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SAFETY EVALUATION REPORT
FOR THE
Amendment Request to Process an Alternate Feed Material (the "Uranium Material") at White Mesa Mill (the "Mill") from Dawn Mining Corporation ("DMC") Midnite Mine, Washington State

Energy Fuels Resources (USA) Inc. (EFRI)
(formerly known as
Denison Mines (USA) Corp.)

White Mesa Uranium Mill
San Juan County, Utah

In Consideration of an Amendment to
Radioactive Materials License No. UT1900479
to Authorize Receipt and Processing of the Uranium Material as an Alternate Feed Material Primarily for the Recovery of Uranium and Disposal of the Resulting Residuals in the Mill's Uranium Tailings Impoundments as
lle.(2) Byproduct Material

PREPARED BY:

URS Professional Solutions, LLC for
the Utah Department of Environmental Quality
Division of Radiation Control

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ABBREVIATIONS AND ACRONYMS

11e.(2)	Section 11e.(2) of the Atomic Energy Act of 1954, as amended
µ	Micro
ALARA	As Low as Reasonably Achievable
AO	(Air) Approval Order
avg	Average
Ba	Barium
Be	Beryllium
Bq	Becquerel
CCD	Countercurrent Decantation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curie
DAC	Derived Air Concentration
Director	Director of Utah Radiation Control Division
DMC	Dawn Mining Corporation
DUSA	Denison Mines (USA) Corp.
EFN	Energy Fuels Nuclear, Inc.
EFRI	Energy Fuels Resources (USA) Inc.
EPA	U.S. Environmental Protection Agency
FES	Final Environmental Statement
FS	Feasibility Study
GMP	Groundwater monitoring program
gpm	Gallons per minute
g/cm^3	Grams per cubic centimeter
GWDP	Ground Water Discharge Permit
GWQS	Ground Water Quality Standard
HDPE	High-density polyethylene
K_d	Distribution coefficient

Kg	Kilogram
lb/ft^3	Pounds per cubic foot
LSA	Low Specific Activity
max	Maximum
MDL	Method Detection Limit
mg/kg	Milligrams per kilogram
ml	Milliliter
mrem	Millirem
MSDS	Material Safety Data Sheet
N	Nitrogen
NEA	Nuclear Energy Agency
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
OECD	Organization for Economic Co-operation and Development
OSHA	Occupational Safety and Health Administration
pCi/g	Picocuries per gram
PEL	Permissible Exposure Limit
ppm	Parts per million
RCRA	Resource Conservation and Recovery Act
RfC	Reference concentration
RfD	Reference dose
RI	Remedial Investigation
RML	Radioactive Materials License
RMPR	Radioactive Material Profile Record
ROD	Record of Decision
RSL	Risk Screening Level
SER	Safety Evaluation Report
SOB	Statement of Basis

SSL	Soil Screening Level
Sv	Sievert
SX	Solvent Extraction
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TEDE	Total Effective Dose Equivalent
TTLC	Total Threshold Limit Concentration
U-nat	Natural uranium
U	Uranium
UAC	Utah Administrative Code
U_3O_8	Triuranium octoxide; yellowcake
UDRC	Utah Division of Radiation Control
UV	Ultraviolet (radiation)
WTP	Water Treatment Plant

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1.0 INTRODUCTION

1.1 Background and Need for Proposed Action

This draft Safety Evaluation Report (SER) has been prepared to evaluate the environmental impacts resulting from the proposed receipt and processing of alternate feed material (Uranium Material) from the Dawn Mining Corporation (DMC) Midnite Mine located in Wellpinit, Washington state, at the White Mesa Uranium Mill. The White Mesa Mill site is located in San Juan County, Utah, approximately 5 miles south of Blanding.

The White Mesa Mill is licensed by the Utah Division of Radiation Control (UDRC) under State of Utah Radioactive Materials License (RML) No. UT1900479. This license and its amendments authorize Energy Fuels Resources (USA) Inc. (EFRI) to receive and process natural uranium-bearing ores and certain specified alternate feed materials, and to possess byproduct material in the form of uranium waste tailings and other uranium byproduct waste generated by the licensee's milling operations.

EFRI, formerly Denison Mines (USA) Corp. (DUSA), submitted a License Amendment Request (Amendment Request), in a letter with supporting attachments dated April 27, 2011, to the UDRC to amend its State of Utah RML No. UT1900479. The amendment request, if approved by UDRC, would allow EFRI to receive and process up to 4,500 tons (dry weight) of Uranium Material from the DMC Site.

The Uranium Material results from treatment of pumped groundwater and surface water at the Midnite Mine site's Waste Treatment Plant (WTP) using either centrifuge or filter press technology. Pilot testing performed by DMC indicates that this Uranium Material is expected to have an average moisture content of 55% to 75% (i.e., a dry solids content between 25% and 45%) for centrifuge-generated material, or approximately 60% to 65% (i.e., a dry solids content between 35% and 40%) for the filter-press generated material.

The Washington Department of Health issued an RML in 1992 for the Uranium Material generated from the Midnite Mine WTP, which was constructed in 1988 and began treating water in 1992. The license was terminated after December 31, 2008 and the regulatory authority for operation of the WTP was transferred as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to the U.S. Environmental Protection Agency (EPA). The Dawn Mill processing facility has been decommissioned and Uranium Material is no longer processed at this location. After December 2008, the Dawn Mill tailings facility accepted Uranium Material for direct disposal as source material in accordance with U.S. Nuclear Regulatory Commission (NRC) guidance on Disposal of Atomic Energy Act Non-Section 11e.(2) Byproduct Material of Tailings Impoundments. Direct disposal in the tailings impoundment has not been an option as of the 2010 operating season because of the upcoming scheduled reclamation of the Midnite Mine tailings facility.

EFRI is requesting that the Uranium Material be received and processed at the White Mesa Mill based on its source material content. Byproducts (residuals) from the extraction of source material would be disposed within one or both of the mill's active lined uranium tailings management/disposal cells (Cells 4A and/or 4B). A groundwater detection monitoring program is currently in place for the tailings management cell area that includes the Cell 1 evaporation

pond, and tailings Cells 2, 3, 4A, and 4B. Before the NRC Agreement State status with the State of Utah was formalized, the NRC had approved similar amendment requests for processing of separate alternate feed materials under this license.

Groundwater quality at the White Mesa Mill site is also regulated under State Ground Water Discharge Permit (GWDP) Number UGW370004 (hereafter referred to as the "Permit"). After review of the subject EFRI License Amendment Request, the Director has determined that the existing Permit is sufficient for monitoring local groundwater quality to assess possible effects of disposal of the byproducts left after processing of the proposed alternate feed material.

1.2 Previous Alternate Feed Proposals and Alternate Feed Assessment Process

In the Final Application for Uranium Mills and Mill Tailings made by the State of Utah to the NRC Office of State and Tribal Affairs, the following commitment was made by the State of Utah:

> "The State of Utah recognizes the importance of and supports the uranium mining and milling industry. The State recognizes that to remain viable at this time, uranium mills must be able to engage in activities other than milling conventionally mined uranium such as processing alternate feed materials for the recovery of uranium alone or together with other minerals."

The State of Utah also agreed to use the most recent NRC guidance (SECY 95-211, SECY-99-012, and NRC Regulatory Issue Summary 2000-23) for review and decisions regarding the acceptability of receipt of alternate feed materials for processing at the Mill and that each amendment would be considered a major amendment for the purposes of licensing. Criteria used for decision-making regarding the acceptance of alternate feed material are:

1. Determination of whether the feed material is an ore.

   For the tailings and wastes from the proposed processing to qualify as 11e.(2) byproduct material, the feed material must qualify as "ore." In determining whether the feed material is ore, NRC has established the following definition of ore: "Ore is a natural or native matter that may be mined and treated for the extraction of any of its constituents or any other matter from which source material is extracted in a licensed uranium or thorium mill."

   The Uranium Material is derived from treatment of natural surface water and groundwater that have come into contact with uranium ore at the Midnite Mine site, which would be processed at the licensed White Mesa Mill primarily for its source material (uranium) content, and therefore qualifies as "ore" under this definition. Additionally, the uranium concentration in the Uranium Material exceeds 0.05% on both a wet and dry basis, thereby causing the Uranium Material to also meet the definition of source material.

2. Determination of whether the feed material contains hazardous waste.

   If the proposed feed material contains hazardous wastes, listed under subpart D Sections 261.30-33 of 40 Code of Federal Regulations (CFR) (or comparable Resource Conservation and Recovery Act (RCRA) authorized State regulations), it would be subject to the EPA or

State regulation under RCRA. If the licensee can show that the proposed feed material does not contain a listed hazardous waste, this issue is resolved.

Feed material exhibiting only a characteristic of hazardous waste (ignitable, corrosive, reactive, toxic) would not be regulated as hazardous waste and could therefore be approved for recycling and extraction of source material. However, this does not apply to residues from water treatment, so determination that such residues are not subject to regulation under RCRA will depend on their not containing any characteristic hazardous waste. Staff may consult with EPA (or the State) before making a determination of whether the feed material contains hazardous waste.

If the feed material contains hazardous waste, the licensee can process it only if it obtains EPA (or State) approval and provides the necessary documentation to that effect. Additionally, for feed material containing hazardous waste, the staff will review documentation from the licensee that provides a commitment from the U.S. Department of Energy or the State to take title to the tailings impoundment after closure.

The Uranium Material is classified as 11e.(2) byproduct material. Under 40 CFR 261.4(b)(7), solid wastes from the extraction, beneficiation, and processing of ores and minerals are not hazardous wastes. In the application for license amendment request made by DUSA on April 27, 2011, DUSA demonstrated that the Uranium Material contained no known listed wastes under Subpart D Sections 261.30-33 of 40 CFR. Therefore, this condition is satisfied.

3. Determination of whether the ore is being processed primarily for its source-material content.

   For the tailings and waste from the proposed processing to qualify as 11e.(2) byproduct material, the ore must be processed primarily for its source-material content. If the only product produced in the processing of the alternate feed is uranium product, this determination is satisfied. If, in addition to uranium product, another material is also produced in the processing of the ore, the licensee must provide documentation showing that the uranium product is the primary product produced.

   Section 3.2 of EFRI's (formerly DUSA's) April 27, 2011 report states that the Uranium Material would be milled primarily for its uranium content. This condition is satisfied.

Currently, EFRI has received UDRC approval of a total of one license amendment authorizing the mill to receive and process alternate feed materials from Fansteel Metals Resources, Inc.'s (FMRI's) site in Oklahoma, described in License Condition 10.19.

1.3 Uranium Material Generation Process Description

The Midnite Mine Uranium Material consists of solid material resulting from treatment of stormwater and groundwater collected from Pit 3 and Pit 4 at the inactive Midnite Mine uranium mine site in Wellpinit, Washington. Water treatment is conducted in an on-site WTP. The WTP employs a conventional lime treatment high-density solids process in which the metals and uranium are precipitated out in the treatment process, and involves addition of barium chloride for removal of radium. Barium chloride is added to the influent water stream, which is then mixed with approximately 90 gallons per minute (gpm) of the total process stream from the clarifier bottoms (clarifier underflow) to increase the overall final WTP solids density. Hydrated

lime is then added to precipitate uranium and metals. Waters recovered from the dewatering process are also added back to the process stream at this point in the process. An anionic water soluble polymer (Neo Solutions, NS-6852) is subsequently added as a coagulant to facilitate clarification. The resultant slurry is settled and filtered to produce a solution free of solids for surface discharge under the Clean Water Act National Pollutant Discharge Elimination System (NPDES) program and EPA CERCLA program.

Sludge generated by the WTP was previously centrifuged and the final solids contained on average 0.18 wet weight percent uranium (0.21 wet weight percent U_3O_8) at an average historical solids content of 15%. No other chemical addition to the sludge generation process occurs in the WTP.

The process stream is sent to one of two clarifiers. The precipitated solids are drawn from the clarifier bottom and approximately 20% of the clarifier underflow (approximately 90 gpm) is pumped back to the agitation tank at the beginning of the process to increase overall WTP solids density. Under the previous centrifuge process, the liquid fraction of the remaining process stream (approximately 36 gpm) was decanted from the top of the clarifier for further treatment and discharged separately from the solids, while the remaining solids fraction from the clarifier underflow was sent to the centrifuge for dewatering.

The dewatered solids were transferred from the centrifuge to the transport truck via a discharge conveyor. The transport truck was housed within the WTP building and remained in that location until it was used to haul the processed sludge material for final disposal or to a stockpile area awaiting future disposal, thereby eliminating any opportunity for other waste materials to be introduced into the Uranium Material.

1.3.1 Filter Press Dewatering

In 2010, DMC proposed using a filter press as part of the WTP operations to further reduce the moisture content of the WTP solid residual material, with the goal of reducing trucking costs for transporting the Uranium Material having less weight than material produced using the centrifuge process. The centrifuges were replaced with a hydraulic filter press in 2011, increasing the percent solids of the final Uranium Material to between 25% and 45%, resulting in a proportional increase in weight percent uranium estimated to be between 0.3 and 0.55 wet weight percent uranium (0.35 and 0.63 wet weight percent U_3O_8). As uranium ores and alternate feed materials are typically evaluated on a dry percent U_3O_8 basis, the actual (dry) percent U_3O_8 of the Uranium Material resulting from the filter press process is estimated to be approximately 1.5 percent U_30_8 (EFRI 2013a).

Pilot-scale filter press testing was performed at the Midnite Mine WTP between September 16 and September 23, 2011. Six test runs were performed to determine resulting filter cake percent solids, sludge volume reduction, evaluate effects of polymer addition, and assess press cycle times and ease of press cleaning. Operational parameters were varied during the six tests. Laboratory analyses were performed on filter cake samples to determine total uranium (dry weight); radioactive concentrations of uranium, Radium-226 and Radium-228, and Thorium-230; and density. Samples were also analyzed for Toxicity Characteristic Leaching Procedure (TCLP), seven RCRA metals, and selenium (EFRI 2012a).

The pilot testing sequence included closing the filter press, filling the press, pressurizing the membrane squeeze, then blow down of the press, using a series of batch tests wherein characteristics of each (e.g., duration of air blow; use of lack of membrane squeeze) were varied. For all tests that used the membrane squeeze, "no free water was observed and the resulting cake was extremely competent and in some cases requiring a screwdriver to break up" (EFRI 2012a). EFRI subsequently further indicated that the term "competent" means the cake was "dry, hard, and difficult to break with hand pressure" (EFRI 2013a, p. 32).

The pilot testing developed a range of Uranium Material characteristics and properties (e.g., moisture, density, metals, and radionuclide content) for bounding the material variability likely expected due to differences in filter equipment between the pilot test and full-scale filter press operations. The Uranium Material density ranged from 1.16 g/cm^3 (72.4 lb/ft^3) to 1.34 g/cm^3 (83.6 lb/ft^3) and moisture content varied from 59.3% to 65.4% (EFRI 2013a, p. 31). EFRI indicated that no significant differences are expected to occur between the pilot-testing equipment and full-scale equipment, with the exception of the equipment size. Both the pilot- and full-scale presses use membrane squeeze and similar pressures for the membrane squeeze and residual material slurry feed (EFRI 2013a, p. 31).

Total uranium results ranged from 8,210 to 9,190 milligram per kilogram (mg/kg) (dry weight basis). Analytical results for radionuclides Radium-226, Radium-228, and Thorium-230 were less than 3.4 picocuries per gram (pCi/g) (dry weight basis).

Analytical results for four samples of the produced filtered solid product from six filter press pilot test runs for the metals ranged from <0.02 mg/L to <10 mg/L. The laboratory-calculated solids contents ranged from 34.6% to 40.7%, depending on the duration of the filling and membrane squeeze cycles.

EFRI estimated that approximately 10 filter press runs will be performed per each approximate 20 cubic yard shipment. A Seiko (or similar) field moisture analyzer will be used to test for moisture content of the filter cake.

EFRI also indicated that composite filter cake field moisture content will be measured on a minimum of three filter press runs per shipment, and that grab samples from the selected filter press runs would be composited and an average moisture content determined for each shipment from this composite sample. The number of filter press run samples used for each composite sample and the measured moisture content will be recorded on a Filter Press Moisture Content log sheet and a copy of the sheet will provided with the shipping papers of each shipment. EFRI also stated (EFRI 2013a, p. 31) that if significant variability in composite moisture content is observed (i.e., greater than 15% moisture content between filter press runs) or if the moisture content is greater than 70%, the filter cake will be tested more frequently for moisture content prior to shipping.

1.4 Additional Background Information: Midnite Mine Site

A Remedial Investigation (RI) was completed for the Midnite Mine Site in 2005. The selected remedy identified for the site is Alternative 5a (Complete Pit Backfill with Passive Drains and Ex-Situ Water Treatment) of the Feasibility Study (FS). Based on the FS and issued in the Record of Decision (ROD) as the selected remedy ("Remedy"), Pits 3 and 4 will be backfilled,

waste rock and proto-ore will be moved and capped, and a new passive water collection system will be installed to capture groundwater from these and other backfilled pit areas. The ROD specifies that a surface water management will be designed to divert surface flows around sources of contamination and therefore minimize the volume of water to be treated after the Remedy is implemented.

The existing Midnite Mine WTP is located on a waste rock pile that must be removed for the Remedy. Therefore, a new water treatment plant will be built before construction of the Remedy begins. It is estimated that the construction will begin in 2013 and will require approximately two years (through the end of 2014) to complete. The new WTP will have a targeted year-round water treatment capacity of 1,000 gpm for the construction phase. It is likely that the new WTP will be comparable to the current treatment employed using lime and barium chloride addition for removal of constituents from the feed water. The flow rate is designed to allow for rapid dewatering of the pits during backfilling, as well as groundwater collection and surface water collection treatment. After construction, it is expected that the flows will be reduced to an ultimate annual value of 65 million gallons and that it will take an estimated 6 to 7 years to reach these reduced flows.

1.5 Review Scope: Environmental Analysis

In accordance with UAC R313-22-38 and R313-24-3, this SER has been prepared to evaluate the following items with respect to the proposed acceptance and processing of the Uranium Material at the Mill:

(1) Assess the radiological and non-radiological impacts to the public health;

(2) Assess potential impacts on waterways and groundwater;

(3) Consider alternatives, including alternative sites and engineering methods;

(4) Consider long-term impacts including decommissioning, decontamination, and reclamation impacts; and

(5) Present information and analysis to support UDRC findings and conclusions with respect to approval of the proposed license amendment.

2.0 CHARACTERISTICS OF THE WHITE MESA MILL SITE AND VICINITY

The climate in the White Mesa facility vicinity is characterized as semi-arid with an annual average precipitation of approximately 12 inches and a mean annual temperature of about 50° F. Runoff in the project area is directed by the general surface topography either westward into Westwater Canyon, eastward into Corral Creek, or to the south into an unnamed branch of Cottonwood Wash. The San Juan River, a major tributary to the Colorado River, is located approximately 18 miles south of the site.

The population density of San Juan County is approximately 1.7 persons per square mile. The town of Blanding is the largest population center near the facility and has a population of about 3,600. Approximately 3.5 miles south, southeast of the site is the White Mesa Reservation, a community of approximately 350 members of the Ute Mountain Ute Tribe. The nearest resident

to the Mill is located approximately 1.4 miles to the northeast of the Mill, which is in the prevailing downwind direction from the Mill site (DUSA 2008).

Approximately 60% of San Juan County is federally owned land administered by the U.S. Bureau of Land Management, the U.S. National Park Service, and the U.S. Forest Service. Primary land uses include livestock grazing, wildlife range, recreation, and exploration for minerals, oil, and gas. A quarter of the county is Native American land owned by either the Navajo Nation or the Ute Mountain Ute Tribe. The land within 5 miles of the site is primarily owned by residents of Blanding. EFRI owns or has claims or leases on approximately 5,500 contiguous acres, of which the White Mesa Mill site encompasses approximately 500 acres.

Groundwater beneath the site mainly occurs in two water-bearing systems: a shallow unconfined perched groundwater zone hosted by the Dakota Sandstone and the Burro Canyon formations, and a deep confined groundwater aquifer in the Entrada/Navajo Sandstone. The perched water zone is found at a depth of about 80 to 100 feet below ground surface beneath the tailings cells area and consists of groundwater perched over the Brushy Basin Member of the Morrison Formation. The deep Entrada/Navajo Sandstones host one of the most permeable aquifers in the region, found at a depth of over 1,000 feet below ground and separated from the shallow aquifer by hundreds of feet of low-permeability shales and mudstones (Brushy Basin and Recapture Members of the Morrison Formation, the Summerville Formation, etc.). Recharge to the aquifers occurs by infiltration along the flanks of the Abajo, Henry, and La Sal Mountains, and along the flanks of structural folds in the terrain.

Groundwater in the shallow perched water-bearing zone (Dakota Sandstone and Burro Canyon Formation) is monitored by EFRI as part of the Mill's GWDP. Water in this zone generally flows southward to southwestward.

Approximately 95 groundwater applications for wells located within a 5-mile radius of the site are on file with the Utah State Engineer's Office. The majority of applications are by private individuals and for wells drawing small, intermittent quantities of water (flow rates less than 8 gpm) from the Burro Canyon formation. For the most part, these wells are located upgradient (north) of the facility. Stockwatering and irrigation are listed as the primary uses. Two deep water supply wells are completed in the Entrada/Navajo Sandstone located approximately 4.5 miles southeast of the site on the Ute Mountain Ute Tribe Reservation. The well casings for these deep water supply wells are perforated at a depth of approximately 1,200 feet below the ground surface.

3.0 OPERATIONS

The White Mesa Mill was built in the late 1970s by Energy Fuels Nuclear, Inc. (EFN) as an outlet for the many small mines that are located in the Colorado Plateau. After about two and one-half years, the mill ceased ore processing 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. The partnership between UMETCO and EFN continued until May 26, 1994, when EFN reassumed complete ownership of the mill. In May 1997, IUC (International Uranium [USA] Corporation) purchased the assets of EFN and operated the facility until December 2006. Denison Mines (USA) Corp. operated the facility between December 2006 and August 2012,

when EFRI took ownership of the Mill. The mill has gone through several operational and shutdown periods from 1980 to date.

EFRI currently operates the Mill. Current License Condition 10.1 specifies a maximum yellowcake production rate of 4,380 tons of yellowcake per year. License Condition 10.1.D. limits the quantities of feed material stored at the White Mesa site, including alternate feed materials or other ores, to the total material storage quantity found in the currently approved mill surety pursuant to License Condition 9.5, unless prior approval for additional storage is first obtained from the Director of the UDRC. The maximum mill throughput is limited in part by annual freeboard limits established for the tailings disposal cells. Freeboard calculations are required to be submitted to the UDRC annually, in accordance with License Condition 10.3.

4.0 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS

4.1 Radiological and Non-Radiological Impacts

4.1.1 Radiological Impacts

Radionuclide Concentrations in DMC Uranium Material

The Radioactive Materials Profile Record (RMPR) submitted with the April 27, 2011 Amendment Request indicates the following radionuclides exist in the Uranium Material alternate feed material: Radium-226, Thorium-228, Thorium-230, Thorium-232, Lead-210, and uranium. Reported minimum and maximum concentrations or activities of specific radionuclides and radionuclide isotopes detected in samples of the Uranium Material (tested in 2010) are summarized in Table 1 below. Table 2 presents specific analytical results from three samples collected in 2010 from the WTP solids (Samples WTPS) [WTPS-2, -2, and -3]. The radionuclides detected in the samples are commonly associated with the natural uranium decay series and natural thorium decay series.

Table 1. Range of Radionuclide Concentrations in DMC Uranium Material (2010 Analytical Results)

Result (dry weight basis)	Total Uranium (mg/kg)	Thorium-228 (pCi/g)	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Lead-210 (pCi/g)	Ra Total (pCi/g)	Radium-226 (pCi/g)
Min	15,000	0.93	20.4	0.66	32.0	36.6	22.8
Max	16,000	1.50	21.4	21.4	34.7	41.0	25.7

Laboratory-reported uncertainties/standard deviations not listed.

Table 2. Analytical Results - Uranium Material for RCRA Listed Hazardous Waste (Radiochemistry Analysis [2010])

Target Analyte[(1)]	Method	Units	Laboratory Results			Calculated Average
			WTPS-1	WTPS-2	WTPS-3	
Total Uranium	**SW6020A**					
Total Uranium		mg/kg	15,000	16,000	15,000	15,333
Gross Alpha/Beta	**GFPC**					
Gross Alpha		pCi/g	4,310±690	4,830±770	5,440±870	4,860
Gross Beta		pCi/g	4,870±780	4,780±760	4,860±780	4,867
Lead-210	**Liquid Scintillation**					
Lead-210		pCi/g	33.1±8.0	34.7±8.4	32.0±7.8	33.3
Radium-226	**GFPC**					
Radium-226		pCi/g	22.8±5.8	25.7±6.6	23.8±6.1	24.1
Total Alpha Emitting Radium	GFPC					
Total Radium		pCi/g	39.7±10	41±11	36.6±9.4	39.1
Total Radium (duplicate sample)		pCi/g	35.8±9.2			
Isotopic Thorium	**Alpha Spectroscopy**					
Thorium-228		pCi/g	1.24±0.99	1.50±0.74	0.93±0.67	1.22
Thorium-230		pCi/g	20.4±3.8	21.4±3.9	20.4±3.7	20.7
Thorium-232		pCi/g	1.14±0.48	0.66±0.34	0.71±0.32	0.84

[(1)]All values as reported by ALS Laboratory as dry weight values.

GFPC = Gas Flow Proportional Counting

The test results presented in Table 2 above establish that the average U-nat content of the Uranium Material is approximately 1.5% on a dry weight basis: 15,333 mg/kg ÷ 1x 10^6 mg/kg = 0.0153 kg/kg or 1.5% (EFRI 2013a, p. 12).

The available analytical data indicate that the concentration of total uranium in the Uranium Material is higher than total uranium concentrations present in Colorado Plateau-derived uranium ores typical of those processed at the White Mesa Mill (e.g., Abdelouas 2006, Table 2). On the other hand, available data indicate that Thorium-230 levels and Radium-226 levels in the Uranium Material are lower than in typical Utah area acid-leach ore-derived uranium mill tailings. Table 3 below compares Thorium-230, total uranium, and Radium-226 concentrations in the Uranium Material to concentrations of the same parameters present in typical uranium mill tailings previously tested at Utah-area acid leach mills.

The average U_3O_8 content of the Uranium Material (1.4%) is higher than the range of U_3O_8 contents (approximately 0.15% to 0.30%) present in typical Colorado Plateau-derived uranium ores, as presented by DUSA/EFRI (see Table 3 below). However, this average concentration is comparable to the range of U_3O_8 concentrations in ores mined at the Arizona 1 uranium mine in the Arizona Strip between 2010 and 2012, which averaged between approximately 0.56% and 0.66%, and is lower than the maximum U_3O_8 concentrations observed in ores mined during each of these three years (2.0 to 2.8 % U_3O_8 (see Table 4).

Table 3. Concentrations of Total Uranium, Radium-226 and Thorium-230 in Uranium Material vs. Average Acid Leached Ore-Derived Uranium Mill Tailings in Utah

Uranium Material	Typical Utah Uranium Mill Tailings
Thorium-230: 20.4-21.4 pCi/g (dry weight basis)	**Thorium-230**: 875 pCi/g [1]
Uranium (Total): 15,000–16,000 µg/g	**Uranium (Total):** 531 µg/g [1]
% U_3O_8: 1.4% (dry weight %)[2]	**% U_3O_8:** 0.15% to 0.30% [2]
Radium-226: 22.8-25.7 pCi/g (dry weight basis)	**Radium-226**: 710 pCi/g [1]

[1] Data from Abdelouas 2006.

[2] Based on information provided by DUSA in its April 27, 2011 Amendment Request.

Table 4. Summary of Arizona 1 Ore Grades (Dry Weight Basis)

Year	Minimum (% U_3O_8)	Maximum (%U_3O_8)	Arithmetic Mean (%U_3O_8)
2010	0.18	2.4	0.56
2011	0.14	2.0	0.66
2012	0.22	2.8	0.62

Table 5 below, summarizes the ranges of radionuclide concentrations of the Uranium Material and compares those concentrations to radionuclide concentrations in other alternate feed materials already approved for processing, and successfully processed at the Mill. These data demonstrate that the primary gamma emitting radionuclide content (uranium, thorium and radium) of the Uranium Material are below the maximum of the range of relevant radionuclide activity concentrations of conventional ores and already-approved alternate feed materials. Therefore, the gamma radiation and radon emissions from this Uranium Material will be correspondingly less than other conventional ores and alternate feed materials that have been processed or licensed for processing at the Mill.

Table 5. Comparison of Radionuclide Activity Concentrations in Proposed Uranium Material and Previous Alternate Feeds

Radionuclide	Range of Uranium Material Radionuclide Activity Concentration1 (pCi/g dry)[2]	Range of Colorado Plateau Ores and Alternate Feed Radionuclide Activity Concentrations[3,4] (pCi/g dry)[2]	Source for Alternate Feed Information
Radium-226	22.8 to 25.7	2,000 avg.; 10,400 max.	W.R. Grace Application April 2000
Total Radium	36.6 to 41.0	1,190 max (Radium-228+Radium-226)	Heritage Application July 2000
Thorium-228	0.93 to 1.50	2,000 avg.; 3,222 max.	W.R. Grace Application April 2000
Thorium-230	20.4 to 21.4	2,000 avg.; 10,400 max.	W.R. Grace Application April 2000
Thorium-232	0.66 to 1.14	8,000 avg.; 31,500 max.	W.R. Grace Application April 2000
Lead-210	32.0 to 41.0	2,805 max.	Based on 1% U, conventional ores
U-nat	15,000 mg/kg to 16,000 mg/kg	686,000 mg/kg U-nat max.[7]	Mill lab monthly assays Cameco UF_4
Gross Alpha	4310±6790 to 5440±870	7,600 avg.; 22,400 max.	Linde Application March 2005 conventional ores[5]
Gross Beta	4780±87 to 4870±780	3,800 avg.; 17,000 max.	Linde Application March 2005 conventional ores[6]

[1] Attachment 2 of the April 2011 Amendment Request (Radioactive Material Profile Record, p. 2 of 11 and associated tables).
[2] pCi/g unless otherwise noted.
[3] Selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes only.
[4] Mined ores range from 0.1% to higher than 1%. Some Arizona strip ores have ranged as high as 2% U_3O_8 (1.7% U-nat). Abundance of uranium daughters can be estimated from the assumption that ores are in secular equilibrium.
[5] Estimated based on assumption of 1% U_3O_8 (0.85% U) at 2830 pCi/g and eight alphas in Uranium-238 series, and neglecting the contribution from Uranium-235.
[6] Estimated based on assumption of 1% U_3O_8 (0.85% U) at 2830 pCi/g and six betas in Uranium-238 series and neglecting the contribution from Uranium-235.
[7] Monthly average grade assays of Cameco UF_4 have periodically been as high as 80.7% U_3O_8 (68.6% U).

DMC arranged for analytical testing of four samples of filter press cake produced from the dewatering filter press pilot testing (testing conducted between September 16 through 23, 2011) for total uranium and the radionuclide isotopes Radium-226, Radium-228, and Thorium-230. Minimum and maximum concentrations of these analytes detected in the samples are summarized in Table 6 below.

Table 6. Range of Radionuclide Concentrations in DMC Uranium Material -– Filter Press Cake Samples (2011 Analytical Results)

Result (dry weight basis)	Total Uranium (mg/kg)	Thorium-230 (pCi/g)	Radium-226 (pCi/g)	Radium-228 (pCi/g)
Min	8,210	2.7	0.07	<0.2
Max	9,980	<3.4	0.2	<0.2

As described above and as summarized in Table 5, the radionuclide activity of the primary gamma emitting radionuclides are below the maximum of the range of relevant radionuclide activity concentrations of already approved alternate feed materials. Therefore, the potential gamma emissions and potential worker exposure to gamma radiation will be within the range of those already appropriately managed and monitored at the Mill (EFRI 2013a, pp. 8-9). Demonstration that the uranium, radium, and thorium activity concentrations of the Uranium Material are below the maximum range of previously approved conventional ores and alternate feed materials indicates that radon levels resulting from processing of the Uranium Material are expected to be within the range for which the existing approved controls and monitoring programs are currently established and considered appropriate. Therefore, no change to the existing radon exposure controls or the radiological monitoring program is considered necessary.

Attachment 2 to the April 2011 Amendment Request includes a completed RMPR. Page 10 of the RMPR presents Uranium Material Analyses for RCRA Listed Hazardous Waste in the top half of the table, and radionuclide data in the bottom half of the table. The second to last line of this table presents total Thorium-232 concentrations in three representative samples of the Uranium Material from the 2010 treatment season (WTPS-1, -2, -3). Thorium-232 results range from 0.66 ± 0.34 pCi/g to 1.14 ± 0.48 pCi/g with an average of 0.84 pCi/g on a dry weight basis.

Based on the following calculations, these test results establish that the average Thorium-232 content of the Uranium Material is approximately 0.00076% on a dry weight basis (EFRI 2013a, p. 13). The Thorium-232 level in the Uranium Material is well below the levels the Mill has been licensed to process in the past.

Thorium-232 specific activity[1] =1.1.x 10^{-7} *Ci/g* (1.1x10^{5} *pCi/g)*

0.84 pCi/g ÷ 1.1 x 10^{5} pCi/g = 0.0000076 or 0.00076%

Consistent with NRC Reg. Guide 3.59, the radionuclides in uranium ore are generally assumed to be in secular equilibrium with Uranium-238, Radium-226, Thorium-230, and Lead-210 concentration can be approximated from U-nat content or ore grade, based on this assumption and the following relationship:

[1] Argonne National Laboratory, EVS. Human Health Fact Sheet, August 2005. URL: http://www.evs.anl.gov/pub/doe/Thorium.pdf

Assuming the U-nat content is 84.8% of U_3O_8, and that the major contributor to activity is Uranium-238, the activity concentration of natural ore is approximately 12,350 *Bq/g* U (or 12,350 *Bq/g* x 27.0 pCi/Bq = *333,800 pCi/g* U); 0.25% U_3O_8 x 84.8% U-nat x 12,350 *Bq/g* x 27.0 pCi/Bq = 708 *pCi/g* for each of the isotopes in equilibrium with Uranium-238. This value is slightly lower than the approximate value of *825 pCi/g* (initially mistakenly typed as pCi/L) in Section 2.6.1 of the April 2011 Amendment Request and stated in EFRI 2013a, p. 14).

The activities of Radium-226, Thorium-230 and Lead-210 of approximately 24.1 *pCi/g*, 20.7 *pCi/g* and 33.3 pCi/*g* (on a dry basis) are well below the activities associated with Colorado Plateau ores with grades of 0.25% U_3O_8.

Derived Air Concentrations from Processing of Uranium Material

The Derived Air Concentrations (DACs) for each Mill Area ("Circuit") involved in processing the proposed Uranium Material are provided in Table 7, below. The DACs are compared with those for conventional ores and a number of other alternate feed materials.

Table 7. Derived Air Concentrations for Ores and Selected Alternate Feed Materials

Mill Area ("Circuit")	Dawn Mining DAC	Conventional Ore (based on Arizona Strip)	UF4	KF	Regen Material	Calcined Material	Heritage
Ore	2.6E-10	6.0E-11	2.1E-10	2.6E-10	4.2E-10	1.3E-11	4.4E-12
Leach	3.4E-10	1.10-E-10	3.0E-10	3.4E-10	4.6E-10	2.5E-11	8.6E-12
CCD	3.9E-10	1.2E-11	2.9E-10	3.9E-10	4.2E-10	1.3E-11	4.4E-12
SX	3.9E-10	1.2E-11	2.9E-10	3.9E-10	4.2E-10	1.3E-11	4.4E-12
Precipitation	5.0E-10	5.0E-10	5.0E-10	5.0E-10	5.0E-10	5.0E-10	5.0E-10
Packaging	2.2E-11	2.2E-11	2.2E-11	2.2E-11	2.2E-11	2.2E-11	2.2E-11
Tailings	2.0E-11	1.7E-11	1.7E-11	1.7E-11	1.7E-11	1.7E-11	8.4E-12

Section 4.1.2 of the Mill's approved Radiation Protection Manual addresses the factors taken into account in calculating Derived Area Concentration (DACs) for alternate feed materials. In order to apply the procedures set out in Section 4.1.2 of the Radiation Protection Manual to the calculation of specific DACs for specific alternate feed materials, the Mill developed an Excel spreadsheet for the calculation of such DACs. Appropriateness of the assumptions and accuracy of use of the spreadsheet are confirmed by an independent consultant as part of the Mill's ALARA audit process. The DACs listed in Table 7 were derived using the calculation spreadsheet and the following assumptions (EFRI 2013a, p. 16):

- Conventional ores are assumed to have uranium daughter isotopes in secular equilibrium. Because most alternate feed materials have been processed in one form or another prior to receipt at the Mill, they are not assumed to have uranium daughter isotopes in secular equilibrium. As a result, DACs are calculated separately for each alternate feed material for each applicable part of the Mill. In process steps where conditions and material

properties are the same for every feed (such as yellowcake precipitation and packaging), the conventional ore DACs are applied to every alternate feed material.

- The DACs for inhalation of each radionuclide were taken from Appendix B of 10 CFR 20 for the indicated solubility class;
- The assigned solubility classes for airborne alpha activity assume:
    - conventional ores are insoluble,
    - 50% of dust in the leach area is from the precipitation area and 50% is from ore (due to proximity),
    - uranium is in soluble form in the Countercurrent Decantation (CCD), Solvent Extraction (SX), and Precipitation areas, and,
    - yellowcake in the packaging area has mixed solubility based characteristics (from Kalkwarf [1979]);
- The DAC for tailings is adjusted for the recovery efficiency, nominally assumed at 95% (i.e., 95% of uranium is recovered and the remaining 5% of the uranium and virtually all uranium daughters remain with tailings);
- Activity from the Uranium-235 chain is not significant and can be, and is typically, ignored (see discussion below); and
- Concentrations of Thorium-232 and its decay products are negligible and can be ignored.

As indicated in the Table 7 above, the Mill has processed ores and/or alternate feeds with DACs that are lower (more restrictive) than the Dawn Mining Uranium Material by as much as two orders of magnitude, depending on the plant area to which the DAC applies. Consequently, the existing radiation protection measures and standard operating procedures developed for worker safety for the processing of natural ores and previous alternate feed materials are deemed sufficient for the processing of the Uranium Material, and no additional personnel protective measures or safety procedures are expected to be required.

Transportation of Uranium Material

DMC/EFRI proposes to transport the Uranium Material in covered end- or side-dump haul trucks. The Uranium Material would be shipped as radioactive low-specific activity (LSA 1) hazardous material. Midnite Mine's shipping company would track the shipment until it reaches the Mill. DMC would ship approximately 25 trucks per year, or an average of one truck per week for the six-month annual period. The amount of trucks used per year may vary depending on Uranium Material production. An estimated range of trucks per year is 2 to 73. The highest number of trucks would be expected in the two years of construction of the DMC Mine Site Remedy.

Trucks transporting the Uranium Material to the Mill site would be surveyed and decontaminated, as necessary, prior to leaving the Midnite Mine site as well as prior to leaving the White Mesa Mill site.

Projected Additional Traffic Volumes

The primary transportation corridors in Utah are illustrated in Figure 1. The Uranium Material would be hauled through Utah southward on Interstate 15, east on Interstate 70 and then south to the Mill on Interstate 191. Section 4.2.2(b) of the April 2011 Amendment Request addresses

traffic impact considerations for this route. The analysis identifies that the original 1979 Final Environmental Statement (FES) and 1978 Environmental Report contemplated the transportation impacts associated with approximately 68 round trips on local highways by 30-ton ore trucks to the Mill per day. In addition, the FES contemplated approximately 183–275 truck shipments of yellowcake from the Mill per year, which equates to one truck every one to two days based on a seven-day work week (one truck every day or so, based on a five-day work week).

Sections 4.2.2(b)(ii) and (iii) of the April 2011 Amendment Request assesses the current truck traffic on Interstate Highways 15, 70, and 191, which are the principal Utah roadways on which trucks carrying the Uranium Material would reach the Mill. These sections identify that, based on 2009 data from the Utah Department of Transportation (UDOT), an average of ten additional trucks per month traveling this route to the Mill from May to October represents an increased traffic load of less than two one hundredths of one percent (0.02%).

Information obtained on July 14, 2010 from UDOT, indicated that on average during 2009, 2,350 multi-unit trucks traveled southward daily on Interstate 15 from Idaho into Utah. On average, between 740 and 6,518 multi-unit trucks traveled southward daily on Interstate 15, across Interstate 50 to Interstate 70. Based on the 2009 UDOT truck traffic information, an average of 10 additional trucks per month traveling this route to the Mill from May to October represents an increased traffic load of less than one half of one percent. This level of truck transportation volume is well below the level contemplated in the original FES and represents a minute fraction of the existing truck volume on the transportation route. EFRI (2013) concludes that transportation impacts associated with the movement of the Uranium Material by truck from the Midnite Mine WTP facility to the Mill are not expected to be significant.

Information provided by the UDOT on July 14, 2010, stated that in 2009, on average, 1,628 multi-unit trucks traveled southward on State Road 191 from Moab across the Grand County line each day. On average, between 285 and 610 multi-unit trucks per day traveled the stretch of State Road 191 south of Monticello, UT toward Blanding, UT. Also, based on the 2009 UDOT truck traffic information, an average of five additional trucks per month traveling this route to the Mill from May to October represents an increased traffic load of less than one quarter of one percent. Based on this information, the truck traffic to the Mill from this project is expected to be an insignificant portion of the existing truck traffic in the area, and well within the level of truck traffic expected from normal Mill operations.

In addition, the amount of yellowcake to be produced from processing the Uranium Material is expected to be transported in approximately one truck load per year. This amount of yellowcake transport would not result in exceedance of the total truck transport frequency associated with yellowcake transport from the Mill at licensed capacity (between 183 and 275 truck shipments of yellowcake from the Mill per year, as contemplated by the 1979 FES).

Radiological Transport Considerations

The transport of radioactive materials is subject to limits on radiation dose rate measured at the transport vehicle as specified in the US CFR. The external radiation standards are specified in 10 CFR 71.47 sections (2) and (3) and are less than 200 millirems per hour (mrem/hr) at any point on the outer surface of the vehicle, and less than 10 mrem/hr at any point two meters from the outer lateral surfaces of the vehicle. To prevent migration of ore dust during transportation,

all trucks transporting the Uranium Material to the Mill Site would be covered by tarpaulins or similar cover. From a radiologic standpoint, the Uranium Material is within the bounds of other ores and alternate feed materials transported for processing at the Mill. No significant incremental radiological impacts are expected to occur with transportation of Uranium Material to the Mill over and above those for other previously approved ores and alternate feed materials at the Mill or from licensed activities at other facilities in the State of Utah. EFRI will be required to comply with applicable requirements of 49 CFR Part 172 and Part 173, and the selected transport company will be required to have all the mandatory training and emergency response programs and certifications in place.

Storage of Uranium Material at Mill Site

EFRI proposes to store the Uranium Material at the Mill Site in the same manner to that used for storing conventional uranium ore at the site. The Uranium Material would be stored on ore pad for temporary storage pending processing. Tarped haul trucks holding the transported Uranium Material would enter the site, roll back the tarp covering and dump their loads onto the ore pad as with conventional ore deliveries. Because the Uranium Material would be temporarily stored on the ore pad awaiting processing and because the Uranium Material does not significantly differ in radiological activity from other ores and alternate feed materials handled at the Mill, EFRI indicates that it expects that gamma radiation and radon emanation from the Uranium Material will be within the levels associated with other ores and alternate feed materials routinely handled at the Mill on a regular basis. The TCLP data provide evidence indicating that the metals present in the Uranium Material do not readily leach and the Uranium Material is not likely to exhibit hazardous waste characteristics if the material were to be exposed to more severe conditions than may be anticipated to occur on the ore storage pad.

EFRI has proposed to control potential air transport of Uranium Material particulates from storage and handling by using standard approved dust control and worker protective equipment practices (EFRI 2013a, p. 6, and April 2011 Amendment Request Section 4.10.2(d), p.17, Section 5.0, p.17). EFRI supported this approach by indicating that the Uranium Material will have a moisture content of approximately 25 to 45 percent (Attachment 2 of the April 2011 Amendment Request), which is 6 to 11 times greater than the minimum moisture content currently contemplated for ores and feeds stored on the ore pad by the Mill's State of Utah Air Approval Order ("AO") for minimization of the potential dust generation.

EFRI furnished an Affidavit signed by the Site Manager for Dawn Mining Company (see Attachment 2 to the April 2011 Amendment Request) providing testimony, based on more than 10 years of first-hand experience, that the Uranium Material "is not prone to degrading to fine dust sized particles". The Affidavit is based on operational experience gained during operation of the WTP at the Midnite Mine Site over a period of more than 10 years.

Weather conditions at the Mill Site are dryer than at the Midnite Mine Site, and possibly higher winds speeds coupled with lower humidity levels may lead to differences in behavior of the Uranium Material with regard to its susceptibility to degrade to a finer dust sized particle than would be expected from ores or other alternate feeds. For this reason, and to help reduce the likelihood of potential future release(s) of fine dust sized particles from Uranium Material in storage at the Mill site, the UDRC will add language to the new license condition to RML No.

UT1900479 requiring that: (1) Uranium Material stored (stockpiled) at the Mill Site be covered with a geomembrane cover and sufficient ballast be placed over the cover to prevent wind uplift of the cover during peak wind conditions at the site; and (2) If at any time, visible dust is observed to be originating from Uranium Material stored on site, that the EFRI RSO or his or her authorized representative take actions within 30 minutes to stop the generation of visible dust.

4.1.2 Non-Radiological Impacts

Based on information provided in the April 27, 2011 submittal (RMPR), the known and possible chemical components in and hazardous waste characteristics of the Uranium Material are summarized in Table 8 below:

Table 8.Chemical Characteristics of the Uranium Material

		(Y)	(N)			(Y)	(N)			(Y)	(N)
a.	Listed HW		X	b.	Derived-From HW		X	c.	Toxic		X
d.	Cyanides		X	e.	Sulfides		X	f.	Dioxins		X*
g.	Pesticides		X	h.	Herbicides		X	i.	PCBs		X*
j.	Explosives		X*	k.	Pyrophorics		X*	l.	Solvents		X*
m.	Organics		X	n.	Phenolics		X*	o.	Infectious		X*
p.	Ignitable		X	q.	Corrosive		X	r.	Reactive		X
s.	Antimony		X*	t.	Beryllium	X		u.	Copper	X	
v.	Nickel	X		w.	Thallium		X*	x.	Vanadium		X*
y.	Alcohols		X	z.	Arsenic		X	aa.	Barium	X	
bb.	Cadmium	X		cc.	Chromium	X		dd.	Lead	X	
ee.	Mercury		X	ff.	Selenium	X		gg.	Silver	X	
hh.	Benzene		X	ii.	Nitrate	X		jj.	Nitrite	X	
kk.	Fluoride	X		ll.	Oil		X	mm.	Fuel		X
nn.	Chelating Agents		X*	oo.	Residue from Water Treatment						X
pp.	Other Known or Possible Materials or Chemicals										X

*The WTP solids were not tested for this component but process knowledge indicates that these components would not be present in the WTP solids.

For a detailed list of all the non-radiological chemical constituents (and their concentrations) found in the Uranium Materials, refer to Attachment 2 of the April 27, 2011 Amendment Request. Key results of prior testing samples of the Uranium Material for non-radiological constituents further described below.

4.2 RCRA Listed Materials Analysis

As stated in Section 1.3, the Uranium Material is considered to be the result of natural ore processing. Based on the testing results, no listed RCRA materials are present in the Uranium Material and the Uranium Material is also exempt under 40 CFR 261.4(b)(7).

4.3 RCRA Characteristic Materials Analysis

The following metals and inorganic constituents (Table 9) were confirmed present in the Uranium Material (Attachment 2 and Attachment 4 of the April 27, 2011 Amendment Request).

Table 9. Metals and Inorganic Constituents Confirmed Present in Uranium Material

Class	Component of DRC Uranium Material*
Alkali Metals	N/A
Alkaline Earths	**Barium**, beryllium, calcium, magnesium, radium
Transition Metals, Lanthanides, and Actinides	cadmium, chromium, copper, cobalt, iron, manganese, nickel, silver, **thorium[1],** zinc.
Other Metals	lead
Metalloids	N/A
Non-Metals Halogens	selenium N/A
Volatile Organic Compounds	N/A
Semi-Volatile Organic Compounds	N/A

*Bold Type = elements or compounds in the Dawn Uranium Material, that are not currently included in the Mill's current GWDP

N/A = Not applicable or not analyzed

[1] Thorium is indirectly monitored under the current GWDP through monitoring for gross alpha

Metals, Calcium and Selenium

A summary of the RCRA evaluation findings for the metal analytes and selenium identified in the Uranium Material is provided below in Table 10 and Table 11 of this report.

The April 27, 2011 Amendment Request (Section 4.5) indicates the following:

"Every metal and non-metal cation and anion component in the Uranium Material already exists in the Mill tailings system and/or is analyzed under the Mill's groundwater monitoring program.

Every component in the Uranium Material has been:

1. Detected in analyses of the tailings cells liquids;
2. Detected in analyses of tailings cells solids;
3. Detected in analyses of alternate feed materials licensed for processing at the Mill; or
4. Detected in process streams or intermediate products when previous alternate feeds were processed at the Mill; or at concentrations that are generally comparable to the concentrations in the Uranium Material; at concentrations that are generally comparable to the concentration in the Uranium Material. Due to the small annual quantities of the Uranium Material, an increase in the concentration of any analyte in the Mill's tailings is not expected to be significant.

The constituents in the Uranium Material are expected to produce no incremental additional environmental, health, or safety impacts in the Mill's tailings system beyond those produced by the Mill's processing of natural ores or previously approved alternate feeds."

The DMC Uranium Material metals analytical results are presented below in Table 10. Additionally, three Uranium Materials samples were collected during the 2010 WTP operations period. A summary of the RCRA listed hazardous waste test results for metals analyses is provided in Table 11. The results indicate that 13 metals; barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, nickel, silver, and zinc were detected in the Uranium Material. Selenium was detected in the Uranium Material at an average of 26 mg/kg (Table 10). Additional discussion of concentrations of metals and selenium detected in the Uranium Material is presented following Table 10 and Table 11 below.

All of the metals are known to be constituents of natural uranium ores and present at a range of concentrations with the exception of barium, which is added to the pumped groundwater and surface water at the Midnite Mine site as part of the WTP process to facilitate radon removal. Residues from creation of the Uranium Material from the WTP process are not RCRA listed hazardous wastes.

Table 10. Uranium Materials Metals Analysis and Selenium for RCRA Toxicity Characteristics (2010 TCLP Testing)

Sample ID	Sample Date	Arsenic (mg/L)	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Lead (mg/L)	Mercury (mg/L)	Selenium (mg/L)	Silver (mg/L)
	2002	<0.05	<10	<0.1	<0.5	<0.5	<0.02	<0.1	<0.5
	2003	<0.5	<10	0.2	<0.5	<0.5	<0.02	<0.1	<0.5
	2004	<0.5	<10	<0.1	<0.5	<0.5	<0.02	<0.1	<0.5
	2005	<0.5	<10	<0.1	<0.5	<0.5	<0.02	<0.1	<0.5
	2006	<0.5	<10	0.25	<0.5	<0.5	<0.02	<0.1	<0.5
	2007	<0.5	<10	<0.1	<0.5	<0.5	<0.02	<0.1	<0.5
	2008	<0.5	<10	<0.1	<0.5	<0.5	<0.02	<0.1	<0.5
	5/20/2009	<0.5	<10	<0.1	<0.5	<0.5	<0.02	<0.1	<0.5
	9/17/2009	<0.06	0.083	<0.005	<0.01	<0.04	<0.0002	<0.06	<0.01
	9/19/2009	<0.04	0.16	0.019	<0.01	<0.04	<0.0002	<0.04	<0.01
	9/23/2009	<0.04	0.12	0.011	<0.01	<0.04	<0.0002	<0.04	<0.01

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Table 10. Uranium Materials Metals Analysis and Selenium for RCRA Toxicity Characteristics (2010 TCLP Testing)

Sample ID	Sample Date	Arsenic (mg/L)	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Lead (mg/L)	Mercury (mg/L)	Selenium (mg/L)	Silver (mg/L)
	10/6/2009	<0.1	0.066	0.03	0.03	<0.08	<0.0002	0.2	<0.02
WTPS-1	4/13/2010	<0.1	<1	<0.05	<0.1	<0.03	<0.002	0.051	<0.1
WTPS-2	4/13/2010	<0.1	<1	<0.05	<0.1	<0.03	<0.002	0.054	<0.1
WTPS-3	4/13/2010	<0.1	<1	<0.05	<0.1	<0.03	<0.002	0.054	<0.1
Count		**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Min		**<0.04**	**0.066**	**<0.005**	**<0.01**	**<0.03**	**<0.002**	**<0.04**	**<0.01**
Max		**<0.1**	**<10**	**<0.05**	**<0.5**	**<0.5**	**<0.02**	**0.2**	**<0.5**
40 CFR Part 261.24		**5**	**100**	**1**	**5**	**5**	**0.2**	**1**	**5**
Pass?		**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

WTPS-Waste Treatment Plant Samples

Table 11. Uranium Material Analyses for RCRA Listed Hazardous Waste (Metals, Calcium and Selenium [2010])

Target Analyte[(1)]	Method	Units	Laboratory Results			Calculated Average
			WTPS-1	WTPS-2	WTPS-3	
Total ICP Metals	**SW6010B**					
Arsenic		mg/kg	<5.9	<5.9	<5.7	<5.8
Barium		mg/kg	8,100	7,900	7,200	7,733
Beryllium		mg/kg	33	36	36	35
Cadmium		mg/kg	40	44	43	42
Calcium		mg/kg	15,000	16,000	16,000	15,667
Chromium		mg/kg	19	20	19	19
Cobalt		mg/kg	1,200	1,200	1,100	1,167
Copper		mg/kg	160	180	170	170
Iron		mg/kg	690	740	740	723
Lead		mg/kg	18	19	17	18
Manganese		mg/kg	110,000	110,000	96,000	105,333
Molybdenum		mg/kg	<5.8	<6.0	<5.7	<5.8
Nickel		mg/kg	1,700	1,800	1,800	1,767
Selenium		mg/kg	25	26	26	26
Silver		mg/kg	11	12	11	11
Thallium		mg/kg	<580	<600	<570	<583

Table 11. Uranium Material Analyses for RCRA Listed Hazardous Waste (Metals, Calcium and Selenium [2010])

Target Analyte[(1)]	Method	Units	Laboratory Results			Calculated Average
			WTPS-1	WTPS-2	WTPS-3	
Tin		mg/kg	<29	<30	<29	<29
Vanadium		mg/kg	<5.8	<6.0	<5.7	<5.8
Zinc		mg/kg	3,400	3,600	3,600	3,533
Total Mercury	**SW7471A**					
Total Mercury		mg/kg	<0.19	<0.2	<0.19	<0.19

(1) All values as reported by ALS Laboratory as dry weight values.

Concentrations of some inorganic constituents (e.g., nickel at concentrations between 1,700 and 1,800 mg/kg; cobalt [1,110 to 1,200 mg/kg]; manganese [96,000 to 110,000 mg/kg]; zinc [3,400 to 3,600 mg/kg]; and beryllium [33 to 36 mg/kg]) detected in the WTP solids samples (Table 10) appear to be elevated with respect to typical uranium ores in the Colorado Plateau (e.g., Miesch 1963, Table 2). Calcium concentrations detected in the Uranium Material are also elevated compared to the natural ground and native substrate at the Midnite Mine Site as a result of calcium being added to the pumped groundwater and surface water as part of the WTP process (Section 8.0 of Attachment 5 of the April 27, 2011 Amendment Request). However, the range of calcium concentrations (15,000 to 16,000 mg/kg) detected in the WTP solid samples are within the range of calcium concentrations (9,500 to 20,000 mg/kg) reported for typical uranium ores in the Colorado Plateau (Miesch 1963, Table 2) and lower than the calcium concentration value (63,100 mg/kg) reported for typical acid-leached uranium mill tailings in the Utah area (Abdelouas 2006, Table 2). The State of Utah has no Ground Water Quality Standard (GWQS) for calcium.

The 2005 RI conducted at the Midnite Mine site indicated that the range of nickel concentrations in groundwater present in Pits 3 and 4, and in surface water in the Pollution Control Pond at the Midnite Mine (up to 2,700 µg/L in Pit 3 and up to 2,760 µg/L in the Pollution Control Pond [from which some water was pumped to Pit 3] from Tables 5-15 thru 5-17 of the 2005 RI) exceeds the Utah GWQS (100 µg/L) and exceeds the range of nickel concentrations detected in wells at White Mesa. However, the range of nickel concentrations in Pits 3 and 4, and in the Pollution Control Pond are lower than the nickel concentrations detected in the tailings waste water samples collected by International Uranium Corporation (IUC) and the NRC between 1980 and March 2003 (7,200 – 370,000 µg/L [82,600 µg/L avg.]) as summarized in the 2004 UDRC Statement of Basis (UDRC 2004).

Similar results to those found and described above for nickel also apply for cobalt, manganese, zinc, and beryllium, with most reported concentrations of zinc in the water in the pits and the surface water pond at the Midnite Mine Site being lower the Utah GWQS for zinc, and the average concentration of manganese in the waters in the pits and the surface water pond at the Midnite Mine Site being similar to the average concentration of manganese detected in tailings

waste water samples sampled by the IUC and NRC (UDRC 2004). Because concentrations of nickel, cobalt, manganese, zinc, and beryllium in water in the pits and surface water control pond at the Midnite Mine Site are less than (or comparable to, in the case of manganese) the concentrations of these same constituents detected in the tailings waste water samples, the presence and expected concentrations of these constituents in the Uranium Material is not likely to produce any incremental additional environmental, health, or safety impacts in the Mill's tailings system beyond those produced by the Mill's processing of natural uranium ores.

According to the April 27, 2011 Amendment Request, if selenium oxides were to be introduced in sufficient quantities to the acid leach circuit the potential exists for unwanted excess chemical reactivity; however, this situation would not occur from processing the Uranium Material at the Mill for the following reasons:

- Selenium and its oxides are incompatible with strong acids, organic materials, and ammonia according to manufacturer's Material Safety Data Sheets (MSDS) and National Institute for Occupational Safety and Health (NIOSH) safety hazard information, and high concentrations of selenium oxides or selenium oxides in pure form pose a fire and explosion risk in contact with organic materials and ammonia. Selenium was detected in the Uranium Material at concentrations between 25 and 26 mg/kg (Table 8). These levels are comparable to or lower than selenium concentrations reported for typical uranium ores in the Colorado Plateau (Miesch 1963, Table 3). Although the Uranium Material contains trace amounts of ammonia, the concentrations (7.9 to 8.3 mg/kg) are not sufficiently high to create instability within the Uranium Material as delivered to the Mill; and
- During the Mill process, selenium oxides will not be in contact with organic materials or ammonia at any time. Insoluble salts of selenium will be precipitated with solids removed from the post-leach thickeners in the alternate feed circuit and will be discharged to the tailings and will proceed no further with the uranium through subsequent processing steps.

Volatile Organic Constituents

The Volatile Organic Constituents (VOCs) sampling results reported in the April 27, 2011 Amendment Request (Table 4 of Attachment 4), and listed below in Table 12, indicate that acetone, chloroform, methylene chloride, and toluene were reported at very low concentrations in the three WTP samples for total analyses. Acetone was reported at concentrations ranging from 22 µg/kg to 33 µg/kg with an average value of 28 µg/kg. Methylene chloride was reported at concentrations ranging from 3.7 µg/kg to 5.8 µg/kg with an average value of 4.4 µg/kg. Toluene was reported at concentrations ranging from 1.3 to 2.2 µg/kg with an average value of 1.8 µg/kg. Trichloroethylene (TCE) was also detected and reported at very low concentrations (1.5 and 2.7 µg/L) in extract samples from the TCLP testing of two samples of the WTP material (Section 4.1 of Attachment 5 of the Amendment Request).

Table 12. Uranium Material Analyses for RCRA Listed Hazardous Waste (Volatile Organics [2010])

Target Analyte[(1)]	Method	Units	Laboratory Results			Calculated Average
			WTPS-1	WTPS-2	WTPS-3	
GC/MS Total Volatile Organics	**SW8260**					
Chloromethane		µg/kg	<1.1	<1.2	<1.1	<1.1
Acetone		µg/kg	22 B	29 B	33 B	28
Methylene Chloride		µg/kg	3.8 J, B	3.7 J, B	5.8 J, B	4.4
2-Butanone		µg/kg	<5.7	<5.9	<5.7	<5.8
Tetrahydrofuran		µg/kg	<7.2	<7.4	<7.2	<7.3
Chloroform		µg/kg	1.7 J	2 J	1.2 J	1.6
Carbon Tetrachloride		µg/kg	<1.3	<1.4	<1.3	<1.3
Benzene		µg/kg	<0.94	<0.96	<0.93	<0.94
Toluene		µg/kg	2.2 J, B	1.9 J, B	1.3 J, B	1.8
m,p-Xylene		µg/kg	<1.9	<1.9	<1.9	<1.9
o-Xylene		µg/kg	<0.95	<0.97	<0.94	<0.95
Naphthalene		µg/kg	<1.4	<1.4	<1.4	<1.4

(1) All values as reported by ALS Laboratory as dry weight-basis values.

B=This flag is used when the analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user. This flag shall be used for a tentatively identified compound as well as for a positively identified target compound.

J= This flag indicates an estimated value. This flag is used as follows: (1) when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed; (2) when the mass spectral and retention time data indicate the presence of a compound that meets the volatile and semi-volatile GC/MS identification criteria, and the result is less than the reporting limit but greater than the method detection limit (MDL); and (4) the reported value is estimated.

Of the five VOC constituents reported detected in the Uranium Material, four were detected in the solids samples and one in the TCLP leachate sample. Additionally, all five VOCs were detected in the associated laboratory quality control blanks for the coinciding sample runs. Review of the site operational history, WTP processes, and chemical history for the Midnite Mine WTP site, did not identify any potential source of these constituents. There are no VOCs used in the mining processes or WTP processes and these chemicals have never been used on the Midnite Mine WTP site or stored at the Midnite Mine WTP site. Chloroform was reported

detected in the three samples just above the Method Detection Limit (MDL). The method blank samples did indicate low levels of total chloroform; however, the detection of chloroform in the blank was below the MDL and was therefore not reported by the laboratory. Information provided in the laboratory reports indicated that acetone, chloroform, methylene chloride, and toluene were therefore attributable to laboratory interferences and are not present in the Uranium Material.

The sample results and laboratory quality control samples for the VOC analyses were reviewed in detail to determine the source of the detections in the Uranium Material. Review of the analytical data indicated that the five VOCs were detected in the laboratory quality control blanks, as presented in Table 13 and discussed below. The table below summarizes the VOC detections in the laboratory quality control blanks.

Table 13. VOC Detections in Laboratory QC Blanks

	Acetone µg/kg dry	Chloroform µg/kg dry	Methylene Chloride µg/kg dry	Toluene µg/kg dry	Trichloroethene µg/L
Matrix	Solid	Solid	Solid	Solid	TCLP Leachate
Reporting Limit	5	5	5	5	5
Laboratory Blank	5.07	0.2*	1.95	1.57	3.3 J

* This detection is slightly below the method detection limit but was noted by the laboratory in correspondence which was submitted in the April 2011 Amendment Request.

The frequency of the reported detections of TCE and the fact that these detections are less than 10 times the amount found in the method blank raised the concentration to the Reporting Limit (5 µg/L).

Because there is no source for these VOCs at the Midnite Mine WTP site and because results associated with method blank contamination are considered questionable, EFRI reasserts that these data are false positives caused by laboratory artifacts (EFRI 2013a). These results and the results for the other VOCs discussed above, indicate that these VOCS are not present in the Uranium Material.

Semi-Volatile Organic Constituents

Analytical results from the 2010 WTP samples for semi-volatile organic constituents (SVOCs) as presented in Attachment 2 and Table 4 of Attachment 4 of the April 27, 2011 Amendment Request, and summarized in Table 14 below, indicate that there were no detectable concentrations of any of the SVOCs tested for. These results are consistent with plant operations and activities historically conducted at the mine site.

Table 14. Uranium Material Analyses for RCRA Listed Hazardous Waste (Semi-Volatiles [2010])

Target Analyte[(1)]	Method	Units	Laboratory Results			Calculated Average
			WTPS-1	WTPS-2	WTPS-3	
GC/MS Total Semi-Volatile Organics	**SW8270D**					
Pyridine		µg/kg	<310	<320	<320	<317
1,4-dichlorobenzene		µg/kg	<310	<320	<320	<317
2-methylphenol		µg/kg	<310	<320	<320	<317
3 + 4-methylphenol		µg/kg	<310	<320	<320	<317
Hexachloroethane		µg/kg	<310	<320	<320	<317
Nitrobenzene		µg/kg	<310	<320	<320	<317
2,4,6-trichlorophenol		µg/kg	<310	<320	<320	<317
2,4,5-trichlorophenol		µg/kg	<310	<320	<320	<317
2,4-dinitrotoluene		µg/kg	<310	<320	<320	<317
Hexachlorobenzene		µg/kg	<310	<320	<320	<317
Pentachlorophenol		µg/kg	<490	<500	<500	<497

(1) All values as reported by ALS Laboratory on a dry weight-basis.

Other Organics

There were no detectable levels of other organic compounds tested in three WTP samples tested in 2010 as presented in Attachment 2 and Attachment 4 of the April 27, 2011 Amendment Request and as summarized in Table 15 below.

Table 15. Uranium Material Analyses for RCRA Listed Hazardous Waste (Other Organics [2010])

Target Analyte[(1)]	Method	Units	Laboratory Results			Calculated Average
			WTPS-1	WTPS-2	WTPS-3	
Gasoline Range Organics	**SW8015B**					
Gasoline Range Organics		mg/kg	<0.38	<0.35	<0.39	<0.37
Diesel Range Organics	**SW8015MB**					
Diesel Range Organics		mg/kg	<6.5	<6.6	<6.8	<6.6
Oil & Grease						
Oil & Grease		mg/kg	<120	<120	<120	<120

(1) All values as reported by ALS Laboratory as dry weight values.

Alkaline Earth Metals

Barium concentrations in the Uranium Material are elevated compared to barium levels in typical uranium mill tailings in the Utah area (Abdelouas 2006, Table 2) and reported for typical uranium ores in the Colorado Plateau (Miesch 1963, Table 2). As described in Section 1.3 above, barium is added to the pumped groundwater and surface during the WTP process.

Data reported in Miesch (1963; Tables 2 and 3) and Abdelouas (2006), based on data from Morrison and Chan (1991), allow the following comparisons (see Table 16) between barium and beryllium concentrations in the Uranium Material to barium and beryllium concentrations detected in: (1) uranium ore from a uranium mine deposit and mill pulp samples from over 200 mine sites on the Colorado Plateau; and (2) uranium mill tailings from different locations in Utah (for acid-leached uranium ores):

Table 16. Concentrations of Selected Inorganics in Uranium Material Compared to Typical Colorado Plateau Uranium Mill Tailings and Uranium Ores

Analyte	Average Concentration in Colorado Plateau Uranium Ores and Mill Pulp Samples[1]	Average Concentration in Utah Area Uranium Mill Tailings[2]	Analytical Results of Uranium Material (average value, dry weight basis)
Ba	550 – 750 µg/g	1,010 µg/g	7,733 µg/g
Be	~ 0.3 0- 0.4 µg/g	Not Reported	35 µg/g

[1] Miesch 1963

[2] Abdelouas 2006

The information in Table 16 indicates that concentrations of barium and beryllium in the Uranium Material appear to be elevated relative to Colorado Plateau-derived ores that may have been processed at the White Mesa Mill and/or compared to their concentrations in typical uranium mill tailings in the Utah area.

Barium may be associated with one RCRA listing, P013, if it resulted from the disposal of barium cyanide commercial chemical products, off-spec commercial chemical products, or manufacturing chemical intermediates. As described above, residual barium is present as a byproduct of the Uranium Material solution treatment (as result of the addition of barium chloride to the Pit 3 influent line in the WTP). Based on information provided by DUSA/EFRI, there is no reason to suspect that barium would have been present in any of the forms mentioned in the RCRA listing P013. Therefore the P013 RCRA listing does not apply to the Uranium Material.

Beryllium may be associated with one RCRA listing, P015, if it resulted from the disposal of commercial chemical beryllium powdered products, off-spec commercial chemical products, or manufacturing chemical intermediates. Information provided by DUSA/EFRI indicates that there is no reason beryllium would be present as a chemical product, off-spec product or manufacturing byproduct on the DMC site.

Non-Metals

Chlorides, fluorides, and sulfates have been introduced into the Mill's uranium circuit in association with natural ores and alternate feeds previously processed at the mill at concentrations higher than those that are present in the Uranium Material. Chlorides have previously been handled at the Mill in concentrations as high as 89,900 mg/kg (see Table 17 below). The average chloride concentration in the Uranium Material is 40 mg/kg. Fluorides have been introduced into the Mill's circuit at levels as high as 460,000 mg/kg (Table 17). The average fluoride concentration in the Uranium Material is 39 mg/kg. Sulfates have also previously been introduced into the Mill's circuit during processing of natural ores and alternate feeds at levels up to 300,000 mg/kg (Table 17). The reaction of sulfuric acid with other metal cations has also generated sulfates in the acid leach system. The mill has previously managed chlorides, fluorides, and sulfates in the Mill circuit and tailings system with no adverse process, environmental, or safety issues.

Table 17 below summarizes levels of five specific constituents which have been introduced into the Mill's uranium circuit during processing of previous alternate feed materials through the Mill.

Table 17. Selected Inorganic Constituents Present in Previous Alternate Feed Materials Processed at Mill

Chemical	Value in Amendment Request Tab 5, Section 4.3 or 8.1	Supporting or Additional Information	Source
Nitrates	350,000 mg/kg	35% (350,000 mg/kg) in Cameco Regen Product alternate feed	Section II of Regen Product MSDS, in Appendix L of EFRI 2013a
Chloride	89,900 mg/kg	Maximum sample from Molycorp ponds alternate feed, 89,900 mg/kg	TTLC table (in Appendix M of this letter) from December 2000 Molycorp Amendment Request
Fluoride	460,000 mg/kg	Honeywell/Converdyne/Allied Signal alternate feed, up to 2% U, 98% calcium fluoride and fluoride impurities (48% or 480,000 mg/kg F based on all being as CaF_2)	MSDS for CaF_2 product, in Appendix N of EFRI 2013a
Sulfate in Mill (Section 4.3)	300,000 mg/kg	A 4.8 million pound (1.4 million gallon) inventory of 93% (930,000 mg/kg) sulfuric acid is introduced into the CCD and pre-leach steps during conventional ore	Mill process description. 1991 RML renewal application and 2007 RML renewal

Table 17. Selected Inorganic Constituents Present in Previous Alternate Feed Materials Processed at Mill

Chemical	Value in Amendment Request Tab 5, Section 4.3 or 8.1	Supporting or Additional Information	Source
		processing. (These concentrations far exceed those identified in Tab 5, Sections 4.3 and 8.1 of the April 2011 Amendment Request.)	application
Sulfate in Tailings (Section 8.1)	No value listed in Tab 5, Section 4.3 or Section 8.1	64,900 to 267,000 mg/L in Cell 4A solutions. 119,000 to 134,000 mg/L in Cell 4B solutions.	2012 Annual Tailings Cells Wastewater Sampling Report, in Appendix O of EFRI 2013a
Ammonia	No value listed in Tab 5, Section 4.3 or Section 8.1	A 108,000 pound (31,000 gallon) inventory of 100% anhydrous ammonia is used to prepare concentrated ammonia solutions introduced into the yellowcake precipitation area during conventional ore processing. Ammonia in this form is added far downstream of feed area and is never in contact with ores or feeds. (These concentrations afar exceed those identified in Tab 5, Sections 4.3 and 8.1 of the April 2011 Amendment Request.)	Mill process description, 1991 RML renewal application and 2007 RML renewal application

2011 Analytical Results for Extractable Metals (TLCP Testing)

DMC arranged for TCLP analytical testing of four samples of filter press cake produced from the dewatering filter press pilot testing (pilot testing conducted between September 16 through 23, 2011) for seven metals and selenium. Reported concentrations for the TCLP testing for the eight tested TCLP extractable analytes are summarized in Table 18 below.

Table 18. Extractable Metals (TCLP Testing) and Extractable Selenium in DM Uranium Material – Filter Press Cake Samples (2011)

Analyte	Units mg/L	Test #2	Test #3	Test #5	Test #6
Arsenic	mg/L	<0.5	<0.5	<0.5	<0.5
Barium	mg/L	<10	<10	<10	<10

Table 18. Extractable Metals (TCLP Testing) and Extractable Selenium in DM Uranium Material – Filter Press Cake Samples (2011)

Analyte	Units mg/L	Test #2	Test #3	Test #5	Test #6
Cadmium	mg/L	<0.1	<0.1	<0.1	<0.1
Chromium	mg/L	<0.5	<0.5	<0.5	<0.5
Lead	mg/L	<0.5	<0.5	<0.5	<0.5
Mercury	mg/L	<0.02	<0.02	<0.02	<0.02
Selenium	mg/L	<0.1	<0.1	<0.1	<0.1
Silver	mg/L	<0.5	<0.5	<0.5	<0.5

Environmental/Exposure Considerations for Non-Radiological Constituents

Barium

As discussed above in this section, barium concentrations detected in the Uranium Material (7,200 to 8,100 µg/g) are elevated somewhat compared to barium levels in typical Colorado Plateau uranium ores in the Utah area and other ores processed at the Mill.

The RCRA characteristic hazardous waste concentrations are based on the TCLP, and the concentration thresholds in 40 CFR 261 Characteristic D List are TCLP values. The TCLP limit for barium is 100 mg/L. As described in the Technical Memorandum in Attachment 5 of the April 2011 Amendment Request, based on analytical testing, the Uranium Material does not exhibit the TCLP characteristic for barium as defined in Table 1 of 40 CFR Part 261.24(b) (Table 3). No TCLP limit has been established for beryllium.

The potential for migration of barium-enriched pore-liquids from the tailings cells (derived from residuals from processing of the Uranium Material) to groundwater is addressed in Section 4.3 below.

Barium Toxicity Information

If an individual were to be exposed to excessive levels of barium, health effects might include, but not be limited to, the following (e.g., IPCS INCHEM 1990; ATSDR 2007a):

- In humans, ingestion (accidental or intentional) of barium compounds may cause gastroenteritis (vomiting, diarrhea, abdominal pain), hypertension, cardiac arrhythmias, skeletal muscle paralysis, and other conditions;
- Evidence indicates that the kidney is a sensitive target of barium toxicity; and
- Inhalation of barium carbonate powder has been found to be associated with paralysis in a male worker.

Table 19 below contains information extracted from the U.S. EPA Pacific Southwest Region 9 Risk Screening Level (RSL) Tables as updated in November 2012. (No comparable regulatory levels were identified for Region 8.) The Soil Screening Levels (SSLs) presented are based on an assumption of a post-remediation industrial use scenario, carcinogenic target risk levels of 1 in one million (l x $l0^{-6}$) and a non-cancer hazard index of 1. The assumption of industrial use is extremely over-conservative for the Mill site which, in post-reclamation condition, will be transferred to the U.S. Department of Energy for oversight in perpetuity.

No carcinogenic target risk levels have been proposed for barium. As shown in the Table 19, barium is present in the Uranium Material at levels more than 20 times lower than the lowest SSL, that is, the SSL based on a non-carcinogenic hazard index of 1.

Table 19. EPA Soil Screening Levels

	Uranium Material (mg/kg)	Ingestion SL TR=1.0E-6 (mg/kg)	Dermal SL TR= 1.0E-6 (mg/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL HG=1 (mg/kg)	Dermal SL HG=1 (mg/kg)	Inhalation SL HG=1 (mg/kg)	Non-carcinogenic SL HI=1 (mg/kg)
Ba	8,100 (8.1E+3)	No limit proposed	No limit proposed	No limit proposed	No limit proposed	2.0E+05	No limit proposed	3.0E+06	1.9E+05
Be[1]	36 (3.6E+1)	No limit proposed	No limit proposed	6.9E+03	6.9E+03	2.0E+03	No limit proposed	1.2E+05	2.0E+03

[1] Be – Beryllium & Be Compounds

Beryllium

The relatively low concentrations of beryllium in the Uranium Material do not pose a significant health and safety hazard. The average measured beryllium concentration in the Uranium Material is between 33 and 36 parts per million (ppm) as identified in Attachment 5, Table 6, Column B of the April 2011 Amendment Request. The baseline beryllium concentration in the existing tailings is 0.5 ppm as identified in Attachment 5, Table 6, Columns F and I of the April 2011 Amendment Request. The maximum estimated beryllium concentration in mill tailings in Cell 4A during the ten-year period evaluated would be 0.6 ppm as identified in Attachment 5, Table 6, Column l0L of the April 2011 Amendment Request. The incremental concentration attributable to the Uranium Material processing would be 0.1 ppm. The average expected beryllium concentration in the Uranium Material is approximately 190 times lower than the SSL (Table 19 above) associated with the acceptable chronic/cancer risk and approximately 55 times lower than the lowest SSL associated with an acceptable non-carcinogenic risk. Health impacts from beryllium exposure and additional analysis of the potential for impacts from processing of the Uranium Material at the Mill are discussed below.

Beryllium Toxicity Information

Beryllium is a toxic metal and a known carcinogen. The principal exposure pathways for beryllium from Uranium Material are inhalation, ingestion and dermal contact. Inhalation can cause irritation to the nose, throat, lungs, and mucous membranes. In some individuals, possibly due to genetic factors, beryllium may cause chronic beryllium disease, a hypersensitivity or allergic conditions causing inflammation and fibrosis resulting in a restriction of the exchange of oxygen between the lungs and the bloodstream (Materion 2011). Beryllium can also be taken

into the body by ingestion of water and food or through the skin. Although skin absorption does not appear to be a major pathway, skin contact can cause an allergic dermal response in sensitive individuals and skin contact with beryllium dusts can result in sensitization (NIOSH 2008). The solubility of the beryllium compound affects the toxicity. The more soluble beryllium salts can cause irritant and allergic contact dermatitis. Delayed hypersensitivity dermal granulomas may be caused by the less soluble forms of beryllium in contaminated wounds (Wambach 2008).

Potential Exposures to Beryllium from Uranium Material Processing

The only potential complete exposure pathway at the Mill for members of the public is inhalation of airborne particulate matter from the tailings. Engineered and administrative controls limit public access at the Mill. An analysis by EFRI (2013a; 2013b) evaluated public health limits from radioparticulates potentially derived from wind transport of tailings particulates and assumed those levels of particulate transport with the beryllium concentrations in the Uranium Material and subsequent tailings. The approach taken was to estimate the mass concentration of particulates in air to which the public could hypothetically be exposed but still remain within the effluent limits set by 10 CFR 20, Appendix B, Table 2 (the effluent limit for Th-230 was used for estimating the maximum allowable particulate tailings mass concentration in air at the site boundary because this parameter represents the lowest [and therefore most critical] value for the radiological constituents of the tailings). These estimated public exposure levels of airborne beryllium were then compared to the EPA reference concentration (RfC) to assess the potential for adverse public health impact from the beryllium in windblown tailings or Uranium Material. The RfC, i.e., the concentration that is *"likely to be without an appreciable risk of deleterious effects during a lifetime"*, for beryllium is 0.02 $\mu g/m^3$ (EPA 2013). Assuming a Thorium-230 concentration in the tailings of 980 pCi/g and a 10 CFR 20 effluent limit of 2×10^{-14} µCi/ml (10 CFR Part 20, Appendix B, Table 2, Column 1), and an estimated (average) beryllium concentration in the ore/alternate feed materials and/or tailings of 0.1 mg/kg (1×10^2 µg/kg), the maximum allowable mass concentration of Th-230 in air to reach the 10 CFR 20 Appendix B effluent limit would be 20 $\mu g/m^3$ ([2×10^{-14} µCi/ml x 1×10^6 ml/ m^3 x 1×10^6 µg/g]/ [980 pCi/g x 1×10^{-6} µCi/Ci] = 20 $\mu g/m^3$). At the hypothetical maximum airborne particulate concentration of 20 $\mu g/m^3$, the beryllium mass concentration in the airborne particulates, given the beryllium concentrations in the ores, feed material, and tailings and the calculated Th-230 air concentration of 20 $\mu g/m^3$, would be 2×10^{-6} $\mu g/m^3$ (1×10^2 µg Be/kg feed x 20 µg feed/m^3 x 10^{-9} kg feed/µg feed = 2×10^{-6} $\mu g/m^3$ beryllium), or a factor of 10,000 below the beryllium RfC. Based on this finding, processing the Uranium Material is not expected to present any significant risk to the general public from beryllium in airborne particulates from the Mill.

Occupational exposures to beryllium might include skin, inhalation, and inadvertent ingestion of beryllium. The concentrations of beryllium in the Uranium Material and tailings solutions are 36 ppm (Attachment 5, Table 6, Column B of the April 2011 Amendment Request) and less than 1 ppm (Attachment 5, Table 6, Column l0L), respectively. The New Hampshire Department of Environmental Services Beryllium Health Information Summary notes that skin exposure to concentrated beryllium can result in allergic skin response (NHDES 2010). Because of the very low concentrations in the Uranium Material and tailings, beryllium is not likely to cause an allergic response from skin contact. The reported adverse effects on skin are generally for the pure beryllium compounds or metal. In any case, the normally required personal protective

equipment and safe work practices at the Mill facility are expected to protect workers from direct contact with the beryllium in Uranium Material, tailings, and mill process solutions.

Inadvertent ingestion is not likely to result in an individual exceeding the reference dose (RfD). The RfD is an estimate of the daily oral intake for humans, including sensitive subgroups that would not result in *"appreciable risk of deleterious effects during a lifetime"* (EPA 2013). The oral RfD for beryllium, is 0.002 mg/kg-day. Assuming a 70-kg adult worker and a beryllium concentration of 36 mg/kg in the Uranium Material (Attachment 5, Table 6, Column B of the April 2011 Amendment Request), a worker would have to inadvertently consume nearly 4 g of Uranium Material per day (0.002 mg/kg x 70 kg adult + 36 mg/kg Be concentration = 4 g). The amount of uranium in the 4 g of Uranium Material (16,000 mg/kg [Table 5 of Attachment 5] = 0.016 g/g x 4 g = 0.064 g = 64 mg U-nat) far exceeds the regulatory intake limit of 10 mg U-nat per week. As such, normal uranium mill work rules and existing controls are expected to provide a reasonable assurance that neither the uranium nor the associated beryllium in the Uranium Material would be inadvertently ingested at levels likely to cause significant occupational health risk.

The concentration of beryllium in workplace air resulting from Uranium Material airborne dust would be below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL; 2 µg/m3) as long as the regulatory limits on airborne uranium concentrations are met. The concentration of Uranium Material in airborne particulates that would meet the 10 mg/week regulatory limit on intake of soluble uranium would be approximately 13 mg/m^3 assuming a breathing rate of 1.2 m^3/hour, a normal 40-hour work week, and a uranium concentration of 16,000 ppm. At 13 mg/m^3 of soluble uranium the Be concentration in airborne particulates associated with the Uranium Material would be approximately 0.5 µg/m^3, a factor of 4 below the OSHA PEL of 2 µg/m3. It is unlikely that a worker would be exposed to airborne particulate matter associated with the Uranium Material for 8 hours per day, 5 days per week. The concentration of beryllium in tailings attributable to processing of the Uranium Material is estimated to be 0.1 ppm (Attachment 5, Table 6, Column 9M of the April 2011 Amendment Request); therefore, inhalation of tailings dust would result in an even lower occupational exposure.

The information provided above indicates that there are no implications to potentially applicable and relevant personnel health criteria from beryllium levels in the Uranium Material as compared to ores and other alternate feed materials previously processed at the Mill. Existing controls and operating procedures used to maintain radiological and non-radiological exposures from ores and other alternate feed materials to protect public and occupational health are considered adequate for handling the proposed Uranium Material.

4.4 Surface Water and Groundwater Effects

4.4.1 Surface Water Effects

There would be no discharge of Mill effluents associated with processing of the Uranium Material at the Mill to local surface waters. All mill process effluent, laundry, and analytical laboratory liquid wastes will be discharged to the Mill's tailings impoundments for disposal by evaporation. Runoff from the Mill and facilities is directed to the tailings impoundments. Sanitary wastes are discharged to State-approved leach fields. As a result, there is no likely

pathway for Uranium Material to impact surface water due to processing of the Uranium Material or disposition of the process residues to the tailings cells. Further, as indicated in semi-annual effluent reports filed by the Mill to date, there is no indication that the Mill is impacting surface waters. No incremental impact is expected to occur to surface waters from any airborne particulates associated with processing of the Uranium Material.

Uranium Material will be transported to the Mill in covered exclusive-used trucks. Upon introduction to the Mill circuit, EFRI proposes that the Uranium Material be processed in a similar fashion as other ores and alternate feed materials. The Uranium Material will be relatively moist, with an expected average moisture content of 55–75%. This moisture is bound water of hydration, and a minor amount of moisture held in capillary tension that is not driven off by the high-pressure filter press. (There is no free water associated with these solids as stated in Section 4.7 of the April 27, 2011 Amendment Request.) This will minimize any potential for dusting while the Uranium Material is introduced into the Mill process. In addition, standard procedures at the Mill for dust suppression will be employed during processing of the Uranium Material and during disposal of the process residuals if necessary. Therefore, there will be no new or incremental risk of discharge to surface waters resulting from the receipt and processing of Uranium Material at the Mill or disposition of the resulting residuals in the tailings disposal cells.

Potential impacts to surface waters from Uranium Material delivery and storage at the Mill Site might include: (1) release of site surface runoff containing Uranium Material contaminants; and/or (2) airborne transport of Uranium Material particulates related to delivery and temporary storage of these materials. Protection of surface water from potential impacts related to receiving and storage and processing this Uranium Material will be accomplished through control of potential surface water discharges using the Mill's existing stormwater and liquid effluent controls (Section 4.7 of the April 2011 Amendment Request). Specifically, stormwater runoff from the Mill and facilities, including the ore storage area where the Uranium Material will be received and stored, is directed to the tailings impoundments through approved stormwater controls contained in the Stormwater Best Management Practices Plan for White Mesa Mill (EFRI 2012b). These are the same controls used for storage of all other areas and alternate feed materials.

Attachment 4 of the April 2011 Amendment Request demonstrates that the Uranium Material passes the TCLP test, which was designed to simulate the leaching of solids within a landfill environment. The pH conditions of the TCLP (pH between 3 and 5 S.U., depending on the material characteristics; EPA Method 1311) are set to be representative of acidic chemical conditions within landfills and tend to be as or more aggressive (lower pH) than conditions experienced under ambient meteoric conditions to which the Uranium Material would typically be exposed during storage (typically pH ~ 5.4; USGS 2001). The Uranium Material therefore does not readily leach and does not exhibit the hazardous waste characteristic of toxicity when exposed to more severe conditions than would be anticipated on the ore storage pad stated on page 13 of the April 2011 Amendment Request. Additionally, the Uranium Material does not exhibit the hazardous characteristics of reactivity, ignitability, or corrosivity, as determined by the specific test results reported in the RMPR in Attachment 2 to the April 2011 Amendment Request.

Based on the TCLP data, moisture content, physical characteristics of the Uranium Material, and observations made during loading, hauling, and storage of the Uranium Material at the Dawn Mining Company Midnite Mine site in Washington State over the past several years (Attachment 2 of the April 2011 Amendment Request), the Uranium Material is expected to be stable during periods of temporary storage at the Mill Site under ambient environmental conditions with respect to expected future precipitation and climatic conditions at the site. However, owing to the more arid climatic conditions at the White Mesa Mill Site compared to the Midnite Mine Site, the potential may exist, if unmitigated, for Uranium Material temporarily stored at the Mill to experience some drying, with possible airborne release of some fine-grained particles from the Uranium Material during windy periods. A new license condition will be added to RML No. UT1900479 to provide additional protective measures and practices during storage of the Uranium Material to address this potential concern (Section 5.1).

Because the chemical and radiological makeup of the Uranium Material are sufficiently similar to natural ores and the resulting tailings, the existing surface water monitoring program at the Mill is sufficient to detect any potential impacts to surface water.

4.4.2 Groundwater Effects

The design of the existing tailings management cells (Cells 4A and 4B) that would be used for disposal of the process residuals from processing of the Uranium Material has been approved by the UDRC. EFRI is required to conduct regular monitoring of the leak detection systems in Cells 4A and 4B and monitoring of groundwater conditions in the vicinity of these disposal cells to detect leakage should it occur.

The receipt and processing of this Uranium Material at the Mill is not expected to pose any incremental additional impacts on groundwater compared to the current uranium mill tailings and alternate feed material residual inventories.

EFRI currently performs groundwater monitoring program at the Mill. With the exception of barium, all constituents identified in the Uranium Material are included in the groundwater monitoring program.

Barium will be introduced into either disposal Cell 4A or 4B with the disposal of the process residuals resulting from the processing of the Uranium Material. Excluding barium, the chemical and radiological makeup of the Uranium Material is similar to other ores and alternate feed materials processed at the Mill, and the resulting residual materials disposed in the tailings cells will have the chemical composition of typical uranium process tailings, for which the Mill's tailings cells were designed. Based on the considerations described in the following section of this SER, the existing groundwater monitoring program at the Mill is expected to be adequate to detect potential future impacts to groundwater resulting from processing of the Uranium Material.

4.5 Evaluation of Need for Additional Groundwater Monitoring Compliance Parameters

With the introduction of the Uranium Material into the mill process, each contaminant found in these materials needs to be considered in order to determine if additional groundwater monitoring compliance parameters should be added to the Ground Water Discharge Permit.

In Attachment 5 of the April 27, 2011 submittal Table 6, "Historical Mill Tailings Composition and Uranium Material Comparison", information is summarized for 26 constituents found in the Uranium Material in relation to concentrations of these constituents present in uranium ores and other alternate feed materials previously licensed for processing at the White Mesa Mill. Because in the last column of Table 6, the units for the listed constituent concentrations in ores and alternate feed materials are given as "mg/L or ppm", direct comparisons between individual constituent concentrations in the Uranium Material and ores and previously licensed alternate feed materials is not always possible. Additional comparisons of constituent concentrations found in the Uranium Material to uranium ores and selected other alternate feed materials, where each concentration is expressed in the same unit (μg/g), are presented above in this SER.

In determining if additional groundwater compliance monitoring parameters were needed for the Permit the following questions and criteria were considered for the 48 contaminants:

1) Is the constituent already included as a groundwater monitoring compliance parameter in the Permit?

2) Are concentrations reported for the constituent in the Uranium Material clearly higher than in uranium ores typically processed at the Mill and/or than present in other alternate feed materials previously licensed for processing at the Mill?

3) Will there be a significant increase in concentration in the tailings inventory?

4) Does available information indicate that the contaminant could be mobile in the groundwater environment (e.g., does it have a relatively low soil-water partitioning coefficient (Kd) or have a Kd value that is equal to or less than that of a chemically similar constituent already included as a groundwater monitoring compliance parameter in the Permit, or does it exhibit high solubility)?

5) Does the contaminant represent a known human toxicity hazard?

6) Is there an existing and reputable groundwater quality compliance standard for the constituent?

7) Are there EPA-approved analytical methods for the constituent and do the approved methods have a detection limit low enough to readily allow determination of whether the constituent concentration exceeds the applicable groundwater quality compliance standard?

As described in Section 4.1 above, the UDRC observed that many of the trace, naturally-occurring constituents identified in the Uranium Material have never been quantified in the Mill's tailings cells and, as a result, have not been considered to date for inclusion in the Permit. However, the overall concentrations of these newly-quantified constituents in the tailings cells

following processing of the Uranium Material and disposal of the residuals in the cells are not expected to change significantly as a result of handling the Uranium Material at the Mill, since these constituents are expected to be present at roughly similar concentrations in the uranium mill tailings and in other alternate feed materials previously processed at the Mill.

According to Table 6 of Attachment 5 in the EFRI (formerly DUSA) April 27, 2011 Amendment Request, for those constituents detected in the Uranium Material and that are already included in the Mill's ongoing groundwater detection monitoring program, the percentage of the total mass in the tailings disposal cells after completion of processing of the Uranium Material (processing of shipments periodically received over a 10-year period) contributed by constituent inventories are projected to be 3% or less for all constituents with the exception of the following: (1) beryllium (approximately 9.2% contribution); (2) copper (approximately 100% contribution); (3) calcium (approximately 5.8% contribution); (4) manganese (approximately 51% contribution); and (5) silver (approximately 14% contribution). A total of 16 of the constituents reported detected in samples of the Uranium Material tested are already required as groundwater monitoring parameters in the Permit.

Barium is not a required groundwater monitoring parameter in the current Ground Water Discharge Permit, and was omitted from the original Permit because concentrations of barium in tailings wastewater samples were found to be less than or equal to the Utah-prescribed groundwater quality standard for barium (see 12/01/04 UDRC Statement of Basis [SOB], Table 5). The State of Utah Department of Environmental Quality has adopted a groundwater quality standard for barium of 2 mg/L (UAC R317-6-2, Table 1).

It is stated in Section 4.6 of the April 2011 Amendment Request and in Section 9.2 of Attachment 5 ("Review of Chemical Contaminants in the DMC Uranium Material to Determine Worker Safety and Environmental Issues and Chemical Compatibility at the Denison Mines White Mesa Mill") included in the April 27, 2011 DUSA submittal that the distribution coefficient (K_d) for barium is 100 to 150,000 L/kg for sandy to clayey soil types. DUSA (2011) also indicated that the UDRC SOB for the GWDP (UDRC 2004) assumes K_d values for calcium ranging from 5 to 100 L/kg. On this basis, DUSA proposed that barium would be less mobile in groundwater than calcium, and that calcium therefore would serve as an effective analogue for barium.

EFRI (2013) submitted additional information indicating that the chemistry of the tailings cells would likely limit the mobility of barium due to the existing abundance of sulfate in the tailings cells. As described above, barium chloride is used to treat radium in the Midnite Mine WTP influent water. In waters where sulfate is present, radium is easily removed by addition of barium chloride: barium chloride dissolves and in the presence of sulfate, the dissolved barium immediately re-precipitates as barium sulfate due to its very low solubility (0.022 mg/L in cold water; Weast 1987). Dissolved radium co-precipitates with the barium sulfate (NEA & IAEA, 2002). In Midnite Mine WTP solids, barium is present as barium sulfate ($BaS0_4$).

The solubility of barium sulfate in cold water is 0.022 mg/L and in concentrated sulfuric acid is 0.025 mg/L (Weast 1987). Once in the EFRI Mill circuit, barium sulfate would remain as barium sulfate due to its very low solubility in concentrated sulfuric acid (0.025 mg/L). At the listed concentrations of sulfate in the tailings solutions (67,600 mg/L to 87,100 mg/L in Cell 4A), a

change in the ambient barium concentration in the tailings solutions (0.02 mg/L) due to placement of the Uranium Material residues to the tailings would be expected to be very small to negligible. Therefore, given the strong tendency of barium to partition to solids, especially in the presence of sulfate, the potential for barium to migrate to groundwater from the tailings cells at the Mill in the event of a release from the tailings cells is considered to be low.

Given the conditions present in the tailings cells, it is likely that mobilization of barium in water will be limited primarily due to solubility considerations. This finding generally supports EFRI's conclusion that barium would be expected to be less mobile than calcium once solubilized and in the groundwater system. For this reason, barium will not be added to the Permit as an additional groundwater monitoring compliance parameter. Should additional information become available at a future date that would suggest that the degree of mobilization of dissolved barium in the tailings pore-water environment is higher than anticipated, UDRC may consider whether barium should be added to the Mill's groundwater compliance monitoring program.

The beryllium in the Uranium Material is derived from beryllium in uranium ores that has dissolved into the local groundwater, which is then precipitated as part of the water treatment process described in the application and Attachments 4 and 5 of the April 2011 Amendment Request. Lime softening is used at the Midnite Mine WTP to precipitate heavy metals, including beryllium, with the metals precipitating in the hydroxide form (Hendricks 2006). In the WTP solids, beryllium is present as beryllium hydroxide, $Be(OH)_2$.

$Be(OH)_2$ is insoluble in water but dissolves in sulfuric acid (NTP 2011) forming beryllium sulfate, $BeSO_4$ (Wiberg, et al. 2001). Therefore, once in the EFRI Mill circuit, beryllium will be present as $BeSO_4$. $BeSO_4$ is readily soluble in water (37 to 42.5 g/l00 mL) and has low solubility in concentrated sulfuric acid (solubility does not exceed 2.5% in the range of 88 to 98 wt% sulfuric acid) (Walsh 2009).

Analysis of tailings pore water in the Cell 2 slimes drain (MWH 2010) indicates high sulfate concentrations (60,600-74,000 mg/L) and low pH (3.11-3.28) conditions, indicating that $BeSO_4$ solubility in the tailings will be more comparable to the above-reported solubility in sulfuric acid.

Excluding barium, the chemical and radiological makeup of the Uranium Material is similar to other ores and alternate feed materials previously processed at the Mill, and it is expected that the resulting residuals left after processing of this material would have a chemical composition similar to that of typical uranium process tailings, for which the Mill's tailings system was designed.

The Mill currently monitors groundwater for a number of other dissolved constituents, such as chloride, fluoride, and sulfate, each of which is an anion that is expected to have a higher mobility in groundwater than a cation such as barium. These anions can be used as indicators of potential tailings cell seepage, and because of their mobility, as 'early warning' indicators for less-mobile constituents such as barium. Chloride, in particular, is a conservative solute that is not retarded with respect to groundwater flow. Chloride salts are highly soluble, so chloride is rarely removed from water by precipitation except under the influence of freezing or evaporation

(Davis and DeWiest 1966). Chloride is also relatively free from effects of exchange, adsorption, and biological activity.

Based on the above considerations, the existing groundwater monitoring program at the Mill is adequate to detect potential future impacts to groundwater from potential releases from the tailings cells where the Uranium Material process residuals would be disposed. Rationale for not adding other remaining constituents found in the Uranium Material to the current groundwater monitoring program is discussed below.

Constituents Omitted from Consideration in Groundwater Monitoring Program

The 29 nutrients, inorganics and metals, and organic constituents or groups of constituents detected in the Uranium Material listed in Table 20 below were not added to the Mill's groundwater monitoring program because they: (1) are already required as groundwater monitoring compliance parameters in the Permit; (2) are considered common laboratory contaminants; and (3) are already addressed by surrogate radiologic monitoring parameters (e.g., gross alpha serves as a surrogate for Radium-226, Thorium-232, Uranium-238, etc…) in the existing groundwater monitoring program.

Table 20. Nutrients, Inorganics and Metals, and Organic Constituents Reported Detected in Uranium Material and Not Added as Groundwater Monitoring Parameters

Nutrients (2)	Ammonia as N and nitrate/nitrite as N
Inorganics and Metals (28)	Beryllium, calcium, cadmium, chromium, cobalt, copper, fluoride, gross alpha, gross beta, Radium-226, thorium isotopes, iron, lead, manganese, nickel, selenium, silver, chloride, sulfate, total uranium, and zinc
Organics (5)	Acetone, methylene chloride, toluene, chloroform, and trichloroethylene[1]

[1] The laboratory reports note that all five organic constituents reported detected were also detected in method blank samples, indicating that that these detections are due to laboratory influences.

Besides barium, the remaining 24 constituents detected in the Uranium Material, after discounting the five organic constituents attributable to laboratory contamination, which are not proposed as additional groundwater monitoring parameters include the following constituents, categorized into two groups with their corresponding UDRC findings.

Cyanide

Although no data were provided on cyanide concentrations in the Uranium Material, if cyanide were to be present in this material, it would be expected to off-gas in the high acid environment of the White Mesa Mill process. Therefore, cyanide was omitted from consideration. Should cyanide be found in future tailings wastewater sampling under Part 1.H.5 of the GWDP, the UDRC may consider whether it should be added as a compliance monitoring parameter at a future date.

Metals, Metalloids, Lanthanides, and Actinides: Thorium

Thorium is not required as a groundwater monitoring parameter in the Permit. Although present in the Uranium Material, concentrations of Thorium-230 detected in the Uranium Material are

lower than those reported present in typical Utah area acid-leached uranium mill tailings and concentrations of Thorium-232 found in the Uranium Material are lower than those reported present in other alternate feed materials previously accepted and processed at the Mill (Section 4.1). For this reason, thorium was eliminated for monitoring consideration.

Conclusions

Table A-1 in Attachment A summarizes the projected percentages of the total constituent mass and concentrations in the tailings disposal cells contributed by constituents in residuals that would be placed in the tailings cells following processing of the Uranium Material (processing of shipments of the Uranium Material periodically received over a 10-year period). These percentages range from between about 5% and 100%; however, the estimated total mass contributed to the tailings from these constituents is less than 0.02% of the estimated total mass in the tailings cells that would receive these process residuals (EFRI 2013a).

The analytical results of the Uranium Material indicated that a total of 24 different nutrients and inorganic constituents were detected in the Uranium Material. Five organic constituents were reportedly detected in the Uranium Material; however, each of those detections was determined to be attributable to laboratory influences and therefore none of these five constituents are present in the Uranium Material. This left a total of 24 constituents detected in the Uranium Material for groundwater monitoring compliance consideration. Of these 24 constituents, 16 are already required as groundwater monitoring compliance parameters in the Ground Water Discharge Permit.

Based on the review of the information provided by EFRI (EFRI 2011; 2012a; 2013a) and as discussed in this SER, the Director of the UDRC has determined that the addition of any of the remaining 8 constituents to the Permit as a new groundwater monitoring compliance parameter is not warranted.

4.6 Alternatives

The action that the UDRC is considering is approval of an amendment request to RML No. UT 1900479 issued pursuant to UAC R313-24 Uranium Mills and Source Material Mill Tailings Disposal Facility Requirements. Subparagraph UAC R313-24-3(1)(c) requires that alternate sites and engineering methods be considered in the analysis of the license amendment request.

Based on its review, the UDRC has concluded that the environmental impacts associated with the proposed action do not warrant either limiting EFRI's future operations or denying the license amendment. The UDRC has concluded that there are no significant environmental impacts associated with the proposed action. Other alternatives need not be evaluated.

4.7 Long-Term Impacts

Based on its review of the Amendment Request and the supporting information provided by EFRI, the UDRC does not anticipate any significant impacts on the reclamation, decommissioning, and decontamination of the White Mesa facility, if the Uranium Material is processed as an alternate feed. In general, the Uranium Material has similar radiological and non-radiological properties to other alternate feeds and natural ores that are processed and have already been processed by EFRI.

Generally, the concentrations of constituents identified in the tailings liquids or solids, feed materials, or process streams at the mill are at concentrations that are generally comparable to the concentrations in the Uranium Material. Due to the small annual and total quantities of the Uranium Material, increases in the concentration of these analytes in the Mill's tailings are determined not to be significant. A few other constituents, such as barium, beryllium. silver, manganese, copper, and calcium are present in the Uranium Material and are either present in lower concentrations in the ores and other alternate feeds at the mill, or as in the case of copper, information on concentration in the ore and other alternate feeds was not available.

Although the percent tota1 of these constituents contributed from the Uranium Material to the mill tailings in the 10-year period appears to be high in some cases – between 5 and l00% (for barium) of these constituents present in the tailings is from the Uranium Material – the total mass contributed is less than 1% of the total mass in the tailings cell (EFRI 2013a, p. 233). In the case of barium, introduction of the Uranium Material into the Mill's tailings cells would substantially increase the amount of barium currently stored (See Table A-1). As discussed in this SER, however, barium dispensed to the tailings cell environment is expected to be precipitated in the form of barium sulfate solids. Barium sulfate is a sparingly soluble sulfate salt: the solubility of barium sulfate in cold water is 0.022 mg/L and in concentrated sulfuric acid only increases to 0.025 mg/L.

Geochemical modeling with the PHREEQC modeling tools[2] using the above solubility data and the geochemical conditions present in the Mill tailings (average tailings sulfate concentration of 65 g/L) predicts that barium from the Uranium Material will remain stable in the tailings impoundment as the solid phase barium sulfate, and would not be expected to dissolve. Given the low solubility of barium sulfate, especially in the presence of sulfate, there is, therefore, no reasonable potential for barium to migrate from the tailings into groundwater.

As discussed in detail in the Mill's approved Reclamation Plan, the components of the decontamination and decommissioning phase and reclamation phase of Mill closure are:

- Demolition of buildings, structures, and facilities (including Cell 1)
- Decontamination to free release standards of any equipment to be released from the site
- Disposal of all demolished structures and equipment in the Mill's tailings cells
- Decontamination of environmental media (onsite and offsite soil) to levels committed in the Reclamation Plan
- Restoration of any potential groundwater contamination to groundwater compliance limits or approved Alternate Corrective Action Compliance Limits

The long-term impacts that an alternate feed material could potentially have on the decontamination and decommissioning phase, reclamation phase, or post-reclamation conditions are:

- Increase in volume of material in the tailings cells
- Addition of a new contaminant that cannot be managed or contained by the existing tailings reclamation design

[2] See http://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqc/.

- Increase in concentration of a contaminant to a level that cannot be managed or contained by the existing tailings reclamation design
- Contamination of soils or sediments requiring management at reclamation
- Change in nature of groundwater conditions requiring restoration at reclamation, to meet applicable groundwater quality standards

As discussed in the April 2011 Amendment Request and in EFRI 2013a, processing of the Uranium Material is not expected to produce any of these impacts because:

- The Uranium Material will not increase the volume of tailings. As discussed in the April 2011 Amendment Request, the Uranium Material will produce no greater volume of tailings than would be produced from processing the same volume of ore. Processing of the Uranium Material does not require the use of any new or modified equipment; hence no additional volume of demolition material would be added to tailings.
- The RMPR, analytical data, and technical memorandum in the April 2011 Amendment Request demonstrate that the sampling and analytical data are representative of the Uranium Material, and the Uranium Material contains no new constituents.
- Processing of the Uranium Material will not require the use of additional chemicals not already in use at the Mill. Therefore, processing of the Uranium Material will not introduce any new chemical constituent that cannot be managed or contained by the existing tailings reclamation design.
- Processing of the Uranium Material is not expected to increase the concentration of any contaminant to a level that cannot be managed or contained by the existing tailings reclamation design. With the exception of barium, all constituents present in the Uranium Material have already been introduced into the Mill at levels higher than the levels present in the Uranium Material. Anticipated increases in barium levels in tailings will have no effect on the integrity of the tailings liner.
- As discussed in Sections 4.1.1.a and 4.1.2, processing of the Uranium Material is not expected to produce any additional mechanism for, or cause a significant increase in airborne deposition in soils or sediments.
- As discussed in Sections 4.2, 4.3, and above in this section, processing of the Uranium Material is not expected to produce any additional pathway for, or cause a significant increase in, concentrations of any constituents present in the Uranium Material in groundwater. Specifically, each constituent in the Uranium Material is either monitored under the Mill's approved GWDP, or represented by a constituent monitored in the GWDP, and the monitoring program required by the GWDP meets the requirements of NRC Reg. Guide 4.14 (NRC 1980) and Utah groundwater regulations. Hence, processing of the Uranium Material is not expected to change the nature of groundwater conditions in a way that would require additional groundwater restoration at or before reclamation.

The constituents in the sands and liquids resulting from processing the Midnite Mine Uranium Materials are not expected to be significantly different from those in the conventional ores either in composition or in concentration of constituents (EFRI 2013a, p. 232). Table 6 of Attachment 5 to the April 2011 Amendment Request indicates that when comparing the Uranium Material to the tailings, all of the constituents found in the Uranium Material are currently processed in the Mill's main circuit and/or the alternate feed circuit in other ores and alternate feed materials with

the exception of copper. No information on the concentration of copper in the ores or alternate feeds is currently available but copper is analyzed under the existing GWDP.

Residuals resulting from processing the Uranium Material would be disposed in Cell 4A, 4B or newer cells that may be constructed during the period of processing. Cells 4A and 4B are constructed of 60-mil high-density polyethylene (HDPE) manufactured by GSE. Manufacturer's material product performance information, including a chemical resistivity list, was provided in Appendix P of EFRI 2013a. Manufacturers generally do not include specific metal cations in chemical resistivity lists since synthetic liners are generally compatible (resistive to) metals, metal halide salts, and many other metal salts in all proportions.

Based on the above information, including a comprehensive chemical compatibility listing for the HDPE geomembrane liner material used in Cells 4A and 4B, the presence of the inorganic and organic constituents in the Uranium Material as listed in Tables 8 through 12 would not be expected to result in any additional detrimental impacts to the HDPE geomembrane liners in Cell 4A or 4B.

In the unlikely event that EFRI were to close prior to processing the Uranium Material, the surety funds would be issued to the Director of the UDRC and the Uranium Material that was on site at the time would be hauled to one of the disposal cells and disposed of directly into the cell. The financial surety does not need to be increased or modified for the acceptance of the Uranium Material, because the Mill cannot possess at any one time, more feed material than can be placed in the cells. Therefore, there is a limit as to how much ore and alternate feed that can be on site for processing at any given time. Surety reviews and adjustments are performed annually by the UDRC. No changes to the surety are necessary for receipt and processing of the Uranium Material.

4.8 Report Findings

Based on the foregoing evaluation of the environmental impacts of the proposed action as described in the April 27, 2011 Amendment Request, in the December 5, 2012 Supplementary Information Letter Report, and in the June 14, 2013 and August 7, 2013 Letters to Mr. Rusty Lundberg of the UDRC (EFRI 2013a; 2013b), and with implementation of the proposed new license condition requiring that: (1) Uranium Material stored at the Mill Site be covered with a durable, UV-tolerant geomembrane and ballast be applied over the geomembrane to prevent wind-induced uplift of the geomembrane; and (2) the EFRI RSO or his or her designee take prompt action to stop generation of any visible dust originating from the stored Uranium Material, the UDRC has determined that no significant adverse effects on public health or the environment are expected to result from implementing the proposed action. The following statements support and summarize this conclusion:

1. An acceptable environmental and effluent monitoring program is in place to monitor effluent releases from the Mill and associated facilities and to detect whether applicable regulatory limits established for environmental media are exceeded. A GWDP for the shallow-perched, water-bearing zone is in place to detect potential seepage of contaminants from the tailings cells. The confined Entrada/Navajo Sandstone Aquifer is separated by low-permeability formations from the tailings cells, further decreasing a potential impact to deep groundwater resources. The potential for seepage to occur while

the material is temporarily stored on the storage pad is minimal due to the dry climate and highly compacted ore pad surface, and the limited duration of storage. Further, decommissioning and reclamation activities at the storage pad can remove any such contamination, should it occur, to the tailings cells for long-term control. An existing dust suppression program is implemented at the Mill to reduce the potential for airborne releases.

2. An approved radiation safety program is in place at the Mill. Site perimeter postings required by License Condition 9.9 are in place at entrances to the Mill. In the past, all worker Total Effective Dose Equivalents (TEDEs) have been found to be well below the 0.05 Sievert (Sv), or 5 rem, annual limit specified in UAC R313-15-201 (10 CFR 20.1201). The licensee has also implemented a bioassay program consistent with NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills."

3. The State's existing Air Approval Order (AO) No. DAQE-AN0112050018-11 requires that visible emissions from ore-loading areas not exceed 15% opacity, and specifies approved testing methods for testing the opacity level. The AO also requires that EFRI comply with all applicable requirements of UAC R307-205 for Fugitive Emission and Fugitive Dust sources, and requires that all ore/feed material storage piles be watered to minimize generation of fugitive dusts as dry conditions warrant or as determined necessary by the Director of the Utah Division of Air Quality, in accordance with requirements contained in UAC R307-401-8.

4. Information provided in the April 2011 Amendment Request and in 2013 (EFRI 2013a; 2013b) indicate that, with the exception of barium, there are no concentrations in the Uranium Material of any constituent in excess of the concentrations in alternate feed materials previously licensed for receipt and processing at the Mill. The Mill's existing airborne effluent monitoring program, which has been designed to comply with the requirements of Reg. Guide 4.14, and which has been in place during the processing of those previously approved alternate feed materials, is considered appropriate for monitoring the potential releases from the acceptance, temporary storage, and processing of the Uranium Material, and from disposal of the processed residual materials in the tailings cells.

Present and potential environmental impacts from the receipt and processing of the Uranium Material were assessed. No significant impacts have been identified as a result of implementing this proposed action. Therefore, UDRC staff have determined that there is not expected to be any significant increased risk to public health or in environmental hazards from the acceptance, temporary storage, and processing of the Uranium Material, and from disposal of the processed residual materials in the designated tailings cells (Cells 4A and/or 4B).

5.0 REQUIRED LICENSE AMENDMENTS AND PERMIT MODIFICATIONS

5.1 License Amendments Proposed

The following license condition changes (new license conditions) would result from this license amendment:

"10.20 The licensee is authorized to receive and process source material from the Dawn Mining Company's Midnite Mine site in Wellpinit, Washington, in accordance with statements, representations, and commitments contained in the Amendment Request submitted to the Executive Secretary dated April 27, 2011 and supplemented by a Letter Report (with attachment) submitted to the Director of the Utah Division of Radiation Control (Director) on December 5, 2012, a Letter Report (with attachments) submitted to the Director on June 14, 2013, and a Letter submitted to the Director on August 7, 2013."

"A Uranium Material stored (stockpiled) at the Mill Site longer than 14 days shall be covered with a durable geomembrane cover, resistant to damage by ultraviolet (UV) radiation and sufficient ballast shall be placed over the cover to prevent wind uplift of the cover during peak wind conditions at the site; and (2) If at any time, visible dust is observed to be originating from Uranium Material stored on site, the EFRI RSO or his or her authorized representative shall take actions within 30 minutes to stop the generation of visible dust."

[*Applicable UDRC License Amendment***:** 6]

5.2 GW Permit Modifications

No permit modifications are required as a result of acceptance of the Uranium Material for processing at the Mill.

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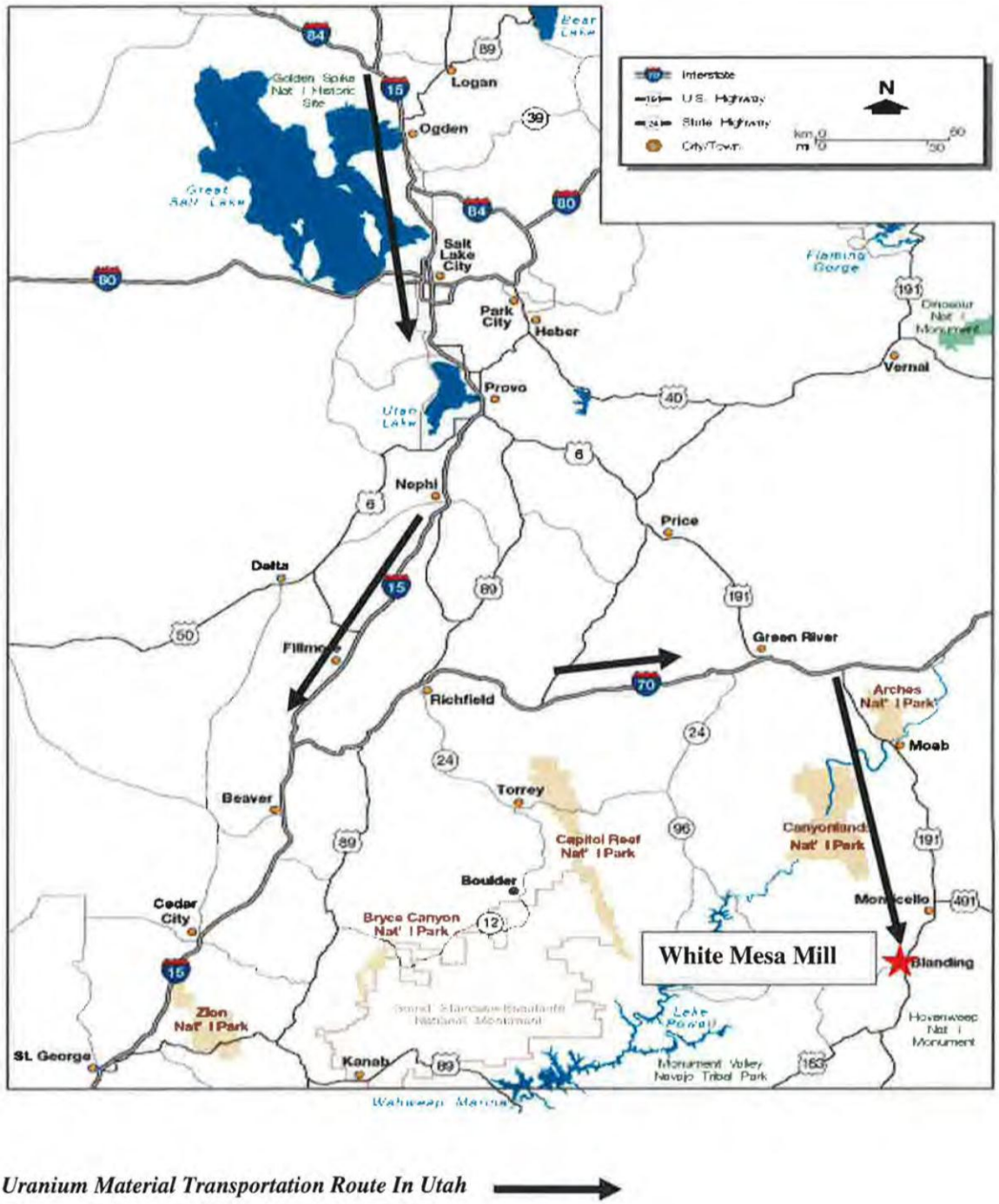

Figure 1. Primary Transportation Corridors in Utah

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ATTACHMENT A:

Table A-1

Total Percentages of Mass and Concentrations Contributed by Uranium Material Constituents to Tailings Over a 10-Year Period

Table A-1. Total Percentage of Mass and Concentrations Contributed by Uranium Material Constituents to Tailings Over a 10-Year Period

							Midnite Mine Uranium Material Composition		Cell 3 Composition in 2004		Baseline for Cell 4A (or 4B)	Year 1		
Component		A Conc. in Ores and Other Alternate Feeds (ppm)[1]	B Range in Uranium Material (mg/kg)[2]	C Estimated Average Conc. In Uranium Material (mg/kg)[3]	D Estimated Historical Maximum Annual Mass in Uranium Material (tons)[4]	E Estimated Conc. Range In Cell 3 Mill Tailings solution (mg/L or ppm)[5]	F Estimated Average Conc. In Cell 3 Mill Tailings solution (mg/L or ppm)[5]	G Estimated Mass in Cell 3 Mill Tailings 2004 (tons)[6]	H Estimated Annual Mass in Cell 4A or 4B Mill Tailings (tons)[7]	I Conc. In Cell 4A (or 4B) Mill Tailings (ppm)[8]	1J Estimated Mass in Uranium Material (tons)[9]	1K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	1L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	1M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]
Acetone			U	U	0	28-514	192	340	41.3	192.0	0.000	41.3	192.0	0.0
Ammonia (NH_4)		100-730	7.9-8.3	8.0	0.002	3-13,900	3,131	5,539	673.2	3131.0	0.002	673.2	3130.6	-0.4
Arsenic (As)		3.5-16,130	U	U	0	0.3-440	149	264	32.0	149.0	0.000	32.0	149.0	0.0
Barium (Ba)		21-43,000	7,200-8,100	7,733	1.523	0.021-0.1	0.02	0.035	0.0	0.0	1.52	1.5	7.1	7.1
Beryllium (Be)		1-105	33-36	35	0.007	0.347-0.78	0.5	0.88	0.1	0.5	0.007	0.1	0.5	0.0
Cadmium (Cd)		0.004-16	40-44	42	0.008	1.64-6.6	3.4	6.0	0.7	3.4	0.008	0.7	3.4	0.0
Calcium (Ca)		up to 217,000	15,000-16,000	15,667	3.086	90-630	368	651	79.1	368.0	3.09	82.2	382.3	14.3
Cobalt (Co)		9-350,400	1,100-1,200	1,167	0.230	14-120	60.7	107	13.1	60.7	0.230	13.3	61.8	1.1
Chromium (Cr)		8-16,000	19-20	19	0.004	1.0-13	6.2	11	1.3	6.2	0.004	1.3	6.2	0.0
Chloride (Cl)		07-89,900	39-41	40	0.008	2,110-8,000	4,608	8,152	990.7	4608.0	0.008	990.7	4607.4	-0.6
Copper (Cu)		Unknown	160-180	170	0.033	Unknown			0.0	0.0	0.033	0.0	0.2	0.2
Fluoride (F)		3-460,000	38-40	38.7	0.008	0.02-4,440	1,695	2,998	364.4	1695.0	0.008	364.4	1694.8	-0.2
Iron (Fe)		up to 46,000	690-740	723	0.142	1,080-3,400	2,212	3,913	475.6	2212.0	0.142	475.7	2212.4	0.4
Lead (Pb)		9-236,000	17-19	18	0.004	0.21-6.0	3	5	0.6	3.0	0.004	0.6	3.0	0.0
Manganese (Mn)		172-3,070	96,000-110,000	105,333	20.751	74-222	146	258	31.4	146.0	20.8	52.1	242.5	96.5
Mercury (Hg)		0.0004-14	U	U	0	0.0008-17.6	3.5	6	0.8	3.5	0.000	0.8	3.5	0.0
Molybdenum (Mo)		12-17,000	U	U	0	0.44-240	52.8	93	11.4	52.8	0.000	11.4	52.8	0.0
Nickel (Ni)		7-450,000	1,700-1,800	1,767	0.348	7.2-370	83	147	17.8	83.0	0.348	18.2	84.6	1.6
Nitrates (NOx)		0.6-350,000	3.1-3.2	3.1	0.001	24	24	42	5.2	24.0	0.0006	5.2	24.0	0.0
Selenium (Se)		0.02-710	25-26	26	0.005	0.18-2.4	1.4	2.5	0.3	1.4	0.0051	0.3	1.4	0.0
Silver (Ag)		0.007-80	11-12	11	0.002	0.005-0.14	0.1	0.2	0.0	0.1	0.002	0.0	0.1	0.0
Sulfate (SO_4=)		24-300,000	17,000	17,000	3.349	28,900-190,000	64,914	114,833	13956.5	64914.0	3.349	13959.9	64920.5	6.5
Thallium (Tl)		0.02-960	U	U	0	0.7-45	16	28	3.4	16.0	0.000	3.4	16.0	0.0
Tin (Sn)		20,900-116,000	U	U	0	<5	5	9	1.1	5.0	0.000	1.1	5.0	0.0
Vanadium (V)		10-25,000	U	U	0	136-510	263	465	56.5	263.0	0.000	56.5	263.0	0.0
Zinc (Zn)		8-14,500	3,400-3,600	3,533	0.696	50-1,300	641	1,134	137.8	641.0	0.696	138.5	644.1	3.1
Total Selected Components											30.2			
Total Tailings Cell Mass									215000.0			215030.2		

* - Assume 20% reduction per year for 5 years from historical maximum levels (190 tons per year) to final remedy estimate of 18 tons per year dry uranium material.

1. The concentration in other alternate feeds represents some selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes.
2. The range in the Uranium Material is based on three sampling events for the DMC WTP solids.
3. The estimated average concentration in Uranium Material has been calculated as the mean value reported.
4. Estimated mass in the Uranium Material is calculated by assuming 197 tons dry annually from historical values.
5. Mill tailings range and average concentrations were taken from Mill tailings samples to date, as summarized in Table 5 of the draft Statement of Basis for the Utah Groundwater Discharge Permit for the Mill (November 29, 2004).
6. Estimated current mass in Mill tailings is calculated by multiplying the estimated average concentration in the Mill tailings in Column F by 1,769,000 dry tons of tailings reported in the Mill's active Tailings Cell No. 3.
7. The baseline estimated annual mass in Mill tailings for cell 4A or 4B is calculated by multiplying the estimated mass in Cell 3 (Column G) by the ratio of Cell 4A (or 4B) total mass capacity of 2,150,000 dry tons to capacity of Cell 3 of 1,769,000 dry tons as of November 29, 2004 and dividing it by ten years as the estimated time to fill cell 4A (or 4B).
8. The baseline concentration in Cell 4A (or 4B) Mill tailings is calculated by dividing Column H by 215,000 dry tons as the assumed annual mass addition of tailings to the Cell without the Uranium Material
9. Year 1 and Year 2 estimated mass in the Uranium Material is assumed to be equal to Column D historical values.
10. The mass in Mill tailings after Uranium Material processing is calculated by adding the total tailings mass from the previous year to the total additional tailings mass added in the current year.
11. The concentration in Cell 4A (or 4B) Mill tailings after Uranium Material processing is calculated by dividing the Mass in Cell 4A (or 4B) Mill tailings for that year by the total cumulative mass in cell 4A (or 4B) tailings after Uranium Material is processed.
12. The increase in baseline Mill tailings concentration after Uranium Material processing is calculated by subtracting baseline concentration (Column I) from the concentration in Cell 4A (or 4B) after Uranium Material processing for that year.
13. The Year 3 and Year 4 approximate estimated mass in the Uranium Material is assumed to be 5 times the amount in Column D based on the estimated increased flow treated to be 1,000 gpm for 7 months of the year and 450 gpm for the remaining 5 months.
14. The Year 5 through Year 10 approximate estimated mass in the Uranium Material is assumed to be reduced from the maximum historical value per year to the final remedy estimate of dry Uranium Material (20 %reduction per year) after 2 years of construction.
15. The Estimated Mass in Uranium Material over 10-Year Period is the Cumulative Contribution from the Uranium Material to the tailings
16. The Estimated Mass in Cell 4A (or 4B) Mill tailings over 10-year period after Uranium Material processing is the total cumulative mass contribution from including Uranium Material to the tailings
17. The approximate percent total contributed from Uranium Material is the 10-year contribution to the tailings from the Uranium Material.

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Table A-1. Total Percentage of Mass and Concentrations Contributed by Uranium Material Constituents to Tailings Over a 10-Year Period

		Year 2							Year 3 (Const)			Year 4 (Const)	
Component		2J Estimated Mass in Uranium Material (tons)[9]	2K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	2L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	2M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]	3J Estimated Mass in Uranium Material (tons)[13]	3K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	3L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	3M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]	4J Estimated Mass in Uranium Material (tons)[13]	4K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	4L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	4M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]
Acetone		0.000	82.6	192.0	0.0	0.000	123.8	191.9	-0.1	0.000	165.1	191.9	-0.1
Ammonia (NH_4)		0.002	1346.3	3130.6	-0.4	0.008	2019.5	3129.9	-1.1	0.008	2692.7	3129.6	-1.4
Arsenic (As)		0.000	64.1	149.0	0.0	0.000	96.1	148.9	-0.1	0.000	128.1	148.9	-0.1
Barium (Ba)		1.52	3.1	7.1	7.1	8.067	11.1	17.2	17.2	8.067	19.2	22.3	22.3
Beryllium (Be)		0.007	0.2	0.5	0.0	0.037	0.4	0.6	0.1	0.037	0.5	0.6	0.1
Cadmium (Cd)		0.008	1.5	3.4	0.0	0.044	2.3	3.5	0.1	0.044	3.0	3.5	0.1
Calcium (Ca)		3.09	164.4	382.3	14.3	16.344	259.9	402.8	34.8	16.344	355.3	413.0	45.0
Cobalt (Co)		0.230	26.6	61.8	1.1	1.217	40.8	63.3	2.6	1.217	55.1	64.0	3.3
Chromium (Cr)		0.004	2.7	6.2	0.0	0.020	4.0	6.2	0.0	0.020	5.4	6.3	0.1
Chloride (Cl)		0.008	1981.5	4607.4	-0.6	0.042	2972.2	4606.5	-1.5	0.042	3963.0	4606.1	-1.9
Copper (Cu)		0.033	0.1	0.2	0.2	0.177	0.2	0.4	0.4	0.177	0.4	0.5	0.5
Fluoride (F)		0.008	728.9	1694.8	-0.2	0.040	1093.3	1694.5	-0.5	0.040	1457.8	1694.4	-0.6
Iron (Fe)		0.142	951.4	2212.4	0.4	0.754	1427.8	2212.9	0.9	0.754	1904.1	2213.1	1.1
Lead (Pb)		0.004	1.3	3.0	0.0	0.019	2.0	3.0	0.0	0.019	2.6	3.1	0.1
Manganese (Mn)		20.8	104.3	242.5	96.5	109.885	245.6	380.6	234.6	109.885	386.8	449.6	303.6
Mercury (Hg)		0.000	1.5	3.5	0.0	0.000	2.3	3.5	0.0	0.000	3.0	3.5	0.0
Molybdenum (Mo)		0.000	22.7	52.8	0.0	0.000	34.1	52.8	0.0	0.000	45.4	52.8	0.0
Nickel (Ni)		0.348	36.4	84.6	1.6	1.843	56.1	86.9	3.9	1.843	75.8	88.1	5.1
Nitrates (NOx)		0.0006	10.3	24.0	0.0	0.003	15.5	24.0	0.0	0.003	20.6	24.0	0.0
Selenium (Se)		0.0051	0.6	1.4	0.0	0.027	0.9	1.5	0.1	0.027	1.3	1.5	0.1
Silver (Ag)		0.002	0.0	0.1	0.0	0.011	0.1	0.1	0.0	0.011	0.1	0.1	0.0
Sulfate (SO_4=)		3.349	27919.7	64920.5	6.5	17.735	41894.0	64929.7	15.7	17.735	55868.2	64934.3	20.3
Thallium (Tl)		0.000	6.9	16.0	0.0	0.000	10.3	16.0	0.0	0.000	13.8	16.0	0.0
Tin (Sn)		0.000	2.2	5.0	0.0	0.000	3.2	5.0	0.0	0.000	4.3	5.0	0.0
Vanadium (V)		0.000	113.1	263.0	0.0	0.000	169.6	262.9	-0.1	0.000	226.2	262.9	-0.1
Zinc (Zn)		0.696	277.0	644.1	3.1	3.686	418.5	648.7	7.7	3.686	560.0	650.9	9.9
Total Selected Components		30.2				160.0				160.0			
Total Tailings Cell Mass			430060.4				645220.4				860380.3		

* - Assume 20% reduction per year for 5 years from historical maximum levels (190 tons per year) to final remedy estimate of 18 tons per year dry uranium material.

1. The concentration in other alternate feeds represents some selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes.
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6. Estimated current mass in Mill tailings is calculated by multiplying the estimated average concentration in the Mill tailings in Column F by 1,769,000 dry tons of tailings reported in the Mill's active Tailings Cell No. 3.
7. The baseline estimated annual mass in Mill tailings for cell 4A or 4B is calculated by multiplying the estimated mass in Cell 3 (Column G) by the ratio of Cell 4A (or 4B) total mass capacity of 2,150,000 dry tons to capacity of Cell 3 of 1,769,000 dry tons as of November 29, 2004 and dividing it by ten years as the estimated time to fill cell 4A (or 4B).
8. The baseline concentration in Cell 4A (or 4B) Mill tailings is calculated by dividing Column H by 215,000 dry tons as the assumed annual mass addition of tailings to the Cell without the Uranium Material
9. Year 1 and Year 2 estimated mass in the Uranium Material is assumed to be equal to Column D historical values.
10. The mass in Mill tailings after Uranium Material processing is calculated by adding the total tailings mass from the previous year to the total additional tailings mass added in the current year.
11. The concentration in Cell 4A (or 4B) Mill tailings after Uranium Material processing is calculated by dividing the Mass in Cell 4A (or 4B) Mill tailings for that year by the total cumulative mass in cell 4A (or 4B) tailings after Uranium Material is processed.
12. The increase in baseline Mill tailings concentration after Uranium Material processing is calculated by subtracting baseline concentration (Column I) from the concentration in Cell 4A (or 4B) after Uranium Material processing for that year.
13. The Year 3 and Year 4 approximate estimated mass in the Uranium Material is assumed to be 5 times the amount in Column D based on the estimated increased flow treated to be 1,000 gpm for 7 months of the year and 450 gpm for the remaining 5 months.
14. The Year 5 through Year 10 approximate estimated mass in the Uranium Material is assumed to be reduced from the maximum historical value per year to the final remedy estimate of dry Uranium Material (20 %reduction per year) after 2 years of construction.
15. The Estimated Mass in Uranium Material over 10-Year Period is the Cumulative Contribution from the Uranium Material to the tailings
16. The Estimated Mass in Cell 4A (or 4B) Mill tailings over 10-year period after Uranium Material processing is the total cumulative mass contribution from including Uranium Material to the tailings
17. The approximate percent total contributed from Uranium Material is the 10-year contribution to the tailings from the Uranium Material.

Table A-1. Total Percentage of Mass and Concentrations Contributed by Uranium Material Constituents to Tailings Over a 10-Year Period

		Year 5							Year 6			Year 7		
Component		5J Estimated Mass in Uranium Material (tons)[14]	5K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	5L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	5M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]	6J Estimated Mass in Uranium Material (tons)[14]	6K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	6L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	6M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]	7J Estimated Mass in Uranium Material (tons)[14]	7K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	7L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	7M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]
Acetone		0.000	206.4	191.9	-0.1	0.000	247.7	191.9	-0.1	0.000	289.0	191.9	-0.1
Ammonia (NH_4)		0.002	3365.8	3129.8	-1.2	0.001	4039.0	3130.0	-1.0	0.001	4712.2	3130.1	-0.9
Arsenic (As)		0.000	160.2	148.9	-0.1	0.000	192.2	148.9	-0.1	0.000	224.2	149.0	0.0
Barium (Ba)		1.52	20.7	19.3	19.3	1.25	22.0	17.0	17.0	0.97	23.0	15.2	15.2
Beryllium (Be)		0.007	0.6	0.6	0.1	0.006	0.7	0.6	0.1	0.004	0.9	0.6	0.1
Cadmium (Cd)		0.008	3.8	3.5	0.1	0.007	4.5	3.5	0.1	0.005	5.2	3.5	0.1
Calcium (Ca)		3.09	437.5	406.9	38.9	2.53	519.2	402.3	34.3	1.97	600.3	398.7	30.7
Cobalt (Co)		0.230	68.4	63.6	2.9	0.188	81.6	63.2	2.5	0.147	94.8	63.0	2.3
Chromium (Cr)		0.004	6.7	6.2	0.0	0.003	8.1	6.2	0.0	0.002	9.4	6.2	0.0
Chloride (Cl)		0.008	4953.7	4606.3	-1.7	0.006	5944.4	4606.5	-1.5	0.005	6935.2	4606.7	-1.3
Copper (Cu)		0.033	0.5	0.4	0.4	0.027	0.5	0.4	0.4	0.021	0.5	0.3	0.3
Fluoride (F)		0.008	1822.2	1694.4	-0.6	0.006	2186.7	1694.5	-0.5	0.005	2551.1	1694.6	-0.4
Iron (Fe)		0.142	2379.8	2213.0	1.0	0.117	2855.5	2212.8	0.8	0.091	3331.2	2212.8	0.8
Lead (Pb)		0.004	3.3	3.0	0.0	0.003	3.9	3.0	0.0	0.002	4.6	3.0	0.0
Manganese (Mn)		20.8	439.0	408.2	262.2	17.0	487.4	377.7	231.7	13.2	532.0	353.4	207.4
Mercury (Hg)		0.000	3.8	3.5	0.0	0.000	4.5	3.5	0.0	0.000	5.3	3.5	0.0
Molybdenum (Mo)		0.000	56.8	52.8	0.0	0.000	68.1	52.8	0.0	0.000	79.5	52.8	0.0
Nickel (Ni)		0.348	94.0	87.4	4.4	0.285	112.1	86.9	3.9	0.222	130.2	86.5	3.5
Nitrates (NOx)		0.0006	25.8	24.0	0.0	0.0005	31.0	24.0	0.0	0.0004	36.1	24.0	0.0
Selenium (Se)		0.0051	1.6	1.5	0.1	0.0042	1.9	1.5	0.1	0.0033	2.2	1.5	0.1
Silver (Ag)		0.002	0.1	0.1	0.0	0.002	0.2	0.1	0.0	0.001	0.2	0.1	0.0
Sulfate (SO_4=)		3.349	69828.1	64931.5	17.5	2.74	83787.3	64929.5	15.5	2.14	97746.0	64927.9	13.9
Thallium (Tl)		0.000	17.2	16.0	0.0	0.000	20.6	16.0	0.0	0.000	24.1	16.0	0.0
Tin (Sn)		0.000	5.4	5.0	0.0	0.000	6.5	5.0	0.0	0.000	7.5	5.0	0.0
Vanadium (V)		0.000	282.7	262.9	-0.1	0.000	339.3	262.9	-0.1	0.000	395.8	262.9	-0.1
Zinc (Zn)		0.696	698.5	649.6	8.6	0.570	836.9	648.6	7.6	0.444	975.2	647.8	6.8
Total Selected Components		30.2				24.7				19.3			
Total Tailings Cell Mass			1075410.5				1290435.3				1505454.5		

* - Assume 20% reduction per year for 5 years from historical maximum levels (190 tons per year) to final remedy estimate of 18 tons per year dry uranium material.

1. The concentration in other alternate feeds represents some selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes.
2. The range in the Uranium Material is based on three sampling events for the DMC WTP solids.
3. The estimated average concentration in Uranium Material has been calculated as the mean value reported.
4. Estimated mass in the Uranium Material is calculated by assuming 197 tons dry annually from historical values.
5. Mill tailings range and average concentrations were taken from Mill tailings samples to date, as summarized in Table 5 of the draft Statement of Basis for the Utah Groundwater Discharge Permit for the Mill (November 29, 2004).
6. Estimated current mass in Mill tailings is calculated by multiplying the estimated average concentration in the Mill tailings in Column F by 1,769,000 dry tons of tailings reported in the Mill's active Tailings Cell No. 3.
7. The baseline estimated annual mass in Mill tailings for cell 4A or 4B is calculated by multiplying the estimated mass in Cell 3 (Column G) by the ratio of Cell 4A (or 4B) total mass capacity of 2,150,000 dry tons to capacity of Cell 3 of 1,769,000 dry tons as of November 29, 2004 and dividing it by ten years as the estimated time to fill cell 4A (or 4B).
8. The baseline concentration in Cell 4A (or 4B) Mill tailings is calculated by dividing Column H by 215,000 dry tons as the assumed annual mass addition of tailings to the Cell without the Uranium Material
9. Year 1 and Year 2 estimated mass in the Uranium Material is assumed to be equal to Column D historical values.
10. The mass in Mill tailings after Uranium Material processing is calculated by adding the total tailings mass from the previous year to the total additional tailings mass added in the current year.
11. The concentration in Cell 4A (or 4B) Mill tailings after Uranium Material processing is calculated by dividing the Mass in Cell 4A (or 4B) Mill tailings for that year by the total cumulative mass in cell 4A (or 4B) tailings after Uranium Material is processed.
12. The increase in baseline Mill tailings concentration after Uranium Material processing is calculated by subtracting baseline concentration (Column I) from the concentration in Cell 4A (or 4B) after Uranium Material processing for that year.
13. The Year 3 and Year 4 approximate estimated mass in the Uranium Material is assumed to be 5 times the amount in Column D based on the estimated increased flow treated to be 1,000 gpm for 7 months of the year and 450 gpm for the remaining 5 months.
14. The Year 5 through Year 10 approximate estimated mass in the Uranium Material is assumed to be reduced from the maximum historical value per year to the final remedy estimate of dry Uranium Material (20 %reduction per year) after 2 years of construction.
15. The Estimated Mass in Uranium Material over 10-Year Period is the Cumulative Contribution from the Uranium Material to the tailings
16. The Estimated Mass in Cell 4A (or 4B) Mill tailings over 10-year period after Uranium Material processing is the total cumulative mass contribution from including Uranium Material to the tailings
17. The approximate percent total contributed from Uranium Material is the 10-year contribution to the tailings from the Uranium Material.

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Table A-1. Total Percentage of Mass and Concentrations Contributed by Uranium Material Constituents to Tailings Over a 10-Year Period

		Year 8								Year 9				Year 10			
Component		8J Estimated Mass in Uranium Material (tons)[14]	8K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	8L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	8M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]	9J Estimated Mass in Uranium Material (tons)[14]	9K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	9L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	9M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]	10J Estimated Mass in Uranium Material (tons)[14]	10K Mass in Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (tons)[10]	10L Conc. In Cell 4A (or 4B) Mill Tailings after Uranium Material Processing (ppm)[11]	10M Increase in Baseline Mill Tailings Conc. After Uranium Material Processing (ppm)[12]
Acetone		0.000	330.2	191.9	-0.1	0.000	371.5	192.0	0.0	0.000	412.8	192.0	0.0
Ammonia (NH_4)		0.001	5385.3	3130.2	-0.8	0.000	6058.5	3130.2	-0.8	0.000	6731.7	3130.3	-0.7
Arsenic (As)		0.000	256.3	149.0	0.0	0.000	288.3	149.0	0.0	0.000	320.4	149.0	0.0
Barium (Ba)		0.70	23.7	13.7	13.7	0.42	24.1	12.4	12.4	0.14	24.2	11.3	11.2
Beryllium (Be)		0.003	1.0	0.6	0.1	0.002	1.1	0.6	0.1	0.001	1.2	0.6	0.051
Cadmium (Cd)		0.004	6.0	3.5	0.1	0.002	6.7	3.5	0.1	0.001	7.4	3.5	0.1
Calcium (Ca)		1.41	680.8	395.7	27.7	0.85	760.8	393.1	25.1	0.29	840.2	390.7	22.7
Cobalt (Co)		0.105	108.0	62.8	2.1	0.063	121.1	62.6	1.9	0.022	134.2	62.4	1.7
Chromium (Cr)		0.002	10.7	6.2	0.0	0.001	12.1	6.2	0.0	0.000	13.4	6.2	0.0
Chloride (Cl)		0.004	7925.9	4606.8	-1.2	0.002	8916.6	4606.9	-1.1	0.001	9907.3	4607.0	-1.0
Copper (Cu)		0.015	0.5	0.3	0.3	0.009	0.5	0.3	0.3	0.003	0.5	0.2	0.2
Fluoride (F)		0.003	2915.5	1694.6	-0.4	0.002	3279.9	1694.6	-0.4	0.001	3644.4	1694.7	-0.3
Iron (Fe)		0.065	3806.8	2212.7	0.7	0.039	4282.5	2212.6	0.6	0.013	4758.1	2212.6	0.6
Lead (Pb)		0.002	5.2	3.0	0.0	0.001	5.9	3.0	0.0	0.000	6.5	3.0	0.0
Manganese (Mn)		9.5	572.9	333.0	187.0	5.7	610.0	315.2	169.2	2.0	643.3	299.2	153.2
Mercury (Hg)		0.000	6.0	3.5	0.0	0.000	6.8	3.5	0.0	0.000	7.5	3.5	0.0
Molybdenum (Mo)		0.000	90.8	52.8	0.0	0.000	102.2	52.8	0.0	0.000	113.5	52.8	0.0
Nickel (Ni)		0.159	148.2	86.1	3.1	0.096	166.1	85.8	2.8	0.033	184.0	85.6	2.6
Nitrates (NOx)		0.0003	41.3	24.0	0.0	0.0002	46.4	24.0	0.0	0.0001	51.6	24.0	0.0
Selenium (Se)		0.0023	2.5	1.4	0.0	0.0014	2.8	1.4	0.0	0.0005	3.1	1.4	0.0
Silver (Ag)		0.001	0.2	0.1	0.0	0.001	0.2	0.1	0.0	0.000	0.2	0.1	0.0
Sulfate (SO_4=)		1.53	111704.0	64926.5	12.5	0.92	125661.4	64925.3	11.3	0.32	139618.3	64924.2	10.2
Thallium (Tl)		0.000	27.5	16.0	0.0	0.000	31.0	16.0	0.0	0.000	34.4	16.0	0.0
Tin (Sn)		0.000	8.6	5.0	0.0	0.000	9.7	5.0	0.0	0.000	10.8	5.0	0.0
Vanadium (V)		0.000	452.4	262.9	-0.1	0.000	508.9	262.9	-0.1	0.000	565.5	262.9	-0.1
Zinc (Zn)		0.318	1113.3	647.1	6.1	0.192	1251.3	646.5	5.5	0.066	1389.2	646.0	5.0
Total Selected Components		13.8				8.3				2.9			
Total Tailings Cell Mass			1720468.3				1935476.7				2150479.5		

* - Assume 20% reduction per year for 5 years from historical maximum levels (190 tons per year) to final remedy estimate of 18 tons per year dry uranium material.

1. The concentration in other alternate feeds represents some selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes.
2. The range in the Uranium Material is based on three sampling events for the DMC WTP solids.
3. The estimated average concentration in Uranium Material has been calculated as the mean value reported.
4. Estimated mass in the Uranium Material is calculated by assuming 197 tons dry annually from historical values.
5. Mill tailings range and average concentrations were taken from Mill tailings samples to date, as summarized in Table 5 of the draft Statement of Basis for the Utah Groundwater Discharge Permit for the Mill (November 29, 2004).
6. Estimated current mass in Mill tailings is calculated by multiplying the estimated average concentration in the Mill tailings in Column F by 1,769,000 dry tons of tailings reported in the Mill's active Tailings Cell No. 3.
7. The baseline estimated annual mass in Mill tailings for cell 4A or 4B is calculated by multiplying the estimated mass in Cell 3 (Column G) by the ratio of Cell 4A (or 4B) total mass capacity of 2,150,000 dry tons to capacity of Cell 3 of 1,769,000 dry tons as of November 29, 2004 and dividing it by ten years as the estimated time to fill cell 4A (or 4B)
8. The baseline concentration in Cell 4A (or 4B) Mill tailings is calculated by dividing Column H by 215,000 dry tons as the assumed annual mass addition of tailings to the Cell without the Uranium Material
9. Year 1 and Year 2 estimated mass in the Uranium Material is assumed to be equal to Column D historical values.
10. The mass in Mill tailings after Uranium Material processing is calculated by adding the total tailings mass from the previous year to the total additional tailings mass added in the current year.
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13. The Year 3 and Year 4 approximate estimated mass in the Uranium Material is assumed to be 5 times the amount in Column D based on the estimated increased flow treated to be 1,000 gpm for 7 months of the year and 450 gpm for the remaining 5 months.
14. The Year 5 through Year 10 approximate estimated mass in the Uranium Material is assumed to be reduced from the maximum historical value per year to the final remedy estimate of dry Uranium Material (20 %reduction per year) after 2 years of construction.
15. The Estimated Mass in Uranium Material over 10-Year Period is the Cumulative Contribution from the Uranium Material to the tailings
16. The Estimated Mass in Cell 4A (or 4B) Mill tailings over 10-year period after Uranium Material processing is the total cumulative mass contribution from including Uranium Material to the tailings
17. The approximate percent total contributed from Uranium Material is the 10-year contribution to the tailings from the Uranium Material.

Table A-1. Total Percentage of Mass and Concentrations Contributed by Uranium Material Constituents to Tailings Over a 10-Year Period

		Final		
Component		N Estimated Mass in Uranium Material over 10-year Period (tons)[15]	O Estimated Mass in Cell 4A (or 4B) Mill Tailings over 10-year Period After Uranium Material Processing (tons)[16]	P Percent Total Contributed from Uranium Material [17]
Acetone		0.0	412.8	0.000%
Ammonia (NH_4)		0.0	6731.7	0.000%
Arsenic (As)		0.0	320.4	0.000%
Barium (Ba)		24.2	24.2	100%
Beryllium (Be)		0.1	1.2	9.24%
Cadmium (Cd)		0.1	7.4	1.77%
Calcium (Ca)		49.0	840.2	5.83%
Cobalt (Co)		3.6	134.2	2.72%
Chromium (Cr)		0.1	13.4	0.444%
Chloride (Cl)		0.1	9907.3	0.001%
Copper (Cu)		0.5	0.5	100%
Fluoride (F)		0.1	3644.4	0.003%
Iron (Fe)		2.3	4758.1	0.048%
Lead (Pb)		0.1	6.5	0.865%
Manganese (Mn)		329.4	643.3	51.2%
Mercury (Hg)		0.0	7.5	0.000%
Molybdenum (Mo)		0.0	113.5	0.000%
Nickel (Ni)		5.5	184.0	3.00%
Nitrates (NOx)		0.0	51.6	0.019%
Selenium (Se)		0.1	3.1	2.63%
Silver (Ag)		0.0	0.2	13.79%
Sulfate (SO_4=)		53.2	139618.3	0.038%
Thallium (Tl)		0.0	34.4	0.000%
Tin (Sn)		0.0	10.8	0.000%
Vanadium (V)		0.0	565.5	0.000%
Zinc (Zn)		11.0	1389.2	0.795%
Total Selected Components		479.5		0.0223%
Total Tailings Cell Mass			2150479.5	

* - Assume 20% reduction per year for 5 years from historical maximum levels (190 tons per year) to final remedy estimate of 18 tons per year dry uranium material.

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