Valley Camp of Utah, Inc.

WORK COPY

Mine Permit Renewal Application

Section R614-301-760 - Channel Reclamation

Volume VI

December, 1989

CONSULTANTS/ENGINEERS
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SALT LAKE CITY, UTAH

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January 31, 1990

Ms. Sue Linner
Utah Division of Oil, Gas & Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RE: Valley Camp Hydrologic Mine Reclamation.

Dear Ms. Linner:

As requested by Steve Tanner of Valley Camp Coal Company, we are enclosing three copies of Volume VI which includes Section R614-301-760 of the mine permit application. Text and figures applicable to the section have been included within this separate volume for the draft submittal. Volume VI will be recombined with Volume II (Hydrology) for the final submittal to the agency. Also attached are corrected pages to be inserted within the three sets of Volume II that you have in your possession. The corrected pages have been revised to reflect the submittal being made with this cover letter. Steve Tanner will replace the sheets in Volume II during his next visit to your offices.

Should you have any questions please call.

Sincerely,

David E. Hansen, Ph.D., P.E.
Vice-President

DEH/dhv

R614-301-760 thru 301-765. CHANNEL RECLAMATION.

General mine reclamation to be completed for the Mine Permit Area is discussed within Sections R614-301-200 and 301-300, and only that information which is relevant to hydrology is discussed herein. Hydrologic aspects of mine reclamation pertain to the design of permanent runoff conveyance facilities which are capable of controlling the post mining 100 Year - 6 Hour precipitation event and the permanent closure of wells. As required under the regulations, all siltation structures will be 1) maintained until removal is authorized by the Division and the disturbed area has been regraded, stabilized and revegetated, and 2) maintained for a minimum of two years following the last augmented seeding. Any well site reclaimed as part of mine closure will be permanently sealed as required to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

Mapping and design details associated with hydrologic mine reclamation is included within this permit on Figures R614-301-760a through R614-301-760d. As shown on the figures, surface drainage facilities have been designed to convey all surface drainage waters from undisturbed areas above reclaimed mine areas, to downstream undisturbed areas. The general overall plan for reclamation associated with surface runoff facilities follows.

FIGURES R614-301-760a through R614-301-760d

As shown on the figures, cut slopes in both the Valcam and Belina Permit Areas will be backfilled, regraded and reshaped. All reclaimed areas will also be revegetated according to methodologies and parameters specified in other areas of this mine permit application. The majority of reshaping of the Belina Permit Area will be completed through the removal of Sediment Pond 004A and coal loadout pad. Because much of the surface disturbances located within the Mine Permit Area were completed prior to these regulations being enforced, little topsoil exists on the site which can be used for regrading and reshaping during reclamation. A small topsoil storage area has been dedicated for use near the Belina Mines as shown on Map R614-301-731.720d. Presently, the stockpile contains approximately 975 cubic yards of substitute topsoil which came from the enlargement of Sediment Pond 002A. This material met the criteria of and was approved by the Utah Division of Oil, Gas and Mining for use as a substitute topsoil material.

The topsoil storage area is closely surrounded by dense forest exhibiting a medium amount of deadfall and heavy ground cover. This provides excellent protection against wind erosion as well as rapid snowmelt in the spring. The storage area has been bermed to prevent access by motor vehicles, as well as to prevent erosion of the material from the storage area. Straw bales are also used along the down gradient end (north end) of the storage area to assist in containment, should a slope failure of the stockpile occur. In the future, topsoil removed from the permit area for mining purposes, will be stored in this area for use during reclamation.

All reclaimed areas will be re-established predominately as grassy rangeland through the use of grass/forb/shrub seed mixtures. This seed mixture should provide a reclaimed surface

similar to that of the adjacent land area, and compatible with the premining land use classification.

Valcam Permit Area

All surface facilities within the Valcam Permit Area will be removed, and the area will be reclaimed except for those facilities associated with the operation of the railroad which traverse the site. Facilities to remain consist of two railroad lines, an access road, and railroad drainage culverts. It is the intent that the existing paved road connecting the highway with the railroad tracks by the stockout tube will not be stripped of its oil surface, and that the railroad will continue to utilize the road in its present oiled condition. Continued use of this road will allow access by railroad personnel to the tracks and adjacent area in the vicinity of the stockout tube. Should the operators of the railroad desire a dirt, rather than oiled road surface at the time of reclamation, then the oiled surface will be removed. The road loop presently used for the truck dump will be removed upon reclamation. A north and south access roadway east of the railroad tracks will replace the existing Valley Camp railroad spur (most easterly track). Continued maintenance of the roadways will be the responsibility of the railroad company.

In general, reclamation includes the removal of all surface facilities, the restoration of the culverted stream emanating from the hills to the east of the facility, the grading and recontouring of sedimentation ponds, and the regrading and shaping of the Valcam Permit Area. Sediment removed from local ponds within both the Valcam and Belina areas will be used in the reclamation process as long as the sediment is found to be non-toxic.

As shown on Figure R614-301-760a, culverts C-1-32, C-4-42 and C-15-24 will remain in place as required for continued drainage of the railroad right-of-way. At the time of reclamation, a riprap pad will be installed at the outlet of all three culverts. The riprap pad design will be similar in nature to other adjacent railroad culverts not installed or owned by Valley Camp. The only exception to this will be that Culvert C-4-42 will be extended to Mud Creek in order to help prevent excessive erosion down the steep reclaimed contour.

The long range plan for channel reclamation at the Valcam Facility includes the design and construction of a riprap channel (RC-1) throughout much of the length of present culvert C-14-42 as shown on Figure R614-301-760a. Reclaimed channel RC-1 begins at a location approximately 300 feet east of the railroad tracks. The existing culvert passing beneath the railroad tracks will be modified in that the upstream and downstream sections will be removed, and replaced with the riprapped channel as shown in the design details. The riprapped channel design is based upon a 100 year - 6 hour precipitation event of 2.3 inches and a design flow rate of 23.0 cfs. Channel RC-1 has a five foot bottom width and uses a riprap D_{50} of 1.0 feet except at the reclaimed outlet of culvert C-14-42 where it is 1.25 feet. All channels have a design freeboard of 0.5 feet which is essentially equal to the flow depth. Additional design details are shown on Figures R614-301-760a, R614-301-760c and R614-301-760d.

It is the present intent to donate the General Office and accompanying property located west of the loadout facilities to the Alpine School District or another beneficiary which will exclude it from reclamation activities. If a decision at a later time is made by Valley Camp of Utah, Inc.

to not donate the property to another entity, then the General Office area will be reclaimed under the same guidelines agreed upon for the Valcam Loadout Facilities.

Belina Permit Area

All surface facilities within the Belina Permit Area will be removed, and the area will be reclaimed. It is proposed to change the land use at the Belina Mines site from a shrub and brush rangeland use to a wildlife habitat with moderate recreational and grazing use. The slight change in land use appears to be compatible since the individual from whom the mine site is leased has shown some interest in using the area as a cattle holding facility. Postmining recreational use also appears to be compatible with both premined and postmined conditions. Since all roadways are to be reclaimed, recreational use will be confined to foot traffic.

Activities to be completed during reclamation are the removal of Sediment Pond 004A; the regrading, reshaping, and revegetation of the mine area; and the reconstruction of Whisky Creek and the side drainage presently passing through the shop area. Whisky Creek is currently diverted beneath the coal loadout pad and sedimentation pond via a 42 inch corrugated metal culvert. Upon reclamation, a new stream channel will be constructed which will be built to match premined stream channel conditions as nearly as possible. Reclaimed channel RC-2 (as shown on Figure R614-301-760b) extends from the undisturbed channel presently located at the inlet to Culvert C-40-42 to the downstream undisturbed sections of Whiskey Creek. Reclaimed channel RC-3 collects waters from the area behind the shop facilities.

The reclamation channels as presented on the design detail sheets have been designed to provide for the required conveyance of the 100 Year - 6 Hour precipitation event with a freeboard of 0.5 feet. The flow rate calculated for the entire Belina Permit Area is 32.2 cfs. This flow rate was used for the lower section of channel RC-2 below the confluence with channel RC-3. The upper section of RC-2 was calculated to have a design flow rate of 13.4 cfs. A design flow rate of 3.1 cfs was calculated and used in the design for channel RC-3. Reclaimed channel design calculations are included within Appendix R614-301-760 as required by the agency. With channel flow depths in the range of 0.5 feet, an additional freeboard depth of 0.5 feet provides adequate channel capacity for runoff design, and to protect against overtopping.

The maximum size riprap which was believed feasible for use in the design of reclamation channels at Valley Camp has a D_{50} of 1.75 feet (Average diameter of 1.75 feet). With this maximum riprap size determined, the proposed reclamation channels for the Belina Permit Area were designed by optimizing the channel slope based upon the maximum riprap size assumed. Using a specified maximum D_{50} of 1.75 feet, the maximum slope which could be designed for channel RC-2 is 16%, and for channel RC-3 is 32%. Complete plan and cross section details are shown on Figures R614-301-760b through R614-301-760d.

Belina Haul Road

The Belina Haul Road connecting Eccles Canyon and the Belina Mines will be backfilled and reclaimed according to the plan presented in the mining reclamation section of this mine permit application, and as shown on the reclamation detail drawings. In general, all drainages

will be restored to the degree possible to premined conditions by removing all fill material, regrading, and reshaping of the adjacent terrain. Generally speaking, all fill material placed as a result of road construction in the vicinity of local drainages will be removed, and the reclaimed drainages will be excavated to the degree possible to local natural grades as determined in the field.

It is generally not feasible to construct post mining reclamation channels along the haul road corridor due to the steepness of the hillsides and natural channels. It is believed that disturbing existing drainages further by attempting to construct riprap channels through areas of road fill will result in increased erosional deterioration and damage to natural drainages beyond that which would occur if the fill material were simply removed. An exception to this statement may apply in the case of reclaimed channel RC-4 which is proposed to be located within the drainage currently occupied by culvert C-25-36.

The drainage occupied by culvert C-25-36 has a channel gradient of 31.6%, a watershed of approximately 140 acres, and a 100 Year - 6 Hour precipitaion event of approximately 34 cfs. Attempts at designing a riprap lined channel (using the "Red Book" methodology) capable of containing this flow event produce unrealistically large riprap diameters. The OSM "Steep Channel Riprap Design" methodology however allows much smaller riprap sizes on steep slopes. Using the OSM method, a D_{50} of 1.5 feet and a channel bottom width of 6.0 feet was found to be adequate. It is recommended that the design of channel RC-4 be re-evaluated at the time of reclamation (if the road is removed), and that consideration be given to alternate design possibilities including the option of restoring the channel to the premined grade without further channel disturbance. Complete plan and cross section details are shown on Figures R614-301-760b through R614-301-760d.

APPENDIX R614-301-760

Channel Reclamation Calculations

HANSEN ALLEN & LUCE Inc

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 = 242.0ac
245.2ac

SLOPE:

CONTOUR LENGTH (Addl. 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	Qi
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 - 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 Coal Company
Project No.: 007.12.100
Channel Section: Channel RC-1

Date: 24-Jan-90
Time: 04:17 PM
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 Coal Company
Project No.: 007.12.100
Channel Section: Channel RC-1

Date: 24-Jan-90
Time: 04:17 PM
Computed:DEH

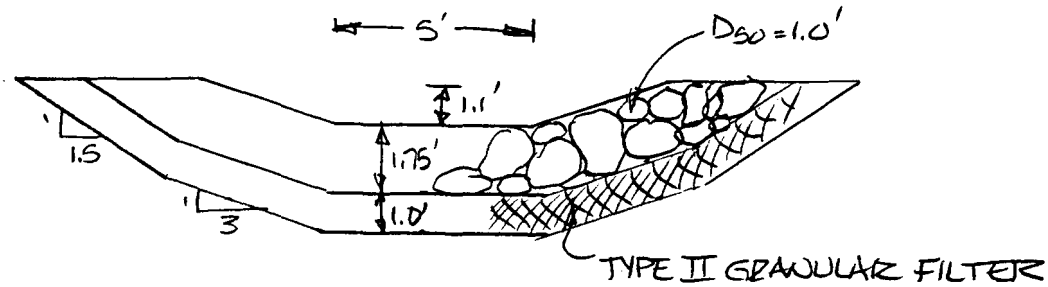
DESIGN CRITERIA:

		UNITS
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 BELOW EXCEPT

D_{50} = 1.0' ; S = 7.9%

OUTLET SECTION

USE SAME AS BELOW 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 100 YR - 6 HR EVENT

INLET D_{50} CAN USE SAME AS CHANNEL

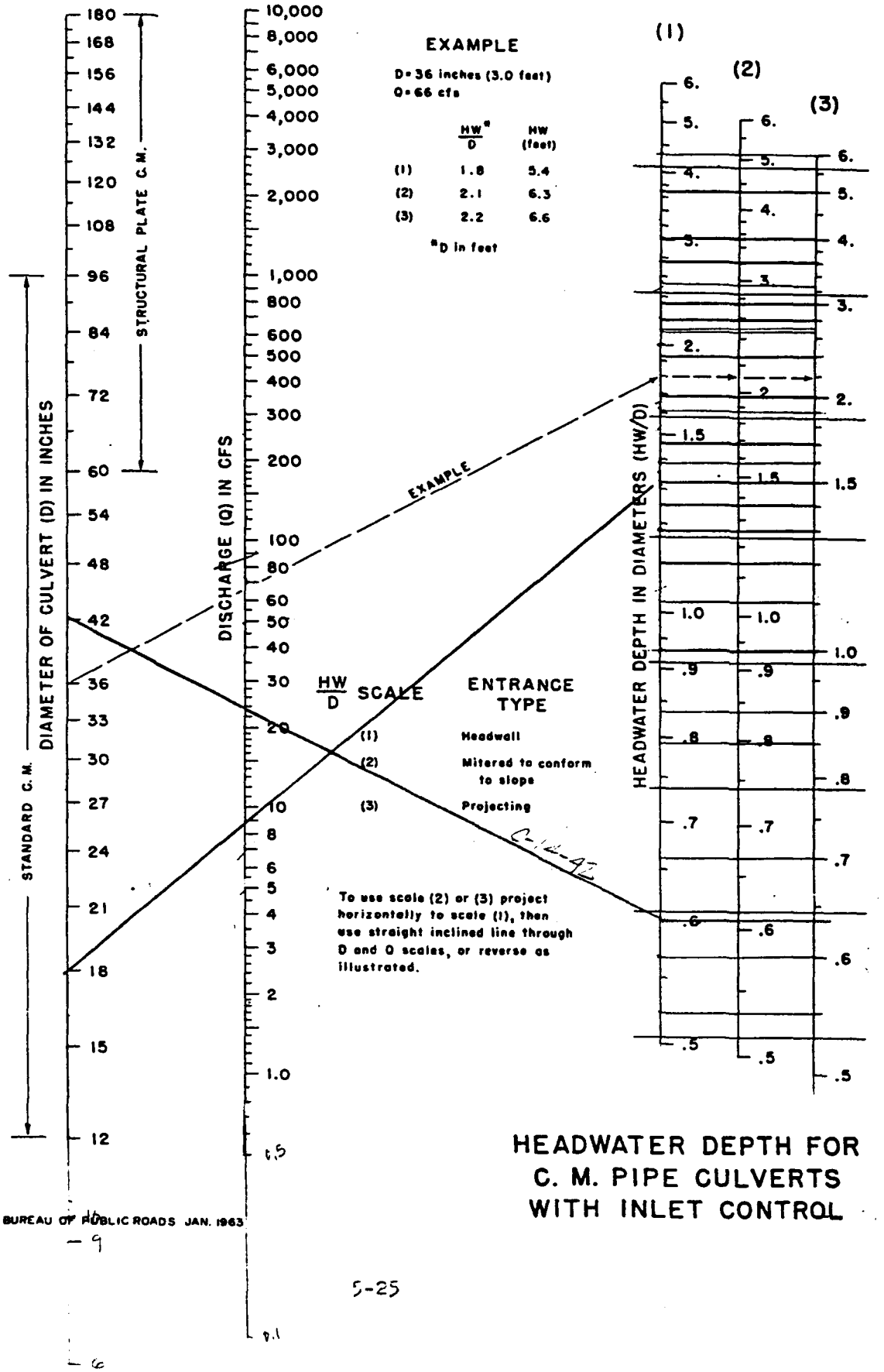
OUTLET D_{50} BASED UPON CULVERT VELOCITY CHARACTERISTICS.

INLET FLOW (CHART 5) SHOWS H_W/d = 0.65

42" × 0.65 = 27.3" = 2.3' RACE RIPRAP TO D = 3.0'

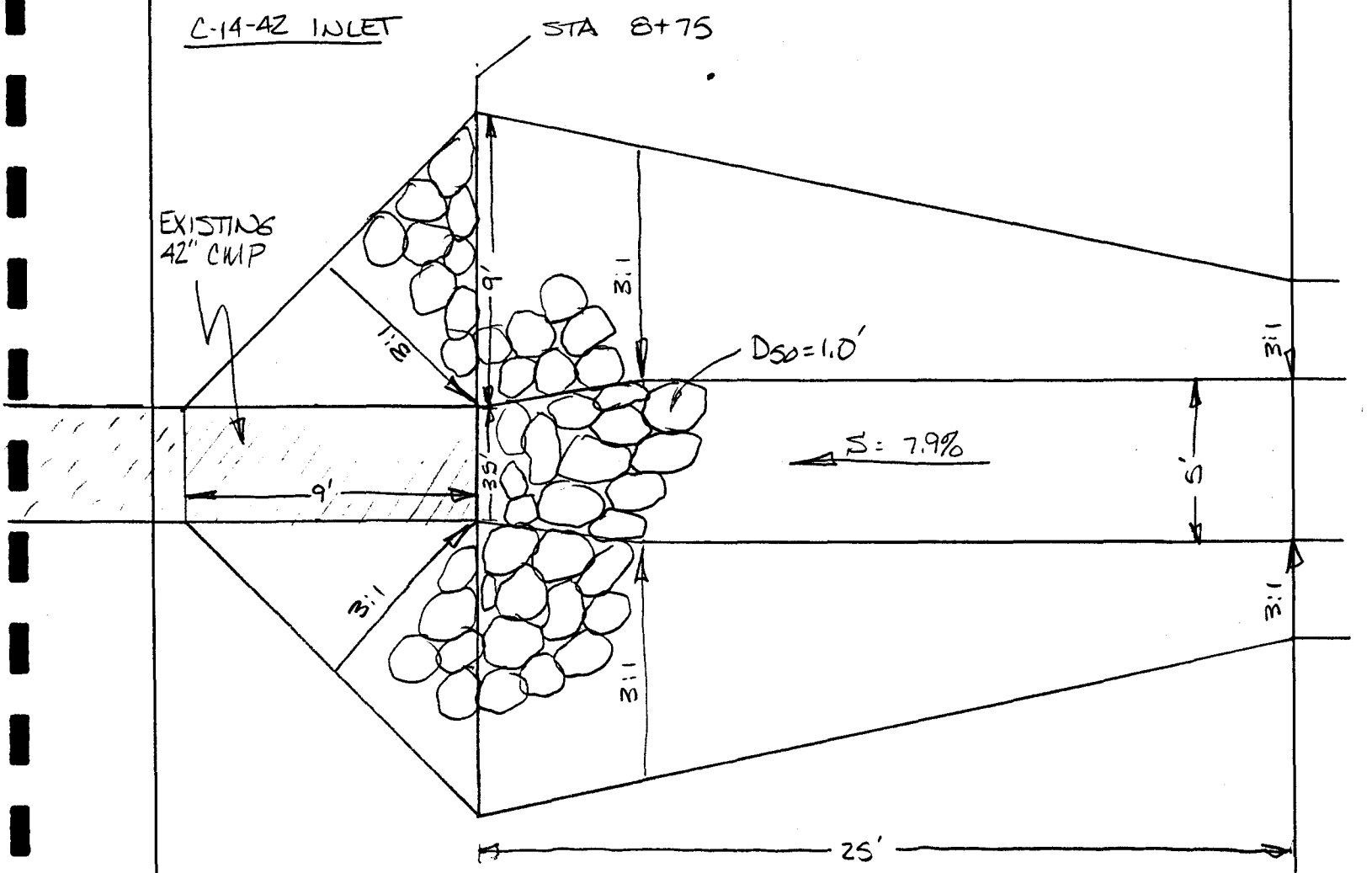
6/12

CHART 5

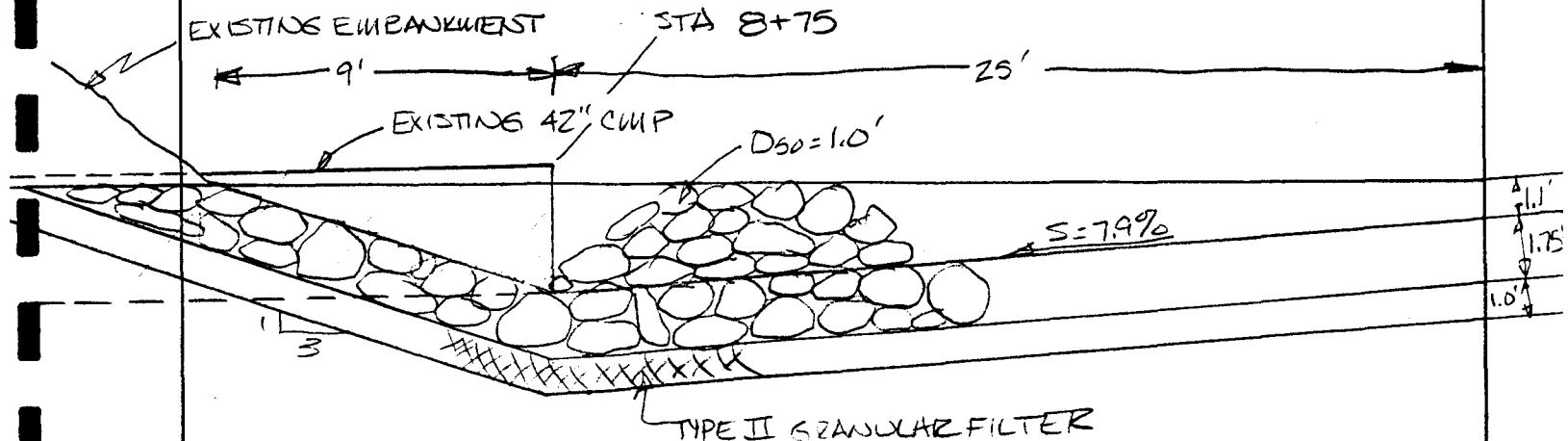


HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

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	

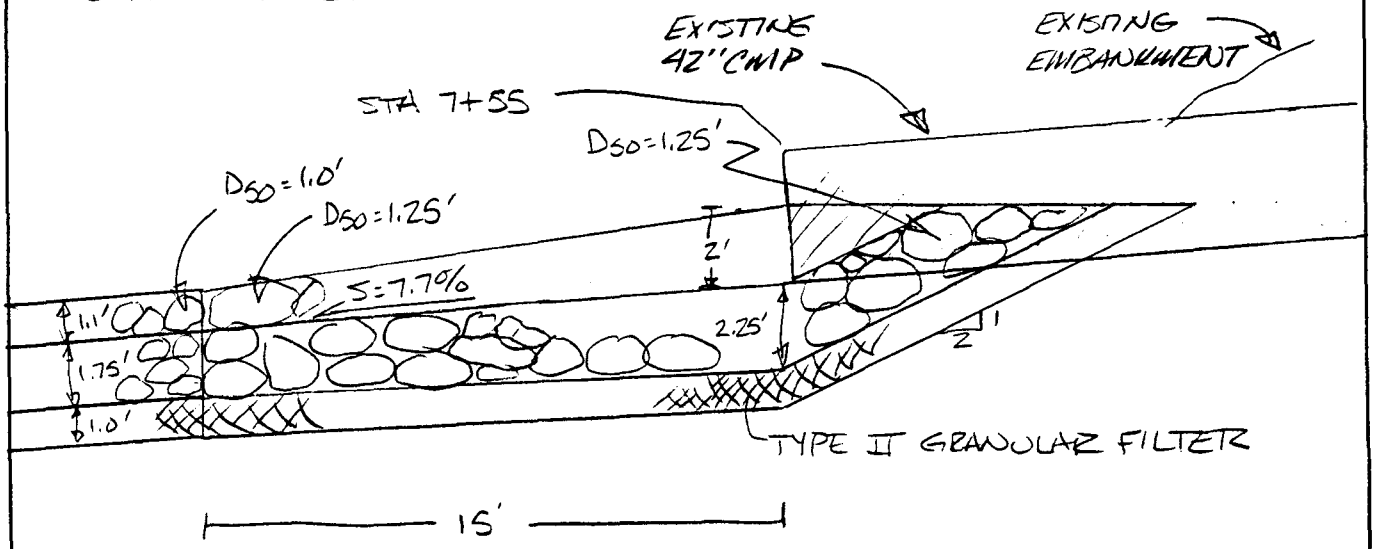
If $S = 5\%$ $\frac{Qn}{1.49 S^{1/2}} = 1.657$

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 Coal Company — Date: 25-Jan-90
Project No.: 007.12.100 — Time: 08:51 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)

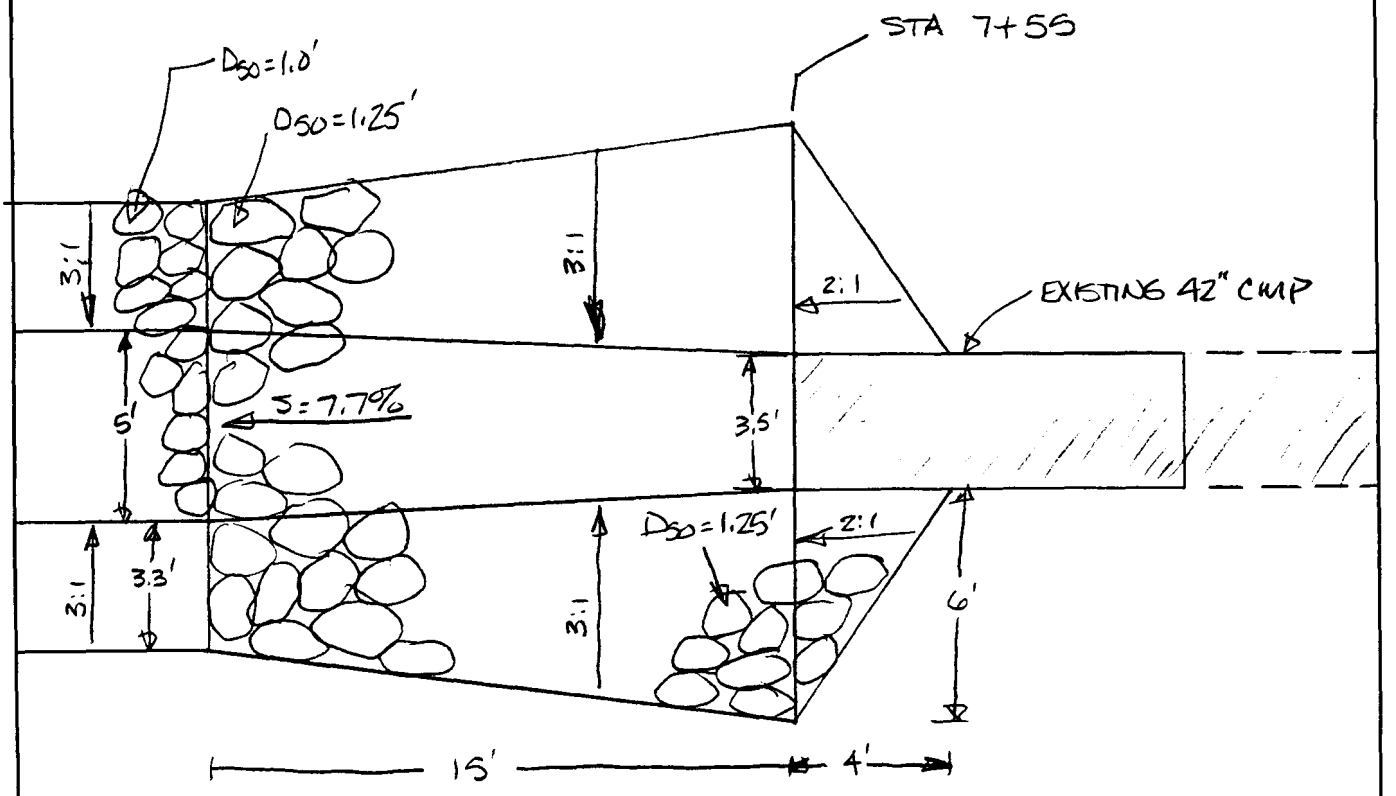
Client: Valley Camp Coal Company — Date: 25-Jan-90
Project No.: 007.12.100 — Time: 08:51 AM
Channel Section: Channel RC-1 - C-14-42 Outlet — Computed:DEH

DESIGN CRITERIA:			UNITS
	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

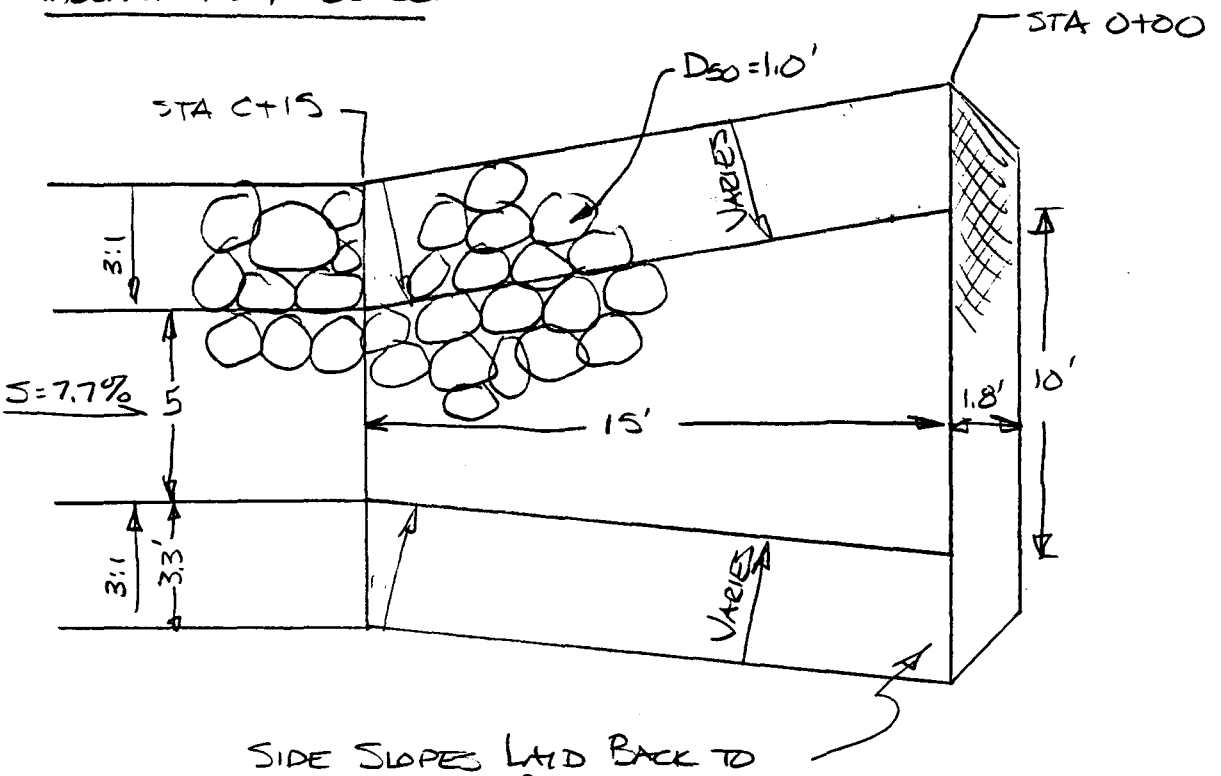
Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	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	

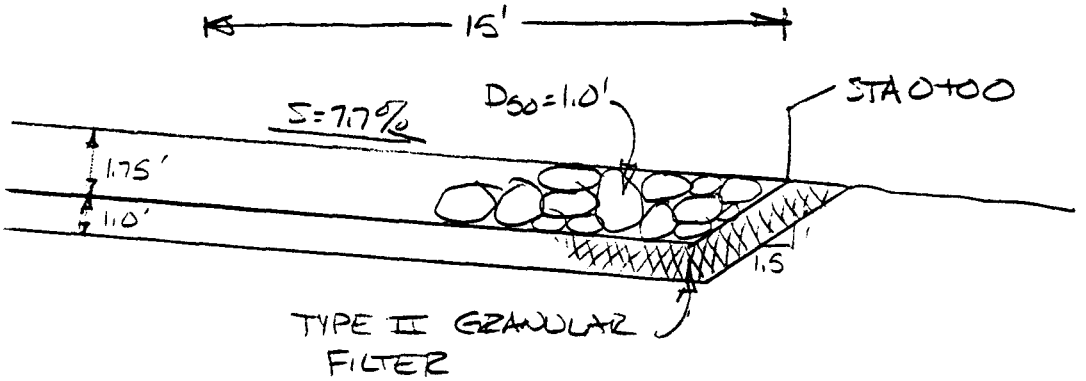
C-14-A2 OUTLET



VALCAIN RC-1 OUTLET



SIDE SLOPES LAID BACK TO MATCH LOCAL CONDITIONS - SIDE SLOPE VARIES BETWEEN STA 0+00 AND STA 0+15



CHANNEL RECLAMATION - BELINA MINE AREA (DETERMINE FLOW IN CHANNEL WHISKEY CREEK TO ELEV ~8750' BELOW POND 4)

COMPLETE CHANNEL (- RC-2)

Rdg: 7½ Min. Topo Sec 30 T13S, R7E = 436

$$\text{Area} = \frac{\left(\frac{5020+5050}{2}\right) * \left(\frac{5260+5280}{2}\right)}{43560\ ft^2/ac} = 609.8\ ac$$

Rdg: Sec 30, Zeiss Copy = 460 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 = 32.5 in * 2000' = 67,000 ft
CONT INT = 20 ft

$$\frac{67{,}000' * 20' * 100}{356.4\ ac * 43560\ ft^2/ac} = 34.5\%$$

VOL. WEIGHTED CURVE NO.

CN	A	Q_i
55	193.7	0.05
70	122.0	0.36
85	40.7	1.02
		$\bar{Q} = 0.27$

$\overline{CN} = 67.0$

TOT. LENGTH = 5000'

$Q_{100yr-6hr}$ = 32.2 cfs

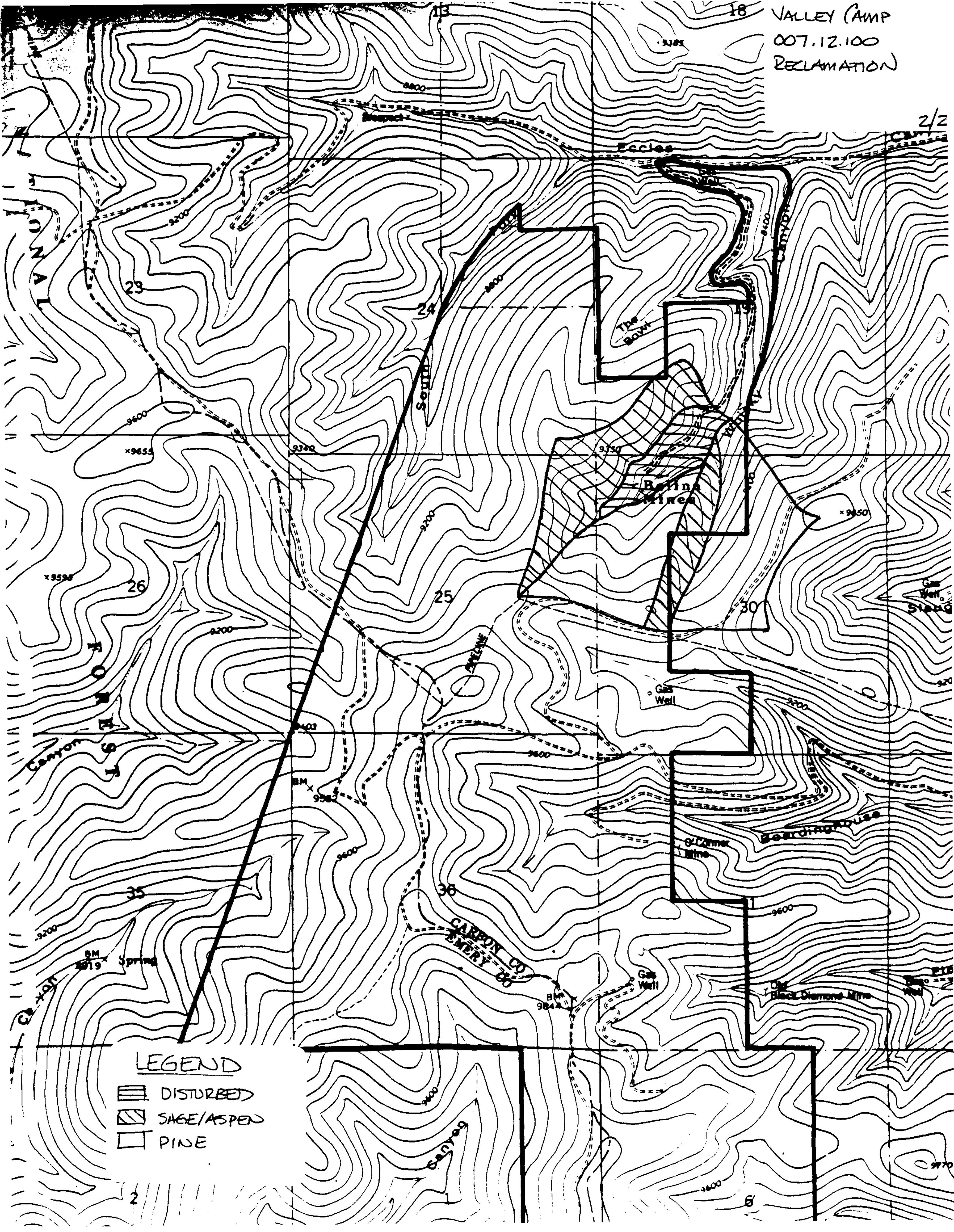
FOR ENTIRE CHANNEL - BREAK OUT UPPER PORTION ABOVE ELEV 8935

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
		$\bar{Q}_i = 0.24$	

$\overline{CN} = 65.6$



VALLEY CAMP
007.12.100
RECLAMATION
2/2
Eccles
Canyon
Belina Mines
South
Tie Bowl
PIPELINE
Gas Well
Boardinghouse
O'Conner Mine
Old Black Diamond Mine
CARBON CO
EMERY CO
Spring
Canyon
FOREST
9200
9600
9650
9655
9598
9349
9350
9403
9582
9844
9919
8800
13
18
19
23
24
25
26
30
35
36
1
2
6
LEGEND
DISTURBED
SAGE/ASPEN
PINE

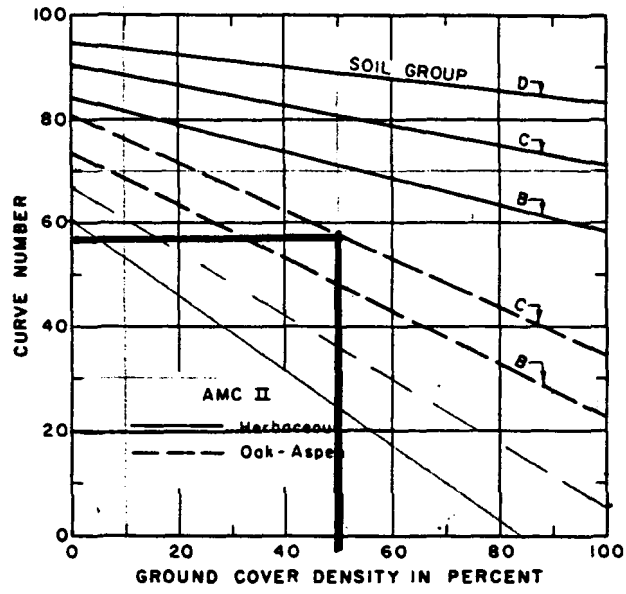


Figure 9.5.--Graph for estimating runoff curve numbers of forest-range complexes in western United States: herbaceous and oak-aspen complexes.

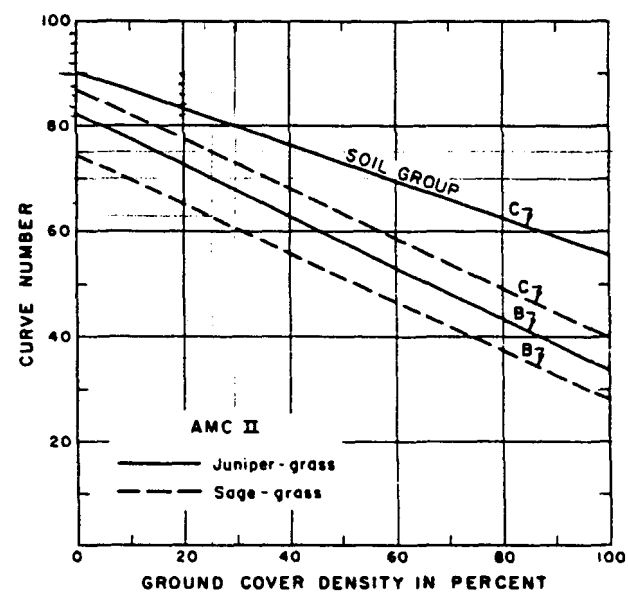


Figure 9.6.--Graph for estimating runoff curve numbers of forest-range complexes in western United States: juniper-grass and sage-grass complexes.

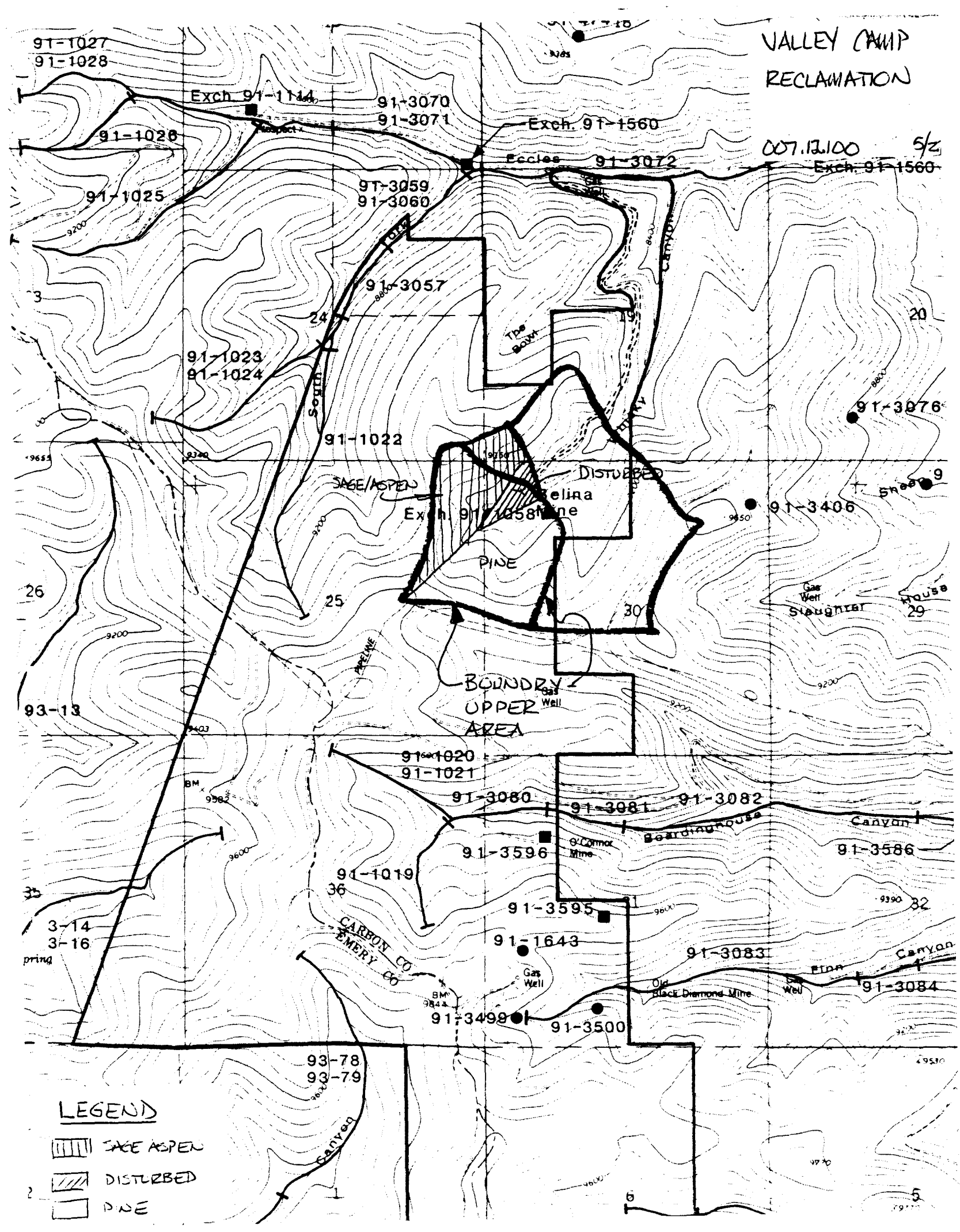
PROJECT : Valley Camo - Belina Mine Reclamation Channel (RC-2)

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
5/2
91-1027
91-1028
Exch 91-1144
91-1026
91-1025
91-3070
91-3071
Exch. 91-1560
Eccles
91-3072
Exch. 91-1560
91-3059
91-3060
91-3057
91-1023
91-1024
91-1022
91-3076
DISTURBED
SAGE/ASPEN
Exch. 91-1058
PINE
91-3406
BOUNDRY
UPPER
AREA
91-1020
91-1021
91-3080
91-3081
91-3082
91-3596
91-3586
91-1019
91-3595
91-1643
91-3083
91-3084
91-3498
91-3500
93-13
3-14
3-16
93-78
93-79
CARBON CO
EMERY CO
LEGEND
SAGE ASPEN
DISTURBED
PINE

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 CHARACTERISTIC

	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 GRADE) TO ALLOW ACCEPTABLE RIPRAP D_{50} (SEE PGS 9+10)

ACCEPT MAX D_{50} = 1.75' - THIS GIVES D_{MAX} = 36" (3 ft)

PROJECT : Valley Camp - Belina Mine Upper Reclamation Channel (Upper 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 - Belina Mine Side Reclamation Channel (EC-3)

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 $D_{MAX} = 1.75'$

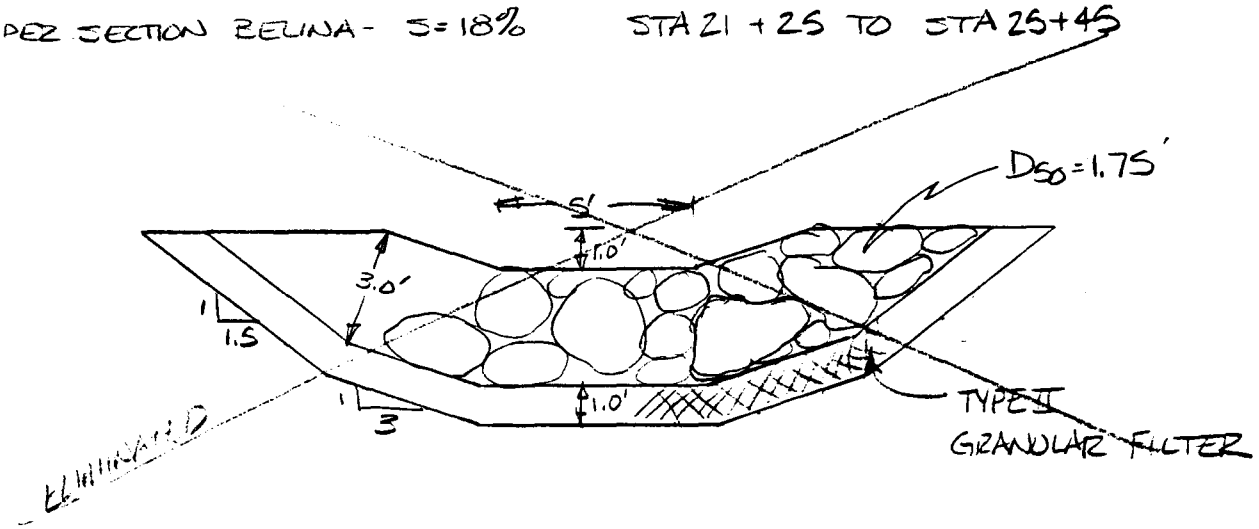
DRAW CONTOURS THROUGH STEEP AREAS WITH A $S_{MAX} = 16\%$

DESIGN CRITERIA

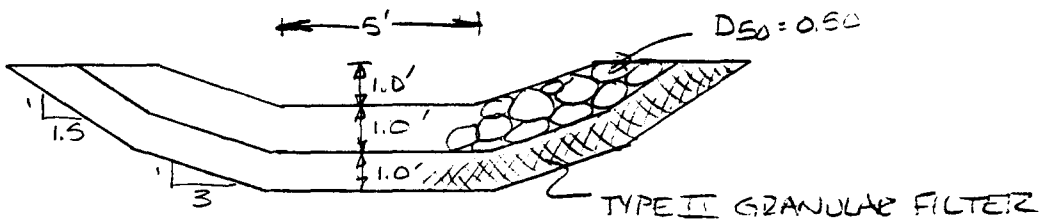
CHANNEL	Q (cfs)	b (ft)	m	Smin (%)	Smax (%)	d (ft)	Dso Smin (ft)	Dso Smax (ft)	Dmax Smin (ft)	Dmax Smax (ft)
UPPER	13.4	5	3	5.0	5.0	1.0	0.50	0.50	1.0	1.0
SIDE	3.1	5	3	32.0	32.0	0.75	1.75	1.75	3.0	3.0
LOWER	32.2	10	3	5.0	16.0	1.1	0.75	1.75	1.25	3.0

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 6+00



Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company — Date: 07-Feb-90
Project No.: 007.12.100 — Time: 10:26 AM
Channel Section: Lower Whiskey Creek - RC-2 — 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 Coal Company — Date: 07-Feb-90
Project No.: 007.12.100 — Time: 10:26 AM
Channel Section: Lower Whiskey Creek - RC-2 — Computed:DEH

DESIGN CRITERIA:			UNITS
	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 = 2iT/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 2iTmax/(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 Coal Company — Date: 07-Feb-90
Project No.: 007.12.100 — Time: 10:27 AM
Channel Section: Upper Whiskey Creek - RC-2 — 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:	7.79	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 Coal Company — Date: 07-Feb-90
Project No.: 007.12.100 — Time: 10:27 AM
Channel Section: Upper Whiskey Creek - RC-2 — 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= 0.76SdS
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 Coal Company — Date: 07-Feb-90
Project No.: 007.12.100 — Time: 10:30 AM
Channel Section: Side Channel - RC-3 — 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<S?):	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<S?):	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)

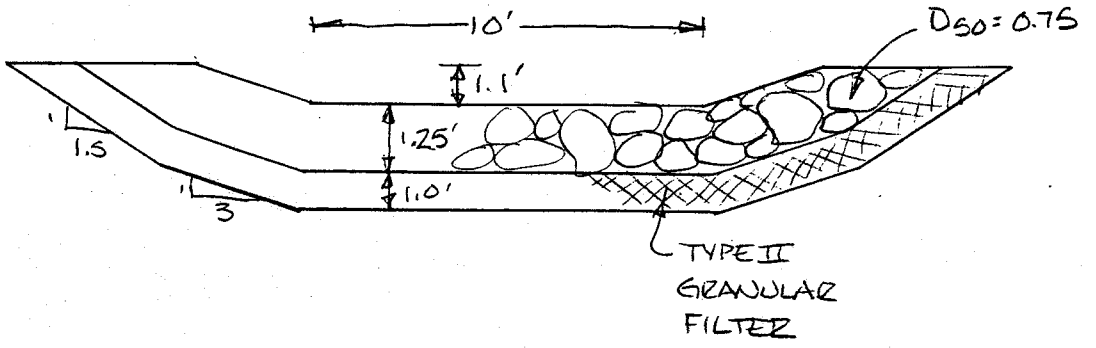
Client: Valley Camp Coal Company — Date: 07-Feb-90
Project No.: 007.12.100 — Time: 10:30 AM
Channel Section: Side Channel - RC-3 — Computed:DEH

DESIGN CRITERIA:			UNITS
	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

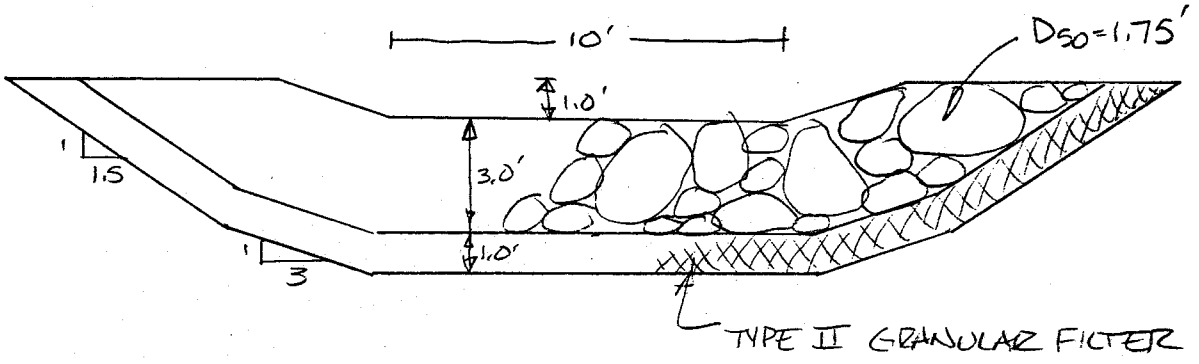
Nb = 21T/(G(SG-1)D)
SFb = (Cos a tan b)/(sin a + Nb tan b)
Tmax= 0.76GdS
Ns = 21Tmax/(G(SG-1)D)
A = Atan(1/m)
B = Atan(Cos(Ar)/(2Sin(A)/NsTan)Ar))+Sin(Ar))
n = Ns(1+Sin(Ar+B)/2)
SFs = Cos(A)Tan(Ar)/(nTan(Ar)+Sin(A)Cos(B))

	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
Nsd	0.17	0.17	
SFb	1.48	1.48	
SFs	1.86	1.86	

LOWER BELINA - $S = 5.0\%$ STA 11+05 TO STA 13+20



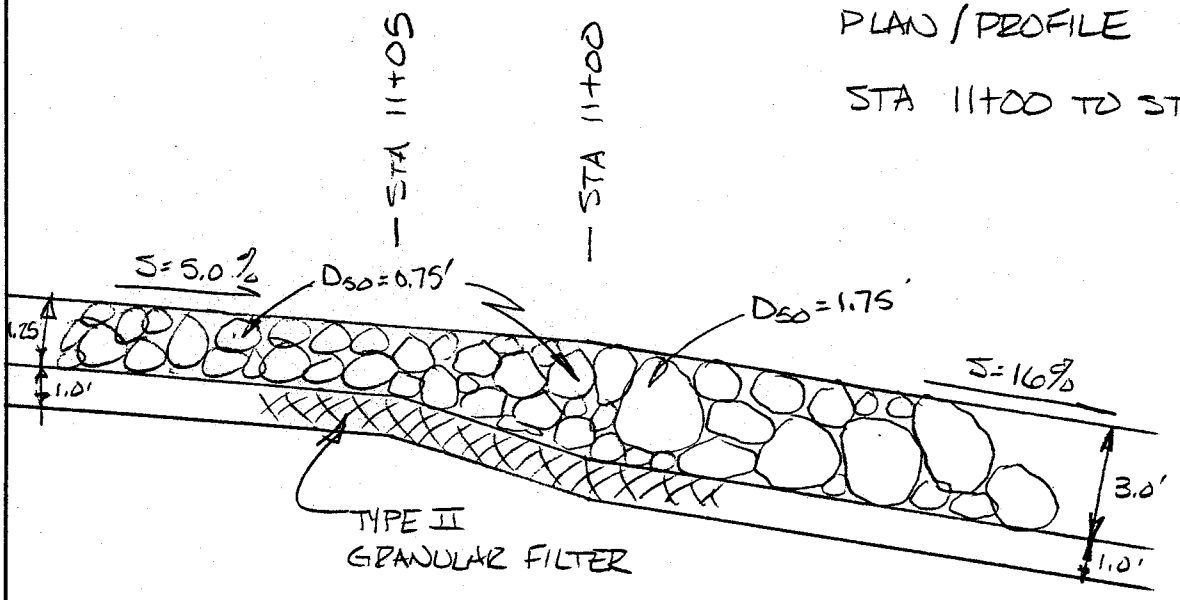
LOWER BELINA - $S = 16\%$ STA 0+00 TO STA 11+00

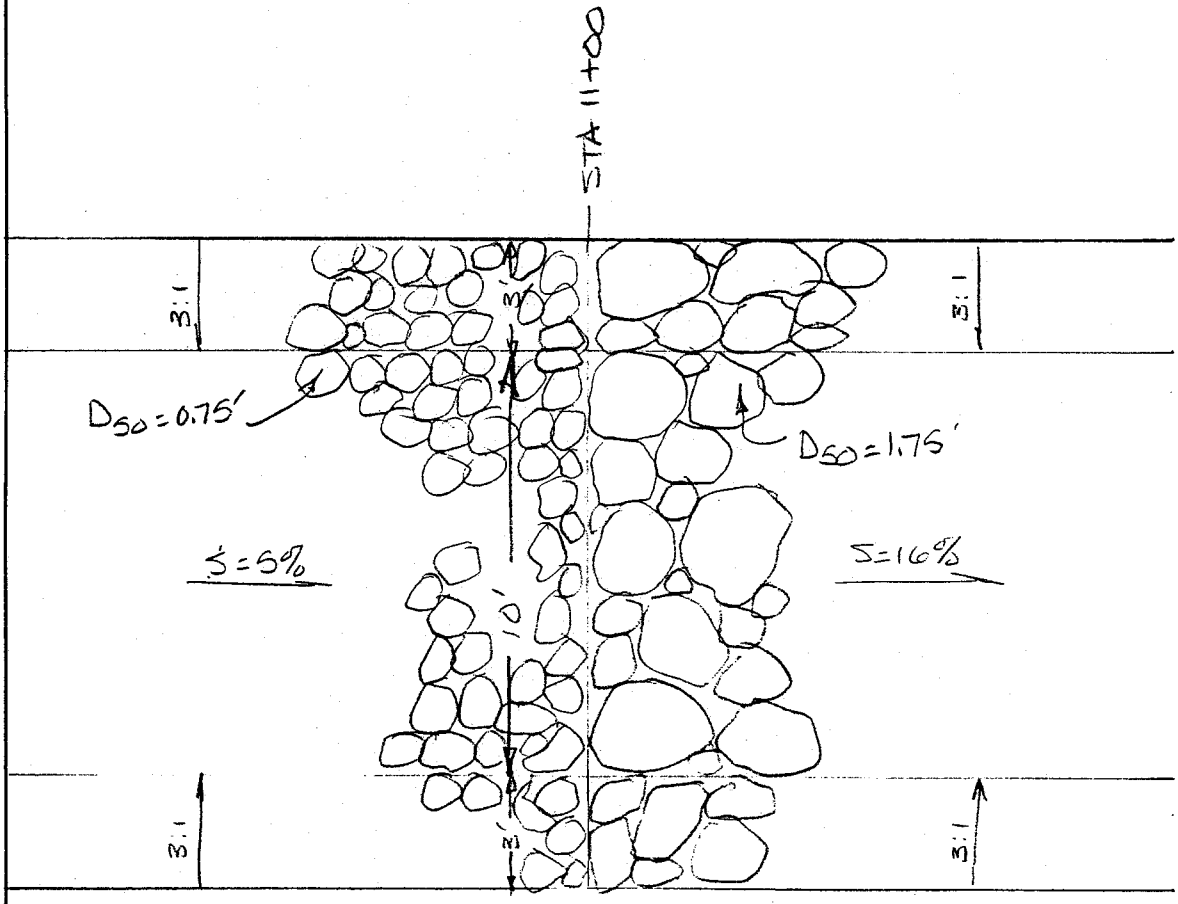


SIDE CHANNEL - $S = 32\%$ STA 0+00 TO STA 5+30

PLAN / PROFILE

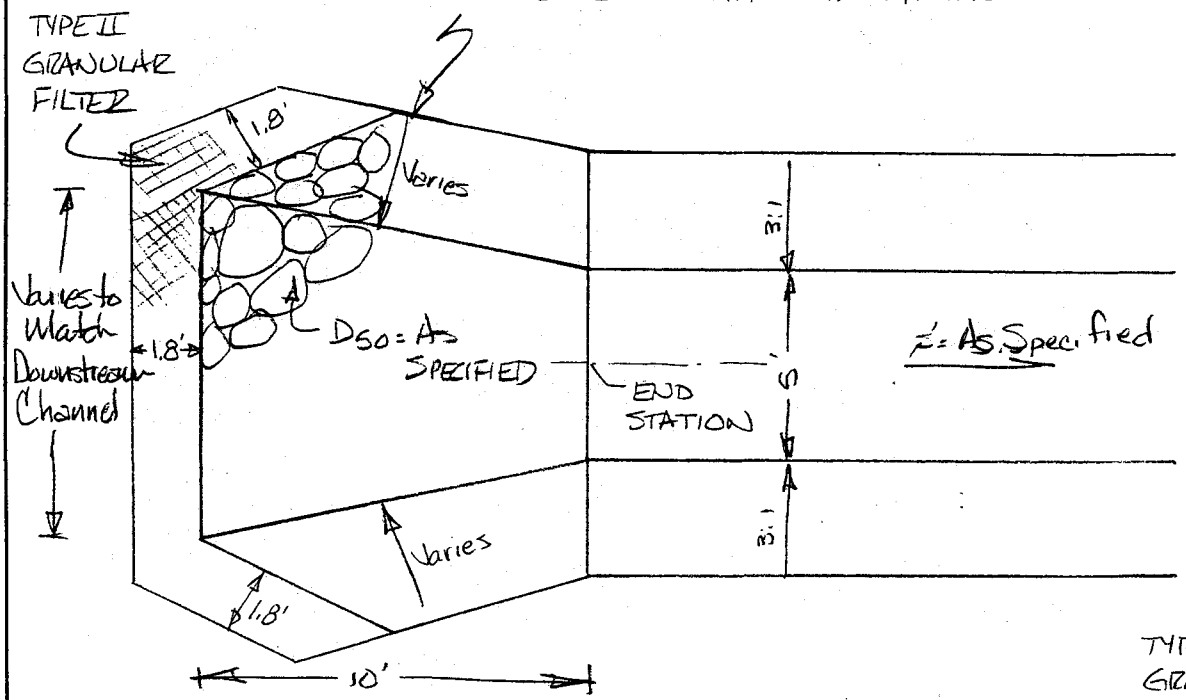
STA 11+00 TO STA 11+05

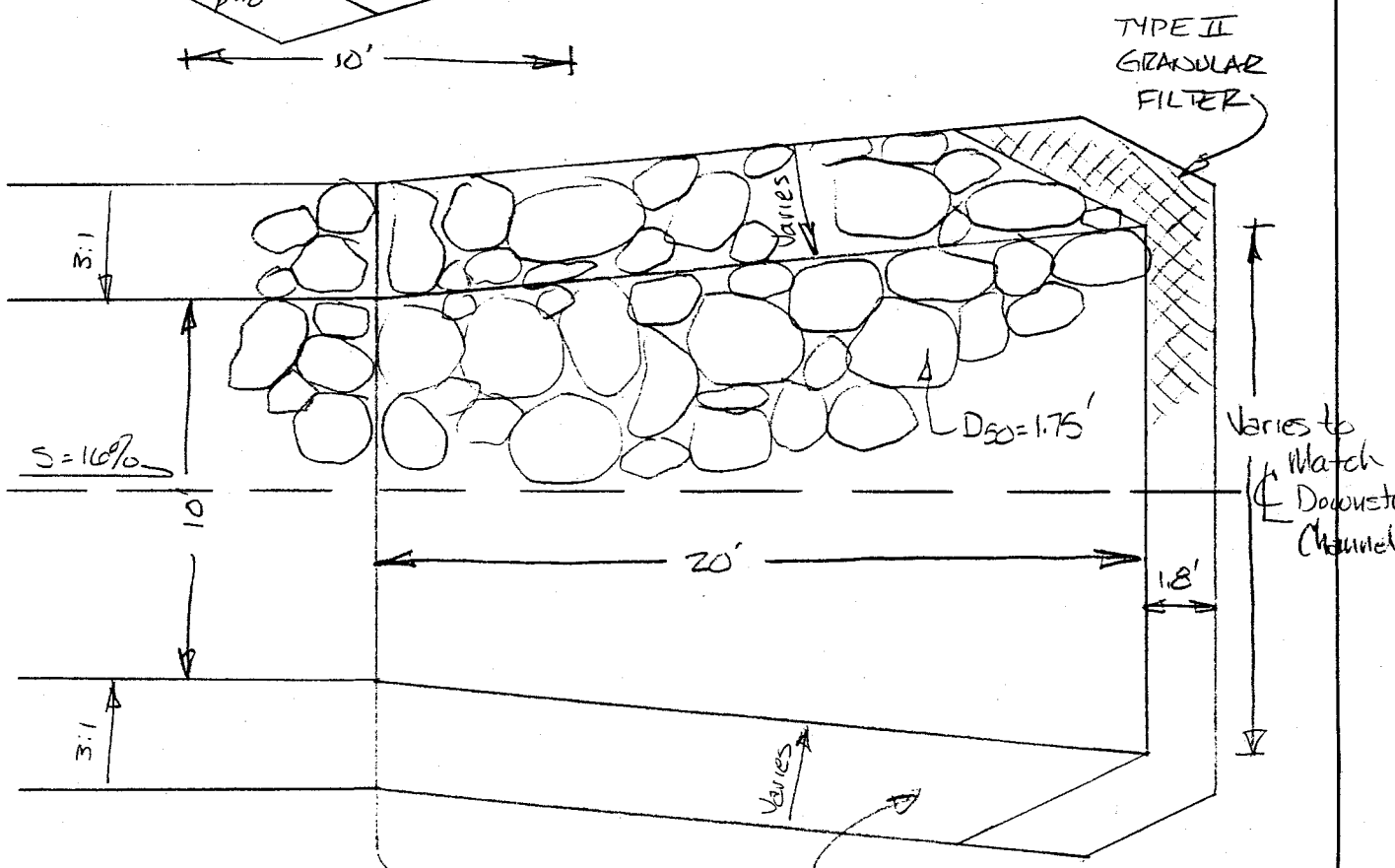




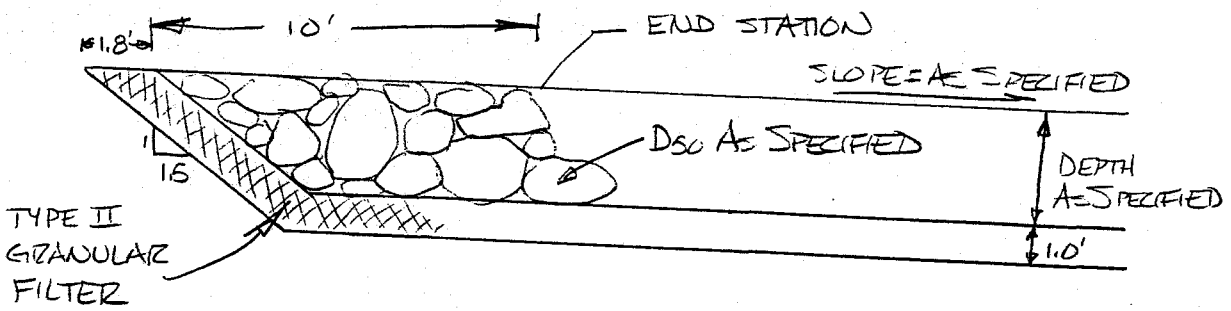
INLET DESIGN - UPPER CHANNEL (RIGHT & LEFT FORKS) STA 25+45
SIDE CHANNEL RIGHT STA 5+30
SIDE CHANNEL LEFT STA 0+00

SIDE SLOPES LAID BACK TO MATCH UPSTREAM CHANNEL. 2H:1V MAXIMUM TYPICAL

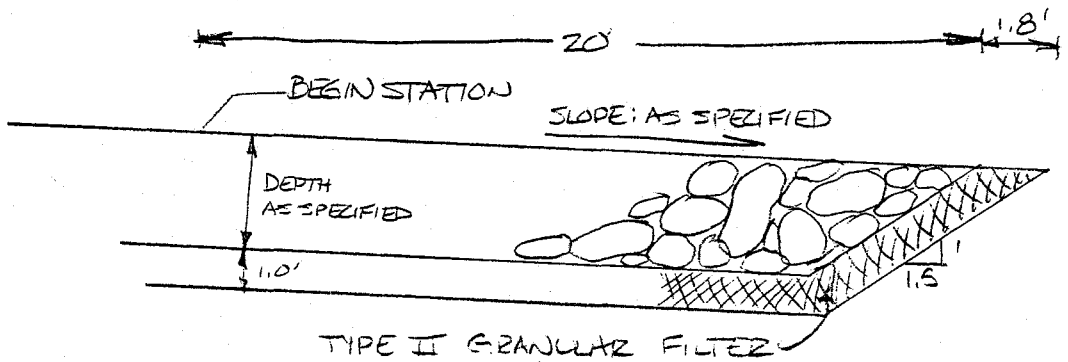




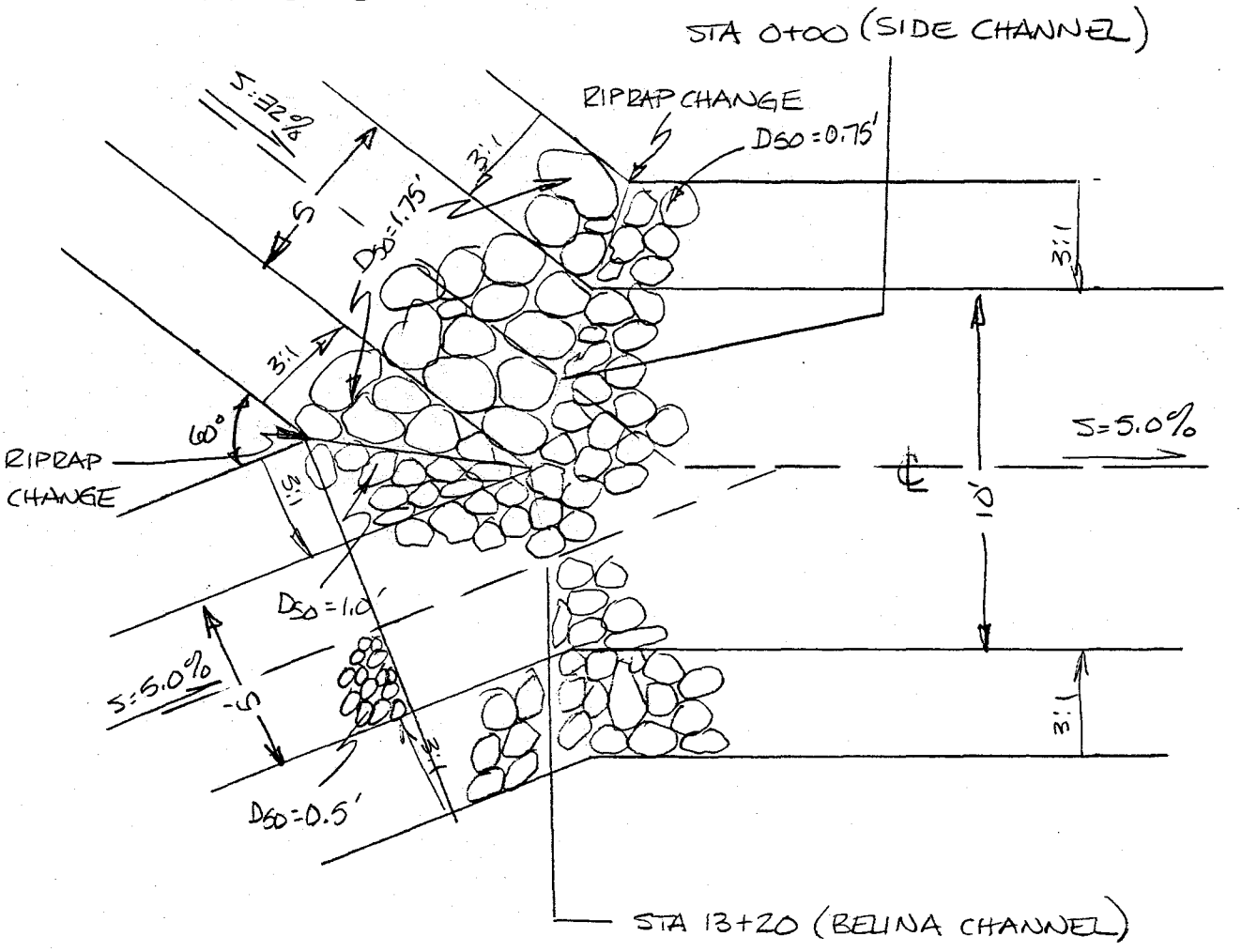
UPSTREAM INLET X-SECTION

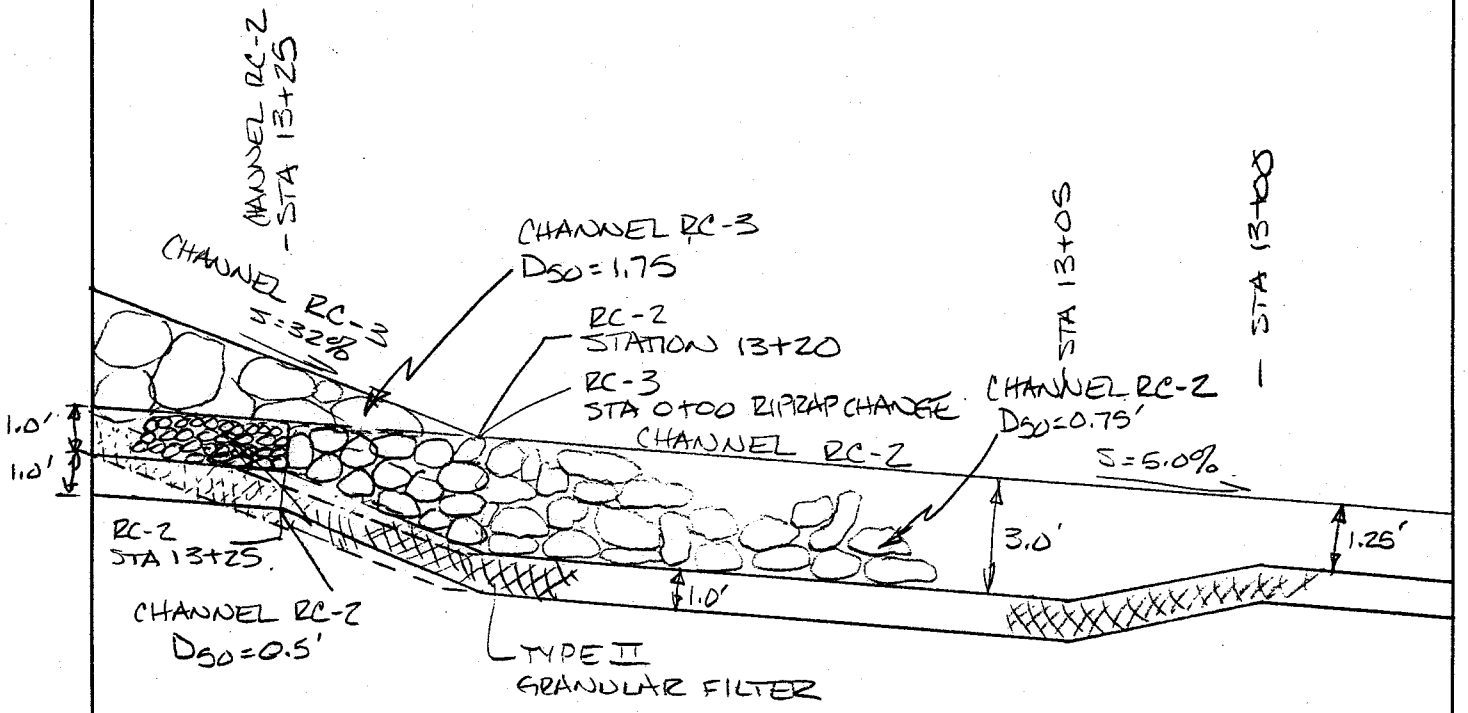


DOWNSTREAM OUTLET SECTION



FORK - STA 13+20





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

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Reclamation
FEATURE
PROJECT NO. 007.12.100

SHEET 1 OF 8
COMPUTED DEH
CHECKED
DATE 6 FEB 90

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-6 HR 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

$Q_{100 YR-6 HR} = 34.1 cfs$

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.

From Figure 5.4 (Sheet 6)

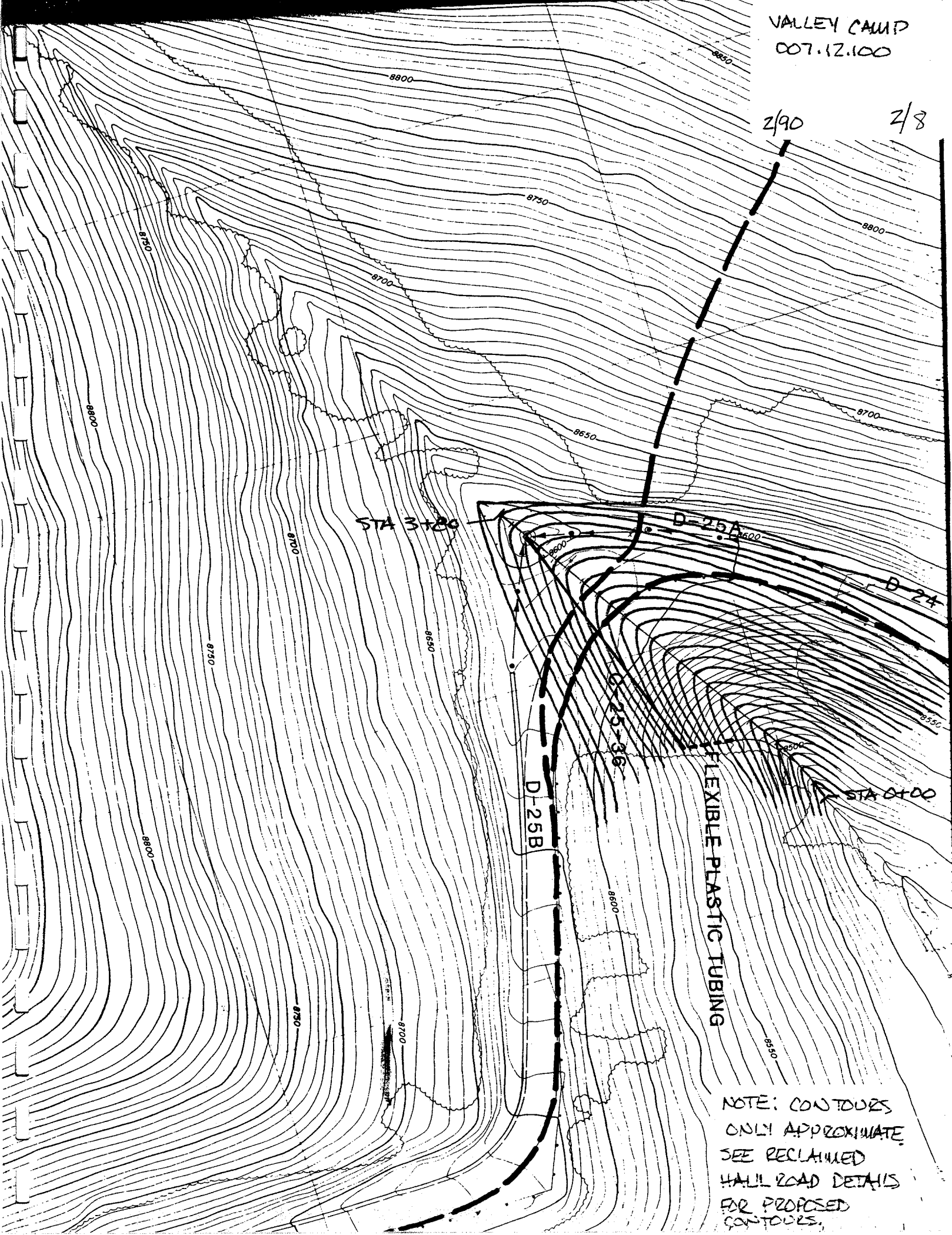
$D_{50} = 1.3'$ USE 1.5'

$e = 0.1'$ USE CHANNEL DEPTH OF 1.0'

RIPRAP FILTER "TYPE II - 1.0' THICK"

$D_{max} = 1.25 D_{50} = 1.88'$ USE 2.0'

$\frac{D_{50}}{D_{10-20}} = 3-3$ $D_{10-20} = \frac{D_{50}}{3-3}$ $D_{10-20} = 0.75 - 0.50'$


VALLEY CAMP
007.12.100
2/90
2/8
8850
8800
8750
8700
8650
8600
8550
STA 3+20
D-25A
D-24
D-25B
D-25-36
FLEXIBLE PLASTIC TUBING
STA 0+00
NOTE: CONTOURS ONLY APPROXIMATE. SEE RECLAIMED HAUL ROAD DETAILS FOR PROPOSED CONTOURS.

PROJECT : Valley Camp - 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	.0065	.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	19.25
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 Coal Company — Date: 06-Feb-90
Project No.: 007.12.100 — Time: 11:24 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:	0.65	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:	0.95	feet
	Riprap (Min S):	Required	
	Riprap (Max S):	Required	

RIPRAP DESIGN - Using the RED BOOK (Applied Hydrology and for Disturbed Areas)

Client: Valley Camp Coal Company — Date: 06-Feb-90
Project No.: 007.12.100 — Time: 11:24 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	
			UNREASONABLE
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	

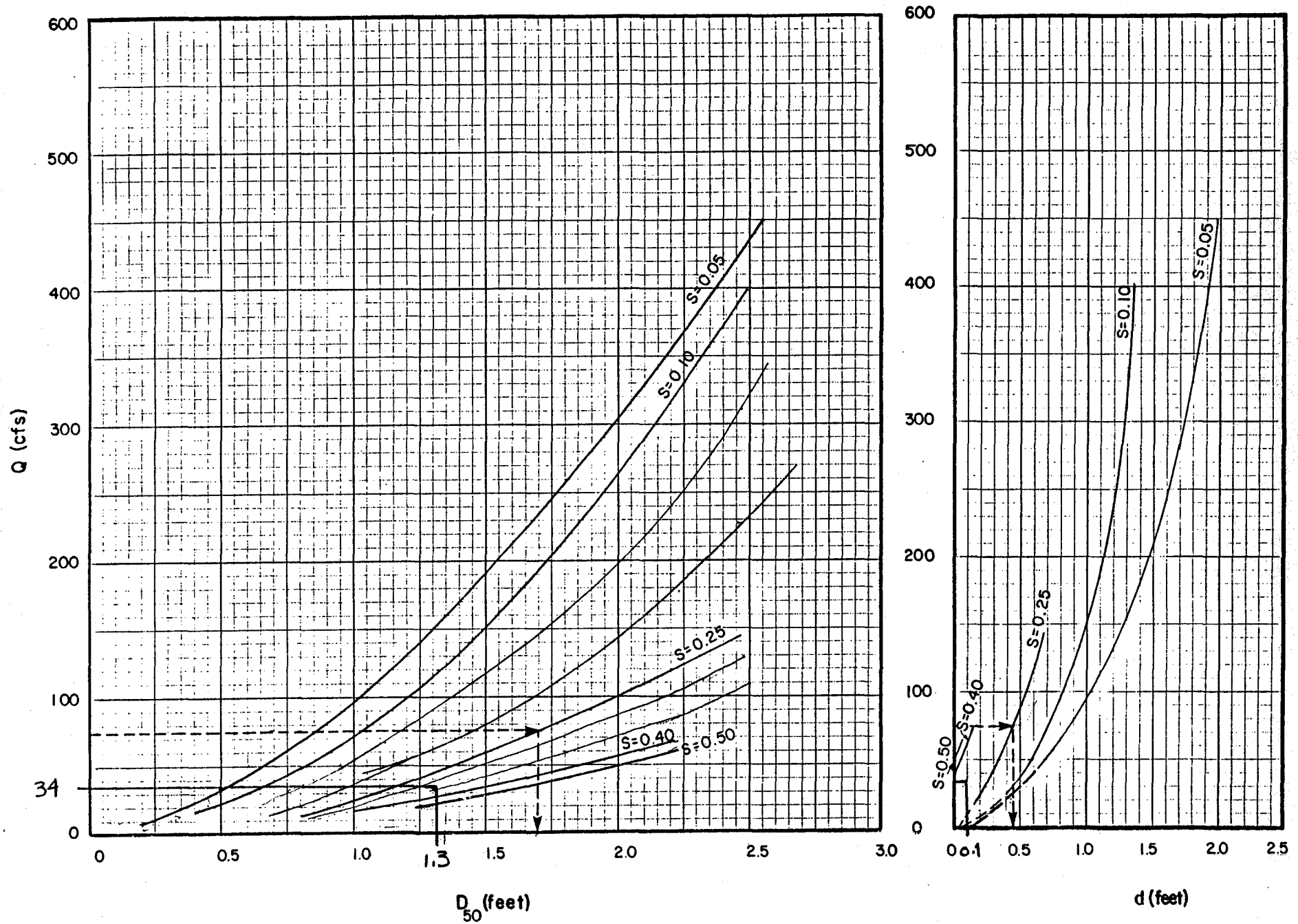
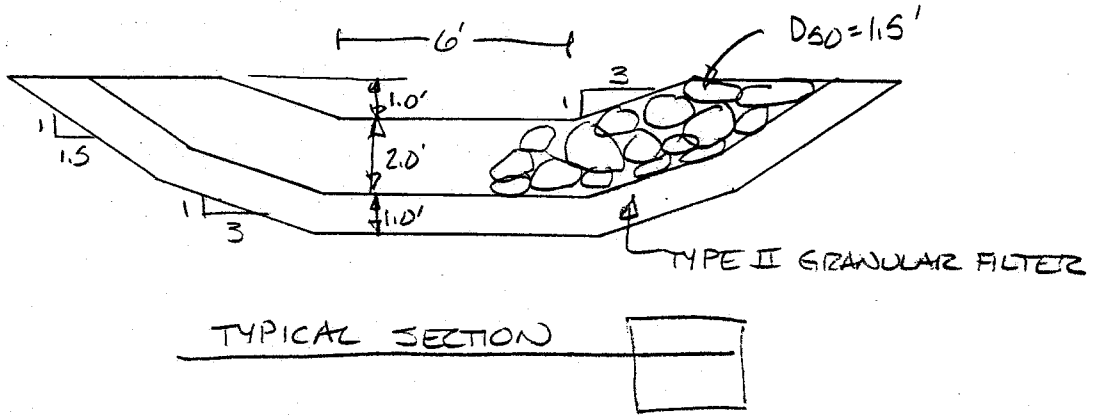


Figure 5.4. Steep slope riprap design, trapezoidal channels, 2:1 sideslopes, 6 ft base width.



TYPICAL SECTION

RIPRAP GRADATION (FROM FIGURES 1 - EXTRAPOLATED) PG 8

% PASSING BY WEIGHT	D_{50} (in)
90-100	24
50-70	20
35-50	18
2-10	5

USE INLET AND OUTLET DETAILS ALREADY DEVELOPED FOR OTHER CHANNELS.

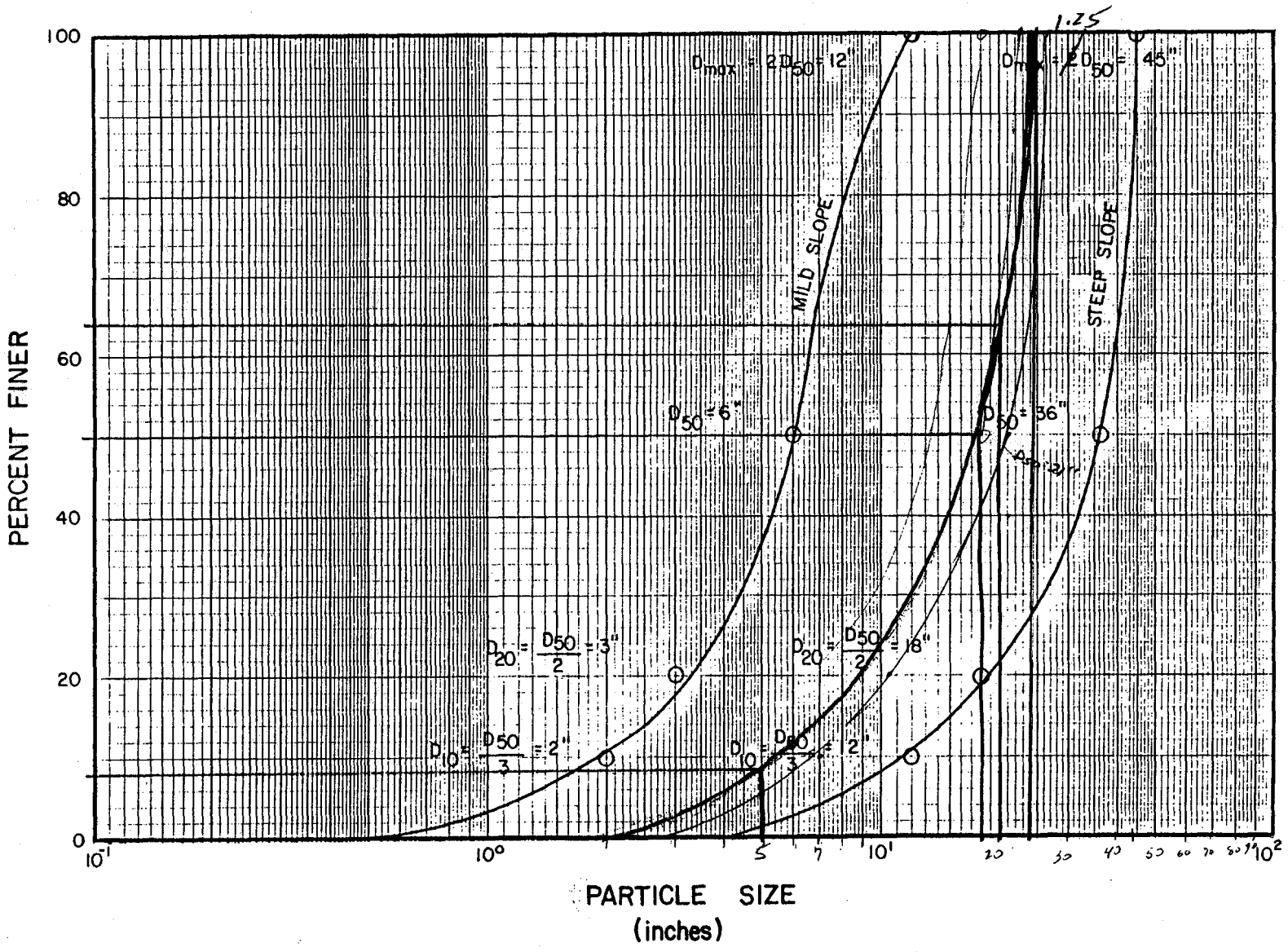


Figure 5.1. Definition sketch illustrating steep and mild slope riprap gradation based on recommended guidelines.

8/8

Figures R614-301-760a thru R614-301-760d

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