0013

UTAH POWER & LIGHT COMPANY

1407 WEST NORTH TEMPLE STREET
P. O. BOX 899
SALT LAKE CITY, UTAH 84110

ACT/015/019 #2

October 3, 1983

RECEIVED
OCT 3 1983
DIVISION OF
OIL, GAS & MINING

Mr. Cyril J. Young
State of Utah
Department of Natural Resources
Division of Oil, Gas & Mining
4241 State Office Building
Salt Lake City, Utah 84114

Re: Waste Rock Disposal Plan
Wilberg Mine ACT/015/018B
Des-Bee-Dove Mine ACT/015/017

Dear Mr. Young:

Enclosed are 28 copies of the amended Waste Rock Disposal Plan for the Wilberg and Des-Bee-Dove Coal Mines.

This revised plan incorporates additional information as requested in your letter of August 8, 1983 and supercedes all previous submittals including those contained in the Coal Mine Permit Applications of March 20, 1981.

Please use these copies to replace Appendix VII of the Wilberg Mine Plan and Appendix V in the Des-Bee-Dove Plan.

Yours truly,

C. E. Shingleton

C. E. Shingleton
Director of Permitting,
Compliance & Services
Mining and Exploration

CES:bb:4088
Encl.

WILBERG WASTE ROCK STORAGE SITE

Introduction

Waste rock generated from the Des-Bee-Dove and Wilberg Coal Mines has exceeded our original estimates to the point where additional storage areas are needed. In this application we propose to add a series of six additional interconnected storage sites to be utilized sequentially as waste rock is generated.

The concept of utilizing individual earthen containment structures is based on existing environmental regulations promulgated from Public Law 95-87.

Specifically, individual small structures to meet only present day needs and ongoing reclamation lessens soil, sediment and hydrological impacts associated with open faced rock disposal structures. Limiting the height of the fill structure assures the long-term structural safety factor stated in the regulations. By design, the containment structure also becomes a sediment structure capturing storm runoff waters and snow melt without discharge. Topsoil handling utilizes small storage piles or berms which are revegetated during use.

There are no long-term negative impacts associated with this type of rock storage disposal.

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OCT 3 1980
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784.19 - Description

784.19 (b) (1) - Geology - The proposed waste rock storage site is an area of low relief paralleling the Wilberg Mine road with a gently sloping topography. The elevation of the site varies from 6890 feet in the northwest corner down to 6700 feet in the southeast. Grimes Wash, an intermittent stream, passes near the site cutting a steep sided channel along a portion of the NE boundary. Along these steeply cut banks, good exposures of the strata are found.

The site is situated upon colluvium ranging in thickness from approximately 50 feet in the northwest corner to 35 feet in the southeast and lying unconformably upon the Mancos Shale. Depths of colluvium are projected from outcrop in Grimes Wash nearby. The colluvium is conglomeratic consisting primarily of cobble sized sandstone material ranging down to pebble and cemented with a friable sandy mud. Boulders in excess of eight feet in diameter are randomly interspersed within the colluvium. The fabric and cementing material of the colluvium render it moderately permeable.

The colluvium weathers to a loose sandy soil, light brown in color with sand particles ranging from fine to medium grained. The soil tends to be low in compactability and of moderate permeability. The loose soil can be eroded during major precipitation events but the permeability of the soil counteracts this by allowing for the infiltration of runoff.

Soils at the proposed site were sampled on the north and south ends. Results of these analyses are shown in Table 1 and in the enclosed soil description.

TABLE I

WASTE ROCK DISPOSAL SITE

	North End	South End
pH	7.90	8.25
ECe (mmhos/cm)	.9	.85
SAR	1.85	1.76
Sand	20%	20%
Silt	60%	65%
Clay	20%	15%
Sodium	110	95
Calcium	210	150
Magnesium	34	42

784.19 (b) (2) - Hydrology - The hydrology of the site is limited to surface water. The natural drainages in the area (as shown on Drawing CM-10361-WB) trend NW/SE terminating into Grimes Wash. Rainfall projections for this area predict a 3.0 inch rainfall for the 100 year/24 hour precipitation event.

Geologic studies of the area (Hintze) identify the Ferron Sandstone as the first possible water bearing member in the Mancos Shale Formation. Oil and gas wells drilled in the area report no water when drilling through the Mancos Shale Formation. One well drilled on the proposed site encountered no water down to 4900 feet from the surface. Another well drilled three miles south of the site encountered no water drilling through the Mancos Shale down to 11,500 feet from the surface (GR elev. 6023'). These wells are the nearest

to the proposed site on record. Records are on file at the Division of Oil, Gas and Mining.

817.71 (a) - Proposed Disposal Plan - The proposed disposal structures will utilize a maximum of 16 acres, including storage of excavated soils, and retaining berms.

The basic disposal plan is to remove the top layer of weathered materials and to form these materials into three connected berms as shown on CM-10361 and Figure 1. This will involve removing some one foot of material at each site which will be utilized to form the berms some 5.5 feet high at a 2 horizontal to 1 vertical slope.

The berm structure will be compacted and revegetated to minimize erosion.

The underground development waste will be stored in the excavation starting at the southeast end and progressing northwesterly.

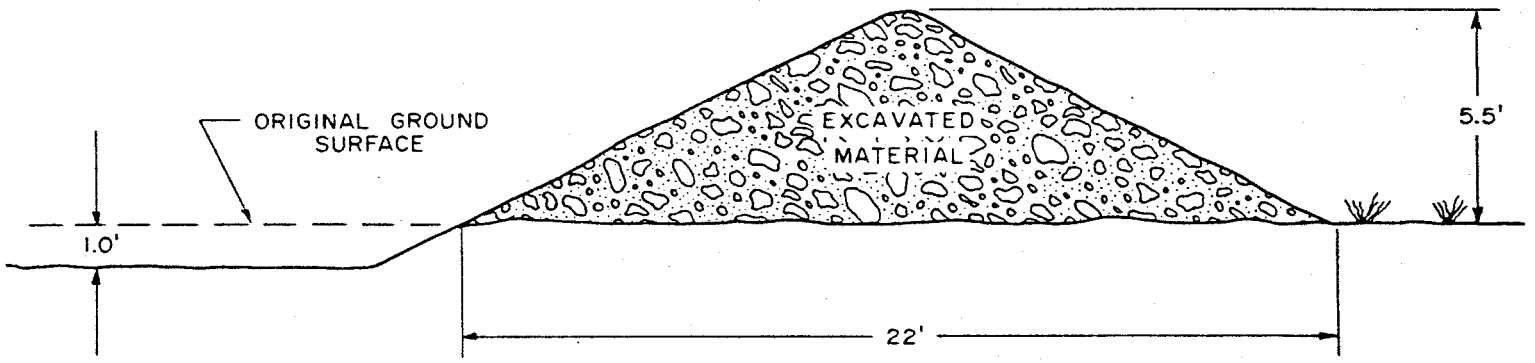
The fill will be placed in a single horizontal lift, 4 feet high, until placement is completed.

The interior berms will then be removed and the material will be used to cover the stored rock and the site will again be reseeded.

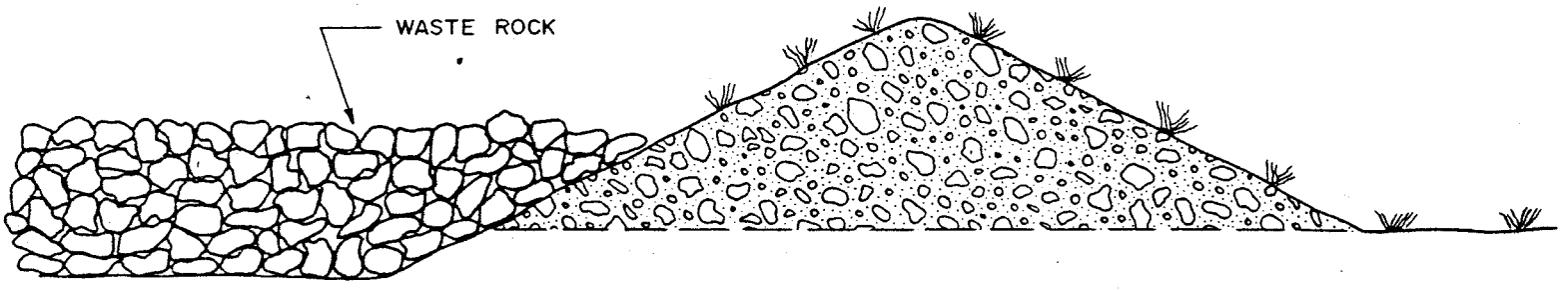
The final slope of the disposal pile will approximate the original contours and will be about 3.6 feet higher than the existing ground with 2:1 outslopes as shown in Figure 1.

Development of each new structure will require construction of two additional berms to form the containment site as shown on Drawing

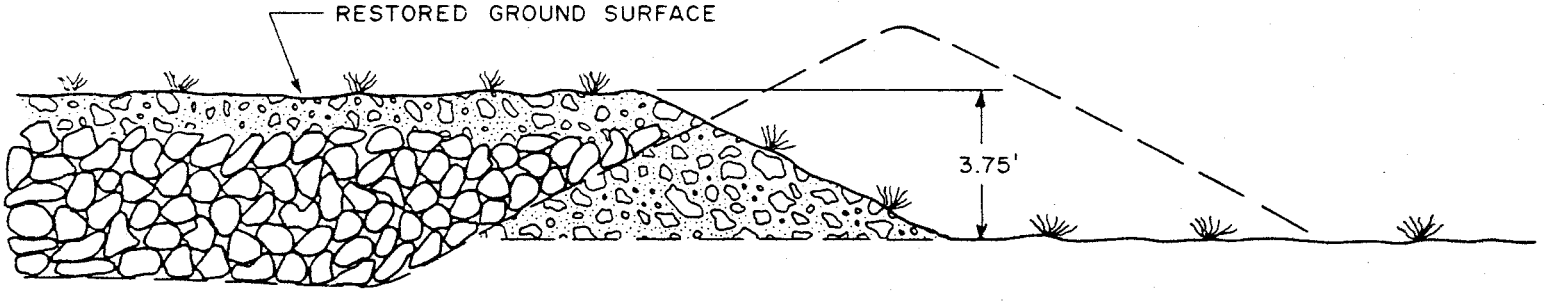
I. EXCAVATION AND BERM CONSTRUCTION



II. PLACEMENT OF FILL



III. COVERED FILL



SCALE: 1" = 5'

FIGURE 1

WASTE ROCK DISPOSAL: BERM DETAIL

CM-10361-WB and Figure 2. This material will be excavated as previously described.

Presently, two containment structures have been built. Extension of these structures requires construction of two additional berms which connect the new structure to the existing structure.

Construction of a typical 150 foot by 400 foot cell excavated one (1) foot deep will yield about 2,200 cubic yards of soil medium. The new berm construction will require about 1200 cubic yards (550 feet of berm x 62 cubic feet per linear foot ÷ 27 = 1,200 cubic yards of material. The remaining 1,000 cubic yards of excavated material will be placed over the adjacent earthen cell last filled. As individual cells are developed, reclamation of completed cells will take place. Soil medium will be approximately 12 inches deep.

Half of the required soil cover will come from the newly developed earthen structure and half from the no longer needed interior berms situated between old and new cells. On final reclamation, exterior berms will be removed and spread in areas lacking the 12 inch cover necessary to complete final grading and backfilling.

Topsoil, or substitute soil medium, will consist solely of the material excavated during construction of the earthen containment structures. Chemical and physical analysis of this soil medium are included in this text.

Physical configuration of the berms, which constitutes the soil storage sites during mining, is a triangular cross-section whose

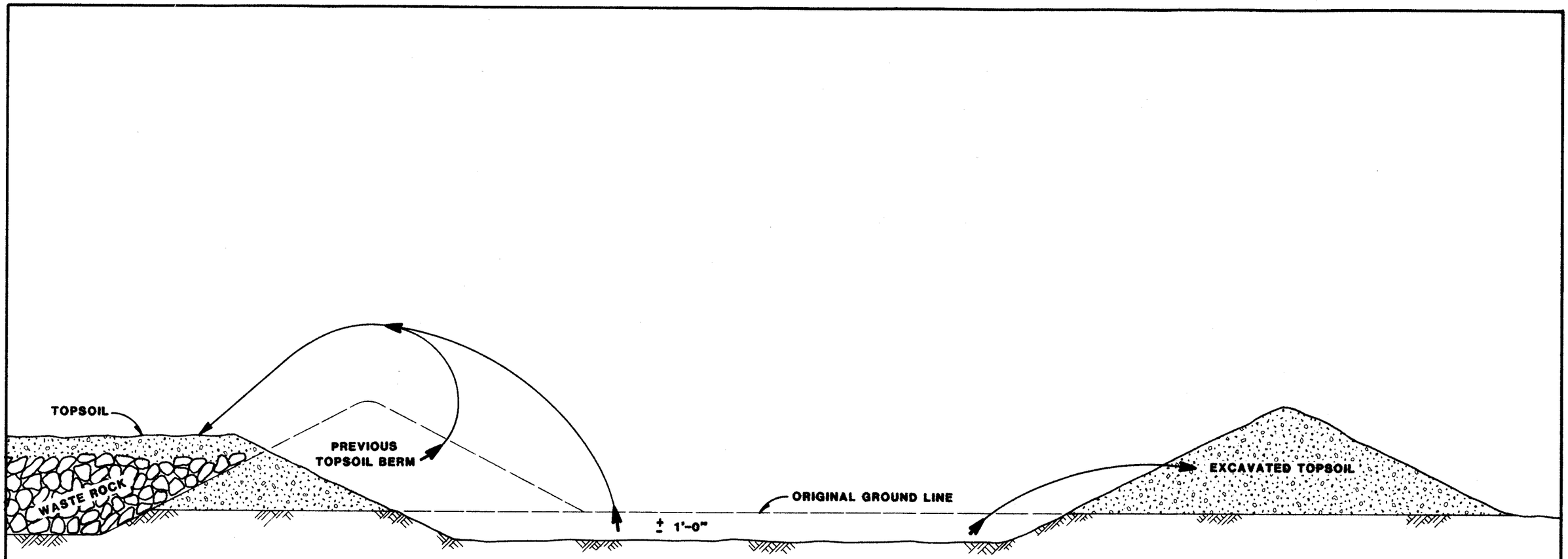


FIGURE 2

TOPSOIL HANDLING PLAN

base is 22 feet wide tapering to a peak which measures 5.5 feet high (see Waste Berm Design, Figure 1.

As the berms are constructed with a crawler tractor compaction is limited. It is desirable to compact the soil only to the point of resisting water migration or to the point of withstanding water impoundment. The earthen containment structures are designed to contain, without discharge, all storm runoff waters up to and including a 10 year 24 hour storm event. Berm compaction is necessary as they are required to hold residual waters. The worst condition would be an empty cell where storm waters would collect towards the southern or closed end of the cell.

Based on S.C.S. curve numbers an unvegetated pit with moderate to poor drainage characteristics would interpolate to be about a CN-80 which would yield a runoff of .44 inches from a 1.8 inch storm event (Figure 3).

Given these factors, and assuming the CN number is correct, the reservoir capacity of impounded waters is .05 acre feet or 2,200 cubic feet. Standing water would measure 18 inches deep, 150 feet long and 20 feet wide. As proven by similar structures, such as cattle watering tanks built throughout the area, it is reasonable to assume this structure is adequate, both structurally and hydrologically.

Final reclamation carries with it a much greater storm event. The N.O.A.A. atlas depicts for this area 3.0 inches as the precipitation expected for a 100 year storm.

10 YEAR / 24 HOUR
HYDROLOGICAL CONDITIONS

1.8" PRECIPITATION EVENT

CN≠80

RUNOFF .44

FORMULA

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

$$Q = \frac{(P-.2S)^2}{(P+.8S)}$$

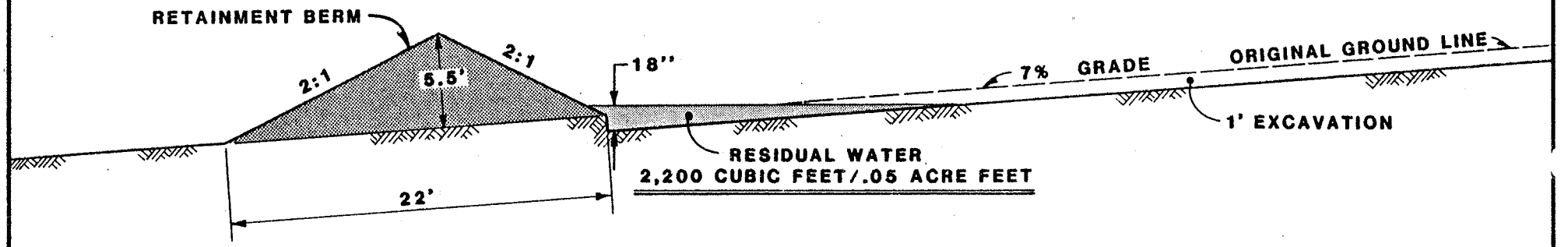


FIGURE 3

TYPICAL LONGITUDE CROSS-SECTION OF AN EMPTY EARTHEN CELL

Each completed waste rock containment structure consists of over four (4) feet of shot and crushed sandstone and mudstone rock. Though pushed and bladed by a crawler tractor during filling, it still is fairly loose in terms of compaction (Figure 4).

784.13 (b)(4) - Top Soil Handling Plan - As previously described, topsoil, or the substitute soil medium, will be the top 12 inches of the proposed containment structure. Of the excavated soils, half will be placed on finished cells or structures and will be placed in a topsoil configuration, together with native seeds, mulch and fertilizer. The other half will be used as containment berms forming the individual cells. Each berm will be compacted lightly to hold its shape and allow interim seeding on its exposed outer faces.

On completion of the individual cells (full of waste rock) interior berms will be bladed and removed. The removed berms will become surface soils for the cells last completed. Duration of the soil medium as a semi-compacted berm would depend on the amount of waste rock being generated.

Applicant does not anticipate any long-term storage of topsoil in berm form before its final disposition. Backfilling and grading of removed berms will loosen the soils for greater acceptance of mulch and water.

Final reclamation will incorporate soil spreading, scarifying, mulching and harrowing. The final cover will reflect a loose and deep cultivated mantle on which the nature plants can establish a deep root zone assuring draught resistant plants.

100 YEAR / 24 HOUR HYDROLOGICAL CONDITIONS

3.0" PRECIPITATION EVENT
CN≠51
RUNOFF .11

FORMULA

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

$$Q = \frac{(P-.2S)^2}{(P-.8S)}$$

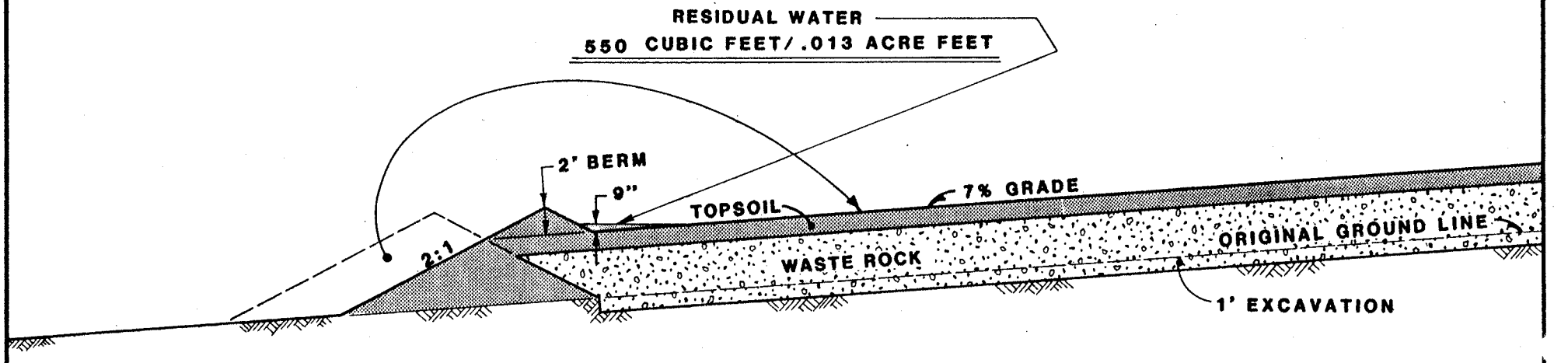


FIGURE 4

FINAL RECLAMATION
TYPICAL LONGITUDE CROSS-SECTION
OF A FILLED EARTHEN CELL

784.19 (a) 817.71 (b) - Disposal Structure - Drawing CM-10359-WB shows present topography and approximate excavation cross-sections.

The proposed excavation will be approximately 1 foot below the existing soil surface. The excavation will be banked on three sides by the excavated material. The open (unbanked) end of the excavation will be on the upslope side.

Construction of the disposal excavation and berms will be accomplished by standard earth construction practice.

Maintenance of the facility will involve annual inspections and required repair. Should the inspection identify a need for repairs, repairs will be made as requested by the inspector.

Waste rock will be transported from the mines and placed on the site by truck. Once disposal is complete and fill leveled, the surrounding berms will be pushed over the fill and graded. The approximate final slope is shown in the cross-sections of Drawing CM-10359-WB.

After replacement of the excavated material over the fill, the site will be reseeded to control erosion. The access road will be removed and interim revegetation completed.

817.73 (a) - Hydrologic Balance Protection - The proposed design includes procedures for protecting the hydrologic balance on the site. Drawing CM-10361-WB shows the berms proposed to be constructed.

Water within the waste dump site will be limited to rainfall. All rainfall within the dump and inslope of surrounding embankments will be retained until it evaporates or seeps into the subsurface. This could be as much as the 10 yr./24 hr. event of 1.8 inches.

817.71 (c) - Stockpiling of Excavated Material - The site proposed for waste disposal is covered with a very thin layer of topsoil. The proposed site was utilized for employee parking during construction of the Wilberg Mine facilities. The Wilberg facility was completed in late 1978. Some vegetation removed has since regenerated. Because the topsoil layer is so thin, segregation of topsoil and other soils is not practicable during excavation of the proposed waste structure. One foot of soil will be excavated and stored in the embankments bounding the excavation and serves two purposes: (1) Berms will contain mine development waste rock and waste water run-off during the operational life of the Des-Bee-Dove/Wilberg Mines, and (2) Berms are in effect soil storage piles.

817.71 (a) (2) - The soil storage berms will be constructed with inslopes and outslopes of one vertical to two horizontal. To hold the excavated material anticipated, the berms will be 5.5 feet high with a 22 foot base. The typical length of the berm surrounding each excavation is 400 feet. Typical berm calculations are included.

The berm stockpiles will be stabilized in tact until disposal is complete. The berms will be stabilized by compaction and temporary revegetation. Once waste rock is disposed as planned, the excavated

soil stored in the berms will be used as cover for the deposited waste rock.

Background Information

817.71 (a) (1) - Composition of Fill Material - The underground development waste rock from Des-Bee-Dove Mine has been analyzed and shows the material to be non-toxic and non-acid forming. The results of the analyses are contained in Table 2.

The anticipated waste from Wilberg Mine will be generated from construction of a rock slope and excess rock developed during mining. The expected rock types encountered in the rock slope construction will be approximately 70% sandstone, 20% interbedded mudstone and siltstone, and 10% bony coal. Analyses of these materials taken from drill cores are contained in Table 3. This analysis indicates the materials to be non-toxic and non-acid forming.

The analysis of the waste rock from Des-Bee-Dove and Wilberg Mines shows clearly that leachate and/or surface runoff from the fill should not degrade surface or ground waters. As a matter of fact, the alkaline nature of the soils in this region could benefit from introduction of acids, neutralizing the soil and making it more viable for support of vegetation.

784.19 (b) (1) - Geotechnical Investigation - The character of bedrock at the proposed waste rock disposal was obtained from outcrop exposures in Grimes Wash nearby. The bedrock is part of the Masuk Shale member of the Mancos Shale Formation. The composition consists

Table 2

Lithology	Number of Samples: Chemical Tests	Number of Samples: Physical Tests		Ca Meq/L	Mg Meq/L	Na Meq/L	SAR[1]	Fe ppm	Zn ppm	SO_4-S ppm	Mo ppm	B ppm	pH (Paste)	E.C.[2] mmhos/cm	Sat. %	Physical Tests: Pyrite FeS_2	Sand %	Silt %	Clay %	Texture
L id Canyon Roof	3		Mean	4.10	1.20	0.87	0.50	5,825	64.42	205.27	<0.1	0.33	7.7	0.83	32.27	8.15	--	--	--	--
			S.D.	1.30	0.56	0.21	0.17	2,528	56.32	61.31	0.00	0.20	0.25	0.25	5.17	10.82	--	--	--	--
Blind Canyon Splits	1		Mean										8.9				--	--	--	--
			S.D.	0.8	0.1	9.2	14.3	5,905	40.69	145.0	<0.1	0.94		1.1	20.9	0.2	—	--	--	--
Blind Canyon Floor	5		Mean	3.90	1.86	18.54	17.36	10,342	55.38	593.58	<0.1	0.55	8.34	2.22	26.46	1.50	--	--	--	--
			S.D.	4.02	1.72	25.43	25.14	4,263	43.90	454.96	0.00	0.60	0.64	2.11	6.57	1.41	--	--	--	--
Hiawatha Roof	3		Mean	4.57	4.30	3.43	1.83	10,925	184.93	198.07	<0.1	0.11	7.80	1.07	32.17	3.3	--	--	--	--
			S.D.	2.54	3.20	3.96	2.14	7,110	203.10	153.48	0.00	0.10	0.17	0.31	7.18	0.00	--	--	--	--
Hiawatha Split	1		Mean	4.9	2.3	1.3	0.7	7,841	69.88	246.1	<0.1	0.26	7.70	0.8	37.5	NA*	--	--	--	--
			S.D.														--	--	--	--
Hiawatha Floor	3		Mean	10.23	16.23	1.27	0.47	3,873	16.32	777.23	<0.1	0.04	5.87	3.03	29.07	NA*	--	--	--	--
			S.D.	1.50	12.53	0.70	0.21	1,394	14.08	313.16	0.00	0.05	2.24	0.90	4.48		--	--	--	--

— = Not Available

Table 3

WILBERG DRILL CORE - SOIL ANALYSES

SEPTEMBER, 1979

Sample #	pH (paste)	E.C. mmhos/cm	Sat. %	Ca meq/l	Mg meq/l	Na meq/l	SAR	Fe ppm	Zn ppm	SO_4-S ppm	Mo ppm	B ppm	Pyrite (FeS_2)	Sand %	Silt %	Clay %	Texture
EM-23C-14	8.2	0.9	21.5	2.3	3.5	1.4	0.9	24223	23.11	20.2	.1	.01		86	5	9	LS
EM-23C-15	8.1	0.6	23.1	1.9	1.6	1.5	1.1	15092	53.77	98.7	.1	0.06					
EM-23C-16	8.0	0.9	19.8	1.7	3.4	1.8	1.1	23064	34.37	148.1	.1	.01					
EM-23C-17	8.1	0.7	19.1	1.7	2.5	1.3	0.9	15423	23.47	67.7	.1	.01					
EM-23C-18	7.7	3.1	19.8	8.4	23.6	2.9	0.7	21730	74.49	1029.6	.1	0.02					
EM-23C-19	7.9	2.5	19.8	7.0	17.9	2.2	0.6	18272	9.17	863.5	.1	.01					
EM-23C-20	8.0	1.6	20.1	3.7	8.9	1.9	0.8	18463	17.49	548.6	.1	.01					
EM-23C-21	7.8	4.1	21.6	11.9	20.8	1.9	0.9	14607	22.38	1089.1	.1	.01					
EM-23C-22	8.0	3.1	25.6	11.8	17.5	2.4	0.6	3122	7.29	1089.1	.1	0.02					
EM-23C-23	8.1	1.6	20.7	4.2	8.2	2.2	0.9	6942	14.23	566.4	.1	0.06					
EM-23C-24	8.1	3.1	22.0	9.8	17.7	3.2	0.9	6527	8.08	999.8	.1	.01					
EM-23C-25	8.3	1.0	20.5	2.0	2.7	1.7	1.1	6085	23.47	204.5	.1	0.06					
EM-23C-26	8.3	0.6	19.9	1.4	0.7	1.3	1.3	572	23.84	79.7	.1	0.10					
EM-23C-27	8.1	1.4	20.3	3.8	6.7	1.5	0.7	10635	55.65	435.8	.1	0.48					
EM-23C-28	7.2	4.1	27.7	13.2	25.5	4.3	1.0	9788	62.40	1207.7	.1	0.55	0.9				
EM-23C-29	8.1	0.8	18.2	1.7	3.4	2.3	1.5	28237	17.16	139.2	.1	0.15					
EM-23C-30	8.3	1.0	16.2	1.2	5.8	2.6	1.4	23064	11.18	198.2	.1	.01					
EM-23C-31	8.1	0.5	33.9	1.4	0.9	1.9	1.8	18272	113.10	38.4	.1	0.40	4.2				
EM-23C-32	8.0	0.7	19.2	1.7	2.7	2.7	1.8	12219	20.95	20.2	.1	0.10					
EM-23C-33	8.3	1.2	18.6	1.4	5.0	3.5	1.9	6195	7.29	97.4	.1	0.06					
EM-23C-34	8.2	0.4	43.1	1.6	8.9	1.9	1.7	2275	13.08	39.8	.1	0.13					
EM-23C-35	8.3	0.5	26.0	1.3	1.0	3.0	2.9	7761	49.14	8.6	.1	0.36					
EM-23C-36	7.8	2.5	21.7	7.4	10.5	6.6	2.2	9788	29.55	798.2	.1	0.36					
EM-23C-37	8.2	1.2	23.8	2.4	8.0	3.4	1.5	11144	7.04	382.6	.1	.01					
AVERAGE	8.05	1.58	22.59	4.37	8.64	2.48	1.26	13062	30.07	423.7	.1	0.13					

FRL #79125

of light to medium blue-gray sandy shale. It usually weathers readily forming debris covered slopes. This member of the formation is devoid of water.

784.19 (b) (2) - A survey of the proposed disposal area has shown the hydrology to be limited to surface runoff from snow melt and rainfall. As discussed in the description, the nearest possible aquifer, the Ferron Sandstone, is devoid of water at this location.

784.19 (b) (3) - No minable coal seams exist beneath the proposed disposal site. The nearest mining operations (past, present or future) are located more than a mile away. Subsidence will have no effect on the disposal site.

784.19 (b) (5) - An investigation of the site by a registered professional engineer was conducted to determine the stability of the site. The site slopes gradually (max. 7%) to the southeast. The site is stable. The minimal amount of surface relief change due to the proposed disposal of waste will not affect that stability. A statement of site investigation findings is attached.

Design of the facility is based upon efforts to minimize surface alteration and control surface runoff while maintaining the most stable possible disposal method feasible. The shallow excavation proposed minimizes the amount of surface relief alteration in a single-lift disposal pattern. The excavated material berms provide a means of controlling runoff in the disposal structure and covering the waste once the disposal is complete. The need to construct separate

runoff controls is eliminated. Also, by design, hauling large amounts of topsoil and cover material is unnecessary.

The low profile nature of the proposed fill ensures its stability. By clearing the surface and placing the fill in a single four-foot lift, slope stability is assured.

817.71 (i) - Inspections - As required by the Division, inspections will be conducted at least quarterly throughout the construction period. Inspections will also be conducted during the following critical construction periods in accordance with the proposed disposal plan: (1) removal of all organic material and soil, (2) final placement and leveling of fill materials, and (3) revegetation. Reports will be submitted to the Division within two weeks of inspection and a copy will be retained at Wilberg Mine.

Temporary Revegetation - Temporary vegetation to stabilize berm slopes and completed containment cells will utilize the permanent grass, forb and shrub species as specified in the permanent revegetation section with the exception of the containerized shrubs. The shrubs will be planted in seed form and will be augmented with containerized shrubs and additional grass and forb seedings during final reclamation as needed to establish the 90% ground cover of the reference area with an 80% confidence level.

Final Reclamation Costs - Reclamation consists of two major steps, (1) topsoil handling, and (2) revegetation.

Soil grading for the most part is accomplished during the construction of the individual earthen cells. For purposes of

determining bonding amounts, applicant allows approximately fifty percent of soils disturbed to be regraded; i.e., on completion of mining and the use of this waste rock site the only topsoil grading necessary will be the exterior berms which will be pulled over the earthen cells.

FINAL RECLAMATION
ESTIMATE OF COST
BACKFILLING AND GRADING

Equipment

1. D-7 Crawler Tractor ---------- $5,500/Month
2. 15 Cubic Yard Motor Scraper ---------- $6,053/Month
3. Farm Tractor & Implements ---------- $ 500/Month

Manpower

Manpower @ $100 per day ---------- $ 100/Day

Description	Equipment/ Manpower	Quantity	Unit Cost	Total Cost	Days
Exterior Berms of 16 Acre Site Near Wilberg	D-7 Crawler Tractor	8,900 cu. yds.	$825/Day	$4,125	5 Days
	Motor Grader (15 Yard)				
			TOTAL	$4,125	5 Days

FINAL RECLAMATION
ESTIMATE OF COST
REVEGETATION

Description	Equipment/ Manpower	Quantities	Unit Cost	Total Cost	Crew Days
Soil Testing	1-Man	16 Acres		$ 200	2 Day
Neutralization Fertilization	Tractor 2-Man Crew	16 Acres	$ 50/Ac	800	3 Days
Surface Preparation	Tractor Scarifier Disc 2-Man Crew	16 Acres		300	2 Days
Mulching	Tractor 2-Man Crew	16 Acres	$250/Day	750	3 Days
Seeding and Planting	Tractor 5-Man Crew	16 Acres	$550/Day	2,750	5 Days
Revegetation Monitoring	1-Man	16 Acres	$100/Day	200	2 Days
Weed and Pest Control	2-Man Crew	16 Acres	$200/Day	400	2 Days
				$5,400	19 Days

FINAL RECLAMATION
ESTIMATE OF COST
MATERIALS (1983 PRICES)

27,200 Ea. Containerized Plants @ $.70	$19,040
800 lbs. Ammonium Nitrate @ $15/100 lbs.	120
800 lbs. Triple Superphosphate @ $20/100 lbs.	160
Seed (Grasses and Forbs) @ $182+75/Ac x 16	4,112
Mulch 2 Ton/Acre @ $100/Ton x 16	3,200
	$26,632

817.71 (d) - Vegetation Information

A pinyon-juniper vegetation type was identified within the permit area and adjacent areas and mapped. Field reconnaissance was utilized to construct the vegetation map. The vegetation of the area adjacent to the proposed storage site was used to infer what species composition and plant cover were before the disturbance occurred.

The reference area was located as close to the disturbed site as feasible. Differences in species composition, plant cover, slope, aspect, soil and geology were minimized. The reference area was marked in the field with metal T-posts and located on the vegetation map.

Vegetal analysis of the reference area consisted of developing a list of plant species by life form, measuring ground cover of plants less than one-meter tall, and determining woody plant density.

Cover of plants less than one-meter tall was measured with a one-half square meter (0.5x1.0 m) quadrat. Plant cover was measured for each species occurring within the quadrat. In addition, total plant cover, rock, litter and bare ground were measured. The location of each sampling point was randomly determined.

The point-center quadrat method was used to measure woody plant density. At each sampling point two perpendicular lines were inscribed to delineate four quarters centered over the sampling point. The distance from the nearest woody plant in each quarter to the sampling point was measured in meters and then the shrub or tree was identified. Woody plant density was determined by the following equations:

$$A_j = (Y_1 = Y_2 + Y_3 + Y_4/4)^2 \quad (1)$$

$$D = U/(\Sigma A_j / N) \quad (2)$$

where: Y_i = distance in meters from point to nearest woody plant in the ith quarter,

A_j = mean area per plant at the jTh point

N = sample size (49 observations points),

D = density, the number of woody plants per unit area (plants/acre),

U = unit area (4,047 M^2 = 1 acre)

Five sampling points were placed 15 paces apart along transects. The starting point and direction of each transect was randomly located.

Statistical adequacy for sample size for aerial plant cover and woody plant density was determined by the following formula:

$$N_{min} = t^2 s^2 / (d\bar{x})^2 \quad (3)$$

where: N_{min} = minimum sample size,

t = t-value for a 2-tailed test,

s = standard deviation,

d = allowable change in sample mean,

$\bar{x}$ = sample mean.

Sample size for plant cover and woody plant density size was tested at the 80 percent confidence level ($t_{0.10,\infty}$=1.282) with 10 percent error of the mean (d=0.10). Adequacy for plant cover and plant density was calculated after 20 samples. Sample size for density was determined using mean area per plant. Table 1 gives the minimum sample size and observed sample size for the reference area. Data presented hereafter will be based on the observed sample number.

Woody plant composition based on density was determined as follows:

$$C = S_i / T \quad (4)$$

$$T = \Sigma S_i \quad (4a)$$

where: S_i = total individuals of the ith species,

T = total number of shrubs sampled,

C = shrub composition.

Jaccard's Community Coefficient was used to quantify the similarity in plant species between the reference and disturbed area. The equation is:

$$I.S. = (C/A+B-C)100\% \quad (5)$$

where: I.S. = similarity index,

A = total species in community A,

B = total species in community B,

C = number of species common to both.

Data for plant cover and woody plant density were collected June 16, 1982 and analyzed June 23-25, 1982.

Bureau of Land Management and Utah Division of Wildlife Resources personnel, located in Price, Utah, were consulted on June 18, 1982 with regard to livestock and big game vegetal use within the permit area. Soil Conservation personnel, located in Price, were consulted with regard to soil classification, range site, and plant productivity of the reference area.

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Permit Area Vegetation

The permit for the Waste Rock Storage Site is 48.6 acres (Fig. 1, Vegetation Map). A pinyon-juniper vegetation was identified within the permit area. Common plants are pinyon-pine, Utah juniper, curlleaf mountain mahogany, and cutler ephedra. Grasses are rare within the permit area.

Disturbed Area

The disturbed area of the Waste Rock Storage Site is about 7.5 acres (Table 2). Elevation varies around 6,780 ft. The area has a six percent slope with a southern exposure. The previously disturbed vegetation was pinyon-juniper (Table 3). Pinyon-pine, Utah juniper, cutler ephedra, and curlleaf mountain mahogany were the important woody plants. Herbaceous plants included several mustards, sky rocket gilea, pensteman, wolly groundsel, Indian ricegrass and bottlebrush squirreltail. Total aerial plant cover varied around 35 to 40 percent. Soils probably belonged to the Kenilworth series of the loamy-skeletal, mixed, mesic, Xerollic Calciorthid. The range site was an Upland Stony Loam (Pinyon-Juniper).

Reference Area

A reference area was established to represent the disturbed pinyon-juniper vegetation type (Table 4). Differences between soils, geology, vegetation, etc. were minimized between the two sites.

The reference area (4800 m^2) has a southern exposure with an elevation of 6,810 ft. Slope varies around six percent. Common plants include pinyon pine, Utah juniper, cutler ephedra, curlleaf mountain mahogany and assorted forbs (Table 5). There is a paucity of grasses within the reference area. Total aerial plant cover is 35 percent. Total cover of plants less than one-meter tall is 3.3 percent (Table 6). Woody plant density is 1,495 plants per acre (Table 7). Pinyon-juniper has the greatest density while black sagebrush has the least. The soil belongs to the Kenilworth series of loamy-skeletal, mixed, mesic Xerollic Calciorthid. The range site is Upland Stony Loam (Pinyon-Juniper) in fair condition and producing 700 pounds of herbage per acre (see Soil Conservation letter in Appendix).

Livestock and Wildlife

The permit area is located within the West Grimes Grazing Allotment managed by the Bureau of Land Management. A range survey prior to 1966 indicated that Sections 34 and 35 had a carrying capacity of 9.7 and 18.2 animal unit months, respectively. Cattle grazing occurred from April 1 to June 10. However, for the past several years, there has not been any significant grazing due to the lack of water (see Bureau of Land Management letter in Appendix).

The area of the Waste Rock Storage Site is considered high-priority winter range for mule deer by the Division of Wildlife Resources (see Division of Wildlife Resources letter in Appendix).

Endangered or Threatened Plants

During the vegetal sampling, no endangered or threatened plant species were identified.

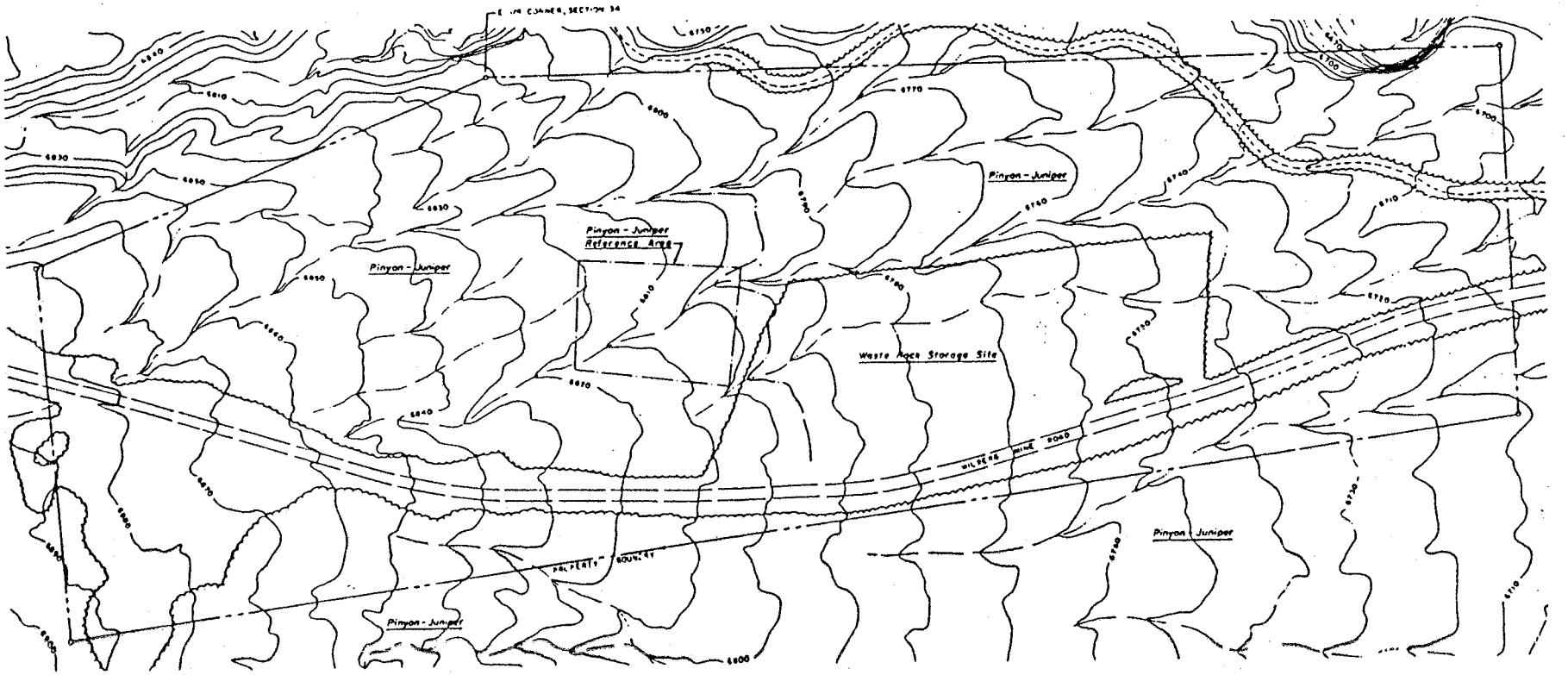

Fig. 1. Vegetation map for the Waste Rock Storage Site permit area (wavy line indicates existing vegetation).

BIO-RESOURCES, INC.
314 N Main St., Logan, Utah 84321
VEGETATION MAP
Waste Rock Storage Site (T17S, R6E SLB&M)
Wilberg Coal Mine, Emery County, Utah
Utah Power & Light Company
D 820-1001

Table 1. Sample adequacy for total percent plant cover and mean distance (M) between woody plants for the pinyon-juniper reference area at Waste Rock Storage Site, Wilberg Coal Mine[1].

Reference Site	Parameter	N_{min}	$\bar{X}$	S.D.	$N_{obs.}$
Pinyon-juniper	Plant cover	142	3.3	3.07	49
	Mean Distance	17	2.7	0.87	25

Table 2. Vegetation type, acres disturbed, and percent of vegetation type at the Waste Rock Storage Site, Wilberg Coal Mine.

Vegetation Type	Area Disturbed	% of Vegetation Type
Pinyon-juniper	7.5	15.4

[1]The mean distance (M) squared equals the mean area (M^2) a single plant occupies. The inverse of the mean area equals the number of woody plants per square meter (density). Equation 2 is then used to convert to the number of plants per acre.

Table 3. Common plant species that were inferred to have grown within the disturbed portion of the pinyon-juniper vegetation type at the Waste Rock Storage Site, Wilberg Coal Mine.

Scientific Name	Common Name
Trees	
Juniperus osteosperma	Utah juniper
Pinus edulis	Pinyon pine
Shrubs	
Artemisia nova	Black sagebrush
Cercocarpus ledifolius	Curlleaf mountain mahogany
Eriogonum microthecum	Slenderbush eriogonum
Ephedra cutleri	Cutler ephedra
Opuntia polyacantha	Plains pricklypear
Xanthocephalum sarothrae	Broome snakeweed
Yucca harrimaniae	Harriman yucca
Forbs	
Bahia dissecta	Ragleaf bahia
Cryptantha flava	Yellow cryptantha
C. flavoculata	Roughseed cryptantha
Descurainia pinnata	Pinnate tansymustard
Erigeron sp.	Fleabane
Euphobia fendleri	Fendler euphobia
Ipomopsis aggregata	Sky rocket gilia
Lepidium montanum	Mountain pepperweed
Penstemon osterhoutii	Osterhout penstemon
Physaria australis	Twinpod
Senecio multilobatus	Lobeleaf groundsel
Streptanthus cordatus	Twistflower
Townsendia incana	Hoary townsendia
Grasses	
Oryzopsis hymenoides	Indian ricegrass
Sitanion hystrix	Bottlebrush squirreltail

Table 4. Similarity between the pinyon-juniper reference area and the disturbed site at the Waste Rock Storage Site, Wilberg Coal Mine.

Parameter	Reference	Disturbed
Cover, %[1]	3.3	3.0-5.0
Woody plant density, No/acre	1,495	-
Species composition, s[2]	26	24
Aspect	Southern	Southern
Slope, %	6	6
Elevation, ft.	6,810	6,780
Soil	Xerollic Calciorthid	Xerollic Calciorthid
Geology	Alluvium	Alluvium
Index of Similarity, %	78.6	

[1]Ground cover of plants less than one-meter tall.
[2]s=total plant species.

Table 5. Common plant species occurring within the pinyon-juniper reference area of the Waste Rock Storage Site, Wilberg Coal Mine.

Scientific Name	Common Name
Trees	
Juniperus osteosperma	Utah juniper
Pinus edulis	Pinyon pine
Shrubs	
Artemisia nova	Black sagebrush
Cercocarpus ledifolius	Curlleaf mountain mahogany
Eriogonum microthecum	Slenderbush eriogonum
Ephedra cutleri	Cutler ephedra
Opuntia polyacantha	Plains pricklypear
Xanthocephalum sarothrae	Broome snakeweed
Yucca harrimaniae	Harriman yucca
Forbs	
Arabis selbyi	Rockcress
Bahia dissecta	Ragleaf bahia
Cryptantha flava	Yellow cryptantha
C. flavoculta	Roughseed cryptantha
Descurainia pinnata	Pinnate tansymustard
Erigeron sp.	Fleabane
Eriogonum sp.	Buckwheat
Euphobia fendleri	Fendler euphorbia
Ipomopsis aggregata	Skyrocket gilia
Lepidium latifolium	Pepperweed
L. montanum	Mountain pepperweed
Penstemon osterhoutii	Osterhout penstemon
Physaria australis	Twinpod
Senecio multilobatus	Loableaf groundsel
Streptanthus cordatus	Twistflower
Thelesperma subnudum	Navajo-tea greenthread
Townsendia incana	Hoary townsendia
Grasses	
No grasses were found within the reference area.	

Table 6. Ground cover for the pinyon-juniper reference area at the Waste Rock Storage Site, Wilberg Coal Mine.

Parameter	Percent Cover	
Total plant cover[1]	3.3	
Woody plant		1.6
Forb		1.7
Litter	18.0	
Rock	9.2	
Bare ground	69.5	
	100	

[1]Ground cover of plants less than one-meter tall.

Table 7. Woody plant density and composition for the pinyon-juniper reference area for the Waste Rock Storage Area, Wilberg Coal Mine.

Species	Composition, %	Density, No/acre
Pinyon pine	46	687
Cutler ephedra	24	359
Utah juniper	16	239
Curlleaf mountain mahogany	8	120
Harriman yucca	5	75
Black sagebrush	1	15
	100	1495

Appendix

Letters from Governmental Agencies