the approved PAP, the Act, and the Rules. Notwithstanding the above, the Division may direct, or the Operator may request and the Division may approve, a modification to this Agreement.

8. The Operator may, at any time, submit a request to the Division to substitute the bonding method. The Division may approve the substitution if the bond meets the requirements of the Act and the Rules, but no bond shall be released until the Division has approved and accepted the replacement bond.

9. Any revision in the Surface Disturbance, the bond amount, the bond type, the liability insurance amount coverage, and/or the liability insurance company, or other revisions affecting the terms and conditions of this Agreement shall be submitted on the form entitled "Stipulation to Revise Reclamation Agreement" and shall be attached hereto as Exhibit "D".

10. This Agreement shall be governed and construed in accordance with the laws of the State. The Operator shall be liable for all costs required to comply with this agreement, including any attorney fees.

11. Any breach of the provisions of this Agreement, the Act, the Rules, or the PAP may, at the discretion of the Division, result in an order to cease coal mining and reclamation operations, revocation of the Operator's permit to conduct coal mining and reclamation operations and/or forfeiture of the bond.

RECLAMATION AGREEMENT

12. In the event of forfeiture, the Operator shall be liable for additional costs in excess of the bond amount which are required to comply with this Agreement. Any excess monies resulting from the forfeiture of the bond amount upon compliance with this contract shall be refunded to the appropriate party.

13. Each signatory below represents that he/she is authorized to execute this Agreement on behalf of the named party. Proof of such authorization is provided on a form acceptable to the Division and is attached hereto.

SO AGREED this 17th day of November, 1989

STATE OF UTAH:

Dianne R. Nielson

Dianne R. Nielson, Director
Division of Oil, Gas and Mining

OPERATOR:

Walter L. Wright

Company Officer - Position
Walter L. Wright, President & COO

J. L. Litman

Company Officer - Position
J.L. Litman
Vice Chairman & CEO

NOTE: An Affidavit of Qualification must be completed and attached to this form for each authorized agent or officer. Where one signs by virtue of Power of Attorney for a company, such Power of Attorney must be filed with this Agreement. If the principal is a corporation, the Agreement shall be executed by its duly authorized officer.

EXHIBIT "A"

SURFACE DISTURBANCE

LEGAL DESCRIPTION

Permit Number ACT/007/001
Effective Date

SURFACE DISTURBANCE
--ooOOoo--

In accordance with the RECLAMATION AGREEMENT, the OPERATOR intends to conduct coal mining and reclamation activities on or within the surface DISTURBANCE as described hereunder:

Total acres of SURFACE DISTURBANCE 79

Legal Description of SURFACE DISTURBANCE:

T.13S., R.7E., SLB&M

Parts of Section 8, 9, 17, 16, 19 & 30

E X H I B I T "B"

B O N D I N G A G R E E M E N T

Surety Bond

Last Revised, July 1989
Exhibit "B" - BONDING AGREEMENT
SURETY BOND

Permit Number ACT/007/001
Expiration Date _____

(FEDERAL COAL)
SURETY BOND
--ooOOoo--

THIS SURETY BOND entered into and by and between the undersigned OPERATOR, and SURETY COMPANY, hereby jointly and severally bind ourselves, our heirs, administrators, executors, successors and assigns unto the State of Utah, Division of Oil, Gas and Mining, and, the U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement (OSMRE) in the penal sum of ($ 2,300,000.00 *) (Surety Bond Amount) for the timely performance of reclamation responsibilities of the surface disturbance described in Exhibit "A" of this Reclamation Agreement.

This SURETY BOND shall remain in effect until all applicable rules and the OPERATOR's reclamation obligation have been met and released by the Division of Oil, Gas and Mining.

Terms for release or adjustment of this BOND are as written and agreed to by the DIVISION and the OPERATOR in the RECLAMATION AGREEMENT incorporated by reference herein, to which this SURETY AGREEMENT has been attached as Exhibit "B".

* Bond Number 8099-56-50

Last Revised, July 1989
Exhibit "B" - BONDING AGREEMENT
SURETY BOND

So agreed this 17th day of November, 19 89.

FOR THE OPERATOR:

Valley Camp of Utah, Inc.
Operator (Company

Walter L Wright
Company Officer - Position
Walter L. Wright, President & COO

FOR THE SURETY COMPANY:

Federal Insurance Company
Surety (Company)

Company Officer - Position Attorney-in-Fact

ACCEPTED BY THE STATE OF UTAH:

Director - Division of Oil, Gas and Mining

NOTE: An Affidavit of Qualification must be completed and attached to this form for each authorized agent or officer. Where one signs by virtue of Power of Attorney for a company, such Power of Attorney must be filed with this Agreement. If the principal is a corporation, the Agreement shall be executed by its duly authorized officer.

CHUBB GROUP of Insurance Companies

15 Mountain View Road, Warren, NJ 07060

COMPANY

RIDER to be attached to and form a part of
Bond No. 8099-56-50 wherein
FEDERAL INSURANCE COMPANY
is named as Surety, on behalf of
Valley Camp of Utah, Inc.
as Principal, in favor of State of Utah, Div. of Oil, Gas and Mining, and
U. S. Dept. of the Interior, Office of Surface Mining
in the sum of $1,521,000.00
dated 6/29/84 effective 6/29/84

IT IS HEREBY UNDERSTOOD AND AGREED that effective the 17th day of November, 1989
the penalty of this bond is increased
from One Million, Five Hundred Twenty One Thousand and 00/100 ($1,521,000.00)
to Two Million, Three Hundred Thousand and 00/100 ($2,300,000.00)
as to losses occurring after the 17th day of November, 1989

Provided, however, that the liability of the Principal and Surety hereon shall not be cumulative or in any event exceed the larger amount referred to herein.

The attached bond shall be subject to all its agreements, limitations and conditions except as herein expressly modified.

Signed, sealed and dated this 14th day of November, 19 89

Valley Camp of Utah, Inc.

By: Walter L Wright
(Principal)

Federal Insurance Company:

By: Mary Elizabeth Hammock
Mary Elizabeth Hammock, Attorney-in-Fact

ACCEPTED

By: [illegible]
(Obligee)

POWER OF ATTORNEY

Know all Men by these Presents, That the FEDERAL INSURANCE COMPANY, 15 Mountain View Road, Warren, New Jersey, a New Jersey Corporation, has constituted and appointed, and does hereby constitute and appoint John W. Hunt, Ronald W. Brown, Mary Elizabeth Hammock, Muriel L. Hoh, M. Joan Norville of Winston Salem, North Carolina and Thomas W. Burke and Teresa T. Gwyn of Charlotte, North Carolina----------

each its true and lawful Attorney-in-Fact to execute under such designation in its name and to affix its corporate seal to and deliver for and on its behalf surety thereon or otherwise, bonds of any of the following classes, to-wit:

1. Bonds and Undertakings filed in any suit, matter or proceeding in any Court, or filed with any Sheriff or Magistrate, for the doing or not doing of anything specified in such Bond or Undertaking.
2. Surety bonds to the United States of America or any agency thereof, including those required or permitted under the laws or regulations relating to Customs or Internal Revenue; License and Permit Bonds or other indemnity bonds under the laws, ordinances or regulations of any State, City, Town, Village, Board or other body or organization, public or private; bonds to Transportation Companies, Lost Instrument bonds; Lease bonds, Workers' Compensation bonds, Miscellaneous Surety bonds and bonds on behalf of Notaries Public, Sheriffs, Deputy Sheriffs and similar public officials.
3. Bonds on behalf of contractors in connection with bids, proposals or contracts.

In Witness Whereof, the said FEDERAL INSURANCE COMPANY has, pursuant to its By-Laws, caused these presents to be signed by its Assistant Vice-President and Assistant Secretary and its corporate seal to be hereto affixed this 1st day of January 19 86

Corporate Seal

FEDERAL INSURANCE COMPANY NEW JERSEY

Richard D. O'Connor
Assistant Secretary

FEDERAL INSURANCE COMPANY
By

George McClellan
Assistant Vice-President

STATE OF NEW JERSEY
County of Somerset } ss.

On this 1st day of January 19 86, before me personally came Richard D. O'Connor to me known and by me known to be Assistant Secretary of the FEDERAL INSURANCE COMPANY, the corporation described in and which executed the foregoing Power of Attorney, and the said Richard D. O'Connor being by me duly sworn, did depose and say that he is Assistant Secretary of the FEDERAL INSURANCE COMPANY and knows the corporate seal thereof; that the seal affixed to the foregoing Power of Attorney is such corporate seal and was thereto affixed by authority of the By-Laws of said Company, and that he signed said Power of Attorney as Assistant Secretary of said Company by like authority; and that he is acquainted with George McClellan and knows him to be the Assistant Vice-President of said Company, and that the signature of said George McClellan subscribed to said Power of Attorney is in the genuine handwriting of said George McClellan and was thereto subscribed by authority of said By-Laws and in deponent's presence.

Notarial Seal

ALICE LEONARD NOTARY PUBLIC NEW JERSEY

Acknowledged and Sworn to before me
on the date above written.

ALICE LEONARD Notary Public

CERTIFICATION NOTARY PUBLIC OF NEW JERSEY
My Commission Expires June 28, 1988

STATE OF NEW JERSEY
County of Somerset } ss.

I, the undersigned, Assistant Secretary of the FEDERAL INSURANCE COMPANY, do hereby certify that the following is a true excerpt from the By-Laws of the said Company as adopted by its Board of Directors on March 11, 1953 and most recently amended March 11, 1983 and that this By-Law is in full force and effect.

"ARTICLE XVIII.

Section 2. All bonds, undertakings, contracts and other instruments other than as above for and on behalf of the Company which it is authorized by law or its charter to execute, may and shall be executed in the name and on behalf of the Company either by the Chairman or the Vice-Chairman or the President or a Vice-President, jointly with the Secretary or an Assistant Secretary, under their respective designations, except that any one or more officers or attorneys-in-fact designated in any resolution of the Board of Directors or the Executive Committee, or in any power of attorney executed as provided for in Section 3 below, may execute any such bond, undertaking or other obligation as provided in such resolution or power of attorney.

Section 3. All powers of attorney for and on behalf of the Company may and shall be executed in the name and on behalf of the Company, either by the Chairman or the Vice-Chairman or the President or a Vice-President or an Assistant Vice-President, jointly with the Secretary or an Assistant Secretary, under their respective designations. The signature of such officers may be engraved, printed or lithographed."

I further certify that said FEDERAL INSURANCE COMPANY is duly licensed to transact fidelity and surety business in each of the States of the United States of America, District of Columbia, Puerto Rico, and each of the Provinces of Canada with the exception of Prince Edward Island; and is also duly licensed to become sole surety on bonds, undertakings, etc., permitted or required by law.

I, the undersigned Assistant Secretary of FEDERAL INSURANCE COMPANY, do hereby certify that the foregoing Power of Attorney is in full force and effect.

Given under my hand and the seal of said Company at Warren, N.J., this 14th day of November 19 89

Corporate Seal

FEDERAL INSURANCE COMPANY NEW JERSEY

Assistant Secretary

EXHIBIT "C"

LIABILITY INSURANCE

Revised November, 1987.

RECEIVED
JAN 22 1988
DIVISION OF
OIL, GAS & MINING

CERTIFICATE OF LIABILITY INSURANCE
Issued to:
State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining
--ooOOoo--

THIS IS TO CERTIFY THAT:

The Home Indemnity Company
(Name of Insurance Company)
P.O. Box 5160
Manchester, NH 03108
(Home Office Address of Insurance Company)

HAS ISSUED TO:

Valley Camp of Utah, Inc.*
(Name of Permit Applicant)
*Please refer to Item 13 of the Named Insured Endorsement on the policy

Valley Camp of Utah, Inc. (Mine Name)

ACT/007/001 (Permit Number)

CERTIFICATE OF INSURANCE:

GL 99 48 43 (Policy Number)

April 1, 1987 (Effective Date)

UNDER THE FOLLOWING TERMS AND CONDITIONS:

As Per UMC/SMC Part 800.60 Terms and Conditions for Liability Insurance;

A. The Division shall require the applicant to submit as part of its permit application a certificate issued by an insurance company authorized to do business in the state of Utah certifying that the applicant has a public liability insurance policy in force for the surface coal mining and reclamation operations for which the permit is sought. Such policy shall provide for personal injury and property damage protection in an amount adequate to compensate any persons injured or property damaged as a result of the surface coal mining and reclamation operations, including the use of explosives and who are entitled to compensation under the applicable provisions of state law. Minimum insurance coverage for bodily injury and property damage shall be $300,000 for each occurrence and $500,000 aggregate.

B. The policy shall be maintained in full force during the life of the permit or any renewal thereof, including the liability period necessary to complete all reclamation operations under this chapter.

CERTIFICATE OF LIABILITY INSURANCE

C. The policy shall include a rider requiring that the insurer notify the Division whenever substantive changes are made in the policy including any termination or failure to renew.

IN ACCORDANCE WITH THE ABOVE TERMS AND CONDITIONS, and the Utah Code Annotated
40-10-10 ~~40-10-1 et seq.~~, the Insurance Company hereby attests to the fact that coverage for said Permit Applicant is in accordance with the above stated requirements of the State of Utah and agrees to notify the Division of Oil, Gas and Mining in writing of any substantive change, including cancellation, failure to renew, or other material change. No change shall be effective until at least thirty (30) days after such notice is received by the Division.
NOTE: The stated policy contains an Absolute Pollution Exclusion

UNDERWRITING AGENT:

Patricia W. Settlemyre — 919/768-4190
(Agent's Name) — (Phone)

Alexander & Alexander of the Carolinas Inc.
(Company Name)

P. O. Box 2896 — Winston-Salem, NC 27102
(Mailing Address) — (City, State, Zip Code)

The undersigned affirms that the above information is true and complete to the best of his or her knowlege and belief, and that he or she is an authorized representative of the above-named insurance company.

1-14-88, Patricia W. Settlemyre, Asst. Branch Manager
(Date, Signature and Title of Authorized Agent of Insurance Company)

Signed and sworn before me by Gloria M. Cook
(Name)

this 14 day of February, 1988

Gloria M. Cook
(Signature)

My Commission Expires: 2-26-89
(Date)

7000R-28

EXHIBIT "D"

STIPULATION TO REVISE RECLAMATION AGREEMENT

Last Revised, July 1989
Exhibit "D" - STIPULATION TO REVISE RECLAMATION AGREEMENT

Permit Number ACT/007/001
Expiration Date _____

COAL
STIPULATION TO REVISE RECLAMATION AGREEMENT
--ooOOoo--

This STIPULATION TO REVISE RECLAMATION AGREEMENT entered into by and between the OPERATOR and DIVISION incorporates the following revisions or changes to the RECLAMATION AGREEMENT: (Identify and Describe Revisions Below)

The attached rider increases the existing bond amount.

In accordance with this STIPULATION TO REVISE RECLAMATION AGREEMENT, the following Exhibits have been replaced by the OPERATOR and are approved by the DIVISION:

x Replace the RECLAMATION AGREEMENT in its entirety.

__ Replace Exhibit "A" - SURFACE DISTURBANCE.

x Replace Exhibit "B" - BONDING AGREEMENT.

__ Replace Exhibit "C" - LIABILITY INSURANCE.

The BONDING amount is revised from ($ 1,521,000) to ($ 2,300,000).

The SURFACE DISTURBANCE is revised from _____ acres to _____ acres.

The EXPIRATION DATE is revised from _____ to _____.

SO AGREED THIS 17th DAY OF November, 1989.

FOR THE STATE OF UTAH:

Dianne R. Nielson
Director, Division of Oil, Gas and Mining

FOR THE OPERATOR:

Walter L Wright
Company Officer - Position
Walter L. Wright, President & COO

Company Officer - Position
J.L. Litman
Vice Chairman & CEO

NOTE: An Affidavit of Qualification must be completed and attached to this form for each authorized agent or officer. Where one signs by virtue of Power of Attorney for a company, such Power of Attorney must be filed with this Agreement. If the principal is a corporation, the Agreement shall be executed by its duly authorized officer.

CHUBB GROUP of Insurance Companies

CHUBB

15 Mountain View Road, Warren, NJ 07060

COMPANY

RIDER to be attached to and form a part of
Bond No. 8099-56-50 wherein
FEDERAL INSURANCE COMPANY
is named as Surety, on behalf of
Valley Camp of Utah, Inc.
as Principal, in favor of State of Utah, Div. of Oil, Gas and Mining, and
U. S. Dept. of the Interior, Office of Surface Mining
in the sum of $1,521,000.00
dated 6/29/84 effective 6/29/84

IT IS HEREBY UNDERSTOOD AND AGREED that effective the 17th day of November, 1989
the penalty of this bond is increased
from One Million, Five Hundred Twenty One Thousand and 00/100 ($1,521,000.00)
to Two Million, Three Hundred Thousand and 00/100 ($2,300,000.00)
as to losses occurring after the 17th day of November, 1989

Provided, however, that the liability of the Principal and Surety hereon shall not be cumulative or in any event exceed the larger amount referred to herein.

The attached bond shall be subject to all its agreements, limitations and conditions except as herein expressly modified.

Signed, sealed and dated this 14th day of November, 19 89

Valley Camp of Utah, Inc.

By: Walter L Wright
(Principal)

Federal Insurance Company:

By: Mary Elizabeth Hammock
Mary Elizabeth Hammock, Attorney-in-Fact

ACCEPTED

By: Donna P. Nelson
(Obligee)

Form 15-02-72 (Ed. 8-75) (Formerly 12451)

POWER OF ATTORNEY

Know all Men by these Presents, That the FEDERAL INSURANCE COMPANY, 15 Mountain View Road, Warren, New Jersey, a New Jersey Corpo tion, has constituted and appointed, and does hereby constitute and appoint John W. Hunt, Ronald W. Brown, Mary Elizabeth Hammock, Muriel L. Hoh, M. Joan Norville of Winston Salem, North Carolina and Thomas W. Burke and Teresa T. Gwyn of Charlotte, North Carolina----------

each its true and lawful Attorney-in-Fact to execute under such designation in its name and to affix its corporate seal to and deliver for and on its behalf surety thereon or otherwise, bonds of any of the following classes, to-wit:

1. Bonds and Undertakings filed in any suit, matter or proceeding in any Court, or filed with any Sheriff or Magistrate, for the doing or not doing of anything specified in such Bond or Undertaking.
2. Surety bonds to the United States of America or any agency thereof, including those required or permitted under the laws or regulations relating to Custo or Internal Revenue; License and Permit Bonds or other indemnity bonds under the laws, ordinances or regulations of any State, City, Town, Villag Board or other body or organization, public or private; bonds to Transportation Companies, Lost Instrument bonds; Lease bonds, Workers' Compensa- tion bonds, Miscellaneous Surety bonds and bonds on behalf of Notaries Public, Sheriffs, Deputy Sheriffs and similar public officials.
3. Bonds on behalf of contractors in connection with bids, proposals or contracts.

In Witness Whereof, the said FEDERAL INSURANCE COMPANY has, pursuant to its By-Laws, caused these presents to be signed by its Assistant Vice-President and Assistant Secretary and its corporate seal to be hereto affixed this 1st day of January 19 86

Corporate Seal

FEDERAL INSURANCE COMPANY NEW JERSEY

Richard D. O'Connor
Assistant Secretary

FEDERAL INSURANCE COMPANY
By
George McClellan
Assistant Vice-President

STATE OF NEW JERSEY
County of Somerset } ss.

On this 1st day of January 1986, before me personally came Richard D. O'Connor to me known and by me known to be Assistant Secretary of the FEDERAL IN- SURANCE COMPANY, the corporation described in and which executed the foregoing Power of Attorney, and the said Richard D. O'Connor being by me duly sworn, did depose and say that he is Assistant Secretary of the FEDERAL INSURANCE COMPANY and knows the corporate seal thereof; that the seal affixed to the foregoing Power of Attorney is such corporate seal and was thereto affixed by authority of the By-Law of said Company, and that he signed said Power of Attorney as Assistant Secretary of said Company by like authority; and that he is acquainted with George McClellan and knows him to be the Assistant Vice-Preside of said Company, and that the signature of said George McClellan subscribed to said Power of Attorney is in the genuine handwriting of said George McClellan and was thereto subscribed by authority of sa By-Laws and in deponent's presence.

Notarial Seal

ALICE LEONARD NOTARY PUBLIC NEW JERSEY

Acknowledged and Sworn to before me on the date above written.

ALICE LEONARD Notary Public

CERTIFICATION NOTARY PUBLIC OF NEW JERSEY
My Commission Expires June 28, 1988

STATE OF NEW JERSEY
County of Somerset } ss.

I, the undersigned, Assistant Secretary of the FEDERAL INSURANCE COMPANY, do hereby certify that the following is a true excerpt from the By-Laws of the said Company as adopted by its Board of Directo on March 11, 1953 and most recently amended March 11, 1983 and that this By-Law is in full force and effect.

"ARTICLE XVIII.

Section 2. All bonds, undertakings, contracts and other instruments other than as above for and on behalf of the Company which it is authorized by law or its charter to execute, may and shall be executed in the name and on behalf of the Company either by the Chairman or the Vice-Chairman or the President or a Vice-President, jointly with the Secretary or an Assistant Secretary, under their respective designations, except that any one or more officers or attorneys-in-fact designated in any resolution of the Board of Directors or the Executive Committee, or in any power of attorney executed as provided for in Section 3 below, may execute any such bond, undertaking or other obligation as provided in such resolution or power of attorney.

Section 3. All powers of attorney for and on behalf of the Company may and shall be executed in the name and on behalf of the Company, either by the Chairman or the Vice-Chairman or the President or a Vice-President or an Assistant Vice-President, jointly with the Secretary or an Assistant Secretary, under their respective designations. The signature of such officers may be engraved, printed or lithographed."

I further certify that said FEDERAL INSURANCE COMPANY is duly licensed to transact fidelity and surety business in each of the States of the United States of America, District of Columbia, Puerto Rico, and each of the Provinces of Canada with the exception of Prince Edward Island; and is also duly licensed to become sole surety on bonds, undertakings, etc., permitted or required by law.

I, the undersigned Assistant Secretary of FEDERAL INSURANCE COMPANY, do hereby certify that the foregoing Power of Attorney is in full force and effect.

Given under my hand and the seal of said Company at Warren, N.J., this 14th day of November 19 89

Corporate Seal

FEDERAL INSURANCE COMPANY NEW JERSEY

Assistant Secretary

PRINTED IN

AFFIDAVITS OF QUALIFICATION

Last Revised, July 1989

AFFIDAVIT OF QUALIFICATION
OPERATOR
--ooOOoo--

I, Walter L. Wright, being first duly sworn under oath, deposes and says that he/~~she~~ is the (officer or agent) President & COO of Valley Camp of Utah, Inc. ; and that he/she is duly authorized to execute and deliver the foregoing obligations; and that said OPERATOR is authorized to execute the same and has complied in all respects with the laws of Utah in reference to commitments, undertakings and obligations herein.

(Signed) Walter L Wright
Name - Position
Walter L. Wright
President & COO

Subscribed and sworn to before me this 27th day of November, 1989.

Valerie A. Young
Notary Public

My Commission Expires:
Valerie A. Young
Carbon County, Utah
My Commission Expires August 12, 1990
_____, 19 ____.

Attest:

STATE OF Utah)
) ss:
COUNTY OF Carbon)

Last Revised, July 1989

AFFIDAVIT OF QUALIFICATION
OPERATOR
--ooOOoo--

I, James L. Litman, being first duly sworn under oath, deposes and says that he/~~she~~ is the (officer or agent) Vice Chairman & CEO of Valley Camp of Utah, Inc. ; and that he/she is duly authorized to execute and deliver the foregoing obligations; and that said OPERATOR is authorized to execute the same and has complied in all respects with the laws of Utah in reference to commitments, undertakings and obligations herein.

(Signed) James L. Litman
Name - Position
James L. Litman
Vice Chairman & CEO

Subscribed and sworn to before me this 20th day of November, 1989.

Barbara A. Bezard
Notary Public

Notarial Seal
Barbara A. Bezard, Notary Public
City of Venango County
My Commission Expires April 26, 1993
Member, Pennsylvania Association of Notaries

My Commission Expires:
April 26, 1993.

Attest:

STATE OF Pennsylvania)
) ss:
COUNTY OF Venango)

Last Revised, July 1989

AFFIDAVIT OF QUALIFICATION
DIRECTOR
--ooOOoo--

I, Dianne R. Nielson, being first duly sworn under oath, deposes and says that she is the Director of the Division of Oil, Gas and Mining, Department of Natural Resources, State of Utah; and that she is duly authorized to execute and deliver the foregoing obligations; and that said DIRECTOR is authorized to execute the same by authority of law on behalf of the State of Utah.

(Signed) Dianne R. Nielson
Dianne R. Nielson, Director
Division of Oil, Gas and Mining

Subscribed and sworn to before me this 30th day of November, 1989.

Marionia L. Henderson
Notary Public

My Commission Expires:

_____, 19 ____.

MARIONIA L. HENDERSON
Notary Public
STATE OF UTAH
My Comm. Exp. July 24, 1992
3 Triad Center, Suite 350 SLC, UT 84180-1203

Attest:

STATE OF _____)
) ss:
COUNTY OF _____)