APPENDICES

APPENDIX 1

Materials And Methods Used To Revegetate
Temporary Revegetation Sites Analyzed In 1986

Utah #2

Site preparation and planting date: Fall 1980
Depth of substitute topsoil material: 6-8'
Seedbed preparation: dozer tracking
Fertilization: method - hydraulic
amount - 100 lbs N per acre every 3 years beginning 3rd year following seeding
Seeding method: hydroseeding
Mulching: method - hydromulching, broadcast
material and amount - wood fiber - Conwed 2,000-1500 to 2000 lbs/acre; straw - 4,000 lbs/acre
Mulch anchoring: tackifier included with hydromulch; none

Belina Area A and Area B

Site preparation and planting date: Fall 1980
Depth of substitute topsoil material: 6"
Seedbed preparation: dozer tracking
Fertilization: method - hydraulic
amount - 100 lbs N per acre every 3 years beginning 3rd year following seeding
Seeding method: hydroseeding
Mulching: method - hydromulching
material and amount - wood fiber - Conwed 2,000 - 1500 to 2000 lbs/acre
Mulch anchoring: tackifier included with hydromulch

Belina Area G

Site preparation and planting date: Fall 1985
Depth of substitute topsoil material: 6"
Seedbed preparation: dozer tracking
Fertilization: method - hydraulic
amount - 100 lbs N per acre every 3 years beginning 3rd year following seeding
Seeding method: hydroseeding
Mulching: method - hydromulching
material and amount - wood fiber - Conwed 2,000 - 1500 to 2000 lbs/acre; straw - 4,000 lbs/acre
Mulch anchoring: tackifier included with hydromulch; none

APPENDIX 2

Seed Mixtures Used on Temporary Revegetation Sites

Belina A, Belina B, Utah #2

Species	% of Mixture (PLS)
Agropyron dasystachyum (Thickspike wheatgrass)	8
Agropyron riparium (Streambank wheatgrass)	16
Agropyron smithii (Western wheatgrass)	12
Agropyron trachycaulum (Slender wheatgrass)	16
Bromus marginatus (Mountain brome)	5
Dactylis glomerata (Orchardgrass)	9
Elymus junceus (Russian wildrye)	8
Poa pratensis (Kentucky bluegrass)	13
Medicago sativa (Alfalfa)	6
Melilotus officinalis (Yellow sweetclover)	2
Artemisia tridentata vaseyana (Mountain big sagebrush)	4
Chrysothamnus nauseosus (Rubber rabbitbrush)	1
Chrysothamnus vicidiflorus (Douglas rabbitbrush)	<1
	100%

Belina G

Species	% of Mixture (PLS)
Agropyron dasystachyum (Thickspike wheatgrass)	10
Agropyron smithii (Western wheatgrass)	16
Agropyron spicatum (Bluebunch wheatgrass)	9
Agropyron trachycaulum (Slender wheatgrass)	11
Bromus marginatus (Mountain brome)	9
Dactylis glomerata (Orchardgrass)	4
Elymus junceus (Russian wildrye)	6
Poa pratensis (Kentucky bluegrass)	4
Medicago sativa (Alfalfa)	4
Melilotus officinalis (Yellow sweetclover)	2
Artemisia tridentata vaseyana (Mountain big sagebrush)	16
Chrysothamnus nauseosus (Rubber rabbitbrush)	4
Chrysothamnus vicidiflorus (Douglas rabbitbrush)	5
	100%

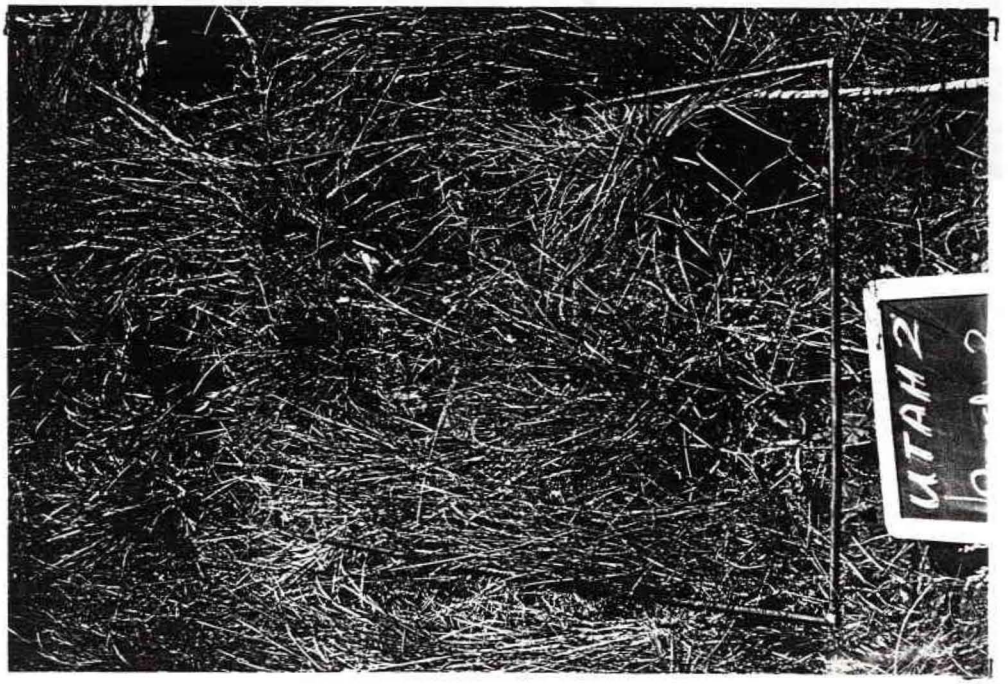
APPENDIX 3

Photographic Addendum

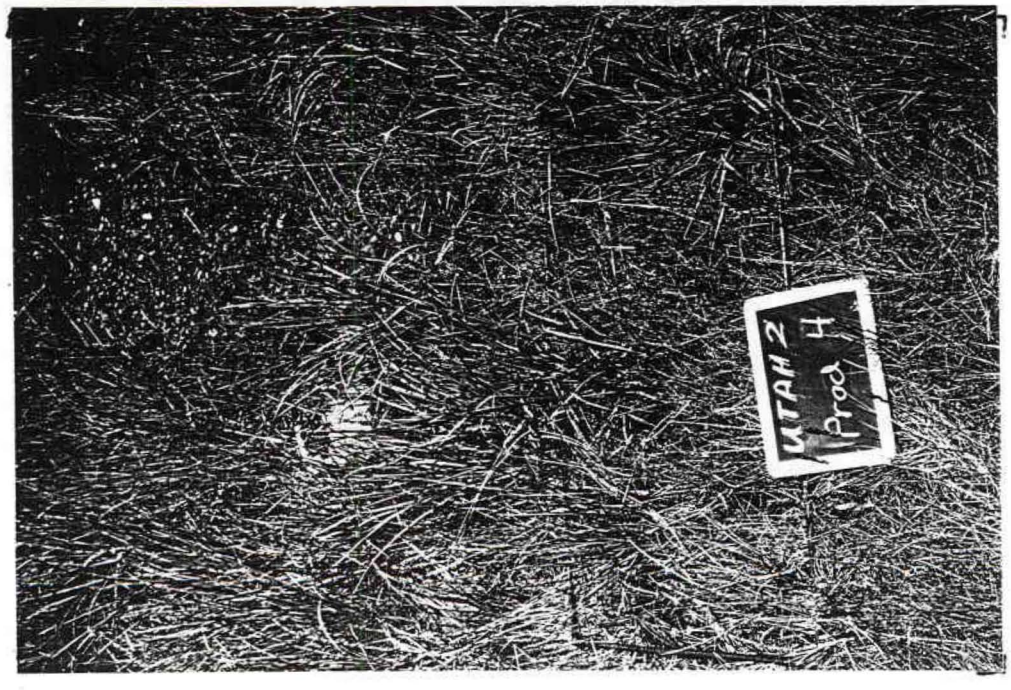
The following photographs were taken on the July 11th and 12th, 1986 field trip to collect temporary revegetation site cover and productivity data. Five photos are presented for each temporary revegetation site evaluated. The first photo in each set of five shows the sites' overall condition and characteristics. The remaining four photos in each set depict randomly selected production quadrats prior to clipping. These photos show site surface conditions more precisely and give an indication of seedbed material surface characteristics, plant density, and general plant vigor.

UTAH # 2 SITE

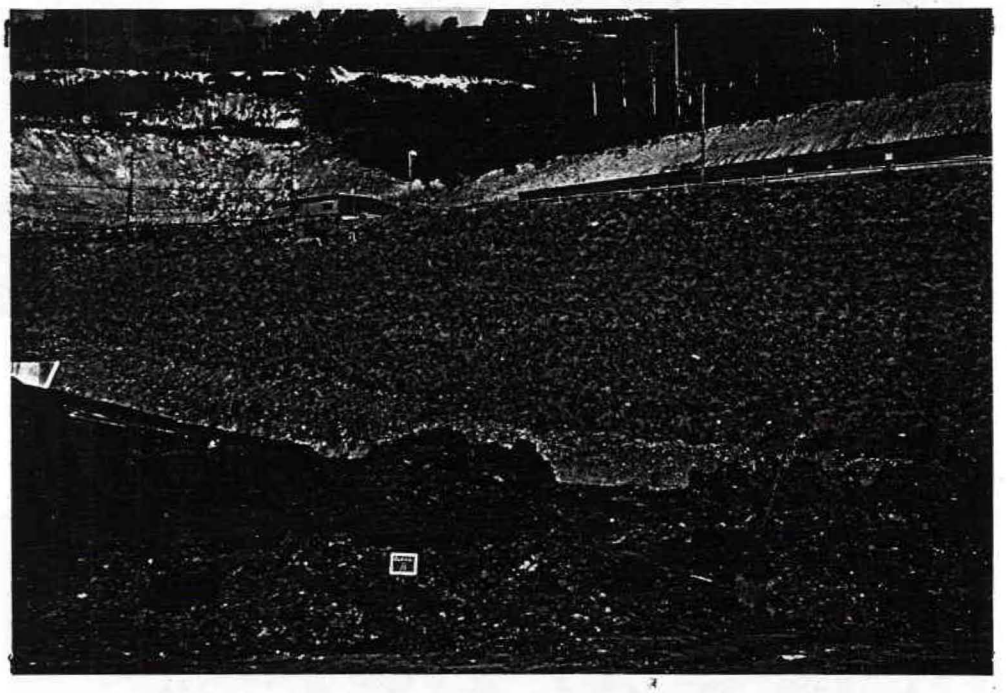
UTAH # 2 QUADRATS



UTAH # 2 QUADRATS



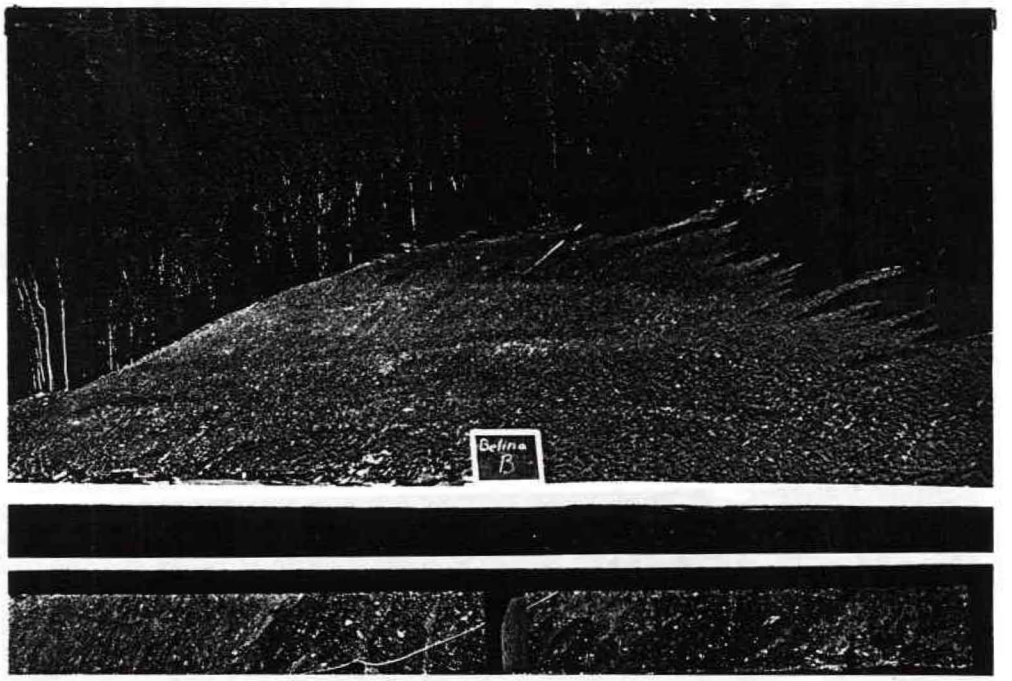
BELINA AREA A SITE



AREA A QUADRATS

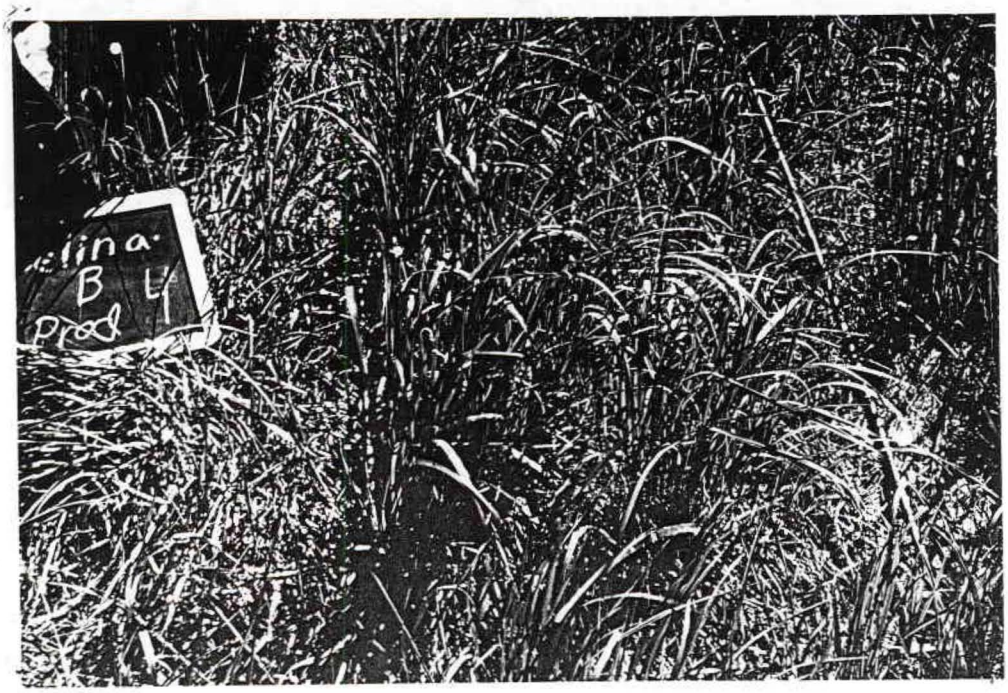
AREA A QUADRATS

BELINA AREA B SITE

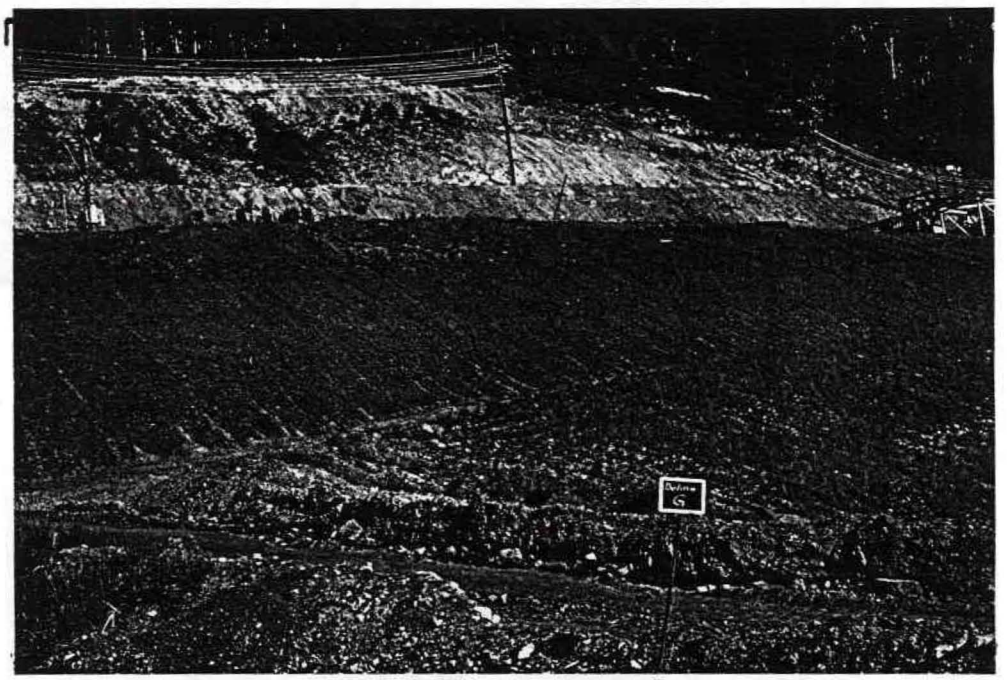


AREA B QUADRATS

AREA B QUADRATS

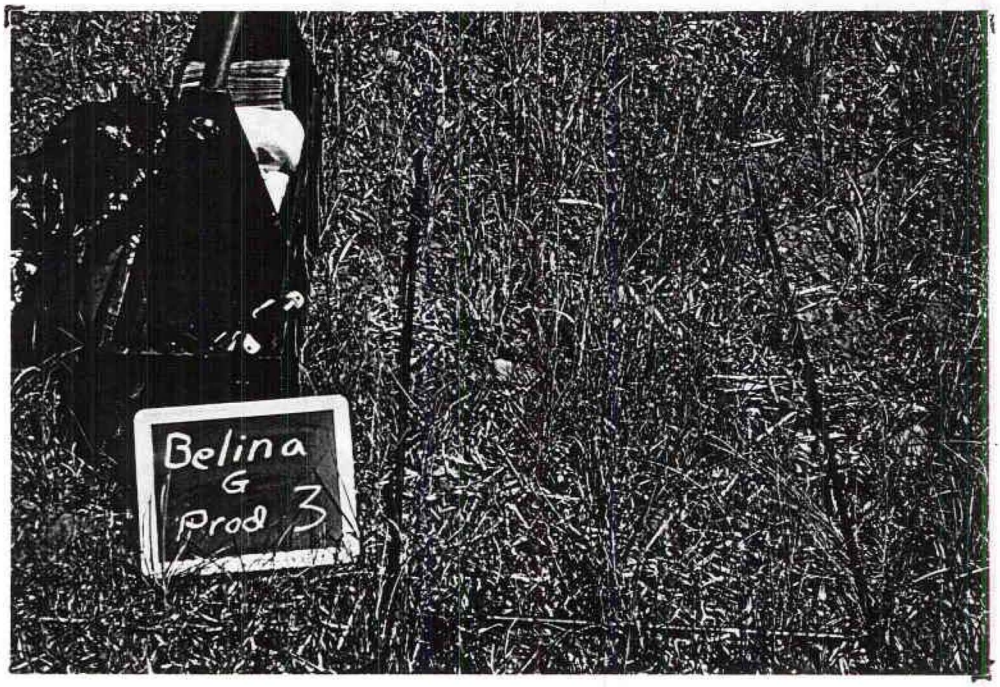


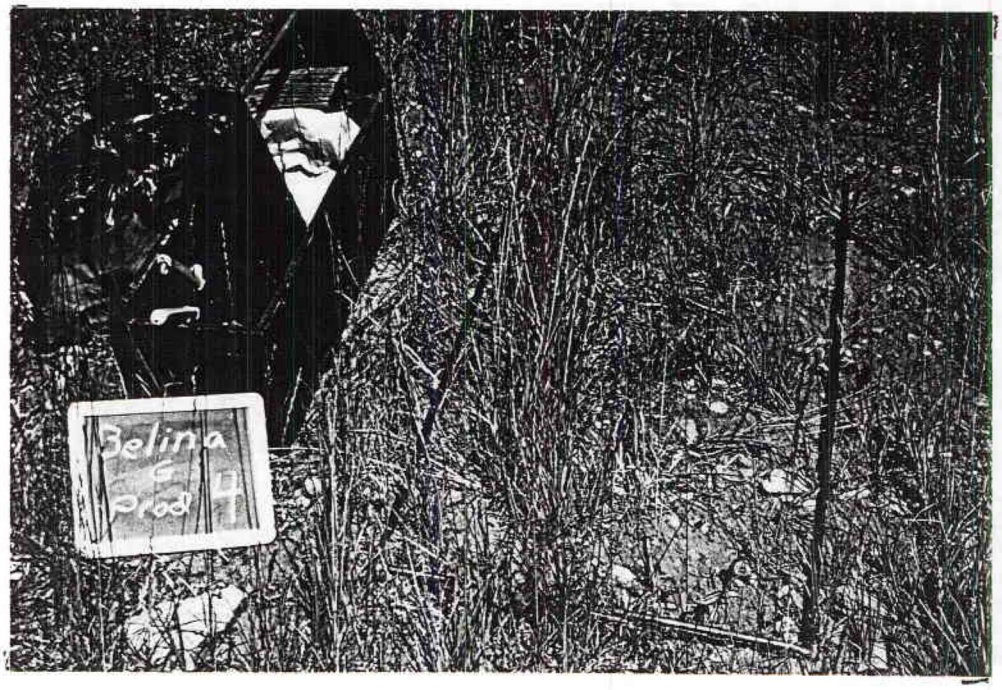
BELINA AREA G SITE



AREA G QUADRATS

AREA G QUADRATS





MAPS

Mt. Nebo Scientific
(Summary 1988-1992)

1988 RESULTS OF VEGETATION SAMPLING AND TEST PLOT MONITORING

Prepared by
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Report by
Patrick D. Collins Ph.D.

Fieldwork: Patrick D. Collins
P. Dean Collins

October 1988

INTRODUCTION

Vegetation test plots were constructed in 1987 to test revegetation potential of available soil material (Vegetation-Supporting Material) of the Mine Permit Area. The test plot design was developed by the State of Utah, Division of Oil, Gas & Mining UDOGM and Valley Camp of Utah, Inc. Plot construction (layout and earthmoving work) was accomplished by (or under the direction of) Valley Camp of Utah, Inc. Seed, fertilizer and hydromulch by the specified design was applied by Mt. Nebo Scientific in October of 1987.

Two main areas were used as sites for the vegetation test plots. These areas were called the Valcam Loadout Facility Site and the Belina Mine Site. The Valcam Loadout Facility site is located south of the truck load-out pad and east of the railroad tracks on an old coal storage area. The Belina Mine Site is on the slope south of the sediment pond.

Monitoring was initiated by sampling the vegetation on the two sites by Mt. Nebo Scientific in August of 1988. An additional site that had been previously implemented by a different contractor was also sampled for comparison at the same time. Results of the quantitative sampling are summarized in this report.

METHODS

Quantitative and qualitative data were taken on each of the two sites. Bi-directional random placement of sampling plots were designed to provide unbiased accuracy of the data compiled. A randomized block design was implemented to insure adequate representation of the entire plot. On the Valcam Loadout Facility Site, three 12.5 meter transects were regulary placed on the plot to adequately cover the entire plot. Twenty sample points were then placed every 1.5 meters along these transects. A one meter buffer strip was placed around the entire plot where sample points were avoided to limit sample bias. There was only one treatment to be monitored on this plot.

The Belina Mine Site, however, had four different treatments to be sampled, plus the one site that was implemented by another contractor. Therefore, a total of five areas or "subplots" were sampled. The subplots were labeled on the data summary tables by directional locations and

treatments and are listed below:

1. NE Subplot, Light Soil A, Fertilized
2. NW Subplot, Light Soil S, Unfertilized
3. SE Subplot, Gray Soil B, Fertilized
4. SW Subplot, Gray Soil B, Unfertilized
5. MC Plot, east and adj. to NEBO SW Plot

Three transects were also placed on each of the subplots listed above.
Eight sample locations were regularly placed on each treatment with a total of 40 samples for all treatments where quadrat placement was avoided.

Cover estimates were made using ocular methods with meter square quadrats. Species cover, total cover, composition and relative frequency were also assessed from the quadrats. Also recorded on data sheets were estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes.

Sampling adaquacy for cover on the Valcam Loadout Facility Site was
achieved using formulas from Snedocor and Cochran (1980), insuring that 80% of the sample were within 10% of the true mean of the test plots. Sample number of the Belina Mine Site was determined by Lynn Kunzler (UDOGM). All sample means, standard deviations, and sample sizes were included in this report to enable the reviewers to apply futher statistical tests if desired.

Plant species nomenclature follows Welsh et al. (A Utah Flora. 1987.
Great Basin Natural Memoir N0. 9). Sample design and Methodologies were approved by a representative of the State of Utah, UDOGM (Lynn Kunzler, Reclamation Biologist). Mr. Kunzler was present on site upon initiation of the test plot sampling in 1988.

RESULTS

Summary Tables
All results of the vegetation sampling for 1988 are shown on the summary tables (Tables 1-12). Included in these tables are:

1) Percent cover and standard deviations (total living cover, mulch and litter, bare ground, rock),
2) composition (% shrubs, forbs, grasses),
3) cover and frequency by species,
4) sample sizes.

NOMENCLATURE

Because the author decided to use the most recent nomenclature for plant species for the summary tables, and because some of the species on the original seed mix list have been changed, a list is provided below showing the old and new scientific names.

OLD NAME (on seed mix lists)	NEW NAME (Welsh 1987)
SHRUBS	
Amelanchier alnifolia	Amelanchier alnifolia
Artemisia tridentata var. vaseyana	Artemisia tridentata vaseyana
Chrysothamnus nauseosus albicaulis	C. nauseosus albicaulis
Rosa woodsii	Rosa woodsii
Sambucus coerulea	Sambucus coerulea
Symphoricarpos oreophilus	Symphoricarpos oreophilus
FORBS	
Achillea millefolium	Achillea millefolium
Artemisia ludoviciana	Artemisia ludoviciana
Linum lewissii	Linum perenne ssp. lewisii
Hedysarum boreale	Hedysarum boreale
Medicago sativa	Medicago satiav
Melilotus officinalis	Melilotus officinalis
Penstemon strictus	Penstemon strictus
GRASSES	
Agropyron dasystachyum	Elymus lanceolatus
Agropyron smithii	Elymus smithii
Bromus Marginatus	Bromus carinatus
Poa canbyi	Poa canbyi
Poa partensis	Poa pratensis

The test plots will continue to be monitored according to the schedule accepted by the State of Utah, (UDOGM), and each years results will be included in the annual report or as soon as it is available from MT. Nebo Scientific Research and Consulting.

TABLE 1
1988 SAMPLING RESULTS-BELINA PLOT
(NE Subplot, Light Soil A, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

CHARACTERISTIC	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
COVER			
Total Living cover	30.25	5.63	8.00
Mulch and Litter	28.13	8.27	8.00
Bareground	6.88	2.42	8.00
Rock	34.75	9.31	8.00
COMPOSITION			
Shrubs	0.39	1.03	8.00
Forbs	1.95	1.53	8.00
Grasses	97.66	2.08	8.00

*Sample size was determined by Utah Division of Oil, Gas and Mining (See METHODS).

TABLE 2
1988 SAMPLING RESULTS-BELINA PLOT
(NE Subplot, Light Soil A, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Picea pungens	0.13	0.13	8.00	12.50
FORBS				
Epilobium	0.38	0.48	8.00	37.50
helleanum	0.13	0.33	8.00	12.50
Hedysarum boreale	0.13	0.33	8.00	12.50
Melitotus officinalis				
GRASSES				
Agropyron	2.75	2.82	8.00	50.00
cristatum	0.63	1.65	8.00	12.50
Elymus lanceolatus	12.88	6.90	8.00	87.50
Elymus smithii	4.00	5.32	8.00	50.00
Elymus spicatus	9.25	10.02	8.00	62.50
Poa pratensis				

TABLE 3
1988 SAMPLING RESULTS-BELINA PLOT
(NW Subplot, Light Soil A, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard devations and sample sizes.

CHARACTERISTIC	MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE*
COVER			
Total Living Cover	20.75	5.93	8.00
Mulch and Litter	17.50	13.92	8.00
Bareground	8.75	4.84	8.00
Rock	53.00	16.48	8.00
COMPOSITION			
Shrubs	---	---	---
Forbs	15.53	17.46	8.00
Grasses	84.47	17.76	8.00

*Sample size was determined by Utah Division of Oil, Gas and Mining (See METHODS)

TABLE 4
1988 SAMPLING RESULTS-BELINA PLOT
(NW Subplot, Light Soil A, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	----	----	----	----
FORBS				
Epilobium halleanum	1.75	1.98	8.00	62.50
Linum perenne ssp. lewissii	0.13	0.33	8.00	12.50
Melilotus officinalis	0.25	0.43	8.00	12.50
Saxifraqa sp.	0.13	0.33	8.00	12.50
Urtica dioica	0.75	1.98	8.00	12.50
GRASSES				
Agropyron cristatum	0.25	0.66	8.00	12.50
Bromus carinatus	1.13	1.69	8.00	25.00
Elymus cinereus	0.63	1.65	8.00	12.50
Elymus lanceolatus	2.88	4.99	8.00	25.00
Elymus smithii	7.50	6.48	8.00	75.00
Elymus spicatus	4.63	7.61	8.00	50.00
Hordeum jubatum	0.13	0.33	8.00	12.50
Poa pratensis	0.63	1.65	8.00	12.50

TABLE 5
1988 SAMPLING RESULTS-BELINA PLOT
(SE Subplot, Gray Soil B, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table sbows means, standard deviations and sample sizes.

CHARACTERISTIC	MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE*
COVER			
Total Living Cover	26.00	7.91	8.00
Mulch and litter	31.15	11.27	8.00
Bareground	14.63	9.80	8.00
Rock	28.13	7.06	8.00
COMPOSITION			
Shrubs	----	----	----
Forbs	11.02	11.24	8.00
Grasses	88.98	11.24	8.00

* Sample size was determined by Utah Division of Oil, Gas and Mining (See METHODS)

TABLE 6
1988 SAMPLING RESULTS-BELINA PLOT
(SE Subplot, Gray Soil B, Fertlized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	----	----	----	----
FORBS				
Epilobium halleanum	1.25	1.48	8.00	75.00
Hedysarum boreale	0.13	0.33	8.00	12.50
Iva axillarus	0.13	0.33	8.00	12.50
Lappula sguarrosa	0.13	0.33	8.00	12.50
Linum perenne	0.13	0.33	8.00	12.50
Melilotus officinalis	0.13	0.33	8.00	12.50
Penstemon strictus	0.13	0.33	8.00	12.50
GRASSES				
Bromus carinatus	4.00	3.24	8.00	62.50
Elymus lanceolatus	1.25	3.31	8.00	12.50
Elymus smithii	11.25	6.23	8.00	87.50
Elymus spicatus	4.00	6.95	8.00	25.00
Poa pratensis	3.38	4.72	8.00	37.50

TABLE 7: 1988 SAMPLING RESULTS-BELINA PLOT
(SW Subplot, Gray Soil B, Unfertilized)

CHARACTERISTIC	%MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
COVER			
Total Living Cover	20.13	9.56	8.00
Mulch and Litter	25.00	7.50	8.00
Bareground	18.13	9.66	8.00
Rock	36.75	8.30	8.00
COMPOSITION			
Shrubs	----	----	----
Forbs	7.10	6.62	8.00
Grasses	92.90	6.62	8.00

* Sample size was determined by Utah Division of Oil, Gas and Mining (See METHODS).

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

TABLE 8
1988 SAMPLING RESULTS-BELINA PLOT
(SW Subplot, Gray Soil B, Unfertilized)

COVER BY SPECIES

SPECIES	%MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	----	----	----	----
FORBS				
Epilobium halleanum	0.63	0.70	8.00	50.00
Fragaria vesca	0.13	0.33	8.00	12.50
Hedysarum boreale	0.38	0.48	8.00	37.50
Melilotus officinalis	0.13	0.33	8.00	12.50
Penstemon strictus	0.13	0.33	8.00	12.50
GRASSES				
Bromus carinatus	3.88	5.69	8.00	62.50
Elymus smithii	7.38	5.41	8.00	100.00
Elymus spicatus	5.00	8.47	8.00	37.50
Poa pratensis	2.50	2.92	8.00	50.00

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

TABLE 9
1988 SAMPLING RESULTS-BELINA SITE
(MC Plot, east and adjacent to MT. NEBO'S SW PLOT)

COVER

CHARACTERISTIC	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE*
COVER			
Total Living Cover	5.50	1.32	8.00
Mulch and litter	43.13	24.61	8.00
Bareground	26.38	19.87	8.00
Rock	25.00	9.89	8.00
COMPOSITION			
Shrubs	2.50	6.61	8.00
Forbs	26.16	27.28	8.00
Grasses	71.34	27.52	8.00

* Sample size was determined by Utah Division of Oil, Gas and Mining (See METHODS).

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

TABLE 10
1988 SAMPLING RESULTS-BELINA PLOT
(MC Plot, east and adjacent to MT. NEBO'S SW Subplot)

COVER BY SPECIES

SPECIES	%MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Amalanchier utahensis	0.13	0.33	8.00	12.50
FORBS				
Epilobium halleanum	0.25	0.66	8.00	12.50
Hedysarum boreale	0.38	0.48	8.00	37.50
Penstemon strictus	0.38	0.48	8.00	37.50
Polygonum aviculare	0.25	0.66	8.00	12.50
GRASSES				
Bromus carinatus	0.50	1.00	8.00	25.00
Bromus tectorum	0.88	1.62	8.00	37.50
Elymus lanceolatus	0.13	0.33	8.00	12.50
Elymus smithii	2.38	2.34	8.00	87.50
Poa pratensis	0.13	0.33	8.00	12.50

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

TABLE 11
1988 SAMPLING RESULTS-PLOTS
(Single plot design)

CHARACTERISTIC	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE*
COVER			
Total Living Cover	27.90	8.83	20.00
Mulch and Litter	17.85	14.43	20.00
Bareground	44.50	26.06	20.00
Rock	9.75	8.62	20.00
COMPOSITION			
Shrubs	0.57	1.40	20.00
Forbs	83.26	11.16	20.00
Grasses	16.17	11.20	20.00

* Sample size insures 80% accuracy withis 10% of the true mean.

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

TABLE 12
1988 SAMPLING RESULTS-UTAH PLOT
(Single Plot Design)

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Artemisia tridentata	0.15	0.36	20.00	15.00
FORBS				
Artemisia ludowiciana	0.10	0.30	20.00	10.00
Chaenactis douglasii	0.10	0.30	20.00	10.00
Chenopodium fremontii	0.10	0.30	20.00	10.00
Circium sp.	0.60	0.66	20.00	50.00
Erigeron sp.	0.15	0.36	20.00	15.00
Eriogonum sp.	0.15	0.36	20.00	15.00
Gayophytum ramosissismum	0.30	0.46	20.00	30.00
Lappula occidentalis	1.15	1.74	20.00	40.00
Linum perenne ssp lewisii	0.30	0.46	20.00	30.00
Melilotus officinalis	7.15	5.77	20.00	85.00
Polygonum aviculare	1.30	2.10	20.00	35.00
Salsola iberica	11.90	7.76	20.00	100.00
GRASSES				
Bromus carinatus	1.65	2.52	20.00	45.00
Elymus lanceolatus	0.80	1.54	20.00	35.00
Elymus smithii	2.00	1.82	20.00	65.00

For the 1989 Test Plot Survey, see Appendix R614-301-341.300. (Mt. Nebo Scientific Reasearch and Consulting.

Immediately following the final year of monitoring, all parties will determine if the available soils are adaquate for use as Vegetation-Supporting Material for reclamation. Also just prior to the time of reclamation the test plots will be sampled for species composition, cover (by species and total vegetation cover), woody plant density and productivity and the soils will be tested to determine the fertilizer treatment needed to initiate and support the vegetation communities.

Within this same time frame, disease/pest testing will be done to evaluated if a control plan will be needed. If it becomes necessary to devise a Disease/Pest Control Plan, Division approval of the plan will be obtained prior to implementation of such plan. D/P testing will be ongoing during the bonded period to assure against invasion of pest or disease.

Irrigation is not envisioned as part of reclamation as the average precipitation should promote germination and adaquate growth for all species planted.

SUMMARY OF VEGETATION MONITORING FOR THE UTAH & BELINA TEST PLOTS

1988-1992

Prepared by

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Prepared for

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Patrick Collins, Ph.D.

January 1993

INTRODUCTION

Following are fifth year results from vegetation monitoring of test plots for *Valley Camp of Utah*. The plots are located near Scofield, Utah. Quantitative data have been previously submitted in the years from 1988 through 1991 for the test plots. This report also contains a summary of the results for the five years of sampling.

The test plots were constructed in 1987 to test revegetation potential of available soil material on the mine area. The test plot design was developed by the State of Utah, Division of Oil, Gas & Mining (DOGM) and Valley Camp of Utah, Inc. Plot construction (layout and earthmoving work) was accomplished by (or under the direction of) *Valley Camp of Utah*. Seed, fertilizer and hydromulch by the specified design was applied by *Mt. Nebo Scientific* in October of 1987.

Two main areas were used as sites for the vegetation test plots. These areas were called the *Utah Plot* and the *Belina Plot*. The Utah Plot is located south of the truck load-out pad and east of the railroad tracks on an old coal storage area. The Belina Plot is on the slope south of the sediment pond.

Monitoring of the vegetation on the two sites was conducted by *Mt. Nebo Scientific* from 1988 through 1992.

METHODS

Quantitative and qualitative data were taken on each of the two sites. Bi-directional random placement of sampling plots were designed to provide unbiased accuracy of the data compiled. A randomized block design was implemented to insure adequate representation of the entire plot. On the Utah site, three 12.5 meter transects were regularly placed on the plot to adequately cover the entire plot. Twenty sample points were then placed every 1.5 meters along these transects. A one meter buffer strip was placed around the entire plot where sample points were avoided to limit sample bias. There was only one treatment to be monitored on this plot.

The Belina site, however, had four different treatments to be sampled. Therefore, a total of four areas or "subplots" were sampled. The subplots were labeled on the data summary tables by directional locations and treatments and are listed below:

1) **NE** Subplot, Light Soil A, Fertilized
2) **NW** Subplot, Light Soil A, Unfertilized
3) **SE** Subplot, Gray Soil B, Fertilized
4) **SW** Subplot, Gray Soil B, Unfertilized

Three transects were also placed on each of the subplots listed above. Eight sample locations were regularly placed on each treatment with a total of 40 samples for all treatments. A one meter buffer

strip was also placed around each of the treatments where quadrat placement was avoided.

Cover estimates were made using ocular methods with meter square quadrats. Species cover, total cover, composition and relative frequency were also assessed from the quadrats. Also recorded on data sheets were estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes. Density of woody species have been negligible, and therefore not sampled quantitatively. Productivity will be measured in a subsequent season if the data were determined to be meaningful by DOGM and a Valley Camp representative.

Sampling adequacy for cover on the Utah Site was achieved using formula suggested by DOGM. Sample number of the Belina Site was determined by L. Kunzler (Biologist, DOGM). All sample means, standard deviations, and sample sizes were included in this report to enable the reviewers to apply further statistical tests if desired.

Plant species nomenclature follows Welsh et al. (A Utah Flora. 1987. Great Basin Naturalist Memoir No. 9). Sample design and methodologies were approved by a representative of the State of Utah, DOGM (L. Kunzler, Reclamation Biologist). Mr. Kunzler was present on site upon initiation of the test plot sampling in 1988.

RESULTS

Summary Tables

All results of the vegetation sampling for 1992 are shown on the summary tables (Tables 1 - 10). Included in these tables are:

1) percent cover and standard deviations (total living cover, mulch & litter, bare ground, & rock),
2) composition (% shrubs, forbs, & grasses),
3) cover and frequency by species,
4) sample sizes.

Summary Figures

Graphs of each of the plots for both cover and composition by lifeform are shown on Figures 1 through 11. The data represents five (5) years of monitoring (1988-1992) and compares each year with one another.

COVER

Total living cover is compared for five years on each subplot at the Belina Plot (see Figures: 1, 3, 5, 7). Nearly without exception, the cover increases with each growing season, then levels off on the

fifth sampling year. Total cover is relatively high on the final year for each of the subplots (35%-40%).

Figure 11 overlays each of the four subplots on the Belina site. Each subplot represents a different treatment. The figure illustrates that the treads for each of the treatments are very similar. In other words, there is probably no significant difference between treatments.

The Utah Plot had similar results, but leveled off in 1991 and then increased again in 1992 (Figure 9).

COMPOSITION

Composition by lifeform is also compared for the five sampling years (see Figures 2, 4, 6, 8). The composition here is the percent of the total living cover represented by shrubs, forbs or grasses.

Grasses are by far, the most important lifeform for cover in all subplots. Woody species never did become well established in any of the treatments. The trends for forbs, however, were not the same for each treatment. In the NE subplot, forbs appear to be increasing (Figure 2). The forbs were more important by cover in the NW and SE subplots and seemed to have stabilized over the five-year sampling period (Figures 4 and 6, respectively). In the SW subplot, forbs appeared to have increased with each year, except for the final sample

year (Table 8).

On the Utah plot, all lifeforms are important by cover. Species diversity was greater on this plot. Forbs made the strongest representation, but decreased each year. Shrubs and grasses increased with nearly every growing season (Figure 10).

Nomenclature

Because the author decided to use more recent nomenclature for plant species for the summary tables, and because some of the species on the original seed mix list have been changed, a list is provided below showing the old and new scientific names.

Old Name (on seed mix lists)	New Name (Welsh 1987)
Shrubs	
Amelanchier alnifolia	Amelanchier alnifolia
Artemisia tridentata var. vaseyana	Artemisia tridentata vaseyana
Chrysothamnus nauseosus albicaulis	C. nauseosus albicaulis
Rosa woodsii	Rosa woodsii
Sambucus coerulea	Sambucus coerulea
Symphoricarpos oreophilus	Symphoricarpos oreophilus
Forbs	
Achillea millefolium	Achillea millefolium
Artemisia ludoviciana	Artemisia ludoviciana
Linum lewisii	Linum perenne ssp. lewisii
Hedysarum boreale	Hedysarum boreale
Medicago sativa	Medicago sativa
Melilotus officinalis	Melilotus officinalis
Penstemon strictus	Penstemon strictus
Grasses	
Agropyron dasystachyum	Elymus lanceolatus
Agropyron smithii	Elymus smithii
Bromus marginatus	Bromus carinatus
Poa canbyi	Poa canbyi
Poa pratensis	Poa pratensis

The test plots will continue to be monitored according to the schedule accepted by the State of Utah, DOGM.

TABLE 1: **1992 SAMPLING RESULTS - BELINA PLOT**
(NE Subplot, Light Soil A, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	**STANDARD DEVIATION**	**SAMPLE SIZE ***
Total Living Cover	38.13	4.28	8
Litter	8.13	2.42	8
Bareground	10.63	1.65	8
Rock	43.13	6.58	8

COMPOSITION

	% MEAN COVER	**STANDARD DEVIATION**	**SAMPLE SIZE ***
Shrubs	--	--	8
Forbs	8.21	8.61	8
Grasses	91.79	8.61	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 2: **1992 SAMPLING RESULTS - BELINA PLOT**
(NE Subplot, Light Soil A, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	**% MEAN COVER**	**STANDARD DEVIATION**	**SAMPLE SIZE**
SHRUBS			
FORBS			
Circium sp.	1.25	2.17	8
Epilobium halleanum	.63	1.65	8
Urtica dioica	1.25	3.31	8
GRASSES			
Bromus carinatus	18.13	11.71	8
Dactylus glomeratus	3.13	5.56	8
Elymus smithii	8.75	4.84	8
Elymus spicatus	3.75	6.50	8
Poa pratensis	1.25	3.31	8

TABLE 3: **1992 SAMPLING RESULTS - BELINA PLOT**
(NW Subplot, Light Soil A, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	41.88	10.29	8
Litter	5.63	1.65	8
Bareground	9.38	3.00	8
Rock	43.13	10.59	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	8
Forbs	13.51	12.77	8
Grasses	86.49	12.77	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 4: **1992 SAMPLING RESULTS - BELINA PLOT**
(NW Subplot, Light Soil A, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	**% MEAN COVER**	**STANDARD DEVIATION**	**SAMPLE SIZE**
SHRUBS			
FORBS			
Circium sp.	.63	1.65	8
Epilobium halleanum	1.88	3.48	8
Urtica dioica	2.50	3.54	8
Linum lewsii	.63	1.65	8
GRASSES			
Bromus carinatus	10.00	7.50	8
Dactylis glomerata	3.13	3.48	8
Elymus smithii	10.00	3.58	8
Elymus spicatus	5.00	7.07	8
Poa pratensis	8.13	14.78	8

TABLE 5: **1992 SAMPLING RESULTS - BELINA PLOT**
(SE Subplot, Gray Soil B, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	43.13	8.99	8
Litter	7.50	2.50	8
Bareground	18.13	6.09	8
Rock	31.25	7.40	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	8
Forbs	16.66	7.18	8
Grasses	83.34	7.18	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 6: **1992 SAMPLING RESULTS - BELINA PLOT**
(SE Subplot, Gray Soil B, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	**% MEAN COVER**	**STANDARD DEVIATION**	**SAMPLE SIZE**
SHRUBS			
FORBS			
Epilobium halleanum	5.00	2.50	8
Medicago sativa	1.88	2.42	8
GRASSES			
Bromus carinatus	23.13	4.64	8
Dactylis glomerata	1.25	2.17	8
Elymus smithii	3.75	5.45	8
Elymus spicatus	4.38	4.64	8
Poa pratensis	23.13	15.19	8

TABLE 7: **1992 SAMPLING RESULTS - BELINA PLOT**
(SW Subplot, Gray Soil B, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	**STANDARD DEVIATION**	**SAMPLE SIZE ***
Total Living Cover	39.38	6.34	8
Litter	7.50	2.50	8
Bareground	9.38	3.90	8
Rock	43.75	7.81	8

COMPOSITION

	% MEAN COVER	**STANDARD DEVIATION**	**SAMPLE SIZE ***
Shrubs	--	--	8
Forbs	17.22	13.99	8
Grasses	82.78	13.99	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 8: **1992 SAMPLING RESULTS - BELINA PLOT**
(SW Subplot, Gray Soil B, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE
SHRUBS			
FORBS			
Epilobium halleanum	3.13	3.48	8
Linum lewsii	1.25	2.17	8
Medicago sativa	1.25	2.17	8
Urtica dioica	.63	1.65	8
GRASSES			
Bromus carinatus	8.75	5.99	8
Dactylis glomerata	5.00	6.17	8
Elymus lanceolatus	1.25	3.31	8
Elymus smithii	12.50	10.00	8
Elymus spicatus	4.38	3.90	8
Poa pratensis	1.25	2.17	8

TABLE 9: **1992 SAMPLING RESULTS - UTAH PLOT**
(Single plot design)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	40.75	7.46	20
Litter	11.50	2.78	20
Bareground	38.25	11.32	20
Rock	9.50	6.87	20

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE
Shrubs	7.74	10.98	20
Forbs	38.92	16.00	20
Grasses	53.34	17.53	20

TABLE 10: **1992 SAMPLING RESULTS - UTAH PLOT**
(Single Plot Design)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE
SHRUBS			
Artemisia tridentata	3.40	4.00	20
FORBS			
Artemisia ludoviciana	1.00	3.00	20
Circium sp.	0.25	1.09	20
Linum perenne ssp. lewisii	5.25	2.95	20
Medicago sativa	0.50	1.50	20
Melilotus officinalis	7.50	6.61	20
Penstemon strictus	.75	1.79	20
Verbascum thapsus	1.00	2.00	20
GRASSES			
Bromus carinatus	.50	2.18	20
Elymus lanceolatus	10.00	5.92	20
Elymus smithii	11.00	7.00	20

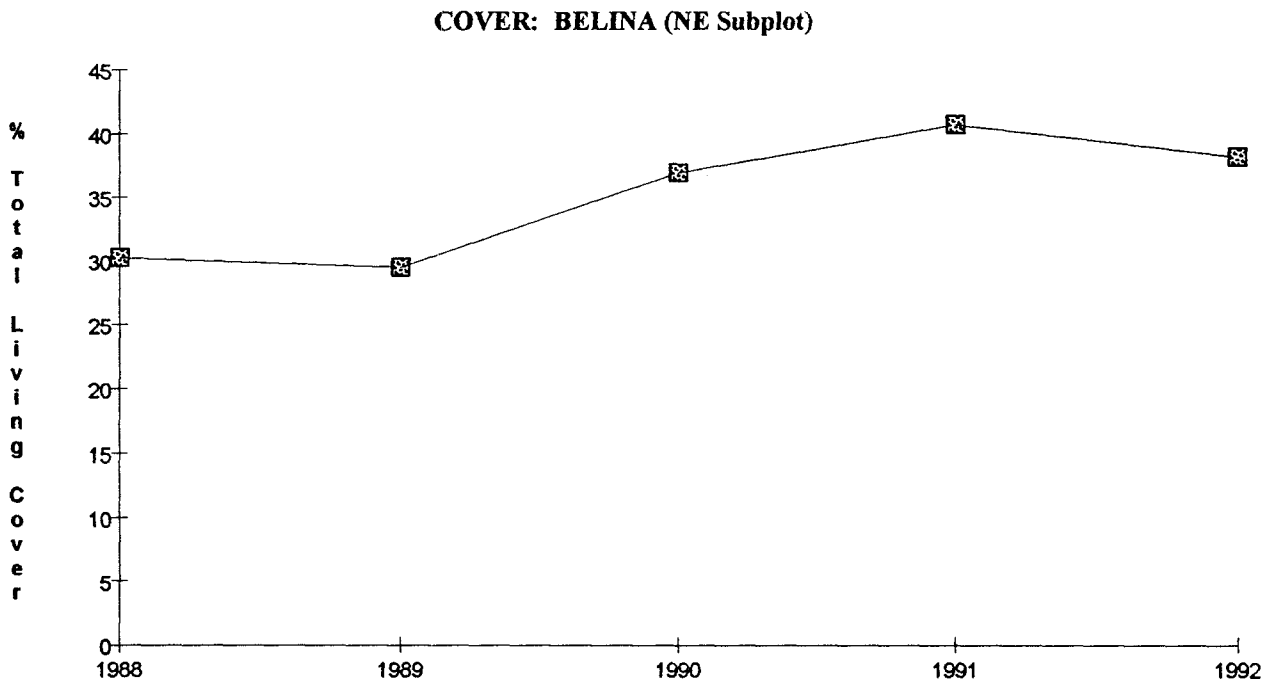
COVER: BELINA (NE Subplot)
% Total Living Cover
45
40
35
30
25
20
15
10
5
0
1988
1989
1990
1991
1992

FIGURE 1

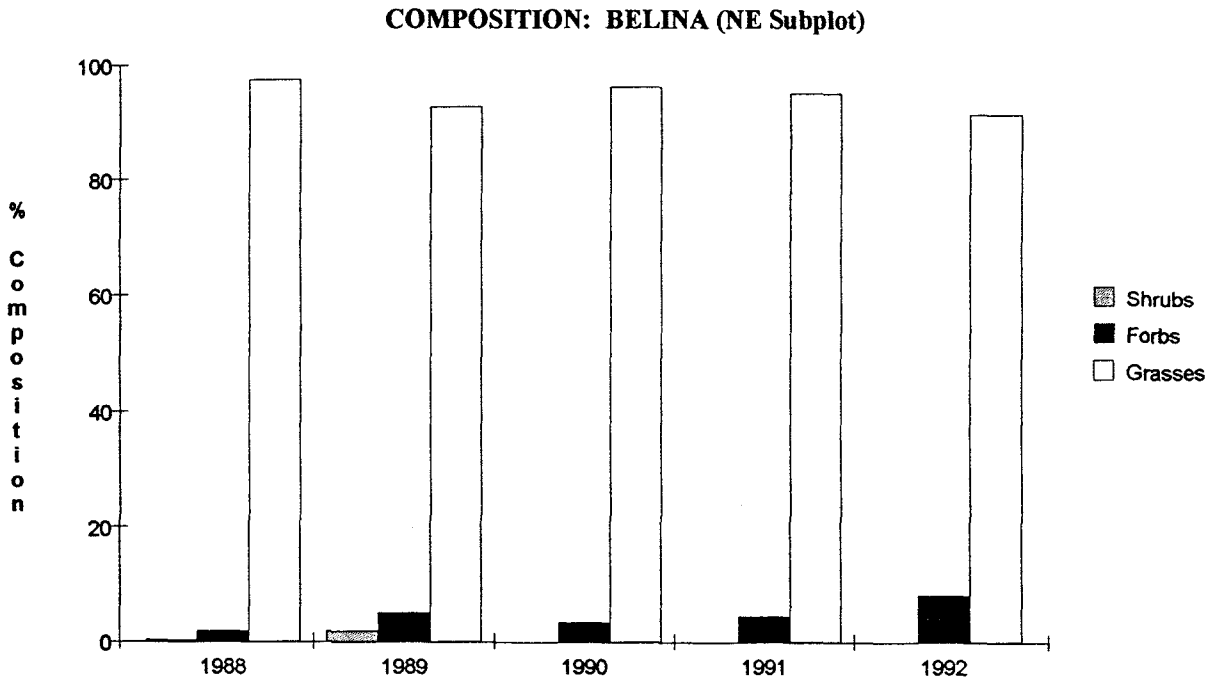
COMPOSITION: BELINA (NE Subplot)
% Composition
100
80
60
40
20
0
1988
1989
1990
1991
1992
Shrubs
Forbs
Grasses

FIGURE 2

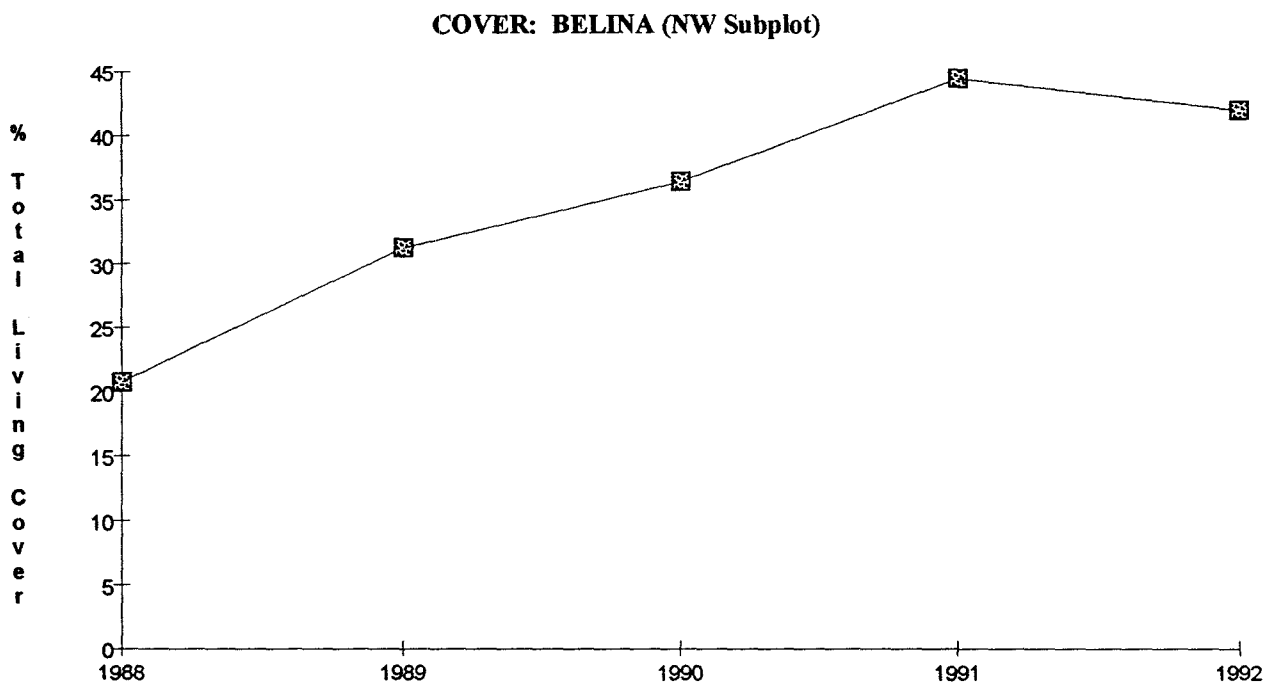
COVER: BELINA (NW Subplot)
% Total Living Cover
45
40
35
30
25
20
15
10
5
0
1988
1989
1990
1991
1992

FIGURE 3

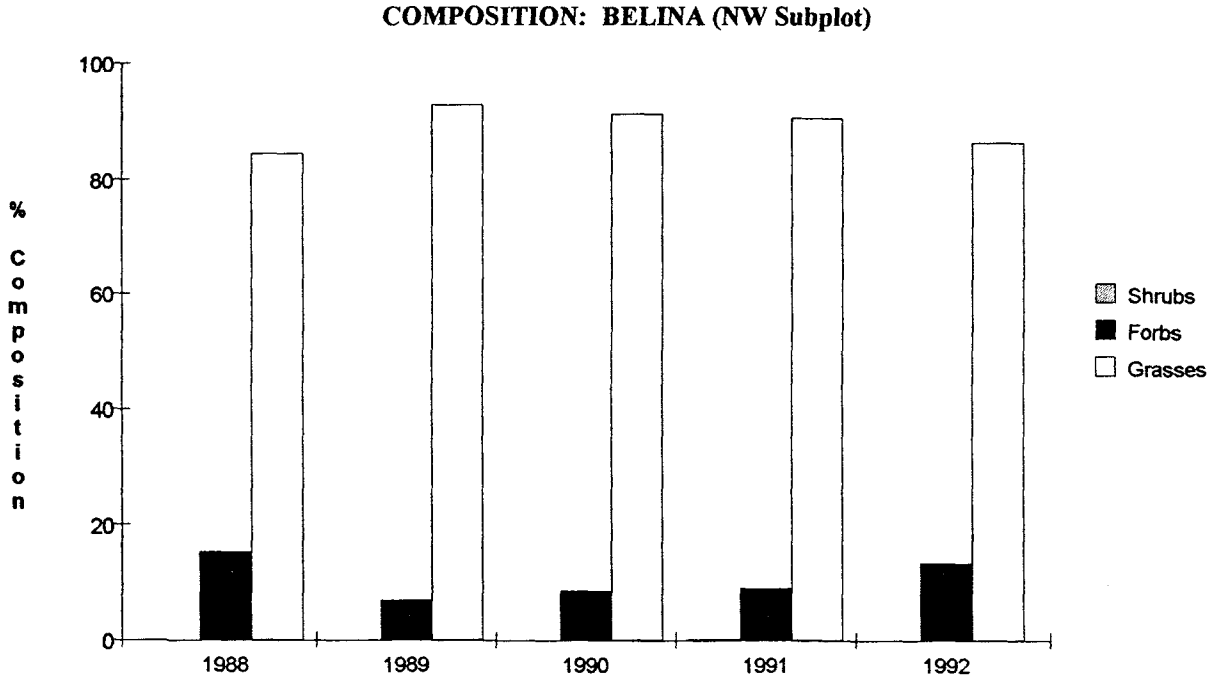
COMPOSITION: BELINA (NW Subplot)
% Composition
100
80
60
40
20
0
1988
1989
1990
1991
1992
Shrubs
Forbs
Grasses

FIGURE 4

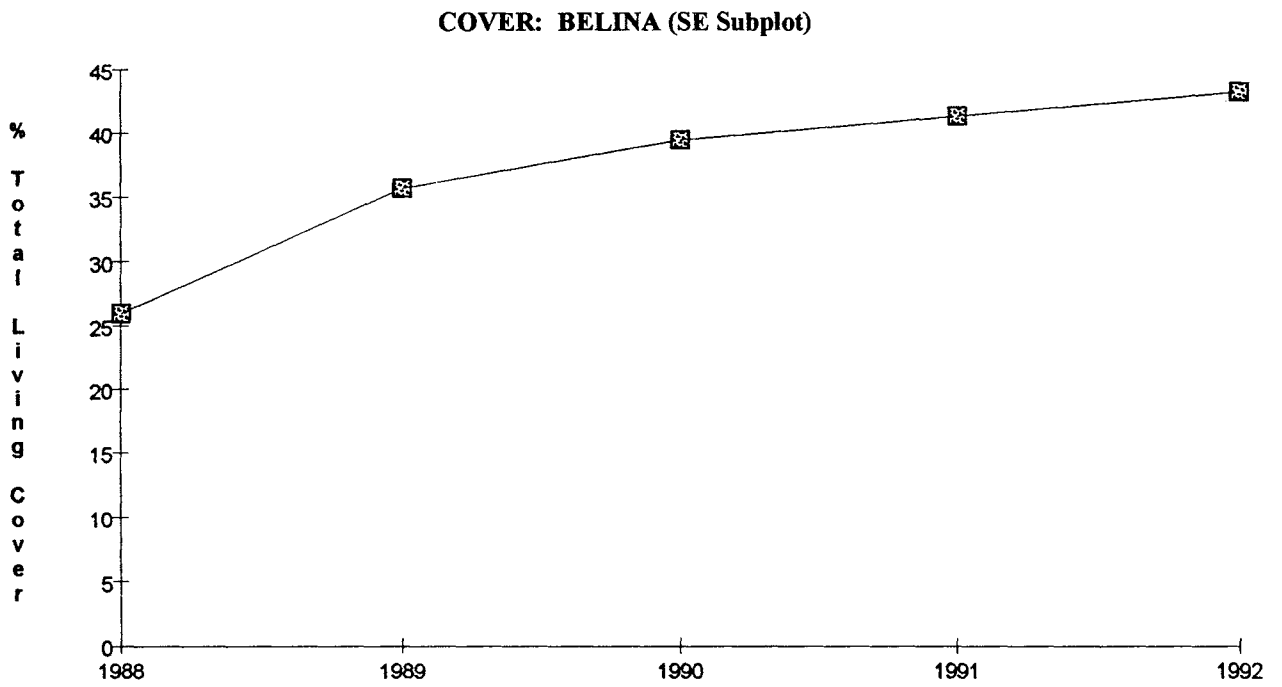
COVER: BELINA (SE Subplot)
% Total Living Cover
45
40
35
30
25
20
15
10
5
0
1988
1989
1990
1991
1992

FIGURE 5

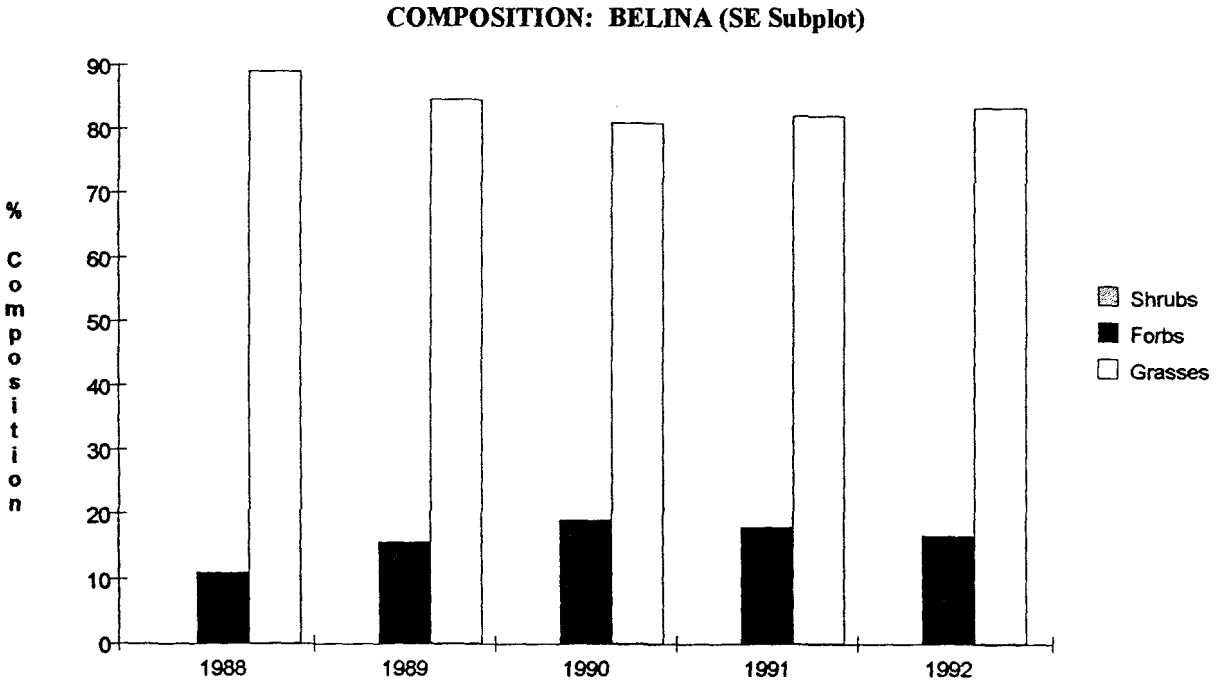
COMPOSITION: BELINA (SE Subplot)
% Composition
90
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
Shrubs
Forbs
Grasses

FIGURE 6

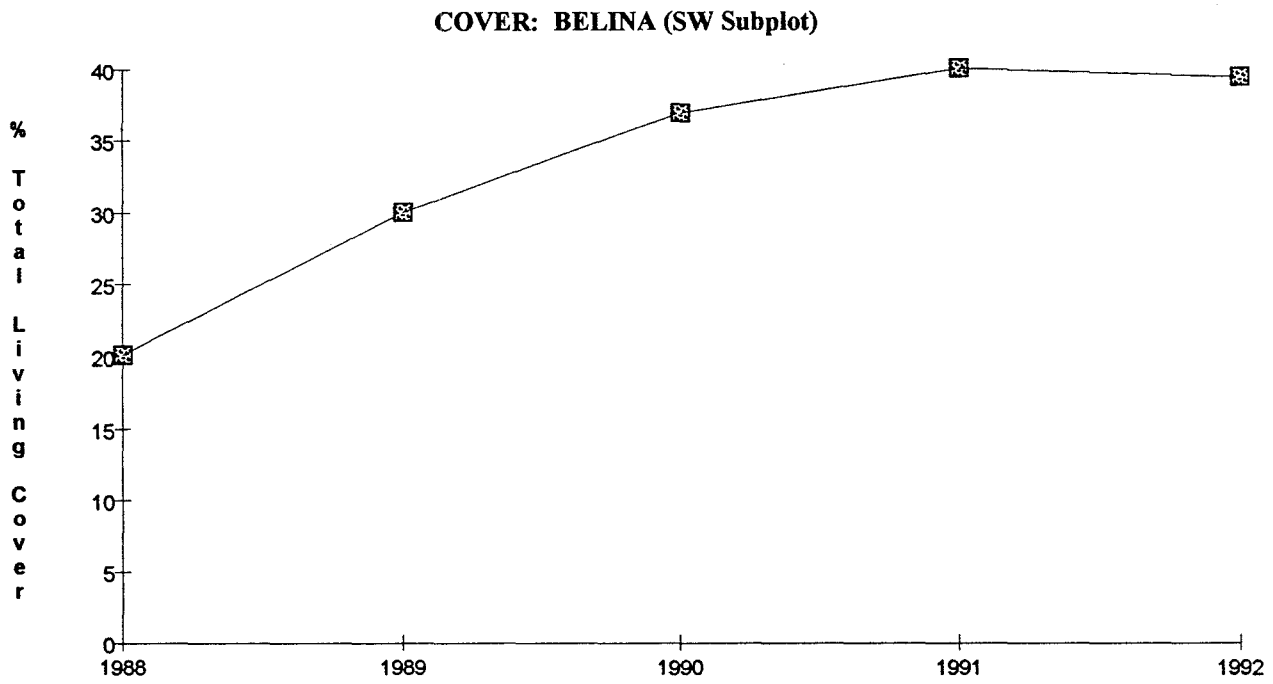
COVER: BELINA (SW Subplot)
% Total Living Cover
40
35
30
25
20
15
10
5
0
1988
1989
1990
1991
1992

FIGURE 7

COMPOSITION: BELINA (SW Subplot)

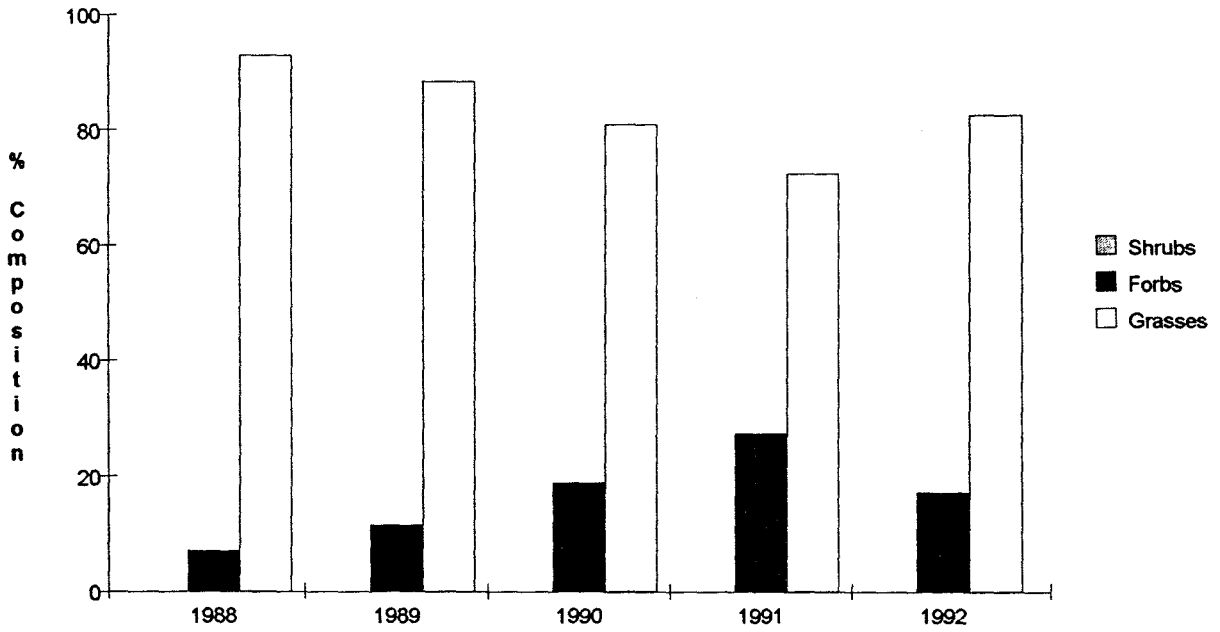

FIGURE 8

COVER: UTAH PLOT

FIGURE 9

COMPOSITION: UTAH PLOT

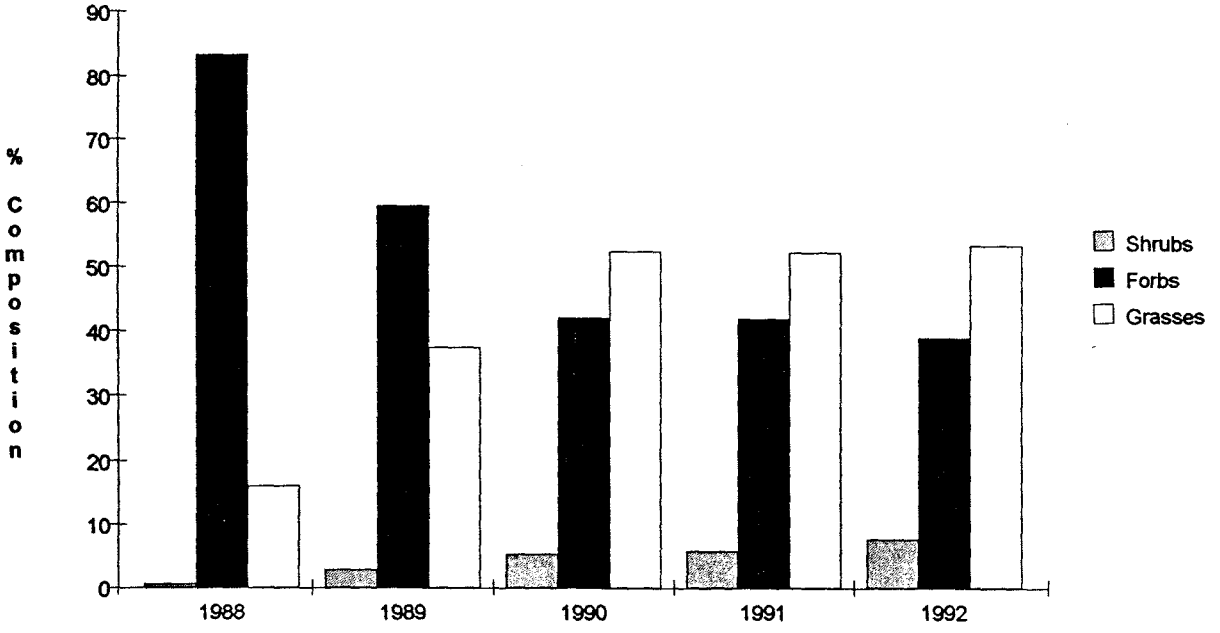

FIGURE 10

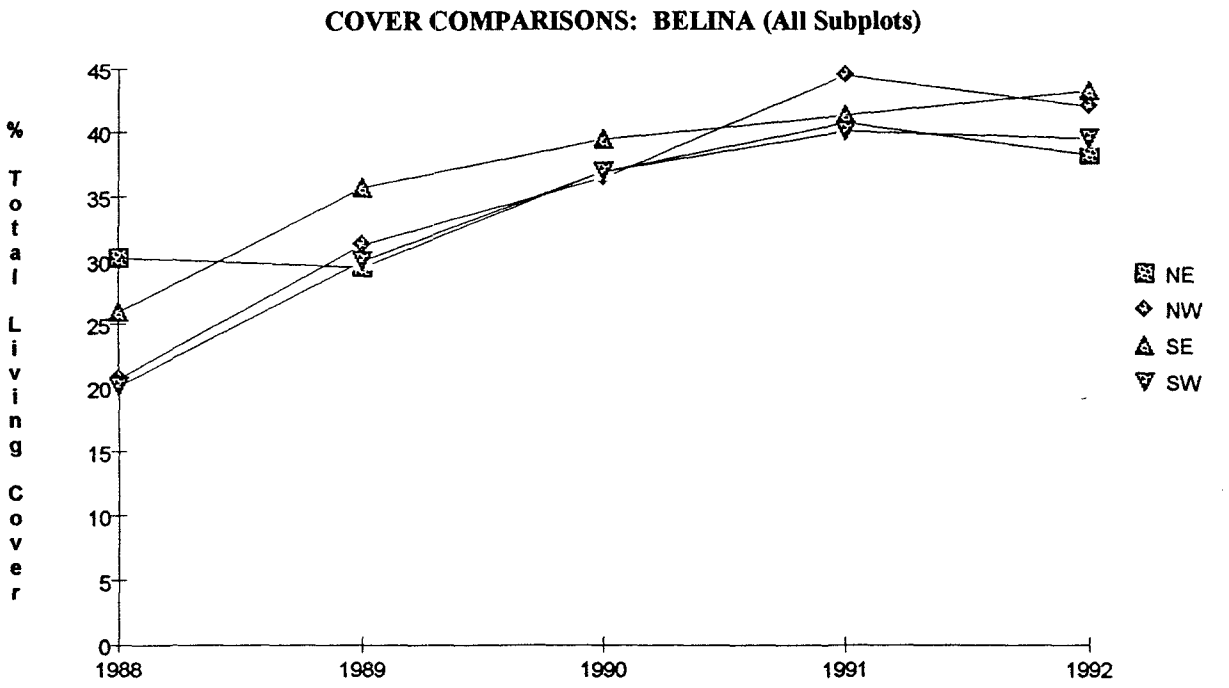
COVER COMPARISONS: BELINA (All Subplots)
% Total Living Cover
45
40
35
30
25
20
15
10
5
0
1988
1989
1990
1991
1992
NE
NW
SE
SW

FIGURE 11

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

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

TO: File

FROM: Paul Baker, Reclamation Biologist

DATE: August 31, 1992

RE: Vegetation Sampling at Belina Mine, Valley Camp Coal Company, Belina Mine, Act/007/001, Folder #2, Carbon County, Utah

On August 13, 1992, Steve Tanner and I sampled the vegetation in three areas at the Belina Mine. The purpose of the sampling was to measure sites that have received interim reclamation treatments to show that revegetation is feasible on the types of slopes and soils that are proposed for final reclamation. Although similar sampling was performed in 1986 for the same reason, no comparison appears to have been made to a reference or other undisturbed area. Test plots were established in 1987 to show that the site is reclaimable using similar techniques to those proposed in the plan. According to 1991 data which, I emphasize, was gathered using different techniques and by different people, the test plots do not appear to be any better than the sites which we sampled this year.

Three areas were sampled using a ten-point pin frame. Each ten points was considered one sample. Area A is a southeast-facing slope in front of the bathhouse between the upper and lower pads. Area B is a north-facing slope above sediment pond 4 and below a stand of spruce and fir. The undisturbed area is an aspen-grass southeast-facing slope to the west and above the mine site. It was not permanently marked as a reference area. The gradients on the slopes were about 50%, 40-45%, and 35% for areas A, B, and the undisturbed area respectively.

Areas A and B were revegetated in 1980 using methods shown on page 96 of the plan. The areas were hydroseeded then hydromulched with 1500-2000 lbs. per acre of wood fiber mulch. A tackifier was included with the mulch. The plan states that, as of 1986, 100 lbs. per acre of nitrogen was applied every 3 years beginning the third year after seeding. Some additional applications of fertilizer may have been made since then. The seed mix included thickspike, western, streambank, and slender wheatgrasses; mountain brome; orchardgrass; Russian wild rye; Kentucky bluegrass; alfalfa; yellow sweet clover; big sage; and rubber and Douglas rabbitbrush.

Area A had 50% vegetation and 38% litter for a total of 88% cover. Bare and rock totaled 12%. Species encountered, in order of dominance, were Kentucky bluegrass, western wheatgrass, sagebrush, orchardgrass, and thickspike wheatgrass. The sample

size was 15, and the minimum sample size required was 9.39. The standard deviation for vegetation and litter was 21.04.

Area B had 40% vegetation and 25% litter for a total of 65% cover. Bare and rock totaled 35%. Species encountered, in order of dominance, were orchardgrass, Kentucky bluegrass, smooth brome, and white fir. Some moss was included in the calculation for vegetation and litter. The sample size was 11, and the minimum sample size required was 14.49. The standard deviation for vegetation and litter was 19.24.

Overstory vegetation was not measured in the undisturbed area although there was some aspen present. This area had 62% vegetation and 33% litter cover for a total of 95%. Bare and rock totaled 5%. Species encountered, in order of dominance, were Kentucky bluegrass, slender wheatgrass, and Letterman's needlegrass. The sample size was 6, and the minimum sample size requirement was 0.46.

The cover of area A (88%) is over 90% of the cover of the undisturbed area (95%), but statistical tests show that area B has not achieved 90% of the undisturbed area cover with 90% confidence. In 1986, some sampling of area B was performed by Cedar Creek Associates. They stated in their report that it had been agreed that only the top 25% of area B would be sampled because an overapplication of fertilizer had stunted some of the grass on the lower 75% of this slope. The effects of this overapplication should be gone by now, however, and I am not certain why cover is lower in this area. Although it is a north-facing slope which has snow on it longer than the other slopes, the most heavily vegetated portion is near the top by the spruce and fir trees which shade this portion of the slope and increase the time that the snow is present even further. The slope is basically a cut slope with little or no "topsoil". It does not have an overabundance of rocks, however.

One other problem with the current sampling is that a north-facing slope was not sampled to compare to area B. The adjacent area is a dense spruce-fir stand which has little understory growth but nearly 100% cover by litter. Some sagebrush-dominated slopes may exist nearby, and, because of their openness, they are probably more similar to area B than the undisturbed area that was sampled.

Based on this sampling, the soils and slopes that were used for area A should be adequate for final reclamation, but this has not been demonstrated for area B. The following additional sampling needs to be performed:

1. Sample the vegetation in a few other areas at the mine from which soil will be gathered for use as substitute topsoil material in final reclamation.

2. Sample a north-facing slope other than a spruce-fir site to make a better

comparison to area B. Include measurements of woody species density.

3. Measure vegetation, including vegetative cover and woody species density, at interim revegetation sites and undisturbed areas at the Valcam Loadout.

4. Measure cover, woody species density, and productivity on the test plots.

The test plot program needs to be completed, but the results are not expected to be much different from the results on the other slopes that received interim revegetation treatments in 1980. 1991 sampling did not show any differences between treatments at the Belina plots and the loadout plot only had one treatment.

If this sampling does not show that the vegetative cover of the adjacent undisturbed areas is being approached by either the test plots or the other areas that have been seeded, some changes to the reclamation plan might be needed. It appears now that additional efforts will be required to establish woody species beyond the methods that have been used in the past. Assuming that area B still does not meet the standards for success when comparing it to a different undisturbed area, further sampling will be needed to indicate a trend toward a potential standard for success in an undisturbed area.

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

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

TO: File

FROM: Paul Baker, Reclamation Biologist

DATE: October 9, 1992

RE: Interim Revegetation at Valcam Loadout, Valley Camp of Utah, Belina Mine, Folder #2, ACT/007/001, Carbon County, Utah

On September 11, 1992, I conducted a partial inspection at Valley Camp's Belina Mine and Valcam Loadout. As part of the inspection, Steve Tanner and I measured ground cover from vegetation, litter, rocks, and bare ground. The purpose was to show that plants have become established and have the ability to establish on substitute topsoil to equal, within 90% with 90% confidence, undisturbed areas.

The areas measured at the loadout were west-facing slopes of about 30-50%. Some native species have become established in these areas, but the dominant grass appears to be Russian wild rye. The slopes have some coal on them which probably affects the vegetation somewhat.

The undisturbed area is on the west side of the highway on what is apparently an alluvial fan. This fan probably extended across the highway and part way up the mountain before the highway, loadout, and Utah Mines were built. Therefore, it probably contains vegetation representative of what existed at the loadout before any disturbance. The area that we measured appeared to have had some grazing on it, but it was not severe. This area also had a west aspect, but the slope was probably less than 10%.

Each area was measured with a pin frame and ten 10-point transects. These were placed randomly within each area. Sample adequacy was achieved for the undisturbed area, but the required sample size for the disturbed area was 21. The reason for the larger sample size requirement for the disturbed areas was probably the variability in vegetation caused by differences in slope and the amount of coal fines. A 10-point transect is not considered adequate according to the "Vegetation Information Guidelines, Appendix A", but following these guidelines is only required for achieving final bond release. The purpose of the sampling was to get a general idea of the vegetation that had established on the interim reclamation sites compared to undisturbed areas using the same methods. The company has test plots that will be evaluated later this year that were intended to prove site reclaimability.

an equal opportunity employer

Ground cover in the undisturbed area was 91%, consisting of 50% vegetation and 41% litter. Vegetative cover was mostly from Kentucky bluegrass and needle and thread grass which were nearly impossible to distinguish. Some sagebrush, green rabbitbrush, and western wheatgrass were also present.

At the interim revegetation site at the loadout, ground cover was 70%, consisting of 50% vegetation and 20% litter. Species encountered, in order of dominance, were Russian wild rye, Kentucky bluegrass, basin wild rye, bluebunch wheatgrass, western wheatgrass, Russian thistle, and Machaeranthera sp.

To be within 90% of the undisturbed area with 90% confidence, the interim revegetation site would have to have had 70.9% ground cover. Cover from vegetation was the same for both areas. The performance standards appear to require that both ground cover and vegetative cover be equal in reclaimed areas as in undisturbed areas. Although ground cover in the interim revegetation area is not as great as in the undisturbed area, there are some major differences which will not be present at final reclamation. The areas measured within the loadout were very steep, and they are continuing to have new coal fines added to them. In spite of this, the vegetative cover is equal to the undisturbed area. I feel that revegetation success can be achieved at the loadout if proper revegetation techniques are used and that, for the present, no new testing needs to be performed.

UDOGM/VC
(1992)

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

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

TO: File

FROM: Paul Baker, Reclamation Biologist PRB

DATE: August 31, 1992

RE: Vegetation Sampling at Belina Mine, Valley Camp Coal Company, Belina Mine, Act/007/001, Folder #2, Carbon County, Utah

On August 13, 1992, Steve Tanner and I sampled the vegetation in three areas at the Belina Mine. The purpose of the sampling was to measure sites that have received interim reclamation treatments to show that revegetation is feasible on the types of slopes and soils that are proposed for final reclamation. Although similar sampling was performed in 1986 for the same reason, no comparison appears to have been made to a reference or other undisturbed area. Test plots were established in 1987 to show that the site is reclaimable using similar techniques to those proposed in the plan. According to 1991 data which, I emphasize, was gathered using different techniques and by different people, the test plots do not appear to be any better than the sites which we sampled this year.

Three areas were sampled using a ten-point pin frame. Each ten points was considered one sample. Area A is a southeast-facing slope in front of the bathhouse between the upper and lower pads. Area B is a north-facing slope above sediment pond 4 and below a stand of spruce and fir. The undisturbed area is an aspen-grass southeast-facing slope to the west and above the mine site. It was not permanently marked as a reference area. The gradients on the slopes were about 50%, 40-45%, and 35% for areas A, B, and the undisturbed area respectively.

Areas A and B were revegetated in 1980 using methods shown on page 96 of the plan. The areas were hydroseeded then hydromulched with 1500-2000 lbs. per acre of wood fiber mulch. A tackifier was included with the mulch. The plan states that, as of 1986, 100 lbs. per acre of nitrogen was applied every 3 years beginning the third year after seeding. Some additional applications of fertilizer may have been made since then. The seed mix included thickspike, western, streambank, and slender wheatgrasses; mountain brome; orchardgrass; Russian wild rye; Kentucky bluegrass; alfalfa; yellow sweet clover; big sage; and rubber and Douglas rabbitbrush.

Area A had 50% vegetation and 38% litter for a total of 88% cover. Bare and rock totaled 12%. Species encountered, in order of dominance, were Kentucky bluegrass, western wheatgrass, sagebrush, orchardgrass, and thickspike wheatgrass. The sample

size was 15, and the minimum sample size required was 9.39. The standard deviation for vegetation and litter was 21.04.

Area B had 40% vegetation and 25% litter for a total of 65% cover. Bare and rock totaled 35%. Species encountered, in order of dominance, were orchardgrass, Kentucky bluegrass, smooth brome, and white fir. Some moss was included in the calculation for vegetation and litter. The sample size was 11, and the minimum sample size required was 14.49. The standard deviation for vegetation and litter was 19.24.

Overstory vegetation was not measured in the undisturbed area although there was some aspen present. This area had 62% vegetation and 23% litter cover for a total of 95%. Bare and rock totaled 5%. Species encountered, in order of dominance, were Kentucky bluegrass, slender wheatgrass, and Letterman's needlegrass. The sample size was 6, and the minimum sample size requirement was 0.46.

The cover of area A (88%) is over 90% of the cover of the undisturbed area (95%), but statistical tests show that area B has not achieved 90% of the undisturbed area cover with 90% confidence. In 1986, some sampling of area B was performed by Cedar Creek Associates. They stated in their report that it had been agreed that only the top 25% of area B would be sampled because an overapplication of fertilizer had stunted some of the grass on the lower 75% of this slope. The effects of this overapplication should be gone by now, however, and I am not certain why cover is lower in this area. Although it is a north-facing slope which has snow on it longer than the other slopes, the most heavily vegetated portion is near the top by the spruce and fir trees which shade this portion of the slope and increase the time that the snow is present even further. The slope is basically a cut slope with little or no "topsoil". It does not have an overabundance of rocks, however.

One other problem with the current sampling is that a north-facing slope was not sampled to compare to area B. The adjacent area is a dense spruce-fir stand which has little understory growth but nearly 100% cover by litter. Some sagebrush-dominated slopes may exist nearby, and, because of their openness, they are probably more similar to area B than the undisturbed area that was sampled.

Based on this sampling, the soils and slopes that were used for area A should be adequate for final reclamation, but this has not been demonstrated for area B. The following additional sampling needs to be performed:

1. Sample the vegetation in a few other areas at the mine from which soil will be gathered for use as substitute topsoil material in final reclamation.

2. Sample a north-facing slope other than a spruce-fir site to make a better

comparison to area B. Include measurements of woody species density.

3. Measure vegetation, including vegetative cover and woody species density, at interim revegetation sites and undisturbed areas at the Valcam Loadout.

4. Measure cover, woody species density, and productivity on the test plots.

The test plot program needs to be completed, but the results are not expected to be much different from the results on the other slopes that received interim revegetation treatments in 1980. 1991 sampling did not show any differences between treatments at the Belina plots and the loadout plot only had one treatment.

If this sampling does not show that the vegetative cover of the adjacent undisturbed areas is being approached by either the test plots or the other areas that have been seeded, some changes to the reclamation plan might be needed. It appears now that additional efforts will be required to establish woody species beyond the methods that have been used in the past. Assuming that area B still does not meet the standards for success when comparing it to a different undisturbed area, further sampling will be needed to indicate a trend toward a potential standard for success in an undisturbed area.

Norman H. Bangerter
Governor
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Executive Director
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Division Director

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

355 West North Temple
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Salt Lake City, Utah 84180-1203
801-538-5340

TO: File

FROM: Paul Baker, Reclamation Biologist

DATE: October 9, 1992

RE: Interim Revegetation at Valcam Loadout, Valley Camp of Utah, Belina Mine, Folder #2, ACT/007/001, Carbon County, Utah

On September 11, 1992, I conducted a partial inspection at Valley Camp's Belina Mine and Valcam Loadout. As part of the inspection, Steve Tanner and I measured ground cover from vegetation, litter, rocks, and bare ground. The purpose was to show that plants have become established and have the ability to establish on substitute topsoil to equal, within 90% with 90% confidence, undisturbed areas.

The areas measured at the loadout were west-facing slopes of about 30-50%. Some native species have become established in these areas, but the dominant grass appears to be Russian wild rye. The slopes have some coal on them which probably affects the vegetation somewhat.

The undisturbed area is on the west side of the highway on what is apparently an alluvial fan. This fan probably extended across the highway and part way up the mountain before the highway, loadout, and Utah Mines were built. Therefore, it probably contains vegetation representative of what existed at the loadout before any disturbance. The area that we measured appeared to have had some grazing on it, but it was not severe. This area also had a west aspect, but the slope was probably less than 10%.

Each area was measured with a pin frame and ten 10-point transects. These were placed randomly within each area. Sample adequacy was achieved for the undisturbed area, but the required sample size for the disturbed area was 21. The reason for the larger sample size requirement for the disturbed areas was probably the variability in vegetation caused by differences in slope and the amount of coal fines. A 10-point transect is not considered adequate according to the "Vegetation Information Guidelines, Appendix A", but following these guidelines is only required for achieving final bond release. The purpose of the sampling was to get a general idea of the vegetation that had established on the interim reclamation sites compared to undisturbed areas using the same methods. The company has test plots that will be evaluated later this year that were intended to prove site reclaimability.

Ground cover in the undisturbed area was 91%, consisting of 50% vegetation and 41% litter. Vegetative cover was mostly from Kentucky bluegrass and needle and thread grass which were nearly impossible to distinguish. Some sagebrush, green rabbitbrush, and western wheatgrass were also present.

At the interim revegetation site at the loadout, ground cover was 70%, consisting of 50% vegetation and 20% litter. Species encountered, in order of dominance, were Russian wild rye, Kentucky bluegrass, basin wild rye, bluebunch wheatgrass, western wheatgrass, Russian thistle, and Machaeranthera sp.

To be within 90% of the undisturbed area with 90% confidence, the interim revegetation site would have to have had 70.9% ground cover. Cover from vegetation was the same for both areas. The performance standards appear to require that both ground cover and vegetative cover be equal in reclaimed areas as in undisturbed areas. Although ground cover in the interim revegetation area is not as great as in the undisturbed area, there are some major differences which will not be present at final reclamation. The areas measured within the loadout were very steep, and they are continuing to have new coal fines added to them. In spite of this, the vegetative cover is equal to the undisturbed area. I feel that revegetation success can be achieved at the loadout if proper revegetation techniques are used and that, for the present, no new testing needs to be performed.

APPENDIX 523

Ground Control Study
Kenneth C. Ko & Assoc.
(1989)
(CONFIDENTIAL)

See Confidential Appendix

APPENDIX 527

Belina Haul Road Reclamation Plan Morrison-Knudsen (1987)

Valley Camp of Utah

Belina Haul Road Reclamation Plan

January 1987

MORRISON-KNUDSEN
A MORRISON-KNUDSEN COMPANY

BELINA HAUL ROAD RECLAMATION PLAN

Prepared For

Valley Camp of Utah, Inc.
Helper, Utah

Prepared By

Morrison-Knudsen Engineers, Inc.
Boise, Idaho

January, 1987

0842h/1

ENGINEERING CERTIFICATION

I, J. Carl Dille, have reviewed Section 2 and 3 and the following Tables, Figures and Exhibits in the Belina Haul Road Reclamation Plan.

REGISTERED PROFESSIONAL ENGINEER
No. 5538
J. CARL DILLE
STATE OF UTAH

J. Carl Dille, P.E.

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Figure 2-9	Slope Stability Analysis of Current
Figure 2-10	Slope Stability Analysis of Reclaimed Haul Road
Figure 3-1	Small Drainage Hydraulic Data
Figure 3-2	Bowl Crossing Hydraulic Data
Figure 3-3	Eccles Creek Channel Design
Figure 3-4	Typical Waterbar Detail
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Table 3.2	Watershed Size and Flow Characteristics
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- 2.3 Critical Fill Areas
- 2.4 Methods and Results of the Slope Stability Analysis

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  - 3.3.1 Small Drainages
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SECTION 1.0 - INTRODUCTION

1.1 General

The following reclamation plan is for Valley Camp of Utah's Belina Haul Road which supports their coal mining operation located on Whiskey Creek in Carbon County, Central Utah.

The haul road is constructed on a cut/fill bench having a total road width of thirty-four feet with very steep natural slopes above and below the road. These two facts create several unique problems when considering reclamation of the road.

This reclamation plan addresses the removal of the road surface materials and associated structures and the recontouring of the area to facilitate the return of the disturbed lands to its pre-mining land use of limited rangeland and wildlife habitat.

1.2 Objectives

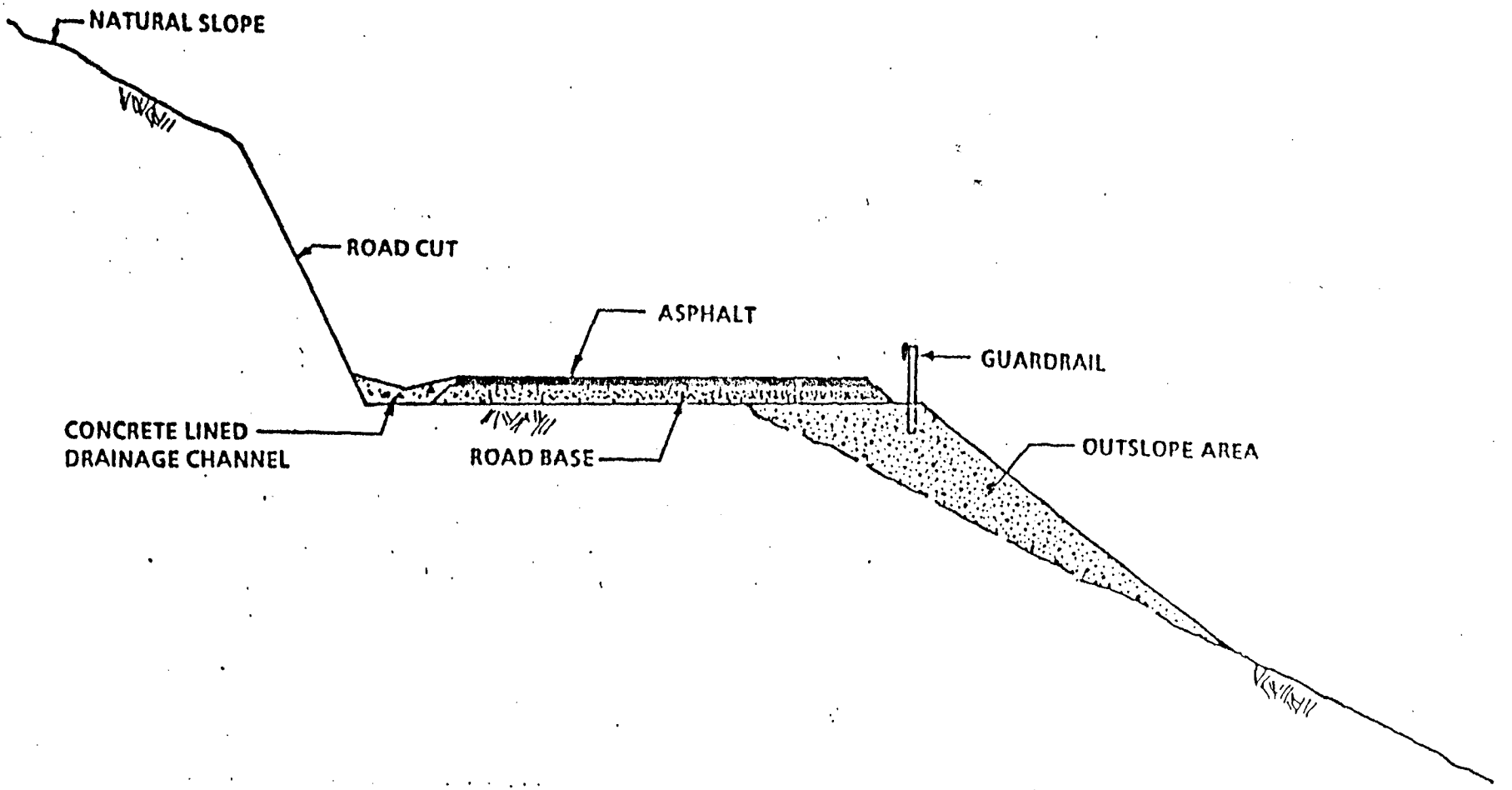
The objectives of this reclamation plan are to eliminate the permanent road surface and support structures and return the disturbed land to a condition capable of supporting the pre-mine land use of limited rangeland and wildlife habitat. These objectives will be obtained by recontouring the road surface to re-establish a drainage pattern comparable to pre-mining conditions; by replacing the soil medium and re-establishing an effective permanent vegetation cover.

The affective area consists of a strip of land approximately 100 feet wide and 1.5 miles long. Although the right-of-way (ROW) is approximately 100 feet wide, this reclamation plan will only address the road surface (34 feet wide); the outslope areas having

questionable slope stability and the area to be re-disturbed to re-establish the natural drainages. Figure 1-1 is a typical cross section illustrating the construction of the Belina Haul Road. Approximately ten acres will require recontouring and/or reclamation activities. The majority of the road outslope areas are considered stable as final reclamation, as discussed in Section 2.0, and therefore will not be disturbed. Determination of slope stability is discussed in detail in Section 2.0. The results of a limited geotechnical evaluation concerning the road outslopes and drainage fills are shown in Table 2.1. Only the potentially unstable slopes and their corresponding station location are shown on this table. These station locations were determined from plan and profile sheets showing the general road location and grade. Survey station locations were shown on the map beginning at the mine portal going towards the Eccles Canyon intersection and ending at Station 83+52.

Reclamation activities will be conducted in a manner that will minimize the potential adverse impacts to the air, water, vegetation, wildlife, and general aesthetics of the area. This proposed reclamation plan will establish a permanent, diversified vegetation cover capable of self-regeneration and soil stabilization that will support the post-mining land use of limited rangeland and wildlife habitat.

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
TYPICAL HAUL ROAD CROSS SECTION
Figure 1-1



SECTION 2 - GEOTECHNICAL INVESTIGATION

2.1 General

The geotechnical investigation for the Belina Haul Road was performed in three phases. Phase I was a site evaluation of the natural talus in the local region. Phase II identified the areas considered to be critical. Phase III was the slope stability analysis for typical sections of the road before and after reclamation. Conclusions were then based upon all three phases.

Soils in this region are considered young and primarily consist of weathered rock high in quartz. The Unified Soil Classification System would consider this material as SP since it is gravelly sand which is poorly graded and has very few fines. This type of soil has essentially no cohesion; therefore, it is considered a pure phi (Ø) soil which will control the type of slope failures and geometry of the natural talus slopes.

2.2 Natural Talus Evaluation

Natural talus slopes in the haul road area widely vary between 30 percent to over 100 percent. By considering the friction angling (Ø) of the soil to be constant across the region, the depth to bedrock will control the natural talus slope stability. Shallow soils are stable at greater slopes than deep soils. The length of run also plays a major role in the stability of the slopes. The natural talus in the region was self-stabilizing due to small failures creating a terracing effect across the hillside. The stabilizing of the natural talus slopes is still occurring and numerous natural slope failures

may be seen around the vicinity of the Belina Haul Road. The friction angle of the talus was derived from the geometry of a recent natural slope failure. This failure analysis produced a friction angle equal to 31°. This value is very typical for SP classified soils.

2.3 Critical Fill Areas

Critical fill areas are defined for this discussion as areas which have localized evidence of recent slope failures, slopes which exceed the friction angle of the soil, or slopes that have similar characteristics of recent failures in the region, such as deep soil horizons. These critical areas are listed in Table 2.1:

TABLE 2.1

POTENTIALLY UNSTABLE SLOPES*

AREA	Station Location	Linear Distance	Slope Pre-Construction	Slope Post-Construction
1	21+10 to 22+70	160'	63%	70%
2	24+06 to 29+34	520'	63%	72%
3	30+40 to 32+00	160'	55%	68%
4	37+18 to 44+00	682'	63%	70%
5	51+17 to 52+75	158'	65%	75%
6	61+00 to 64+12	312'	70%	80%
7	73+00 to 75+60	260'	84%	128%
8	77+18 to 82+46	528'	84%	143%

TOTAL = 2,780 Feet

*Typical Geometries for each one of these reaches are illustrated in Figures 2.1 to 2.8.

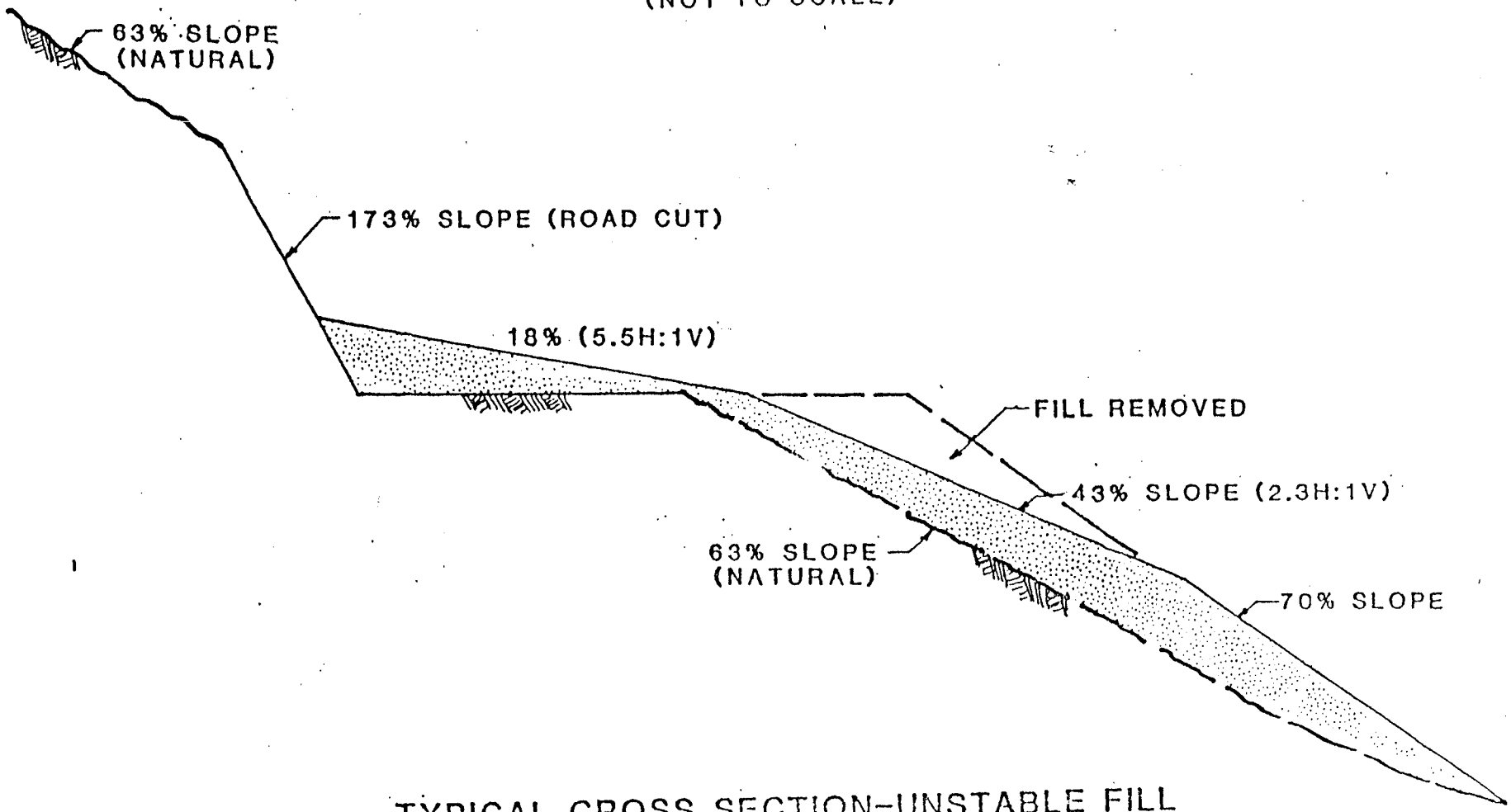
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-1

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA 21 + 10 TO 22 + 70

AREA 1

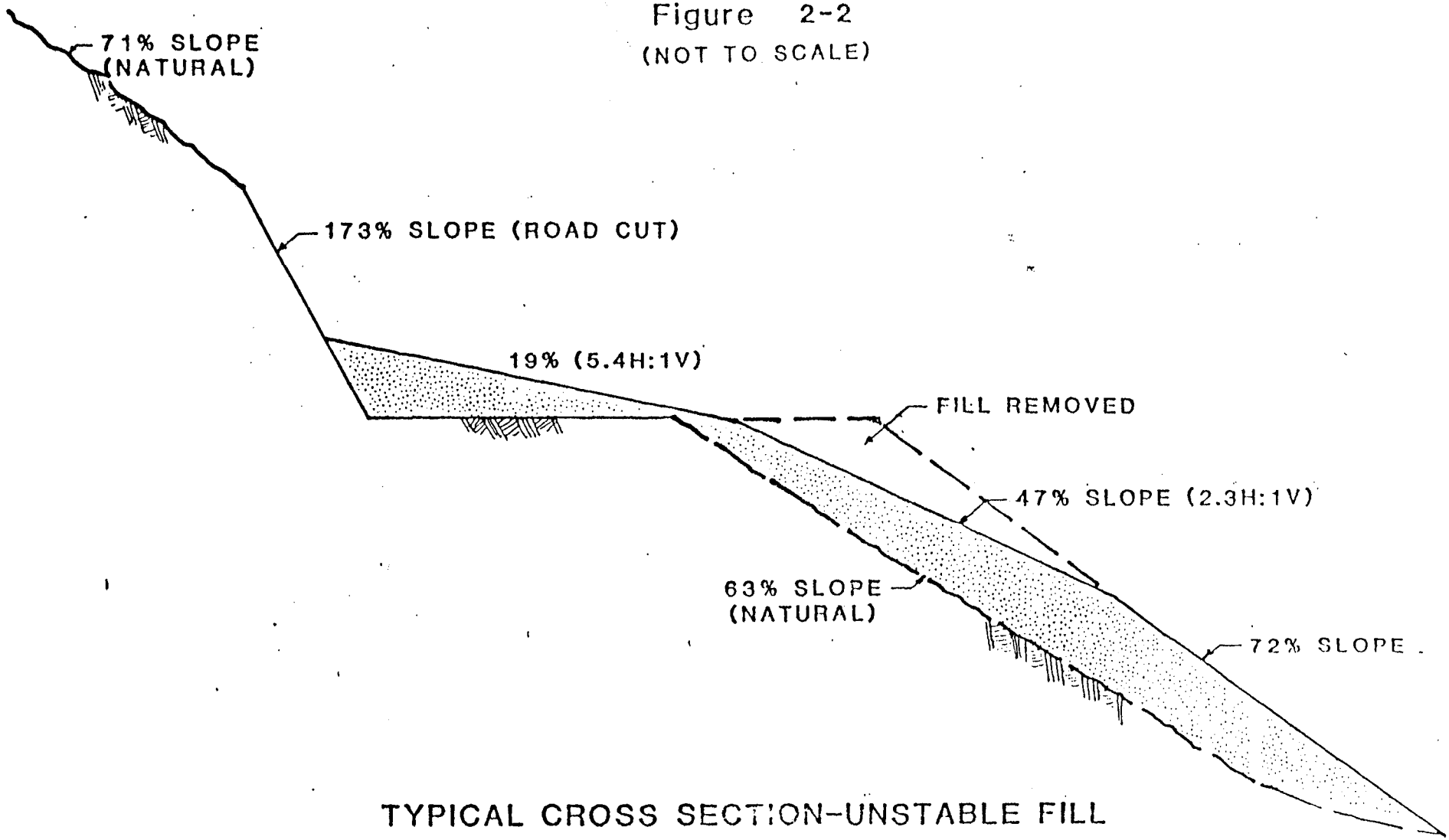
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-2

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 24 + 06 TO 29 + 34

AREA 2

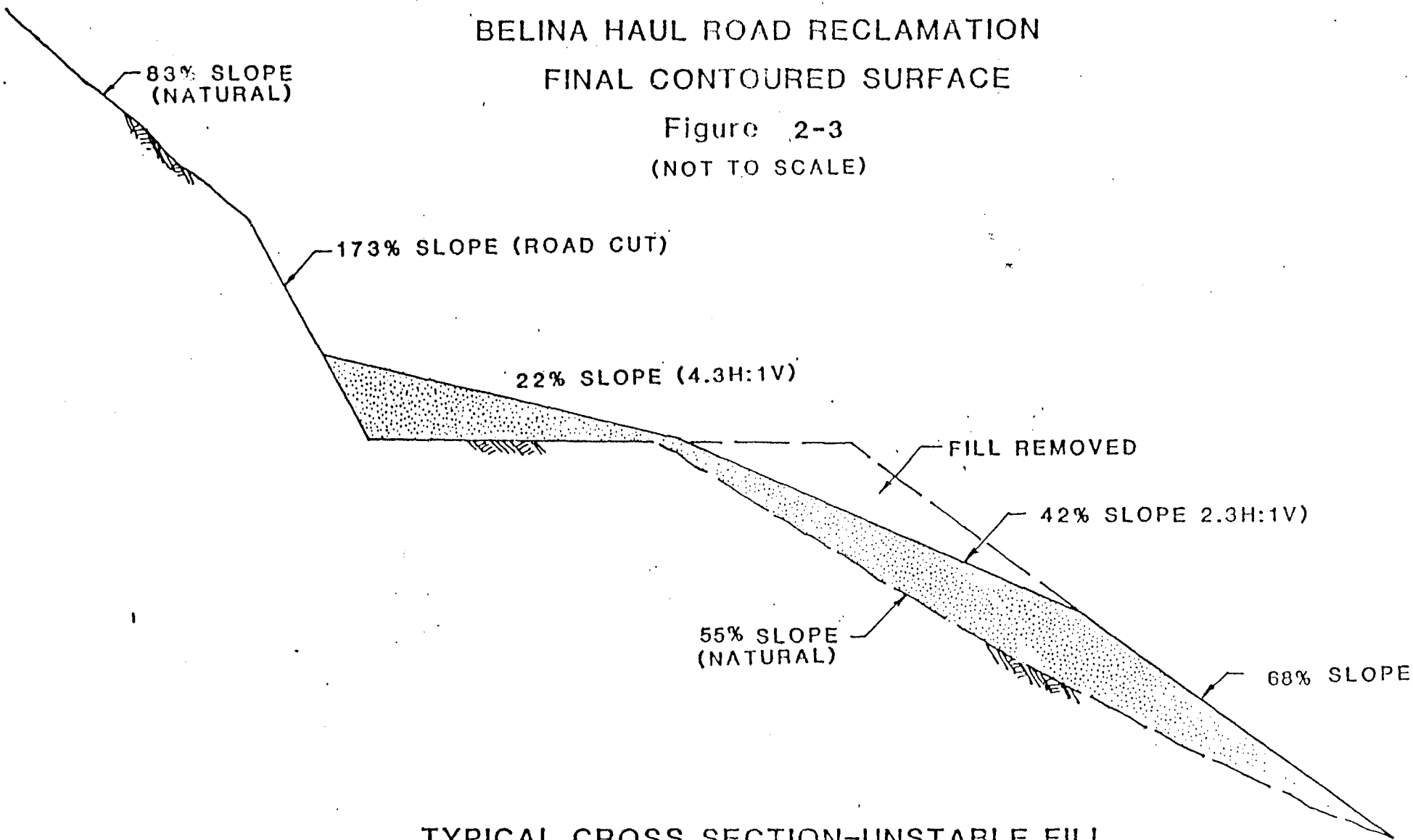
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-3

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 30+40 TO 32+00

AREA 3

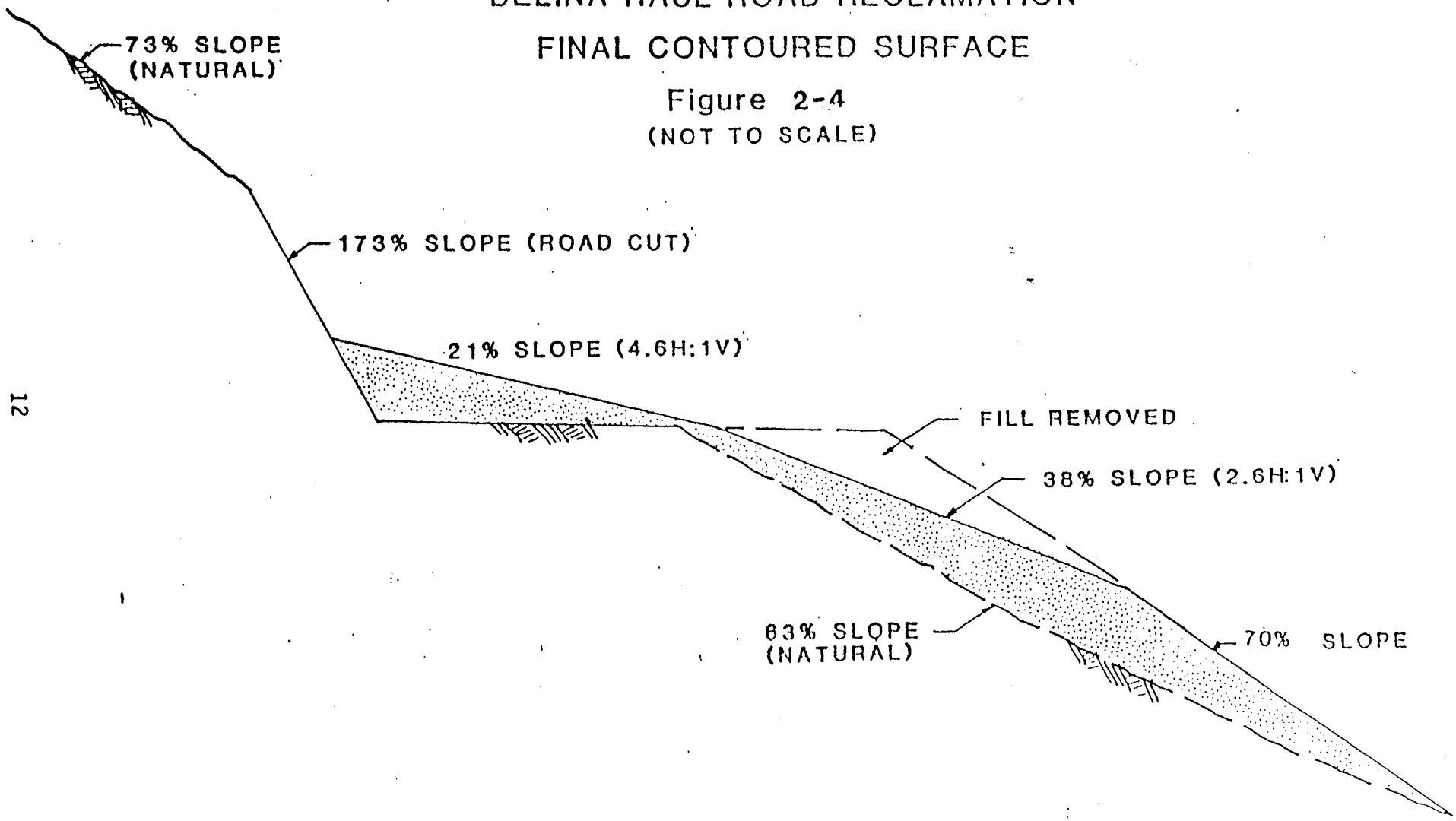
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-4

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 37 + 18 TO 44 + 00

AREA 4

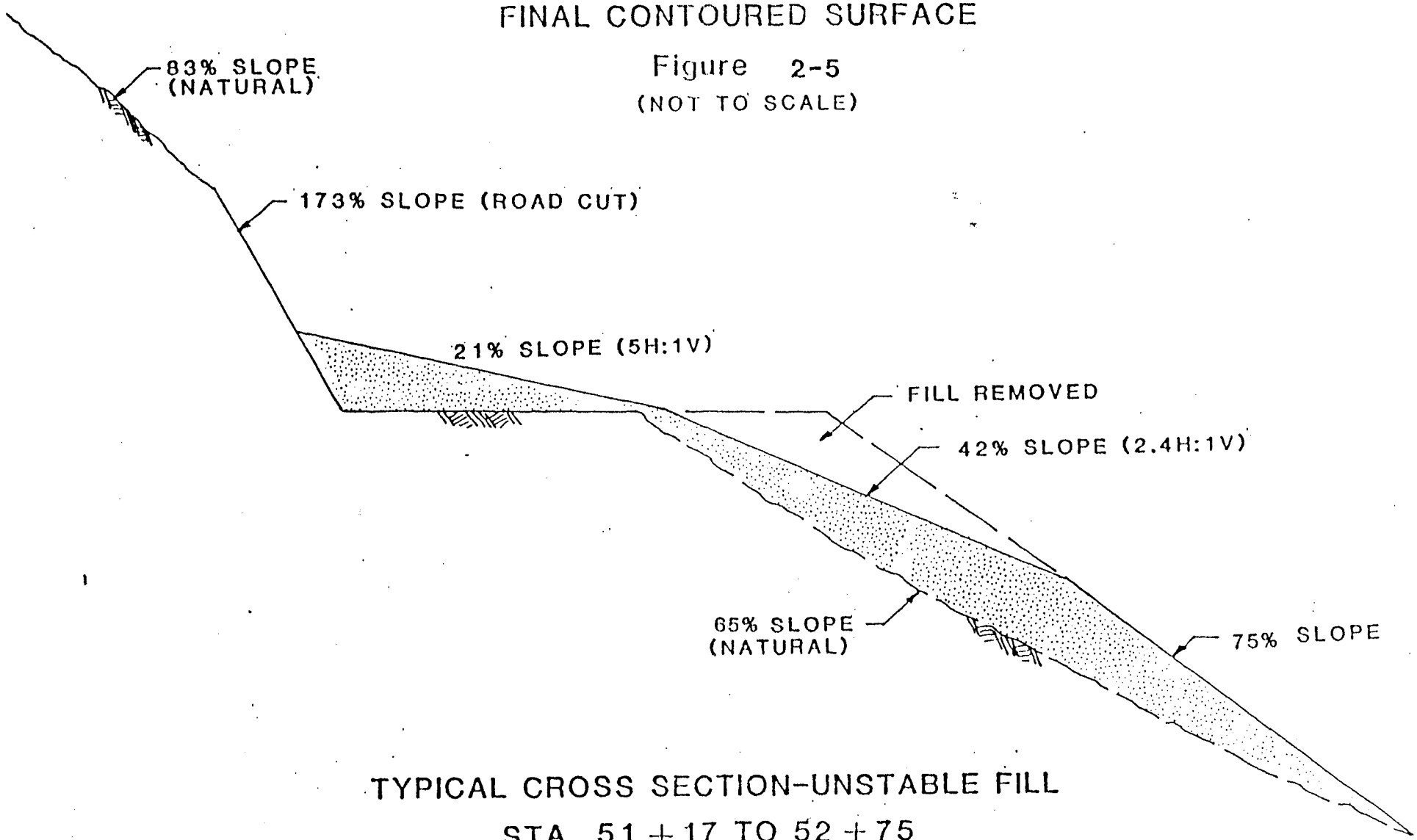
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-5

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 51 + 17 TO 52 + 75

AREA 5

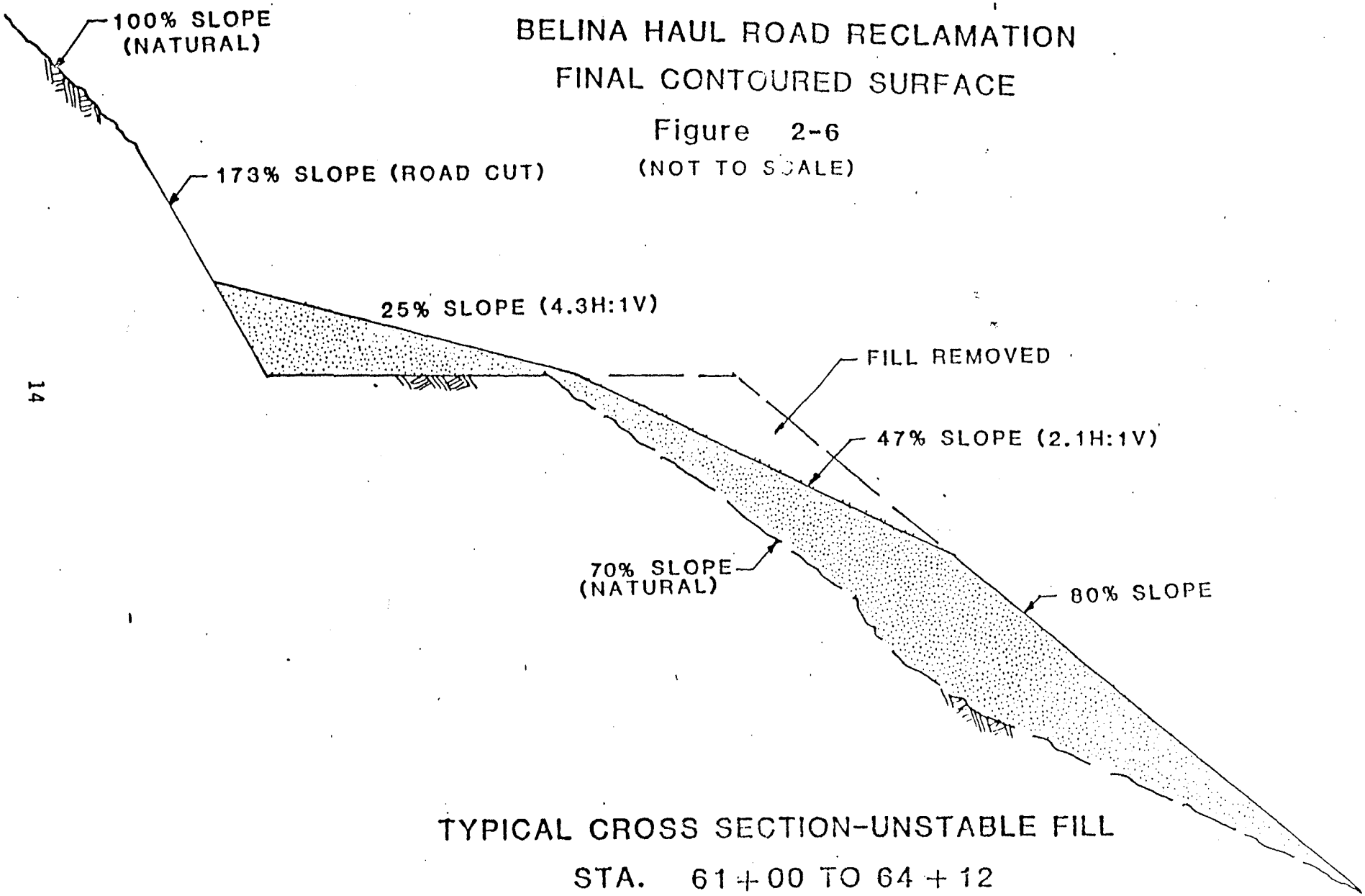
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-6

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 61+00 TO 64+12

AREA 6

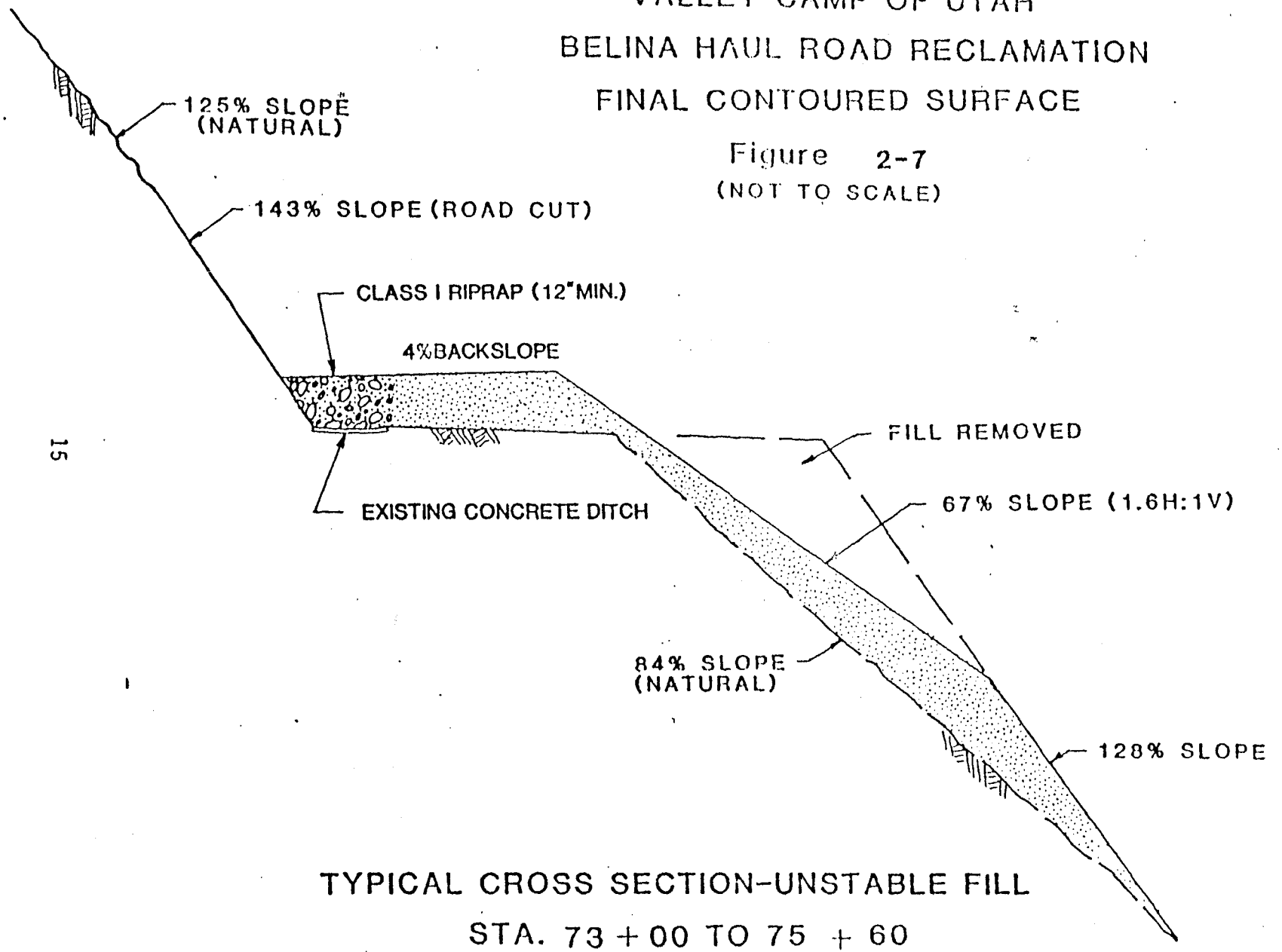
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-7

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 73 + 00 TO 75 + 60

AREA 7

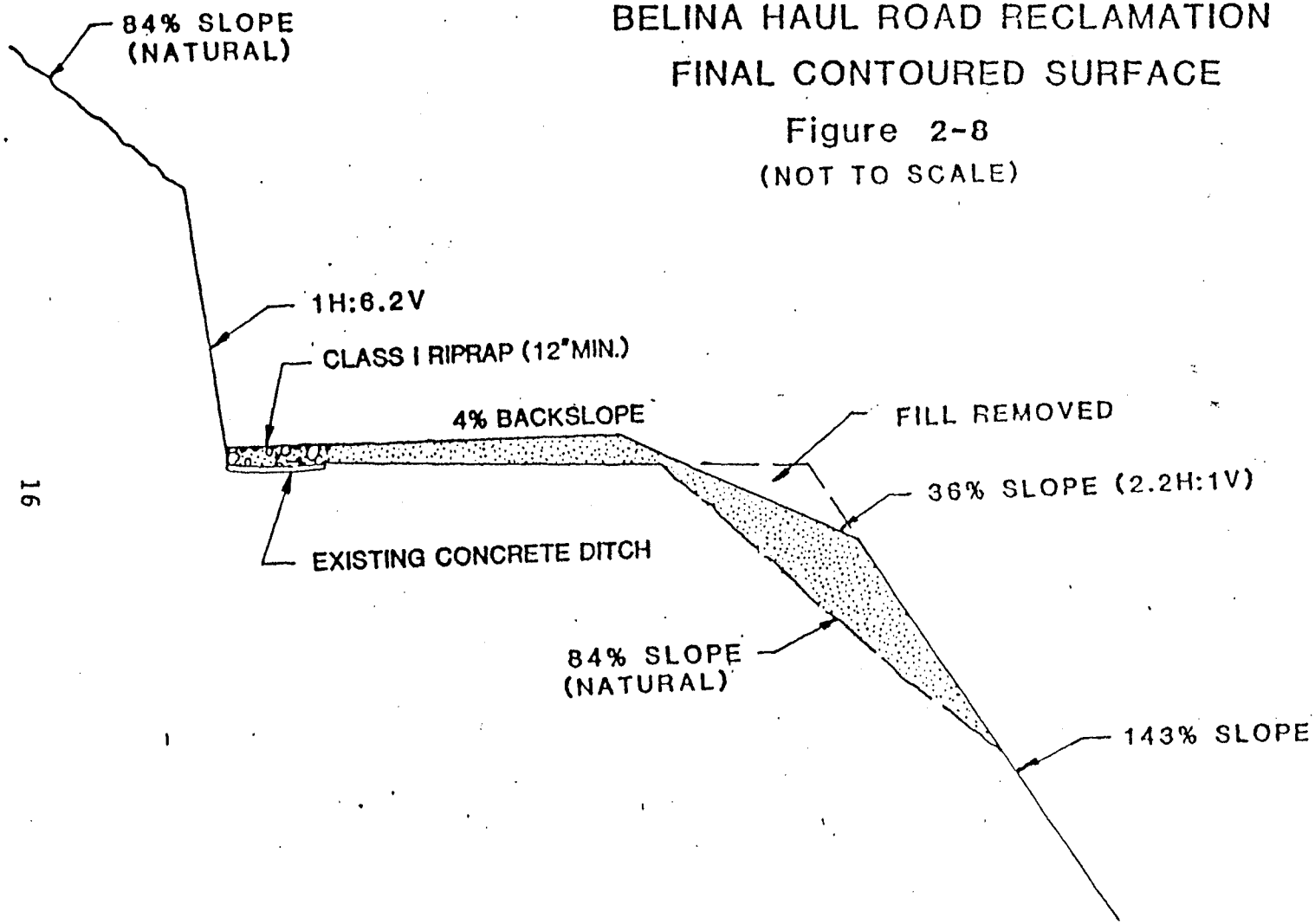
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-8

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 77+18 TO 82+46

AREA 8

The Bowel Crossing has not been considered to be a critical fill area due to the reclamation plans in this reach. By removing the top portion of the fill, this region does not present a slope stability problem and should remain stable.

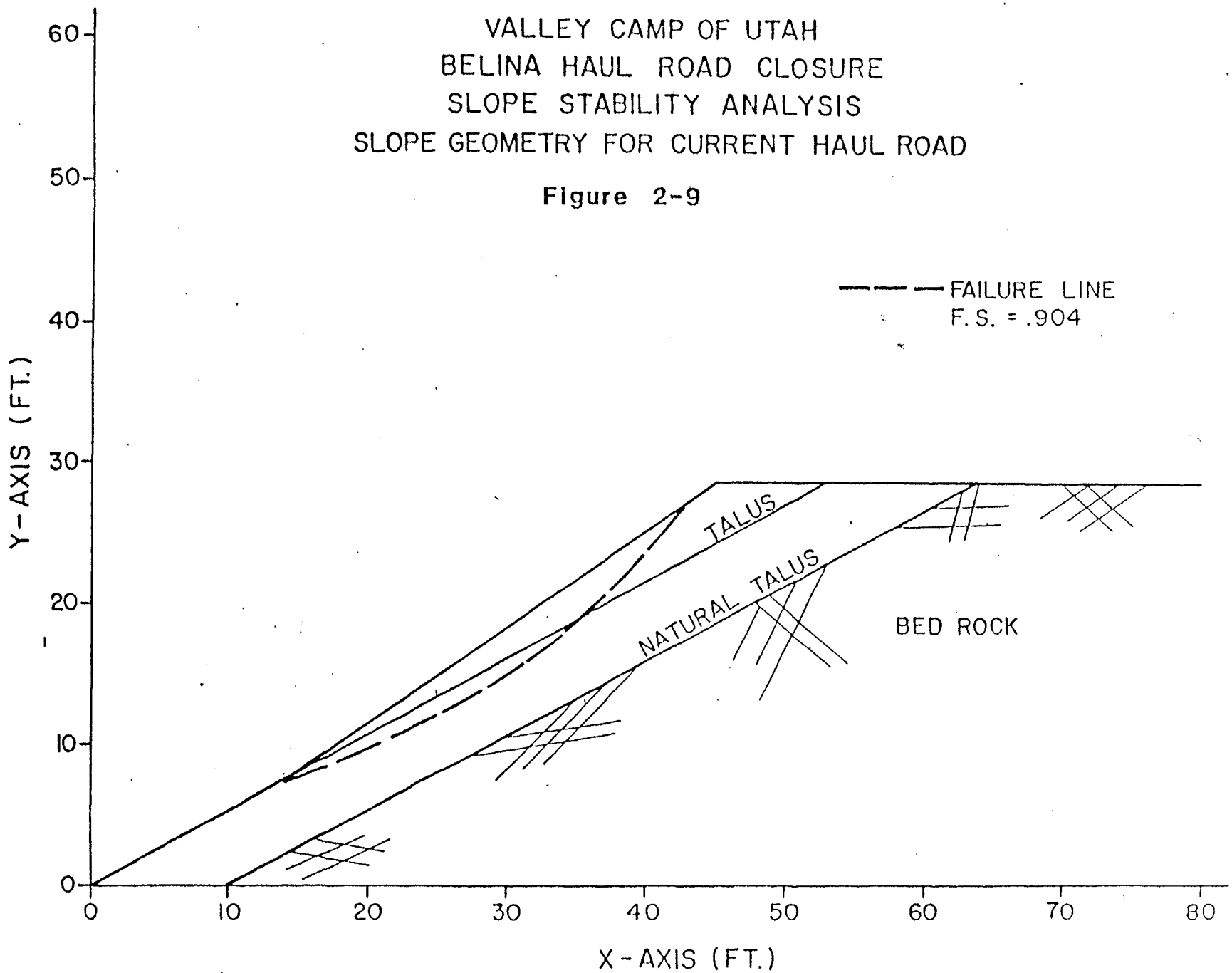
2.4 Methods and Results of the Slope Stability Analyses

The slope stability analysis was performed using the computer model STABL 5. Typical geometries before and after reclamation of the Belina Haul Road are illustrated in Figures 2.9 and 2.10. The natural talus slope used for model input was set equal to 53 percent and the talus slope to 68 percent. The reclamation slope was based upon the capability of a backhoe to reach downslope 25 feet. The soil density was assumed to be 100 pounds per cubic foot with a phi value of 31°.

The factor of safety for the talus on the current haul road was estimated to be .904, which is reasonable since the talus' phi value input is 31° and no adjustment was made for the irregular bedrock formation. The factor of safety after reclamation was estimated to be 1.08, which increases the factor of safety from the original haul road geometry by 19 percent. This increases the factor of safety to be greater than most of the natural talus since many of the natural slopes are unstable. Most natural talus slopes in the region have a factor of safety equal to 1.00 for their given geometry. Note that the failure plane configuration produced by the model shows shallow, circular failures which are predominant in this region. The very steep slopes noted in this study were made up of coarser sands and gravels which have considerably higher friction angles than the soil used for the typical section modeling. This non-homogeneity is common in young, shallow soils with some deviation in parent material and weathering exposure.

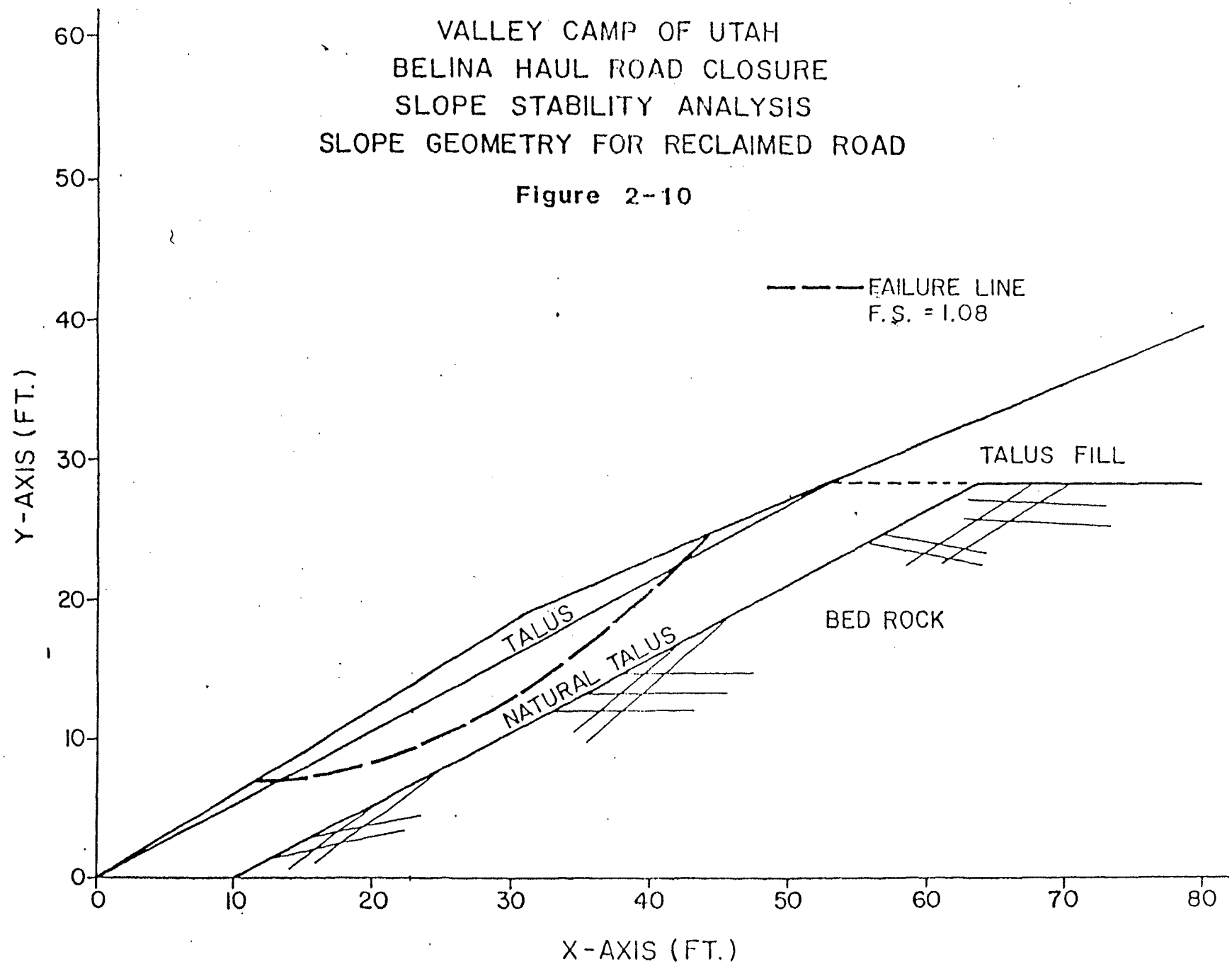
VALLEY CAMP OF UTAH
BELINA HAUL ROAD CLOSURE
SLOPE STABILITY ANALYSIS
SLOPE GEOMETRY FOR CURRENT HAUL ROAD

Figure 2-9



VALLEY CAMP OF UTAH
BELINA HAUL ROAD CLOSURE
SLOPE STABILITY ANALYSIS
SLOPE GEOMETRY FOR RECLAIMED ROAD

Figure 2-10



SECTION 3.0 SURFACE HYDROLOGY/HYDRAULICS

3.1 General

Surface water runoff was determined for the seven small drainages on the Belina Haul Road using the Soil Conservation Service (SCS) curve number method and the TR-20 Computer Program. Once flows were determined for each of the drainages, typical channels were developed and the velocity was determined so that the riprap sizing could be developed. Also included as part of the surface water design are the water bars to be constructed along the recontoured road.

3.2 Design Flows

The design storm for the seven drainages shown on Exhibit 3-1 was the 100 year, 24 hour, which has a rainfall amount of 3.65 inches. This is based on information developed for the Clear Creek Summit, Utah. Table 3-1 shows the precipitation depths versus return period for the Clear Creek Summit Site. The flows were developed based on a Type II rainfall distribution and are shown in Table 3-1.

The major parameters used in determining the runoff with the TR-20 model are the drainage area, time of concentration and CN. The time of concentration is defined as the time required for water to travel from the most hydraulic point of the watershed to the point of interest. It is computed by adding together the time for various segments of the conveyance system. For the mountainous drainage along the Belina Haul Road the time was estimated following the steps outlined in the SCS TR-55 publication and consist of three parts, sheet flow, shallow concentrated flow and open channel flow. The time of travel for each segment was computed and added together to determine the time of concentration for the drainage.

TABLE 3-1

Estimated precipitation depths for various return periods and durations at Clear Creek, Summit, Utah (from Richardson (1971).

RETURN PERIOD (years)	DURATION 5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.10	.16	.20	.28	.35	.46	.57	.84	1.08	1.33
2	.12	.19	.25	.34	.43	.57	.70	1.04	1.34	1.65
5	.16	.24	.31	.43	.54	.72	.90	1.34	1.73	2.14
10	.19	.29	.37	.51	.65	.86	1.06	1.55	1.99	2.45
25	.24	.38	.48	.66	.84	1.08	1.31	1.88	2.39	2.92
50	.25	.38	.48	.67	.85	1.13	1.40	2.07	2.67	3.29
100	.27	.42	.53	.73	.93	1.24	1.54	2.29	2.96	3.65

Runoff curve number (CN) are based on hydrologic soil group, cover type, and antecedent moisten condition of the soil. The soils and vegetation maps from Valley Camps' approved mining permit application (UT-0013) were used to determine the CN value for each of the drainages. The USFS has recently completed classifying their lands and assigning CN values and was contacted to see how values compared. In general the values computed for the haul road agreed quite closely and were slightly higher giving a more conservative estimate of the flow and were judged to be reasonable for forest lands. Table 3-2 below shows the date used to compute the design flows for each of the drainages.

TABLE 3.2

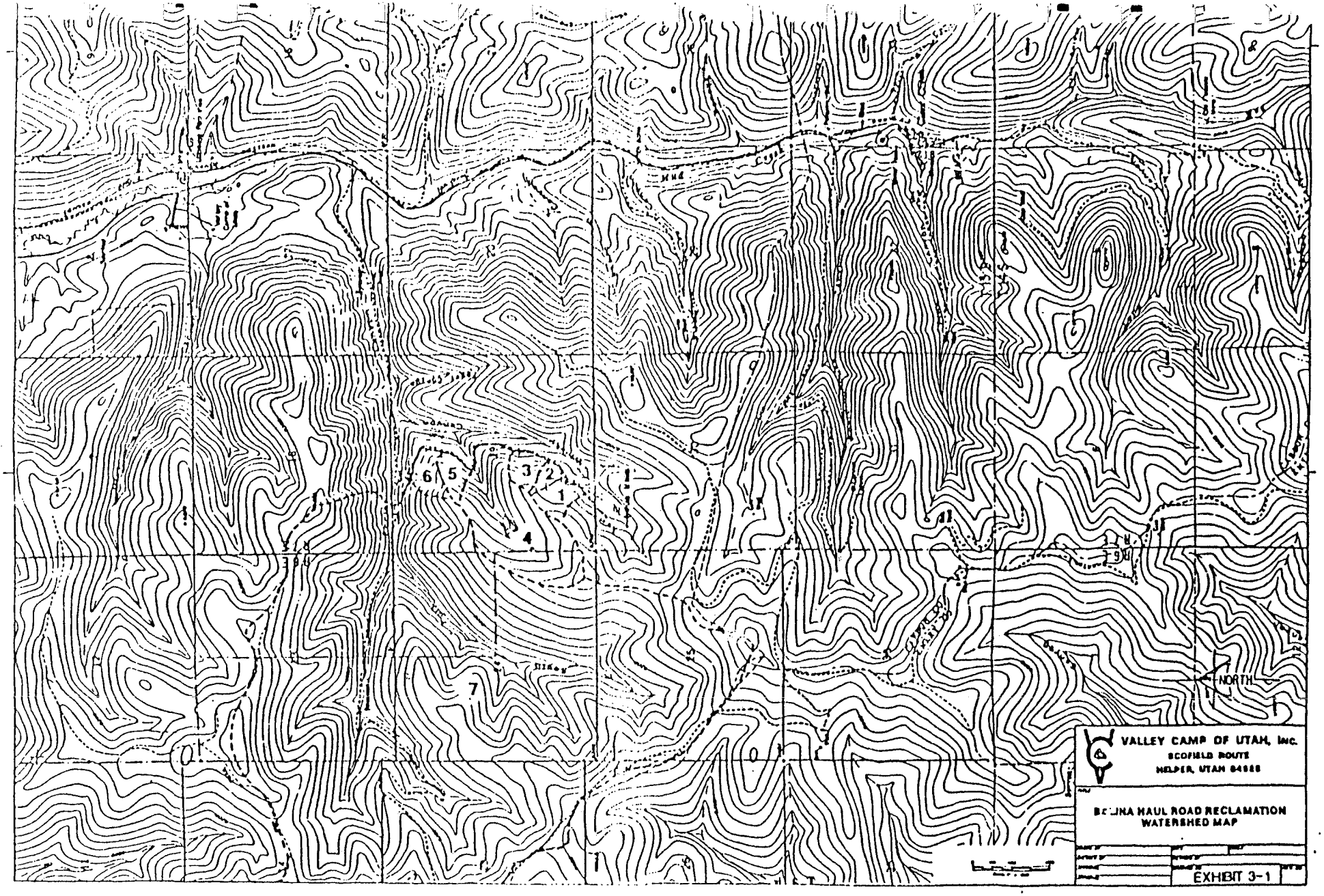
WATERSHED SIZE AND FLOW CHARACTERISTICS

Watershed #	CN	tc hrs.	Area, AC	Q cfs
1	60	.49	18.8	6.7
2	60	.35	9.6	4.3
3	60	.74	11.8	3.2
4 (Bowl Crossing)	60	.71	147.8	44.0
5	60	.71	14.2	4.0
6	60	.56	25.0	8.3
7 (Eccles Creek)	60	1.37	2087.0	378.

3.3 Channel Design

It is proposed in the reclamation plan that the existing culverts be removed and the ephemeral channels reestablished at their original slope and be protected with riprap. Figure 3.1 shows a typical section through the road after regrading and contouring and the various hydraulic data.

The slope will vary from about 15 percent across the road to a maximum of 65-70 percent along the slope face. To replace the culverts on five of the smallest drainages, a small "V" ditch will


1
2
3
4
5
6
7
9
NORTH
VALLEY CAMP OF UTAH, INC.
SCOFIELD ROUTE
HELPER, UTAH 84526
BELINA HAUL ROAD RECLAMATION
WATERSHED MAP
EXHIBIT 3-1

be constructed to carry the flow from each of the small drainages through the road sections. These small ditches will be protected with riprap and a typical section is shown on Figure 3-1.

Velocities were computed using the Manning's equation. The channel roughness coefficient, n, was estimated based on values for small mountain streams where the depth of flow is small when compared to the size of bed material. In Open-Channel Hydraulics, Chow suggested n values range from .040 to .070 for small, steep mountain streams with cobbles and boulders. Values were also determined from the paper Two Approaches for Estimation of Manning's n in Mountain Streams, by Weache, et al. at the Wyoming Water Research Center. Based on their method, n is estimated to range from .065 to .085. A value of .06 was used in all of the computation. It was felt that the turbulence would be very high since the average depth of flow would range from .5 feet to 1.0 feet and the riprap size would range from 1.0 feet to 2.0 feet.

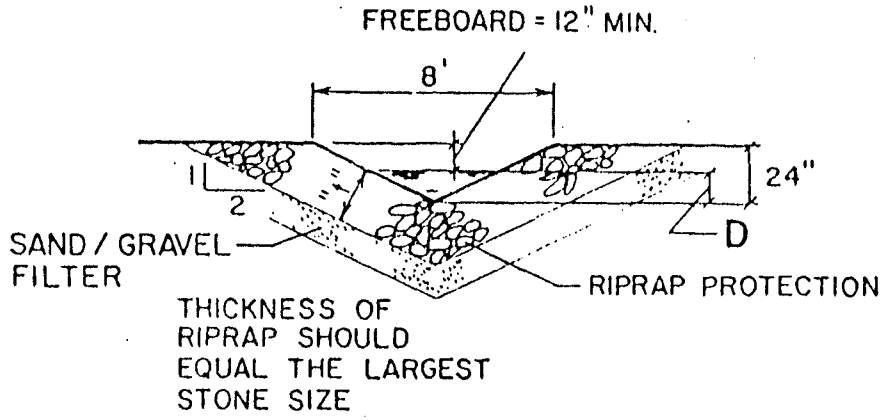
While this value is higher than those typically used, (.035 - .045), it is felt justified because the depth of flow is much greater than the stone size and this is not the case for the Belina Haul Road drainages.

3.3.1 Small Drainages

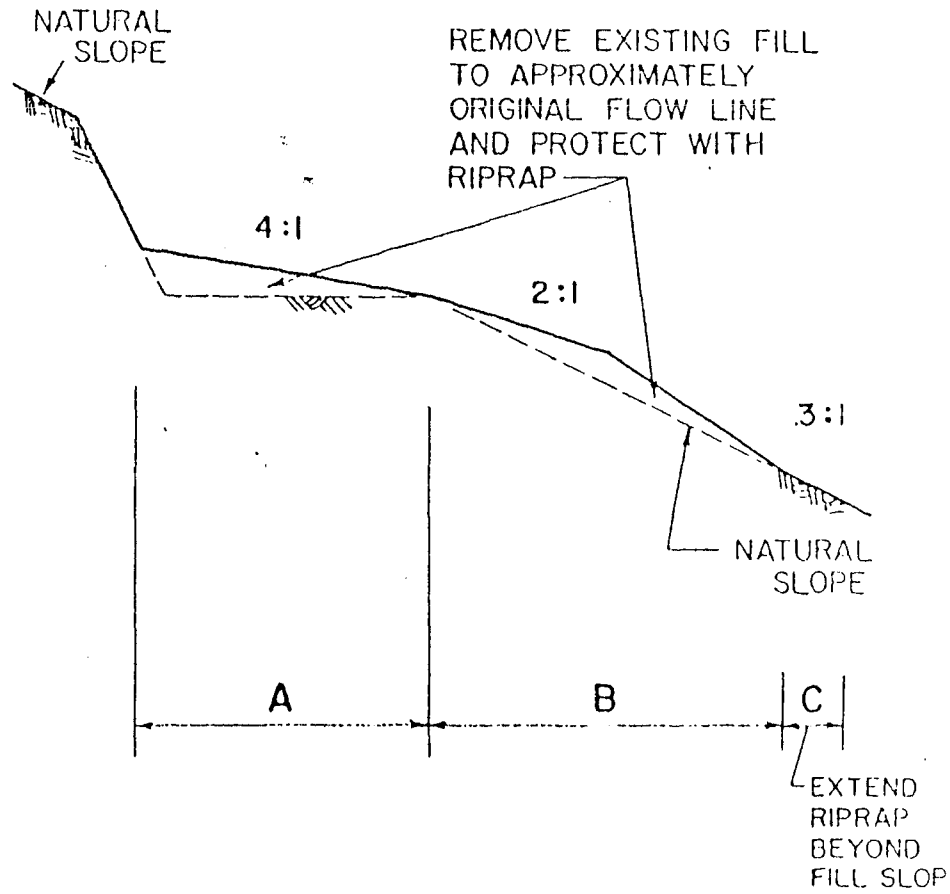
Flows vary from 3.2 to 8.3 cfs for the five smallest drainages. The small "V" ditches were designed based on the maximum flow of 8.3 cfs. This will provide a conservative design and will standardize them making construction easier. The velocity will vary from about 4 feet per second for the 15 percent slope to about 10 ft/sec. on the steeper slope of 70 percent. Details for each of the crossings are shown on Figure 3-1.

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
SMALL DRAINAGE
HYDRAULIC DATA

Figure 3–1



TYPICAL "V" DITCH
FOR SMALL DRAINAGES



TYPICAL STREAM CROSSING
FOR SMALL DRAINAGES

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
SMALL DRAINAGE
HYDRAULIC DATA
Figure 3–1a

AREA	DRAINAGE	CHANNEL SLOPE	Q In cfs.	*D Depth Ft.	VELOCITY Ft./Sec.	RIPRAP CLASS
*A	1	15%	6.7	.85	5	I
	2	15%	4.3	.70	4	I
	3	15%	3.2	.65	4	I
	5	15%	4.0	.70	4	I
	6	15%	8.3	.90	5	I
*B	1	63%	6.7	.65	9	II
	2	63%	4.3	.55	8	II
	3	55%	3.2	.50	7	II
	5	70%	4.0	.50	8	II
	6	70%	8.3	.70	10	II
*C	ALL					II

*SEE FIGURE 3-1 FOR LOCATION

3.3.2 Bowl Crossing

Design of the channel for the Bowl Crossing drainage (Area 4) was done in a similar manner. The 100 year design flood is estimated at 44 cfs. It is proposed that a small overland flow channel be constructed through the rock fill after the soil fill has been removed, (See Section 4.3.1) which will have a bottom width of four feet. Figure 3-2 shows a typical section through the fill. The existing culvert will remain in place and will carry the smaller flows. The new overland flow channel will carry the flood flows for the more infrequent storms and also if the culvert should become clogged. The velocity in the new channel will vary from 8 ft/sec. across the rock fill where the slope is about 15 percent to 13 ft/sec. down the steeper natural slope. Details of the channel and hydraulic data are shown on Figure 3-2.

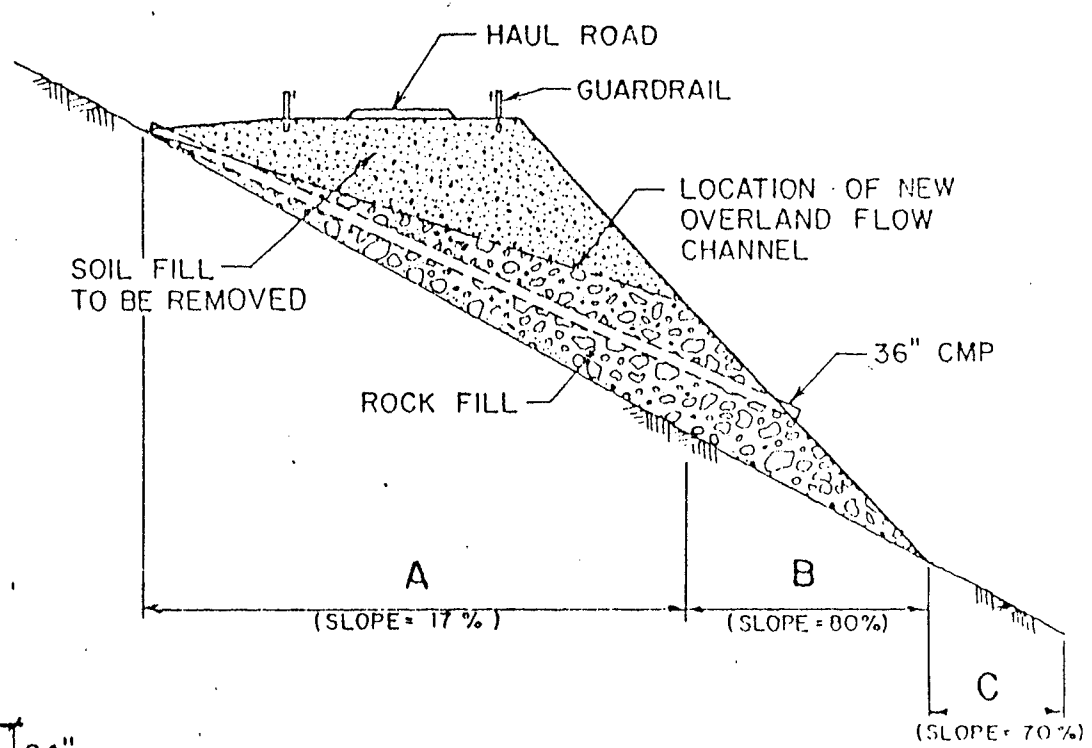
The design for Eccles Creek drainage is covered in Section 3.5.

3.4 Riprap Design

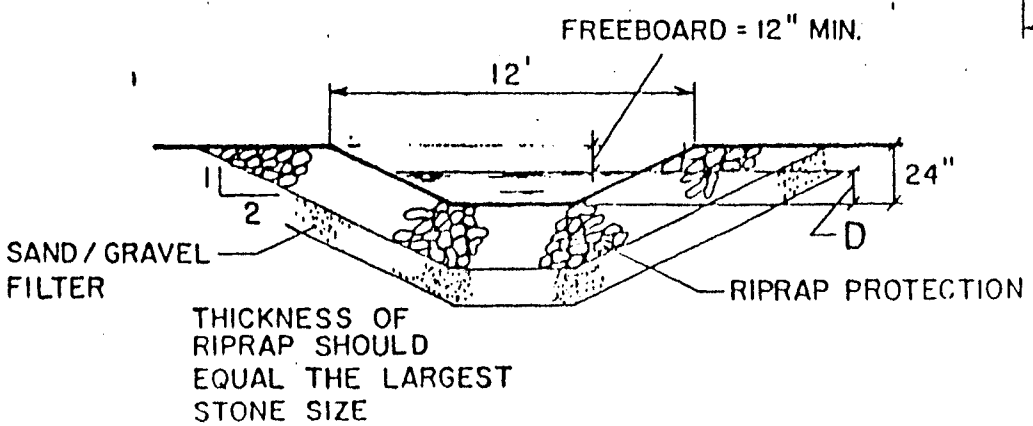
Rirrap sizing was selected based on the above velocities using USBR Engineering Monograph #25 and FHWA Hydraulic Engineering Circular #11. The d_{50} size is four inches on the flatter slopes (Class I) and is nine inches on the steeper slopes (Class II). Gradation for the different classes of riprap are shown in the Table 3.3.

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
BOWL CROSSING
HYDRAULIC DATA
Figure 3-2

AREA	D Depth Ft.	VELOCITY Ft./Sec.	RIPRAP CLASS
A	1.0	8	II
B	.70	13	II
C	.70	13	II



SECTION THRU BOWL CROSSING



TYPICAL DITCH
FOR BOWL CROSSING
DESIGN Q = 44 cfs.

TABLE 3.3

RIPRAP DESIGN

Class	Max.	Size, In d_{50}	Min.
I	8	4	1 1/2
II	24	18	6
III	36	24	8

Riprap should be reasonably well graded from the maximum size down to the minimum. The concrete removed from the project will be used as part of the riprap protection and will be broken so as not to be larger than the d_{50} size and will not makeup more than 15 percent of the volume. The riprap will extend beyond the toe of the fill slopes a minimum of five feet to provide energy dissipation at the termination of the riprap channels, the energy dissipator will be small mounds of riprap approximately 18"-24" high to help spread the flows out and reduce erosion.

A filter blanket will be constructed and placed between the riprap and the native material. The filter will be constructed of a well-graded gravel with a minimum size of about 3/16" up to a maximum required by the riprap class and is shown below in Table 3.4.

TABLE 3.4

RIPRAP FILTER DESIGN

RIPRAP CLASS	MAX, in	MIN, in	THICKNESS, in
I	*		
II	4	3/16	9
III	6	3/16	9

*Not required; native material acceptable

3.4.1 Small Drainages

The existing native material appears to be sandy gravelly material based on field inspections. The gradation is estimated to be from 3 inches down to less than 1/8" with a d_{50} size of about 3/8". This material will meet the requirements for a filter material for the Class I riprap, since the d_{15} Riprap/d_{85} Base is less than 5.

3.4.2 Bowl Crossing

Based on field observations and discussions with the mining operation people, it appears that the blast rock in the Bowl crossing fill has a maximum size of 18 inches to 36 inches. This would provide adequate protection based on the above velocities. If, when the soil fill is removed and the channel is constructed, it is determined that the actual blast rock is not large enough, additional riprap protection (Class III) will be provided.

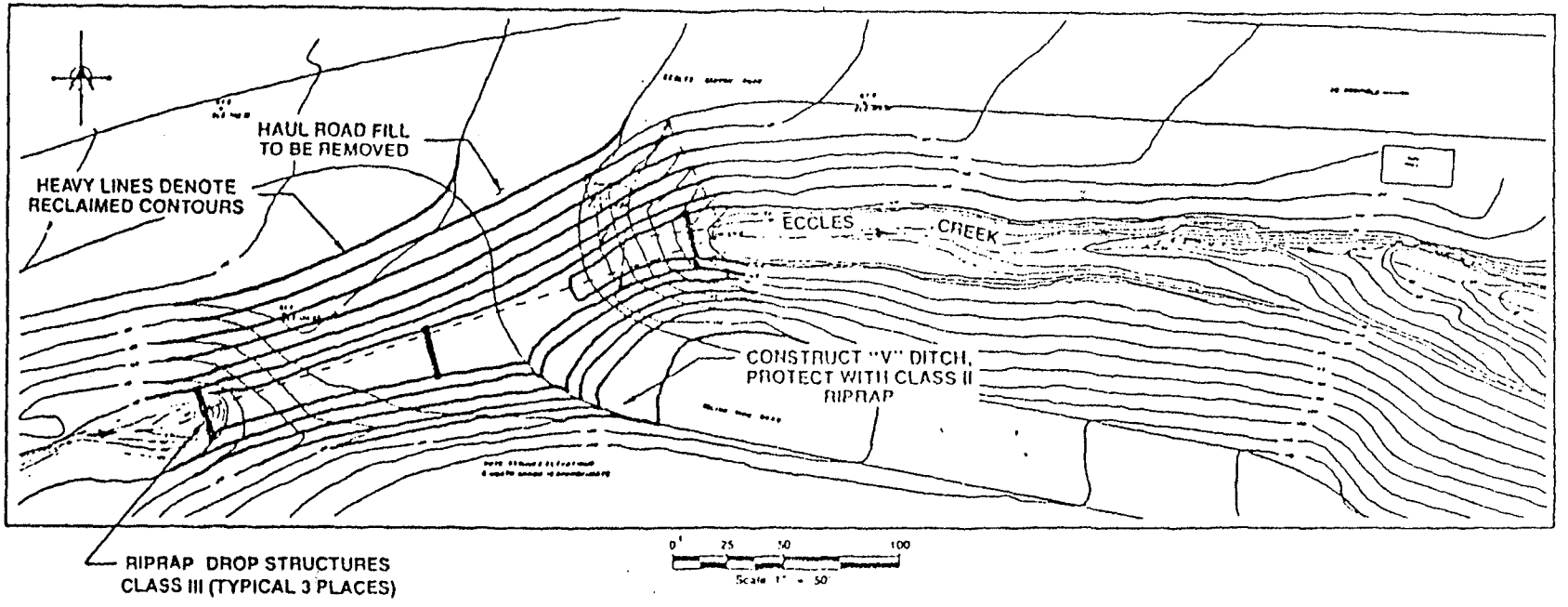
After excavating the soil fill at the Bowl Crossing the base material will be examined to determine if it meets the filter criteria. If it does not, a filter will be constructed meeting the gradation shown in Table 3-4.

3.5 Eccles Creek

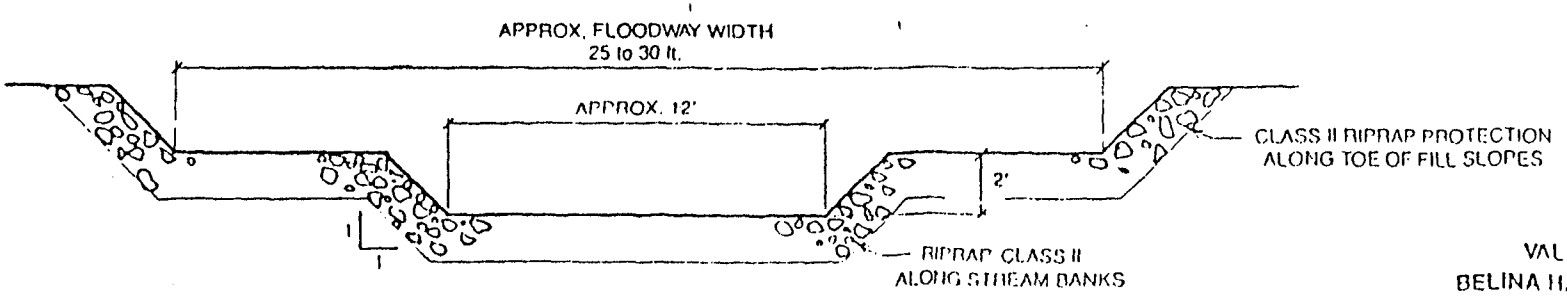
The drainage above the Belina Haul in Eccles Creek is the largest with an area of 2,047 acres. The 100 year 24 hour storm is estimated to be about 378 cfs. The channel slope in this area is estimated to be 2 - 2.5 percent. This channel will have a low flow section with a width of 12 feet. The velocity for the 100 year storm will be approximately 6.6 feet per second with depth varying from about 1.5 feet in the floodway to 3.5 feet in the main channel. A Manning's n of .060 was used in computing the flow depth and velocities for Eccles Creek. Based on this velocity and depth of flow, the Class II (24 inch)

riprap will be required. The channel will be constructed with similar geometry to the recently reconstructed channel below the Belina Haul Road turnout. A typical section through this channel is shown in Figure 3-3. The design of this channel will be similar to the recently completed channel reconstruction just downstream. This will maintain continuity in the channel design. The channel will include several drop structures to maintain a reasonable stream gradient of 2.5 percent or less. These drop structures will be constructed of large rock so that they will maintain a natural appearance. Figure 3-3 shows a plan view of the proposed new alignment after the fill is removed.

The velocity and depth were also computed for the average annual flow to evaluate the effects on fish passage, and are presented in Table 3.3. The average annual flow is estimated to be about 28 cfs. This flow was computed using the USGS report, "Methods for Estimating Peak Discharges and Flood Boundaries of Streams in Utah", WRI 83-4129. In addition to the average annual flow, depths and velocities were computed for several other flows.



ECCLES CREEK PLAN VIEW



TYPICAL SECTION THROUGH ECCLES CREEK

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
ECCLES CREEK CHANNEL DESIGN
PLAN AND SECTION
Figure 3-3

TABLE 3.3

ECCLES CREEK CHANNEL HYDRAULICS

Discharge, cfs	Depth, Ft.	Velocity, Ft./Sec.	Channel Slope %
15	.55	2.2	2.0
20	.65	2.5	2.0
28*	.80	2.8	2.0
30	.85	2.9	2.0

*Average annual flow

These are within the reported sustainable swimming speed for trout, which is two to six feet per second as reported in Fisheries Handbook, by Milo C. Bell, 1986. These velocities were not related to depth of flow in Milo C. Bell's report.

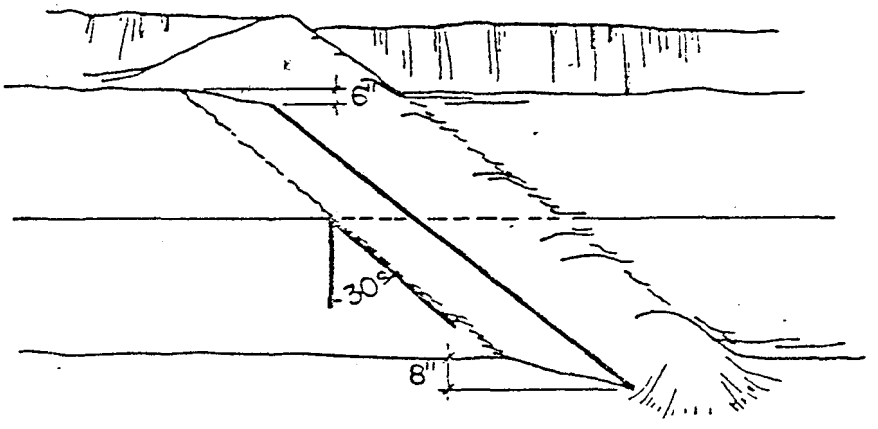
3.6 Concrete Ditch: Sta 71+00 to 82+00

A riprap ditch will be constructed at the base of the cut slope from about Sta. 71+00 to Sta. 82+00 where the haul road intersects Eccles Creek as shown on Figure 2-7 and Figure 2-8. Class I riprap will be placed over the existing concrete ditch with a minimum depth of about 12 inches. The reclaimed back slope of the road surface will contain the design flows. The last 100 feet of this ditch has a slope of about 35 percent where it drops down into Eccles Creek. This reach will be constructed similar to those in Figure 3-1. The ditch will have side slopes of 2H:1V and be protected with Class II riprap.

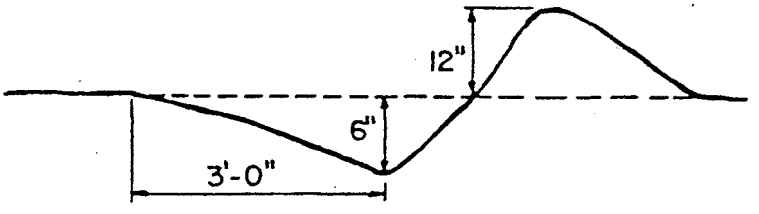
3.7 Water Control Bars

Water control bars will be constructed to reduce erosion of the recontoured haulroad. Figure 3-4 shows a typical waterbar. These structures will be spaced approximately 100 feet apart along the road. Waterbars will be placed more frequently if, during the final reclamation work it is determined they would be necessary to control runoff. Class I riprap protection will be included in the construction of the water control bars. The riprap will be placed at the point where the flow breaks over the edge of the old road bed.

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
TYPICAL WATERBAR
DETAILS
Figure 3–4



PLAN



SECTION

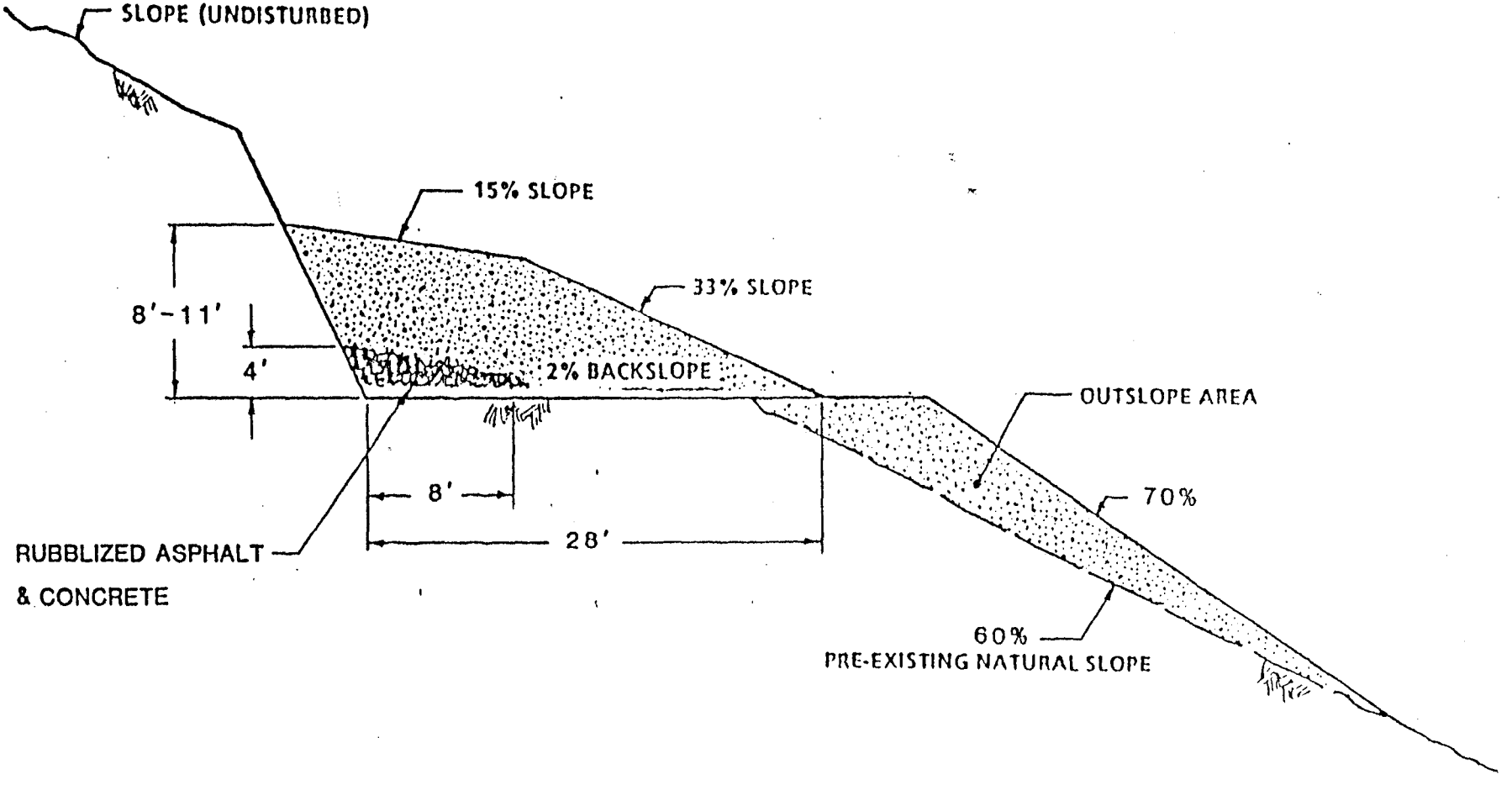
SECTION 4.0 - RECLAMATION PROCEDURES

4.1 Road Surface Removal

Reclamation of the road will begin with the removal of the asphaltic concrete road surface and the Portland cement concrete lining of the water control ditch which is located at the toe of the road cut slope. A portion of the cement concrete ditch (from station 71+00 to station 82+00) will be left in place and backfilled with riprap, as discussed in Section 3.6. After the road surface is reclaimed and the recontoured surface sloped back towards the hill at approximately four percent, this water control structure will convey water to Eccles Creek. Leaving this portion of the concrete ditch in place will minimize infiltration to the fractured rock hillside, thereby lessening the chance of slope failure. This water control structure will be monitored for bond release for the same period as the rest of the reclamation. The cement concrete lining will be rubblized to eliminate any slippage surface when it and the asphaltic concrete and fill material are placed for disposal. The larger pieces of cement concrete will be salvaged and used as riprap if they meet the specifications for riprap discussed in Section 3.4.

The asphaltic concrete will then be broken and will be placed against the toe of the cut slope over the previously placed broken Portland cement concrete. The asphaltic concrete will be piled approximately four feet deep adjacent to the cut slope and graded to ground level seven to eight feet out from the toe of the slope (Figure 4-1). There are approximately 3,500 in place cubic yards of asphaltic concrete to dispose of. To insure a competent fill and prevent piping, the asphaltic concrete will be placed in an engineered manner and compacted. The asphalt will be broken by ripping it with the

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
TYPICAL CROSS SECTION - STABLE FILL
FINAL CONTOURED SURFACE
Figure 4-1
(NOT TO SCALE)



scarifiers on a motor grader or equivalent machine. The scarifiers are approximately 17-20 inches apart. It is expected, therefore, that their use will create pieces of asphalt less than two-feet square. If necessary a dozer will be walked over the ripped asphalt to further reduce the size. The rubblized asphalt will then be bladed to the toe of the cut slope by a motor grader or equivalent equipment. The asphalt will be compacted in one foot lifts. Once the asphaltic concrete surface has been removed, the gravel road base material will be ripped or disked to eliminate compaction and to promote water infiltration and root penetration.

After the asphalt is placed and compacted it will be covered with soil removed from the out slope fill portions of the road, to a sufficient depth to prevent it from being exposed to the atmosphere. The surface of the replaced soil will be contoured as shown in Figure 4-1 to reestablish a drainage pattern similar to that which was present prior to mining.

4.2 Corrugated Metal Pipe Removal

Seven of the eight corrugated metal pipe (CMP) culverts buried in the Belina haul road will be removed during reclamation. These channels, which include Eccles Creek, will be cleared of fill material, recontoured and riprapped as necessary to prevent excessive erosion. The riprap material will consist of large competent rock and/or broken pieces of cement concrete as discussed in Section 3.4 of this report. The removed CMP will be salvaged if possible, or disposed of in a section of the underground mine workings as detailed in Section 784.13 of Valley Camp's approved Mining and Reclamation Plan Permit Number UT0013.

The remaining CMP is the large culvert through the fill in the Bowl. As agreed to during a site visit with UDOGM personnel, this CMP will be left in place unplugged. The reconstruction of a channel through the fill will provide a significant overflow safety factor in the unlikely event that the CMP would become dammed or plugged.

4.3 Recontouring

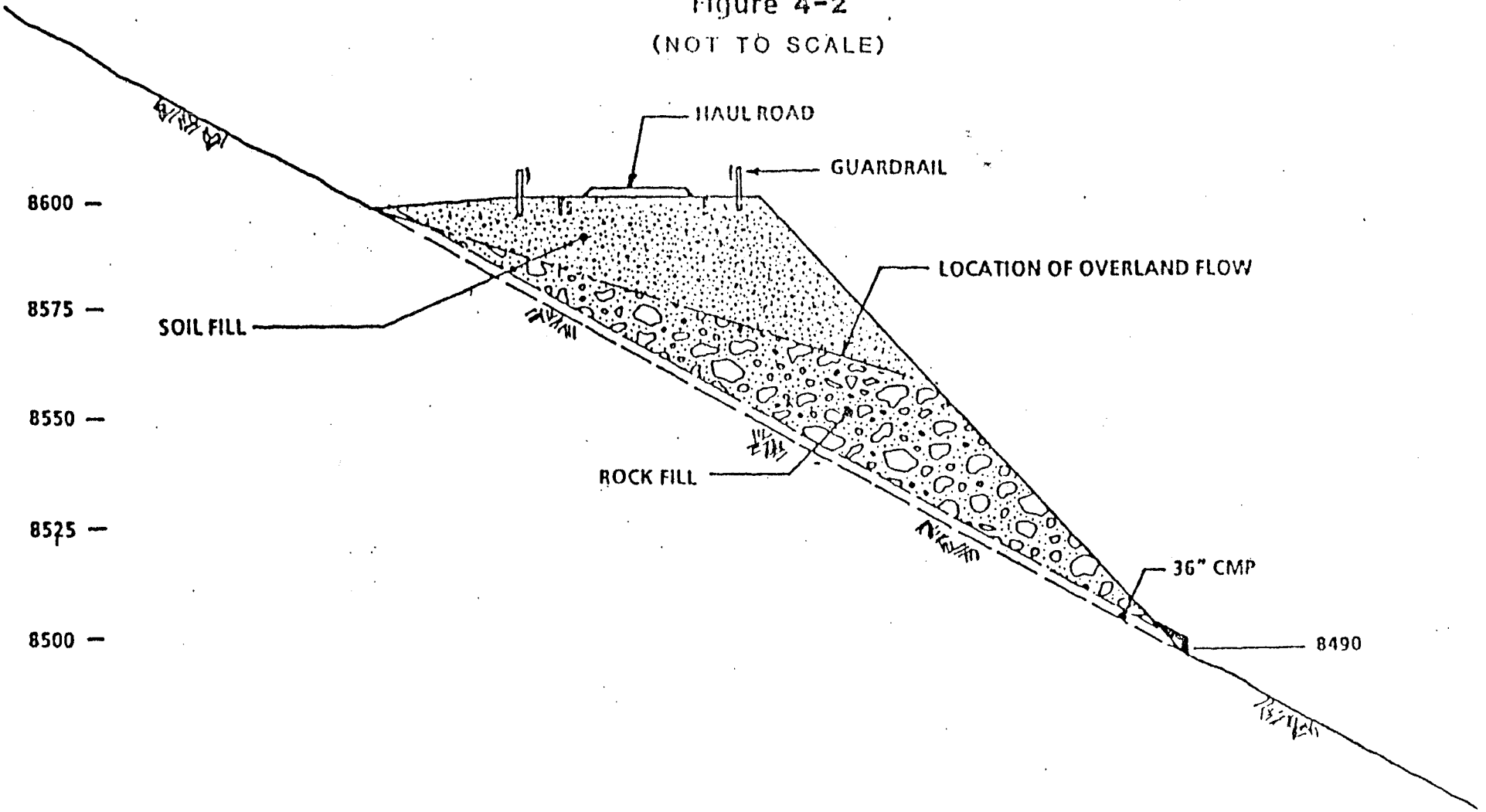
The recontoured areas will be developed by placing soil material excavated from two major fill areas (the Bowl crossing and the Eccles Creek crossing) on the "cut" portions of the road against the cut slopes as buttress fills. Additionally, portions of the road outslope fill areas are considered to be of questionable stability and will therefore also be excavated and placed in the buttress fills. Approximately 30,000 to 35,000 cubic yards of material will be excavated and placed during this recontouring effort. Drainage crossovers will be constructed across this recontoured surface to shorten the slope length and prevent excessive erosion (refer to Section 3.6 for details). These cutouts or crossovers will be riprapped to prevent the development of rills and gullies.

The reclaimed surface of the haul road will in most cases, slope to the outside. In some cases, however, it will slope back to the hill. Approximately the first 1,100 feet of the road, (from station 82+00 to station 71+00 on the CEI, 9/83 drawings) has a very steep outslope (approaching 120 percent) toward Eccles Creek. To keep water off of the face of this area and protect Eccles Creek the recontoured surface will pitch into the hill at approximately four percent (Figure 2.8). Runoff will be collected in a riprapped ditch constructed at the base of the road cut slope and will be conveyed down the hill and released to Eccles Creek approximately at the haul road/creek junction. The design of this ditch is addressed in Section 3.5 of this report.

4.3.1 Bowl Crossing

The largest fill is located near the midpoint of the haul road. It consists of blast rock on the bottom and soil on the top. The soil portion (approximately 15,000 yd^3) will be excavated and an overland channel will be developed through the remaining rock. The CMP will be left in place unplugged. This new drainage will be a permanent

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
THE BOWL CROSSING
Figure 4-2
(NOT TO SCALE)



structure constructed from competent rock which meets riprap specifications. In addition, energy dissipaters will be utilized, if necessary, to control the flow of water until it reaches the natural drainage channel. Figure 4.2 is a cross section showing the present road surface, fill slopes, and the projected location of the overland flow channel.

4.3.2 Eccles Creek Crossing

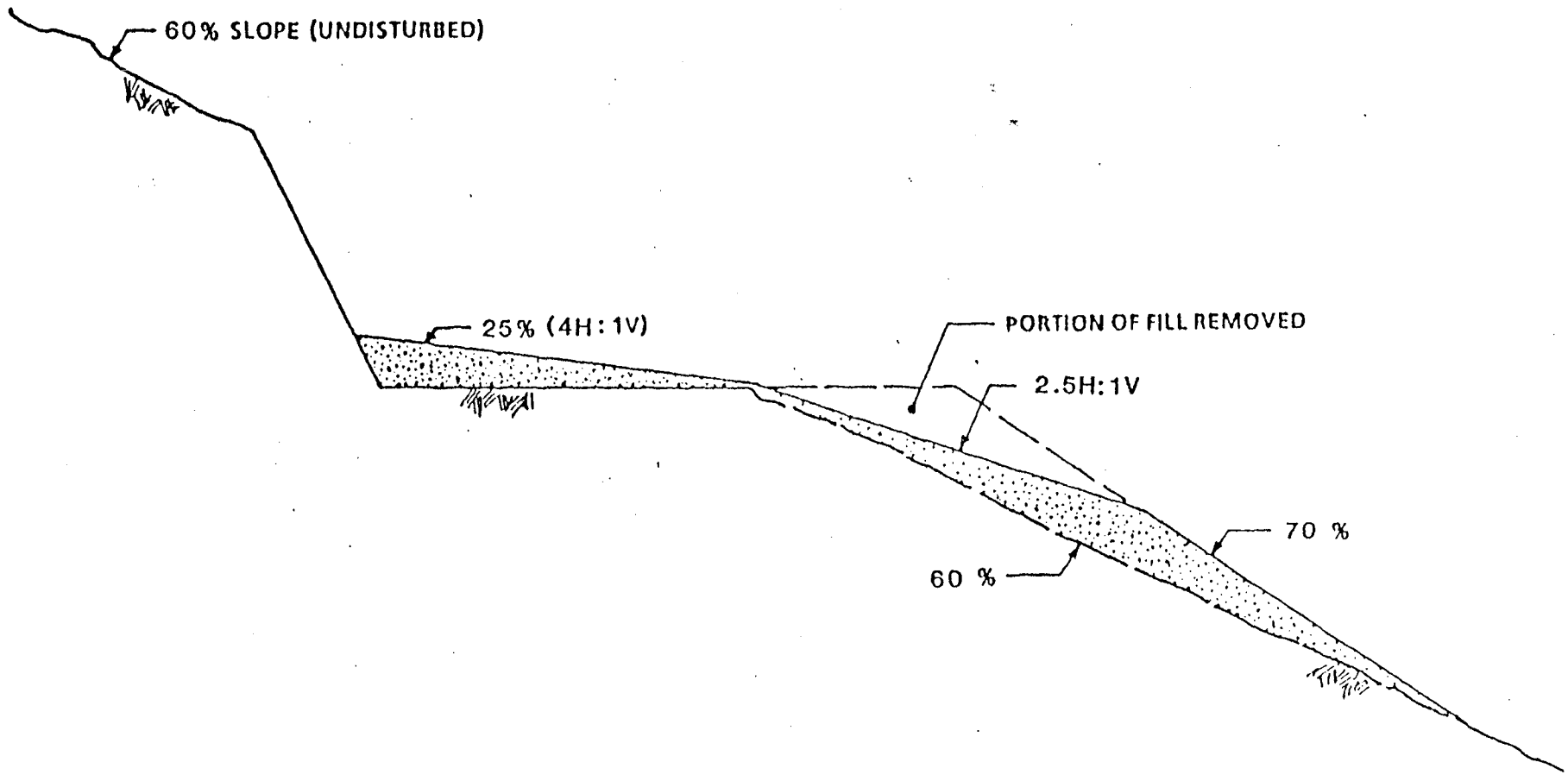
The second major fill is located at the intersection of the Belina Haul Road and the Eccles Canyon Road. This fill consists primarily of blast rock from the development of the first section of the haul road and is covered with soil. Again, only the soil portion will be removed. The remaining rock will be used as riprap for the rehabilitation of Eccles Creek, provided it meets riprap specifications. Any unused rock will be disposed of as discussed in Section 784.13 of Valley Camp's approved mining and reclamation plan (UT 0013). The corrugated metal pipe will be removed and disposed of similarily. These activities will allow Eccles Creek to return to its natural channel.

4.3.3 Unstable Fill Slopes

The third area from which backfill material will be obtained is from the portions of the outslope road fills that have been determined to be potentially unstable (Table 2.1). A sufficient quantity of fill will be removed from each of these fill slopes to reduce the potential of the slope failing. To initiate reclamation of these fill slopes, the guard rails will be removed and the support post and metal rails will be salvaged or disposed of.

The excavated material (Figure 4.3) will be removed using a backhoe or a similar machine to reach down the slope to retrieve material. As a result of this operation, the road edge will be cut back toward the

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
TYPICAL CROSS SECTION - UNSTABLE FILL
FINAL CONTOURED SURFACE
Figure 4-3
(NOT TO SCALE)



toe of the cut slope ten to fifteen feet. With the removal of this material the final surface will have an approximate slope of 2.5H:1V. The excavated material will be placed on the remaining road surface thereby creating an outslope of approximately 4H:1V.

The quantity of fill material estimated to be removed from the various sources and the estimate of the storage capacity that can be developed from utilizing the road surface is given in Table 4.1.

TABLE 4.1

VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

SOIL DISPOSAL VOLUMETRICS

Fill Material To Remove:

o Eccles Creek Fill	4,000 $yd^3 \pm$
o The Bowl Crossing Fill	15,000 $yd^3 \pm$
o Haul Road Outslopes	6,000 $yd^3 \pm$
o Remaining CMP Removal	1,500 $yd^3 \pm$
o Asphaltic Concrete and Broken Cement Concrete	5,000 $yd^3 \pm$
GRAND TOTAL	31,500 $yd^3 +$

Storage Capacity:

o Haul Road with Stable Outslopes (3,470 feet)	25,000 $yd^3 \pm$
o Haul Road with Portion of Outslopes Removed (2,780 feet)	6,000 $yd^3 \pm$
o Backslope Section of Road (1,250 feet)	3,000 $yd^3 \pm$
GRAND TOTAL	34,000 $yd^3 +$

4.4 Topsoiling

During the construction of the haul road the overlaying topsoil and subsoils were excavated and stockpiled where possible, sidecast or used as fill. During the reclamation of the haul road some of the material which was sidecast and/or used for fill material will be excavated and used to recontour the road. The suitability of this material as a growth medium is evidenced by the vegetation currently growing on it and in fact very similar material has already been approved for use as topsoil at this mine by the Utah Division of Oil Gas and Mining. Prior to using this material as topsoil however, it will be analyzed for pH, texture, electrical conductivity, calcium, magnesium, sodium, organic matter, phosphorous and potassium. Because this material is a mixture of topsoil and subsoil and because no segregated topsoil stockpiles exist at this mine "topsoil" will not be placed on the regraded surface.

4.5 Seed Bed Preparation

The soil removed from the large fills will be replaced using dozers and scrapers. Soil removal from the potentially unstable outslopes will be accomplished using a backhoe or similar equipment. The soil replaced by scrapers and dozers will be scarified to a depth sufficient to allow root penetration whereas the soil placed by the backhoe will not require loosening since it will be subject only to limited packing. The final recontoured surface will then be disked or tracked on the contour prior to seeding.

4.6 Seeding

Seeding will follow the procedures and seed mixes outlined in Valley Camp's approved Mining and Reclamation plan, Permit Number UT 0013.

Areas of the haul road outslopes and cut slopes which will not be disturbed by reclamation activities will be subjected to a statistically valid vegetation survey at the time to determine the adequacy of the existing vegetation when compared to reference areas identified in Mining Permit Number UT-0013. If it is determined necessary, these undisturbed areas will be interseeded or interplanted with shrubs.

4.7 Fertilizing

A chemical analysis will be performed on samples of the soil which will indicate the nutrients and amounts necessary for proper plant growth. Fertilizer will be applied either just prior to or immediately following seeding.

4.8 Mulching

Mulch will be applied at approximately 2,000 pounds per acre, depending on the material of choice, and will follow application of the seed and fertilizer. The mulch will be straw or any of the other commonly used mulch materials. At the time of reclamation, where it is deemed necessary, a tackifying agent or some other means will be used to hold the mulch in place.

4.9 Erosion Control and Maintenance

During reclamation activities, interim erosion control measures such as filter fabric and straw bales will be used to control water flow. Once a drainage channel is established, these interim structures will be removed and the disturbed areas will be seeded, fertilized and mulched. At the conclusion of reclamation activities, runoff will be slowed by the proper placing of straw bales, filter fabric fences, riprap or mulch, in potential

problem areas. If runoff channels develop in excess of nine inches, the most applicable erosion control technique will be selected. For example, small erosion channels will be blocked with a filter fabric fence, a straw bale or some other material to slow the water and allow vegetation to establish.

4.10 Revegetation

The revegetated area will be monitored closely to ensure that a diverse, permanent vegetation cover capable of self-regeneration is developed. Revegetation success of the newly reclaimed haul road areas will be determined by following the techniques developed in Section 817.116 of Valley Camp's approved mining and reclamation plan, Permit Number UT-0013.

4.11 Reclamation Costs

Reclamation costs are summarized by task for the purpose of bonding costs. These cost estimates are made with the knowledge that the efficiency of workers and machinery may far exceed the normal rate because of the very limited work space, and the difficulty in scheduling of crews. The reclamation cost estimates are given in Table 4.2.

TABLE 4.2

RECLAMATION COST ESTIMATES

Remove Concrete and Asphaltic Concrete:			
Rip Portland Cement Concrete and Breakup Asphaltic Concrete			$ 3,500
Remove and Place Asphaltic Concrete (40 hrs. @ $87.50/hr.)			2,800
Compact Asphaltic Concrete			1,600
Break and Remove Concrete Ditch			6,500
Rip/Scarify Road Base Material (65 acres) (8 hrs. @ $75.00/hr.)			600
Remove corrugated Metal Pipes			8,000
Remove and Dispose Guard Rails, Posts, and Signs			5,800
Remove and Place Fill Material:			
20,000 yd^3 (Intersecting Drainage Fills)			50,000
7,000 yd^3 (Road Outslope Fills) (80 hrs. @ $100/hr.)			8,000
Recontour Road Surface:			
10.0 Acres ± (80 hrs. @ $100.00/hr.			8,000
Construct Riprap Drainage Channels:			
8 each (@ 200 feet each)			32,000
Redistribute Topsoil Substitute (10 Acres x 6" Deep):			
8,100 yd^3 ± (@$2.50/yd.)			20,000
Seedbed Preparation (Scarification, Disking, Harrowing)			1,000
Fertilizing, Seeding, and Mulching:			
Seed:	(10 acres @ 24.0 lbs/acre @ $15.00/P.L.S. lb.)	$3,600	
Fertilizer:	(10.0 acres @ $425.00/acre)	$4,250	
Mulching:	(10.0 acres @ $500.000/acre	$5,000	
Equipment and Labor:		$2,000	
Total			14,850
Monitoring			1,000
	TOTAL		$163,650
	10% Mobilization and Demobilization		16,365
	15% Profit and Administration		24,548
	Maintenance-10 Acres @ $100.00/ac/yr.		1,000
	TOTAL BONDING COST		$205,563

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

WESTERN REGION OFFICE
MINERALS AND ENVIRONMENTAL DIVISION
720 PARK BLVD./P.O. BOX 79
BOISE, IDAHO U.S.A. 83707
PHONE: (208) 386-5000 TELEX: 368439

APPENDIX 623.100b

Coal Analyses

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

SUMMARY OF ANALYSES OF COAL

PARAMETER	ANALYZED IN VALLEY CAMP COAL	DOGM GUIDELINE CLASSIFICATION
pH	7.84	Good
Selenium	0.008	Good
Boron	0.93	Good
SAR	0.167	Good
ABP	19.11	Good

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (708) 953-9300
SINCE 1908
Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84528
TELEPHONE: (801) 653-2311
FAX: (801) 653-2479

December 4, 1992

VALLEY CAMP OF UTAH, INC.
Scofield Route
Helper UT 84526

Sample identification by
VALLEY CAMP OF UTAH, INC.

Kind of sample reported to us: Coal

Sample taken at: Valley Camp

Sample taken by: Valley Camp

Date sampled: 10/1-10/31

Date received: November 3, 1992

Valley Camp Composite
DS Samples
Made By CT&E
Top Size 8 Mesh
6.75 lbs.
2 Bags

SOIL ONLY

Analysis report no. 59-153854

SOIL ANALYSIS

pH	7.84units
Conductivity	620 mmhos/cm
Extractable Selenium	0.008 ug/g
Extractable Boron	0.93 ug/g

Total Nitrogen	1.26 %
Nitrate-nitrogen	0.66 mg/kg
Organic Carbon	3.55 %

SOLUBLE CATIONS

Calcium	40.92meq/l
Magnesium	8.23 meq/l
Sodium	0.83 meq/l

Sodium Adsorption Ratio	0.167
Exchangeable Sodium Percentage	-1.024

ACID BASE POTENTIAL

Maximum Acid Potential	8.16 tons $CaCO_3$/ 1000 tons
Neutralization Potential	27.27 tons $CaCO_3$/ 1000 tons

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

June Koman

Manager, Huntington Laboratory

APPENDIX 623.100a

Historical Soils Analyses

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

September 16, 1986

TO: Technical File

FROM: James S. Leatherwood, Reclamation Soils Specialist

RE: Substitute Topsoil Suitability, Belina Complex, Valley Camp of Utah, Inc., ACT/007/001, Folder #2, Carbon County, Utah

Pursuant to Conditions #5 and #6, the operator has submitted analytical data for the Utah No. 2 and Belina Pad materials. This information has been presented to determine the suitability of these materials as substitute topsoils. The following delineates the submitted data with a corresponding topsoil substitute suitability rating as defined in Table 2 of the Draft Topsoil and Overburden Guideline (enclosed).

BELINA PAD

Sample Site No. 1
Overall Rating = Good-Fair

Parameter	Depth	Data	Rating(5)	Parameter	Depth	Data	Rating
pH				Texture			
	0-2	7.5	G		0-2	sl	G
	2-4	7.4	G		2-4	scl	G
	4-6	7.5	G		4-6	c	P
	6-8	7.8	G		6-8	c	P
$CaCO_3$%				EC(1)			
	0-2	0.45	G		0-2	0.80	G
	2-4	0.35	G		2-4	0.77	G
	4-6	0.29	G		4-6	0.85	G
	6-8	0.36	G		6-8	0.95	G

page 2
Memo to Tech. File
ACT/007/001
Substitute Topsoil
September 16, 1986

BELINA PAD

Sample Site No. 1 (Cont'd.)
Overall Rating = Good-Fair

Parameter	Depth	Data	Rating(5)	Parameter	Depth	Data	Rating
SAR(2)				OM%(3)			
	0-2	0.047	G		0-2	4.7	
	2-4	0.064	G		2-4	3.9	
	4-6	0.087	G		4-6	4.5	
	6-8	0.100	G		6-8	3.4	
SAT%(4)							
	0-2	22.5	P				
	2-4	21.9	P				
	4-6	19.3	P				
	6-8	24.6	P				

BELINA PAD

Sample Site No. 2
Overall Rating = Good-Fair

Parameter	Depth	Data	Rating(5)	Parameter	Depth	Data	Rating
pH				EC(1)			
	0-2	7.2	G		0-2	0.90	G
	2-4	7.3	G		2-4	0.75	G
	4-8	7.5	G		4-8	0.69	G
$CaCO_3$%				SAR(2)			
	0-2	0.21	G		0-2	0.039	G
	2-4	0.39	G		2-4	0.062	G
	4-8	0.44	G		4-8	0.063	G
Texture				OM%(3)			
	0-2	sil	G		0-2	3.6	
	2-4	l	G		2-4	5.4	
	4-8	cl	F		4-8	4.8	
Sat%(4)							
	0-2	23.4	P				
	2-4	18.7	P				
	4-8	25.7	F				

page 3
Memo to Tech. File
ACT/007/001
Substitute Topsoil
September 16, 1986

BELINA PAD

Sample Site No. B-5
Overall Rating = Good-Fair

Parameter	Depth	Data	Rating(5)
pH			
	0-2.5	7.2	G
	2.5-5.0	7.4	G
	5.0-7.5	7.8	G
	7.5-10.0	7.3	G
	10.0-12.5	7.5	G
	12.5-15.0	7.8	G
	15.0-17.5	7.4	G
	17.5-20.0	7.9	F
	20.0-22.5	7.5	G
	22.5-25.0	7.5	G
	25.0-27.5	7.4	G
	27.5-30.0	7.4	G
CaCO%			
	0-2.5	0.46	G
	2.5-5.0	0.42	G
	5.0-7.5	0.38	G
	7.5-10.0	0.39	G
	10.0-12.5	0.37	G
	12.5-15.0	0.35	G
	15.0-17.5	0.30	G
	17.5-20.0	0.41	G
	20.0-22.5	0.36	G
	22.5-25.0	0.32	G
	25.0-27.5	0.40	G
	27.5-30.0	0.40	G
Texture			
	0-2.5	c	P
	2.5-5.0	cl	F
	5.0-7.5	c	P
	7.5-10.0	scl	G
	10.0-12.5	c	P
	12.5-15.0	sl	G
	15.0-17.5	sl	G
	17.5-20.0	l	G
	20.0-22.5	sl	G
	22.5-25.0	scl	G
	25.0-27.5	scl	G
	27.5-30.0	sl	G

Parameter	Depth	Data	Rating
EC(1)			
	0-25	0.75	G
	2.5-5.0	0.80	G
	5.0-7.5	0.84	G
	7.5-10.0	0.90	G
	10.0-12.5	0.78	G
	12.5-15.0	0.88	G
	15.0-17.5	0.92	G
	17.5-20.0	0.88	G
	20.0-22.5	0.76	G
	22.5-25.0	0.80	G
	25.0-27.5	0.74	G
	27.5-30.0	0.75	G
SAR(2)			
	0-2.5	0.08	G
	2.5-5.0	0.06	G
	5.0-7.5	0.08	G
	7.5-10.0	0.10	G
	10.0-12.5	0.05	G
	12.5-15.0	0.06	G
	15.0-17.5	0.05	G
	17.5-20.0	0.06	G
	20.0-22.5	0.06	G
	22.5-25.0	0.08	G
	25.0-27.5	0.06	G
	27.5-30.0	0.06	G
OM%(3)			
	0-2.5	3.3	
	2.5-5.0	4.6	
	5.0-7.5	8.2	
	7.5-10.0	5.9	
	10.0-12.5	7.7	
	12.5-15.0	5.5	
	15.0-17.5	6.8	
	17.5-20.0	4.9	
	20.0-22.5	10.5	
	22.5-25.0	6.8	
	25.0-27.5	4.9	
	27.5-30.0	4.9	

Parameter	Depth	Data	Rating(5)	Parameter	Depth	Data	Rating
Sat%(4)							
	0-2.5	24.5	P				
	2.5-5.0	21.8	P				
	5.0-7.5	24.6	P				
	7.5-10.0	23.8	P				
	10.0-12.5	31.5	G-F				
	12.5-15.0	27.1	F				
	15.0-17.5	20.7	P				
	17.5-20.0	21.5	P				
	20.0-22.5	28.2	F				
	22.5-25.0	20.4	P				
	25.0-27.0	25.1	F				
	27.5-30.0	19.7	P				

UTAH NO. 2 PAD

Sample Site No. 1
10-ft. Depth
Overall Rating = Good

Parameter	Data	Rating(5)	Parameter	Data	Rating
pH	7.3	G	Texture	l	G
Sat%(4)	34.3	G-F	EC(1)	0.79	G
SAR(2)	0.65	G	OM%(3)	1.9	

UTAH NO. 2 PAD

Sample Site No. 2
8-ft. Depth
Overall Rating = Good

Parameter	Data	Rating(5)	Parameter	Data	Rating
pH	7.4	G	Texture	sl	G
Sat%(4)	30.5	G-F	EC(1)	1.08	G
SAR(2)	0.59	G	OM%(3)	2.5	

Sample Site No. 3
6-ft. Depth
Overall Rating = Good-Fair

Parameter	Data	Rating(5)	Parameter	Data	Rating
pH	5.5	F	Texture	1	G
Sat%(4)	32.2	G-F	EC(1)	0.31	G
SAR(2)	0.92	G	OM%(3)	4.5	

(1) Electrical Conductivity (mmhos/cm @ 25°C)

(2) Sodium Adsorption Rates

(3) Organic matter percent (Organic matter suitability ratings are undetermined at this time. Data is presented for information purposes only.

(4) Saturation Percent (Data on the Belina Pad materials is misleading. In some cases there is a high clay content and low saturation percentage- See Sample Site No. 1, 4-6 and 6-8 feet samples).

(5) Ratings:

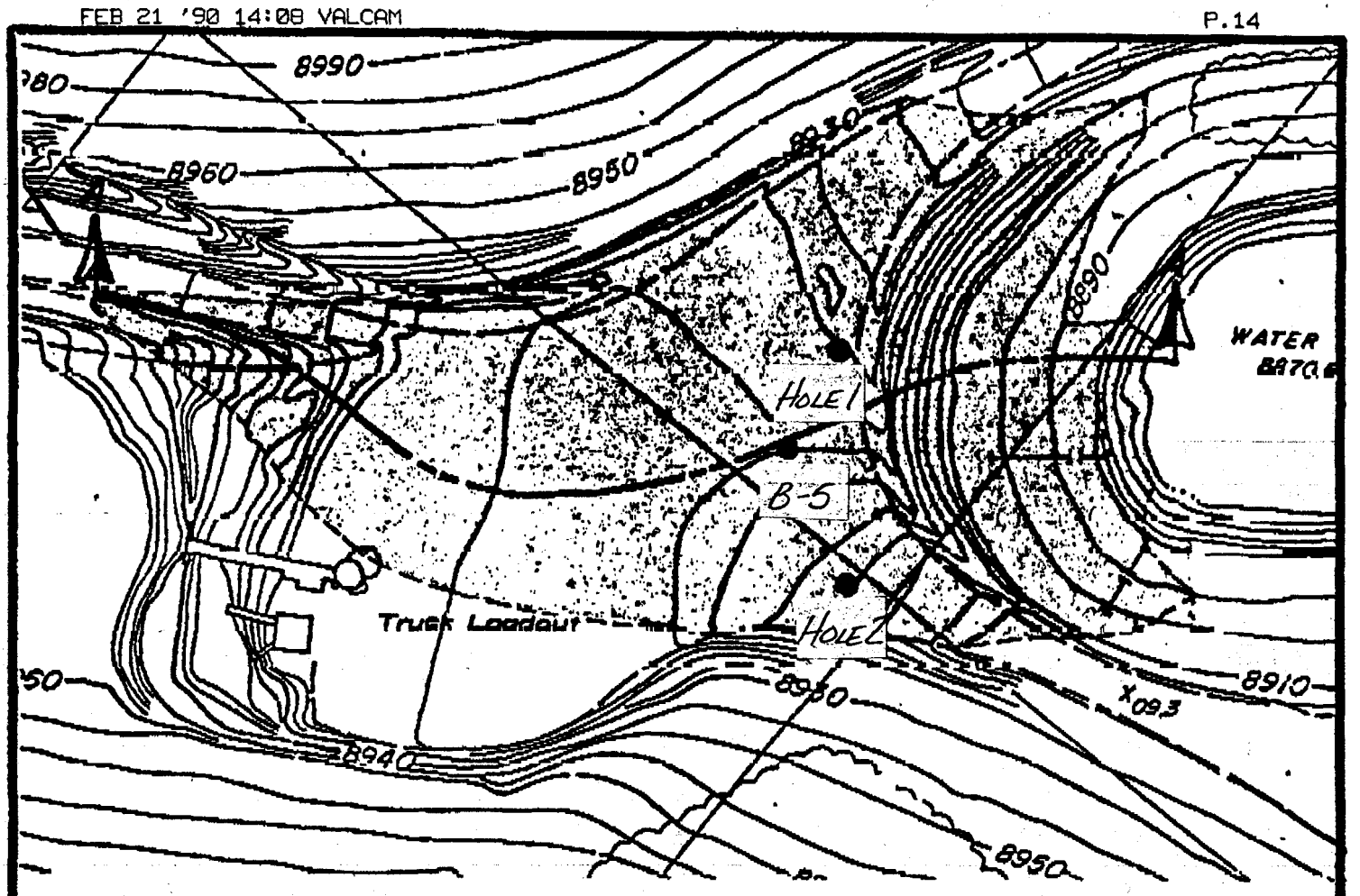
Good = G
Fair = F
Poor = P
Unsuitable = U

Enclosure(s)
JSL/djh
cc: S. Linner
L. Kunzler
0798R/6

Table 2. Suitability Limits for Rating Topsoil Substitutes*

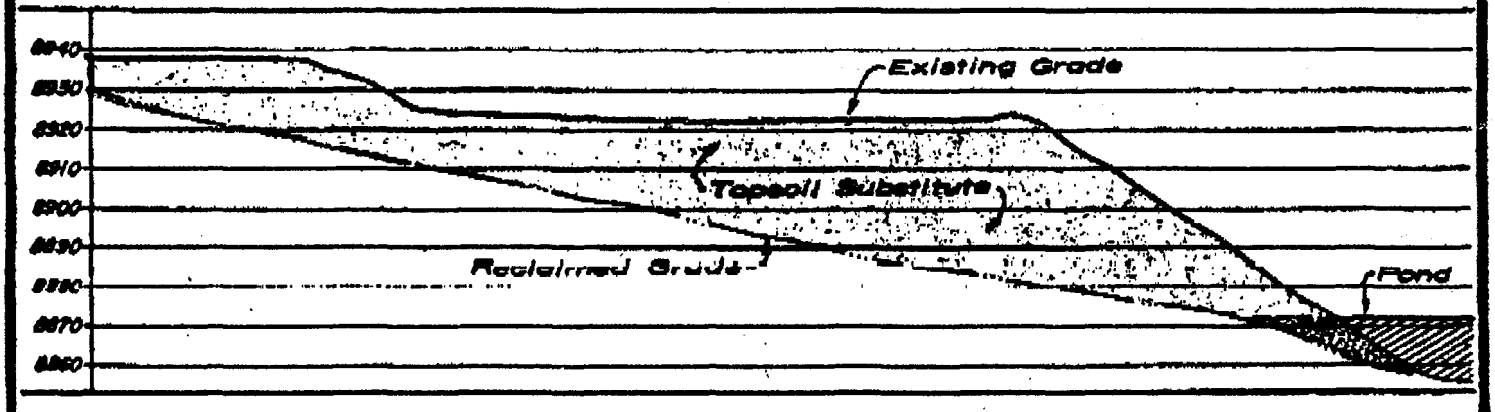
	Good	Fair	Poor	Unsuitable
Available water capacity	>0.10	0.05-0.10	<0.05	
pH	6.1-7.8	5.1-6.1 7.9-8.4	4.5-5.0 8.5-9.0	<4.5 >9.0
USDA Textural Class	SL L, SiL SCL VFSL FSL	CL,SICL, SC,LS LFS	SIC S, SC, C COS, FS, VFS	G, VCOS
Slope (%)	<8	8-15	>15	
Electrical Conductivity	0-4	5-8	9-15	>16
Sodium Adsorption Ratio (SAR)	5	6-10	10-12 Fine Texture 10-15 Coarse Texture	>12 Fine Texture >15 Coarse Texture
Boron	<5.0			>5.0
Selenium	<0.1	>01		
Rock Fragments (% Volume)				
3 inches	0-15	15-25	25-30	30
3-10 inches	0-15	15-25	25-30	30
More than 10 inches	0-3	3-7	7-10	10
Alkalinity as Calcium Carbonate %	0-15	15-25	25-40	>40
Saturation Percentage (%)			<25 >80	

* Many native species have their roots in soils that are determined poor to unsuitable by these values. Therefore, plant growth trials may be needed where re-establishment of native species is desired.



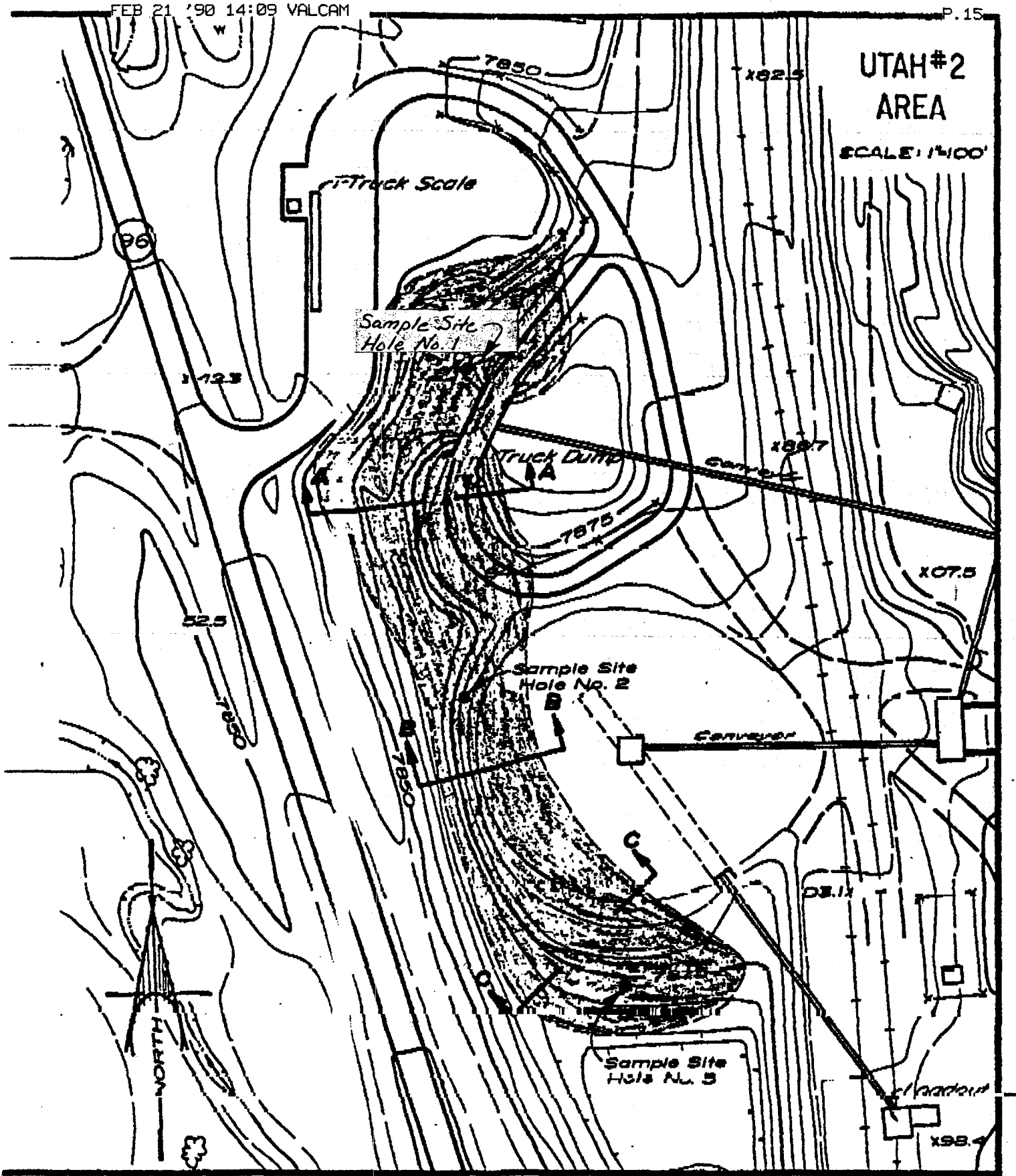
PLAN VIEW
SCALE: 1" = 100'

Approx. Topsoil Substitute = 54,000 Tons
600' x 200' x 8.2' = 984,000 CU. FT.
(110 lbs. per cu. ft.)



SECTION A-A
SCALE: Horz. - 1" = 100'
Vert. - 1" = 50'

DRAWN BY: Ed Sanderson	DATE: Oct. 13, 1983	VALLEY CAMP of UTAH SCOFIELD ROUTE HELPER, UTAH 84526
CHECKED BY:	DATE:	
REVISED BY:	SCALE: "As Noted"	
APPROVAL ENG.:		
APPROVAL SAFETY:	TITLE: BELINA SUBSTITUTE TOPSOIL AREA	DRAWING NO. A5-0075 / REV. NO. 2
APPROVAL MINE:		



BY: Ed Sanderson	DATE: Dec. 12, 83	VALLEY CAMP of UTAH SCOFIELD ROUTE HELPER, UTAH 84526
D BY:	DATE:	
D BY:	SCALE: "As Noted"	
AL ENG.:		
L SAFETY:	TITLE: UTAH #2 SUBSTITUTE TOPSOIL	DRAWING NO. B5-0013 / REV. NO. 0
AL MINE:		

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 1

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006765

SAMPLE: SOIL SAMPLES FROM BELINA PAD #1 COLLECTED 9-23-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. #30-83-10-007831.

	0 - 2 FT.	2 - 4 FT.	4 - 6 FT.	6 - 8 FT.	
%-Clay % USDA 18	12.80	28.20	85.50	60.20	
-Sand % USDA 18	65.80	53.50	27.50	27.30	
-Silt % USDA 18	21.40	18.30	14.00	12.50	
Acid/Base Pot.Tons/1000 Tons	.43	.41	.39	.46	
Boron Sol.ppm USDA 60	.057	.119	.089	.008	
Ca.Carbonate Tons/1000Tons	4.50	3.45	2.87	3.60	
Calcium Carbonate ppm USDA 60	4,500.00	3,450.00	2,870.00	3,600.00	3855
Calcium Sol. Meq/l USDA 60	130.73	108.78	117.26	122.00	
Conductivity µ hos/cm @ 25	.80	.77	.85	.95	
Copper ppm AB DTPA 1	.250	.100	.300	.050	0.18
Iron ppm AB DTPA 1	66.500	68.300	59.200	77.500	67.9
Magnesium Sol. Meq/l USDA 60	15	15.33	14.26	17.26	15.7
Manganese ppm AB DTPA 1	14.500	12.600	10.500	6.650	11.1

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LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 1

CERTIFICATE OF ANALYSIS
83-006765

	0 - 2 FT.	2 - 4 FT.	4 - 6 FT.	6 - 8 FT.	
Moisture %	19.80	22.50	36.40	33.20	
Molybdenum ppm AB DTPA 1	.075	.036	.055	.028	
Neut./Potential Tons/1000Tons	4.07	3.04	2.48	3.14	
Nitrate NO3-N ppm USDA 60	3.30	4.20	5.40	6.70	
Organic Material % (WB)	4.70	3.90	4.50	3.36	
PH USDA 60	7.50	7.40	7.45	7.80	
Phosphorus ppm AB DTPA 1	20.60	31.40	4.50	16.20	18.2
Potassium ppm USDA 60	114.00	95.00	81.00	110.00	100.0
Pyritic Sulfur % ASTM D2492	.0140	.0133	.0125	.0150	
Saturation %	22.50	21.90	19.30	24.60	
Selenium ppm AB DTPA 1	.015	.010	.006	.002	
Sodium Absorption Ratio	.047	.064	.087	.100	
Sodium Sol.Meq/l USDA 60	.42	.51	.72	.85	0.63
Zinc ppm AB DTPA 1	1.650	2.400	1.900	2.300	2.1

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 2

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

'ALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006766

SAMPLE: SOIL SAMPLES FROM BELINA PAD #2 COLLECTED 9-23-83
RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	0 - 2 FT.	2 - 4 FT.	4 - 8 FT.	
1-Clay % USDA 18	10.50	19.50	30.80	
-Sand % USDA 18	20.00	50.00	37.70	
-Silt % USDA 18	69.50	30.50	31.50	
Acid/Base Pot.Tons/1000 Tons	.38	.37	.36	
oron Sol.ppm USDA 60	.058	.013	.112	
Ca.Carbonate Tons/1000Tons	2.07	2.87	4.39	
Calcium Carbonate ppm USDA 60	2,700.00	3,870.00	4,390.00	3653
alcium Sol. Meq/l USDA 60	95.30	117.26	127.64	
Conductivity mmhos/cm @ 25	.90	.75	.69	
opper ppm AB DTPA 1	.200	.270	.300	0.26
Iron ppm AB DTPA 1	51.500	45.600	44.900	47.3
Magnesium Sol. Meq/l USDA 60	21.41	15.65	17.28	18.1
anganese ppm AB DTPA 1	4.900	8.600	9.300	7.6

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LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 2

PAGE: 2

CERTIFICATE OF ANALYSIS
83-006766

	0 - 2 FT.	2 - 4 FT.	4 - 8 FT.	
Moisture %	23.00	34.60	40.20	
Molybdenum ppm AB DTPA 1	.008	.010	.009	
Neut./Potential Tons/1000Tons	2.32	3.50	4.03	
Nitrate NO3-N ppm USDA 60	2.40	4.60	5.10	
Organic Material % (WB)	3.60	5.40	4.80	
pH USDA 60	7.20	7.30	7.50	
Phosphorus ppm AB DTPA 1	16.50	26.40	25.40	22.8
Potassium ppm USDA 60	110.00	86.00	79.00	91.7
Pyritic Sulfur % ASTM D2492	.0123	.0120	.0115	
Saturation %	23.40	18.70	25.10	
Selenium ppm AB DTPA 1	.025	.017	.001	
Sodium Absorption Ratio	.039	.062	.063	
Sodium Sol.Meq/l USDA 60	.30	.51	.54	0.45
Zinc ppm AB DTPA 1	.950	1.850	1.990	1.00

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8781

Test Hole No. B-5

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006763

SAMPLE: SOIL SAMPLES FROM BELINA PAD COLLECTED 9-15-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	0 - 2.5	2.5 - 5	5 - 7.5	7.5 - 10	10 - 12.5
% Clay % USDA 18	54.50	38.60	51.90	22.50	48.90
% Sand % USDA 18	33.50	39.80	31.50	56.50	25.50
% Silt % USDA 18	12.00	21.60	16.60	21.00	25.60
Acid/Base Pot.Tons/1000 Tons	.39	.42	.34	.37	.57
Boron Sol.ppm USDA 60	.258	.168	.241	.165	.117
Calc.Carbonate Tons/1000Tons	4.60	4.20	3.77	3.92	3.70
Calcium Carbonate ppm USDA 60	4,600.00	4,200.00	3,770.00	3,920.00	3,700.00
Calcium Sol. Meq/l USDA 60	127.74	123.75	115.26	118.26	128.74
Conductivity mmhos/cm @ 25	.75	.80	.04	.90	.78
Copper ppm AB DTPA 1	.020	.090	.100	.150	.280
Iron ppm AB DTPA 1	56.500	54.200	63.500	74.100	58.900
Magnesium Sol. Meq/l USDA 60	14.79	14.40	13.76	13.57	13.11
Manganese ppm AB DTPA 1	9.200	6.800	4.900	8.300	9.500

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	0 - 2.5	2.5 - 5	5 - 7.5	7.5 - 10	10 - 12.5
Moisture %	19.80	21.50	22.40	22.50	34.50
Molybdenum ppm AB DTPA 1	.166	.175	.116	.150	.1[illegible]
Neut./Potential Tons/1000Tons	4.21	3.78	3.43	3.55	3.[illegible]
Nitrate NO3-N ppm USDA 60	2.10	4.60	1.80	2.50	1.95
Organic Material % (WB)	3.30	4.60	8.20	5.90	7.[illegible]
pH USDA 60	7.70	7.40	7.80	7.30	7.50
Phosphorus ppm AB DTPA 1	12.90	15.60	8.70	16.20	11.[illegible]
Potassium ppm USDA 60	112.00	95.00	86.00	69.00	72.[illegible]
Pyritic Sulfur % ASTM D2492	.0125	.0136	.0110	.0120	.0185
Saturation %	24.50	21.00	24.60	20.00	31.[illegible]
Selenium ppm AB DTPA 1	.005	.001	.001	<.001	<.001
Sodium Absorption Ratio	.001	.062	.000	.096	.0[illegible]
Sodium Sol.Meq/l USDA 60	.69	.52	.65	.78	.[illegible]
Zinc ppm AB DTPA 1	1.770	1.950	1.800	7.100	7.500

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40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 486-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	12.5 - 15	15 - 17.5	17.5 - 20	20 - 22.5	22.5 -25
-Clay % USDA 18	15.30	14.00	20.00	24.20	31.50
1-Sand % USDA 18	60.20	54.50	33.50	24.50	58.60
-Silt % USDA 18	24.50	31.50	46.50	51.30	9.90
cid/Base Pot.Tons/1000 Tons	.38	.51	.56	.42	.38
Boron Sol.ppm USDA 60	.098	.258	.410	.165	.137
a.Carbonate Tons/1000Tons	3.49	2.96	4.13	3.59	3.15
Calcium Carbonate ppm USDA 60	3,490.00	2,960.00	4,130.00	3,590.00	3,150.00
alcium Sol. Meq/l USDA 60	109.73	99.10	122.50	114.42	102.79
onductivity mmhos/cm @ 25	.88	.92	.88	.76	.80
Copper ppm AB DTPA 1	.030	.050	.100	.240	.250
ron ppm AB DTPA 1	66.900	71.400	75.200	61.500	59.500
Magnesium Sol. Meq/l USDA 60	10.52	13.57	15.24	13.68	14.42
.langanese ppm AB DTPA 1	11.600	9.500	8.500	6.750	8.500
loisture %	18.50	23.50	21.50	24.60	20.50
Molybdenum ppm AB DTPA 1	.085	.025	.016	.025	.165
leut./Potential Tons/1000Tons	3.11	2.45	3.57	3.17	2.77
Nitrate NO3-N ppm USDA 60	2.80	4.40	3.50	1.80	2.85

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Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	12.5 - 15	15 - 17.5	17.5 - 20	20 - 22.5	22.5 -25
Organic Material % (WB)	5.50	6.80	4.85	10.50	6.[illegible]
PH USDA 60	7.80	7.44	7.90	7.50	7.45
Phosphorus ppm AB DTPA 1	10.50	14.50	21.60	15.50 14.72	11.[illegible]
Potassium ppm USDA 60	105.00	120.00	119.00	88.00 102.2	79.00
Pyritic Sulfur % ASTM D2492	.0122	.0165	.0180	.0135	.01[illegible]
Saturation %	27.10	20.70	21.50	28.20	20.[illegible]
Selenium ppm AB DTPA 1	<.001	<.001	<.001	<.001	<.001
Sodium Absorption Ratio	.060	.050	.060	.064	.0[illegible]
Sodium Sol.Meq/l USDA 60	.47	.38	.50	.52 .50	.65
Zinc ppm AB DTPA 1	2.200	1.300	1.450	1.220 1.65	2.1[illegible]

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LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUIDE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
ELPER, UTAH
84526

83-006764

AMPLE: SOIL SAMPLES FROM BELINA PAD COLLECTED 9-15-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	25 - 27.5	27.5 - 30		TOTAL AVG
-Clay % USDA 18	22.00	17.10		
-Sand % USDA 18	49.50	53.50		
-Silt % USDA 18	28.50	29.40		
cid/Base Pot.Tons/1000 Tons	.37	.34		
Boron Sol.ppm USDA 60	.066	.098		
a.Carbonate Tons/1000Tons	4.02	3.96		
Calcium Carbonate ppm USDA 60	4,025.00	3,960.00	3993	3791
Calcium Sol. Meq/l USDA 60	120.25	119.01		
onductivity mmhos/cm @ 25	.74	.75		
Copper ppm AB DTPA 1	.420	.460	.44	0.20
Iron ppm AB DTPA 1	45.500	43.800	44.65	60.9
Magnesium Sol. Meq/l USDA 60	14.53	15.24	14.89	13.90
Manganese ppm AB DTPA 1	11.200	10.850	11.03	8.8

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. R-5

CERTIFICATE OF ANALYSIS
83-006764

	25 - 27.5	27.5 - 30	TOTAL	AVG
Moisture %	31.40	29.50		
Molybdenum ppm AB DTPA 1	.118	.037		
Neut./Potential Tons/1000Tons	3.65	3.62		
Nitrate NO3-N ppm USDA 60	6.40	5.30		
Organic Material % (WB)	4.85	4.91		
PH USDA 60	7.35	7.40		
Phosphorus ppm AB DTPA 1	30.70	29.20	29.95	16.53
Potassium ppm USDA 60	96.00	91.00	93.5	94.33
Pyritic Sulfur % ASTM D2492	.0119	.0110		
Saturation %	25.10	19.70		
Selenium ppm AB DTPA 1	<.001	<.001		
Sodium Absorption Ratio	.056	.061		
Sodium Sol.Meq/l USDA 60	.45	.50	0.48	0.55
Zinc ppm AB DTPA 1	1.700	1.800	1.75	2.06

FORD CHEMICAL LABORATORY, INC.

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Valley Camp of Utah, Inc.
Belina Mine Site
Clear Creek, Utah 84526

IE: UTAH NO. 2 AREA ~~Belina Mine~~

ANALYSIS BY: INTER-MOUNTAIN LABORATORIES, INC.

DATE: September 24, 1983
PAGE: 1 of 2

)	Hole No.	Depth Interval Ft.	pH	Cond. mmhos/cm @ 25°C	Saturation %	Particle Size Sand %	Silt %	Clay %	Texture	Soluble Cations Ca	Mg Meq/l	Na	SAR (1)
)93	1	10/feet [illegible]	7.3	0.79	34.3	50.4	38.9	10.7	Loam	5.29	1.71	1.22	0.65
)94	2	[illegible]	7.4	1.08	30.5	59.5	30.7	9.8	Sandy Loam	7.75	2.35	1.32	0.59
)95	3	[illegible]	5.5	0.31	32.2	44.0	42.5	13.5	Loam	1.81	0.41	0.97	0.92

)tnotes: (1) Sodium Adsorption Ratio

FEB 21 '90 14:07 VALCAM

Valley Camp of Utah, Inc.
Belina Mine Site
Clear Creek, Utah 84526

NE: ~~Belina Mine~~ UTAH NO. 2 PAED

ANALYSIS BY: INTER-MOUNTAIN LABORATORIES, INC.

DATE: September 24, 1983
PAGE: 2 of 2

b .	Hole No.	OM% (13)	K+ (14)	PO4 (15)	Fe ppm (2)	Zn ppm (3)	B ppm (4)	N ppm (5)	Mo ppm (6)	Cu ppm (7)	Mn ppm (8)	TS % (9)	AB (10)	NP (11)	ABP (12)
093	1	1.9	123.	17.4	15.1	1.09	0.84	7.13	0.09	0.51	9.35	0.05	1.56	22.3	20.7
094	2	2.5	69.	13.7	16.6	1.12	0.85	5.71	0.08	0.41	13.3	0.05	1.56	57.1	55.5
095	3	4.5	68.	8.74	59.3	0.66	0.76	4.30	0.05	0.80	7.52	0.05	1.56	11.9	10.3

Footnotes:
(13) Organic Matter
(14) Potassium
(15) Phosphate as P
(2) Iron DTPA
(3) Zinc DTPA
(4) Boron
(5) Nitrate Nitrogen
(6) Ammonium Extractable Molybdenum
(7) Copper DTPA
(8) Manganese DTPA
(9) Total Sulfur Per Cent
(10) Acid Base
(11) Neutralization Potential
(12) Acid Base Potential in Tons Calcium Carbonate per 1000 Tons of Soil

8 March 1983

MIDECO

420 CHIPETA WAY - SUITE 260
UNIVERSITY OF UTAH RESEARCH PARK
SALT LAKE CITY, UTAH 84108
TELEPHONE: (801) 582-3136
TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47009
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, 0'-5'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.7
Specific Conductivity	145 umhos/cm
Alkalinity	5,600 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	27 28.27	0.0027
Calcium	11,500	1.15
Copper	18	0.0018
Sodium	250	0.025

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO
420 CHIPETA WAY - SUITE 280
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SALT LAKE CITY, UTAH 84108
TELEPHONE: (801) 582-3136
TWX 010 936-6258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47001
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	DP 1, 5'-6.6'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	7.9
Specific Conductivity	155 umhos/cm
Alkalinity	4,400 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	23	0.0023
Calcium	5,600	0.56
Copper	16	0.0016
Sodium	360	0.036

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO

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ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47005
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, 6.6'-10'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.8
Specific Conductivity	135 umhos/cm
Alkalinity	2,600 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	41	0.0041
Calcium	37,300	3.73
Copper	16	0.0016
Sodium	150	0.015

David W. Gayer
Environmental Lab Director

ph

8 March 1983

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TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	46995
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, 10'-15'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.1
Specific Conductivity	130 umhos/cm
Alkalinity	2,400 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	34	0.0034
Calcium	21,700	2.17
Copper	8	0.0008
Sodium	100	0.010

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO
420 CHIPETA WAY - SUITE 280
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ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	46999
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	DP-1, 15'-20'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	7.8
Specific Conductivity	130 umhos/cm
Alkalinity	2,800 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	24	0.0024
Calcium	8,900	0.89
Copper	6	0.0006
Sodium	90	0.009

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO
420 CHIPETA WAY - SUITE 280
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SALT LAKE CITY, UTAH 84108
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TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47002
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, ROOFLOC 25'-26'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	7.2
Specific conductivity	110 umhos/cm
Alkalinity	2,800 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	20	0.0020
Calcium	700	0.07
Copper	10	0.0010
Sodium	90	0.009

David W. Gayer
Environmental Lab Director

ph

8 March 1983

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420 CHIPETA WAY - SUITE 280
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TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47008
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, LOCROOF 26'-27'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.4
Specific Conductivity	78 umhos/cm
Alkalinity	1,600 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	43	0.0043
Calcium	1,800	0.18
Copper	20	0.0020
Sodium	110	0.011

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO
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TWX 910-925-5268

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47000
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, LOCROOF 27'-28'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.1
Specific Conductivity	62 umhos/cm
Alkalinity	2,200 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	18	0.0018
Calcium	1,000	0.10
Copper	14	0.0014
Sodium	35	0.0035

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO
420 CHIPETA WAY - SUITE 280
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SALT LAKE CITY, UTAH 84108
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ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	46997
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, LOCROOF 28'-29'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	7.5
Specific Conductivity	82 umhos/cm
Alkalinity	2,400 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	24	0.0024
Calcium	4,400	0.44
Copper	21	0.0021
Sodium	110	0.011

David W. Cayes
Environmental Lab Director

ph

8 March 1983

MIDECO

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SALT LAKE CITY, UTAH 84108
TELEPHONE: (801) 582-3136
TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	46998
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, LOCROOF 29'-30'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.0
Specific Conductivity	50 umhos/cm
Alkalinity	2,800 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	18	0.0018
Calcium	1,900	0.19
Copper	22	0.0022
Sodium	140	0.014

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO
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SALT LAKE CITY, UTAH 84108
TELEPHONE: (801) 582-3136
TWX 910-925-5256

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47003
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-1, LOCFLOOR 40'-41.5'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	7.9
Specific Conductivity	170 umhos/cm
Alkalinity	2,400 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	39	0.0039
Calcium	33,700	3.37
Copper	12	0.0012
Sodium	120	0.012

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO

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UNIVERSITY OF UTAH RESEARCH PARK
SALT LAKE CITY, UTAH 84108
TELEPHONE: (801) 582-3135
TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	46996
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-2, 0'-3'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	7.9
Specific Conductivity	69 umhos/cm
Alkalinity	2,570 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	20	0.0020
Calcium	1,500	0.15
Copper	14	0.0014
Sodium	30	0.0030

David W. Gayer
Environmental Lab Director

ph

8 March 1983

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420 CHIPETA WAY • SUITE 280
UNIVERSITY OF UTAH RESEARCH PARK
SALT LAKE CITY, UTAH 84108
TELEPHONE: (801) 582-3136
TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	46994
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-2, 5'-8'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	7.7
Specific Conductivity	65 umhos/cm
Alkalinity	2,800 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	21	0.0021
Calcium	1,300	0.13
Copper	14	0.0014
Sodium	60	0.006

David W. Gayer
Environmental Lab Director

ph

8 March 1983

420 CHIPETA WA. -
UNIVERSITY OF UTA
SALT LAKE CITY '7
TELEPHONE: (80 B
TWX 910-925-525.

MIDECO

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47006
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-2, 8'-13'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.2
Specific Conductivity	65 umhos/cm
Alkalinity	2,800 mg/kg as Ca( ),

	mg/kg	Approx. %
Boron	16	0.0016
Calcium	500	0.05
Copper	17	0.0017
Sodium	86	0.0086

David W. Gayer
Environmental L

ph

8 March 1983

MIDECO
420 CHIPETA WAY - SUITE 280
UNIVERSITY OF UTAH RESEARCH PARK
SALT LAKE CITY, UTAH 84108
TELEPHONE (801) 582-3136
TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47004
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-2, 13'-18'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

TEST REQUESTED	RESULTS
pH	8.5
Specific Conductivity	69 umhos/cm
Alkalinity	2,400 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	15	0.0015
Calcium	700	0.07
Copper	7	0.0007
Sodium	37	0.0037

David W. Gayer
Environmental Lab Director

ph

8 March 1983

MIDECO
426 CHIPETA WAY SUITE 260
UNIVERSITY OF UTAH RESEARCH PARK
SALT LAKE CITY, UTAH 84108
TELEPHONE: (801) 582-3136
TWX 910-925-5258

ENVIRONMENTAL LAB ANALYSIS

LAB NUMBER	47007
SPONSOR	Valley Camp of Utah
SAMPLE IDENTIFICATION	BP-2, 18'-23'
STARTING DATE	25 Feb 83
COMPLETION DATE	01 Mar 83

****

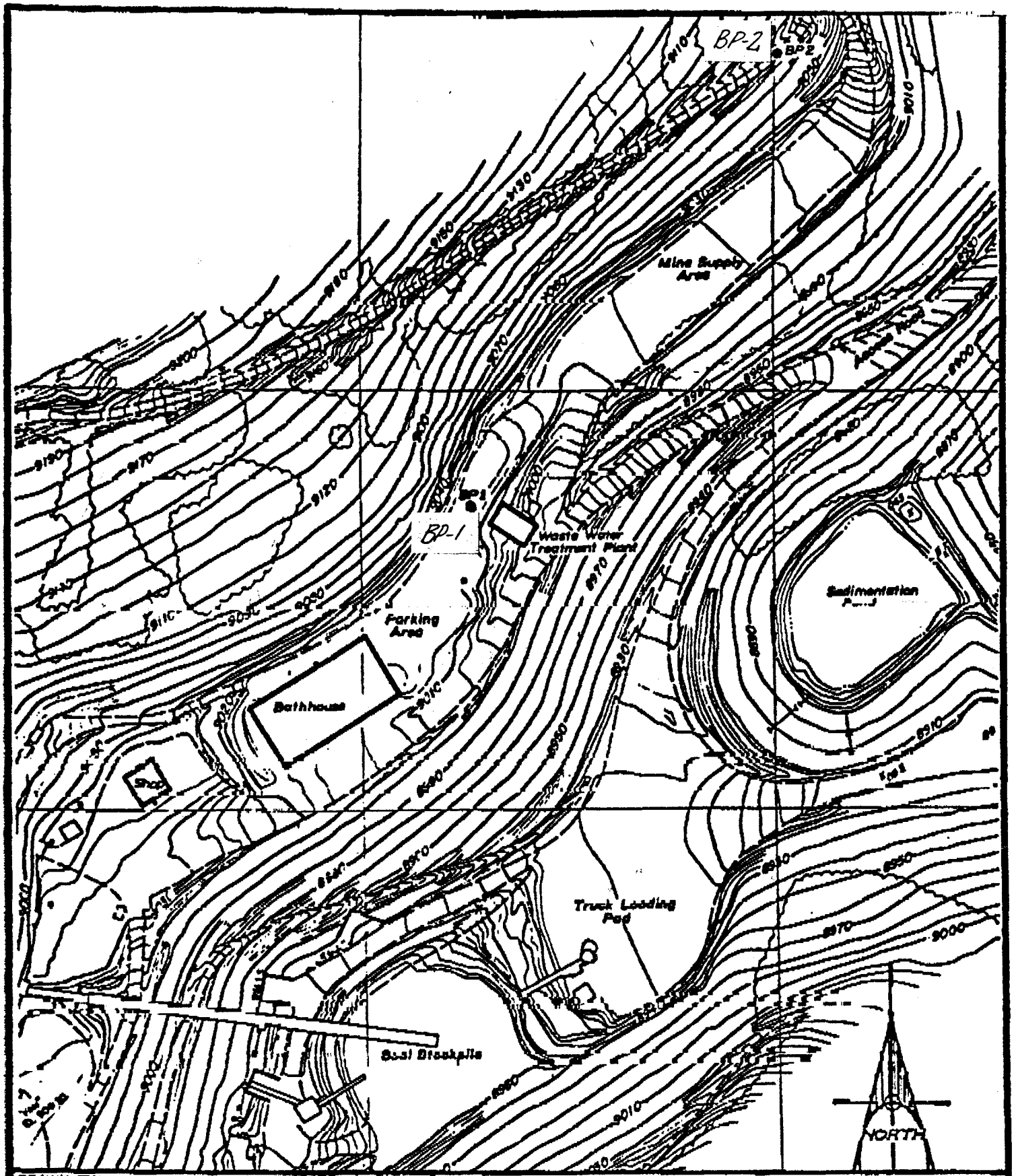
TEST REQUESTED	RESULTS
pH	8.1
Specific Conductivity	71 umhos/cm
Alkalinity	2,290 mg/kg as $CaCO_3$

	mg/kg	Approx. %
Boron	30	0.0030
Calcium	800	0.08
Copper	6	0.0006
Sodium	110	0.011

David W. Gayer
Environmental Lab Director

ph

8 March 1983



DRAWN BY: Ed Sanderson	DATE: March 7, 83
CHECKED BY:	DATE:
REVISED BY:	SCALE: NONE
APPROVAL ENG.:	
APPROVAL SAFETY:	TITLE:

VALLEY CAMP of UTAH
SCOFIELD ROUTE
HELPER, UTAH 84526

NVLAP
Accredited

GARCO TESTING LABORATORIES

532 West 3560 South
Salt Lake City, Utah 84115
Phone 266-4498

5826 South 1900 West
Roy, Utah 84067
Phone 776-5355

December 2, 1988

RECEIVED
DEC - 6 1988
VALLEY CAMP OF UTAH, INC.

Valley Camp of Utah, Inc.
Scofield Route
Helper, Utah 84526

Attn: Steve Tanner:

Sample 1 & 5
Soil Classification - Sandy Clay (CL)

Pn (PSF)	500	1000	1500
At Peak % Load	15.9	20.5	34.1
(PSF) Shear Strength	763	984	1637
M.C.i	15.2	15.8	14.7
γ di	115.7	113.4	120.1
MC f	17.3	16.9	15.8
γ df	108.2	120.4	126.4

Sample 2
Soil Classification - Very fine sand (ML)

Pn (PSF)	100	200	400
At Peak % Load	6.1	7.1	8.6
Shear Strength (PSF)	293	341	413
M.C.i	42.7	40.6	32.0
γ di	76.4	78.8	83.8
MC f	44.6	41.6	38.5
γ df	75.4	80.4	85.9

MC = Moisture Content
γf = Dry Unit Weight

Sincerely,

Tom McNamee
Lab Manager

cc: Randy Harten
Div of Oil,Gas,Mining

NVLAP Accredited

GARCO TESTING LABORATORIES

532 West 3560 South
Salt Lake City, Utah 84115
Phone 266-4498

5826 South 1900 West
Roy, Utah 84067
Phone 776-5355

RECEIVED 1988 VHA

December 2, 1988

Valley Camp
Scofield Route
Helper, Utah 84526

Attn: Steve Tanner

Gentlemen,

Enclosed are the in place density, direct shear, soil classification and cohesion properties of samples taken from Valley Camp Pond #1.

The pond bottom is a light brown sandy clay with some silt. The south and west sides have a gray silty sand. The color change could be natural but is probably the result of coal dust deposited in the pond over the years.

Samples were taken by driving (by hand) a thin walled aluminum tube into cut outs from the embankment approximately 2 feet above the water and 2 feet in from the surface.

Samples #1 & #5, and #2 & #3, were so similar that only one direct shear was done per set. Sample #4 was disturbed and no direct was performed but the torvane shear in the field was 200 psf.

As to the request of Randy Harten, Division of Oil, Gas and Mining, no engineering analysis has been performed , only the testing of the samples. If you have any questions regarding this information please do not hesitate to call.

Sincerely,

Tom McNamee
Lab Manager

cc: Randy Harten
Division of Oil, Gas,Mining

BY EGL DATE 11/18/58

CHECKED BY

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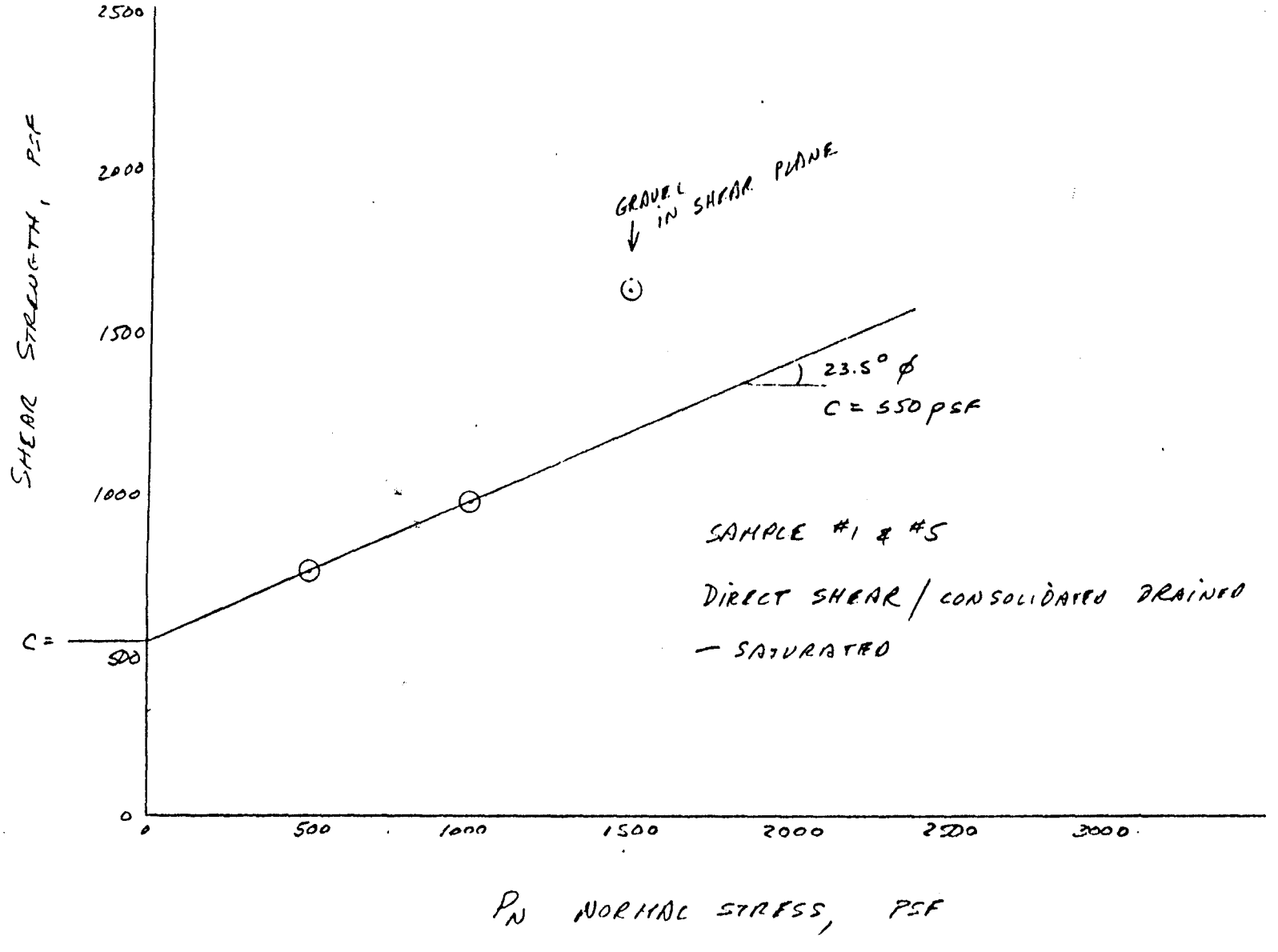
REVISIONS

BY DATE TO EO

BY DATE TO EO



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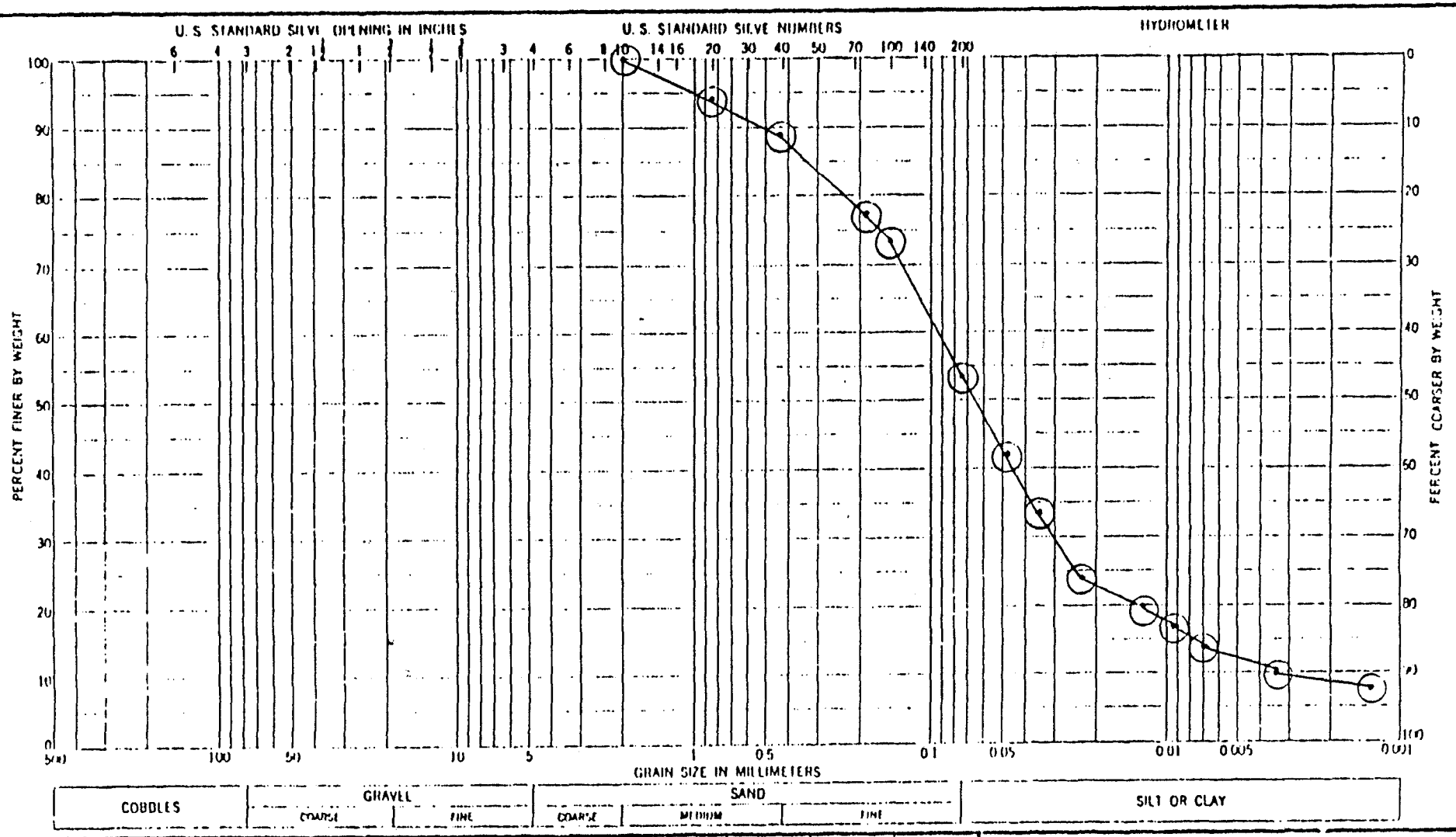


Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
1		SANDY CLAY (CL)		18	16	2

Project VALLEY CAMP

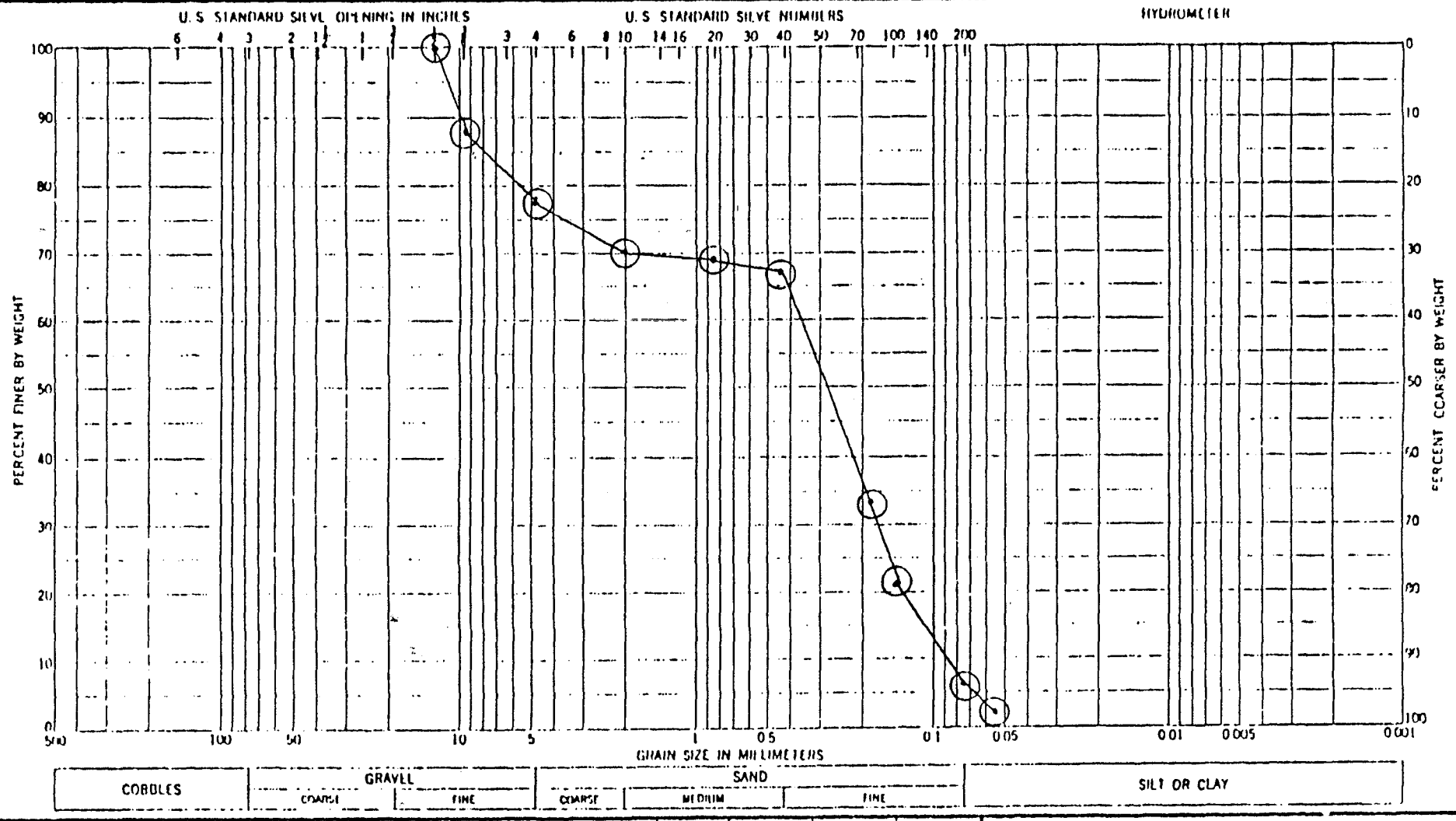
Area POND #1

Boring No 1

Date

GRADATION CURVES

ENG FORM 1 MAY 63 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
4	—	SILTY SAND (SM) WELL GRADED SAND (SW)		NON-PLASTIC		

Project VALLEY CAMP

Area POND #1

Boring No 4

Date

GRADATION CURVES

ENG FORM 1 MAY 63 2087

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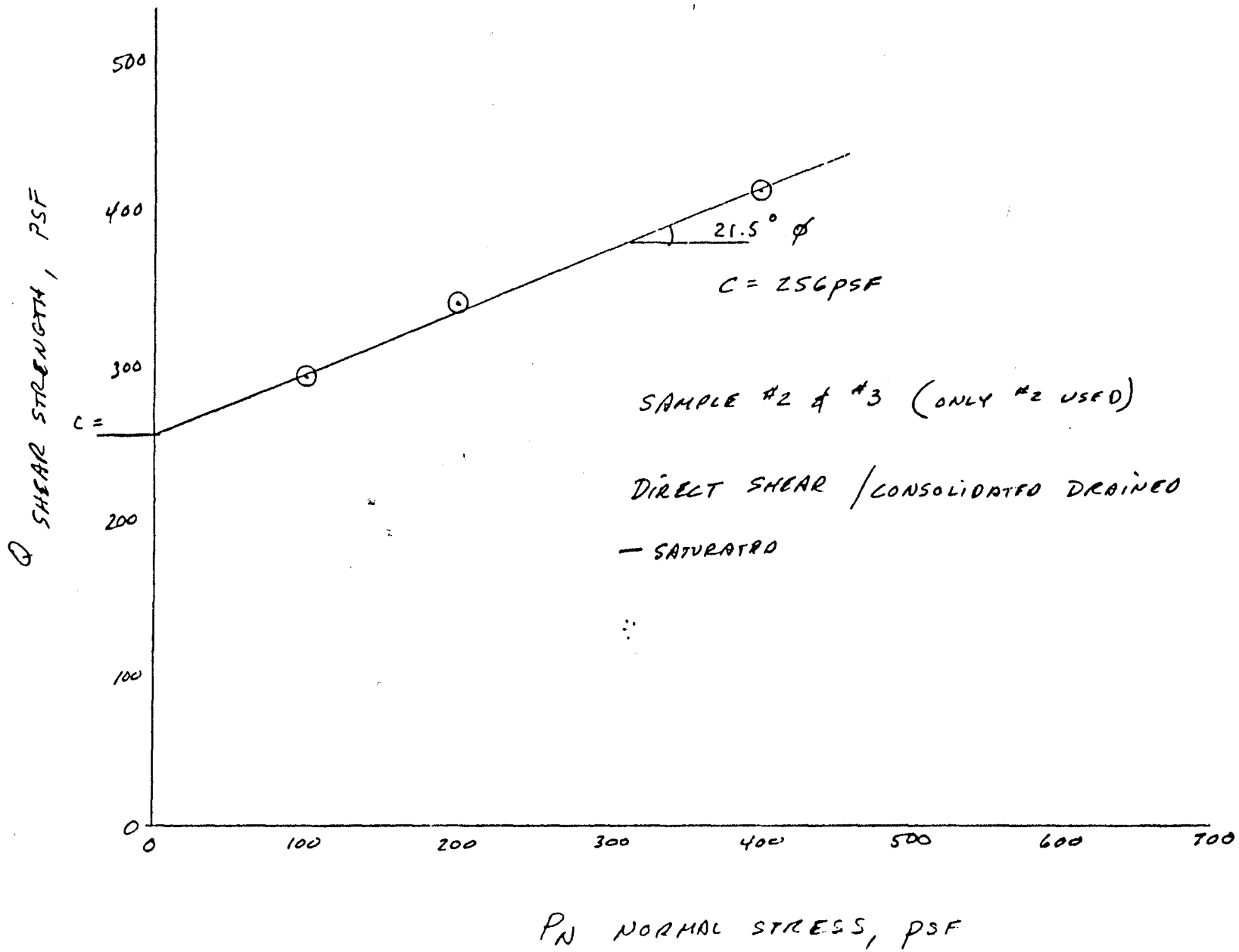
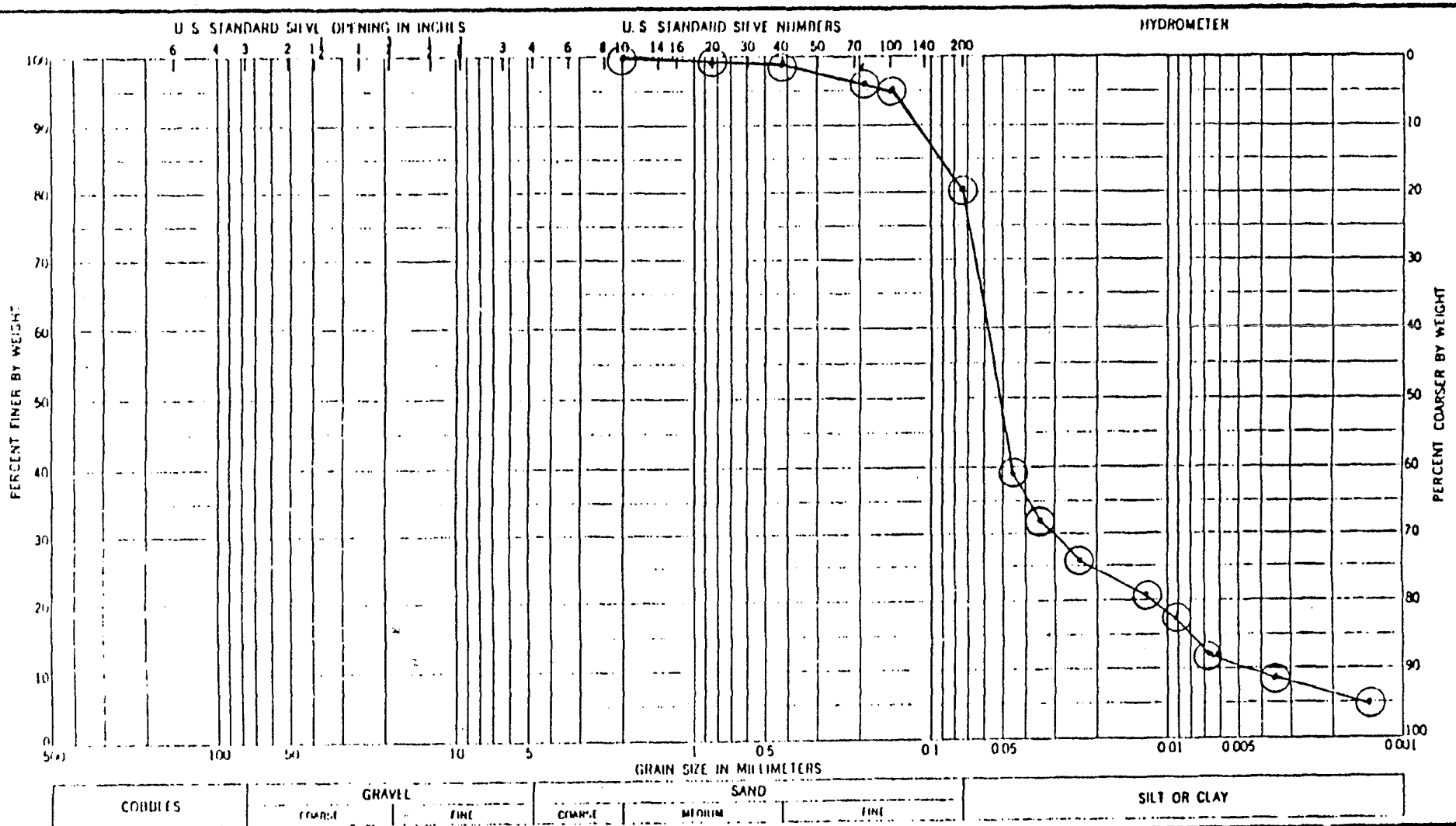
BY DATE TO EO



FILE
SUBJECT GRACO - DS/CD TEST
SHEET 0

PRINTED IN U.S.A.



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
2	–	VERY FINE SAND (ML)		NON-PLASTIC		

Project VALLEY CAMP

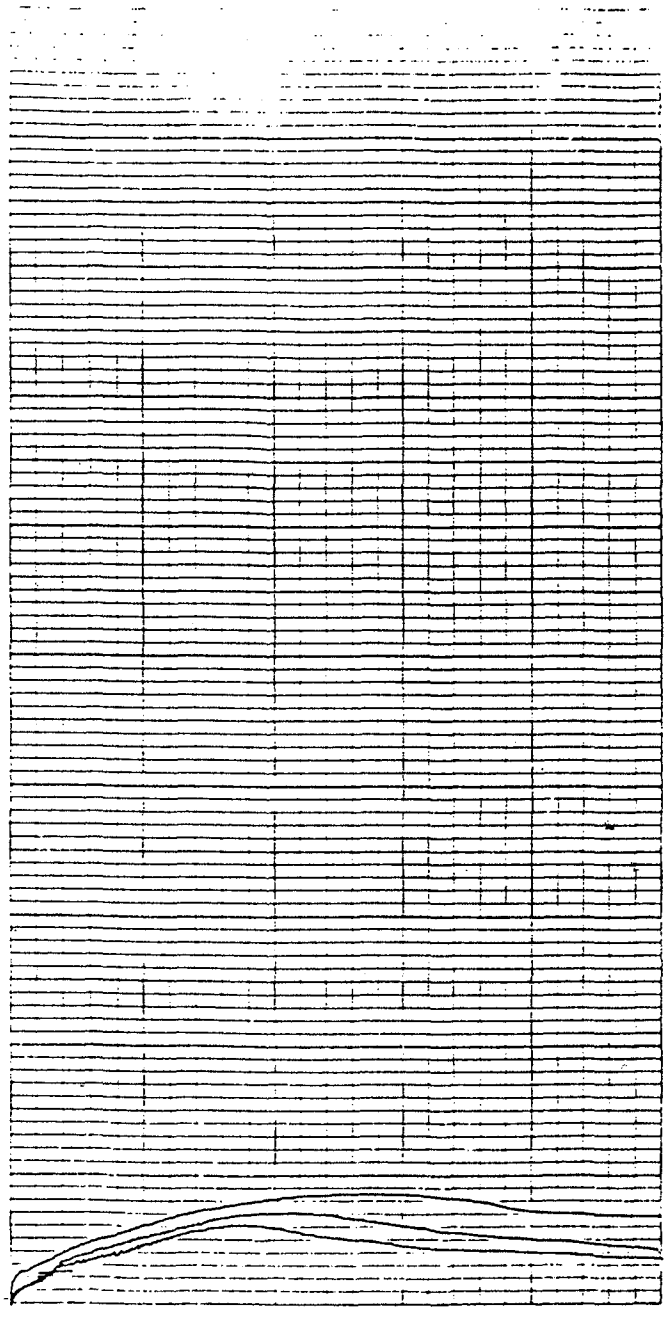
Area POND #1

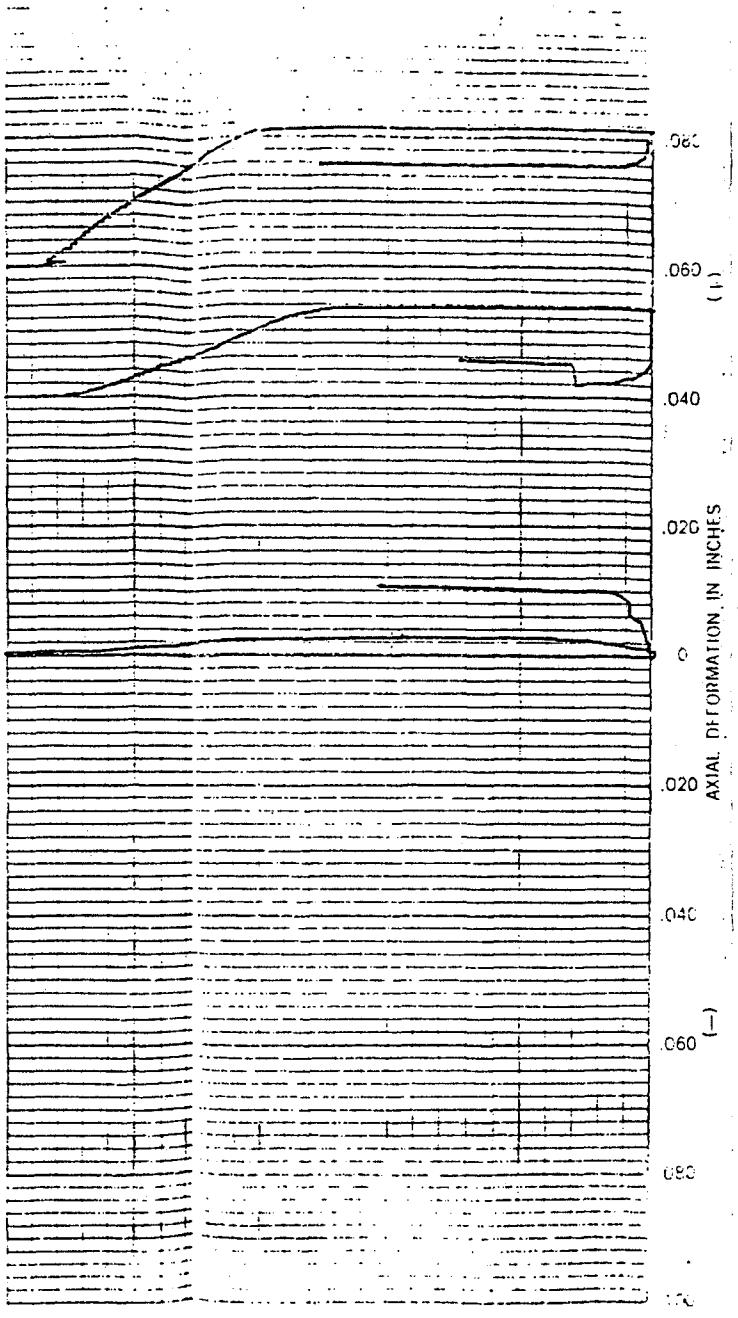
Boring No. 2

Date

GRADATION CURVES

ENG FORM 1 MAY 63 2087





DIRECT SHEAR TEST
Sheet 1 of 2

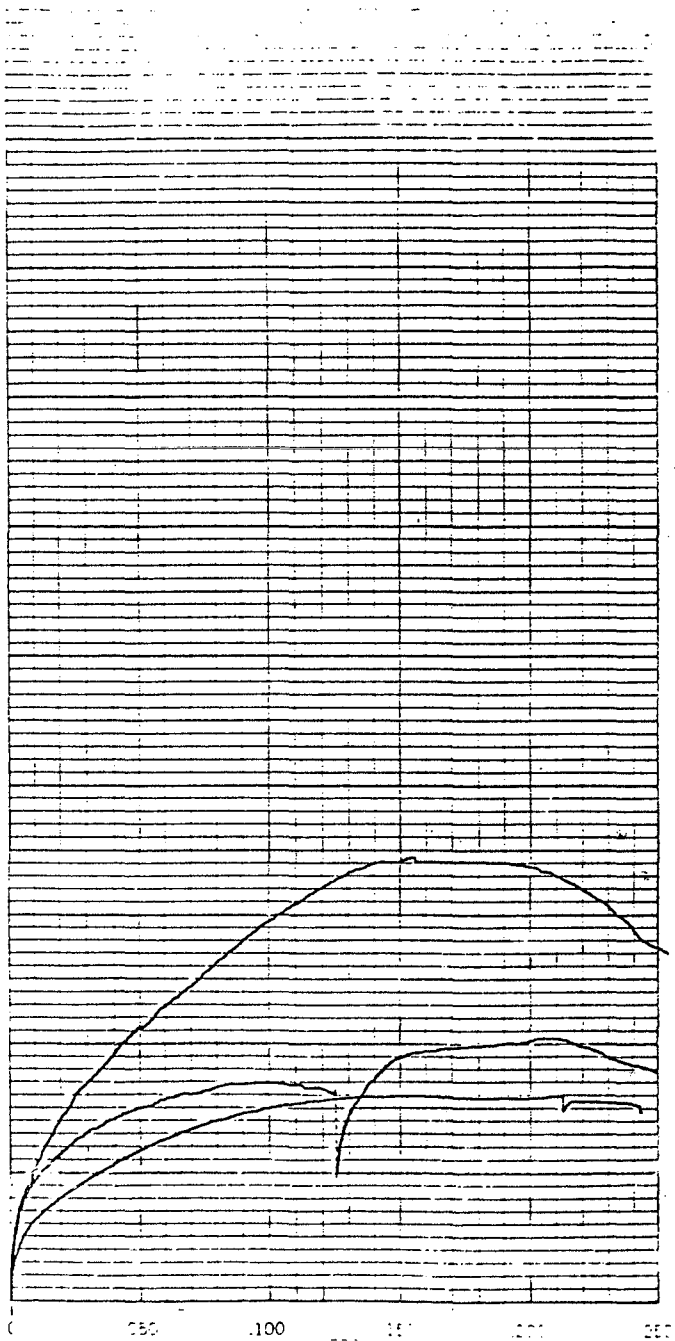
PROJECT Y/ALLEY CAMP PROJECT NO. 506
LOCATION SLC
BORING — SAMPLE 2 DEPTH (FT.)
SAMPLED BY GARCO TESTED BY
SOIL IDENTIFICATION GRAY SI CLAY & ORG

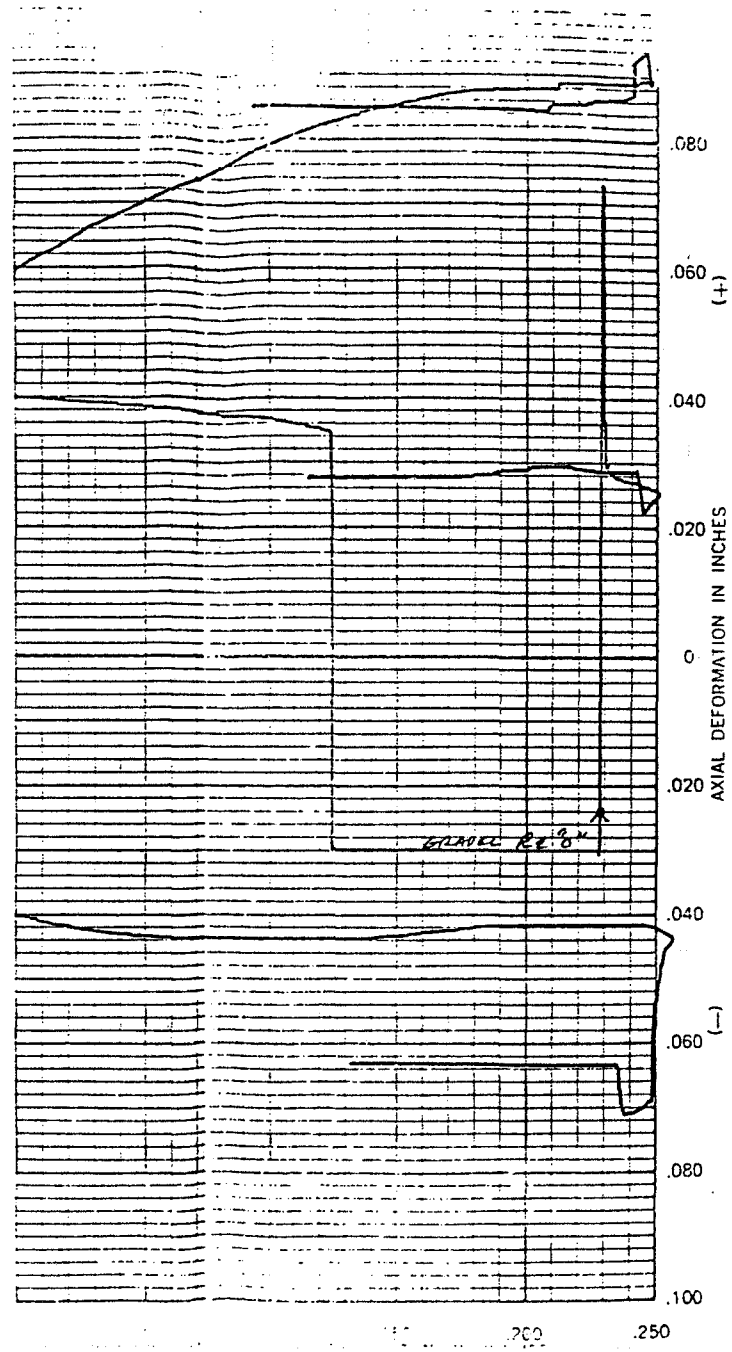
TYPE OF TEST DS/CD
SHEARING RATE .012 IN/MIN
NORMAL PRESSURE PSI = 4800
LOAD RANGE USED 40(12K) = 48

	PEAK	ULTIMATE
% SHEAR LOAD		
SHEAR STRENGTH (psf)		
HORIZONTAL DEFORMATION (in.)		

PN	100	200	400
~~REMARKS~~ At Peak % LOAD	6.1	7.1	8.6
SHEAR STRENGTH	293	341	413
M.C.	42.7	40.6	32.0
γ_{di}	76.4	78.8	83.8
M.C.f	44.6	41.6	38.5
γ_{df}	75.4	80.4	85.9

OFFICE NUMBER 31 RECORDER NUMBER 7434
SHEAR EQUIPMENT NUMBER 7327 B
RECORDER CALIBRATION CHECKED 8/84
RECORDER PERFORMANCE CHECKED 8/84
EQUIPMENT PERFORMANCE CHECKED 8/84
EQUIPMENT CHECKED BY EGC DATE 11/13/





DIRECT SHEAR TEST DATA SHEET
Sheet 1 of 2

PROJECT Valley Camp PROJECT NO. 5066
LOCATION SLC
BORING — SAMPLE 5 DEPTH (FT.) —
SAMPLED BY CARLO TESTED BY PGK 11 R. St
SOIL IDENTIFICATION BrFi-C SA CLAY OCC TR Fi GVL

TYPE OF TEST: DS/CD
SHEARING RATE: .012 in./hr.
NORMAL PRESSURE: psi = 4800 p
LOAD RANGE USED: 20 = 48. psi

	PEAK	ULTIMATE
% SHEAR LOAD		
SHEAR STRENGTH (psf)		
HORIZONTAL DEFORMATION (in.)		

PN	500	1000	1500
~~REMARKS~~ At Peak % LOAD	15.9	20.5	34.1
SHEAR STRENGTH	763	984	1637
H.C.i	15.2	15.8	14.7
γdi	115.7	113.4	120.1
H.C.f	17.3	16.9	15.8
γdf	108.2	120.4	126.4

GRADED RE.8"

OFFICE NUMBER: 31 RECORDER NUMBER: 7434
SHEAR EQUIPMENT NUMBER: 7327B
RECORDER CALIBRATION CHECKED: 8/84
RECORDER PERFORMANCE CHECKED: 8/84
EQUIPMENT PERFORMANCE CHECKED: 8/84
EQUIPMENT CHECKED BY EGL DATE 1/13/88

ROLLINS,
BROWN and
GUNNELL,
INC. professional engineers

November 16, 1988

NOV 17 1988

VALLEY CAMP OF UTAH, INC.

Barry Barnum
Scofield Route
Helper, UT 84526

Gentlemen:

We have completed the required testing of soil samples obtained from two test pits excavated at Valley Camp near Scofield, Utah. The location of the test pits are shown in Figure No. 1 with their logs presented in Figure No. 2. It will be observed that the subsurface materials in both areas consist of a brown gravelly sandy silty clay.

Sampling of the test pits occurred at three-foot intervals throughout the depth investigated. Each sample was classified according to the Unified Soil Classification System. The symbols designating the soil type are shown on the logs.

The in-place unit weight and natural moisture content are also shown on the logs ranging from about 90 pounds per cubic foot to about 110 pounds per cubic foot and 6% to 11% respectively for Test Hole No. 1 and from 91 pounds per cubic foot to 97 pounds per cubic foot and 8.6% to 21.5% respectively for Test Hole No. 2.

The saturated unit weight for samples obtained from about 6 feet below the ground surface in Test Hole No. 1 is 118.2 pounds per cubic foot.

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

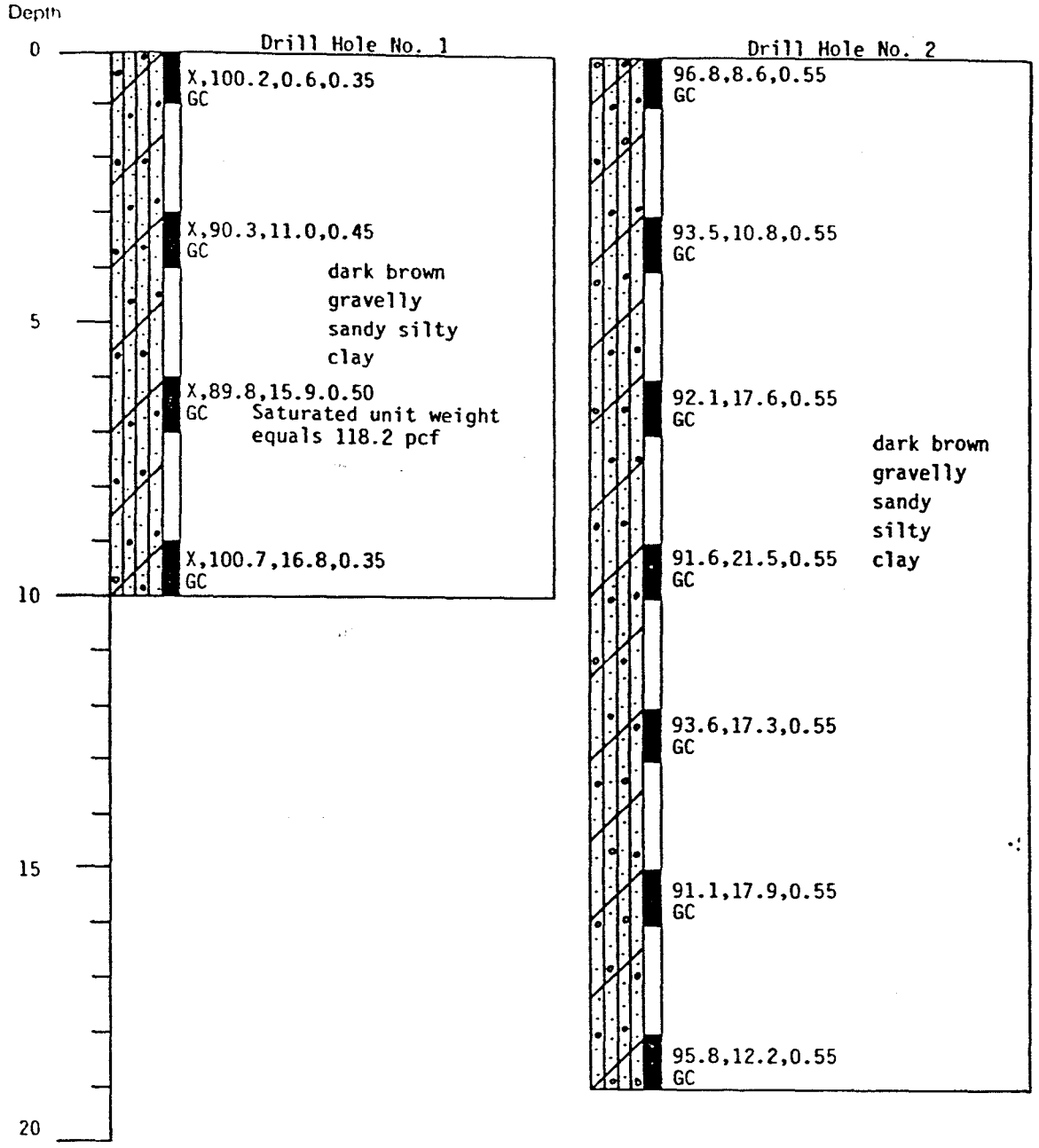
A consolidated drained direct shear test was performed on the samples from a depth of 6 feet in Test Hole No. 1. The results are shown in Figure No. 3 in the form of a Mohr envelope. The results indicate a friction angle of 38.5 degrees and a cohesion of 1 psi.

If you have any questions regarding the information contained herein, please contact me.

Yours truly,

Steven L. Smith

SLS:jsh



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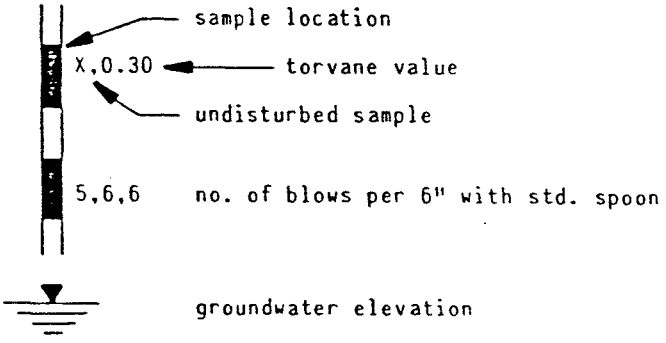
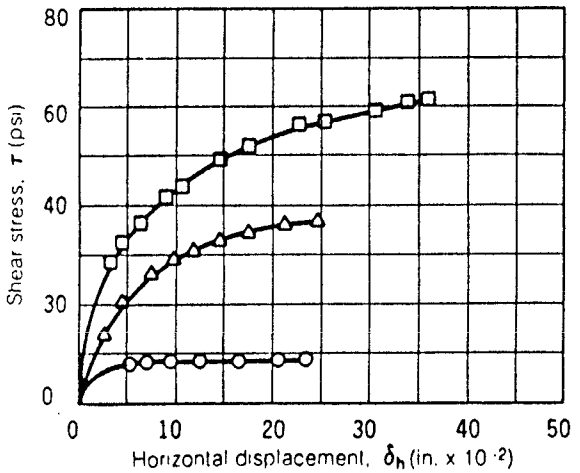
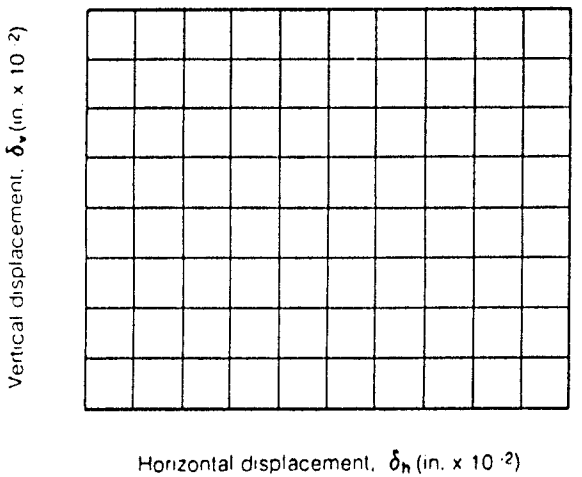


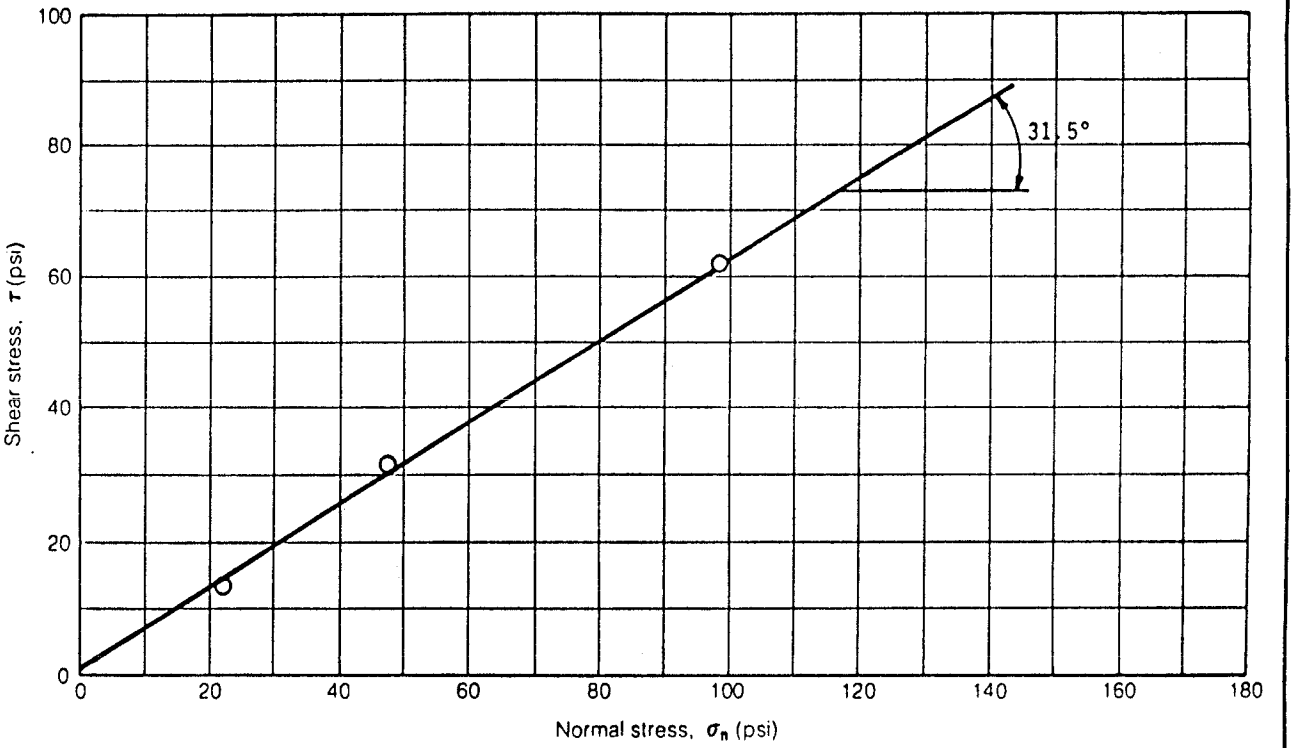
ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

Log of Borings for:
Valley Camp of Utah

Figure No. 2







Test no. or symbol	Sample size (inches)	Sample data		Degree of saturation (%)*	Normal stress σ_n (psi)	Maximum shear stress τ (psi)	Strain rate (inches / minute)	Shear strength parameters	
		Dry density (pcf)	Moisture content (%)					Friction angle ϕ (degrees)	Cohesion (c / psi)
○		88.6	15.9	100	22.7	13.0	.005	31.5	1
□		88.6	15.9	100	45.8	31.1	.005		
△		88.6	15.9	100	99.2	61.0	.005		

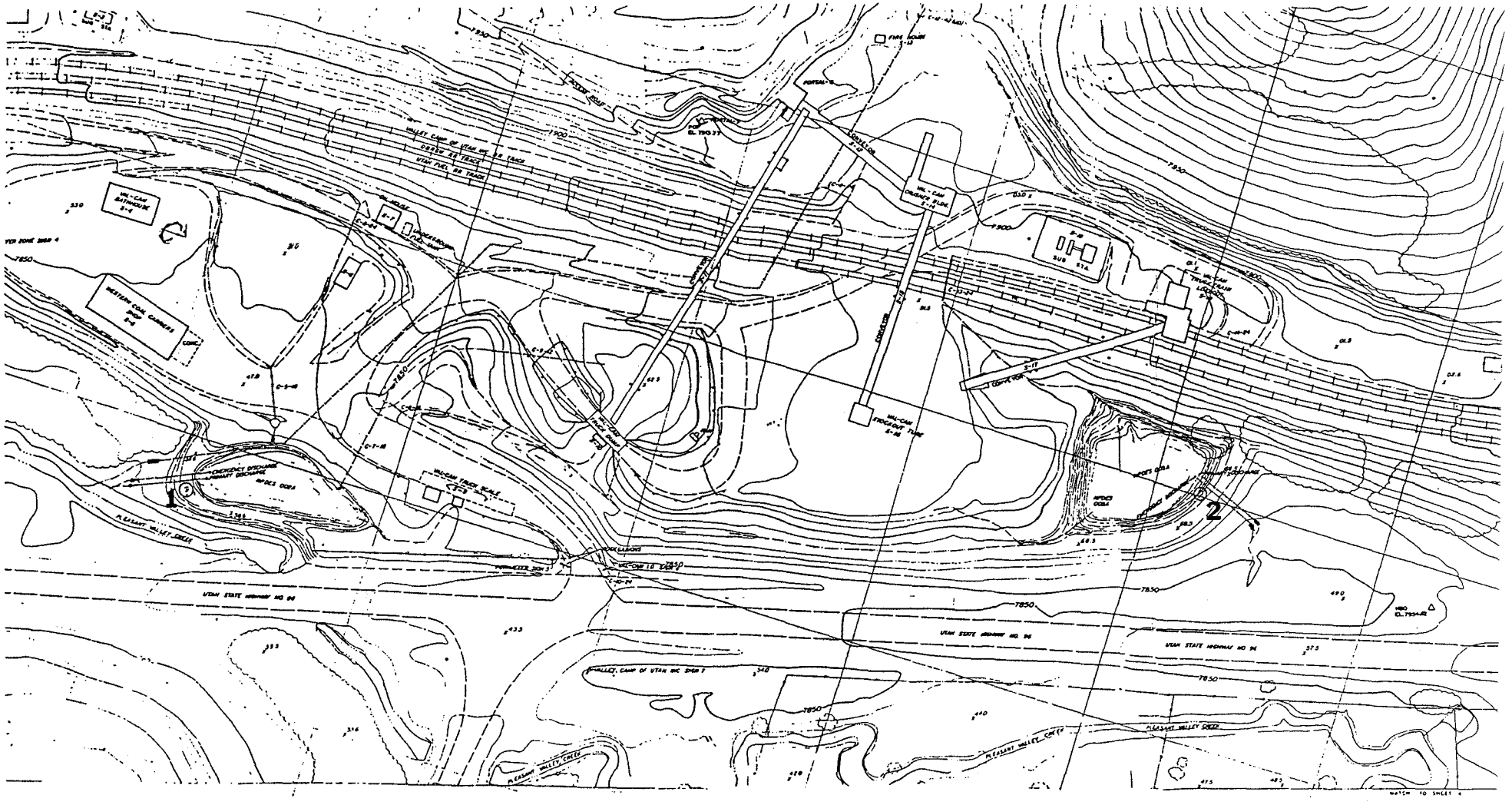
*Assumed

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

DIRECT SHEAR TEST
Project: Valley Camp of Utah

HOLE NO. 1
DEPTH: 6'

FIGURE NO. 3



ROLLINS, BROWN and GUNNELL, INC. professional engineers

Site Plan and Location of Drill Holes
Valley Camp of Utah

FIGUR
NO 1

APPENDIX 622.100

Well Logs
(CONFIDENTIAL)

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

See Confidential Appendix