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January 14, 2011

VIA E-MAIL AND OVERNIGHT DELIVERY

Rusty Lundberg
Utah Department of Environmental Quality
195 North 1950 West
P.O. Box 144810
Salt Lake City, UT 84114-4820

DRC-2011-001189

Re: State of Utah Division of Radiation Control ("DRC") Request for Information Letter of January 12, 2011 Regarding Reclamation Plan Revision 3.2A, Utah Radioactive Materials License UT1900479

Dear Mr. Lundberg:

This letter transmits Denison Mines (USA) Corp's proposed addendum, entitled Revision 3.2 Edition B to the approved Reclamation Plan Revision 3.0 and submittals referred to as Revision 3.1 for White Mesa Mill ("Revision 3.0/3.1"). This letter also responds to DRC's Request for information ("RFI") letter of January 12, 2011 requesting additional changes to previously submitted versions of this document. As requested in the DRC letter, the addendum has been entitled Reclamation Plan Revision 3.2.Edition B ("Revision 3.2.B"). and all changes have been linked to the previously approved version, Revision 3.0/3.1.

Reclamation Plan Revision 3.2.B consists of:

- the contents of approved Revision 3.0 and submittals referred to as Revision 3.1,
- additional changes as requested in DRC's RFI letter of November 30, 2010, and
- additional changes as requested in DRC's RFI letter of January 12, 2011.

For ease of comparison, the Addendum Revision 3.2..B has been developed from, and all redlined changed linked to, the approved Revision 3.0/3.1. For ease of review, the text sections included in the Addendum have been provided in both redline/strikeout and black-line ("clean") form, which are provided, respectively, as Attachments 1 and 2 to this letter. These revisions incorporate all the changes requested in DRC's above-named letters.

Denison requests that UDEQ review and approve the attachments to this letter.

Denison has provided, below, specific responses to each request in DRC's RFI letter. The sections and numbering of the remainder of this letter follow that of the RFI. Each DRC request is shown in italics, below, followed by Denison's response.

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DEQ Comments and Responses

1. Our letter of November 30, 2010, paragraph 3, stated that, "Existing Figure A-S.1-2 in approved Revision 3.1 appears to contain cross Sections and details which are essential to be retained in the Reclamation Plan."

a. Therefore, existing Figure A-5.1-2 must somehow be retained 'and not replaced by the Addendum..."

Recap:

The referenced Figure·A-5.1-2 in Reclamation Plan Rev. 3.1 (labeled on the figure to include drawings through Rev. No.4 dated July 9, 2008), provides Section A-A' and Details 1 through 3. The figure is titled, "... Reclamation Cover Details. and Cross Section."

In contrast, Reclamation Plan Rev. 3.2 provided a Figure A-51-2 titled, "Reclamation Cover and Cross Sections ... " This figure provided Sections B-B', C-C', and D-D'. Not the same sections or details as Rev. 3.1. As stated in DUSA's letter of June 29, 2010, it appeared that this figure was provided as a "replacements for" the figure of the. same figure number. However, the latter Figure A-5.1-2 (Rev. 3.2) does not contain any of the drawings provided in the earlier Rev. 3.1 figure of the same name. Therefore, to keep the original drawing concepts provided on Figure A-5.1-2 (Rev. 3.1), DRC requested that the, "existing Figure A-5 .1-2 must somehow be retained and not replaced by the Addendum ... "

Comment:

After receipt of the subject letter of December 20~ 2010, we have compared the submitted figures in Rev. 3.2A with the corresponding previous figures in Rev. 3.1. It appears that proposed Figures A-5.1-2 and A-5.1-3 are not the same as the Rev. 3.1 figures of the same number. Also, some correction to the drawings is needed.

In as much as these figures are to replace the corresponding figures of the same number as part of a formal addendum, we request you please correct the following:

a. Correct a transposition of figure numbers by changing the figure numbers proposed as Figures A-5.1-2 and A-5.1-3 in Rev. 3.2A to correspond to the figures of the same number from Rev. 3.1.

Denison Response: The transposition of figure numbers has been corrected.

b. Section D-D' needs to be revised to include the addition of Cell 4B.

Denison Response: Section D-D' has been revised to include Cell 4B.

2. In Rev. 3.2A, Appendix G, a technical memorandum from MWH dated January 29, 2010 is provided. This gives the design justification for the 6-inch thick filter blanket on cell outside slopes of the cells. This memo was not provided in the subject Emails sent. This item must be provided in electronic format as well as the paper copy of the Reclamation Plan.

Denison Response: The MWH memo has been included in paper and digital formats..

3. In our letter of November 30, 2010, we requested that, "the cover and the text of Reclamation Plan be revised to state that Reclamation Plan Revision 3.2 is in the form of an Addendum to Reclamation Plan 3.0 and 3.1." However, the subject DUSA December 20, 2010 letter *describes Rev. 3.2A is an addendum to proposed Rev. 3.2. This designation will lead to confusion, which must be avoided. Please revise the plan's cover, text and transmittal letter to show that the next version, e.g. Rev. 3.2B, is an addendum to Rev. 3.0 and Rev. 3.1 (which have already been approved by the DRC). Rev. 3.2B needs to be complete, and not rely on the previous Rev. 3.2 or 3.2A addendums.*

a. In response to our letter mentioned above, the DUSA letter of December 20, 2010 provides replacement cover, which states, "Addendum/Changed Pages for the White Mesa Mill and Tailings Management System." However, the Reclamation Plan addendum cover needs to be edited to be explicit and accurate as to what the addendum applies to in accordance with the above paragraph.

Denison Response: The cover has been changed..

b. Also, the text of the Reclamation Plan addendum (Rev. 3.2A) does not address this point, as requested in the mentioned DRC letter. A separate preface page in the addendum may be an appropriate method to address our request.

Denison Response: A Preface page has been added.

c. Please assure that Rev. 3.2.B is complete, and does not rely on the previous Rev. 3.2 or 3.2A addendums.

Denison Response: Revision 3.2.B is complete and has been linked to the approved Revision 3.0/3.1.

4. The upcoming revised edition of the Reclamation Plan Revision 3.2 (i.e. a revision of the Addendum) will need to be identified by a unique edition name, but still retain the Reclamation Plan Revision 3.2 label, e.g. "Edition B," or other method for identifying the unique edition.

Denison Response: As requested, the Plan has been identified as Revision 3.2 Edition B or "Revision 3.2.B."

5. We recognize that in the process of DRC review and DUSA response that identification needs will require designation of editions or versions such as B, C, etc. However, we request that when the final revision is ready for approval that DUSA submit a final document labeled as Rev.3.2-final.

Denison Response: Comment Noted.

Please contact the undersigned if you have any questions or require any further information.

Yours very truly,

DENISON MINES (USA) CORP.

Jo Ann Tischler

Jo Ann Tischler
Director, Compliance and Permitting

cc: David C. Frydenlund

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Harold R. Roberts
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White Mesa Mill Reclamation Plan

Revision 3.2 Edition B ("Revision 3.2.B")

Addendum/Changed Pages

for the

White Mesa Mill and Tailings Management System

January 2011

State of Utah11e.(2) Byproduct Material License # UT1900479

Revision 3.2.B constitutes an Addendum to Approved Revision 3.0 and 3.1 of the White Mesa Mill Reclamation Plan

PREFACE

This document contains Revision 3.2 Edition B (Revision 3.2.B), an Addendum to the White Mesa Mill Reclamation Plan Rev. 3.0 and 3.1. The White Mesa Mill Reclamation Plan Revision 3.2.B does the following:

- Completely replaces the content of Rev. 3.1, by replacing Figures A-5.1-1, A-5.1-2 and A-5.1-3 of Rev. 3.1, which was the entire content of Rev. 3.1.
- For Rev. 3.0, replaces with revised documents the text, figures, tables, appendices, and attachments included under this cover that correspond to the same items in existing Revision 3.0.
- Adds the new documents under this cover to the Reclamation Plan.
- Maintains the remaining balance of the contents of Approved Revision 3.0,

The contents of this Addendum, when combined with the existing approved Revision 3.0/3.1 as described above, constitute the complete current version of the White Mesa Mill Reclamation Plan.

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Introduction

White Mesa Mill Reclamation Plan Revision 3.2.B

for

Reclamation

of the

White Mesa Mill and Tailings Management System

January 2011

State of Utah11e.(2) Byproduct Material License # UT1900479

INTRODUCTION

This reclamation Plan (the "Plan") prepared by Denison Mines(USA) Corp. ("Denison"), for Denison's White Mesa Uranium Mill (the "Mill"), located approximately 6.0 miles south of Blanding Utah. The Plan presents Denison's plans and estimated costs for the reclamation of the Mill's tailings Cells 1, 2, 3, 4A and 4B, and for decommissioning of the Mill and Mill site.

Summary of Plan

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.
- Alternate feed Circuit
- Truck Shop.
- Temporary Storage 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. Any uncontaminated or decontaminated equipment to be considered for salvage will be released in accordance with the United States Nuclear Regulatory Commission ("NRC") document,guidance and in compliance with the conditions of the Mill's State of Utah Radioactive materials License No. UT1900479 (the "License"). As with the equipment for disposal, any contaminated soils from the Mill and surrounding areas and any ore or feed materials on the Mill site 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 set out in Attachment C. Attachment C will be reviewed and updated on a yearly basis.

Plan Organization

General site characteristics pertinent to this 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 Section1.6.3.

The Plan itself, 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 which have been reproduced as appendices for ease of review, include:

- Semi-Annual Effluent Reports, (January through June 2008), (June through December 2008) and (January through June 2009) for the Mill, Which have been submitted previously on November 24, 2009;

- Site hydrogeology and Estimation of Groundwater Travel Times in the Perched Zone White Mesa Uranium Mill Site Near Blanding, Utah, August 27, 2009, prepared by Hydro Geo Chem, Inc. (the "2009 HGC Report), submitted previously on November 24, 2009;

- The Mill's *Stormwater Best Management Practices Plan*, Revision 1.3: June 12, 2008, submitted previously on November 24, 2009;

- Tailings Cover Design, White Mesa Mill, October 1996. submitted previously on November 24, 2009;

- *National Emissions Standards for Hazardous Air Pollutants* Radon Flux Measurement Program, White Mesa Mill Site,2008. Tellco Environmental, submitted previously on November 24, 2009; and

- *Semi-Annual Monitoring Report July 1 – December 31, 2008 and Annual Monitoring Summary for 2008, White Mesa Mill Meteorological Station*, January 20, 2009 McVehil-Monnett Associates, Inc., submitted previously on November 24, 2009.

As required by Part I.H.11 of the Mill's State of Utah Ground Water Discharge Permit No. UGW370004 (the "GWDP"), Denison is in the process of completing an infiltration and contamination transport model of the final tailings cover system to demonstrate the long-term ability of the cover to protect nearby groundwater quality. Upon review of such modeling, the executive Secretary of the State of Utah radiation Control Board (the "Executive Secretary") will determine if changes to the cover system as set out in the Plan are needed to ensure compliance with the performance criteria contained in Part I.D.8 of the GWDP. Although the modeling has not been completed, modeling results to date suggest that some changes to the final cover design as set out in the Plan will be needed. However, as the details of such re-design have not been finalized at this time, the approved 2000 cover design and basis will continue to be used for this version of the Plan. This Plan will be amended in the future to incorporate any changes to the design of the tailings cover system that result from the current modeling effort.

INTRODUCTION

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This document reclamation Plan (the "Plan") prepared by International Uranium Denison Mines(USA) Corporation, ("IUSADenison"), for Denison's White Mesa Uranium Mill (the "Mill"), located approximately 6.0 miles south of Blanding Utah. The Plan presents IUSA'sDenison's plans and estimated costs for the reclamation of the Mill's tailings Cells 1-I, 2, 3, 4A and 4B, and for decommissioning of the White Mesa Mill and Mill site.

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

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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.

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- Clarifiers to the west of the mill building including the preleach thickener and claricone.
- Boiler and all ancillary equipment and buildings.

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- 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.
- Alternate feed Circuit
- Truck Shop.
- Temporary Storage Building

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These decommissioned areas would include, but not be limited to, the following:

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- Coarse ore bin and associated equipment, conveyors and structures.

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- Boiler and all ancillary equipment and buildings.
- Entire vanadium precipitation, drying, and fusion circuit.

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- 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 United States Nuclear Regulatory Commission ("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-1358guidance and in compliance with the conditions of the Mill's State of Utah Radioactive materials License No. UT1900479 (the "License"). As with the equipment for disposal, any contaminated soils from the mMill and surrounding areas and any ore or feed materials on the Mill site will be disposed of in the tailings facilities in accordance with Section 4.0 of Attachment A, Plans and Specifications.

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The estimated reclamation costs for surety are ~~summarized as follows:~~set out in Attachment C. Attachment C will be reviewed and updated on a yearly basis.

~~White Mesa Reclamation~~
~~Cost Summary~~

~~Direct Costs~~		
~~Mill Decommissioning~~		~~1,505,166~~
~~Cell 1 Reclamation~~		~~933,169~~
~~Cell 2 Reclamation~~		~~1,082,869~~
~~Cell 3 Reclamation~~		~~1,565,444~~
~~Cell 4A Reclamation~~		~~120,128~~
~~Misc. Items (Project General)~~		~~1,939,480~~
	~~Subtotal Direct:~~	~~$7,146,257~~
~~Profit Allowance~~	~~10%~~	~~714,626~~
~~Contingency~~	~~15%~~	~~1,071,939~~
~~Licensing and Bonding~~	~~2%~~	~~142,925~~
~~Long-Term Care Fund~~		~~606,721~~
	~~Total Surety Requirement:~~	~~$9,682,467~~

~~REPORT ORGANIZATION~~Plan Organization

General site characteristics pertinent to ~~the reclamation~~ this ~~p~~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~~1.6.3.

The ~~Reclamation~~ Plan itself, 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.

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

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- Semi-Annual Effluent Reports, White Mesa Mill, SUA-1358, Docket No. 40-8681, (January through June 2008), (June through December 2008) and (July through December 1995January through June 2009) and Semi-Annual Effluent Report, White Mesa Mill, SUA-1358, Docket No. 40-8681, (January through June 1996) Energy Fuels Nuclear, Inc. for the Mill, Which have been submitted previously on November 24, 2009;

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- Points of Compliance, White Mesa Uranium Mill, September 1994. Titan. The Mill's *Stormwater Best Management Practices Plan*, Revision 1.3: June 12, 2008, submitted previously on November 24, 2009;

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As required by Part I.H.11 of the Mill's State of Utah Ground Water Discharge Permit No. UGW370004 (the "GWDP"), Denison is in the process of completing an infiltration and contamination transport model of the final tailings cover system to demonstrate the long-term ability of the cover to protect nearby groundwater quality. Upon review of such modeling, the executive Secretary of the State of Utah radiation Control Board (the "Executive Secretary") will determine if changes to the cover system as set out in the Plan are needed to ensure compliance with the performance criteria contained in Part I.D.8 of the GWDP. Although the modeling has not been completed, modeling results to date suggest that some changes to the final cover design as set out in the Plan will be needed. However, as the details of such re-design have not been finalized at this time, the approved 2000 cover design and basis will continue to be used for this version of the Plan. This Plan will be amended in the future to incorporate any changes to the design of the tailings cover system that result from the current modeling effort.

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Section 2.0 Existing Facility

White Mesa Mill Reclamation Plan
Revision 3.2.B

for

Reclamation

of the

White Mesa Mill and Tailings Management System

January 2011

State of Utah11e.(2) Byproduct Material License # UT1900479

2.0 EXISTING FACILITY

The following sections describe the construction history of the 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 Mill is a uranium/vanadium mill that 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 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, Denison (then named International Uranium (USA) Corporation) and its affiliates purchased the assets of EFN and is the current owner of the facility. Throughout this Plan, the names Denison and IUSA are used interchangeably.

2.1.1 Mill and Tailings Management Facility

The Source Materials License Application for the White Mesa Mill was submitted to NRC on February 8, 1978. Between that 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 United States Environmental Protection Agency ("EPA") 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 on June 29, 1981, and Cell 3 on September 2, 1982. In January of 1990 an additional cell, designated Cell 4A, was completed and initially used solely for solution storage and evaporation. Cell 4A was only used for a short period of time and then taken out of service because of concerns about the synthetic lining system. IN 2007, Cell 4A was retrofitted with a new State of Utah approved lining system and was put back into service in October of 2008. Cell 4B construction was authorized by License Amendment No. 4, issued on June 17, 2010, and the cell is currently under construction.

The Cell 4A and 4B design and operational details are more specifically described in the following documents, hereby incorporated by reference:

1) Cell 4A Construction Quality Assurance Report, July 2008
2) Cell 4B Construction Quality Assurance Report, November 2010
3) Discharge Minimization technology Monitoring Plan, Revision 11, and Best Available Technology Operations and Maintenance Plan revision 2, November 12, 2010 (under review).

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 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 Mill was shut down during all of 1984. The Mill operated at least part of each year from 1985 through 1990. Mill operations 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. After acquisition of the Mill by Denison and its affiliates several local mines were restarted and the Mill processed conventional ores during 1999 and early 2000. With the resurgence in uranium and vanadium process in 2003, Denison reopened several area mines and again began processing uranium and vanadium ores in April of 2008. Mill operations were suspended in 2009, and resumed in March of 2010. Typical employment figures for the Mill are 110 during uranium-only operations and 140 during uranium/vanadium operations.

Commencing in the early 1990's through today, the Mill has processed alternate feed materials from time to time when the Mill has been processing conventional ores. Alternate feed materials are uranium-bearing materials other than conventionally-mined uranium ores. The Mill installed an alternate feed circuit in 2009 that allows the Mill to process certain alternate feed materials simultaneously with conventional ores.

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 same basic process steps used for the recovery of uranium from conventional ores are used for the recovery of uranium from alternate feed materials, with some variations depending on the particular alternate feed material.

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 of conventional ore were processed. During the third operational period from July 1988 through November 1990, 1,015,032 tons of conventional ore were processed. During the fourth operational period from August 1995 through January 1996, 203,317 tons of conventional ore were processed. In the fifth operational period from May 1996 through September 1996, the Mill processed 3,868 tons of calcium fluoride alternate feed material. From 1997 to early 1999,, the Mill processed 58,403 tons from several additional feed stocks.

With rising uranium prices in the late 1990's, company mines were reopened in 1997, and 87,250 tons of conventional ore were processed in 1999 and early 2000. In 2002 and 2003, the Mill processed 266,690 tons of alternate feed material from government cleanup projects. An additional 40,866 tons of alternate feed materials were processed in 2007. From April 2008 through May 2009 the Mill processed an additional 184,795 tons of conventional ore.

Inception to date material processed through May 2009 totals 4,128,468 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. Tailings from alternate feed materials that are similar physically to conventional ores, which comprise most of the tons of alternate feed materials processed to date at the Mill, are similar to the tailings for conventional ores. Tailings from some of the higher grade, lower volume alternate feed materials may vary somewhat from the tailings from conventional ores, primarily in moisture and density 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 1 was previously referred to as Cell 1-I, but is now referred to as Cell 1);
- Cell 2, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands. This Cell is full and has been partially reclaimed;
- Cell 3, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands and solutions. This cell is partially filled and has been partially reclaimed; and
- Cell 4A, constructed with a geosynthetic clay liner, a 60 Millimeter (mil) HDPE liner, a 300 mil HDPE geonet drainage layer, a second 60 mil HDPE liner, and a slimes drain network over the entire cell bottom. This cell was placed into service in October of 2008.
- Cell 4B, will be constructed with a geosynthetic clay liner, a 60 Millimeter (mil) HDPE liner, a 300 mil HDPE geonet drainage layer, a second 60 mil HDPE liner, and a slimes drain network over the entire cell bottom. This cell will be constructed during the 2010 construction season.

Total estimated design capacity of Cells 2, 3, and 4A is approximately six million (mm) tons. Figures 1.5-4 and 1.5-5 show the locations of the tailings cells.

Denison has submitted an application to the Executive Secretary to amend the License and GWDP to authorize the construction of tailings Cell 4B, which will be located adjacent to Cell 4A and will provide approximately two million additional tons of tailings capacity. That application was approved by the Executive Secretary on June 17, 2010.

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.

Slurry disposal has taken place in Cells 2, 3 and 4A. Tailings placement in Cell 2 and Cell 3 was accomplished by means of the final grade method, described below.

The final grade method used in Cell 2 and 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. Coarse tailings sand from the discharge points are graded into low areas to reach the final disposal elevation. 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.

Slurry disposal in Cell 4A is from several pre-determined discharge points located around the north and east sides of the cell. Slurry discharge is only allowed on skid pads, or protective HDPE sheets, to prevent damage to the synthetic lining system. Once tailings solids have reach the maximum elevation around the perimeter of the cell, discharge points can be moved toward the interior of the cell. Slurry disposal in Cell 4B will be conducted in the same manner as Cell 4A.

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 three (3) areas:

- Cell 1, which is used for solutions only;
- Cell 3, in which tailings and solutions exist;
- Cell 4A, in which tailings and solutions exist, and
- Cell 4B after construction is complete.

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, 3, and 4A are brought back to the CCD circuit where metallurgical benefit can be realized. Cell 4B will be operated in the same manner as Cell 4A. 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 Monitoring and Reporting Under the Mill's GWDP

2.3.1.1 Groundwater Monitoring

a) Plugged and Excluded Wells

Wells MW-6, MW-7, and MW-8 were plugged because they were in the area of Cell 3, as was MW-13, in the Cell 4A area. Wells MW-9 and MW-10 are dry and have been excluded from the monitoring program. MW-16 is dry and has been plugged as part of the tailings Cell 4B construction.

b) Groundwater Monitoring at the Mill Prior to Issuance of the GWDP

At the time of renewal of the License by NRC in March, 1997 and up until issuance of the GWDP in March 2005, the Mill implemented a groundwater detection monitoring program to ensure compliance to 10 CFR Part 40, Appendix A, in accordance with the provisions of the License. The detection monitoring program was in accordance with the report entitled, *Points of Compliance, White Mesa Uranium Mill*, prepared by Titan Environmental Corporation, submitted by letter to the NRC dated October 5, 1994 (Titan, 1994b). Under that program, the Mill sampled monitoring wells MW-5, MW-11, MW-12, MW-14, MW-15 and MW-17, on a quarterly basis. Samples were analyzed for chloride, potassium, nickel and uranium, and the results of such sampling were included in the Mill's Semi-Annual Effluent Monitoring Reports that were filed with the NRC up until August 2004 and with the DRC subsequent thereto.

Between 1979 and 1997, the Mill monitored up to 20 constituents in up to 13 wells. That program was changed to the Points of Compliance Program in 1997 because NRC had concluded that:

- The Mill and tailings system had produced no impacts to the perched zone or deep aquifer; and
- The most dependable indicators of water quality and potential cell failure were considered to be chloride, nickel, potassium and natural uranium.

c) Issuance of the GWDP

On March 8, 2005, the Executive Secretary issued the GWDP, which includes a groundwater monitoring program that supersedes and replaces the groundwater monitoring requirements set out in the License. Groundwater monitoring under the GWDP commenced in March 2005, the results of which are included in the Mill's *Quarterly Groundwater Monitoring Reports* that are filed with the Executive Secretary.

d) Current Ground Water Monitoring Program at the Mill Under the GWDP

The current groundwater monitoring program at the Mill under the GWDP consists of monitoring at 22 point of compliance monitoring wells: MW-1, MW-2, MW-3, MW-3A, MW-5, MW-11, MW-12, MW-14, MW-15, MW-17, MW-18, MW-19, MW-23, MW-24, MW-25, MW-26, MW-27, MW-28, MW-29, MW-30, MW-31 and MW-32. The locations of these wells are indicated on Figure 1.5-2.

Part I.E.1.(c) of the GWDP requires that each point of compliance well must be sampled for the following constituents:

Table 2.3-1
Groundwater Monitoring Constituents Listed in Table 2 of the GWDP

Nutrients:
Ammonia (as N)
Nitrate & Nitrite (as N)

Heavy Metals:
Arsenic
Beryllium
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Silver
Thallium
Tin
Uranium
Vanadium
Zinc

Radiologics:
Gross Alpha

Volatile Organic Compounds:
Acetone
Benzene
2-Butanone (MEK)
Carbon Tetrachloride
Chloroform
Chloromethane
Dichloromethane
Naphthalene
Tetrahydrofuran
Toluene
Xylenes (total)

Others:
Field pH (S.U.)
Fluoride
Chloride
Sulfate
TDS

Further, Part I.E.1.(c) of the GWDP, requires that, in addition to pH, the following field parameters must also be monitored:

- Depth to groundwater
- Temperature
- Tubidity
- Specific conductance,

and that, in addition to chloride and sulfate, the following general organics must also be monitored:

- Carbonate, bicarbonate, sodium, potassium, magnesium, calcium, and total anions and cations.

Sample frequency depends on the speed of ground water flow in the vicinity of each well. Parts I.E.1(a) and (b) of the GWDP provide that quarterly monitoring is required for all wells where local groundwater average linear velocity has been found by the Executive Secretary to be equal to or greater than 10 feet/year, and semi-annual monitoring is required where the local groundwater average linear velocity has been found by the Executive Secretary to be less than 10 feet/year.

Based on these criteria, quarterly monitoring is required at MW-11, MW-14, MW-25, MW-26, MW-30 and MW-31, and semi-annual monitoring is required at MW-1, MW-2, MW-3, MW-3A, MW-5, MW-12, MW-15, MW-17, MW-18, MW-19, MW-23, MW-24, MW-27, MW-28, MW-29 and MW-32.

2.3.1.2 Deep Aquifer

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. Due to the fact that the deep confined aquifer at the site is hydraulically isolated from the shallow perched aquifer, no monitoring of the deep aquifer is required under the GWDP.

2.3.1.3 Seeps and Springs

Pursuant to Part I.H.8 of the GWDP, Denison has a *Sampling Plan for Seeps and Springs in the Vicinity of the White Mesa Uranium Mill*, Revision: 0, March 17, 2009 (the "SSSP") that requires the Mill to perform groundwater sampling and analysis of all seeps and springs found downgradient or lateral gradient from the tailings cells.

Under the SSSP, seeps and springs sampling is conducted on an annual basis between May 1 and

July 15 of each year, to the extent sufficient water is available for sampling, at five identified seeps and springs near the Mill. The sampling locations were selected to correspond with those seeps and springs sampled for the initial Mill site characterization performed in the 1978 ER, plus additional sites located by Denison, the BLM and Ute Mountain Ute Indian Tribe representatives.

Samples are analyzed for all ground water monitoring parameters found in Table 2.3-1 above. The laboratory procedures utilized to conduct the analyses of the sampled parameters are those utilized for groundwater sampling. In addition to these laboratory parameters, the pH, temperature and conductivity of each sample will be measured and recorded in the field. Laboratories selected by Denison to perform analyses of seeps and springs samples will be required to be certified by the State of Utah in accordance with UAC R317-6-6.12.A.

The seeps and springs sampling events will be subject to the Mill's QAP, unless otherwise specifically modified by the SSSP to meet the specific needs of this type of sampling.

2.3.1.4 Discharge Minimization Technology and Best Available Technology Standards and Monitoring

2.3.1.4.1 General

Part I.D. of the GWDP sets out a number of Discharge Minimization Technology ("DMT") and Best Available Technology ("BAT") standards that must be followed. Part I.E. of the GWDP sets out the Ground Water Compliance and Technology Performance Monitoring requirements, to ensure that the DMT and BAT standards are met. These provisions of the GWDP, along with the *White Mesa Mill Tailings Management System and Discharge Minimization (DMT) Monitoring Plan*, 9/08 Revision: Denison-6 (the "DMT Plan"), the *Cell 4Aand 4B BAT Monitoring, Operations and Maintenance Plan R.evision 2.0* (under review) and other plans and programs developed pursuant to such Parts of the GWDP, set out the methods and procedures for inspections of the facility operations and for detecting failure of the system.

In addition to the programs discussed above, the following additional DMT and BAT performance standards and associated monitoring are required under Parts I.D and I.E. of the GWDP

b) Tailings Cell Operation

Part I.D.2 of the GWDP provides that authorized operation and maximum disposal capacity in each of the existing tailings Cells, 1, 2 and 3 shall not exceed the levels authorized by the License and that under no circumstances shall the freeboard be less than three feet, as measured from the top of the flexible membrane liner ("FML"). Part I.E.7(a) of the GWDP requires that the wastewater pool elevations in Cells 1 and 3 must be monitored weekly to ensure compliance with the maximum wastewater elevation criteria mandated by Condition 10.3 of the License.

Part I.D.2 further provides that any modifications by Denison to any approved engineering design parameter at these existing tailings cells requires prior Executive Secretary approval, modification of the GWDP and issuance of a construction permit.

c) Slimes Drain Monitoring

Part I.D.3(b)(1) of the GWDP requires that Denison must at all times maintain the average wastewater head in the slimes drain access pipe to be as low as reasonably achievable (ALARA) in each tailings disposal cell, in accordance with the approved DMT Plan. Compliance will be achieved when the average annual wastewater recovery elevation in the slimes drain access pipe, determined pursuant to the currently approved DMT Plan meets the conditions in Equation 1 specified in Part I.D.3(b)(1) of the GWDP.

Part I.E.7(b) of the GWDP requires that Denison must monitor and record monthly the depth to wastewater in the slimes drain access pipes as described in the currently approved DMT Plan at Cell 2, and upon commencement of de-watering activities, at Cell 3, in order to ensure compliance with Part I.D.3(b)(1) of the GWDP.

d) Maximum Tailings Waste Solids Elevation

Part I.D.3(c) of the GWDP requires that upon closure of any tailings cell, Denison must ensure that the maximum elevation of the tailings waste solids does not exceed the top of the FML.

e) Wastewater Elevation in Roberts Pond

Part I.D.3(e) of the GWDP requires that Roberts Pond be operated so as to provide a minimum 2-foot freeboard at all times, and that under no circumstances will the water level in the pond exceed an elevation of 5,624 feet above mean sea level. Part I.D.3(e) also provides that in the event the wastewater elevation exceeds this maximum level, Denison must remove the excess wastewater and place it into containment in Cell 1 within 72 hours of discovery.

Part I.E.7(c) of the GWDP requires that the wastewater level in Roberts Pond must be monitored and recorded weekly, in accordance with the currently approved DMT Plan, to determine compliance with the DMT operations standard in Part I.D.3(e) of the GWDP;

f) Inspection of Feedstock Storage Area

Part I.D.3(f) of the GWDP requires that open-air or bulk storage of all feedstock materials at the Mill facility awaiting Mill processing must be limited to the eastern portion of the Mill site (the "ore pad") described by the coordinates set out in that Part of the GWDP, and that storage of feedstock materials at the facility outside of this defined area, must meet the requirements of Part I.D.11 of the GWDP. Part I.D.11 requires that Denison must store and manage feedstock materials outside the defined ore storage pad in accordance with the following minimum performance requirements:

(i) Feedstock materials will be stored at all times in water-tight containers, and
(ii) Aisle ways will be provided at all times to allow visual inspection of each and every feedstock container, or

(iii) Each and every feedstock container will be placed inside a water-tight overpack prior to storage, or

(iv) Feedstock containers shall be stored on a hardened surface to prevent spillage onto subsurface soils, and that conforms with the following minimum physical requirements:

A. A storage area composed of a hardened engineered surface of asphalt or concrete, and

B. A storage area designed, constructed, and operated in accordance with engineering plans and specifications approved in advance by the Executive Secretary. All such engineering plans or specifications submitted shall demonstrate compliance with Part I.D.4 of the GWDP, and

C. A storage area that provides containment berms to control stormwater run-on and run-off, and

D. Stormwater drainage works approved in advance by the Executive Secretary, or

(v) Other storage facilities and means approved in advance by the Executive Secretary.

Part I.E.7(d) of the GWDP requires that Denison conduct weekly inspections of all feedstock storage areas to:

(i) Confirm that the bulk feedstock materials are maintained within the approved feedstock storage area specified by Part I.D.3(f) of the GWDP; and

(ii) Verify that all alternate feedstock materials located outside the approved feedstock storage area are stored in accordance with the requirements found in Part I.D.11 of the GWDP.

Part I.E.7(f) further provides that Denison must conduct weekly inspections to verify that each feed material container complies with the requirements of Part I.D.11 of the GWDP.

The Mill's Standard Operating Procedure under the License for inspection of the Mill's ore pad is contained in Section 3.3 of the DMT Plan.

g) Monitor and Maintain Inventory of Chemicals

Part I.D.3(g) of the GWDP requires that for all chemical reagents stored at existing storage facilities and held for use in the milling process, Denison must provide secondary containment to capture and contain all volumes of reagent(s) that might be released at any individual storage area. Response to spills, cleanup thereof, and required reporting must comply with the provisions of the Mill's *Emergency Response Plan*, which is found in the Mill's *Stormwater Best Management Practices Plan*, Revision 1.3; June 12, 2008 (a copy of which is included as Appendix C), as stipulated by Parts I.D.10 and I.H.16 of the GWDP. Part I.D.3(g) further provides that for any new construction of reagent storage facilities, such secondary containment and control must prevent any contact of the spilled or otherwise released reagent or product with the ground surface.

Part I.E.9 of the GWDP requires that Denison must monitor and maintain a current inventory of all chemicals used at the facility at rates equal to or greater than 100 kg/yr. This inventory must be maintained on-site, and must include:

(iii) Identification of chemicals used in the milling process and the on-site laboratory; and

(iv) Determination of volume and mass of each raw chemical currently held in storage at the facility.

2.3.1.5 BAT Performance Standards for Cell 4A and 4B

a) BAT Operations and Maintenance Plan

Part I.D.6 and Part I.D.13 of the GWDP provide that Denison must operate and maintain Cell 4A and Cell 4B, respectively, so as to prevent release of wastewater to groundwater and the environment in accordance with the Mill's *Cell 4A and 4B BAT Monitoring, Operations and Maintenance Plan*, pursuant to Part I.H.8 of the GWDP. The Mill's *Cell 4A* and Cell 4B *BAT Monitoring, Operations and Maintenance Plan*, 11/2010 Revision: Denison 2.0 (under review) includes the following performance standards:

(i) The fluid head in the leak detection system shall not exceed 1 foot above the lowest point in the lower membrane liner;

(ii) The leak detection system maximum allowable daily leak rate shall not exceed 24,160 gallons/day for Cell 4A or 26,145 gallons/day for Cell 4B;

(iii) After Denison initiates pumping conditions in the slimes drain layer in Cell 4A or Cell 4B, Denison will provide continuous declining fluid heads in the slimes drain layer, in a manner equivalent to the requirements found in Part I.D.3(b) for Cells 2 and 3; and

(iv) Under no circumstances shall the freeboard be less than 3 feet in Cell 4A or Cell 4B, as measured from the top of the FML.

b) Implementation of Monitoring Requirements Under the BAT Operations and Maintenance Plan

The *Cell 4A and 4B BAT Monitoring, Operations and Maintenance Plan* also requires Denison to perform the following monitoring and recordkeeping requirements.

(i) Weekly Leak Detection System (LDS) Monitoring - including:

A. Denison must provide continuous operation of the leak detection system pumping and monitoring equipment, including, but not limited to, the submersible pump, pump controller, head monitoring, and flow meter equipment approved by the Executive Secretary. Failure of any pumping or monitoring equipment not repaired and made fully operational within 24-hours of discovery shall constitute failure of BAT and a violation of the GWDP;

B. Denison must measure the fluid head above the lowest point on the secondary FML by the use of procedures and equipment approved by the Executive Secretary. Under no circumstance shall fluid head in the leak detection system sump exceed a 1-foot level above the lowest point in the lower FML on the cell floor. For purposes of compliance monitoring this 1-foot distance shall equate to 2.28 feet above the leak detection system transducer;

C. Denison must measure the volume of all fluids pumped from the leak detection system. Under no circumstances shall the average daily leak detection system flow volume exceed 24,160 gallons/day for Cell 4A or 26,145 gallons/day for Cell 4B; and

D. Denison must operate and maintain wastewater levels to provide a 3-foot Minimum of vertical freeboard in tailings Cell 4A and Cell 4B. Such measurements must be made to the nearest 0.1 foot.

(ii) Slimes Drain Recovery Head Monitoring

Immediately after the Mill initiates pumping conditions in the Cell 4A or Cell 4B slimes drain system, monthly recovery head tests and fluid level measurements will be made in accordance with the requirements of Parts I.D.3 and I.E.7(b) of the GWDP and any plan approved by the Executive Secretary.

2.3.1.6 Stormwater Management and Spill Control Requirements

Part I.D.10 of the GWDP requires that Denison will manage all contact and non-contact stormwater and control contaminant spills at the facility in accordance with the Mill's stormwater best management practices plan. The Mill's *Stormwater Best Management Practices Plan, Revision 1.3:* June 12, 2008 (a copy of which is included as Appendix C) includes the following provisions:

a) Protect groundwater quality or other waters of the state by design, construction, and/or active operational measures that meet the requirements of the Ground Water Quality Protection Regulations found in UAC R317-6-6.3(G) and R317-6-6.4(C);
b) Prevent, control and contain spills of stored reagents or other chemicals at the Mill site;
c) Cleanup spills of stored reagents or other chemicals at the Mill site immediately upon discovery; and
d) Report reagent spills or other releases at the Mill site to the Executive Secretary in accordance with UAC 19-5-114.

2.3.1.7 Tailings and Slimes Drain Sampling

Part I.E.8 of the GWDP requires that, on an annual basis, Denison must collect wastewater quality samples from each wastewater source at each tailings cell at the facility, including surface impounded wastewaters, and slimes drain wastewaters, pursuant to the Mill's *Tailings and Slimes Drain Sampling Program*, Revision 0, November 20, 2008 (the "WQSP"). All such sampling must be conducted in August of each calendar year.

The purpose of the WQSP is to characterize the source term quality of all tailings cell wastewaters, including impounded wastewaters or process waters in the tailings cells, and wastewater or leachates collected by internal slimes drains. The WQSP requires:

- Collection of samples from the pond area of each active cell and the slimes drain of each cell that has commenced de-watering activities;
- Samples of tailings and slimes drain material will be analyzed at an offsite contract laboratory and subjected to the analytical parameters included in Table 2 of the GWDP (see Table 2.3-1 above) and general inorganics listed in Part I.E.1(d)(2)(ii) of the GWDP, as well as semi-volatile organic compounds;
- A detailed description of all sampling methods and sample preservation techniques to be employed;
- The procedures utilized to conduct these analyses will be standard analytical methods utilized for groundwater sampling and as shown in Section 8.2 of the Mill's QAP;
- The contracted laboratory will be certified by the State of Utah in accordance with UAC R317-6-6.12A; and
- 30-day advance notice of each annual sampling event must be given, to allow the Executive Secretary to collect split samples of all tailings cell wastewater sources.

The tailings and slimes drain sampling events are subject to the Mill's QAP, unless otherwise specifically modified by the WQSP to meet the specific needs of this type of sampling.

2.3.2 Monitoring and Inspections Required Under the License

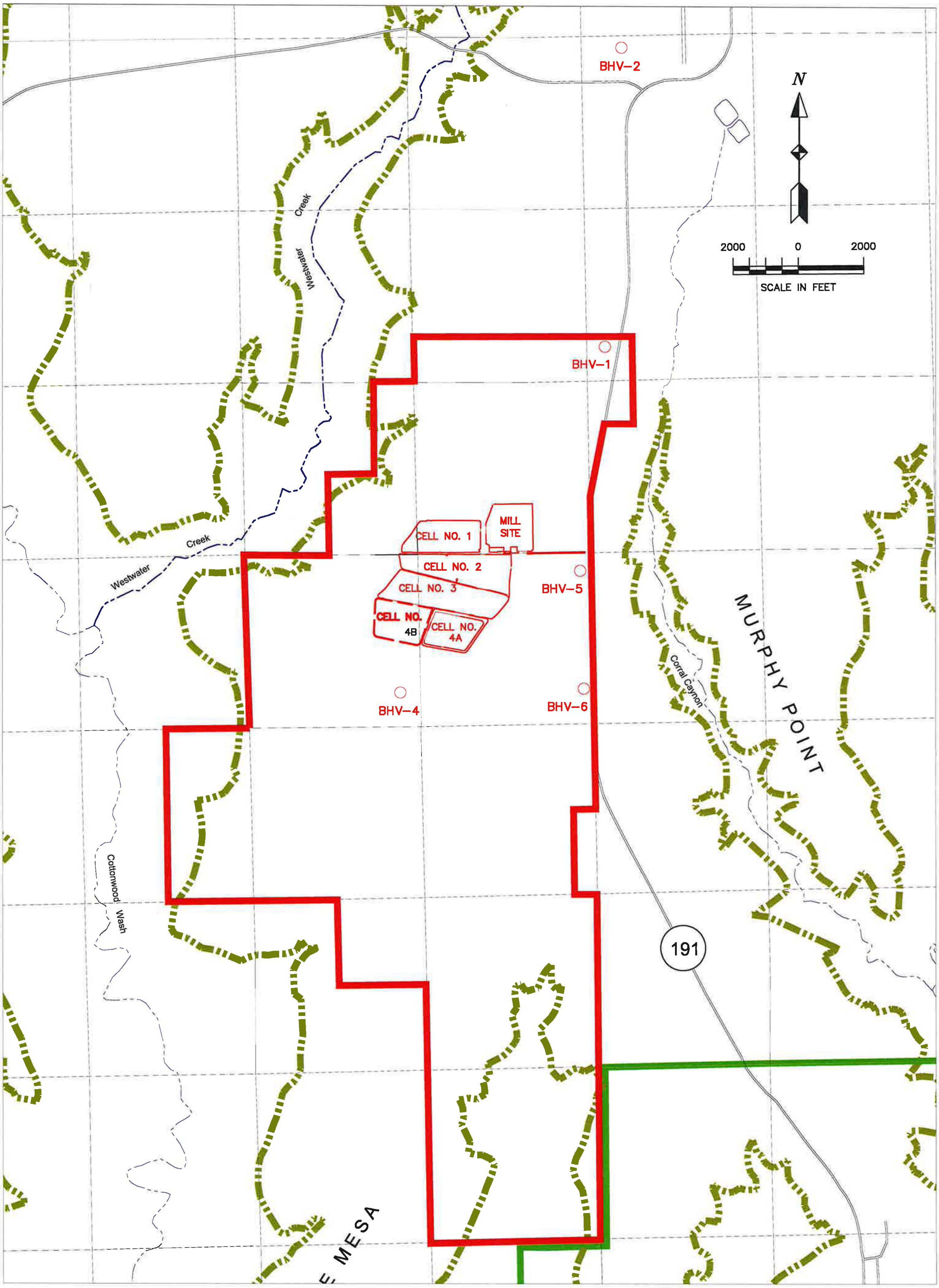
2.3.2.1 Environmental Monitoring

The environmental monitoring program is designed to assess the effect of Mill process and disposal operations on the unrestricted environment. Delineation of specific equipment and procedures is presented in the Mill's *Environmental Protection Manual,* included as Appendix A to the 2007 License Renewal Application.

c) Ambient Air Monitoring

(i) Ambient Particulate

Airborne radionuclide particulate sampling is performed at five locations, termed BHV-1, BHV-2, BHV-4, BHV-5 and BHV-6. With the approval of the NRC and effective November, 1995, BHV-3 was removed from the active air particulate monitoring program. At that time, the Mill proposed (and NRC determined) that a sufficient air monitoring data base had been compiled at station BHV-3 to establish a representative airborne particulate radionuclide background for the Mill. BHV-6 was installed by the Mill at the request of the White Mesa Ute Community. This station began operation in July of 1999 and provides airborne particulate information in the southerly direction between the Mill and the White Mesa Ute Community. Figure 2.3-1 shows the locations of these air particulate monitoring stations.



Property Boundary
Reservation Boundary
Canyon Rim
Air Monitor Stations

Denison Mines (USA) Corp.

Project	WHITE MESA MILL	
REVISIONS	County:	State: UT
Date / By	Location:	
11-09 / dls	Figure 2.3-1 High Volume Air Monitoring Stations	
01/13/11 / BM		
	Scale: as shown	Date: JAN 2011
	Author: HRR	Drafted By: B.Munkhbaatar

The present sampling system consists of high volume particulate samplers utilizing mass flow controllers to maintain an air flow rate of approximately 32 standard cubic feet per minute. Samplers are operated continuously with a goal for on-stream operating period at ninety percent. Filter rotation is weekly with quarterly site compositing for particulate radionuclide analysis. Analysis is done for U-natural, Th-230, Ra-226, and Pb-210.

See Section 3.13.1.7(a) of the 2007 ER for a summary of historic monitoring results for airborne particulate.

(ii) Ambient Radon

With the approval of the NRC, Radon-222 monitoring at the BHV stations was discontinued in 1995, due to the unreliability of monitoring equipment available at that time to detect the new 10 CFR standard of 0.1 pCi/l. From that time until the present, the Mill demonstrated compliance with the requirements of R313-15-301 by calculation authorized by the NRC in September 1995 and as contemplated by R313-15-302 (2) (a).

This calculation was performed by use of the MILDOS code for estimating environmental radiation doses for uranium recovery operations (Strenge and Bender 1981) in 1991 in support of the Mill's 1997 license renewal and more recently in 2007 in support of the 2007 License Renewal Application, by use of the updated MILDOS AREA code (Argonne 1998). The analysis under both the MILDOS and MILDOS AREA codes assumed the Mill to be processing high grade Arizona Strip ores at full capacity, and calculated the concentrations of radioactive dust and radon at individual receptor locations around the Mill. Specifically, the modeling under these codes assumed the following conditions:

- 730,000 tons of ore per year
- Average grade of 0.53% U_3O_8
- Yellowcake production of 4,380 tons of U_3O_8 per year (8.8 million pounds U_3O_8 per year).

Based on these conditions, the MILDOS and MILDOS AREA codes calculated the combined total effective dose equivalent from both air particulate and radon at the current nearest residence (approximately 1.2 miles north of the Mill), i.e., the individual member of the public likely to receive the highest dose from Mill operations, as well as at all other receptor locations, to be below the ALARA goal of 10 mrem/yr for air particulate alone as set out in R313-15-101(4). Mill operations are constantly monitored to ensure that operating conditions do not exceed the conditions assumed in the above calculations. If conditions are within those assumed above, radon has been calculated to be within regulatory limits. If conditions exceed those assumed above, then further evaluation will be performed in order to ensure that doses to the public continue to be within regulatory limits. Mill operations to date have never exceeded the License conditions assumed above.

In order to determine if detection equipment has improved since 1995, the Mill has, commencing with the first quarter of 2007, re-instituted direct measurements of radon at the five air particulate monitoring locations currently utilized for air particulate sampling. The reliability of this data is currently under review by Denison.

d) External Radiation

TLD badges, as supplied by Landauer, Inc., or equivalent, are utilized at BHV-1, BHV-2, BHV-3, BHV-4, BHV-5 and BHV-6 to determine ambient external gamma exposures (see Figure 2.3-1). System quality assurances are determined by placing a duplicate monitor at one site continuously. Exchanges of TLD badges are on a quarterly basis. Badges consist of a minimum of five TLD chips. Measurements obtained from location BHV-3 have been designated as background due to BHV-3's remoteness from the Mill site (BHV-3 is located approximately 3.5 miles west of the Mill site). For further procedural information see Section 4.3 of the Mill's *Environmental Protection Manual,* included as Appendix A to the 2007 License Renewal Application. See Section 3.13.1.7(c) of the 2007 ER for a summary of historic monitoring results for external radiation.

e) Soil and Vegetation

(i) Soil Monitoring

Soil samples from the top one centimeter of surface soils are collected annually at each of BHV-1, BHV-2, BHV-3, BHV-4 and BHV-5 (see Figure 2.3-1). A minimum of two kilograms of soil is collected per site and analyzed for U-natural and Ra-226. For further procedural information see Section 4.1 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. See Section 3.13.1.7.1 of the 2007 ER for a summary of the historic results for soil monitoring. The 2007 ER concludes that the results of sampling are low, less than the unrestricted release limits.

(i) Vegetation Monitoring

Forage vegetation samples are collected three times per year from animal grazing locations to the northeast (near BHV-l (the meteorological station)), northwest (to the immediate west of the site) and southwest (by BHV-4) of the Mill site. Samples are obtained during the grazing season, in the late fall, early spring, and in late spring. A minimum of three kilograms of vegetation are submitted from each site for analysis of Ra-226 and Pb-210. For further procedure information see Section 4.2 of the Mill's *Environmental Protection Manual* included as Appendix A to the

2007 License Renewal Application. See Section 3.13.7(d) of the 2007 ER for a summary of the historic results for vegetation monitoring. The 2007 ER concludes that the most recent results indicate no increase in uptake of Ra-226 and Pb-210 in vegetation.

d) Meteorological

Meteorological monitoring is done at a site near BHV-1. The sensor and recording equipment are capable of monitoring wind velocity and direction, from which the stability classification is calculated. Data integration duration is one-hour with hourly recording of mean speed, mean wind direction, and mean wind stability (as degrees sigma theta).

The data from the meteorological station is retrieved monthly by down loading onto a Campbell Scientific data module, or the equivalent. The data module is sent to an independent meteorological contractor where the module is downloaded to a computer record, and the data is correlated and presented in a Semi-Annual Meteorological Report.

Monitoring for precipitation consists of a daily log of precipitation using a standard NOAA rain gauge, or the equivalent, installed near the administrative office, consistent with NOAA specifications.

Windrose data is summarized in a format compatible with MILDOS and UDAD specifications for 40 CFR 190 compliance. For further procedural information see Section 1.3 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. A windrose for the site is set out in Figure 1.1-1.

e) Point Emissions

Stack emission monitoring from yellowcake facilities follows EPA Method 5 procedures and occurs on a quarterly basis, during operation of the facility. Particulate sampling is analyzed for Unat on a quarterly basis and for Th-230, Ra-226, and Pb-210 on a semi-annual basis. Demister and ore stack emission monitoring follows EPA Method 5 procedure on a semi-annual basis, during operation of the facility. Particulate samples are analyzed for Unat, Th-230, Ra-226, and Pb-210. Monitored data includes scrubber system operation levels, process feed levels, particulate emission concentrations, isokinetic conditions, and radionuclide emission concentrations. For further procedure information see Section 1.4 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. Historic stack emission data are summarized in Section 3.13.1.7(e) of the 2007 ER.

f) Surface Water Monitoring

Surface water monitoring is conducted at two locations adjacent to the Mill facility known as Westwater Canyon and Cottonwood Creek. Samples are obtained annually from Westwater and quarterly from Cottonwood using grab sampling. For Westwater Creek, samples will be of sediments if a water sample is not available. Field monitored parameters and laboratory monitored parameters are listed in Table 2.3-2. For further procedural information see Section 2.1 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. See Section 3.7.4 of the 2007 ER for a summary of the historic results for surface water monitoring.

Table 2.3-2
Operational Phase Surface Water Monitoring Program

Monitoring Sites
Westwater Creek and Cottonwood Creek

Field Requirements

1. Temperature C;
2. Specific Conductivity umhos at 25 C;
3. pH at 25 C;
4. Sample date;
5. Sample ID Code;

Vendor Laboratory Requirements

Semiannual*	Quarterly
One gallon Unfiltered and Raw	One gallon Unfiltered and Raw
One gallon Unfiltered, Raw and preserved to pH <2 with HNO_3	One gallon Unfiltered, Raw and Preserved to pH <2 with HNO_3
Total Dissolved Solids	Total Dissolved Solids
Total Suspended Solids	Total Suspended Solids
Gross Alpha	
Suspended Unat	
Dissolved Unat	
Suspended Ra-226	
Dissolved Ra-226	
Suspended Th-230	
Dissolved Th-230	

*Semiannual sample must be taken a minimum of four months apart.
**Annual Westwater Creek sample is analyzed for semi-annual parameters.
Radionuclides and LLDs reported in µCi/ml

2.3.2.2 Additional Monitoring and Inspections Required Under the License

Under the License daily, weekly, and monthly inspection reporting and monitoring are required by NRC Regulatory Guide 8.31, *Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities will be As Low As is Reasonable Achievable*, Revision 1, May 2002 ("Reg Guide 8.31"), by Section 2.3 of the Mill's ALARA Program and by the DMT Plan, over and above the inspections described above that are required under the GWDP. A copy of the Mill's ALARA Program is included as Appendix I to the 2007 License Renewal Application.

a) Daily Inspections

Three types of daily inspections are performed at the Mill under the License:

(i) Radiation Staff Inspections

Paragraph 2.3.1 of Reg. Guide 8.31 provides that the Mill's Radiation Safety Officer ("RSO") or designated health physics technician should conduct a daily walk-through (visual) inspection of all work and storage areas of the Mill to ensure proper implementation of good radiation safety procedures, including good housekeeping that would minimize unnecessary contamination. These inspections are required by Section 2.3.1 of the Mill's ALARA Program, and are documented and on file in the Mill's Radiation Protection Office.

(ii) Operating Foreman Inspections

30 CFR Section 56.18002 of the Mine Safety and Health Administration regulations requires that a

competent person designated by the operator must examine each working place at least once each shift for conditions which may adversely affect safety or health. These daily inspections are documented and on file in the Mill's Radiation Protection Office.

(iii) Daily Tailings Inspection

Paragraph 2.2 of the DMT Plan requires that during Mill operation, the Shift Foreman, or other person with the training specified in paragraph 2.4 of the DMT Plan, designated by the RSO, will perform an inspection of the tailings line and tailings area at least once per shift, paying close attention for potential leaks and to the discharges from the pipelines. Observations by the Inspector are recorded on the appropriate line on the Mill's Daily Inspection Data form.

b) Weekly Inspections

Three types of weekly inspections are performed at the Mill under the License:

(i) Weekly Inspection of the Mill Forms

Paragraph 2.3.1 of Reg. Guide 8.31 provides that the RSO and the Mill foreman should, and Section 2.3.2 of the Mill's ALARA Program provides that the RSO and Mill foreman, or their respective designees, shall conduct a weekly inspection of all Mill areas to observe general radiation control practices and review required changes in procedures and equipment. Particular attention is to be focused on areas where potential exposures to personnel might exist and in areas of operation or locations where contamination is evident.

(ii) Weekly Ore Storage Pad Inspection Forms

Paragraph 3.3 of the DMT Plan requires that weekly feedstock storage area inspections will be performed by the Radiation Safety Department, to confirm that the bulk feedstock materials are stored and maintained within the defined area of the ore pad and that all alternate feed materials located outside the defined ore pad area are maintained within water tight containers. The results of these inspections are recorded on the Mill's Ore Storage/Sample Plant Weekly Inspection Report.

(iii) Weekly Tailings and DMT Inspection

Paragraphs 3.1 and 3.2 of the DMT Plan require that weekly inspections of the tailings area and DMT requirements be performed by the radiation safety department.

c) Monthly Reports

Two types of monthly reports are prepared by Mill staff:

(i) Monthly Radiation Safety Reports

At least monthly, the RSO reviews the results of daily and weekly inspections, including a review of all monitoring and exposure data for the month and provides to the Mill Manager a monthly report containing a written summary of the month's significant worker protection activities (Section 2.3.4 of the Mill's ALARA Program).

(ii) Monthly Tailings Inspection Reports

Paragraph 4 of the DMT Plan requires that a Monthly Inspection Data form be completed for the monthly tailings inspection. This inspection is typically performed in the fourth week of each month and is in lieu of the weekly tailings inspection for that week.

Mill staff also prepares a monthly summary of all daily, weekly, monthly and quarterly tailings inspections.

d) Quarterly Tailings Inspections

Paragraph 5 of the DMT Plan requires that the RSO or his designee perform a quarterly tailings inspection.

e) Annual Evaluations

The following annual evaluations are performed under the License, as set out in Section 6 of the DMT Plan.

(i) Annual Technical Evaluation

An annual technical evaluation of the tailings management system must be performed by a registered professional engineer (PE), who has experience and training in the area of geotechnical aspects of retention structures. The technical evaluation includes an on-site inspection of the tailings management system and a thorough review of all tailings records for the past year. The Technical Evaluation also includes a review and summary of the annual movement monitor survey (see paragraph (ii) below).

All tailings cells and corresponding dikes are inspected for signs of erosion, subsidence, shrinkage, and seepage. The drainage ditches are inspected to evaluate surface water control structures.

In the event tailings capacity evaluations were performed for the receipt of alternate feed material during the year, the capacity evaluation forms and associated calculation sheets will be reviewed to ensure that the maximum tailings capacity estimate is accurate. The amount of tailings added to the system since the last evaluation will also be calculated to determine the estimated capacity at the time of the evaluation.

As discussed above, tailings inspection records consist of daily, weekly, monthly, and quarterly tailings inspections. These inspection records are evaluated to determine if any freeboard limits are being approached. Records will also be reviewed to summarize observations of potential concern. The evaluation also involves discussion with the Environmental and/or Radiation Technician and the RSO regarding activities around the tailings area for the past year. During the annual inspection, photographs of the tailings area are taken. The training of individuals is also reviewed as a part of the Annual Technical Evaluation.

The registered engineer obtains copies of selected tailings inspections, along with the monthly and quarterly summaries of observations of concern and the corrective actions taken. These copies are then included in the *Annual Technical Evaluation Report*.

The *Annual Technical Evaluation Report* must be submitted by November 15th of every year to the Directing Dam Safety Engineer, State of Utah, Natural Resources.

(ii) Annual Movement Monitor Survey

A movement monitor survey is conducted by a licensed surveyor annually in accordance with Condition 11.3 of the License, approved on June 17, 2010. The movement monitor survey consists of surveying monitors along dikes 4A-S and 4B-S to detect any possible settlement or movement of the dikes. The data generated from this survey is reviewed and incorporated into the *Annual Technical Evaluation Report* of the tailings management system.

(iii) Annual Leak Detection Fluid Samples

In the event solution has been detected in a leak detection system in Cells 1, 2 or 3, a sample will be collected on an annual basis. This sample will be analyzed according to the conditions set forth in License Condition 11.3.C. The results of the analysis will be reviewed to determine the origin of the solution.

2.0 EXISTING FACILITY

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

2.1 Facility Construction History

The White MesaMill is a uranium/vanadium mill that 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 Mmill 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, Denison (then named International Uranium (USA) Corporation) and its affiliates purchased the assets of EFN and is the current owner of the facility. Throughout this Plan, the names Denison and IUSA are used interchangeably.

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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 thatis 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 United States Environmental Protection Agency ("EPA") and the State of Utah, archeological clearance for the Mmill 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 Cell 4A, was completed and placed into useinitially used solely for solution storage and evaporation. Cell 4A was only used for a short period of time and then taken out of service because of concerns about the synthetic lining system. IN 2007, Cell 4A was retrofitted with a new State of Utah approved lining system and was put back into service in October of 2008. Cell 4B construction was authorized by License Amendment No. 4, issued on June 17, 2010, and the cell is currently under construction.

The Cell 4A and 4B design and operational details are more specifically described in the following documents, hereby incorporated by reference:

1) Cell 4A Construction Quality Assurance Report, July 2008
2) Cell 4B Construction Quality Assurance Report, November 2010

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3) Discharge Minimization technology Monitoring Plan, Revision 11, and Best Available Technology Operations and Maintenance Plan revision 2, November 12, 2010 (under review).

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 Mmill 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. After acquisition of the Mill by Denison and its affiliates several local mines were restarted and the Mill processed conventional ores during 1999 and early 2000. With the resurgence in uranium and vanadium process in 2003, Denison reopened several area mines and again began processing uranium and vanadium ores in April of 2008. Mill operations were suspended in 2009, and resumed in March of 2010. Typical employment figures for the Mmill are 1108 during uranium-only operations and 14038 during uranium/vanadium operations.

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Commencing in the early 1990's through today, the Mill has processed alternate feed materials from time to time when the Mill has been processing conventional ores. Alternate feed materials are uranium-bearing materials other than conventionally-mined uranium ores. The Mill installed an alternate feed circuit in 2009 that allows the Mill to process certain alternate feed materials simultaneously with conventional ores.

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2.2.2 Mill Circuit

While originally designed for a capacity of 1,500 dry tons per day (dtpd.), the Mmill 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

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fusion furnaces when it is converted to the mill's primary vanadium product, V_2O_5 tech flake, commonly called "black flake."

The same basic process steps used for the recovery of uranium from conventional ores are used for the recovery of uranium from alternate feed materials, with some variations depending on the particular alternate feed material.

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 of conventional ore were processed. During the third operational period from July 1988 through November 1990, -1,015,032 tons of conventional ore were processed. During the fourth operational period from August 1995 through January 1996, -203,317 tons of conventional ore were processed. In t~~T~~he fifth operational period from May 1996 through September 1996, the Mill processed 3,868 tons of calcium fluoride alternate feed material. ~~Since early~~From 1997 to early 1999,, the M~~m~~ill ~~has~~ processed 58,403 tons from several additional feed stocks.

With rising uranium prices in the late 1990's, company mines were reopened in 1997, and 87,250 tons of conventional ore were processed in 1999 and early 2000. In 2002 and 2003, the Mill processed 266,690 tons of alternate feed material from government cleanup projects. An additional 40,866 tons of alternate feed materials were processed in 2007. From April 2008 through May 2009 the Mill processed an additional 184,795 tons of conventional ore.

Inception to date material processed through ~~April 1999~~May 2009 totals ~~3,815,577~~4,128,468 tons. This total is for all processing periods combined.

2.2.3 Tailings Management Facilities

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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. Tailings from alternate feed materials that are similar physically to conventional ores, which comprise most of the tons of alternate feed materials processed to date at the Mill, are similar to the tailings for conventional ores. Tailings from some of the higher grade, lower volume alternate feed materials may vary somewhat from the tailings from conventional ores, primarily in moisture and density 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 1 was previously referred to as Cell 1-I, but is now referred to as Cell 1);.
- Cell 2, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands. This Cell is full and has been partially reclaimed;
- Cell 3, constructed with a 30-millimeter (ml) PVC earthen-covered liner, is used for the storage of barren tailings sands and solutions. This cell is partially filled and has been partially reclaimed; and
- Cell 4A, constructed with a geosynthetic clay liner, a 60 Millimeter (mil) HDPE liner, a 300 mil HDPE geonet drainage layer, a second 60 mil HDPE liner, and a slimes drain network over the entire cell bottom. This cell was placed into service in October of 2008.
- Cell 4B, will be constructed with a geosynthetic clay liner, a 60 Millimeter (mil) HDPE liner, a 300 mil HDPE geonet drainage layer, a second 60 mil HDPE liner, and a slimes

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drain network over the entire cell bottom. This cell will be constructed during the 2010 construction season.

40 millimeter (ml) HDPE liner, is currently not used.

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Total estimated design capacity of Cells 2, 3, and 4A is approximately six million (mm) cubic yardstons. Figures 1.5-4 and 1.5-5 show the locations of the tailings cells.

Denison has submitted an application to the Executive Secretary to amend the License and GWDP to authorize the construction of tailings Cell 4B, which will be located adjacent to Cell 4A and will provide approximately two million additional tons of tailings capacity. That application was approved by the Executive Secretary on June 17, 2010.

2.2.3.1 Tailings Management

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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.

Slurry disposal has taken place in Cells 2, 3 and 4A. Tailings placement in Cell 2 and Cell 3 was accomplished by means of the final grade method, described below.

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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 2 and 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. Coarse tailings sand from the discharge points are graded into low areas to reach the final disposal elevation. 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.

Slurry disposal in Cell 4A is from several pre-determined discharge points located around the north and east sides of the cell. Slurry discharge is only allowed on skid pads, or protective HDPE sheets, to prevent damage to the synthetic lining system. Once tailings solids have reach the maximum elevation around the perimeter of the cell, discharge points can be moved toward the interior of the cell. Slurry disposal in Cell 4B will be conducted in the same manner as Cell 4A.

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2.2.3.2 Liquid Management

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As a zero-discharge facility, the White Mesa Mill must evaporate all of the liquids utilized during processing. This evaporation takes place in two three (3) areas:

- Cell 1, which is used for solutions only;
- Cell 3, in which tailings and solutions exist;
- Cell 4A, in which tailings and solutions exist, and
- Cell 4B after construction is complete.

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The original engineering design indicated a net water gain into the cells would occur during Mmill 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, 3, and 4A3 are brought back to the CCD circuit where metallurgical benefit can be realized. Cell 4B will be operated in the same manner as Cell 4A. Recycle to other parts of the mill circuit are not feasible due to the acid content of the solution.

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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 and Reporting Under the Mill's GWDP

2.3.1.1 Groundwater Monitoring

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a) Plugged and Excluded Wells

Wells MW-6, MW-7, and MW-8 were plugged because they were in the area of Cell 3, as was MW-13, in the Cell 4A area. Wells MW-9 and MW-10 are dry and have been excluded from the monitoring program. MW-16 is dry and has been plugged as part of the tailings Cell 4B construction.

b) Groundwater Monitoring at the Mill Prior to Issuance of the GWDP

At the time of renewal of the License by NRC in March, 1997 and up until issuance of the GWDP in March 2005, the Mill implemented a groundwater detection monitoring program to ensure compliance to 10 CFR Part 40, Appendix A, in accordance with the provisions of the License. The detection monitoring program was in accordance with the report entitled, *Points of Compliance, White Mesa Uranium Mill*, prepared by Titan Environmental Corporation, submitted by letter to the NRC dated October 5, 1994 (Titan, 1994b). Under that program, the Mill sampled monitoring wells MW-5, MW-11, MW-12, MW-14, MW-15 and MW-17, on a quarterly basis.

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Samples were analyzed for chloride, potassium, nickel and uranium, and the results of such sampling were included in the Mill's Semi-Annual Effluent Monitoring Reports that were filed with the NRC up until August 2004 and with the DRC subsequent thereto.

Between 1979 and 1997, the Mill monitored up to 20 constituents in up to 13 wells. That program was changed to the Points of Compliance Program in 1997 because NRC had concluded that:

- The Mill and tailings system had produced no impacts to the perched zone or deep aquifer; and
- The most dependable indicators of water quality and potential cell failure were considered to be chloride, nickel, potassium and natural uranium.

c) Issuance of the GWDP

On March 8, 2005, the Executive Secretary issued the GWDP, which includes a groundwater monitoring program that supersedes and replaces the groundwater monitoring requirements set out in the License. Groundwater monitoring under the GWDP commenced in March 2005, the results of which are included in the Mill's *Quarterly Groundwater Monitoring Reports* that are filed with the Executive Secretary.

d) Current Ground Water Monitoring Program at the Mill Under the GWDP

The current groundwater monitoring program at the Mill under the GWDP consists of monitoring at 22 point of compliance monitoring wells: MW-1, MW-2, MW-3, MW-3A, MW-5, MW-11, MW-12, MW-14, MW-15, MW-17, MW-18, MW-19, MW-23, MW-24, MW-25, MW-26, MW-27, MW-28, MW-29, MW-30, MW-31 and MW-32. The locations of these wells are

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indicated on Figure 1.5-2.

Part I.E.1.(c) of the GWDP requires that each point of compliance well must be sampled for the following constituents:

Table 2.3-1
Groundwater Monitoring Constituents Listed in Table 2 of the GWDP

Nutrients:
Ammonia (as N)
Nitrate & Nitrite (as N)

Heavy Metals:
Arsenic
Beryllium
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Silver
Thallium
Tin
Uranium
Vanadium
Zinc

Radiologics:
Gross Alpha

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Volatile Organic Compounds:
Acetone
Benzene
2-Butanone (MEK)
Carbon Tetrachloride
Chloroform
Chloromethane
Dichloromethane
Naphthalene
Tetrahydrofuran
Toluene
Xylenes (total)

Others:
Field pH (S.U.)
Fluoride
Chloride
Sulfate
TDS

Further, Part I.E.1.(c) of the GWDP, requires that, in addition to pH, the following field parameters must also be monitored:

- Depth to groundwater
- Temperature
- Tubidity,
- Specific conductance,

and that, in addition to chloride and sulfate, the following general organics must also be monitored:

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- Carbonate, bicarbonate, sodium, potassium, magnesium, calcium, and total anions and cations.

Sample frequency depends on the speed of ground water flow in the vicinity of each well. Parts I.E.1(a) and (b) of the GWDP provide that quarterly monitoring is required for all wells where local groundwater average linear velocity has been found by the Executive Secretary to be equal to or greater than 10 feet/year, and semi-annual monitoring is required where the local groundwater average linear velocity has been found by the Executive Secretary to be less than 10 feet/year.

Based on these criteria, quarterly monitoring is required at MW-11, MW-14, MW-25, MW-26, MW-30 and MW-31, and semi-annual monitoring is required at MW-1, MW-2, MW-3, MW-3A, MW-5, MW-12, MW-15, MW-17, MW-18, MW-19, MW-23, MW-24, MW-27, MW-28, MW-29 and MW-32.

2.3.1.2 Deep Aquifer

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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. Due to the fact that the deep confined aquifer at the site is hydraulically isolated from the shallow perched aquifer, no monitoring of the deep aquifer is required under the GWDP.

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2.3.1.3 Seeps and Springs

Pursuant to Part I.H.8 of the GWDP, Denison has a *Sampling Plan for Seeps and Springs in the Vicinity of the White Mesa Uranium Mill*, Revision: 0, March 17, 2009 (the "SSSP") that requires the Mill to perform groundwater sampling and analysis of all seeps and springs found downgradient or lateral gradient from the tailings cells.

Under the SSSP, seeps and springs sampling is conducted on an annual basis between May 1 and July 15 of each year, to the extent sufficient water is available for sampling, at five identified seeps and springs near the Mill. The sampling locations were selected to correspond with those seeps and springs sampled for the initial Mill site characterization performed in the 1978 ER, plus additional sites located by Denison, the BLM and Ute Mountain Ute Indian Tribe representatives.

Samples are analyzed for all ground water monitoring parameters found in Table 2.3-1 above. The laboratory procedures utilized to conduct the analyses of the sampled parameters are those utilized for groundwater sampling. In addition to these laboratory parameters, the pH, temperature and conductivity of each sample will be measured and recorded in the field. Laboratories selected by Denison to perform analyses of seeps and springs samples will be required to be certified by the State of Utah in accordance with UAC R317-6-6.12.A.

The seeps and springs sampling events will be subject to the Mill's QAP, unless otherwise specifically modified by the SSSP to meet the specific needs of this type of sampling.

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2.3.1.4 Discharge Minimization Technology and Best Available Technology Standards and Monitoring

2.3.1.4.1 General

Part I.D. of the GWDP sets out a number of Discharge Minimization Technology ("DMT") and Best Available Technology ("BAT") standards that must be followed. Part I.E. of the GWDP sets out the Ground Water Compliance and Technology Performance Monitoring requirements, to ensure that the DMT and BAT standards are met. These provisions of the GWDP, along with the *White Mesa Mill Tailings Management System and Discharge Minimization (DMT) Monitoring Plan*, 9/08 Revision: Denison-6 (the "DMT Plan"), the *Cell 4Aand 4B BAT Monitoring, Operations and Maintenance Plan Revision 2.0* (under review) and other plans and programs developed pursuant to such Parts of the GWDP, set out the methods and procedures for inspections of the facility operations and for detecting failure of the system.

In addition to the programs discussed above, the following additional DMT and BAT performance standards and associated monitoring are required under Parts I.D and I.E. of the GWDP

b) Tailings Cell Operation

Part I.D.2 of the GWDP provides that authorized operation and maximum disposal capacity in each of the existing tailings Cells, 1, 2 and 3 shall not exceed the levels authorized by the License and that under no circumstances shall the freeboard be less than three feet, as measured from the top of the flexible membrane liner ("FML"). Part I.E.7(a) of the GWDP requires that the wastewater pool elevations in Cells 1 and 3 must be monitored weekly to ensure compliance with

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the maximum wastewater elevation criteria mandated by Condition 10.3 of the License.

Part I.D.2 further provides that any modifications by Denison to any approved engineering design parameter at these existing tailings cells requires prior Executive Secretary approval, modification of the GWDP and issuance of a construction permit.

c) Slimes Drain Monitoring

Part I.D.3(b)(1) of the GWDP requires that Denison must at all times maintain the average wastewater head in the slimes drain access pipe to be as low as reasonably achievable (ALARA) in each tailings disposal cell, in accordance with the approved DMT Plan. Compliance will be achieved when the average annual wastewater recovery elevation in the slimes drain access pipe, determined pursuant to the currently approved DMT Plan meets the conditions in Equation 1 specified in Part I.D.3(b)(1) of the GWDP.

Part I.E.7(b) of the GWDP requires that Denison must monitor and record monthly the depth to wastewater in the slimes drain access pipes as described in the currently approved DMT Plan at Cell 2, and upon commencement of de-watering activities, at Cell 3, in order to ensure compliance with Part I.D.3(b)(1) of the GWDP.

d) Maximum Tailings Waste Solids Elevation

Part I.D.3(c) of the GWDP requires that upon closure of any tailings cell, Denison must ensure that the maximum elevation of the tailings waste solids does not exceed the top of the FML.

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e) Wastewater Elevation in Roberts Pond

Part I.D.3(e) of the GWDP requires that Roberts Pond be operated so as to provide a minimum 2-foot freeboard at all times, and that under no circumstances will the water level in the pond exceed an elevation of 5,624 feet above mean sea level. Part I.D.3(e) also provides that in the event the wastewater elevation exceeds this maximum level, Denison must remove the excess wastewater and place it into containment in Cell 1 within 72 hours of discovery.

Part I.E.7(c) of the GWDP requires that the wastewater level in Roberts Pond must be monitored and recorded weekly, in accordance with the currently approved DMT Plan, to determine compliance with the DMT operations standard in Part I.D.3(e) of the GWDP;

f) Inspection of Feedstock Storage Area

Part I.D.3(f) of the GWDP requires that open-air or bulk storage of all feedstock materials at the Mill facility awaiting Mill processing must be limited to the eastern portion of the Mill site (the "ore pad") described by the coordinates set out in that Part of the GWDP, and that storage of feedstock materials at the facility outside of this defined area, must meet the requirements of Part I.D.11 of the GWDP. Part I.D.11 requires that Denison must store and manage feedstock materials outside the defined ore storage pad in accordance with the following minimum performance requirements:

(i) Feedstock materials will be stored at all times in water-tight containers, and

(ii) Aisle ways will be provided at all times to allow visual inspection of each and every feedstock container, or

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(iii) Each and every feedstock container will be placed inside a water-tight overpack prior to storage, or

(iv) Feedstock containers shall be stored on a hardened surface to prevent spillage onto subsurface soils, and that conforms with the following minimum physical requirements:

A. A storage area composed of a hardened engineered surface of asphalt or concrete, and

B. A storage area designed, constructed, and operated in accordance with engineering plans and specifications approved in advance by the Executive Secretary. All such engineering plans or specifications submitted shall demonstrate compliance with Part I.D.4 of the GWDP, and

C. A storage area that provides containment berms to control stormwater run-on and run-off, and

D. Stormwater drainage works approved in advance by the Executive Secretary, or

(v) Other storage facilities and means approved in advance by the Executive Secretary.

Part I.E.7(d) of the GWDP requires that Denison conduct weekly inspections of all feedstock storage areas to:

(i) Confirm that the bulk feedstock materials are maintained within the approved feedstock storage area specified by Part I.D.3(f) of the GWDP; and

(ii) Verify that all alternate feedstock materials located outside the approved feedstock storage area are stored in accordance with the requirements found in Part I.D.11 of the GWDP.

Part I.E.7(f) further provides that Denison must conduct weekly inspections to verify that each

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feed material container complies with the requirements of Part I.D.11 of the GWDP.

The Mill's Standard Operating Procedure under the License for inspection of the Mill's ore pad is contained in Section 3.3 of the DMT Plan.

g) Monitor and Maintain Inventory of Chemicals

Part I.D.3(g) of the GWDP requires that for all chemical reagents stored at existing storage facilities and held for use in the milling process, Denison must provide secondary containment to capture and contain all volumes of reagent(s) that might be released at any individual storage area. Response to spills, cleanup thereof, and required reporting must comply with the provisions of the Mill's *Emergency Response Plan*, which is found in the Mill's *Stormwater Best Management Practices Plan*, Revision 1.3; June 12, 2008 (a copy of which is included as Appendix C), as stipulated by Parts I.D.10 and I.H.16 of the GWDP. Part I.D.3(g) further provides that for any new construction of reagent storage facilities, such secondary containment and control must prevent any contact of the spilled or otherwise released reagent or product with the ground surface.

Part I.E.9 of the GWDP requires that Denison must monitor and maintain a current inventory of all chemicals used at the facility at rates equal to or greater than 100 kg/yr. This inventory must be maintained on-site, and must include:

(iii) Identification of chemicals used in the milling process and the on-site laboratory; and

(iv) Determination of volume and mass of each raw chemical currently held in storage at the facility.

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2.3.1.5 BAT Performance Standards for Cell 4A and 4B

a) BAT Operations and Maintenance Plan

Part I.D.6 and Part I.D.13 of the GWDP provide that Denison must operate and maintain Cell 4A and Cell 4B, respectively, so as to prevent release of wastewater to groundwater and the environment in accordance with the Mill's *Cell 4A and 4B BAT Monitoring, Operations and Maintenance Plan*, pursuant to Part I.H.8 of the GWDP. The Mill's *Cell 4A* and Cell 4B *BAT Monitoring, Operations and Maintenance Plan*, 11/2010 Revision: Denison 2.0 (under review) includes the following performance standards:

(i) The fluid head in the leak detection system shall not exceed 1 foot above the lowest point in the lower membrane liner;

(ii) The leak detection system maximum allowable daily leak rate shall not exceed 24,160 gallons/day for Cell 4A or 26,145 gallons/day for Cell 4B;

(iii) After Denison initiates pumping conditions in the slimes drain layer in Cell 4A or Cell 4B, Denison will provide continuous declining fluid heads in the slimes drain layer, in a manner equivalent to the requirements found in Part I.D.3(b) for Cells 2 and 3; and

(iv) Under no circumstances shall the freeboard be less than 3 feet in Cell 4A or Cell 4B, as measured from the top of the FML.

b) Implementation of Monitoring Requirements Under the BAT Operations and Maintenance Plan

The *Cell 4A and 4B BAT Monitoring, Operations and Maintenance Plan* also requires Denison to

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perform the following monitoring and recordkeeping requirements.

(i) Weekly Leak Detection System (LDS) Monitoring - including:

A. Denison must provide continuous operation of the leak detection system pumping and monitoring equipment, including, but not limited to, the submersible pump, pump controller, head monitoring, and flow meter equipment approved by the Executive Secretary. Failure of any pumping or monitoring equipment not repaired and made fully operational within 24-hours of discovery shall constitute failure of BAT and a violation of the GWDP;

B. Denison must measure the fluid head above the lowest point on the secondary FML by the use of procedures and equipment approved by the Executive Secretary. Under no circumstance shall fluid head in the leak detection system sump exceed a 1-foot level above the lowest point in the lower FML on the cell floor. For purposes of compliance monitoring this 1-foot distance shall equate to 2.28 feet above the leak detection system transducer;

C. Denison must measure the volume of all fluids pumped from the leak detection system. Under no circumstances shall the average daily leak detection system flow volume exceed 24,160 gallons/day for Cell 4A or 26,145 gallons/day for Cell 4B; and

D. Denison must operate and maintain wastewater levels to provide a 3-foot Minimum of vertical freeboard in tailings Cell 4A and Cell 4B. Such measurements must be made to the nearest 0.1 foot.

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(ii) Slimes Drain Recovery Head Monitoring

Immediately after the Mill initiates pumping conditions in the Cell 4A or Cell 4B slimes drain system, monthly recovery head tests and fluid level measurements will be made in accordance with the requirements of Parts I.D.3 and I.E.7(b) of the GWDP and any plan approved by the Executive Secretary.

2.3.1.6 Stormwater Management and Spill Control Requirements

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Part I.D.10 of the GWDP requires that Denison will manage all contact and non-contact stormwater and control contaminant spills at the facility in accordance with the Mill's stormwater best management practices plan. The Mill's *Stormwater Best Management Practices Plan, Revision 1.3:* June 12, 2008 (a copy of which is included as Appendix C) includes the following provisions:

a) Protect groundwater quality or other waters of the state by design, construction, and/or active operational measures that meet the requirements of the Ground Water Quality Protection Regulations found in UAC R317-6-6.3(G) and R317-6-6.4(C);
b) Prevent, control and contain spills of stored reagents or other chemicals at the Mill site;
c) Cleanup spills of stored reagents or other chemicals at the Mill site immediately upon discovery; and
d) Report reagent spills or other releases at the Mill site to the Executive Secretary in accordance with UAC 19-5-114.

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2.3.1.7 Tailings and Slimes Drain Sampling

Part I.E.8 of the GWDP requires that, on an annual basis, Denison must collect wastewater quality samples from each wastewater source at each tailings cell at the facility, including surface impounded wastewaters, and slimes drain wastewaters, pursuant to the Mill's *Tailings and Slimes Drain Sampling Program*, Revision 0, November 20, 2008 (the "WQSP"). All such sampling must be conducted in August of each calendar year.

The purpose of the WQSP is to characterize the source term quality of all tailings cell wastewaters, including impounded wastewaters or process waters in the tailings cells, and wastewater or leachates collected by internal slimes drains. The WQSP requires:

- Collection of samples from the pond area of each active cell and the slimes drain of each cell that has commenced de-watering activities;
- Samples of tailings and slimes drain material will be analyzed at an offsite contract laboratory and subjected to the analytical parameters included in Table 2 of the GWDP (see Table 2.3-1 above) and general inorganics listed in Part I.E.1(d)(2)(ii) of the GWDP, as well as semi-volatile organic compounds;
- A detailed description of all sampling methods and sample preservation techniques to be employed;
- The procedures utilized to conduct these analyses will be standard analytical methods utilized for groundwater sampling and as shown in Section 8.2 of the Mill's QAP;
- The contracted laboratory will be certified by the State of Utah in accordance with UAC R317-6-6.12A; and

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- 30-day advance notice of each annual sampling event must be given, to allow the Executive Secretary to collect split samples of all tailings cell wastewater sources.

The tailings and slimes drain sampling events are subject to the Mill's QAP, unless otherwise specifically modified by the WQSP to meet the specific needs of this type of sampling.

2.3.2 Monitoring and Inspections Required Under the License

2.3.2.1 Environmental Monitoring

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The environmental monitoring program is designed to assess the effect of Mill process and disposal operations on the unrestricted environment. Delineation of specific equipment and procedures is presented in the Mill's *Environmental Protection Manual*, included as Appendix A to the 2007 License Renewal Application.

c) Ambient Air Monitoring

(i) Ambient Particulate

Airborne radionuclide particulate sampling is performed at five locations, termed BHV-1, BHV-2, BHV-4, BHV-5 and BHV-6. With the approval of the NRC and effective November, 1995, BHV-3 was removed from the active air particulate monitoring program. At that time, the Mill proposed (and NRC determined) that a sufficient air monitoring data base had been compiled at station BHV-3 to establish a representative airborne particulate radionuclide background for the Mill. BHV-6 was installed by the Mill at the request of the White Mesa Ute Community. This station began operation in July of 1999 and provides airborne particulate information in the

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southerly direction between the Mill and the White Mesa Ute Community. Figure 2.3-1 shows the locations of these air particulate monitoring stations.

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Insert Fig 2.3-1 locations of air particulate stations

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The present sampling system consists of high volume particulate samplers utilizing mass flow controllers to maintain an air flow rate of approximately 32 standard cubic feet per minute. Samplers are operated continuously with a goal for on-stream operating period at ninety percent. Filter rotation is weekly with quarterly site compositing for particulate radionuclide analysis. Analysis is done for U-natural, Th-230, Ra-226, and Pb-210.

See Section 3.13.1.7(a) of the 2007 ER for a summary of historic monitoring results for airborne particulate.

(ii) Ambient Radon

With the approval of the NRC, Radon-222 monitoring at the BHV stations was discontinued in 1995, due to the unreliability of monitoring equipment available at that time to detect the new 10 CFR standard of 0.1 pCi/l. From that time until the present, the Mill demonstrated compliance with the requirements of R313-15-301 by calculation authorized by the NRC in September 1995 and as contemplated by R313-15-302 (2) (a).

This calculation was performed by use of the MILDOS code for estimating environmental radiation doses for uranium recovery operations (Strenge and Bender 1981) in 1991 in support of the Mill's 1997 license renewal and more recently in 2007 in support of the 2007 License Renewal Application, by use of the updated MILDOS AREA code (Argonne 1998). The analysis under both the MILDOS and MILDOS AREA codes assumed the Mill to be processing high grade Arizona Strip ores at full capacity, and calculated the concentrations of radioactive dust and radon at individual receptor locations around the Mill. Specifically, the modeling under these codes assumed the following conditions:

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- 730,000 tons of ore per year
- Average grade of 0.53% U_3O_8
- Yellowcake production of 4,380 tons of U_3O_8 per year (8.8 million pounds U_3O_8 per year).

Based on these conditions, the MILDOS and MILDOS AREA codes calculated the combined total effective dose equivalent from both air particulate and radon at the current nearest residence (approximately 1.2 miles north of the Mill), i.e., the individual member of the public likely to receive the highest dose from Mill operations, as well as at all other receptor locations, to be below the ALARA goal of 10 mrem/yr for air particulate alone as set out in R313-15-101(4). Mill operations are constantly monitored to ensure that operating conditions do not exceed the conditions assumed in the above calculations. If conditions are within those assumed above, radon has been calculated to be within regulatory limits. If conditions exceed those assumed above, then further evaluation will be performed in order to ensure that doses to the public continue to be within regulatory limits. Mill operations to date have never exceeded the License conditions assumed above.

In order to determine if detection equipment has improved since 1995, the Mill has, commencing with the first quarter of 2007, re-instituted direct measurements of radon at the five air particulate monitoring locations currently utilized for air particulate sampling. The reliability of this data is currently under review by Denison.

d) External Radiation

TLD badges, as supplied by Landauer, Inc., or equivalent, are utilized at BHV-1, BHV-2, BHV-3, BHV-4, BHV-5 and BHV-6 to determine ambient external gamma exposures (see Figure 2.3-1).

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System quality assurances are determined by placing a duplicate monitor at one site continuously. Exchanges of TLD badges are on a quarterly basis. Badges consist of a minimum of five TLD chips. Measurements obtained from location BHV-3 have been designated as background due to BHV-3's remoteness from the Mill site (BHV-3 is located approximately 3.5 miles west of the Mill site). For further procedural information see Section 4.3 of the Mill's *Environmental Protection Manual*, included as Appendix A to the 2007 License Renewal Application. See Section 3.13.1.7(c) of the 2007 ER for a summary of historic monitoring results for external radiation.

e) Soil and Vegetation

(i) Soil Monitoring

Soil samples from the top one centimeter of surface soils are collected annually at each of BHV-1, BHV-2, BHV-3, BHV-4 and BHV-5 (see Figure 2.3-1). A minimum of two kilograms of soil is collected per site and analyzed for U-natural and Ra-226. For further procedural information see Section 4.1 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. See Section 3.13.1.7.1 of the 2007 ER for a summary of the historic results for soil monitoring. The 2007 ER concludes that the results of sampling are low, less than the unrestricted release limits.

(i) Vegetation Monitoring

Forage vegetation samples are collected three times per year from animal grazing locations to the northeast (near BHV-I (the meteorological station)), northwest (to the immediate west of the site) and southwest (by BHV-4) of the Mill site. Samples are obtained during the grazing season, in

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the late fall, early spring, and in late spring. A minimum of three kilograms of vegetation are submitted from each site for analysis of Ra-226 and Pb-210. For further procedure information see Section 4.2 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. See Section 3.13.7(d) of the 2007 ER for a summary of the historic results for vegetation monitoring. The 2007 ER concludes that the most recent results indicate no increase in uptake of Ra-226 and Pb-210 in vegetation.

d) Meteorological

Meteorological monitoring is done at a site near BHV-1. The sensor and recording equipment are capable of monitoring wind velocity and direction, from which the stability classification is calculated. Data integration duration is one-hour with hourly recording of mean speed, mean wind direction, and mean wind stability (as degrees sigma theta).

The data from the meteorological station is retrieved monthly by down loading onto a Campbell Scientific data module, or the equivalent. The data module is sent to an independent meteorological contractor where the module is downloaded to a computer record, and the data is correlated and presented in a Semi-Annual Meteorological Report.

Monitoring for precipitation consists of a daily log of precipitation using a standard NOAA rain gauge, or the equivalent, installed near the administrative office, consistent with NOAA specifications.

Windrose data is summarized in a format compatible with MILDOS and UDAD specifications for 40 CFR 190 compliance. For further procedural information see Section 1.3 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal

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Application. A windrose for the site is set out in Figure 1.1-1.

e) Point Emissions

Stack emission monitoring from yellowcake facilities follows EPA Method 5 procedures and occurs on a quarterly basis, during operation of the facility. Particulate sampling is analyzed for Unat on a quarterly basis and for Th-230, Ra-226, and Pb-210 on a semi-annual basis. Demister and ore stack emission monitoring follows EPA Method 5 procedure on a semi-annual basis, during operation of the facility. Particulate samples are analyzed for Unat, Th-230, Ra-226, and Pb-210. Monitored data includes scrubber system operation levels, process feed levels, particulate emission concentrations, isokinetic conditions, and radionuclide emission concentrations. For further procedure information see Section 1.4 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. Historic stack emission data are summarized in Section 3.13.1.7(e) of the 2007 ER.

f) Surface Water Monitoring

Surface water monitoring is conducted at two locations adjacent to the Mill facility known as Westwater Canyon and Cottonwood Creek. Samples are obtained annually from Westwater and quarterly from Cottonwood using grab sampling. For Westwater Creek, samples will be of sediments if a water sample is not available. Field monitored parameters and laboratory monitored parameters are listed in Table 2.3-2. For further procedural information see Section 2.1 of the Mill's *Environmental Protection Manual* included as Appendix A to the 2007 License Renewal Application. See Section 3.7.4 of the 2007 ER for a summary of the historic results for surface water monitoring.

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Table 2.3-2
Operational Phase Surface Water Monitoring Program

Monitoring Sites
Westwater Creek and Cottonwood Creek

Field Requirements

1. Temperature C;
2. Specific Conductivity umhos at 25 C;
3. pH at 25 C;
4. Sample date;
5. Sample ID Code;

Vendor Laboratory Requirements

Semiannual*	Quarterly
One gallon Unfiltered and Raw	One gallon Unfiltered and Raw
One gallon Unfiltered, Raw and preserved to pH <2 with HNO_3	One gallon Unfiltered, Raw and Preserved to pH <2 with HNO_3
Total Dissolved Solids	Total Dissolved Solids
Total Suspended Solids	Total Suspended Solids
Gross Alpha	
Suspended Unat	
Dissolved Unat	
Suspended Ra-226	
Dissolved Ra-226	
Suspended Th-230	
Dissolved Th-230	

*Semiannual sample must be taken a minimum of four months apart.
**Annual Westwater Creek sample is analyzed for semi-annual parameters.
Radionuclides and LLDs reported in µCi/ml

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2.3.2.2 Additional Monitoring and Inspections Required Under the License

Under the License daily, weekly, and monthly inspection reporting and monitoring are required by NRC Regulatory Guide 8.31, *Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities will be As Low As is Reasonable Achievable*, Revision 1, May 2002 ("Reg Guide 8.31"), by Section 2.3 of the Mill's ALARA Program and by the DMT Plan, over and above the inspections described above that are required under the GWDP. A copy of the Mill's ALARA Program is included as Appendix I to the 2007 License Renewal Application.

a) Daily Inspections

Three types of daily inspections are performed at the Mill under the License:

(i) Radiation Staff Inspections

Paragraph 2.3.1 of Reg. Guide 8.31 provides that the Mill's Radiation Safety Officer ("RSO") or designated health physics technician should conduct a daily walk-through (visual) inspection of all work and storage areas of the Mill to ensure proper implementation of good radiation safety procedures, including good housekeeping that would minimize unnecessary contamination. These inspections are required by Section 2.3.1 of the Mill's ALARA Program, and are documented and on file in the Mill's Radiation Protection Office.

(ii) Operating Foreman Inspections

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30 CFR Section 56.18002 of the Mine Safety and Health Administration regulations requires that a competent person designated by the operator must examine each working place at least once each shift for conditions which may adversely affect safety or health. These daily inspections are documented and on file in the Mill's Radiation Protection Office.

(iii) Daily Tailings Inspection

Paragraph 2.2 of the DMT Plan requires that during Mill operation, the Shift Foreman, or other person with the training specified in paragraph 2.4 of the DMT Plan, designated by the RSO, will perform an inspection of the tailings line and tailings area at least once per shift, paying close attention for potential leaks and to the discharges from the pipelines. Observations by the Inspector are recorded on the appropriate line on the Mill's Daily Inspection Data form.

b) Weekly Inspections

Three types of weekly inspections are performed at the Mill under the License:

(i) Weekly Inspection of the Mill Forms

Paragraph 2.3.1 of Reg. Guide 8.31 provides that the RSO and the Mill foreman should, and Section 2.3.2 of the Mill's ALARA Program provides that the RSO and Mill foreman, or their respective designees, shall conduct a weekly inspection of all Mill areas to observe general radiation control practices and review required changes in procedures and equipment. Particular attention is to be focused on areas where potential exposures to personnel might exist and in areas of operation or locations where contamination is evident.

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(ii) Weekly Ore Storage Pad Inspection Forms

Paragraph 3.3 of the DMT Plan requires that weekly feedstock storage area inspections will be performed by the Radiation Safety Department, to confirm that the bulk feedstock materials are stored and maintained within the defined area of the ore pad and that all alternate feed materials located outside the defined ore pad area are maintained within water tight containers. The results of these inspections are recorded on the Mill's Ore Storage/Sample Plant Weekly Inspection Report.

(iii) Weekly Tailings and DMT Inspection

Paragraphs 3.1 and 3.2 of the DMT Plan require that weekly inspections of the tailings area and DMT requirements be performed by the radiation safety department.

c) Monthly Reports

Two types of monthly reports are prepared by Mill staff:

(i) Monthly Radiation Safety Reports

At least monthly, the RSO reviews the results of daily and weekly inspections, including a review of all monitoring and exposure data for the month and provides to the Mill Manager a monthly report containing a written summary of the month's significant worker protection activities (Section 2.3.4 of the Mill's ALARA Program).

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(ii) Monthly Tailings Inspection Reports

Paragraph 4 of the DMT Plan requires that a Monthly Inspection Data form be completed for the monthly tailings inspection. This inspection is typically performed in the fourth week of each month and is in lieu of the weekly tailings inspection for that week.

Mill staff also prepares a monthly summary of all daily, weekly, monthly and quarterly tailings inspections.

d) Quarterly Tailings Inspections

Paragraph 5 of the DMT Plan requires that the RSO or his designee perform a quarterly tailings inspection.

e) Annual Evaluations

The following annual evaluations are performed under the License, as set out in Section 6 of the DMT Plan.

(i) Annual Technical Evaluation

An annual technical evaluation of the tailings management system must be performed by a registered professional engineer (PE), who has experience and training in the area of geotechnical aspects of retention structures. The technical evaluation includes an on-site inspection of the tailings management system and a thorough review of all tailings records for the past year. The Technical Evaluation also includes a review and summary of the annual movement monitor survey

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(see paragraph (ii) below).

All tailings cells and corresponding dikes are inspected for signs of erosion, subsidence, shrinkage, and seepage. The drainage ditches are inspected to evaluate surface water control structures.

In the event tailings capacity evaluations were performed for the receipt of alternate feed material during the year, the capacity evaluation forms and associated calculation sheets will be reviewed to ensure that the maximum tailings capacity estimate is accurate. The amount of tailings added to the system since the last evaluation will also be calculated to determine the estimated capacity at the time of the evaluation.

As discussed above, tailings inspection records consist of daily, weekly, monthly, and quarterly tailings inspections. These inspection records are evaluated to determine if any freeboard limits are being approached. Records will also be reviewed to summarize observations of potential concern. The evaluation also involves discussion with the Environmental and/or Radiation Technician and the RSO regarding activities around the tailings area for the past year. During the annual inspection, photographs of the tailings area are taken. The training of individuals is also reviewed as a part of the Annual Technical Evaluation.

The registered engineer obtains copies of selected tailings inspections, along with the monthly and quarterly summaries of observations of concern and the corrective actions taken. These copies are then included in the *Annual Technical Evaluation Report*.

The *Annual Technical Evaluation Report* must be submitted by November 15th of every year to the Directing Dam Safety Engineer, State of Utah, Natural Resources.

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(ii) Annual Movement Monitor Survey

A movement monitor survey is conducted by a licensed surveyor annually in accordance with Condition 11.3 of the License, approved on June 17, 2010. The movement monitor survey consists of surveying monitors along dikes 4A-S and 4B-S to detect any possible settlement or movement of the dikes. The data generated from this survey is reviewed and incorporated into the *Annual Technical Evaluation Report* of the tailings management system.

(iii) Annual Leak Detection Fluid Samples

In the event solution has been detected in a leak detection system in Cells 1, 2 or 3, a sample will be collected on an annual basis. This sample will be analyzed according to the conditions set forth in License Condition 11.3.C. The results of the analysis will be reviewed to determine the origin of the solution.

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.

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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.

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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

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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.

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

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Section 3.0 Reclamation Plan

White Mesa Mill Reclamation Plan
Revision 3.2.B

for

Reclamation

of the

White Mesa Mill and Tailings Management System

January 2011

State of Utah11e.(2) Byproduct Material License # UT1900479

3.0 RECLAMATION PLAN

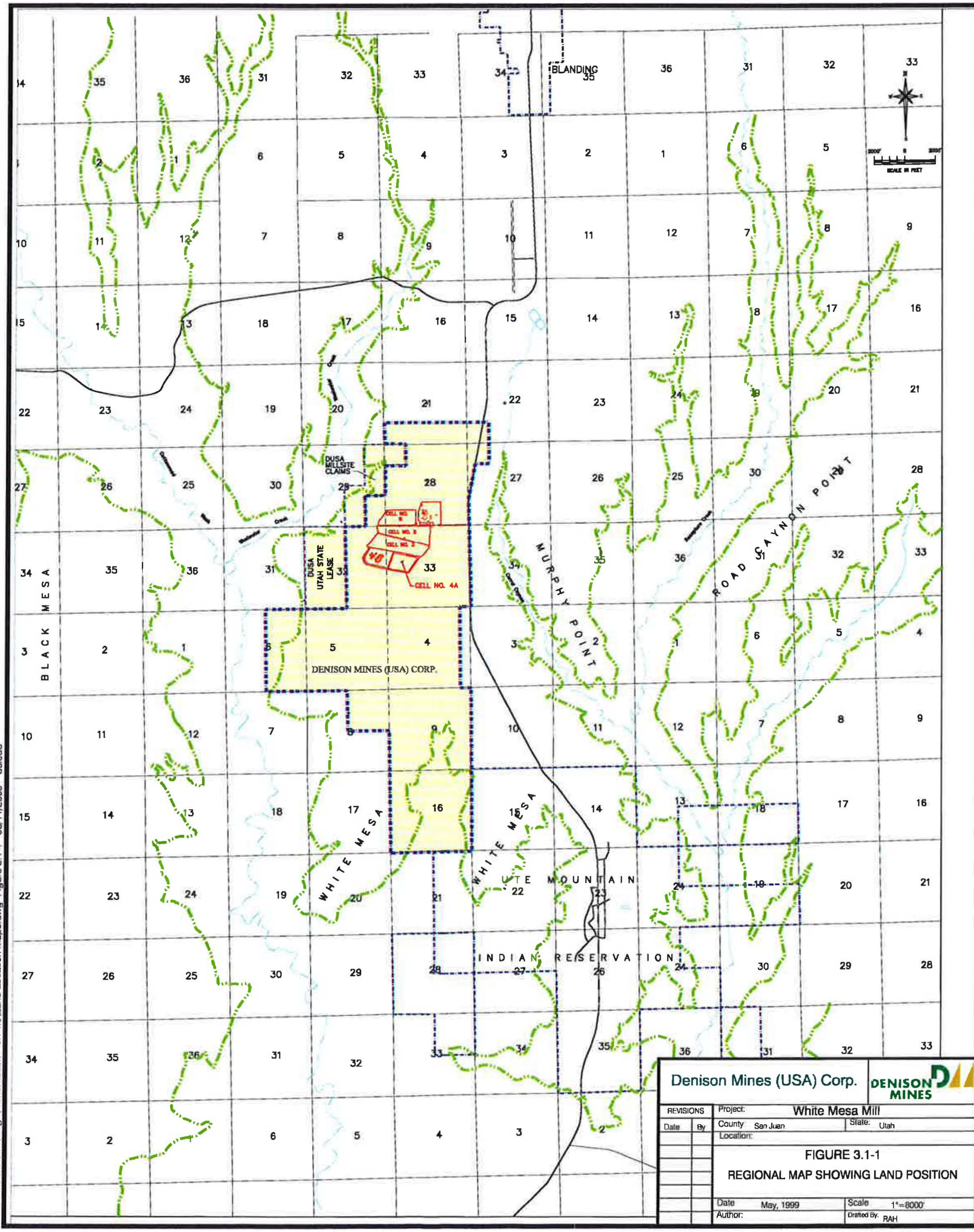
This section provides an overview of the Mill location and property; details the facilities to be reclaimed; and describes the design criteria applied in this Plan. Reclamation plans and specifications are presented in Attachment A. Attachment B presents the quality plan for construction activities. 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. Additonal land is controlled by 46 Mill site claims. Total land holdings are approximately 5,415 acres..



Denison Mines (USA) Corp.

DENISON MINES

REVISIONS | Date | By

Project: White Mesa Mill

County: San Juan State: Utah

Location:

FIGURE 3.1-1

REGIONAL MAP SHOWING LAND POSITION

Date: May, 1999 Scale: 1"=8000'

Author: Drafted By: RAH

Y:\USA\Utah\Mill\dwgs\Reclamation Plan 4.0\Land Location Maps.dwg Figure 3.1-1 03/11/2009 dsledd

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 (evaporation). Cell 1 was previously referred to as Cell I-1. It is now referred to as Cell 1;
- Cells 2 and 3, 4A and 4B (tailings);
- Mill buildings and equipment;
- On-site contaminated areas; and
- Off-site contaminated areas (i.e., potential areas affected by windblown tailings).

The reclamation of the above facilities will include the following:

- Placement of contaminated soils, crystals, and synthetic liner material and any contaminated underlying soils from Cell 1 into tailings Cells 4A or 4B.
- 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 Tailings Area)
- Placement of materials and debris from Mill Decommissioning into tailings Cells 4A or 4B or in the Cell 1 Tailings Area;

- Placement of an engineered multi-layer cover over the entire area of Cells 2, 3, 4A and 4B and the Cell 1 Tailings Area.
- Construction of runoff control and diversion channels as necessary;
- Reconditioning of Mill and ancillary areas; and
- Reclamation of borrow sources.

INSERT FIGURE 3.2-1

3.2.2 Tailings and Evaporative Cells

The following subsections describe the cover design and reclamation procedures for Cells1-I, 2, 3, 4A and 4B. 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 to be placed over the uranium tailings and mill decommissioning materials in the Cell 1-I Tailings Area, Cell 2, Cell 2, Cell 4A and Cell 4B was designed using on-site materials that will contain tailings and radon emissions in compliance with regulations of the NRC, the State of Utah, and by reference, the EPA. The cover consists of a one-foot thick layer of clay, available from within the site boundaries (Section 16 or stockpiles on site), 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) and 40 CFR 61.250-61.256;
- 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 3.3.2). 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, 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 will be evaporated to dryness. The synthetic liner and raffinate crystals will then be removed and placed in tailings Cells 4A or 4B. 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.e., the Cell 1 Tailings Area), 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 Tailings Area needed for storage of additional material will depend on the status of Cell 4A and 4B at the time of final mill decommissioning. A portion of the Mill area decommissioning material may be placed in Cell 4A or 4B if space is available, but for purposes of the reclamation design the entire quantity of contaminated materials from the Mill site decommissioning is assumed to be placed in the Cell 1 Tailings Area. This results in approximately 10 acres of the Cell 1 Tailings Area and being utilized for permanent tailings storage. The remaining area of Cell 1 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 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 be as described in Section 3.2.2.1 above, and 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 filled with tailings, debris and contaminated soils and covered with the same multi-layered engineered cover as Cell 2 and Cell 3.

3.2.2.6 Cell 4B

Cell 4B will be filled with tailings, debris and contaminated soils and covered with the same multi-layered engineered cover as Cell 2, Cell 3 and Cell 4A.

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, Equipment, and Other 11e.(2) Byproduct Material

The uranium and vanadium sections, including ore reclaim, grinding, pre-leach, leach, CCD, SX, and precipitation and drying circuits as well as the alternate feed circuit, decontamination pads, scale house, sample plant, truck shop and all other structures on site 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 dry waste materials from Mill decommissioning, contaminated soils underlying the Mill areas, and ancillary contaminated materials will be disposed of in tailings Cell 4A, Cell 4B, or the Cell 1 Tailings Area. All other 11e.(2) byproduct material on site will be disposed of in Cell 4A or Cell 4B.

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.

See also Section 3.1 of Attachment A.

The estimated reclamation costs for surety are set out in Attachment C. Attachment C will be reviewed and updated on a yearly basis.

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 or will be transported and disposed of as contaminated material. 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

As required by Part I.H.1 of the GWDP, Denison is in the process of completing an infiltration and contamination transport model of the final tailings cover system to demonstrate the long-term ability of the cover to protect nearby groundwater quality. Upon review of such modeling, the executive Secretary will determine if changes to the cover systems as set outin the iPlan are needed to ensure compliance with the performance criteria contained in part I.D.8 of the GWDP. Although the modeling has not been completed, modeling results to date suggest that some changes to the final cover design as set out in this Plan will be needed. However, as the details of such re-design have not been finalized at this time, the approved 2000 cover deiagn and basis will continue to be used for this version of the Plan. This Plan will be amended in the future to incorporate any changes to the design of the tailings cover system that result from the current modeling effort.

The design criteria summaries in this section are adapted from Tailings Cover Design, Mill (Titan, 1996). A copy of the Tailings Cover Design report is included in 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 Appendix A to 10 CFR Part 40 (which are incorporated by reference into UAC R313-24-4), and 40 CFR Part 192 was used as criteria in final designs under this Plan. In addition, the following documents also provided guidance:

- EPA, 1994, *The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3*, EPA/600/R-94/168b, September;
- 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; and.
- NUREG 1620, 2003, *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 of 1978.*

As mentioned above, the requirements set out in Part I.D.8 of the GWDP require that the cover system for each tailings cell will be designed and constructed to meet the following minimum requirements for a period of not less than 200 years:

- Minimize the infiltration of precipitation or other surface water into the tailings, including, but not limited to the radon barrier;
- Prevent the accumulation of leachate head within the tailings waste layer that could rise above or over-top the maximum FML elevation internal to any disposal cell, i.e. create a "bathtub" effect; and
- Ensure that groundwater quality at the compliance monitoring wells deosn ot exceed the GWQSs or GWCLs specified in Part I.C.1 and table 2 of the GWDP.

Upon completion of the Infiltration Analysis, this Plan will be revised as necessary to ensure compliance with these requirements.

3.3.2 Radon Flux Attenuation

The EPA rules in 40 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 (incorporate by reference into UAC R313-24-4) 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 Cell 2 is fully covered and Cell 3 is partially covered with three to four feet of random fill. During the period 2004 through 2007, cell 2 was only partially covered with such random fill. Radon flux measurements, averaged over the covered areas, were as follows (Denison 2004-2008):

Table 3.3-1

Average Radon Flux from Tailings Cells 2004-2008

(pCi/m2/sec)

	2004	2005	2006	2007	2008
Cell 2	13.9	7.1	7.9	13.5	3.9
Cell 3	10.8	6.2	10.0	8.9	3.1

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 applicable 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 8.87×10^{-7} cm/sec. The hydraulic conductivity of the clay source from Section 16 was measured in the laboratory to be 3.7×10^{-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 previously submitted Appendix D.

As mentioned above, potential infiltration into the tailings cap is currently ebing remodelined in the Infiltration Analysis. Any changes to this Plan that are required as a result of such remodeling will be incorporated into a subsequent revision to this Plan.

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.

The need for a filter or bedding material beneath the riprap was evaluated using methods presented in NUREG/CR-4620. The function of the filter is to prevent stone penetration into the cover, and to prevent soil erosion of the cover at the riprap/soil cover interface. The likelihood of soil erosion at the interface is evaluated by calculating the interstitial flow velocity through the riprap.

Interstitial velocities were calculated using procedures presented by Abt et al. (1991), which updates the Leps relationship that is presented in NUREG/CR-4620. Details of these calculations are presented in Attachment G. The interstitial velocities on the top slope and the toe apron are sufficiently low that a bedding layer is not necessary. However, the interstitial velocity within the riprap on the side slopes is within the range of values where bedding is conditionally recommended. Because of the wide difference in grain size distributions between the riprap and the random fill, it is recommended that a 6-inch layer of bedding material be placed between these two materials.

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.

3.0 RECLAMATION PLAN

This section provides an overview of the Mmill location and property; details the facilities to be reclaimed; and describes the design criteria applied in this reclamation planPlan. Reclamation pPlans and sSpecifications 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 rReclamation pPlan.

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

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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 acresAdditonal land is controlled by 46 Mill site claims. Total land holdings are approximately 5,415 acres..

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INSERT FIGURE 3.1-1

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 (evaporationve). Cell 1 was previously referred to as Cell I-1. It is now referred to as Cell 1;,
- Cells 2 and 3, 4A and 4B (tailings); and Cell 4A (not currently used).
- Mill buildings and equipment;.
- On-site contaminated areas; and.
- Off-site contaminated areas (i.e., potential areas affected by windblown tailings).

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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 and any contaminated underlying soils from Cell 1 into tailings -Cells 2 and 34A or 4B.
- 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 Mmill site

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decommissioning. (the Cell 1-I Tailings Area)

- Placement of materials and debris from Mill Decommissioning into tailings Cells 4A or 4B or in the Cell 1 Tailings Area;
- Placement of an engineered multi-layer cover on the Cell 1-I Tailings Area, and over the entire area of Cells 2, 3, 4A and 4B3 and the Cell 1 Tailings Area.
- Construction of runoff control and diversion channels as necessary;.
- Reconditioning of Mmill and ancillary areas; and.
- Reclamation of borrow sources.

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INSERT FIGURE 3.2-1

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3.2.2 Tailings and Evaporative Cells

The following subsections describe the cover design and reclamation procedures for Cells1-I, 2, 3, 4A -and 4BA. 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

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A six-foot thick soil cover for to be placed over the uranium tailings and mill decommissioning materials in the Cell 1-I Tailings Area, Cell 2, Cell 2, Cell 4A and Cell 4B3 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, the State of Utah,") 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 or stockpiles on site), 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) and 40 CFR 61.250-61.256;
- Minimize infiltration into the reclaimed tailings cells;

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- 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

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attenuation calculation, as it effectively contributes to the reduction of radon emissions (see Section 3.3.21). 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

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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 -Mmill 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 4A or 4B3. 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.

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A portion of Cell 1 (i.e., the Cell 1 Tailings Area)-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 Tailings

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Area needed for storage of additional material will depend on the status of Cell 4A2 and 3-4B at the time of final mill decommissioning. A portion of the MMill area decommissioning material may be placed in Cell 4A2 or 4B3 if space is availaible, but for purposes of the reclamation design the entire quantity of contaminated materials from the -MMill site decommissioning is assumed to be placed in the Cell 1 Tailings Area-I. This results in approximately 10 acres of the Cell 1-I Tailings AArea and being utilized for permanent tailings storage. This area is refered to as the Cell 1-I Tailings AreaThe remaining area of. Cell 1-I will then be breached and converted to a sedimentation basin. All runoff from the Cell 1-I Tailings Area, the MMill 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

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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.

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The cover will be as described in Section 3.2.2.1 above, and 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

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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

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Cell 4A will be filled with tailings, debris and contaminated soils and covered with the same multi-layered engineered cover as Cell 2 and Cell 3.

3.2.2.6 Cell 4B

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Cell 4B will be filled with tailings, debris and contaminated soils and covered with the same multi-layered engineered cover as Cell 2, Cell 3 and 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

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

3.2.3.1 Mill Building, -and Equipment, and Other 11e.(2) Byproduct Material

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The uranium and vanadium sections, including ore reclaim, grinding, pre-leach, leach, CCD, SX, and precipitation and drying circuits as well as the alternate feed circuit, decontamination pads, scale house, sample plant, truck shop and all other structures on site 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 Mmill 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 dry waste materials from Mmill decommissioning, contaminated soils underlying the Mmill areas, and ancillary contaminated materials will be disposed of in tailings Cell -4A2, Cell 4B3, or the Cell 1 -I Tailings Area. All other 11e.(2) byproduct material on site will be disposed of in Cell 4A or Cell 4B.

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

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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.

See also Section 3.1 of Attachment A.

The estimated reclamation costs for surety are set out in Attachment C. Attachment C will be reviewed and updated on a yearly basis.

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INSERT FIGURE 3.2.3-1

LAYOUT OF MILL YARD AND ORE PAD

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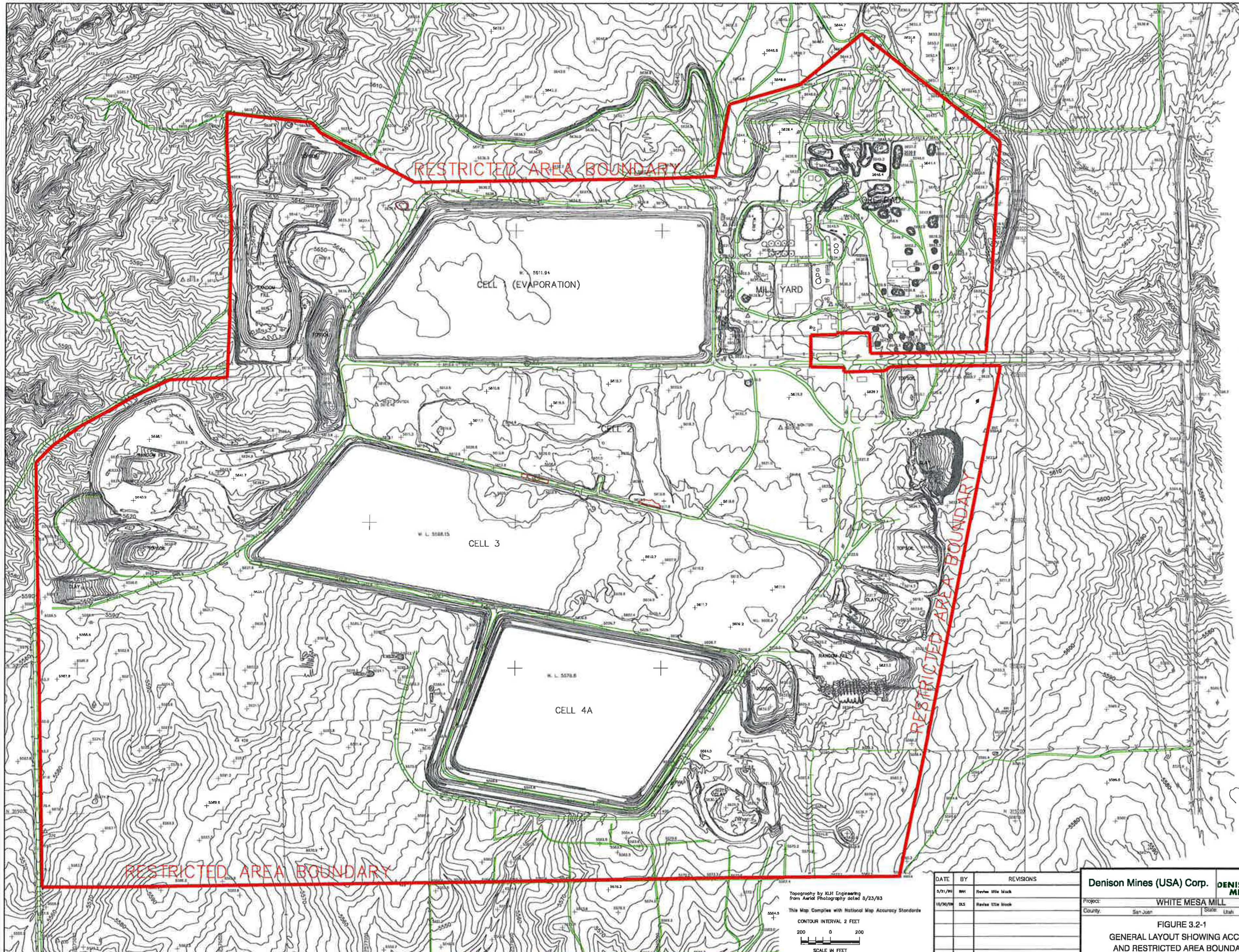

Topography by KLH Engineering
from Aerial Photography dated 8/23/93

This Map Complies with National Map Accuracy Standards

CONTOUR INTERVAL 2 FEET

200 0 200

SCALE IN FEET

DATE	BY	REVISIONS
5/21/99	RAH	Revise title block
10/30/09	DLS	Revise title block

Denison Mines (USA) Corp.

DENISON MINES

Project: WHITE MESA MILL

County: San Juan State: Utah

FIGURE 3.2-1

GENERAL LAYOUT SHOWING ACCESS AND RESTRICTED AREA BOUNDARY

Date May, 1999 Design RAVH Drafted By: RAH

3.2.3.2 Mill Site

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Contaminated areas on the Mmill 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 or will be transported and disposed of as contaminated material. 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 Mmill-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 Mmill 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.As required by Part I.H.1 of the GWDP, Denison is in the process of completing an infiltration and contamination transport model of the final tailings cover system to demonstrate the long-term ability of the cover to protect nearby groundwater quality. Upon review of such modeling, the executive Secretary will determine if changes to the cover systems as set outin the iPlan are needed to ensure compliance with the performance criteria contained in part I.D.8 of the GWDP.

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Although the modeling has not been completed, modeling results to date suggest that some changes to the final cover design as set out in this Plan will be needed. However, as the details of such re-design have not been finalized at this time, the approved 2000 cover deiagn and basis will continue to be used for this version of the Plan. This Plan will be amended in the future to incorporate any changes to the design of the tailings cover system that result from the current modeling effort.

The design criteria summaries in this section are adapted from Tailings Cover Design, Mill (Titan, 1996). A copy of the Tailings Cover Design report is included in 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 Appendix A to 10 CFR Part 40 (which are incorporated by reference into UAC R313-24-4), and 40 CFR Part 192 was used as criteria in final designs under this Preclamation 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*

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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; and.
- NUREG 1620, 2003, *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 of 1978.*

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As mentioned above, the requirements set out in Part I.D.8 of the GWDP require that the cover system for each tailings cell will be designed and constructed to meet the following minimum requirements for a period of not less than 200 years:

- Minimize the infiltration of precipitation or other surface water into the tailings, including, but not limited to the radon barrier;
- Prevent the accumulation of leachate head within the tailings waste layer that could rise above or over-top the maximum FML elevation internal to any disposal cell, i.e. create a "bathtub" effect; and
- Ensure that groundwater quality at the compliance monitoring wells deosn ot exceed the GWQSs or GWCLs specified in Part I.C.1 and table 2 of the GWDP.

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Upon completion of the Infiltration Analysis, this Plan will be revised as necessary to ensure compliance with these requirements.

3.3.2 Radon Flux Attenuation

The Environmental Protection Agency (EPA) rules in 40 Code of Federal Regulation (CFR) Part

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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 (incorporate by reference into UAC R313-24-4) 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

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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:

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- 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)].

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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

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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).

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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.

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3.3.2.2 Empirical Data

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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 areCell 2 is fully covered and Cell 3 is partially covered with three to four feet of random fill. During the period 2004 through 2007, cell 2 was only partially covered with such random fill. Radon flux measurements, averaged over the covered areas, were as follows (EFN 1994-1996, IUC 1997-1998Denison 2004-2008):

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

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Table 3.3-1

Average Radon Flux from Tailings Cells 2004-2008

(pCi/m2/sec)

	2004	2005	2006	2007	2008
Cell 2	13.9	7.1	7.9	13.5	3.9
Cell 3	10.8	6.2	10.0	8.9	3.1

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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 applicable 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

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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 8.87×10^{-7} cm/sec. The hydraulic conductivity of the clay source from Section 16 was measured in the laboratory to be 3.7×10^{-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

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- 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 previously submitted Appendix D.

As mentioned above, potential infiltration into the tailings cap is currently ebing remodelined in the Infiltration Analysis. Any changes to this Plan that are required as a result of such remodeling will be incorporated into a subsequent revision to this Plan.

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.

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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).

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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

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the side slopes is 4.9 ft./sec.

The need for a filter or bedding material beneath the riprap was evaluated using methods presented in NUREG/CR-4620. The function of the filter is to prevent stone penetration into the cover, and to prevent soil erosion of the cover at the riprap/soil cover interface. The likelihood of soil erosion at the interface is evaluated by calculating the interstitial flow velocity through the riprap.

Interstitial velocities were calculated using procedures presented by Abt et al. (1991), which updates the Leps relationship that is presented in NUREG/CR-4620. Details of these calculations are presented in Attachment G. The interstitial velocities on the top slope and the toe apron are sufficiently low that a bedding layer is not necessary. However, the interstitial velocity within the riprap on the side slopes is within the range of values where bedding is conditionally recommended. Because of the wide difference in grain size distributions between the riprap and the random fill, it is recommended that a 6-inch layer of bedding material be placed between these two materials.

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.

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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.

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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

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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)

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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.

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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.

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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.

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Attachment A
White Mesa Mill Reclamation Plan
Revision 3.2.B

Plans and Specifications

for

Reclamation

of the

White Mesa Mill and Tailings Management System

January 2011

State of Utah11e.(2) Byproduct Material License # UT1900479

ATTACHMENT A

PLANS AND SPECIFICATIONS

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

DENISON MINES (USA) CORP.

INDEPENDENCE PLAZA

1050 17TH STREET, SUITE 950

DENVER, CO 80265

January 2011 Revision 3.2.B

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1.0 GENERAL

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

2.0 CELL 1 RECLAMATION

2.1 Scope

The reclamation of Cell 1 (previously referred to as 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 dike for permanent disposal of contaminated material and debris from the Mill site decommissioning, referred to as the Cell 1 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 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, 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 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 Tailings Area

2.3.1 General

A clay lined area will be constructed adjacent to and parallel with the existing Cell 1 dike for permanent disposal of contaminated material and debris from the Mill site decommissioning (the Cell 1 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 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 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.

INSERT FIGURE A-2.2.4-1

SEDIMENTATION BASIN DETAILS

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 Alternate Feed processing circuit
- Decontamination pads
- The office building.
- The shop and warehouse building.
- The sample plant building.
- The Reagent storage 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 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 and alternate feed materials 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 other 11e.(2) byproduct materials will be disposed of in the tailings cells.

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.

Insert FIGURE A3.2-1
MILL SITE AND ORE PAD FINAL GRADING PLAN

3.3.1 Guidance

The necessity for remedial actions will be based upon an evaluation prepared by Denison, and approved by the Executive Secretary, 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 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 alternate feed circuit.
- The ore pad and ore feed areas.
- Tailings Cells No. 2, 3, 4A, and 4B.
- Evaporation Cell No. 1.

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 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 Executive Secretary approval. The Plan will be in accordance with NRC Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs. In general, the Plan will detail Denison'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 procedures utilized in compliance with the existing License.

Insert Figure A3.3-1

Insert Figure A3.3-2

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 Executive Secretary.

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, 2, 3, 4A AND 4B

5.1 Earth Cover

A multi-layered earthen cover will be placed over tailings Cells 2, 3, 4A and 4B and a portion of Cell 1 used for disposal of contaminated materials (the Cell1 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.

<u>Clay Layer Materials</u>

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.

Insert A5.1-1

Insert Figure A-5.1-2

Insert FIGURE A-5.1-3

RECLAMATION COVER CROSS SECTIONS

Insert Figure A-5.1-4

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 Executive Secretary. 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 DRC. Settlement observations will be made in accordance with Quality Control Procedure QC-16-WM, "Monitoring of Temporary Settlement Plates."

INSERT TABLE 5.3.2.1-1

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.

Riprap bedding should be placed between the random fill and the riprap on the side slopes. The bedding should consist of medium sand, and should be placed with a minimum layer thickness of 6 inches.

6.2 Materials

Materials utilized for riprap applications will meet the following specifications:

Material	D_{50} Size	D_{100} Size	Layer Thickness
Top Surface Riprap	0.3"	0.6"	6"
Slope Surface Bedding	No. 40 Sieve	3"	6"
Slope Surface Riprap	3.5"	7"	8"
Toe Apron Riprap	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 and bedding material will be hauled to the reclaimed surfaces and placed on the surfaces using belly dump highway trucks and road graders. Riprap and bedding 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 and bedding 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 and bedding will avoid accumulation of riprap or bedding sizes less than the minimum D_{50} size and nesting of the larger sized rock. The riprap and bedding 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 at the Mill. 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 and bedding 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 gradations will be performed for each type of riprap and bedding when approximately one-third (1/3) and two-thirds (2/3) of the total volume of each type have been produced or delivered. In addition, test series for rock durability will be performed on any riprap material at this same time. 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 A

PLANS AND SPECIFICATIONS

FOR

RECLAMATION

OF

WHITE MESA FACILITIES

BLANDING, UTAH

PREPARED BY

~~INTERNATIONAL URANIUM~~ DENISON MINES (USA) CORP.

INDEPENDENCE PLAZA

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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 (previously referred to as 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 millMill site decommissioning, referedreferred 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 millMill 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~~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

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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~~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

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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

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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 millMill 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.

INSERT FIGURE A-2.2.4-1

SEDIMENTATION BASIN DETAILS

3.0 MILL DECOMMISSIONING

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

3.1 Mill

The uranium and vanadium processing areas of the ~~mill~~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~~Mill, screens, pumps and cyclones.
- The three preleach tanks to the east of the ~~mill~~Mill building, including all tankage, agitation equipment, pumps and piping.
- The seven leach tanks inside the main ~~mill~~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~~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~~Mill building.
- The Alternate Feed processing circuit
- Decontamination pads
- The office building.
- The shop and warehouse building.
- The sample plant building.
- The Reagent storage 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 millMill 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 millMill site will be primarily superficial and include the ore storage area and surface contamination of some roads. All ore and alternate feed materials 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 other 11e.(2) byproduct materials will be disposed of in the tailings cells.

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 millMill site and ancillary areas is shown on Figure A-3.2-1.

3.3 Windblown Contamination

Windblown contamination is defined as millMill 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.

Insert FIGURE A3.2-1

MILL SITE AND ORE PAD FINAL GRADING PLAN

3.3.1 Guidance

The necessity for remedial actions will be based upon an evaluation prepared by IUCDenison, and approved by the NRCExecutive Secretary, 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 millMill 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 alternate feed circuit.
- The ore pad and ore feed areas.
- Tailings Cells No. 2, 3, and 4A, and 4B.

- Evaporative cellEvaporation Cell No. 1-I.

The remaining areas of the millMill 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.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~~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~~Executive Secretary approval. The Plan will be in accordance with NRC Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs. In general, the Plan will detail ~~the Company's~~Denison'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~~procedures utilized in compliance with the existing License.

Insert Figure A3.3-1

Insert Figure A3.3-2

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~~Executive Secretary.

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, 3, 4A AND 34BA

5.1 Earth Cover

A multi-layered earthen cover will be placed over tailings Cells 2, and 3, 4A and 4BA 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.

Insert A5.1-1

Insert Figure A-5.1-2

Insert FIGURE A-5.1-3

RECLAMATION COVER CROSS SECTIONS

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SECTIONS D-D' & E-E' FROM FIGURE A-5.1-1

Insert Figure A-5.1-4

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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 millMill 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

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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

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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

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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.~~Executive Secretary. Data collected will be analyzed and the reclamation techniques and schedule adjusted accordingly.

5.4.1.2 Installation

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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

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

INSERT TABLE 5.3.2.1-1

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.

Riprap bedding should be placed between the random fill and the riprap on the side slopes. The bedding should consist of medium sand, and should be placed with a minimum layer thickness of 6 inches.

6.2 Materials

Materials utilized for riprap applications will meet the following specifications:

LocationMaterial	D_{50} Size	D_{100} Size	Layer Thickness
Top Surface Riprap	0.3"	0.6"	6"
Slope Surface Bedding	No. 40 Sieve	3"	6"
Slope Surface Riprap	3.5"	7"	8"

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Toe Apron Riprap	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 and bedding material will be hauled to the reclaimed surfaces and placed on the surfaces using belly dump highway trucks and road graders. Riprap and bedding 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 and bedding 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 and bedding will avoid accumulation of riprap or bedding sizes less than the minimum D_{50} size and nesting of the larger sized rock. The riprap and bedding 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~~at the ~~White Mesa Project~~Mill. 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 and bedding 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 gradations will be performed for each type of riprap and bedding when approximately one-third (1/3) and two-thirds (2/3) of the total volume of each type have been produced or delivered. In addition, test series for rock durability will be performed on any riprap material at this same time. 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.

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Attachment C
White Mesa Mill Reclamation Plan
Revision 4.4

Revised Cost Estimates

for

Reclamation

of the

White Mesa Mill and Tailings Management System

November 2010

State of Utah11e.(2) Byproduct Material License # UT1900479

Copy 1 State of Utah

PREFACE TO ATTACHMENT C

The White Mesa Mill Reclamation Cost Estimate Revision 4.4 was submitted in its entirety under separate cover in November 2010. This Attachment ("Attachment C") contains a summary table of the White Mesa Mill Reclamation Costs from Revision 4.4 of the Reclamation Cost Estimate.

WHITE MESA MILL RECLAMATION COST ESTIMATE
November 2010
Revision 4.4

Mill Decommissioning		$2,106,401
Cell 1		$1,711,993
Cell 2		$1,589,352
Cell 3		$2,056,143
Cell 4A		$1,348,393
Cell 4B		$1,337,266
Miscellaneous		$3,295,557
Subtotal Direct Costs		$13,445,107
Profit Allowance	10.00%	$1,344,511
Contingency	15.00%	$2,016,766
Licensing & Bonding	2.00%	$268,902
UDEQ Contract Administration	4.00%	$537,804
Contractors Equipment Floater		$82,250
Automobile and General Liability Insurance		$284,600
Long Term Care Fund		$797,448
Total Reclamation		$18,777,388
Revised Bond Amount		$18,777,388

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Attachment G
White Mesa Mill Reclamation Plan
Revision 3.2.B

Channel, Toe Apron and Rip Rap Filter Blanket Design Calculations

for

Reclamation

of the

White Mesa Mill and Tailings Management System

January 2011

State of Utah11e.(2) Byproduct Material License # UT1900479

ATTACHMENT G

CHANNEL, TOE APRON AND RIP RAP FILTER BLANKET

DESIGN CALCULTIONS

FOR

RECLAMATION

OF

WHITE MESA MILL FACILITIES

BLANDING, UTAH

PREPARED BY

DENISON MINES (USA) CORP.

1050 17th STREET, SUITE 950

DENVER, COLORADO 80265

January 2011 Revision 3.2.B

MWH

BUILDING A BETTER WORLD

TECHNICAL MEMORANDUM

TO: Doug Oliver

DATE: January 29, 2010

FROM: Roslyn Stern

SUBJECT: Evaluation of need for filter layer on side slopes of Denison's White Mesa Mill Tailings Cell Cover

---

The following evaluation was performed to evaluate the need for a filter layer under the rock layer on the side slopes of the tailings cells cover for the White Mesa Mill. Supporting assumptions, calculations, and discussion are provided following the conclusions and recommendations.

Conclusions and Recommendations

The calculated interstitial velocities on the top slope and the toe apron are sufficiently low that a bedding layer is not necessary. However, the interstitial velocity within the erosion protection on the side slopes is within the range of values where bedding is conditionally recommended. Because of the wide difference in grain size distribution between the erosion protection and the random fill, it is recommended that a 6-inch layer (for constructability) of bedding material be placed between these two materials. The bedding material should be medium sand with the following specifications:

Sieve Size	Percent Passing
3 inches	100
No. 4	65-100
No. 20	20-70
No. 200	0-5

The need for a rock layer on the sideslopes and underlying filter zone can be evaluated as part of the detailed cover design. The rock layer on the sideslopes could be replaced with a rock mulch (gravel-amended topsoil) that has the appropriate median size for erosion protection. A rock mulch (gravel-amended topsoil) is being proposed for the cover surface.

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Suite 206
Fort Collins, Colorado 80525

TEL 970 377 9410
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www.mwhglobal.com

Supporting Documentation and Discussion

Problem Statement

Evaluate the need for bedding layer between cover soils and erosion protection material (rock) by estimating interstitial pore velocities using method proposed by Abt et al. (1991). This evaluation is being completed for the currently permitted rock cover design.

Assumptions

- Reclamation cover, as described in Section 3.2.2 of the 2000 Reclamation Plan (International Uranium Corp, 2000) consists of six-foot soil cover. The cover consists, from bottom to top, of a minimum of three feet of random fill (platform fill), one foot of clay, and two feet of random fill (frost barrier).

- Cells 2 and 3 will have final cover placed at a 0.2 percent grade, with 5H:1V side slopes (Section 3.2.2.3).

- Erosion protection on the top surface of the cover will be provided by placing a minimum of 3 inches of riprap with a median diameter (D_{50}) of 0.3 inches (Section 3.3.5) and a D_{100} of 0.6 inches (Section 6.2 of Attachment A – Plans and Specifications). The overland flow velocity calculated for the top of the cover is less than 2.0 ft/sec (Section 3.3.5).

- Erosion protection of the side slopes of the cover will be provided by placing a minimum of 8 inches of riprap with a D_{50} of 3.5 inches (Section 3.3.5) and a D_{100} of 7 inches (Section 6.2 of Attachment A – Plans and Specifications). The calculated flow velocity on the side slopes is 4.9 ft/sec (Section 3.3.5).

- Erosion protection of the toe apron will be provided by placing riprap with a D_{50} of 6.4 inches (Section 3.3.5) and a D_{100} of 12 inches (Section 6.2 of Attachment A – Plans and Specifications).

- As described in Section 5.2 of Attachment A (Plans and Specifications), the random fill used as platform fill and frost barrier protection is specified to have at least 30 percent of the material finer than the number 40 sieve, with a D_{100} less than 8 inches.

- The peak unit discharge from the tailings cells is 1.8 cfs/ft (Attachment 12 to Attachment G – Channel and Toe Apron Design Calculations)

Discussion

NUREG-1623, Appendix D, recommends a filter or bedding layer be placed under erosion protection if interstitial velocities are greater than 1 ft/sec, in order to prevent erosion of the underlying soils. Bedding is not required if interstitial velocities are less than 0.5 ft/sec, and recommended depending on the characteristics of the underlying soil if velocities are between 0.5 and 1 ft/sec.

Interstitial velocities are calculated by procedures presented by Abt et al. (1991) as given in the following equation. This method updates the Leps (1973) relationship that is presented in NUREG/CR-4620 (Nelson et al. 1986):

$$V_i = 0.23(g \times D_{10} \times S)^{0.5}$$

Where:
- V_i = interstitial velocities (ft/s),
- G = acceleration of gravity (ft/s2),
- D_{10} = rock diameter at which 10 percent is finer (inches), and
- S = gradient in decimal form.

The maximum D_{10} of the erosion protection is estimated based on D_{50} required for erosion protection, assuming the erosion protection will have a coefficient of uniformity (CU) of 6 and a band width of 5. Band width refers to the ratio of the minimum and maximum allowed particle sizes acceptable for any given percent finer designation. USDA (1994) recommends CU to be a maximum of 6 in order to prevent gap-grading of filters. Table 1 summarizes the results.

Table 1. Results of Bedding Requirements

Location	Top Cover	Cover Side Slopes	Toe Apron
Minimum D_{50} (inches)	0.3	3.5	6.4
Maximum D_{10} (inches)	0.35	1.24	3.73
Slope (%)	0.2	20	1
Interstitial Velocity (ft/s)	0.03	0.65	0.25

References

Abt, S.R., J.F. Ruff, and R.J. Wilter (1991). Estimating Flow Through Riprap, Journal of Hydraulic Engineering, v. 117, No. 5, May.

International Uranium (USA) Corp (2000). Reclamation Plan, White Mesa Mill, Blanding, Utah, Revision 3.0, July.

Johnson, T.L. (2002). Design of Erosion Protection for Long-Term Stabilization, NUREG-1623, U.S. Nuclear Regulatory Commission (NRC), February.

Nelson, J.D., S.R. Abt, R.L. Volpe, D. van Zyl, N.E. Hinkle, W.P. Staub (1986) Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill tailings Impoundments, NUREG/CR-4620, U.S. Nuclear Regulatory Commission (NRC), June.

U.S. Department of Agriculture (USDA) (1994). Gradation Design of Sand and Gravel Filters, National Engineering Handbook, Part 633, Chapter 26, October.

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Figures

White Mesa Mill Reclamation Plan
Revision 3.2.B

for

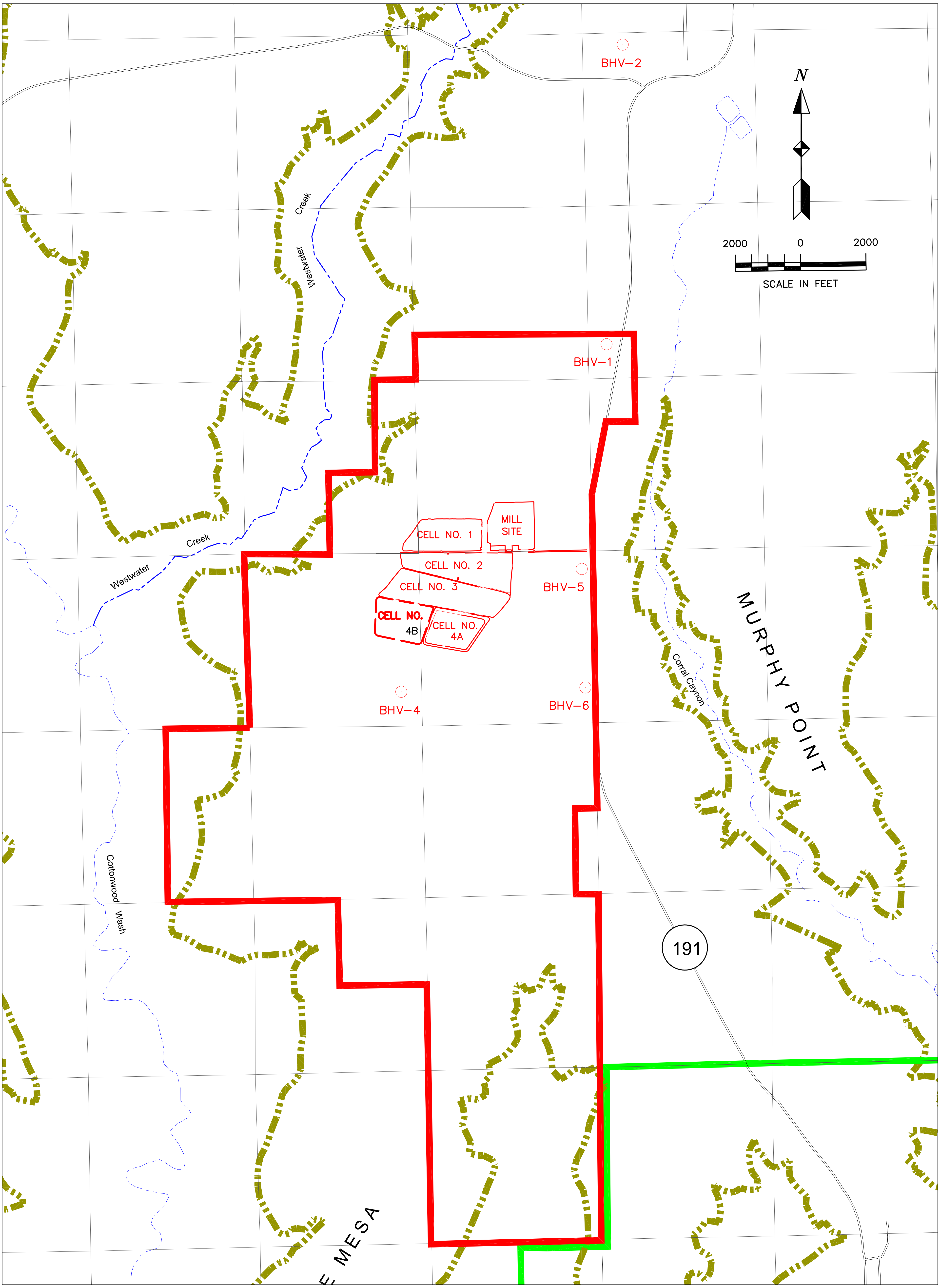
Reclamation

of the

White Mesa Mill and Tailings Management System

January 2011

State of Utah11e.(2) Byproduct Material License # UT1900479



Property Boundary
Reservation Boundary
Canyon Rim
Air Monitor Stations

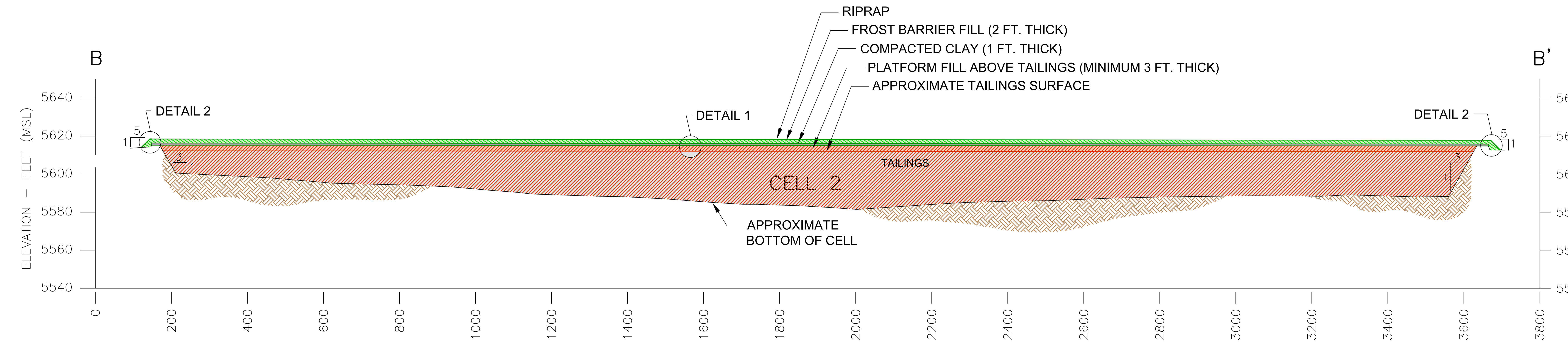
Denison Mines (USA) Corp.

Project	WHITE MESA MILL
County:	State: UT
Location:	

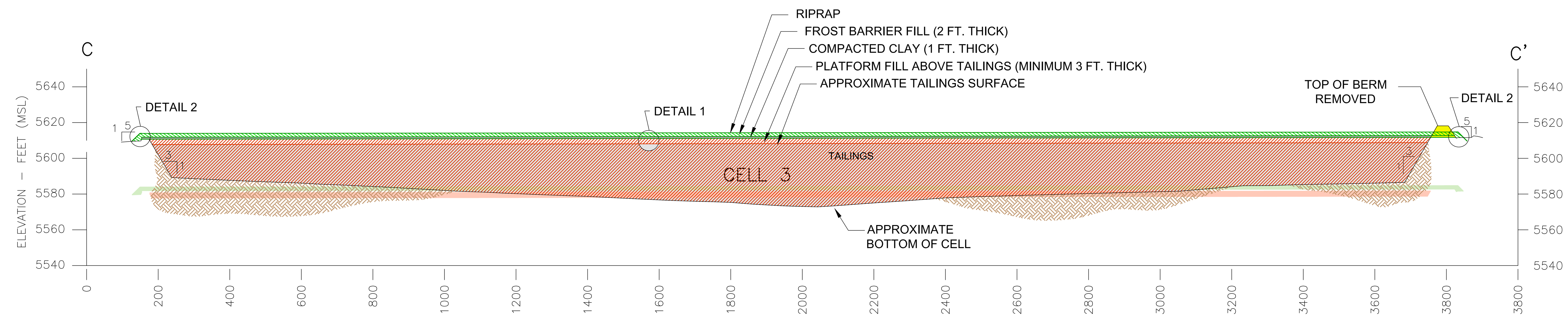
REVISIONS	
Date	By
11-09	dls
01/13/11	BM

Figure 2.3-1
High Volume
Air Monitoring Stations

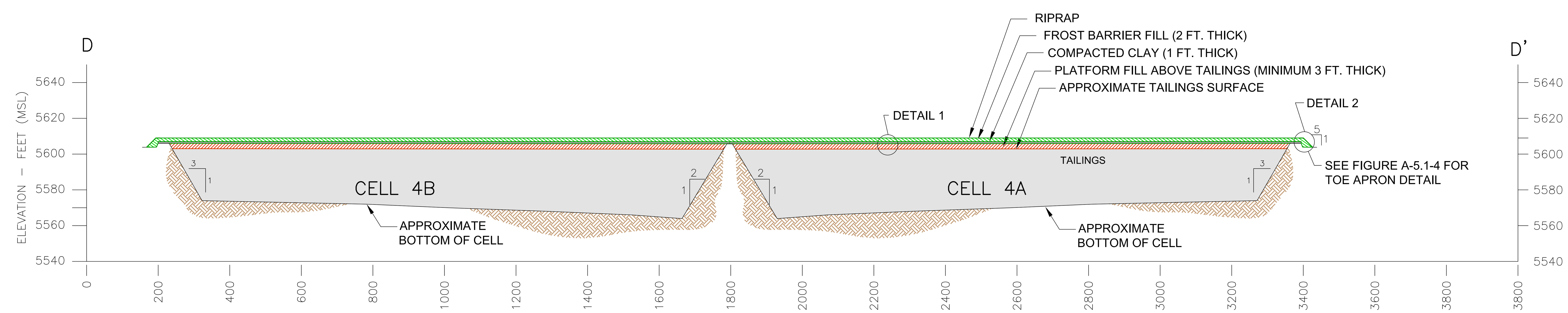
Scale: as shown | Date: JAN 2011
Author: HRR | Drafted By: B.Munkhbaatar



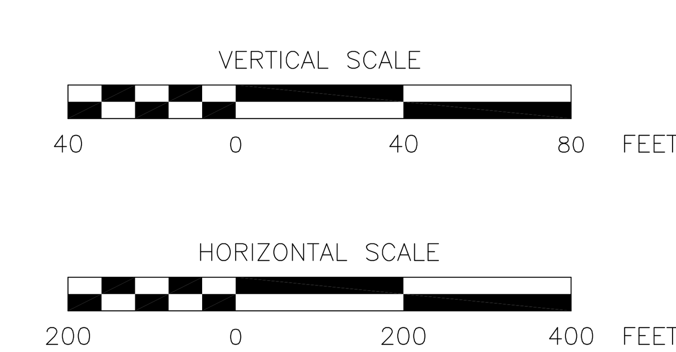
SECTION B–B'



SECTION C–C'



3 SECTION D–D' 2



REV. No.	DATE	BY	REVISIONS
1	11/19/98	RAH	Delete clay layer from exterior side slopes, change layer names, & change title block
2	7/11/08	dmf	Add section D–D'
	2/10/10	DLS	Add detail reference on section D–D'
	12/17/10	BM	Revision date update
3	01/13/11	BM	Add CELL 4B on section D–D'

Denison Mines (USA) Corp.

Project: WHITE MESA MILL

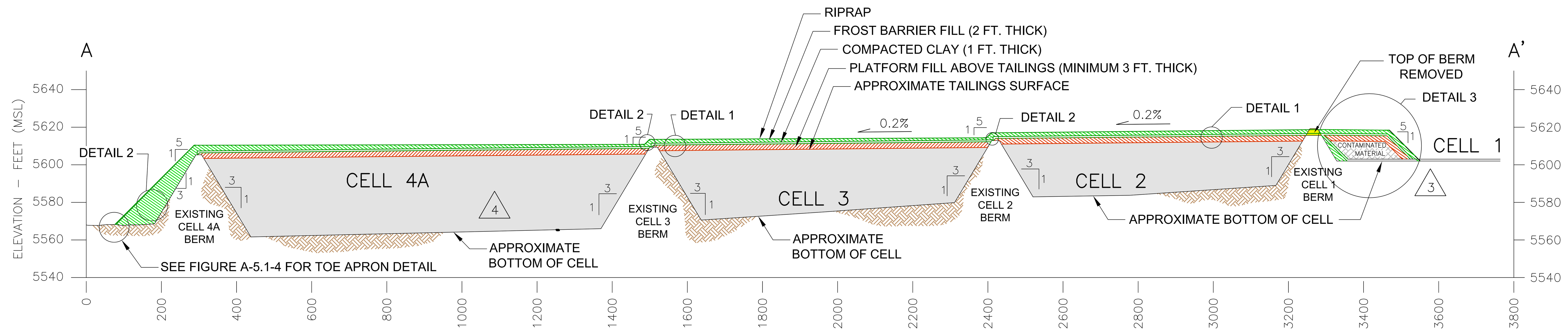
County: San Juan State: Utah

FIGURE A-5.1-3

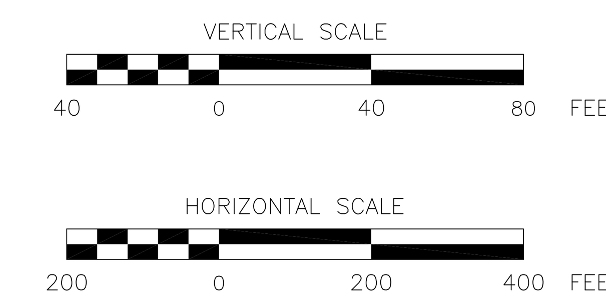
RECLAMATION COVER AND CROSS SECTIONS

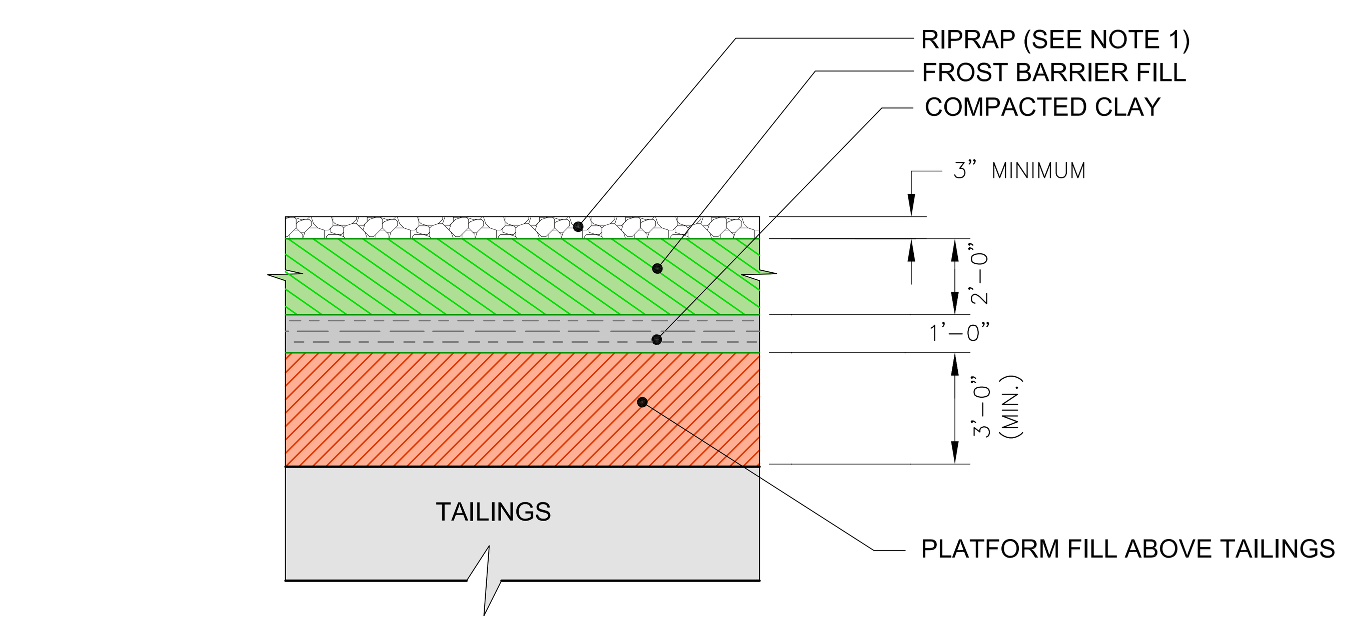
RECLAMATION PLAN REVISION 3.2.B

Date: March, 2010 Design: Drafted By: D.Sledd



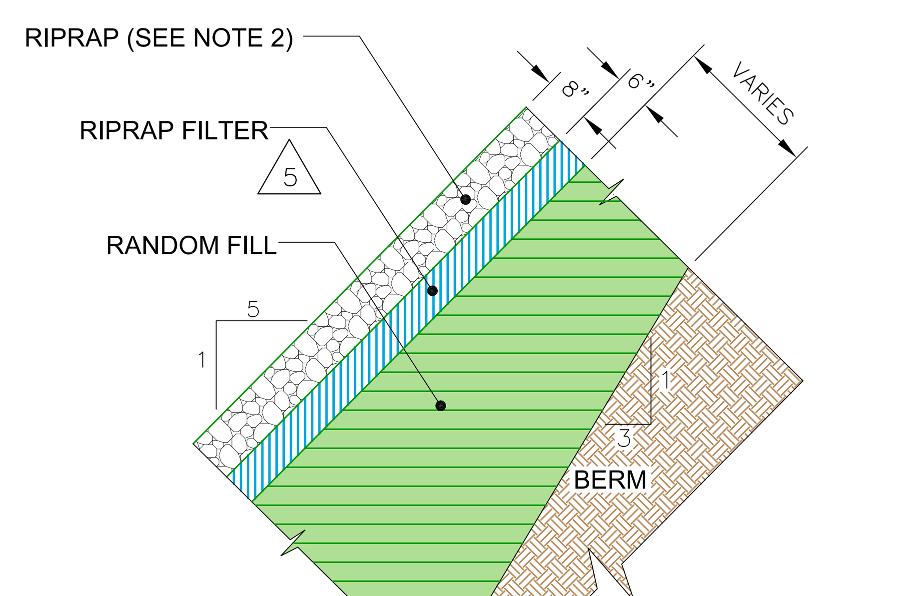
SECTION A–A' (WITH COVER ON CELLS 2, 3 & 4A)





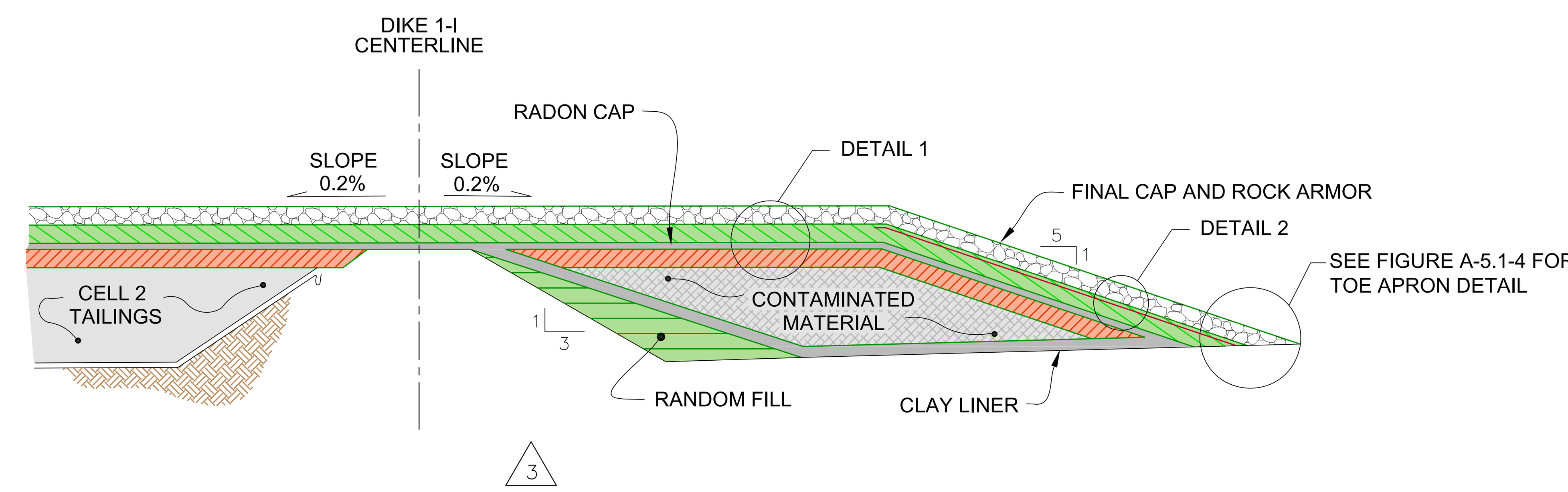
DETAIL 1: COVER DETAIL FOR POND SURFACE AREAS

(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 0.34 INCHES.
2. RIPRAP PLACED ON THE SIDE SLOPES OF COVER WILL CONSIST OF ROCK WITH D50 MINIMUM OF 3.5 INCHES.
3. RIPRAP FILTER PLACED ON THE SIDE SLOPES OF COVER WILL CONSISTS OF MEDIUM SAND
4. POND BOTTOM ELEVATIONS INFERRED FROM 'CELL 4 PHASE A AND PHASE B PLAN', WESTERN ENGINEERS INC., (JANUARY 17, 1989).
5. SEE FIGURES 1 AND 2 FOR CROSS SECTION LOCATIONS.
6. 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	6/30/00	DLS	Add Cell 1–I Disposal Area
4	7/09/08	dmf	Add Cell 4A Cover
5	2/10/10	DLS	Add riprap filter and detail references
	12/17/10	BM	Add riprap filter and detail references update
	01/13/11	BM	Change figure number, revision update

Denison Mines (USA) Corp.

Project: WHITE MESA MILL

County: San Juan State: Utah

FIGURE A-5.1-2

RECLAMATION COVER DETAILS & CROSS SECTION

RECLAMATION PLAN REVISION 3.2.B

Date: March, 2010 Design: Drafted By: D.Sledd

LEGEND

- 5582.6 — EXISTING SPOT ELEVATION
- 5612 — ELEVATION OF TOP OF COVER
- 5612 — ELEVATION OF TOP OF COVER CELL 4B
- ~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. SEE FIGURES A-5.1-2 AND A-5.1-3 FOR CROSS SECTIONS AND DETAILS.
6. 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

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
4	3/25/08	dmf	Add Cell 4A Reclamation Cap
5	2/10/10	DLS	Add detail reference
6	6/16/10	dmf	Add Cell 4B Reclamation Cap
7	1/13/11	bm	Revision Update

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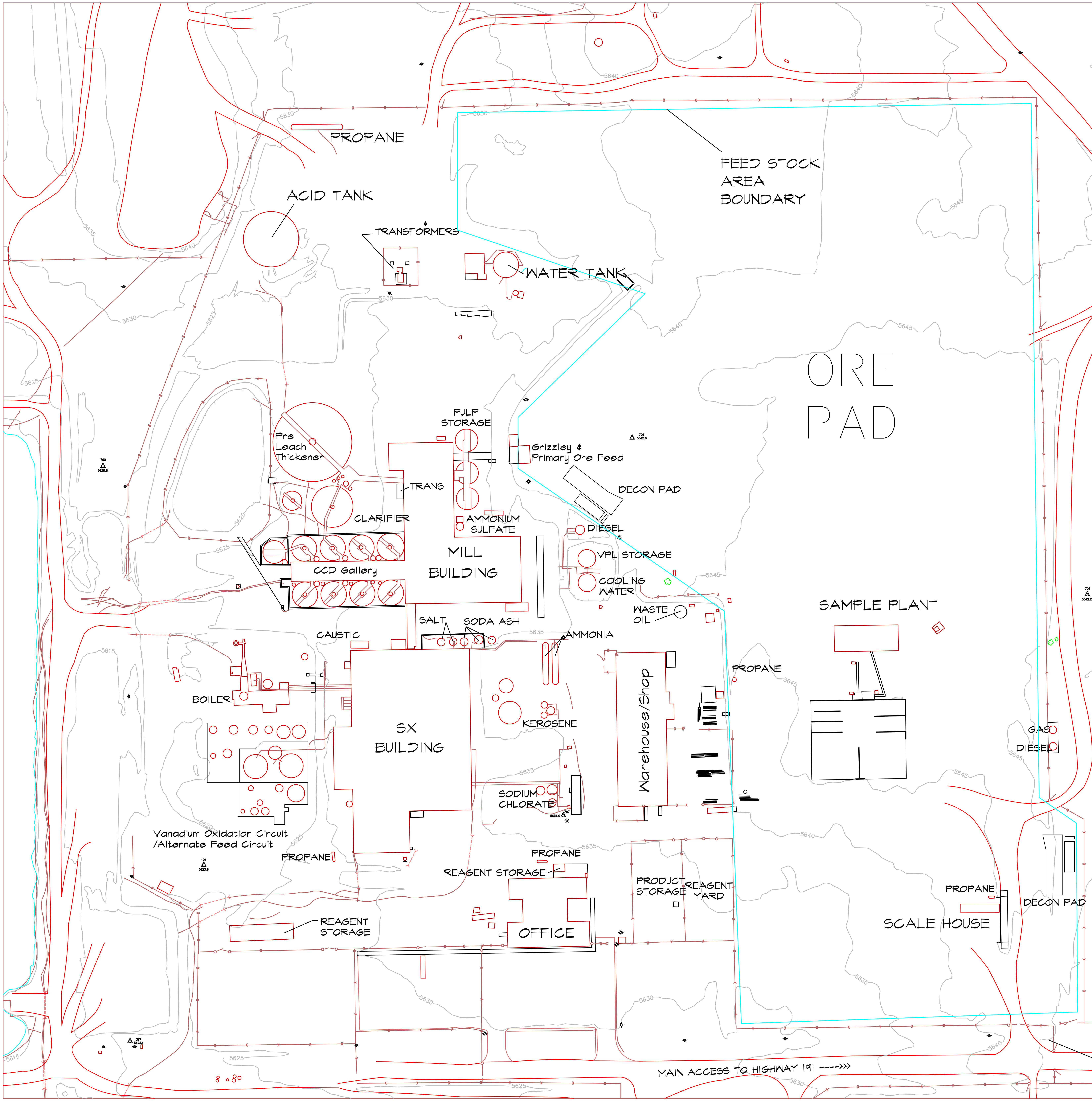
Project: WHITE MESA MILL

County: San Juan State: Utah

FIGURE A-5.1-1
RECLAMATION COVER GRADING PLAN
RECLAMATION PLAN REV. 3.2.B

Date: March, 2010 Design: Drafted By: D.Sledd

REV. No.	DATE	BY	REVISIONS
1	2-10-10	DLS	Tanks added
2	12-17-10	BM	Feed Stock Area Boundary added
3	01-13-11	BM	Revision Update



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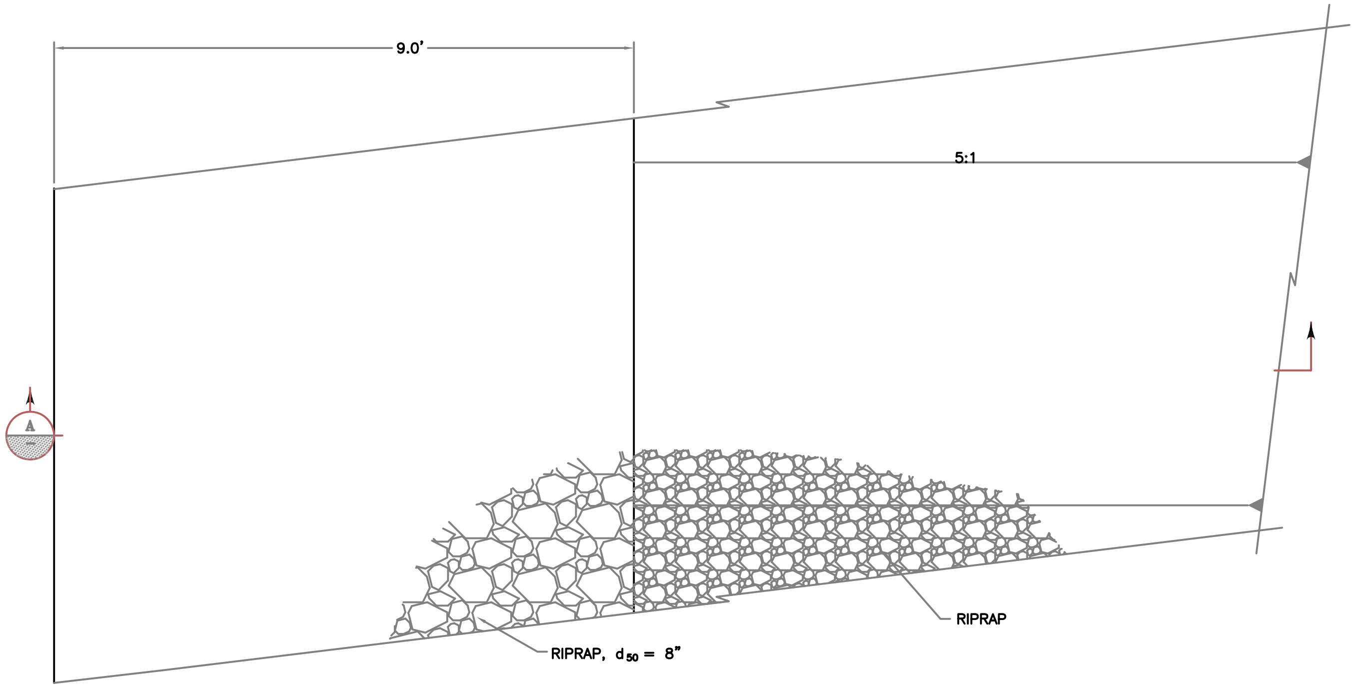
Project: WHITE MESEA MILL

County: San Juan State: Utah

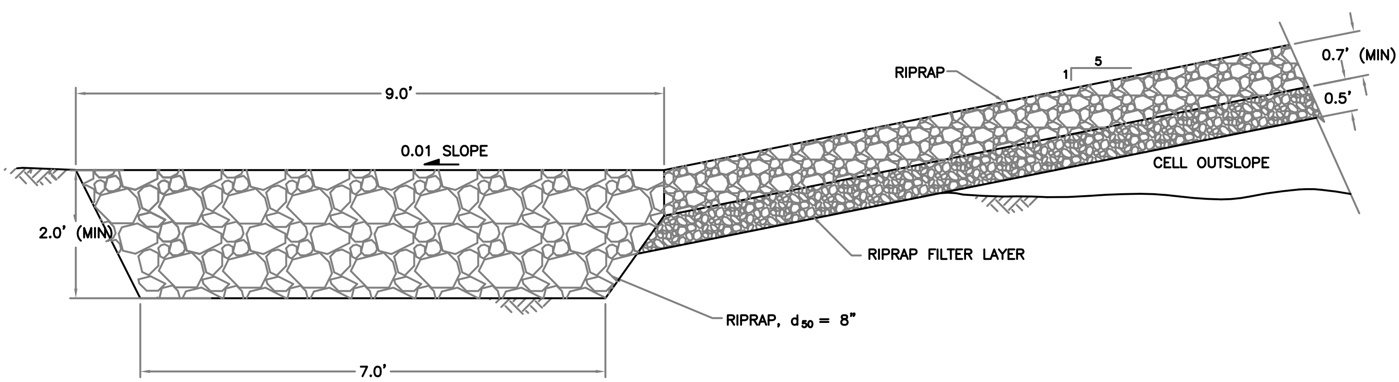
FIGURE 3.2.3-1
SITE MAP-LOCATIONS OF BUILDINGS AND TANKAGE
RECLAMATION PLAN REVISION 3.2.B

Date: March, 2010 | Design: unknown | Drafted By: D.Sledd

W:\USA\Utah\Mill\Dwgs\Reclamation Plans\RecPlan 3.2B\Figure 3.2.3-1 BLDGS and Tanks Site Map.dwg Layout1 12/17/2010



PLAN
NTS



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Denison Mines (USA) Corp.

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REVISIONS	
Date	By
2-22-10	DLS
12-17-10	BM
01-13-10	BM

Project: WHITE MESA MILL

County: San Juan | State: Utah

Location:

FIGURE A-5.1-4

Rock Apron at Base of Toe Cell Outslopes

RECLAMATION PLAN REVISION 3.2.B

Scale: N/A | Date: 4/2/99 | Drafted By: RAH