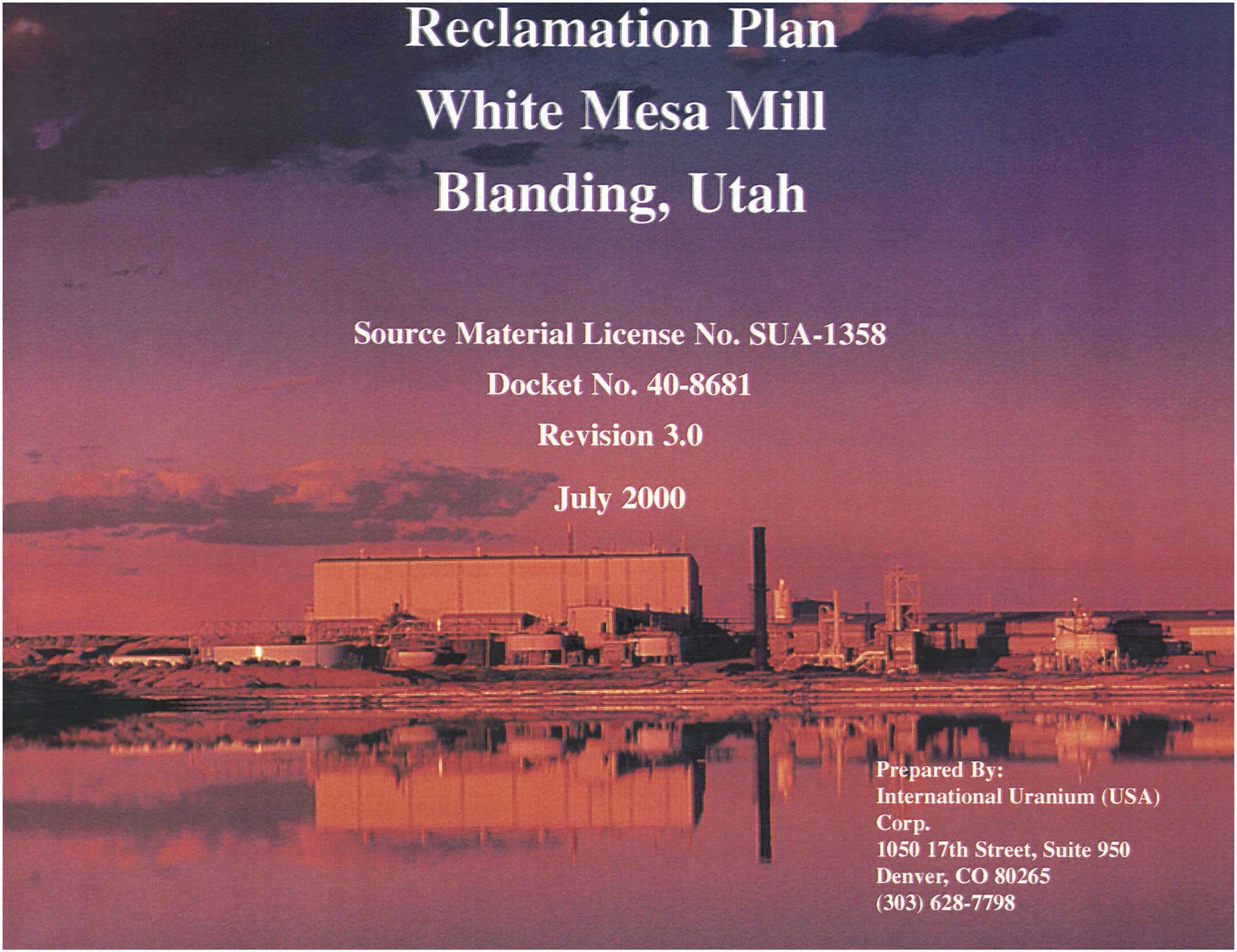

Reclamation Plan
White Mesa Mill
Blanding, Utah

Source Material License No. SUA-1358

Docket No. 40-8681

Revision 3.0

July 2000

Prepared By:
International Uranium (USA) Corp.
1050 17th Street, Suite 950
Denver, CO 80265
(303) 628-7798

Reclamation Plan
White Mesa Mill
Blanding, Utah

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(Previously Submitted with Revision 1.0, February 28, 1997)

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INTRODUCTION

This document prepared by International Uranium (USA) Corporation ("IUSA"), presents IUSA's plans and estimated costs for the reclamation of Cells 1-I, 2, 3, and 4, and for decommissioning of the White Mesa Mill.

The uranium processing sections of the mill will be decommissioned as follows:

The uranium and vanadium processing areas of the mill, including all equipment, structures and support facilities will be decommissioned and disposed of in tailings or buried on site as appropriate. All equipment, including tankage and piping; agitation; process control instrumentation and switchgears; and contaminated structures; will be cut up, removed, and buried in tailings prior to final cover placement. Concrete structures and foundations will be demolished and removed or covered with soil as appropriate. These decommissioned areas would include, but not be limited to, the following:

- Coarse ore bin and associated equipment, conveyors and structures.
- Grind circuit including semi-autogenous grind (SAG) mill, screens, pumps and cyclones.
- Three pre-leach tanks to the east of the mill building, including all associated tankage, agitation equipment, pumps, and piping.
- Seven leach tanks inside the main mill building, including all associated agitation equipment, pumps and piping.
- Counter-current decantation (CCD) circuit including all thickeners and equipment, pumps and piping.
- Uranium precipitation circuit, including all thickeners, pumps and piping.
- Two yellowcake dryers and all mechanical and electrical support equipment, including uranium packaging equipment.
- Clarifiers to the west of the mill building including the preleach thickener and claricone.
- Boiler and all ancillary equipment and buildings.

- Entire vanadium precipitation, drying, and fusion circuit.
- All external tankage not included in the above list including: reagent tanks for the storage of acid, ammonia, kerosene, water, or dry chemicals; and the vanadium oxidation circuit.
- Uranium and vanadium solvent extraction (SX) circuit including all SX and reagent tankage, mixers and settlers, pumps, and piping.
- SX building.
- Mill building.
- Office building.
- Shop and warehouse building.
- Sample plant building.

The sequence of demolition would proceed so as to allow the maximum use of support areas of the facility, such as the office and shop areas. It is anticipated that all major structures and large equipment will be demolished with the use of hydraulic shears. These will speed the process, provide proper sizing of the materials to be placed in tailings, and reduce exposure to radiation and other safety hazards during the demolition. Any uncontaminated or decontaminated equipment to be considered for salvage will be released in accordance with the NRC document, Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials, dated September, 1984, and in compliance with the conditions of Source Material License SUA-1358. As with the equipment for disposal, any contaminated soils from the mill area will be disposed of in the tailings facilities in accordance with Section 4.0 of Attachment A, Plans and Specifications.

The estimated reclamation costs for surety are summarized as follows:

White Mesa Reclamation
Cost Summary

Direct Costs		
Mill Decommissioning		1,505,168
Cell 1-I Reclamation		1,234,212
Cell 2 Reclamation		1,082,870
Cell 3 Reclamation		1,565,444
Cell 4A Reclamation		120,128
Misc. Items (Project General)		1,939,480
	Subtotal Direct:	$7,447,302
Profit Allowance	10%	744,730
Contingency	15%	1,117,095
Licensing and Bonding	2%	148,946
Long Term Care Fund		606,721
	Total Surety Requirement:	$10,064,794

REPORT ORGANIZATION

General site characteristics pertinent to the reclamation plan are contained in Section 1.0. Descriptions of the facility construction, operations and monitoring are given in Section 2.0. The current environmental monitoring program is described in Section 2.3. Seismic risk was assessed in Section 2.6.3.

The Reclamation Plan including descriptions of facilities to be reclaimed and design criteria, is presented in Section 3.0. Section 3.0 Attachments A through H are the Plans and Specifications, Quality Plan for Construction Activities, Cost Estimates, and supplemental testing and design details.

Supporting documents (previously submitted), which have been reproduced as appendices for ease of review, include:

- Semi-Annual Effluent Report, White Mesa Mill, SUA-1358, Docket No. 40-8681, (July through December 1995) and Semi-Annual Effluent Report, White Mesa Mill, SUA-1358, Docket No. 40-8681, (January through June 1996) Energy Fuels Nuclear, Inc.

- Hydrogeologic Evaluation of White Mesa Uranium Mill, July 1994. Titan Environmental Corporation (Titan).

- Points of Compliance, White Mesa Uranium Mill, September 1994. Titan.

- Tailings Cover Design, White Mesa Mill, October 1996. Titan.

- Neshaps Radon Flux Measurement Program, White Mesa Mill, 1995, October 1995. Tellco Environmental.

1.0 SITE CHARACTERISTICS

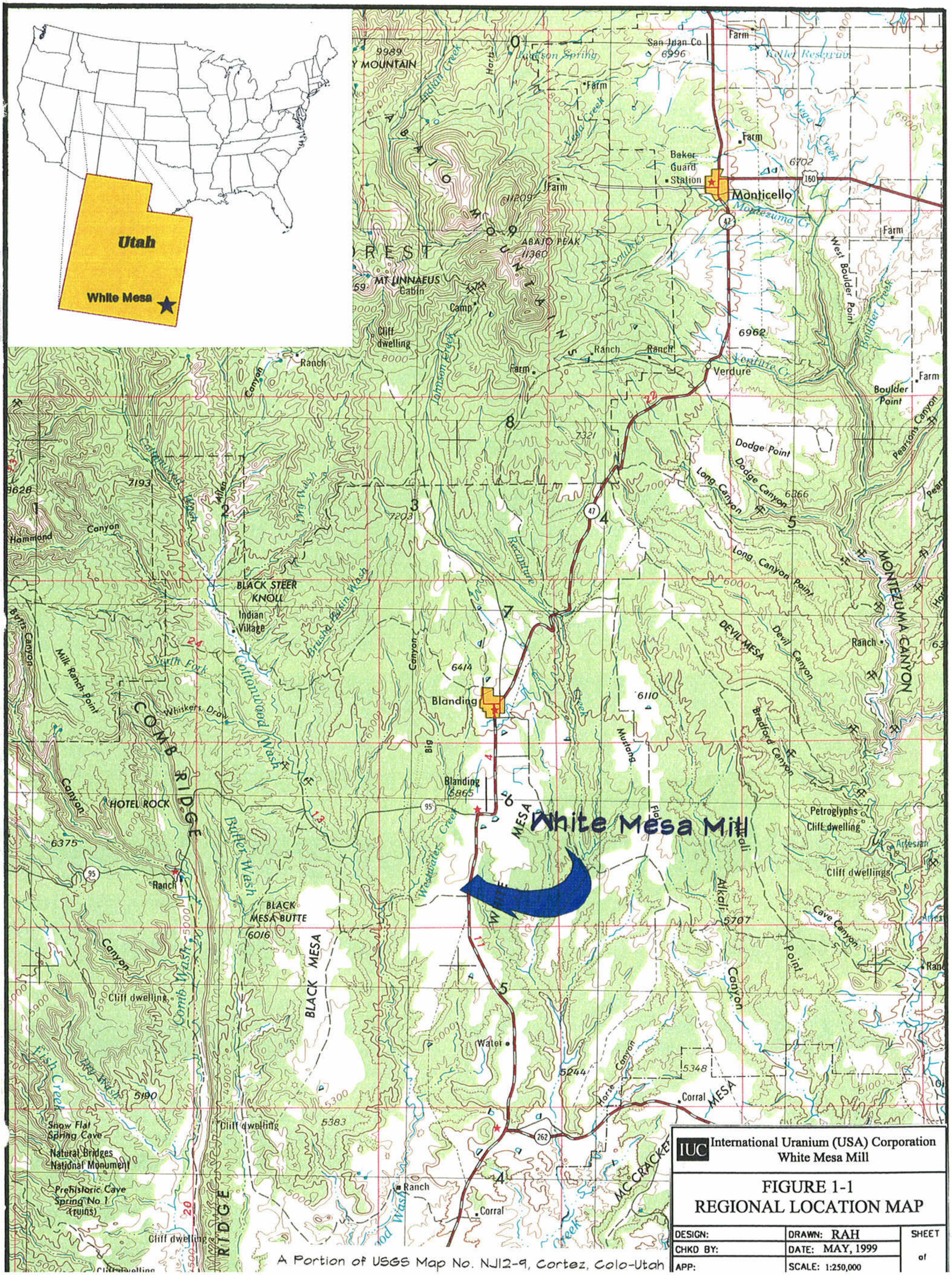
The White Mesa Mill is located in southeastern Utah (see Figure 1-1), approximately six miles south of Blanding, Utah (see Figure 1-2).

The Environmental Report ("ER") (Dames and Moore 1978b) has been reproduced, with minor revisions, to describe site characteristics. The Final Environmental Statement ("Final ES") (U.S. NRC 1979) has also been used, where noted below, for descriptions of the preoperational environment. Section 2.0, Site Characteristics, contains certain pertinent sections reproduced from the Final ES with minor changes in syntax. Where these sections were reproduced, the ER or Final ES section numbers are referenced in parentheses after the section title.

Section 1.6.1, Regional Geology, and Section 1.6.2, Blanding Site Geology, were reproduced from the ER with minor changes in syntax. Section 1.6.3, Seismic Risk Assessment, summarizes the results of static and pseudostatic analyses performed in September of 1996. Additional Probabilistic Risk Assessment was performed in April 1999, as it relates to the potential for liquefaction of the tailings sands. This Assessment is included as Attachment E to this Plan. These analyses were based on the most recent data available as well as previously collected data, and were used to establish the stability of the side slopes of the tailings soil cover. Complete details of the tailings cover design are provided in Appendix D, Tailings Cover Design, White Mesa Mill (Titan Environmental Corporation, 1996).

The Semi-Annual Effluent Report for July through December, 1996 (EFN, 1996) is reproduced in Appendix A. Subsequent Semi-Annual Effluent Reports through December of 1998 have been submitted to the NRC in compliance with License requirements. Many of the graphs in the Semi-

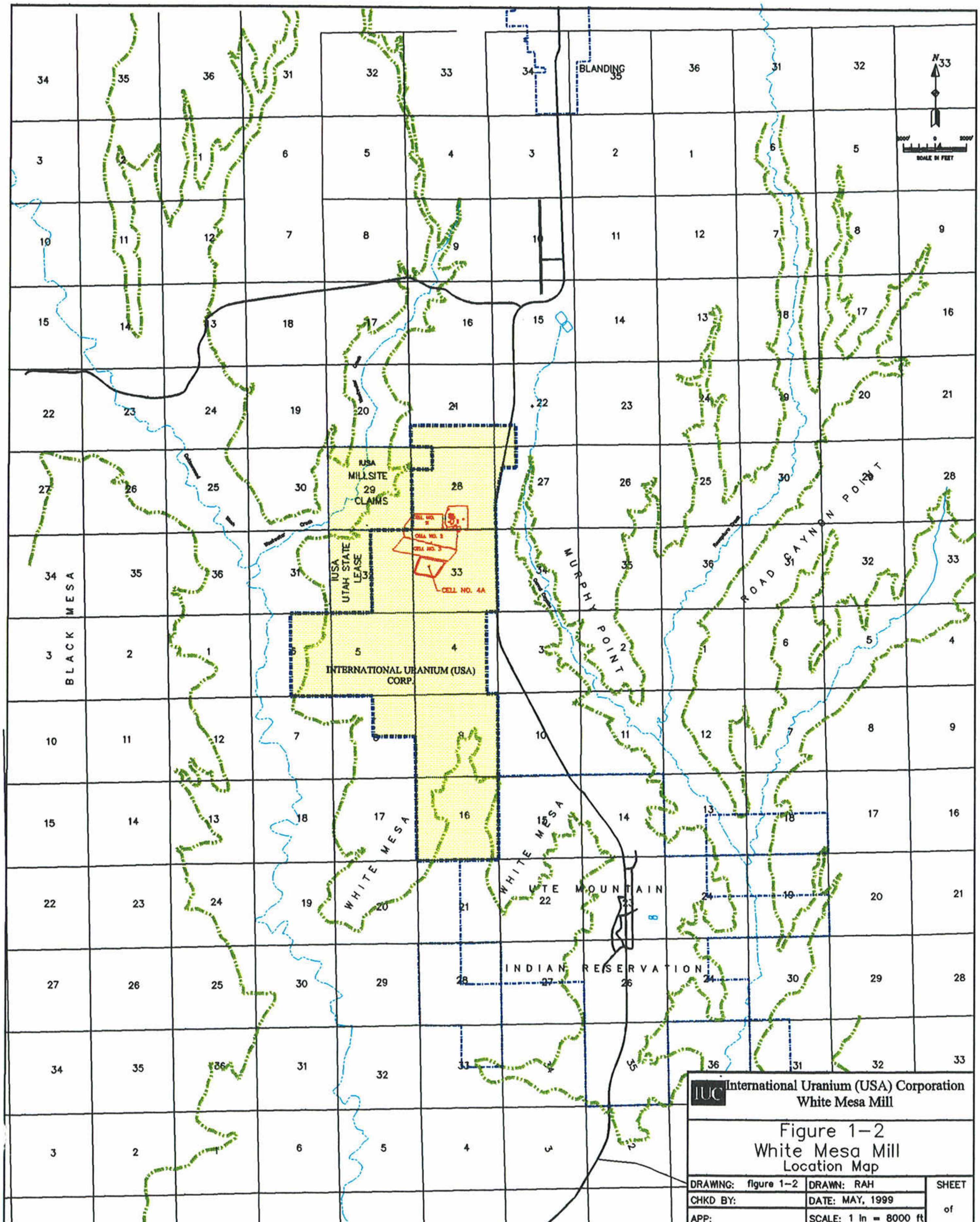
Annual Effluent Report show data from late 1979 or early 1980 to the present. The word "current" is used to describe these data and/or updates. The Hydrogeologic Evaluation of White Mesa Uranium Mill (Titan, 1994) is reproduced in Appendix B. Points of Compliance, White Mesa Mill (Titan, 1994) is reproduced in Appendix C. Tailings Cover Design, White Mesa Mill (Titan, 1996) is reproduced in Appendix D. Appendix E is the most recently completed radon monitoring report. All of these Appendices were previously submitted.



IUC International Uranium (USA) Corporation
White Mesa Mill

FIGURE 1-1
REGIONAL LOCATION MAP

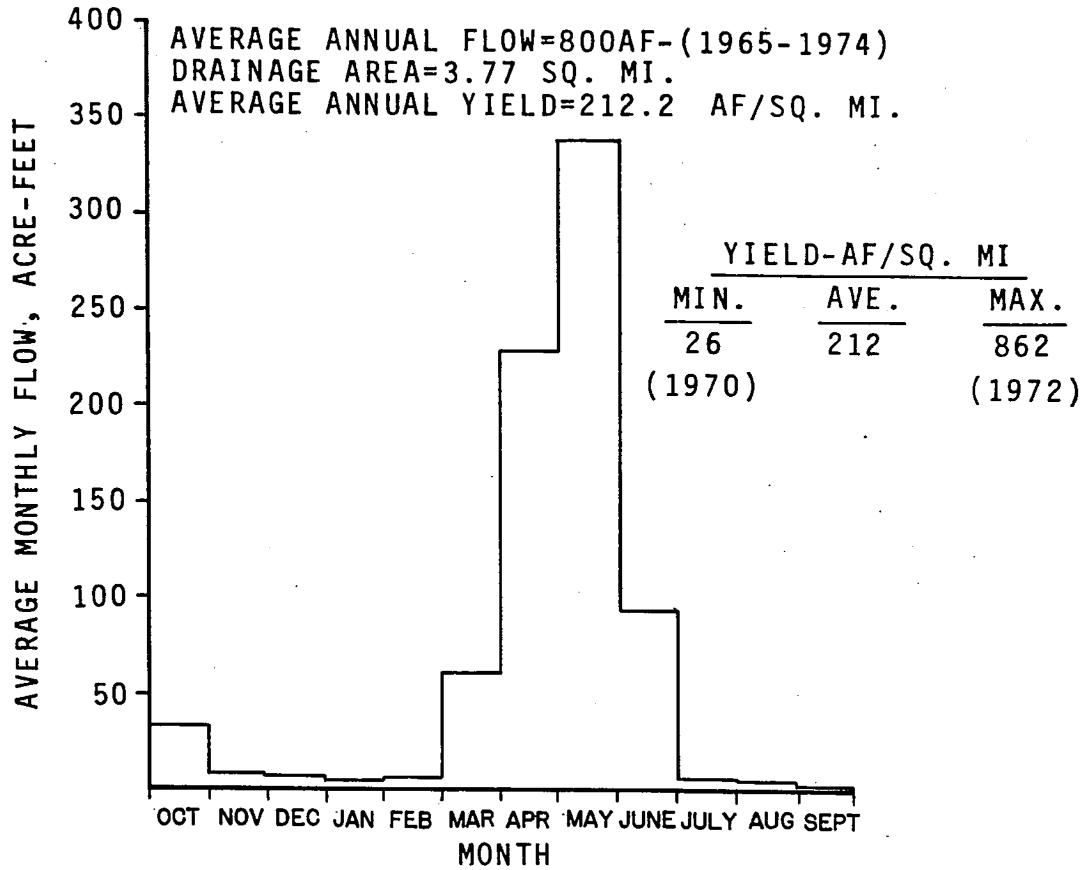
DESIGN:	DRAWN: RAH	SHEET
CHKD BY:	DATE: MAY, 1999	of
APP:	SCALE: 1:250,000	



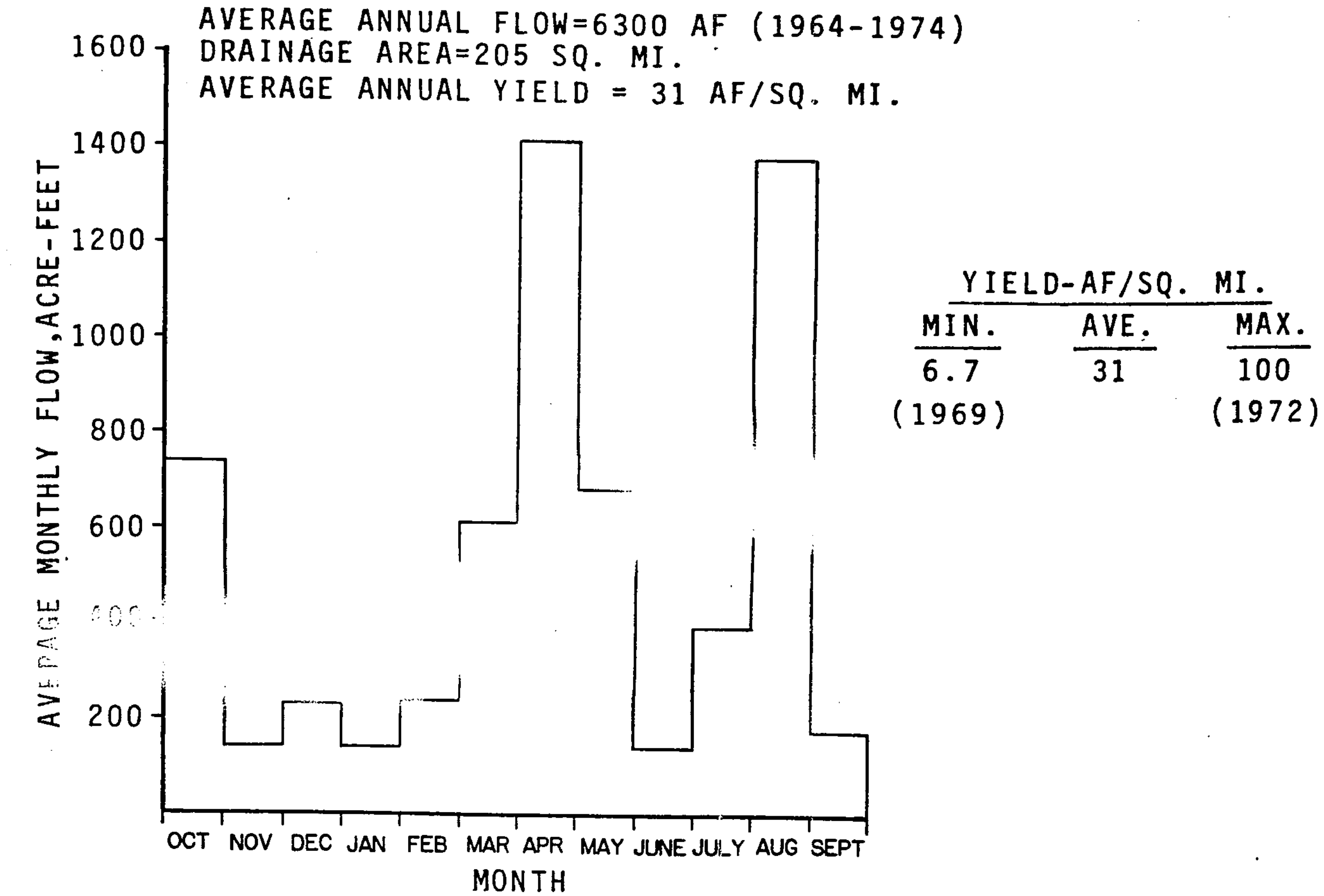
International Uranium (USA) Corporation
White Mesa Mill

Figure 1–2
White Mesa Mill
Location Map

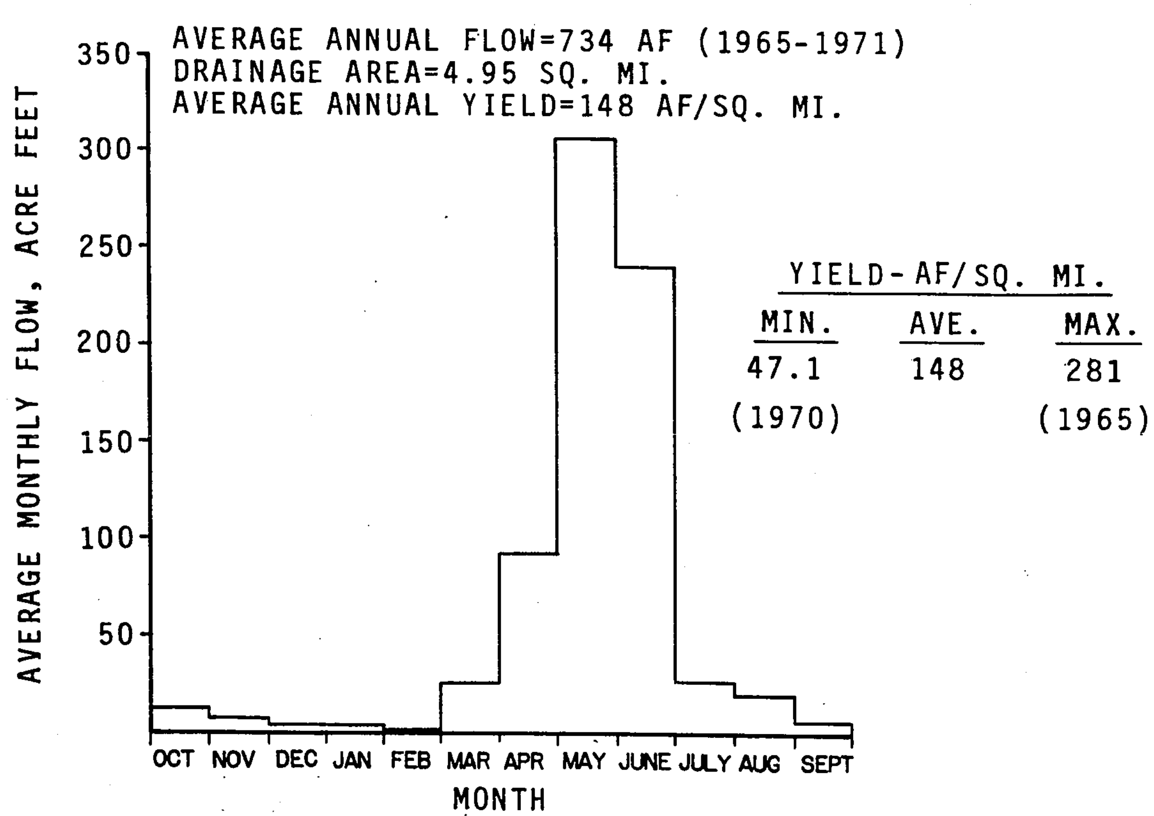
DRAWING: figure 1–2	DRAWN: RAH	SHEET
CHKD BY:	DATE: MAY, 1999	of
APP:	SCALE: 1 in = 8000 ft	



RECAPTURE CREEK NEAR BLANDING
USGS GAUGE 09378630



COTTONWOOD WASH NEAR BLANDING
USGS GAUGE 09378700



SPRING CREEK ABOVE DIVERSIONS,
NEAR MONTICELLO
USGS GAUGE 09376900

NOTES

1. FOR THE LOCATION OF WATERCOURCES SUMMARIZED, SEE PLATE
2. SOURCE OF DATA. WATER RESOURCES DATA RECORDS. COMPILED AND PUBLISHED BY U S G S

IUC International Uranium (USA) Corporation
White Mesa Mill

FIGURE 1.4-2
Stream Flow Summary
in the Vacinity of Blanding, Utah

DESIGN:	DRAWN: RAH	SHEET
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1.1 CLIMATE

Text on climate and associated tables are adapted, with minor revisions, from the Final ES. New table numbers are added to the text below to correspond to sections in this Reclamation Plan, but the original table numbers from the Final ES are cited on the modified tables, for ease of reference.

1.1.1 General Influences (Final ES Section 2.1.1)

Although varying somewhat with elevation and terrain in the vicinity of the site, the climate can generally be described as semiarid. Skies are usually clear with abundant sunshine, precipitation is light, humidity is low, and evaporation is high. Daily ranges in temperature are relatively large, and winds are normally light to moderate. Influences that would result in synoptic meteorological conditions are relatively weak; as a result, topography and local micrometerological effects play an important role in determining climate in the region.

Seasons are well defined in the region. Winters are cold but usually not severe, and summers are warm. The normal mean annual temperature reported for Blanding, Utah, is about 50° F (10° C), as shown in Table 1.1-1 (Table 2.1 in the Final ES). January is usually the coldest month in the region, with a normal mean monthly temperature of about 27° F (-3° C). Temperatures of 0° F (-18° C) or below may occur in about two of every three years, but temperatures below -15° F (-26° C) are rare. July is generally the warmest month, having a normal mean monthly temperature of about 73° F (23° C). Temperatures above 90° F (32° C) are not uncommon in the summer and are reported to occur about 34 days a year; however, temperatures above 100° F (38° C) occur rarely.

1.1.2 Precipitation (Final ES Section 2.1.2)

Precipitation in the vicinity of the White Mesa Uranium Project is light (Table 1.1-2) (Final ES Table 2.2). Normal annual precipitation is about 12 inches (30 cm). Most precipitation in the area is rainfall, with about 25 percent of the annual total in the form of snowfall.

There are two separate rainfall seasons in the region. The first occurs in late summer and early autumn when moisture-laden air masses occasionally move in from the Gulf of Mexico, resulting in showers and thunderstorms. The second rainfall period occurs during the winter when Pacific storms frequent the region.

1.1.3 Winds (Final ES Section 2.1.3)

Wind speeds are generally light to moderate at the site during all seasons, with occasional strong winds during late winter and spring frontal activity and during thunderstorms in the summer. Southerly wind directions are reported to prevail throughout the year.

1.1.4 Storms (Final ES Section 2.1.4)

Thunderstorms are frequent during the summer and early fall when moist air moves into the area from the Gulf of Mexico. Related precipitation is usually light, but a heavy local storm can produce over an inch of rain in one day. The maximum 24-hour precipitation reported to have fallen during a 30-year period at Blanding was 1.98 inches (5.02 cm). Hailstorms are uncommon in this area. Although winter storms may occasionally deposit comparable amounts of moisture, maximum short-term precipitation is usually associated with summer thunderstorms.

Tornadoes have been observed in the general region, but they occur infrequently. Strong winds can occur in the area along with thunderstorm activity in the spring and summer. The White Mesa site is susceptible to occasional dust storms, which vary greatly in intensity, duration, and time of occurrence. The basic conditions for blowing dust in the region are created by wide areas of exposed dry topsoil and strong, turbulent winds. Dust storms usually occur following frontal passages during the warmer months and are occasionally associated with thunderstorm activities.

TABLE 1.1-1

Temperature means and extremes at Blanding, Utah[a]

Month	Means						Extremes					
	Daily maximum		Daily minimum		Monthly		Record highest		Year	Record lowest		Year
	°C	°F	°C	°F	°C	°F	°C	°F		°C	°F	
January	3.9	39.1	-9.1	15.6	-2.6	27.4	16	60	1956	-27	-17	1937
February	6.5	43.7	-6.4	20.4	0.1	32.1	19	67	1932	-31	-23	1933
March	11.1	51.9	-3.3	26.1	3.9	39.0	22	72	1934	17	2	1948
April	17.0	62.6	0.9	33.7	8.9	48.1	28	82	1943	12	11	1936
May	22.2	71.9	5.2	41.3	13.7	56.6	33	92	1951	-5	23	1933
June	28.2	82.8	9.6	49.2	18.9	66.0	38	100	1954	-2	28	1947
July	31.7	89.1	13.8	56.9	27.8	73.0	39	103	1931	2	36	1934
August	30.3	86.5	13.1	55.5	21.7	71.0	37	98	1954	6	42	1950
September	26.2	79.3	8.7	47.7	17.6	63.6	35	95	1948	-2	29	1934
October	19.0	66.2	2.7	36.9	10.9	51.6	32	90	1937	-10	14	1935
November	10.4	50.8	-4.4	24.1	3.1	37.5	21	69	1934	-22	-7	1931
December	5.3	41.6	-7.4	18.6	1.1	30.1	16	61	1949	-24	-11	1935
Annual	17.7	63.8	1.9	35.5	9.8	49.7	39	103	July 1931	-31	-23	February 1933

[a]Period of record: 1931-1960 (30 years).

Source: Adapted from U. S. NRC (1979) Final Environmental Statement, Page 2-2, Table 2.1.
Original Source: Plateau Resources, Limited, *Application for Source Material License,* Table 2.2-1, p. 2-6, Apr. 3, 1978.

TABLE 1.1-2

Precipitation means and extremes at Blanding, Utah[a]

	Total						
Month	Mean monthly		Maximum monthly		Greatest daily		Year
	cm	in.	cm	in.	cm	in.	
January	3.04	1.20	10.31	4.06	2.64	1.04	1952
February	2.95	1.16	4.39	1.73	2.62	1.03	1937
March	2.38	0.94	5.00	1.97	2.54	1.00	1937
April	2.18	0.86	5.41	2.13	2.69	1.06	1957
May	1.63	0.64	5.11	2.01	2.39	0.94	1947
June	1.39	0.55	5.51	2.17	3.56	1.40	1938
July	2.13	0.84	7.79	3.07	3.35	1.32	1930
August	3.02	1.19	12.59	4.96	5.03	1.98	1951
September	3.02	1.19	9.60	3.78	3.07	1.21	1933
October	3.51	1.38	16.79	6.61	3.94	1.55	1940
November	1.88	0.74	5.21	2.05	2.41	0.95	1946
December	3.20	1.26	9.29	3.66	3.56	1.40	1931

[a]Period of record: 1931-1960 (30 years).

Source: Adapted from U. S. NRC (1979) Final Environmental Statement, Page 2-2, Table 2.2.
Original Source: Plateau Resources, Limited, *Application for Source Material License,* Table 2.2-2, p. 2-8, Apr. 3, 1978.

1.2 TOPOGRAPHY

The following text is reproduced from Section 2.3 of the Final ES.

The site is located on a "peninsula" platform tilted slightly to the south-southeast and surrounded on almost all sides by deep canyons, washes, or river valleys. Only a narrow neck of land connects this platform with high country to the north, forming the foothills of the Abajo Mountains. Even along this neck, relatively deep stream courses intercept overland flow from the higher country. Consequently, this platform (White Mesa) is well protected from runoff flooding, except for that caused by incidental rainfall directly on the mesa itself. The land on the mesa immediately surrounding the White Mesa site is relatively flat.

1.3 ARCHEOLOGICAL RESOURCES

The following discussion of archeological sites is adapted from Section 2.5.2.3 of the Final ES.

1.3.1 Archeological Sites

Archeological surveys of portions of the entire project site were conducted between the fall of 1977 and the spring of 1979. The total area surveyed contained parts of Section 21, 22, 27, 28, 32, and 33 of T37S, R22E, and encompassed 2,000 acres (809 ha), of which 200 acres (81 ha) are administered by the U. S. Bureau of Land Management and 320 acres (130 ha) are owned by the State of Utah. The remaining acreage is privately owned. During the surveys, 121 sites were recorded and all were determined to have an affiliation with the San Juan Anasazi who occupied this area of Utah from 0 A.D. to 1300 A.D. All but 22 of the sites were within the project boundaries.

Table 1.3-1, adapted from Final ES Table 2.18, summarizes the recorded sites according to their probable temporal positions. The dates of occupation are the best estimates available, based on professional experience and expertise in the interpretation of archeological evidence. Available evidence suggests that settlement on White Mesa reached a peak in perhaps 800 A.D. Occupation remained at approximately that level until some time near the end of Pueblo II or in the Pueblo II/Pueblo III transition period. After this period, the population density declined sharply, and it may be assumed that the White Mesa was, for the most part, abandoned by about 1250 A.D.

Archeological test excavations were conducted by the Antiquities Section, Division of State History, in the spring of 1978, on 20 sites located in the area later to be occupied by tailings cells 2, 3 and 4. Of these sites, 12 were deemed by the State Archeologist to have significant National Register potential and four possible significance. The primary determinant of significance in this study was the presence of structures, though storage features and pottery artifacts were also common.

In the fall of 1978, a surface survey was conducted on much of the previously unsurveyed portions of the proposed mill site. Approximately 45 archeological sites were located during this survey, some of which are believed to be of equal or greater significance than the more significant sites form the earlier study. Determination of the actual significance of all untested sites would require additional field investigation.

TABLE 1.3-1

Distribution of Recorded Sites According to Temporal Position

Temporal position	Approximate dates (A.D.)*a*	Number of sites
Basket Maker III	575-750	2
Basket Maker III/Pueblo I	575-850	27
Pueblo I	750-850	12
Pueblo I/Pueblo II	850-950	13
Pueblo II	950-1100	14
Pueblo II/Pueblo III	1100-1150	12
Pueblo III	1150-1250	8
Pueblo II+	*b*	5
Multicomponent	*c*	3
Unidentified	*d*	14

a Includes transitional periods.

b Although collections at these locations were lacking in diagnostic material, available evidence indicates that the site would have been used or occupied no earlier than 900 A.D. and possibly later.

c Ceramic collections from each of these sites indicate an occupation extending from Pueblo I through Pueblo II and into Pueblo III.

d These sites did not produce evidence strong enough to justify any identification.

Source: Adapted from Dames & Moore (1978b) (ER), Table 2.3-2, U. S. NRC (1979) Final Environmental Statement, Page 2-20, Table 2.18, and from supplementary reports on project archeology.

Pursuant to 10 CFR Part 63.3, the NRC submitted on March 28, 1979, a request to the Keeper of the National Register for a determination of eligibility for the area which had been surveyed and tested. The area contained 112 archeological sites and six historical sites. The determination by the Keeper of the National Register on April 6, 1979, was that the White Mesa Archeological District is eligible for inclusion in the National Register.

1.3.2 Current Status of Excavation

Archeological investigations for the entire mill site and for Cells 1-I through Cell 4 were completed with the issuance of four separate reports covering 30 sites, excluding re-investigations. (Lindsay 1978, Nielson 1979, Casjens et al 1980, and Agenbroad et al 1981).

The sites reported as excavated are as follows:

6380	6394	6437
6381	6395	6684
6384	6396	6685
6385	6397	6686
6386	6403	6697
6387	6404	6698
6388	6420	6699
6391	6429	6754
6392	6435	6757
6393	6436	7754

Sites for which excavation has not been required are:

6379	6441	7658	7690
6382	6443	7659	7691
6405	6444	7660	7693

The sites remaining to be excavated are (continued):

6408	6445	7661	7696
6421	6739	7665	7700
6427	6740	7668	7752
6430	7653	7675	7876
6431	7655	7684	8014
6432	7656	7687	
6439	7657	7689	

1.4 SURFACE WATER

The following description of undisturbed surface water conditions is adapted from Section 2.6.1 of the Final ES. Since construction, the mill has been designed to prevent runon or runoff of storm water. No perennial surface water drainages exist on the site. The description of surface water quality in subsection 1.4.2 reflects baseline sampling performed in July 1977 - March 1978. Continuous monitoring of surface water is not possible due to lack of streamflow.

1.4.1 Surface Water Description (Final ES Section 2.6.1.1)

The mill site is located on White Mesa, a gently sloping (1% SSW) plateau that is physically defined by the adjacent drainages which have cut deeply into regional sandstone formations. There is a small drainage area of approximately 62 acres (25 ha) above the site that could yield surface runoff to the site. Runoff from the project area is conducted by the general surface topography to either

Westwater Creek, Corral Creek, or to the south into an unnamed branch of Cottonwood Wash. Local porous soil conditions, topography and low acreage annual rainfall [11.8 inches (30 cm)] cause these streams to be intermittently active, responding to spring snowmelt and local rainstorms (particularly thunderstorms). Surface runoff from approximately 384 acres (155 ha) of the project site drains westward and is collected by Westwater Creek, and runoff from another 384 acres (155 ha) drains east into Corral Creek. The remaining 713 acres (289 ha) of the southern and southwestern portions of the site drain indirectly into Cottonwood Wash (Dames & Moore, 1978b, p. 2-143). The site and vicinity drainages carry water only on an intermittent basis. The major drainages in the project vicinity are depicted in Figure 1.4-1 and their drainages tabulated in Table 1.4-1. Total runoff from the site (total yield per watershed area) is estimated to be less than 0.5 inch (1.3cm) annually (Dames & Moore, 1978b, p. 2-143).

There are no perennial surface waters on or in the vicinity of the project site. This is due to the gentle slope of the mesa on which the site is located, the low average annual rainfall of 11.8 inches (29.7 cm) per year at Blanding (Dames & Moore, 1978b, p. 2-168), local soil characteristics and the porous nature of local stream channels. Prior to construction, three small ephemeral catch basins were present on the site to the northwest and northeast of the scale house.

Corral Creek is an intermittent tributary to Recapture Creek. The drainage area of that portion of Corral Creek above and including drainage from the eastern portion of the site is about 5 square miles (13 km^2). Westwater Creek is also an intermittent tributary of Cottonwood Wash. The Westwater Creek drainage basin covers nearly 27 square miles (70 km^2) at its confluence with Cottonwood Wash 1.5 miles (2.5 km) west of the project site. Both Recapture Creek and Cottonwood Wash are similarly intermittently active, although they carry water more often and for longer periods of time due to their larger watershed areas. They both drain to the south and are tributaries of the San Juan River. The confluences of Recapture Creek and Cottonwood Wash with the San Juan River are approximately 18 miles (29 km) south of the project site. The San Juan River, a major tributary for the upper Colorado River, has a drainage of 23,000 square miles (60,000 km^2) measured at the USGS gauge to the west of Bluff, Utah (Dames & Moore, 1978b, p. 2-130).

International Uranium (USA) Corporation
White Mesa Mill

FIGURE 1.4-1
Drainage Map of the Vicinity of the White Mesa Mill

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● 1 USGS GAUGE NO. 09376900
● 2 USGS GAUGE NO. 09378630
● 3 USGS GAUGE NO. 09378700

TABLE 1.4-1

Drainage Areas of Project Vicinity and Region

Basin description	Drainage area	
	km²	sq. miles
Corral Creek at confluence with Recapture Creek	15.0	5.8
Westwater Creek at confluence with Cottonwood Wash	68.8	26.6
Cottonwood Wash at USGS gage west of project site	<531	<205
Cottonwood Wash at confluence with San Juan River	<860	<332
Recapture Creek at USGS gage	9.8	3.8
Recapture Creek at confluence with San Juan River	<518	<200
San Juan River at USGS gage downstream at Bluff, Utah	<60,000	<23,000

Source: Adapted from Dames & Moore (1978b), Table 2.6-3

Storm runoff in these streams is characterized by a rapid rise in the flow rates, followed by rapid recession primarily due to the small storage capacity of the surface soils in the area. For example, on August 1, 1968, a flow of 20,500 cfs (581 m^3/sec) was recorded in Cottonwood Wash near Blanding. The average flow for that day, however, was only 4,340 cfs (123 m^3/sec). By August 4, the flow had returned to 16 cfs (0.5 m^3/sec) (Dames & Moore, 1978b, p. 2-135). Monthly streamflow summaries are presented in Figure 1.4-2 for Cottonwood Wash and Recapture Creek. Flow data are not available for the two smaller water courses closest to the project site, Corral Creek and Westwater Creek, because these streams carry water infrequently and only in response to local heavy rainfall and snowmelt, which occurs primarily in the months of April, August, and October. Flow typically ceases in Corral and Westwater Creeks within 6 to 48 hours after precipitation or snowmelt ends.

1.4.2 Surface Water Quality (Final ES Section 2.6.1.2)

Sampling of surface water quality in the project vicinity began in July 1977 and continued through March 1978. Baseline data describe and evaluate existing conditions at the project site and vicinity. Sampling of the temporary on-site surface waters (two catch basins) has been attempted but without success because of the lack of naturally occurring water in these basins. The basin to the northeast of the mill site has been filled with well water to serve as a nonpotable water source during construction of office and laboratory buildings in conjunction with the mill (approximately six months). This water has not been sampled but presumably reflects the poor quality associated with local groundwater. Sampling of ephemeral surface waters in the vicinity was possible only during major precipitation events, as these streams are normally dry at other times.

The locations of the surface water sample sites are presented in Figure 1.4-3. The water quality values obtained for these sample sites are given in Dames & Moore (1978b) Table 2.6-7, and U.S. NRC (1979) Table 2.22. Water quality samples were collected during the spring at several intermittently active streams that drain the project area. These streams include Westwater Creek (S1R, S9) Corral Creek below the small irrigation pond (S3R), the junction of Corral Creek and Recapture Creek (S4R), and Cottonwood Creek (S8R). Samples were also taken from a surface pond southeast of the mill (S5R). No samples were taken at S2R on Corral Creek or at the small wash (S6R) located south of the site.

Surface water quality in the vicinity of the mill is generally poor. Waters in Westwater Creek (S1R and S9) were characterized by high total dissolved solids (TDS; mean of 674 mg/liter) and sulfate levels (mean 117 mg of SO_4 per liter). The waters were typically hard (total hardness measured as $CaCO_3$; mean 223 mg/liter) and had an average pH of 8.25. Estimated water velocities for Westwater Creek averaged 0.3 fps (0.08 m/sec) at the time of sampling.

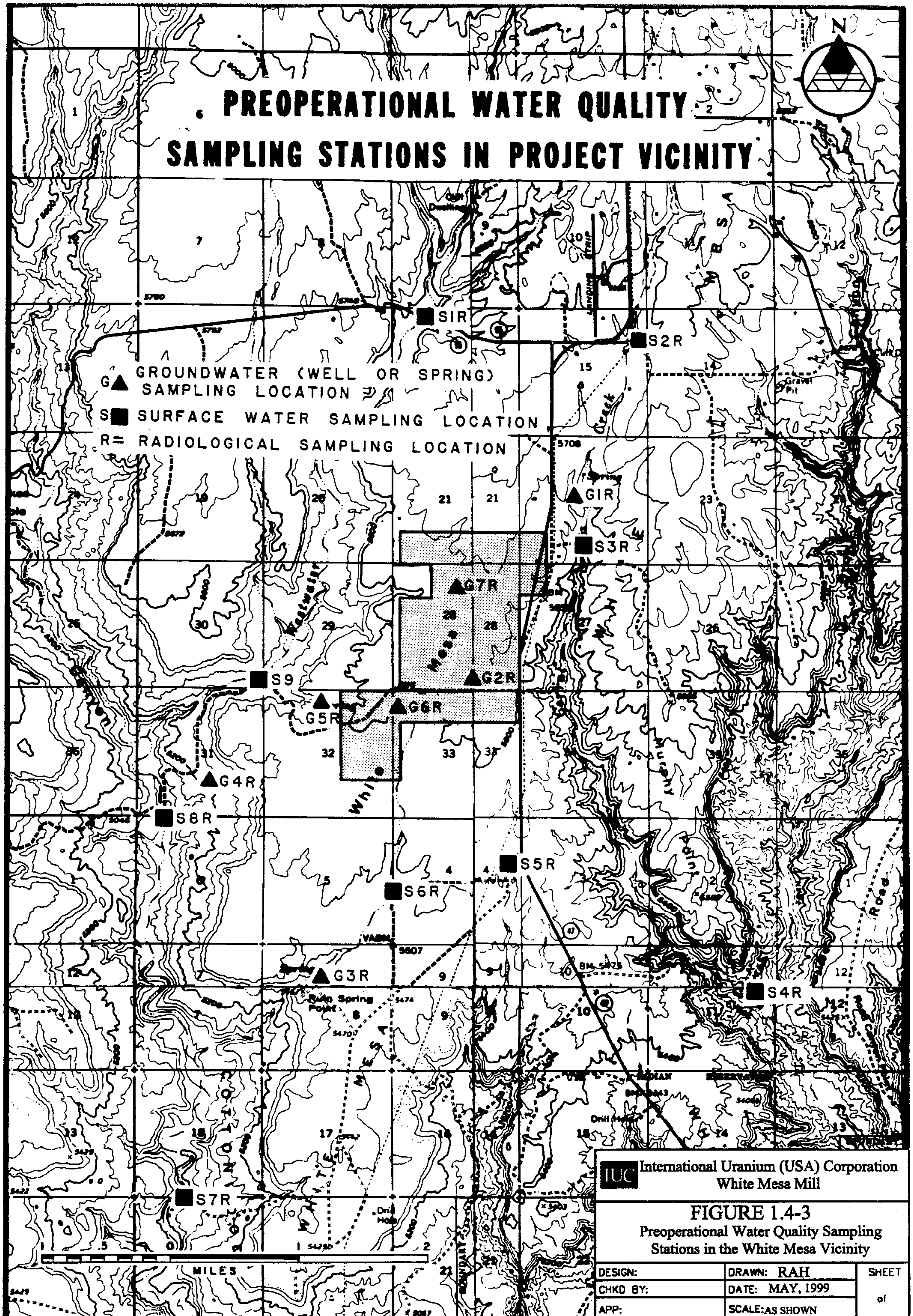


FIGURE 1.4-3
Preoperational Water Quality Sampling Stations in the White Mesa Vicinity

Samples from Cottonwood Creek (S8R) were similar in quality to Westwater Creek water samples, although the TDS and sulfate levels were lower (TDS averaged 264 mg/liter; SO_4 averaged 40 mg/liter) during heavy spring flow conditions [80 fps (24 m/sec) water velocity].

The concentrations of TDS increased downstream in Corral Creek, averaging 3,180 mg/liter at S3R and 6,660 mg/liter (one sample) at S4R. Total hardness averaged in excess of 2,000 mg/liter, and pH values were slightly alkaline. Estimated water velocities in Corral Creek were typically less than 0.1 fps (0.03 m/sec) during sampling.

The spring sample collected a the surface pond south of the project site (S5R) indicated a TDS concentration of less than 300 mg/liter. The water was slightly alkaline with moderate dissolved sulfate levels averaging 42 mg/liter.

During heavy runoff, the concentration of total suspended solids in these streams increased sharply to values in excess of 1,500 mg/liter (U.S. NRC 1979, Table 2.22). High concentrations of certain trace elements were measured in some sampling areas. Levels of mercury (total) were reported as high as 0.002 mg/liter (S3R, 7/25/77; S8R, 7/25/77). Total iron measured in the pond (S5R, 11/10/77) was 9.4 mg/liter. These values appear to reflect groundwater quality in the vicinity and are probably due to evaporative concentration and not due to human perturbation of the environment.

1.5 GROUNDWATER

The following descriptions of groundwater occurrence and characteristics in and around the White Mesa Mill is a summary and compilation of information contained in documents previously submitted to and reviewed by the U.S. NRC. These include the Final ES, the Hydrogeologic

Evaluation of White Mesa Uranium Mill ("Hydrogeologic Evaluation") (Titan, 1994a), Points of Compliance, White Mesa Uranium Mill ("POC") (Titan, 1994b), the Semi-Annual Effluent Report's through December 1998.

The Hydrogeologic Evaluation referenced numerous technical studies: Regional geologic and geohydrologic data were obtained primarily from U.S. Geologic Survey (U.S.G.S.) and State of Utah publications; Site-specific information was obtained from the 1978 Environmental Report (Dames & Moore); a 1992 groundwater study report submitted to the NRC by Umetco; a 1991 groundwater hydrology report on White Mesa prepared by Hydro-Engineering; and reports by D'Appolonia (1981, 1982, and 1984). See the Hydrogeologic Evaluation, transmitted herewith in its entirety as Appendix B, for complete data tables, lists of references, and technical details described in this section.

This section is primarily an adaptation of the Hydrogeologic Evaluation. For ease of reference, a copy of the Hydrogeologic Evaluation is included as Appendix B previously submitted to the NRC. The POC is included as Appendix C also previously submitted. The Hydrogeologic Evaluation focused on description and definition of the site hydrostratigraphy, and occurrence of groundwater as it relates to the natural and manmade safeguards which protect groundwater resources from potential leakage of tailings cells at the site. The POC summarized and statistically analyzed the available groundwater database, and proposed a revised groundwater monitoring and data review program.

The findings of the Hydrogeologic Evaluation indicated that the tailings located in the existing disposal cells are not impacting groundwater at the site. In addition, it does not appear that future impacts to groundwater would be expected as a result of continuing operations.

These conclusions are based on chemical and hydrogeologic data which show that:

1. The chemistry of perched groundwater encountered below the site does not show concentrations or increasing trends in concentrations of constituents that would indicate seepage from the existing disposal cells;

2. The useable aquifer at the site is separated from the facility by about 1,200 feet of unsaturated, low-permeability rock;

3. The useable aquifer is under artesian pressure and, therefore, has an upward pressure gradient which would preclude downward migration of constituents into the aquifer; and

4. The facility has operated for a period of 19 years and has caused no discernible impacts to groundwater during this period.

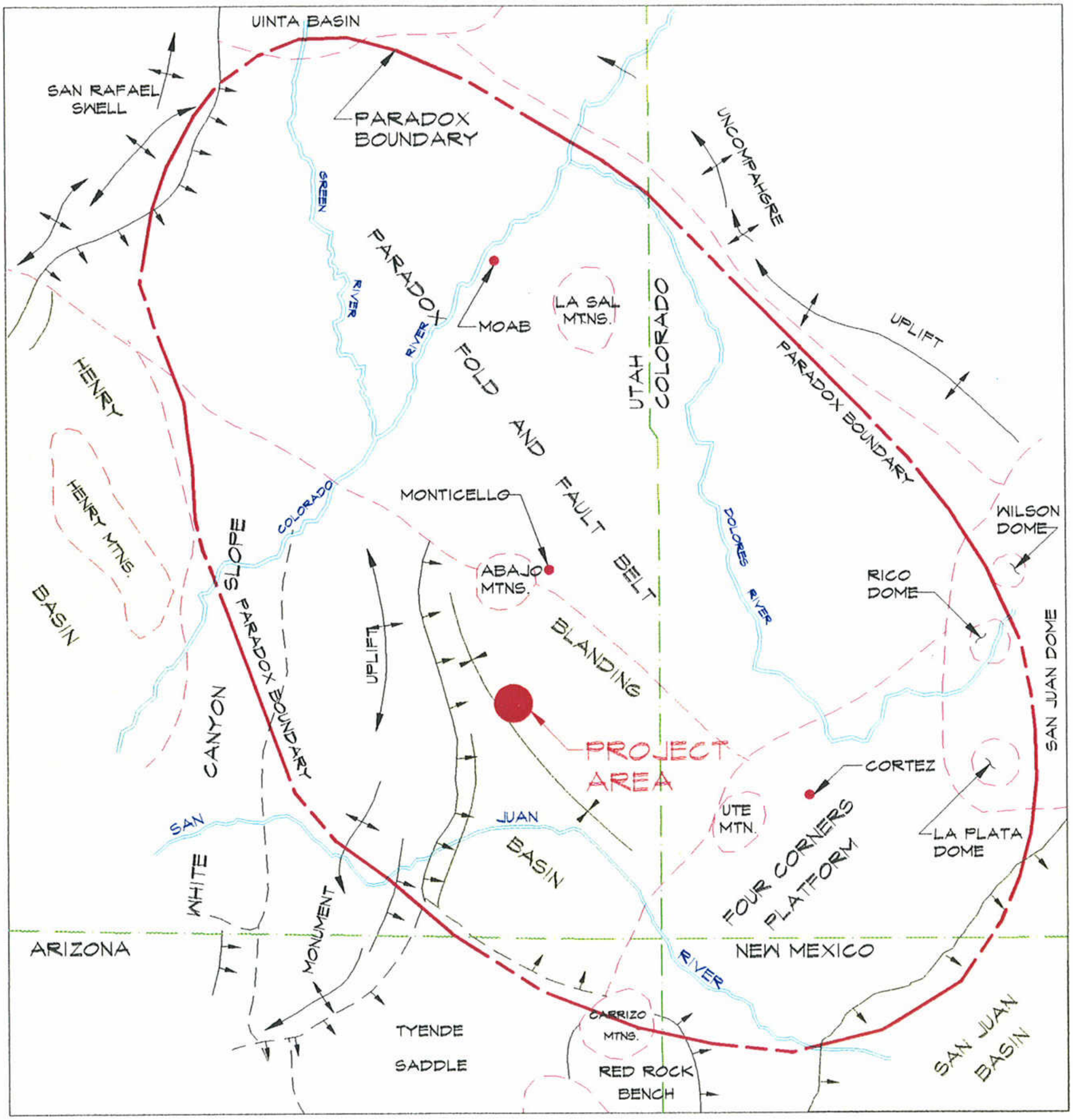
Continued monitoring of groundwater at the site are performed to verify that past, current, and future operations will not impact groundwater. The existing monitoring program and results are presented in the Semi-annual Effluent reports which are regularly submitted to the NRC.

1.5.1 Site Description

As shown on Figure 1.1-2, White Mesa Uranium Mill is located in southeastern Utah, approximately six miles south of the town of Blanding. It is situated on White Mesa, a flat area bounded on the east by Corral Canyon, to the west by Westwater Creek, and to the south by Cottonwood Canyon. The site consists of the uranium processing mill, and four engineered lined tailings disposal cells.

1.5.2 Geologic Setting

The White Mesa Uranium Mill site is located near the western edge of the Blanding Basin within the Canyon Lands section of the Colorado Plateau physiographic province (Figure 1.5-1, Hydrogeologic Evaluation Figure 1.1). The Canyon Lands have undergone broad, fairly horizontal uplift and subsequent erosion which have produced the region's characteristic topography represented by high plateaus, mesas, buttes and deep canyons incised into relatively flat lying sedimentary rocks of pre-Tertiary age. Elevations range from approximately 3,000 feet in the bottoms of the deep canyons along the southwestern margins of the region to more than 11,000 feet in the Henry, Abajo and La Sal mountains located to the northwest and northeast of the facility. With the exception of the deep canyons and isolated mountain peaks, an average elevation slightly in excess of 5,000 feet persists over most of the Canyon Lands. The average elevation at the White Mesa Uranium Mill is 5,600 feet mean sea level (MSL).



BOUNDARY OF TECTONIC DIVISION

MONOCLINE SHOWING TRACE OF AXIS AND DIRECTION OF DIP

ANTICLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

SYNCLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

FIGURE 1.5.1

Colorado Plateau Geologic Map

1.5.2.1 Stratigraphy

Rocks of Upper Jurassic and Cretaceous age are exposed in the canyon walls in the vicinity of the White Mesa Uranium Mill site. These rock units (Figure 1.5-2, Hydrogeologic Evaluation Figure 1.2) include, in descending order, the following: Eolian sand of Quaternary Age and varying thickness overlies the Dakota sandstone and Mancos shale on the mesa. A thin deposit of talus derived from rock falls of Dakota sandstone and Burro Canyon formation mantles the lower valley flanks. Underlying these units are the Cretaceous Age erosional remnants of Mancos shale, Dakota Sandstone, and Burro Canyon formation. Erosional remnants of Mancos shale are only found north of the Mill site. The Brushy Basin, Westwater Canyon, Recapture and Salt Wash Members of the upper Jurassic Age Morrison formation are encountered below the Burro Canyon formation. The Summerville formation, Entrada Sandstone and Navajo Sandstone are the deepest units of concern encountered at the site.

1.5.2.2 Local Geologic Structure

In general, the rock formations of the region are flat-lying with dips of 1 to 3 degrees. The rock formations are incised by streams that have formed canyons between intervening areas of broad mesas and buttes. An intricate system of deep canyons along and across hog-backs and cuestas has resulted from faulting, upwarping and dislocation of rocks around the intrusive rock masses, such as the Abajo Mountains. Thus the region is divided up into numerous hydrological areas controlled by structural features.

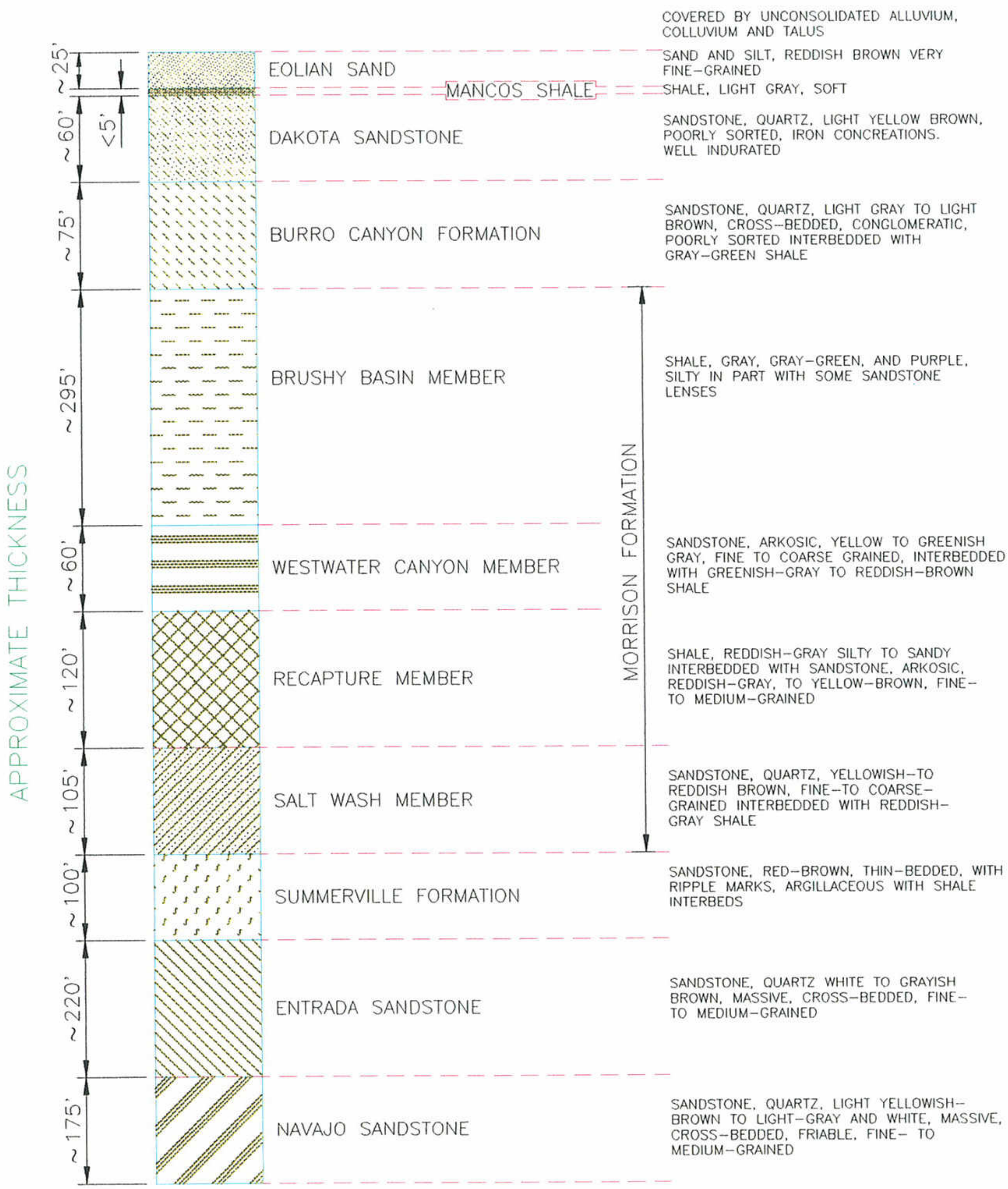


FIGURE 1.5-2

Generalized Stratigraphy of White Mesa

The strata underlying White Mesa have a regional dip of 1/2 to 1 degrees to the south; however, local dips of 5 degrees have been measured. Haynes, et al (1972) includes a map showing the structure at the base of the Dakota formation. Approximately 25 miles to the north, the Abajo Mountains, formed by igneous intrusions, have caused local faulting, upwarping, and displacement of the sedimentary section. However, no faults have been mapped in the immediate vicinity of White Mesa.

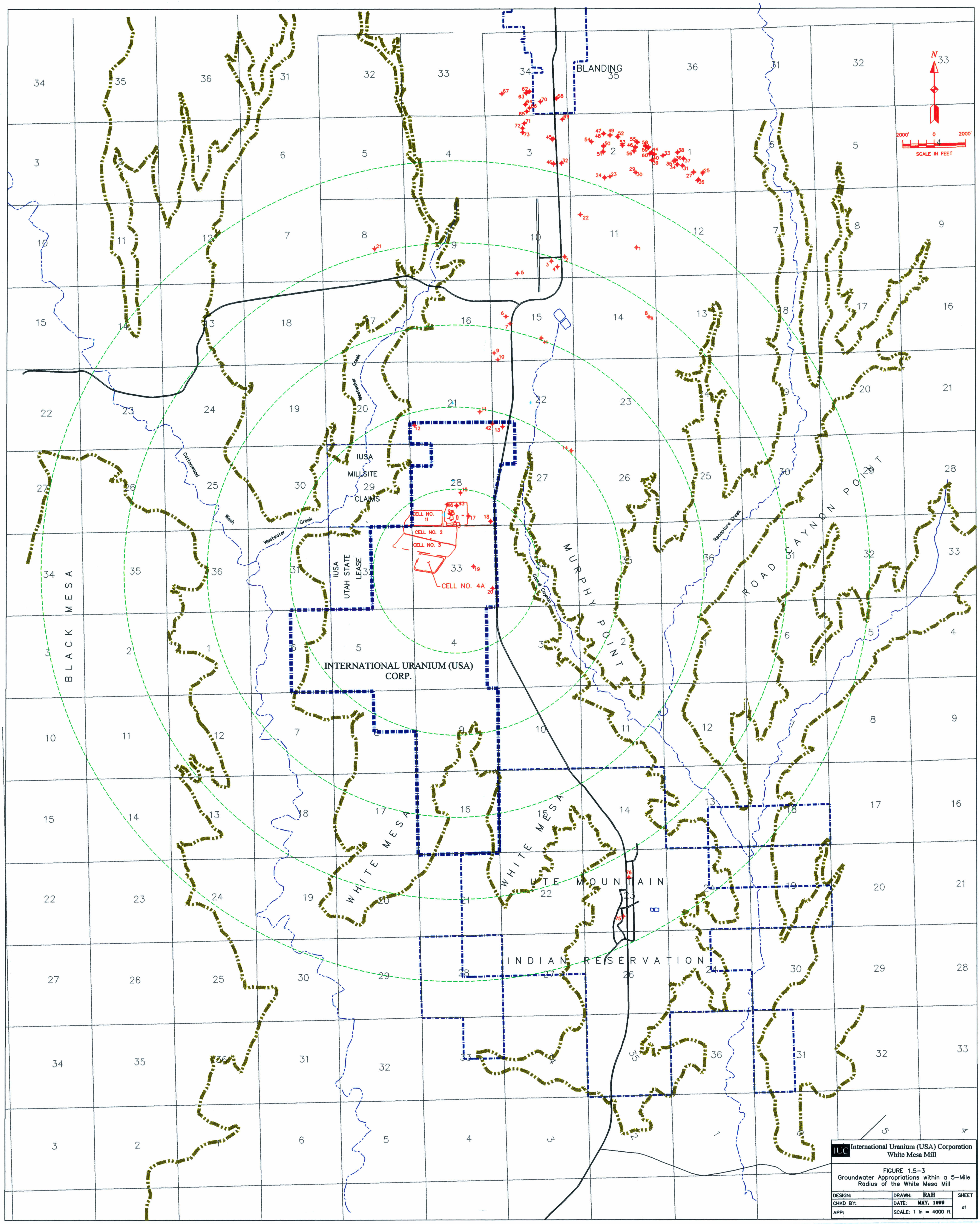
1.5.3 Hydrogeologic Setting

On a regional basis, the formations that are recognized as aquifers are: Cretaceous-age Dakota Sandstone and the upper part of the Morrison formation of late Jurassic age; the Entrada Sandstone, and the Navajo Sandstone of Jurassic age; the Wingate Sandstone and the Shinarump Member of the Chinle formation of Triassic age; and the DeChelle Member of the Cutler formation of Permian age.

Recharge to aquifers in the region occurs by infiltration of precipitation into the aquifers along the flanks of the Abajo, Henry and La Sal Mountains and along the flanks of folds, such as Comb Ridge Monocline and the San Rafael Swell, where the permeable formations are exposed at the surface (Figure 1.5-1, Hydrogeologic Evaluation Figure 1.1).

Seventy-six groundwater appropriation applications, within a five-mile radius of the Mill site, are on file with the Utah State Engineer's office. A summary of the applications is presented in Table 1.5-1 and shown on Figure 1.5-3. The majority of the applications is by private individuals and for wells drawing small, intermittent quantities of water, less than eight gpm, from the Burro Canyon formation. For the most part, these wells are located upgradient (north) of the White Mesa Uranium

Mill site. Stockwatering and irrigation are listed as primary uses of the majority of the wells. It is important to note that no wells completed in the perched groundwater of the Burro Canyon formation exist directly downgradient of the site within the five-mile radius. Two water wells which available data indicate are completed in the Entrada/Navajo sandstone (Clow, 1997), exist approximately 4.5 miles southeast of the site on the Ute Mountain Ute Reservation. These wells supply domestic water for the Ute Mountain Ute White Mesa Community, situated on the mesa along Highway 191 (see Figure 1.5-3). Data supplied by the Tribal Environmental Programs Office indicate that both wells are completed in the Entrada/Navajo sandstone, which is approximately 1,200 feet below the ground surface. Insufficient data are available to define the groundwater flow direction in the Entrada/Navajo sandstone in the vicinity of the mill.



International Uranium (USA) Corporation
White Mesa Mill

FIGURE 1.5-3
Groundwater Appropriations within a 5-Mile Radius of the White Mesa Mill

DESIGN:	DRAWN: RAH	SHEET
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APP:	SCALE: 1 in = 4000 ft	

Table 1.5-1
Wells Located Within A 5-Mile Radius of The White Mesa Uranium Mill

Map No.	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
1	Nielson, Norman and Richard C.	11	37S	22E	0.015	IDS	150-200
2	Guymon, Willard M.	10	37S	22E	0.015	S	82
3	Nielson, J. Rex	10	37S	22E	0.015	IDS	160
4	Nielson, J. Rex	10	37S	22E	0.013	S	165
5	Lyman, Fred S.	10	37S	22E	0.022	IDS	120
6	Plateau Resources	15	37S	22E	0.015	O	740
7	Plateau Resources	15	37S	22E	0.015	O	135
8	Nielson, Norman and Richard C.	14	37S	22E	0.015	IS	150-200
9	Lyman, George F.	15	37S	22E	0.015	S	135
10	Holt, N.E., McLaws, W.	15	37S	22E	0.007	S	195
11	Perkins, Dorothy	21	37S	22E	0.015	S	150
12	Energy Fuels Nuclear, Inc.	21	37S	22E	0.6	O	1600
13	Energy Fuels Nuclear, Inc.	22	37S	22E	1.11	O	1820
14	Utah Launch Complex	27	37S	22E	0.015	D	650
15	Energy Fuels Nuclear, Inc.	28	37S	22E	1.11	O	1885
16	Energy Fuels Nuclear, Inc.	28	37S	22E	1.11	O	1850
17	Energy Fuels Nuclear, Inc.	28	37S	22E	0.015	DSO	1800
18	Energy Fuels Nuclear, Inc.	28	37S	22E	0.6	O	1600
19	Jones, Alma U.	33	37S	22E	0.015	S	200
20	Energy Fuels Nuclear, Inc.	33	37S	22E	0.6	O	1600
21	BLM	8	37S	22E	0.01	S	170
22	Halliday, Fred L.	11	37S	22E	0.015	IS	180
23	Perking, Paul	2	37S	22E	0.015	ID	180
24	Redd, James D.	2	37S	22E	0.1	ID	200
25	Brown, Aroe G.	1	37S	22E	0.015	IS	210
26	Brown, George	1	37S	22E	0.015	IDS	140

Table 1.5-1
Wells Located Within A 5-Mile Radius of
The White Mesa Uranium Mill
(continued)

Map No.	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
27	Brown, Llo M.	1	37S	22E	0.004	IDS	141
28	Rentz, Alyce M.	1	37S	22E	0.015	ID	180
29	Rogers, Clarence	2	37S	22E	0.015	S	142
30	Perkins, Dorothy	2	37S	22E	0.015	S	100-200
31	Brandt J.R. & C.J.	1	37S	22E	0.015	IDS	160
32	Montella, Frank A.	3	37S	22E	0.015	IDO	190
33	Snyder, Bertha	1	37S	22E	0.1	IDS	196
34	Martineau, Stanley D.	1	37S	22E	0.015	ID	160
35	Kirk, Ronald D. & Catherine A.	1	37S	22E	0.015	IDS	160
36	Palmer, Ned J. and Marilyn	1	37S	22E	0.015	IDS	0
37	Grover, Jess M.	1	37S	22E	0.015	S	160
38	Monson, Larry	1	37S	22E	0.015	IDS	140
39	Neilson, Norman and Richard	1	37S	22E	0.015	IS	132
40	Watkins, Henry Clyde	1	37S	22E	0.015	IS	150
41	Shumway, Glen & Eve	15	37S	22E	0.015	IS	60
42	Energy Fuels Nuclear, Inc. (not drilled)	21	37S	22E	0.600	O	1600
43	Energy Fuels Nuclear, Inc. (#1)	28	37S	22E	1.100	O	1860
44	Watkins, Ivan R.	1	37S	22E	0.200	S	185
45	Waukesha of Utah	3	37S	22E	0.015	D	226
46	Simpson, William	3	37S	22E	0.030	ID	180
47	Guyman, Willard M.	2	37S	22E	0.030	S	164
48	Harrieson, Lynda	2	37S	22E	0.012	IDS	---
49	Hurst, Reed	2	37S	22E	0.015	D	100-300
50	Kaer, Alvin	2	37S	22E	0.015	IDS	100-300
51	Heiner, Gerald B.	2	37S	22E	0.015	ID	75
52	Laws, James A.	2	37S	22E	0.015	IDS	100-300

Table 1.5-1
Wells Located Within A 5-Mile Radius of
The White Mesa Uranium Mill
(continued)

Map No.	Water Right	SEC	TWP	RNG	CFS	USE	Depth (ft.)
53	Laws, J. Parley	2	37S	22E	0.015	IDS	
54	Anderson, Dennis & Edith	2	37S	22E	0.015	IDS	160
55	Guymon, Eugene	2	37S	22E	0.100	IDS	130
56	Guymon, Eugene	2	37S	22E	0.015	S	130
57	Guymon, Dennis & Doris	2	37S	22E	0.030	IDS	210
58	Guymon, Eugene	2	37S	22E	0.115	IDS	100-200
59	Guymon, Eugene	2	37S	22E	0.115	IDS	100-200
60	Perkins, Dorothy	2	37S	22E	0.015	IDS	140
61	Watkins, Ivan R.	1	37S	22E	0.015	IDS	145
62	Roper, Lloyd	34	36S	22E	0.015	ID	180
63	Smith, Lee & Marylynn	34	36S	22E	0.060	IDS	170
64	McDonald, Kenneth P.	34	36S	22E	0.015	IDS	734
65	Brake, John	34	36S	22E	0.015	ID	250
66	Brake, John	34	36S	22E	0.015	IS	150
67	Redd, Parley V. & Reva V.	34	36S	22E	0.015	IS	200
68	C & C Construction	34	26S	22E	0.015	IS	190
69	Guymon, Dean W.	3	37S	22E	0.015	IDS	180
70	Phillips, Elizabeth Ann Hurst	34	36S	22E	0.015	I	165
71	Howe, Leonard R.	3	37S	22E	0.015	O	160
72	Shumway, Mark Eugene	3	37S	22E	0.015	ID	
73	Shumway, Mark Eugene	3	37S	22E	0.015	IDS	150
74	Lyman, Henry M.	3	37S	22E	0.100	IDS	200
75	Uta Mountain Ute	23	38S	22E	0.535	D	-
76	Ute Mountain Ute	23	38S	22E	0.1606	D	1515

Notes:
D - Domestic
I - Irrigation
S - Stockwatering
O - Industrial
SEC - Section
TWP - Township
RNG - Range
CFS - Cubic Feet Per Second

The well yield from wells completed in the Burro Canyon formation within the White Mesa site is generally lower than that obtained from wells in this formation upgradient of the site. For the most part, the documented pumping rates from on-site wells completed in the Burro Canyon formation are less than 0.5 gpm. Even at this low rate, the on-site wells completed in the Burro Canyon formation are typically pumped dry within a couple of hours.

This low productivity suggests that the White Mesa Uranium Mill is located over a peripheral fringe of perched water; with saturated thickness in the perched zone discontinuous and generally decreasing beneath the site, and with conductivity of the formation being very low. These observations have been verified by studies performed for the U.S. Department of Energy's disposal site at Slick Rock, which noted that the Dakota Sandstone, Burro Canyon formation, and upper claystone of the Brushy Basin Member are not considered aquifers due to the low permeability, discontinuous nature, and limited thickness of these units (U.S. DOE, 1993).

1.5.3.1 Hydrostratigraphy

The site stratigraphy is described above in Section 1.5.2.1. The detailed site stratigraphic column with descriptions of each geologic unit is provided on Figure 1.5-2. The following discussion, adapted from the Hydrogeologic Evaluation, focuses on those geologic units at or in the vicinity of the site which have or may have groundwater present.

The presence of groundwater within and in proximity to the site has been documented in three strata: the Dakota Sandstone, the Burro Canyon formation, and the Entrada/Navajo Sandstone. The Burro Canyon formation hosts perched groundwater over the Brushy Basin Member of the Morrison formation at the site.

The Entrada/Navajo Sandstones form one of the most permeable aquifers in the region. This aquifer is separated from the Burro Canyon formation by the Morrison formation and Summerville formation. Water in this aquifer is under artesian pressure and is used by the site's operator for industrial needs and consumption. The artesian conditions present in this aquifer are discussed in Section 1.5.6.4.

Geologic cross sections which illustrate the stratigraphic position of the Entrada/Navajo Sandstone aquifer and intervening strata are shown on Figures 1.5.3-1, 1.5.3-2, and 1.5.3-3 (from Hydrogeologic Evaluation Figures 2.1, 2.2, and 2.3, respectively). The summary of the borehole information supporting the site's stratigraphy, description of the drilling information and boring logs are presented in Appendix A of the Hydrogeologic Evaluation. With the exception of six deep water supply wells installed at various locations around the site and completed in Entrada/Navajo Sandstone, all of the boring data are from wells drilled through the Dakota/Burro Canyon Sandstones and terminated in the Brushy Basin Member. The drilling and logging data indicate that the physical characteristics of the bedrock vary considerably, both vertically and laterally. The following sections discuss the relevance of those strata and their physical characteristics to the site's hydrogeology.

Dakota Sandstone

The Dakota Sandstone is a low- to moderately-permeable formation that produces acceptable quality water at low production rates. Water from this formation is typically used for stock water and/or irrigation.

The Dakota Sandstone is the uppermost stratum in which the tailings disposal cells are sited. At the ground surface, the Dakota Sandstone is overlain by a veneer of reddish-brown clayey or sandy silts with a thickness of up to 10 feet and extends to depths of 43 to 66 feet below the surface (D'Appolonia, 1982). The Dakota Sandstone at this site is typically composed of moderately hard to hard sandstones with random discontinuous shale (claystone) and siltstone layers. The sandstones are moderately cemented (upper part of formation) to well cemented with kaolinitic clays. The claystones and siltstones are typically 2 to 3 feet thick, although boring WMMW-19 encountered a siltstone layer having a thickness of 8 feet at 33 to 41 feet below the ground surface.

Porosity of the Dakota Sandstone is predominately intergranular. Laboratory tests performed (see Table 1.5.3.1-1, from Hydrogeologic Evaluation Table 2.1) show the total porosity of the sandstone varies from 13.4 to 26.0 percent with an average value of 19.9 percent. The formation is very dry to dry with volumetric water contents varying from 0.6 to 7.1 percent with an average value of 3.0 percent. Saturation values for the Dakota Sandstone vary from 3.7 to 27.2 percent. The hydraulic conductivity values as determined from packer tests range from 9.12E-04 centimeters per second (cm/sec) to 2.71E-06 cm/sec with a geometric mean of 3.89E-05 cm/sec (Dames & Moore, 1978; Umetco, 1992). A summary of hydraulic properties of the Dakota Sandstone is presented in Table 1.5.3.1-2 (Hydrogeologic Evaluation Table 2.2).

Table 1.5.3.1-1
Properties of the Dakota/Burro Canyon Formation
White Mesa Uranium Mill

Formation	Well No. and Sample Interval		Moisture Content (Percent)	Mosture Content Volumetric	Dry Unit Weight (lbs/cu ft)	Porosity (Percent)	Particle Sp. Gr.	Saturation (Percent)	Retained Moisture (Percent)	Liquid Limit (Percent)	Plastic Limit (Percent)	Plasticity Index (Percent)	Rock Type
Dakota	WMMW-16	26.4' - 38.4'	1.5	3.3	135.2	17.9	2.64	18.2	5.1				Sandstone
	WMMW-16	37.8' - 38.4'	0.4	0.8	127.4	22.4	2.63	3.7	6.3				Sandstone
	WMMW-17	27.0' - 27.5'	0.3	0.6	138.8	13.4	2.57	4.8	5.1				Sandstone
	WMMW-17	49.0' - 49.5'	3.6	7.1	121.9	26.0	2.64	27.2	9.6				Sandstone
Burro Canyon	WMMW-16	45.0' - 45.5'	5.6	12.6	140.9	16.4	2.70	77.2		29.6	15.4	14.2	Sandy Mudstone
	WMMW-16	47.5' - 48.0'	2.6	5.9	142.8	12.0	2.60	48.9	4.4				Sandstone
	WMMW-16	53.5' - 54.1'	0.7	1.4	129.0	19.9	2.58	7.1	6.4				Sandstone
	WMMW-16	60.5' - 61.0'	0.1	0.2	117.9	27.3	2.61	0.8	9.9				Sandstone
	WMMW-16	65.5' - 66.0'	2.6	5.5	131.5	19.3	2.62	28.2	7.1				Sandstone
	WMMW-16	73.0' - 73.5'	0.1	0.3	130.3	20.6	2.63	1.3	5.5				Sandstone
	WMMW-16	82.0' - 82.4'	0.1	0.1	134.3	18.5	2.64	0.6	4.8				Sandstone
	WMMW-16	90.0' - 90.7'	0.1	0.3	161.5	2.0	2.64	12.8	0.9				Sandstone
	WMMW-16	91.1' - 91.4'	5.2	9.8	118.1	29.1	2.67	33.8		33.7	16.2	17.5	Claystone
	WMMW-17	104.0' - 104.5'	0.2	0.4	161.4	1.7	2.67	26.6	0.8				Sandstone
Average:			**1.65**	**3.4**	**135**	**17.6**	**2.63**	**21**	**5.5**				

Adapted from: Table 2.1, Hydrogeologic Evaluation.

Table 1.5.3.1-2
Summary of Hydraulic Properties
White Mesa Mill

Boring/Well Location	Test Type	Interval (ft. - ft.)	Document Referenced		Hydraulic Conductivity (ft./yr.)	Hydraulic Conductivity (cm./sec.)
Soils						
6	Laboratory Test	9	D&M		1.2E+01	1.2E-05
7	Laboratory Test	4.5	D&M		1.0E+01	1.0E-05
10	Laboratory Test	4	D&M		1.2E+01	1.2E-05
12	Laboratory Test	9	D&M		1.4E+02	1.4E-04
16	Laboratory Test	4.5	D&M		2.2E+01	2.1E-05
17	Laboratory Test	4.5	D&M		9.3E+01	9.0E-05
19	Laboratory Test	4	D&M		7.0E+01	6.8E-05
22	Laboratory Test	4	D&M		3.9E+00	3.8E-06
			Geometric Mean		2.45E+01	2.37E-05
Dakota Sandstone						
No. 3	Injection Test	28-33	D&M	(1)	5.68E+02	5.49E-04
No. 3	Injection Test	33-42.5	D&M		2.80E+00	2.71E-06
No. 12	Injection Test	16-22.5	D&M		5.10E+00	4.93E-06
No. 12	Injection Test	22.5-37.5	D&M		7.92E+01	7.66E-05
No. 19	Injection Test	26-37.5	D&M		7.00E+00	6.77E-06
No. 19	Injection Test	37.5-52.5	D&M		9.44E+02	9.12E-04
			Geometric Mean		4.03E+01	3.89E-05
Burro Canyon Formation						
No. 3	Injection Test	42.5-52.5	D&M		5.80E+00	5.61E-06
No. 3	Injection Test	52.5-63	D&M		1.62E+01	1.57E-05
No. 3	Injection Test	63-72.5	D&M		5.30E+00	5.13E-06
No. 3	Injection Test	72.5-92.5	D&M		3.20E+00	3.09E-06

Table 1.5.3.1-2
Summary of Hydraulic Properties
White Mesa Mill
(continued)

Boring/Well Location		Test Type	Interval (ft. - ft.)		Document Referenced		Hydraulic Conductivity (ft./yr.)	Hydraulic Conductivity (cm./sec.)
No. 3		Injection Test	92.5-107.5		D&M		4.90E+00	4.74E-06
No. 3		Injection Test	122.5-142		D&M		6.00E+01	5.80E-07
No. 9		Injection Test	27.5-42.5		D&M		2.70E+00	2.61E-06
No. 9		Injection Test	42.5-59		D&M		2.00E+00	1.93E-06
No. 9		Injection Test	59-82.5		D&M		7.00E+01	6.77E-07
No. 9		Injection Test	82.5-107.5		D&M		1.10E+00	1.06E-06
No. 9		Injection Test	107.5-132		D&M		3.00E+01	2.90E-07
No. 12		Injection Test	37.5-57.5		D&M		9.01E+01	8.70E-07
No. 12		Injection Test	57.5-82.5		D&M		1.40E+00	1.35E-06
No. 12		Injection Test	82.5-102.5		D&M		1.07E+01	1.03E-05
No. 28		Injection Test	76-87.5		D&M		4.30E+00	4.16E-06
No. 28		Injection Test	87.5-107.5		D&M		3.00E+01	2.90E-07
No. 28		Injection Test	107.5-132.5		D&M		2.00E+01	1.93E-07
WMMW1	(7)	Recovery	92-112		Peel	(2)	3.00E+00	2.90E-06
WMMW3	(7)	Recovery	67-87		Peel		2.97E+00	2.87E-06
WMMW5	(7)	Recovery	95.5-133.5		H-E		1.31E+01	1.27E-05
WMMW5	(7)	Recovery	95.5-133.5		Peel		2.10E+01	2.03E-05
WMMW11	(7)	Recovery	90.7-130.4		H-E	(3)	1.23E+03	1.19E-03
WMMW11	(7)	Single well drawdown	90.7-130.4		Peel		1.63E+03	1.58E-03
WMMW12	(7)	Recovery	84-124		H-E		6.84E+01	6.61E-05
WMMW12	(7)	Recovery	84-124		Peel		6.84E+01	6.61E-05
WMMW14		Single well drawdown	90-120	(5)	H-E		1.21E+03	1.16E-03
WMMW14		Single well drawdown	90-120	(6)	H-E		4.02E+02	3.88E-04
WMMW15		Single well drawdown	99-129		H-E		3.65E+01	3.53E-05
WMMW15	(7)	Recovery	99-129		Peel		2.58E+01	2.49E-05
WMMW16		Injection Test	28.5-31.5		Peel		9.42E+02	9.10E-04
WMMW16		Injection Test	45.5-51.5		Peel		5.28E+01	5.10E-05

Table 1.5.3.1-2
Summary of Hydraulic Properties
White Mesa Mill
(continued)

Boring/Well Location	Test Type	Interval (ft. - ft.)	Document Referenced		Hydraulic Conductivity (ft./yr.)	Hydraulic Conductivity (cm./sec.)
WMMW16	Injection Test	65.5-71.5	Peel		8.07E+01	7.80E-05
WMMW16	Injection Test	85.5-91.5	Peel		3.00E+01	2.90E-05
WMMW17	Injection Test	45-50	Peel		3.10E+00	3.00E-06
WMMW17	Injection Test	90-95	Peel		3.62E+00	3.50E-06
WMMW17	Injection Test	100-105	Peel		5.69E+00	5.50E.06
WMMW18	Injection Test	27-32	Peel		1.14E+02	1.10E-04
WMMW18	Injection Test	85-90	Peel		2.69E+01	2.60E-05
WMMW18	Injection Test	120-125	Peel		4.66E+00	4.50E-06
WMMW19	Injection Test	55-60	Peel		8.69E+00	8.40E-06
WMMW19	Injection Test	95-100	Peel		1.45E+00	1.40E-06
			Geometric Mean		1.05E+01	1.01E-05
Entrada/Navajo Sandstones						
WW-1	Recovery		D'Appolonia	(4)	3.80E+02	3.67E-04
WW-1	Multi-well drawdown		D'Appolonia		4.66E+02	4.50E-04
WW-1,2,3	Multi-well drawdown		D'Appolonia		4.24E+02	4.10E-04
			Geometric Mean		4.22E+02	4.08E-04

Notes:
(1) D&M = Dames & Moore, Environmental Report, White Mesa Uranium Project, January, 1978.
(2) Peel = Peel Environmental Services, UMETCO Minerals Corp., Ground Water Study, White Mesa Facility, June 1994.
(3) H-E= Hydro-Engineering, Ground-Water Hydrology at the White Mesa Tailings Facility, July, 1991.
(4) D'Appolonia, Assessment of the Water Supply System, White Mesa Project, Feb. 1981.
(5) Early test data.
(6) Late test data.
(7) Test data reanalyzed by TEC.

Adapted from: Table 2.2, Hydrogeologic Evaluation.

Burro Canyon Sandstone

Directly below the Dakota Sandstone, the borings encountered sandstones and random discontinuous shale layers of the Burro Canyon formation to depths of 91 to 141 feet below the site. The importance of this stratum to the site's hydrogeology is that it hosts perched water beneath the site. Beneath the Burro Canyon formation, the Brushy Basin Member is composed of variegated bentonitic mudstone and siltstone; its permeability is lower than the overlying Burro Canyon formation and prevents downward percolation of groundwater (Haynes, et al, 1972). Observed plasticity of claystones (Umetco, 1992) forming the Brushy Basin Member indicates low potential for open fractures which could increase permeability. Section 1.5.3.2 contains a summary of a drilling program carried out in response to agency requests to obtain additional hydrogeologic data.

Previous investigators have seldom made a distinction between the Dakota and Burro Canyon Sandstones. However, examination of borehole cuttings, cores and geophysical logging methods has allowed separation of the two formations. Although similar to the Dakota, the Burro Canyon formation varies from a very fine- to coarse-grained sandstone. The sand grains are generally poorly sorted. The coarse-grained layers also tend to be conglomeratic. The grains are cemented with both silica and kaolin, but silica-cemented sandstones are dominant. The formation becomes argillaceous near the contact with the Brushy Basin Member.

The saturated thickness in the Burro Canyon formation varies across the project area from 55 feet in the northern section to less than 5 feet in the southern area. Some wells are dry, which suggests that the zone of saturation is not continuous. Saturation ceases or is marginal along the western and southern section of the project. The extent toward the east is not defined, but its maximum extent is certainly not beyond the walls of Westwater Creek and Corral Canyons where the Burro Canyon formation crops out. Perched groundwater elevations and saturated thickness of this formation are shown on Figures 1.5.3.1-4 and 1.5.3.1-5, respectively (from Hydrogeologic Evaluation Figures 2.4 and 2.5).

Hydraulic properties of this stratum have been determined from 12 single, well-pumping/recovery tests and from 30 packer tests. A summary of the hydraulic properties is given in Table 1.5.3.1-2 (Hydrogeologic Evaluation Table 2.2). These tests indicate the hydraulic conductivity geometric mean to be 1.0E-05 cm/sec. The physical properties of the Burro Canyon Sandstone are summarized in Table 1.5.3.1-1. Based on the core samples tested, the sandstones of the Burro Canyon formation vary in total porosity from 1.7 to 27.6 percent, the average being 16.0 percent. Volumetric water content in these sandstones ranges from 0.1 to 7.1 percent, averaging 2.2 percent, with the fine-grained materials having the higher moisture content. Porosities in the claystone layers vary from 16.4 to 29.1 percent with saturation values ranging from 33.8 to 77.2 percent.

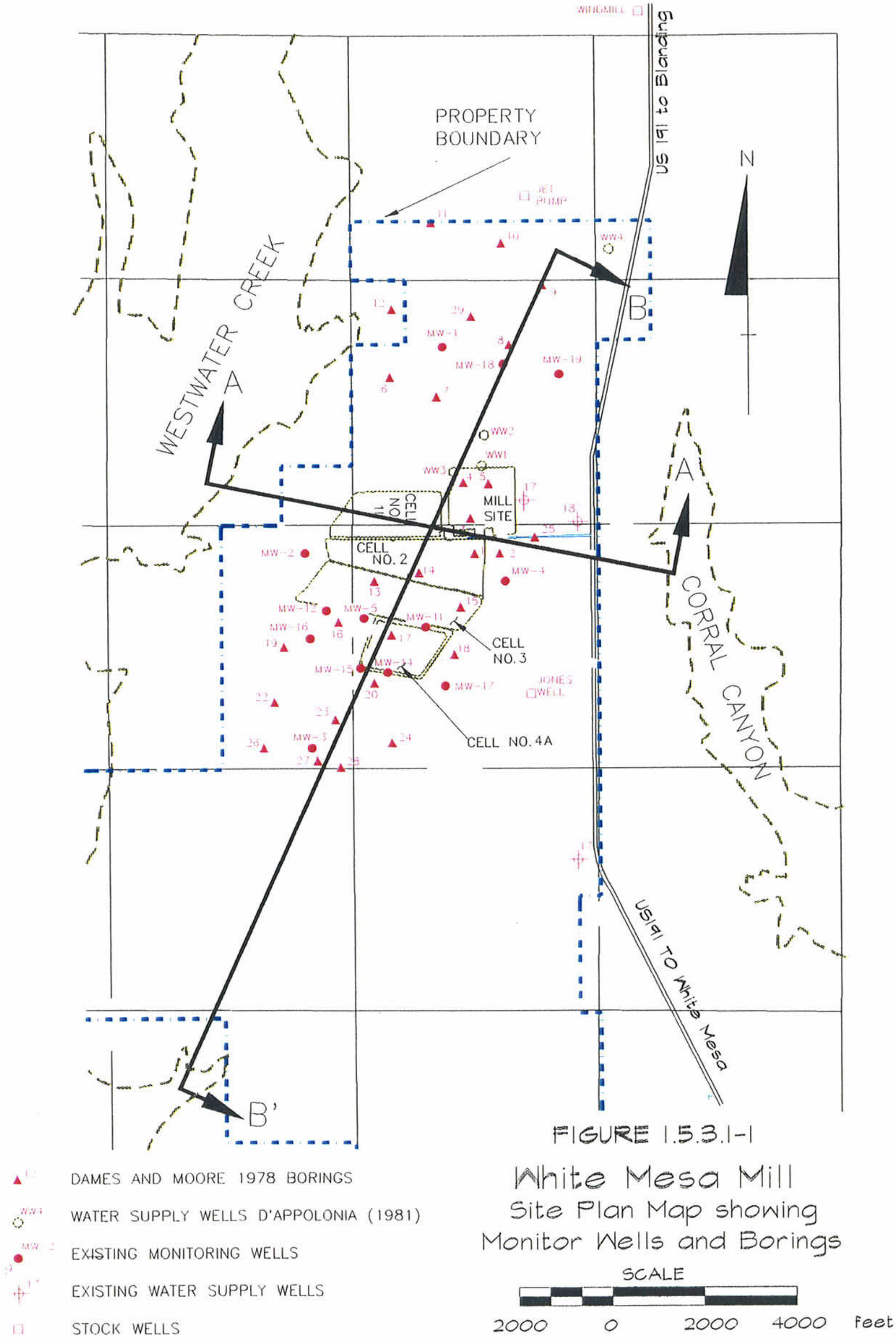


FIGURE 1.5.3.1-1

White Mesa Mill
Site Plan Map showing
Monitor Wells and Borings

Brushy Basin Member

The Brushy Basin Member of the Morrison formation is the first aquitard isolating perched water in the Burro Canyon formation from the productive Entrada/Navajo Sandstones. The Brushy Basin Member, in contrast to the overlying Dakota Sandstone, is composed of bentonitic mudstone and claystone. Limited site-specific hydraulic property data are available for the Brushy Basin Member.

The thickness of the Brushy Basin Member in this region reportedly varies from 200-450 feet (Dames & Moore, 1978). This stratum was penetrated by six water supply wells [see Figure 1.5.3.1-1 (Hydrogeologic Evaluation Figure 2.1)]and Appendix A of the Hydrogeologic Evaluation) and its thickness was estimated at 275 feet. Borings which terminate in the Brushy Basin Member encounter moderately plastic dark green to dark reddish-brown mudstones. Plastic bentonitic mudstone is not prone to develop fracturing. Hence, competency of this strata, as an aquitard, is very likely.

Entrada/Navajo Aquifer

Within and in proximity to the site, the Entrada/Navajo Sandstones are both prolific aquifers. Since site water wells are screened in both aquifers, they are, from a hydrogeologic standpoint, treated as a single aquifer. The Entrada/Navajo Sandstone is the first useable aquifer of significance documented within the project area. This aquifer is present at depths between 1,200 and 1,800 feet below the surface and is capable of delivering from 150 to 225 gpm of water per well (D'Appolonia, 1981).

Water is present under artesian pressure and is documented to rise by about 800 to 900 feet above the top of Entrada/Navajo Sandstone contact with the overlying Summerville formation. The static water level is about 400 to 500 feet below the surface (Figures 1.5.3.1-2 and 1.5.3.1-3). Section 1.5.6.4. provides a more detailed discussion regarding the artesian conditions of this formation.

The thickness of the strata separating this aquifer from water present in the Burro Canyon formation is about 1,200 feet. This confining layer is competent enough to maintain pressure of 900 feet of water or 390 pounds per square inch (psi) within the Entrada/Navajo Aquifer.

The positioning of this aquifer and its hydraulic head versus other strata is shown on Figures 1.5.3.1-2 and 1.5.3.1-3. In-situ hydraulic pressure of groundwater in the Entrada/Navajo Aquifer is strong evidence of the confining (i.e. "aquitard") properties of the overlying sedimentary section. Due to the presence of significant artesian pressure in this aquifer, any future hydraulic communication between perched water in the Burro Canyon formation and the Entrada/Navajo Aquifer is unlikely.

1.5.3.2 Data Collected in 1994

This subsection contains a summary of a 1994 drilling program carried out in response to a request by the U. S. Nuclear Regulatory Commission (NRC) and the U. S. Environmental Protection Agency (EPA) to further investigate the competence of the Brushy Basin member of the Morrison formation and to provide additional hydrogeologic data. Three vertical and four angle core holes were drilled.

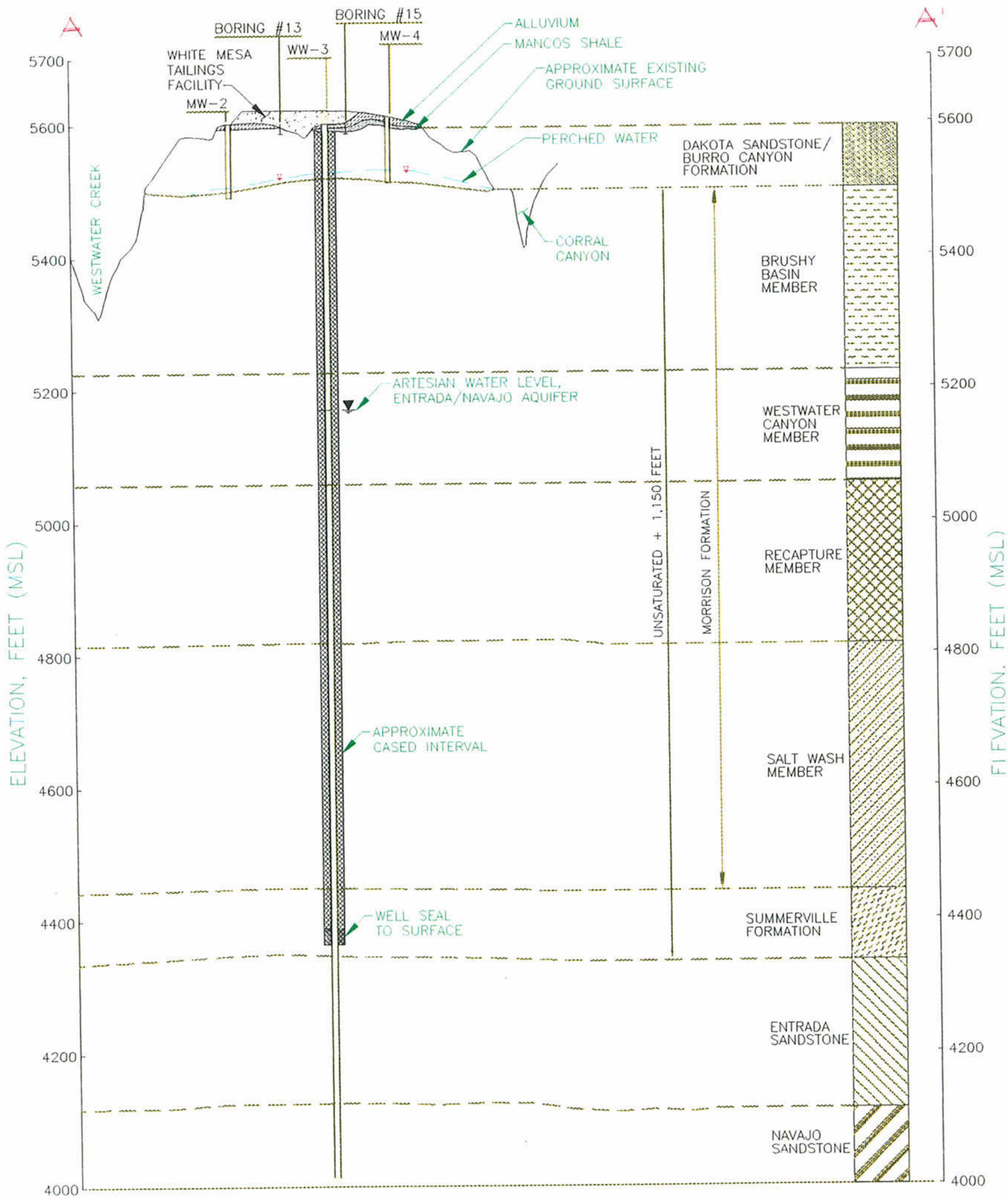


FIGURE 1.5.3.1-2
White Mesa Mill
Section A-A'

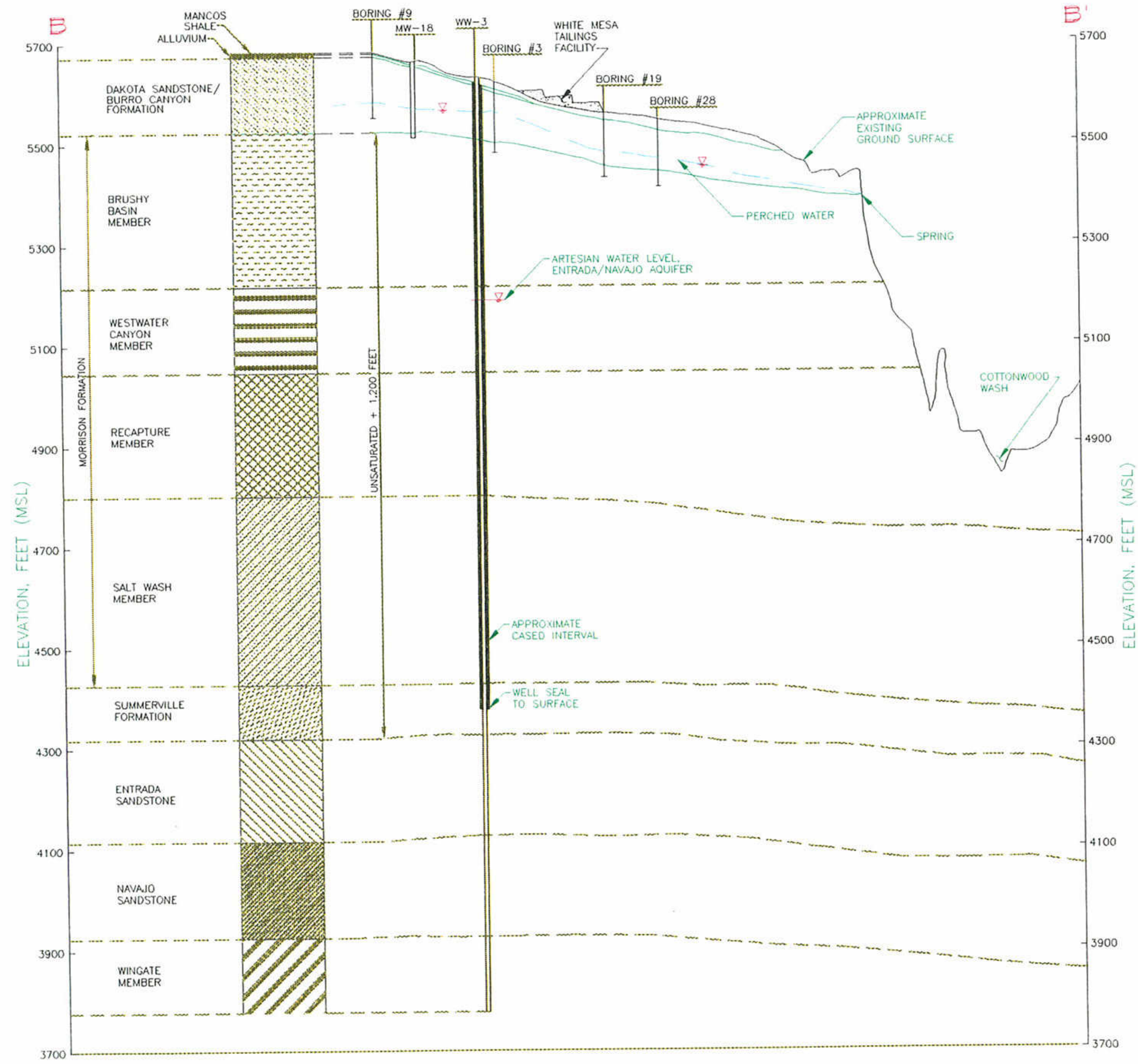


FIGURE 1.5.3.1-3
White Mesa Mill
Section B-B'

The three vertical holes (WMMW-20, WMMW-21, and WMMW-22) were drilled downgradient of the existing monitoring wells. Constant head packer tests were conducted over intervals within the Brushy Basin member to gain information about the horizontal hydraulic conductivity of this unit. Selected cores samples of the Brushy Basin member were analyzed for vertical hydraulic conductivities. The three vertical holes were drilled to sufficient depth to penetrate 20± feet of Brushy Basin Member. Four core holes were drilled along the edge of tailings ponds No. 3 and No. 4. The cores were examined to determine if open fractures were present. Few fractures were observed, and where noted, they were closed and infilled with gypsum. Packer tests were conducted during the drilling of the holes to gain further information about the hydraulic conductivity of the rocks.

Upon completion of drilling, all the geotechnical holes were logged using wireline geophysical methods. A video camera survey was performed in three of the four core holes. The holes were then plugged and abandoned.

Selected cores of the Brushy Basin from all the holes were sent for laboratory measurement of the vertical permeability. The results of these tests are presented in Table 1.5.3.2-1. The hydraulic conductivities calculated from these tests vary from 7.10E-06 cm/sec to 8.90E-04 cm/sec in the Dakota formation, from 9.88E-07 cm/sec to 7.70E-04 cm/sec in the Burro Canyon formation and from 2.30E-07 cm/sec to 1.91E-06 cm/sec in the Brushy Basin member. Three packer tests run within the Brushy Basin member yielded "No Take." Due to the low hydraulic conductivities, measurements could not be made with the equipment available. The hydraulic conductivities of these zones can be expected to be lower than the zones in which actual measurements were made. It can, therefore, be assumed that the hydraulic conductivities of these zones are less than 2.30E-07 cm/sec. Packer tests tend to reflect horizontal hydraulic conductivities which can be expected to be greater than vertical hydraulic conductivities of the same zone.

Slug tests were conducted in wells WMMW-20 and WMMW-22. The test results are shown in Table 1.5.3.2-1. A hydraulic conductivity of 3.14E-06 cm/sec was calculated for WMMW-20 and 9.88E-07 cm/sec (essentially 1.0E-06 cm/sec) for WMMW-22.

Cores from the Brushy Basin were sent to Western Engineers of Grand Junction, Colorado for horizontal and vertical permeability determination. The results of these tests are shown on Table 1.5.3.2-2. The vertical hydraulic conductivities of the cores vary from 5.95E-04 to 7.28E-11 cm/sec. The geometric mean of the vertical permeabilities is 1.23E-08 cm/sec.

For the few analyses conducted for horizontal permeabilities, the results ranged from 1.09E-07 to 6.14E-10 cm/sec and the geometric mean of these values was calculated to be 6.72E-09 cm/sec.

Packer tests were conducted over zones within the Dakota, Burro Canyon and Brushy Basin units. The cores and video surveys of the drill holes showed that the few closed hairline fractures present in the Burro Canyon and Dakota Formations do not substantially affect the hydraulic conductivity of the formations.

TABLE 1.5.3.2-1
Summary of Borehole Tests, 1994 Drilling Program
White Mesa Project, San Juan County, Utah

Well No.	Interval	Type of Test	Formation	Hydraulic Conductivity gpd/ft^2	Hydraulic Conductivity cm/sec
WMMW-20	110.5-114.5	Constant Head	Brushy Basin	0.005	2.30E-07
	87.0-90.0	Slug	Burro Canyon	0.015	5.29E-06
WMMW-21	109.5-117.0	Constant Head	Brushy Basin	0.17	8.15E-06
WMMW-22	130.0-140.0	Constant Head	Brushy Basin	-No Take-	
	76-120	Slug	Burro Canyon	0.06	3.14E-06
GH-94-1	34.0-40.0	Constant Head	Dakota	0.16	7.10E-06
	40.0-50.0	Constant Head	Dakota	1.18	5.60E-05
	70.0-80.0	Constant Head	Burro Canyon	0.01	9.88E-07
	92.0-100	Constant Head	Burro Canyon	13.1	6.20E-04
	103.0-110.0	Constant Head	Burro Canyon	15.84	7.70E-04
	130.0-140.0	Constant Head	Brushy Basin	3.6	1.70E-04
	163.0-165.0	Constant Head	Brushy Basin	-No Take-	
GH-94-2A	34.0-40.0	Constant Head	Dakota	0.66	3.10E-05
	32.5-40.0	Constant Head	Dakota	18.72	8.90E-04
	50.0-56.0	Constant Head	Dakota	2.30	1.10E-04
	60.0-70.0	Constant Head	Burro Canyon	1.04	4.90E-05
	70.0-80.0	Constant Head	Burro Canyon	4.18	2.00E-04
	80.0-90.0	Constant Head	Burro Canyon	3.02	1.50E-04
	138.0-144.0	Constant Head	Brushy Basin	-No Take-	
GH-94-3	155.0-161.0	Constant Head	Brushy Basin	0.07	3.26E-06
	138.0-144.0	Constant Head	Brushy Basin	0.06	2.70E-06

TABLE 1.5.3.2-2
Results of Laboratory Tests

Well No.	Interval Tested (ft)	Formation Tested	Vertical Permeabilities cm/sec
WMMW-20	92.0-92.5	Brushy Basin	7.96E-11
	95.4-96.0	Brushy Basin	2.96E-09
	104.0-104.4	Brushy Basin	2.43E-09
	105.0-105.5	Brushy Basin	7.28E-11
	109.5-110.0	Brushy Basin	1.02E-09
WMMW-21	94.8-95.3	Brushy Basin	5.78E-06
	106.5-107.0	Brushy Basin	6.38E-10
	114.5-115.0	Brushy Basin	1.46E-07
WMMW-22	122.2-122.7	Brushy Basin	1.08E-06
	126.3-127.2	Brushy Basin	6.94E-10
	133.3-133.7	Brushy Basin	2.11E-09
	137.3-137.8	Brushy Basin	5.95E-04
GH-1	163.0-163.5	Brushy Basin	1.68E-08
	165.0-165.5	Brushy Basin	6.76E-07
GH-2A	161.0-161.5	Brushy Basin	6.73E-09
GH-3	157.0-157.5	Brushy Basin	9.42E-10
GH-4	158.0-158.5	Brushy Basin	2.17E-09

Well No.	Interval Tested (ft)	Formation Tested	Horizonal Permeabilities cm/sec
WMMW-20	95.4-96.0	Brushy Basin	1.09E-07
	105.0-105.5	Brushy Basin	6.14E-10
WMMW-21	94.8-95.3	Brushy Basin	8.31E-10
WMMW-22	137.3-137.8	Brushy Basin	3.67E-08

1.5.4 Climatological Setting

The climate of southeastern Utah is classified as dry to arid continental. The region is generally typified by warm summer and cold winter temperatures, with precipitation averaging less than 11.8 inches annually and evapotranspiration in the range of 61.5 inches annually (Dames and Moore, 1978).

Precipitation in southeastern Utah is characterized by wide variations in seasonal and annual rainfall and by long periods of no rainfall. Short duration summer storms furnish rain in small areas of a few square miles and this is frequently the total rainfall for an entire month within a given area. The average annual precipitation in the region ranges from less than 8 inches at Bluff to more than 16 inches on the eastern flank of the Abajo Mountains, as recorded at Monticello. The mountain peaks in the Henry, La Sal and Abajo Mountains may receive more than 30 inches of precipitation, but these areas are very small in comparison to the vast area of much lower precipitation in the region.

1.5.5 Perched Groundwater Characteristics

The perched water in the Burro Canyon formation originates in the areas north of the site as shown by the direction of groundwater flow from north to south (see Figure 1.5.5-1). The thickness of saturation is greatest in the northern and central sections of the site and reduces toward the south. The configuration of the perched water table and map of saturated thicknesses are provided on Figures 1.5.5-1 and 1.5.5-2, respectively. The topography of the Brushy Basin Member which defines the bottom of the perched water is shown on Figure 1.5.5-3 (Hydrogeologic Evaluation Figure 2.6).

The groundwater from the Burro Canyon formation discharges into the adjacent canyons (Westwater Creek and Corral Canyon) as evidenced by springs and productive vegetation patterns. Some part of the groundwater flow may enter the Brushy Basin Member via relief fractures which occur in close proximity to the canyons. The location of the canyons which bound the White Mesa on the west, east and south are shown on Figure 1.5.3-1.

The geometric mean of the hydraulic conductivity of the saturated part of Burro Canyon formation is 1.0E-05 cm/sec. The water yield per well is very low, as documented by nine pumping tests, and is typically below 0.5 gpm. In contrast to the very low pumping rates observed in eight wells, Well WMMW-11 produced a higher yield on the order of 2 gpm. This higher yield may be attributable to the presence of localized high-permeability material, such as a lense of coarser material acting as a drainage gallery. Localized fracturing could also cause a similar effect, but few fractures have been documented during drilling of this or other wells (Umetco, 1992; Dames & Moore, 1978).

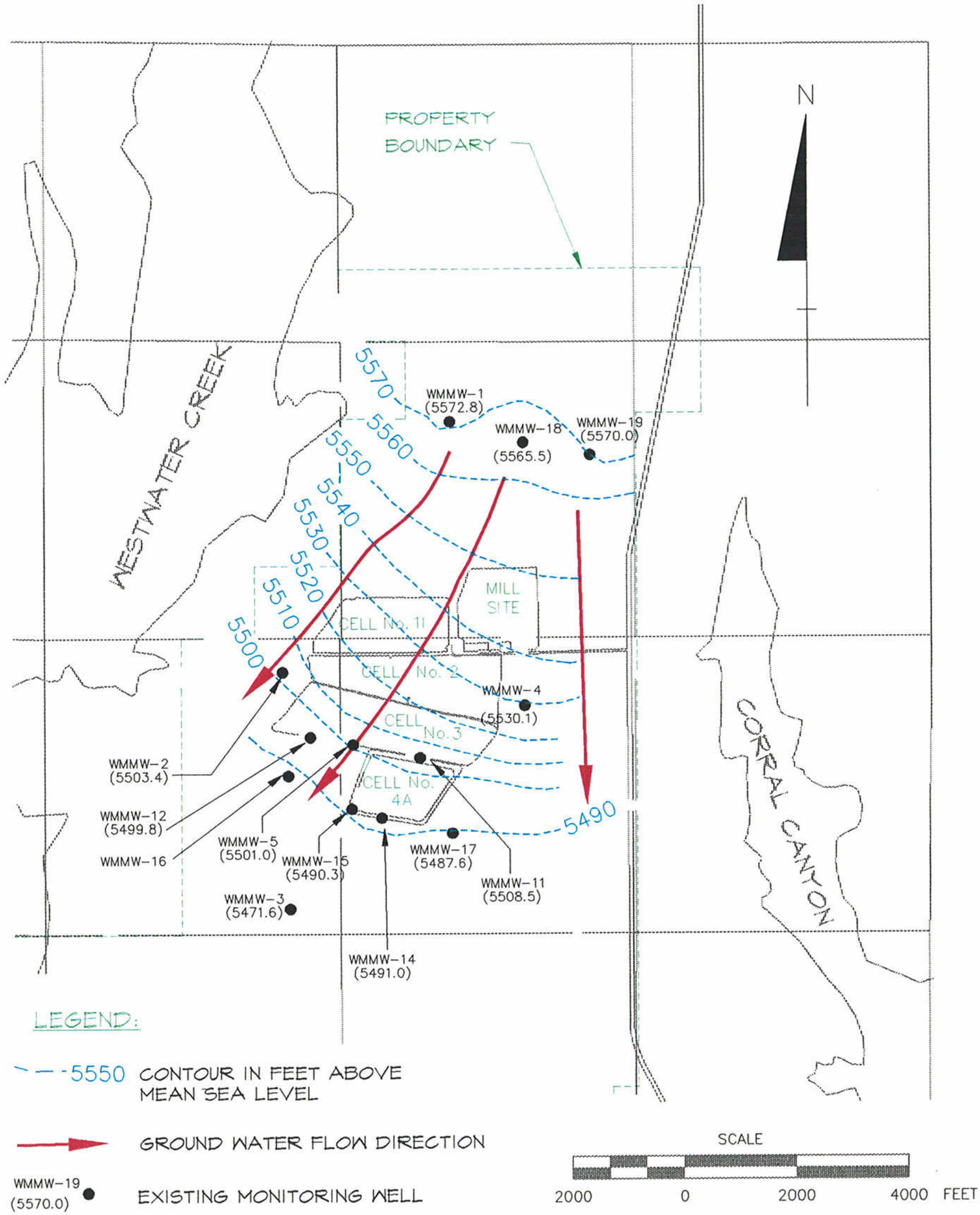


FIGURE 1.5.5-1 : Perched Ground Water Levels

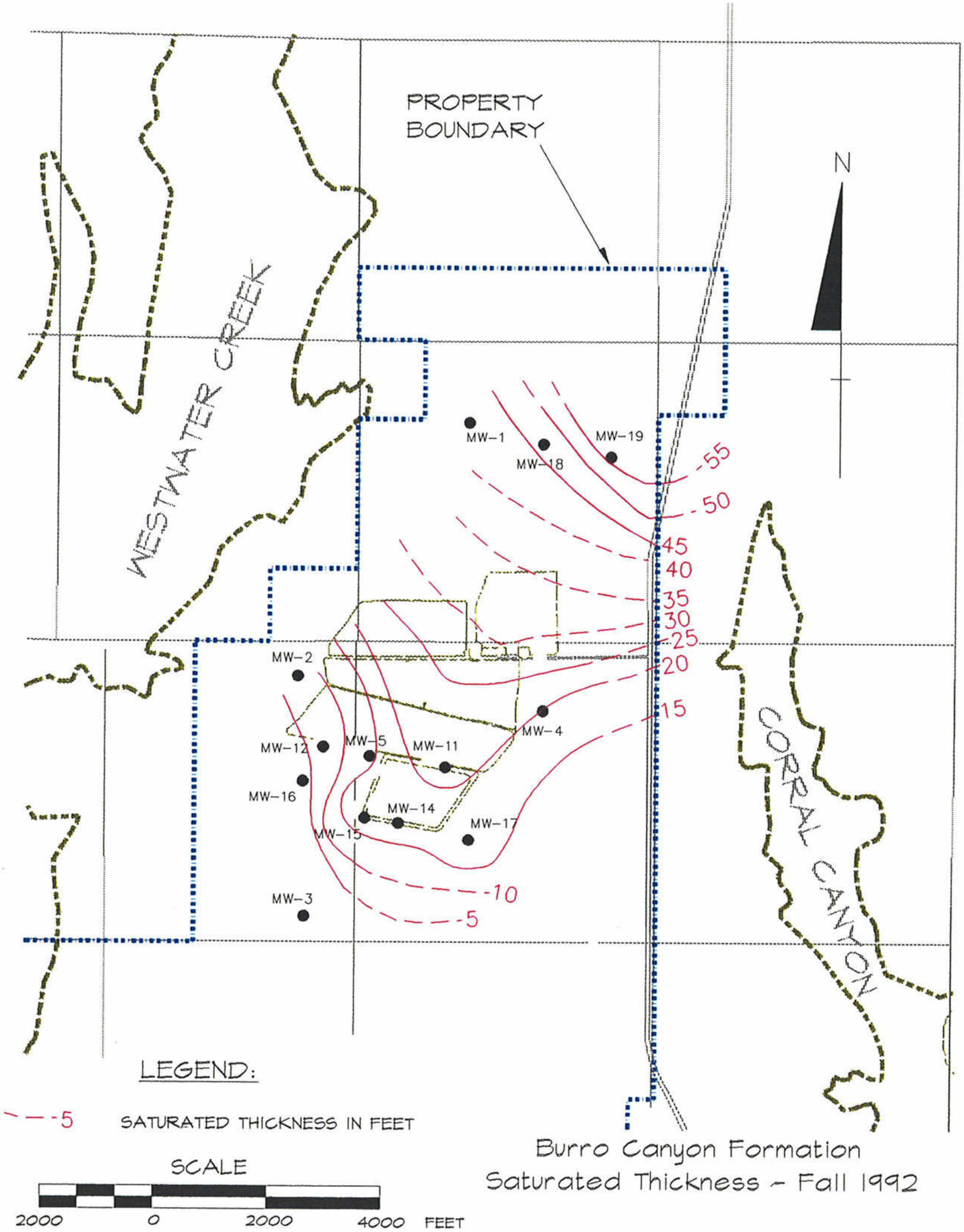


FIGURE 1.5.5-2: Saturated Thickness of Perched Water

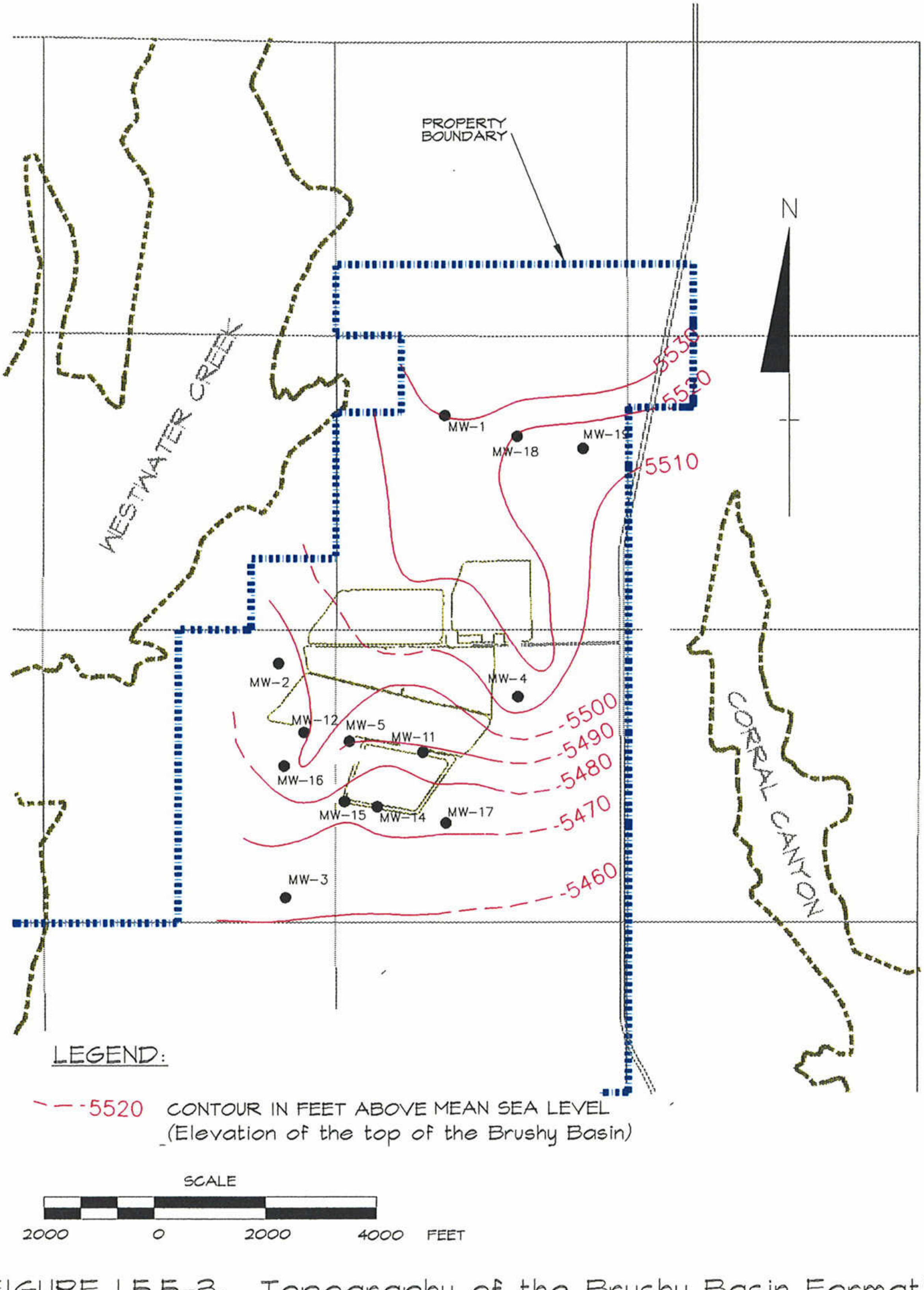


FIGURE 1.5.5-3: Topography of the Brushy Basin Formation

Table 1.5.5-1
Monitoring Well and Ground Water Elevation Data
White Mesa Uranium Mill

Well Name	Date Installed	Total Depth	Perforations	Water Level Date	Water Level Depth (ft.)	Water Level Elevation (ft.-MSL)	Measuring Point Above LDS (ft.)	Measuring Point Elevation (ft.-MSL)
WMMW-1	Sep-79	117'	92'-112'	11/19/92	75.45	5572.77	2.0	5648.22
WMMW-2	Sep-79	128.8'	85'-125'	11/19/92	110.06	5503.43	1.8	5613.49
WMMW-3	Sep-79	98'	67'-87'	11/19/92	83.74	5471.58	2.0	5555.32
WMMW-4	Sep-79	123.6'	92'-12'	11/19/92	92.42	5530.15	1.6	5622.57
WMMW-5	May-80	136'	95.5'-133.5'	11/19/92	108.32		0.6	5609.33
WMMW-6	May-80	This well was destroyed during construction of Cell 3.						
WMMW-7	May-80	This well was destroyed during construction of Cell 3.						
WMMW-8	May-80	This well was destroyed during construction of Cell 3.						
WMMW-11	Oct-82	135'	90.7'-130.4'	11/19/92	102.53	5508.55	2.4	5611.08
WMMW-12	Oct-82	130.3'	84'-124'	11/19/92	109.68	5499.77	0.9	5609.45
WMMW-13	Oct-82	118.5'	This well was destroyed during construction of Cell 4A.					
WMMW-14	Sep-89	129.1'	90'-120'	11/19/92	105.34	5491.05	0.0	5596.39
WMMW-15	Sep-89	138'	99'-129'	11/19/92	108.28	5490.34	0.8	5598.62
WMMW-16	Dec-92	91.5'	78.5'-88.5'	7/12/92	Dry		1.5	
WMMW-17	Dec-92	110'	90'-100'	11/30/92	87.56		1.5	
WMMW-18	Dec-92	148.5'	103.5'-133.5'	11/30/92	92.11		1.5	
WMMW-19	Dec-92	149'	101'-131'	10/12/92	85.00		1.5	
#9-1	May-80	33.5'	10'-30'	3/4/91	Dry		1.8	5622.83
#9-2	May-80	62.7'	39.7"-59.7"	3/4/91	Dry		2	5622.58
#10-2	May-80	33.5'	11.3'-31.3'	3/4/91	Dry		2	5633.58
#10-2	May-80	62.2'	39.2'-59.2'	3/4/91	Dry		2.1	5633.39

Notes:
1. Well locations provided on Figure 1.5.3-1.
2. LDS = leak detection system.
3. ft.-MSL = feet - mean sea level.

Adapted from: Table 2.3, Hydrogeologic Evaluation

1.5.5.1 Perched Water Quality

Groundwater monitoring of the Burro Canyon formation saturated zone has been conducted at the White Mesa facility since 1979. Table 1.5.5-1 (Hydrogeologic Evaluation Table 2.3) provides a list of wells that have been constructed for monitoring purposes at the facility. Figure 1.5.3.1-1 indicates the locations of these wells. The water quality data obtained from these wells are provided both in tabular and graphical form in Appendix B of the Hydrogeologic Evaluation, with more recent data in the Semi-annual Effluent Report for July through December 1995 and the Semi-annual Effluent Report for January through June 1995 (Energy Fuels Nuclear, Inc).

Examination of the spatial distribution and temporal trends (or lack thereof) in concentrations of analyzed constituents provides three significant conclusions:

1. The quality of perched water throughout the site shows no discernible pattern in variation,

2. The water is generally of poor quality [moderately high values of chloride, sulfate, and totally dissolved solids (TDS)], and

3. Analytical results show that operations at the White Mesa Uranium Mill have not impacted the quality of the perched water of the Burro Canyon formation.

To arrive a these conclusions, comparisons of the water chemistries from the various wells were analyzed in the Hydrogeologic Evaluation by graphical techniques. The purpose of the comparisons was to determine if trends in chloride, which would be associated with water from the tailings ponds, were increasing in the perched water of the Burro Canyon formation. The trilinear plot and the Stiff diagram were used to conduct a preliminary evaluation of differences or similarities in water quality data between wells. The following is a summary of the conclusions drawn in the Hydrogeologic Evaluation.

Temporal and Spatial Variations

The trilinear plots and Stiff diagrams presented in the Hydrogeologic Evaluation (Figures 2.7-2.10) show that the water from all wells is of the sulfate (anion) type. The cation definition of the water type is variable. Of the 13 wells analyzed for water chemistry, four fall in the calcium-sulfate type category, four fall in the (sodium plus potassium)-sulfate type, two samples classify as the magnesium-sulfate type. Five samples have no dominant cation type. However, these five samples tend to classify more closely to the (sodium plus potassium)-sulfate and calcium-sulfate types.

The spatial variability of water quality data within the Burro Canyon formation is illustrated on Hydrogeologic Evaluation Figures 2.7 through 2.13, and the data Tabled in Appendix B of the Hydrogeologic Evaluation. Upgradient Monitoring Wells WMMW-1, WMMW-18, and WMMW-19 varied in sulfate concentrations from 676 to 1736 milligrams per liter (mg/l). Likewise, chloride concentrations in these wells varied from 12 to 92 mg/l. Across the site, sulfate and chloride concentrations vary with no discernible pattern to the variations. Details regarding chemistry of the Burro Canyon formation water can be found in Appendix B of the Hydrogeologic Evaluation.

Variability of water within the Burro Canyon formation is the result of slow moving to nearly stagnant groundwater flow beneath the site. These conditions are likely leading to dissolution of minerals from the Brushy Basin Member and the formation of sulfate-dominated waters.

Statistical Analysis

Because of the variable groundwater chemistry in the Burro Canyon formation baseline data, comparison of individual well groundwater chemistries to a single background groundwater well is not an appropriate method of monitoring potential disposal cell leakage or groundwater impacts. Water quality baseline and comparisons to that baseline established on a well-by-well basis has been proposed in the POC, as this method will best provide a meaningful representation of changes in groundwater chemistry.

Based on a review of water quality data gathered from 1979 through 1992, which are presented in the Hydrogeologic Evaluation, and considering the apparent variability of chemical composition of perched water and the absence of any impact from operations, EFN proposes to apply, an intra-well approach for assessing water quality trends. This approach, described in Appendix C, the Points of Compliance (POC) report (Titan, 1994), involves determination of background concentrations for a number of selected wells.

1.6 GEOLOGY

The following text is copied, with minor revisions, from the Environmental Report (Dames and Moore, 1978b) (ER). The text has been duplicated herein for ease of reference and to provide background information concerning the site geology. ER Subsections used in the following text are shown in parentheses immediately following the subsection titles.

The site is near the western margin of the Blanding Basin in southeastern Utah and within the Monticello uranium-mining district. Thousands of feet of multi-colored marine and non-marine sedimentary rocks have been uplifted and warped, and subsequent erosion has carved a spectacular landscape for which the region is famous. Another unique feature of the region is the wide-spread presence of unusually large accumulations of uranium-bearing minerals.

1.6.1 Regional Geology

The following descriptions of regional physiography; rock units; and structure and tectonics are reproduced from the ER for ease of reference and as a review of regional geology.

1.6.1.1 Physiography (ER Section 2.4.1.1)

The project site is within the Canyon Lands section of the Colorado Plateau physiographic province. To the north, this section is distinctly bounded by the Book Cliffs and Grand Mesa of the Uinta Basin; western margins are defined by the tectonically controlled High Plateaus section, and the southern boundary is arbitrarily defined along the San Juan River. The eastern boundary is less distinct where the elevated surface of the Canyon Lands section merges with the Southern Rocky Mountain province.

Canyon Lands has undergone epeirogenic uplift and subsequent major erosion has produced the region's characteristic angular topography reflected by high plateaus, mesas, buttes, structural benches, and deep canyons incised into flat-laying sedimentary rocks of pre-Tertiary age. Elevations range from approximately 3,000 feet (914 meters) in the bottom of the deeper canyons along the southwestern margins of the section to more than 11,000 feet (3,353 meters) in the topographically anomalous laccolithic Henry, Abajo and La Sal Mountains to the northeast. Except for the deeper canyons and isolated mountain peaks, an average elevation in excess of 500 feet (1,524 meters) persists over most of the Canyon Lands section.

On a more localized regional basis, the project site is located near the western edge of the Blanding Basin, sometimes referred to as the Great Sage Plain (Eardly, 1958), lying east of the north-south trending Monument Uplift, south of the Abajo Mountains and adjacent to the northwesterly-trending Paradox Fold and Fault Belt (Figure 1.6-1). Topographically, the Abajo Mountains are the most prominent feature in the region, rising more than 4,000 feet (1,219 meters) above the broad, gently rolling surface of the Great Sage Plain.

The Great Sage Plain is a structural slope, capped by the resistant Burro Canyon formation and the Dakota Sandstone, almost horizontal in an east-west direction but descends to the south with a regional slope of about 2,000 feet (610 meters) over a distance of nearly 50 miles (80 kilometers). Though not as deeply or intricately dissected as other parts of the Canyon Lands, the plain is cut by numerous narrow and vertical-walled south-trending valleys 100 to more than 500 feet (30 to 152+ meters) deep. Water from the intermittent streams that drain the plain flow southward to the San Juan River, eventually joining the Colorado River and exiting the Canyon Lands section through the Grand Canyon.

1.6.1.2 Rock Units (ER Section 2.4.1.1)

The sedimentary rocks exposed in southeastern Utah have an aggregate thickness of about 6,000 to 7,000 feet (1,829 to 2,134 meters) and range in age from Pennsylvanian to Late Cretaceous. Older unexposed rocks are known mainly from oil well drilling in the Blanding Basin and Monument Uplift. These wells have encountered correlative Cambrian to Permian rock units of markedly differing thicknesses but averaging over 5,000 feet (1,524 meters) in total thickness (Witkind, 1964). Most of the wells drilled in the region have bottomed in the Pennsylvanian Paradox Member of the Hermosa formation. A generalized stratigraphic section of rock units ranging in age from Cambrian through Jurassic and Triassic (?), as determined from oil-well logs, is shown in Table 1.6-1. Descriptions of the younger rocks, Jurassic through Cretaceous, are based on field mapping by various investigators and are shown in Table 1.6-2.

Paleozoic rocks of Cambrian, Devonian and Mississippian ages are not exposed in the southeastern Utah region. Most of the geologic knowledge regarding these rocks was learned from the deeper oil wells drilled in the region, and from exposures in the Grand Canyon to the southwest and in the Uinta and Wasatch Mountains to the north. A few patches of Devonian rocks are exposed in the San Juan Mountains in southwestern Colorado. These Paleozoic rocks are the result of periodic transgressions and regressions of epicontinental seas and their lithologies reflect a variety of depositional environments.

In general, the coarse-grained feldspathic rocks overlying the Precambrian basement rocks grade upward into shales, limestones and dolomites that dominate the upper part of the Cambrian. Devonian and Mississippian dolomites, limestones and interbedded shales unconformably overlay the Cambrian strata. The complete absence of Ordovician and Silurian rocks in the Grand Canyon, Uinta Mountains, southwest Utah region and adjacent portions of Colorado, New Mexico and Arizona indicate that the region was probably epeirogenically positive during these times.

The oldest stratigraphic unit that crops out in the region is the Hermos formation of Middle and Late Pennsylvanian age. Only the uppermost strata of this formation are exposed, the best exposure being in the canyon of the San Juan River at the "Goosenecks" where the river traverses the crest of the

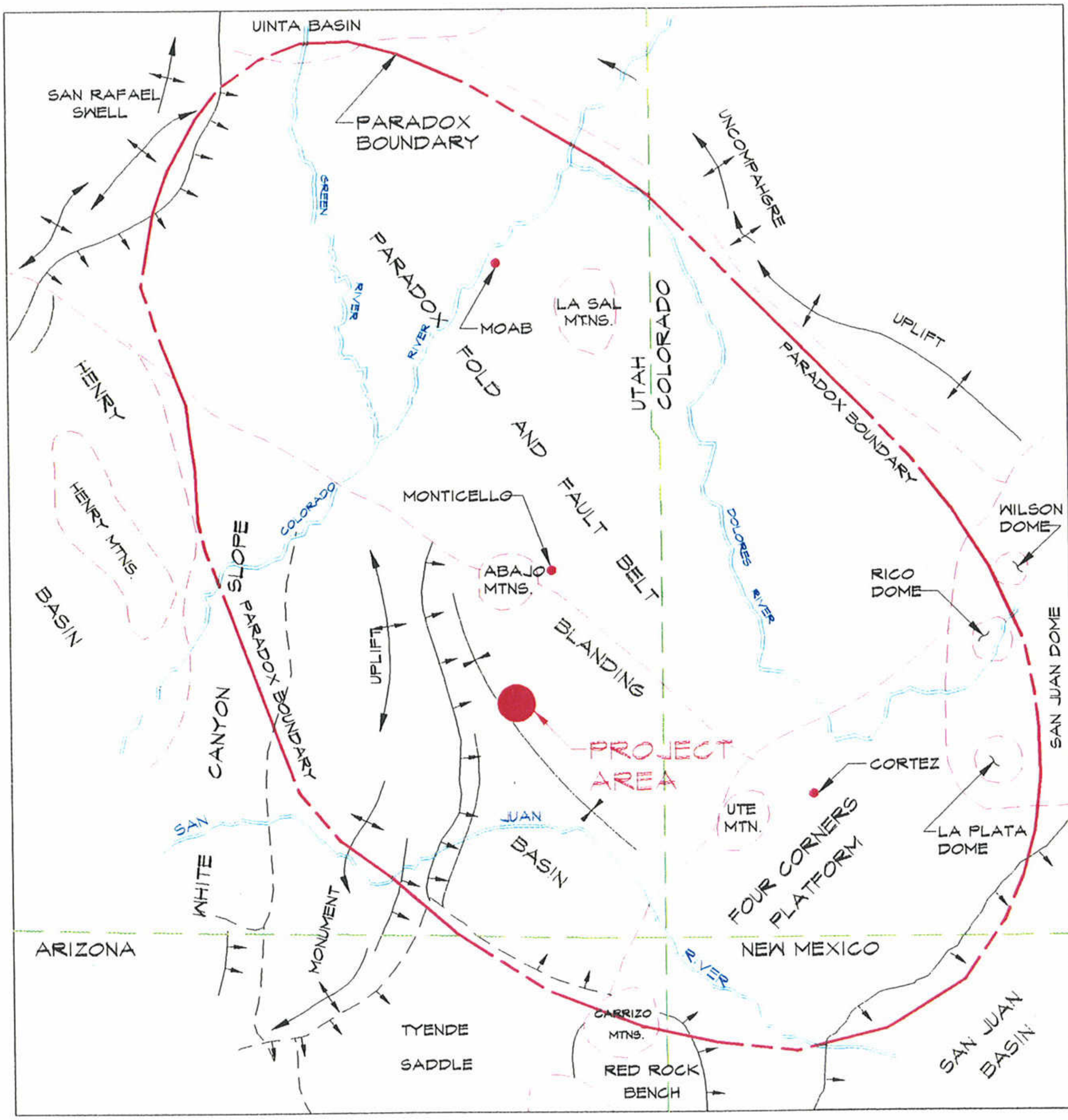
Monument uplift. Other exposures are in the breached centers of the Lisbon Valley, Moab and Castle Valley anticlines. The Paradox Member of the Hermosa formation is sandwiched between a relatively thin lower unnamed member consisting of dark-gray shale siltstone, dolomite, anhydrite, and limestone, and an upper unnamed member of similar lithology but having a much greater thickness. Composition of the Paradox Member is dominantly a thick sequence of interbedded slate (halite), anhydrite, gypsum, and black shale. Surface exposures of the Paradox in the Moab and Castle Valley anticlines are limited to contorted residues of gypsum and black shale.

Conformably overlying the Hermosa is the Pennsylvanian and Permian (?) Rico formation, composed of interbedded reddish-brown arkosic sandstone and gray marine limestone. The Rico represents a transition zone between the predominantly marine Hermosa and the overlying continental Cutler formation of Permian age.

Two members of the Cutler probably underlying the region south of Blanding are, in ascending order, the Cedar Mesa Sandstone and the Organ Rock Tongue. The Cedar Mesa is a white to pale reddish-brown, massive, cross-bedded, fine-to medium-grained eolian sandstone. An irregular fluvial sequence of reddish-brown fine-grained sandstones, shaly siltstones and sandy shales comprise the Organ Rock Tongue.

The Moenkopi formation, of Middle (?) and Lower Triassic age, unconformably overlies the Cutler strata. It is composed of thin, evenly-bedded, reddish to chocolate-brown, ripple-marked, cross-laminated siltstone and sandy shales with irregular beds of massive medium-grained sandstone.

A thick sequence of complex continental sediments known as the Chinle formation unconformably overlies the Moenkopi. For the purpose of making lithology correlations in oil wells this formation is divided into three units: The basal Shinarump Member, the Moss Back Member and an upper undivided thick sequence of variegated reddish-brown, reddish- to greenish-gray, yellowish-brown to light-brown bentonitic claystones, mudstones, sandy siltstone, fine-grained sandstone, and limestones. The basal Shinarump is dominantly a yellowish-grey, fine- to coarse-grained sandstone, conglomeratic sandstone and conglomerate characteristically filling ancient stream channel scours eroded into the Moenkopi surface. Numerous uranium deposits have been located in this member in the White Canyon mining district to the west of Comb Ridge. The Moss Back is typically composed of yellowish- to greenish-grey, fine- to medium-grained sandstone, conglomeratic sandstone and conglomerate. It commonly comprises the basal unit of the Chinle where the Shinarump was not deposited, and in a like manner, fills ancient stream channels scoured into the underlying unit.



BOUNDARY OF TECTONIC DIVISION

MONOCLINE SHOWING TRACE OF AXIS AND DIRECTION OF DIP

ANTICLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

SYNCLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

FIGURE 1.6.1

Tectonic Index Map

TABLE 1.5-1

GENERALIZED STRATIGRAPHIC SECTION OF SUBSURFACE ROCKS BASED ON OIL-WELL LOGS

(After Stokes, 1954; Witkind, 1964; Huff and Lesure, 1965, Johnson and Thordarson, 1966)

Era	Age	Stratigraphic Unit	Thickness* (ft.)	Description
MESOZOIC		Glen Canyon Group:		
	Jurassic and Triassic (?)	Navajo Sandstone	300 - 400	Buff to light gray, massive, cross-bedded, friable sandstone
	Triassic (?)	Kayenta Formation	100 - 150	Reddish-brown sandstone and mudstone and occasional conglomerate lenses
	Triassic	Wingate Sandstone	250 - 350	Reddish-brown, massive, cross-bedded, fine-grained sandstone
		Chinle Formation:		
		Undivided	600 - 700	Variegated claystone with some thin beds of siltstone and limestone
		Moss Back Member	0 - 100	Light colored, conglomeratic sandstone and conglomerate
		Shinarump Member	0 - 20	Yellowish-gray, fine to coarse-grained sandstone; conglomeratic sandstone and conglomerate
		— Unconformity —		
	Middle (?) and Lower Triassic	Moenkopi Formation	50 - 100	Reddish-brown mudstone and fine-grained sandstone
		— Unconformity —		
PALEOZOIC	Permian	Cutler Formation:		
		Organ Rock Member	0 - 600	Reddish-brown, sandy mudstone
		Cedar Mesa Sandstone Member	1100 - 1400	Reddish-brown, massive, fine to medium-grained sandstone
	Pennsylvanian and Permian (?)	Rico Formation	450	Red and gray calcareous, sandy shale; gray limestone and sandstone
	Pennsylvanian	Hermosa Formation:		
		Upper Member	1000 - 1200	Gray, massive limestone; some shale and sandstone
		Paradox Member	1200	Halite, anhydrite, gypsum, shale, and siltstone
		Lower Member	200	Limestone, siltstone, and shale
		— Unconformity —		
	Mississippian	Leadville Limestone	500	White to tan sucrose to crystalline limestone
	Devonian	Ouray Limestone	100	Light gray and tan, thin-bedded limestone and dolomite
		Zilbert Formation	200	Gray and brown dolomite and limestone with thin beds green shale and sandstone
		— Unconformity —		
	Cambrian	Ophir Formation and Tintic Quartzite	600	Gray and brown limestone and dolomite, feldspathic sandstone and arkose

* To convert feet to meters, multiply by 0.3043. Average thickness given if range is not shown.

TABLE 1 6-[illegible]

GENERALIZED STRATIGRAPHIC SECTION OF EXPOSED ROCKS IN THE PROJECT VICINITY

(After Haynes et. al., 1962, Witkind, 1964, Huff and Lesure, 1965)

ERA	SYSTEM	SERIES (Age)		STRATIGRAPHIC UNIT	THICKNESS* (ft.)	LITHOLOGY
CENOZOIC	QUATERNARY	Holocene to Pleistocene		Alluvium	2 - 25+	Silt, sand and gravel in arroyos and stream valleys.
				Colluvium and Talus	0 - 15+	Slope wash, talus and rock rubble ranging from cobbles and boulders to massive blocks fallen from cliffs and outcrops of resistant rock.
				Loess	0 - 22+	Reddish-brown to light-brown, unconsolidated, well-sorted silt to medium-grained sand; partially cemented with caliche in some area; reworked partly by water.
				Unconformity		
MESOZOIC	CRETACEOUS	Upper Cretaceous		Mancos Shale	0 - 11(?)	Gray to dark-gray, fissile, thin-bedded marine shale with fossiliferous sandy limestone in lower strata.
				Dakota Sandstone	30 - 75	Light yellowish-brown to light gray-brown, thick bedded to cross-bedded sandstone, conglomeratic sandstone; interbedded this lenticular gray carbonaceous claystone and impure coal; local course basal conglomerate.
				Unconformity		
		Lower Cretaceous		Burro Canyon Formation	50 - 150	Light-gray and light-brown, massive and cross-bedded conglomeratic sandstone and interbedded green and gray-green mudstone; locally contains thin discontinuous beds of silicified sandstone and limestone near top.
				Unconformity (?)		
	Jurassic	Upper Jurassic	Morrison Formation	Brushy Basin Member	200 - 450	Variegated gray, pale-green, reddish-brown, and purple bentonitic mudstone and siltstone containing thin discontinuous sandstone and conglomerate lenses.
				Westwater Canyon Member	0 - 250	Interbedded yellowish- and greenish-gray to pinkish-gray, fine- to course-grained arkosic sandstone and greenish-gray to reddish-brown sandy shale and mudstone.
				Recapture Member	0 - 200	Interbedded reddish-gray to light brown fine-to medium-grained sandstone and reddish-gray silty and sandy claystone.
				Salt Wash Member	0 - 350	Interbedded yellowish-brown to pale reddish-brown fine-grained to conglomeritic sandstones and greenish- and reddish-gray mudstone.
				Unconformity		
			San Rafael Group	Bluff Sandstone	0 - 150+	White to grayish-brown, massive, cross-bedded, fine- to medium-grained eolian sandstone.
				Summerville Formation	25 - 125	Thin-bedded, ripple-marked reddish-brown muddy sandstone and sandy shale.
				Entrada Sandstone	150 - 180	Reddish-brown to grayish-white, massive, cross-bedded, fine- to medium-grained sandstone.
		Middle Jurassic		Carmel Formation	20 - 100+	Irregularly bedded reddish-brown muddy sandstone and sandy mudstone with local thin beds of brown to gray limestone and reddish-to greenish-gray shale.
				Unconformity		

*To convert feet to meters, multiply feet by 0.3048.

In the Blanding Basin the Glen Canyon Group consists of three formations which are, in ascending order, the Wingate Sandstone, the Kayenta and the Navajo Sandstone. All are conformable and their contacts are gradational. Commonly cropping out in sheer cliffs, the Late Triassic Wingate Sandstone is typically composed of buff to reddish-brown, massive, cross-bedded, well-sorted, fine-grained quartzose sandstone of eolian origin. Late Triassic (?) Kayenta is fluvial in origin and consists of reddish-brown, irregularly to cross-bedded sandstone, shaly sandstone and, locally, thin beds of limestone and conglomerate. Light yellowish-brown to light-gray and white, massive, cross-bedded, friable, fine- to medium-grained quartzose sandstone typifies the predominantly eolian Jurassic and Triassic (?) Navajo Sandstone.

Four formations of the Middle to Late Jurassic San Rafael Group unconformably overly the Navajo Sandstone. These strata are composed of alternating marine and non-marine sandstones, shales and mudstones. In ascending order, the formations are the Carmel formation, Entrada Sandstone, Summerville formation, and Bluff Sandstone. The Carmel usually crops out as a bench between the Navajo and Entrada Sandstones. Typically reddish-brown muddy sandstone and sandy mudstone, the Carmel locally contains thin beds of brown to gray limestone and reddish- to greenish-gray shale. Predominantly eolian in origin, the Entrada is a massive cross-bedded fine- to medium-grained sandstone ranging in color from reddish-brown to grayish-white that crops out in cliffs or hummocky slopes. The Summerville is composed of regular thin-bedded, ripple-marked, reddish-brown muddy sandstone and sandy shale of marine origin and forms steep to gentle slopes above the Entrada. Cliff-forming Bluff Sandstone is present only in the southern part of the Monticello district thinning northward and pinching out near Blanding. It is a white to grayish-brown, massive, cross-bedded eolian sandstone.

In the southeastern Utah region the Late Jurassic Morrison formation has been divided in ascending order into the Salt Wash, Recapture, Westwater Canyon, and Brushy Basin Members. In general, these strata are dominantly fluvial in origin but do contain lacustrine sediments. Both the Salt Wash and Recapture consist of alternating mudstone and sandstone; the Westwater Canyon is chiefly sandstone with some sandy mudstone and claystone lenses, and the heterogenous Brushy Basin consists of variegated bentonitic mudstone and siltstone containing scattered thin limestone, sandstone, and conglomerate lenses. As strata of the Morrison formation are the oldest rocks exposed in the project area vicinity and are one of the two principal uranium-bearing formations in southeast Utah, the Morrison, as well as younger rocks, are described in more detail in Section 1.6.2.2.

The Early Cretaceous Burro Canyon formation rests unconformably (?) on the underlying Brushy Basin Member of the Morrison formation. Most of the Burro Canyon consists of light-colored, massive, cross-bedded fluvial conglomerate, conglomerate sandstone and sandstone. Most of the conglomerates are near the base. Thin, even-bedded, light-green mudstones are included in the formation and light-grey thin-bedded limestones are sometimes locally interbedded with the mudstones near the top of the formation.

Overlying the Burro Canyon is the Dakota Sandstone of Upper Cretaceous age. Typical Dakota is dominantly yellowish-brown to light-gray, thick-bedded, quartzitic sandstone and conglomeratic sandstone with subordinate thin lenticular beds of mudstone, gray carbonaceous shale and, locally, thin seams of impure coal. The contact with the underlying Burro Canyon is unconformable whereas the contact with the overlying Mancos Shale is gradational from the light-colored sandstones to dark-grey to black shaly siltstone and shale.

Upper Cretaceous Mancos Shale is exposed in the region surrounding the project vicinity but not within it. Where exposed and weathered, the shale is light-gray or yellowish-gray, but is dark, to olive-gray where fresh. Bedding is thin and well developed; much of it is laminated.

Quaternary alluvium within the project vicinity is of three types: alluvial silt, sand and gravels deposited in the stream channels; colluvium deposits of slope wash, talus, rock rubble and large displaced blocks on slopes below cliff faces and outcrops of resistant rock; and alluvial and windblown deposits of silt and sand, partially reworked by water, on benches and broad upland surfaces.

1.6.1.3 Structure and Tectonics (ER Section 2.4.1.3)

According to Shoemaker (1954 and 1956), structural features within the Canyon Lands of southeastern Utah may be classified into three main categories on the basis of origin or mechanism of the stress that created the structure. These three categories are: (1) structures related to large-scale regional uplifting or downwarping (epeirogenic deformation) directly related to movements in the basement complex (Monument Uplift and the Blanding Basin); (2) structures resulting from the plastic deformation of thick sequences of evaporite deposits, salt plugs and salt anticlines, where the structural expression at the surface is not reflected in the basement complex (Paradox Fold and Fault Belt); and (3) structures that are formed in direct response to stresses induced by magmatic intrusion including local laccolithic domes, dikes and stocks (Abajo Mountains).

Each of the basins and uplifts within the project area region is an asymmetric fold usually separated by a steeply dipping sinuous monocline. Dips of the sedimentary beds in the basins and uplifts rarely exceed a few degrees except along the monocline (Shoemaker, 1956) where, in some instances, the beds are nearly vertical. Along the Comb Ridge monocline, the boundary between the Monument Uplift and the Blanding Basin, approximately eight miles (12.9 kilometers) west of the project area, dips in the Upper Triassic Wingate sandstone and in the Chinle formation are more than 40 degrees to the east.

Structures in the crystalline basement complex in the central Colorado Plateau are relatively unknown but where monoclines can be followed in Precambrian rocks they pass into steeply dipping faults. It is probable that the large monoclines in the Canyon Lands section are related to flexure of the layered sedimentary rocks under tangential compression over nearly vertical normal or high-angle reverse faults in the more rigid Precambrian basement rocks (Kelley, 1955; Shoemaker, 1956; Johnson and Thordarson, 1966).

The Monument Uplift is a north-trending, elongated, upwarped structure approximately 90 miles (145 kilometers) long and nearly 35 miles (56 kilometers) wide. Structural relief is about 3,000 feet (914 meters) (Kelley, 1955). Its broad crest is slightly convex to the east where the Comb Ridge monocline defines the eastern boundary. The uniform and gently descending western flank of the uplift crosses the White Canyon slope and merges into the Henry Basin (Figure 1.6-1).

East of the Monument Uplift, the relatively equidimensional Blanding Basin merges almost imperceptibly with the Paradox Fold and Fault Belt to the north, the Four Corners Platform to the southeast and the Defiance Uplift to the south. The basin is a shallow feature with approximately 700 feet (213 meters) of structural relief as estimated on top of the Upper Triassic Chinle formation by Kelley (1955), and is roughly 40 to 50 miles (64 to 80 kilometers) across. Gentle folds within the basin trend westerly to northwesterly in contrast to the distinct northerly orientation of the Monument Uplift.

Situated to the north of the Monument Uplift and Blanding Basin is the most unique structural feature of the Canyon Lands section, the Paradox Fold and Fault Belt. This tectonic unit is dominated by northwest trending anticlinal folds and associated normal faults covering an area about 150 miles (241 kilometers) long and 65 miles (104 kilometers) wide. These anticlinal structures are associated with salt flowage from the Pennsylvanian Paradox Member of the Hermosa formation and some show piercement of the overlying younger sedimentary beds by plug-like salt intrusions (Johnson and Thordarson, 1966). Prominent valleys have been eroded along the crests of the anticlines where salt piercements have occurred or collapses of the central parts have resulted in intricate systems of step-faults and grabens along the anticlinal crests and flanks.

The Abajo Mountains are located approximately 20 miles (32 kilometers) north of the project area on the more-or-less arbitrary border of the Blanding Basin and the Paradox Fold and Fault Belt (Figure 1.6-1). These mountains are laccolithic domes that have been intruded into and through the sedimentary rocks by several stocks (Witkind, 1964). At least 31 laccoliths have been identified. The youngest sedimentary rocks that have been intruded are those of Mancos Shale of Late Cretaceous age. Based on this and other vague and inconclusive evidence, Witkind (1964), has assigned the age of these intrusions to the Late Cretaceous or early Eocene.

Nearly all known faults in the region of the project area are high-angle normal faults with displacements on the order of 300 feet (91 meters) or less (Johnson and Thordarson, 1966). The largest known faults within a 40-mile (64 kilometer) radius around Blanding are associated with the Shay graben on the north side of the Abajo Mountains and the Verdure graben on the south side. Respectively, these faults trend northeasterly and easterly and can be traced for approximate distances ranging from 21 to 34 miles (34 to 55 kilometers) according to Witkind (1964). Maximum displacements reported by Witkind on any of the faults is 320 feet (98 meters). Because of the extensions of Shay and Verdure fault systems beyond the Abajo Mountains and other geologic evidence, the age of these faults is Late Cretaceous or post-Cretaceous and antedate the laccolithic intrusions (Witkind, 1964).

A prominent group of faults is associated with the salt anticlines in the Paradox Fold and Fault Belt. These faults trend northwesterly parallel to the anticlines and are related to the salt emplacement. Quite likely, these faults are relief features due to salt intrusion or salt removal by solution (Thompson, 1967). Two faults in this region, the Lisbon Valley fault associated with the Lisbon Valley salt anticline and the Moab fault at the southeast end of the Moab anticline have maximum vertical displacements of at least 5,000 feet (1,524 meters) and 2,000 feet (609 meters), respectively, and are probably associated with breaks in the Precambrian basement crystalline complex. It is possible that zones of weakness in the basement rocks represented by faults of this magnitude may be responsible for the beginning of salt flowage in the salt anticlines, and subsequent solution and removal of the salt by groundwater caused collapse within the salt anticlines resulting in the formation of grabens and local complex block faults (Johnson and Thordarson, 1966).

The longest faults in the Colorado Plateau are located some 155 to 210 miles (249 to 338 kilometers) west of the project area along the western margin of the High Plateau section. These faults have a north to northeast echelon trend, are nearly vertical and downthrown on the west in most places. Major faults included in this group are the Hurrican,Toroweap-Sevier, Paunsaugunt, and Paradise faults. The longest fault, the Toroweap-Sevier, can be traced for about 240 miles (386 kilometers) and may have as much as 3,000 feet (914 meters) of displacement (Kelley, 1955).

From the later part of the Precambrian until the middle Paleozoic the Colorado Plateau was a relatively stable tectonic unit undergoing gentle epeirogenic uplifting and downwarping during which seas transgressed and regressed, depositing and then partially removing layers of sedimentary materials. This period of stability was interrupted by northeast-southwest tangential compression that began sometime during late Mississippian or early Pennsylvanian and continued intermittently into the Triassic. Buckling along the northeast margins of the shelf produced northwest-trending uplifts, the most prominent of which are the Uncompahgre and San Juan Uplifts, sometimes referred to as the Ancestral Rocky Mountains. Clearly, these positive features are the earliest marked tectonic controls that may have guided many of the later Laramide structures (Kelley, 1955).

Subsidence of the area southwest of the Uncompahgre Uplift throughout most of the Pennsylvanian led to the filling of the newly formed basin with an extremely thick sequence of evaporites and associated interbeds which comprise the Paradox Member of the Hermosa formation (Kelley, 1956). Following Paradox deposition, continental and marine sediments buried the evaporite sequence as epeirogenic movements shifted shallow seas across the region during the Jurassic, Triassic and much of the Cretaceous. The area underlain by the Paradox Member in eastern Utah and western Colorado is commonly referred to as the Paradox Basin (Figure 1.6-1). Renewed compression during the Permian initiated the salt anticlines and piercements, and salt flowage continued through the Triassic.

The Laramide orogeny, lasting from Late Cretaceous through Eocene time, consisted of deep-seated compressional and local vertical stresses. The orogeny is responsible for a north-south to northwest trend in the tectonic fabric of the region and created most of the principal basins and uplifts in the eastern-half of the Colorado Plateau (Grose, 1972; Kelley, 1955).

Post-Laramide epeirogenic deformation has occurred throughout the Tertiary; Eocene strata are flexed sharply in the Grand Hogback monocline, fine-grained Pliocene deposits are tilted on the flanks of the Defiance Uplift, and Pleistocene deposits in Fisher Valley contain three angular unconformaties (Shoemaker, 1956).

1.6.2 Blanding Site Geology

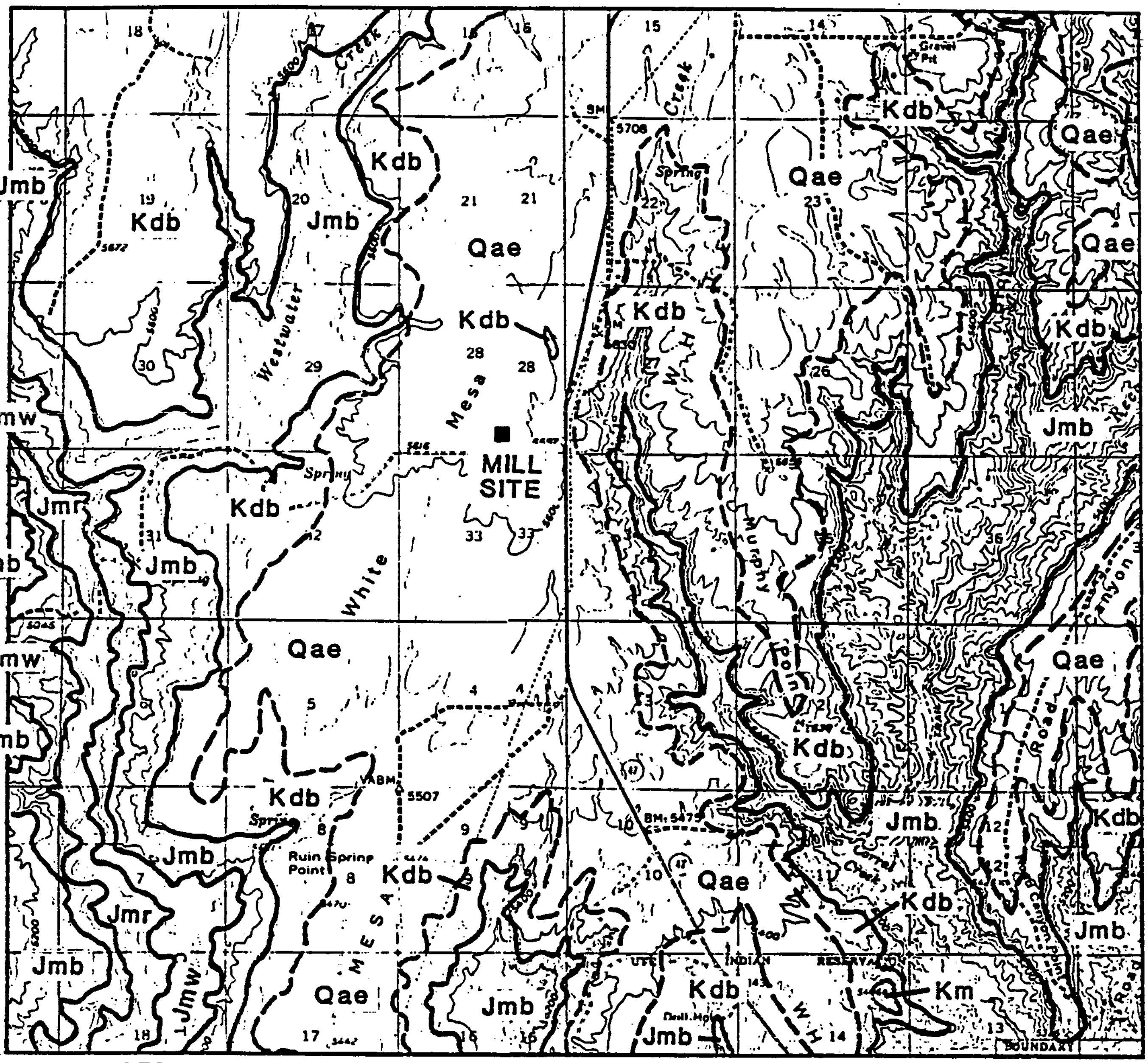
The following descriptions of physiography and topography; rock units; structure; relationship of earthquakes to tectonic structure; and potential earthquake hazards to the project area are reproduced from the ER for ease of reference and as a review of the mill site geology. (See Figure 1.6-2)

1.6.2.1 Physiography and Topography (ER Section 2.4.2.1)

The project site is located near the center of White Mesa, one of the many finger-like north-south trending mesas that make up the Great Sage Plain. The nearly flat upland surface of White Mesa is underlain by resistant sandstone caprock which forms steep prominent cliffs separating the upland from deeply entrenched intermittent stream courses on the east, south and west.

Surface elevations across the project site range from about 5,550 to 5,650 feet (1,692 to 1,722 meters) and the gently rolling surface slopes to the south at a rate of approximately 60 feet per mile (18 meters per 1.6 kilometer).

Maximum relief between the mesa's surface and Cottonwood Canyon on the west is about 750 feet (229 meters) where Westwater Creek joins Cottonwood Wash. These two streams and their tributaries drain the west and south sides of White Mesa. Drainage on the east is provided by Recapture Creek and its tributaries. Both Cottonwood Wash and Recapture Creeks are normally intermittent streams and flow south to the San Juan River. However, Cottonwood Wash has been known to flow perennially in the project vicinity during wet years.



REFERENCES: GEOLOGY, IN PART, AFTER HAYNES ET AL., 1962. BASE MAP PREPARED FROM PORTIONS OF THE BLANDING, BRUSHY BASIN WASH, BLUFF, AND MONTEZUMA CREEK U.S.G.S. 15-MINUTE TOPOGRAPHIC QUADRANGLES.

EXPLANATION

Qae	LOESS
Km	MANCOS SHALE
Kdb	DAKOTA AND BURRO CANYON FORMATIONS (UNDIFFERENTIATED)
Jmb	MORRISON FORMATION: BRUSHY BASIN MEMBER
Jmw	WESTWATER CANYON MEMBER
Jmr	RECAPTURE MEMBER
—— — —	CONTACT, DASHED WHERE APPROXIMATE

N.

3000 0 3000 6000

SCALE IN FEET

After Umetco 1988

IUC International Uranium (USA) Corporation
White Mesa Mill

FIGURE 1.6-2
White Mesa Millsite
Geology of the Surrounding Area

DESIGN:	DRAWN: RAH	SHEET
CHKD BY:	DATE: MAY, 1999	of
APP:	SCALE: AS SHOWN	

1.6.2.2 Rock Units (ER Section 2.4.2.2)

Only rocks of Jurassic and Cretaceous ages are exposed in the vicinity of the project site. These include, in ascending order, the Upper Jurassic Salt Wash, Recapture, Westwater Canyon, and Brushy Basin Members of the Morrison formation; the Lower Cretaceous Burro Canyon formation; and the Upper Cretaceous Dakota Sandstone. The Upper Cretaceous Mancos Shale is exposed as isolated remnants along the rim of Recapture Creek valley several miles southeast of the project site and on the eastern flanks of the Abajo Mountains some 20 miles (32 kilometers) north but is not exposed at the project site. However, patches of Mancos Shale may be present within the project site boundaries as isolated buried remnants that are obscured by a mantle of alluvial windblown silt and sand.

The Morrison formation is of particular economic importance in southeast Utah since several hundred uranium deposits have been discovered in the basal Salt Wash Member (Stokes, 1967).

In most of eastern Utah, the Salt Wash Member underlies the Brushy Basin. However, just south of Blanding in the project vicinity the Recapture Member replaces an upper portion of the Salt Wash and the Westwater Canyon Member replaces a lower part of the Brushy Basin. A southern limit of Salt Wash deposition and a northern limit of Westwater Canyon deposition has been recognized by Haynes et al. (1972) in Westwater Canyon approximately three to six miles (4.8 to 9.7 kilometers), respectively, northwest of the project site. However, good exposures of Salt Wash are found throughout the Montezuma Canyon area 13 miles (21 kilometers) to the east.

The Salt Wash Member is composed dominantly of fluvial fine-grained to conglomeratic sandstones, and interbedded mudstones. Sandstone intervals are usually yellowish-brown to pale reddish-brown while the mudstones are greenish- and reddish-gray. Carbonaceous materials ("trash") vary from sparse to abundant. Cliff-forming massive sandstone and conglomeratic sandstone in discontinuous beds make up to 50 percent or more of the member. According to Craig et al. (1955), the Salt Wash was deposited by a system of braided streams flowing generally east and northeast. Most of the uranium-vanadium deposits are located in the basal sandstones and conglomeratic sandstones that fill stream-cut scour channels in the underlying Bluff Sandstone, or where the Bluff Sandstone has been removed by pre-Morrison erosion, in similar channels cut in the Summerville formation. Mapped thicknesses of this member range from zero to approximately 350 feet (0-107 meters) in southeast Utah. Because the Salt Wash pinches out in a southerly direction in Recapture Creek three miles (4.8 kilometers) northwest of the project site and does not reappear until exposed in Montezuma Canyon, it is not known for certain that the Salt Wash actually underlies the site.

The Recapture Member is typically composed of interbedded reddish-gray, white, and light-brown fine- to medium-grained sandstone and reddish-gray, silty and sandy claystone. Bedding is gently to sharply lenticular. Just north of the project site, the Recapture intertongues with and grades into the Salt Wash and the contact between the two cannot be easily recognized. A few spotty occurrences of uriniferous mineralization are found in sandstone lenses in the southern part of the Monticello district and larger deposits are known in a conglomeratic sandstone facies some 75 to 100 miles (121 to 161 kilometers) southeast of the Monticello district. Since significant ore deposits have not been found in extensive outcrops in more favorable areas, the Recapture is believed not to contain potential resources in the project site (Johnson and Thordarson, 1966).

Just north of the project site, the Westwater Canyon Member intertongues with and grades into the lower part of the overlying Brushy Basin Member. Exposures of the Westwater Canyon in Cottonwood Wash are typically composed of interbedded yellowish- and greenish-gray to pinkish-gray, lenticular, fine- to coarse-grained arkosic sandstone and minor amounts of greenish-gray to reddish-brown sandy shale and mudstone. Like the Salt Wash, the Westwater Canyon Member is fluvial in origin, having been deposited by streams flowing north and northwest, coalescing with streams from the southwest depositing the upper part of the Salt Wash and the lower part of the Brushy Basin (Huff and Lesure, 1965). Several small and scattered uranium deposits in the Westwater Canyon are located in the extreme southern end of the Monticello district. Both the Recapture Member and the Westwater Canyon contain only traces of carbonaceous materials, are believed to be less favorable host rocks for uranium deposition (Johnson and Thordarson, 1966) and have very little potential for producing uranium reserves.

The lower part of the Brushy Basin is replaced by the Westwater Canyon Member in the Blanding area but the upper part of the Brushy Basin overlies this member. Composition of the Brushy Basin is dominantly variegated bentonitic mudstone and siltstone. Bedding is thin and regular and usually distinguished by color variations of gray, pale-green, reddish-brown, pale purple, and maroon. Scattered lenticular thin beds of distinctive green and red chert-pebble conglomeratic sandstone are found near the base of the member, some of which contain uranium-vanadium mineralization in the southernmost part of the Monticello district (Haynes et al., 1972). Thin discontinuous beds of limestone and beds of grayish-red to greenish-black siltstone of local extent suggest that much of the Brushy Basin is probably lacustrine in origin.

For the most part, the Great Sage Plain owes its existence to the erosion of resistant sandstones and conglomerates of the Lower Cretaceous Burro Canyon formation. This formation unconformably(?) overlies the Brushy Basin and the contact is concealed over most of the project area by talus blocks and slope wash. Massive, light-gray to light yellowish-brown sandstone, conglomeratic sandstone and conglomerate comprise more than two-thirds of the formation's thickness. The conglomerate and sandstone are interbedded and usually grade from one to the other. However, most of the conglomerate is near the base. These rocks are massive cross-bedded units formed by a series of interbedded lenses, each lens representing a scour filled with stream-deposited sediments. In places the formation contains greenish-gray lenticular beds of mudstone and claystone. Most of the Burro Canyon is exposed in the vertical cliffs separating the relatively flat surface of White Mesa from the canyons to the west and east. In some places the resistant basal sandstone beds of the overlying Dakota Sandstone are exposed at the top of the cliffs, but entire cliffs of Burro Canyon are most common. Where the sandstones of the Dakota rest on sandstones and conglomerates of the Burro Canyon, the contact between the two is very difficult to identify and most investigators map the two formations as a single unit (Figure 1.6-2). At best, the contact can be defined as the top of a silicified zone in the upper part of the Burro Canyon that appears to be remnants of an ancient soil that formed during a long period of weathering prior to Dakota deposition (Huff and Lesure, 1965).

The Upper Cretaceous Dakota Sandstone disconformably overlies the Burro Canyon formation. Locally, the disconformity is marked by shallow depressions in the top of the Burro Canyon filled with Dakota sediments containing angular to sub-rounded rock fragments probably derived from Burro Canyon strata (Witkind, 1964) but the contact is concealed at the project site. The Dakota is composed predominantly of pale yellowish-brown to light gray, massive, intricately cross-bedded, fine- to coarse-grained quartzose sandstone locally well-cemented with silica and calcite; elsewhere it is weakly cemented and friable. Scattered throughout the sandstone are lenses of conglomerate, dark-gray carbonaceous mudstones and shale and, in some instances, impure coal. In general, the lower part of the Dakota is more conglomeratic and contains more cross-bedded sandstone than the upper part which in normally more thinly bedded and marine-like in appearance. The basal sandstones and conglomerates are fluvial in origin, whereas the carbonaceous mudstones and shales were probably deposited in back water areas behind beach ridges in front of the advancing Late

Cretaceous sea (Huff and Lesure, 1965). The upper sandstones probably represent littoral marine deposits since they grade upward into the dark-gray siltstones and marine shales of the Mancos Shale.

The Mancos shale is not exposed in the project vicinity. The nearest exposures are small isolated remnants resting conformably on Dakota Sandstone along the western rim above Recapture Creek 4.3 to 5.5 miles (6.9 to 8.9 kilometers) southeast of the project site. Additional exposures are found on the eastern and southern flanks of the Abajo Mountains approximately 16 to 20 miles (26 to 32 kilometers) to the north. It is possible that thin patches of Mancos may be buried at the project site but are obscured by the mantle of alluvial windblown silt and sand covering the upland surface. The Upper Cretaceous Mancos shale is of marine origin and consists of dark- to olive-gray shale with minor amounts of gray, fine-grained, thin-bedded to blocky limestone and siltstone in the lower part of the formation. Bedding in the Mancos is thin and well developed, and much of the shale is laminated. Where fresh, the shale is brittle and fissile and weathers to chips that are light- to yellowish-gray. Topographic features formed by the Mancos are usually subdued and commonly displayed by low rounded hills and gentle slopes.

A layer of Quaternary to Recent reddish-brown eolian silt and fine sand is spread over the surface of the project site. Most of the loess consists of subangular to rounded frosted quartz grains that are coated with iron oxide. Basically, the loess is massive and homogeneous, ranges in thickness from a dust coating on the rocks that form the rim cliffs to more than 20 feet (6 meters), and is partially cemented with calcium carbonate (caliche) in light-colored mottled and veined accumulations which probably represent ancient immature soil horizons.

1.6.2.3 Structure (E.R. Section 2.4.2.3)

The geologic structure at the project site is comparatively simple. Strata of the underlying Mesozoic sedimentary rocks are nearly horizontal; only slight undulations along the caprock rims of the upland are perceptible and faulting is absent. In much of the area surrounding the project site the dips are less than one degree. The prevailing regional dip is about one degree to the south. The low dips and simple structure are in sharp contrast to the pronounced structural features of the Comb Ridge Monocline to the west and the Abajo Mountains to the north.

The project area is within a relatively tectonically stable portion of the Colorado Plateau noted for its scarcity of historical seismic events. The epicenters of historical earthquakes from 1853 through 1986 within a 200-mile (320 km) radius of the site are shown in Figure 1.6-3. More than 1,146 events have occurred in the area, of which at least 45 were damaging; that is, having an intensity of VI or greater on the Modified Mercalli Scale. A description of the Modified Mercalli Scale is given in Table 1.6-3. All intensities mentioned herein refer to this table. Table 1.6-3 also shows a generalized relationship between Mercalli intensities and other parameters to which this review will refer. Since these relationships are frequently site specific, the table values should be used only for approximation and understanding. Conversely, the border between the Colorado Plateau and the Basin and Range Province and Middle Rocky Mountain Province some 155 to 240 miles (249 to 386 km) west and northwest, respectively, from the site is one of the most active seismic belts in the western United States.

Only 63 non-duplicative epicenters have been recorded within a 120 mile (200 km) radius of the project area (Figure 1.6-4). Of these, 50 had an intensity IV or less (or unrecorded) and two were recorded as intensity VI. The nearest event occurred in the Glen Canyon National Recreation Area approximately 38 miles (63 km) west-northwest of the project area. The next closest event occurred approximately 53 miles (88 km) to the northeast. Just east of Durango, Colorado, approximately 99 miles (159 km) due east of the project area, an event having local intensity of V was recorded on August 29, 1941 (Hadsell, 1968). It is very doubtful that these events would have been felt in the vicinity of Blanding.

Three of the most damaging earthquakes associated with the seismic belt along the Colorado Plateau's western border have occurred in the Elsinore-Richfield are about 168 miles (270 km) northwest of the project site. All were of intensity VIII. On November 13, 1901, a strong shock caused extensive damage from Richfield to Parowan. Many brick structures were damaged; rockslides were reported near Beaver. Earthquakes with the ejection of sand and water were reported, and some creeks increased their flow. Aftershocks continued for several weeks (von Hake, 1977). Following several weeks of small foreshocks, a strong earthquake caused major damage in the Monroe-Elsinore-Richfield area on September 29, 1921. Scores of chimneys were thrown down, plaster fell from ceilings, and a section of a new two-story brick wall collapsed at Elsinore's schoolhouse. Two days later, on October 1, 1921, another strong tremor caused additional damage to the area's structures. Large rockfalls occurred along both sides of the Sevier Valley and hot springs were discolored by iron oxides (von Hake, 1977). It is probable that these shocks may have been perceptible at the project site but they certainly would not have caused any damage.

Seven events of intensity VII have been reported within 320 kilometers (km) around Blanding, Utah, which is the area shown in Figure 1.6-3. Of these, only two are considered to have any significance with respect to the project site. On August 18, 1912, an intensity VII shock damaged houses in northern Arizona and was felt in Gallup, New Mexico, and southern Utah. Rock slides occurred near the epicenter in the San Francisco Mountains and a 50-mile (80 km) earth crack was reported north of the San Francisco Range (U. S. Geological Survey, 1970). Nearly every building in Dulce, New Mexico, was damaged to some degree when shook by a strong earthquake on January 22, 1966. Rockfalls and landslides occurred 10 to 15 miles (16 to 24 km) west of Dulce along Highway 17 where cracks in the pavement were reported (Hermann et al., 1980). Both of these events may have been felt at the project site but, again, would certainly not have caused any damage. Figure 1.6-4 shows the occurrence of seismic events within 200 km of Blanding.

TABLE 1.6-3

Modified Mercalli Scale, 1956 Version[a]

M§	Intensity	Effects	v. † cm/s	g ‡
	I.	Not felt. Marginal and long-period effects of large earthquakes (for details see text).		
3	II.	Felt by persons at rest on upper floors, or favorably placed.		
	III.	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.		0.0035-0.007
4	IV.	Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak.		0.007-0.015
	V.	Felt outdoors: direction estimated. Sleepers wakened. Liquids disturbed. Some spilled. Small unstable objects displaced or upset. Doors swing close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.	1-3	0.015-0.035
5	VI.	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc. off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle - CFR).	3-7	0.035-0.07
6	VII.	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments - CFR). Some cracks in masonry C. Waves on ponds: water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.	7-20	0.07-0.15
	VIII.	Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none is masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.	20-80	0.15-0.35
7	IX.	General panic. Masonry D destroyed, masonry C heavily damaged. Sometimes with complete collapse, masonry B seriously damaged. (General damage to foundations - CFR). Frame structures, if not bolted, shifted off foundations. Frames rocked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters.	.80-200	0.35-0.7
8	X.	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.	200-500	0.7-1.2
	XI.	Rails bent greatly. Underground pipelines completely out of service.		>1.2
	XII.	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.	From Fig. 11.14	

Note: Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering (which has no connection with the conventional Class A, B, C construction).

- <u>Masonry A</u> : Good workmanship, mortar, and design reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.
- <u>Masonry B</u> : Good workmanship and mortar; reinforced, but not designed to resist lateral forces.
- <u>Masonry C</u> : Ordinary workmanship and mortar; no extreme weaknesses such as non-ded-ia corners, but masonry is neither reinforced nor designed against horizontal forces.
- <u>Masonry D</u> : Week materials such as adobe, poor mortar, low standards of workmanship, week horizontally.

[a]From Richter (1958). [1]Adapted with permission of W. H. Freeman and Company by Hunt (1984).

†Average peak ground velocity, cm/s.

‡Average peak acceleration (away from source).

§Magnitude correlation.

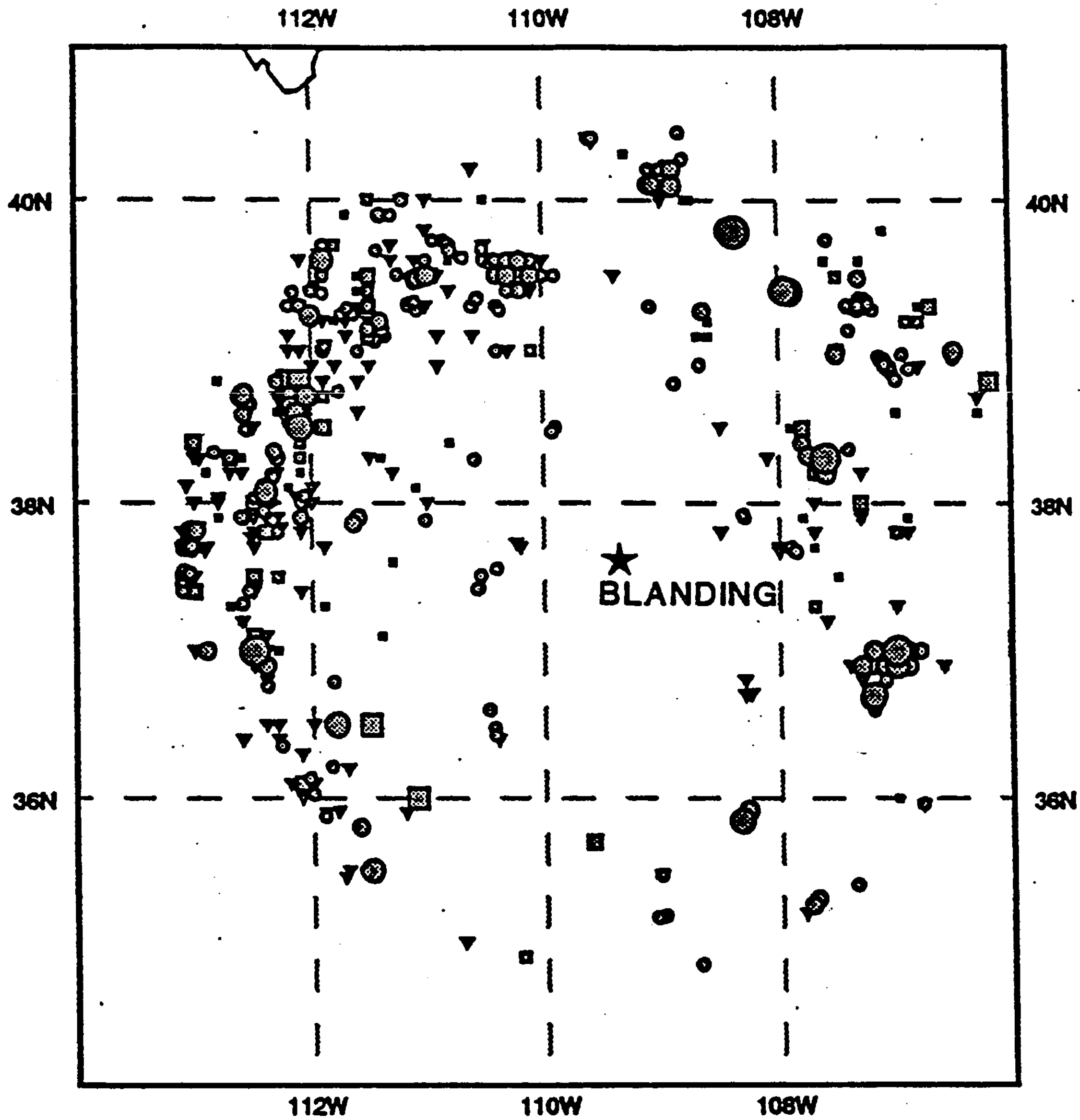
1.6.2.4 Relationship of Earthquakes to Tetonic Structures

The majority of recorded earthquakes in Utah have occurred along an active belt of seismicity that extends from the Gulf of California, through western Arizona, central Utah, and northward into western British Columbia. The seismic belt is possibly a branch of the active rift system associated with the landward extension of the East Pacific Rise (Cook and Smith, 1967). This belt is the Intermountain Seismic Belt shown in Figure 1.6-5 (Smith, 1978).

It is significant to note that the seismic belt forms the boundary zone between the Basin and Range - Great Basin Provinces and the Colorado Plateau - Middle Rocky Mountain Provinces. This block-faulted zone is about 47 to 62 miles (75 to 100 km) wide and forms a tectonic transition zone between the relatively simple structures of the Colorado Plateau and the complex fault-controlled structures of the Basin and Range Province (Cook and Smith, 1967).

Another zone of seismic activity is in the vicinity of Dulce, New Mexico, near the Colorado border. This zone, which coincides with an extensive series of tertiary intrusives, may also be related to the northern end of the Rio Grande Rift. This rift is a series of fault-controlled structural depressions extending southward from southern Colorado through central New Mexico and into Mexico. The rift is shown on Figure 1.6-5 trending north-south to the east of the project area.

Most of the events south of the Utah border of intensity V and greater are located within 50 miles (80 km) of post-Oligocene extrusives. This relationship is not surprising because it has been observed in many other parts of the world (Hadsell, 1968).



1146 EARTHQUAKES PLOTTED

MAGNITUDES	NO INTENSITY OR MAGNITUDE ▼	INTENSITIES
<4.0		I-IV
5.0		V
6.0		VII
7.0		IX

NATIONAL GEOPHYSICAL DATA CENTER / NOAA BOULDER, CO 80303

After Umetco 1988

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White Mesa Mill

FIGURE 1.6-3
Seismicity within 320 KM
of the White Mesa Mill

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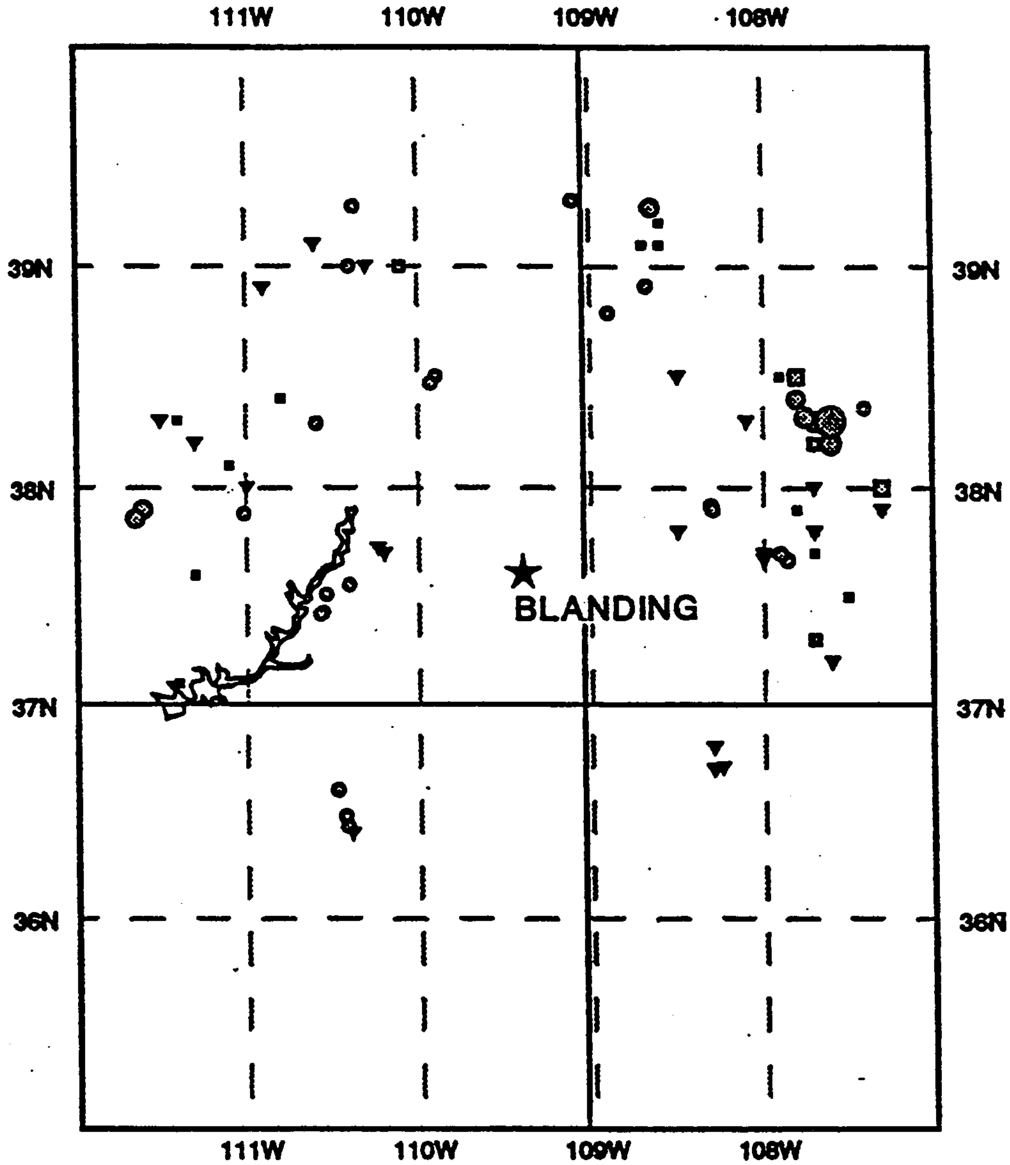

103 EARTHQUAKES PLOTTED

MAGNITUDES
<4.0
5.0
6.0
7.0

NO INTENSITY OR MAGNITUDE

INTENSITIES
I-IV
V
VII
IX

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FIGURE 1.6-4
Seismicity within 200 KM
of the White Mesa Mill

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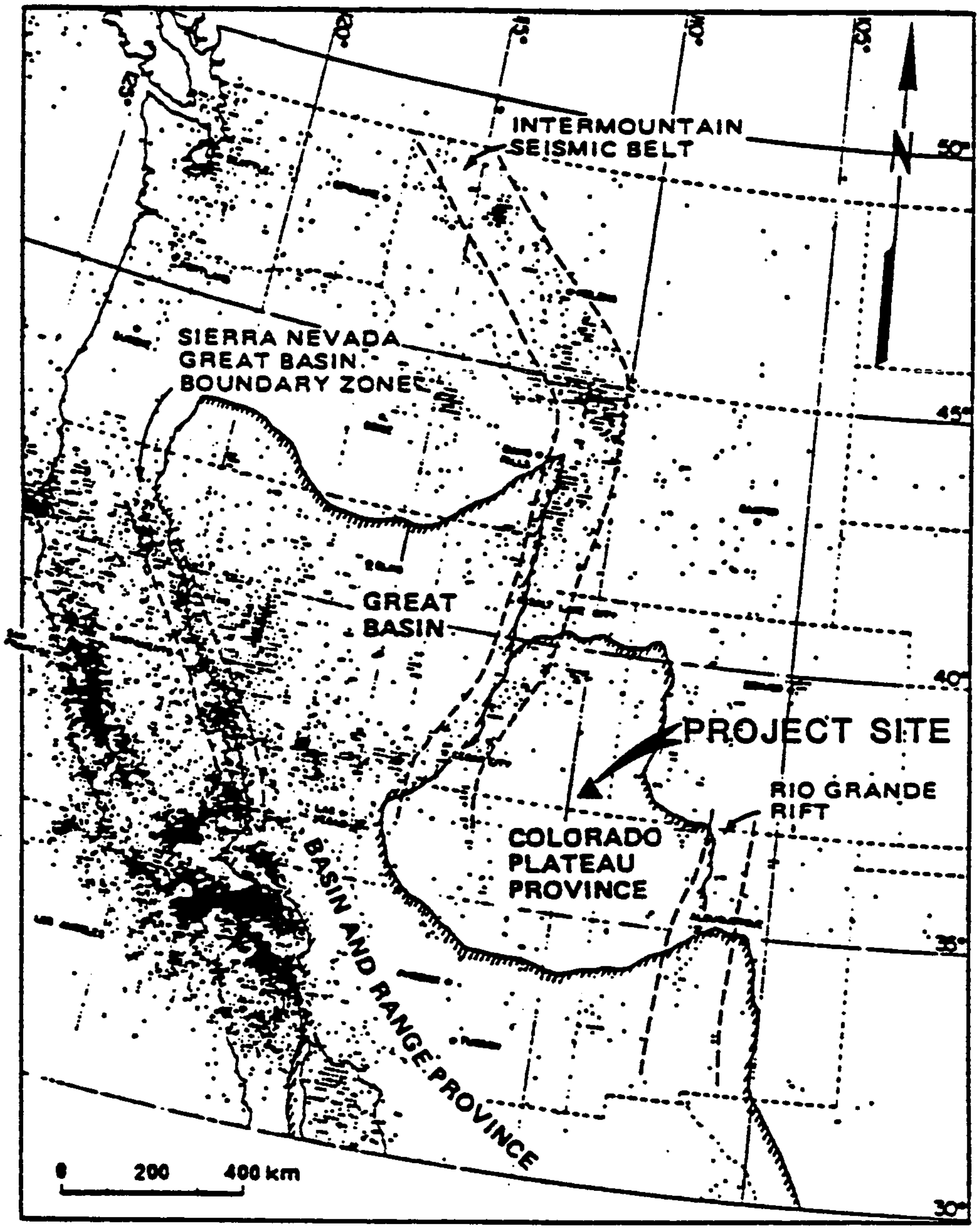

Modified from Smith, 1978

SHOWS RELATIONSHIP OF THE COLORADO PLATEAU PROVINCE TO MARCANAL BELTS

After Umetco, 1988

IUC International Uranium (USA) Corporation White Mesa Mill		
FIGURE 1.6-5 Seismicity of the Western United States 1950 to 1976		
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In Colorado, the Rio Grande Rift zone is one of three siesmotectonic provinces that may contribute energy to the study area. Prominent physiographic expression of the rift includes the San Luis Valley in southern Colorado. The valley is a half-graben structure with major faulting on the eastern flank. Extensional tectonics is dominant in the area and very large earthquakes with recurrence intervals of several thousand years have been projected (Kirkham and Rodgers, 1981). Mountainous areas to the west of the Rio Grande rift province include the San Juan Mountains. These mountains are a complex domicil uplift with extensive Oligocene and Miocene volcanic cover. Many faults are associated with the collapse of the calderas and apparently have not moved since. Faults of Neogene age exist in the eastern San Juan Mountains that may be related to the extension of the Rio Grande rift. Numerous small earthquakes have been felt or recorded in the western mountainous province despite an absence of major Neogene tectonic faults (Kirkham and Rodgers, 1981).

The third seismotectonic province in Colorado, that of the Colorado Plateau, extends into the surrounding states to the west and south. In Colorado, the major tectonic element that has been recurrently active in the Quaternary is the Uncompahgre uplift. Both flanks are faulted and earthquakes have been felt in the area. The faults associated with the Salt Anticlines are collapsed features produced by evaporite solution and flowage (Cater, 1970). Their non-tectonic origin and the plastic deformation of the salt reduces their potential for generating even moderate-sized earthquakes (Kirkham and Rodgers, 1981).

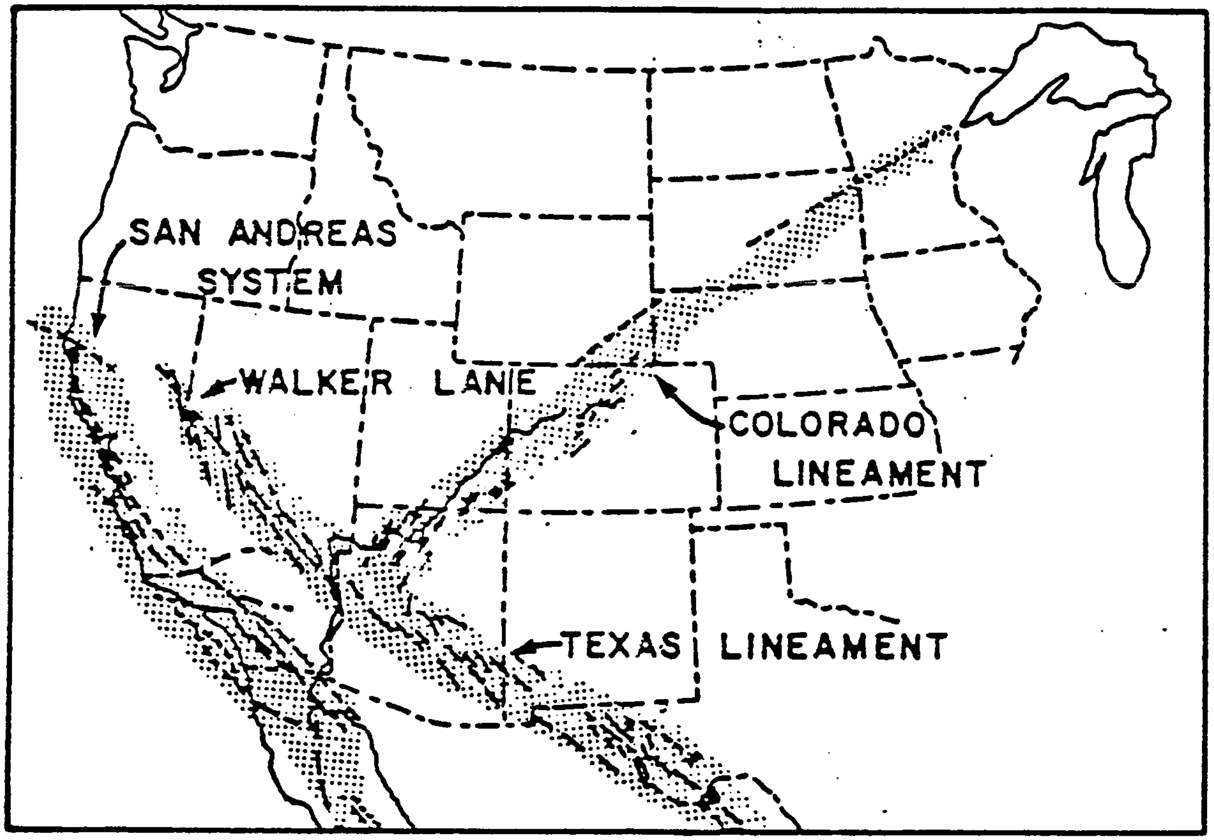
Case and Joesting (1972) have called attention to the fact that regional seismicity of the Colorado Plateau includes a component added by basement faulting. They inferred a basement fault trending northeast along the axis of the Colorado River through Canyonlands. This basement faulting may be part of the much larger structure that Hite (1975) examined and Warner (1978) named the Colorado lineament (Figure 1.6-6). This 1,300-mile (2,100 km) long lineament that extends from northern Arizona to Minnesota is suggested to be a Precambrian wrench-fault system formed some 2.0 to 1.7 billion years before present. While it has been suggested that the Colorado lineament is a source zone for larger earthquakes (m = 4 to 6) in the west-central United States, the observed spatial relationship between epicenters and the trace of the lineament does not prove a casual relation (Brill and Nuttli, 1983). In terms of contemporary seismicity, the lineament does not act as a uniform earthquake generator. Only specific portions of the proposed structure can presently be considered seismic source zones and each segment exhibits seismicity of distinctive activity and character (Wong, 1981). This is a reflection of the different orientations and magnitudes of the stress fields along the lineament. The interior of the Colorado Plateau forms a tectonic stress province, as defined by Zoback and Zoback (1980), that is characterized by generally east-west tectonic compression. Only where extensional stresses from the Basin and Range province of the Rio Grande rift extend into the Colorado Plateau would the Colorado lineament in the local area be suspected of having the capability of generating a large magnitude earthquake (Wong, 1984). At the present time, the well defined surface expression of regional extension is far to the west and far to the east of the project area.

Recent work by Wong (1984) has helped define the seismicity of the whole Colorado Plateau. He called attention to the low level (less than M_L = 3.6) but high number (30) of earthquakes in the Capitol Reef Area from 1978 to 1980 that were associated with the Waterpocket fold and the Cainville monocline, two other major tectonic features of the Colorado Plateau. Only five earthquakes in the sequence were of M_L greater than 3, and fault plane solutions suggest the swarm was produced by normal faulting along northwest-trending Precambrian basement structures (Wong, 1984). The significance of the Capitol Reef seismicity is its relatively isolated occurrence within the Colorado Plateau and its location at a geometric barrier in the regional stress field (Aki, 1979). Stress concentration that produces earthquakes at bends or junctures of basement faults as indicated by this swarm may be expected to occur at other locations in the Colorado Plateau Province. No inference that earthquakes such as those at Capitol Reef are precursors for larger subsequent events is implied.

1.6.2.5 Potential Earthquake Hazards to Project

The project site is located in a region known for its scarcity of recorded seismic events. Although the seismic history for this region is barely 135 years old, the epicentral pattern, or fabric, is basically set and appreciable changes are not expected to occur. Most of the larger seismic events in the Colorado Plateau have occurred along its margins rather than in the interior central region. Based on the region's seismic history, the probability of a major damaging earthquake occurring at or near the project site is very remote. Studies by Algermissen and Perkins (1976) indicate that southeastern Utah, including the site, is in an area where there is a 90 percent probability that a horizontal acceleration of four percent gravity (0.04g) would not be exceeded within 50 years.

Minor earthquakes, not associated with any seismic-tectonic trends, can presumably occur randomly at almost any location. Even if such an event with an intensity as high as VI should occur at or near the project site, horizontal ground accelerations would not exceed 0.10g but would probably range between 0.05 and 0.09g (Coulter et al., 1973; Trifunac and Brady, 1975). These magnitudes of ground motion would not pose significant hazards to the existing and proposed facilities at the Project Site.



SOURCE: WARNER, 1978

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FIGURE 1.6-6

COLORADO LINEAMENT

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1.6.3 Seismic Risk Assessment

In addition to general estimates of earthquake hazards, such as those offered by Dames and Moore (1978b), and summarized above, a more detailed analysis of the relationship between the project area and regional seismicity was performed. As can be seen in Figure 1.6-3, a map based on the seismologic data base from the National Geophysical Data Center of the National Oceanic and Atmospheric Administration (NOAA 1988), many events occur within the Intermountain Seismic Belt and within the Rio Grande rift. Since the Colorado Plateau Province (and particularly the Blanding basin portion, in which the project site lies) is a distinctly different tectonic province, the historical sample chosen for magnitude/frequency estimates was limited to a radius of about 120 miles (200 km) from the project. This sample included a region which is more representative of the seismicity of the Colorado Plateau.

Static and pseudostatic analyses were performed to establish the stability of the side slopes of the tailings soil cover. These analyses, together with analyses of radon flux attenuation, infiltration, freeze/thaw effects, and erosion protection, are summarized below, and are detailed in Appendix D, the Tailings Cover Design report (Titan, 1996).

The side slopes are designed at an angle of 5H:1V. Because the side slope along the southern section of Cell 4A is the longest and the ground elevation drops rapidly at its base, this slope was determined to be critical and is thus the focus of the stability analyses.

The computer software package GSLOPE, developed by MITRE Software Corporation, was used to determine the potential for slope failure. GSLOPE applies Bishop's Method of slices to identify the critical failure surface and calculate a factor of safety (FOS). The slope geometry and properties of the construction materials and bedrock are input into the model. These data and drawings are included in the Stability Analysis of Side Slopes Calculation brief included as Appendix G of the Tailings Cover Design report. For this analysis, competent bedrock is designated at 10 feet below the lowest point of the foundation [i.e., at a 5,540-foot elevation above mean sea level (msl)]. This is a conservative estimate, based on the borehole logs supplied by Chen and Associates (1979), which indicate bedrock near the surface.

1.6.3.1 Static Analysis

For the static analysis, a Factor of Safety ("FOS") of 1.5 or more was used to indicate an acceptable level of stability. The calculated FOS is 2.91, which indicates that the slope should be stable under static conditions. Results of the computer model simulations are included in Appendix G of the Tailings Cover Design report.

1.6.3.2 Pseudostatic Analysis (Seismicity)

The slope stability analysis described above was repeated under pseudostatic conditions in order to estimate a FOS for the slope when a horizontal ground acceleration of 0.10g is applied. The slope geometry and material properties used in this analysis are identical to those used in the stability analysis. A FOS of 1.0 or more was used to indicate an acceptable level of stability under pseudostatic conditions. The calculated FOS is 1.903, which indicates that the slope should be stable under dynamic conditions. Details of the analysis and the simulation results are included in Appendix G of the Tailings Cover Design report.

In June of 1994, Lawrence Livermore National Laboratory ("LLNL") (1994) published a report on seismic activity in southern Utah, in which a horizontal ground acceleration of 0.12g was proposed for the White Mesa site. The evaluations made by LLNL were conservative to account for tectonically active regions that exist, for example, near Moab, Utah. Although, the LLNL report states that "...[Blanding] is located in a region known for its scarcity of recorded seismic events," the stability of the cap design slopes using the LLNL factor was evaluated. The results of a sensitivity analysis reveal that when considering a horizontal ground acceleration of 0.12g, the calculated FOS is 1.778 which is still above the required value of 1.0, indicating adequate safety under pseudostatic conditions. This analysis is also included in Appendix G of the Tailings Cover Design report.

1.7 BIOTA (ER Section 2.9)

1.7.1 <u>Terrestrial</u> (ER Section 2.9.1)

1.7.1.1 Flora (ER Section 2.9.1.1)

The natural vegetation presently occurring within a 25-mile (40-km) radius of the site is very similar to that of the potential, being characterized by pinyon-juniper woodland intergrading with big sagebrush (Artemisia tridentata) communities. The pinyon-juniper community is dominated by Utah juniper (Juniperus osteosperma) with occurrences of pinyon pine (Pinus edulis) as a codominant or subdominant tree species. The understory of this community, which is usually quite open, is composed of grasses, forbs, and shrubs that are also found in the big sagebrush communities. Common associates include galleta grass (Hilaria jamesii), green ephedra (Ephedra viridis), and broom snakewood (Gutierrezia sarothrae). The big sagebrush communities occur in deep, well-drained soils on flat terrain, whereas the pinyon-juniper woodland is usually found on shallow rocky soil of exposed canyon ridges and slopes.

Seven community types are present on the project site (Table 1.7-1 and Figure 1.7-1). Except for the small portions of pinyon-juniper woodland and the big sagebrush community types, the majority of the plant communities within the site boundary have been disturbed by past grazing and/or treatments designed to improve the site for rangeland. These past treatments include chaining, plowing, and reseeding with crested wheatgrass (Agropyron desertorum). Controlled big sagebrush communities are those lands containing big sagebrush that have been chained to stimulate grass production. In addition, these areas have been seeded with crested wheatgrass. Both grassland communities I and II are the result of chaining and/or plowing and seeding with crested wheatgrass. The reseeded grassland II community is in an earlier stage of recovery from disturbance than the reseeded grassland I community. The relative frequency, relative cover, relative density, and importance values of species sampled in each community are presented in Dames and Moore (1978b), Table 2.8-2. The percentage of vegetative cover in 1977 was lowest on the reseeded grassland II community (10.7%) and highest on the big sagebrush community (33%) (Table 1.7-2).

Based upon dry weight composition, most communities on the site were in poor range condition in 1977 (Dames & Moore (1978), Tables 2.8-3 and 2.8-4). Pinyon-juniper, big sagebrush, and controlled big sagebrush communities were in fair condition. However, precipitation for 1977 at the project site was classed as drought conditions (Dames & Moore (1978b), Section 2.8.2.1). Until July, no production was evident on the site.

No designated or proposed endangered plant species occur on or near the project site (Dames & Moore (1978b), Section 2.8.2.1). Of the 65 proposed endangered species in Utah, six have documented distributions on San Juan County. A careful review of the habitat requirements and known distributions of these species indicates that, because of the disturbed environment, these species would probably not occur on the project site.

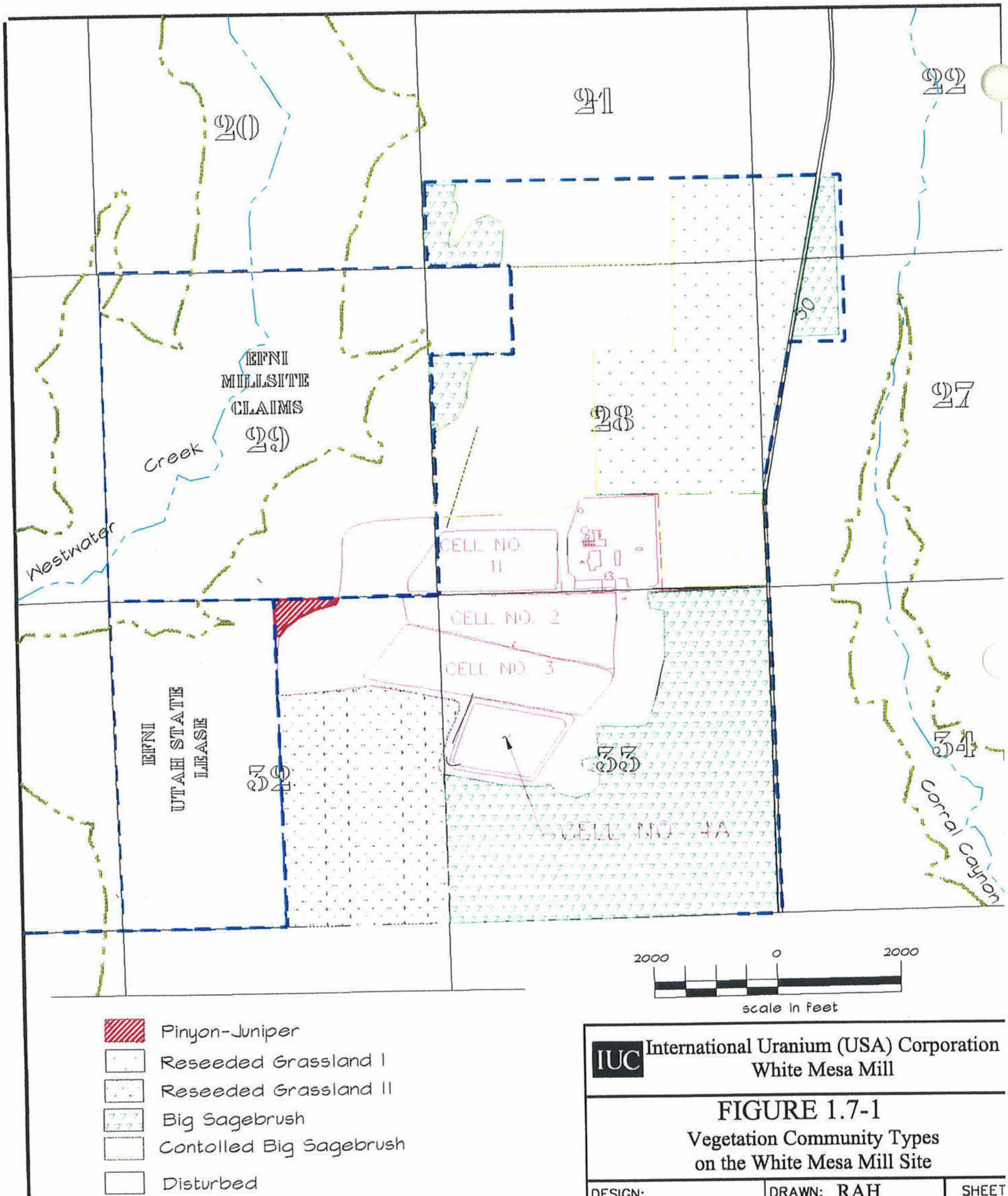

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FIGURE 1.7-1
Vegetation Community Types on the White Mesa Mill Site

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TABLE 1.7-1

Community Types and Expanse Within the Project site Boundary

Community Type	Expanse	
	Ha	Acres
Pinyon-juniper Woodland	5	13
Big Sagebrush	113	278
Reseeded Grassland I	177	438
Reseeded Grassland II	121	299
Tamarisk-salix	3	7
Controlled Big Sagebrush	230	569
Disturbed	17	41

TABLE 1.7-2

Ground Cover For Each Community Within the Project Site Boundary

Community Type	Percentage of Each Type of Cover		
	Vegetative Cover	Litter	Bare Ground
Pinyon-juniper Woodland[a]	25.9	15.6	55.6
Big Sagebrush	33.3	16.9	49.9
Reseeded Grassland I	15.2	24.2	61.0
Reseeded Grassland II	10.7	9.5	79.7
Tamarisk-salix	12.0	20.1	67.9
Controlled Big Sagebrush	17.3	15.3	67.4
Disturbed	13.2	7.0	80.0

[a]Rock covered 4.4% of the ground.

1.7.1.2 Fauna (ER Section 2.9.1.2)

Wildlife data have been collected through four seasons at several locations on the site. The presence of a species was based on direct observations, trappings and signs such as the occurrence of scat, tracks, or burrows. A total of 174 vertebrate species potentially occur within the vicinity of the mill (Dames & Moore (1978b), Appendix D), 78 of which were confirmed (Dames & Moore (1978b), Section 2.8.2.2).

Although seven species of amphibians are thought to occur in the area, the scarcity of surface water limits the use of the site by amphibians. The tiger salamander (Ambystoma tigrinum) was the only species observed. It appeared in the pinyon-juniper woodland west of the project site (Dames & Moore (1978b), Section 2.8.2.2).

Eleven species of lizards and five snakes potentially occur in the area. Three species of lizards were observed: the sagebrush lizard (Sceloparas graciosus), western whiptail (Cnemidophorus tigris), and the short-horned lizard (Phrynosoma douglassi) (Dames & Moore (1978b), Section 2.8.2.2). The sagebrush and western whiptail lizard were found in sagebrush habitat, and the short-horned lizard was observed in the grassland. No snakes were observed during the field work.

Fifty-six species of birds were observed in the vicinity of the project site (Table 1.7-3). The abundance of each species was estimated by using modified Emlen transects and roadside bird counts in various habitats and seasons. Only four species were observed during the February sampling. The most abundant species was the horned lark (Eremophila aepestis) followed by the common raven (Corvus corax), which were both concentrated in the grassland. Avian counts increased drastically in May. Based on extrapolation of the Emlen transect data, the avian density on grassland of the project site during spring was about 123 per 100 acres (305 per square kilometer). Of these individuals, 94 percent were horned larks and western meadowlarks (Sturnella neglecta). This density and species composition are typical of rangeland habitats. In late June the species diversity declined somewhat in grassland but peaked in all other habitats. By October the overall diversity decreased but again remained the highest in grassland.

Raptors are prominent in the western United States. Five species were observed in the vicinity of the site (Table 1.7-3). Although no nests of these species were located, all (except the golden eagle, Aquila chrysaetos) have suitable nesting habitat in the vicinity of the site. The nest of a prairie falcon (Falco mexicanus) was found about 3/4 mile (1.2 km) east of the site. Although no sightings were made of this species, members tend to return to the same nests for several years if undisturbed (Dames & Moore (1978b), Section 2.8.2.2).

Of several mammals that occupy the site, mule deer (Odocoileus hemionus) is the largest species. The deer inhabit the project vicinity and adjacent canyons during winter to feed on the sagebrush and have been observed migrating through the site to Murphy Point (Dames & Moore (1978b), Section 2.8.2.2). Winter deer use of the project vicinity, as measured by browse utilization, is among the heaviest in southeastern Utah [25 days of use per acre (61 days of use per hectare) in the pinyon-juniper-sagebrush habitats in the vicinity of the project site]. In addition, this area is heavily used as a migration route by deer traveling to Murphy Point to winter. Daily movement during winter periods by deer inhabiting the area has also been observed between Westwater Creek and Murphy Point. The present size of the local deer herd is not known.

Other mammals present at the site include the coyote (Canis latrans), red fox (Vulpes vulpes), gray fox (Urocyon cineroargenteus), striped skunk (Mephitis mephitis), badger (taxidea taxus), longtail weasel (Mustela frenata), and bobcat (Lynx rufus). Nine species of rodents were trapped or observed on the site, the deer mouse (Peromyscus maniculatus) having the greatest distribution and abundance. Although desert cottontails (Sylvilagus auduboni) were uncommon in 1977, black-tailed jackrabbits (Lepus californicus) were seen during all seasons.

Three currently recognized endangered species of animals could occur in the project vicinity. However, the probability of these animals occurring near the site is extremely low. The project site is within the range of the bald eagle (Haliaeetus leucocephalus) and the American peregrine falcon (Falco peregrinus anatum), but the lack of aquatic habitat indicates a low probability of these species occurring on the site. Although the black-footed ferret (Musetela nigripes) once ranged in the vicinity of the site, it has not been sighted in Utah since 1952, and the Utah Division of Wildlife feels it is highly unlikely that this animal is present (Dames & Moore (1978b), Section 2.8.2.2).

1.7.2 Aquatic Biota (ER Section 2.9.2)

Aquatic habitat at the project site ranges temporally from extremely limited to nonexistent due to the aridity, topography and soil characteristics of the region and consequent dearth of perennial surface water. Two small catch basins (Dames & Moore (1978b), Section 2.6.1.1), approximately 20 m in diameter, are located on the project site, but these only fill naturally during periods of heavy rainfall (spring and fall) and have not held rainwater during the year-long baseline water quality monitoring program. One additional small basin was completed in 1994 to serve as a diversionary feature for migrating waterfowl. Although more properly considered features of the terrestrial environment, they essentially represent the total aquatic habitat on the project site. When containing water, these catch basins probably harbor algae, insects, other invertebrate forms, and amphibians.

TABLE 1.7-3
Birds Observed in the Vicinity of the White Mesa Project

Species	Relative Abundance and Status[a]	Species	Relative Abundance and Status[a]
Mallard	CP	Pinyon Jay	CP
Pintail	CP	Bushtit	CP
Turkey Vulture	US	Bewick's Wren	CP
Red-tailed Hawk	CP	Mockingbird	US
Golden Eagle	CP	Mountain Bluebird	CS
Marsh Hawk	CP	Black-tailed Gnatcatcher	H
Merlin	UW	Ruby-crowned Kinglet	CP
American Kestrel	CP	Loggerhead Shrike	CS
Sage Grouse	UP	Starling	CP
Scaled Quail	Not Listed	Yellow-rumped Warbler	CS
American Coot	CS	Western Meadowlark	CP
Killdeer	CP	Red-winged Blackbird	CP
Spotted Sandpiper	CS	Brewer's Blackbird	CP
Mourning Dove	CS	Brown-headed Cowbird	CS
Common Nighthawk	CS	Blue Grosbeak	CS
White-throated Swift	CS	House Finch	CP
Yellow-bellied Sapsucker	CP	American Goldfinch	CP
Western Kingbird	CS	Green-tailed Towhee	CS
Ash-throated Flycatcher	CS	Rufous-sided Towhee	CP
Say's Phoebe	CS	Lark Sparrow	CS
Horned Lark	CP	Black-throated Sparrow	CS
Violet-green Swallow	CS	Sage Sparrow	UC
Barn Swallow	CS	Dark-eyed Junco	CW
Cliff Swallow	CS	Chipping Sparrow	CS
Scrub Jay	CP	Brewer's Sparrow	CS
Black-billed Magpie	CP	White-crowned Sparrow	CS
Common Raven	CP	Song Sparrow	CP
Common Crow	CW	Vesper Sparrow	CS

[a]W. H. Behle and M. L. Perry, *Utah Birds*, Utah Museum of Natural History, University of Utah, Salt Lake City, 1975.

Relative Abundance	Status
C = Common	P = Permanent
U = Uncommon	S = Summer Resident
H = Hypothetical	W = Winter Visitant

Source: Dames & Moore (1978b), Table 2.8-5

They may also provide a water source for small mammals and birds. Similar ephemeral catch and seepage basins are typical and numerous to the northeast of the project site and south of Blanding.

Aquatic habitat in the project vicinity is similarly limited. The three adjacent streams (Corral Creek, Westwater Creek, and an unnamed arm of Cottonwood Wash) are only intermittently active, carrying water primarily in the spring during increased rainfall and snowmelt runoff, in the autumn, and briefly during localized but intense electrical storms. Intermittent water flow most typically occurs in April, August, and October in those streams. Again, due to the temporary nature of these steams, their contribution to the aquatic habitat of the region is probably limited to providing a water source for wildlife and a temporary habitat for insect and amphibian species.

No populations of fish are present on the project site, nor are any known to exist, in its immediate vicinity. The closest perennial aquatic habitat to the mill appears to be a small irrigation basin (approximately 50 m in diameter) about 3.8 miles (6 km) upgrade to the northeast. This habitat was not sampled for biota and it has been reported that the pond is intermittent and probably does not harbor any fish species.

The closest perennial aquatic habitat known to support fish populations is the San Juan River 18 miles (29 km) south of the project site. Five species of fish Federally designated (or proposed) as endangered or threatened occur in Utah (Table 1.7-4). One of the five species, the woundfin (Plegopterus argentissiumus), does not occur in southeastern Utah where the mill site is located. The Colorado squawfish (Ptychocheilus lucius) and humpback chub (Gila cypha), however, are reported as inhabiting large river systems in southeastern Utah. The bonytail chub (Gila elegans), classified as threatened by the State and proposed as endangered by Federal authorities, is also limited in its distribution to main channels or large rivers. The humpback sucker (razorback sucker; Xyrauchen texanus), protected by the State and proposed as threatened by the Federal authorities, is found in southeastern Utah inhabiting backwater pools and quiet areas of mainstream rivers. The closest habitat suitable for the Colorado squawfish, humpback chub, bonytail chub, and humpback sucker is the San Juan River 18 miles (29 km) south of the site.

During the preparation of Energy Fuels Nuclear's (EFN), the predecessor to IUSA, license renewal application for Source Material License SU-1358, NRC staff prepared an Environmental assessment (EA) which was issued on February 27, 1997, with a final finding of no significant impact (FONSI) prepared and issued on March 5, 1997. In this EA, NRC staff addressed the issue of endangered species on the site as follows:

"In the vicinity of the site, four animal species classified as either endangered or threatened (i.e., the bald eagle (Haliaeetus leucocephalus), the American peregrine falcon (Falco peregrinis anatum), the black-footed ferret (Mustela nigripes), and the Southwestern willow flycatcher (Empidonax traillii extimus) could occur. While the ranges of the bald eagle, peregrine falcon and willow flycatcher encompass the project area, their likelihood of utilizing the site is extremely low. The black-footed ferret has not been seen in Utah since 1952, and is not expected to occur any longer in the area.

No populations of fish are present on the project site, nor are any known to exist in the immediate area of the site. Four species of fish designated as endangered or threatened occur in the San Juan River 29 km (18 miles) south of the site. There are no discharges of mill effluents to surface waters, and therefore, no impacts are expected for the San Juan River due to operations of the White Mesa mill.

Currently, no designated endangered plant species occur on or near the plant site."

TABLE 1.7-4

Threatened and Endangered Aquatic Species Occurring in Utah

Species	Habitat	Listing	Occurrence in Southeastern Utah
Woundfin *Plegopterus Argentissimus*	Silty streams; muddy, swift-current areas; Virgin River critical habitat[a]	Federal - endangered[b] State - threatened	No
Humpback Chub *Gila Cypha*	Large river systems, eddies, and backwater	Federal - endangered[b] State - threatened	Yes
Colorado River Squawfish *Ptychocheilus Lucius*	Main channels of large river systems in Colorado drainage	Federal - endangered[b] State - threatened	Yes
Bonytail Chub *Gila Elegans*	Main channels of large river systems in Colorado drainage	Federal - proposed endangered[c] State - threatened	Yes
Humpback Sucker (razorback sucker) *Xyrauchen Texanus*	Backwater pools and quiet-water areas of main rivers	Federal - proposed threatened[c] State - threatened	Yes

a "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 42(211): 57329 (1977).

b "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 42(135): 36419-39431 (1977).

c "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 43(79): 17375-17377 (1978).

1.8 NATURAL RADIATION

The following sections describe background levels of natural radiation and refer the reader to recent reports containing current radiation monitoring data.

1.8.1 Background (ER Section 2.10)

Radiation exposure in the natural environment is due to cosmic and terrestrial radiation and to the inhalation of radon and its daughters. Measurements of the background environmental radioactivity were made at the mill site using thermoluinescent dosimeters (TLDs). The results indicate an average total body dose of 142 millirems per year, of which 68 millirems is attributable to cosmic radiation and 74 millirems to terrestrial sources. The cosmogenic radiation dose is estimated to be about 1 millirem per year. Terrestrial radiation originates from the radionuclides potassium-40, rubidium-87, and daughter isotopes from the decay of uranium-238, thorium-232, and, to a lesser extent, uranium-235. The dose from ingested radionuclides is estimated at 18 millirems per year to the total body. The dose to the total body from all sources of environmental radioactivity is estimated to be about 161 millirems per year.

The concentration of radon in the area is estimated to be in the range of 500 to 1,000 pCi/m^3, based on the concentration of radium-226 in the local soil. Exposure to this concentration on a continuous basis would result in a dose of up to 625 millirems per year to the bronchial epithelium. As ventilation decreases, the dose increases; for example, in unventilated enclosures, the comparable dose might reach 1,200 millirems per year.

The medical total body dose for Utah is about 75 millirems per year per person. The total dose in the area of the mill from natural background and medical exposure is estimated to be 236 millirems per year.

1.8.2 Current Monitoring Data

The most recent data for radon, gamma, vegetation, air and stock sampling, groundwater, surface water, meteorological monitoring, and soil sampling discussed in the following sections are found in the Semi-Annual Effluent Report for July through December 1998.

1.8.2.1 Environmental Radon

Until 10 CFR 20 standards were reduced to 0.1 pCi/l, environmental radon concentrations were determined by using Track Etch detectors. There was one detector at each of five environmental monitoring stations with a duplicate at BHV-2, the nearest residence. See the Semi-Annual Effluent reports, for maps showing these locations. After 1995, with concurrence of the NRC, environmental radon concentrations are no longer measured at these locations due to the lack of sensitivity of available monitoring methods to meet the new 10 CFR 20 standard of 0.1 pCi/l.

1.8.2.2 Environmental Gamma

Gamma radiation levels are determined by Thermal Luminescent Dosimeters (TLDs). The TLDs are placed at the five environmental stations located around the perimeter boundary of the mill site discussed above. The badges are exchanged quarterly. The data are presented in Appendix A.

1.8.2.3 Vegetation Samples

Vegetation samples are collected at three locations around the mill periphery. The sampling locations are northeast, northwest, and southwest of the mill facility. Vegetation samples are collected during early spring, late spring, and fall. Vegetation results are included in Appendix A. No trends are apparent, as the Ra-226 and Pb-210 concentrations at each sampling location have remained consistent.

1.8.2.4 Environmental Air Monitoring and Stack Sampling

Air monitoring at the White Mesa Mill is conducted at four high volume (40 standard cubic feet per minute) stations located around the periphery of the mill. These locations are shown in Appendix A. BHV-1 is located at the northern mill boundary at the meteorological station site. BHV-2 is further north at the nearest residence. BHV-4 is south of Cell 3 and BHV-5 is just south of the ore storage pad. The Semi-Annual Effluent reports contain air monitoring data.

The results of the first quarter 1996 stack samples are presented in Appendix A. These samples were collected during the period between January 27, 1996 and February 3, 1996. Samples were collected from the North Yellowcake Dryer, the South Yellowcake Dryer, and the Yellowcake Baghouse. The Demister Stack and Grizzly Stack were not sampled because they were not in operation during that time. The material being processed during that time for recovery of the source material content was a uranium/calcium fluoride solid in powder form, which requires no grinding. No second quarter 1996 gas samples were collected on any process stack, because material processing and drying operations ceased on March 23, 1996. Graphical representation of uranium release rate is presented in Appendix A. The south yellowcake dryer and yellowcake baghouse have only been sampled twice. No graphs had been generated for those data.

Pursuant to NRC License Amendment No. 41 for the White Mesa Mill Source Material License No. SUA-1358, air particulate radionuclide monitoring at BHV-3 was discontinued at the end of the third quarter 1995. Sufficient data were accumulated over a 12-year period to adequately establish background radionuclide concentrations. As a result of Amendment No. 41, the air particulate radionuclide concentrations at each monitoring site are calculated by subtracting the appropriate quarterly background average. Appendix A tables show the radionuclide concentrations at each location with background concentrations subtracted, and the results of the dose calculations, including the 50-year dose commitment to the nearest residence. Appendix A shows the yearly dose to the nearest resident, which is very low. No apparent trends are evident.

1.8.2.5 Groundwater

The Semi-Annual Effluent Reports detail the groundwater monitoring data and the Quality Control (QC) results. No trends are apparent.

1.8.2.6 Surface Water

The results of surface water monitoring are presented in the Semi-Annual Effluent Reports. Cottonwood Creek is sampled Semi-annually and Westwater Creek is sampled on an annual basis. No trends are apparent.

1.8.2.7 Meteorological Monitoring

The Semi-Annual Air Quality and Meteorology Monitoring Report provided by Enecotech is included in the Semi-Annual Effluent Reports.

2.0 EXISTING FACILITY

The following sections describe the construction history of the White Mesa Mill; the mill and mill tailings management facilities; mill operations including the mill circuit and tailings management; and both operational and environmental monitoring.

2.1 Facility Construction History

The White Mesa uranium/vanadium mill was developed in the late 1970's by Energy Fuels Nuclear, Inc. (EFN) as an outlet for the many small mines that are located in the Colorado Plateau and for the possibility of milling Arizona Strip ores. At the time of its construction, it was anticipated that high uranium prices would stimulate ore production. However, prices started to decline about the same time as mill operations commenced.

As uranium prices fell, producers in the region were affected and mine output declined. After about two and one-half years, the White Mesa Mill ceased ore processing operations altogether, began solution recycle, and entered a total shutdown phase. In 1984, a majority ownership interest was acquired by Union Carbide Corporation's (UCC) Metals Division which later became Umetco Minerals Corporation (Umetco), a wholly-owned subsidiary of UCC. This partnership continued until May 26, 1994 when EFN reassumed complete ownership. In May of 1997, International Uranium Corporation purchased the assets of EFN and is the current owner of the facility.

2.1.1 Mill and Tailings Management Facility

The Source Materials License Application for the White Mesa Mill was submitted to the U. S. Nuclear Regulatory Commission (NRC) on February 8, 1978. Between this date and the date the first ore was fed to the mill grizzly on May 6, 1980, several actions were taken including: increasing mill design capacity, permit issuance from the Environmental Protection Agency and the State of Utah, archeological clearance for the mill and tailings areas, and an NRC pre-operational inspection on May 5, 1980.

Construction on the tailings area began on August 1, 1978 with the movement of earth from the area of Cell 2. Cell 2 was completed on May 4, 1980, Cell 1-I on June 29, 1981, and Cell 3 on September 2, 1982. In January of 1990 an additional cell, designated 4A, was completed and placed into use solely for solution storage and evaporation.

2.2 Facility Operations

In the following subsections, an overview of mill operations and operating periods are followed by descriptions of the operations of the mill circuit and tailings management facilities.

2.2.1 Operating Periods

The White Mesa Mill was operated by EFN from the initial start-up date of May 6, 1980 until the cessation of operations in 1983. Umetco, as per agreement between the parties, became the operator of record on January 1, 1984. The White Mesa Mill was shut down during all of 1984. The mill operated at least part of each year from 1985 through 1990. Mill operations were again ceased during the years of 1991 through 1994. EFN reacquired sole ownership on May 26, 1994 and the mill operated again during 1995 and 1996. Typical employment figures for the mill are 118 during uranium-only operations and 138 during uranium/vanadium operations.

2.2.2 Mill Circuit

While originally designed for a capacity of 1,500 dry tons per day (dtpd.), the mill capacity was boosted to the present rated design of 1980 dtpd. prior to commissioning.

The mill uses an atmospheric hot acid leach followed by counter current decantation (CCD). This in turn is followed by a clarification stage which precedes the solvent extraction (SX) circuit. Kerosene containing iso-decanol and tertiary amines extract the uranium and vanadium from the aqueous solution in the SX circuit. Salt and soda ash are then used to strip the uranium and vanadium from the organic phase.

After extraction of the uranium values from the aqueous solution in SX, uranium is precipitated with anhydrous ammonia, dissolved, and re-precipitated to improve product quality. The resulting precipitate is then washed and dewatered using centrifuges to produce a final product called "yellowcake." The yellowcake is dried in a multiple hearth dryer and packaged in drums weighing approximately 800 to 1,000 lbs. for shipping to converters.

After the uranium values are stripped from the pregnant solution in SX, the vanadium values are transferred to tertiary amines contained in kerosene and concentrated into an intermediate product called vanadium product liquor (VPL). An intermediate product, ammonium metavanadate (AMV), is precipitated from the VPL using ammonium sulfate in batch precipitators. The AMV is then filtered on a belt filter and, if necessary, dried. Normally, the AMV cake is fed to fusion furnaces when it is converted to the mill's primary vanadium product, V_2O_5 tech flake, commonly called "black flake."

The mill processed 1,511,544 tons of ore and other materials from May 6, 1980 to February 4, 1983. During the second operational period from October 1, 1985 through December 7, 1987, 1,023,393 tons were processed. During the third operational period from July 1988 through November 1990, 1,015,032 tons were processed. During the fourth operational period from August 1995 through January 1996, 203,317 tons were processed. The fifth operational period from May 1996 through September 1996, processed 3,868 tons of calcium fluoride material. Since early 1997, the mill has processed 58,403 tons from several additional feed stocks. Inception to date material processed through April 1999 totals 3,815,577 tons. This total is for all processing periods combined.

2.2.3 Tailings Management Facilities

Tailings produced by the mill typically contain 30 percent moisture by weight, have an in-place dry density of 86.3 pounds per cubic foot (Cell 2), have a size distribution with a predominant -325 mesh size fraction, and have a high acid and flocculent content.

The tailings facilities at White Mesa currently consist of four cells as follows:

- Cell 1, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the evaporation of process solution.
- Cell 2, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands.
- Cell 3, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands and solutions.
- Cell 4A, constructed with a 40-millimeter (ml) HDPE liner, is currently not used.

Total estimated design capacity of Cells 2, 3, and 4A is approximately six million (mm) cubic yards.

2.2.3.1 Tailings Management

Constructed in shallow valleys or swale areas, the lined tailings facilities provide storage below the existing grade and reduce potential exposure. Because the cells are separate and distinct, individual tailings cells may be reclaimed as they are filled to capacity. This phased reclamation approach minimizes the amount of tailings exposed at any given time and reduces potential exposure to a minimum.

The perimeter discharge method involves setting up discharge points around the east, north, and west boundaries of the cell. This results in low cost disposal at first, followed by higher disposal costs toward the end of the cell's life. The disadvantage to this method is that reclamation activities cannot take place until near the end of the cell's life. This disadvantage was recognized and led to the development of the final grade method.

Slurry disposal has taken place in both Cells 2 and 3. Tails placement accomplished in Cell 2 was by means of the above described perimeter discharge method, while in Cell 3 the final grade method, described below, has been employed.

The final grade method used in Cell 3 calls for the slurry to be discharged until the tailings surface comes up to final grade. The discharge points are set up in the east end of the cell and the final grade surface is advanced to the slimes pool area. When the slimes pool is reached, the discharge points are then moved to the west end of the cell and worked back to the middle. An advantage to using the final grade method is that maximum beach stability is achieved by (1) allowing water to drain from the sands to the maximum extent, and (2) allowing coarse sand deposition to help provide stable beaches. Another advantage is that radon release and dust prevention measures (through the placement of the initial layer of the final cover) are applied as expeditiously as possible.

2.2.3.2 Liquid Management

As a zero-discharge facility, the White Mesa Mill must evaporate all of the liquids utilized during processing. This evaporation takes place in two areas:

- Cell 1, which is used for solutions only;
- Cell 3, in which tailings and solutions exist; and

The original engineering design indicated a net water gain into the cells would occur during mill operations. As anticipated, this has been proven to be the case. In addition to natural evaporation, spray systems have been used at various times to enhance evaporative rates and for dust control. To minimize the net water gain, solutions are recycled from the active tailings cells to the maximum extent possible. Solutions from Cells 1 and 3 are brought back to the CCD circuit where metallurgical benefit can be realized. Recycle to other parts of the mill circuit are not feasible due to the acid content of the solution.

2.3 Monitoring Programs

Operational monitoring is defined as those monitoring activities that take place only during operations. This is contrasted with environmental monitoring, which is performed whether or not the mill is in operation.

2.3.1 Operational Monitoring

In the mill facilities area, the operational monitoring programs consist of effluent gas stack sampling; daily inspection of process tanks, lines and equipment; and daily inspection of tailing impoundments and leak detection systems. Quarterly effluent gas stack samples are collected on all mill process stacks when those process systems are operating. These include the yellowcake dryers No. 1 and No. 2, the vanadium dryer stack, their respective scrubber stacks, the demister stack, and the grizzly stack.

A visual inspection is made daily by supervisory personnel of all process tanks and discharge lines in the mill and of the tailings management area. In the event of a failure in one of the normal process streams, corrective actions are taken to ensure that there are no discharges to the environment.

Leak detection systems ("LDS") under each tailings cell are monitored for the presence of solution weekly. If solution is present in the LDS of Cells 2, 3, or 4, a program, described under License Condition 11.3, provides for actions to be taken.

2.3.2 Environmental Monitoring

Environmental monitoring consists of the following: groundwater and surface water samples; air particulate samples, gamma radiation measurements, soil, and vegetation samples. Refer to the Semi-annual Effluent Reports contained in Appendix A for sampling location, frequency and analytical results.

Groundwater

Wells MW-6, MW-7, and MW-8 were plugged because they were under Cell 3, as was MW-13, under Cell 4A. Wells MW-9 and MW-10 are dry and have been excluded from the monitoring program. The ten monitoring wells in or near the uppermost aquifer are MW-1, MW-2, MW-3, MW-4, MW-5, MW-11, MW-12, MW-14, MW-15 and MW-17. These wells vary in depth from 94 to 189 feet. Flow rates in these wells vary from 15 gallons per month to 10 gallons per hour. The culinary well (one of the supply wells) is completed in the Navajo aquifer, at a depth of approximately 1,800 feet below the ground surface.

The groundwater monitoring program consists of parameters measured quarterly and semi-annually. Quarterly parameters include: pH, specific conductance, temperature, depth to water, chlorides, sulfates, total dissolved solids (TDS), nickel, potassium, and U-natural. The parameters measured on a semi-annual basis, in addition to the quarterly parameters, are: arsenic, selenium, sodium, radium-226, thorium-230, and lead-210. Semi annual parameters which all measured are: all physical chemical criteria of quarterly sampling as well as additional analyte parameters as, Se Na and Radionuclides Ra-226, Th-230, and Pb216.

Surface Water

Surface water samples are taken from the two nearby streams, Westwater Creek and Cottonwood Creek. Cottonwood Creek usually contains running water, but has also been dry on occasion. Westwater Creek rarely contains running water, and when it does, it is from precipitation runoff. Water samples are collected quarterly from Cottonwood Creek and analyzed for TDS and total suspended solids (TSS). Additional semi-annual water samples are collected at a minimum of four

(4) months apart. These samples are analyzed for TDS, TSS, dissolved and suspended U-nat, Ra-226, and Th-230.

Currently the program includes sampling water from Westwater Creek once a year, if the creek is flowing. However, if water is not running, an alternate soil sample is collected from the creek bed. Water samples from Westwater Creek are analyzed for TDS, TSS, Dissolved and Suspended U-nat, Ra-226, and Th-230. If a soil sample is collected, it is analyzed for U-nat and Ra-226 (per License Condition 24C).

Radiation

Natural radiation monitoring includes air particulate sampling, gamma radiation measurements, and vegetation and soil sampling. Air particulate monitoring is conducted continuously at four monitoring stations located around the periphery of the mill. Gamma radiation measurements, vegetation sampling, and soil sampling are conducted at five locations. See Section 1.8 for details concerning the monitoring program.

Gamma radiation levels are determined at the five environmental monitoring stations and are reported quarterly, with duplicate samples collected at the nearest residence.

Approximately five pounds of "new growth" vegetation samples are collected from areas "northeast of the mill, northwest of the mill, and southwest of the mill" during early spring, late spring, and late fall. Sample collection areas vary depending on the growth year (i.e. in low or no moisture years it may take an area several acres in size to collect five pounds of vegetation, while in "wet" years a much smaller area is needed). Vegetation is analyzed for radium-226 and lead-210.

Soils are sampled at each of the five environmental monitoring stations annually in August. The soils are analyzed for U-natural and radium-226.

3.0 RECLAMATION PLAN

This section provides an overview of the mill location and property; details the facilities to be reclaimed; and describes the design criteria applied in this reclamation plan. Reclamation Plans and Specifications are presented in Attachment A. Attachment B presents the quality plan for construction activities. Attachment C presents cost estimates for reclamation. Attachments D through H present additional material test results and design calculations to support the Reclamation Plan.

3.1 Location and Property Description

The White Mesa Mill is located six miles south of Blanding, Utah on US Highway 191 on a parcel of land encompassing all or part of Sections 21, 22, 27, 28, 29, 32, and 33 of T37S, R22E, and Sections 4, 5, 6, 8, 9, and 16 of T38S, R22E, Salt Lake Base and Meridian described as follows (Figure 3.1-1):

> The south half of Section 21; the southeast quarter of the southeast quarter of Section 22; the northwest quarter of the northwest quarter and lots 1 and 4 of Section 27 all that part of the southwest quarter of the northwest quarter and the northwest quarter southwest quarter of Section 27 lying west of Utah State Highway 163; the northeast quarter of the northwest quarter, the south half of the northwest quarter, the northeast quarter and the south half of Section 28; the southeast quarter of the southeast quarter of Section 29; the east half of Section 32 and all of Section 33, Township 37 South, Range 22 East, Salt Lake Base and Meridian. Lots 1 through 4, inclusive, the south half of the north half, the southwest quarter, the west half of the southeast quarter, the west half of the east half of the southeast quarter and the west half of the east half of

the east half of the southeast quarter of Section 4; Lots 1 through 4, inclusive, the south half of the north half and the south half of Section 5 (all); Lots 1 and 2, the south half of the northeast quarter and the south half of Section 6 (E1/2); the northeast quarter of Section 8; all of Section 9 and all of Section 16, Township 38 South, Range 22 East, Salt Lake Base and Meridian. Containing approximately 4,871 acres.

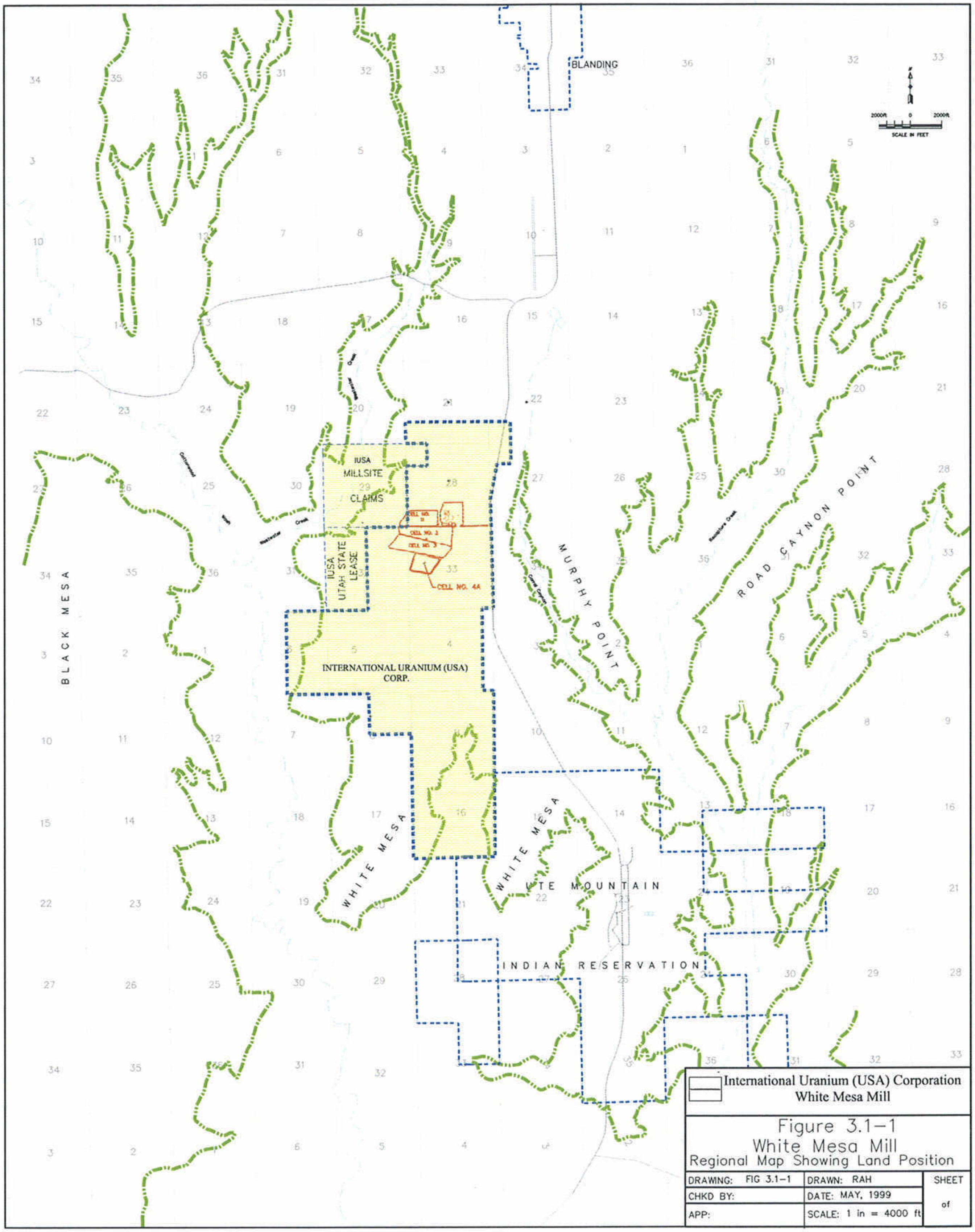


Figure 3.1–1
White Mesa Mill
Regional Map Showing Land Position

DRAWING: FIG 3.1–1	DRAWN: RAH	SHEET
CHKD BY:	DATE: MAY, 1999	of
APP:	SCALE: 1 in = 4000 ft	

3.2 Facilities to be Reclaimed

See Figure 3.2-1 for a general layout of the mill yard and related facilities and the restricted area boundary.

3.2.1 Summary of Facilities to be Reclaimed

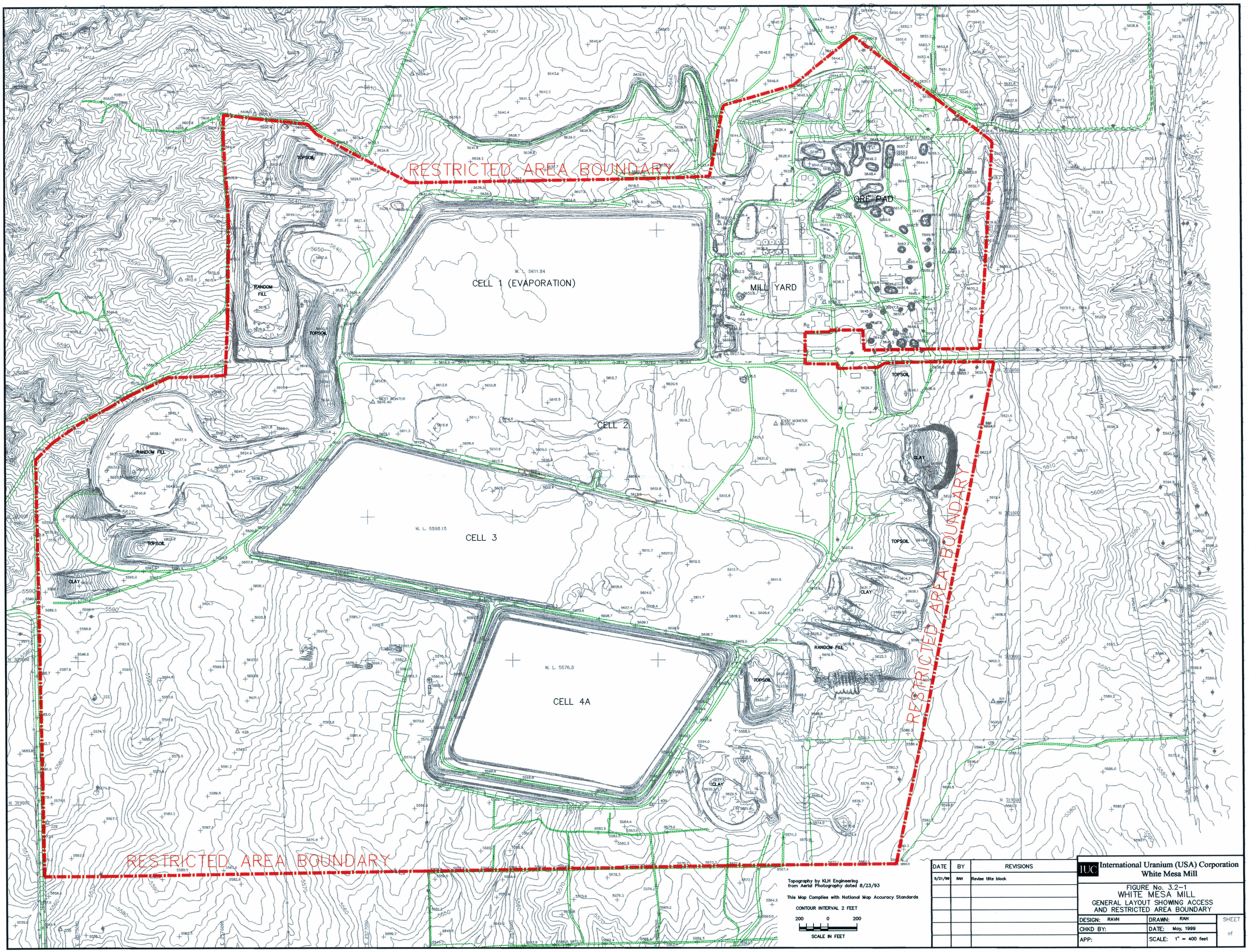
The facilities to be reclaimed include the following:

- Cell 1 (evaporative), Cells 2 and 3 (tailings) and Cell 4A (not currently used).
- Mill buildings and equipment.
- On-site contaminated areas.
- Off-site contaminated areas (i.e., potential areas affected by windblown tailings).

The reclamation of the above facilities will include the following:

- Placement of materials and debris from mill decommissioning in tailings Cells 1, 2 or 3.
- Placement of contaminated soils, crystals, and synthetic liner material from Cell 1 in tailings Cells 2 and 3.
- Placement of contaminated soils, crystals and synthetic liner material from Cell 4A in tailings Cells 2 and 3.
- Placement of a compacted clay liner on a portion of the Cell 1 impoundment area to be used for disposal of contaminated materials and debris from the mill site decommissioning. (the Cell 1-I Tailings Area)
- Placement of an engineered multi-layer cover on the Cell 1-I Tailings Area, and over the entire area of Cells 2 and 3.

- Construction of runoff control and diversion channels as necessary.
- Reconditioning of mill and ancillary areas.
- Reclamation of borrow sources.



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5/21/99	RAH	Revise title block

IUC International Uranium (USA) Corporation
White Mesa Mill

FIGURE No. 3.2-1
WHITE MESA MILL
GENERAL LAYOUT SHOWING ACCESS AND RESTRICTED AREA BOUNDARY

DESIGN: RAH	DRAWN: RAH	SHEET
CHKD BY:	DATE: May, 1999	of
APP:	SCALE: 1" = 400 feet	

3.2.2 Tailings and Evaporative Cells

The following subsections describe the cover design and reclamation procedures for Cells1-I, 2, 3, and 4A. Complete engineering details and text are presented in the Tailings Cover Design report, Appendix D, previously submitted. Additional information is provided in Attachments D, E and F to this submittal.

3.2.2.1 Soil Cover Design

A six-foot thick soil cover for the uranium tailings and mill decommissioning materials in the Cell 1-I Tailings Area, Cell 2 and Cell 3 was designed using on-site materials that will contain tailings and radon emissions in compliance with regulations of the United States Nuclear Regulatory Commission ("NRC") and by reference, the Environmental Protection Agency ("EPA"). The cover consists of a one-foot thick layer of clay, available from within the site boundaries (Section 16), below two feet of random fill (frost barrier), available from stockpiles on site. The clay is underlain by three feet (minimum) random fill soil (platform fill), also available on site. In addition to the soil cover, a minimum three-inch (on the cover top) to 8-inch (on the cover slopes) layer of riprap material will be placed over the compacted random fill to stabilize slopes and provide long-term erosion resistance (see Attachments D and H for characterization of cover materials).

Uranium tailings soil cover design requirements for regulatory compliance include:

- Attenuate radon flux to an acceptable level (20 picoCuries-per meter squared-per second [pCi/m^2/sec]) (NRC, 1989);
- Minimize infiltration into the reclaimed tailings cells;

- Maintain a design life of up to 1,000 years or to the extent reasonably achievable, and in any case for at least 200 years; and
- Provide long-term slope stability and geomorphic durability to withstand erosional forces of wind, the probable maximum flood event, and a horizontal ground acceleration of 0.1g due to seismic events.

Several models/analyses were utilized in simulating the soil cover effectiveness: radon flux attenuation, hydrologic evaluation of infiltration, freeze/thaw effects, soil cover erosion protection, and static and pseudostatic slope stability analyses. These analyses and results are discussed in detail in Sections 3.3.1 through 3.3.5, and calculations are also shown in the Tailings Cover Design report, (Appendix D, Attachment E and Attachment F). The soil cover (from top to the bottom) will consist of: (1) minimum of three inches of riprap material; (2) two feet of compacted random fill; (3) one foot of compacted clay; and (4) minimum three feet of compacted random fill soil.

The final grading plan is presented in Section 5, Figure 5.1-1. As indicated on the figures, the top slope of the soil cover will be constructed at 0.2 percent and the side slopes, as well as transitional areas between cells, will be graded to five horizontal to one vertical (5H:1V).

A minimum of three feet random fill is located beneath the compacted fill and clay layers (see cross-sections on Figures 5.1-2 and 5.1-3). The purpose of the fill is to raise the base of the cover to the desired subgrade elevation. In many areas, the required fill thickness will be much greater. However, the models and analyses presented in the Tailings Cover Design report (Appendix D) were performed conservatively, assuming only a three-foot layer. For modeling purposes, this lower, random fill layer was considered as part of the soil cover for performing the radon flux attenuation calculation, as it effectively contributes to the reduction of radon emissions (see Section 3.3.1). The fill was also evaluated in the slope stability analysis (see Section 3.3.6). However, it is not defined as part of the soil cover for other design calculations (infiltration, freeze/thaw, and cover erosion).

3.2.2.2 Cell 1-I

Cell 1-I, used during mill operations solely for evaporation of process liquids, is the northernmost existing cell and is located immediately west of the mill. It is also the highest cell in elevation, as the natural topography slopes to the south. The drainage area above and including the cell is 216 acres. This includes drainage from the mill site.

Cell 1-I will be evaporated to dryness. The synthetic liner and raffinate crystals will then be removed and placed in tailings Cells 2 or 3. Any contaminated soils below the liner will be removed and also placed in the tailings cells. Based on current regulatory criteria, the current plan calls for excavation of the residual radioactive materials to be designed to ensure that the concentration of radium-226 in land averaged over any area of 100 square meters does not exceed the background level by more than:

- 5 pCi/g, averaged over the first 15 cm of soil below the surface, and
- 15 pCi/g, averaged over a 15 cm thick layer of soil more than 15 cm below the surface.

A portion of Cell 1-I, adjacent to and running parallel to the downstream cell dike, will be used for permanent disposal of contaminated materials and debris from the mill site decommissioning and windblown cleanup. The actual area of Cell 1-I needed for storage of additional material will depend on the status of Cell 2 and 3 at the time of final mill decommissioning. A portion of the mill area decommissioning material may be placed in Cell 2 or 3 if space is availible, but for purposes of the reclamation design the entire quantity of contaminated materials from the mill site decommissioning is assumed to be placed in Cell 1-I. This results in approximately 10 acres of the Cell 1-I area being utilized for permanent tailings storage. This area is refered to as the Cell 1-I Tailings Area. Cell 1-I will then be breached and converted to a sedimentation basin. All runoff from the Cell 1-I Tailings Area, the mill area and the area immediately north of Cell 1-I will be routed into the sedimentation basin and will discharge onto the natural ground via the channel located at the southwest corner of the basin. The channel is designed to accommodate the PMF flood.

The HEC-1 model was used to determine the PMF and route the flood through the sedimentation basin (Attachment G). The peak flow was determined to be 1,344 cubic feet per second (cfs). A 20-foot wide channel will discharge the flow to the natural drainage. During the local storm PMF event, the maximum discharge through the channel will be 1,344 cfs. The entire flood volume will pass through the discharge channel in approximately four hours.

At peak flow, the velocity in the discharge channel will be 7.45 feet per second (fps). The maximum flow depth will be 1.45 feet. This will be a bedrock channel and the allowable velocity for a channel of this type is 8-10 fps, therefore no riprap is required. A free board depth of 0.5 feet will be maintained for the PMP event.

3.2.2.3 Cell 2

Cell 2 will be filled with tailings and covered with a multi-layered engineered cover to a minimum cover thickness of six feet. The final cover will drain to the south at a 0.2 percent gradient.

The cover will consist of a minimum of three feet of random fill (platform fill), followed by a clay radon barrier of one foot in thickness, and two feet of upper random fill (frost barrier) for protection of the radon barrier. A minimum of three inches of rock will be utilized as armor against erosion. Side slopes will be graded to a 5:1 slope and will have 0.67 feet (8 inches) of rock armor protection.

3.2.2.4 Cell 3

Cell 3 will be filled with tailings, debris and contaminated soils and covered with the same multi-layered engineered cover as Cell 2.

3.2.2.5 Cell 4A

Cell 4A will be evaporated to dryness and the crystals, synthetic liner and any contaminated soils placed in tailings. Non-contaminated materials in cell 4A dikes will be used to reduce the southern slopes of Cell 3 from the current 3:1 to 5:1. A 200 foot wide breach and bedrock channel will allow drainage of the precipitation which falls in the Cell area and from reclaimed areas above Cell area (See Attachment G, Figure A-5.1-1, and Sections D and E).

3.2.3 Mill Decommissioning

A general layout of the mill area is shown in Figure 3.2.3-1.

3.2.3.1 Mill Building and Equipment

The uranium and vanadium sections, including ore reclaim, grinding, pre-leach, leach, CCD, SX, and precipitation and drying circuits will be decommissioned as follows:

All equipment including instrumentation, process piping, electrical control and switchgear, and contaminated structures will be removed. Contaminated concrete foundations will be demolished and removed or covered with soil as required. Uncontaminated equipment, structures and waste materials from mill decommissioning may be disposed of by sale, transferred to other company-owned facilities, transferred to an appropriate off-site solid waste site, or disposed of in one of the tailings cells. Contaminated equipment, structures and waste materials from mill decommissioning, contaminated soils underlying the mill areas, and ancillary contaminated materials will be disposed of in tailings Cell 2, Cell 3, or the Cell 1-I Tailings Area.

Debris and scrap will have a maximum dimension of 20 feet and a maximum volume of 30 cubic feet. Material exceeding these limits will be reduced to within the acceptable limits by breaking, cutting or other approved methods. Empty drums, tanks or other objects having a hollow volume greater than five cubic feet will be reduced in volume by at least 70 percent. If volume reduction is not feasible, openings shall be made in the object to allow soils or other approved material to enter the object.

Debris and scrap will be spread across the designated areas to avoid nesting and to reduce the volume of voids present in the placed mass. Stockpiled soils, and/or other approved material shall be placed over and into the scrap in sufficient amounts to fill the voids between the large pieces and the volume within the hollow pieces to form a coherent mass.

50 0 50 100

SCALE 1" = 100'
CONTOUR INTERVAL 5 feet

Topography by Intermountain Technical Services Inc. from aerial photography dated: May 14, 1991

Figure 3.2.3–1

IUC International Uranium (USA) Corp. White Mesa Mill		
WHITE MESA MILL SITE MAP SHOWING LOCATIONS OF BUILDINGS AND TANKAGE		
DESIGN:	DRAWN: R Van Horn	SHEET
CHKD BY:	DATE: 11/27/94	of
APP:	SCALE:	

JN 91027

3.2.3.2 Mill Site

Contaminated areas on the mill site will be primarily superficial and includes the ore storage area and surface contamination of some roads. All ore will have been previously removed from the ore stockpile area. All contaminated materials will be excavated and be disposed in one of the tailings cells. The depth of excavation will vary depending on the extent of contamination and will be governed by the criteria in Attachment A, Section 3.2.

Windblown material is defined as mill-derived contaminants dispersed by wind to surrounding areas. Windblown contaminated material detected by a gamma survey using the criteria in Attachment A, Section 3.2, will be excavated and disposed in one of the tailings cells.

Disturbed areas will be covered, graded and vegetated as required. The proposed grading plan for the mill site and ancillary areas is shown on Figure A-3.2-1 in Attachment A.

3.3 Design Criteria

The design criteria summaries in this section are adapted from Tailings Cover Design, White Mesa Mill (Titan, 1996). A copy of the Tailings Cover Design report is included as Appendix D, previously submitted. It contains all of the calculations used in design discussed in this section. Additional design information is included in Attachments D through H to this submittal.

3.3.1 Regulatory Criteria

Information contained in 10 CFR Part 20, Appendix A, 10 CFR Part 40, and 40 CFR Part 192 was used as criteria in final designs under this reclamation plan. In addition, the following documents also provided guidance:

- Environmental Protection Agency (EPA), 1994, "The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3," EPA/600/R-94/168b, September.
- Nuclear Regulatory Commission (NRC), 1989, "Regulatory Guide 3.64 (Task WM-503-4) Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers," March.
- NRC, 1980, "Final Staff Technical Position Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites," August.
- NUREG/CR-4620, Nelson, J. D., Abt, S. R., et. al., 1986, "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments," June.
- NUREG/CR-4651, 1987, "Development of Riprap Design Criteria by Riprap Testing in Flumes: Phase 1," May.
- U. S. Department of Energy, 1988, "Effect of Freezing and Thawing on UMTRA Covers," Albuquerque, New Mexico, October.

3.3.2 Radon Flux Attenuation

The Environmental Protection Agency (EPA) rules in 40 Code of Federal Regulation (CFR) Part 192 require that a "uranium tailings cover be designed to produce reasonable assurance that the radon-222 release rate would not exceed 20 pCi/m^2/sec for a period of 1,000 years to the extent reasonably achievable and in any case for at least 200 years when averaged over the disposal area over at least a one year period" (NRC, 1989). NRC regulations presented in 10 CFR Part 40 also restrict radon flux to less than 20 pCi/m^2/sec. The following sections present the analyses and design for a soil cover which meets this requirement.

3.3.2.1 Predictive Analysis

The soil cover for the tailings cells at White Mesa Mill was evaluated for attenuation of radon gas using the digital computer program, RADON, presented in the NRC's Regulatory Guide 3.64 (Task

WM 503-4) entitled "Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers." The RADON model calculates radon-222 flux attenuation by multi-layered earthen uranium mill tailings covers, and determines the minimum cover thickness required to meet NRC and EPA standards. The RADON model uses the following soil properties in the calculation process:

- Soil layer thickness [centimeters (cm)];
- Soil porosity (percent);
- Density [grams-per-cubic centimeter (gm/cm^3)];
- Weight percent moisture (percent);
- Radium activity (piC/g);
- Radon emanation coefficient (unitless); and
- Diffusion coefficient [square centimeters-per-second (cm^2/sec)].

Physical and radiological properties for tailings and random fill were analyzed by Chen and Associates (1987) and Rogers and Associates (1988). Clay physical data from Section 16 was analyzed by Advanced Terra Testing (1996) and Rogers and Associates (1996). Additional testing of cover materials was performed in April 1999. The test results are included in Attachment D. See Appendix D, previously submitted, for additional laboratory test results.

The RADON model was performed for the following cover section (from top to bottom):

- two feet compacted random fill (frost barrier);
- one foot compacted clay; and
- a minimum of three feet random fill occupying the freeboard space between the tailings and clay layer (platform fill).

The top one foot of the lower random fill, clay layer and two foot upper random fill are compacted to 95 percent maximum dry density. The top riprap layer was not included as part of the soil cover for the radon attenuation calculation.

The most current RADON modeling is included in Attachment F.

The results of the RADON modeling exercise, based on two different compaction scenarios, show that the uranium tailings cover configuration will attenuate radon flux emanating from the tailings to a level of 18.2 to 19.8 $pCi/m^2/sec$. This number was conservatively calculated as it takes into account the freeze/thaw effect on the uppermost part (6.8 inches) of the cover (Section 3.3.4). The soil cover and tailing parameters used to run the RADON model, in addition to the RADON input and output data files, are presented in Appendix D as part of the Radon Calculation brief (See Appendix B in the Tailings Cover Design report, previously submitted in its entirety as Appendix D) and the most current model included as Attachment F to this submittal. Based on the model results, the soil cover design of six-foot thickness will meet the requirements of 40 CFR Part 192 and 10 CFR Part 40.

3.3.2.2 Empirical Data

Radon gas flux measurements have been made at the White Mesa Mill tailings piles over Cells 2 and 3 (see Appendix D). Currently these cells are partially covered with three to four feet of random fill. Radon flux measurements, averaged over the covered areas, were as follows (EFN 1994-1996, IUC 1997-1998):

	1994	1995	1996	1997	1998
Cell 2	7.7 $pCi/m^2/sec$	6.1 $pCi/m^2/sec$	14.2 pCi/m2/sec	7.4 pCi/m2/sec	9.8 pCi/m2/sec
Cell 3	7.5 $pCi/m^2/sec$	11.1 $pCi/m^2/sec$	22.4 $pCi/m^2/sec$	14.5 pCi/m2/sec	23.8 pCi/m2/sec

Empirical data suggest that the random fill cover, alone, is currently providing an effective barrier to radon flux. Thus, the proposed tailings cover configuration, which is thicker, moisture adjusted, contains a clay layer, and is compacted, is expected to attenuate the radon flux to a level below that predicted by the RADON model. The field radon flux measurements confirm the conservatism of the cover design. This conservatism is useful, however, to guarantee compliance with NRC regulations under long term climatic conditions over the required design life of 200 to 1,000 years.

3.3.3 Infiltration Analysis

The tailings ponds at White Mesa Mill are lined with synthetic geomembrane liners which under certain climatic conditions, could potentially lead to the long-term accumulation of water from infiltration of precipitation. Therefore, the soil cover was evaluated to estimate the potential magnitude of infiltration into the capped tailings ponds. The Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.0 (EPA, 1994) was used for the analysis. HELP is a quasi two-dimensional hydrologic model of water movement across, into, through, and out of capped and lined impoundments. The model utilizes weather, soil, and engineering design data as input to the model, to account for the effects of surface storage, snowmelt, run-off, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, and unsaturated vertical drainage on the specific design, at the specified location.

The soil cover was evaluated based on a two-foot compacted random fill layer over a one-foot thick, compacted clay layer. The soil cover layers were modeled based on material placement at a minimum of 95 percent of the maximum dry density, and within two percent of the optimum moisture content per American Society for Testing and Materials (ASTM) requirements. The top riprap layer and the bottom random fill layer were not included as part of the soil cover for infiltration calculations. These two layers are not playing any role in controlling the infiltration through the cover material.

The random fill will consist of clayey sands and silts with random amounts of gravel and rock-size materials. The average hydraulic conductivity of several samples of random fill was calculated, based on laboratory tests, to be 8.87 x 10^{-7} cm/sec. The hydraulic conductivity of the clay source from Section 16 was measured in the laboratory to be 3.7 x 10^{-8} cm/sec. Geotechnical soil properties and laboratory data are presented in Appendix D.

Key HELP model input parameters include:

- Blanding, Utah, monthly temperature and precipitation data, and HELP model default solar radiation, and evapotranspiration data from Grand Junction, Colorado. Grand Junction is located northeast of Blanding in similar climate and elevation;

- Soil cover configuration identifying the number of layers, layer types, layer thickness, and the total covered surface area;

- Individual layer material characteristics identifying saturated hydraulic conductivity, porosity, wilting point, field capacity, and percent moisture; and

- Soil Conservation Service runoff curve numbers, evaporative zone depth, maximum leaf area index, and anticipated vegetation quality.

Water balance results, as calculated by the HELP model, indicate that precipitation would either run-off the soil cover or be evaporated. Thus, model simulations predict zero infiltration of surface water through the soil cover, as designed. These model results are conservative and take into account the freeze/thaw effects on the uppermost part (6.8 inches) of the cover (See Section 1.3 of the Tailings Cover Design report, Appendix D). The HELP model input and output for the tailings soil cover are presented in the HELP Model calculation brief included in Appendix D.

3.3.4 Freeze/Thaw Evaluation

The tailings soil cover of one foot of compacted clay covered by two feet of random fill was evaluated for freeze/thaw impacts. Repeated freeze/thaw cycles have been shown to increase the bulk soil permeability by breaking down the compacted soil structure.

The soil cover was evaluated for freeze/thaw effects using the modified Berggren equation as presented in Aitken and Berg (1968) and recommended by the NRC (U.S. Department of Energy, 1988). This evaluation was based on the properties of the random fill and clay soil, and meteorological data from both Banding, Utah and Grand Junction, Colorado.

The results of the freeze/thaw evaluation indicate that the anticipated maximum depth of frost penetration on the soil cover would be less than 6.8 inches. Since the random fill layer is two feet thick, the frost depth would be confined to this layer and would not penetrate into the underlying clay layer. The performance of the soil cover to attenuate radon gas flux below the prescribed standards, and to prevent surface water infiltration, would not be compromised. The input data and results of the freeze/thaw evaluation are presented in the Effects of Freezing on Tailings Covers Calculation brief included as Appendix E in the Tailings Cover Design report, which was previously submitted as Appendix D.

3.3.5 Soil Cover Erosion Protection

A riprap layer was designed for erosion protection of the tailings soil cover. According to NRC guidance, the design must be adequate to protect the soil/tailings against exposure and erosion for 200 to 1,000 years (NRC, 1990). Currently, there is no standard industry practice for stabilizing tailings for 1,000 years. However, by treating the embankment slopes as wide channels, the hydraulic design principles and practices associated with channel design were used to design stable slopes that will not erode. Thus, a conservative design based on NRC guidelines was developed. Engineering details and calculations are summarized in the Erosion Protection Calculation brief provided in Appendix F in the Tailings Cover Design report, which was previously submitted as Appendix D.

Riprap cover specifications for the top and side slopes were determined separately as the side slopes are much steeper than the slope of the top of the cover. The size and thickness of the riprap on the top of the cover was calculated using the Safety Factor Method (NUREG/CR-4651, 1987), while the Stephenson Method (NUREG/CR-4651, 1987) was used for the side slopes. These methodologies were chosen based on NRC recommendations (1990).

By the Safety Factor Method, riprap dimensions for the top slope were calculated in order to achieve a slope "safety factor" of 1.1. For the top of the soil cover, with a slope of 0.2 percent, the Safety Factor Method indicated a median diameter (D_{50}) riprap of 0.28 inches is required to stabilize the top slope. However, this dimension must be modified based on the long-term durability of the specific rock type to be used in construction. The suitability of rock to be used as a protective cover has been assessed by laboratory tests to determine the physical characteristics of the rocks (See Attachment H). The North pit source has an over sizing factor of 9.85%. The riprap sourced from this pit should have a D50 size of at least 0.31 inches and should have an overall layer thickness of at least three inches on the top of the cover.

Riprap dimensions for the side slopes were calculated using Stephenson Method equations. The side slopes of the cover are designed at 5H:1V. At this slope, Stephenson's Method indicated the unmodified riprap D_{50} of 3.24 inches is required. Again, assuming that the North pit material will be used, the modified D_{50} size of the riprap should be at least 3.54 inches with an overall layer thickness of at least 8 inches.

The potential of erosion damage due to overland flow, sheetflow, and channel scouring on the top and side slopes of the cover, including the riprap layer, has been evaluated. Overland flow calculations were performed using site meteorological data, cap design specifications, and guidelines set by the NRC (NUREG/CR-4620, 1986). These calculations are included in Appendix F of the Tailings Cover Design report (Appendix D previously submitted). According to the guidelines, overland flow velocity estimates are to be compared to "permissible velocities," which have been suggested by the NRC, to determine the potential for erosion damage. When calculated, overland flow velocity estimates exceed permissible velocities, additional cover protection should be considered. The permissible velocity for the tailings cover (including the riprap layer) is 5.0 to 6.0 feet-per-second (ft./sec.) (NUREG/CR-4620). The overland flow velocity calculated for the top of the cover is less than 2.0 ft./sec., and the calculated velocity on the side slopes is 4.9 ft./sec. A rock apron will be constructed at the toe of high slopes and in areas where runoff might be concentrated (See Figure A-5.1-4). The design of the rock aprons is detailed in Attachment G.

3.3.6 Slope Stability Analysis

Static and pseudostatic analyses were performed to establish the stability of the side slopes of the tailings soil cover. The side slopes are designed at an angle of 5H:1V. Because the side slope along the southern section of Cell 4A is the longest and the ground elevation drops rapidly at its base, this slope was determined to be critical and is thus the focus of the stability analyses.

The computer software package GSLOPE, developed by MITRE Software Corporation, has been used for these analyses to determine the potential for slope failure. GSLOPE applies Bishop's Method of slices to identify the critical failure surface and calculate a factor of safety (FOS). The slope geometry and properties of the construction materials and bedrock are input into the model.

These data and drawings are included in the Stability Analysis of Side Slopes Calculation brief included in Appendix G of the Tailings Cover Design report. For this analysis, competent bedrock is designated at 10 feet below the lowest point of the foundation [i.e., at a 5,540-foot elevation above mean sea level (msl)]. This is a conservative estimate, based on the borehole logs supplied by Chen and Associates (1979), which indicate bedrock near the surface.

3.3.6.1 Static Analysis

For the static analysis, a Factor of Safety ("FOS") of 1.5 or more was used to indicate an acceptable level of stability. The calculated FOS is 2.91, which indicates that the slope should be stable under static conditions. Results of the computer model simulations are included in Appendix G of the Tailings Cover Design report.

3.3.6.2 Pseudostatic Analysis (Seismicity)

The slope stability analysis described above was repeated under pseudostatic conditions in order to estimate a FOS for the slope when a horizontal ground acceleration of 0.10g is applied. The slope geometry and material properties used in this analysis are identical to those used in the stability analysis. A FOS of 1.0 or more was used to indicate an acceptable level of stability under pseudostatic conditions. The calculated FOS is 1.903, which indicates that the slope should be stable under dynamic conditions. Details of the analysis and the simulation results are included in Appendix G of the Tailings Cover Design report.

In June of 1994, Lawrence Livermore National Laboratory ("LLNL") published a report entitled Seismic Hazard Analysis of Title II Reclamation Plans, (Lawrence Livermore National Laboratory, 1994) which included a section on seismic activity in southern Utah. In the LLNL report, a horizontal ground acceleration of 0.12g was proposed for the White Mesa site. The evaluations made by LLNL were conservative to account for tectonically active regions that exist, for example, near Moab, Utah. Although, the LLNL report states that "...[Blanding] is located in a region known for its scarcity of recorded seismic events," the stability of the cap design slopes using the LLNL factor was evaluated. The results of a sensitivity analysis reveal that when considering a horizontal ground acceleration of 0.12g, the calculated FOS is 1.778 which is still above the required value of 1.0, indicating adequate safety under pseudostatic conditions. This analysis is also included in Appendix G of the Tailings Cover Design report. A probabilistic seismic risk analysis (See Attachment E) was performed in April 1999 during an evaluation of cover stability.

3.3.7 Soil Cover-Animal Intrusion

To date, the White Mesa site has experienced only minor problems with burrowing animals. In the long term, no measures short of continual annihilation of target animals can prevent burrowing. However, reasonable measures will discourage burrowing including :

- Total cover thickness of at least six-feet;
- Compaction of the upper three feet of soil cover materials to a minimum of 95 percent, and the lower three feet to 80-90 percent, based on a standard Proctor (ASTM D-698); and
- Riprap placed over the compacted random fill material.

3.3.8 Cover Material/Cover Material Volumes

Construction materials for reclamation will be obtained from on-site locations. Fill material will be available from the stockpiles that were generated from excavation of the cells for the tailings facility. If required, additional materials are available locally to the west of the site. A clay material source, identified in Section 16 at the southern end of the White Mesa Mill site, will be used to construct the one-foot compacted clay layer. Riprap material will be produced from off-site sources.

Detailed material quantities calculations are provided in Attachment C, Cost Estimates for Reclamation of White Mesa Mill Facilities, as part of the volume and costing exercise.

ATTACHMENT A

PLANS AND SPECIFICATIONS

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

INDEPENDENCE PLAZA

1050 17TH STREET, SUITE 950

DENVER, CO 80265

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1.0 GENERAL

The specifications presented in this section cover the reclamation of the White Mesa Mill facilities.

2.0 CELL 1-I RECLAMATION

2.1 Scope

The reclamation of Cell 1-I consists of evaporating the cell to dryness, removing raffinate crystals, synthetic liner and any contaminated soils, and constructing a clay lined area adjacent to and parallel with the existing Cell 1-I dike for permanent disposal of contaminated material and debris from the mill site decommissioning, refered to as the Cell 1-I Tailings Area. A sedimentation basin will then be constructed and a drainage channel provided.

2.2 Removal of Contaminated Materials

2.2.1 Raffinate Crystals

Raffinate crystals will be removed from Cell 1-I and transported to the tailings cells. It is anticipated that the crystals will have a consistency similar to a granular material when brought to the cells, with large crystal masses being broken down for transport. Placement of the crystals will be performed as a granular fill, with care being taken to avoid nesting of large sized material. Voids around large material will be filled with finer material or the crystal mass broken down by the placing equipment. Actual placement procedures will be evaluated by the QC officer during construction as crystal materials are brought and placed in the cells.

2.2.2 Synthetic Liner

The PVC liner will be cut up, folded (when necessary), removed from Cell 1-I, and transported to the tailings cells. The liner material will be spread as flat as practical over the designated area. After placement, the liner will be covered as soon as possible with at least one foot of soil, crystals or other materials for protection against wind, as approved by the QC officer.

2.2.3 Contaminated Soils

The extent of contamination of the mill site will be determined by a scintillometer survey. If necessary, a correlation between scintillometer readings and U-nat/Radium-226 concentrations will be developed. Scintillometer readings can then be used to define cleanup areas and to monitor the cleanup. Soil sampling will be conducted to confirm that the cleanup results in a concentration of Radium-226 averaged over any area of 100 square meters that does not exceed the background level by more than:

- 5 pCi/g averaged over the first 15 cm of soils below the surface, and
- 15 pCi/g averaged over a 15 cm thick layer of soils more than 15 cm below the surface

Where surveys indicate the above criteria have not been achieved, the soil will be removed to meet the criteria. Soil removed from Cell 1-I will be excavated and transported to the tailings cells. Placement and compaction will be in accordance with Section 4.0 of these Plans and Specifications.

2.3 Cell 1-I Tailings Area

2.3.1 General

A clay lined area will be constructed adjacent to and parallel with the existing Cell 1-I dike for permanent disposal of contaminated material and debris from the mill site decommissioning (the Cell 1-I Tailings Area). The area will be lined with 12 inches of clay prior to placement of contaminated materials and installation of the final reclamation cap.

2.3.2 Materials

Clays will have at least 40 percent passing the No. 200 sieve. The minimum liquid limit of these soils will be 25 and the plasticity index will be 15 or greater. These soils will classify as CL, SC or CH materials under the Unified Soil Classification System.

2.3.3 Borrow Sources

Clay will be obtaned from suitable materials stockpiled on site during cell construction or will be imported from borrow areas located in Section 16, T38S, R22E, SLM.

2.4 Liner Construction

2.4.1 General

Placement of clay liner materials will be based on a schedule determined by the availability of contaminated materials removed from the mill decommissioning area in order to maintain optimum moisture content of the clay liner prior to placing of contaminated materials

2.4.2 Placement and Compaction

2.4.2.1 Methods

Placement of fill will be monitored by a qualified individual with the authority to stop work and reject material being placed. The full 12 inches of the clay liner fill will be compacted to 95% maximum dry density per ASTM D 698.

In all layers of the clay liner will be such that the liner will, as far as practicable, be free of lenses, pockets, streaks or layers of material differing substantially in texture, gradation or moisture content from the surrounding material. Oversized material will be controlled through selective excavation of stockpiled material, observation of placement by a qualified individual with authority to stop work and reject material being placed and by culling oversized material from the fill.

If the moisture content of any layer of clay liner is outside of the Allowable Placement Moisture Content specified in Table A-5.3.2.1-1, it will be moistened and/or reworked with a harrow, scarifier, or other suitable equipment to a sufficient depth to provide relatively uniform moisture content and a satisfactory bonding surface before the next succeeding layer of clay material is placed. If the compacted surface of any layer of clay liner material is too wet, due to precipitation, for proper compaction of the earthfill material to be placed thereon, it will be reworked with harrow, scarifier or other suitable equipment to reduce the moisture content to the required level shown in Table A-5.3.2.1-1. It will then be recompacted to the earthfill requirements.

No clay material will be placed when either the materials, or the underlying material, is frozen or when ambient temperatures do not permit the placement or compaction of the materials to the specified density, without developing frost lenses in the fill.

2.4.2.2 Moisture and Density Control

As far as practicable, the materials will be brought to the proper moisture content before placement, or moisture will be added to the material by sprinkling on the fill. Each layer of the fill will be conditioned so that the moisture content is uniform throughout the layer prior to and during compaction. The moisture content of the compacted liner material will be within the limits of standard optimum moisture content as shown in Table A-5.3.2.1-1. Material that is too dry or too wet to permit bonding of layers during compaction will be rejected and will be reworked until the moisture content is within the specified limits. Reworking may include removal, re-harrowing, reconditioning, rerolling, or combinations of these procedures.

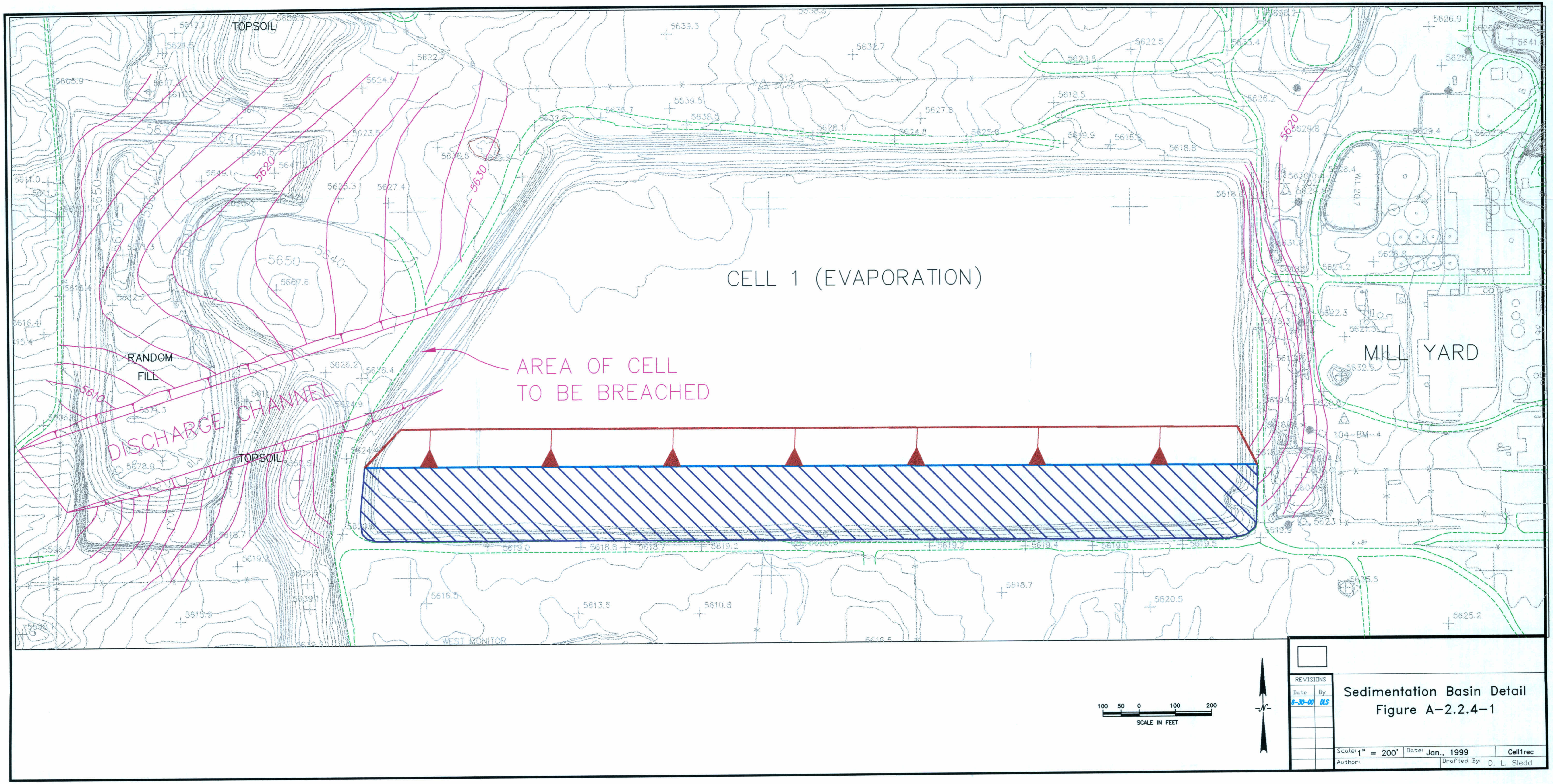
Density control of compacted clay will be such that the compacted material represented by samples having a dry density less than the values shown in Table A-5.3.2.1-1 will be rejected. Such rejected material will be reworked as necessary and rerolled until a dry density equal to or greater than the percent of its standard Proctor maximum density shown in Table A-5.3.2.1-1.

To determine that the moisture content and dry density requirements of the compacted liner material are being met, field and laboratory tests will be made at specified intervals taken from the compacted fills as specified in Section 7.4, "Frequency of Quality Control Tests."

2.5 Sedimentation Basin

Cell 1-I will then be breached and constructed as a sedimentation basin. All runoff from the mill area and immediately north of the cell will be routed into the sedimentation basin and will discharge onto the natural ground via the channel located at the southwest corner of the basin. The channel is designed to accommodate the PMF flood.

A sedimentation basin will be constructed in Cell 1-I as shown in Figure A-2.2.4-1. Grading will be performed to promote drainage and proper functioning of the basin. The drainage channel out of the sedimentation basin will be constructed to the lines and grades as shown.



TOPSOIL
RANDOM FILL
DISCHARGE CHANNEL
TOPSOIL
CELL 1 (EVAPORATION)
AREA OF CELL TO BE BREACHED
MILL YARD
104-BM-4
WEST MONITOR
100 50 0 100 200
SCALE IN FEET
REVISIONS
Date By
6-30-00 DLS
Sedimentation Basin Detail
Figure A-2.2.4-1
Scale: 1" = 200'
Date: Jan., 1999
Cell1rec
Author:
Drafted By: D. L. Sledd

3.0 MILL DECOMMISSIONING

The following subsections detail decommissioning plans for the mill buildings and equipment; the mill site; and windblown contamination.

3.1 Mill

The uranium and vanadium processing areas of the mill, including all equipment, structures and support facilities, will be decommissioned and disposed of in tailings or buried on site as appropriate. All equipment, including tankage and piping, agitation equipment, process control instrumentation and switchgear, and contaminated structures will be cut up, removed and buried in tailings prior to final cover placement. Concrete structures and foundations will be demolished and removed or covered with soil as appropriate. These decommissioned areas would include, but not be limited to the following:

- Coarse ore bin and associated equipment, conveyors and structures.
- Grind circuit including semi-autogeneous grind (SAG) mill, screens, pumps and cyclones.
- The three preleach tanks to the east of the mill building, including all tankage, agitation equipment, pumps and piping.
- The seven leach tanks inside the main mill building, including all agitation equipment, pumps and piping.
- The counter-current decantation (CCD) circuit including all thickeners and equipment, pumps and piping.
- Uranium precipitation circuit, including all thickeners, pumps and piping.

- The two yellow cake dryers and all mechanical and electrical support equipment, including uranium packaging equipment.
- The clarifiers to the west of the mill building including the preleach thickener (PLT) and claricone.
- The boiler and all ancillary equipment and buildings.
- The entire vanadium precipitation, drying and fusion circuit.
- All external tankage not included in the previous list including reagent tanks for the storage of acid, ammonia, kerosene, water, dry chemicals, etc. and the vanadium oxidation circuit.
- The uranium and vanadium solvent extraction (SX) circuit including all SX and reagent tankage, mixers and settlers, pumps and piping.
- The SX building.
- The mill building.
- The office building.
- The shop and warehouse building.
- The sample plant building.

The sequence of demolition would proceed so as to allow the maximum use of support areas of the facility such as the office and shop areas. It is anticipated that all major structures and large equipment will be demolished with the use of hydraulic shears. These will speed the process, provide proper sizing of the materials to be placed in tailings, and reduce exposure to radiation and other safety hazards during the demolition. Any uncontaminated or decontaminated equipment to be considered for salvage will be released in accordance with the terms of Source Material License Condition 9.10. As with the equipment for disposal, any contaminated soils from the mill area will be disposed of in the tailings facilities in accordance with Section 4.0 of the Specifications.

3.2 Mill Site

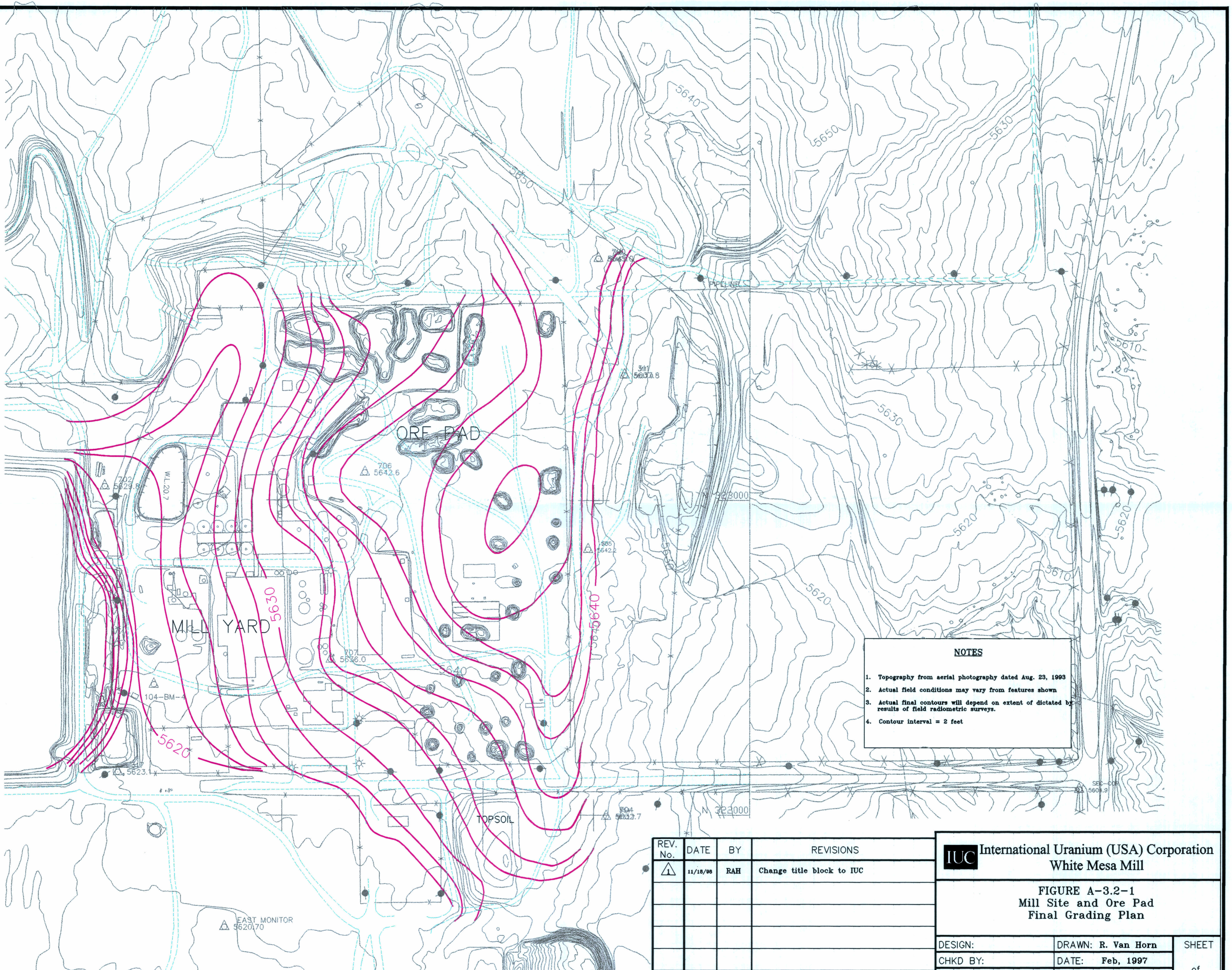
Contaminated areas on the mill site will be primarily superficial and include the ore storage area and surface contamination of some roads. All ore will have been previously removed from the ore stockpile area. All contaminated materials will be excavated and be disposed in one of the tailings cells in accordance with Section 4.0 of these Plans and Specifications. The depth of excavation will vary depending on the extent of contamination and will be based on the criteria in Section 2.2.3 of these Plans and Specifications.

All ancillary contaminated materials including pipelines will be removed and will be disposed of by disposal in the tailing cells in accordance with Section 4.0 of these Plans and Specifications.

Disturbed areas will be covered, graded and vegetated as required. The proposed grading plan for the mill site and ancillary areas is shown on Figure A-3.2-1.

3.3 Windblown Contamination

Windblown contamination is defined as mill derived contaminants dispersed by the wind to surrounding areas. The potential areas affected by windblown contamination will be surveyed using scintillometers taking into account historical operational data from the Semi-annual Effluent Reports and other guidance such as prevailing wind direction and historical background data. Areas covered by the existing Mill facilities and ore storage pad, the tailings cells and adjacent stockpiles of random fill, clay and topsoil, will be excluded from the survey. Materials from these areas will be removed in conjunction with final reclamation and decommissioning of the Mill and tailings cells.



NOTES

1. Topography from aerial photography dated Aug. 23, 1993
2. Actual field conditions may vary from features shown
3. Actual final contours will depend on extent of dictated by results of field radiometric surveys.
4. Contour interval = 2 feet

REV. No.	DATE	BY	REVISIONS
1	11/18/98	RAH	Change title block to IUC

IUC International Uranium (USA) Corporation
White Mesa Mill

FIGURE A–3.2–1
Mill Site and Ore Pad
Final Grading Plan

DESIGN:	DRAWN: R. Van Horn	SHEET
CHKD BY:	DATE: Feb, 1997	of
APP:	SCALE: 1" = 200'	

3.3.1 Guidance

The necessity for remedial actions will be based upon an evaluation prepared by IUC, and approved by the NRC, of the potential health hazard presented by any windblown materials identified. The assessment will be based upon analysis of all pertinent radiometric and past land use information and will consider the feasibility, cost-effectiveness, and environmental impact of the proposed remedial activities and final land use. All methods utilized will be consistent with the guidance contained in NUREG-5849: "Manual for Conducting Radiological Surveys in Support of License Termination."

3.3.2 General Methodology

The facility currently monitors soils for the presence of Ra-226, Th-230 and natural uranium, such results being presented in the second semi-annual effluent report for each year. Guideline values for these materials will be determined and will form the basis for the cleanup of the White Mesa Mill site and surrounding areas. For purposes of determining possible windblown contamination, areas used for processing of uranium ores as well as the tailings and evaporative facilities will be excluded from the initial scoping survey, due to their proximity to the uranium recovery operations. Those areas include:

- The mill building, including CCD, Pre-Leach Thickener area, uranium drying and packaging, clarifying, and preleach.
- The SX building, including reagent storage immediately to the east of the SX building.
- The ore pad and ore feed areas.
- Tailings Cells No. 2, 3, and 4A.
- Evaporative cell No. 1-I.

The remaining areas of the mill will be divided up into two areas for purposes of windblown determinations:

- The restricted area, less the above areas; and,
- A halo around the restricted area.

Areas within the restricted area, as shown on Figure 3.2-1 will be initially surveyed on a 30 x 30 meter grid as described below in Section 3.3.3. The halo around the suspected area of contamination will also be initially surveyed on a 50 x 50 meter grid using methodologies described below in Section 3.3.3. Any areas which are found to have elevated activity levels will be further evaluated as described in Sections 3.3.4 and 3.3.5. Initial surveys of the areas surrounding the Mill and tailings area have indicated potential windblown contamination only to the north and east of the Mill ore storage area, and to the southwest of Cell 3, as indicated on Figure 3.2-1.

3.3.3 Scoping Survey

Areas contaminated through process activities or windblown contamination from the tailings areas will be remediated to meet applicable cleanup criteria for Ra-226, Th-230 and natural uranium. Contaminated areas will be remediated such that the residual radionuclides remaining on the site, that are distinguishable from background, will not result in a dose that is greater than that which would result from the radium soil standard (5 pCi/gram above background).

Soil cleanup verification will be accomplished by use of several calibrated beta/gamma instruments. Multiple instruments will be maintained and calibrated to ensure availability during Remediation efforts.

Initial soil samples will be chemically analyzed to determine on-site correlation between the gamma readings and the concentration of radium, thorium and uranium, in the samples. Samples will be taken from areas known to be contaminated with only processed uranium materials (i.e. tailings sand and windblown contamination) and areas in which it is suspected that unprocessed uranium materials (i.e. ore pad and windblown areas downwind of the ore pad) are present. The actual number of samples used will depend on the correlation of the results between gamma readings and the Ra-226 concentration. A minimum of 35 samples of windblown tailings material, and 15 samples of unprocessed ore materials is proposed. Adequate samples will be taken to ensure that graphs can be developed to adequately project the linear regression lines and the calculated upper and lower 95 percent confidence levels for each of the instruments. The 95 percent confidence limit will be used for the guideline value for correlation between gamma readings and radium concentration. Because the unprocessed materials are expected to have proportionally higher values of uranium in relation to the radium and thorium content, the correlation to the beta/gamma readings are expected to be different than readings from areas known to be contaminated with only processed materials. Areas expected to have contamination from both processed and unprocessed materials will be evaluated on the more conservative correlation, or will be cleaned to the radium standard which should ensure that the uranium is removed.

Radium concentration in the samples should range from 25% of the guideline value (5 pCi/gram above background) for the area of interest, through the anticipated upper range of radium contamination. Background radium concentrations have been gathered over a 16 year period at sample station BHV-3 located upwind and 5 miles west of the White Mesa mill. The radium background concentration from this sampling is 0.93 pCi/gram. This value will be used as an interim value for the background concentration. Prior to initiating cleanup of windblown contamination, a systematic soil sampling program will be conducted in an area within 3 miles of the site, in geologically similar areas with soil types and soil chemistry similar to the areas to be cleaned, to determine the average background radium concentration, or concentrations, to be ultimately used for the cleanup.

An initial scoping survey for windblown contamination will be conducted based on analysis of all pertinent radiometric and past land use information. The survey will be conducted using calibrated beta/gamma instruments on a 30 meter by 30 meter grid. Additional surveys will be conducted in a halo, or buffer zone, around the projected impact area. The survey in the buffer area will be conducted on a 50 meter by 50 meter grid. Grids where no readings exceed 75% of the guideline value (5 pCi/gram above background) will be classified as unaffected, and will not require remediation.

The survey will be conducted by walking a path within the grid as shown in Figure A-3.3-1. These paths will be designed so that a minimum of 10% of the area within the grid sidelines will be scanned, using an average coverage area for the instrument of one (1) meter wide. The instrument will be swung from side to side at an elevation of six (6) inches above ground level, with the rate of coverage maintained within the recommended duration specified by the specific instrument manufacturer. In no case will the scanning rate be greater than the rate of 0.5 meters per second (m/sec) specified in NUREG/CR-5849 (NRC, 1992).

3.3.4 Characterization and Remediation Control Surveys

After the entire subarea has been classified as affected or unaffected, the affected areas will be further scanned to identify areas of elevated activity requiring cleanup. Such areas will be flagged and sufficient soils removed to, at a minimum, meet activity criteria. Following such remediation, the area will be scanned again to ensure compliance with activity criteria. A calibrated beta/gamma instrument capable of detecting activity levels of less than or equal to 25 percent of the guideline values will be used to scan all the areas of interest.

3.3.5 Final Survey

After removal of contamination, final surveys will be taken over remediated areas. Final surveys will be calculated and documented within specific 10 meter by 10 meter grids with sample point locations as shown in Figure A-3.3.2. Soil samples from 10% of the surveyed grids will be chemically analyzed to confirm the initial correlation factors utilized and confirm the success of cleanup effort for radium, thorium and uranium. Ten (10) percent of the samples chemically analyzed will be split, with a duplicate sent to an off site laboratory. Spikes and blanks, equal in number to 10 percent of the samples that are chemically analyzed, will be processed with the samples.

3.3.6 Employee Health and Safety

Programs currently in place for monitoring of exposures to employees will remain in effect throughout the time period during which tailings cell reclamation, mill decommissioning and clean up of windblown contamination are conducted. This will include personal monitoring (film badges/TLD's) and the ongoing bioassay program. Access control will be maintained at the Restricted Area boundary to ensure employees and equipment are released from the site in accordance with the current License conditions. In general, no changes to the existing programs are expected and reclamation activities are not expected to increase exposure potential beyond the current levels.

3.3.7 Environment Monitoring

Existing environmental monitoring programs will continue during the time period in which reclamation and decommissioning is conducted. This includes monitoring of surface and groundwater, airborne particulates, radon, soils and vegetation, according to the existing License conditions. In general, no changes to the existing programs are expected and reclamation activities are not expected to increase exposure potential beyond the current levels.

3.3.8 Quality Assurance

At least six (6) months prior to beginning of decommission activities, a detailed Quality Assurance Plan will be submitted for NRC approval. The Plan will be in accordance with Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs. In general, the Plan will detail the Company's organizational structure and responsibilities, qualifications of personnel, operating procedures and instructions, record keeping and document control, and quality control in the sampling procedure and outside laboratory. The Plan will adopt the existing quality assurance/quality control procedure utilized in compliance with the existing License.

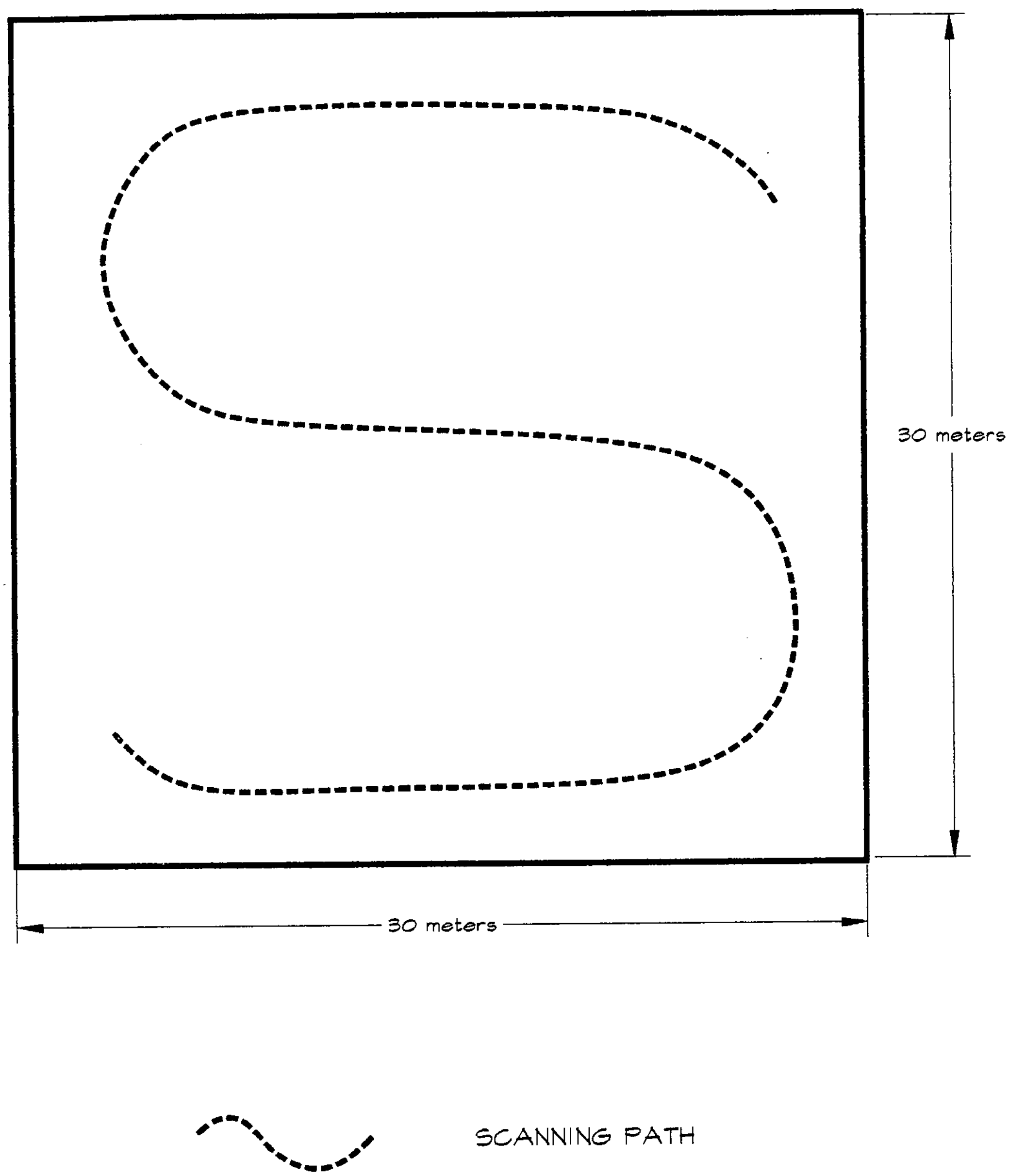


FIGURE A-3.3-1
TYPICAL SCANNING PATH
SCOPING SURVEY

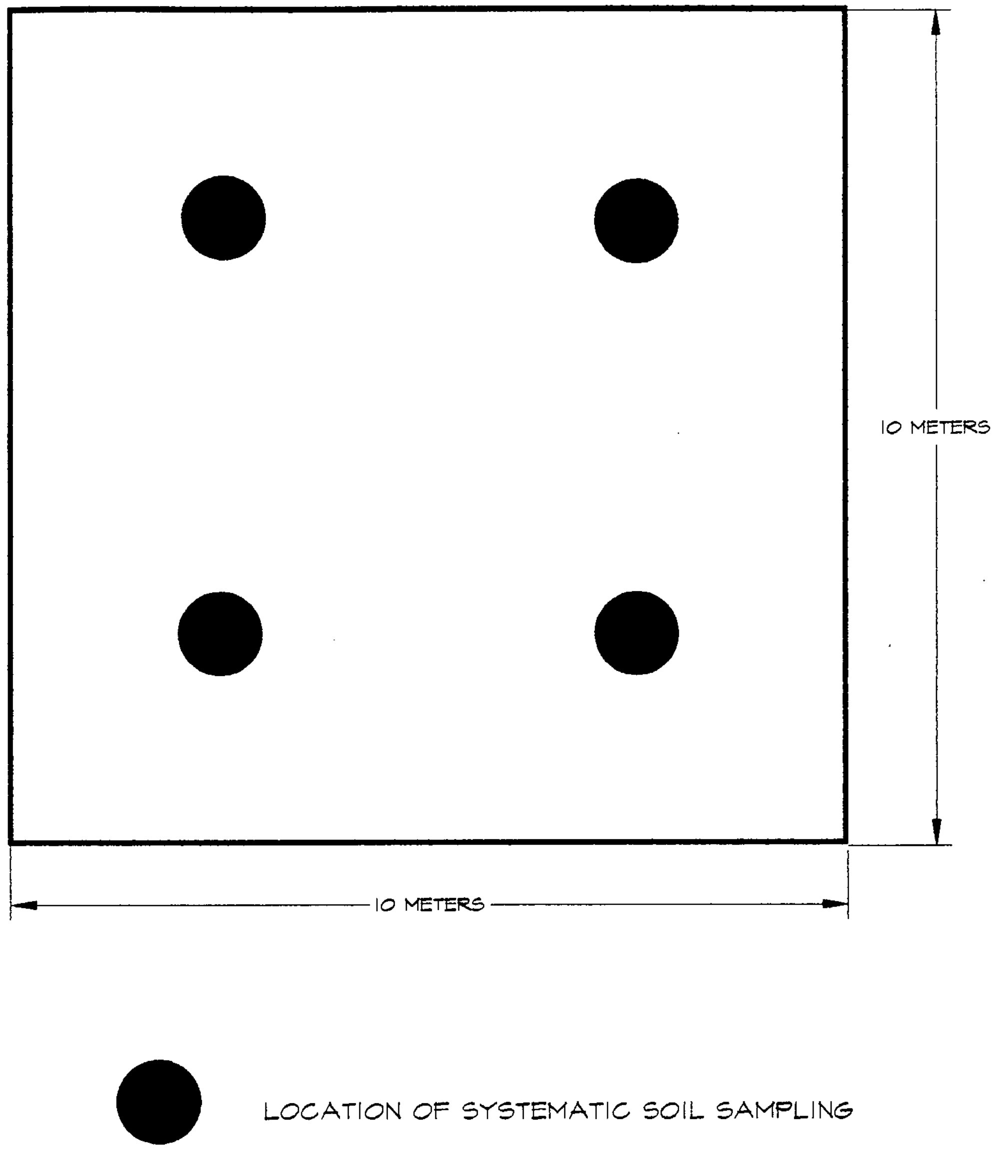


FIGURE A-3.3-2
STANDARD SAMPLING PATTERN FOR
SYSTEMATIC SURVEY OF SOIL

4.0 PLACEMENT METHODS

4.1 Scrap and Debris

The scrap and debris will have a maximum dimension of 20 feet and a maximum volume of 30 cubic feet. Scrap exceeding these limits will be reduced to within the acceptable limits by breaking, cutting or other approved methods. Empty drums, tanks or other objects having a hollow volume greater than five cubic feet will be reduced in volume by at least 70 percent. If volume reduction is not feasible, openings will be made in the object to allow soils, tailings and/or other approved materials to enter the object at the time of covering on the tailings cells. The scrap, after having been reduced in dimension and volume, if required, will be placed on the tailings cells as directed by the QC officer.

Any scrap placed will be spread across the top of the tailings cells to avoid nesting and to reduce the volume of voids present in the disposed mass. Stockpiled soils, contaminated soils, tailings and/or other approved materials will be placed over and into the scrap in sufficient amount to fill the voids between the large pieces and the volume within the hollow pieces to form a coherent mass. It is recognized that some voids will remain because of the scrap volume reduction specified, and because of practical limitations of these procedures. Reasonable effort will be made to fill the voids. The approval of the Site Manager or a designated representative will be required for the use of materials other than stockpiled soils, contaminated soils or tailings for the purpose of filling voids.

4.2 Contaminated Soils and Raffinate Crystals

The various materials will not be concentrated in thick deposits on top of the tailings, but will be spread over the working surface as much as possible to provide relatively uniform settlement and consolidation characteristics of the cleanup materials.

4.3 Compaction Requirements

The scrap, contaminated soils and other materials for the first lift will be placed over the existing tailings surface to a depth of up to four feet thick in a bridging lift to allow access for placing and compacting equipment. The first lift will be compacted by the tracking of heavy equipment, such as a Caterpillar D6 Dozer (or equivalent), at least four times prior to the placement of a subsequent lift. Subsequent layers will not exceed two feet and will be compacted to the same requirements.

During construction, the compaction requirements for the crystals will be reevaluated based on field conditions and modified by the Site Manager or a designated representative, with the agreement of the NRC Project Manager.

The contaminated soils and other cleanup materials after the bridging lift will be compacted to at least 80 percent of standard Proctor maximum density (ASTM D-698).

5.0 RECLAMATION CAP - CELLS 1-I, 2, AND 3

5.1 Earth Cover

A multi-layered earthen cover will be placed over tailings Cells 2, and 3 and a portion of Cell 1-I used for disposal of contaminated materials (the Cell1-I Tailings Area). The general grading plan is shown on Drawing A-5.1-1. Reclamation cover cross-sections are shown on Drawings A-5.1-2 and A-5.1-3.

5.2 Materials

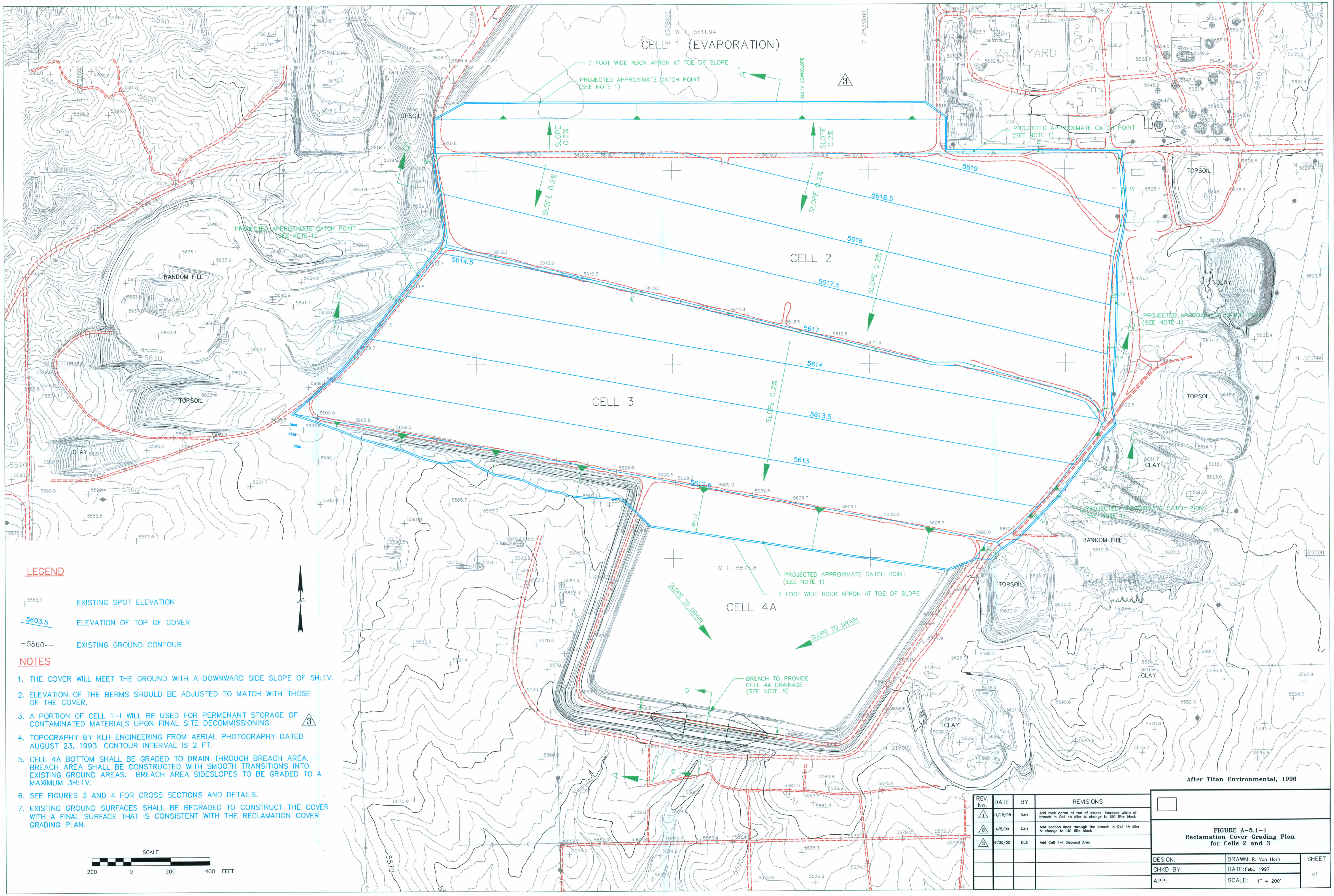
5.2.1 Physical Properties

The physical properties of materials for use as cover soils will meet the following:

Random Fill (Platform Fill and Frost Barrier)
These materials will be mixtures of clayey sands and silts with random amounts of gravel and rock size material. In the initial bridging lift of the platform fill, rock sizes of up to 2/3 of the thickness of the lift will be allowed. On all other random fill lifts, rock sizes will be limited to 2/3 of the lift thickness, with at least 30 percent of the material finer than 40 sieve. For that portion passing the No. 40 sieve, these soils will classify as CL, SC, MC or SM materials under the Unified Soil Classification System. Oversized material will be controlled through selective excavation at the stockpiles and through the utilization of a grader, bulldozer or backhoe to cull oversize from the fill.

Clay Layer Materials

Clays will have at least 40 percent passing the No. 200 sieve. The minimum liquid limit of these soils will be 25 and the plasticity index will be 15 or greater. These soils will classify as CL, SC or CH materials under the Unified Soil Classification System.



LEGEND

5582.6	EXISTING SPOT ELEVATION
5603.5	ELEVATION OF TOP OF COVER
—5560—	EXISTING GROUND CONTOUR

NOTES

1. THE COVER WILL MEET THE GROUND WITH A DOWNWARD SIDE SLOPE OF 5H:1V.
2. ELEVATION OF THE BERMS SHOULD BE ADJUSTED TO MATCH WITH THOSE OF THE COVER.
3. A PORTION OF CELL 1–I WILL BE USED FOR PERMENANT STORAGE OF CONTAMINATED MATERIALS UPON FINAL SITE DECOMMISSIONING. (3)
4. TOPOGRAPHY BY KLH ENGINEERING FROM AERIAL PHOTOGRAPHY DATED AUGUST 23, 1993. CONTOUR INTERVAL IS 2 FT.
5. CELL 4A BOTTOM SHALL BE GRADED TO DRAIN THROUGH BREACH AREA. BREACH AREA SHALL BE CONSTRUCTED WITH SMOOTH TRANSITIONS INTO EXISTING GROUND AREAS. BREACH AREA SIDESLOPES TO BE GRADED TO A MAXIMUM 3H:1V.
6. SEE FIGURES 3 AND 4 FOR CROSS SECTIONS AND DETAILS.
7. EXISTING GROUND SURFACES SHALL BE REGRADED TO CONSTRUCT THE COVER WITH A FINAL SURFACE THAT IS CONSISTENT WITH THE RECLAMATION COVER GRADING PLAN.

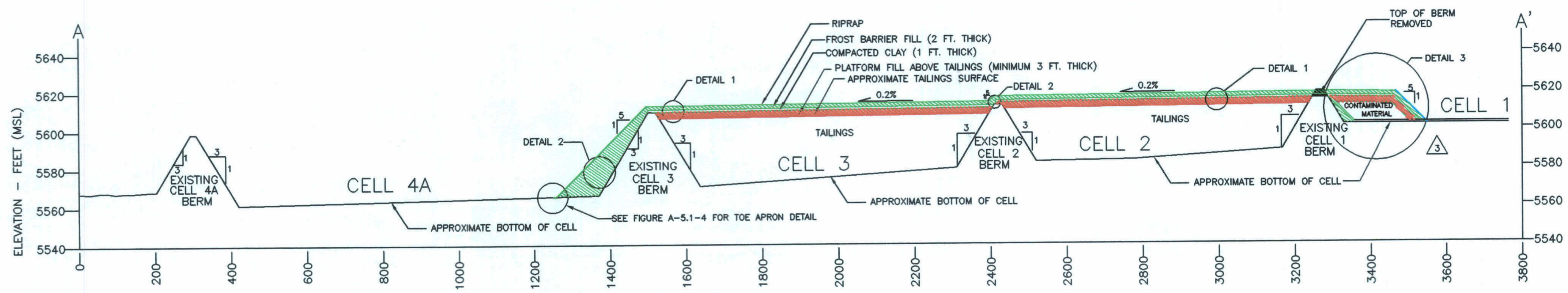
SCALE: 200 0 200 400 FEET

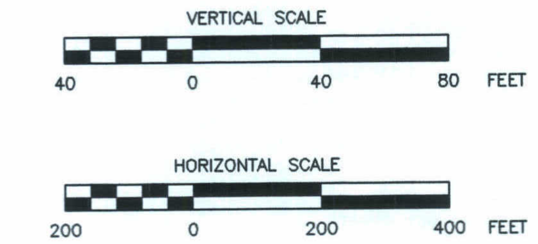
After Titan Environmental, 1996

REV. No.	DATE	BY	REVISIONS
1	11/18/98	RAH	Add rock apron at toe of slopes, increase width of breach in Cell 4A dike & change to IUC title block
2	4/5/99	RAH	Add section lines through the breach in Cell 4A dike & change to IUC title block
3	6/30/00	DLS	Add Cell 1–I Disposal Area

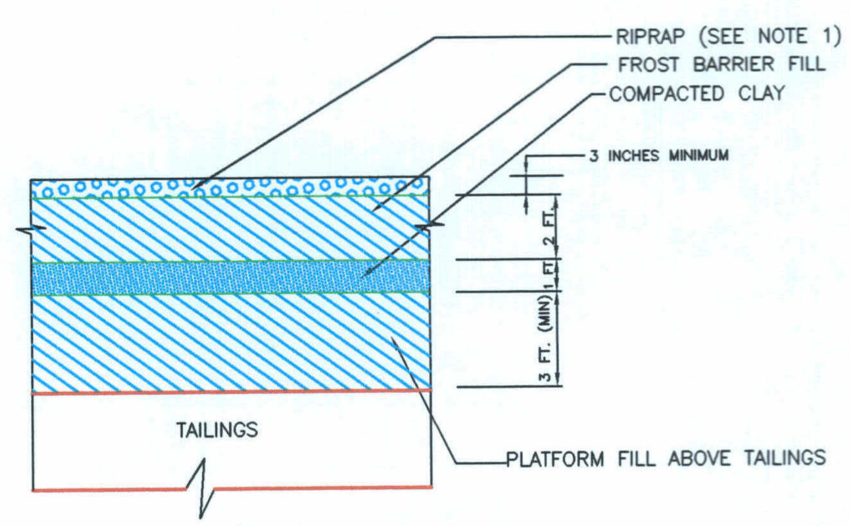
FIGURE A–5.1–1
Reclamation Cover Grading Plan for Cells 2 and 3

DESIGN:	DRAWN: R. Van Horn	SHEET
CHKD BY:	DATE: Feb., 1997	of
APP:	SCALE: 1" = 200'	



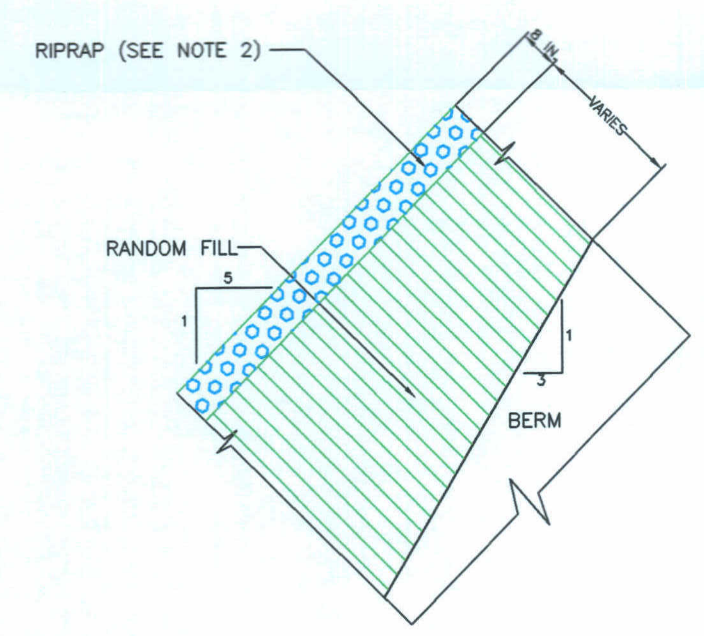


SECTION A–A' (WITH COVER ON CELLS 2 & 3)



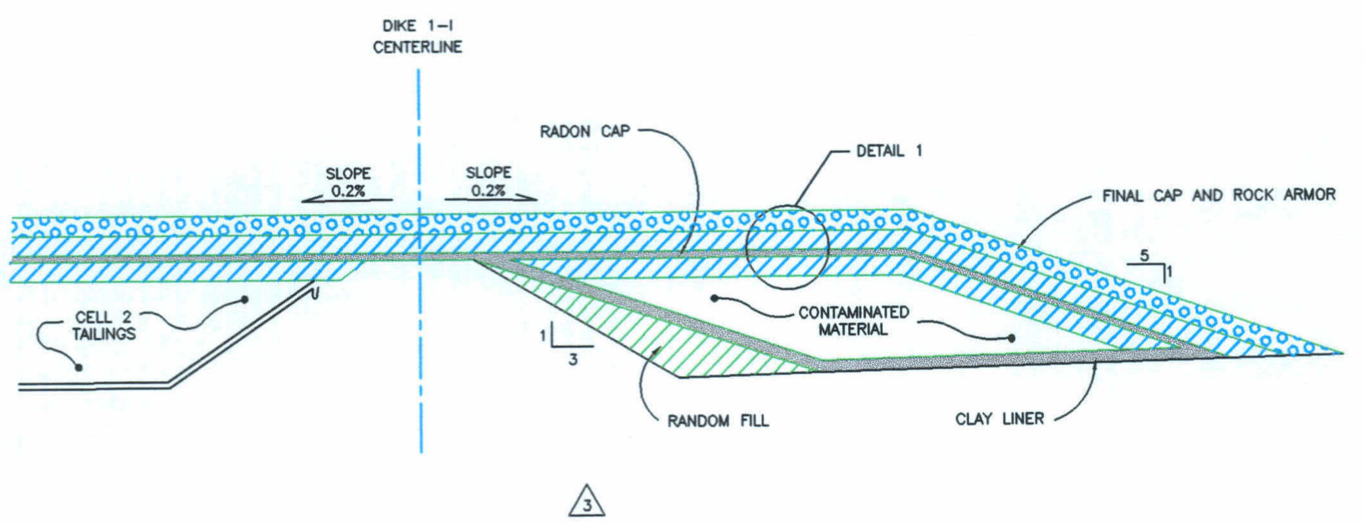
DETAIL 1: COVER DETAIL FOR POND SURFACE AREAS

(NOT TO SCALE)



DETAIL 2: COVER DETAIL FOR SIDE SLOPES

(NOT TO SCALE)



DETAIL 3: COVER DETAIL FOR CELL 1 CONTAMINATED MATERIAL

(NOT TO SCALE)

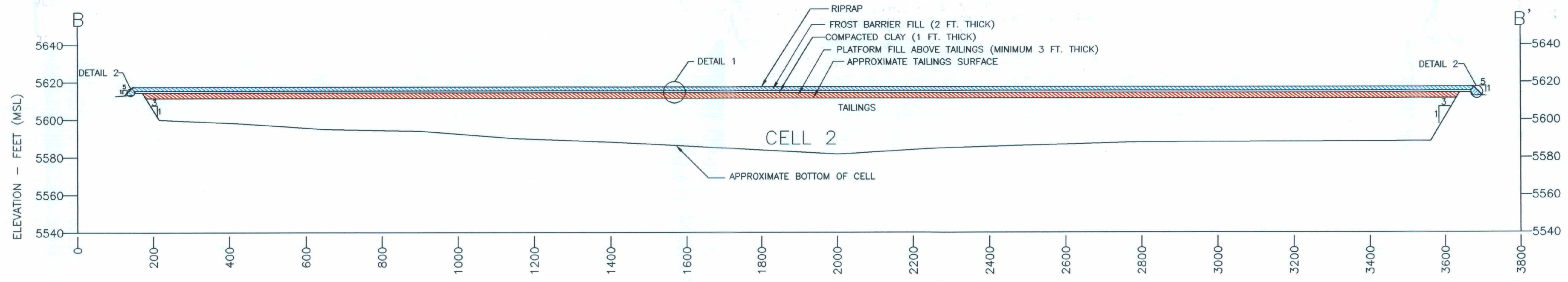
NOTES:

1. RIPRAP PLACED ON THE TOP OF COVER WILL CONSIST OF ROCK WITH D50 MINIMUM OF 0.3 INCHES.
2. RIPRAP PLACED ON THE SIDE SLOPES OF COVER WILL CONSIST OF ROCK WITH D50 MINIMUM OF 3.5 INCHES.
3. POND BOTTOM ELEVATIONS INFERRED FROM 'CELL 4 PHASE A AND PHASE B PLAN', WESTERN ENGINEERS INC., (JANUARY 17, 1989).
4. SEE FIGURES 1 AND 2 FOR CROSS SECTION LOCATIONS
5. EXISTING GROUND SURFACES SHALL BE REGRADED TO CONSTRUCT THE COVER WITH A FINAL SURFACE THAT IS CONSISTENT WITH THE RECLAMATION COVER GRADING PLAN.

REV. No.	DATE	BY	REVISIONS
1	11/19/98	RAH	Delete clay layer from exterior side slopes, change layer names, & change title block
2	5/20/99	RAH	Add Rock apron at toe of 5:1 slope
3	8/30/00	DLS	Add Cell 1-I Disposal Area

FIGURE A–5.1–2
Reclamation Cover and Cross Sections

DESIGN:	DRAWN: R. Van Horn	SHEET
CHKD BY:	DATE: Feb., 1997	of
APP:	SCALE: As Shown	



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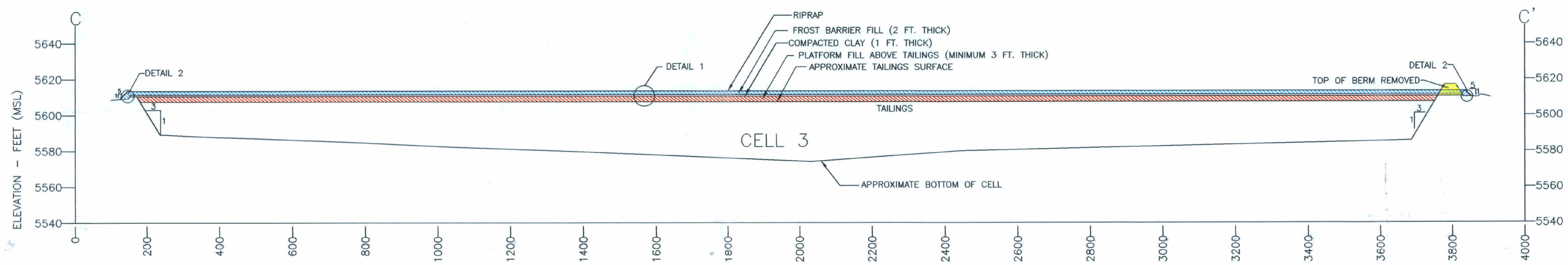

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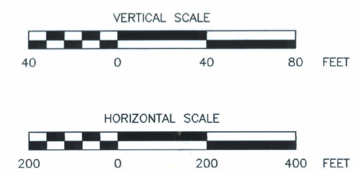

NOTES:

1. FOR POND SURFACE AND SIDE SLOPE COVER DETAILS SEE FIGURE 3.
2. POND BOTTOM INFERRED FROM 'CELL 4 PHASE A AND PHASE B PLAN', WESTERN ENGINEERING INC., (JANUARY 17, 1989).
3. SEE FIGURES 1 AND 2 FOR CROSS SECTIONS LOCATIONS
4. EXISTING GROUND SURFACES SHALL BE REGRADED TO CONSTRUCT THE COVER WITH A FINAL SURFACE THAT IS CONSISTENT WITH THE RECLAMATION COVER GRADING PLAN.

REV. No.	DATE	BY	REVISIONS
1	11/18/96	RAH	Delete clay layer on exterior slopes, change layer names, & change title block

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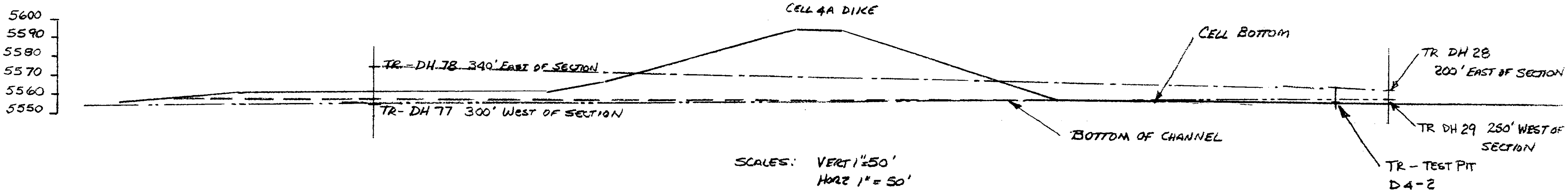
White Mesa Mill

FIGURE A–5.1–3
Reclamation Cover
Cross Sections

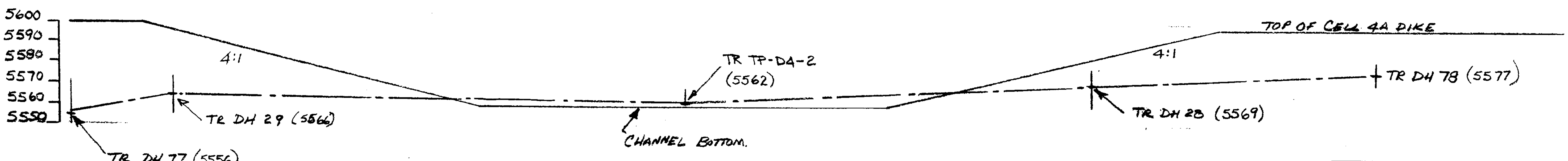
DESIGN:	DRAWN: R. Van Horn	SHEET
CHKD BY:	DATE: Feb., 1997	of
APP:	SCALE: As Shown	

TR = TOP OF ROCK



SCALES: VERT 1" = 50'
HORZ 1" = 50'

SECTION D - D'



SCALE: VERT: 1" = 50'
HORZ. 1" = 50'

SECTION E - E'

REV. No.	DATE	BY	REVISIONS

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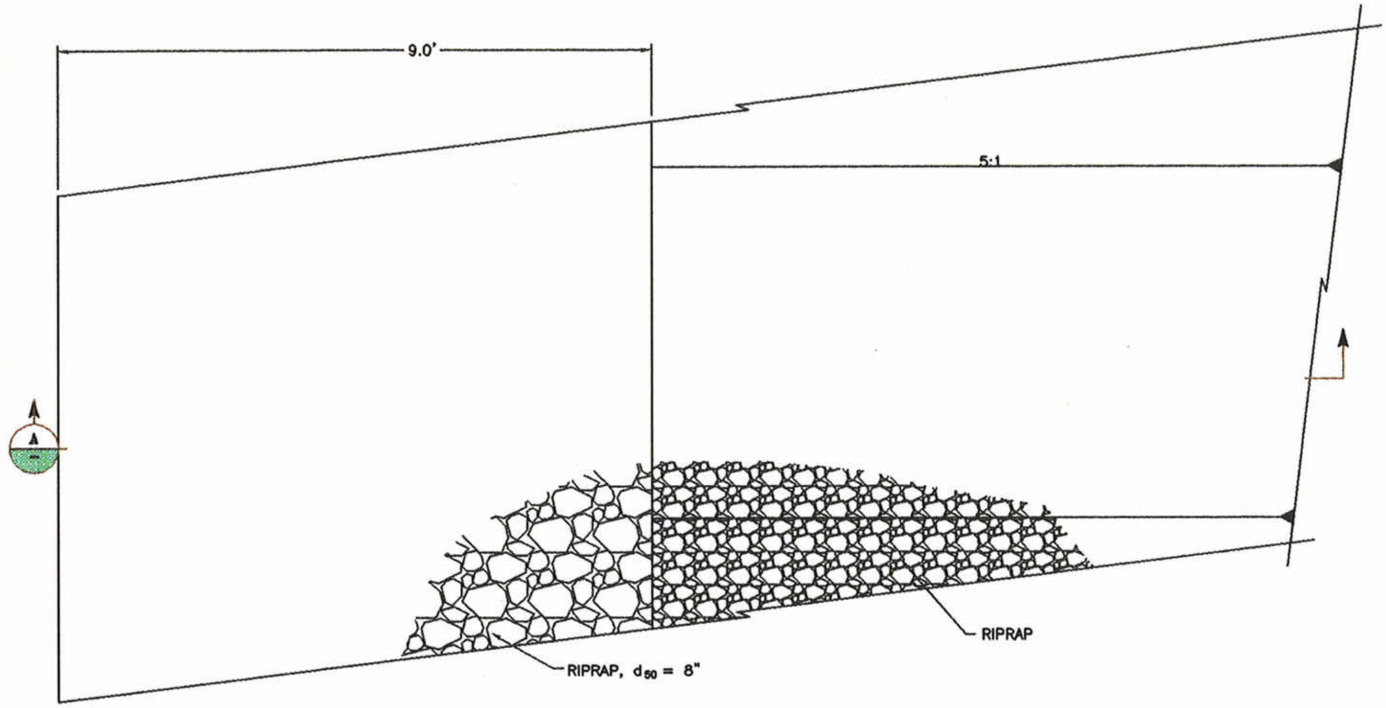
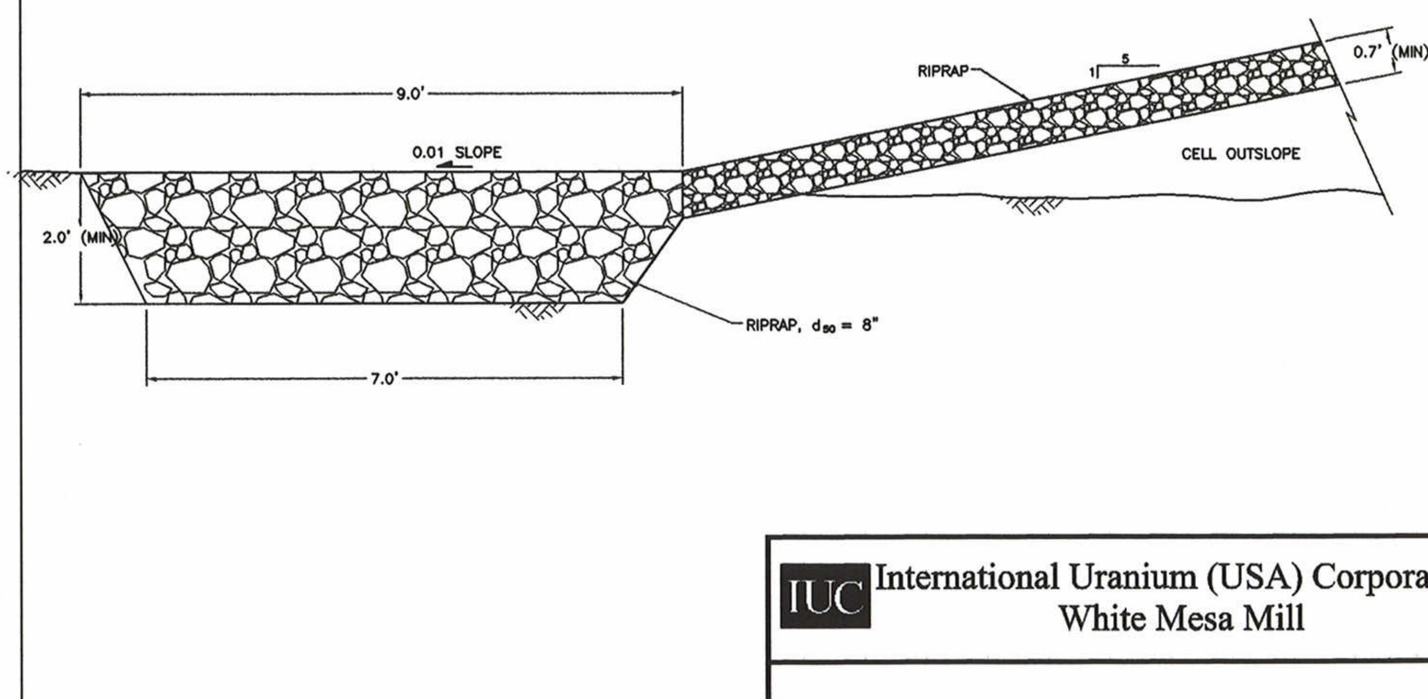
White Mesa Mill

Sections D-D' & E-E' from Figure A-5.1-1 of Reclamation Plan

DESIGN: RAH	DRAWN:	RAH	SHEET	
CHKD BY:	DATE:	4/5/99		of
APP:	SCALE:	as shown		



PLAN
NTS



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White Mesa Mill

FIGURE A–5.1–4
Rock Apron at Base of Toe of Cell Outslope

DESIGN: A. Kuhn	DRAWN:	RAH	SHEET 1 of 1	
CHKD BY:	DATE:	4/2/99		
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5.2.2 Borrow Sources

The sources for soils for the cover materials are as follows:

1. Random Fill (Platform and Frost Barrier) - stockpiles from previous cell construction activities currently located to the east and west of the tailing facilities.

2. Clay - will be from suitable materials stockpiled on site during cell construction or will be imported from borrow areas located in Section 16, T38S, R22E, SLM.

3. Rock Armor - will be produced through screening of alluvial gravels located in deposits 1 mile north of Blanding, Utah, 7 miles north of the mill site.

5.3 Cover Construction

5.3.1 General

Placement of cover materials will be based on a schedule determined by analysis of settlement data, piezometer data and equipment mobility considerations. Settlement plates and piezometers will be installed and monitored in accordance with Section 5.4 of these Plans and Specifications.

5.3.2 Placement and Compaction

5.3.2.1 Methods

Platform Fill

An initial lift of 3 to 4 feet of random fill will be placed over the tailings surface to form a stable working platform for subsequent controlled fill placement. This initial lift will be placed by pushing random fill material or contaminated materials across the tailings in increments, slowly enough that the underlying tailings are displaced as little as possible. Compaction of the initial lift will be limited to what the weight of the placement equipment provides. The maximum rock size, as far as practicable, in the initial lift is 2/3 of the lift thickness. Placement of fill will be monitored by a qualified individual with the authority to stop work and reject material being placed. The top surface (top 1.0 feet) of the platform fill will be compacted to 90% maximum dry density per ASTM D 698.

Frost Barrier Fill

Frost barrier fill will be placed above the clay cover in 12- inch lifts, with particle size limited to 2/3 of the lift thickness. Frost barrier material will come from the excavation of random fill stockpiles, If oversized material is observed during the excavation of fill material it will be removed as far as practicable before it is placed in the fill.

In all layers of the cover the distribution and gradation of the materials throughout each fill layer will be such that the fill will, as far as practicable, be free of lenses, pockets, streaks or layers of material differing substantially in texture, gradation or moisture content from the surrounding material. Nesting of oversized material will be controlled through selective excavation of stockpiled material, observation of placement by a qualified individual with authority to stop work and reject material being placed and by culling oversized material from the fill utilizing a grader. Successive loads of material will be placed on the fill so as to produce the best practical distribution of material.

If the compacted surface of any layer of fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it will be moistened and/or reworked with a harrow, scarifier, or other suitable equipment to a sufficient depth to provide relatively uniform moisture content and a satisfactory bonding surface before the next succeeding layer of earthfill is placed. If the compacted surface of any layer of earthfill in-place is too wet, due to precipitation, for proper compaction of the earthfill material to be placed thereon, it will be reworked with harrow, scarifier or other suitable equipment to reduce the moisture content to the required level shown in Table 5.3.2.1-1. It will then be recompacted to the earthfill requirements.

No material will be placed when either the materials, or the underlying material, is frozen or when ambient temperatures do not permit the placement or compaction of the materials to the specified density, without developing frost lenses in the fill.

5.3.2.2 Moisture and Density Control

As far as practicable, the materials will be brought to the proper moisture content before placement on tailings, or moisture will be added to the material by sprinkling on the earthfill. Each layer of the fill will be conditioned so that the moisture content is uniform throughout the layer prior to and during compaction. The moisture content of the compacted fill will be within the limits of standard optimum moisture content as shown in Table 5.3.2.1-1. Material that is too dry or too wet to permit bonding of layers during compaction will be rejected and will be reworked until the moisture content is within the specified limits. Reworking may include removal, re-harrowing, reconditioning, rerolling, or combinations of these procedures.

Density control of compacted soil will be such that the compacted material represented by samples having a dry density less than the values shown in Table 5.3.2.1-1 will be rejected. Such rejected material will be reworked as necessary and rerolled until a dry density equal to or greater than the percent of its standard Proctor maximum density shown in Table 5.3.2.1-1.

To determine that the moisture content and dry density requirements of the compacted fill are being met, field and laboratory tests will be made at specified intervals taken from the compacted fills as specified in Section 7.4, "Frequency of Quality Control Tests."

5.4 Monitoring Cover Settlement

5.4.1 Temporary Settlement Plates

5.4.1.1 General

Temporary settlement plates will be installed in the tailings Cells. At the time of cell closure, a monitoring program will be proposed to the NRC. Data collected will be analyzed and the reclamation techniques and schedule adjusted accordingly.

5.4.1.2 Installation

At the time of cell closure or during the placement of interim cover temporary settlement plates will be installed. These temporary settlement plates will consist of a corrosion resistant steel plate 1/4 inch thick and two foot square to which a one inch diameter corrosion resistant monitor pipe has been welded. The one inch monitor pipe will be surrounded by a three inch diameter guard pipe which will not be attached to the base plate.

The installation will consist of leveling an area on the existing surface of the tailings, and placing the base plate directly on the tailings. A minimum three feet of initial soil or tailings cover will be placed on the base plate for a minimum radial distance of five feet from the pipe.

5.4.1.3 Monitoring Settlement Plates

Monitoring of settlement plates will be in accordance with the program submitted to and approved by the NRC. Settlement observations will be made in accordance with Quality Control Procedure QC-16-WM, "Monitoring of Temporary Settlement Plates."

5.2.2 Borrow Sources

The sources for soils for the cover materials are as follows:

1. Random Fill (Platform and Frost Barrier) - stockpiles from previous cell construction activities currently located to the east and west of the tailing facilities.

2. Clay - will be from suitable materials stockpiled on site during cell construction or will be imported from borrow areas located in Section 16, T38S, R22E, SLM.

3. Rock Armor - will be produced through screening of alluvial gravels located in deposits 1 mile north of Blanding, Utah, 7 miles north of the mill site.

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5.3.1 General

Placement of cover materials will be based on a schedule determined by analysis of settlement data, piezometer data and equipment mobility considerations. Settlement plates and piezometers will be installed and monitored in accordance with Section 5.4 of these Plans and Specifications.

5.3.2 Placement and Compaction

5.3.2.1 Methods

Platform Fill

An initial lift of 3 to 4 feet of random fill will be placed over the tailings surface to form a stable working platform for subsequent controlled fill placement. This initial lift will be placed by pushing random fill material or contaminated materials across the tailings in increments, slowly enough that the underlying tailings are displaced as little as possible. Compaction of the initial lift will be limited to what the weight of the placement equipment provides. The maximum rock size, as far as practicable, in the initial lift is 2/3 of the lift thickness. Placement of fill will be monitored by a qualified individual with the authority to stop work and reject material being placed. The top surface (top 1.0 feet) of the platform fill will be compacted to 90% maximum dry density per ASTM D 698.

Frost Barrier Fill

Frost barrier fill will be placed above the clay cover in 12- inch lifts, with particle size limited to 2/3 of the lift thickness. Frost barrier material will come from the excavation of random fill stockpiles, If oversized material is observed during the excavation of fill material it will be removed as far as practicable before it is placed in the fill.

In all layers of the cover the distribution and gradation of the materials throughout each fill layer will be such that the fill will, as far as practicable, be free of lenses, pockets, streaks or layers of material differing substantially in texture, gradation or moisture content from the surrounding material. Nesting of oversized material will be controlled through selective excavation of stockpiled material, observation of placement by a qualified individual with authority to stop work and reject material being placed and by culling oversized material from the fill utilizing a grader. Successive loads of material will be placed on the fill so as to produce the best practical distribution of material.

If the compacted surface of any layer of fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it will be moistened and/or reworked with a harrow, scarifier, or other suitable equipment to a sufficient depth to provide relatively uniform moisture content and a satisfactory bonding surface before the next succeeding layer of earthfill is placed. If the compacted surface of any layer of earthfill in-place is too wet, due to precipitation, for proper compaction of the earthfill material to be placed thereon, it will be reworked with harrow, scarifier or other suitable equipment to reduce the moisture content to the required level shown in Table 5.3.2.1-1. It will then be recompacted to the earthfill requirements.

No material will be placed when either the materials, or the underlying material, is frozen or when ambient temperatures do not permit the placement or compaction of the materials to the specified density, without developing frost lenses in the fill.

5.3.2.2 Moisture and Density Control

As far as practicable, the materials will be brought to the proper moisture content before placement on tailings, or moisture will be added to the material by sprinkling on the earthfill. Each layer of the fill will be conditioned so that the moisture content is uniform throughout the layer prior to and during compaction. The moisture content of the compacted fill will be within the limits of standard optimum moisture content as shown in Table 5.3.2.1-1. Material that is too dry or too wet to permit bonding of layers during compaction will be rejected and will be reworked until the moisture content is within the specified limits. Reworking may include removal, re-harrowing, reconditioning, rerolling, or combinations of these procedures.

Density control of compacted soil will be such that the compacted material represented by samples having a dry density less than the values shown in Table 5.3.2.1-1 will be rejected. Such rejected material will be reworked as necessary and rerolled until a dry density equal to or greater than the percent of its standard Proctor maximum density shown in Table 5.3.2.1-1.

To determine that the moisture content and dry density requirements of the compacted fill are being met, field and laboratory tests will be made at specified intervals taken from the compacted fills as specified in Section 7.4, "Frequency of Quality Control Tests."

5.4 Monitoring Cover Settlement

5.4.1 Temporary Settlement Plates

5.4.1.1 General

Temporary settlement plates will be installed in the tailings Cells. At the time of cell closure, a monitoring program will be proposed to the NRC. Data collected will be analyzed and the reclamation techniques and schedule adjusted accordingly.

5.4.1.2 Installation

At the time of cell closure or during the placement of interim cover temporary settlement plates will be installed. These temporary settlement plates will consist of a corrosion resistant steel plate 1/4 inch thick and two foot square to which a one inch diameter corrosion resistant monitor pipe has been welded. The one inch monitor pipe will be surrounded by a three inch diameter guard pipe which will not be attached to the base plate.

The installation will consist of leveling an area on the existing surface of the tailings, and placing the base plate directly on the tailings. A minimum three feet of initial soil or tailings cover will be placed on the base plate for a minimum radial distance of five feet from the pipe.

5.4.1.3 Monitoring Settlement Plates

Monitoring of settlement plates will be in accordance with the program submitted to and approved by the NRC. Settlement observations will be made in accordance with Quality Control Procedure QC-16-WM, "Monitoring of Temporary Settlement Plates."

TABLE A-5.3.2.1-1

Placement and Compaction Criteria
Reclamation Cover Materials

Cover Layer	Maximum Lift Thickness	Per Cent Compaction	Allowable Placement Moisture Content from Optimum Moisture Content
Platform Fill	3 Feet Bridging Lift*	80	
	1 Foot	90	± 2
Clay Layer	1 Foot	95	0 to + 3
Frost Barrier	2 Feet	95	± 2
Riprap			
Top of Tails	6 Inches		
Slope	8 Inches		

Note:
* Compaction of the bridging lift is dependent on stability of fill and equipment used
Percent Compaction is based on standard Proctor dry density (ASTM D-698).

Optimum moisture content of a soil will be determined by ASTM D-2216 or D-4643 methods.

6.0 ROCK PROTECTION

6.1 General

The side slopes of the reclaimed cover will be protected by rock surfacing. Drawings 5.1-1, 5.1-2, and 5.1-3 show the location of rock protection with the size, thickness and gradation requirements for the various side slopes.

A riprap layer was designed for erosion protection of the tailings soil cover. According to NRC guidance, the design must be adequate to protect the soil/tailings against exposure and erosion for 200 to 1,000 years (NRC, 1990). Currently, there is no standard industry practice for stabilizing tailings for 1,000 years. However, by treating the embankment slopes as wide channels, the hydraulic design principles and practices associated with channel design were used to design stable slopes that will not erode. Thus, a conservative design based on NRC guidelines was developed. Engineering details and calculations are summarized in the Tailings Cover Design report (Appendix D).

Riprap cover specifications for the top and side slopes were determined separately as the side slopes are much steeper than the slope of the top of the cover. The size and thickness of the riprap on the top of the cover was calculated using the Safety Factor Method (NUREG/CR-4651, 1987), while the Stephenson Method (NUREG/CR-4651, 1987) was used for the side slopes. These methodologies were chosen based on NRC recommendations (1990).

By the Safety Factor Method, riprap dimensions for the top slope were calculated in order to achieve a slope "safety factor" of 1.1. For the top of the soil cover, with a slope of 0.2 percent, the Safety Factor Method indicated a median diameter (D_{50}) riprap of 0.28 inches is required to stabilize the top slope. However, this dimension must be modified based on the long-term durability of the specific rock type to be used in construction. The suitability of rock to be used as a protective cover has been assessed by laboratory tests to determine the physical characteristics of the rocks. The gravels sourced from pits located north of Blanding require an oversizing factor of 9.35%. Therefore, riprap created from this source should have a D_{50} size of at least 0.306 inches and should have an overall layer thickness of at least three inches on the top of the cover. From a practical construction standpoint the minimum rock layer thickness may be up to six (6) inches.

Riprap dimensions for the side slopes were calculated using Stephenson Method equations. The side slopes of the cover are designed at 5H:1V. At this slope, Stephenson's Method indicated the unmodified riprap D_{50} of 3.24 inches is required. Again assuming that the gravel from north of Blanding will be used, the modified D_{50} size of the riprap should be at least 3.54 inches with an overall layer thickness of at least 8 inches.

6.2 Materials

Materials utilized for riprap applications will meet the following specifications:

Location	D_{50} Size	D_{100} Size	Layer Thickness
Top Surface	0.3"	0.6"	6"
Slope Surface	3.5"	7"	8"
Toe Apron	6.4"	12"	24"

Riprap will be supplied to the project from gravel sources located north of the project site. Riprap will be a screened product.

Riprap quality will be evaluated by methods presented in NUREG/1623 Design of Erosion Protection for Long-Term Stabilization Size adjustment will be made in the riprap for materials not meeting the quality criteria.

6.3 Placement

Riprap material will be hauled to the reclaimed surfaces and placed on the surfaces using belly dump highway trucks and road graders. Riprap will be dumped by trucks in windrows and the grader will spread the riprap in a manner to minimize segregation of the material. Depth of placement will be controlled through the establishment of grade stakes placed on a 200 x 200 foot grid on the top of the cells and by a 100 x 100 foot grid on the cell slopes. Physical checks of riprap depth will be accomplished through the use of hand dug test pits at the center of each grid in addition to monitoring the depth indicated on the grade stakes. Placement of the riprap will avoid accumulation of riprap sizes less than the minimum D_{50} size and nesting of the larger sized rock. The riprap layer will be compacted by at least two passes by a D-7 Dozer (or equivalent) in order to key the rock for stability.

7.0 QUALITY CONTROL/QUALITY ASSURANCE

7.1 Quality Plan

A Quality Plan has been developed for construction activities for the White Mesa Project. The Quality Plan includes the following:

1. QC/QA Definitions, Methodology and Activities.
2. Organizational Structure.
3. Surveys, Inspections, Sampling and Testing.
4. Changes and Corrective Actions.

5. Documentation Requirements.
6. Quality Control Procedures.

7.2 Implementation

The Quality Plan will be implemented upon initiation of reclamation work.

7.3 Quality Control Procedures

Quality control procedures have been developed for reclamation and are presented in Attachment B of this Reclamation Plan. Procedures will be used for all testing, sampling and inspection functions.

7.4 Frequency of Quality Control Tests

The frequency of the quality control tests for earthwork will be as follows:

1. The frequency of the field density and moisture tests will be not less than one test per 1,000 cubic yards (CY) of compacted contaminated material placed and one test per 500 CY of compacted random fill, radon barrier or frost barrier. A minimum of two tests will be taken for each day that an applicable amount of fill is placed in excess of 150 CY. A minimum of one test per lift and at least one test for every full shift of compaction operations will be taken.

   Field density/moisture tests will be performed utilizing a nuclear density gauge (ASTM D-2922 density and ASTM D-3017 moisture content). Correlation tests will be performed at a rate of one for every five nuclear gauge tests for compacted contaminated materials (one per 2,500 CY placed) and one for every ten nuclear gauge tests for other compacted materials (one per 5,000 CY of material placed). Correlation tests will be sand cone tests (ASTM D-1556) for density determination and oven drying method (ASTM D-2216) for moisture determination.

2. Gradation and classification testing will be performed at a minimum of one test per 2,000 CY of upper platform fill and frost barrier placed. A minimum of one test will be performed for each 1,000 CY of radon barrier material placed. For all materials other than random fill and contaminated materials, at least one gradation test will be run for each day of significant material placement (in excess of 150 CY).

3. Atterberg limits will be determined on materials being placed as radon barrier. Radon barrier material will be tested at a rate of at least once each day of significant material placement (in excess of 150 CY). Samples should be randomly selected.

4. Prior to the start of field compaction operations, appropriate laboratory compaction curves will be obtained for the range of materials to be placed. During construction, one point Proctor tests will be performed at a frequency of one test per every five field density tests (one test per 2,500 CY placed). Laboratory compaction curves (based on complete Proctor tests) will be obtained at a frequency of approximately one for every 10 to 15 field density tests (one lab Proctor test per 5,000 CY to 7,500 CY placed), depending on the variability of materials being placed.

5. For riprap materials, each load of material will be visually checked against standard piles for gradation prior to transport to the tailings piles.

   Prior to delivery of any riprap materials to the site rock durability tests will be performed for each gradation to be used. Test series for riprap durability will include specific gravity, absorption, sodium soundness and LA abrasion. During construction additional test series _and gradations will be performed for each type of riprap when approximately one-third (1/3) and two-thirds (2/3) of the total volume of each type have been produced or delivered. For any type of riprap where the volume is greater than 30,000 CY, a test series and gradations will be performed for each additional 10,000 CY of riprap produced or delivered.

ATTACHMENT B

QUALITY PLAN

FOR

CONSTRUCTION ACTIVITIES

WHITE MESA PROJECT

BLANDING, UTAH

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

1050 17th STREET, SUITE 950

DENVER, COLORADO 80265

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1.0 GENERAL

1.1 SCOPE OF QUALITY PLAN

The following Quality Plan for Construction Activities ("Quality Plan") describes how the Construction Quality Control/Quality Assurance ("QC/QA") activities are implemented.

This Quality Plan includes the following:

(1) Organizational Structure;
(2) Surveys, Inspections, Sampling and Testing;
(3) Changes and Corrective Actions; and
(4) Documentation Requirements.

1.2 QUALITY PLAN OBJECTIVES

The objectives of the Quality Plan are as follows:

(1) Quality Control: To verify that the construction is in accordance with the Plans and Specifications.
(2) Quality Assurance: To provide cross-checks and auditing functions on Quality Control.
(3) Monitoring: To provide the required information and data to evaluate the effects of Construction Activities.

1.3 DEFINITIONS

Compliance Report: A report prepared by the QC Officer ("QCO") upon completion of a Construction Segment. A Compliance Report requires the approval of the Site Manager. Any subsequent Construction Segment that is dependent upon successful completion of a specific Construction Segment cannot be initiated until a Compliance Report is prepared and approved for the previous dependent Construction Segment. Compliance Reports are to be completed on Form No. F-23 which is attached in Part V.

Construction Task: A basic construction feature of a Construction Project involving a specific Construction Activity.

Construction Project: The total authorized/approved Project that requires several Construction Segments to complete.

Design Change: Changes made in a Construction Project that alters or changes the intent of the Plans and Specifications. Design changes require approval of the Design Engineer and the Site Manager or a designated representative. Design Changes are to be reported on Form No. F-26, which is attached in Part V.

Field Change: Changes made during construction to fit field conditions that do not alter the intent of the Plans and Specifications. Field Changes require approval of the Site Manager or a designated representative. Field Changes are to be reported on Form No. F-25, which is attached in Part V.

Final Construction Report: A report prepared by the Site Manager or a designated representative upon completion of a Construction Project. This report will be submitted to the NRC.

1.4 QUALITY CONTROL/QUALITY ASSURANCE

1.4.1 Methodology

1.4.1.1 Flow of Activities

Figure 1 shows the general relationships of Quality Control and Quality Assurance activities in the performance of the Construction Activities for a given work area. The Quality Control Activities implemented with standardized QC procedures, provide the necessary tests and observations for the construction, sampling and monitoring process. Quality Assurance audits and reviews will provide oversight of the QC Activities.

1.4.1.2 Compliance Reports

For each project, the Quality Plan requires a Compliance Report at the successful completion of a Construction Segment. The Construction Tasks making up a Construction Segment will be determined to be in compliance with the Plans and Specifications by the QCO. A Compliance Report will then be prepared by the QCO with a copy to the NRC Project Manager, and submitted to the Site Manager for approval, before the next dependent phase of construction can begin. The Site Manager will review Quality Control data, Quality Assurance documentation, and review any observations before approving the Compliance Report.

After the Construction Project has been completed, a Final Construction Report will be prepared by the Site Manager or a designated representative for submittal to the NRC.

1.4.2 Quality Control

1.4.2.1 General

Quality Control ("QC") will be conducted by the QCO or a designated representative. Hereinafter referred to as the QCO. The QCO will implement the QC Program.

1.4.2.2 Quality Control Activities

Quality Control requirements for a Construction Project are presented in the Specifications.

The Quality Control Activities will be implemented with standardized Quality Control Procedures. The Quality Control Procedures include field sampling, testing, observations and monitoring procedures, and laboratory testing procedures. The Quality Control Procedures are listed and are included in Part VI.

1.4.3 Quality Assurance

1.4.3.1 General

Quality Assurance ("QA") will be conducted by the QAO or a designated representative. The QAO will implement the QA Program.

1.4.3.2 Quality Assurance Activities

The QA functions will be implemented by the QAO by performing the following activities.

1.4.3.2.1 Pre-qualification of QC Technicians

Each QC Technician ("QCT") will be pre-qualified by a QAO, who is a knowledgeable specialist in the area of qualification. The QAO will determine the areas of expertise of the respective technician and maintain a QA file on the technician. Areas of competency will be identified and training needs noted for the respective technician.

1.4.3.2.2 Verification of Effectiveness of QC Program

The effectiveness of the QC Program will be verified by the QAO by performing the following audits:

(1) Test and Sampling Procedures. Test procedures will be audited on a quarterly basis by appropriate specialists. This will entail direct observation of test methods and sampling, and performing random duplicate tests.

(2) Equipment. Equipment will be inspected and checked regularly. Calibration certificates will be verified and maintained in the files.

(3) Calculations and Documentation. Calculations from tests and monitoring will be spot checked randomly from the files. Documentation will be checked for accuracy and completeness.

1.4.4 Documentation

Each QA activity and audit will be documented in writing. Audit reports will be prepared by the QAO and submitted to the Site Manager. These will be kept in the White Mesa project files, and made available for review by the NRC Project Manager.

1.5 MONITORING

Monitoring functions fall under the responsibilities of the QCO. Scheduled monitoring and observations shall be made at the intervals required in the Plans and Specifications by Quality Control Technicians ("QCTs") under the direction of the QCO. Monitoring records will be reviewed by the QCO and will be available for review by the NRC. The QAO will audit monitoring records on an unscheduled basis. Monitoring records originals will be maintained in the White Mesa Project Files.

2.0 ORGANIZATIONAL STRUCTURE

2.1 SCOPE

The following items are covered in this section:

(1) A description of the Quality Control Organization.

(2) The classification, qualifications, duties, responsibilities and authority of personnel.

(3) The individual who will be responsible for overall management at the site for Quality Control.

(4) The specific authority and responsibility of all other personnel regarding the Quality Plan.

(5) A program for information flow among workers, construction management and inspectors about various QC/QA, and health and safety requirements.

2.2 ORGANIZATION

A schematic diagram of the organization for implementation of the Quality Plan is shown on Figure B-2. The Site Manager, the QCO, and the QAO, play major roles.

2.3 DUTIES AND QUALIFICATIONS OF PERSONNEL

2.3.1 Personnel Designations

The Site Manager or a designated representative will be referred to as the "Site Manager."

The Quality Control Officer or a designated representative will be referred to as the "QC Officer ("QCO")."

The Quality Assurance Officer or a designated representative will be referred to as the "QA Officer ("QAO")."

2.3.2 Site Manager

2.3.2.1 Duties, Responsibilities and Authority

The Site Manager will oversee the Construction Project and will be responsible for the conduct, direction and supervision of the Work. As shown on the organizational chart, the Site Manager will have ultimate responsibility for all construction and QC/QA Activities. The Site Manager will appoint all personnel, and interact as required with the QAO, the QCO and the NRC Project Manager.

2.3.3 Designated Representative for Site Manager

In the absence of the Site Manager, a designated representative will assume the duties of the Site Manager.

2.3.4 Quality Control Officer ("QCO")

2.3.4.1 Duties, Responsibilities and Authority

The QCO will be responsible for overall implementation and management of the Quality Control Program for the Construction Project. The QCO will supervise Field and Laboratory Quality Control Technicians, and will coordinate with the Document Control Manager, the Office Staff and the Health and Safety Officer. The QCO will have specific authority and responsibility with regard to all other personnel for the Quality Plan. The QCO will have the authority to reject work or material, to require removal or placement, to specify and require appropriate corrective actions if it is determined that the Quality Control/Quality Assurance, personnel, instructions, controls, tests, records are not conforming to the Plans and Specifications. The signature of the QCO is required on all Compliance Reports ("CR's") required in the Specifications.

The QCO will be familiar with the existing White Mesa Facilities, and QC/QA methodology. Responsibilities of the QCO will include the following:

(1) Provide overall surveillance of Quality Control requirements.

(2) Be familiar with all documents, requirements, equipment and procedures relating to project construction.

(3) Provide and document Quality Control Technician ("QCT") training.

(4) Evaluate and approve all reports.

(5) Assure schedules are met and adequately documented.

(6) Schedule data reduction activities.

(7) Arrange consultation with additional staff, the QAO, Site Manager, and/or NRC Project Manager to help find solutions to unsolved problems.

(8) Identify invalid, unacceptable, or unusable data.

(9) Take corrective action if Quality Control procedures indicate the construction is not meeting the requirements of the Specifications.

(10) Assure all documentation is complete, accurate, and up to date.

(11) Interact and cooperate with QA Technicians.

2.3.5 Designated Representative for QCO

In the absence of the QCO, a designated representative will assume the duties of the QCO. In addition, the designated representative may be assigned some of the duties, responsibilities and authority of the QCO.

2.3.6 Quality Assurance Officer ("QAO")

2.3.6.1 Duties

The QAO, who may be an independent consultant, will implement the Quality Assurance functions which includes pre-qualification of QCTs, verification of test procedures and results by spot retests, equipment checks, and review of calculations and documentation and Compliance Reports (CR's). The QAO should be familiar with the construction process and be qualified in construction testing.

Responsibilities of the QAO will include the following:

(1) Be familiar with all documents, requirements, equipment and procedures relating to project construction.

(2) Certify that the QCO is qualified to conduct the various test and monitoring procedures and observations, and document same.

(3) Through spot checks, retests, equipment checks and review of calculations and documentation verify test procedures, monitoring and observations are being performed correctly and accurately in accordance with the Specifications.

(4) Consult with the QCO, and the Site Manager to help solve problems.

(5) Prepare QA reports for review by the Site Manager and NRC Project Manager.

2.3.7 Designated Representative of the Quality Assurance Officer

In the absence of the Quality Assurance Officer ("QAO"), the designated representative of the QAO will assume the duties of the QAO. In addition, certain specialists may be designated to assume some of the duties of the QAO.

2.3.8 NRC Project Manager

The NRC Project Manager will represent the NRC's interests in the Construction Project. The NRC Project Manager may choose to review selected procedures, personnel qualifications, equipment, calculations, and documentation.

2.3.9 Quality Control Technicians ("QCT")

2.3.9.1 Duties

The Quality Control Technicians ("QCTs) for implementation of the Quality Plan will be classified as follows:

(1) Construction Quality Control Technicians - Field.

(2) Construction Quality Control Technicians - Laboratory.

A QCT may be qualified for and perform the duties in more than one classification.

2.3.9.2 Qualifications

The QCO will supervise (or may appoint a supervisor) for each classification to provide scheduling, oversee equipment calibrations, enforce documentation requirements, and provide for preliminary document review. The number of QCTs in each classification will depend on the project needs as the work progresses.

The Construction QCTs will satisfactorily complete a training program and receive on-the-job training as required under the direction of the QCO.

A procedure verification program will be implemented by the QAO for all Construction QCTs.

2.4 PROGRAM FOR INFORMATION FLOW

2.4.1 Review of Documents

The Plans and Specifications for the Construction Project describe the work to be performed, the QC/QA, and the monitoring requirements. These documents will be reviewed and approved in depth by licensee personnel, including the QCO and Site Manager.

2.4.2 Information Flow

2.4.2.1 Internal Information Flow

As shown on the Organization Chart (Figure B-2), the Construction Superintendent gives instructions to the Construction Foremen, who supervise the construction workers. The Construction Superintendent may directly supervise all or some of the construction workers.

The QCO monitors the construction work and completes the forms and reports as given in the Quality Control Procedures. The QCO ensures that all key personnel receive the required information.

Section 4.0 below, "Changes and Corrective Actions," outlines the procedure for implementing changes and corrective actions.

2.4.2.2 Information Flow to NRC

All reports of sampling, tests, inspections and construction records will be maintained in the White Mesa Project files. These documents will be available to the NRC Project Manager at all times. The NRC Project Manager will have the right to inspect and reproduce any documents as needed.

A list of the required reports is shown on Table B-I. These reports will be kept in the White Mesa Project Files.

3.0 SURVEYS, INSPECTIONS, SAMPLING AND TESTING

3.1 SCOPE

The following items are covered in this Section:

(1) Methods and procedures for surveys, inspections, sampling and testing during various construction tasks.

(2) The necessary qualifications of individuals performing surveys, inspections, sampling and testing.

(3) The number and type of surveys, inspections and/or tests to be conducted.

TABLE B-1
REQUIRED REPORTS

REPORT TYPE	FREQUENCY	ORIGINATOR	APPROVAL
Construction Activities	Daily during Construction	QC Technician	QC Officer
Sampling, Field and Laboratory Testing	Report for each respective test	QC Technician	QC Officer
*Compliance Report	Upon completion of Construction Segment	QC Officer	Site Manager
*Final Construction Report	After completion of the Construction Project	QC Officer Site Manager	Site Manager

* Reports to be submitted to the NRC

3.2 QUALITY CONTROL PROCEDURES

Quality Control Procedures will be written to meet the following objectives:

(1) To describe the equipment, calibration and methods/procedures to be followed in performing surveys, sampling and testing.

(2) To describe the procedures to observe construction activities.

(3) To describe the procedures for monitoring.

All Quality Control Procedures for sampling, testing, and monitoring will be conducted by the QCO and/or QCTs. The results will be reviewed and approved by the QCO before being delivered to the Document Control Officer ("DCO") for reproduction, distribution, and filing.

All boundary surveys will be made and documented by a registered land surveyor. Construction surveys will be made and documented by appropriately trained QCTs.

3.3 FREQUENCY AND TYPE

The number and type of survey, observations, inspections and/or tests are specified in the Plans and Specifications.

4.0 CHANGES AND CORRECTIVE ACTIONS

4.1 SCOPE

The methodology for dealing with changes and corrective actions is detailed in this Section.

4.2 AUTHORITY OF PERSONNEL

The Site Manager and/or the QCO will have the authority to reject material or work, to require removal or replacement, to specify and require appropriate actions if it is determined that the Quality Control/Quality Assurance, personnel, instructions, controls, tests, records are not conforming to the Plans and Specifications.

4.3 METHODOLOGY

4.3.1 Field and Design Changes

Changes in locations or alignments of construction features that do not alter design concepts will be approved by the Site Manager or a designated representative. These changes will require a Field Change Order (Form F-25).

Changes in design concepts will be approved and documented by the Design Engineer, will be approved by the Site Manager. These changes will require a Design Change Order (Form F-26).

All changes will be recorded in the Final Construction Report including "as-built" drawings for the work.

4.3.2 Corrective Actions

The QCO will require corrective actions if tests and observations indicate the work is not conforming to the intent of the Plans and Specifications. Appropriate corrective actions will be determined by reviewing pertinent Quality Control records. Contemplated corrective actions will be brought to the attention of the Site Manager and the Construction Superintendent.

5.0 DOCUMENTATION

5.1 SCOPE

Documentation requirements will include the following:

(1) The identification of the person who has authority to provide for the submittal and/or storage of all survey, test and inspection reports.

(2) Specification of reporting requirements, forms, formats, and distribution of reports.

(3) A description of record keeping to document construction methods and results, surveys, sampling, testing and inspection of construction. Samples of forms and records will be included.

(4) Documentation of corrective actions.

5.2 PERSONNEL

5.2.1 <u>Document Control Officer ("DCO")</u>

5.2.1.1 Duties

The Document Control Officer ("DCO") will be appointed by the Site Manager. Responsibilities will include:

(1) Maintaining permanent files for the Construction Project. All tests, surveys, monitoring and report originals will be maintained in the project files.

(2) Instituting and overseeing data reproduction and distribution. A distribution list will be prepared for each project number and will be reviewed and approved by the QCO.

5.3 FORMS

All test results, sampling, surveys, and monitoring will be documented on the forms for those particular procedures where applicable. Specific surveys require a notebook prepared for data recording. Each Construction Field QCT will complete a Construction Activities report for each day's work. Forms will be completed so that all important data are recorded. Data required on all forms and notebooks includes project number, date, technician's signature, and the signature of the supervisor or a designee, who has reviewed and approved the work. The DCO will return all incomplete forms to the appropriate supervisor to be properly filled out.

Forms F-23, F-25, and F-26 follow.

Form No. F-26

DESIGN CHANGE ORDER

Project No. ____________ Date ____________

Drawing No. ____________

Specification No. ____________

Design feature

____

____

____

Change in design

____

____

____

____

Reason

____

____

____

Initiated by: ____________________________

Approvals:

Site Manager ____________________________

NRC Project Manager ____________________________

Design Engineer ____________________________

Form No. F-25

FIELD CHANGE ORDER

Project No. ______________ Date ________________

Drawing No. ______________

Specification No. ____________

Design feature

____

____

____

____

Modifications

____

____

____

____

Reason

____

____

____

____

Initiated by: ________________________________

Approved by: ________________________________

Site Manager

Form No. F-23

COMPLIANCE REPORT

Project No. ______________ Date ________________

Construction Segment ____

____

Drawing No. ______________

Specification No. _____________

Description of Completed Construction Segment

____

____

____

____

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____

By: QC Officer ________________________________

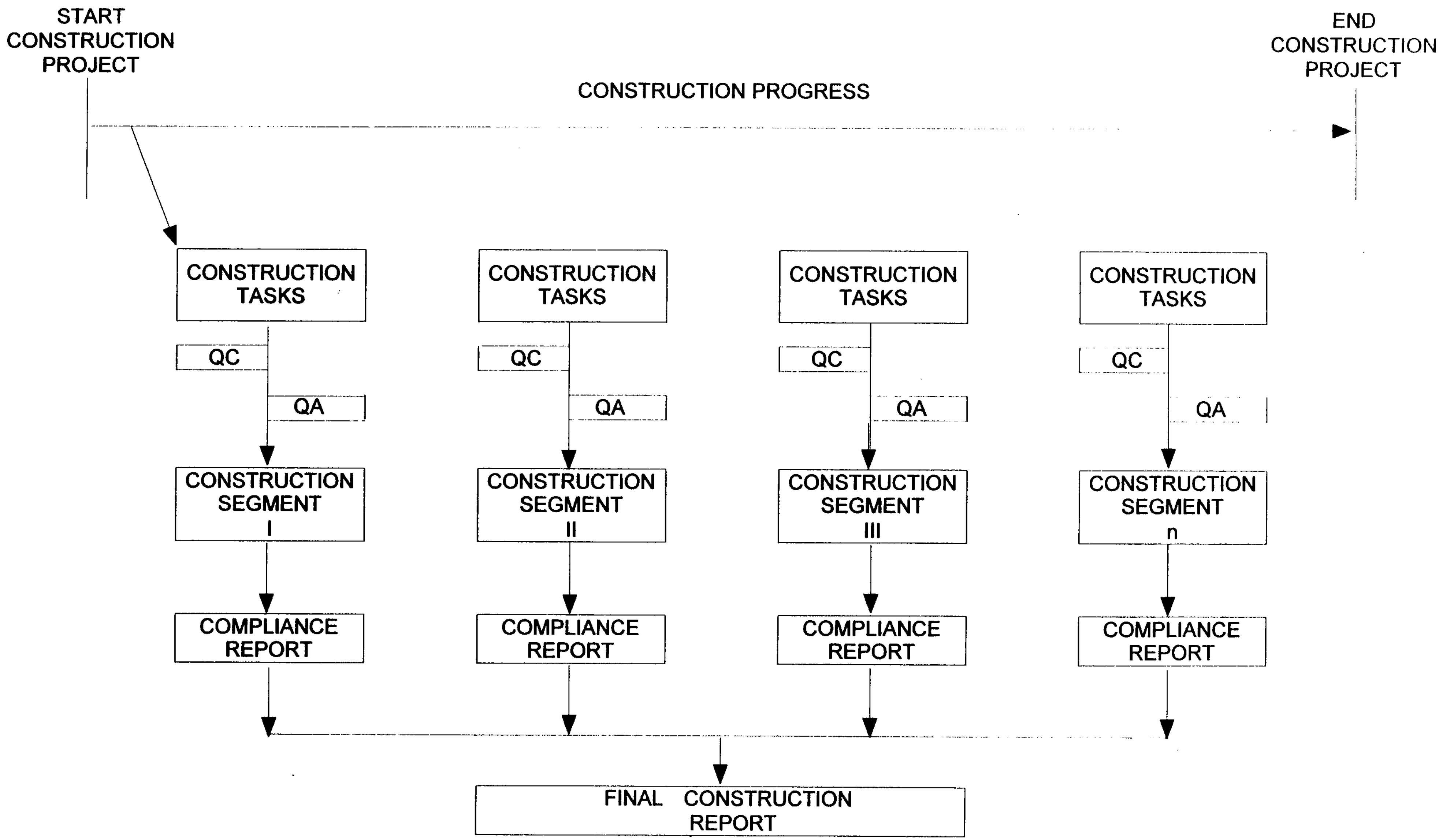
Approvals

Site Manager ________________________________

NRC Project Manager ____________________________

FIG B-1

TYPICAL FLOW CHART FOR CONSTRUCTION PROJECT



ATTACHMENT C

COST ESTIMATES

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

1050 17th STREET, SUITE 950

DENVER, COLORADO 80265

International Uranium (USA) Corp.

Cost Estimates for Reclamation

Of

White Mesa Mill

Blanding, Utah

JULY 2000

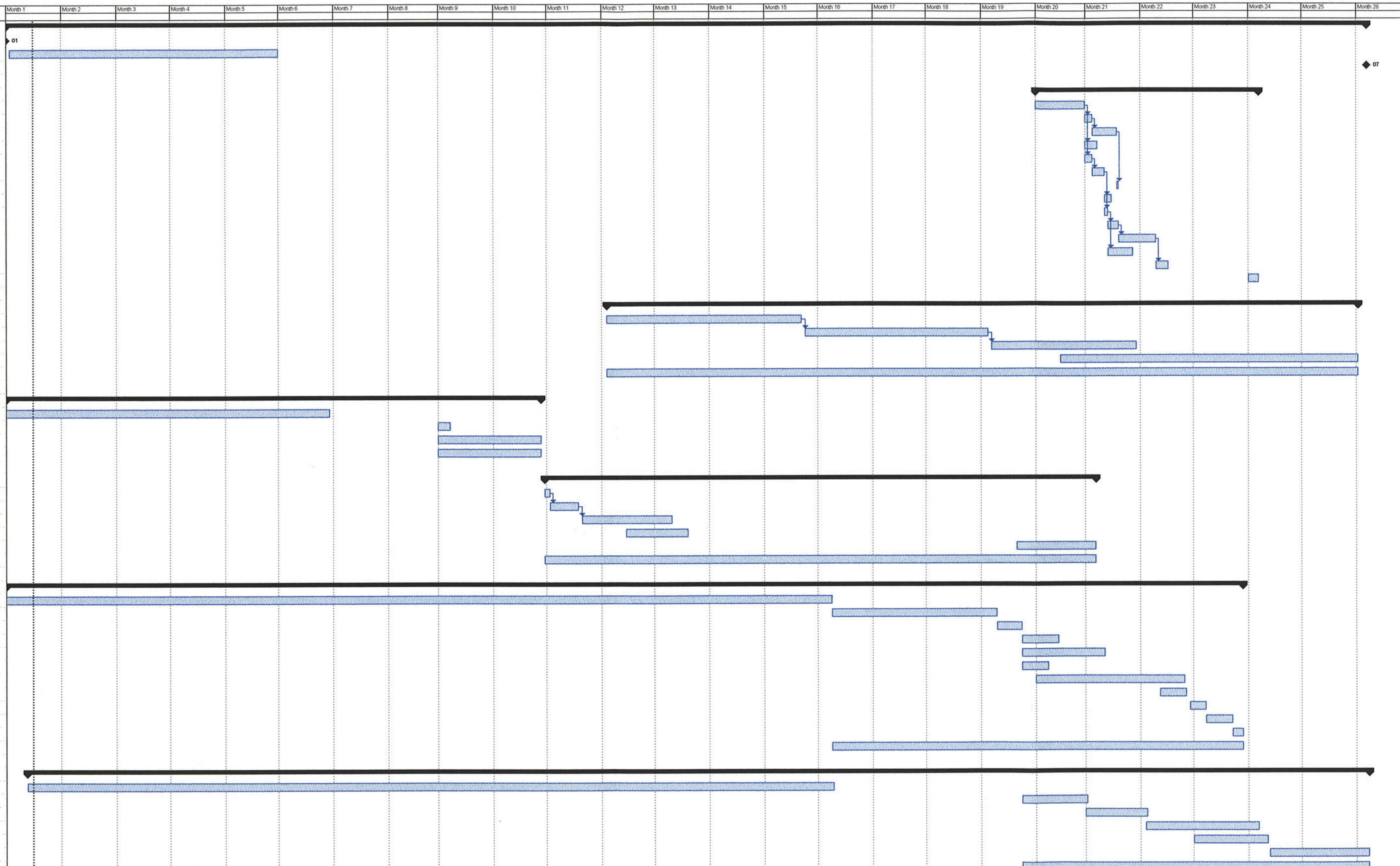
Source Material License No. SUA-1358
Docket No. 40-8681

International Uranium (USA) Corp.

Cost Estimates for Reclamation of White Mesa Mill

Table of Contents

ID	Task Name
1	**Project Startup**
2	Start Reclamation
	Obtain Permit for Borrow Site Section 16
	Reclamation Complete
5	
6	**Mill Decommissioning**
7	Mill Building Demolition
8	Ore Feed Demolition
9	SX Building Demolition
10	CCD Circuit Removal
11	Vanadium Oxidation Circuit Removal
12	Boiler Plant Demolition
13	Sample Plant Demolition
14	Misc. Tankage and Spare Parts
15	Cleanup Equipment Storage Area
16	Main Shop Warehouse Demolition
17	Mill Yard Decontamination
18	Ore Storage Pad Decontamination
19	Revegetate Mill Yard and Ore Pad
20	Remove Office Building
21	
22	**Wind Blown Contamination**
23	Scoping Survey
24	Characterization Survey
25	Windblown Cleanup
26	Final Status Survey
27	Quality Control
28	
29	**Reclamation of Cell 4A**
30	Dewatering
31	Remove Fencing
32	Remove Liner and Contaminated Materials
33	Quality Control
34	
	Reclamation of Cell 2
	Place Remainder of Bridging Lift
37	Place upper 12" Platform
38	Place Clay Layer (Radon Barrier)
39	Place Upper Random Fill (Frost Barrier)
40	Place Rock Armor
41	Quality Control
42	
43	**Reclamation of Cell 1-I**
44	Dewatering
45	Crystal Removal
46	Contaminated Material Removal
47	Topsoil Application
48	Construct Outfall Channel
49	Installation of Clay Liner
50	Disposal of Mill Debris and Contaminated Soil
51	Place Lower Random Fill
52	Place Clay Layer (Radon Barrier)
53	Place Upper Random Fill (Frost Barrier)
54	Place Rock Armor
55	Quality Control
56	
57	**Reclamation of Cell 3**
58	Dewatering
59	Place Remainder of Bridging Lift
60	Place upper 12" Platform
61	Place Clay Layer (Radon Barrier)
62	Place Upper Random Fill (Frost Barrier)
63	Place Rock Armor
64	Quality Control



hite Mesa Mill Reclamation Sc n 07/16/00	Task	Split	Progress	Milestone	Summary	Rolled Up Task	Rolled Up Split	Rolled Up Milestone	Rolled Up Progress	External Tasks	Project Summary	

International Uranium (USA) Corporation
White Mesa Mill Reclamation
Revision 3.0 - July 2000

WHITE MESA MILL RECLAMATION COST ESTIMATE
July 2000

		July 2000 Estimate
Mill Decommissioning		$1,505,167
Cell 2		$1,082,870
Cell 3		$1,565,444
Cell 4A		$120,128
Cell 1		$1,234,212
Miscellaneous		$1,939,480
Subtotal Direct Costs		$7,447,302
Profit Allowance	10.00%	$744,730
Contingency	15.00%	$1,117,095
Licensing & Bonding	2.00%	$148,946
Long Term Care Fund		$606,721
Total Reclamation		$10,064,794
Revised Bond Amount		$10,064,794

MILL DECOMMISIONING

Mill Building Demolition

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	720	$12,757
Mechanics	hrs	$13.80	640	$8,829
Laborers	hrs	$10.35	320	$3,311
Small Tools	hrs	$1.25	960	$1,200
Cat 769 Haul Truck	hrs	$60.52	640	$38,735
Truck Drivers	hrs	$12.74	640	$8,154
Cat 988 Loader	hrs	$95.68	160	$15,308
Cat 375 Excavator	hrs	$123.76	160	$19,802
PC-400 with Shears	hrs	$159.84	160	$25,574
65 Ton Crane	hrs	$55.91	160	$8,946
30 Ton Crane	hrs	$40.80	80	$3,264
Equipment Maintenance (Butler)	hrs	$10.01	1,360	$13,617
Concrete Removal	sf	$3.30	37,500	$123,750

Total Mill Building Demolition **$283,247**

Ore Feed Demolition

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	48	$850
Mechanics	hrs	$13.80	64	$883
Laborers	hrs	$10.35	32	$331
Small Tools	hrs	$1.25	96	$120
Cat 769 Haul Truck	hrs	$60.52	64	$3,873
Truck Drivers	hrs	$12.74	64	$815
Cat 988 Loader	hrs	$95.68	16	$1,531
Cat 375 Excavator	hrs	$123.76	16	$1,980
PC-400 with Shears	hrs	$159.84	16	$2,557
30 Ton Crane	hrs	$40.80		$0
Equipment Maintenance (Butler)	hrs	$10.01	112	$1,121

Total Ore Feed Demolition **$14,063**

SX Building Demolition

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	240	$4,252
Mechanics	hrs	$13.80	320	$4,415
Laborers	hrs	$10.35	160	$1,655
Small Tools	hrs	$1.25	480	$600
Cat 769 Haul Truck	hrs	$60.52	320	$19,367
Truck Drivers	hrs	$12.74	320	$4,077
Cat 988 Loader	hrs	$95.68	80	$7,654
Cat 375 Excavator	hrs	$123.76	80	$9,901
PC-400 with Shears	hrs	$159.84	80	$12,787
65 Ton Crane	hrs	$55.91		$0
30 Ton Crane	hrs	$40.80		$0
Equipment Maintenance (Butler)	hrs	$10.01	560	$5,607
Concrete Removal	sf	$3.30	55,970	$184,701

Total SX Building Demolition **$255,017**

CCD Circuit Removal

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	195	$3,455
Mechanics	hrs	$13.80	120	$1,655
Laborers	hrs	$10.35	60	$621
Small Tools	hrs	$1.25	180	$225
Cat 769 Haul Truck	hrs	$60.52	120	$7,263
Truck Drivers	hrs	$12.74	120	$1,529
Cat 988 Loader	hrs	$95.68	30	$2,870
Cat 375 Excavator	hrs	$123.76	30	$3,713
PC-400 with Shears	hrs	$159.84	30	$4,795
65 Ton Crane	hrs	$55.91	30	$1,677
30 Ton Crane	hrs	$40.80	15	$612
Equipment Maintenance (Butler)	hrs	$10.01	315	$3,154
Concrete Removal	sf	$3.30	15,000	$49,500

Total CCD Circuit Removal **$81,070**

Sample Plant Removal

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	24	$425
Mechanics	hrs	$13.80	32	$441
Laborers	hrs	$10.35	16	$166
Small Tools	hrs	$1.25	48	$60
Cat 769 Haul Truck	hrs	$60.52	32	$1,937
Truck Drivers	hrs	$12.74	32	$408
Cat 988 Loader	hrs	$95.68	8	$765
Cat 375 Excavator	hrs	$123.76	8	$990
PC-400 with Shears	hrs	$159.84	8	$1,279
30 Ton Crane	hrs	$40.80		$0
Equipment Maintenance (Butler)	hrs	$10.01	56	$561
Concrete Removal	sf	$3.30	4,200	$13,860

Total Sample Plant Removal **$20,892**

Boiler Demolition

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	120	$2,126
Mechanics	hrs	$13.80	160	$2,207
Laborers	hrs	$10.35	80	$828
Small Tools	hrs	$1.25	240	$300
Cat 769 Haul Truck	hrs	$60.52	160	$9,684
Truck Drivers	hrs	$12.74	160	$2,038
Cat 988 Loader	hrs	$95.68	40	$3,827
Cat 375 Excavator	hrs	$123.76	40	$4,951
PC-400 with Shears	hrs	$159.84	40	$6,394
65 Ton Crane	hrs	$55.91		$0
30 Ton Crane	hrs	$40.80		$0
Equipment Maintenance (Butler)	hrs	$10.01	280	$2,804
Concrete Removal	sf	$3.30	2,900	$9,570

Total Boiler Demolition **$44,728**

Vanadium Oxidation Circuit Removal

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	48	$850
Mechanics	hrs	$13.80	64	$883
Laborers	hrs	$10.35	32	$331
Small Tools	hrs	$1.25	96	$120
Cat 769 Haul Truck	hrs	$60.52	64	$3,873
Truck Drivers	hrs	$12.74	64	$815
Cat 988 Loader	hrs	$95.68	16	$1,531
Cat 375 Excavator	hrs	$123.76	16	$1,980
PC-400 with Shears	hrs	$159.84	16	$2,557
65 Ton Crane	hrs	$55.91		$0
30 Ton Crane	hrs	$40.80		$0
Equipment Maintenance (Butler)	hrs	$10.01	112	$1,121
Concrete Removal	sf	$3.30	1,200	$3,960

Total Vanadium Oxidation Circuit Removal **$18,023**

Main Shop/Warehouse Demolition

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	96	$1,701
Mechanics	hrs	$13.80	128	$1,766
Laborers	hrs	$10.35	64	$662
Small Tools	hrs	$1.25	192	$240
Cat 769 Haul Truck	hrs	$60.52	128	$7,747
Truck Drivers	hrs	$12.74	128	$1,631
Cat 988 Loader	hrs	$95.68	32	$3,062
Cat 375 Excavator	hrs	$123.76	32	$3,960
PC-400 with Shears	hrs	$159.84	32	$5,115
Equipment Maintenance (Butler)	hrs	$10.01	224	$2,243
Concrete Removal	sf	$3.30	19,300	$63,690

Total Main Shop/Warehouse Demolition **$91,816**

Office Building Demolition

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	72	$1,276
Mechanics	hrs	$13.80	96	$1,324
Laborers	hrs	$10.35	48	$497
Small Tools	hrs	$1.25	144	$180
Cat 769 Haul Truck	hrs	$60.52	96	$5,810
Truck Drivers	hrs	$12.74	96	$1,223
Cat 988 Loader	hrs	$95.68	24	$2,296
Cat 375 Excavator	hrs	$123.76	24	$2,970
PC-400 with Shears	hrs	$159.84	24	$3,836
Equipment Maintenance (Butler)	hrs	$10.00	168	$1,680
Concrete Removal	sf	$3.30	12,100	$39,930

Total Office Building Demolition **$61,023**

Misc. Tankage & Spare Parts Removal

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	24	$425
Mechanics	hrs	$13.80	32	$441
Laborers	hrs	$10.35	16	$166
Small Tools	hrs	$1.25	48	$60
Cat 769 Haul Truck	hrs	$60.52	32	$1,937
Truck Drivers	hrs	$12.74	32	$408
Cat 988 Loader	hrs	$95.68	8	$765
Cat 375 Excavator	hrs	$123.76	8	$990
PC-400 with Shears	hrs	$159.84	8	$1,279
Equipment Maintenance (Butler)	hrs	$10.00	56	$560
Concrete Removal	sf	$3.20		$0

Total Misc. Tankage & Spare Parts Removal **$7,031**

Mill Yard Decontamination

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	582	$10,312
Cat 637 Scraper	hrs	$140.50	257	$36,110
Cat 988 Loader	hrs	$95.68	65	$6,219
Cat D8N Dozer With Ripper	hrs	$68.67	65	$4,463
Cat D7 Dozer	hrs	$57.90	65	$3,764
Cat 651 Waterwagon	hrs	$72.12	65	$4,688
Cat 14G Motorgrader	hrs	$48.93	65	$3,180
Equipment Maintenance (Butler)	hrs	$10.01	582	$5,827

Total Mill Yard Decontamination **$74,563**

Ore Storage Pad Decontamination

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	429	$7,601
Cat 637 Scraper	hrs	$140.50	189	$26,555
Cat 988 Loader	hrs	$95.68	48	$4,593
Cat D8N Dozer With Ripper	hrs	$68.67	48	$3,296
Cat D7 Dozer	hrs	$57.90	48	$2,779
Cat 651 Waterwagon	hrs	$72.12	48	$3,462
Cat 14G Motorgrader	hrs	$48.93	48	$2,348
Equipment Maintenance (Butler)	hrs	$10.01	429	$4,295

Total Ore Storage Pad Decontamination **$54,930**

Equipment Storage Area Cleanup

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	154	$2,729
Cat 637 Scraper	hrs	$140.50	69	$9,695
Cat 988 Loader	hrs	$95.68	17	$1,627
Cat D8N Dozer With Ripper	hrs	$68.67	17	$1,167
Cat D7 Dozer	hrs	$57.90	17	$984
Cat 651 Waterwagon	hrs	$72.12	17	$1,226
Cat 14G Motorgrader	hrs	$48.93	17	$832
Equipment Maintenance (Butler)	hrs	$10.01	154	$1,542

Total Equipment Storage Area Cleanup **$19,801**

Revegetate Mill Yard & Ore Pad

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	231	$4,093
Cat 637 Scraper	hrs	$140.50	132	$18,547
Cat 988 Loader	hrs	$95.68	0	$0
Cat D8N Dozer With Ripper	hrs	$68.67	33	$2,266
Cat D7 Dozer	hrs	$57.90	33	$1,911
Cat 651 Waterwagon	hrs	$72.12		$0
Cat 14G Motorgrader	hrs	$48.93	33	$1,615
Equipment Maintenance (Butler)	hrs	$10.01	231	$2,313

Total Revegetate Mill Yard & Ore Pad **$30,744**

Total Demolition and Decontamination **$1,056,948**

CLEANUP OF WINDBLOWN CONTAMINATION

Scoping Survey

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Soil Samples	each	$50.00	100	$5,000
Survey Crew	hrs	$13.19	752	$9,917
Sample Crew	hrs	$13.19	1,312	$17,301

Total Scoping Survey **$32,218**

Characterization Survey

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Soil Samples	each	$50.00	472	$23,600
Sample Crew	hrs	$13.19	1,136	$14,980

Total Characterization Survey **$38,580**

Final Status Survey

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Soil Samples	each	$50.00	300	$15,000
Sample Crew	hrs	$13.19	3,552	$46,840

Total Final Status Survey **$61,840**

Windblown Cleanup

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	1,190	$21,084
Cat 637 Scraper	hrs	$140.50	680	$95,543
Cat D8N Dozer With Ripper	hrs	$68.67	170	$11,673
Cat D7 Dozer	hrs	$57.90	170	$9,844
Cat 14H Motorgrader	hrs	$48.93	170	$8,317
Soil Samples	each	$50.00	500	$25,000
Survey Crew	hrs	$13.19	163	$2,149
Sample Crew	hrs	$13.19	83	$1,095
Equipment Maintenance (Butler)	hrs	$10.01	1,190	$11,915

Total Windblown Cleanup **$186,621**

Quality Control

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Quality Control Contractor	hrs	$62.00	2,080	**$128,960**

Total Quality Control **$128,960**

Total Cleanup Windblown Contamination **$448,219**

TOTAL MILL DECOMMISIONING **$1,505,166**

INTERNATIONAL URANIUM (USA) CORP.
COST ESTIMATE

IE/PROJECT............ Date............ Calc by............ Sheet..... of.........

MILL DECOMMISSIONING

1) REMOVAL OF CONTAMINATED MATERIALS FROM MILL YARD.

ASSUME:

- 18" (1.5 feet) WILL HAVE TO BE REMOVED
- AREA (FROM CAD) = 1,643,453 ft²
  = 37.8 ACRES

Therefore VOLUME MOVED = [1,643,453 × 1.5] ÷ 27 = 91,302 yd³

SAY **91,300 yd³**

$\frac{91,300 \text{ yd}}{355 \text{ yd/hr}}$ = **257 hours**

HAUL ROUTE # 2

2) REMOVAL OF CONTAMINATED MATERIALS FROM ORE PAD

ASSUME:

- 18" WILL HAVE TO BE REMOVED
- AREA (from CAD) = 976,780 ft²
  = 22.4 ACRES.

Therefore VOLUME MOVED = [976,780 × 1.5] ÷ 27 = 54,265 yd³

SAY **54,300 yd³**

$\frac{54,300 \text{ yd}}{287 \text{ yd/hr}}$ = **189 hours**

HAUL ROUTE # 3

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COST ESTIMATE

NE/PROJECT .... Date .... Calc by .... Sheet ...... of ......

MILL DECOMMISSIONING

3) DEMOLITION EQUIPMENT
- KAMATSU PC400 (OR CAT EQUIVALENT) WITH La Bounty Shears (hydraulic)
- CAT 275L BACKHOE w/ GRAPPLES.
- 769C ROCK TRUCKS (4 ea)
- 988 LOADER (1 ea)

4) DEMOLITION CREW.
- HEAVY EQUIPMENT OPERATORS - PC400, 275, 988
- DUST CONTROL - 2 - LABORERS
- MECHANICS - CUTTING UP OF DEBRIS TO REMOVE VOIDS 4
- TRUCK DRIVERS - 4 ea - 769D TRUCKS

5) TOOL & EXPENDABLE ALLOWANCE, COVERING THE FOLLOWING:
- SAFETY GEAR
- HAND TOOLS
- BOTTLED GASES & TORCHES.
- ALLOW 1.25 / MAN HOUR FOR ALL BUT H.E. OPERATORS + TRUCK DRIVERS

NE/PROJECT .... Date .... Calc by .... Sheet ...... of ......

MILL DECOMMISSIONING

6) DEMOLITION TIME ESTIMATES. (SHEAR & GRAPPLE)

◦ MILL BUILDING	20 days
◦ COARSE ORE	2 days
◦ SX BUILDING	10 days
◦ CCD, PLT, CLARKONE	5 days
◦ SAMPLE PLANT	1 day
◦ BOILER	5 days
◦ Vanadium Oxidation	2 days
◦ SHOP / WAREHOUSE	4 days
◦ OFFICE BUILDING	3 days
◦ MISC TANKAGE & "NORTH FORTY"	4 days

7) FOUNDATION DEMOLITION

- ASSUME THAT MEANS 020-750-0440 OVER ENTIRE AREA OF STRUCTURE WILL SUFFICE @ \$3.30/ft²
- AREAS ARE AS FOLLOWS. (FROM CAD)

	AREA, FT²	EST \$
MILL BUILDING	37,500	120,000
SX BUILDING	55,970	179,100
SHOP / WAREHOUSE	19,280	61,700
OFFICE	12,100	38,700
SAMPLE PLANT	4,200	13,400
DIESEL SHOP	2050	6,600
BOILER	2900	9,300

- LABOR \$2.75, EQUIP \$.55

INTERNATIONAL URANIUM (USA) CORP.
COST ESTIMATE

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MILL DECOMMISSIONING

8) REVEGITATION
ASSUME ---
- MILL YARD AREA = 1,643,453 ft^2
- ORE PAD AREA = 976,780 ft^2
- PLACE 6"
- 637 ROUTE #4 APPROXIMATES HAUL

therefore $\left[[1,643,453 + 976,780]\, ft^2 * \tfrac{1}{2}\, ft \right] \div 27\, ft^3/yd = 48,522\, yd^3$

say **48,600 yd^3**

$\therefore \dfrac{48,600\, yd^3}{368\, yd^3/hr}$ = **132 "637" hours**

MILL DECOMMISSIONING

WIND BLOWN CONTAMINATION

1) Scoping Survey

- Initial survey will be conducted on a area to be determined But for this estimate it is defined as an area approximated by A perimeter 1000 feet outside of the Restricted Area Boundries This is conservative since wind blown contamination would most likely be found down wind of the site, which is on the East side of the restricted area

- Area determined by Cad. = 38,728,000 ft^2

Area Requiring wind blown Survey is

Total Area –	38,728,000 ft^2
Cell 4A	1,909,000 ft^2
Cell 3	3,234,000 ft^2
Cell 2	2,987,000 ft^2
Cell 1	2,576,000 ft^2
Mill Yard	1,643,000 ft^2
Ore Storage Pad	977,000 ft^2
	25,402,000 ft^2

- Assume Placement of standard NRC/EPA 10 x 10 meter grid (1076 ft^2)
- Assume Scoping Survey Completed by Scanning with MR meter Held close to ground while traveling at ± 0.5 m/sec as per Guidance in NUREG 5849.

- Survey Crew of 2 Capable of setting 500 grid points per Day

$$\frac{25,402,000\ ft^2}{1076\ ft^2} = 23,600 \text{ Grid points}$$

$$\frac{23600 \text{ Points}}{500 \text{ points/Day}} \cong 47 \text{ Days}$$

2 men x 8hrs x 47 Days = **752 man hrs** – Survey

- Scanning Crew Consists of 2 men –

- Coverage 0.5 m/sec x 60 sec/min x 8hrs/day = 14,400 m/Day

Assume .8 eff. factor

14,400 m/day x .8 = 11,520 m/day

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Windblown Contamination – Scoping Survey

- Assume 30 meter path for each 10 x 10 grid to cover 10% of surface area (per NUREG 5849)

Crew can scan $\frac{11,520 \text{ m/day}}{30 \text{ m/grid}}$ = 384 Grids/day

∴ $\frac{23,600 \text{ Grids}}{384 \text{ Grids/day}}$ ≅ 62 Day to complete initial scan

62 Days x 2 men x 8 hrs/day = **992 man hrs**

- Assume map production + data reduction take scanning crew an additional 20 days to complete

20 days x 2 men x 8 hrs/day = **320 man Hrs**

Total scanning man hrs = **1312**

- Scoping survey will require 100 confirmatory soil samples at a cost of $50.00/each (Unat + Ra 226)
- Samples can be taken at same time as scanning takes place.

2) Characterization Survey –

Survey of areas identified as affected areas by scoping survey

- Assume:
  - 20% of area will require additional sampling
  - Probing will be used, 4 probe sites/grid (Beta/Gamma)
  - Soil samples will be required on 10% of grid samples
    - Samples will be for Unat + Ra 226
    - Cost/Sample = $50 (Lab)

$\frac{25,402,000 \text{ ft}^2}{1076 \text{ ft}^2/\text{grid}}$ = 23,608 Grids x .2 = 4722 Grids

- Crew can cover 100 Grids/day probing
- Crew can take 25 soil samples/day

Probing takes $\frac{4722 \text{ Grids}}{100 \text{ Grid/day}}$ ≅ **47 Days**

47 x 2 x 8 = **752 hrs**

WINDBLOWN CONTAMINATION – CHARACTERIZATION SURVEY

Soil Sample are 10% of Probe grids

4721 × .10 = 472 Soil Samples

$\frac{472 \text{ Samples}}{25 \text{ Samples/day}} \cong$ 19 days × 8hrs × 2 = 304 man hrs

Map Preparation + Data Reduction take another 5 days

5 day × 2 man × 8 hr = 80 man hrs

TOTAL Hrs = 1136 man hrs

3) REMEDIATION CONTROL SURVEY

- Provided by QA/QC Contractor

4) FINAL STATUS SURVEY

- IN ORDER TO GAIN FINAL RELEASE, WILL REQUIRE 4 GAMMA ESTIMATES PER EACH 100 m² GRID SQUARE IN THE AFFECTED AREA (20% of AREA)
- 200 RANDOM SOIL SAMPLES WILL BE GATHERED FROM THE UNAFFECTED AREAS (80% of AREA)
- WILL REQUIRE 100 CONFIRMATORY SAMPLES FOR THE AFFECTED AREA

Therefore

	25,402 ÷ 1076 ft²/100m²	=	23,607 GRIDS TOTAL
	23,607 × 0.20	=	4,721 GRIDS AFFECTED
	4,721 × 4	=	18,886 GAMMA ESTIMATES.

- CREW CAN TAKE 100 PROBE SAMPLES / DAY
  ∴ 18886 ÷ 100 = 188.8 days say 190 days
- CREW CAN TAKE 25 SOIL SAMPLES / DAY
  ∴ [200 + 100] ÷ 25 = 12 days.

- ASSUME 20 additional DAYS FOR DATA REDUCTION & REPORT GENERATION

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COST ESTIMATE

NE/PROJECT........ Date........ Calc by........ Sheet.... of....

MILL DECOMISSIONING
WIND BLOWN CONTAMINATION (Cont)

5) CLEAN-UP.

- ASSUME 20% OF AREA SURVEYED REQUIRES CORRECTIVE ACTION
- 6" OF SOIL WILL BE STRIPPED

Therefore 25,402 Mft² × 0.20 × 0.5 ft = 2,540,000 ft³

or 94,080 yd³

say **94,100 yd³**

- AS IT IS NOT KNOWN WHAT AREAS MAY BE CONTAMINATED, ASSUME THE USE OF 637 HAUL ROUTE #6 TO BE CONSERVATIVE
- BECAUSE OF THE POTENTIAL FOR IRREGULAR & DISCONNECTED AREAS, EFFICIENCY WILL BE ONLY 50% OF REGULAR 637 EFFICIENCY.

Therefore 277 yd³/hr × 0.50 = 138.5 yd³/hr

say **138 yd³/hr**

Therefore 94,100 yd³ ÷ 138 yd³/hr = 681 scraper hours

say **680 hours**

RECLAMATION OF CELL 2

Obtain Permits for Clay Borrow Site - Section 16

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Permits & Licences	ea	$10,000.00	5	**$50,000**

Total Obtain Permits for Clay Borrow Site - Section 16 **$50,000**

Place Remainder of Bridging Lift

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	178	$3,154
Cat 637 Scraper	hrs	$140.50	78	$10,959
Cat 825 Compactor	hrs	$66.15	20	$1,323
Cat D8N Dozer With Ripper	hrs	$68.67	20	$1,373
Cat D7 Dozer	hrs	$57.90	20	$1,158
Cat 651 Waterwagon	hrs	$72.12	20	$1,442
Cat 14G Motorgrader	hrs	$48.93	20	$979
Equipment Maintenance (Butler)	hrs	$10.01	178	$1,782

Total Place Remainder of Bridging Lift **$22,171**

Place Lower Random Fill (12")

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	902	$15,981
Cat 637 Scraper	hrs	$140.50	402	$56,483
Cat 825 Compactor	hrs	$66.15	100	$6,615
Cat D8N Dozer With Ripper	hrs	$68.67	100	$6,867
Cat D7 Dozer	hrs	$57.90	100	$5,790
Cat 651 Waterwagon	hrs	$72.12	100	$7,212
Cat 14G Motorgrader	hrs	$48.93	100	$4,893
Equipment Maintenance (Butler)	hrs	$10.01	902	$9,032

Total Place Lower Random Fill (12") **$112,872**

Clay Layer

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	1,674	$29,660
Cat 825 Compactor	hrs	$66.15	300	$19,844
Cat D8N Dozer With Ripper	hrs	$68.67	300	$20,600
Cat D7 Dozer	hrs	$57.90	0	$0
Cat 651 Waterwagon	hrs	$72.12	300	$21,635
Cat 14G Motorgrader	hrs	$48.93	300	$14,678
Cat 980 Loader	hrs	$64.99	237	$15,402
5000 Gallon Water Truck	hrs	$40.64	237	$9,631
Highway Trucks	hrs	$32.00	1,896	$60,672
Truck Drivers	hrs	$12.74	1,896	$24,156
Equipment Maintenance (Butler)	hrs	$10.01	3,570	$35,746

Total Place Clay Layer **$252,023**

RECLAMATION OF CELL 2

Upper Randum Fill

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	1,990	$35,258
Cat 637 Scraper	hrs	$140.50	796	$111,842
Cat 825 Compactor	hrs	$66.15	199	$13,163
Cat D8N Dozer With Ripper	hrs	$68.67	199	$13,665
Cat D7 Dozer	hrs	$57.90	199	$11,523
Cat 651 Waterwagon	hrs	$72.12	199	$14,352
Cat 14G Motorgrader	hrs	$48.93	199	$9,736
5000 Gallon Water Truck	hrs	$40.64	199	$8,087
Equipment Maintenance (Butler)	hrs	$10.01	1,990	$19,925

Total Place Upper Randum Fill **$237,550**

Rock Armour

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	789	$13,979
Cat D7 Dozer	hrs	$57.90	263	$15,229
Cat 651 Waterwagon	hrs	$72.12	263	$18,967
Cat 14G Motorgrader	hrs	$48.93	263	$12,867
Rock Cost Delivered	CY	$3.34	66,200	$220,965
Equipment Maintenance (Butler)	hrs	$10.01	180	$1,802

Total Place Rock Armour **$283,810**

Quality Control

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Quality Control Contractor	hrs	$62.00	1,050	**$65,100**

Total Quality Control **$65,100**

TOTAL RECLAMATION OF CELL 2 **$1,023,526**

Volume Calculations
Cell 2

2/10/99

1) Area of Cell 2 - 2,986,660 ft^2 = **68.56 Acres**

2) Area of Cell 2 Still open 2/10/99 (See Figure A)

1000 × 200 Approximate Area ≈ 200,000 sf (4.6 acres)

3) Assumptions:

- Bridging layer is placed using random fill from piles west of Cell 2
- Cell will be graded to Design elevation utilizing finer materials in random fill stockpile and from "Clay" stockpiles.
- Clay will be mined, blended & hauled from borrow site located in Section 16 - 4 miles South of the mill - using Belly dump Trucks - Clay Layer on top of Cell only, except on South slope Common to Cell 3
- The upper 2 feet of random fill will be placed utilizing the fine random fill and clay stockpiles
- Rock for side Armor, Top Armor and Toe aprons will come from an offsite gravel source 1 mile north of Blanding, Rock will be produced through screening, stockpiled and trucked to the site at the time of use. Belly dump Trucks will Dump gravel in windrows on the top and sides of the Cell.

4) Bridging Layer (Random Fill) Left to place

$$\frac{200{,}000\ ft^2 \times 3\ ft}{27\ ft^3/cy} = 22{,}222\ cy \rightarrow \boxed{23{,}000\ cy}$$

5) Bring Lower random fill up to Design Elevations

Assume Full Area of Cell × 1 foot thick

$$\frac{2{,}986{,}660\ ft^2 \times 1\ ft}{27\ ft^3/cy} = 110{,}617\ cy \rightarrow \boxed{110{,}700\ cy}$$

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Volume Calculation Cell 2
(cont)

6) Placement of Clay Layer (1 foot thick on top of cell only)

Full Area of Cell × 1ft thick

$$\frac{2986,660 ft^2 \times 1ft}{27 ft^3/cy} = 110,617 cy \rightarrow \boxed{110,700 cy}$$

7) Upper Random Fill Volume – Top of Pile

Full Area of Cell × 2 ft Thick

$$\frac{2986,660 ft^2 \times 2ft}{27 ft^3/cy} = 221,234 cy \rightarrow \boxed{221,300 cy}$$

8) Armor Protection – Top of Cell

Full Area of Cell × .5ft

$$\frac{2986,660 ft^2 \times .5 ft}{27 ft^3/cy} = 55,309 cy - \boxed{55,400 cy}$$

9) Cell 2 North Slope (Slope #1) Common with Cell 1

- Average height = 12 feet
- Length ≅ 2600 ft

a) Random Fill to Reduce Slope From 3:1 to 5:1

First Wedge $$\left[\frac{12 \times 12 \times 5}{2} - \frac{12 \times 12 \times 3}{2}\right] \times 2600$$

$$= \frac{374,400 ft^3}{27 ft^3/cy} = 13,867 cy$$

$$= \boxed{13,900 cy}$$

Remaining Random Fill

$$\left[\frac{15 \times 15 \times 5}{2} - \frac{12 \times 12 \times 5}{2}\right] \times 2600$$

$$\frac{526,500 ft^3}{27 ft^3/cy} = \boxed{19,500 cy}$$

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Volume Calculations Cell 2
(Cont)

Total Random Fill N slope = **33,400 cy**

b) Rock Armour 8" thick - (.67 ft)

$$\left[\frac{15.67 \times 15.67 \times 5}{2} - \frac{15 \times 15 \times 5}{2}\right] \times 2600 \text{ ft}$$

$$\frac{132,957 \text{ ft}^3}{27 \text{ ft}^3/\text{cy}} = 4925 \text{ cy} \rightarrow \boxed{5000 \text{ cy}}$$

c) Toe Apron $\frac{2 \times 7 \times 2600}{27} =$ 1348 cy → **1400 cy** → **6400 cy**

10) North slope common with mill yard

- Average height 1 ft
- Average length 900 ft

a) Random Fill — Wedge — $\left[\frac{1 \times 1 \times 5}{2} - \frac{1 \times 1 \times 3}{2}\right] \times 900 \text{ ft}$

$$\frac{900 \text{ ft}^3}{27 \text{ ft}^3/\text{cy}} = 33 \text{ cy} \rightarrow \boxed{100 \text{ cy}}$$

Remaining Fill → Random $\left[\frac{4 \times 4 \times 5}{2} - \frac{1 \times 1 \times 5}{2}\right] \times 900 \text{ ft}$

$$\frac{33,750 \text{ ft}^3}{27 \text{ ft}^3/\text{cy}} = 1250 \text{ cy}$$

→ **1300 cy**

Total Random Fill **1,400 cy**

b) Rock Armour. 8" thick

$$\left[\frac{4.67 \times 4.67 \times 5}{2} - \frac{4 \times 4 \times 5}{2}\right] \times 900$$

$$\frac{13,070 \text{ ft}^3}{27 \text{ ft}^3} = 484 \text{ cy}$$

500 cy

No Toe Apron No Fill

Volume Calculation Cell 2
(Cont)

11) Cell 2 West Dike Slope # 3

- Average Height 2 ft
- Length 500 ft.

a) Random Fill

Wedge $\left[\frac{2 \times 2 \times 5}{2} - \frac{2 \times 2 \times 3}{2}\right] \times 500 = 2000$ cft

= 74 cy → **100 cy**

Remaining Random fill $\left[\frac{5 \times 5 \times 5}{2} - \frac{2 \times 2 \times 5}{2}\right] \times 500$

$= \frac{26,250 \text{ ft}^3}{27 \text{ ft}^3/\text{cy}} \simeq 972$ cy ⇒ **1,000 cy**

Total **1100 cy**

b) Rock Armor $\left[\frac{5.67 \times 5.67 \times 5}{2} - \frac{5 \times 5 \times 5}{2}\right] \times 500$

$= \frac{8936 \text{ ft}^3}{27 \text{ ft}^3} \simeq 331$ cy → **400 cy**

Toe Apron (?) → not required for slope 10' long – Drainage from Cell goes south to Cell 3 and then off of South slope of Cell 3

12) Cell 2 East Dike (Slope # 4)

- Average height 1 ft
- Length = 1,250 ft

a) Random Fill Wedge From # 10 1 ft^3/LF

$1 \text{ ft}^3/\text{LF} \times 1250' = 1250 \text{ ft}^3$

= 46 cy → **100 cy**

Remaining Random Fill – From # 10 37.5 ft^3/LF

$\frac{37.5 \text{ ft}^3/\text{LF} \times 1250 \text{ LF}}{27 \text{ ft}^3/\text{cy}} = 1736$ cy → **1800 cy**

Total – Random Fill **1900 cy**

Volume Calculation Cell 2
(cont)

12 (cont) Rock Armor 8" (.67') thick

Using #10 14.52 ft³/LF Dike

14.52 cf/lf x 1250 LF = 18,153 ft³

$\frac{18,153\ ft^3}{27\ ft^3/cy} \Rightarrow$ 672 cy → **700 cy**

No toe apron →

13) South Slope Cell 2 Common with Cell 3

- Average Height 3 ft
- Length 3500 ft

a) Random Fill — Wedge → $\left[\frac{3 \times 3 \times 5}{2} + \frac{3 \times 3 \times 3}{2}\right] \times 3{,}500$

$= \frac{31500\ ft^3}{27} = 1167$ cy

→ **1200 cy**

b) Clay Layer $\left[\frac{4 \times 4 \times 5}{2} - \frac{3 \times 3 \times 5}{2}\right] \times 3500$

$\frac{61250\ ft^3}{27} = 2268$ cy → **2300 cy**

c) Random Fill (upper) $\left(\frac{6 \times 6 \times 5}{2} - \frac{4 \times 4 \times 5}{2}\right) \times 3500$

$\frac{175,000\ ft^3}{27} = 6481$ cy → **6500 cy**

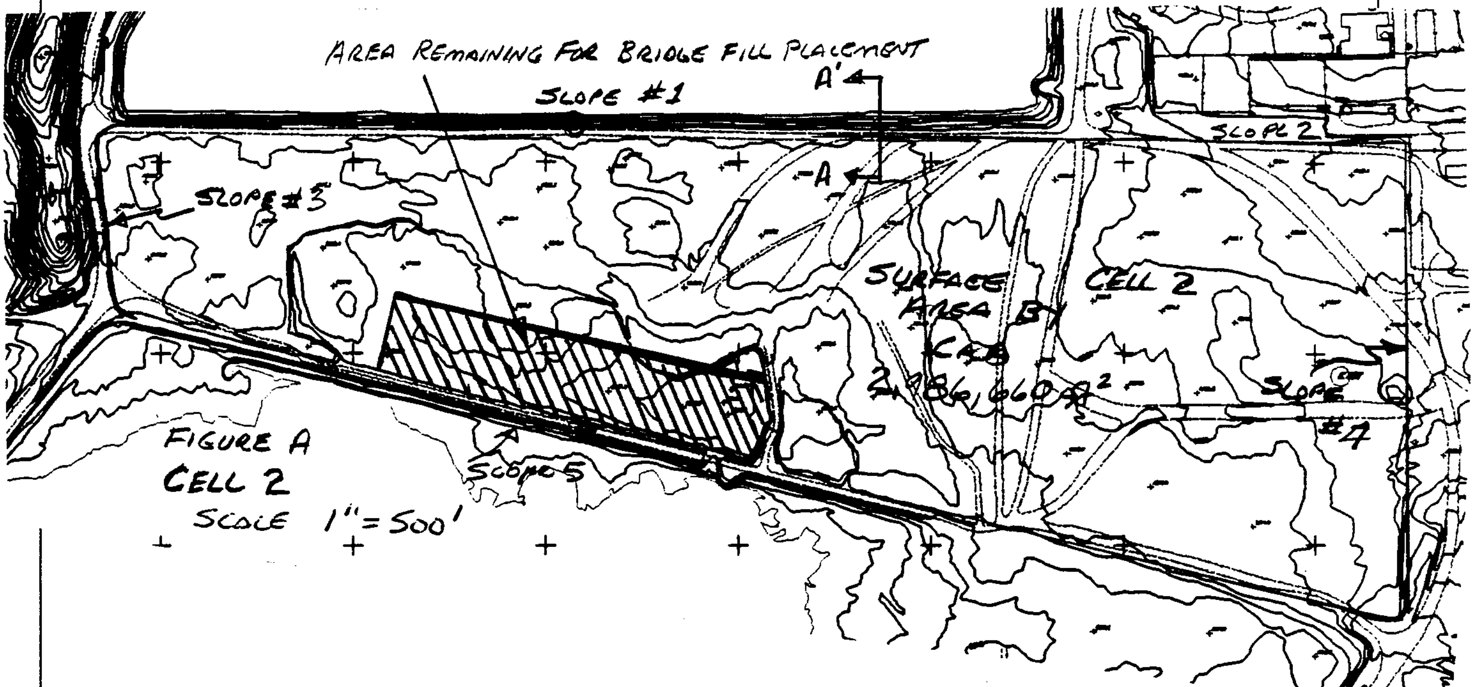
D.) Rock Armor —

$\left(\frac{6.67 \times 6.67 \times 5}{2} - \frac{6 \times 6 \times 5}{2}\right) \times 3500$

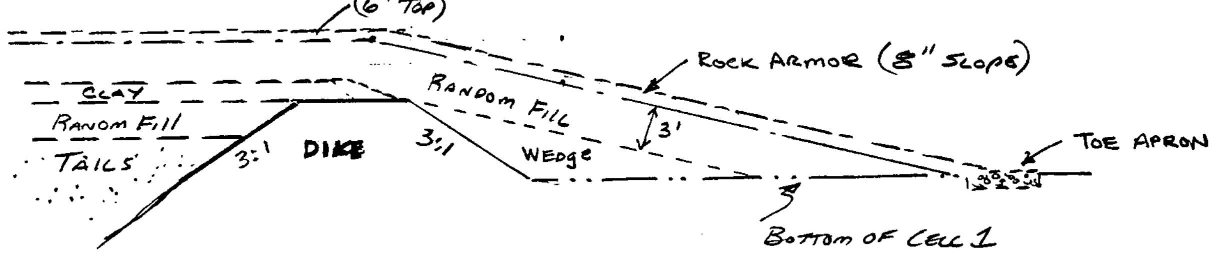
$\frac{74,278\ ft^3}{27} = 2751$ cy → **2800 cy**

No toe apron —

CELL 2 VOLUME CALCULATIONS



SECTION A-A (NOT TO SCALE) TYPICAL SECTION THRU EXTERIOR DIKE
SHOWING COVER



A

A'

Volume Calculations
Cell 2

Volume Summary.

	Bridge Layer	Lower Random	Clay	Upper Random	Armour
Top of Cell	23,000	110,700	110,700	221,300	55,400
North (Slope #1)		13,900	—	19,500	6,400
North (Slope #2)		100	—	1,300	500
West (Slope #3)		100	—	1,000	400
East (Slope 4)		100	—	1,800	700
South (Slope 5)		1200	2,300	6,500	2800
Totals	23,000	126,100	113,000	251,400	66,200

PROJECT QUANTITIES

Cell Slopes

0.6667

Slope No.		Height feet	Length feet	EXISTING DIKE "A"		WEDGE "B"		RANDOM FILL "C"		RANDOM FILL "D"		RIPRAP "E"	
				AREA	VOL (CY)	AREA	VOL (CY)	AREA	VOL (CY)	AREA	VOL (CY)	AREA	VOL (CY)
1	**Cell 2 North dike**	12	2,600	216.0	20,800	144.0	13,867	62.5	6,019	140.0	13,481	51.7	4,976
2	**Cell 2 North Dike**	1	900	1.5	50	1.0	33	7.5	250	30.0	1,000	15.0	500
3	**Cell 2 West Dike**	2	500	6.0	111	4.0	74	12.5	231	40.0	741	18.3	340
4	**Cell 2 East Dike**	1	1,250	1.5	69	1.0	46	7.5	347	30.0	1,389	15.0	694
5	**Cell 2 South Dike**	3	3,500	0.0	0	9.0	1,167	17.5	2,269	50.0	6,481	30.7	3,976
	Cell 2 Slope Totals		6,150		21,031		15,187		9,116		23,093		10,485
6	**Cell 3 West Dike**	2	1,100	6.0	244	4.0	163	12.5	509	40.0	1,630	18.3	747
7	**Cell 3 South Dike**	16	1,750	384.0	24,889	256.0	16,593	82.5	5,347	180.0	11,667	65.0	4,213
8	**Cell 3 South Dike**	39	1,700	2,281.5	143,650	1,521.0	95,767	197.5	12,435	410.0	25,815	141.7	8,920
9	**Cell 3 East Dike**	6	800	54.0	1,600	36.0	1,067	32.5	963	80.0	2,370	31.7	938
	Cell 3 Slope Totals		5,350		170,383		113,589		19,255		41,481		14,819
	Total Material Requirements (CY)				191,414		128,776		28,370		64,574		25,304

NOTE:

Values shown in the "Area" column are the CROSS SECTIONAL AREA for the component in SQUARE FEET.
Values shown in the "Volume" column are the component's area x length converted to CUBIC YARDS.

CELL 2 RECLAMATION

CAT 637 RESOURCE REQUIREMENTS

	Volume	Route	Yds/Hr	%	Equip hrs
Cell 2 Bridging Lift					
Tailings Surface	23,000	5	296	100%	77.7
				TOTAL	**77.7**
Cell 2 Lower Random fill					
Tailings surface	110,700	5	296	67%	250.6
Tailings Surface	110,700	4	368	33%	99.3
Slope 1	13,900	5	296	100%	47.0
Slope 2	100	4	368	100%	0.3
Slope 3	100	5	296	100%	0.3
Slope 4	100	4	368	100%	0.3
Slope 5	1,200	5	296	100%	4.1
				TOTAL	**401.7**
Cell 2 Upper Random Fill					
Tailings surface	221,300	5	296	67%	500.9
Tailings Surface	221,300	4	368	33%	198.4
Slope 1	19,520	5	296	100%	65.9
Slope 2	1,300	4	368	100%	3.5
Slope 3	100	5	296	100%	0.3
Slope 4	1,800	4	368	100%	4.9
Slope 5	6,500	5	296	100%	22.0
				TOTAL	**796.0**
Cell 2 Rock Armour use Highway Trucks					

Clay Production

Haulage From Section 16

Haul Profile From Section 16 — Loaded

#	Segment Length	Grade		Loaded	Empty
1	2000'	4%	600 m.	1 min	.65
2	1800'	11%	540 m	1.8 min	1 min
3	4200'	1.8%	1260 m	1.4 min	1.2 min
4	5600'	0.5%	1600 m	1.6 min	1.5 min
5	5700'	1.4%	1710 m	1.75 min	1.68 min
6	5200'	0.8%	1560 m	1.5 min	1.48 min
	24,500'			9.05 min	7.43 min
					16.48 min

4.6 mile trip loaded
9.2 mile round trip

Clay = 2800#/cy loose.

FIXED TIMES — LOADING —
980 F 7 cy Bucket 3 passes to load
.5 min/cycle = 1.5 minute load
Dump → using belly dumps → continuous.

1.5 minutes to load × 8 trucks = 12 minutes
Cycle is 18 minutes → 6 minutes to spare.

OFF ROAD application 22 cy/load

Cycle time = 18 minutes/truck
50 minute hr = 2.7 cycles/hr

22 cy/cycle × 2.7 cycles/hr × 8 trucks
= [illegible]5 cy/hr.

Cell 2 = 113,000 cy clay / .8 = ___ hrs Loader + haulage + Dozer
(Dozer Rips 500 cy/hr / say =)

= 141,250 Lcy = 297 hrs (8 trucks) Spreading + compacting takes place as material hauled.
use 300 hrs

				Using 8 Load factor
Trucks	237 × 8 =	1896 hrs		2376 hrs
				(Excess hrs to strip OB + Prep)
Dozer	300 × 1 =	300 hrs		
				Strip
Loader	238 × 1 =	238 hrs	297	300
Grader	239 × 1 =	239 hrs	297	300 + 20
WW	238 × 1 =	239 hr	297	300
Compactor				300 + 20

22
27

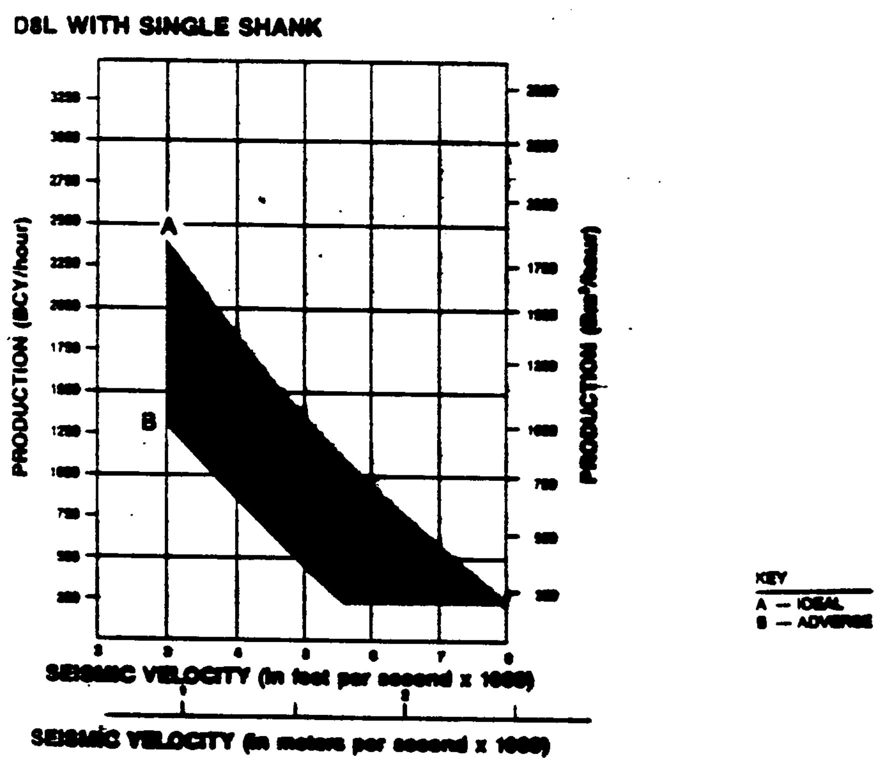
INTERNATIONAL URANIUM (USA) CORP.
COST ESTIMATE

E/PROJECT WHITE MESA RECL. Date .... Calc by .... Sheet .... of ....

CLAY PRODUCTION COSTS
– SECTION 16 SOURCE –

1). CLAY PRODUCTION

- CLAYS WILL BE RIPPED FROM SOURCE @ SECTION 16
- APPROX 400 VERTICAL FEET OF BRUSHY BASIN EXPOSURE
- FROM CAT HAND BOOK ...
  MAX SEISMIC VELOCITY OF CLAY ≥ 6000 ft/sec



- BASED ON THE ABOVE, D8 CAT SHOULD BE ABLE TO PRODUCE AT LEAST 250 BCY /HOUR WITH AN AVERAGE OF -

  500 BCY/HR

- WE WILL ASSUME THAT THE CAT IS UTILIZED EVERY DAY OF CLAY PRODUCTION FOR RIPPING AND OR DOZING/BLENDING/ PREPARATION.

RECLAMATION OF CELL 3

Dewatering of Cell 3

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Dewatering of Cell 3	hrs	$0.48	62,400	**$30,000**

Total Dewatering of Cell 3 **$30,000**

Place Remainder of Bridging Lift

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	1,945	$34,465
Cat 637 Scraper	hrs	$140.50	865	$121,536
Cat 825 Compactor	hrs	$66.15	216	$14,304
Cat D8N Dozer With Ripper	hrs	$68.67	216	$14,832
Cat D7 Dozer	hrs	$57.90	216	$12,507
Cat 651 Waterwagon	hrs	$72.12	216	$15,578
Cat 14G Motorgrader	hrs	$48.93	216	$10,568
Equipment Maintenance (Butler)	hrs	$10.01	1,945	$19,477

Total Place Remainder of Bridging Lift **$243,268**

Place Lower Random Fill (12")

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	1,745	$30,913
Cat 637 Scraper	hrs	$140.50	775	$108,891
Cat 825 Compactor	hrs	$66.15	194	$12,816
Cat D8N Dozer With Ripper	hrs	$68.67	194	$13,321
Cat D7 Dozer	hrs	$57.90	194	$11,233
Cat 651 Waterwagon	hrs	$72.12	194	$13,991
Cat 14G Motorgrader	hrs	$48.93	194	$9,491
Equipment Maintenance (Butler)	hrs	$10.01	1,745	$17,470

Total Place Lower Random Fill (12") **$218,127**

Clay Layer

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	1,975	$34,993
Cat 637 Scraper	hrs	$140.50	0	$0
Cat 825 Compactor	hrs	$66.15	375	$24,805
Cat D8N Dozer With Ripper	hrs	$68.67	350	$24,034
Cat D7 Dozer	hrs	$57.90	0	$0
Cat 651 Waterwagon	hrs	$72.12	350	$25,241
Cat 14G Motorgrader	hrs	$48.93	375	$18,347
Cat 980 Loader	hrs	$64.99	350	$22,746
5000 Gallon Water Truck	hrs	$40.64	175	$7,111
Highway Trucks	hrs	$40.00	2,800	$112,000
Truck Drivers	hrs	$12.74	2,800	$35,674
Equipment Maintenance (Butler)	hrs	$10.01	4,775	$47,811

Total Place Clay Layer **$352,761**

RECLAMATION OF CELL3

Upper Randum Fill

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	2,490	$44,117
Cat 637 Scraper	hrs	$140.50	996	$139,943
Cat 825 Compactor	hrs	$66.15	249	$16,470
Cat D8N Dozer With Ripper	hrs	$68.67	249	$17,098
Cat D7 Dozer	hrs	$57.90	249	$14,418
Cat 651 Waterwagon	hrs	$72.12	249	$17,957
Cat 14G Motorgrader	hrs	$48.93	249	$12,182
5000 Gallon Water Truck	hrs	$40.64	249	$10,118
Equipment Maintenance (Butler)	hrs	$10.01	2,490	$24,932

Total Place Upper Randum Fill **$297,236**

Rock Armour

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	948	$16,796
Cat D7 Dozer	hrs	$57.90	316	$18,298
Cat 651 Waterwagon	hrs	$72.12	316	$22,789
Cat 14G Motorgrader	hrs	$48.93	316	$15,460
Rock Cost Delivered	CY	$3.34	76,110	$254,044
Equipment Maintenance (Butler)	hrs	$10.01	948	$9,492

Total Place Rock Armour **$336,880**

Quality Control

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Quality Control Contractor	hrs	$62.00	1,406	**$87,172**

Total Quality Control **$87,172**

TOTAL RECLAMATION OF CELL 3 **$1,565,444**

2/16/99

Volume Calculations Cell 3

1) Area of Top of cell by CAD – 3,234,252 ft²

74.25 ACRES

2) Area of Bridging layer (lower Random) placed
1,080,000 ft²

25 ACRES

3) Assumptions:

- Bridging Lift (random Fill) comes from random Fill stockpiles west of Cells – using haul Route #6.
- Stockpiles designated as "Clay" will be used for top 12" of Lower random Fill
- Clay for the radon barrier will be mined, blended, and hauled from Section 16 four miles South of the mill. 8" on slopes, 6" on top + 2'x7' apron at bottom of South slopes
- 2 foot Layer of upper random fill will come from finer material in random fill stockpiles and "Clay" stockpiles
- Rock Armor for top, side slopes, and toe aprons will come from same source as Cell 2 Rock Armor. → Gravel pit North of Blanding.
- Clay Layer extends over only the Top of Cell NOT ON Slopes.

4) Bridging layer left to place

$$\frac{(3,234,252\,ft^2 - 1,080,000\,ft^2) \times 3\,ft}{27\,ft^3/cy} = cy$$

$$\frac{2154254 \times 3}{27} = 239,361\ cy$$

↓

239,400 CY

5) Bring lower random fill up to design elevations (assume over total area for estimate, in reality parts of east end of pond is up to elevation already.)

$$\frac{3,234,252\,ft^2 \times 1\,ft}{27\,ft^3/cy} = 119,787\,cy \longrightarrow$$ **119,800 cy**

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2/17/99

Volume Calculations Cell 3

6) Placement of Clay Layer (1 foot thick) over full area Top of Cell

$$\frac{3,234,252\ ft^2 \times 1ft}{27 ft^3/cy} = 119,773\ cy \rightarrow \boxed{119,800\ cy}$$

[.8 Load factor]

7) upper random fill volume over full area of Cell

$$\frac{3234,252\ ft^2 \times 2ft}{27\ ft^3/cy} = 239,574\ cy \rightarrow \boxed{239,600\ cy}$$

8) Armor protection - Top of Cell 6" (.5ft)

$$\frac{3,234,252\ ft^2 \times .5\ ft}{27\ ft^3/cy} = 59,894\ cy \rightarrow \boxed{59,900\ cy}$$

9) Cell 3 West Slope (Slope #6) 2 foot high, 1100 foot long

- No Clay on slopes
- Toe Apron only at base of long slopes or where drainage off of the Cells is directed

- Random fill wedge → No existing dike → so transition from top cover

$$\left(\frac{2 \times 2 \times 5}{2} \times 1100\ ft\right)/27 = 407 cy \rightarrow \boxed{410 cy}$$

- Random Fill

$$\left(\frac{5 \times 5 \times 5}{2} - \frac{2 \times 2 \times 5}{2}\right) \times 1100 ft \rightarrow 57,750\ ft^3$$

$$\frac{57,750\ ft^3}{27 ft^3/cy} = 2138\ cy \rightarrow \boxed{2,200\ cy}$$

- Rock Armor

$$\left(\frac{5.67 \times 5.67 \times 5}{2} - \frac{5 \times 5 \times 5}{2}\right) \times 1100 \rightarrow 19,659\ ft^3$$

$$\frac{19,659\ ft^3}{27 ft^3/cy} = 728\ cy \rightarrow \boxed{730\ cy}$$

Volume Calculation Cell 3

10) Cell 3 South Dike (West End) Slope #7

- 16 ft Average height
- 1,750 foot Long

Random Fill Wedge → 3:1-5:1 Conversion →

$$\left[\frac{16 \times 16 \times 5}{2} - \frac{16 \times 16 \times 3}{2}\right] \times 1750 ft \rightarrow 448,000 ft^3$$

$$\frac{448,000 ft^3}{27 ft^3/cy} = 16,592 cy \rightarrow \boxed{16,600 cy}$$

Random fill - 1

$$\left[\frac{19 \times 19 \times 5}{2} - \frac{16 \times 16 \times 5}{2}\right] \times 1750 = 459,375 ft^3$$

$$\frac{459,375 ft^3}{27 ft^3/cy} = 17,013 cy \rightarrow \boxed{17,100 cy}$$

Rock Armor — slope → 8" thick

$$\left[\frac{19.67 \times 19.67 \times 5}{2} - \frac{19 \times 19 \times 5}{2}\right] \times 1750 \rightarrow$$

$$\frac{113,351 ft^3}{27 ft^3/cy} = 4198 cy \rightarrow \boxed{4200 cy}$$

Rock Apron at toe of slope

$$\frac{2' \text{THICK} \times 7' \text{WIDE} \times 1750' \text{Long}}{27 ft^3/cy} = 907 cy \rightarrow \boxed{1000 cy}$$

---

11) Cell 3 South Dike (East End Common with Cell 4A) Slope #8

- 39 ft Average height
- 1700 ft Long

Toe Apron full length

Random Fill Wedge $\left[\frac{39 \times 39 \times 5}{2} - \frac{39 \times 39 \times 3}{2}\right] \times 1700 ft \rightarrow 2,585,700 ft^3$

$$\frac{2585,700 ft^3}{27 ft^3/cy} = 95,766 cy \rightarrow \boxed{95,800 cy}$$

1521

No. 5505 Engineer's Computation Pad ALVIN

Volume Calculation Cell 3 2/16/99

11) Cont

Upper Random Fill

$$\left[\frac{42 \times 42 \times 5}{2} - \frac{39 \times 39 \times 5}{2}\right] \times 1700 \rightarrow 1{,}032{,}750\ ft^3$$

$$\frac{1{,}032{,}750\ ft^3}{27\ ft^3/cy} \rightarrow 38{,}250\ cy \rightarrow \boxed{38{,}300\ cy}$$

Rock Armor

$$\left[\frac{42.67 \times 42.67 \times 5}{2} - \frac{42 \times 42 \times 5}{2}\right] \times 1700 \rightarrow 241{,}098\ ft^3$$

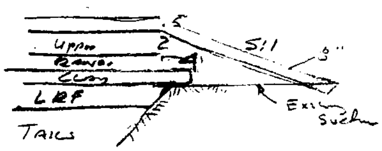
$$\frac{241{,}098\ ft^3}{27\ ft^3/cy} - 8930\ cy \rightarrow \boxed{8950\ cy}$$

Rock Toe Apron

$$\frac{2ft \times 7ft \times 1700\ ft}{27\ ft^3/cy} = 881\ cy \rightarrow \boxed{900\ cy}$$

Total Rock $\boxed{9850\ cy}$

12) Cell 3 East Slope



- Average height 4 feet
- 800 feet long

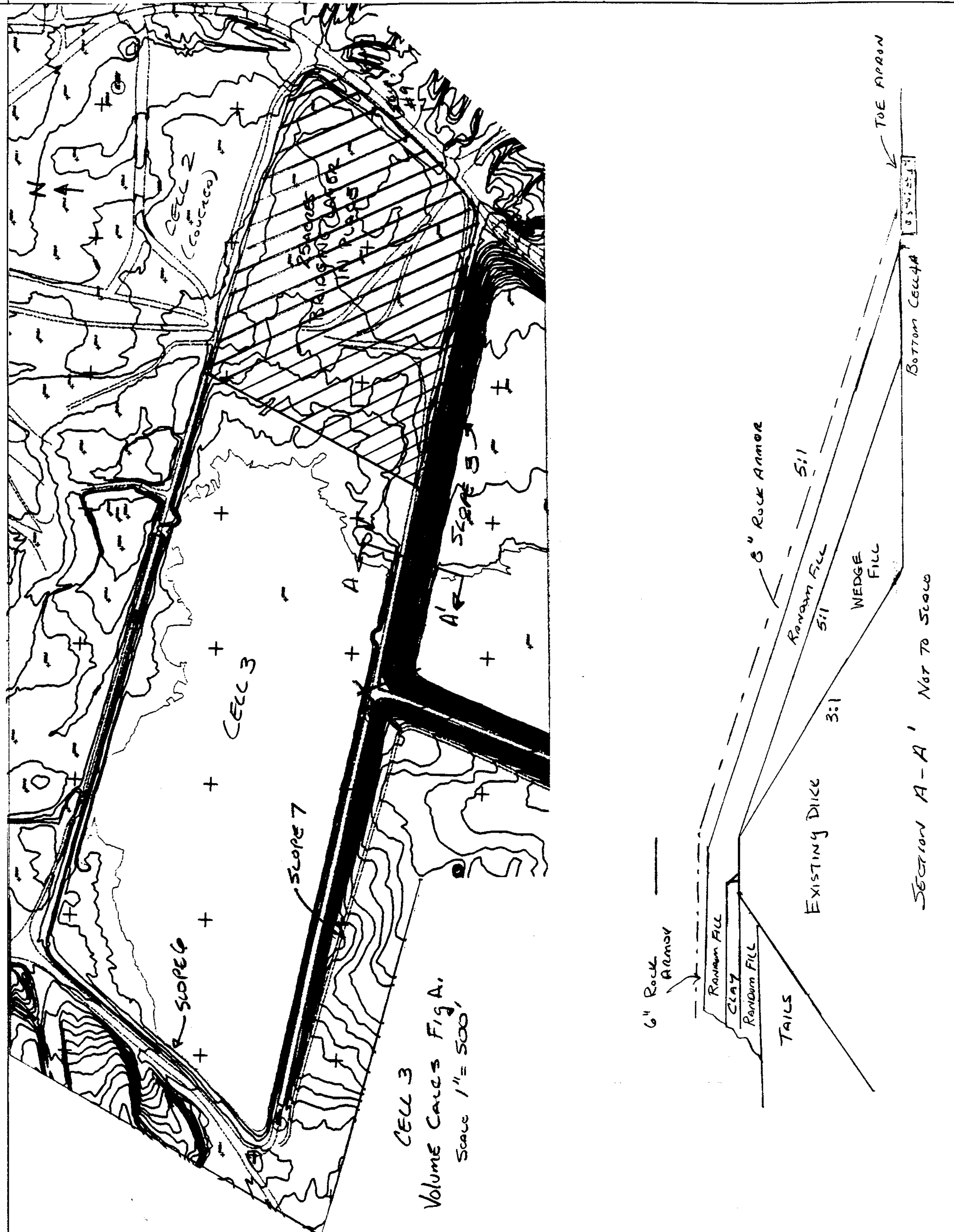
Random Fill (No existing dike) $- \frac{4 \times 4 \times 5}{2} \times 800 = 32{,}000\ ft^3$

$$\frac{32{,}000\ ft^3}{27\ ft^3/cy} = 1185\ cy \Rightarrow \boxed{1200\ cy}$$

Rock Armor $- \left(\frac{4.67 \times 4.67 \times 5}{27} - \frac{4 \times 4 \times 5}{2}\right) \times 800 = 11{,}618\ ft^3$

$$\frac{11{,}618\ ft^3}{27\ ft^3/cy} \Rightarrow \boxed{430\ cy} \rightarrow$$

No Toe Apron


CELL 2 (COVERED)
N
CELL 3
SLOPE 6
SLOPE 7
SLOPE 8
A
A'
CELL 3
Volume Calcs Fig A.
Scale 1" = 500'
6" Rock Armor
Random Fill
Clay
Random Fill
Tails
Existing Dike
6" Rock Armor
Random Fill
5:1
5:1
Wedge Fill
3:1
Toe Apron
Bottom Cell 4A
Section A-A' Not to Scale

Volume Calculation Cell 3

Volume Summary

	Bridge Layer	Lower Rand	Clay	Upper Random	Armor
Top of Cell	239,400	119,800	119,800	239,400	59,900
West Slope (#6)	—	410	—	2,200	730
South Dike (#7)	—	16,600	—	17,100	5,200
South Dike (#8)	—	95,800	—	38,300	9,850
East Slope (9)	—	—	—	1,200	430
Totals (cy)	239,400	232,610	119,800	298,200	76,110

No. 5505
Engineer's Computation Pad
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CELL 3 PRODUCTION
(USE SAME ASSUMPTION AS CELL 2)
CLAY

Clay Volume = 119,800 BCY / .8 Swell factor = 149,750 LCY

TRUCKING 475 LCY/hr — 8 TRUCKS + 1 LOADER

149,750 LCY / 475 Lcy/hr ≅ 316 hr + 10% ⇒ use 350 hrs

350 × 8 Trucks = 2800 hrs

980 LOADER — 350 hrs
D8N Dozer w/Ripper — 350 hrs
CAT 651 WW 350 hrs
CAT 825 Compactor 375 hrs
CAT 14G Grader 395 hrs
5000 Gallon Water Tw 175 hrs

ROCK ARMOR

Rock Armor Volume = 76,110 cy — 38 cy/Truck × 8 TRUCKS

304 cy/hr — Delivered
Say 25% EXTRA TIME TO FINISH SPREADING — (
241 cy/hr → 316 hrs

CELL 3 RECLAMATION

CAT 637 RESOURCE REQUIREMENTS

	Volume	Route	Yds/Hr	%	Equip hrs
Cell 3 Bridging Lift					
Tailings Surface	239,400	6	277	100%	864.3
				TOTAL	**864.3**
Cell 3 Lower Random Fill					
Tailings surface	119,800	6	296	100%	404.7
Slope 6	410	6	296	100%	1.4
Slope 7	16,600	6	368	100%	45.1
Slope 8	95,800	6	296	100%	323.6
Slope 9	0	6	368	100%	0.0
				TOTAL	**774.9**
Cell 3 Upper Random fill					
Tailings surface	239,400	6	296	100%	808.8
Slope 6	2,200	6	296	100%	7.4
Slope 7	17,100	6	368	100%	46.5
Slope 8	38,300	6	296	100%	129.4
Slope 9	1,200	6	368	100%	3.3
				TOTAL	**995.3**
Cell 3 Rock Armour use Highway Trucks					

CELL 4A CLEANUP

Dewatering of Cell 4A

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Dewatering of Cell 4A	hrs	$0.48	11,500	**$5,529**

Total Dewatering of Cell 4A **$5,529**

Remove Fencing

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Cat 988 Loader	hrs	$95.68	40	$3,827
Equipment Operators	hrs	$17.72	40	$709
Equipment Maintenance (Butler)	hrs	$10.01	40	$401
Laborers	hrs	$10.35	160	$1,655

Total Remove Fencing **$6,592**

Remove Liner & Contaminated Material to Cell 3

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	303	$5,368
Cat 769 Truck	hrs	$60.52	606	$36,677
Truck Driver	hrs	$12.74	606	$7,721
Cat 988 Loader	hrs	$95.68	303	$28,990
Equipment Maintenance (Butler)	hrs	$10.01	909	$9,102

Total Remove Liner & Contaminated Material to Cell 3 **$87,858**

Quality Control

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Quality Control Contractor	hrs	$62.00	325	$20,150

Total Quality Control **$20,150**

TOTAL CELL 4A CLEANUP **$120,128**

INTERNATIONAL URANIUM (USA) CORP.
COST ESTIMATE

NE/PROJECT .... Date .... Calc by .... Sheet ..... of .....

CELL 4A WORK

1) ASSUMPTIONS
- ANY XTALS ARE PICKED UP WITH LINER
- AVERAGE OF 1 FOOT UNDER LINER WILL GO TO CELL 3
- ALL DIKE MATERIAL IS UNCONTAMINATED & CAN BE UTILIZED FOR CELL 3 COVER, THEREFORE, NO COST IS PLACED AGAINST ITS REMOVAL
- AREA OF CELL FOR VOLUME ESTIMATES IS 1,909 M ft^2
- CRYSTALS ESTIMATED TO BE 6" THICK OVER ENTIRE AREA

Therefore

QUANTITY OF CONTAMINATED MATERIAL =

$$\left[1{,}909{,}000 \times \left[\tfrac{6}{12} + \tfrac{12}{12}\right]\right] \div 27\ ft^3/yd^3 = 106{,}055$$

say **106,100 yd^3**

and

BASED ON HAUL ROUTE 8 PROFILE, EFFICIENCY = 175 yd^3/truck hour.

$$106100\ yd^3 \div 175\ yd^3 = 606 \text{ TRUCK HOURS}$$
$$= 303 \text{ FLEET HOURS (2 TRUCKS)}$$

RECLAMATION OF CELL 1

Dewatering of Cell 1

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Dewatering of Cell 1	hrs	$0.48	62,400	**$30,000**

Total Dewatering of Cell 1 **$30,000**

Crystal Removal

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	2,695	$47,749
Cat 769 Truck	hrs	$60.52	2,157	$130,548
Truck Drivers	hrs	$12.74	2,157	$27,481
Cat 988 Loader	hrs	$95.68	539	$51,570
Cat D8N Dozer With Ripper	hrs	$68.67	539	$37,012
Cat 375 Excavator	hrs	$123.76	539	$66,709
Cat 651 Waterwagon	hrs	$72.12	539	$38,872
Cat 14G Motorgrader	hrs	$48.93	539	$26,371
Equipment Maintenance (Butler)	hrs	$10.01	4,852	$48,582

Total Crystal Removal **$474,893**

Contaminated Materials Removal

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	616	$10,914
Cat 637 Scraper	hrs	$140.50	308	$43,275
Cat D8N Dozer With Ripper	hrs	$68.67	77	$5,287
Cat 825C Compactor	hrs	$66.15	77	$5,093
Cat 651 Waterwagon	hrs	$72.12	77	$5,553
Cat 14G Motorgrader	hrs	$48.93	77	$3,767
Equipment Maintenance (Butler)	hrs	$10.01	616	$6,168

Total Contaminated Materials Removal **$80,058**

Topsoil Application

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	240	$4,252
Cat 637 Scraper	hrs	$140.50	120	$16,861
Cat D8N Dozer With Ripper	hrs	$68.67	40	$2,747
Cat 651 Waterwagon	hrs	$72.12	40	$2,885
Cat 14G Motorgrader	hrs	$48.93	40	$1,957
Equipment Maintenance (Butler)	hrs	$10.01	240	$2,403

Total Topsoil Application **$31,104**

RECLAMATION OF CELL1

Construct Channel

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	858	$15,202
Cat 637 Scraper	hrs	$140.50	272	$38,217
Cat 769 Truck	hrs	$60.52	450	$27,235
Truck Drivers	hrs	$12.74	450	$5,733
Cat 988 Loader	hrs	$95.68	150	$14,352
Drilling & Blasting Contractor	BCY	$1.50	89,100	$133,650
Cat 14G Motorgrader	hrs	$48.93	218	$10,666
Cat D8N Dozer With Ripper	hrs	$68.67	218	$14,970
Equipment Maintenance (Butler)	hrs	$10.01	1,308	$13,097

Total Construct Channel **$273,121**

Place Clay Liner

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	355	$6,290
Cat 637 Scraper	hrs	$140.50	0	$0
Cat 825 Compactor	hrs	$66.15	60	$3,969
Cat D8N Dozer With Ripper	hrs	$68.67	60	$4,120
Cat D7 Dozer	hrs	$57.90	0	$0
Cat 651 Waterwagon	hrs	$72.12	60	$4,327
Cat 980 Loader	hrs	$64.99	60	$3,899
5000 Gallon Water Truck	hrs	$40.64	30	$1,219
Highway Trucks	hrs	$40.00	435	$17,400
Truck Drivers	hrs	$12.74	435	$5,542
Cat 14G Motorgrader	hrs	$48.93	85	$4,159
Equipment Maintenance (Butler)	hrs	$10.01	1,580	$15,820

Total Place Clay Liner **$66,745**

Place Lower Random Fill

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	602	$10,666
Cat 637 Scraper	hrs	$140.50	172	$24,167
Cat 825 Compactor	hrs	$66.15	86	$5,689
Cat D8N Dozer With Ripper	hrs	$68.67	86	$5,906
Cat D7 Dozer	hrs	$57.90	86	$4,980
Cat 651 Waterwagon	hrs	$72.12	86	$6,202
Cat 14G Motorgrader	hrs	$48.93	86	$4,208
Equipment Maintenance (Butler)	hrs	$10.01	602	$6,028

Total Place Lower Random Fill **$67,844**

RECLAMATION OF CELL1

Clay Cap

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	305	$5,404
Cat 637 Scraper	hrs	$140.50	0	$0
Cat 825 Compactor	hrs	$66.15	55	$3,638
Cat D8N Dozer With Ripper	hrs	$68.67	55	$3,777
Cat D7 Dozer	hrs	$57.90	0	$0
Cat 651 Waterwagon	hrs	$72.12	55	$3,967
Cat 14G Motorgrader	hrs	$48.93	55	$2,691
Cat 980 Loader	hrs	$64.99	55	$3,574
5000 Gallon Water Truck	hrs	$40.64	30	$1,219
Highway Trucks	hrs	$40.00	440	$17,600
Truck Drivers	hrs	$12.74	440	$5,606
Equipment Maintenance (Butler)	hrs	$10.01	305	$3,054

Total Place Clay Cap **$50,529**

Upper Random Fill

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	688	$12,190
Cat 637 Scraper	hrs	$140.50	172	$24,167
Cat 825 Compactor	hrs	$66.15	86	$5,689
Cat D8N Dozer With Ripper	hrs	$68.67	86	$5,906
Cat D7 Dozer	hrs	$57.90	86	$4,980
Cat 651 Waterwagon	hrs	$72.12	86	$6,202
Cat 14G Motorgrader	hrs	$48.93	86	$4,208
5000 Gallon Water Truck	hrs	$40.64	86	$3,495
Equipment Maintenance (Butler)	hrs	$10.01	688	$6,889

Total Place Upper Random Fill **$73,724**

RECLAMATION OF CELL1

Rock Armor

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	90	$1,595
Cat D7 Dozer	hrs	$57.90	30	$1,737
Cat 651 Waterwagon	hrs	$72.12	30	$2,164
Cat 14G Motorgrader	hrs	$48.93	30	$1,468
Rock Cost Delivered	CY	$3.34	8,607	$28,729
Equipment Maintenance (Butler)	hrs	$10.01	90	$901

Total Place Rock Armor **$36,593**

Quality Control

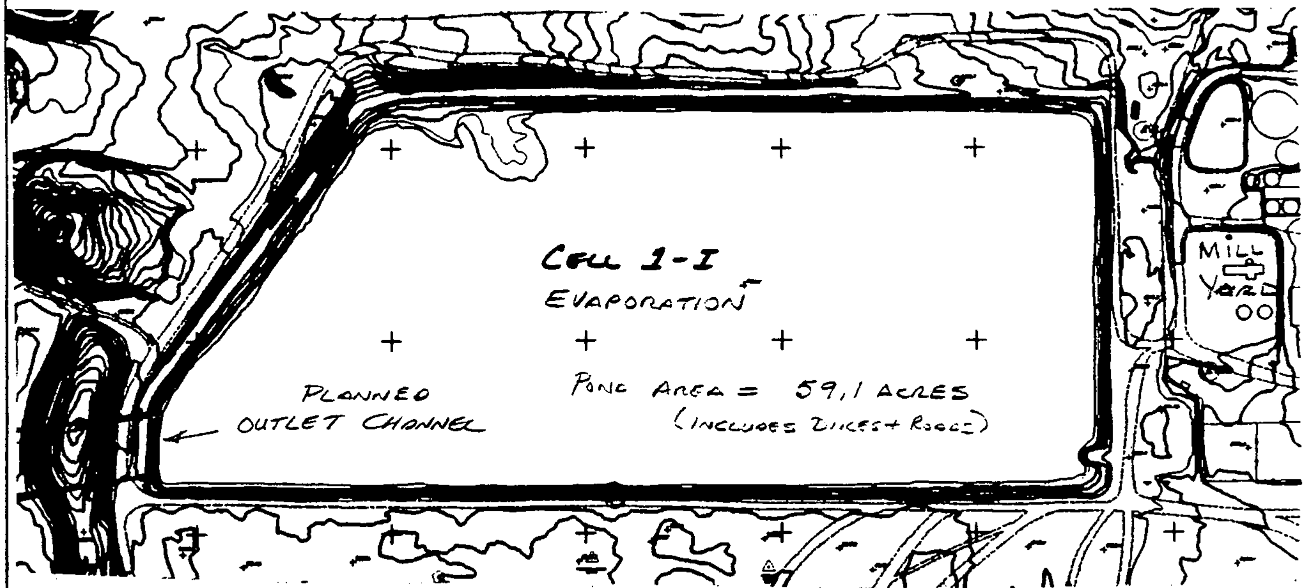
Resource Description	Units	Cost/Unit	Task Units	Task Cost
Quality Control Contractor	hrs	$62.00	800	**$49,600**

Total Quality Control **$49,600**

TOTAL RECLAMATION OF CELL 1 **$1,234,212**

1

Cell 1 Volume Calcula



Cell 1 - Scale 1" = 500'

1) Crystal Volume + Liner Cover

- Crystal thickness based on historical elevation of top of Crystal Layer and Areal mapping → Assume 3 ft thick
- Soil cover over PVC. Liner 1½' by design and as builts
- Liner Crystals and Soil Cover all picked up at same time.

Area of Pond $\frac{2,575,703 \text{ ft}^2 \times (3 \text{ ft} + 1.5 \text{ ft})}{27 \text{ ft}^2/\text{cy}} = 429,283$ cy

→ **429,300 cy**

2) Volume of Contaminated material under Liner.

- Assume for purposes of this estimate that 1 ft of Contaminated material must be removed from under liner for whole Cell

$\frac{2,575,703 \text{ ft}^2 \times 1 \text{ ft}}{27 \text{ ft}^3/\text{cy}} = 95,396$ cy → **95,400 cy**

3) Time Required to haul Xyls + Liner Cover Assuming the use of 4-769 Trucks, a 275L Trackhoe; 988 Loader. Assume haul Route # 1 for production (199 cy/hr) truck/hr)

$\frac{429,300 \text{ cy}}{199 \text{ cy/hr}} = 2157$ truck hrs — 539 hrs / truck

CELL 1 VOLUME CALCULATIONS

4) TIME REQUIRED TO REMOVE MATERIAL FROM UNDER LINER IN PLACE IN CELL #3 – USE HAUL ROUTE #1 – 4 SCRAPERS

$\frac{95,500 \text{ cy}}{310 \text{ cy/hr/scraper}}$ = 308 scraper hours   4 scrapers = 77 hrs/unit.

5) TOP SOIL VOLUMES → place 6" of Top soil over Area of

Cell 1 – $\frac{2,575,703 \text{ ft}^2 \times .5 \text{ ft}}{27 \text{ ft}^3/\text{cy}}$ ≅ 47,698 cy

→ 48,000 cy

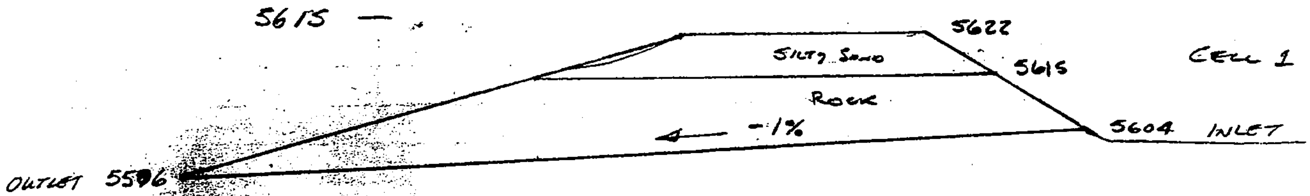
USE Scraper fleet Assume Route 1 → 310 cy/hr/scraper

$\frac{48000 \text{ cy}}{310 \text{ cy/hr/scraper}}$ ≅⇒ 155 hrs using one Scraper

If use 4 Scrapers ≅ 40 hr/UNIT.

6) DISCHARGE CHANNEL VOLUME →

- CHANNEL WILL HAVE base WIDTH OF 150 ft – SIDE SLOPE 3:1
- CHANNEL FLOW LINE will drop at .01 ft/ft (1%)
- ROCK ELEVATION BASED ON Drill holes + Construction Report is at 5615 –

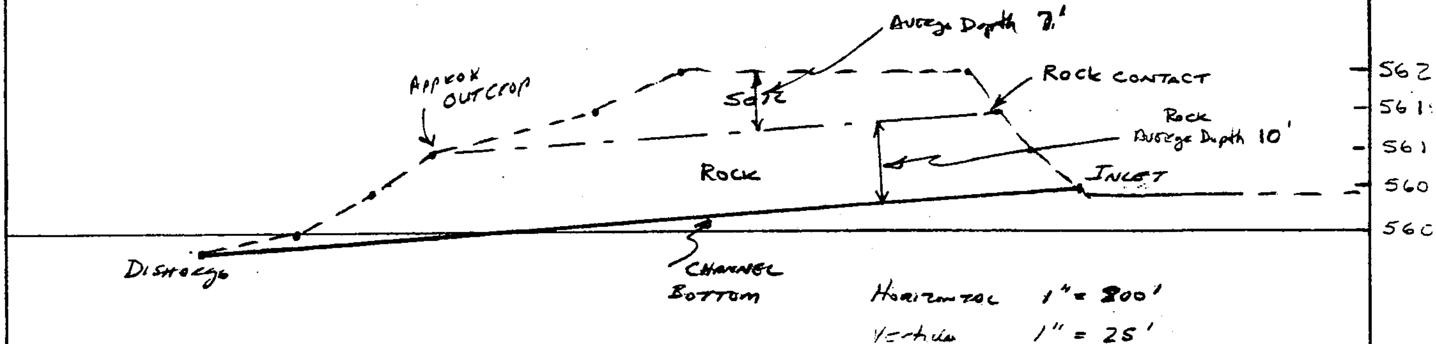


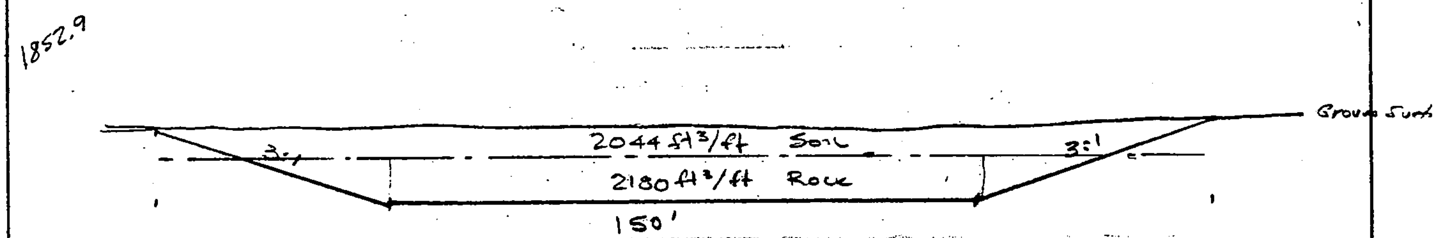
- Random Fill and Top soil stockpiles will be used in the reclamation of Cells 2 + 3 and the mill yard before discharge channel is built.

Cell 1 Volume Calculations

OUTLET CHANNEL SECTIONS

SECTION A-A'





B-B' 1" = 50'

- Assume

  Rock = 81 cy/ft channel Length
  Soil = 76 cy/ft channel Length

  800 ft channel = 64,800 cy Rock
  60,800 cy Soil

- Use Scrapers on Soil Removal

- Drill and Blast Rock Use Trucks to Haul away
  Based on EFN's Experience during Construction – Rock does Not Rip
  Blasting is required.

- Assume Route 1 for Trucks + Scrapers

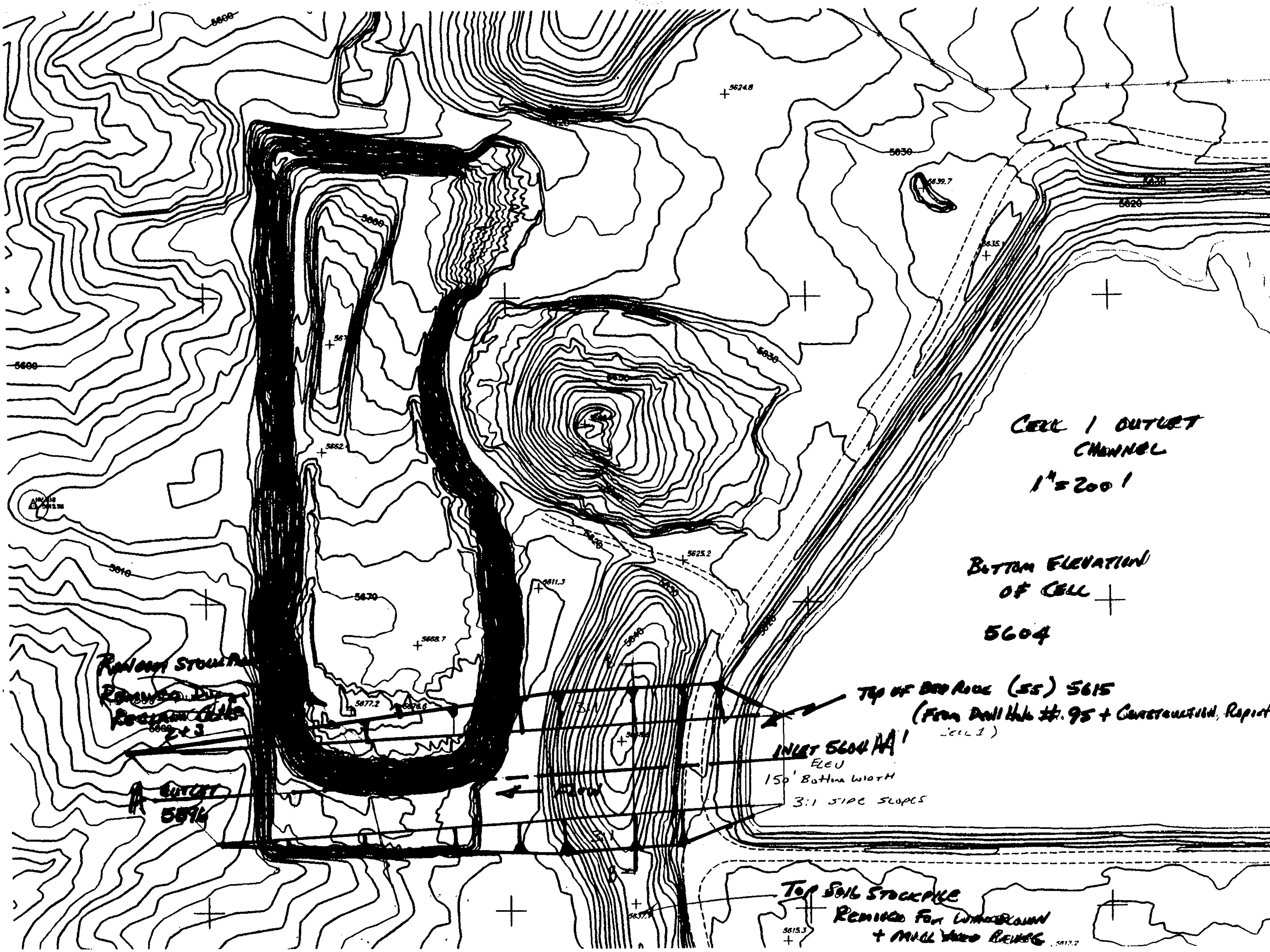
  Trucks – 199 cy/truck/hr
  Scrapers – 310 cy/hr

Channel Excavation (Continued)

Soil → 69,800 cy / 310 cy/hr = 196 scraper hrs ⇒ 50 hr/individual scraper, 4 scrapers

Rock → 64,800 cy / 199 cy/hr = 325 truck hrs ⇒ 2 trucks = 163 hrs/each

Drilling + Blasting Rock → 10 ft average depth → $1.50/cy
Based on Recent Contractor Quote


CELL 1 OUTLET CHANNEL
1" = 200'
BOTTOM ELEVATION OF CELL
5604
TOP OF BED ROCK (SS) 5615
(FROM DRILL HOLE #.95 + CONSTRUCTION REPORT CELL 1)
INLET 5604 A A'
ELEV
150' BOTTOM WIDTH
3:1 SIDE SLOPES
TOP SOIL STOCKPILE
REMOVED FOR WINDBLOWN + MILL YARD REMOVAL
OUTLET
5596
FLOW
5624.8
5630
5639.7
5620
5635.1
5625.2
5611.3
5670
5668.7
5652
5677.2
5615.3
5617.2
5600
5610
5680

AMERICAN MINE SER\

BOB HEMBREE (303)389-4125

August 18, 1998

Via Fax:

Attn: Mark Kerr, KLG Associates, Inc.

Re: Drilling and Blasting Limestone, Mill Creek, Oklahoma

We are please to submit the following proposal to provide all equipment, labor and materials for the above referenced project as follows:

Description	Unit Price	Est. Quantity
Mobilization	$8,000.00	1
Drill and Blast Cuts >20' Deep	$ 1.35/CY	30,000 CY
Seismic Monitoring	$300.00/EA	2

General Clarifications:
> Layout and grade control by others
> Excavation by others
> Explosives storage on site
> Pricing assumes two 10 hour drilling shifts per day for 6 days per week
> If bonding is required add 1%
> Night working lights by others
> Pricing assumes dry hole conditions, add $.15 per CY if wet hole conditions are encountered
> Pricing is based on a minimum of 30,000 CY shot during a 10 day period

If you have any questions or need additional information, please feel free to contact me at 303.499.4770.

Sincerely,

C. B. Slatten, Project Manager

RECENT QUOTE FOR DRILL + BLAST USE $1.50/CY

Calculation / Work Sheet

Page ____ of ____

Project: Rec. Plan Revision 3.0 by ______ Date 07-06-00

Revision to Topsoil Cost - Cell 1-I

5) Place 6" of Topsoil over open area of Cell 1-I

Total area of Cell 1 - w/ side slopes = 60 AC.

Area consumed by new disposal area =

$(175' + 100') \times 2{,}600 = 715{,}000\ ft^2 = 16.41$ AC.

use 16.-

Total area to be topsoiled = 60 - 16 = 44 acres

Total volume = $\frac{44 \times 43{,}560 \times 0.5\ ft}{27} = 35{,}493\ yd^3$

Use scraper fleet - assume Route No. 1

$310\ yd^3 / hr / machine$

$\frac{35{,}493\ yd^3}{310} = 114.5\ hr.$ use 3 machines

38.17 hr. —

use 40 hr. × 3

120 hr. Total

Calculation / Work Sheet

Project: Rec. Plan Revision 3.0 by: ______ Page ____ of ____ Date 07-06-00

Revision to Channel construction cost.

New channel width - 1,200 ft (was 800 ft)

- Assume Rock 81 cy / ft of channel length
  Soil 76 " " " " "

1100 ft 89,100 cy rock
83,600 cy soil

- use scrapers on soil removal
- Drill + Blast rock - use trucks to haul

Based on EFN's experience during construction - rock is not easily ripped - Blasting is required

- Assume Route 2 for Trucks and Scrapers.

Trucks 199 yd^3 / truck / hr
Scrapers 310 " scraper / "

Rock - $\frac{89,100\ yd^3}{199}$ = 448 hr - 3 trucks - 150 hr. ea
450 hr

Soil $\frac{83,600\ yd^3}{310}$ = 270 - 4 units = 67.5 = 68 hr ea
272 hr.

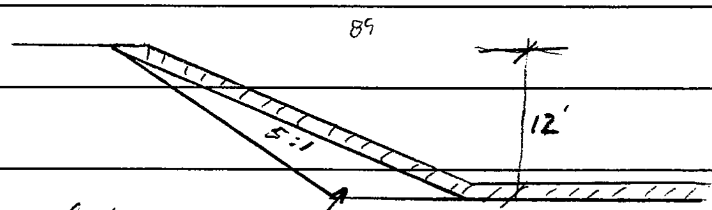
Support equipment - 150 hr. + 68 hr. = 218 hr.

Calculation / Work Sheet

Project: Rec. Plan Revision 3.0 by: ______ Page ___ of ___ Date 07-06-00

Installation of Clay Liner in Cell 1-I

Clay liner - Average depth of Tailings - 18'



Slope length = (5)(18) = 90'

Horizontal length - 176

175 + 90 = 265 Total length = 266

265 - 89 = 176 266 ft

266 ft × 12" × 2600 ft = 691,600 ft^3

25,615 yd^3 liner

Clay production cost - from Cell 2 estimate

22 yd^3 per cycle × 2.7 cycles / hr = 59.4 yd^3 per hour / truck

Use 8 trucks = 475 yd^3/hr.

$\frac{25,615 \text{ yd}^3}{475}$ = 54 hr. - use 60 hr

Calculation / Work Sheet

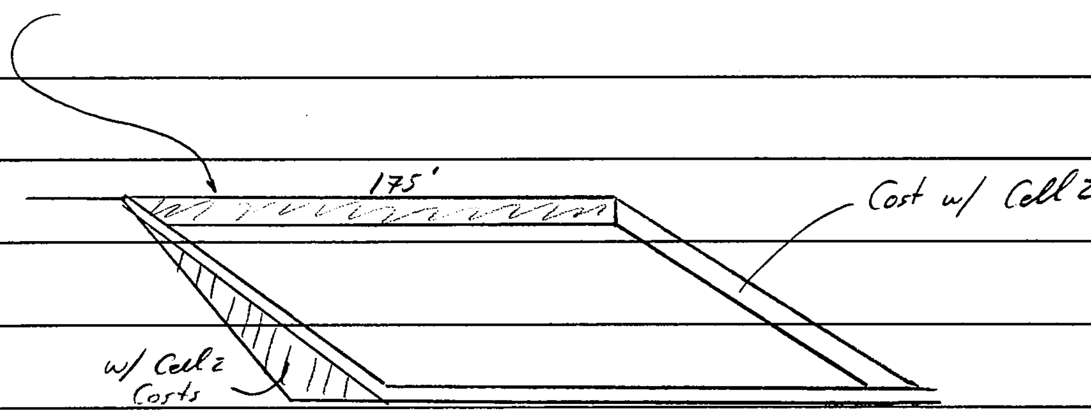
Page ____ of ____

Project: Rec. Plan Revision 3.0 by: ______ Date 07-06-00

Installation of lower Random fill

North Slope lower Random Fill included with Cell 2 Cost (19,500 yd³)

lower Random Fill on extention Area.



3' thick - 175' wide x 2600 ft

50,556 yd³

Use Route 5 haulage - scrapers ⇒ 296 yd³ / hr. = 171 hr.

use 174

use 2 scrapers - 87 hr. each

Calculation / Work Sheet

Page ____ of ____

Project: Rec. Plan Revision 3.0 by: ______ Date 07-06-00

Clay Cap - top and side slope

top - 175 ft
slope - 90 ft

265 ft × 1.0 ft thick × 2,600 ft

25,518 yd^3

Use same haulage factor for clay liner

22 yd^3 per truck cycle - × 2.7 cycles/hr -

59.4 yd^3 per hour/truck

8 trucks = 475 yd^3/hr = 53.7 hr - use 55

440 truck hr.

55 other

Calculation / Work Sheet

Project: Rec. Plan Revision 3.0 by: *[initials]*

Page ____ of ____
Date 07-06-00

Place Upper Random Fill

2'-0" lay over top and slope

Total width – 175' + 90' = 265 ft

265 × 2600 × 2'-0" = 1,378,000 ft^3

= 51,037 yd^3

Use Route 5 haulage – scrapers 296 yd^3/hr = 172 hr.

use 2 scrapers = 86 hr.

Calculation / Work Sheet

Project: Rec. Plan Revision 3.0 by: [signature] Page ___ of ___ Date 07-06-00

Installation of Rock Armor

Top of new area : 175' x 2600 ft

6" Thick $175 \times 2600 \times 0.5 = 227{,}500\ ft^3$

$8{,}426\ yd^3$

Toe Apron on East and West sections

$(175' \times 7' \times 2'\ \text{Thick}) \times 2 = 4900\ ft^3 = 182\ yd^3$

Upstream slope and toe apron running east-west included in Cell 2 Reclamation Costs

Total $8{,}607\ yd^3$

$8{,}607\ yd^3$ — $38\ yd^3$ / truck 226.5 hr. – use 227

use 8 trucks 28.31 hr. – use 30

MISCELLANEOUS ITEMS

Equipment Mobilization

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Butler Machinery Mobilization	LS	$148,200.00	1	**$148,200**
Other Equipment Mobilization	LS	$2,500.00	1	**$2,500**

Total Equipment Mobilization **$150,700**

Office Facilities

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Run New Powerline	LS	$15,000.00	1	**$15,000**
Utilities for Offices	months	$1,000.00	36	**$36,000**

Total Temporary Office Facilities **$51,000**

Wheel Wash Facility

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Laborers	hrs	$10.35	8,320	**$86,084**
Construct Wheel Wash Facility	LS	$50,000.00	1	**$50,000**

Total Wheel Wash Facility **$136,084**

MANAGEMENT/SUPPORT

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Manager/Engineer	hrs	$48.69	6,240	**$303,826**
Radiation Safety Officer	hrs	$37.87	6,240	**$236,309**
Secretary	hrs	$15.01	6,240	**$93,680**
Clerk	hrs	$12.51	4,866	**$60,877**
Environmental Technician	hrs	$20.02	4,866	**$97,403**
Maintenance Foreman	hrs	$27.51	6,240	**$171,661**
Chemist	hrs	$22.52	2,080	**$46,840**
Security	hrs	$7.78	18,720	**$145,583**
Safety Engineer	hrs	$20.02	4,160	**$83,271**
Misc. Materials & Supplies	hrs	$36.45	6,240	**$227,448**
Health Physics Costs	hrs	$64.81	2,080	**$134,800**

Total Management/Support **$1,601,696**

TOTAL MISCELLANEOUS ITEMS **$1,939,480**

ROCK PRODUCTION COST

Assumptions:

Rock is obtained from gravel source north of Blanding, UT that is a BLM Public pit
Rock is processed by screening only, no crushing is required 1.25 CY of feed for 1 CY of product
Rock is produced and stockpiled at the site
Site is 7 road miles from the mill, 6 miles of which is paved public highway
Rock will be hauled in 22 CY bellydump trucks, contract haulers ($45.00/hr)
Rock will be dumped in windrows on Cells by trucks, spread by grader, and compacted by D7 Dozer
Trucks can average 30 MPH (1.75 rounds/hr)

	Product Required (CY)	Reject Factor	Material Feed to Plant (CY)	Plant Throughput (CY/hr)	Plant Operating Hours
Material fed to plant	146,000	25.0%	182,500	122	1,500

PRODUCTION OF RIPRAP

Resource Description	Units	Cost/Unit	Task Units	Task Cost
Equipment Operators	hrs	$17.72	2,340	$41,460
Laborer	hrs	$10.35	1,500	$15,520
Cat D8N Dozer With Ripper	hrs	$68.67	365	$25,064
Cat 980 Loader	hrs	$64.99	1,975	$128,353
Screening Plant w/conveyors	hrs	$55.00	1,500	$82,500
Contract Highway Trucks - Bellydumps	hrs	$45.00	3,800	$171,000
Equipment Maintenance (Butler)	hrs	$10.01	2,340	$23,430

Total Production of RipRap **$487,326**

RIPRAP COST PER CUBIC YARD DELIVERED **$3.34**

EQUIPMENT COSTS

WHITE MESA MILL RECLAMATION COST
HOURLY EQUIPMENT COSTS 1999 DOLLARS

Actual equipment rates quoted from Butler machinery 6 month rental period
November 3, 1998

	Units	RATE		MTCE	FUEL	FUEL @	TOTAL	Mob/Demob	Mob/Demob	Operating Hrs
		MONTHLY	HOURLY	EXPENDABLES	USAGE	$0.75	COST	per machine	Totals	per Month
637E Scraper	4	21,200	120.45	2.05	24.0	18.00	$140.50	$10,800.00	$43,200.00	704
D8N Dozer	1	10,800	61.36	0.93	8.5	6.38	$68.67	$7,400.00	$7,400.00	176
D7H Dozer	1	9,100	51.70	0.95	7.0	5.25	$57.90	$6,400.00	$6,400.00	176
825C Compactor	1	9,600	54.55	1.10	14.0	10.50	$66.15	$7,300.00	$7,300.00	176
980 F Loader	1	10,000	56.82	1.42	9.0	6.75	$64.99	$7,300.00	$7,300.00	176
988 F Loader	1	15,000	85.23	1.45	12.0	9.00	$95.68	$8,600.00	$8,600.00	176
769C Haul Truck	4	9,200	52.27	1.50	9.0	6.75	$60.52	$7,400.00	$29,600.00	704
375 Excavator	1	19,600	111.36	1.90	14.0	10.50	$123.76	$15,000.00	$15,000.00	176
651 Water Wagon	1	10,000	56.82	1.80	18.0	13.50	$72.12	$8,000.00	$8,000.00	176
5000 gal Water Truck	1	5,700	32.39	0.75	10.0	7.50	$40.64	$3,000.00	$3,000.00	176
14G Motor Grader	1	7,700	43.75	1.05	5.5	4.13	$48.93	$5,600.00	$5,600.00	176
16G Motor Grader	1	11,000	62.50	1.20	8.5	6.38	$70.08	$6,800.00	$6,800.00	176
									$148,200.00	3,168

Equipment Rental Rate Quoted by Power Motive, Denver, Colorado (2/2/99) for PC400 Kamatsu Excavator with LaBounty MSD 70R Shear

PC-400 w Shear	22,950.00	130.40	18.94	14.0	10.50	$159.84		$2,500.00
Small tools allocation - Demolition - $1.25/mechanic labor hour for oxygen/acetalene, expendables						$1.25		
Total Equipment Mobilization								$150,700.00

	Monthly Maintenance Flat Rate	Planned Operating Hours/month	Availabiltiy Factor	Maintenance Cost per Operating Hour
Butler Equipment Maintenance Cost	$29,500.00	3,168	0.93	$10.01

Crane Rental Rates	RATE		MTCE	FUEL	FUEL @	TOTAL
	MONTHLY	HOURLY	EXPENDABLES	USAGE	$0.86	COST
30 ton Hydraulic Crane	7,500	42.61	2.05	15.0	11.25	$55.91
65 ton Hydraulic Crane	5,500	31.25	2.05	10.0	7.50	$40.80

Butler CAT

Butler Machinery Co.

Butler Machinery Co.
1351 Page Dr.
PO Box 9559
Fargo, ND 58106

(701) 232-0033
FAX (701) 298-1717

DATE: 11-3-98

TO: Bob Hembree

COMPANY: International Uranium Corp.

FROM: Oscar Swenson

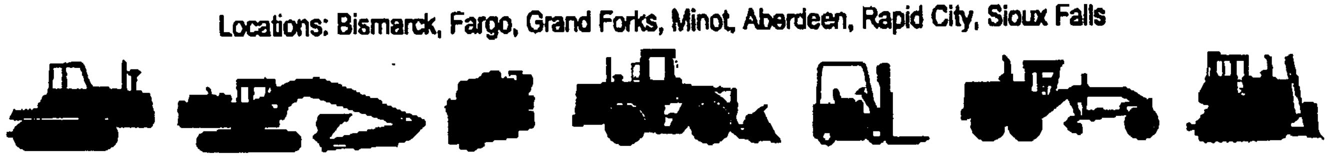
DIRECT DIAL (AUDIX): 701-298-1733

ACKNOWLEDGE RECEIPT OF THIS FAX ☐ YES ☐ NO

NUMBER OF PAGES: 5
(INCLUDING THIS COVER SHEET)

NOTES:

Locations: Bismarck, Fargo, Grand Forks, Minot, Aberdeen, Rapid City, Sioux Falls



Butler

CAT

Butler Machinery Company • (701) 232-0033 • FAX (701) 298-1717 • 1351 Page Dr. • Box 9558 • Fargo, ND 58106

NOVEMBER 3, 1998

INTERNATIONAL URANIUM CORPORATION
ATTN: BOB HEMBREE
1050 SEVENTEENTH ST. SUITE 950
DENVER CO 80265

DEAR BOB:

THANK YOU FOR THE INVITATION TO QUOTE INTERNATIONAL URANIUM CORPORATION (IRC) THE EQUIPMENT NEEDED FOR THEIR MINING PROJECT IN BLANDING, UTAH. BUTLER MACHINERY COMPANY (BUTLER) RESPECTFULLY SUBMITS OUR PROPOSAL FOR A MAINTAINED FLEET OF CATERPILLAR MACHINES.

LISTED ON ATTACHMENT A, YOU WILL FIND THE MODELS, QUANTITIES, MONTHLY RENTAL RATES, HOURS ALLOWED PER MONTH, EXCESS HOUR CHARGE, GUARANTEED NUMBER OF MONTHS RATES ARE BASED UPON, TOTAL FREIGHT CHARGES AND THE MAINTENANCE RATE PER HOUR FOR MATERIALS ONLY.

ALL RATES SHOWN ON ATTACHMENT A DO NOT INCLUDE ANY STATE, LOCAL, PROPERTY OR ANY OTHER TAXES THAT MAY BE APPLICABLE.

RATES ARE BASED UPON ELECTRIC HOUR METER READINGS WHICH ARE ATTACHED TO THE DASH OF EACH MACHINE. RATES ARE BASED ON 176 HOURS OF USE EACH MONTH. EXCESS HOUR CHARGES, IF ANY, WILL BE CALCULATED AND INVOICED AT THE END OF THE PROJECT. THERE WOULD BE NO CREDIT ISSUED FOR ANY HOURS UNDER THE ALLOWED DURING THE TERM OF THIS PROPOSAL. IF IRC ELECTS TO DOUBLE SHIFT MACHINES, THEN BUTLER WOULD INVOICE THOSE HOURS AT THE END OF EACH MONTH. (TO FIGURE THE DOUBLE SHIFT RATES, TAKE THE EXCESS HOUR RATE SHOWN ON ATTACHMENT A TIMES THE NUMBER OF HOURS).

RATES ARE BASED UPON A MINIMUM GUARANTEE OF 6 MONTHS AND A <u>PACKAGE DEAL</u>.

<u>MAINTENANCE:</u>
THE MAINTENANCE RATES <u>PER HOUR</u> LISTED ON ATTACHMENT A INCLUDES THE MATERIAL PART ITEMS ONLY, SUCH AS AIR, OIL, AND FUEL FILTERS, LUBRICANT OILS, GREASE, ANTI-FREEZE, BATTERIES, FAN BELTS, LIGHTS AND MAKE-UP OILS. BUTLER WOULD INVOICE IRC ACTUAL HOURS USED ON MACHINES AT THE END OF EACH MONTH.

Fargo, 58108 3402 36th Ave. S. P.O. Box 9559 | Bismarck, 58502 3630 Miriam Ave. P.O. Box 757 | Minot, 58702 1505 Hwy.2, Bypass E P.O. Box 1058 | Grand Forks, 58208 1201 S. 46th St. P.O. Box 12280 | Rapid City, 57709 3801 Deadwood Ave. N. P.O. Box 2070 | Sioux Falls, 57101 3201 N Louise Ave. P.O. Box 1307 | Aberdeen, 57402 4950 E. Highway 12 P.O. Box 38

OUR MONTHLY MAINTENANCE CHARGE WOULD BE $29,500.00, WHICH INCLUDES OUR LABOR, SPECIALIZED LUBE TRUCKS, SUPPORT VEHICLES AND EQUIPMENT, SPECIALIZED TOOLING, SCHEDULED OIL SAMPLING, PARTS TRAILERS AND INVENTORIES, MILEAGE AND TRAVEL EXPENSE. BUTLER WILL PROVIDE TWO (2) FULL-TIME MAINTENANCE TECHNICIANS ON SITE FIFTY (50) HOURS PER WEEK ON A SCHEDULE TO BE DETERMINED, MONDAY THROUGH FRIDAY. IRC WOULD HAVE TO SCHEDULE THE MACHINES AVAILABLE FOR A TIME FRAME YET TO BE DETERMINED ADEQUATE FOR BUTLER MAINTENANCE PERSONNEL TO PERFORM THE REQUIRED MAINTENANCE. BUTLER WOULD INVOICE IRC FOR THE MONTHLY MAINTENANCE CHARGE AT THE BEGINNING OF EACH MONTH.

REPAIRS:

BUTLER WOULD BE RESPONSIBLE FOR ALL REPAIRS INCLUDING PARTS AND LABOR ON OUR MACHINES OTHER THAN FAILURES CAUSED BY DAMAGES OR MIS-USE. REPAIRS INCLUDE ITEMS AS MINOR AS STARTERS, ALTERNATORS, WATER PUMPS, HYDRAULIC HOSES, ETC. TO THE MAJOR ITEMS SUCH AS ENGINES, TRANSMISSIONS, DIFFERENTIALS, BRAKES, HYDRAULIC PUMPS AND CYLINDERS, ETC. IF TIME PERMITS AND IRC REQUESTS BUTLER'S TECHNICIAN TO PERFORM REPAIRS OR MAINTENANCE ON THEIR MACHINES, OUR HOURLY CHARGE WOULD BE $47.00 PER HOUR PLUS MATERIALS.

FREIGHT:

FREIGHT CHARGES INCLUDE BOTH DELIVERY AND RETURN, ASSEMBLY, AND DISASSEMBLY OF EQUIPMENT.

IRC'S RESPONSIBILITIES INCLUDE:

OPERATORS. PROVIDE THE OPERATORS AS NEEDED TO OPERATE MACHINES AS STATED IN CATERPILLAR'S OPERATING GUIDE. BUTLER WILL PROVIDE, AT NO EXPENSE TO IRC, QUALIFIED TRAINING INSTRUCTORS FOR THE PURPOSES OF TRAINING OPERATORS. THIS TRAINING WOULD TAKE PLACE ON THE JOBSITE AT THE INITIAL START UP OF THE JOB AND WOULD INCLUDE CLASSROOM, WALK AROUND, AND IN IRON DEMONSTRATIONS.

FUEL. SUPPLY AND FILL ALL FUEL FOR EQUIPMENT INCLUDING BUTLER'S SERVICE VEHICLES.

DAMAGES. THIS INCLUDES GLASS BREAKAGE, BENT HANDRAILS, STEP LADDERS, FENDERS, ETC. BUTLER'S NORMAL POLICY FOR REPAIRING DAMAGES TO RENTAL MACHINES IS TO REPAIR THEM WHEN THE RENTAL PERIOD IS COMPLETED, HOWEVER, IF THE DAMAGED ITEM IS OF A SAFETY CONCERN, WE WOULD REPAIR THE DAMAGES AS SOON AS POSSIBLE AFTER THEY OCCURRED. AN ITEMIZED LIST OF THE PARTS AND LABOR REQUIRED WOULD BE PROVIDED TO IRC PRIOR TO STARTING THE REPAIR, AND INVOICED AT CURRENT LIST PRICES PLUS FREIGHT UPON COMPLETION.

UNDERCARRIAGE AND TIRES: IRC WOULD BE RESPONSIBLE FOR ALL TIRE WEAR INCLUDING TIRE DAMAGES ON THE MACHINES WITH AN ASTERISK LISTED ON ATTACHMENT A. EQUIPMENT WOULD HAVE TO BE RETURNED WITH SAME BRAND AND MODEL TIRES AS WHEN DELIVERED, OR PRORATED ACCORDINGLY BY PERCENTAGE OF TIRE WEAR AND CONDITION AT TERMINATION OF RENTAL PERIOD.

UPON DELIVERY OF MACHINES, A REPRESENTATIVE OF BUTLER, A REPRESENTATIVE OF IRC AND A REPRESENTATIVE FROM AN INDEPENDENT TIRE DEALER OR MANUFACTURER WOULD JOINTLY VERIFY IN WRITING THE CONDITION, PERCENTAGE OF WEAR, AND TIRE VALUE. UPON TERMINATION OF RENTAL, WE WOULD AGAIN HAVE THE REPRESENTATIVES MENTIONED ABOVE DETERMINE THE CONDITION, PERCENTAGE OF WEAR, AND TIRE VALUES. ANY DIFFERENCES NOTED, WOULD THEN BE CHARGED OR CREDITED TO IRC INCLUDING BOTH MATERIALS AND LABOR.

UNDERCARRIAGE WEAR ON ALL TRACK TYPE MACHINES WOULD BE BUTLER'S EXPENSE.

GROUND ENGAGING TOOLS:

IRC WOULD BE RESPONSIBLE FOR ALL PARTS RELATING TO GROUND ENGAGING TOOLS (G.E.T.), I.E. CUTTING EDGES, RIPPER TIPS AND PROTECTORS, BUCKET TIPS AND ADAPTERS, EDGES BETWEEN ADAPTERS, WEAR PLATES ON BOTTOM OF BUCKETS AND ALL MOUNTING HARDWARE. BUTLER WOULD INSTALL THESE ITEMS ON AN AS NEEDED BASIS AT THE CURRENT CATERPILLAR LIST PRICE PLUS FREIGHT AT NO ADDITIONAL LABOR COSTS. ALL MACHINES WOULD BE DELIVERED WITH NEW G.E.T. ITEMS AND ARE TO BE RETURNED WITH NEW.

WE WISH TO THANK IRC AND YOU FOR GIVING US THE OPPORTUNITY TO PRESENT OUR PROPOSAL AND FOR ALL THE CONSIDERATION WE RECEIVE.

SINCERELY YOURS,

BUTLER MACHINERY COMPANY

Oscar D. Swenson

OSCAR D. SWENSON
RENTAL FLEET MARKETING MANAGER

ODS/del
cc: JOEL NIKLE, RENTAL FLEET MANAGER

AT[illegible] [illegible]MENT A
INTERNATIONAL URANIUM CORPORATION
EQUIPMENT NEEDED FOR JOB IN BLANDING, UTAH
NOVEMBER 3, 1998

MODEL	QTY	MONTHLY RENTAL RATE	HOURS ALLOWED PER MONTH	EXCESS HOUR CHARGE	MINIMUM GUARANTEED NUMBER OF MONTHS RATE BASED UPON	TOTAL** FREIGHT CHARGES TO & FROM	MAINTENANCE RATE PER HOUR
*637E	4	$21,200 EA.	176 EA.	$66 EA.	6 EA.	$10,800 EA.	$2.05 EA.
D9N/RIPPER	1	13,300	176	42	6	8,600	1.40
D8N/RIPPER	1	10,800	176	34	6	7,400	1.15
D7H/RIPPER	1	9,100	176	28	6	6,400	.95
825C	1	9,600	176	30	6	7,300	1.10
980F	1	10,000	176	32	6	7,300	1.15
*988F	1	15,000	176	48	6	8,600	1.45
*769C	4	9,200 EA.	176 EA.	28 EA.	6 EA.	7,400 EA.	1.50 EA.
375L	1	19,600	176	56	6	15,000	1.90
10,000 GALLON WATER WAGON	1	10,000	176	30	6	8,000	1.80
5,000 GALLON WATER WAGON	1	5,700	176	18	6	3,000	.75
14G/RIPPER	1	7,700	176	24	6	5,600	1.05
16G/RIPPER	1	11,000	176	34	6	6,800	1.20

* PLUS TIRE WEAR
** INCLUDES ASSEMBLY AND DISASSEMBLY

Date: Feb 22, 1999

INTERNATIONAL URANIUM
BLANDING UTAH
ATTN: WALLY BRICE
CONFIDENTAIL PRICE INFORMATION FAX # 1 435 678 2224
TERMS: NET 15 DAYS ON TRANSPORT LOADS

Red dyed diesel for off road use delivered in transport quanities to various sites

	Blanding	Sunday Mines	La Sal Mine	Dove Creek
Rack dsl #2	$0.4250	$0.3825	$0.3825	$0.4485
Freight	$0.0450	$0.0500	$0.0550	$0.0400
Taxes	$0.0000	$0.0063	$0.0000	$0.0063
Margin	$0.0200	$0.0200	$0.0200	$0.0200
Sales Tax	$0.0000	$0.0000	$0.0000	$0.0000
Total Price	$0.4900	$0.4588	$0.4575	$0.5128

Utah charges sales tax on dyed diesel fuel .06%

Red dyed diesel for off road use delivered in bobtail load (500-2000) to various sites

	Blanding	Sunday Mines	La Sal Mine	Dove Creek
Rack dsl # 2	$0.4275	$0.3825	$0.3825	$0.4465
Frt & Margin	$0.1500	$0.1500	$0.1500	$0.1500
Taxes	$0.0000	$0.0063	$0.0000	$0.0063
Sales Tax	$0.0000	$0.0000	$0.0000	$0.0000
Total Price	$0.5775	$0.5388	$0.5325	$0.6028

Utah Charges sales tax on dyed diesel 06%

No Lead Gasoline 86 octane gasoline delivered in transport loads to various sites

	Blanding	Sunday Mines	La Sal Mine	Dove Creek
Rack	$0.4300	$0.3900	$0.3900	$0.4450
Freight	$0.0450	$0.0500	$0.0550	$0.0400
Taxes	$0.4290	$0.4103	$0.4290	$0.4103
Margin	$0.0200	$0.0200	$0.0200	$0.0200
Total Price	$0.9240	$0.8703	$0.8940	$0.9153

No Lead Gasoline 86 octane delivered in bobtail deliveries(500-2000)to various site

	Blanding	Sunday Mines	La Sal Mine	Dove Creek
Rack	$0.4300	$0.3900	$0.3900	$0.4450
Frt & Margin	$0.1500	$0.1500	$0.1500	$0.1500
Taxes	$0.4290	$0.4103	$0.4290	$0.4103
Total Price	$1.0090	$0.9503	$0.9690	$1.0053

Propane Delivered Transport Loads Blanding Utah

	Blanding
Rack	$0.2700
Freight	$0.0450
Margin	$0.0100
Taxes	$0.0000
Total Price	$0.3250 +.06 % Utah Sales Tax exempt

Propane bobtail loads deliverd to various sites

	Blanding	Sunday Mine	La Sal Mine	Dove Creek
Rack	$0.2700	$0.2700	$0.2700	$0.2700
Frt & Margin	$0.1500	$0.1500	$0.1500	$0.1500
Taxes	$0.0000	$0.0000	$0.0000	$0.0000
Total Price	$0.4200	$0.4200	$0.4200	$0.4200

Utah charges .06% sales tax on propane
Colorado charges .03% sales tax

FROM: FRALEY & CO. INC CORTEZ COLORADO NEIL JONES 1 800 392 6939

(801) 201-7418

Webb Crane

100 Ton Hydraulic
$4800 Mob. & Demob. w/operator (Blanding, UT)
200/hr. on site
$100/Per Diem Not available 10/9/98

75 Ton Conventional w/operator
$3900 Mob. & Demob.
$180/hr. on site 200 hr/mo.
$100 Per Diem Not available 10/9/98

40 Ton Rough Terrain (Our Operator)
$6600/month
2200/week Not available 10/9/98
$1632 mob & Demob

~~Hewlett~~ Packard

LaVeryle & Dan

Crane Service 70,122.00
~~60~~ 65 Ton
$7,500.00/month
$3600.00 mob. & Demob.
50 Ton $7000.00/month
$3,600.00 mob & Demob.

POWER MOTIVE CORP

FAX Transmission

To: BOB EMBREE
Company: I.W.C.
From: TERRY BERG

Date: 2/25/99
C.C.
FAX #: 303-389-4163

FOLLOWING PAGES SHOW CONFIGURATION OF THE CEC SCREEN-ITS

THE 4 x 10 SIZE RENTS @ 8,800.-/MO.

THE 5 x 12 SIZE RENTS @ 10,600.-/MO.

3" ON TOP DECK & 1/2" ON BOTTOM DECK IS A COMFORTABLE SET-UP FOR EITHER PLANT.

THANKS

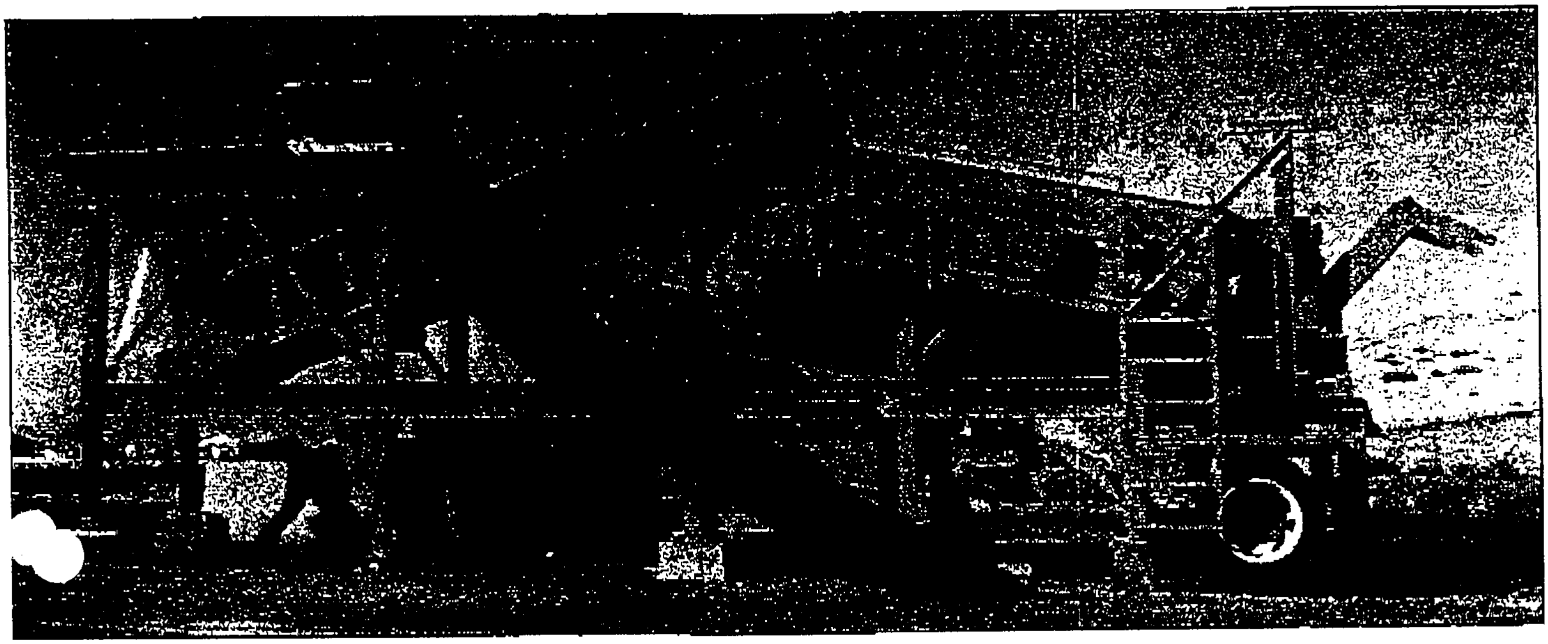
T. BERG

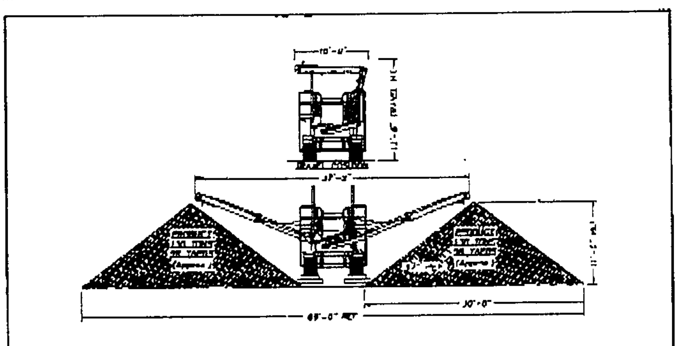
VOICE: 303-355-5900 FAX: 303-388-9328

5000 VASQUEZ BLVD, DENVER, CO 80216

Construction Equipment Co.

SCREEN-IT 4 X 10





TRANSPORT

Height: 13'6" Fifth Wheel Pull
Width: 10'0" Spring Suspension, air brakes
Length: 39' Lights, oil filled hubs

ENGINE

4 cylinder Deutz; 46 HP - Air Cooled
65 gallon fuel tank

OPTIONS

4 individual jacking legs
Shredder
Grizzly dump
Stacking Conveyors
Ball decks

HOPPER

5.5 cu. yard charging hopper
Height to load 12'3"
Side Loading width 12'0"

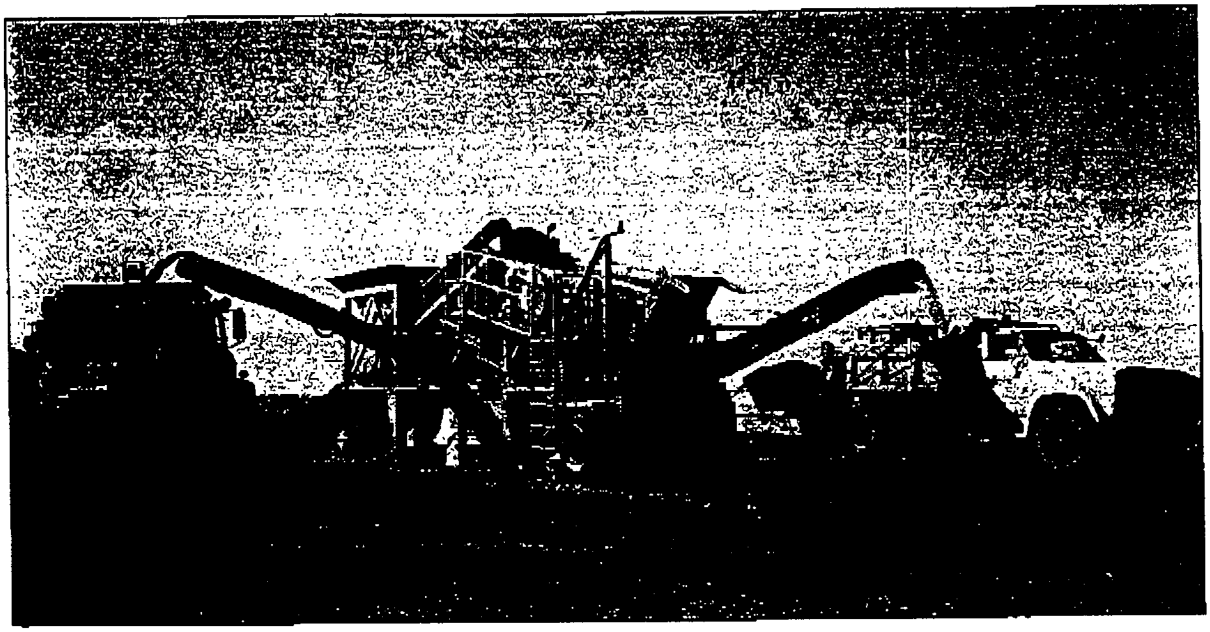
SCREEN

4 x 10; 2 Deck Screen
Hydraulic drive 5/8" Throw
Rubber Spring Suspension

CONVEYORS

36" wide feed conveyor
36" wide under screen conveyor
24" side discharge conveyor
24" rear discharge conveyor

Diesel Hydraulic-Self Contained Portable and Easy to Set Up



High Production Screens Sand and Gravel

Conveyors Can Load Directly Into Truck

CEC

Construction Equipment Co.
18650 S.W. Pacific Hwy
Tualatin, OR 97062
503-692-9000
Fax 503-692-6220

Area Dealer

POWER MOTIVE
5000 VASQUEZ BLVD.
DENVER, CO 80216
PHONE: (303) 355-5900
FAX: (303) 388-9325

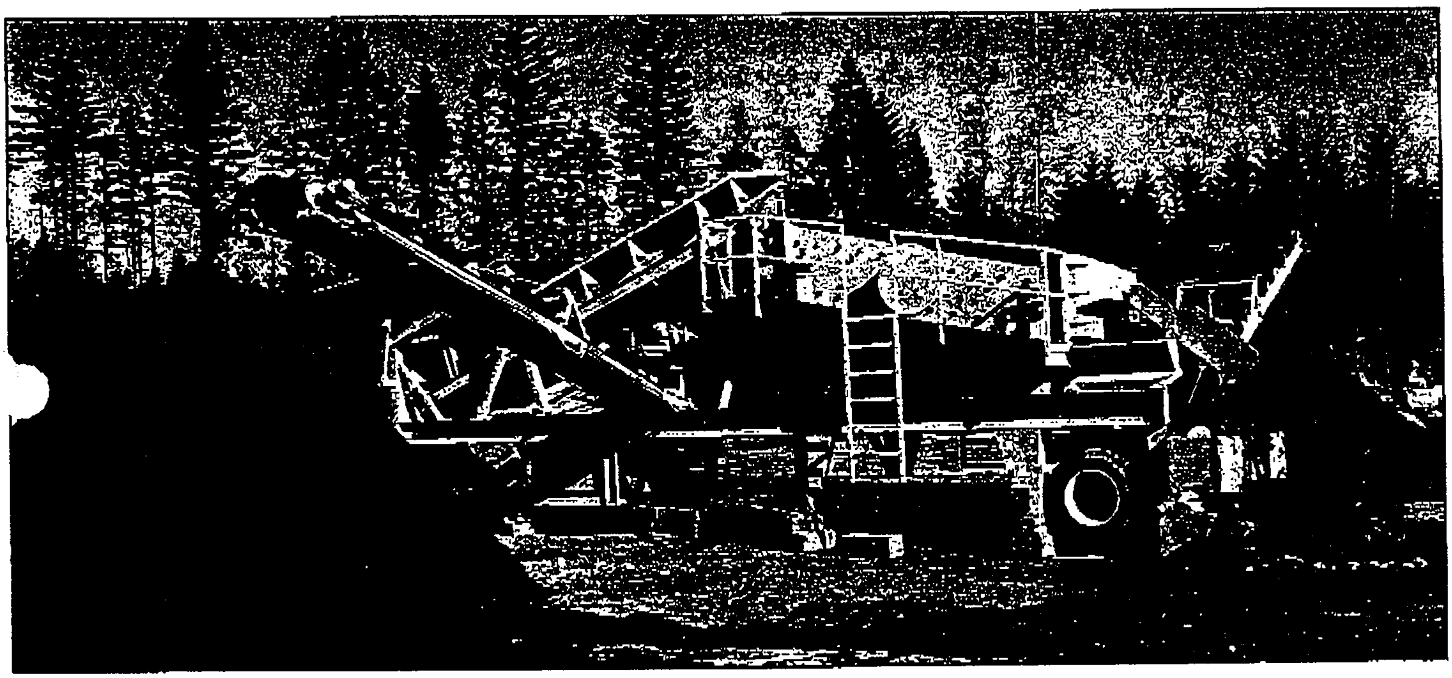
CEC

Construction Equipment Co.

SCREEN IT - Series II

Highly Portable - All Hydraulic Setup

Produces Three Different Products



SCREENS COMPOST 120-140 YARDS PER HOUR
SCREENS GRAVEL UP TO 600 TONS PER HOUR

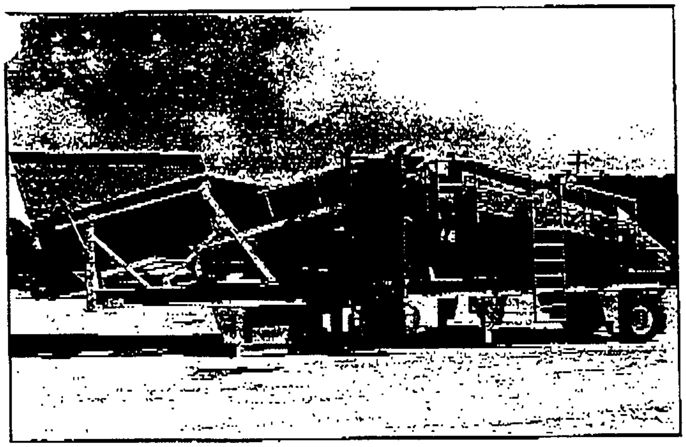
SCREENS: LOG YARD WASTE, COMPOST, BARK, TOP SOIL, SAND & GRAVEL, TRASH, C & D, STUMPS, CONCRETE, ROCK AND MANY RECYCLE MATERIALS

Patent #5234564

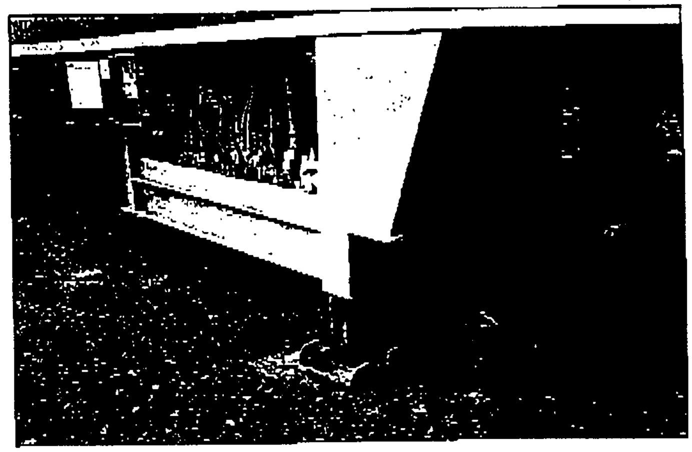
Construction Equipment Co.
P.O. Box 1271
Lake Grove, Oregon 97035
503-635-4427
Fax 503-635-7819

Area Dealer

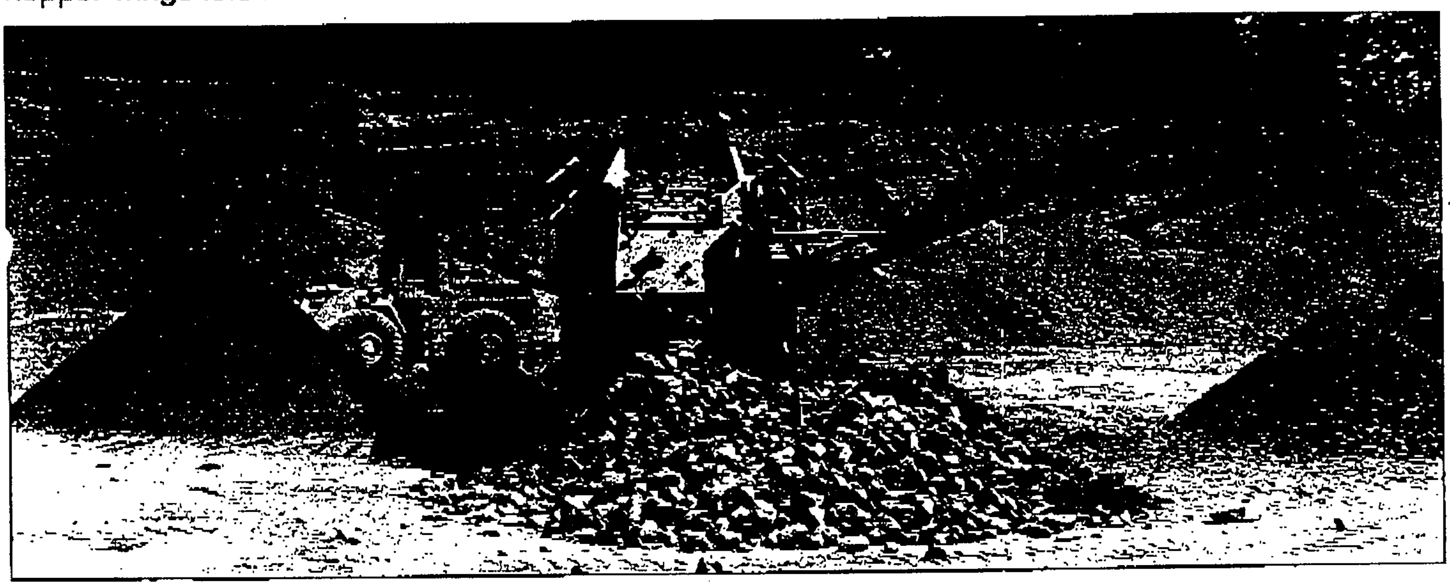
ALL HYDRAULIC FOLD AND SETUP



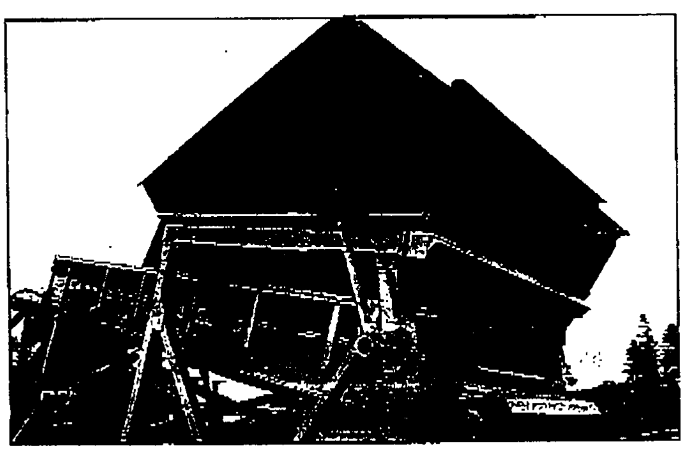
Travel position of the SCREEN IT in which feed conveyor and hopper hydraulically slide back and lower down to transportation height, while hopper wings fold in.



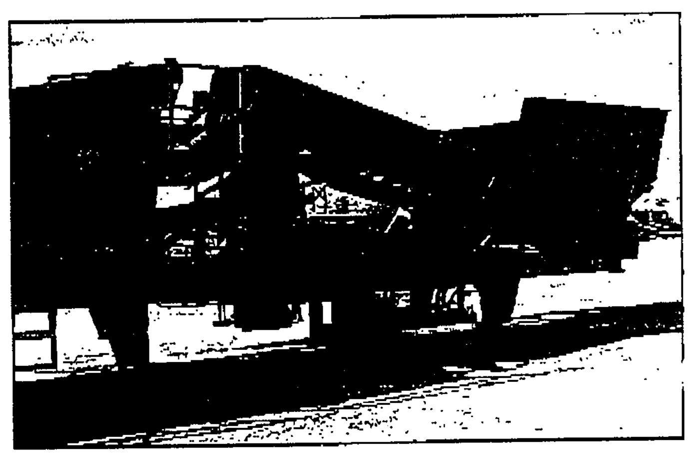
Hydraulic jacking legs are standard for cantelever style blocking, but four (4) individual jacking legs can be an option.



Side and rear discharge conveyors hydraulically fold out to the height of 14'.

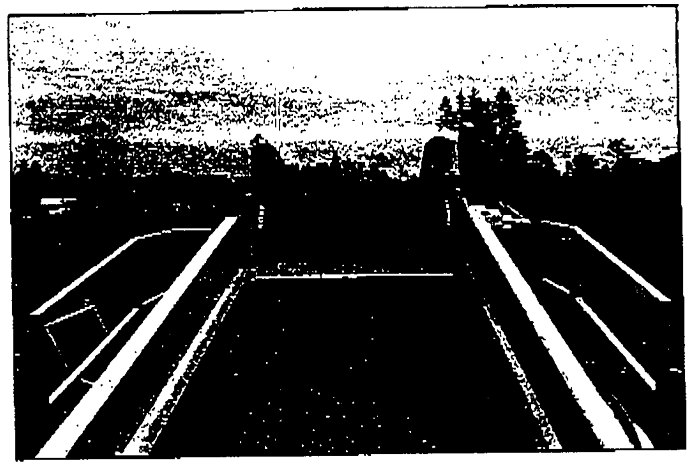


Feed conveyor moves up and forward hydraulically, while the hopper wing walls extend for operation.



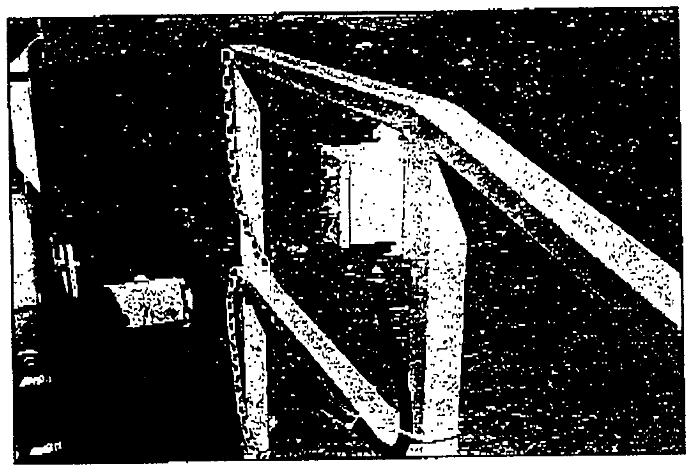
Feed conveyor hydraulically moves back and down for transport.

The charging hopper folds out to the width of 14' while in its working position.

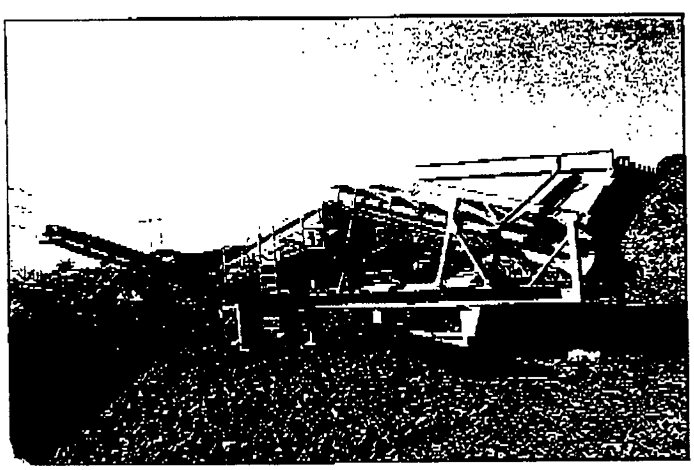


A 48" wide variable feed conveyor with 20" rubber lagged head pulley feeds a 5 x 12 2 Deck screen.

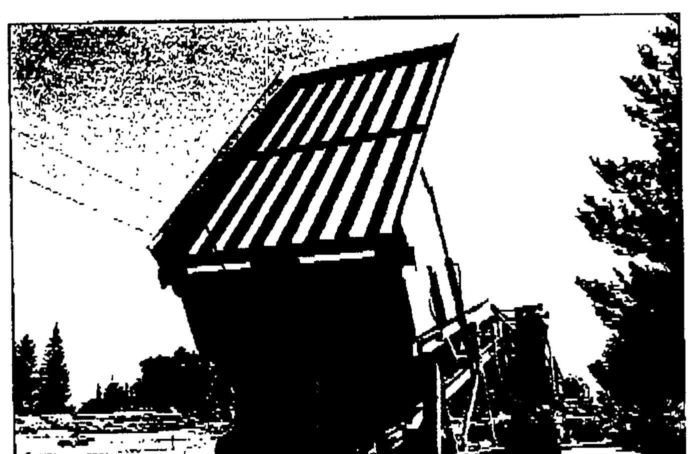
Control panel and hydraulic controls are all located in turnkey area. Powered by a Deutz 4 cylinder, 70 HP diesel engine.



Actuator switch to control speed of feed conveyor is located on the catwalk platform along with kill switch. Actuator switch also located at control panel.

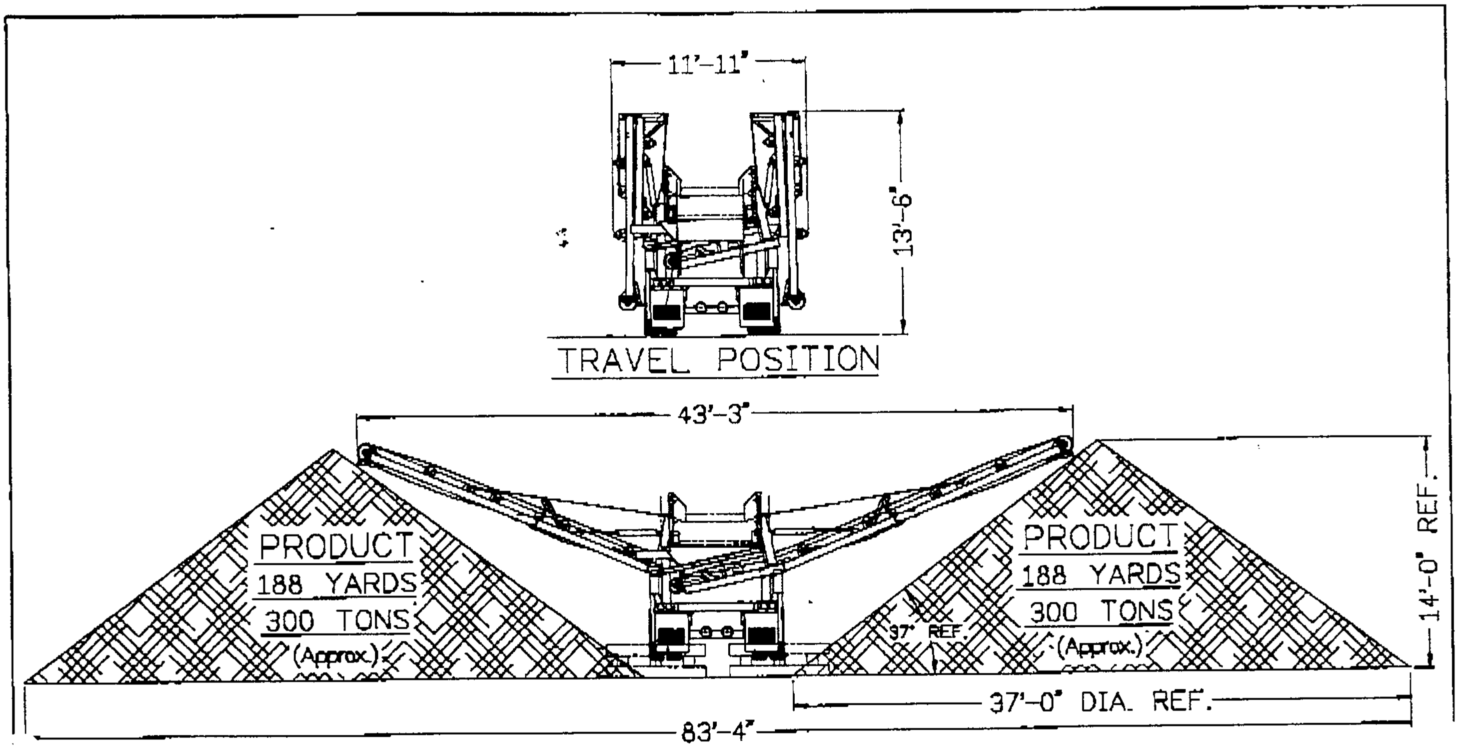


.ne SCREEN IT has an optional 14 foot long by 8 foot wide hydraulic dumping grizzly. An operator controlled remote dumping system is also available.



The optional grizzly dumps to the rear of the plant.

SCREENING,
Topsoil To 250 yds./hr.
Sand & Gravel To 600 Tons/hr.



HYDRAULIC DRIVE

TRANSPORT

Height:	13' 6"	Fifth wheel pull
Width:	11' 11"	Spring suspension, air brakes
Length:	43' 0"	Lights, oil filled hubs
Weight:	38,600	Transport speed 65 mph

HOPPER

14.5 cu. yard charging hopper
Height to load 13' 6"
Width at rear 14' - Working position
Width at rear 8' - Travel position

ENGINE

4 cylinder Deutz
70 HP • Air Cooled
65 gallon fuel tank
110 gallon hydraulic tank

SCREEN

5 x 12, 2 Deck with step deck
Hydraulic drive with 3/8" to 5/8" throw
Rubber spring suspension

OPTIONS

4 individual jacking legs
Shredder
Grizzly Dump
Stacking conveyors
79 HP Turbo Diesel (Water Cooled)
98 HP Turbo Diesel (Air Cooled)

CONVEYORS

48" wide feed conveyor 23' 10" long
42" wide under screen conveyor
30" side discharge conveyor 18' 4" long
30" rear discharge conveyor 18' 4" long

637 SCRAPER EFFICIENCY

NOMINAL CAPACITY 31

HAUL ROUTE	TRAVEL TIME	FIXED TIME	EFFICIENCY	MINUTES PER TRIP	TRIPS/ HOUR	YARDS/ HOUR
1	3.90	1.20	85%	6.0	10.0	310
2	3.25	1.20	85%	5.2	11.5	355
3	4.30	1.20	85%	6.5	9.3	287
4	3.10	1.20	85%	5.1	11.9	368
5	4.15	1.20	85%	6.3	9.5	296
6	4.50	1.20	85%	6.7	8.9	277
7	3.75	1.20	85%	5.8	10.3	319

CAT 637 SCRAPER

TRAVEL TIMES FOR CAT 637 SCRAPERS

BASED ON PROJECTED HAUL ROUTES

Haul Segment	Distance Feet	Distance Meters	Rolling Risistance	Grade %	Ave Speed MPH	Time Min
1a	200	67	7.5	0.0	9.1	0.25
1b	500	167	5.0	0.0	12.6	0.45
1c	200	67	3.0	2.5	9.1	0.25
1d	1400	467	3.0	0.0	18.7	0.85
1e	250	83	3.0	0.0	9.5	0.30
1f	250	83	3.0	0.0	11.4	0.25
1g	1400	467	3.0	0.0	21.2	0.75
1h	200	67	3.0	(2.5)	11.4	0.20
1i	400	133	5.0	0.0	13.0	0.35
1j	200	67	7.5	0.0	9.1	0.25
						3.90
2a	200	67	7.5	0.0	9.1	0.25
2b	2150	717	3.0	(0.5)	22.2	1.10
2c	250	83	5.0	0.0	9.5	0.30
2d	250	83	5.0	0.0	11.4	0.25
2e	2250	750	3.0	+0.5	23.2	1.10
2f	200	67	7.5	0.0	9.1	0.25
						3.25
3a	250	83	7.5	0.0	8.1	0.35
3b	3300	1100	3.0	-0.5	23.4	1.60
3c	250	83	5.0	0.0	9.5	0.30
3d	250	83	5.0	0.0	11.4	0.25
3e	3300	1100	3.0	+0.5	25.0	1.50
3f	250	83	7.5	0.0	9.5	0.30
						4.30
4a	350	117	7.5	-3.5	11.4	0.35
4b	1450	483	3.0	0.0	19.4	0.85
4c	250	83	5.0	0.0	9.5	0.30
4d	250	83	5.0	0.0	11.4	0.25
4e	1700	567	3.0	0.0	22.7	0.85
4f	500	167	7.5	+3.5	11.4	0.50
						3.10

CAT 637 SCRAPER

Haul Segment	Distance Feet	Distance Meters	Rolling Risistance	Grade %	Ave Speed MPH	Time Min
5a	1400	467	7.5	-2.75	15.9	1.00
5b	1350	450	3.0	0.0	19.2	0.80
5c	250	83	5.0	0.0	9.5	0.30
5d	250	83	5.0	0.0	11.4	0.25
5e	2250	750	3.0	0.0	23.2	1.10
5f	700	233	7.5	+5.5	11.4	0.70
						4.15
6a	600	200	7.5	0.0	11.4	0.60
6b	900	300	3.0	-3.3	20.5	0.50
6c	1450	483	3.0	0.0	19.4	0.85
6d	400	133	5.0	0.0	11.4	0.40
6e	400	133	5.0	0.0	11.4	0.40
6f	1450	483	3.0	0.0	22.0	0.75
6g	900	300	3.0	+3.3	17.0	0.60
6h	450	150	7.5	0.0	12.8	0.40
						4.50
7a	750	250	7.5	-1.5	12.2	0.70
7b	1600	533	3.0	0.0	20.2	0.90
7c	350	117	5.0	0.0	11.4	0.35
7d	350	117	5.0	0.0	11.4	0.35
7e	1600	533	3.0	0.0	22.7	0.80
7f	750	250	7.5	+1.5	13.1	0.65
						3.75

769C TRUCK EFFICIENCY

NOMINAL CAPACITY 25

HAUL ROUTE	TRAVEL TIME	FIXED TIME	EFFICIENCY	MINUTES PER TRIP	TRIPS/ HOUR	YARDS/ HOUR
1	3.90	2.50	85%	7.5	8.0	199
2	3.05	2.50	85%	6.5	9.2	230
3	4.00	2.50	85%	7.6	7.8	196

CAT 769 TRUCKS

TRAVEL TIMES FOR CAT 769C TRUCKS

BASED ON PROJECTED HAUL ROUTES

Haul Segment	Distance Feet	Distance Meters	Rolling Risistance	Grade %	Ave Speed MPH	Time Min
1a	200	67	7.5	0.0	7.6	0.30
1b	500	167	5.0	0.0	12.6	0.45
1c	200	67	3.0	2.5	9.1	0.25
1d	1400	467	3.0	0.0	18.7	0.85
1e	250	83	3.0	0.0	9.5	0.30
1f	250	83	3.0	0.0	11.4	0.25
1g	1400	467	3.0	0.0	22.7	0.70
1h	200	67	3.0	(2.5)	11.4	0.20
1i	400	133	5.0	0.0	13.0	0.35
1j	200	67	7.5	0.0	9.1	0.25
						3.90
2a	200	67	7.5	0.0	7.6	0.30
2b	2150	717	3.0	(0.5)	24.4	1.00
2c	250	83	5.0	0.0	9.5	0.30
2d	250	83	5.0	0.0	11.4	0.25
2e	2250	750	3.0	+0.5	26.9	0.95
2f	200	67	7.5	0.0	9.1	0.25
						3.05
3a	250	83	7.5	0.0	8.1	0.35
3b	3300	1100	3.0	-0.5	25.0	1.50
3c	250	83	5.0	0.0	9.5	0.30
3d	250	83	5.0	0.0	11.4	0.25
3e	3300	1100	3.0	+0.5	28.8	1.30
3f	250	83	7.5	0.0	9.5	0.30
						4.00
4a	350	117	7.5	-3.5	11.4	0.35
4b	1450	483	3.0	0.0	19.4	0.85
4c	250	83	5.0	0.0	9.5	0.30
4d	250	83	5.0	0.0	11.4	0.25
4e	1700	567	3.0	0.0	22.7	0.85
4f	500	167	7.5	+3.5	11.4	0.50
						3.10

CAT 769 TRUCKS

Haul Segment	Distance Feet	Distance Meters	Rolling Risistance	Grade %	Ave Speed MPH	Time Min
5a	1400	467	7.5	-2.75	15.9	1.00
5b	1350	450	3.0	0.0	19.2	0.80
5c	250	83	5.0	0.0	9.5	0.30
5d	250	83	5.0	0.0	11.4	0.25
5e	2250	750	3.0	0.0	23.2	1.10
5f	700	233	7.5	+5.5	11.4	0.70
						4.15
6a	600	200	7.5	0.0	11.4	0.60
6b	900	300	3.0	-3.3	20.5	0.50
6c	1450	483	3.0	0.0	19.4	0.85
6d	400	133	5.0	0.0	11.4	0.40
6e	400	133	5.0	0.0	11.4	0.40
6f	1450	483	3.0	0.0	22.0	0.75
6g	900	300	3.0	+3.3	17.0	0.60
6h	450	150	7.5	0.0	12.8	0.40
						4.50
7a	750	250	7.5	-1.5	12.2	0.70
7b	1600	533	3.0	0.0	20.2	0.90
7c	350	117	5.0	0.0	11.4	0.35
7d	350	117	5.0	0.0	11.4	0.35
7e	1600	533	3.0	0.0	22.7	0.80
7f	750	250	7.5	+1.5	13.1	0.65
						3.75

Specified Wages

Heavy Construction **1998 Estimate Labor Rates**** 0.1397 0.2128

Labor Classification	Base Rate	Mandated Fringe	Labor Burden (FICA, SUI, FUI, etc.	Company Benefits (medical, life insure, etc)	Fringe Costs	Labor Cost/HR
Boiler Makers	$19.60	$8.76	$2.74	no added cost	$11.50	$31.10
Millwrights	$19.83	$3.25	$2.77	$0.97	$6.99	$26.82
Ironworkers	$19.92	$6.66	$2.78	no added cost	$9.44	$29.36
Carpenters	$10.81		$1.51	$2.30	$3.81	$14.62
Cement Masons	$11.52		$1.61	$2.45	$4.06	$15.58
Electricians	$14.52	$2.71	$2.03	$0.38	$5.12	$19.64
Ironworkers - Reinforcing	$11.00		$1.54	$2.34	$3.88	$14.88
Laborers (including pipelayers)	$7.65	$1.60	$1.07	$0.03	$2.70	$10.35
Pipefitters	$12.60		$1.76	$2.68	$4.44	$17.04
POWER EQUIPMENT OPERATORS						
Backhoes	$10.00		$1.40	$2.13	$3.53	$13.53
Cranes	$10.43		$1.46	$2.22	$3.68	$14.11
Dozers++	$13.10		$1.83	$2.79	$4.62	$17.72
Graders	$12.67		$1.77	$2.70	$4.47	$17.14
Loaders	$11.26		$1.57	$2.40	$3.97	$15.23
Scrapers+	$10.00		$1.40	$2.13	$3.53	$13.53
Trackhoes	$10.00		$1.40	$2.13	$3.53	$13.53
Tractors	$9.42		$1.32	$2.00	$3.32	$12.74
TRUCK DRIVERS	$9.42		$1.32	$2.00	$3.32	$12.74

Note: base rates do not include FICA, worker comp, unemployment, or company benefits which increase the cost per hour

** General Decision UT980009 - Modification 0 - 2/13/98

++ Operator Rate used in 1999 estimate

LABOR COSTS

Nonspecified Wages	Base Rate	Mandated Fringe	Labor Burden (FICA, SUI, FUI, etc.	Company Benefits (medical, life insure, etc)	Fringe Costs	Labor Cost/HR
Survey Crew Member	$9.75	$0.00	$1.36	$2.07	$3.44	$13.19
Sample Crew Member	$9.75	$0.00	$1.36	$2.07	$3.44	$13.19
Mechanic (Demolition)	$10.20	$0.00	$1.42	$2.17	$3.60	$13.80
Manager/Engineer	$36.00	$0.00	$5.03	$7.66	$12.69	$48.69
Radiation Safety Officer	$28.00	$0.00	$3.91	$5.96	$9.87	$37.87
Secretary	$11.10	$0.00	$1.55	$2.36	$3.91	$15.01
Clerk	$9.25	$0.00	$1.29	$1.97	$3.26	$12.51
Engineer	$28.00	$0.00	$3.91	$5.96	$9.87	$37.87
Environmental Technician	$14.80	$0.00	$2.07	$3.15	$5.22	$20.02
Safety Engineer	$14.80	$0.00	$2.07	$3.15	$5.22	$20.02
Maintenance Foreman	$20.34	$0.00	$2.84	$4.33	$7.17	$27.51
Security Personnel	$5.75	$0.00	$0.80	$1.22	$2.03	$7.78
Chemist	$16.65	$0.00	$2.33	$3.54	$5.87	$22.52

IUC INTERNATIONAL URANIUM (USA) CORPORATION

6425 S. Highway 191 ♦ P.O. Box 809 ♦ Blanding, UT 84511 ♦ 435 678-2221 ♦ 435 678 2224 (fax)

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GENERAL DECISION UT980009 02/13/98 UT9
General Decision Number UT980009

Superseded General Decision No. UT970009

State: Utah

Construction Type:
HEAVY

County(ies):

BEAVER	IRON	SEVIER
CARBON	JUAB	UINTAH
DAGGETT	KANE	WASHINGTON
EMERY	PIUTE	WAYNE
GARFIELD	SAN JUAN	
GRAND	SAN PETE	

HEAVY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	02/13/1998

COUNTY(ies):

BEAVER	IRON	SEVIER
CARBON	JUAB	UINTAH
DAGGETT	KANE	WASHINGTON
EMERY	PIUTE	WAYNE
GARFIELD	SAN JUAN	
GRAND	SAN PETE	

BOIL0192B 04/01/1995

	Rates	Fringes
BOILERMAKERS	19.60	8.76

CARP0722B 10/29/1995

	Rates	Fringes
MILLWRIGHTS	19.83	3.25

IRON0027G 07/01/1997

	Rates	Fringes
IRONWORKERS:		
Structural	17.92	6.66

SUUT3007A 03/01/1986

	Rates	Fringes
CARPENTERS	10.81	
CEMENT MASONS	11.52	
ELECTRICIANS	14.52	2.71
IRONWORKERS:		
Reinforcing	11.00	
LABORERS (including pipelayers)	7.65	1.60
PIPEFITTERS	12.60	
POWER EQUIPMENT OPERATORS:		
Backhoes	10.00	
Cranes	10.43	
Dozers	13.10	
Graders	12.67	
Loaders	11.26	
Scrapers	10.00	
Trackhoes	10.00	
Tractors	9.42	
TRUCK DRIVERS	9.42	

9.25

From: Shauna Vigil
To: w.deal@cisna.com
Date: Fri, Nov 13, 1998 11:21 AM
Subject: Heavy Construction Davis-Bacon wages

Heavy Construction Projects

Modification Number	Publication Date
0	02/13/1998

County (ies)

Beaver	Iron	Sevier
Carbon	Juab	Uintah
Daggett	Kane	Washington
Emery	Piute	Wayne
Garfield	San Juan	
Grand	San Pete	

	Rates	Fringes
Boilermakers	19.60	8.76

	Rates	Fringes
Millwrights	19.83	3.25

	Rates	Fringes
Ironworkers:Structural	18.92	6.66

	Rates	Fringes
Carpenters	10.81	
Cement Masons	11.52	
Electricians	14.52	2.71
Ironworkers:Reinforcing	11.00	
Laborers (including pipelayers)	7.65	1.60
Pipefitters	12.60	
Power Equipment Operators:		
Backhoes	10.00	
Cranes	10.43	
Dozers	13.10	
Graders	12.67	
Loaders	11.26	
Scrapers	10.00	
Trackhoes	10.00	
Tractors	9.42	
Truck Drivers	9.42	

Let me know if this works out o.k.
Shauna :)

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PREPARED: 03:14 PM 03-Feb-99
ALP036

INTERNATIONAL URANIUM (USA) CORP
SALARY ALLOCATION-JOURNAL ENTRY SUPPORT
JAN 31, 1999
(FINAL)

		SALARY	PENSN	BONUS	TAXES	INSUR	VACAT	HOLIDY	SICK	OTHER	DENOHD	TOTAL	PRPTY	VACAT	HOLIDY	SICK	OTHER
249	3H [redacted]	1,280.00	12.50		168.38	234.00	32.57	65.23	13.01			1,805.69	1,727.45		78.24		
294	3H [redacted]	1,296.00			212.26	234.00	33.57	67.03	13.47			1,856.33	1,775.93		80.40		
307	3H [redacted]	1,576.00			238.17	234.00	39.36	78.84				2,166.37	2,071.81		94.56		
214	3H [redacted]	1,612.00			243.51	234.00	40.13	80.37	16.03			2,226.04	2,129.64		96.40		
306	3H [redacted]	1,649.09			247.45	234.00	40.93	81.97	18.44			2,271.88	2,173.56		98.32		
OPERATIONS - HOURLY		201,681.02	602.15	0.00	28,185.40	24,948.00	5,682.11	9,781.64	1,900.32	0.00	0.00	272,780.64	240,341.32	10,466.12	12,032.88	324.00	616.32

1.353 overall Burden # 28,185.40
.1397 Taxes → Fees
Benefits # 42,914.22
.2128

LONG TERM CARE CALCULATION

Long Term Care Calculation

Base Amount (Starting in Dec. 1978)	$250,000
CPI-U December, 1978	67.7
CPI-U January, 1999	164.3

Adjusted Long Term Care = $250,000 x (CPI-U most recent / CPI-U Dec., 1978)

Adjusted Long Term Care	$606,721

Consumer Price Indexes

Table 1. Consumer Price Index for All Urban Consumers (CPI-U): U. S. City Average, by expenditure category and commodity and service group

Table 1. Consumer Price Index for All Urban Consumers (CPI-U): U.S. city average, b
and service group

(1982-84=100, unless otherwise noted)

CPI-U	Relative importance, December 1998	Unadjusted indexes Dec. 1998	Unadjusted indexes Jan. 1999	U perce Jan. Jan 199
Expenditure category				
All items	100.000	163.9	164.3	1
All items (1967=100)	-	491.0	492.3	
Food and beverages	16.408	162.7	163.9	2
Food	15.422	162.3	163.6	2
Food at home	9.691	162.6	164.3	2
Cereals and bakery products	1.544	182.3	184.2	2
Meats, poultry, fish, and eggs	2.569	147.3	146.4	-1
Dairy and related products (1)	1.088	157.6	161.2	8
Fruits and vegetables	1.440	200.7	208.6	3
Nonalcoholic beverages and beverage materials	1.049	131.7	133.5	-0
Other food at home	2.002	152.4	153.0	2
Sugar and sweets	.377	150.1	151.7	0
Fats and oils	.309	151.9	150.5	7
Other foods	1.316	166.9	167.7	2
Other miscellaneous foods (1) (2)	.320	104.9	104.1	3
Food away from home (1)	5.730	163.0	163.5	2
Other food away from home (1) (2)	.175	103.3	103.5	3
Alcoholic beverages	.986	167.2	167.6	1
Housing	39.828	161.3	161.8	2
Shelter	30.283	184.0	184.7	3
Rent of primary residence (3)	7.007	174.9	175.3	3
Lodging away from home (2) (3)	2.376	103.8	107.1	1
Owners' equivalent rent of primary residence (3) (4)	20.529	190.7	191.0	3
Tenants' and household insurance (1) (2)	.371	99.9	99.7	-0
Fuels and utilities	4.735	126.6	126.2	-2
Fuels	3.801	111.4	110.9	-3
Fuel oil and other fuels	.227	86.1	86.6	-10
Gas (piped) and electricity (3)	3.574	118.9	118.3	-2
Household furnishings and operations	4.810	126.6	126.8	1

Apparel	4.831	130.7	127.9	-1
Men's and boys' apparel	1.358	130.3	128.1	-1
Women's and girls' apparel	1.939	122.4	117.7	-2
Infants' and toddlers' apparel (1)	.272	129.6	130.0	4
Footwear	.876	127.5	125.6	-1
Transportation	16.999	140.7	140.4	-1
Private transportation	15.653	137.2	136.7	-1
New and used motor vehicles (2)	7.843	100.9	100.6	0
New vehicles	4.983	144.1	144.4	0
Used cars and trucks (1)	1.914	153.1	150.6	1
Motor fuel	2.493	86.2	85.0	-13
Gasoline (all types)	2.476	85.7	84.5	-13
Motor vehicle parts and equipment	.549	101.2	101.2	-0
Motor vehicle maintenance and repair	1.624	169.6	169.8	2
Public transportation (1)	1.346	188.4	190.4	1
Medical care	5.713	245.2	246.6	3
Medical care commodities	1.252	225.6	225.9	3
Medical care services	4.461	249.6	251.3	3
Professional services (3)	2.854	224.6	225.8	3
Hospital and related services (3)	1.354	291.4	294.4	3
Recreation (2)	6.120	101.2	101.7	1
Video and audio (1) (2)	1.748	100.7	101.4	0
Education and communication (2)	5.478	100.7	100.9	1
Education (2)	2.694	104.7	105.0	4
Educational books and supplies	.203	257.3	258.4	5
Tuition, other school fees, and childcare	2.492	301.7	302.4	4
Communication (1) (2)	2.783	97.1	97.3	-2
Information and information processing (1) (2)	2.580	96.9	96.9	-2
Telephone services (1) (2)	2.327	100.3	100.7	0
Information and information processing other than telephone services (1) (5)	.253	34.8	33.8	-26
Personal computers and peripheral equipment (1) (2)	.148	64.2	61.4	-36
Other goods and services	4.624	250.3	255.4	10
Tobacco and smoking products	1.159	331.2	354.2	39
Personal care (1)	3.465	158.3	158.9	2
Personal care products (1)	.742	148.7	149.9	2
Personal care services (1)	.973	168.3	168.8	2
Miscellaneous personal services	1.491	237.8	238.9	3
Commodity and service group				
Commodities	42.109	142.2	142.5	0
Food and beverages	16.408	162.7	163.9	2
Commodities less food and beverages	25.702	130.2	129.9	-0
Nondurables less food and beverages	14.345	132.1	131.8	-0
Apparel	4.831	130.7	127.9	-1
Nondurables less food, beverages, and apparel	9.514	137.8	138.8	0
Durables	11.356	127.4	127.1	-0
Services	57.891	185.7	186.3	2
Rent of shelter (4)	29.912	191.5	192.3	3
Transportation services	6.963	188.4	188.8	0
Other services	10.768	219.5	220.5	3
Special indexes				
All items less food	84.578	164.2	164.5	1
All items less shelter	69.717	157.8	158.1	1

All items less medical care	94.287	159.4	159.8	1
Commodities less food	26.688	131.7	131.4	-0
Nondurables less food	15.331	134.2	133.9	0
Nondurables less food and apparel	10.500	139.7	140.7	0
Nondurables	30.753	147.5	147.9	1
Services less rent of shelter (4)	27.979	192.8	193.3	1
Services less medical care services	53.429	179.8	180.3	2
Energy	6.294	98.9	98.1	-7
All items less energy	93.706	172.3	172.9	2
All items less food and energy	78.284	174.8	175.3	2
Commodities less food and energy commodities	23.967	143.9	143.7	1
Energy commodities	2.720	86.3	85.2	-12
Services less energy services	54.316	192.5	193.2	2
Purchasing power of the consumer dollar	-	$ .610	$ .608	
Purchasing power of the consumer dollar - old base	-	$ .204	$ .203	

1 Not seasonally adjusted.
2 Indexes on a December 1997=100 base.
3 This index series was calculated using a Laspeyres estimator. All other item s geometric means estimator in January, 1999.
4 Indexes on a December 1982=100 base.
5 Indexes on a December 1988=100 base.
- Data not available.
NOTE: Index applies to a month as a whole, not to any specific date.

Table of Contents

Consumer Price Indexes

Bureau of Labor Statistics
gibson_s@bls.gov
Last modified: Friday, February 19 1999
URL: /news.release/cpi.t01.htm

News United States Department of Labor
Bureau of Labor Statistics Washington, D.C. 20212

Consumer Price Index

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2-19-1999

U.S. Department Of Labor
Bureau of Labor Statistics
Washington, D.C. 20212

Consumer Price Index

All Urban Consumers - (CPI-U)

U.S. city average

All items

1982-84=100

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.
1913	9.8	9.8	9.8	9.8	9.7	9.8	9.9	9.9	10.0	10.0	10.1
1914	10.0	9.9	9.9	9.8	9.9	9.9	10.0	10.2	10.2	10.1	10.2
1915	10.1	10.0	9.9	10.0	10.1	10.1	10.1	10.1	10.1	10.2	10.3
1916	10.4	10.4	10.5	10.6	10.7	10.8	10.8	10.9	11.1	11.3	11.5
1917	11.7	12.0	12.0	12.6	12.8	13.0	12.8	13.0	13.3	13.5	13.5
1918	14.0	14.1	14.0	14.2	14.5	14.7	15.1	15.4	15.7	16.0	16.3
1919	16.5	16.2	16.4	16.7	16.9	16.9	17.4	17.7	17.8	18.1	18.5
1920	19.3	19.5	19.7	20.3	20.6	20.9	20.8	20.3	20.0	19.9	19.8
1921	19.0	18.4	18.3	18.1	17.7	17.6	17.7	17.7	17.5	17.5	17.4
1922	16.9	16.9	16.7	16.7	16.7	16.7	16.8	16.6	16.6	16.7	16.8
1923	16.8	16.8	16.8	16.9	16.9	17.0	17.2	17.1	17.2	17.3	17.3
1924	17.3	17.2	17.1	17.0	17.0	17.0	17.1	17.0	17.1	17.2	17.2
1925	17.3	17.2	17.3	17.2	17.3	17.5	17.7	17.7	17.7	17.7	18.0
1926	17.9	17.9	17.8	17.9	17.8	17.7	17.5	17.4	17.5	17.6	17.7
1927	17.5	17.4	17.3	17.3	17.4	17.6	17.3	17.2	17.3	17.4	17.3
1928	17.3	17.1	17.1	17.1	17.2	17.1	17.1	17.1	17.3	17.2	17.2
1929	17.1	17.1	17.0	16.9	17.0	17.1	17.3	17.3	17.3	17.3	17.3
1930	17.1	17.0	16.9	17.0	16.9	16.8	16.6	16.5	16.6	16.5	16.4
1931	15.9	15.7	15.6	15.5	15.3	15.1	15.1	15.1	15.0	14.9	14.7
1932	14.3	14.1	14.0	13.9	13.7	13.6	13.6	13.5	13.4	13.3	13.2
1933	12.9	12.7	12.6	12.6	12.6	12.7	13.1	13.2	13.2	13.2	13.2
1934	13.2	13.3	13.3	13.3	13.3	13.4	13.4	13.4	13.6	13.5	13.5
1935	13.6	13.7	13.7	13.8	13.8	13.7	13.7	13.7	13.7	13.7	13.8
1936	13.8	13.8	13.7	13.7	13.7	13.8	13.9	14.0	14.0	14.0	14.0
1937	14.1	14.1	14.2	14.3	14.4	14.4	14.5	14.5	14.6	14.6	14.5
1938	14.2	14.1	14.1	14.2	14.1	14.1	14.1	14.1	14.1	14.0	14.0
1939	14.0	13.9	13.9	13.8	13.8	13.8	13.8	13.8	14.1	14.0	14.0
1940	13.9	14.0	14.0	14.0	14.0	14.1	14.0	14.0	14.0	14.0	14.0
1941	14.1	14.1	14.2	14.3	14.4	14.7	14.7	14.9	15.1	15.3	15.4
1942	15.7	15.8	16.0	16.1	16.3	16.3	16.4	16.5	16.5	16.7	16.8
1943	16.9	16.9	17.2	17.4	17.5	17.5	17.4	17.3	17.4	17.4	17.4
1944	17.4	17.4	17.4	17.5	17.5	17.6	17.7	17.7	17.7	17.7	17.7
1945	17.8	17.8	17.8	17.8	17.9	18.1	18.1	18.1	18.1	18.1	18.1
1946	18.2	18.1	18.3	18.4	18.5	18.7	19.8	20.2	20.4	20.8	21.3

1947	21.5	21.5	21.9	21.9	21.9	22.0	22.2	22.5	23.0	23.0	23.1
1948	23.7	23.5	23.4	23.8	23.9	24.1	24.4	24.5	24.5	24.4	24.2
1949	24.0	23.8	23.8	23.9	23.8	23.9	23.7	23.8	23.9	23.7	23.8
1950	23.5	23.5	23.6	23.6	23.7	23.8	24.1	24.3	24.4	24.6	24.7
1951	25.4	25.7	25.8	25.8	25.9	25.9	25.9	25.9	26.1	26.2	26.4
1952	26.5	26.3	26.3	26.4	26.4	26.5	26.7	26.7	26.7	26.7	26.7
1953	26.6	26.5	26.6	26.6	26.7	26.8	26.8	26.9	26.9	27.0	26.9
1954	26.9	26.9	26.9	26.8	26.9	26.9	26.9	26.9	26.8	26.8	26.8
1955	26.7	26.7	26.7	26.7	26.7	26.7	26.8	26.8	26.9	26.9	26.9
1956	26.8	26.8	26.8	26.9	27.0	27.2	27.4	27.3	27.4	27.5	27.5
1957	27.6	27.7	27.8	27.9	28.0	28.1	28.3	28.3	28.3	28.3	28.4
1958	28.6	28.6	28.8	28.9	28.9	28.9	29.0	28.9	28.9	28.9	29.0
1959	29.0	28.9	28.9	29.0	29.0	29.1	29.2	29.2	29.3	29.4	29.4
1960	29.3	29.4	29.4	29.5	29.5	29.6	29.6	29.6	29.6	29.8	29.8
1961	29.8	29.8	29.8	29.8	29.8	29.8	30.0	29.9	30.0	30.0	30.0
1962	30.0	30.1	30.1	30.2	30.2	30.2	30.3	30.3	30.4	30.4	30.4
1963	30.4	30.4	30.5	30.5	30.5	30.6	30.7	30.7	30.7	30.8	30.8
1964	30.9	30.9	30.9	30.9	30.9	31.0	31.1	31.0	31.1	31.1	31.2
1965	31.2	31.2	31.3	31.4	31.4	31.6	31.6	31.6	31.6	31.7	31.7
1966	31.8	32.0	32.1	32.3	32.3	32.4	32.5	32.7	32.7	32.9	32.9
1967	32.9	32.9	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8
1968	34.1	34.2	34.3	34.4	34.5	34.7	34.9	35.0	35.1	35.3	35.4
1969	35.6	35.8	36.1	36.3	36.4	36.6	36.8	37.0	37.1	37.3	37.5
1970	37.8	38.0	38.2	38.5	38.6	38.8	39.0	39.0	39.2	39.4	39.6
1971	39.8	39.9	40.0	40.1	40.3	40.6	40.7	40.8	40.8	40.9	40.9
1972	41.1	41.3	41.4	41.5	41.6	41.7	41.9	42.0	42.1	42.3	42.4
1973	42.6	42.9	43.3	43.6	43.9	44.2	44.3	45.1	45.2	45.6	45.9
1974	46.6	47.2	47.8	48.0	48.6	49.0	49.4	50.0	50.6	51.1	51.5
1975	52.1	52.5	52.7	52.9	53.2	53.6	54.2	54.3	54.6	54.9	55.3
1976	55.6	55.8	55.9	56.1	56.5	56.8	57.1	57.4	57.6	57.9	58.0
1977	58.5	59.1	59.5	60.0	60.3	60.7	61.0	61.2	61.4	61.6	61.9
1978	62.5	62.9	63.4	63.9	64.5	65.2	65.7	66.0	66.5	67.1	67.4
1979	68.3	69.1	69.8	70.6	71.5	72.3	73.1	73.8	74.6	75.2	75.9
1980	77.8	78.9	80.1	81.0	81.8	82.7	82.7	83.3	84.0	84.8	85.5
1981	87.0	87.9	88.5	89.1	89.8	90.6	91.6	92.3	93.2	93.4	93.7
1982	94.3	94.6	94.5	94.9	95.8	97.0	97.5	97.7	97.9	98.2	98.0
1983	97.8	97.9	97.9	98.6	99.2	99.5	99.9	100.2	100.7	101.0	101.2
1984	101.9	102.4	102.6	103.1	103.4	103.7	104.1	104.5	105.0	105.3	105.3
1985	105.5	106.0	106.4	106.9	107.3	107.6	107.8	108.0	108.3	108.7	109.0
1986	109.6	109.3	108.8	108.6	108.9	109.5	109.5	109.7	110.2	110.3	110.4
1987	111.2	111.6	112.1	112.7	113.1	113.5	113.8	114.4	115.0	115.3	115.4
1988	115.7	116.0	116.5	117.1	117.5	118.0	118.5	119.0	119.8	120.2	120.3
1989	121.1	121.6	122.3	123.1	123.8	124.1	124.4	124.6	125.0	125.6	125.9
1990	127.4	128.0	128.7	128.9	129.2	129.9	130.4	131.6	132.7	133.5	133.8
1991	134.6	134.8	135.0	135.2	135.6	136.0	136.2	136.6	137.2	137.4	137.8
1992	138.1	138.6	139.3	139.5	139.7	140.2	140.5	140.9	141.3	141.8	142.0
1993	142.6	143.1	143.6	144.0	144.2	144.4	144.4	144.8	145.1	145.7	145.8
1994	146.2	146.7	147.2	147.4	147.5	148.0	148.4	149.0	149.4	149.5	149.7
1995	150.3	150.9	151.4	151.9	152.2	152.5	152.5	152.9	153.2	153.7	153.6
1996	154.4	154.9	155.7	156.3	156.6	156.7	157.0	157.3	157.8	158.3	158.6
1997	159.1	159.6	160.0	160.2	160.1	160.3	160.5	160.8	161.2	161.6	161.5
1998	161.6	161.9	162.2	162.5	162.8	163.0	163.2	163.4	163.6	164.0	164.0
1999	164.3										

ATTACHMENT D

RECLAMATION MATERIAL CHARACTERISTICS

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

INDEPENDENCE PLAZA

1050 17TH STREET, SUITE 950

DENVER, CO 80265

Attachment D - Reclamation Material Characteristics

Material proposed for use in the reclamation of the White Mesa Mill tailings cells is available from stockpiles on the site, which were generated from construction of the existing cells. In the case of clay material for radon barrier, it is available to supplement the onsite material from the Section 16 borrow site located approximately 3 miles to the south of the exiting cells.

The characteristics of the materials are generally described in the text of the Reclamation Plan. In addition, test work was completed on the clay borrow material as well as the onsite stockpiles.

The Section 16 clay material was originally tested in 1982 by D'Appolonia Consulting Engineers, Inc. This test work included:

-- Classification
- Grain size, sieve and hydrometer
- Atterberg limits
- Specific gravity

-- X-ray diffraction

-- Cation Exchange Capacity

-- Exchangeable Cations

-- Modified Proctor

-- Permeability

A copy of the full D'Appolonia Report is included in this Attachment

The onsite random fill and clay stockpiles were sampled in characterized in a program detailed in the April 15, 1999, submittal to the NRC, "Additional Clarifications to the White Mesa Mill Reclamation Plan". A copy of this sampling and testing program are included in this Attachment as well as the results of the characterization work. The samples wee characterized for:

-- Classification
- Grain size and sieve
- Atterberg limits

-- Standard Proctor

The results of these tests for the onsite stockpiled material are included in this Attachment.

D'APPOLONIA

CONSULTING ENGINEERS, INC.

March 8, 1982

Project No. RM78-682B

Mr. H. R. Roberts
Energy Fuels Nuclear, Inc.
1515 Arapahoe Street
Three Park Central, Suite 900
Denver, Colorado 80202

Letter Report
Section 16 Clay Material Test Data
White Mesa Uranium Project
Blanding, Utah

Dear Harold:

This report presents the results of field investigations and laboratory tests performed on Section 16 clay material. The material tested was obtained from borings and test pits made in April 1979. The laboratory tests were performed and the data retained in our files until your recent request for the data.

Field Investigations

The area of investigation is a canyon located in Section 16, about three miles south of the mill site. Seven borings were drilled as part of the field investigations. These borings, 100 through 106, are located approximately as shown on Figure 1.

The borings were drilled with a rig provided by Energy Fuels using the rotary method with air pressure to flush out the cuttings. Samples were obtained by sampling the cuttings on five foot intervals. Only qualitative information on the subsurface materials is available because of the method of drilling and sampling utilized. However, the qualitative information and samples obtained are suitable to provide preliminary data on the character of the subsurface materials present.

Three test pits (1-3) were excavated to obtain bulk samples for laboratory testing. The location of the test pits is shown on Figure 1.

Samples from Boring 2-16 drilled by Energy Fuels in November 1978 were also provided to D'Appolonia for testing. The location of Boring 2-16 is shown on Figure 1.

Subsurface Conditions

The subsurface conditions in the canyon, based on the boring data, are shown on Cross Sections A-A' and B-B' presented on Figures 2 and 3, respectively. The plan locations of these cross sections is shown on Figure 1. As shown on the cross sections, the subsurface consists of a surficial layer of red clayey and silty sand about five feet thick. The underlying material is mostly a red or gray silty clay. The consistency of the silty clay layer varies from stiff to hard, based on observations of the drillers and rig during drilling. A lense or layer of very hard silt was noted in Boring 105. This layer appears to be a well cemented unit from the cutting samples obtained. In Boring 106, the surficial sand layer was about 20 feet thick and a clayey sand layer was also encountered at a depth of about 30 feet.

The laboratory soil classifications for the tested samples are also shown on Cross Sections A-A' and B-B'. The testing program is discussed in detail in the following section, however, the testing results indicate that the silty clay layer is mostly a CL or CH material with one sample being a SM and two a ML. These test results show the material is basically a fine grained soil with a varying amount of silt and clay size particles. The plasticity characteristics of the material vary from low to high. Further discussion of the test results and material characteristics is given below.

Water in the borings was not noted except for Boring 104 for which a depth of about 43 feet was measured. This depth is not considered completely reliable since it was measured only one day after drilling and the water level may not have had time to stabilize.

Laboratory Test Results

The laboratory testing program conducted on samples from the borings and test pits included the following types of tests:

- o Classification
  - Grain size, sieve and hydrometer
  - Atterberg limits
  - Specific gravity
- o X-Ray Diffraction
- o Cation Exchange Capacity
- o Exchangeable Cations
- o Modified Proctor Compaction Density
- o Permeability

The results of the classification tests are given on Table 1. The soil classifications given are shown on Cross Sections A-A' and B-B' (Figures 2 and 3) and were discussed above.

The cation exchange capacity (CEC) and exchangeable ions were conducted to evaluate the type of clays present and the chemical effects resulting from contact with the tailings liquid. Tests were run on samples from Test Pits 2 and 3 samples and Boring 103 (15-20 foot depth). Soil from each sample was treated by soaking in simulated tailings liquid for 48 hours before testing. Both treated and untreated (as received) samples were tested and the results are presented on Table 2. Results of the testing are summarized as follows:

- o The untreated samples indicate pH (1:1) values between 7.40 and 8.35 with CEC values in the 45-56 meq/100g range. The predominate exchangeable ions are calcium and sodium for Test Pits 2 and 3 and calcium and magnesium for Boring 103 (15-20 ft).
- o The treated samples indicate pH (1:1) values between 1.70 and 2.35 with CEC values in the 90-100 meq/100g range. The predominate exchangeable ions are hydrogen, calcium, and magnesium for all the samples.

These results indicate that exposure to the tailings water causes:

- the pH (1:1) of the material to decrease.
- the exchangeable hydrogen and magnesium to increase.
- the exchangeable calcium and sodium to decrease.
- the CEC to increase by a factor of about two due primarily to the large increase in exchangeable hydrogen.

The effects of these changes on clay material properties, particularly permeability, is discussed in the following paragraphs.

The X-ray diffraction tests were run on material from the same three samples as tested for CEC and exchangeable ions. The x-ray diffraction testing was conducted to evaluate the type of clay minerals occurring in the material. The results of the testing are given on Table 3. As shown, about 50 percent of the material is quartz, 25 percent montmorillonite, 25 percent illite, and minor percentages of other minerals. Montmorillonite is an active clay mineral which typically has a low coefficient of permeability. Illite is also a clay mineral, but it is typically relatively inactive with a somewhat higher coefficient of permeability.

Modified Proctor compaction tests were conducted on four different samples. Test Pits 1, 2 and 3 samples were tested and a composite sample from Boring 2-16 (85 to 210 feet depth). The results of the modified Proctor tests are given on Table 1. The average maximum dry density measured is 107 pounds per cubic foot and the average optimum water content is 17.5 percent.

Permeability tests were conducted on compacted samples of material from Boring 2-16 (composite 85-120 feet), Boring 101 (composite 0-25 feet), Boring 103 (composite 0-25 feet) and Test Pit 2. The tests were conducted in permeability cells with a confining pressure applied around the sample which is encased in a rubber membrane. A differential pressure was applied across the sample and flow of fluid through the sample measured. Both distilled water and simulated tailings liquid were used in the tests. The tests on Borings 101 and 103, and Test Pit 2 were conducted over a period of about five months to assess the effects of tailings liquid on the permeability of the material. The tests were conducted with distilled water for about two months to establish saturation and steady state flow. Tailings liquid was then introduced to the sample and the test continued for three more months. The results of the permeability tests are presented on Table 4 along with other pertinent sample data. The material has an average coefficient of permeability with water of 3.3×10^{-10} centimeters per second and 5.1×10^{-10} centimeters per second with simulated tailings liquid. The test results indicate that the permeability of the material was essentially the same with distilled water and tailings liquid and no degradation of the material was indicated.

Conclusions and Recommendations

Based on the field and laboratory investigations discussed above, conclusions which can be made regarding the materials in Section 16 are:

- The material is mostly a silty clay (CL to CH) with slight variation in properties. The clay minerals are mostly montmorillonite with some illite.
- The material varies laterally with some layers or lenses of sand and silt. The consistency of the material also varies from stiff to hard or very hard.
- The permeability values of the material are very low and long-term permeability tests conducted with simulated tailings liquid indicate little change in permeability with time. This result is in good agreement with the results of the CEC, exchangeable ion tests and x-ray diffraction test results.
- The clay material is suitable for use as borrow for use as a clay liner or in situ as a natural liner layer.

Recommendations for further assessment of the clay for use as a borrow area or in situ clay liner source are:

- Geotechnical borings with split spoon samples to assess the material characteristics more specifically, including consistency, natural water content, and classification.

- o Field permeability tests (falling or rising head) in the borings to measure the in situ permeability.
- o Installation of piezometers to determine the ground water level.

Additional discussion of the above recommendations can be provided as necessary depending on your needs.

Very truly yours,

Corwin E. Oldweiler
Project Engineer

CEO:par

TABLE 1

LABORATORY TEST RESULTS

BORING/ TEST PIT	SAMPLE DEPTH (FEET)	GRAIN SIZE ANALYSIS SAND (PERCENT)	SILT (PERCENT)	CLAY (PERCENT)	ATTERBERG LIMITS LIQUID (PERCENT)	PLASTIC (PERCENT)	PLASTICITY (PERCENT)	USCS CLASSIFICATION	SPECIFIC GRAVITY	OPTIMUM PROCTOR VALUES DRY DENSITY (PCF)	WATER CONTENT (PERCENT)
101	0-5	61	22	17	24.0	18.5	5.5	SC-SM	-	-	-
	5-10	26	48	26	58.9	24.1	34.8	CH	-	-	-
	10-15	10	50	40	73.0	28.2	44.8	CH	-	-	-
	15-20	7	54	39	103.0	31.2	71.8	CH	2.59	-	-
102	5-10	-	-	-	-	-	NP	ML	-	-	-
	10-15	-	-	-	-	-	NP	ML	-	-	-
	15-20	-	-	-	20.3	10.2	10.1	CL	-	-	-
103	0-5	70	18	12	17.0	14.9	2.1	SM	2.71	-	-
	5-10	15	38	47	73.8	24.9	48.9	CH	-	-	-
	10-15	13	49	38	59.8	26.6	33.2	CH	-	-	-
	15-20	13	50	37	71.0	21.6	49.4	CH	-	-	-
104	0-5	55	30	15	18.4	16.2	2.2	SM	-	-	-
	5-10	30	43	27	31.2	16.5	14.7	CL	-	-	-
	10-15	66	17	17	-	-	-	-	-	-	-
	15-20	37	31	32	35.7	11.8	23.9	CL	-	-	-
105	0-5	58	22	20	-	-	NP	SM	-	-	-
	5-10	65	17	18	-	-	NP	SM	-	-	-
	10-15	62	17	21	24.0	12.0	12.0	SC	-	-	-
	15-20	17	36	47	71.0	18.9	52.1	CH	-	-	-
1(1)	-	17	40	43	108.0	25.0	83.0	CH	-	99.9	19.9
2(1)	-	17	50	33	141.2	18.4	122.8	CH	-	111.5	15.0
3(1)	-	3	42	55	115.0	23.0	92.0	CH	2.60	101.0	20.5
2-16	65	-	-	-	32.0	15.8	16.2	CL	-	-	-
	125	7	43	50	57.5	25.9	31.6	CH	-	-	-
	180	-	-	-	148.5	25.3	123.0	CH	-	-	-
	COMPOSITE 85-210(2)	95	5	0	-	-	-	SW-SC	-	-	-
	COMPOSITE 85-210(3)	18	47	35	-	-	-	cl-ml	2.72	115.8	14.7

(1) These samples are Test Pits
(2) Sample tested before soaking.
(3) Sample tested after soaking 16 hours.

TABLE 2

CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATION TEST RESULTS

PARAMETER	UNITS	UNTREATED SAMPLES TEST PIT 2	UNTREATED SAMPLES TEST PIT 3	UNTREATED SAMPLES BORING 103	TREATED SAMPLES[1] TEST PIT 2[2]	TREATED SAMPLES[1] TEST PIT 3	TREATED SAMPLES[1] BORING 103
pH (1:1)	-	8.35	7.40	7.60	2.30	2.35	1.70
Buffer pH	-	NA	NA	NA	2.28	2.20	2.15
Exchangeable:							
H	meq/100g	0	0	0	56.6	57.6	58.2
Ca	meq/100g	19.5	21.1	25.8	12.3	13.5	18.7
Mg	meq/100g	4.3	4.9	15.4	17.0	20.3	17.8
Na	meq/100g	20.0	28.0	6.5	3.7	6.5	2.6
K	meq/100g	1.2	2.5	0.6	0.8	1.6	0.5
Cation Exchange Capacity (CEC)	meq/100g	45	56	48	90	100	98

(1) Samples soaked in simulated tailings liquid for 48 hours before testing.
(2) Represents triplicate results.

TABLE 3

X-RAY DIFFRACTION SEMI-QUANTITATIVE RESULTS

SAMPLE	QUARTZ	ANDESINE	MONTMORILLONITE	ILLITE	MIXED LAYER
Test Pit 2	50%+	-5%	10-25%	10-25%	5-10%
Test Pit 3	50%+	5-10%	10-25%	10-25%	5-10%
Boring 101 (15'-20' Depth)	50%+	5-10%	25-50%	Trace	-5%

TABLE 4

PERMEABILITY TEST RESULTS

BORING/ TEST PIT	SAMPLE DEPTH (FEET)	INITIAL CONDITIONS DRY DENSITY (PCF)	INITIAL CONDITIONS WATER CONTENT (PERCENT)	COEFFICIENTS OF PERMEABILITY WITH DISTILLED WATER (CM/SEC)	COEFFICIENTS OF PERMEABILITY WITH TAILINGS LIQUID (CM/SEC)
103	0-25	116.7	13.3	1.2×10^{-9}	9.4×10^{-10}
101	0-25	117.5	14.6	5.2×10^{-10}	7.5×10^{-10}
2	-	110.7	14.7	4.7×10^{-10}	2.3×10^{-10}
2-16	85-210	101	15	-	1.0×10^{-10}
2-16	85-210	110	15	-	5.5×10^{-10}

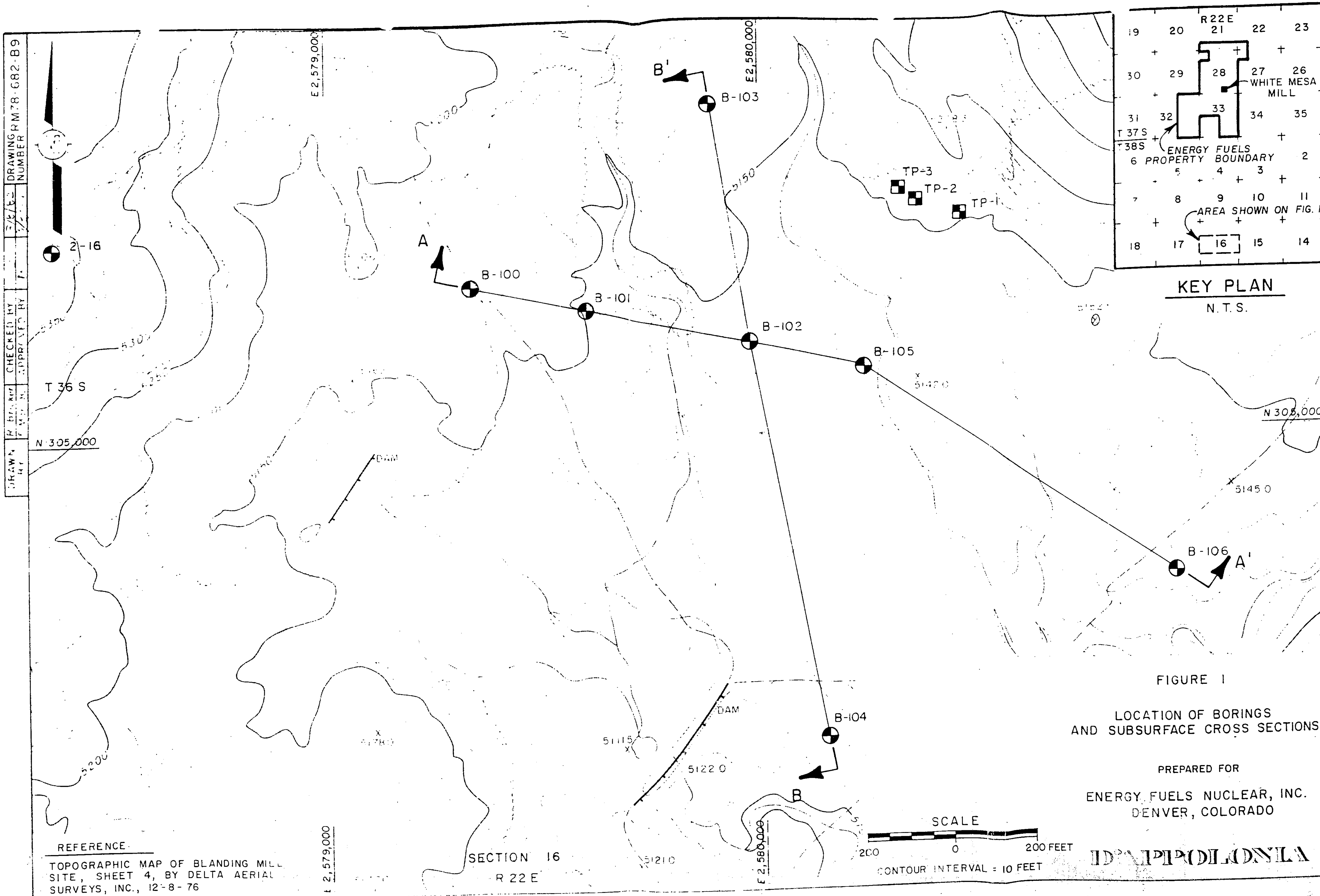


FIGURE 1

LOCATION OF BORINGS AND SUBSURFACE CROSS SECTIONS

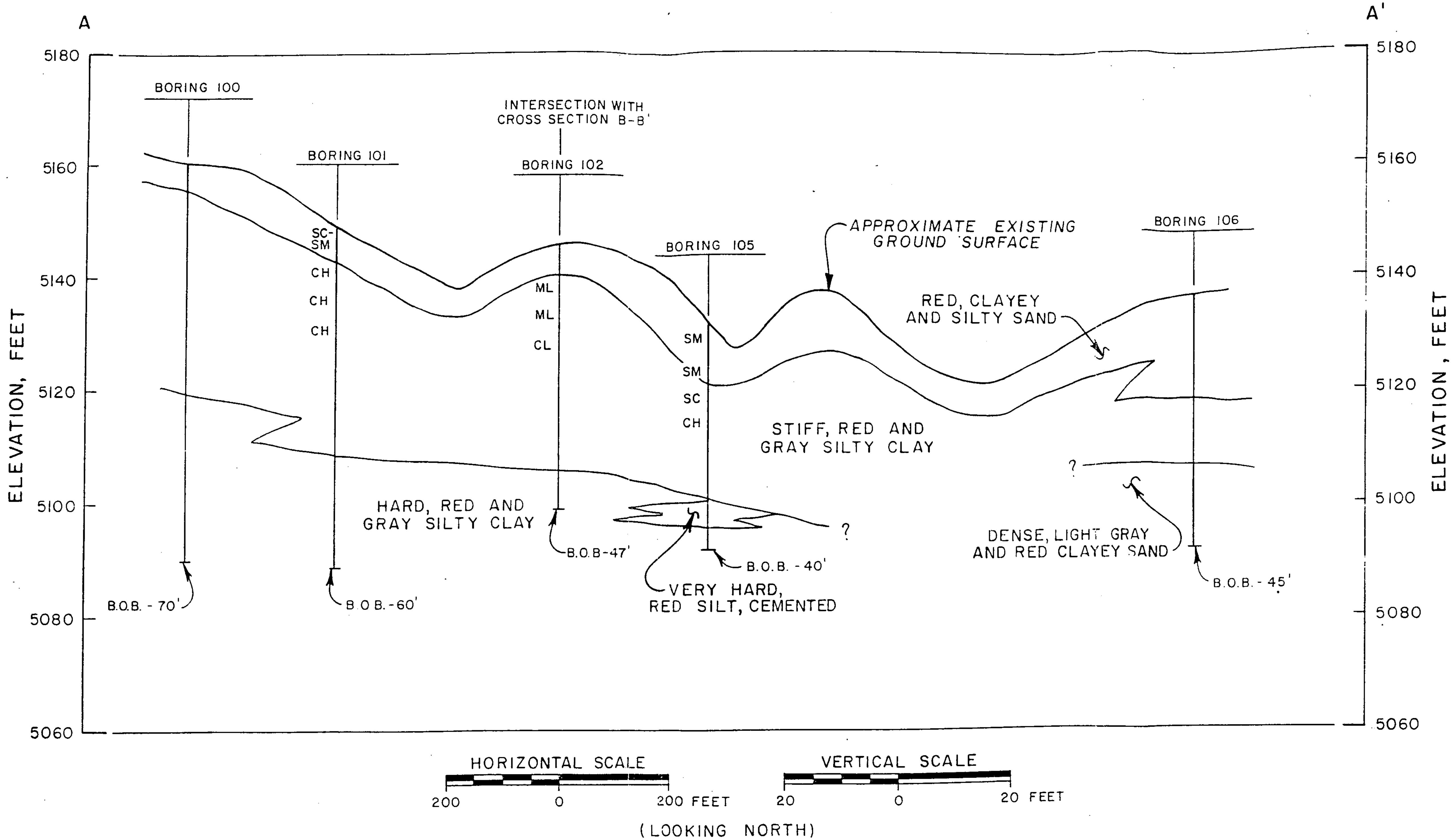


FIGURE 2

SUBSURFACE CROSS SECTION A-A

THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE INDICATED

LEGEND:

CH - LABORATORY SOIL CLASSIFICATION
(UNIFIED SOIL CLASSIFICATION SYSTEM)

NOTES:

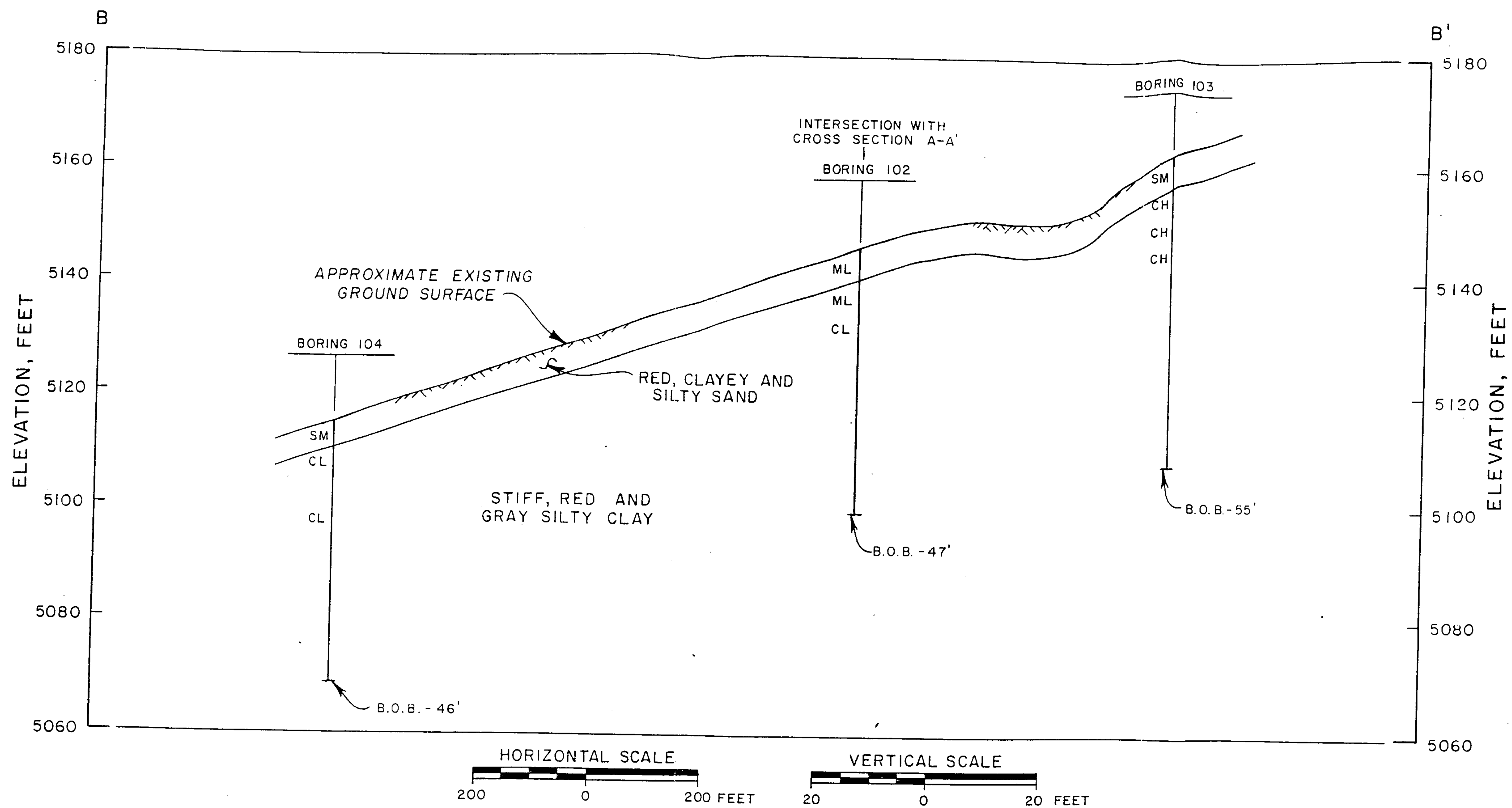
1. FOR PLAN LOCATION OF CROSS SECTION, SEE FIGURE 1.
2. VERTICAL EXAGGERATION EQUALS 10X.

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

DRAWN BY	R. Bricker 4 Mar. 82	CHECKED BY		APPROVED BY		DRAWING NUMBER RM78-682-B7



(LOOKING WEST)

DRAWN BY: R. Bricker, 4 Mar. 82 | CHECKED BY | APPROVED BY | DRAWING NUMBER RM78-682-B8

FIGURE 3

SUBSURFACE CROSS SECTION B-B'

PREPARED FOR

ENERGY FUELS NUCLEAR, INC.
DENVER, COLORADO

D'APPOLONIA

THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE INDICATED

LEGEND:

CH - LABORATORY SOIL CLASSIFICATION (UNIFIED SOIL CLASSIFICATION SYSTEM)

NOTES:

1. FOR PLAN LOCATION OF CROSS SECTION, SEE FIGURE 1.
2. VERTICAL EXAGGERATION EQUALS 10 X.

19 1253 HERCULENE A&B SMITH CO PGH PA

Soil Sampling and Testing Program – White Mesa Mill

The purpose of this Soil Sampling and Testing Program is to verify the soil classification, gradation and compaction characteristics (standard proctor) of the stockpiled random fill and clay materials that will be used for cover materials on the tailings cells at the White Mesa Mill. Additionally this program will verify the compaction characteristics and gradation of the random fill materials utilized in the platform fill previously placed on Cells 2 and 3.

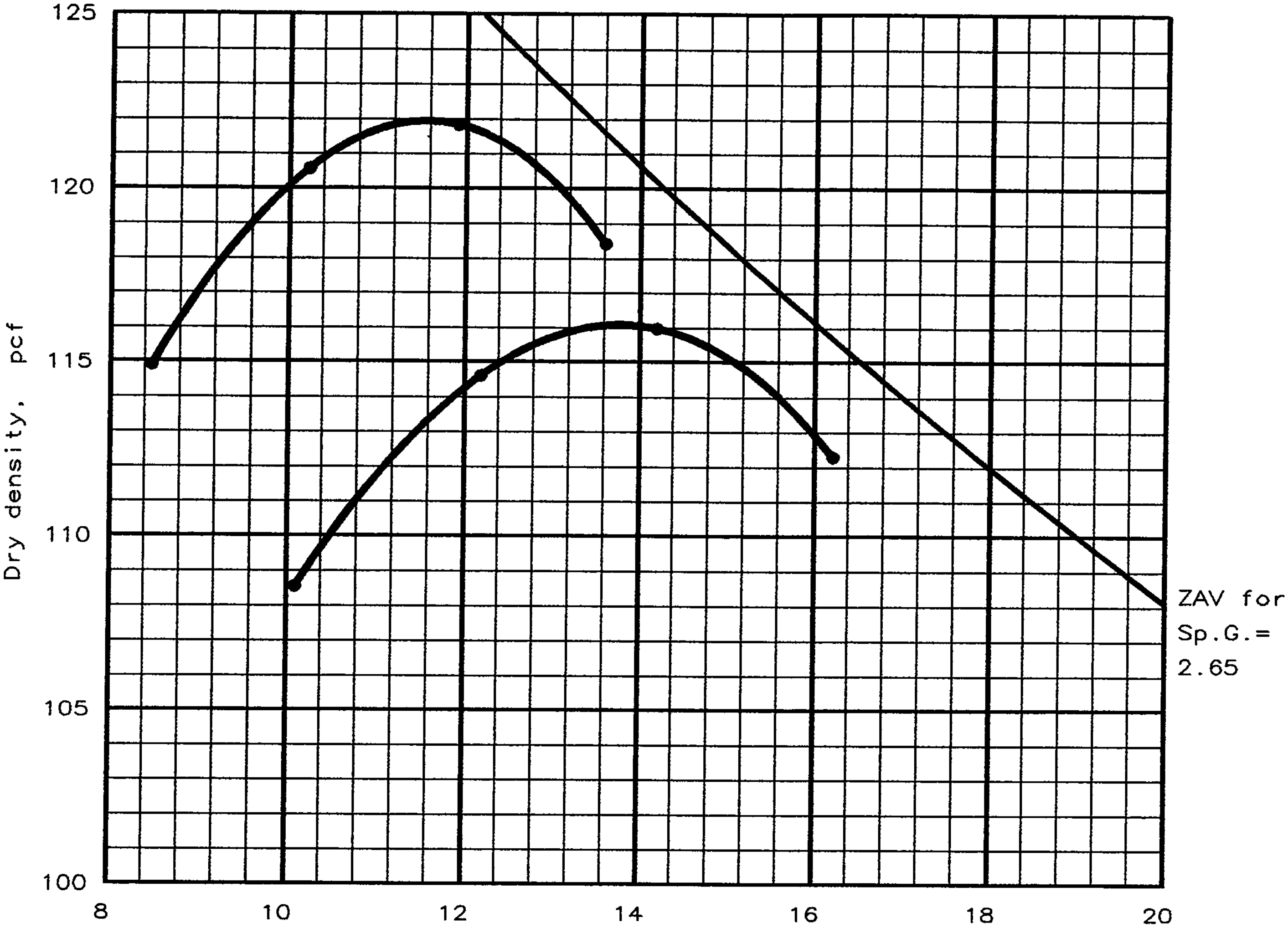
Sampling

Sampling will take place on each of six stockpiles of random fill (designated RF-1 through RF-6 on Exhibit A), two clay material stockpiles (C-1 and C-2 on Exhibit A), and on platform fill areas in Cells 2 & 3. A total of 9 samples will be taken from the random fill stockpiles. Two (2) samples will be taken from the clay stockpiles and three (3) samples will be taken from the covered areas of the cells. Samples will be taken from test pits excavated by a backhoe. Samples will be taken from a depth of 8 feet in stockpiles and from 2 foot depth in cells. One backhoe bucket full of material will be taken from the test pit at the specified depth and dumped separately. This sample will be quartered and one quarter will be screened to minus 2" (rocks over 8" will be removed prior to screening). Two five gallon sample buckets will be filled with sample randomly selected from the screened fraction. Oversized material remaining after the screening of the sample will be visually classified and then weighed. Sample locations will be indicated on a site map and sample descriptions will recorded and maintained in the facility's records. A total of fourteen samples will be submitted for testing during this program.

Testing

Samples will be packaged and shipped to a certified commercial testing laboratory for testing. Tests will be run on each sample for standard proctor (ASTM D698), particle size analysis (ASTM C117 and ASTM C136), soil classification (ASTM D2487) and plasticity index (Atterberg limits ASTM D4318).

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure B, Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			16.1 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 122.0 pcf Optimum moisture = 11.6 %	116.1 pcf 13.8 %	2-1-W Sand, clayey, grvly, brn

Project No.: 804899
Project: International Uranium Corporation
Location: Soil Sample Testing

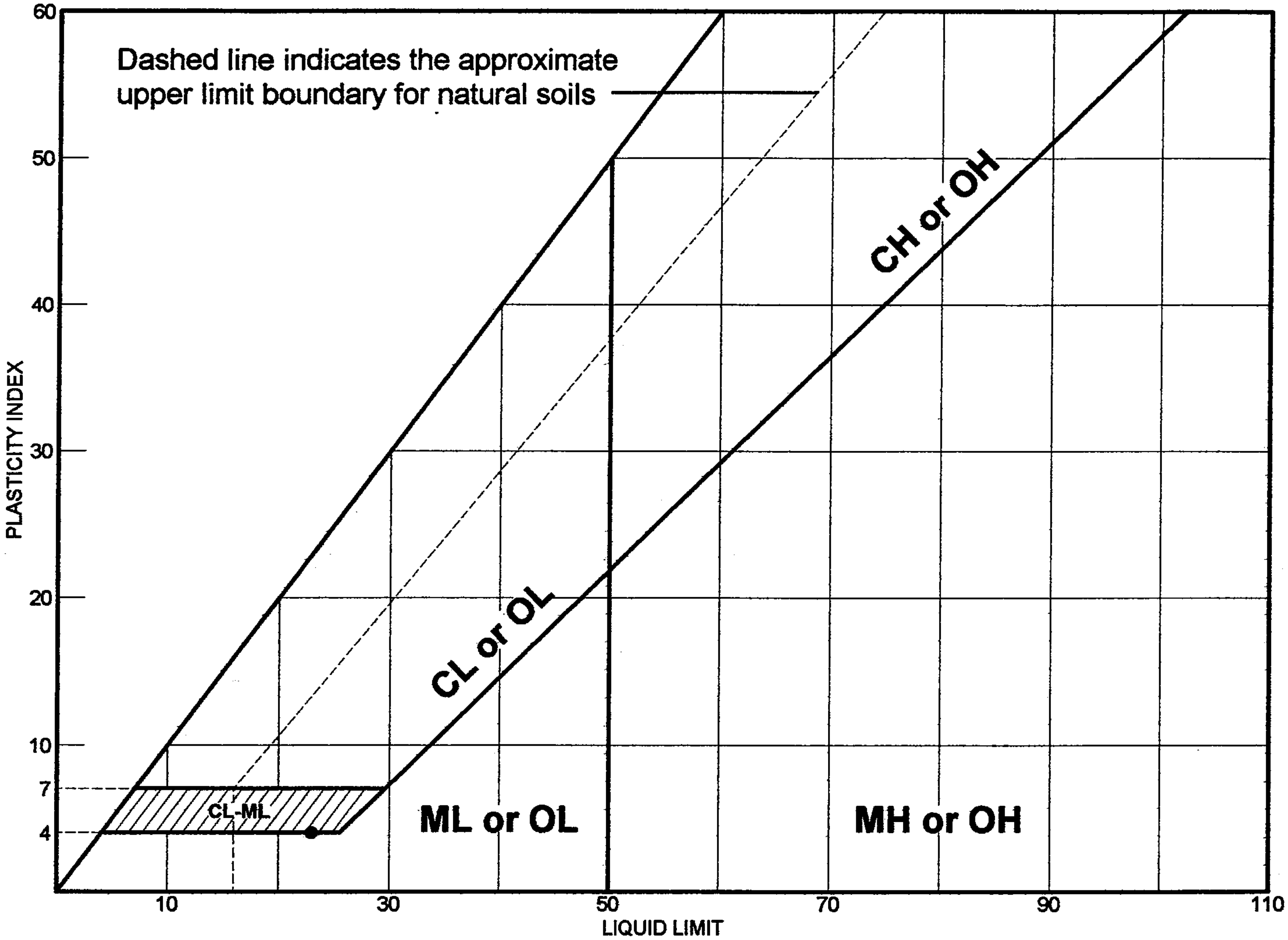
Date: 5/3/99

Remarks:
SUBMITTED BY: Client
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST
WESTERN COLORADO TESTING, INC.

Fig. No. 7

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sand, very clayey, sl silty, red	23	19	4	56.9	25.1	SM

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** 2-1-W

Remarks:

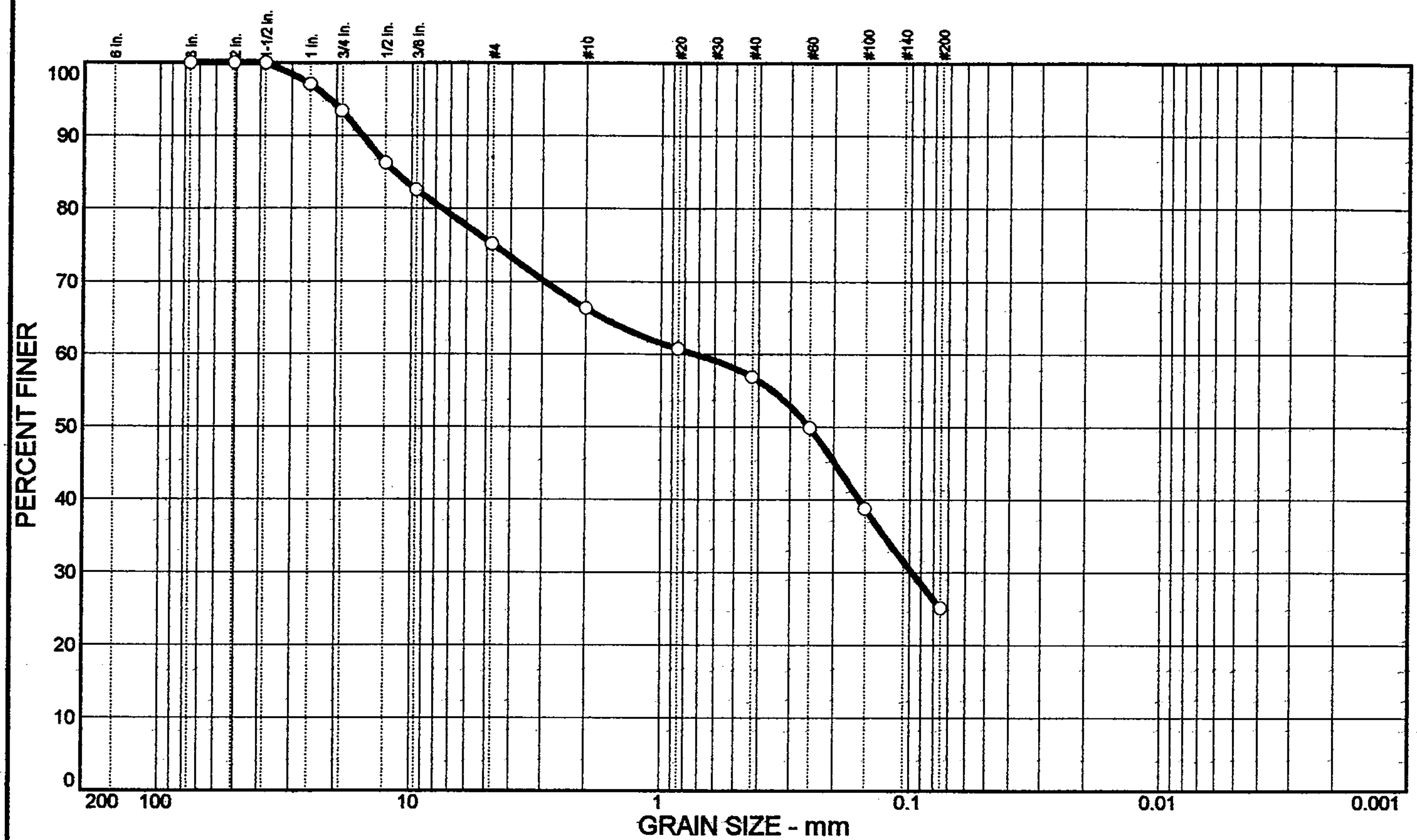
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 22

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		24.8	50.1			SM	A-2-4(0)	19	23

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	97.1		
3/4	93.4		
1/2	86.3		
3/8	82.6		
	GRAIN SIZE		
D_{60}	0.726		
D_{30}	0.0973		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	75.2		
#10	66.3		
#20	60.7		
#40	56.9		
#60	49.9		
#100	38.8		
#200	25.1		

SOIL DESCRIPTION

○ Sand, very clayey, sl silty, red

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: 2-1-W

WESTERN COLORADO TESTING, INC.

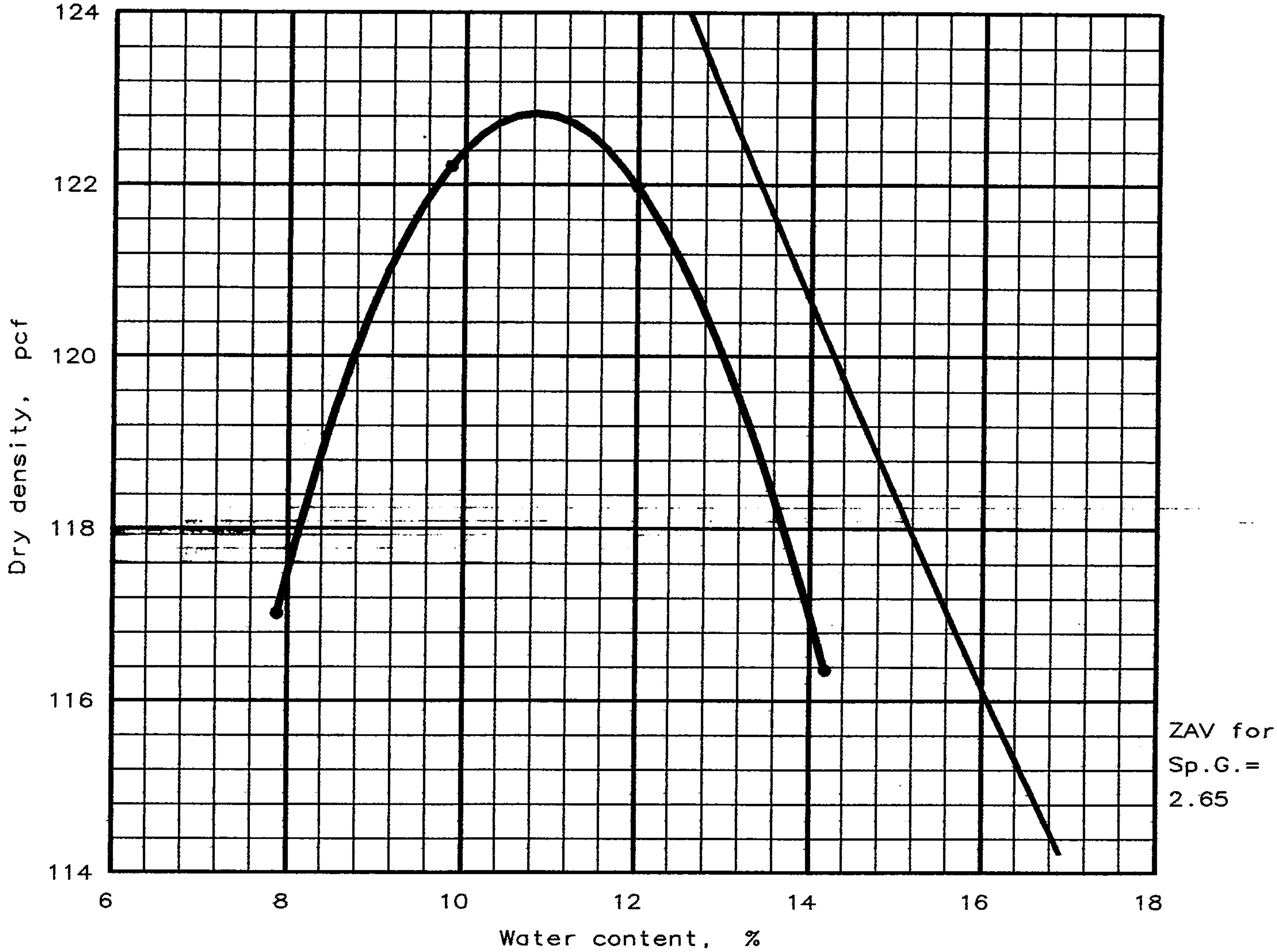
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 38

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure B, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			13.4 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 122.8 pcf Optimum moisture = 10.8 %	122.8 pcf 10.8 %	2W-7C Sand, silty, gravely, br

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

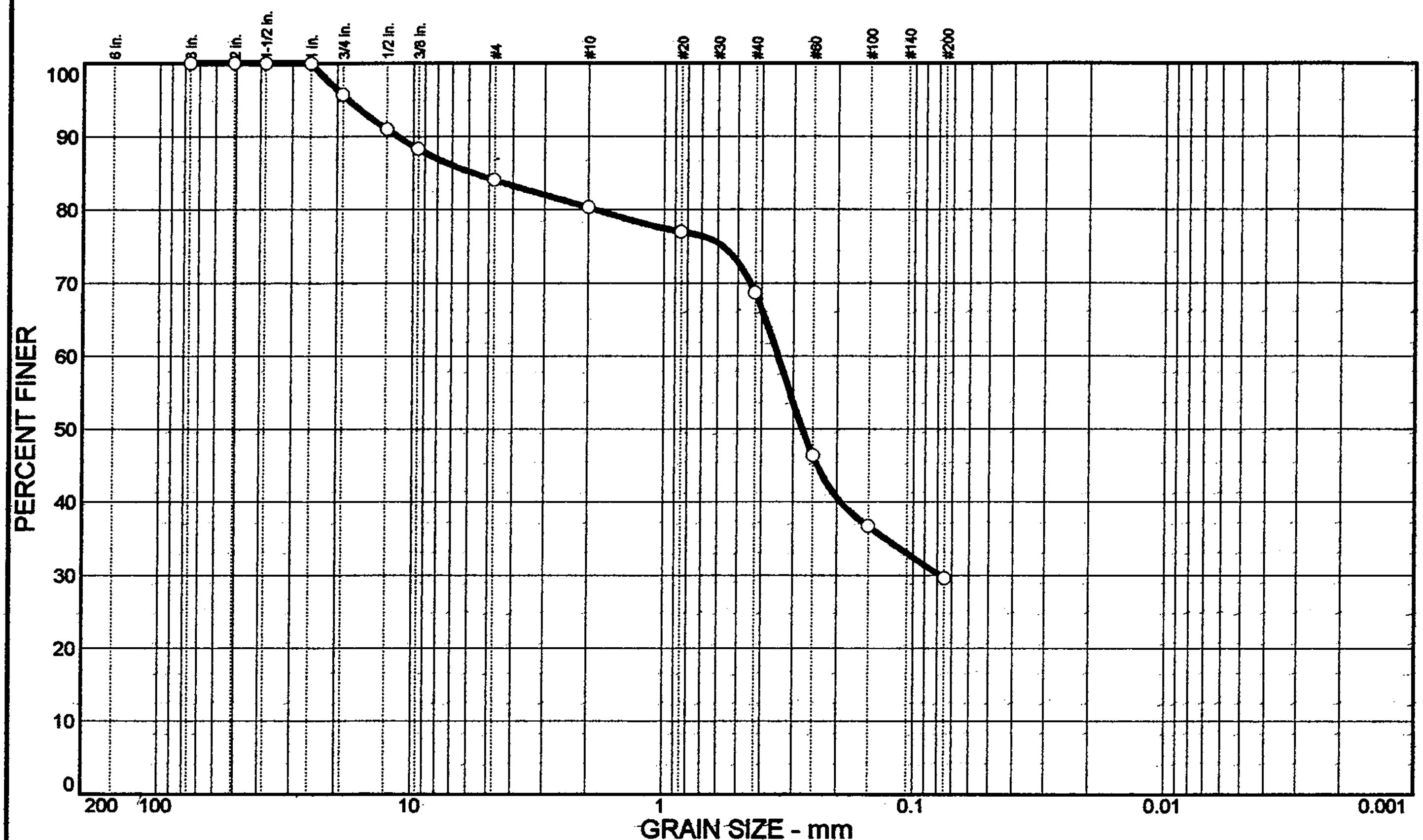
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 8

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		15.9	54.5			SM	A-2-4(0)	NP	

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	95.7		
1/2	91.0		
3/8	88.3		
	GRAIN SIZE		
D_{60}	0.344		
D_{30}	0.0781		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	84.1		
#10	80.3		
#20	77.0		
#40	68.6		
#60	46.4		
#100	36.7		
#200	29.6		

SOIL DESCRIPTION

○ Sand, silty, gravely, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: 2W-7C

WESTERN COLORADO TESTING, INC.

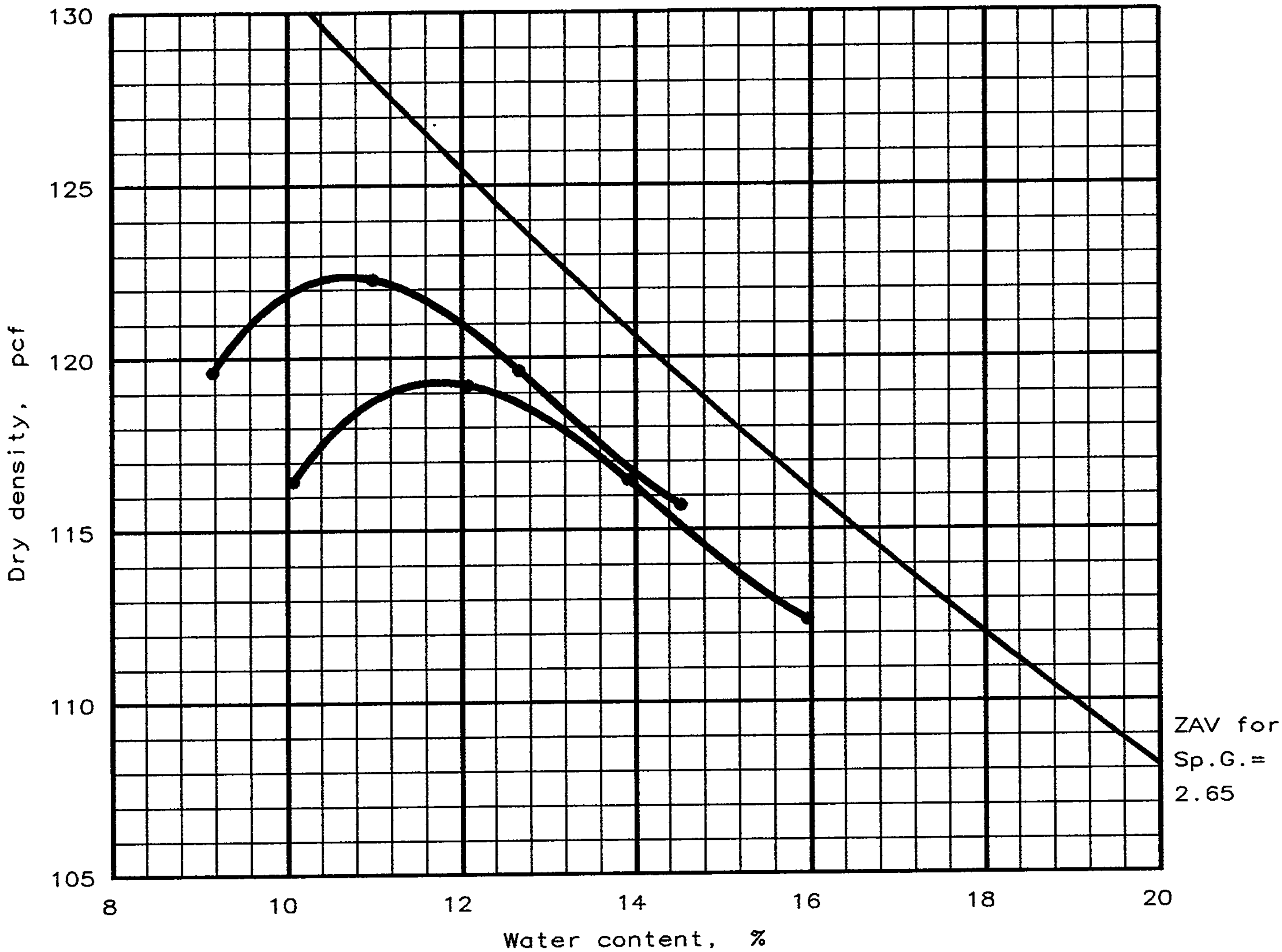
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 39

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure C, Standard

Oversize correction applied to each point

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
			N/A %	2.65			9.0 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 122.4 pcf Optimum moisture = 10.7 %	119.3 pcf 11.8 %	3-1C Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

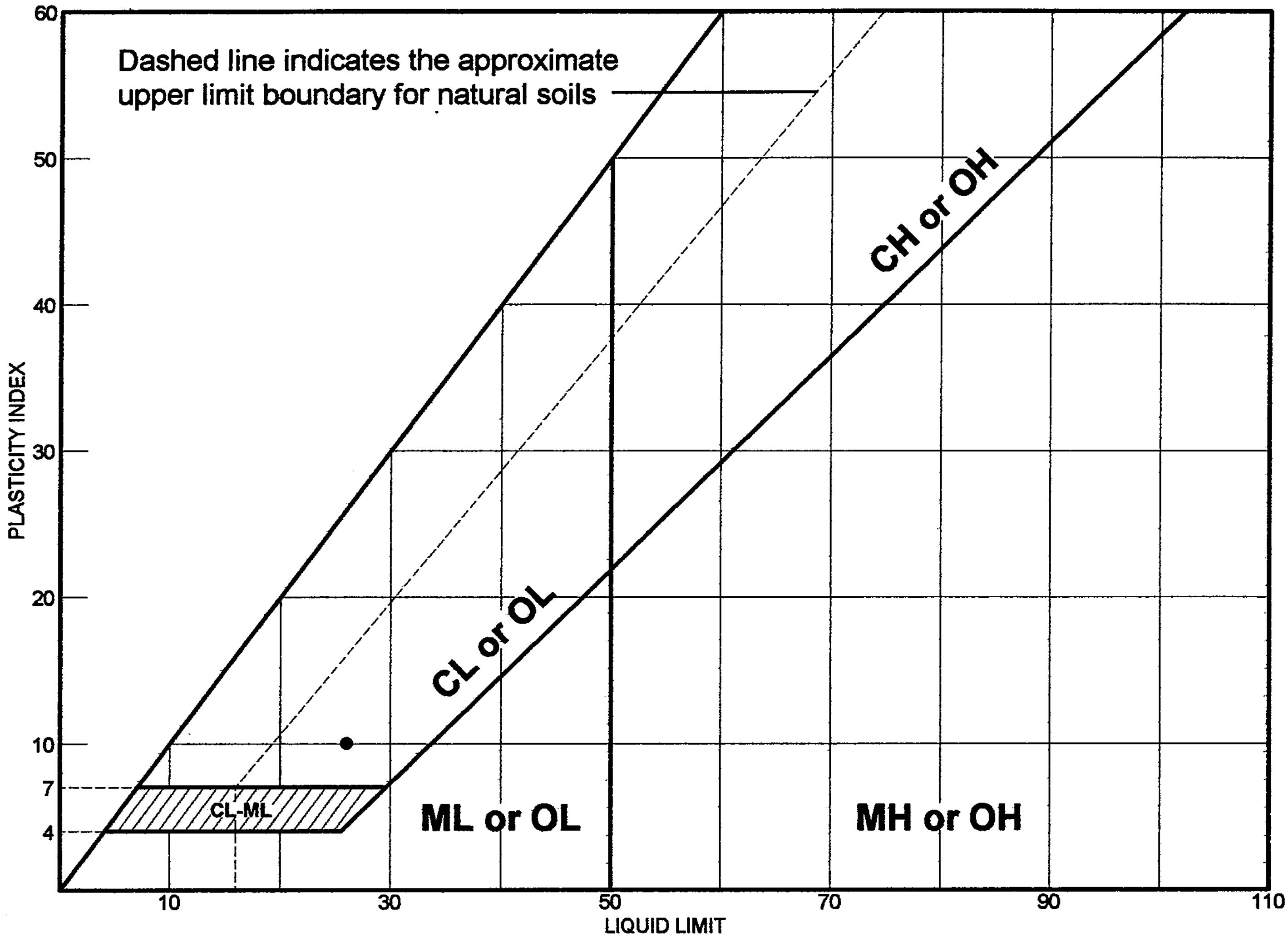
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 9

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sand, clayey, gravely, brown	26	16	10	69.5	36.9	SM

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** 3-1C

Remarks:

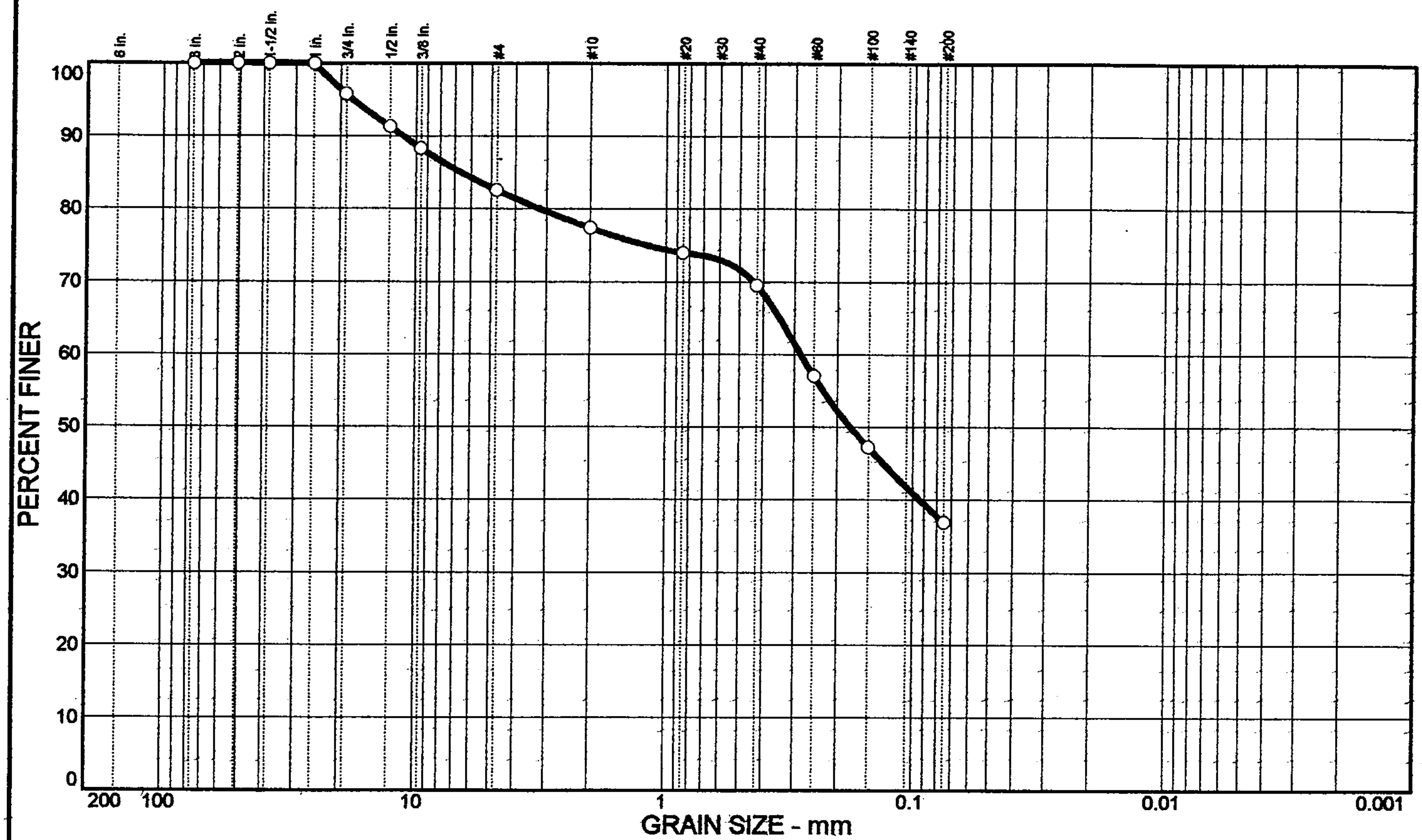
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 23

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		17.4	45.7			SM	A-4(0)	16	26

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	95.8		
1/2	91.3		
3/8	88.3		
	GRAIN SIZE		
D_{60}	0.282		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	82.6		
#10	77.4		
#20	74.0		
#40	69.5		
#60	57.0		
#100	47.2		
#200	36.9		

SOIL DESCRIPTION

○ Sand, clayey, gravely, brown

REMARKS:

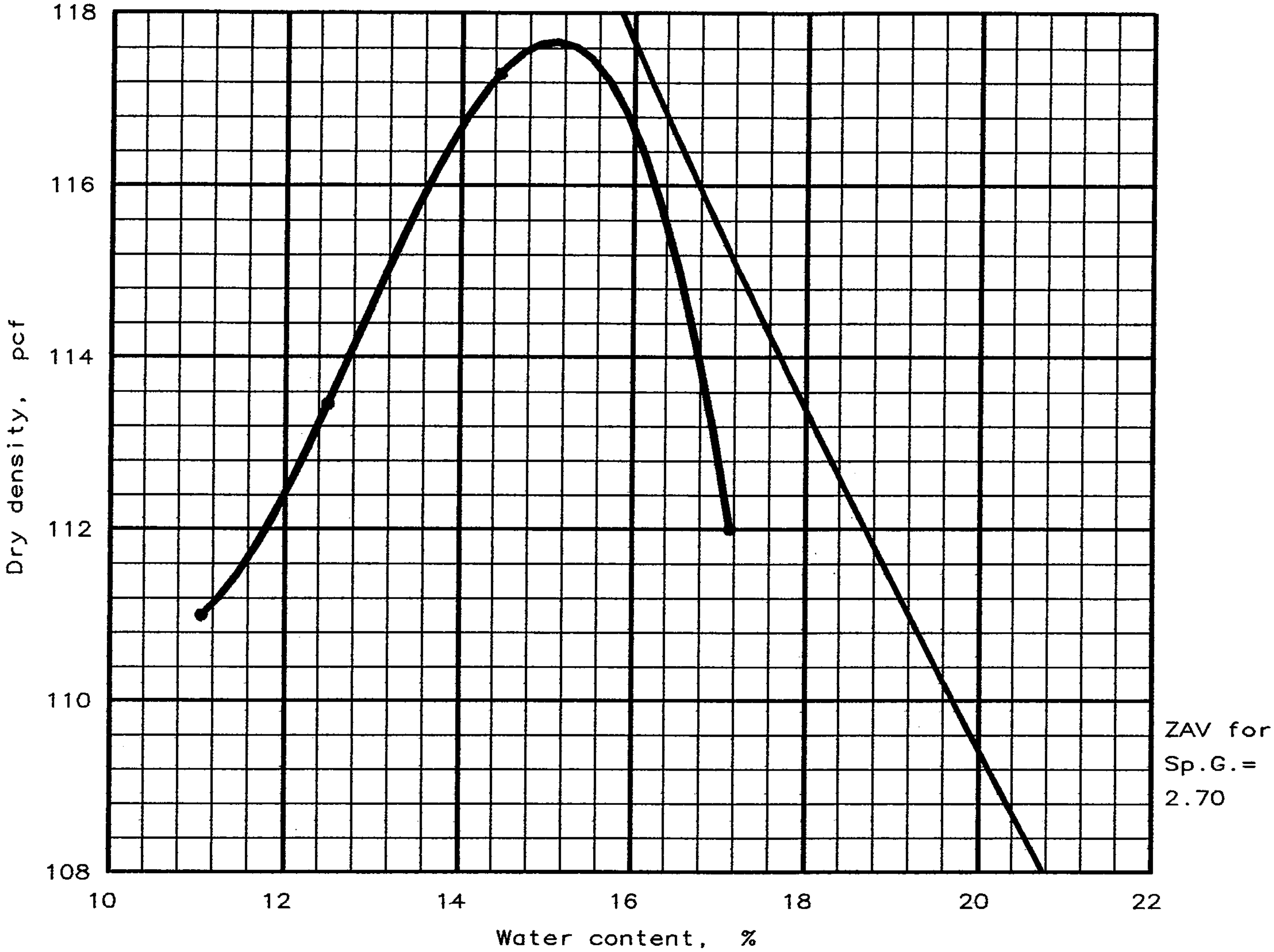
○ Tested By: JH

○ Source:

Sample No.: 3-1C

WESTERN COLORADO TESTING, INC.	Client: International Uranium Corporation Project: Soil Sample Testing Project No.: 804899 Figure 40

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			N/A %	2.70				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 117.7 pcf Optimum moisture = 15.1 %	117.7 pcf 15.1 %	C1-S1 Clay, v sandy, silty, rd

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

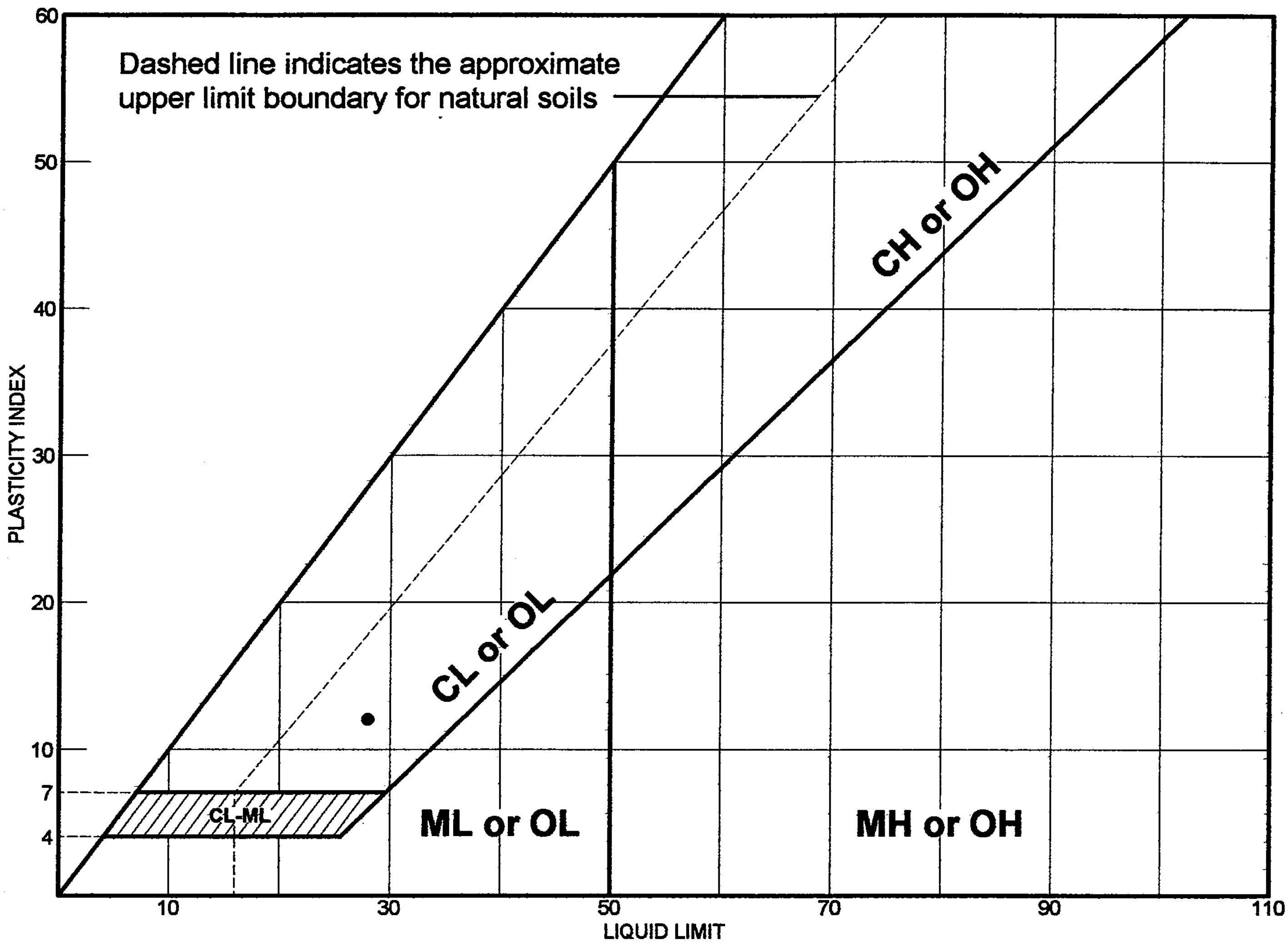
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 10

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clay, very sandy, silty, red	28	16	12	98.3	64.8	CL

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** C1-S1

Remarks:

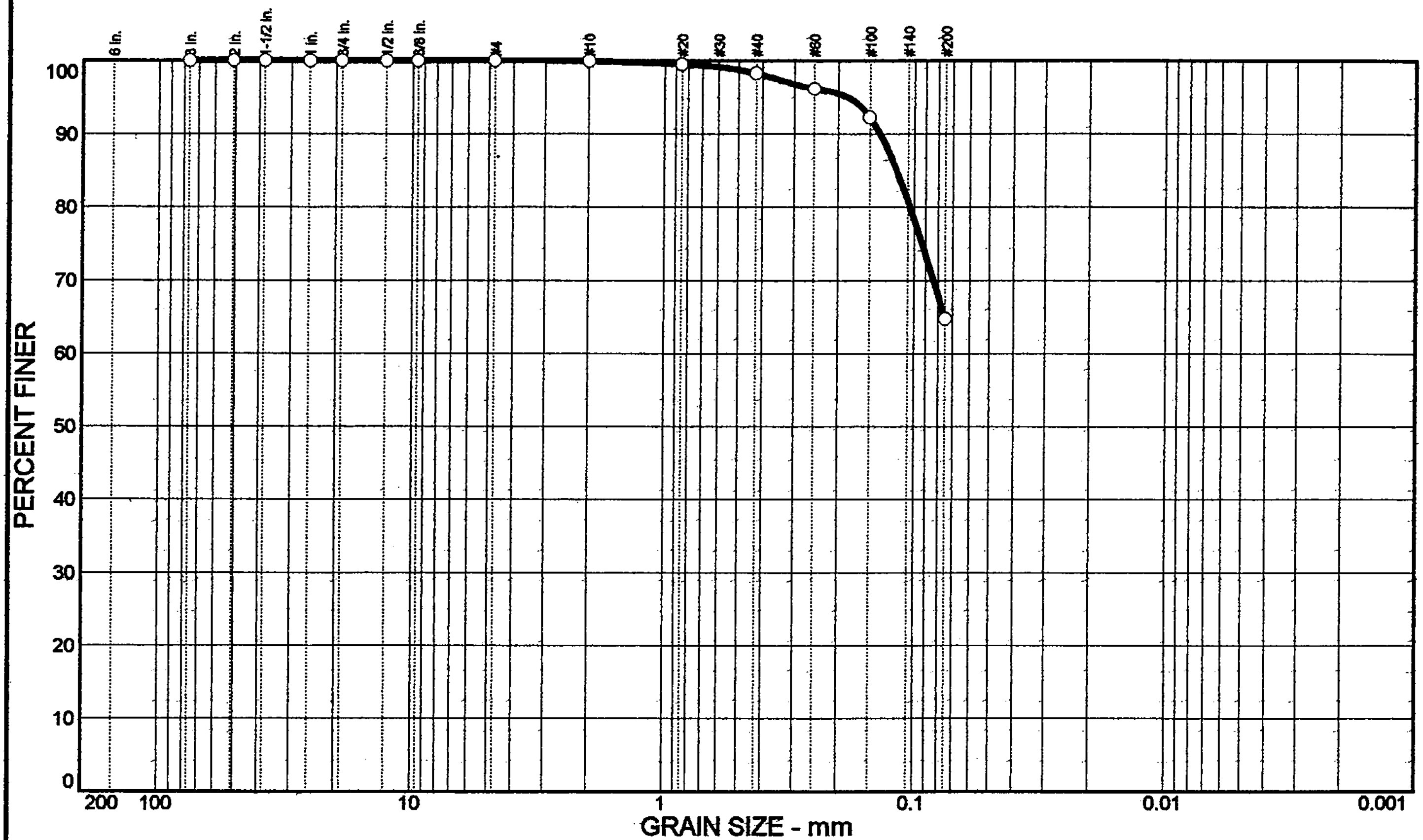
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 24

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.0	35.2			CL	A-6(5)	16	28

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	100.0		
#10	99.9		
#20	99.5		
#40	98.3		
#60	96.2		
#100	92.3		
#200	64.8		

SOIL DESCRIPTION

○ Clay, very sandy, silty, red

REMARKS:

○ Tested By: JH

○ Source: Sample No.: C1-S1

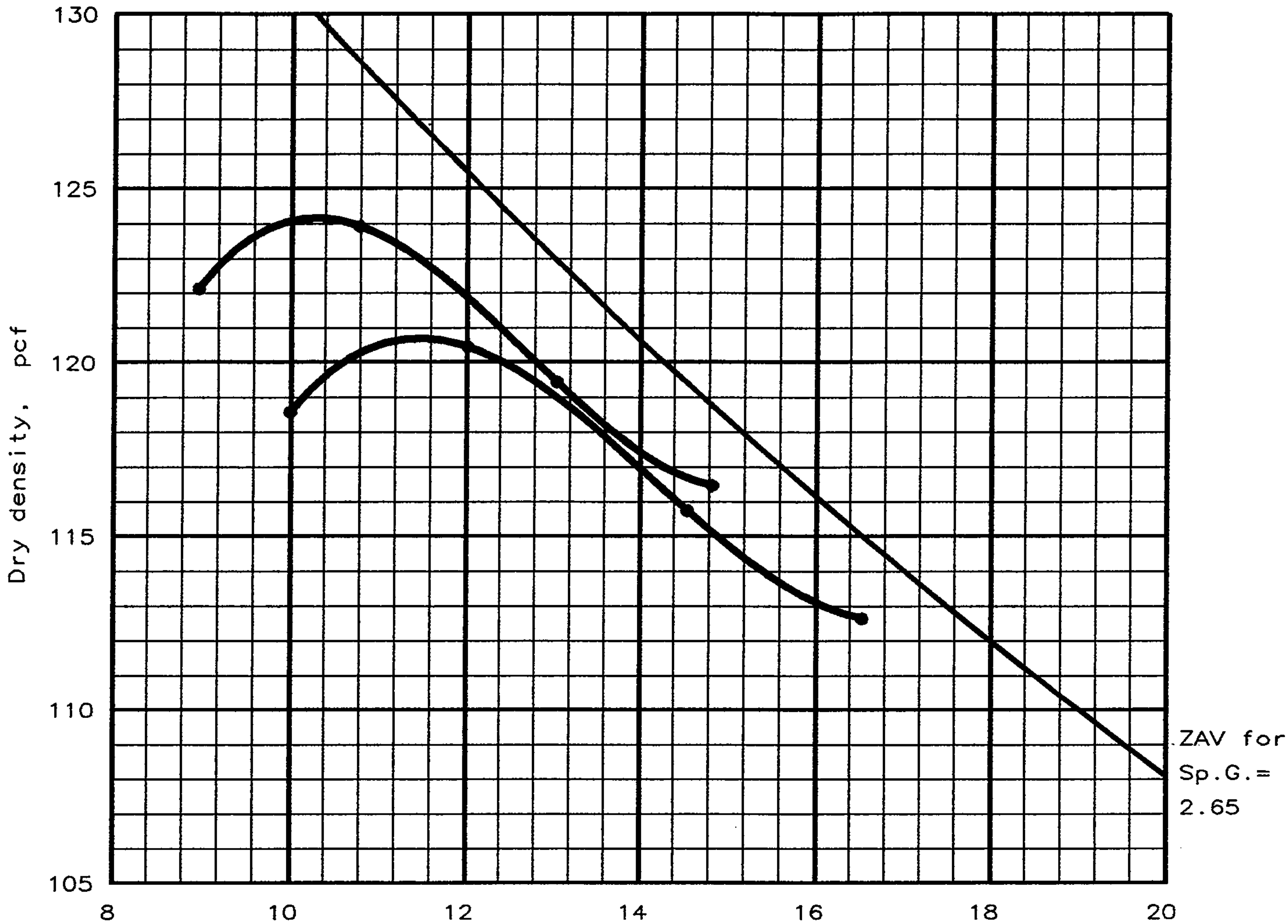
WESTERN COLORADO TESTING, INC.

Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899 Figure 41

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure C, Standard

Oversize correction applied to each point

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
			N/A %	2.65			10.3 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 124.2 pcf Optimum moisture = 10.3 %	120.7 pcf 11.5 %	C2-S1 Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

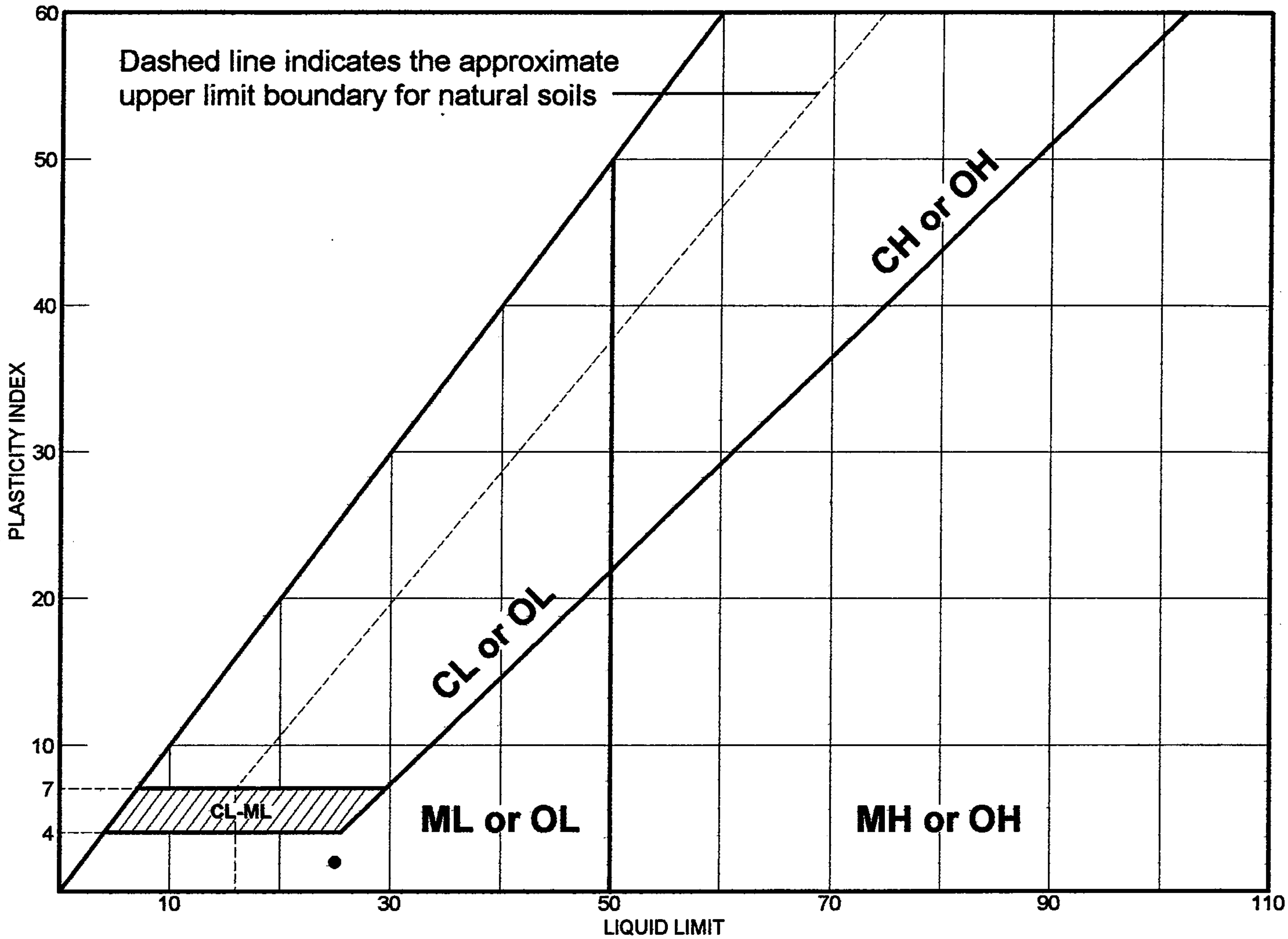
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 11

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sand, clayey, gravely, brown	25	23	2	48.2	26.7	SM

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** C2-S1

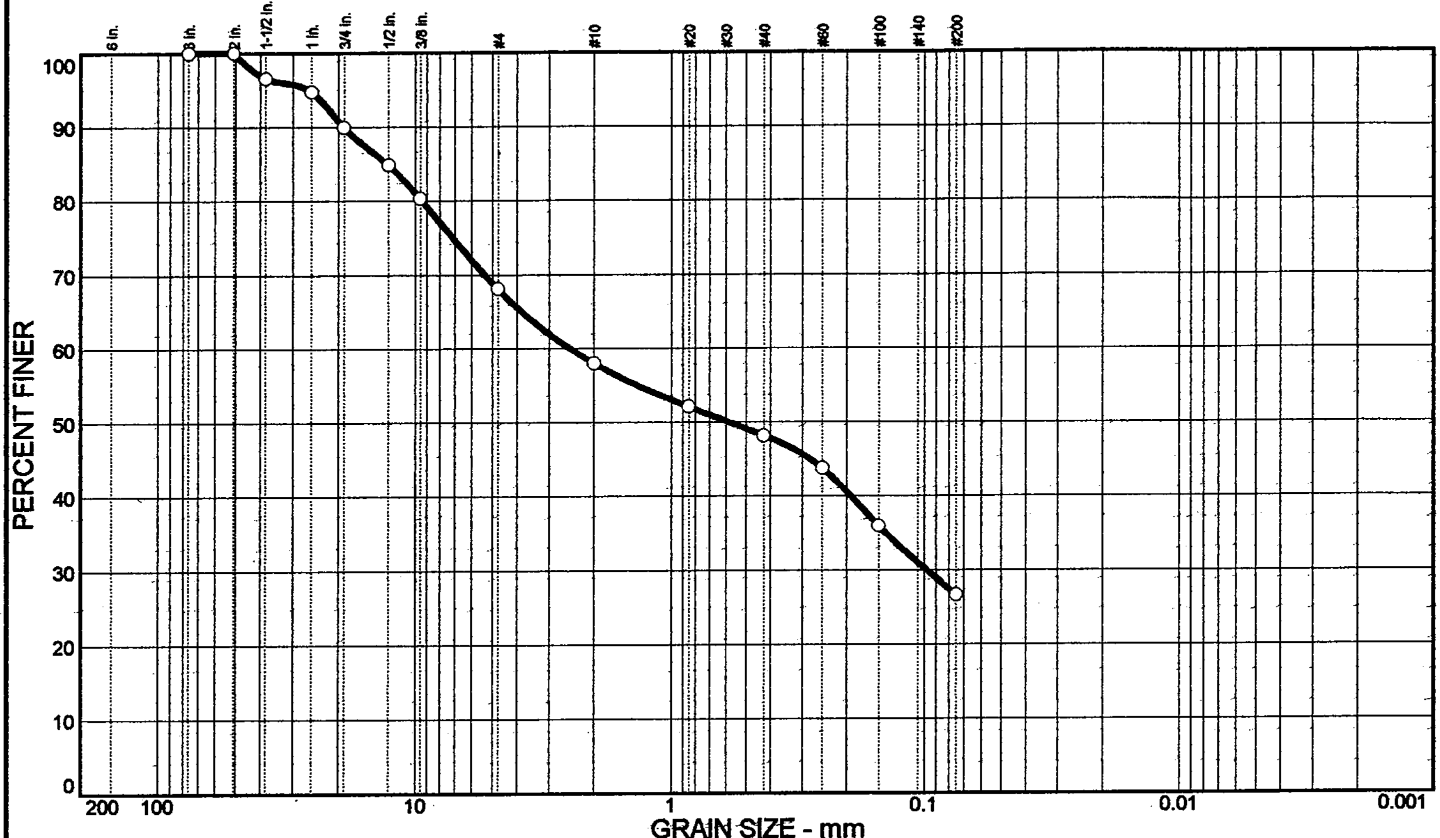
Remarks:
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 25

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		31.9	41.4			SM	A-2-4(0)	23	25

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	96.6		
1	94.8		
3/4	90.0		
1/2	84.9		
3/8	80.3		
	GRAIN SIZE		
D_{60}	2.48		
D_{30}	0.0977		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	68.1		
#10	58.0		
#20	52.1		
#40	48.2		
#60	43.8		
#100	36.0		
#200	26.7		

SOIL DESCRIPTION

○ Sand, clayey, gravely, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: C2-S1

WESTERN COLORADO TESTING, INC.

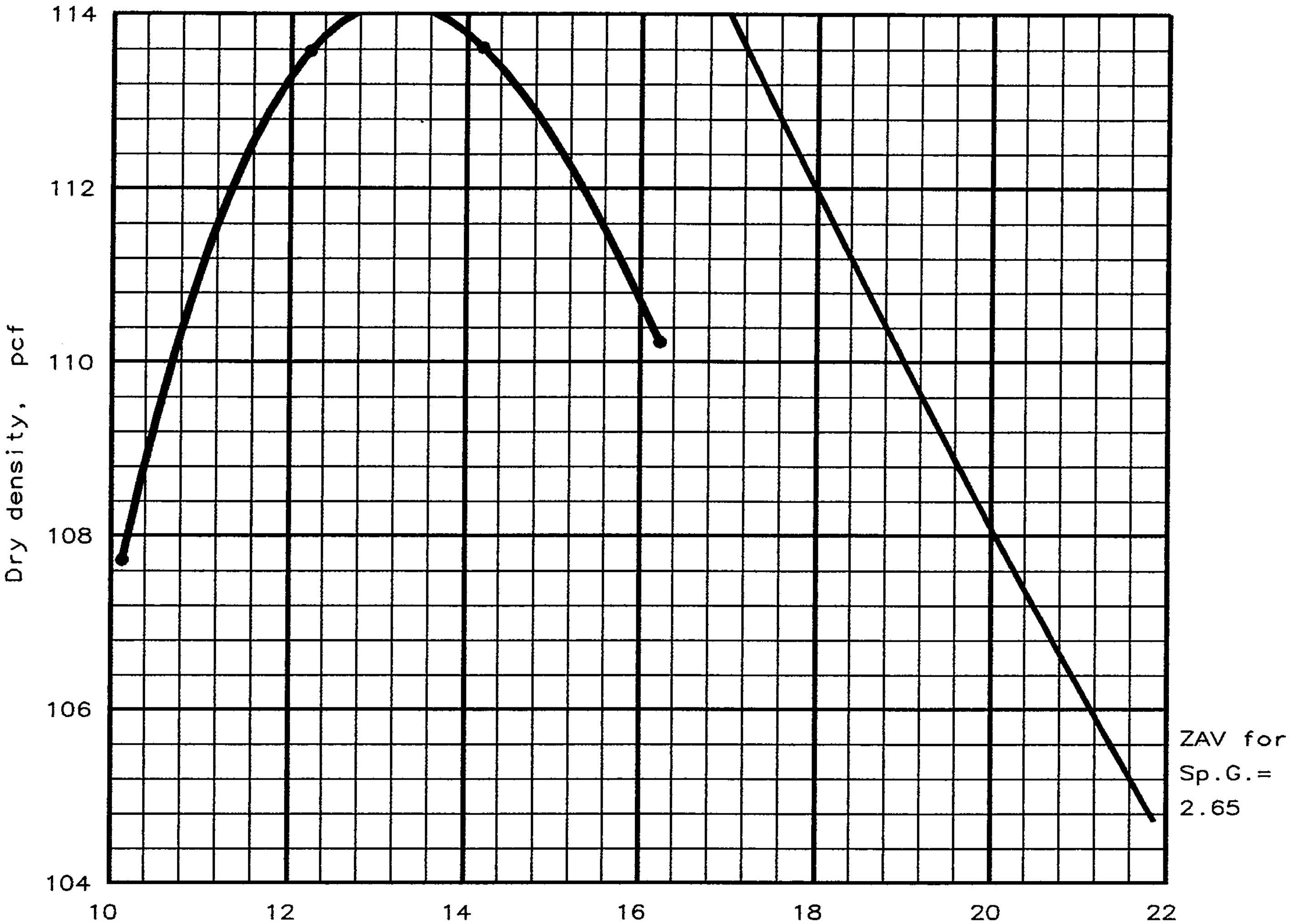
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 42

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 114.1 pcf Optimum moisture = 13.2 %	114.1 pcf 13.2 %	RF1-S1 Clay, silty, sandy, red

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

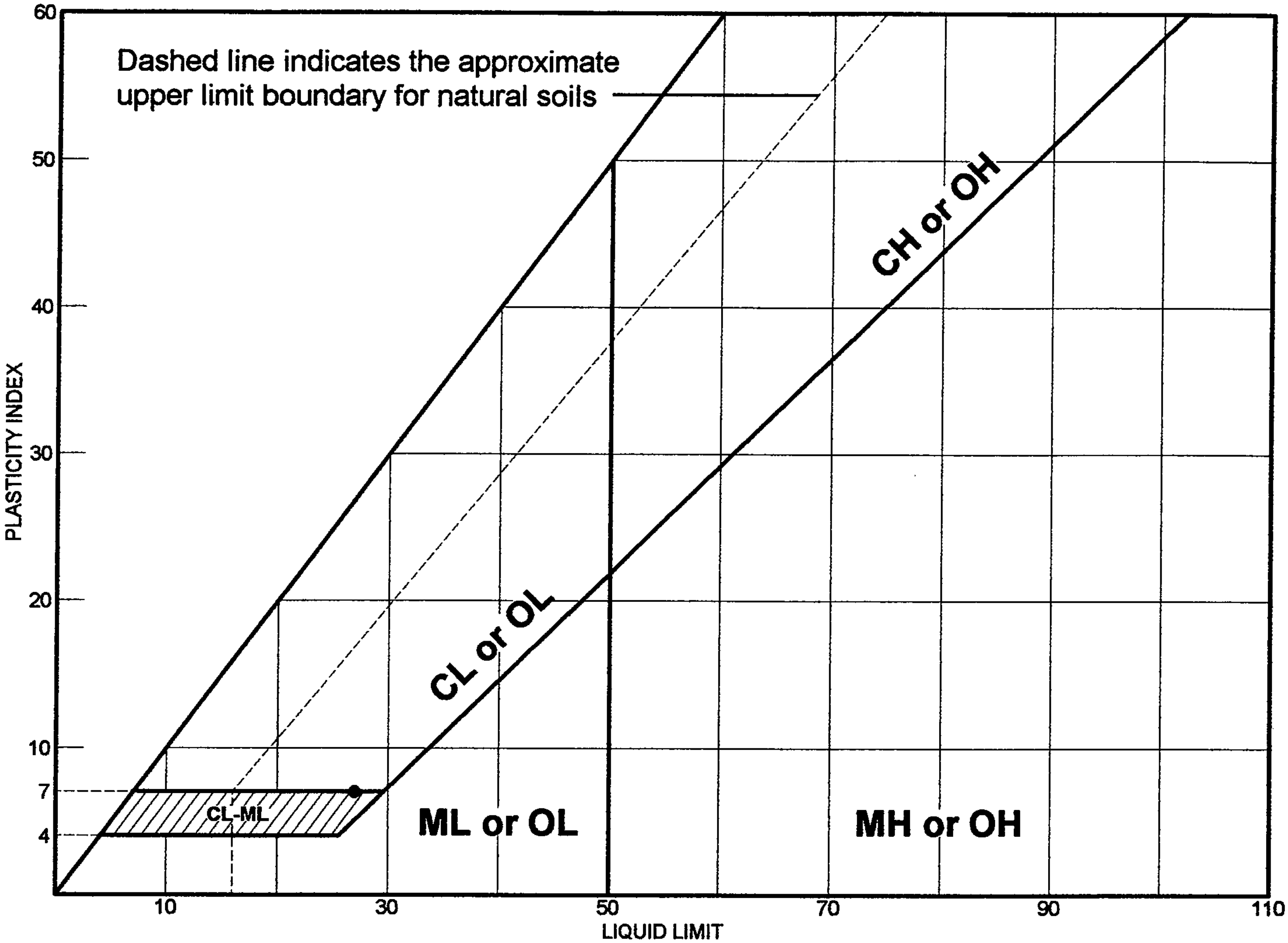
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 12

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clay, silty, sandy, red	27	20	7	99.1	63.1	ML

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** RF1-S1

Remarks:

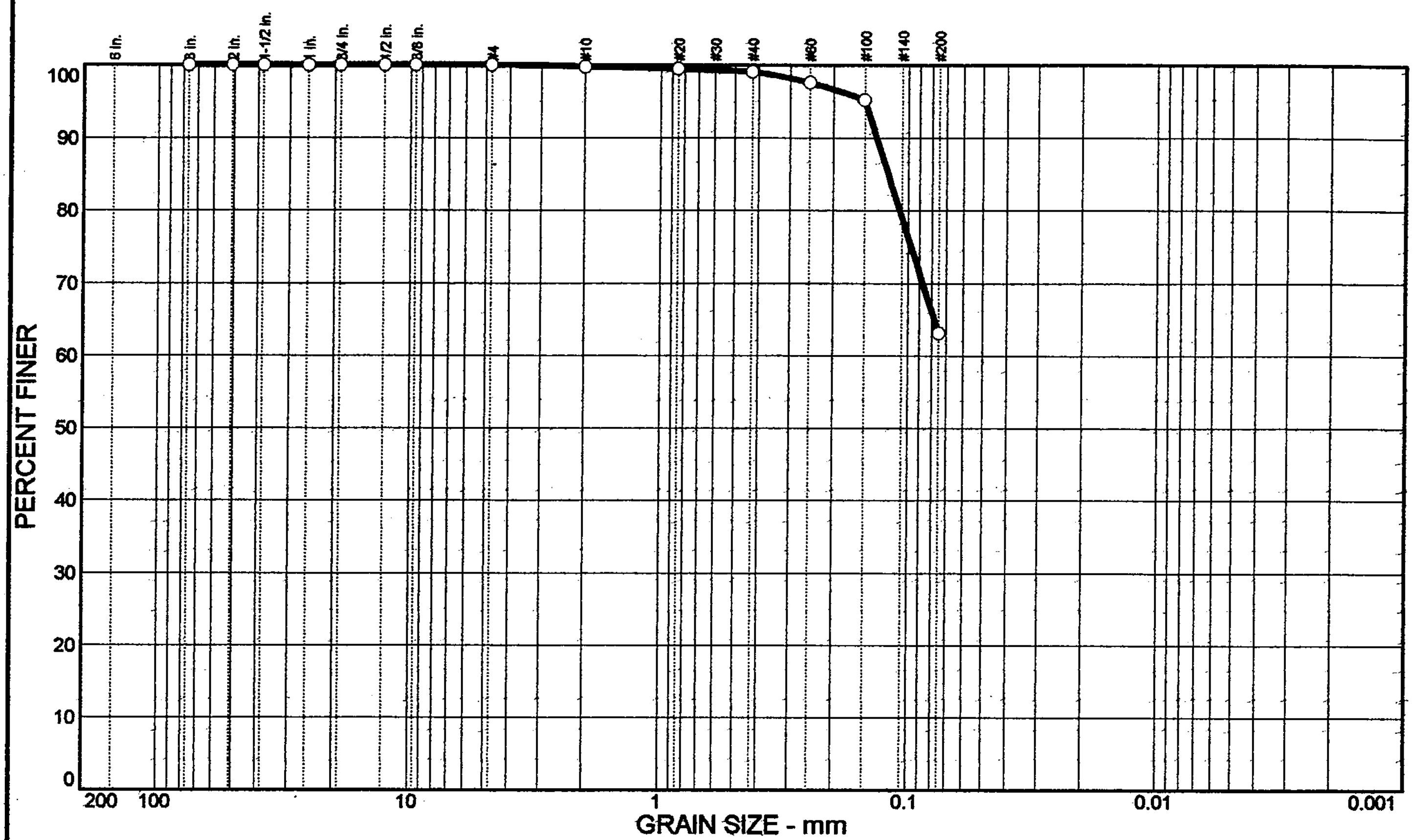
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 26

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.0	36.9			ML	A-4(0)		

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	100.0		
#10	99.8		
#20	99.5		
#40	99.1		
#60	97.6		
#100	95.2		
#200	63.1		

SOIL DESCRIPTION

○ Clay, silty, sandy, red

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF1-S1

WESTERN COLORADO TESTING, INC.

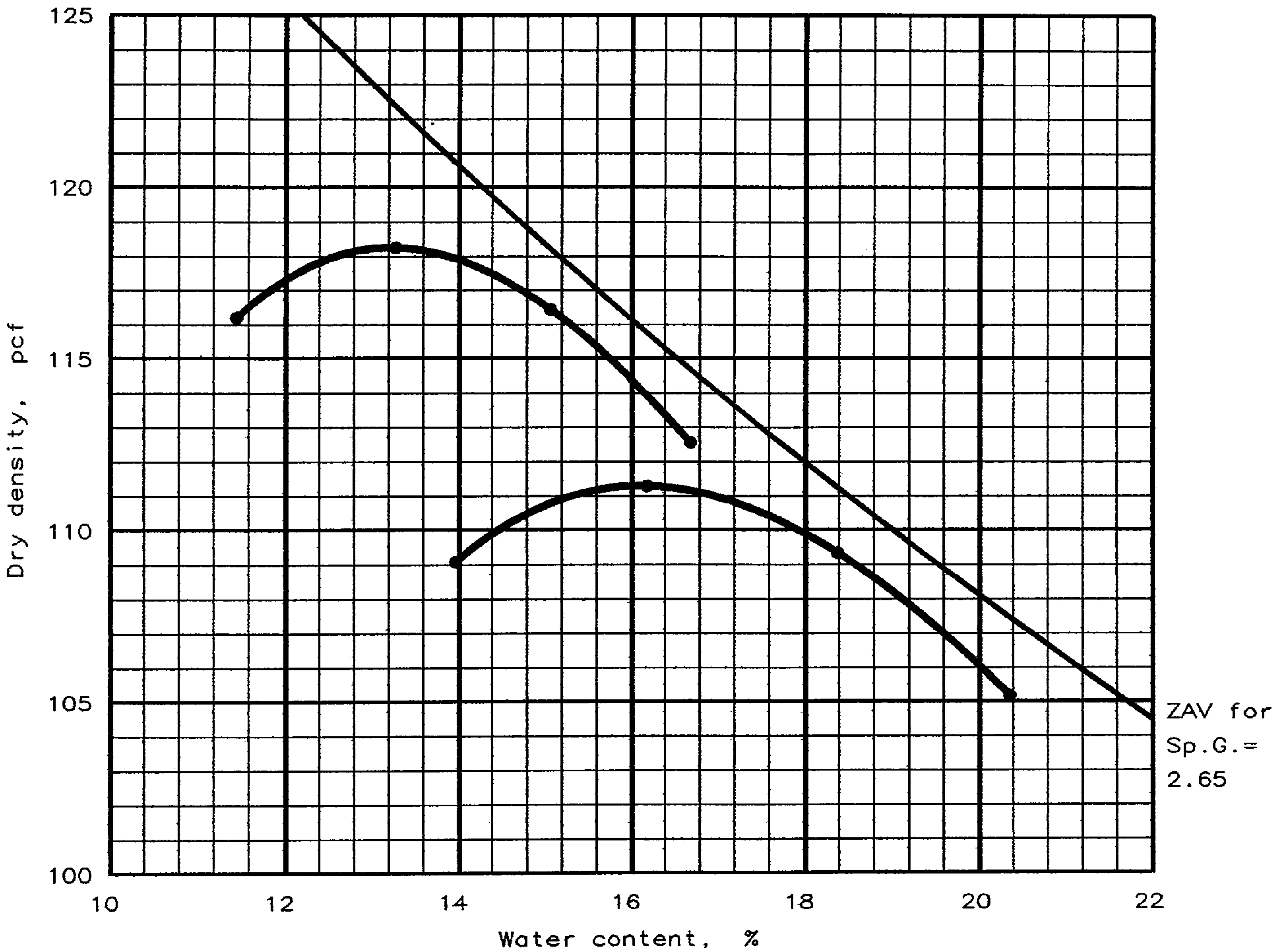
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 43

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure B, Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			18.0 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 118.3 pcf Optimum moisture = 13.2 %	111.3 pcf 16.1 %	RF2-S1 Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

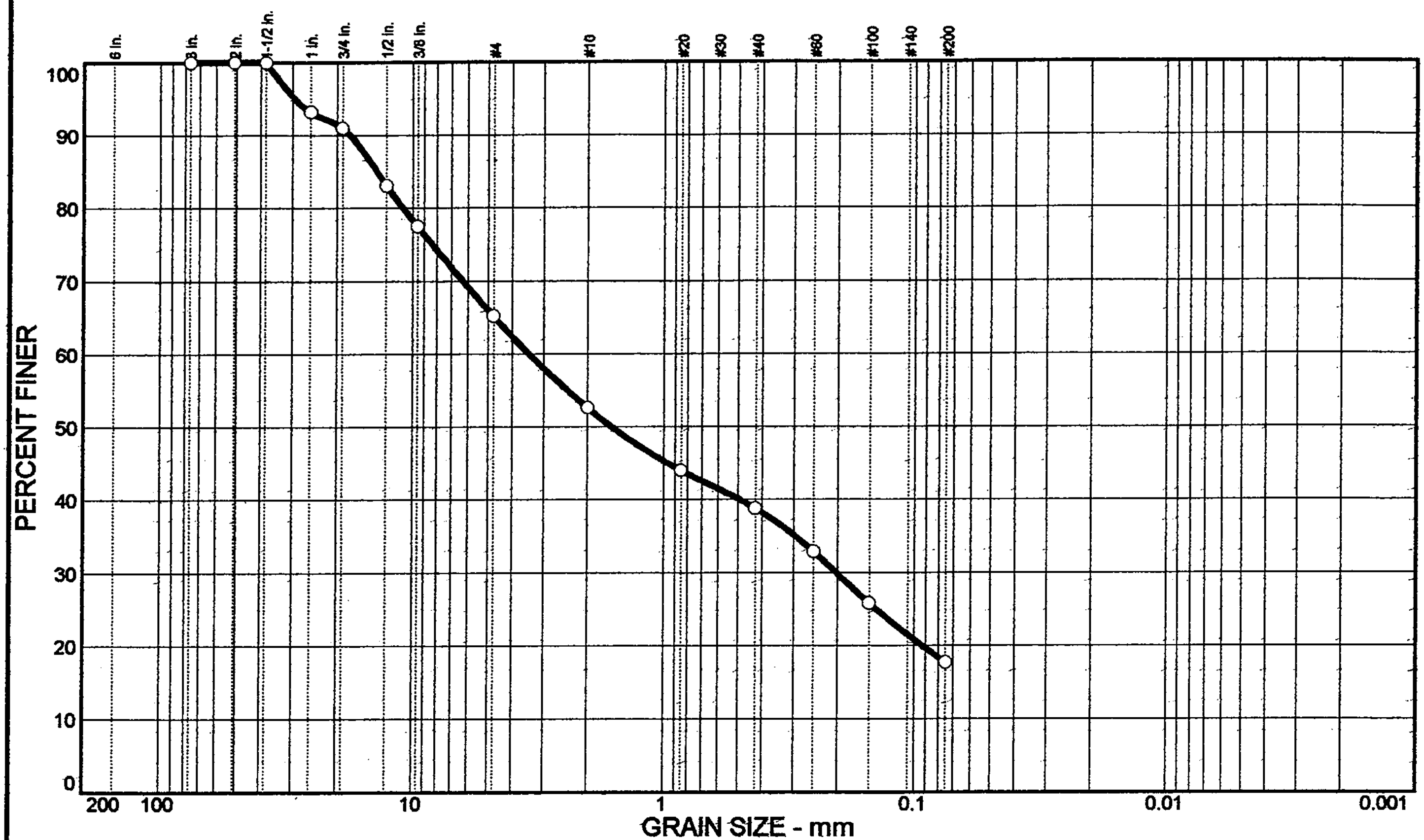
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 13

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		34.8	47.5			SM	A-1-b	NP	NP

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	93.2		
3/4	91.0		
1/2	83.1		
3/8	77.5		
	GRAIN SIZE		
D_{60}	3.42		
D_{30}	0.203		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	65.2		
#10	52.6		
#20	44.0		
#40	38.8		
#60	32.9		
#100	25.8		
#200	17.7		

SOIL DESCRIPTION

○ Sand, sl clayey, gravely, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF2-S1

WESTERN COLORADO TESTING, INC.

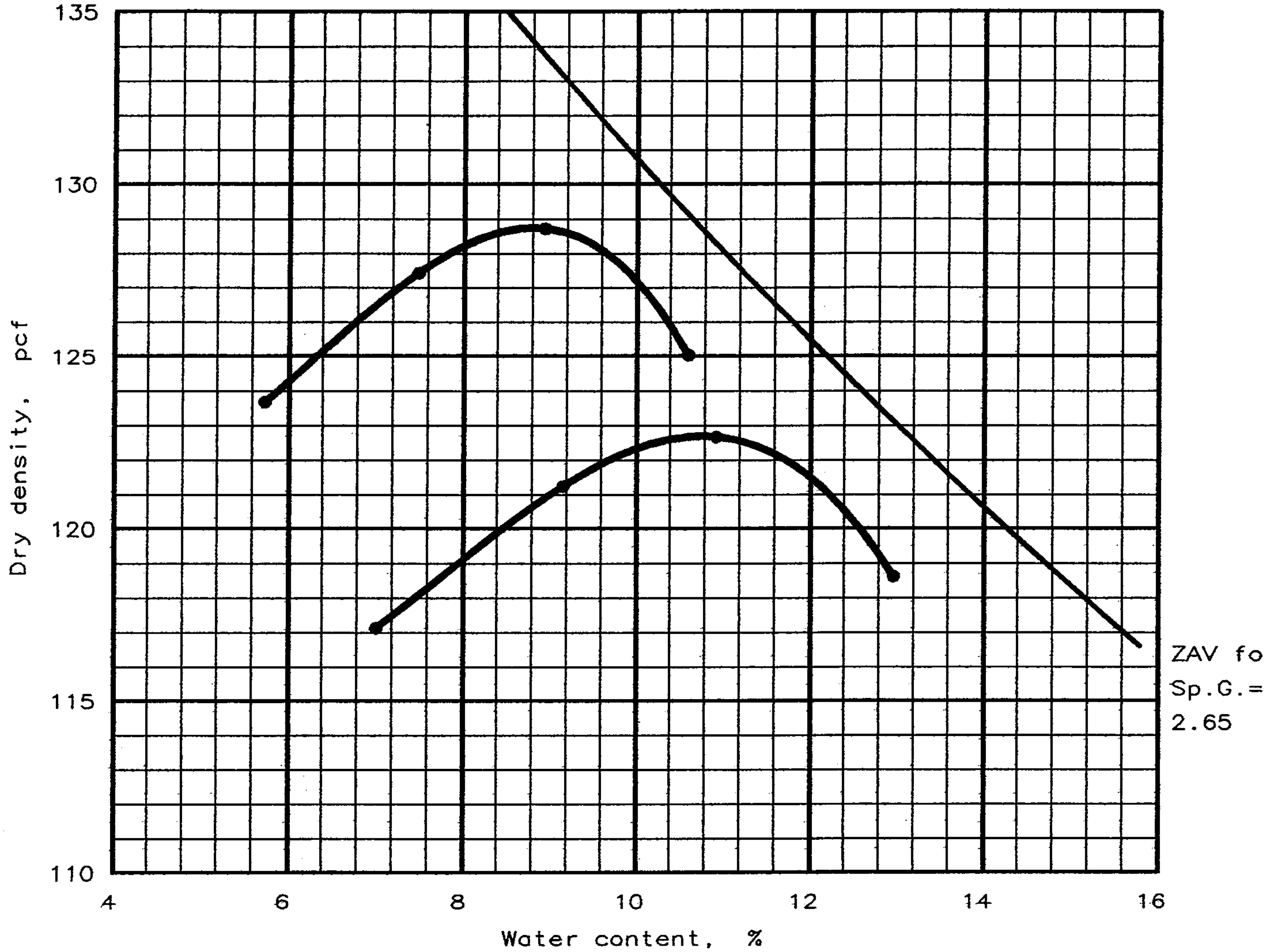
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 44

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure C, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			18.2 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 128.7 pcf Optimum moisture = 8.8 %	122.7 pcf 10.8 %	RF2-S2 Sand, gravely, brown

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

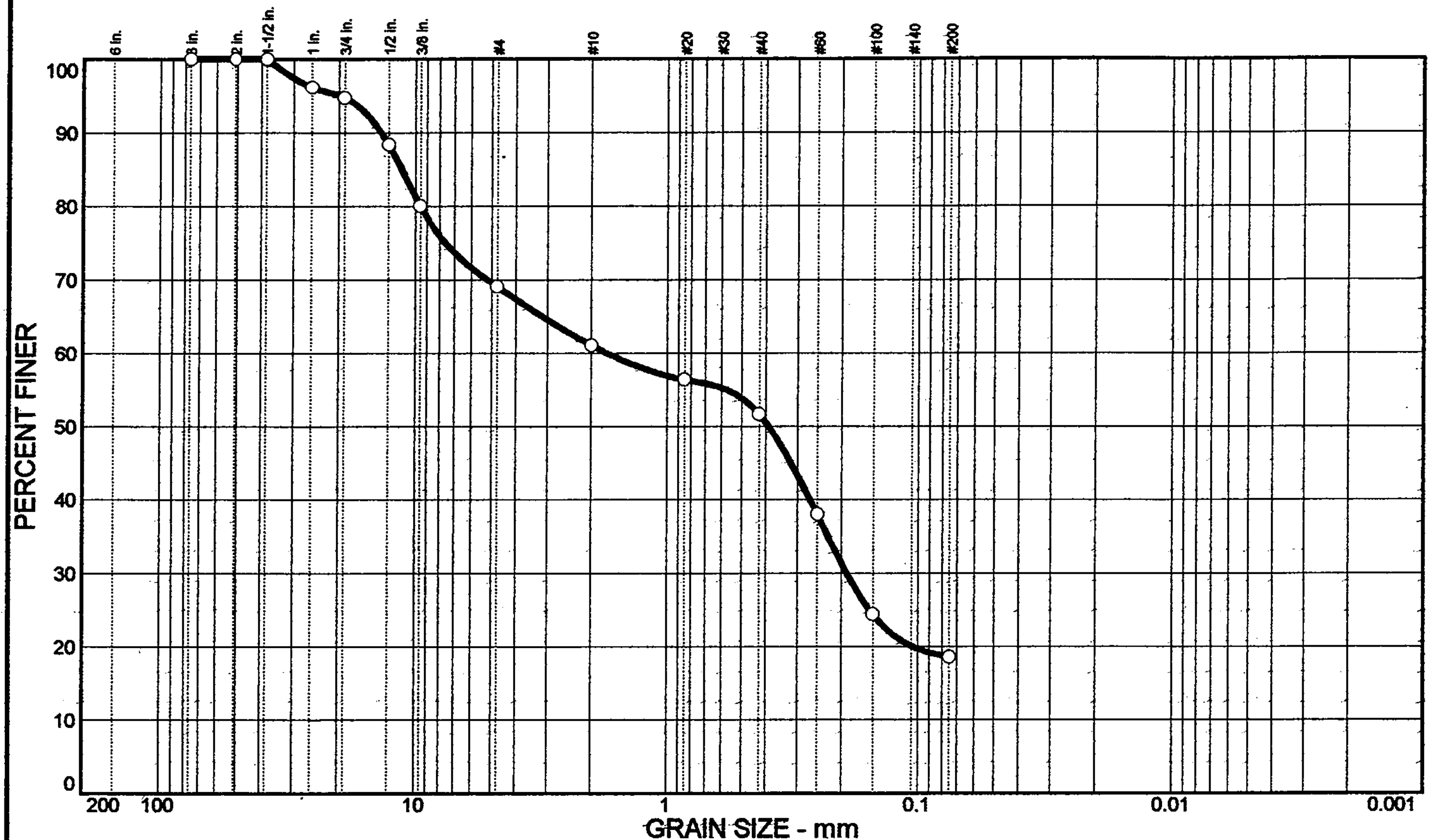
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 14

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		30.9	50.5			SM	A-2-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	96.2		
3/4	94.8		
1/2	88.4		
3/8	80.1		
	GRAIN SIZE		
D_{60}	1.73		
D_{30}	0.190		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	69.1		
#10	61.1		
#20	56.4		
#40	51.7		
#60	38.0		
#100	24.4		
#200	18.6		

SOIL DESCRIPTION

○ Sand, gravely, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF2-S2

WESTERN COLORADO TESTING, INC.

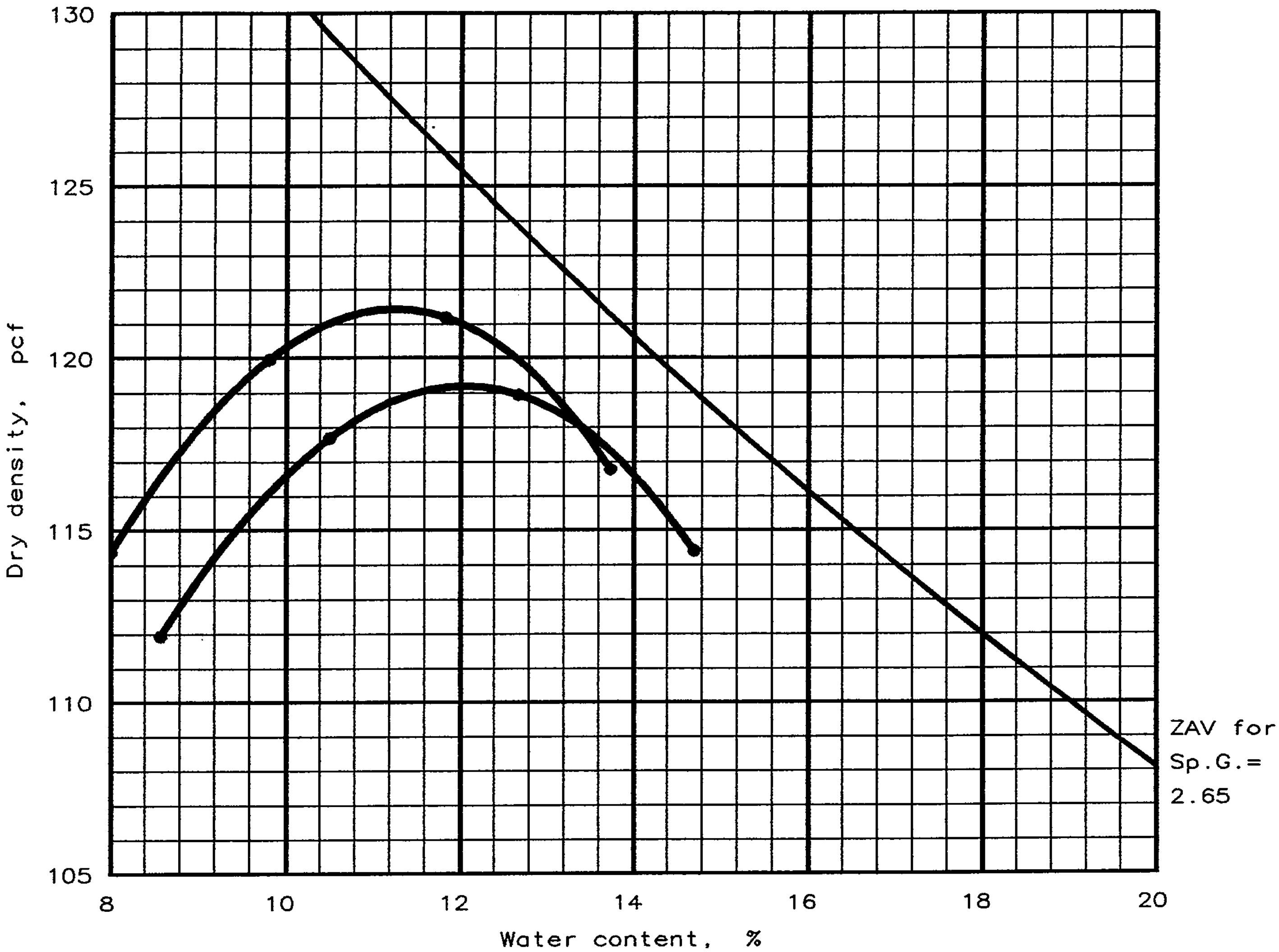
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 45

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure C, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			6.6 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 121.4 pcf Optimum moisture = 11.3 %	119.2 pcf 12.1 %	RF3-S1 Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

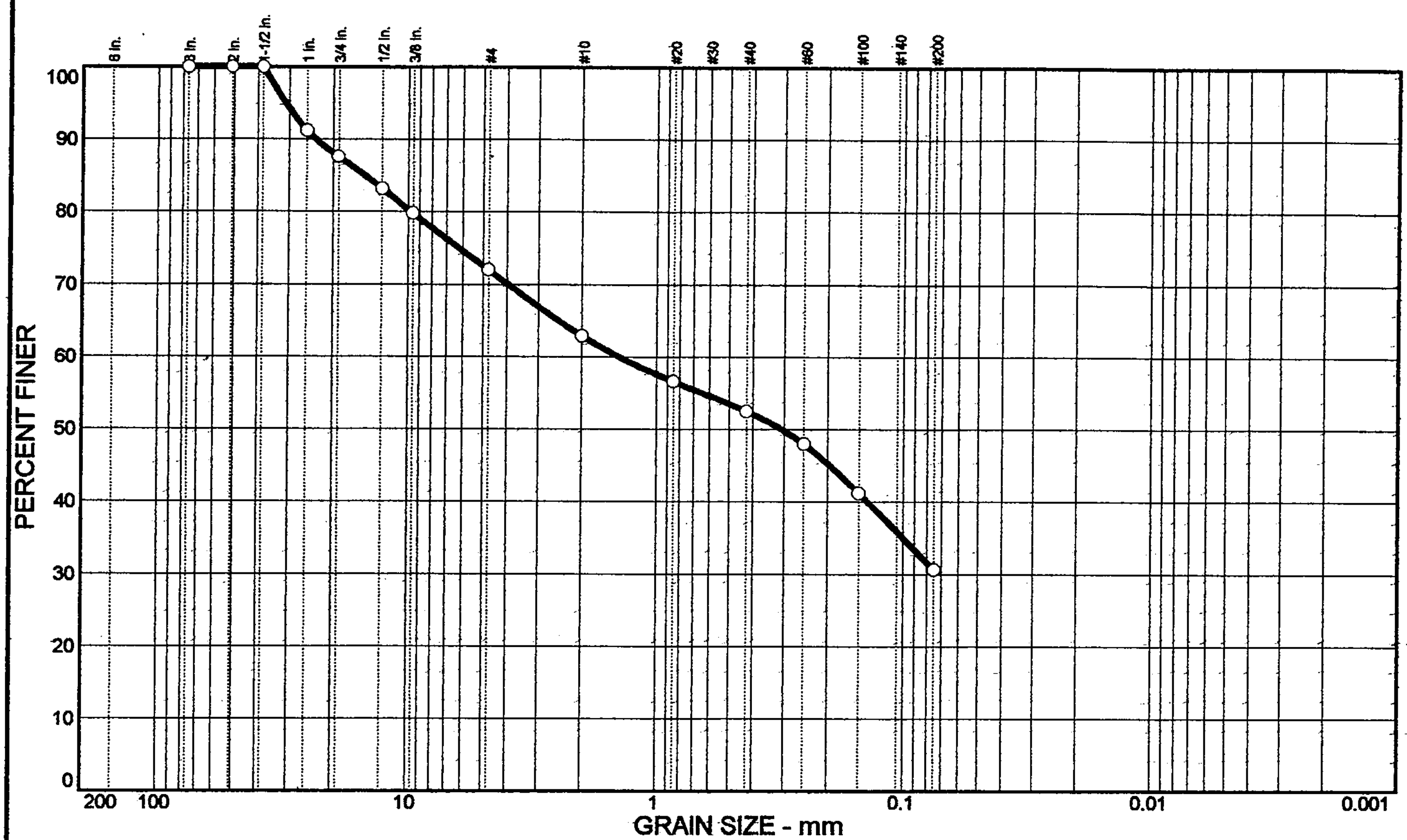
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 15

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		28.0	41.4			SM	A-2-4(0)	NP	

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	91.2		
3/4	87.6		
1/2	83.2		
3/8	79.8		
	GRAIN SIZE		
D_{60}	1.41		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	72.0		
#10	62.9		
#20	56.6		
#40	52.5		
#60	48.0		
#100	41.2		
#200	30.6		

SOIL DESCRIPTION

○ Sand, sl clayey, gravely, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF3-S1

WESTERN COLORADO TESTING, INC.

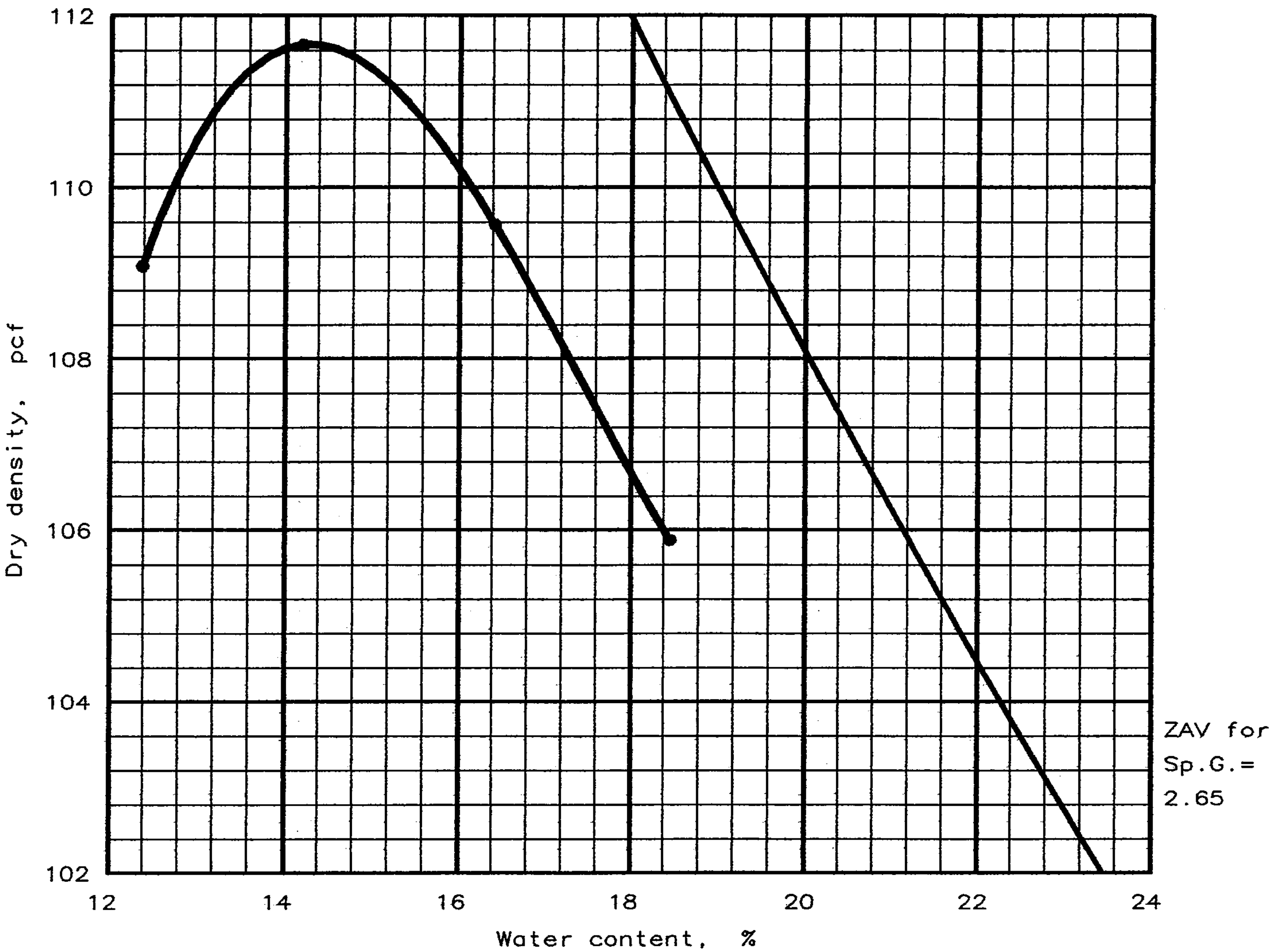
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 46

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 111.7 pcf Optimum moisture = 14.3 %	111.7 pcf 14.3 %	RF3-S2 Clay, v sandy, red

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

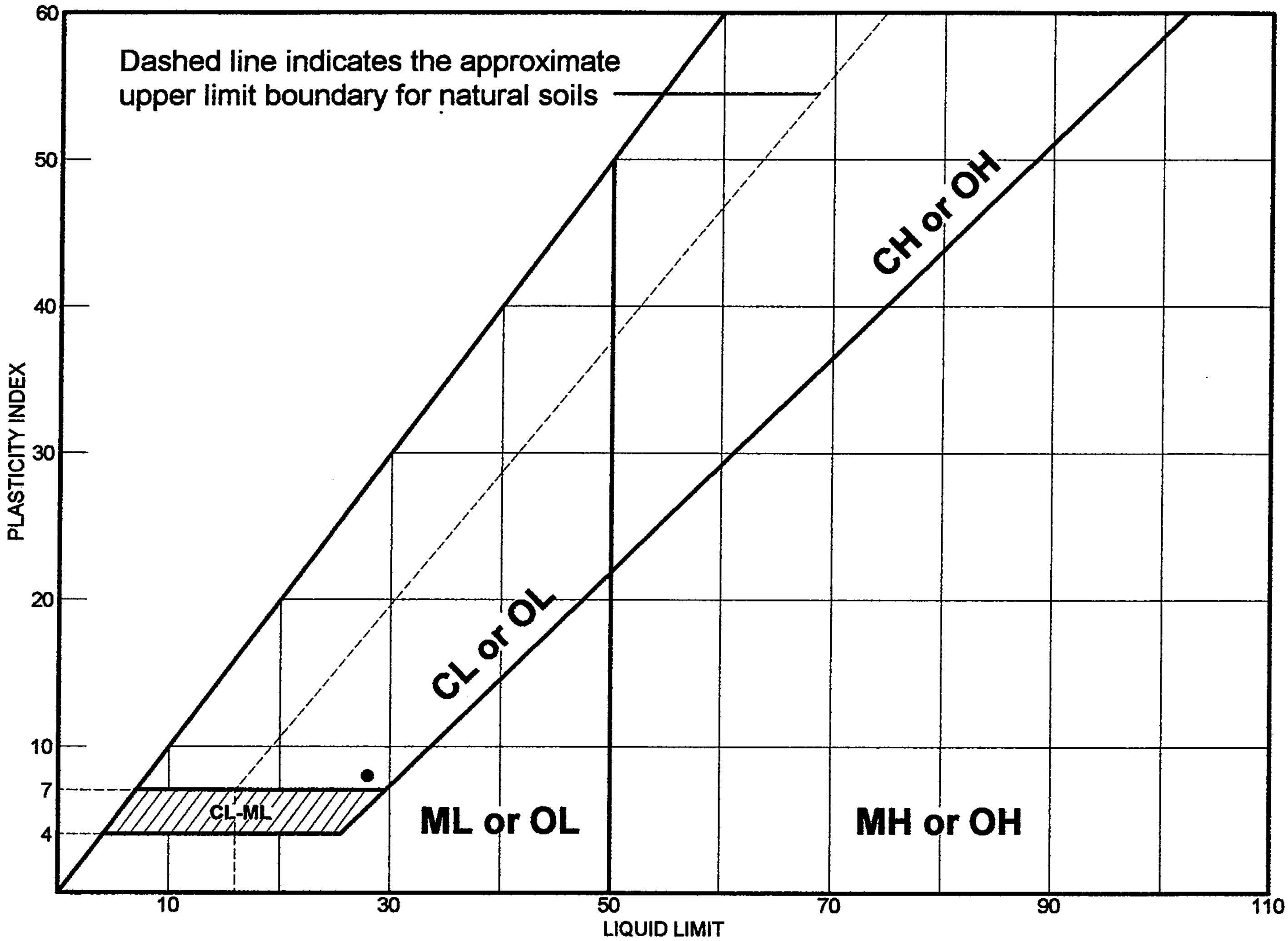
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 16

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clay, very sandy, red	28	20	8	69.0	39.0	SM

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** RF3-S2

Remarks:

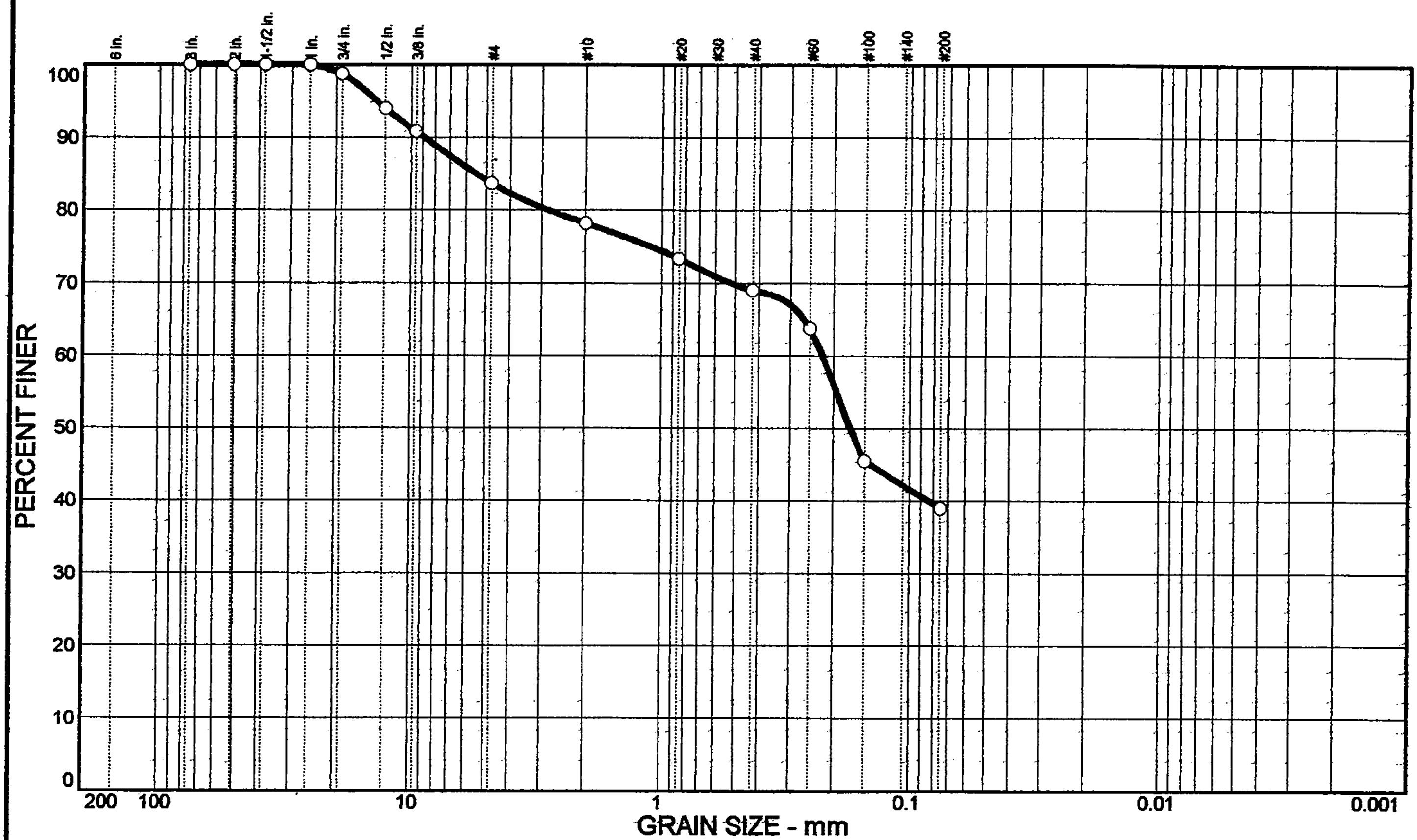
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 27

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		16.3	44.7			SM	A-4(0)		

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	98.7		
1/2	94.0		
3/8	90.8		
	GRAIN SIZE		
D_{60}	0.222		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	83.7		
#10	78.2		
#20	73.4		
#40	69.0		
#60	63.7		
#100	45.5		
#200	39.0		

SOIL DESCRIPTION

○ Clay, very sandy, red

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF3-S2

WESTERN COLORADO TESTING, INC.

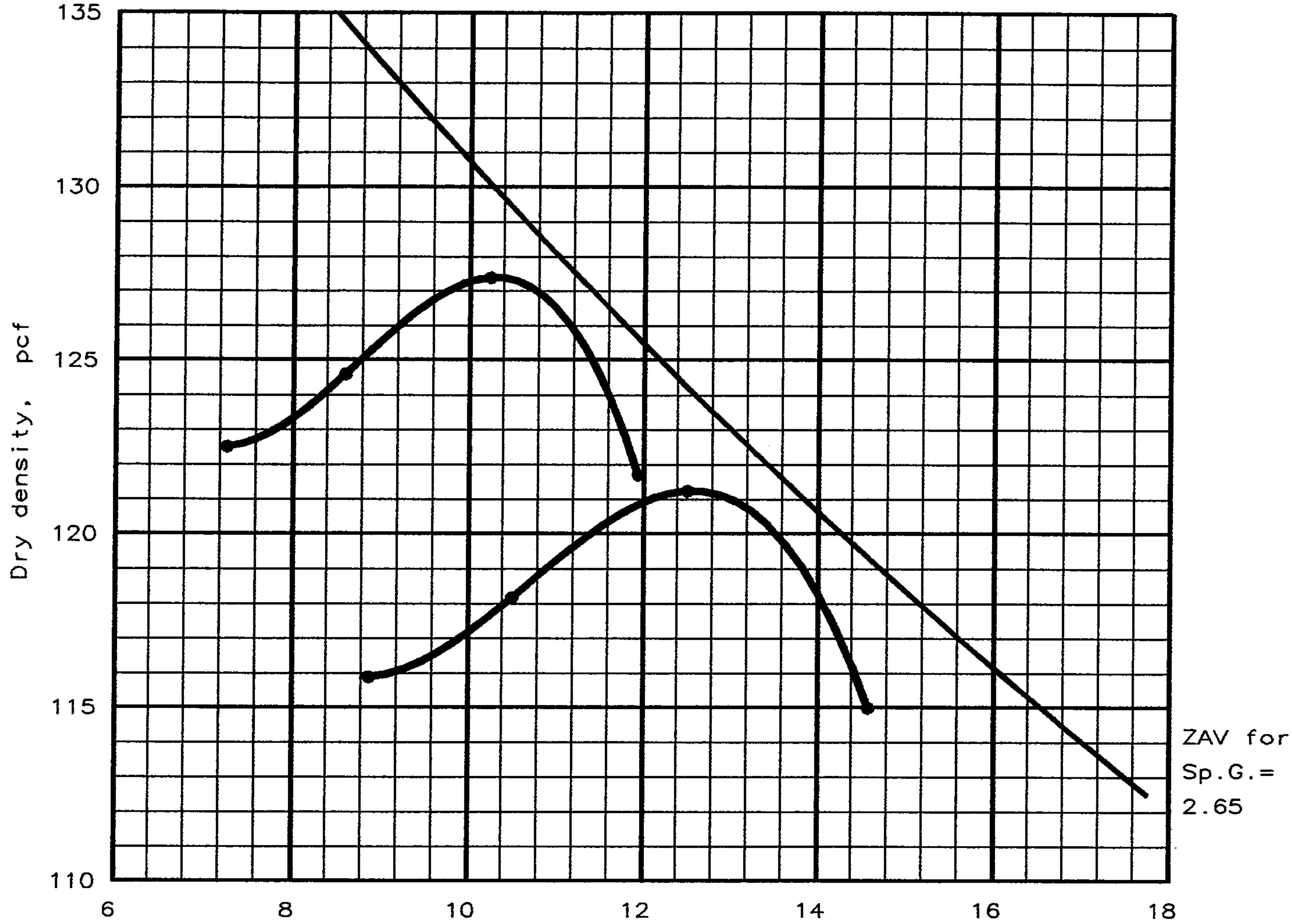
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 47

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure C, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			18.1 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 127.4 pcf Optimum moisture = 10.3 %	121.3 pcf 12.6 %	RF3-S3 Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

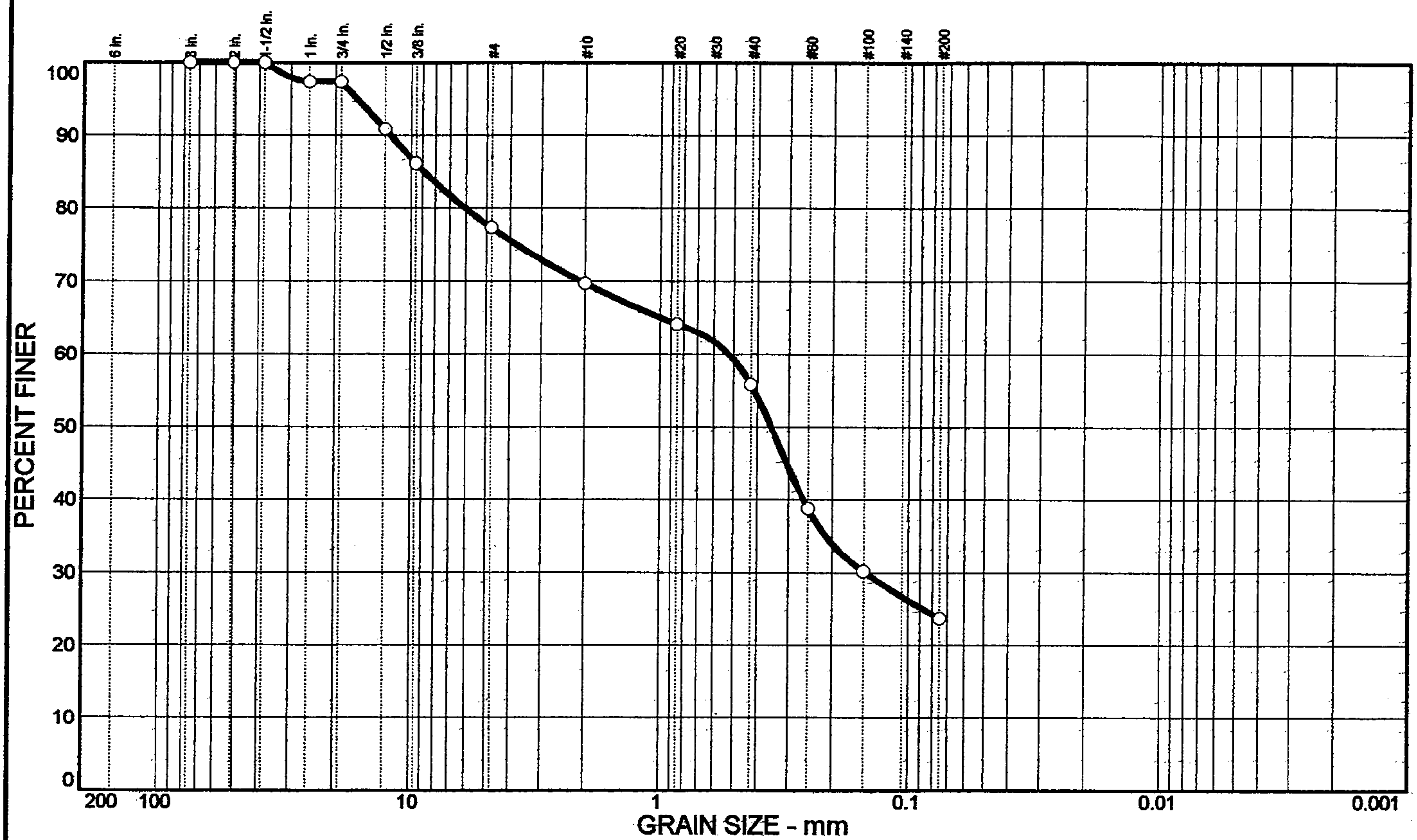
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 17

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		22.7	53.6			SM	A-2-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	97.4		
3/4	97.4		
1/2	90.9		
3/8	86.2		
	GRAIN SIZE		
D_{60}	0.523		
D_{30}	0.147		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	77.3		
#10	69.7		
#20	64.1		
#40	55.8		
#60	38.8		
#100	30.2		
#200	23.7		

SOIL DESCRIPTION

○ Sand, sl clayey, gravely, brown

REMARKS:

○ Tested By: JH

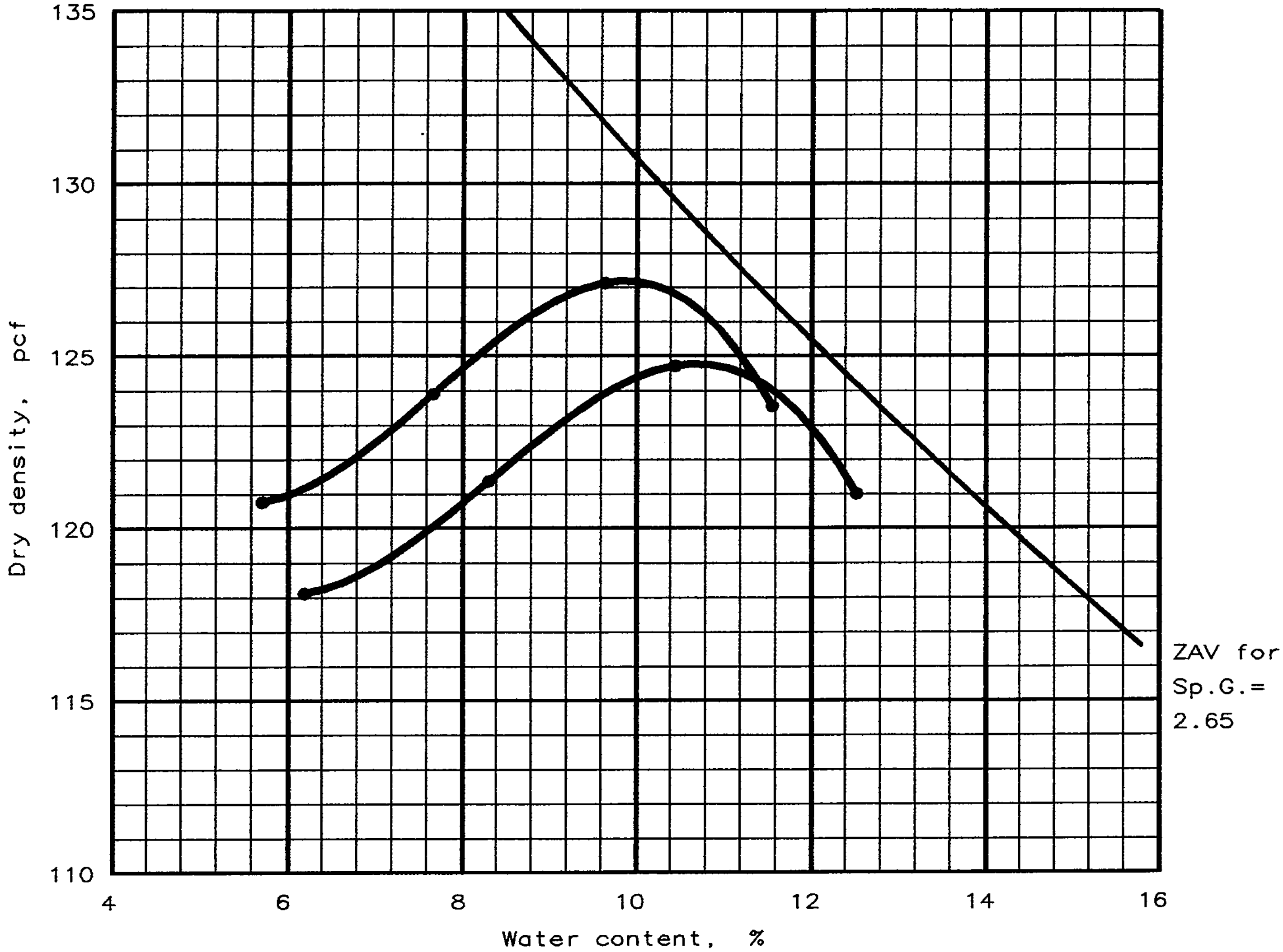
○ Source: Sample No.: RF3-S3

WESTERN COLORADO TESTING, INC.

Client: International Uranium Corporation
Project: Soil Sample Testing

Project No.: 804899 Figure 48

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure C, Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			7.7 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 127.2 pcf Optimum moisture = 9.9 %	124.8 pcf 10.7 %	RF4-S1 Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

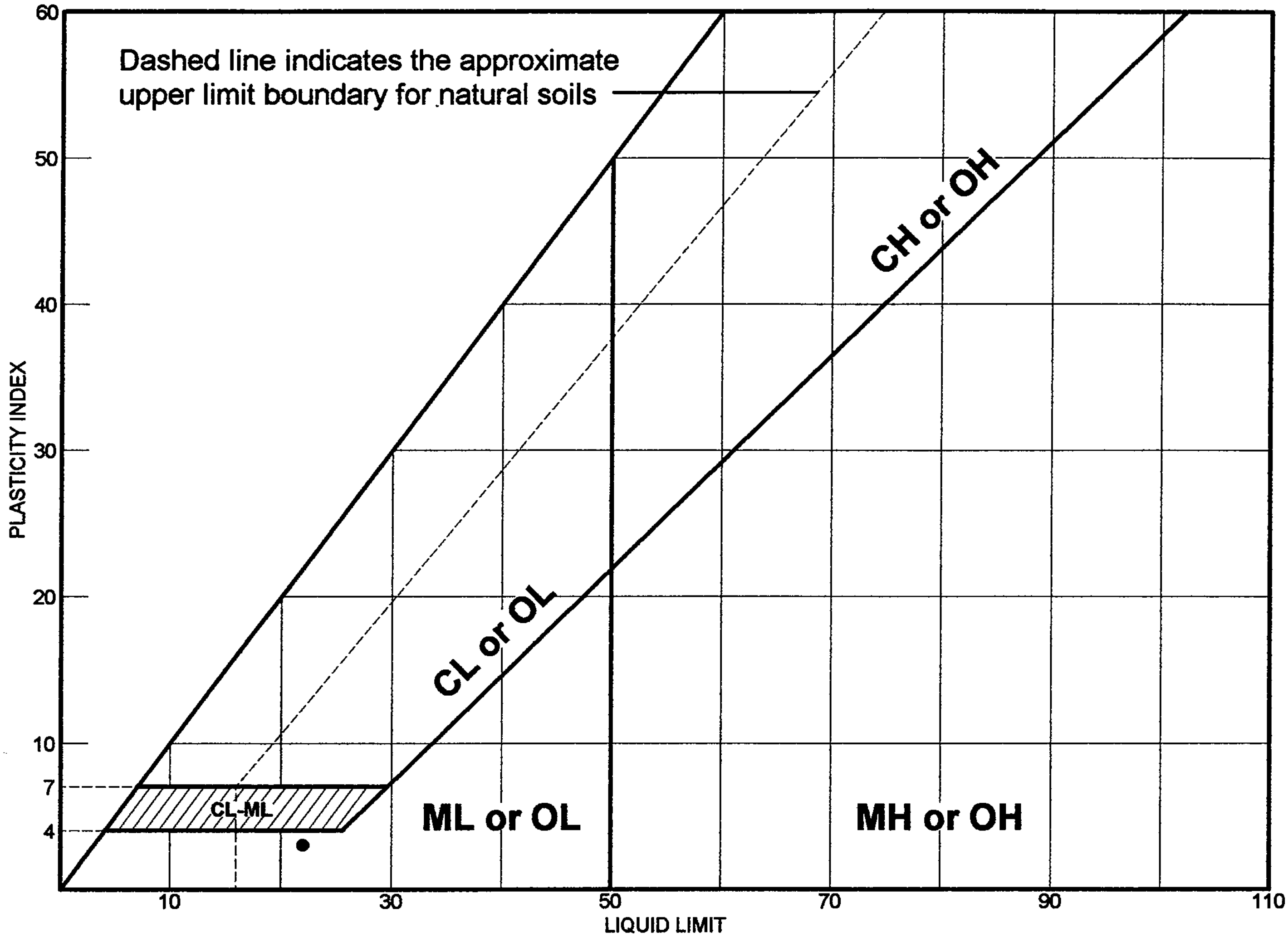
Remarks:

SUBMITTED BY: Client

TESTED BY: JH

Fig. No. 18

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sand, clayey, gravely, brown	22	19	3	51.1	25.5	SM

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** RF4-S1

Remarks:

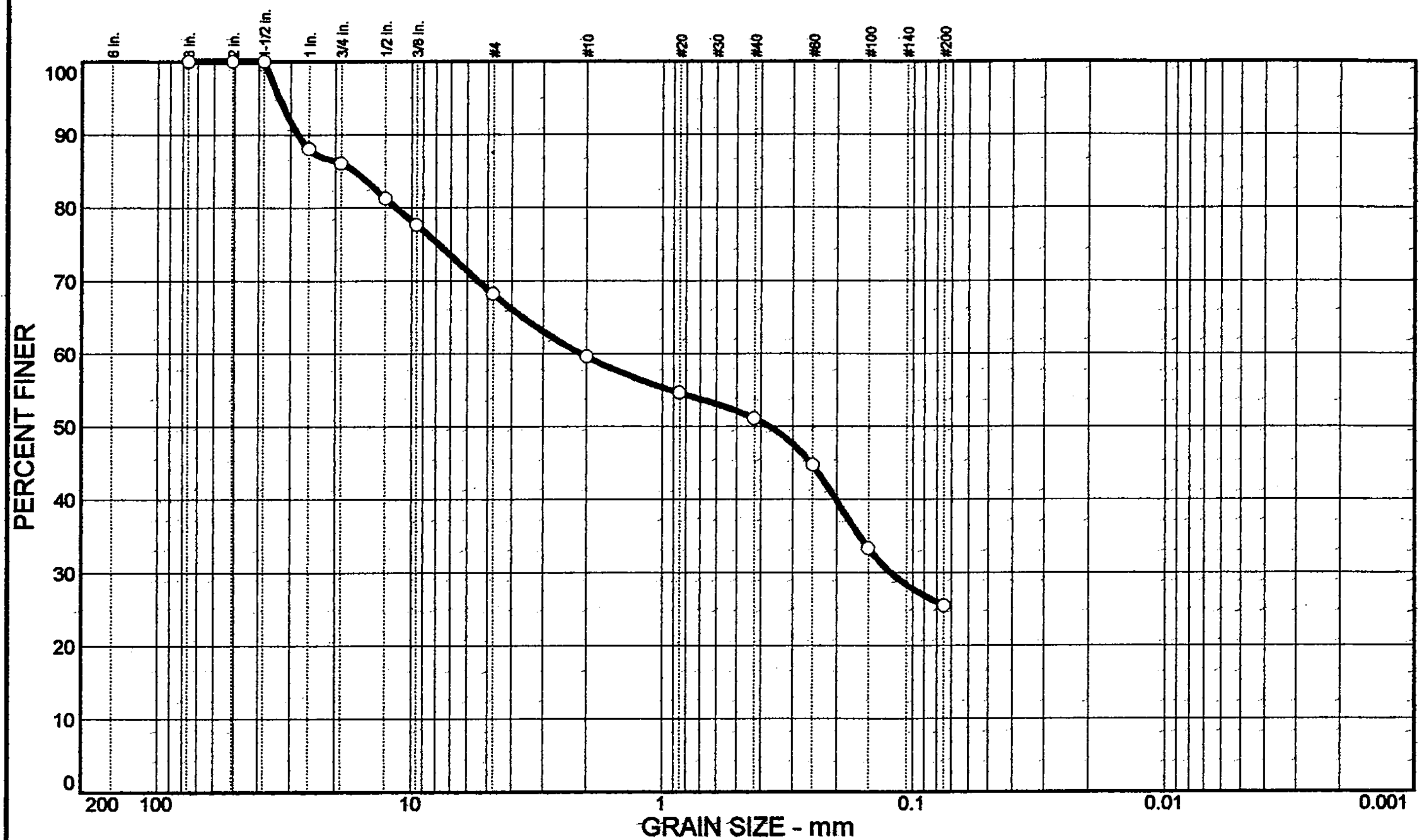
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 28

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		31.8	42.7			SM	A-2-4(0)		

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	88.1		
3/4	86.1		
1/2	81.3		
3/8	77.7		
	GRAIN SIZE		
D_{60}	2.11		
D_{30}	0.122		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	68.2		
#10	59.6		
#20	54.6		
#40	51.1		
#60	44.7		
#100	33.3		
#200	25.5		

SOIL DESCRIPTION

○ Sand, clayey, gravely, brown

REMARKS:

○ Tested By: JH

○ Source: Sample No.: RF4-S1

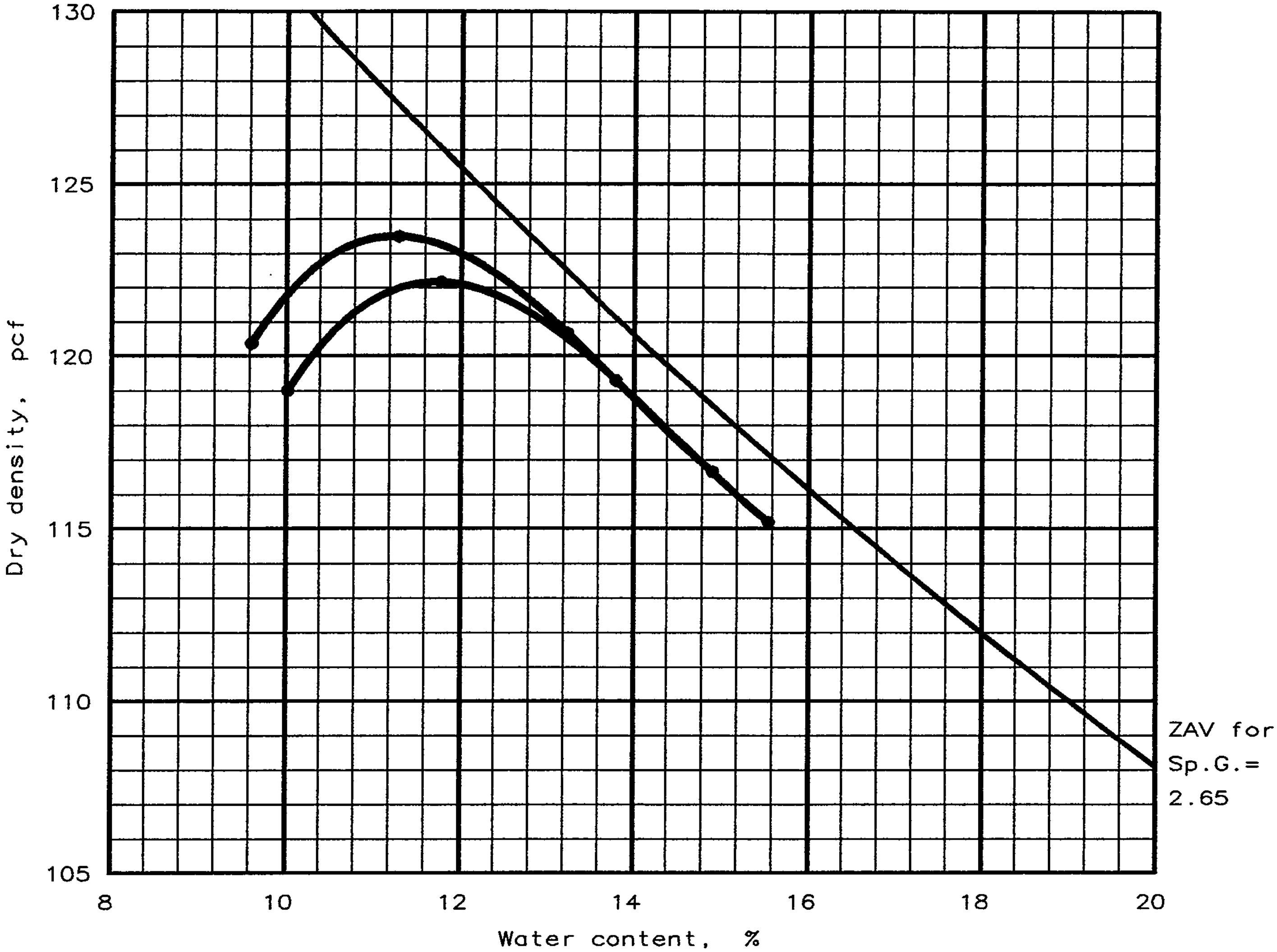
WESTERN COLORADO TESTING, INC.

Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899 Figure 49

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure B, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in	% < No.200
	USCS	AASHTO						
			N/A %	2.65			4.1 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 123.5 pcf Optimum moisture = 11.3 %	122.2 pcf 11.7 %	RF5-S1 Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

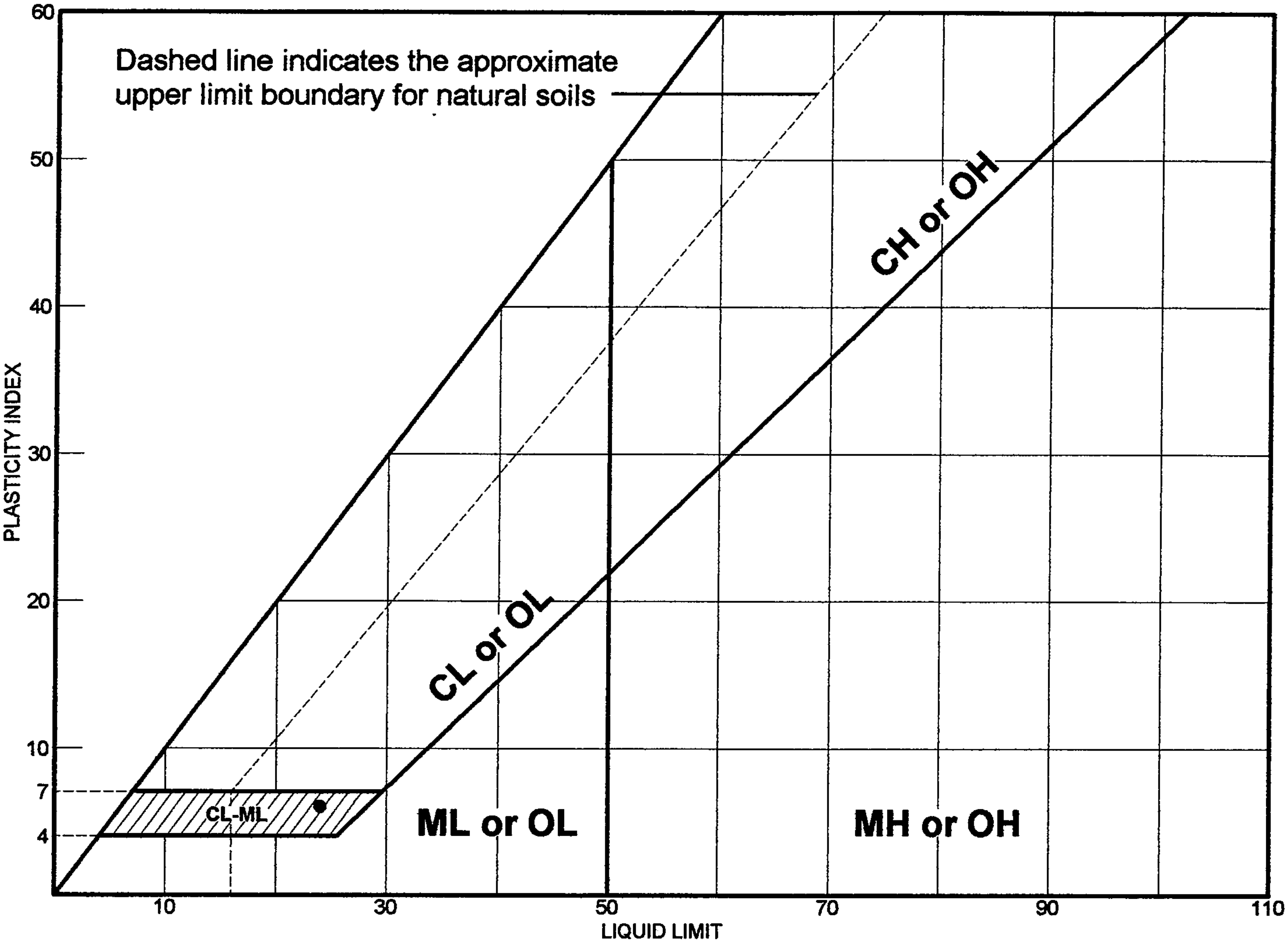
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 19

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sand, clayey, gravely, brown	24	18	6	74.3	41.6	SM

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** RF5-S1

Remarks:

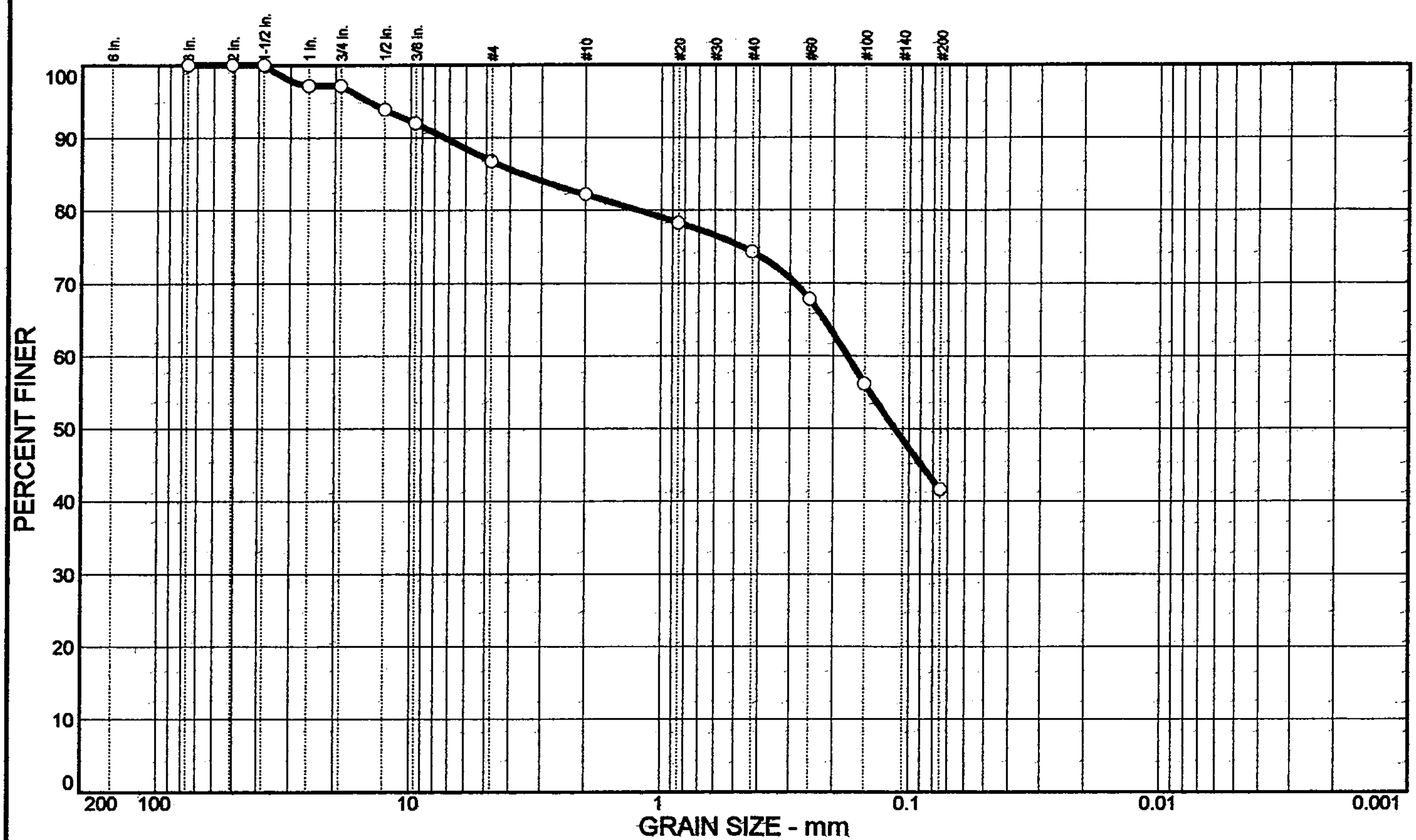
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 29

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		13.2	45.2			SM	A-4(0)		

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	97.2		
3/4	97.2		
1/2	93.9		
3/8	92.0		
	GRAIN SIZE		
D_{60}	0.176		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	86.8		
#10	82.2		
#20	78.3		
#40	74.3		
#60	67.8		
#100	56.2		
#200	41.6		

SOIL DESCRIPTION

○ Sand, clayey, gravely, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF5-S1

WESTERN COLORADO TESTING, INC.

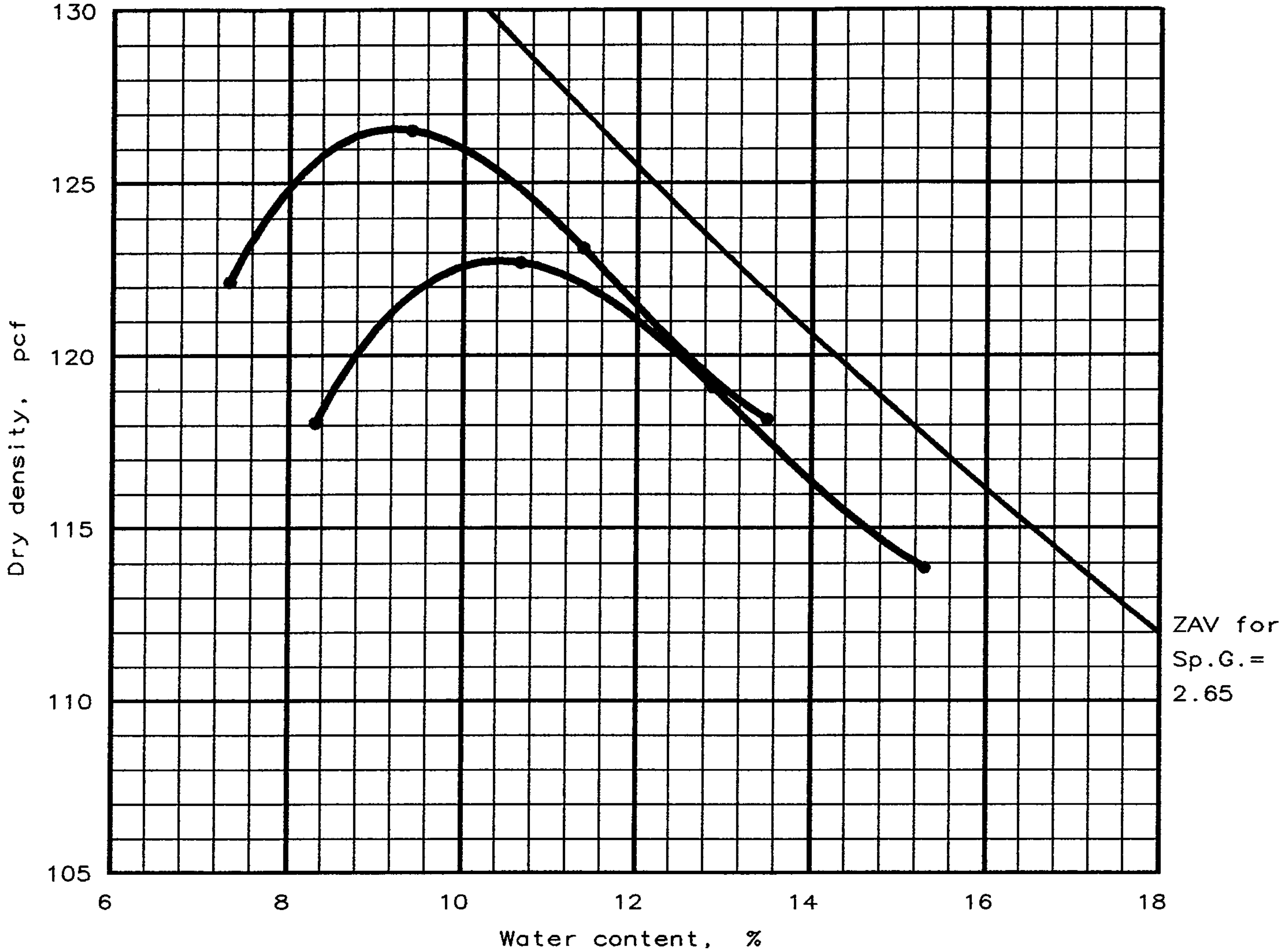
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 50

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure C, Standard

Oversize correction applied to each point

Elev/ Depth	Classification USCS	AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
			N/A %	2.65			11.7 %	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 126.6 pcf Optimum moisture = 9.2 %	122.8 pcf 10.4 %	RF6-S1 Sand, clayey, grvly, brn

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

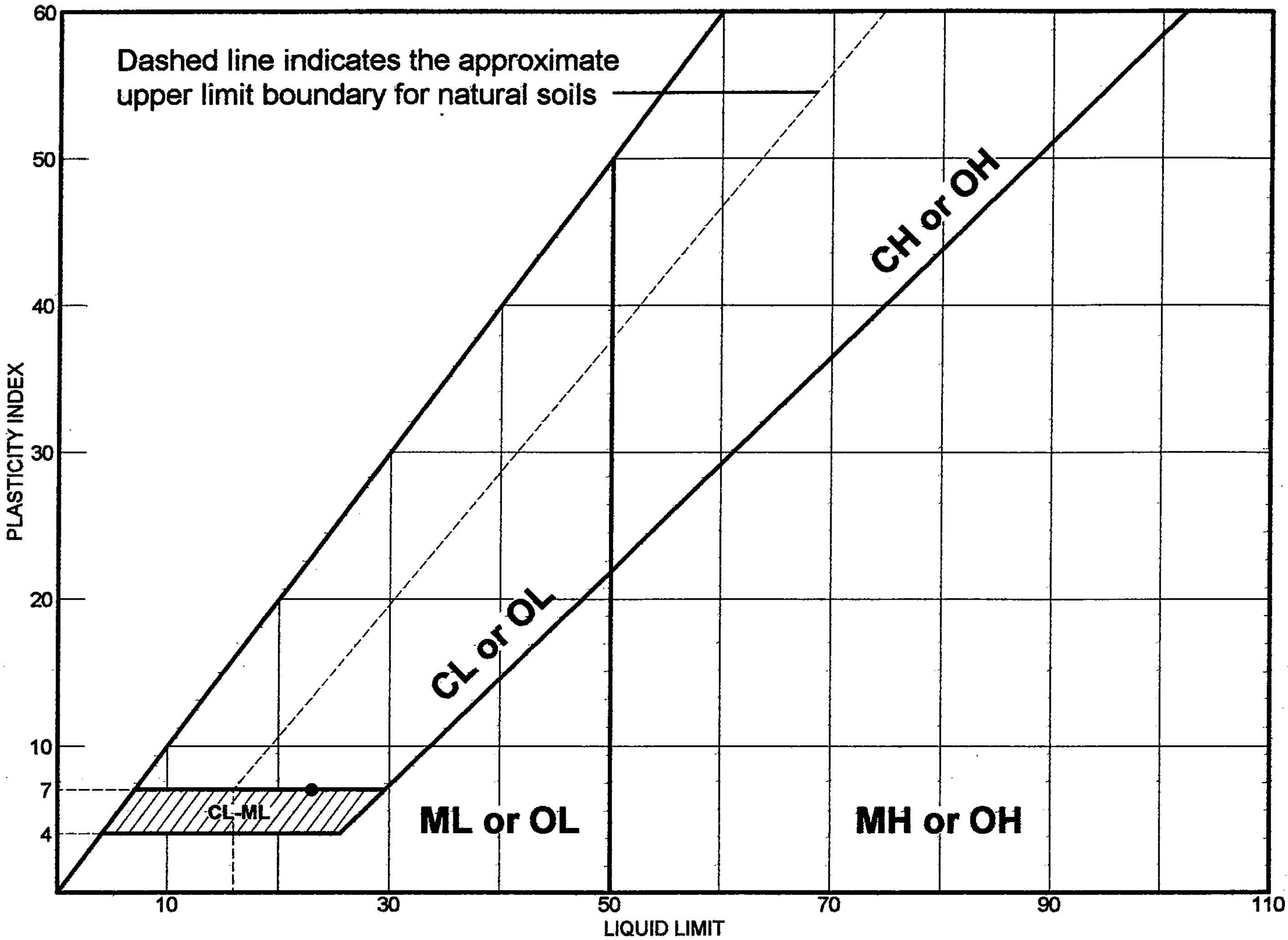
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 20

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sand, clayey, gravely, brown	23	16	7	53.0	30.6	GC-GM

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** RF6-S1

Remarks:

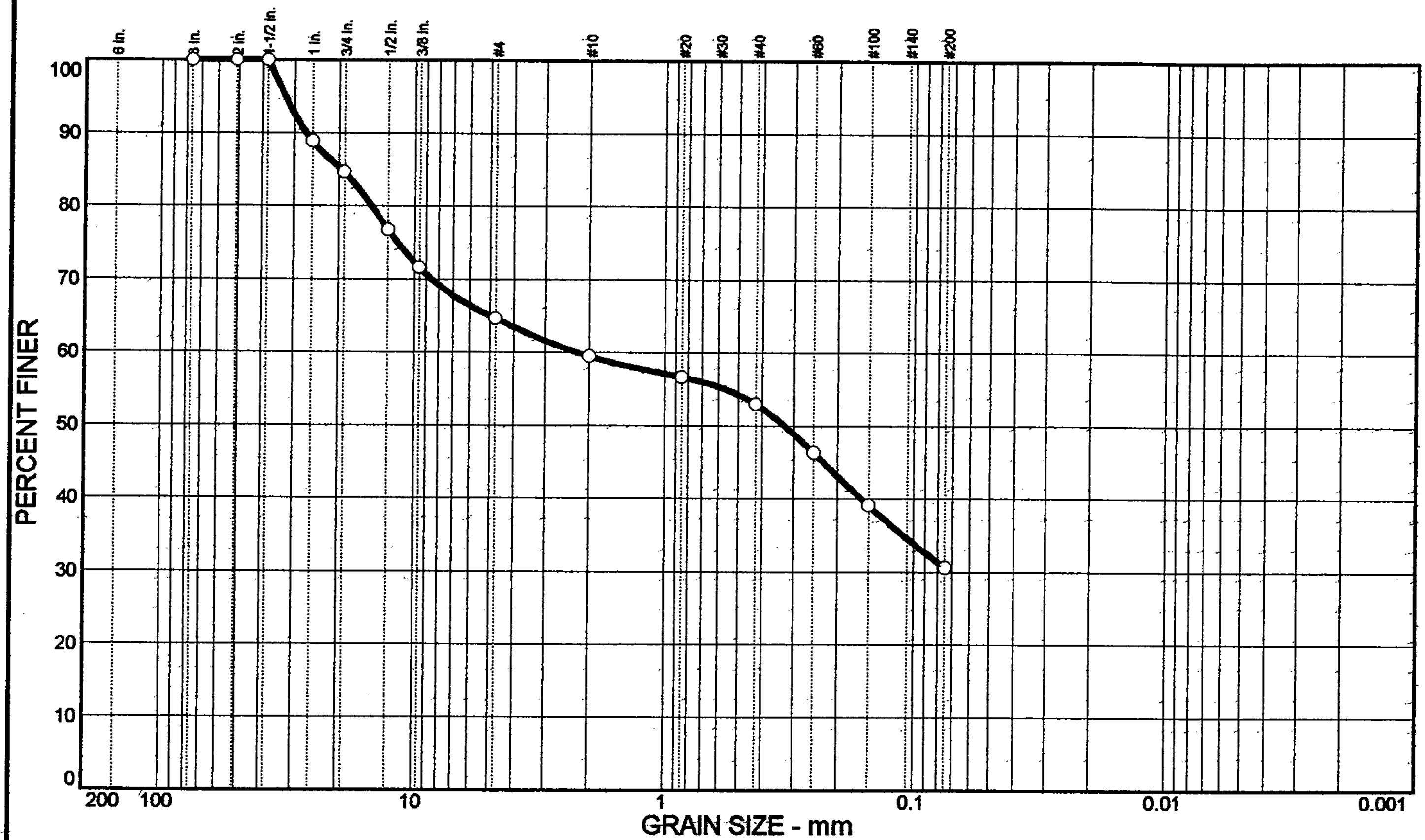
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 30

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		35.3	34.1			GC-GM	A-2-4(0)	16	23

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	88.9		
3/4	84.7		
1/2	76.8		
3/8	71.6		
	GRAIN SIZE		
D_{60}	2.23		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	64.7		
#10	59.5		
#20	56.7		
#40	53.0		
#60	46.4		
#100	39.1		
#200	30.6		

SOIL DESCRIPTION

○ Sand, clayey, gravely, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF6-S1

WESTERN COLORADO TESTING, INC.

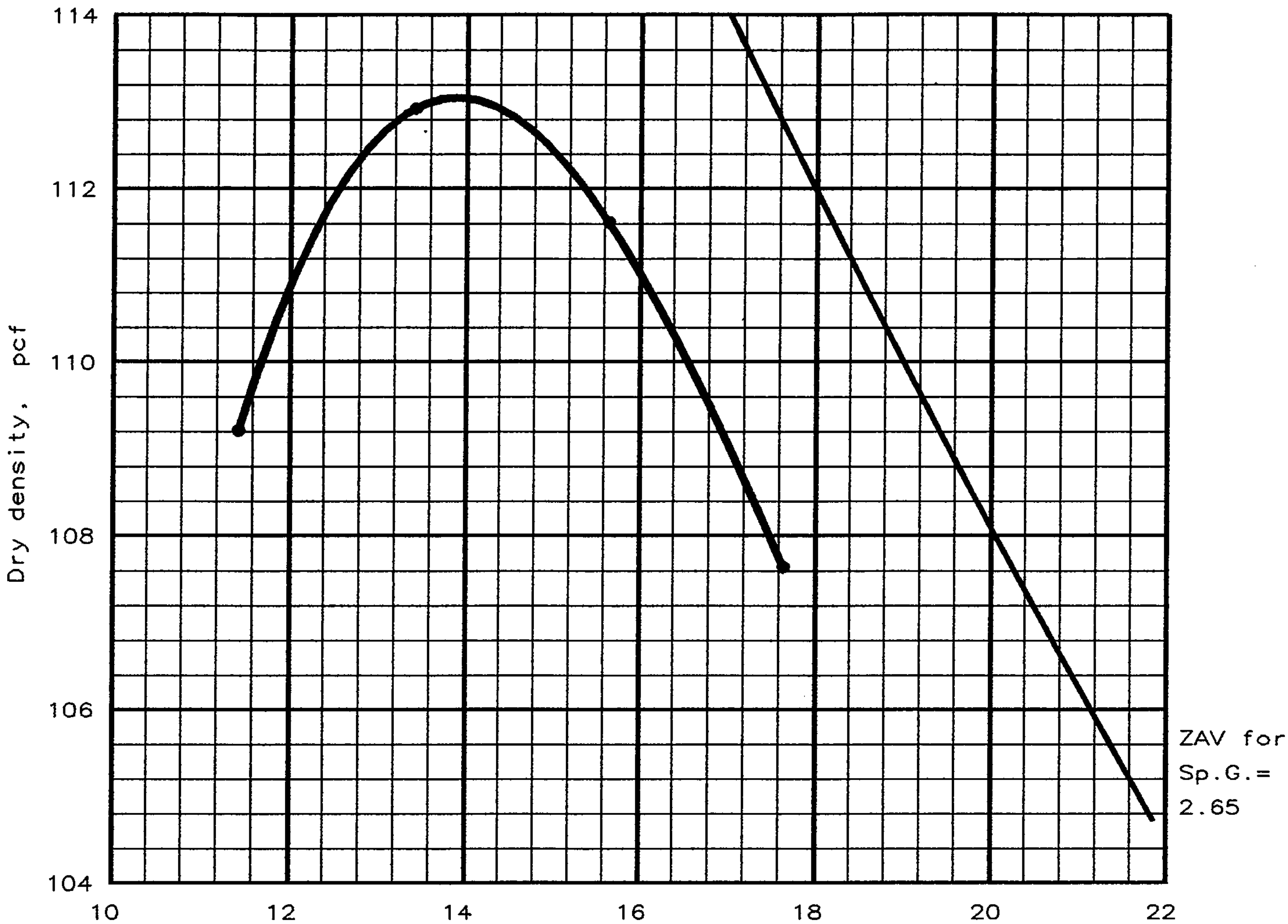
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 51

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 113.1 pcf	113.1 pcf	RF7-S1
Optimum moisture = 13.9 %	13.9 %	Clay, v sandy, silty, rd

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 5/3/99

Remarks:

SUBMITTED BY: Client

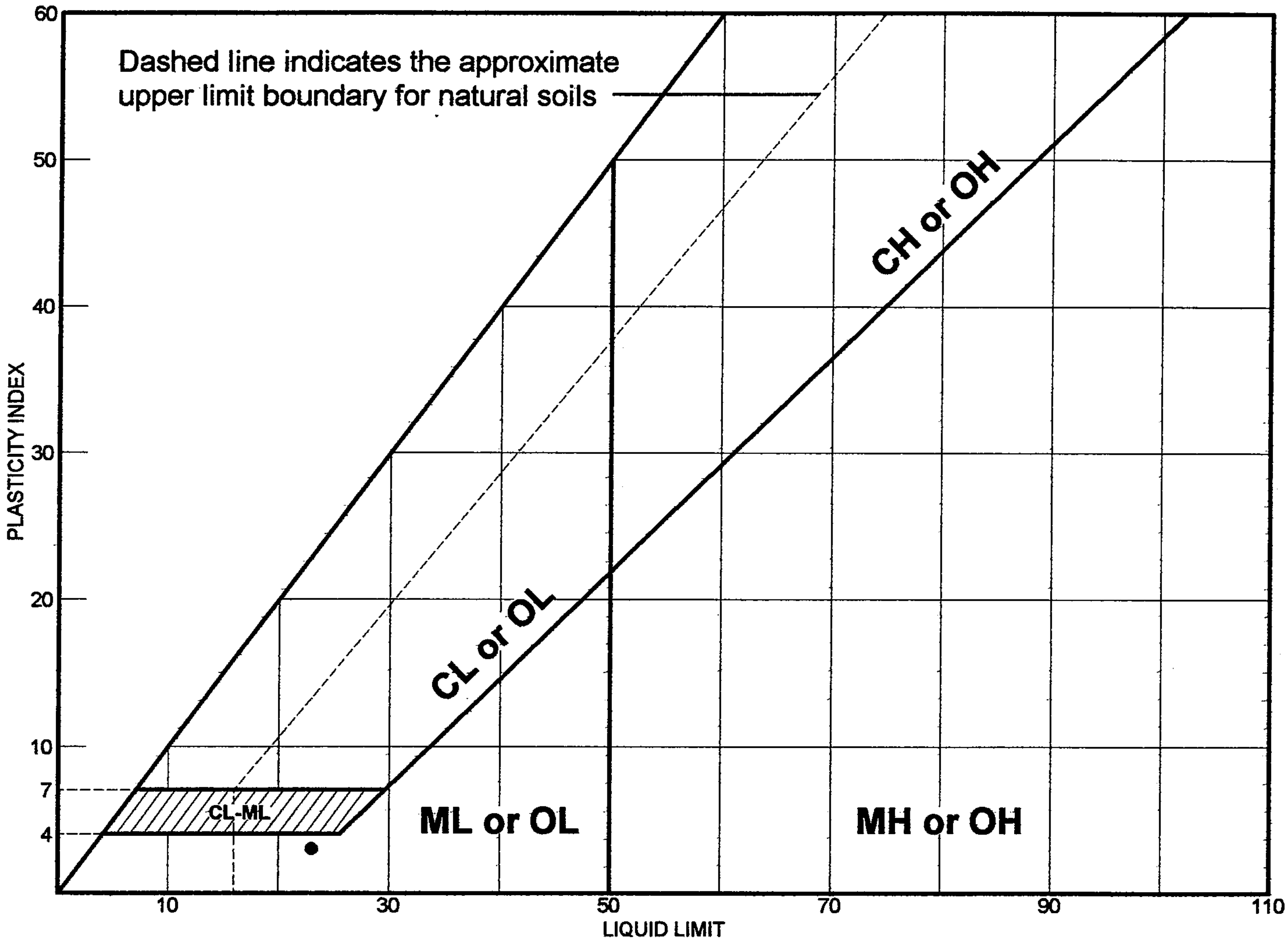
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 21

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clay, very sandy, silty, red	23	20	3	88.6	56.8	ML

Project No. 804899 **Client:** International Uranium Corporation

Project: Soil Sample Testing

● **Source:** **Sample No.:** RF7-S1

Remarks:
● Tested By: JH

LIQUID AND PLASTIC LIMITS TEST REPORT

WESTERN COLORADO TESTING, INC.

Figure 31

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		7.1	36.1			ML	A-4(0)	20	23

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	97.3		
1/2	95.9		
3/8	95.0		
	GRAIN SIZE		
D_{60}	0.0801		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	92.9		
#10	92.1		
#20	90.9		
#40	88.6		
#60	86.6		
#100	83.7		
#200	56.8		

SOIL DESCRIPTION

○ Clay, very sandy, silty, red

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: RF7-S1

WESTERN COLORADO TESTING, INC.	Client: International Uranium Corporation Project: Soil Sample Testing Project No.: 804899 Figure 52

ATTACHMENT E

EVALUATION OF POTENTIAL SETTLEMENT

DUE TO EARTHQUAKE-INDUCED LIQUEFACTION

AND

PROBABILISTIC SEISMIC RISK ASSESSMENT

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

INDEPENDENCE PLAZA

1050 17TH STREET, SUITE 950

DENVER, CO 80265

EVALUATION OF POTENTIAL SETTLEMENT DUE TO EARTHQUAKE-INDUCED LIQUEFACTION
INTERNATIONAL URANIUM CORPORATION, WHITE MESA MILL
5/6/99

An evaluation of potential settlement due to earthquake-induced liquefaction of tailings at International Uranium Corporation's White Mesa mill has been performed, and the results are reported below. This analysis applies to cells #2 and #3 and uses conditions of those cells that existed before May 1999, ore sieve analyses, calculated average in-place density, seismic analyses by Knight Piesold, and typical physical property values from the literature. Two analyses were performed using methods applied to the Maybell UMTRA site by Morrison-Knudsen Engineers (per information supplied by the NRC to IUC).

Method I is the Stress Ratio method of Takimatsu and Seed, 1987[1]. This method uses the SPT blow counts (N) as input for the analysis. No N values are available for the White Mesa tailings, so N values were estimated (see page 2 of calculations) using the grain size properties determined in recent tests by Western Colorado Testing Inc. and the average in-place density determined by IUC from volumetric calculations. The N values are conservatively estimated to range from 0 at ground surface to 8 at 35 feet depth, values consistent with very loose to loose fine grained (relative density 0 to 35), non-plastic soils according to Terzaghi et al, 1996[2], and NAVFAC DM-7, 1971[3]. According to KME's UMTRA Design Procedures, Chap. 11, App. 11B, Fig 11B-2, this is conservative because under field conditions the minimum relative density should be about 36%. For additional conservatism, it was assumed that the tailings are completely saturated below ground surface. The results of this calculation, tabulated on page A2, indicate that the maximum settlement should be about one foot in 35 feet of tailings and that most of that settlement originates in the upper 15 feet. According to Borns and Mattson, 1999[4], an earthen cover of the type used on tailings impoundments should not exhibit cracking in response to rapid settlement until differential settlement exceeds about 0.75%. At White Mesa, estimated differential settlements are not significant (less than 1%) over the tailing cell with the possible exception of the inslope areas where differential settlement, expressed as vertical feet of settlement over horizontal distance, could exceed 0.01 (1%) in the upper 5 feet and between 10 and 20 feet of the inslope depth. Differential settlements would be accommodated initially by plastic deformation of the cover, then by cracking, so not all of the differential

[1] Takimatsu, K. and H.B. Seed, 1987; "Evaluation of Settlements in Sands Due to Earthquake Shaking", Journal of Geotechnical Engineering, ASCE, Vol. 113, No. 8
[2] Terzaghi, k., R.B. Peck, and G. Mesri, 1996; *Soil Mechanics in Engineering Practice,* 3rd Edition, John Wiley & Sons
[3] Dept. Of Navy, Navy Facilities Engineering Command, 1971; Design Manual *Soil Mechanics, Foundations, and Earth Structures*, NAVFAC DM-7
[4] Borns, D. And E. Mattson, 1999, "Simulated Subsidence of the Monticello Cover", Sandia National Laboratories Draft Report, 3/10/99

settlement would be expressed by offset along fractures. However, if it is conservatively assumed that all differential settlement is expressed in fracture offset, then the largest offset would be about 0.175 feet (2.1 inches) about 30-45 feet from the top of the cell inslope. It is more likely that this differential settlement would result in some cover flexure or, at worst, several small fractures with offsets totaling not more than 2.1 inches.

The other method used for analysis, MKE's Method II, is from the Committee on Earthquake Engineering, 1985[5]. It is based on evaluating the shear strain in the tailings caused by an earthquake. It relies not on N values but on shear wave velocities and shear modulus/ maximum shear modulus ratio, both of which are estimated based on empirical data. This removes the effect of uncertainty associated with the lack of site-specific in-place tailings characterization. Using the same assumptions as in Method I, the estimated maximum settlement from liquefaction is 0.0581 feet, or 0.7 inches. The associated differential settlements are all well below the 0.75% threshold of concern for cracking of the cover.

The differences in settlement estimates of the two methods are substantial, about 17.5 times. However, the two estimates probably provide bounding limits for the range of likely liquefaction-induced settlement. If the Method I results are used, then the following consequences of the design earthquake liquefaction would be conservatively predicted:

maximum settlement - 1.015 feet in the deepest part of the cell, up to 0.4 feet along the cell margins over the inslope

maximum differential settlement - 2.7% within about 15 feet horizontal distance of the top of inslope, 1.2% to 0.8 % between 30 and 60 feet from top of inslope

impacts on cover - settlement of cover in response to tailing settlement, with maximum flexure over the upper half of the inslopes, where some cracking is possible with offsets less than two inches and probably less than one inch

[5] Committee on Earthquake Engineering, Commission on Engineering and Technical Systems, National Research Council, 1985; "Liquefaction of Soils During Earthquakes", National Academy Press

EVALUATION OF LIQUEFACTION POTENTIAL
WHITE MESA MILL TAILINGS

Tailing Samples Parameters
from tests by Western Colorado Testing Inc., April 1999

Sample #	USCS	LL	PI	Max. Dry Density pcf	Optimum Moisture %	% -#200
C2-ST1	SM	NP	NP	109.2	15.2	24.1
C2-TS2	ML	29	29	103.5	20.8	82.7
C2-TS3	SM	NP	NP	110.4	16.0	32.7
C2-TS4	SM	NP	NP	107.4	16.8	32.2
C3-TS1	ML	24	23	105.7	16.0	60.8
C3-TS2	SM	NP	NP	105.4	15.3	23.0
ave. for	SM	NP	NP	108.1	15.8	28.0
ave. for	ML	26.5	26	104.6	18.4	71.75

Seismic Parameters

Design Life	1000 yrs	from Knight Piesold (Julio Valera), 4/23/99
Return Period	10000 yrs	from Knight Piesold (Julio Valera), 4/23/99
Peak Horiz Acceler.	0.18g	from Knight Piesold (Julio Valera), 4/23/99
Seismic Coeff.	0.12g	(DOE, 1989, Technical Approach Document, Revision II, Uranium Mill Tailings Remedial Action Project)

Tailing In-place Characteristics

From mill screen analyses:

	Ore Blanding #4	Anchutz #1	Hanksville #2A	Hanksville #1	Average
% -#200	27.2	30.7	37.6	23.2	29.7

Ave. Dry Unit Wt. of all tailings, in pcf = 86.31 from IUC volumetric calcs.

From this value and ave. % -#200, ave. unit wts of sand and slimes would be:

Ave. pcf = 86.31 = SDpcf * .703 + SLpcf * .297

Parameters:

Tav = ave cyclic shear stress from earthquake, psi
P_o = total overburden pressure at depth considered, psi = (86.31+ n*62.4) * depth = (86.31+ 0.478*62.4) * depth = 116.1 pcf/ft *
P_o' = effective overburden pressure at depth considered, psi = P_o - depth * 62.4
r_d = stress reduction factor (1.0 at surface to 0.89 at 35') per Kovacs and Solomne, 1984
a_{max} = peak acceleration at ground surface = .18g
N_1 = SPT N value normalized to an effective overburden pressure of 1 tsf and effective energy delivered to drill rods of 60% of theoretical free-fall energy
= C_n * N
N = SPT N value
C_n = correction factor based on effective overburden pressure at depth of SPT count

Assumptions:

1) N values are assumed to increase with depth, from 1 to 8 (see page 3)
2) Tailings are saturated to ground surface

Estimation of N Values:

No SPT tests have been performed, so N values are estimated using physical properties of samples, average in-place dry density, and standard soil mechanics references.

1) From NAVFAC DM-7, Fig. 3-7, relative density ranges from 0 to 35% for SM to ML soil with dry density of 86.31 pcf, and corresponding N values range from 1 to 8 (Fig. 4-2).

2) From MKE UMTRA Design Procedures, Chap. 11, App. 11B, Fig.11B-2, minimum relative density under field conditions is about 36%, corresponding to N_1 = 0,and maximum relative density (100%) corresponds to N_1 of about 47.

3) Based on 1 and 2 above, it is reasonable to estimate that the relative density of the SM/ ML tailings in-place is at least 35% and that the N values range from 1 at the surface to 8 at 35 feet depth.

N_1 = C_n * N

N_1 = corrected SPT value
N = recorded SPT value
C_n = correction coeff.
= 0.77 log10 (20/(P_o'/2000))

z	N	P_o'	C_n	N_1
5	1	269	1.67	1.67
10	2	537	1.44	2.88
15	3	806	1.31	3.92
20	4	1074	1.21	4.84
25	5	1343	1.14	5.68
30	6	1611	1.07	6.44
35	8	1880	1.02	8.18

Calculation of Settlement:

shear stress ratio Tav/P_o' = 0.65 * (a_{max}/g) * (P_o/P_o') * r_d

Depth, z ft	N_1	P_o psf	P_o' psf	P_o/P_o'	r_d	Tav/P_o'	Vol. strain % (1)	Thickness of Layer, ft	Settlement ft
5	1.67	581	269	2.162	1	0.2530	8	5	0.4
10	2.88	1161	537	2.162	0.98	0.2479	5	10	0.5
15	3.92	1742	806	2.162	0.96	0.2428	4.5	15	0.675
20	4.84	2322	1074	2.162	0.95	0.2403	4	20	0.8
25	5.68	2903	1343	2.162	0.93	0.2352	3.6	25	0.9
30	6.44	3483	1611	2.162	0.92	0.2327	3.2	30	0.96
35	8.18	4064	1880	2.162	0.89	0.2251	2.9	35	1.015

(1) from Fig 6, Tokimatsu and Seed, 1987

Differential Settlements over Cell Inslopes:

Slopes are 3H:1V

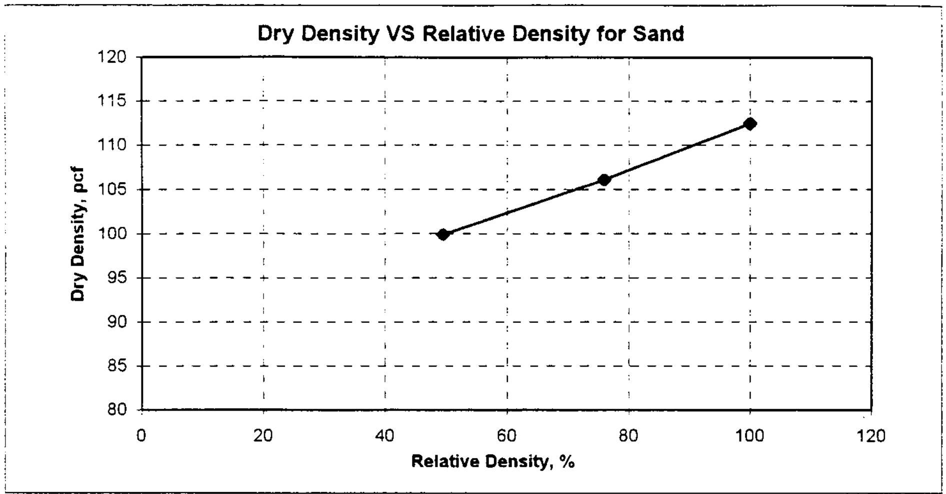
Horizontal Distance over slope ft.	Depth of Tailings over slope ft.	Settlement ft.	Differential Settlement, vertical ft./ horizontal ft.
15	5	0.4	0.027
30	10	0.5	0.007
45	15	0.675	0.012
60	20	0.8	0.008
75	25	0.9	0.007
90	30	0.96	0.004
105	35	1.015	0.004

CORRELATION BETWEEN RELATIVE DENSITY AND ABSOLUTE DRY DENSITY OF SANDS

By AKK
5/6/99

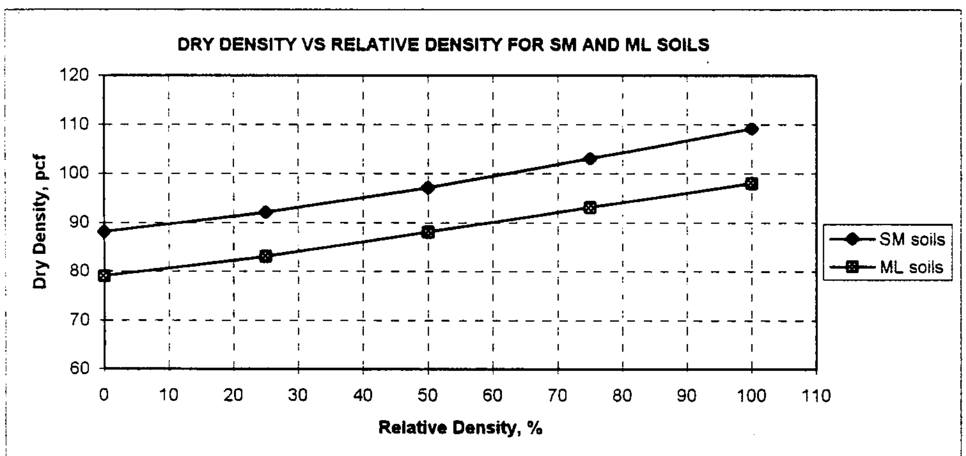
after Terzaghi et al, 1996; Fig 44.1

Relative Density	Dry Density	
	pcf	Mg/m^3
49.5	99.89	1.6
76	106.1	1.7
100	112.4	1.8



after NAVFAC DM-7, 1971, Fig. 3-7

Relative Density, %	Dry Density,pcf SM soils	Dry Density,pcf ML soils
0	88	79
25	92	83
50	97	88
75	103	93
100	109	98



Based on these relationships, the average dry density of 86.31 pcf corresponds to relative density in the 0% to 40% range, depending on the amount of silt vs sand. Therefore, N values would range from 1 at ground surface to 8 at depths of 35-40 ft.

Parameters:

T	= peak shear stress from earthquake, psi
P_o	= total overburden pressure at depth considered, psi = =w*z
r_d	= stress reduction factor (1.0 at surface to 0.9 at 30', 0.8 at 40')
S	= strain
g	= acceleration of gravity, ft/sec/sec
a	= peak acceleration at ground surface = 0.18g
w	= unit weight, pcf
z	= depth, ft.
d	= mass density
G	= shear modulus
G/G_{max}	= modulus reduction factor for strain
V_s	= shear wave velocity, fps
pr	= Poisson's ratio
E_A	= axial strain
h	= thickness of layer, ft.
dh	= settlement in layer, ft.

Assumptions:

1) Tailings are saturated to ground surface
2) $G/G_{max} = 0.80$
3) V_s = 3000 fps, per Committee on Earthquake Engineering, 1985
4) pr = 0.5
5) Shear wave travels path that is 45 degrees from vertical, so $E_{lateral} = pr * E_A$

Calculations:

$S = T/G = ((a/g)*P_o*r_d)/G = ((a/g)*(w*z)*r_d)/G = a*z*(w/g)*r_d/G$

$G_{max} = d*V_s^2 = (w/g)*V_s^2$

$d = G_{max}/V_s^2 = w/g$

$S = a*z*d*r_d/G = a*z*(G_{max}/V_s^2)*r_d/G = a*z*r_d/(V_s^2*(G/Gmax))$

$= a*z*r_d/(V_s^2*0.80) = 1.25*a*z*r_d/V_s^2 = 1.25*a*z*r_d/(300)^2$

$= 1.25*(0.18*32.2)*z*r_d/90000 = 1.25*(0.18*32.2)*z*r_d/90000$

$S = 0.0000805*z*r_d$

r_d = 1.0 at surface to 0.9 at 30', 0.8 at 40' (Kovacs and Solomne, 1984)

$E_A = S/(1+pr) = dh/h = 0.00008*z*r_d/1.5$

$dh = 0.00008*z*r_d*h/1.5$

Settlements:

Depth, z ft	r_d	Thickness of Layer, h, ft	Strain S	Axial Strain E_A	Settlement dh, ft
5	1	5	0.0004	0.00027	0.0013
10	0.98	10	0.0008	0.00052	0.0052
15	0.96	15	0.0012	0.00077	0.0115
20	0.95	20	0.0015	0.00101	0.0203
25	0.93	25	0.0019	0.00124	0.0310
30	0.92	30	0.0022	0.00147	0.0442
35	0.89	35	0.0025	0.00166	0.0581

Differential Settlements over Cell Inslopes:

Slopes are 3H:1V

Horizontal Distance over slope ft.	Depth of Tailings over slope ft.	Settlement ft.	Differential Settlement, vertical ft./ horizontal ft.
15	5	0.0013	0.0001
30	10	0.0052	0.0003
45	15	0.0115	0.0004
60	20	0.0203	0.0006
75	25	0.0310	0.0007
90	30	0.0442	0.0009
105	35	0.0581	0.0009

Memorandum

Date: April 23, 1999 International Uranium Corporation

To: Mr. Harold R. Roberts

From: Julio E. Valera

Re: **Probabilistic Seismic Risk Assessment**

As stipulated by the Nuclear Regulatory Commission (NRC) in their *"Draft Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites under Title II of the Uranium Mill Tailings Radiation Control Act"*, (UMTRCA) - NUREG-1620, a probabilistic seismic hazard analysis (PSHA) may be considered as an acceptable method to a deterministic maximum credible earthquake (MCE) analysis for establishing the peak horizontal acceleration (PHA) for a site.

The NRC draft standard (Section 1.4) states the following: *"An exceedance value no greater than 10^{-4} per year should be used in determining the PHA for the site. This 10^{-4} value represents a 1 in 10 chance of the site exceeding the PHA in a 1,000-year period, which is appropriate for a 1,000 -year design life"*. Based on this understanding, Knight Piésold has performed a simplified seismic risk assessment for IUC's White Horse Mesa Uranium Mill Tailings Facility to establish the probabilistic PHA for the site. The simplified PSHA has made use of probabilistic seismic hazards maps recently developed for the contiguous USA as part of a joint effort by the Federal Emergency Management Agency (FEMA), and the U. S. Geological Survey (USGS) to develop new maps for use in seismic design. A detailed description of the development of the maps is contained in the USGS Open-File Report 96-532, National Seismic Hazards Maps: Documentation, June 1996 by Frankel et al. (1996). The maps provide probabilistic ground motion design parameters with 2%, 5% and 10% probabilities of exceedance in 50 years, corresponding to recurrence intervals of 475, 975 and 2500 years, respectively. The maps were developed using a soft-rock site as the reference site condition which is reasonably representative of the conditions at White Horse Mesa mill site. A probability of exceedance of 10% for a 1,000 year design life as stipulated by the NRC corresponds to a recurrence interval of 10,000 years. A similar probability of exceedance for a 200 year design life corresponds to an earthquake recurrence interval of 2000 years.

The latitude and longitude for the White Horse Mill are 37^0 35' N, and 109^0 30' W, respectively. Using these coordinates, values of PHA were obtained from the USGS seismic hazards maps at the three recurrence intervals previously mentioned. These are plotted in the accompanying figure versus return period. A best-fit straight line and curve were fitted to the data to extrapolate to larger return periods. The following PHA values were obtained for the White Horse Mesa Mill site:

Design Life (yrs)	Return Period (yrs)	PHA (g)
200	2,000	0.11
1,000	10,000	0.18

Thus based on extrapolation of the USGS data, a PHA equal to 0.18g would correspond to the 10,000 year event for the site.

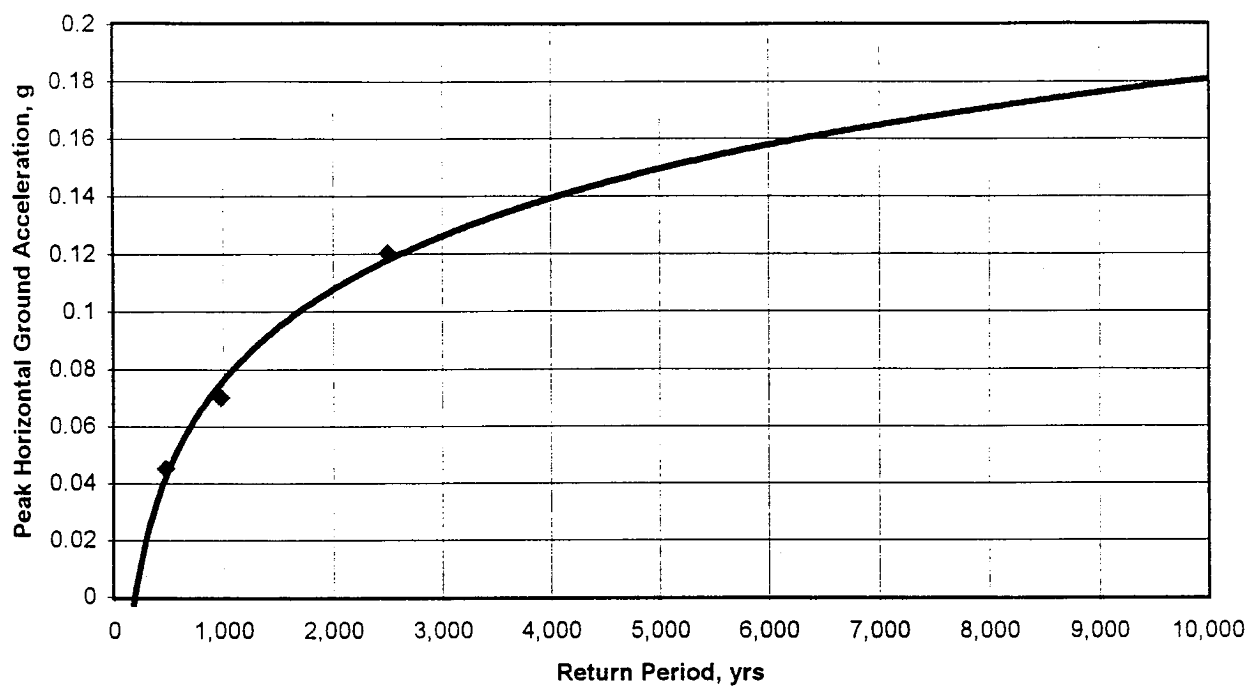
In Section 1.4.3 of NUREG-1620 the NRC states that in order *"to assess potential site ground motion from earthquakes not associated with known tectonic structures (i.e., random or floating earthquakes), the largest floating earthquake reasonably expected within the tectonic province (no smaller than magnitude 6.2) should be identified"*. They also state that a site-to-source distance of 15 km should be used for floating earthquakes within the host tectonic province in a dterministic analysis.

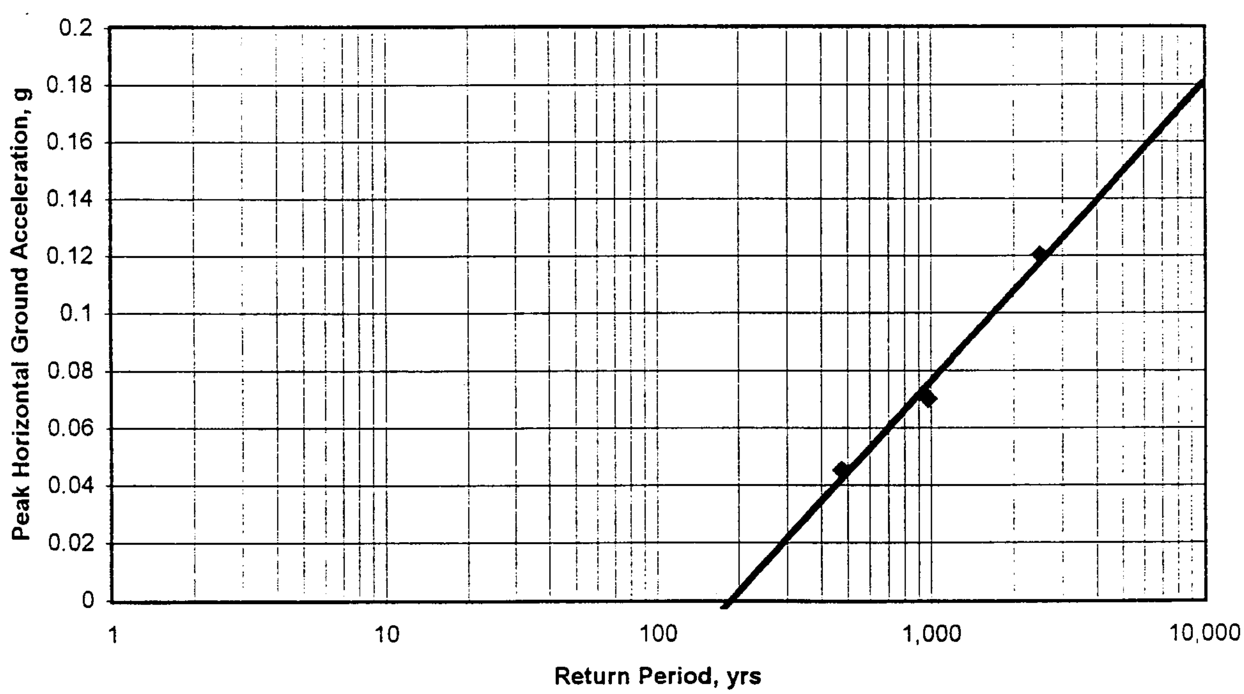
In addition to the PHA, it is necessary to establish the magnitude of the corresponding earthquake in order to conduct a liquefaction assessment of the tailings impoundment. An estimate of this magnitude was obtained using the acceleration attenuation relationship developed by Campbell and Bozorgnia (1994) which is considered by the NRC as an acceptable relationship. The attenuationship relationship used for this study assumed strike-slip faulting and soft rock site conditions. A site-to-source distance of 15 km was also used with a PHA of 0.18g to establish the corresponding magnitude. By coincidence a magnitude of 6.2 was obtained.

Thus based on this simplified seismic risk assessment, a magnitude 6.2 earthquake producing a PHA of 0.18g at the mill site represents the 10,000 year event which has a 10% probability of exceedance during a mine life of 1000 years.

White Mesa
Ground accelerations from Frankel et al. (1996)

return period, yrs	accel.
475	0.045
975	0.07
2500	0.12





White Mesa Mill - Soil Testing, tailings samples

WESTERN COLORADO TESTING, INC.
529 25 1/2 Road, Suite B-101
Grand Junction, Colorado 81505
(970) 241-7700 • Fax (970) 241-7783

May 4, 1999
WCT #804899

International Uranium USA Corporation
Independence Plaza, Suite 950
1050 17th Street
Denver, Colorado 80265

Subject: Soil Sample Testing

As requested, we have completed the soil laboratory work for International Uranium USA Corporation. The testing performed included the following:

21 Sieve Analyses
21 Atterberg Limit Tests
21 Standard Proctor Tests (ASTM D698)
6 Hydrometer Tests
6 Specific Gravity Tests

Data sheets are included for each test except for the specific gravities. The results of these are shown below:

Sample	Avg. Bulk Specific Gravity	Avg. Bulk Specific Gravity (SSD)	Apparent Specific Gravity	Absorption Percent
C2 - TS1	2.337	2.468	2.673	5.372
C2 - TS2	2.137	2.392	2.868	11.926
C2 - TS3	2.157	2.359	2.705	9.396
C2 - TS4	2.265	2.432	2.721	7.402
C3 - TS1	2.456	2.562	2.746	4.294
C3 - TS2	2.349	2.464	2.655	4.900

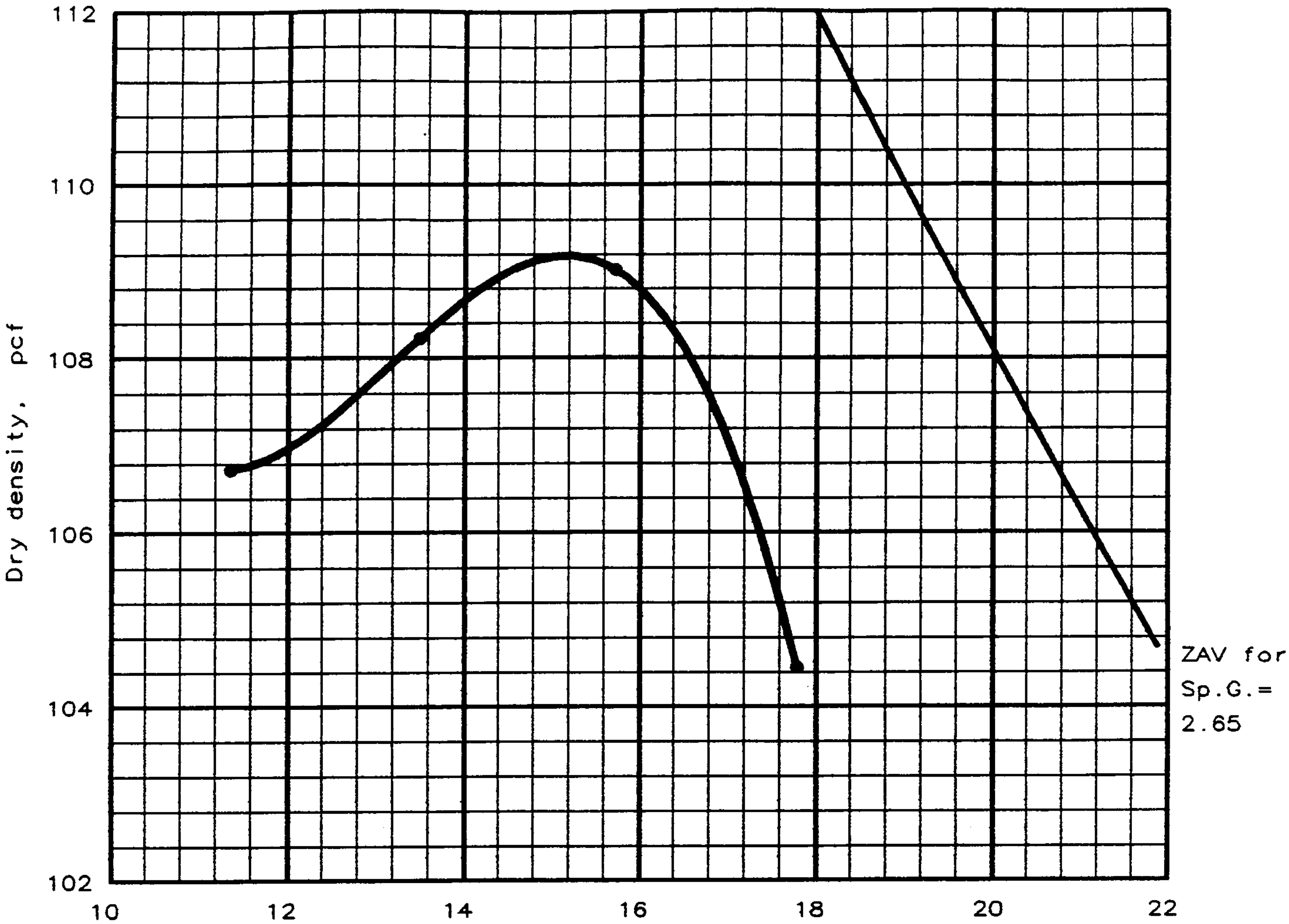
We have been happy to be of service. If you have any questions or we may be of further assistance, please call.

Respectfully Submitted:
WESTERN COLORADO TESTING, INC.

Wm. Daniel Smith, P.E.
Senior Geotechnical Engineer

WDS/mh
Msb:jobs\8048L0504

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 109.2 pcf Optimum moisture = 15.2 %	109.2 pcf 15.2 %	C2-ST1

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 4/27/99

Remarks:

SUBMITTED BY: Client

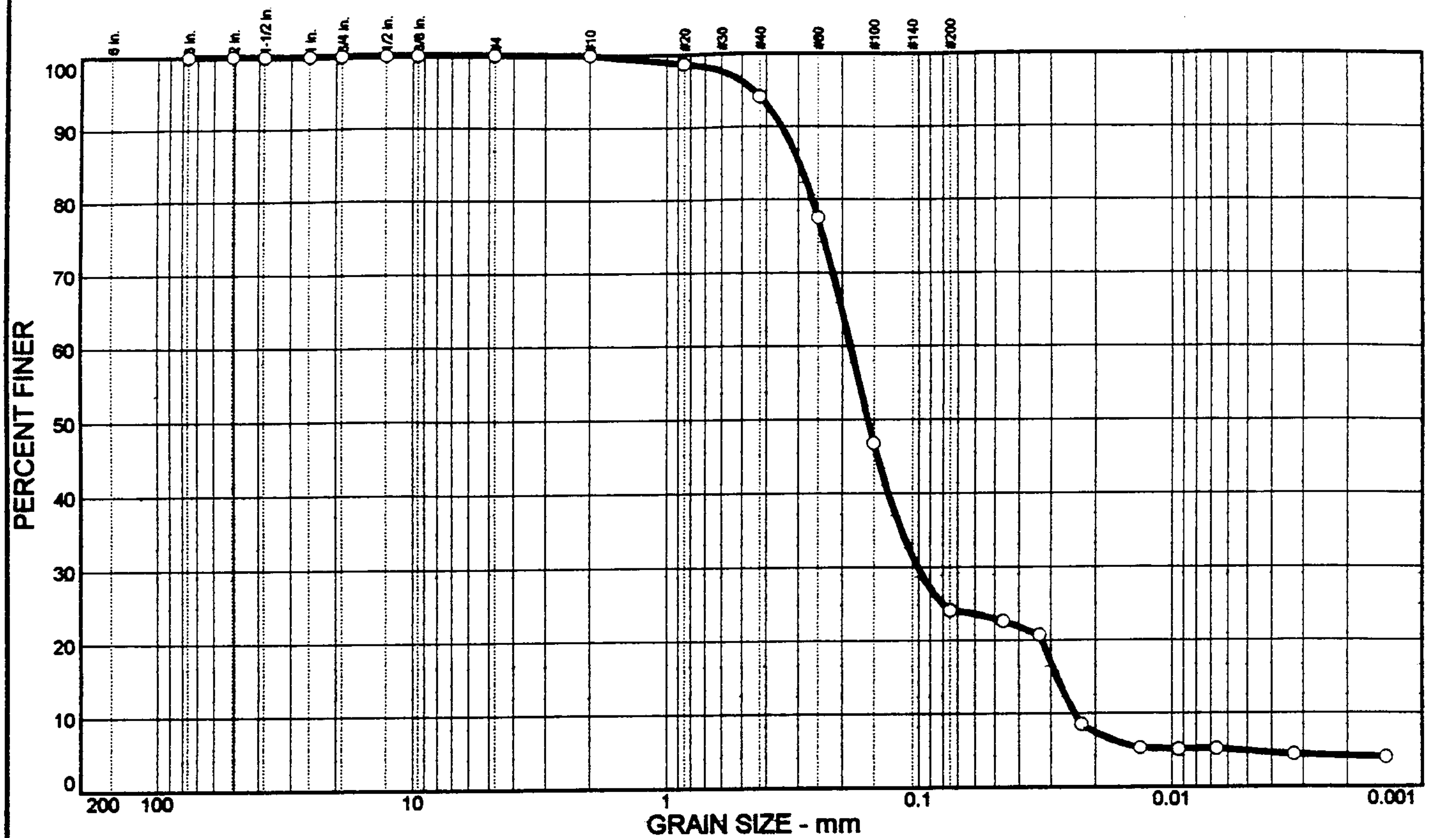
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 1

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.0	75.9	19.3	4.8	SM	A-2-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}	0.186		
D_{30}	0.100		
D_{10}	0.0241		
	COEFFICIENTS		
C_c	2.25		
C_u	7.74		

SIEVE number size	PERCENT FINER ○		
#4	100.0		
#10	100.0		
#20	98.7		
#40	94.1		
#60	77.5		
#100	46.8		
#200	24.1		

SOIL DESCRIPTION

○ Sand, silty, gray/brown

REMARKS:

○ Tested by: JH

○ Source:

Sample No.: C2-ST1

WESTERN COLORADO TESTING, INC.

Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 32

MOISTURE-DENSITY RELATIONSHIP TEST

Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 103.5 pcf Optimum moisture = 20.8 %	103.5 pcf 20.8 %	C2-TS2

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 4/27/99

Remarks:

SUBMITTED BY: Client

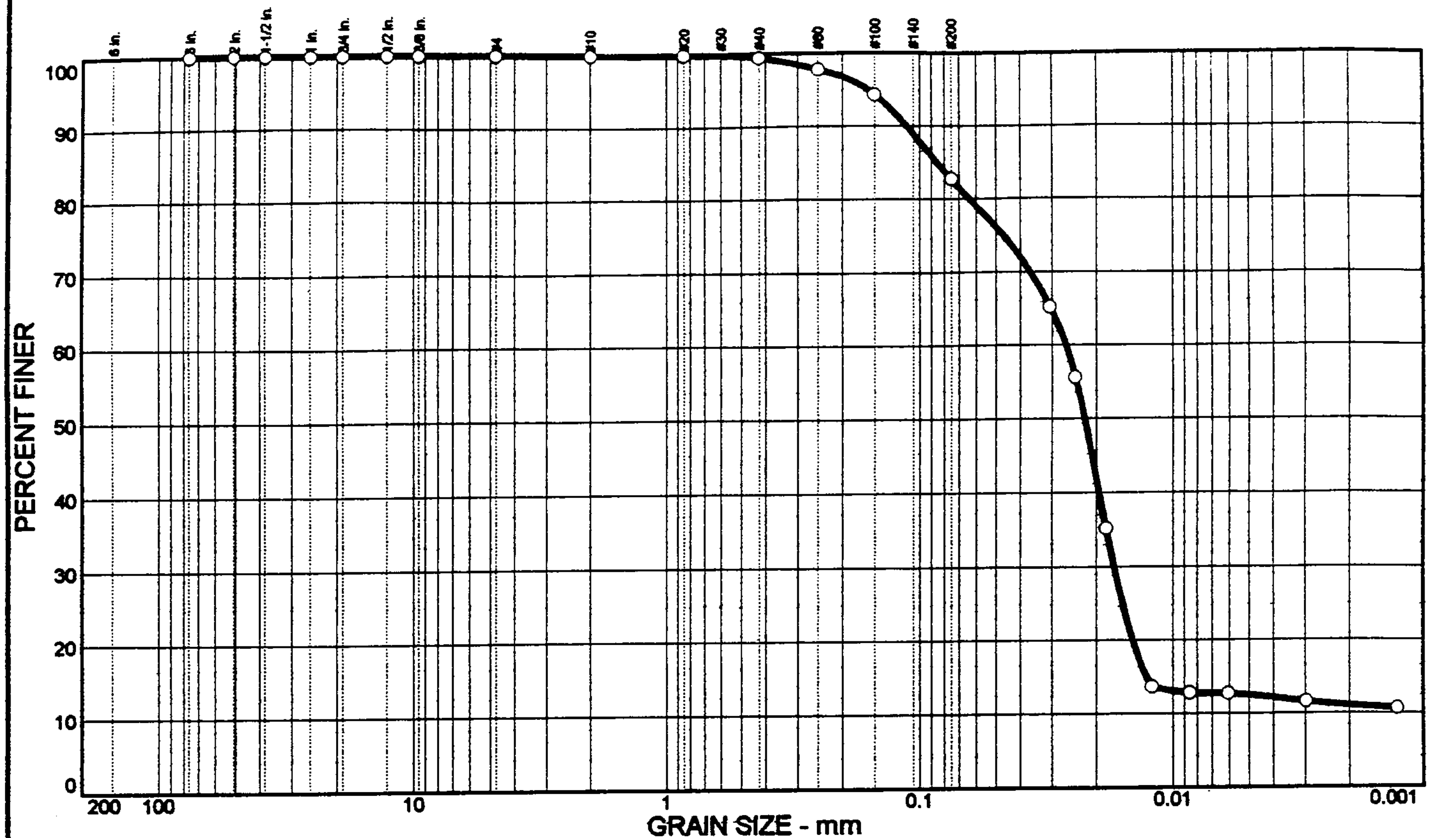
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 2

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.0	17.3	70.2	12.5	ML	A-4(0)	29	29

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}	0.0264		
D_{30}	0.0170		
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.4		
#60	97.8		
#100	94.3		
#200	82.7		

SOIL DESCRIPTION

○ Silt, clayey, sandy, gray

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: C2-TS2

WESTERN COLORADO TESTING, INC.

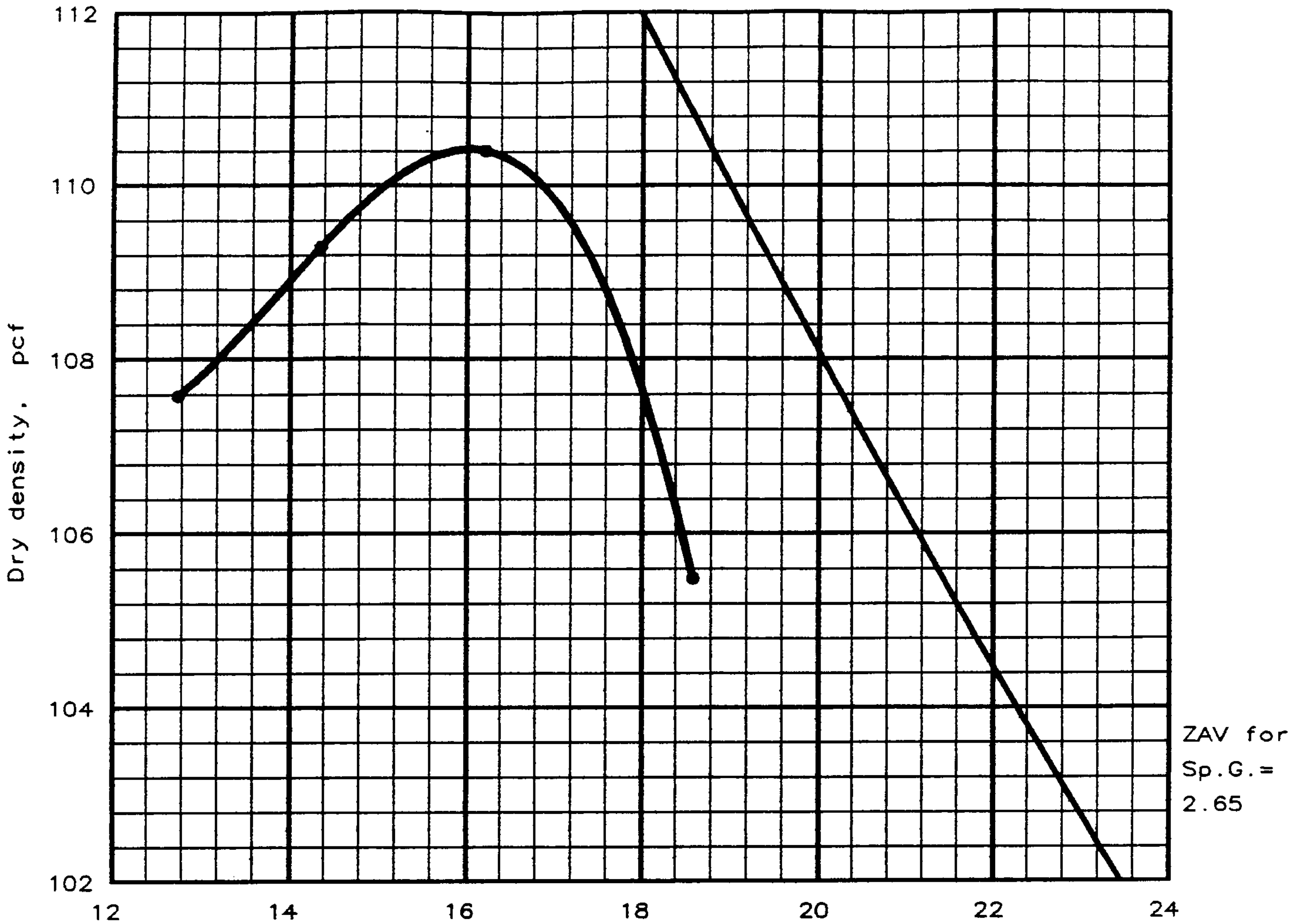
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 33

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 110.4 pcf Optimum moisture = 16.0 %	110.4 pcf 16.0 %	C2-TS3

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 4/27/99

Remarks:

SUBMITTED BY: Client

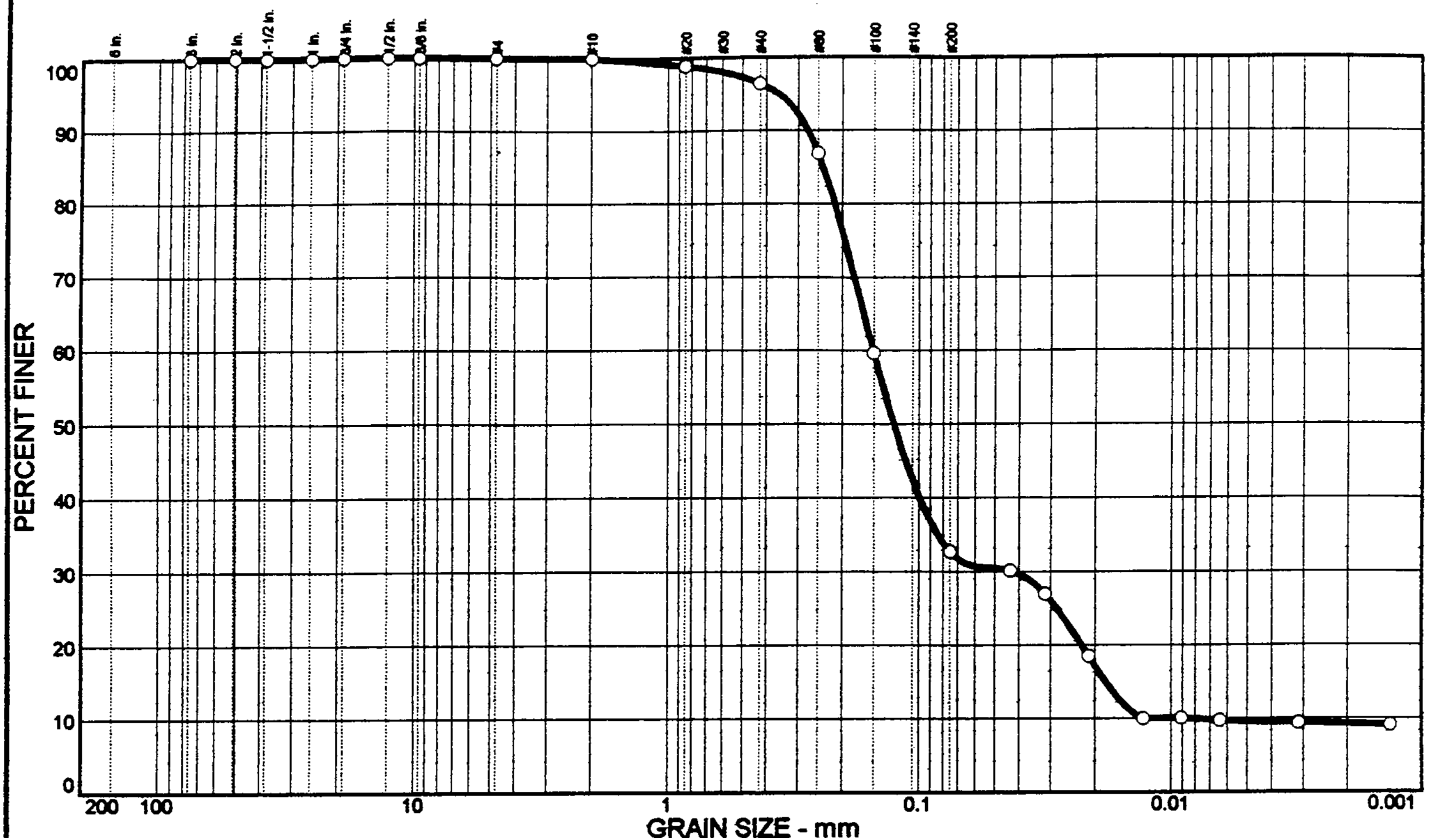
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 3

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.0	67.3	23.2	9.5	SM	A-2-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}	0.151		
D_{30}	0.0425		
D_{10}	0.0084		
	COEFFICIENTS		
C_c	1.42		
C_u	18.03		

SIEVE number size	PERCENT FINER ○		
#4	100.0		
#10	100.0		
#20	98.9		
#40	96.4		
#60	86.9		
#100	59.6		
#200	32.7		

SOIL DESCRIPTION

○ Sand, silty, gray/brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: C2-TS3

WESTERN COLORADO TESTING, INC.

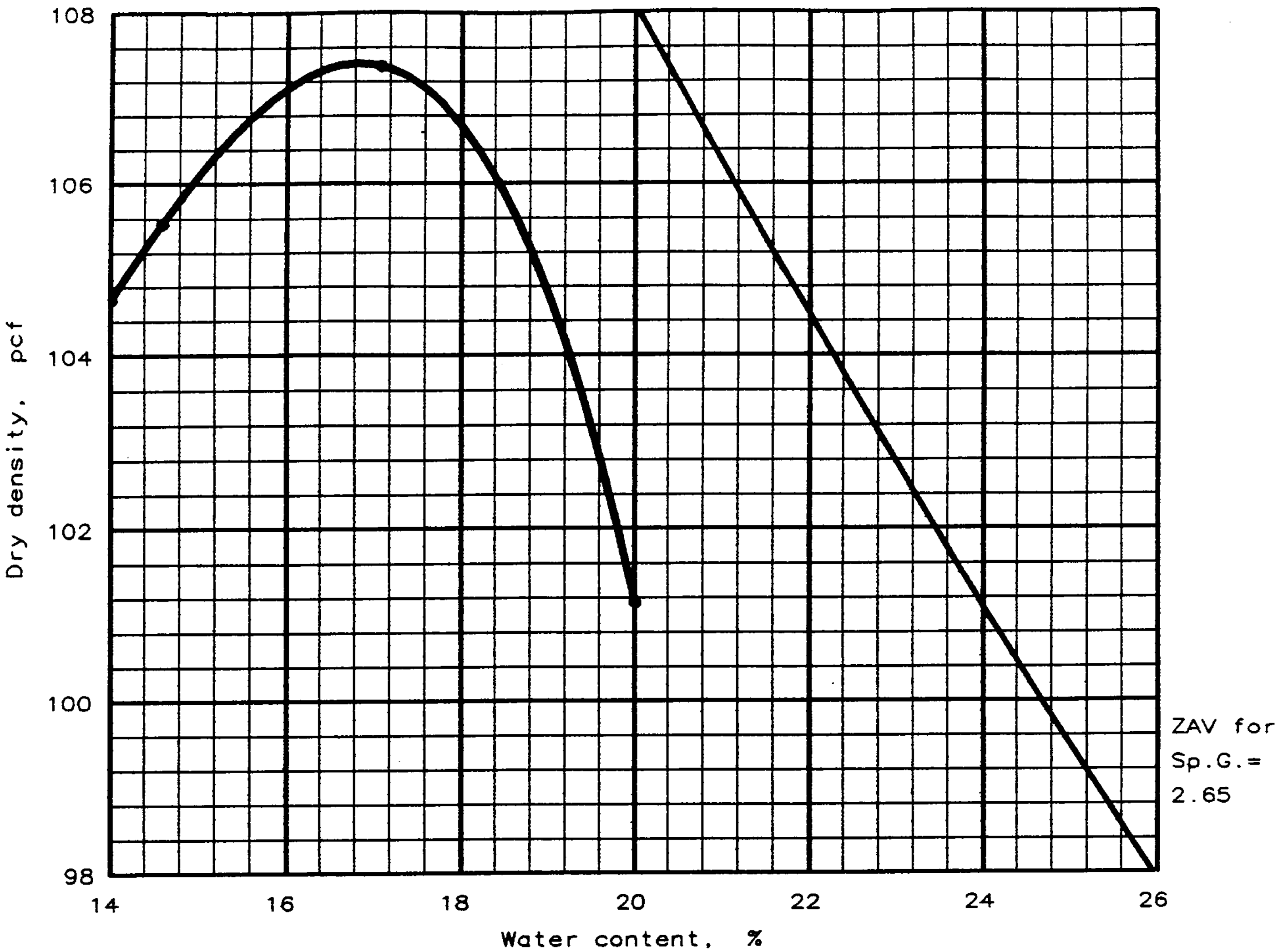
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 34

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 107.4 pcf Optimum moisture = 16.8 %	107.4 pcf 16.8 %	C2-TS4

Project No.: 804899
Project: International Uranium Corporation
Location: Soil Sample Testing

Date: 4/27/99

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

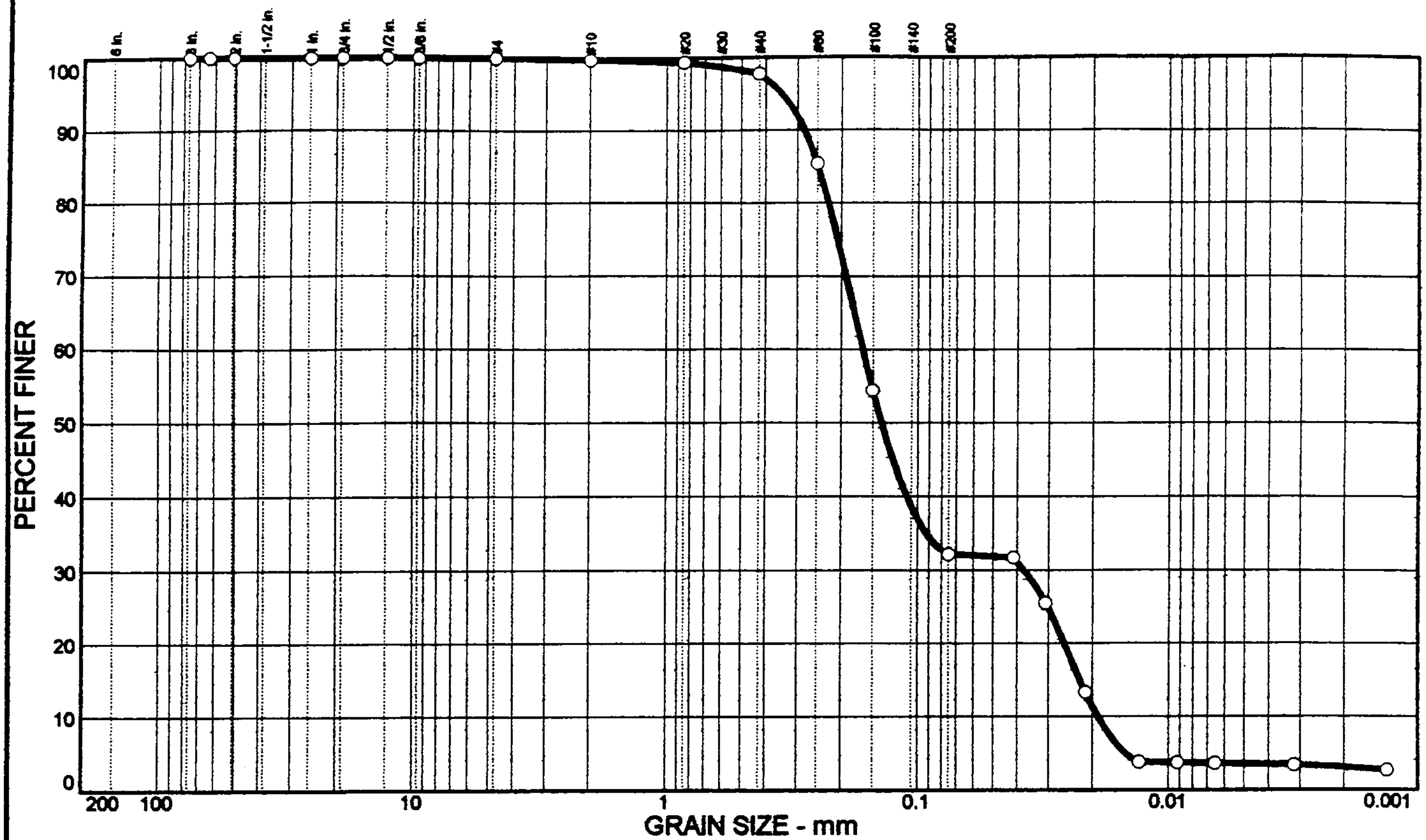
Remarks:

SUBMITTED BY: Client

TESTED BY: JH

Fig. No. 4

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
O		0.0	67.8	28.7	3.5	SM	A-2-4(0)	NP	NP

SIEVE inches size	PERCENT FINER O		
3	100.0		
2.5	100.0		
2	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}	0.164		
D_{30}	0.0376		
D_{10}	0.0189		
	COEFFICIENTS		
C_c	0.45		
C_u	8.69		

SIEVE number size	PERCENT FINER O		
#4	100.0		
#10	99.8		
#20	99.4		
#40	97.8		
#60	85.4		
#100	54.4		
#200	32.2		

SOIL DESCRIPTION

O Sand, silty, gray/brown

REMARKS:

O Tested By: JH

O Source:

Sample No.: C2-TS4

WESTERN COLORADO TESTING, INC.

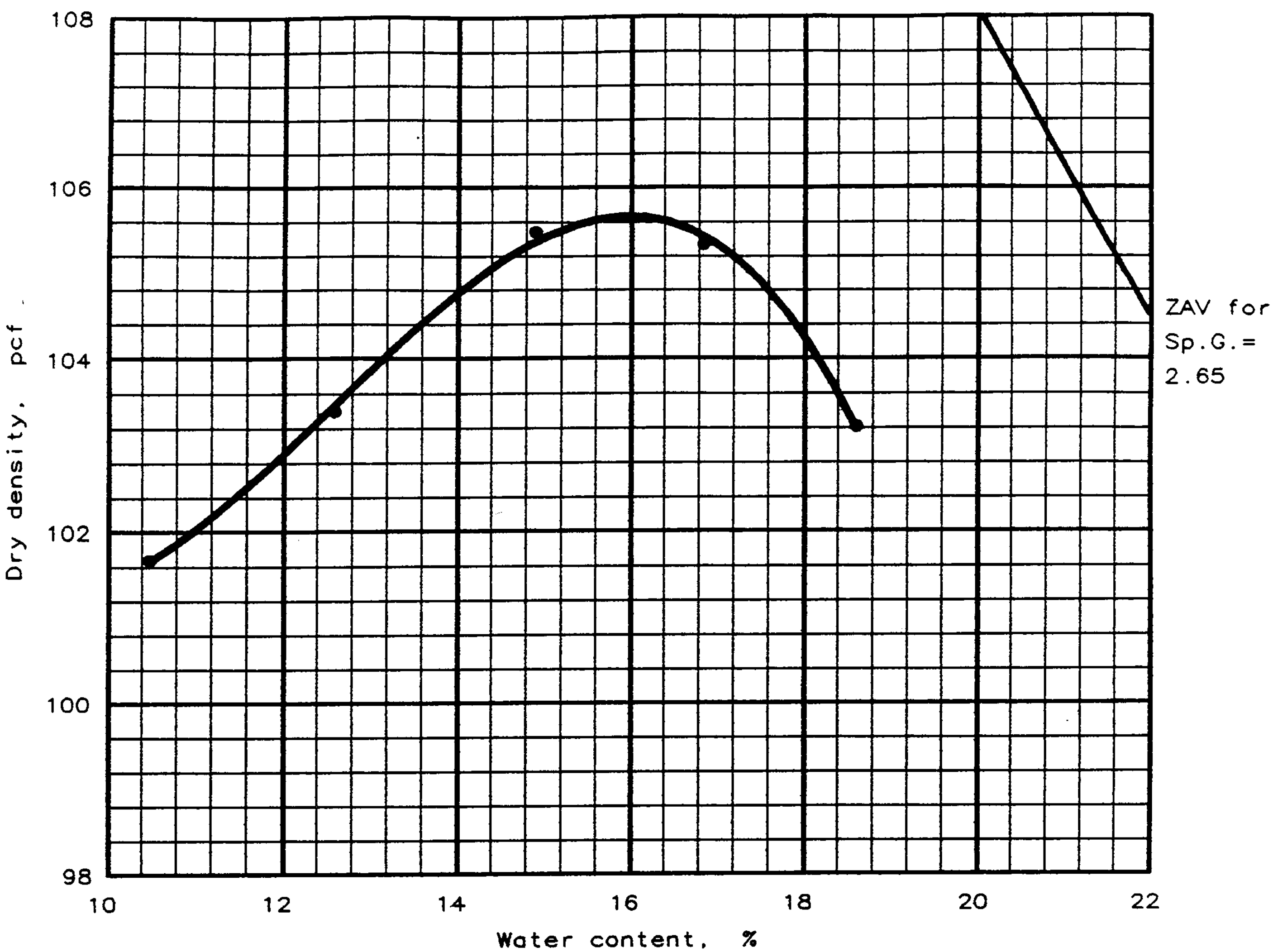
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 35

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 105.7 pcf Optimum moisture = 16.0 %	105.7 pcf 16.0 %	C3-TS1

Project No.: 804899

Project: International Uranium Corporation

Location: Soil Sample Testing

Date: 4/27/99

Remarks:

SUBMITTED BY: Client

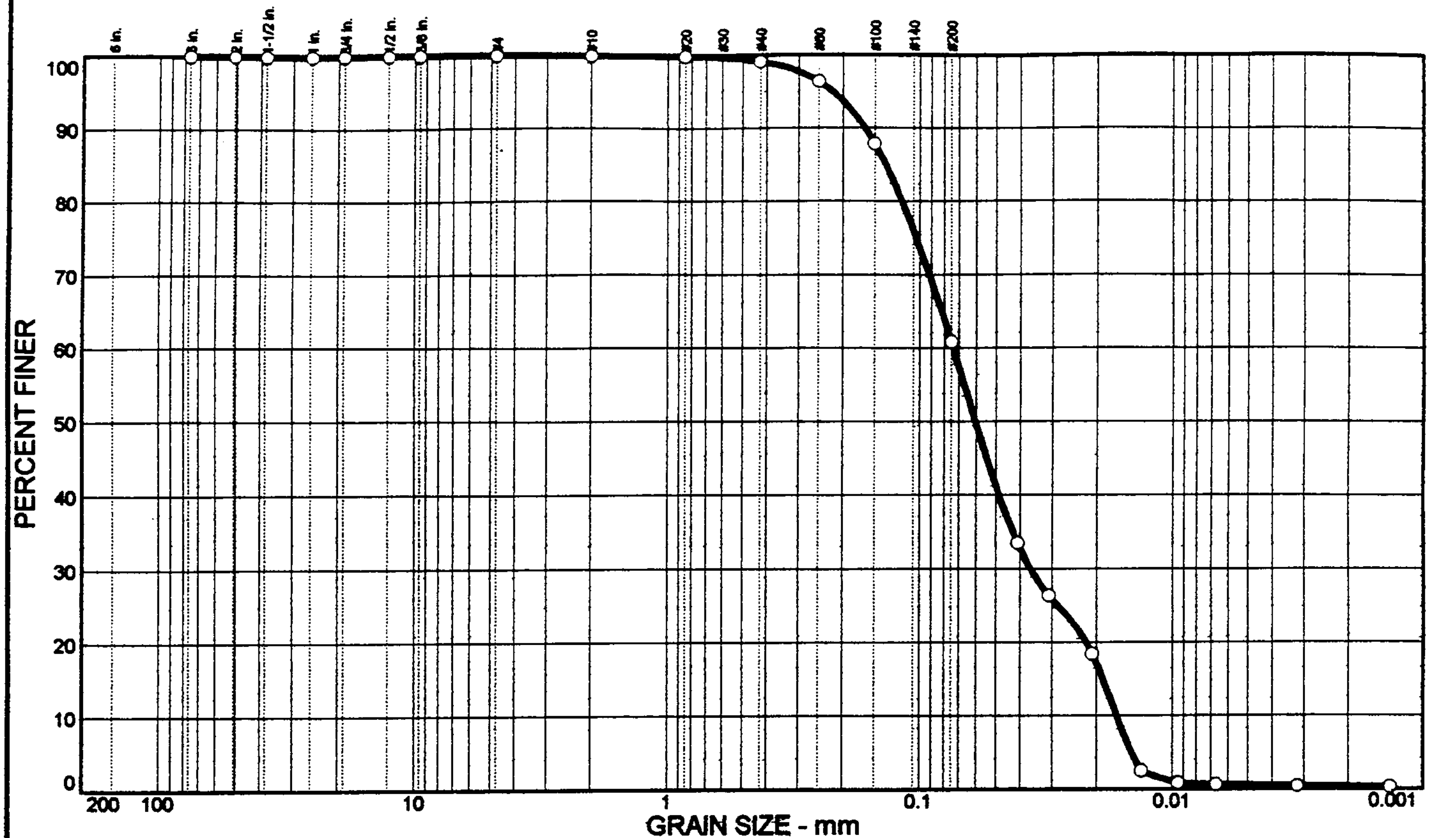
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST

WESTERN COLORADO TESTING, INC.

Fig. No. 5

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.0	39.2	60.3	0.5	ML	A-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}	0.0738		
D_{30}	0.0364		
D_{10}	0.0166		
	COEFFICIENTS		
C_c	1.08		
C_u	4.45		

SIEVE number size	PERCENT FINER ○		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.1		
#60	96.3		
#100	87.8		
#200	60.8		

SOIL DESCRIPTION

○ Silt, sandy, brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: C3-TS1

WESTERN COLORADO TESTING, INC.

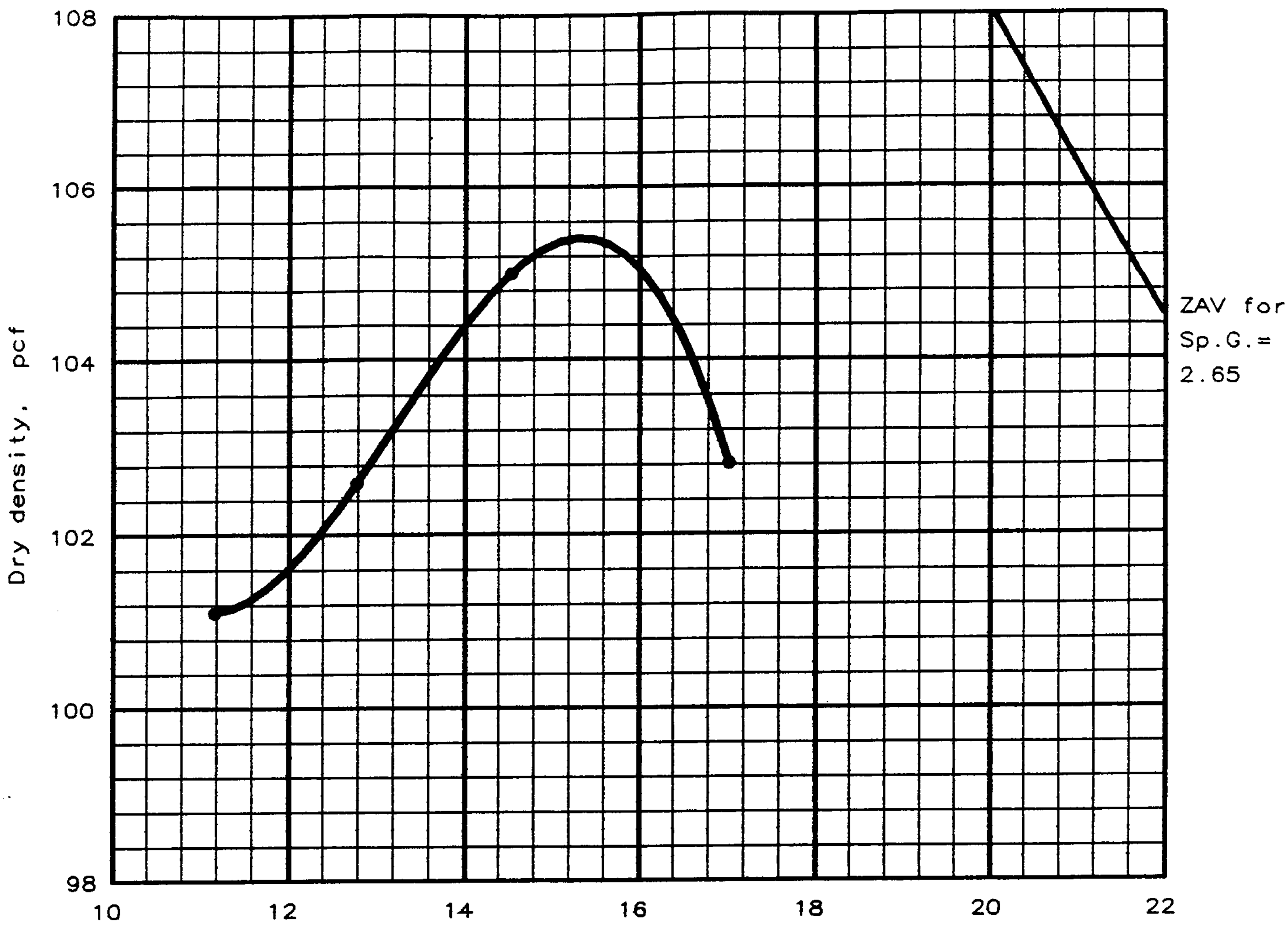
Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 36

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
			N/A %	2.65				

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 105.4 pcf Optimum moisture = 15.3 %	105.4 pcf 15.3 %	C3-TS2

Project No.: 804899
Project: International Uranium Corporation
Location: Soil Sample Testing

Date: 4/27/99

Remarks:
SUBMITTED BY: Client
TESTED BY: JH

MOISTURE-DENSITY RELATIONSHIP TEST
WESTERN COLORADO TESTING, INC.

Fig. No. 6

PARTICLE SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.0	77.0	16.9	6.1	SM	A-2-4(0)	NP	NP

SIEVE inches size	PERCENT FINER ○		
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}	0.185		
D_{30}	0.102		
D_{10}	0.0260		
	COEFFICIENTS		
C_c	2.16		
C_u	7.12		

SIEVE number size	PERCENT FINER ○		
#4	100.0		
#10	99.9		
#20	99.0		
#40	94.6		
#60	78.1		
#100	46.9		
#200	23.0		

SOIL DESCRIPTION

○ Sand, silty, gray/brown

REMARKS:

○ Tested By: JH

○ Source:

Sample No.: C3-TS2

WESTERN COLORADO TESTING, INC.

Client: International Uranium Corporation

Project: Soil Sample Testing

Project No.: 804899

Figure 37

Tailings Cell 2 - Dry Density Calculation

Cell 2 – Original Design Volume

2,380,000 tons @ 92 dpcf	=	1,916,264 yd^3
Design change to east end - + 5%	=	95,000 yd^3
Total as built volume	=	2,011,264 yd^3
Remaining storage volume	=	<23,000> yd^3
		1,988,264 yd^3

Total Tailings to Date

As of October 23, 1989	2,299,708 tons
Cabot	12,000 tons
On-Site Waste	5,000 tons
	2,316,708 tons

$$\frac{2,316,708 \text{ tons}}{1,988,264 \text{ yd}^3} = 86.31 \text{ dpcf}$$

TO: Bill Deal

FROM: Shannon Clark

DATE: June 25, 1997

SUBJECT: Cell 3 Calculated Capacity Left

I was asked by you, to find the original capacity of Cell 3 and the capacity we have left to fill.

In the Environmental files I found where John Hamrick had listed the cells and capacities and , off the 19 C's had calculated the from inception tons deposited to each cell.

Cell 2	2,299,708	
Cell 3	1,249,000	(+600,000 tons = License Amendment)

as of October 23, 1989.

I then went to Gary Richards to find the dry tons fed to the mill to date off of the 19C report Fed to the mill, inception to-date, is 3,757,344 tons. We have produced 14,050 tons of Yellowcake and 16,200 tons of Vanadium.

3,757,344	Dry tons fed to mill
- 14,050	YC produced in tons
3,743,294	Tons to tails
- 16,200	Vanadium Produced
3,727,094	Tons to tails
-2,299,708	Tons deposited into Cell 2
1,427,386	Tons in Cell 3 at this point

2,091,717	Available tons in Cell 3 at time of construction
- 1,427,386	Tons deposited into Cell 3 as of now
664,331	**Tons of space left in Cell 3 (in theory)**
	This calculates out to be 68% full.

White Mesa Mill - Screen Analysis of Ore Feed to Leach

Table 5

Screen Analysis of Feed Ore to Leach

Grind conditions:

Rod mill	7-5/8" diam x 9-1/2", steel, ribbed, 85/90 rpm
Rod charge	8.9 kg
Ore charge	1.00 kg, minus 6-mesh
% solids	50
Time	3 min

Size Mesh (Tyler)	Weight Distribution, %			
	Blanding No. 4 HRI-11868	Anschutz No. 1 HRI-11870	Hanksville No. 1 1/ HRI-11175-1	Three-Ore Composite
+35	0.0	0.0	0.5	
35x48	2.5	0.2	1.9	
48x65	16.2	7.4	15.3	1.2
65x100	25.0	25.2	26.2	12.7
100x150	18.7	21.9	19.5	28.9
150x200	10.4	14.6	13.4	20.1
200x270	4.5	7.6	6.2	13.7
270x325	1.5	2.8	1.8	6.0
-325	21.2	20.3	15.2	2.9
	100.0	100.0	100.0	14.5
				100.0

1/ Data from June 15, 1977 report "Uranium Recovery from Hanksville and Blanding Station Ores."

Screen Analysis of Blanding No. 4, Anschutz No. 1, and Hanksville No. 2A Ore Feed to Leach

Grinding conditions:

Mill — Rod, steel, 7-5/8" diam x 9-1/2", ribbed, 85/90 rpm

Rod charge — Steel rods, 9" in length

Diam inch	No. of Rods	Weight kg
1/4	6	0.54
3/8	7	1.11
1/2	16	4.49
5/8	6	2.76
		8.90

Ore charge — 1.0 kg, minus 6-mesh

H_2O — 1.0 kg

Time — 3 min

Screen analysis:

Size Mesh (Tyler)	Weight Distribution, % Blanding No. 4 HRI-11868	Anschutz No. 1 HRI-11870	Hanksville No. 2A HRI-11869
+28			12.3
28x35	0.0	0.0	11.3
35x48	2.5	0.2	13.5
48x65	16.2	7.4	9.2
65x100	25.0	25.2	7.1
100x150	18.7	21.9	4.8
150x200	10.4	14.6	4.2
200x270	4.5	7.6	3.0
270x325	1.5	2.8	2.3
-325	21.2	20.3	32.3
	100.0	100.0	100.0

ATTACHMENT F

RADON EMANATION CALCULATIONS

(REVISED)

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

INDEPENDENCE PLAZA

1050 17TH STREET, SUITE 950

DENVER, CO 80265

Memorandum

Date: April 15, 1999 1626B

To: File 1626B

From: Roman Popielak and Pete Duryea

Re: **Radon Emanation Calculations (Revised)**

At the request of International Uranium (USA) Corporation (IUC), we have completed a series of analyses of the expected levels of radon flux from the White Mesa uranium tailings facility for the tailings cover design. These analyses accounted for recent comments from the United States Nuclear Regulatory Commission (NRC).

Analysis Methodology and Input Parameters

The analyses conducted and described herein adopted the methods and approach detailed in NRC Regulatory Guide 3.64 and more specifically the computer code RADON Version 1.2. The code, which considers one-dimensional steady state gas diffusion, requires input data including: layer thickness, porosity, dry density, radium activity, emanation coefficient, gravimetric water content and radon diffusion coefficient. These input data were based exclusively on available data from previous work by others including Rogers and Associates Engineering Corporation, Advanced Terra Testing, Chen and Associates, D'Appolonia Consulting Engineers Inc. and TITAN Environmental. Key laboratory data and a summary of parameters selected for these analyses are presented in the attached Table 1.

The current cover design includes 2.0 feet of random fill (frost barrier fill) over 1.0 foot of compacted clay which in turn overlies 3.0 feet of random fill (platform fill). In the analyses, the thickness of final cover was reduced by 6.8 inches to 1.4 feet to account for the depth of frost penetration as evaluated by TITAN Environmental. The actual tailings thickness is on the order of 44 feet, which meets the NRC guidelines for an infinitely thick source, and hence it could be modeled in program RADON as a 500.0-centimeter thick layer. Available data on the in-situ density of the tailing was used. All available historical Proctor compaction results for the other materials were evaluated to select appropriate maximum dry densities for the clay and random fill.

The clay layer and frost barrier fill, which are to be placed and compacted as engineered fill materials, were modeled with 95-percent standard Proctor compaction. The platform fill material is dumped and spread directly on top of the tailing surface. Once in place, the material is compacted by selective routing of equipment traffic, and it then provides a working surface for subsequent operations such as placement and compaction of the clay layer and frost barrier fill. The compaction of material comprising the platform is expected to be higher at its top than at its contact with the tailings.

Within the platform fill, the surficial material is likely to exhibit fairly high compaction given the influence of the contact stresses exerted by equipment traffic and later by the compaction of overlying material. Such stresses diminish with depth, so lower portions of the platform fill will not have experienced as significant a compactive effort. Compaction of the platform fill is therefore likely to range from about 80-percent of standard Proctor at the base of the random fill immediately above the tailing to 90- to 95-percent of standard Proctor compaction at the top of the platform fill immediately below the equipment loads just described.

The porosity of each of the materials/sublayers was calculated from its dry density and specific gravity of soil solids. Radium activities and emanation coefficients were selected for each soil type from available lab data, and the long term water contents were selected for the analyses as follows. In the absence of other data, the tailing was modeled with a 6.0 percent by weight moisture content as the NRC recognizes that value as a practical lower bound for soils in the western United States. Long term moisture content can be conservatively modeled as the residual (or irreducible) water content from capillary moisture retention data since a lower value is more critical, that is it yields a higher radon flux. Such data was provided and used for the random fill and the clay.

The final, and one of the more critical parameters, was the radon diffusion coefficient. This parameter is dependent upon the porosity and degree of saturation of the soil, and although lab data was available, it was for conditions other than those modeled. So in the absence of diffusion coefficient data at the porosities and degrees of saturation of interest, a correlation provide by the NRC was employed to compute the diffusion coefficients adopted for the analyses. These values ranged from 0.0071 to 0.0507 cm^2/sec. It should be noted that the resultant values did seem to match well with the trends observed in the available laboratory data.

Results and Conclusions

Since there were not data available describing the degree and distribution of compaction in the platform fill, a series of analyses were conducted based on varying assumptions about the condition of that material. In each of those cases, the platform fill was divided into a series of sublayers whose thickness and degree of compaction were selected based upon engineering judgement and previous experience with similar situations.

The two cases of distribution of compaction considered to represent the conditions anticipated at White Mesa are presented in attached Figure 1 as Case I and Case II. The results of the radon flux evaluation for those two cases are attached. For the reasonably conservative input parameters listed herein and an interim cover comprising 1.0 foot each at 80-, 90 and 95-percent compaction as shown as Case I in Figure 1, a radon flux at the ground surface of 18.2 pCi/m^2/sec is expected. For Case II with 0.5 foot of 95-percent compaction material overlying 1.0 feet of 90-percent compaction material and 1.5 feet of 85-percent compaction material, the radon flux at the ground surface is 19.8 pCi/m^2/sec. Both of these results are within the 20.0 pCi/m /sec limit specified by the NRC.

Therefore, it appears that the cover design should be acceptable assuming that the conditions described herein do not vary significantly from those in the field.

In conclusion, empirical knowledge of the site conditions should be taken under consideration in evaluation of the model results. At present, approximately 80-percent of Cell No.2 is covered with the random fill (platform fill). This fill supports traffic of the heavy, 30 ton haulers. Hence the degree of compaction of the layer(s) as represented in the radon flux models (see Figure 1) may have already been achieved in certain locations within the cell. The platform fill has been very effective to date in attenuating the radon flux, which as currently recorded is 7.4 pCi/m^2/sec which is well below the standard of 20.0 pCi/m^2/sec. Based on these observations, it would appear that the performance of the tailings cover, which will ultimately include the clay layer and frost barrier fill in addition to the fill currently in place, as a barrier controlling radon flux is anticipated to meet the regulatory requirements.

Table 1
Laboratory and Model Input Data

LABORATORY DATA

Material	Specific Gravity G_s	Max. Dry Unit Wt. $\gamma_{dry,max}$ (pcf)	Max. Dry Density $\rho_{dry,max}$ (g/cm^3)	95% Max. Dry Density $\rho_{dry,95\% max}$ (g/cm^3)	Porosity(1) n	Dry Density ρ_{dry} (g/cm^3)	Radium Activity (pCi/g)	Emanation Coefficient	Water Content w (% by wt.)	Diffusion(7) Coefficient D (cm^2/sec)	Saturation(2) S	Diffusion(3) Coefficient D (cm^2/sec)
Tailings	2.85	104.0	1.67	1.58	0.491	1.45	981.0	0.19	13.2	2.00E-02	0.390	2.07E-02
	2.85	104.0	1.67	1.58	0.495	1.44	981.0	0.19	19.1	8.40E-03	0.556	1.06E-02
Rnd. Fill (Comp.)	2.67	120.2	1.93	1.83	0.307	1.85	1.9	0.19	6.5	1.60E-02	0.392	1.63E-02
	2.67	120.2	1.93	1.83	0.311	1.84	1.9	0.19	12.5	4.50E-04	0.740	1.99E-03
Clay (Site #1)	2.69	121.3	1.94	1.85	0.312	1.85	2.2	0.20	8.1	1.60E-02	0.480	1.12E-02
	2.69	121.3	1.94	1.85	0.316	1.84	2.2	0.20	12.6	1.40E-03	0.734	2.13E-03
Clay (Site #4)	2.75	108.7	1.74	1.65	0.400	1.65	2.0	0.11	15.4	1.10E-02	0.635	5.48E-03
	2.75	108.7	1.74	1.65	0.400	1.65	2.0	0.11	19.3	4.20E-04	0.796	1.34E-03
Clay (UT-1)	2.39	113.5	1.82	1.73	0.280	1.72	1.5	0.22	14.5	9.10E-03	0.890	2.84E-04

SELECTED MODEL INPUT DATA

Material	Specific(6) Gravity G_s	Max. Dry(6) Unit Wt. $\gamma_{dry,max}$ (pcf)	Max. Dry Density $\rho_{dry,max}$ (g/cm^3)	Specified Dry Density $\rho_{dry,spec}$ (g/cm^3)	Porosity(1) n	Dry(4) Density ρ_{dry} (g/cm^3)	Radium(6) Activity (pCi/g)	Emanation(6) Coefficient	Water(5) Content w (% by wt.)	Diffusion(3) Coefficient D (cm^2/sec)	Saturation(2) S
Tailings	2.85	N/A	N/A	N/A	0.583	1.19	981.0	0.19	6.0	5.07E-02	0.122
Rnd. Fill @ 80% Std.	2.67	120.2	1.93	1.54	0.423	1.54	1.9	0.19	9.8	2.12E-02	0.357
Rnd. Fill @ 85% Std.	2.67	120.2	1.93	1.64	0.387	1.64	1.9	0.19	9.8	1.62E-02	0.415
Rnd. Fill @ 90% Std.	2.67	120.2	1.93	1.73	0.351	1.73	1.9	0.19	9.8	1.15E-02	0.484
Rnd. Fill @ 95% Std.	2.67	120.2	1.93	1.83	0.315	1.83	1.9	0.19	9.8	7.05E-03	0.570
Clay @ 95% Std.	2.72	100.0	1.60	1.52	0.440	1.52	1.9	0.18	14.1	1.30E-02	0.488

(1) $n=1-(\rho_{dry}/G_s/\rho_w)$

(2) $S=w*G_s*\rho_{dry}/\rho_w/(G_s*\rho_w-\rho_{dry})$

(3) $D=0.07\exp(-4(S-Sn^2+S^5))$ per NRC correlation

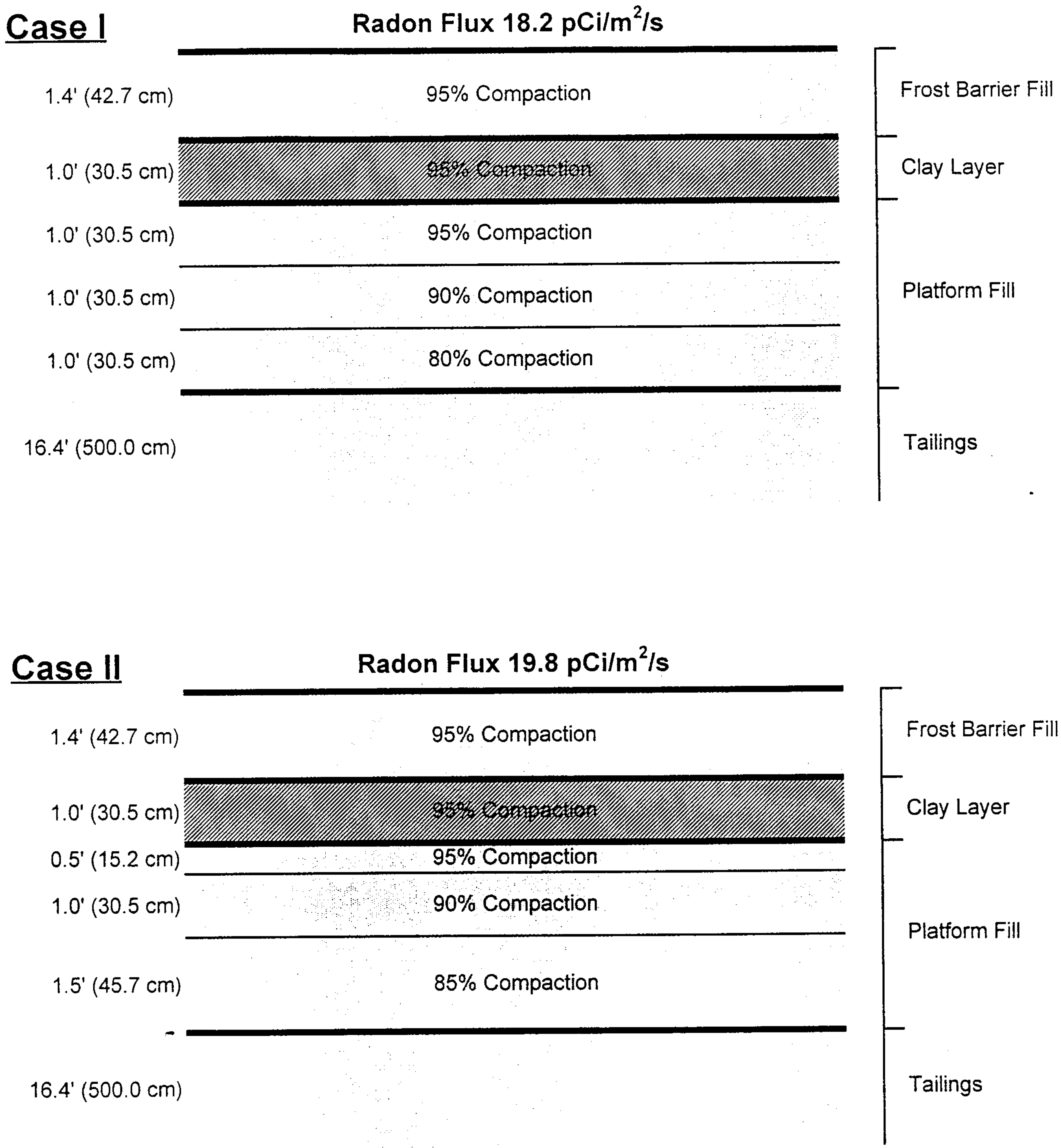
(4) Tailings based on 74.2 pcf. Rnd. Fill ranges from 80 to 95% Std. Proctor. Clay based on 95% Std. Proctor.

(5) Tailings based on w=6% per NRC. Others based on capillary moisture data. Rnd. Fill w=9.8% and Clay w=14.1% (average of two tests).

(6) Values for clay are an average of test results.

(7) Individual lab test results.

Figure 1
Cover Cross Sections for Radon Flux Models



Note: Percent compaction is based upon the maximum dry density by standard Proctor.

-----*****! RADON !*****-----

Version 1.2 - Feb. 2, 1989 - G.F. Birchard tel.# (301)492-7000
U.S. Nuclear Regulatory Commission Office of Research

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

WHITE MESA CASE I

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	6	
DESIRED RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
SURFACE FLUX PRECISION	0	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1

THICKNESS	500	cm
POROSITY	.583	
MEASURED MASS DENSITY	1.19	g cm^-3
MEASURED RADIUM ACTIVITY	981	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	7.990D-04	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.122	
MEASURED DIFFUSION COEFFICIENT	.0507	cm^2 s^-1

LAYER 2

THICKNESS	30.5	cm
POROSITY	.423	
MEASURED MASS DENSITY	1.54	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	2.760D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.357	
MEASURED DIFFUSION COEFFICIENT	.0212	cm^2 s^-1

LAYER 3

THICKNESS	30.5	cm
POROSITY	.351	
MEASURED MASS DENSITY	1.73	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	3.737D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.483	
MEASURED DIFFUSION COEFFICIENT	.0115	cm^2 s^-1

LAYER 4

THICKNESS	30.5	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.83	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.404D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.569	
MEASURED DIFFUSION COEFFICIENT	.0071	cm^2 s^-1

LAYER 5

THICKNESS	30.5	cm
POROSITY	.44	
MEASURED MASS DENSITY	1.52	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.18	
CALCULATED SOURCE TERM CONCENTRATION	2.481D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	14.1	%
MOISTURE SATURATION FRACTION	.487	
MEASURED DIFFUSION COEFFICIENT	.013	cm^2 s^-1

LAYER 6

THICKNESS	42.7	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.83	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.404D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.569	
MEASURED DIFFUSION COEFFICIENT	.0071	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
6	-1.000D+00	0.000D+00	0	2.000D+01	0.000D+00

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	5.070D-02	5.830D-01	7.990D-04	1.225D-01	1.190
2	3.050D+01	2.120D-02	4.230D-01	2.760D-06	3.568D-01	1.540
3	3.050D+01	1.150D-02	3.510D-01	3.737D-06	4.830D-01	1.730
4	3.050D+01	7.100D-03	3.150D-01	4.404D-06	5.693D-01	1.830
5	3.050D+01	1.300D-02	4.400D-01	2.481D-06	4.871D-01	1.520
6	4.270D+01	7.100D-03	3.150D-01	4.404D-06	5.693D-01	1.830

BARE SOURCE FLUX FROM LAYER 1: 6.938D+02 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	1.417D+02	2.911D+05
2	3.050D+01	8.383D+01	1.976D+05
3	3.050D+01	5.158D+01	1.220D+05
4	3.050D+01	3.608D+01	5.146D+04
5	3.050D+01	2.274D+01	4.139D+04
6	4.270D+01	1.824D+01	0.000D+00

-----*****! RADON !*****-----

Version 1.2 - Feb. 2, 1989 - G.F. Birchard tel.# (301)492-7000
U.S. Nuclear Regulatory Commission Office of Research

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

WHITE MESA CASE II

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	6	
DESIRED RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
SURFACE FLUX PRECISION	0	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

\YER 1

THICKNESS	500	cm
POROSITY	.583	
MEASURED MASS DENSITY	1.19	g cm^-3
MEASURED RADIUM ACTIVITY	981	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	7.990D-04	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.122	
MEASURED DIFFUSION COEFFICIENT	.0507	cm^2 s^-1

LAYER 2

THICKNESS	45.7	cm
POROSITY	.387	
MEASURED MASS DENSITY	1.64	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	3.213D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.415	
MEASURED DIFFUSION COEFFICIENT	.0162	cm^2 s^-1

LAYER 3

THICKNESS	30.5	cm
POROSITY	.351	
MEASURED MASS DENSITY	1.73	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	3.737D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.483	
MEASURED DIFFUSION COEFFICIENT	.0115	cm^2 s^-1

LAYER 4

THICKNESS	15.2	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.83	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.404D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.569	
MEASURED DIFFUSION COEFFICIENT	.0071	cm^2 s^-1

LAYER 5

THICKNESS	30.5	cm
POROSITY	.44	
MEASURED MASS DENSITY	1.52	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.18	
CALCULATED SOURCE TERM CONCENTRATION	2.481D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	14.1	%
MOISTURE SATURATION FRACTION	.487	
MEASURED DIFFUSION COEFFICIENT	.013	cm^2 s^-1

LAYER 6

THICKNESS	42.7	cm
POROSITY	.315	
MEASURED MASS DENSITY	1.83	g cm^-3
MEASURED RADIUM ACTIVITY	1.9	pCi/g^-1
MEASURED EMANATION COEFFICIENT	.19	
CALCULATED SOURCE TERM CONCENTRATION	4.404D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.8	%
MOISTURE SATURATION FRACTION	.569	
MEASURED DIFFUSION COEFFICIENT	.0071	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
6	-1.000D+00	0.000D+00	0	2.000D+01	0.000D+00

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	5.070D-02	5.830D-01	7.990D-04	1.225D-01	1.190
2	4.570D+01	1.620D-02	3.870D-01	3.213D-06	4.153D-01	1.640
3	3.050D+01	1.150D-02	3.510D-01	3.737D-06	4.830D-01	1.730
4	1.520D+01	7.100D-03	3.150D-01	4.404D-06	5.693D-01	1.830
5	3.050D+01	1.300D-02	4.400D-01	2.481D-06	4.871D-01	1.520
6	4.270D+01	7.100D-03	3.150D-01	4.404D-06	5.693D-01	1.830

BARE SOURCE FLUX FROM LAYER 1: 6.938D+02 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	1.382D+02	2.930D+05
2	4.570D+01	7.131D+01	1.485D+05
3	3.050D+01	4.602D+01	9.400D+04
4	1.520D+01	3.921D+01	5.586D+04
5	3.050D+01	2.469D+01	4.491D+04
6	4.270D+01	1.977D+01	0.000D+00

ATTACHMENT G

CHANNEL AND TOE APRON

DESIGN CALCULATIONS

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

INDEPENDENCE PLAZA

1050 17TH STREET, SUITE 950

DENVER, CO 80265

ATTACHMENT 7 - RESPONSE TO NRC COMMENTS 7/17/98

TABLE OF SIX-HOUR LOCAL PMP RAINFALL DEPTH VS DURATION FOR WHITE MESA MIL

6-Hour Storm Rainfall is 10 inches (ref: Hydrologic Design Report for White Mesa Mill, 1990)
6/1 Hr Ratio for WHITE MESA is 1.22 (Figure 4.7 and Table 4.4, HMR 49)
ONE-HOUR PMP IS: 8.20 inches at 5000 ft. elevation
97.0% or 7.95 inches at 5600 ft. elevation (1)

DURATION HOURS	% OF 1-HR PMP	RAINFALL DEPTH, IN INCHES, AT AVERAGE ELEVATION OF: (based on Table 6.3A, HMR 49)	
		5000 ft	5600 ft(1)
0	0	0.00	0.00
0.25	74	6.07	5.88
0.5	89	7.30	7.08
0.75	95	7.79	7.55
1	100	8.20	7.95
2	111	9.10	8.83
3	116	9.51	9.22
4	119	9.75	9.46
5	121	9.92	9.62
6	122	10.00	9.70

Plot of data is adaptation of Figure 12.10, HMR 55A, to site rainfall.
(1) Average elevation of site in vicinity of base of cell 4Aeach tanks

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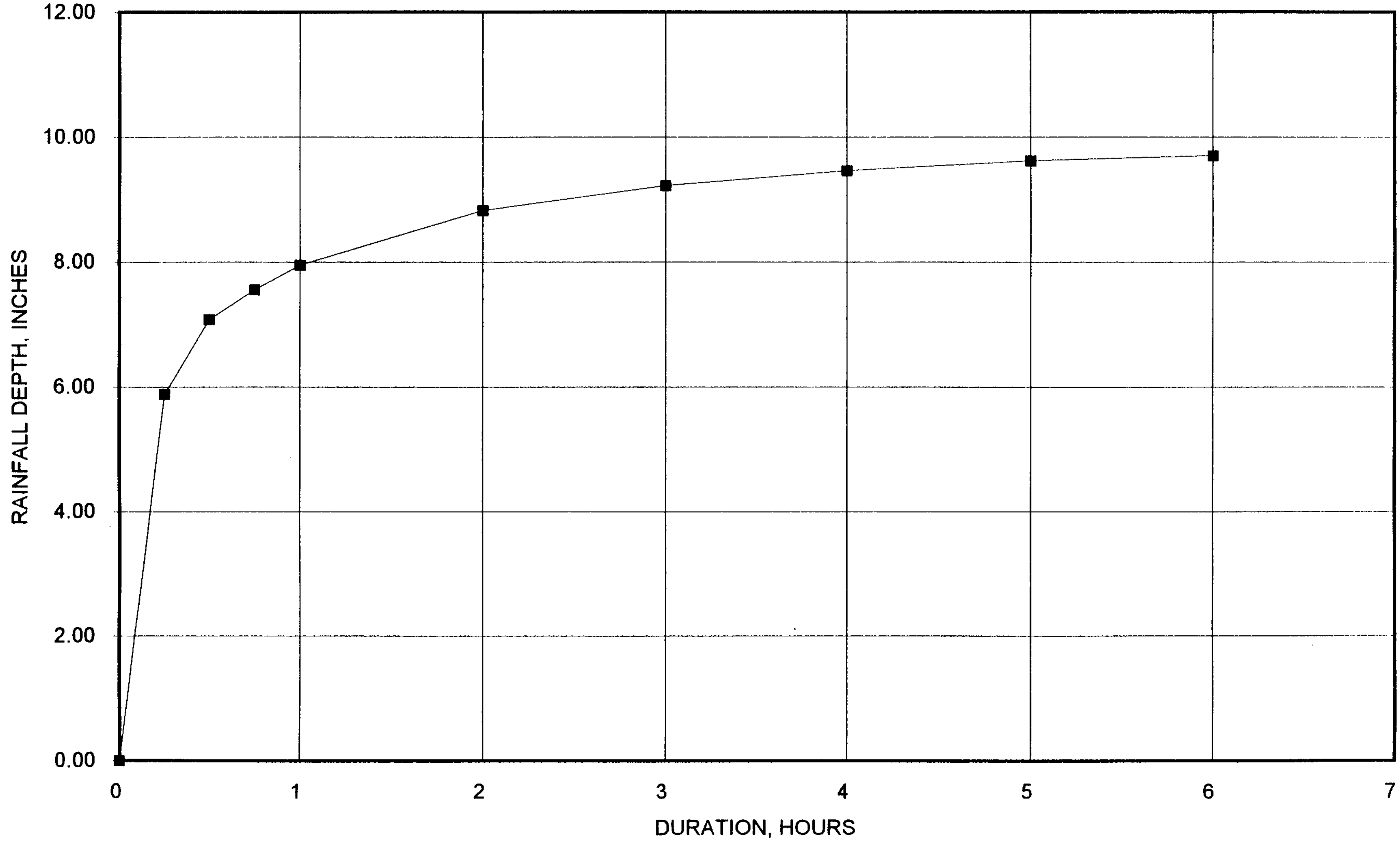
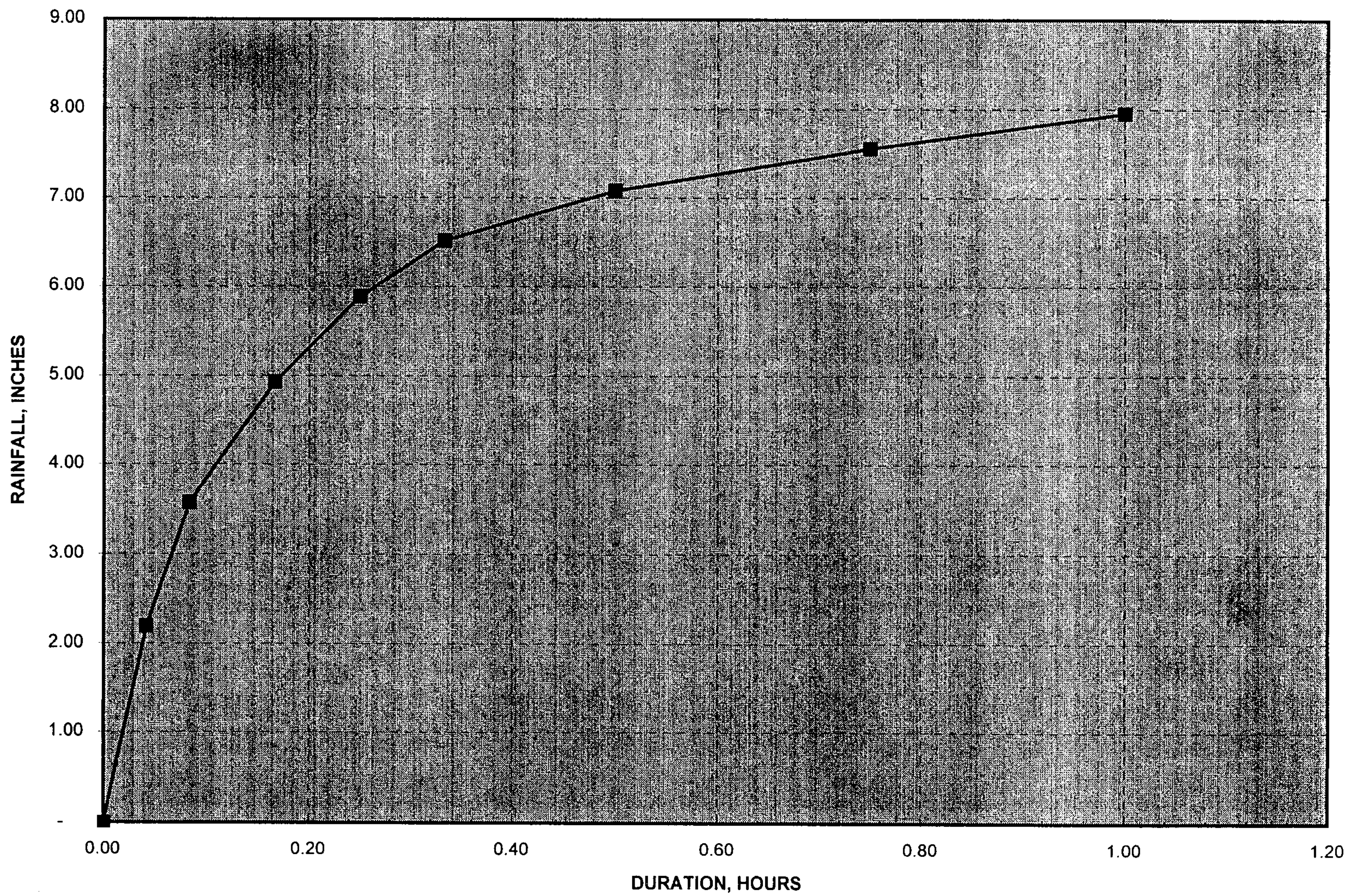
TIME DISTRIBUTION OF FIRST ONE HOUR, OR THE ONE-HOUR PMP
(after Table 2.1, NUREG CR 4620)

RAINFALL DURATION MINUTES	RAINFALL DURATION HOURS	% OF ONE-HOUR PMP	RAINFALL DEPTH IN INCHES AT ELEVATION:	
			5000 ft	5600 ft(1)
0	0	0	0	0
2.5	0.04	27.5	2.25	2.19
5	0.08	45	3.69	3.58
10	0.17	62	5.08	4.93
15	0.25	74	6.07	5.88
20	0.33	82	6.72	6.52
30	0.50	89	7.30	7.08
45	0.75	95	7.79	7.55
60	1.00	100	8.20	7.95

DEPTH VS DURATION FOR 6-HR PMP
WHITE MESA MILL, UTAH
ATTACHMENT 8 RESPONSE TO NRC COMMENTS 7/17/98



RAINFALL-DURATION CURVE FOR ONE-HOUR PMP AT WHITE MESA MILL
ATTACHMENT 9 - RESPONSE TO NRC COMMENTS 7/17/98



ATTACHMENT 11 RESPONSES TO NRC COMMENTS 7/17/98

RATIONAL METHOD CALCULATION OF PMF PEAK DISCHARGE, VELOCITY, AND DEPTH THROUGH CELL #1 DISCHARGE CHANNEL

FLOW PATH ELEMENT	ELEMENT LENGTH L	MAX. ELEV.	MIN. ELEV.	GRADIENT S	SLOPE ANGLE degrees	tc hours	RAINFALL WITHIN tc (1)	i in/hr	SURFACE AREA acres	PEAK DISCHARGE Q, cfs
LONGEST	4800	5655	5610	0.0094	0.54	0.54	7.20	13.43	143	1344

FLOW PARAMETERS IN CELL #1 DISCHARGE CHANNEL AT PEAK PMF DISCHARGE

	Channel Bottom Width, b ft	Channel Side Slopes	Channel Gradient, s ft/ft	Manning Coeff., n	Qn/1.49*s^.5	Flow Depth, y ft	Cross Section Area of Flow a, ft^2	Hydraulic Radius R, ft	a(R)^.67	Velocity v fps	Allowable Peak Velocity fps (COE, 1970)
Bedrock Channel	100	3:1	0.0100	0.025	226	1.62	169.9	1.54	226.95	7.96	8-10
Bedrock Channel	120	3:1	0.0100	0.025	226	1.45	180.3	1.40	225.46	7.45	8-10

RATIONAL METHOD CALCULATION OF PMF PEAK DISCHARGE, VELOCITY, DEPTH AND SCOUR THROUGH CELL 4A BREACH WITH BREACH WIDENED TO 200 FEET - IUC WHITE MESA

FLOW PATH ELEMENT	ELEMENT LENGTH L	MAX. ELEV.	MIN. ELEV.	GRADIENT S	SLOPE ANGLE degrees	tc hours	RAINFALL WITHIN tc (1)	i in/hr	SURFACE AREA acres	PEAK DISCHARGE Q, cfs
CELL 2 COVER	1230	5619.5	5617	0.0020	0.12	0.34	6.53	19.29	41.30	637
CELL 2/3 BERM	10	5617	5615	0.2000	11.31	0.34	6.54	19.24	1.10	654
CELL 3 COVER	900	[illegible]	5613.2	0.0020	0.11	0.61	7.30	12.01	35.12	992
CELL 3/4A BERM	180	[illegible]	5577.2	0.2000	11.31	0.62	7.40	11.92	6.40	1053
CELL 4A	1400	5577.2	5562	0.0109	0.62	0.82	7.70	9.42	27.70	1262
CELL 4A INSLOPES	80	5599	5560	0.4875	25.99	0.04	2.00	47.62	5.68	216
CELL 4A BREACH	275	5562	5560	0.0073	0.42	0.92	7.80	8.44	0.38	1481

FLOW PARAMETERS IN CELL 4A BREACH AT PEAK PMF DISCHARGE

	Breach Bottom Width, b ft	Breach Side Slopes	Breach Channel Gradient, s ft/ft	Manning Coeff., n	Qn/1.49*s^.5	**Flow Depth, y** ft	Cross Section Area of Flow a, ft^2	Hydraulic Radius R, ft	a(R)^.67	**Velocity** v fps	Allowable Peak Velocity fps (COE, 1970)	Riprap Size d50 inches (ref. 1)
Soil (SM) Channel	200	3:1	0.0073	0.03	350	**1.39**	283.8	1.36	348.59	**5.20**	2-4	4.00
Rock Channel	200	3:1	0.0073	0.025	291	**1.25**	254.7	1.23	291.78	**5.82**	8-10	N/A

NOTE: If rounded rock (river cobbles and gravel) is used, rock size should be increased by 33%, per Fig. 4.10, NUREG /CR 4651, Vol. 2

Reference 1 - Fig 4.11, NUREG CR 4620

DEPTH OF SCOUR OF CELL 4A BREACH CHANNEL

All methods used are from Pemberton, E.L., and J.M. Lara, 1984, "Computing Degradation and Local Scour", Technical Guideline for Bureau of Reclamation

ds = depth of scour, ft.
q = unit discharge, cfs/ft

			Soil Channel 200' wide
Method 1	ds=K*q^0.24		
	K = constant, 2.45		
		q =	5.2
		ds =	**3.64**
Method 2	ds = 0.25 dm		
	dm = mean water depth at design discharge =		1.4
		ds =	**0.34**
Method 3	ds = 0.6*dfo		
	dfo = q^0.666/Fbo^0.333 =		3.00
	Fbo = zero bed factor = 1.0 ft/s^2 for fine sand		
		ds =	**1.80**
Method 4	ds = 0.25 * dma		
	dma = unit cross section of flow =		1.39
		ds =	**0.35**
Method 5	ds = dm*((Vm/Vc)-1)		
	Vm = mean velocity =		5.22
	Vc =		2
		ds =	**2.19**

AVERAGE SCOUR DEPTH, ft = **1.66**

ATTACHMENT 12 TABLE - RESPONSES TO NRC COMMENTS 7/17/98

ROCK APRON DESIGN TABLE - TAILING CELL EROSION PROTECTION
WHITE MESA MILL

FLOW PATH ELEMENT	ELEMENT LENGTH L ft	ELEMENT WIDTH W ft	GRADIENT S ft/ft	SLOPE ANGLE degrees	tc (minimum is 0.042) hours	RAINFALL WITHIN tc inches	INTENSITY in/hr	Peak Unit Discharge q cfs/ft	d50 inches
APRON	10	1	0.01	0.57	0.60	7.29	12.07	1.80	**7.3**

Notes:
The top cover element length is 2450 ft. This was used in the calculations for time of concentration and peak unit discharge.
The outslope element length is 240 ft. This was used in the calculations for time of concentration and peak unit discharge.
The d50 for the outslope was calculated per Abt, S.R. and Johnson, T.L., "Riprap Design for Overtopping Flow," ASCE Journal of Hydraulic Engineering, 1991.
The d50 for the apron was calculated per Abt, S.R., Johnson, T.L., Thornton, C.I. and Trabant, S.C., "Riprap Sizing at Toe of Embankment Slopes," ASCE Journal of Hydraulic Engineering, July 1998.

DEPTH OF SCOUR AT DOWNSTREAM EDGE OF TOE APRON

All methods used are from Pemberton, E.L., and J.M. Lara, 1984, "Computing Degradation and Local Scour", Technical Guideline for Bureau of Reclamation

ds = depth of scour, ft.
q = unit discharge, cfs/ft

Method 1 **ds=K*q^0.24**
K = constant, 2.45
q = 1.81 cfs/ft

ds = **2.82** ft

Method 2 **ds = 0.25 dm**
dm = mean water depth at design discharge

ds = **0.22** ft.

Method 3 **ds = 0.6*dfo**
dfo = q^0.666/Fbo^0.333
Fbo = zero bed factor = 1.0 ft/s^2 for fine sand

ds = **0.09** ft

Method 4 **ds = 0.25 * dma**
dma = unit cross section of flow = 0.87 ft

ds = **0.22** ft

Method 5 **ds = dma*((Vm/Vc)-1)**
Vm = mean velocity = 1.81/0.78 fps
Vc = 0.5 fps

ds = **3.17** ft

AVERAGE SCOUR DEPTH = **1.30 ft**
minimum depth of downstream edge scour barrier

ATTACHMENT H

ROCK TEST RESULTS

BLANDING AREA GRAVEL PITS

PREPARED BY

INTERNATIONAL URANIUM (USA) CORP.

INDEPENDENCE PLAZA

1050 17TH STREET, SUITE 950

DENVER, CO 80265

TO: Harold R. Roberts cc: William N. Deal

FROM: Robert A. Hembree

DATE: November 20, 1998

SUBJECT: Rock Test Results – Blanding Area Gravel Pits

Attached you will find the results for lab tests that were performed on rock samples obtained from three gravel sources around the White Mesa Mill. These samples were taken from the Cow Canyon pit located just north of Bluff (15 miles south of the mill), the Brown Canyon pit located on the east side of Recapture Canyon four miles northeast of the mill, and the North Pit located one mile northeast of Blanding. A 75 pound sample of material was collected from each site, each sample was crushed and screened to a +1/2 –1 ½ inch size. Testing was performed by Western Colorado Testing in Grand Junction, Colorado. All samples were tested for specific gravity, absorption, sulfate soundness and L.A. Abrasion.

Test results indicate that all three sites score high enough to be used as rip rap sources for the reclamation cover at the mill (see attached scoring calculations). The Cow Canyon site scores high enough that there would be no over-sizing required; it is suitable for use in channels as well as on side and top slopes. The Brown Canyon site requires the most over-sizing at nineteen percent (19%). The North Pit material would require over-sizing of 9.35%. These test results prove that there are sources of rip rap material within a reasonable distance of the mill site. The average over-sizing factor for the three sites is 9.5%, which is well below the 25% number used in the 1996 reclamation cost estimate. The over-sizing factor used in the Titan Design Study was also 25%.

Based on the results of the testing IUC could use any of these three sites. The North Pit would be the most reasonable choice of material sites since it has a lower over-sizing factor than the Brown Canyon site and is closer to the mill than the Cow Canyon site. The North Pit also has the advantage of being an established public pit on BLM administered land.

RAH/rah

NRC Rip Rap Scoring Calculations

Weighting Factors for Igneous Rocks
Oversizing for side slopes, top slopes, and well drained toes and aprons
Rock Scoring less than 50% is rejected, rock scoring over 80% does not require oversizing

Cow Canyon Pit (Bluff)

Lab Test	Lab Results	Score	Weight	Score x Weight	Max. Score
Specific Gravity	2.63	7.5	9	67.5	90
Absorption, %	0.47	8.25	2	16.5	20
Sodium Sulfate Sound., %	0.2	10	11	110	110
L.A. Abrasion, %	6.4	7.5	1	7.5	10
Totals				201.5	230

Overall Score 87.61 %

Oversizing none %

Brown Canyon Site

Lab Test	Lab Results	Score	Weight	Score x Weight	Max. Score
Specific Gravity	2.525	5.5	9	49.5	90
Absorption, %	2.61	1.75	2	3.5	20
Sodium Sulfate Sound., %	5.5	7.5	11	82.5	110
L.A. Abrasion, %	10.3	4.75	1	4.75	10
Totals				140.25	230

Overall Score 60.98 %

Oversizing 19.02 %

North Pit (N. Blanding)

Lab Test	Lab Results	Score	Weight	Score x Weight	Max. Score
Specific Gravity	2.557	6.25	9	56.25	90
Absorption, %	2.84	1.25	2	2.5	20
Sodium Sulfate Sound., %	3.2	8.75	11	96.25	110
L.A. Abrasion, %	6.3	7.5	1	7.5	10
Totals				162.5	230

Overall Score 70.65 %

Oversizing 9.35 %

WESTERN COLORADO TESTING, INC.
529 25 1/2 Road, Suite B-101
Grand Junction, Colorado 81505
(970) 241-7700 • Fax (970) 241-7783

November 16, 1998
WCT #811898

International Uranium USA Corporation
Independence Plaza
1050 17th Street
Denver, Colorado 80265

Attention: Mr. Bob Hembree

Reference: Rock Durability Testing

As requested, three (3) potential sources of riprap for use in reclamation of tailings ponds in Blanding, Utah were tested for rock durability. The riprap material was obtained, crushed to testing size, and delivered to Western Colorado Testing, Inc. by the client. The three sources of material were tested for specific gravity and absorption (ASTM C127), Sodium Sulfate Soundness (ASTM C88), and Los Angeles Abrasion (ASTM C131). The results of the testing are provided below.

Material Source: Cow Canyon	
Test	**Result**
Bulk Specific Gravity, g/cc	2.630
SSD Specific Gravity, g/cc	2.642
Apparent Specific Gravity, g/cc	2.663
Water Absorption, %	0.47
Sodium Sulfate Soundness, Avg. % Loss	0.2
L.A. Abrasion, % Loss @ 100 Rev.	6.4

Material Source: Brown Canyon	
Test	**Result**
Bulk Specific Gravity, g/cc	2.460
SSD Specific Gravity, g/cc	2.525
Apparent Specific Gravity, g/cc	2.629
Water Absorption, %	2.61
Sodium Sulfate Soundness, Avg. % Loss	5.5
L.A. Abrasion, % Loss @ 100 Rev.	10.3

Material Source: North Pit	
Test	**Result**
Bulk Specific Gravity, g/cc	2.485
SSD Specific Gravity, g/cc	2.557
Apparent Specific Gravity, g/cc	2.674
Water Absorption, %	2.84
Sodium Sulfate Soundness, Avg. % Loss	3.2
L.A. Abrasion, % Loss @ 100 Rev.	6.3

If there are any questions or if additional testing is needed, please feel free to contact our office.

Respectfully Submitted:
WESTERN COLORADO TESTING, INC.

Kyle Alpha
Construction Services Manager

KA/mh
Mab:jobs\81181.1116