DRAFT

Utah Division of Radiation Control
Ground Water Quality Discharge Permit
Statement of Basis
For a
Uranium Milling Facility
At White Mesa, South of Blanding, Utah

Owned and Operated by
International Uranium (USA) Corporation
Independence Plaza, Suite 950
1050 17th Street
Denver, Colorado 80265

December 1, 2004

Purpose

The purpose of this Statement of Basis (SOB) is to describe technical and regulatory basis to proposed permit requirements found in a Ground Water Quality Discharge Permit No. UGW370004, (hereafter Permit) for the International Uranium (USA) Corporation (hereafter IUC) uranium mill facility located about six miles south of Blanding, Utah on White Mesa in Sections 28, 29, 32, and 33, Township 37 South, Range 22 East, Salt Lake Base and Meridian, San Juan County, Utah.

Introduction and History

The White Mesa uranium mill was constructed in 1979-1980 and licensed under federal regulations by the Nuclear Regulatory Commission (NRC), Source Material License SUA-1358 (hereafter NRC License). Initially, the facility consisted of the mill works and one tailings disposal cell, Cell 2, which was completed in May, 1980 (2/82 D'Appolonia Consulting Engineers Report, p. 3-1). In June, 1981 construction of a wastewater storage pond, Cell 1, was completed (ibid., p. 1-1). Construction of a second tailings cell, Cell 3, was completed in September, 1982 (3/83 Energy Fuels Nuclear Report, p. 1-2). Finally, tailings disposal Cell 4A was completed in January, 1990 (5/28/99 IUC Groundwater Information Report, p. A-11). However, Cell 4A has not been used yet for tailings disposal, but instead for storage of raffinate (personal communication, Mr. Harold Roberts).

Groundwater at White Mesa is primarily found in two aquifers: a shallow unconfined or perched aquifer, and a deep underlying confined aquifer. The shallow aquifer is found almost entirely in the Cretaceous-age Burro Canyon Formation, where groundwater is perched on top of the underlying Jurassic-age Brushy Basin Member of the Morrison Formation. The Brushy Basin Member is about 200 - 400 feet thick and consists of low permeability shale and mudstone in the Blanding area (Hintze, p. 200). At White Mesa, IUC estimates that the Brushy Basin member is about 295 feet thick (7/94 Titan Environmental Report, Fig. 1.2). From information provided by IUC, the geologic contact between these two formations is found at a depth of about 78 to 149 feet below ground surface (bgs, see 9/6/02 IUC map submittal). The water table in the perched aquifer is found at shallower depths, and discharges to seeps and springs along the margin of White Mesa. Upgradient of the mill site, the perched aquifer is used for drinking water, stock watering, and irrigation. Downgradient of the mill site, the perched aquifer supports stock watering and some wildlife habitat.

The deep confined aquifer under White Mesa is found in the Entrada and underlying Navajo Sandstones. IUC estimates the top of the Entrada Sandstone at the site is found at a depth of more than 1,150 feet bgs (7/94 Titan Environmental Report, Fig. 2.3). This deep aquifer is hydraulically isolated from the shallow perched aquifer by at least two (2) shale members of the Morrison Formation, including the Brushy Basin [~295 feet thick] and the Recapture [~ 120 feet thick] Members (ibid., Fig. 1.2). Other formations are also found between the perched and deep confined aquifers, that also include many layers of thin shale interbeds that contribute to hydraulic isolation of these two groundwater systems, including: the Morrison Formation Westwater Canyon [~ 60 feet thick], and Salt Wash [~ 105 feet thick] Members, and the Summerville Formation [~ 100 feet thick] (ibid.). Artesian groundwater conditions found in the deep Entrada/Navajo Sandstone aquifer also reinforce this concept of hydraulic isolation from the shallow perched system. Regionally, the deep confined aquifer is the primary drinking water supply, and must be protected from pollution sources. A few miles south of the mill site the Ute Mountain Ute community depends on this deep confined aquifer for drinking water supply.

Between 1979 and 1997 the initial groundwater monitoring program approved by NRC for the facility examined up to 13 wells and 20 different chemical and radiological contaminants; largely collected on a quarterly basis. In 1997, after examination of the historical data, the NRC reduced the monitoring program to six (6) point of compliance (POC) wells in the perched aquifer, all found a short distance south of Tailings Cells 3 and 4A. These include IUC wells MW-5, MW-11, MW-12, MW-14, MW-15, and MW-17. At the same time the NRC reduced the number of analytical parameters to four (4) contaminants that the NRC considered dependable indicators of tailings cell leakage: chloride, nickel, potassium, and uranium. This is the same quarterly monitoring program recently used by IUC to demonstrate compliance with its NRC License.

Under the NRC approved program IUC uses an intra-well control chart method to determine compliance. This method compares recent groundwater quality results in each individual POC well with a control limit for each analyte. In practice, control limits are calculated individually for each monitoring well and analyte, based on historical or background data that has not been altered or influenced by the activity in question (EPA, February, 1989, pp. 7-1 and 7-12). Determination of non-compliance occurs when a recent concentration exceeds its individual control limit on the control chart (ibid., 7-5). Information provided by IUC shows that control limits were established under the NRC License for four analytes: chloride, nickel, potassium, and uranium (9/94 Titan Environmental Report, Appendix B). Since 1979, the Mill has not received any violation under its NRC approved groundwater monitoring program. To verify this apparent compliance, the Executive Secretary has required submittal of an historical Background Ground Water Quality Report, pursuant to Part I.H.3 of the Permit.

In May, 1999 IUC and the Utah Division of Radiation Control (DRC) commenced an annual split sampling program for groundwater monitoring wells at the White Mesa facility. This program was comprehensive in that it included all monitoring wells at the facility completed in the shallow aquifer (not just POC wells), and a large number of groundwater contaminants, including: heavy metals, nutrients, general chemistry analytes, radiologics, and volatile organic compounds (VOCs).

During the May, 1999 split sampling event excess chloroform concentrations were discovered in monitoring well MW-4, which is not a NRC POC well, found along the eastern margin of the site. Because these concentrations were above the State Ground Water Quality Standard (GWQS), the DRC initiated enforcement action against IUC on August 23, 1999 thru issuance of a Groundwater Corrective Action Order, which required completion of: 1) a contaminant investigation report to define and bound the contaminant plume, and 2) a groundwater corrective action plan to clean it up. Repeated groundwater sampling by both IUC and DRC have confirmed the presence of chloroform in concentrations that exceed the State GWQS along the eastern margin of the site in wells that appear to be upgradient or cross-gradient from the tailings cells. Other VOC contaminants have also been detected in these samples. After installation of 20 new monitoring wells at the site, groundwater studies appear to have defined the eastern and southern boundaries of the chloroform plume. IUC believes the source of this contamination was caused by laboratory wastewater disposal activities that pre-dated mill operation. While the exact number and location of all the potential chloroform sources is still not yet resolved, an experimental long-term pump test was initiated in April, 2003 to investigate one possible cleanup methodology.

While the contaminant investigation and groundwater remediation plan are not yet complete, the DRC believes that additional time is available to resolve these requirements based on the following factors: 1) hydraulic isolation found between the shallow and deep confined aquifers, 2) the large horizontal distance and the long groundwater travel times between the existing groundwater contamination on site and the seeps and springs where the shallow aquifer discharges at the edge of White Mesa, and 3) lack of human exposure for these shallow aquifer contaminants along this travel path. Upon completion of the contaminant investigation and before approval of the groundwater remediation plan, the DRC will provide a public comment period and hearing to inform the local community of the planned cleanup actions and receive comments thereon.

With all this as a backdrop, the NRC delegated its uranium mill regulatory program to the State of Utah, effective August 16, 2004. As a result, the DRC is the primary regulatory authority for the IUC White Mesa mill for both radioactive materials and groundwater protection. Shortly, the existing NRC Source Materials License will be converted to a State Radioactive Materials License (RML). In this process, this proposed Permit will replace the groundwater protection provisions of the NRC Source Materials License.

After review of the existing design, construction, and operation of the IUC facility; and after consideration of the requirements in both the Utah Water Quality Act (Utah Code Annotated 19-5) and the Ground Water Quality Protection Regulations (Utah Administrative Code R317-6), the DRC has determined that a number of changes and enhancements are required in order to meet State requirements for groundwater protection. These changes are discussed in detail below.

Major Permit Requirements

1. Groundwater Classification (Part I.A and Table 1) – was assigned by the Executive Secretary on a well-by-well basis after review of groundwater quality characteristics for the shallow aquifer at the IUC White Mesa site. A well-by-well approach was selected by the Executive Secretary in order to acknowledge the spatial variability of groundwater

quality at the IUC facility, and afford the most protection to those portions of the shallow aquifer that exhibited the highest quality groundwater. Details regarding this classification at the IUC facility are discussed below:

A. TDS Background Concentrations - the Executive Secretary has established a general policy that allows groundwater classification to be based on a statistical construct of the mean total dissolved solids (TDS) concentration plus the second standard deviation ($X+2\sigma$). Using a well-by-well approach, this $X+2\sigma$ value would be derived from available data from each individual well. Inherent in this approach is the assumption that the TDS data used for this basis is composed solely of data representative of background or natural conditions at the site, and not groundwater quality altered by the facility in question.

In determination of the background TDS concentrations, the Executive Secretary typically considers concentration trend or time series analysis. Spatial analysis of the data may also be considered to evaluate proximity of the reported concentrations to possible contamination sources. Increasing contaminant trends in individual wells, spatial contaminant distribution patterns, and other statistical considerations may be used to identify the presence of man-caused groundwater pollution at the site. These types of evaluations are especially important at existing facilities that pre-dated the 1989 promulgation of the GWQP rules; such as the IUC White Mesa site.

Evaluations of this kind will be submitted shortly by IUC in the Background Groundwater Quality Report (Part I.H.3), and reviewed by the Executive Secretary. Pending this submittal, the Executive Secretary has decided to base the well-by-well groundwater classification on the average TDS concentration available, and omit any consideration of concentration variance. This approach is conservative, in that it will result in a generally lower concentration basis for the classification decision. At some future date, when such evaluations are available and found acceptable by the Executive Secretary, the background TDS concentrations will be revised, and the Permit re-opened and modified, pursuant to Part IV.N.2 or 3 of the Permit.

B. Impact of Historic Wildlife Pond Recharge (Local Groundwater Mounds) – IUC has demonstrated that four (4) existing wildlife ponds at the White Mesa facility discharge water to the shallow aquifer, that in turn has created two (2) local groundwater mounds; one (1) each at the Northern and Southern Wildlife Ponds (see 10/15/02 IUC submittal, water level map). The existence of these groundwater mounds has been confirmed by the Executive Secretary thru both independent water level measurements and preparation of a water table contour map for the White Mesa facility for the September, 2002 split sampling event (see Attachment 1, below).

The quality of water maintained in these wildlife ponds is likely high, in that it is derived from Recapture Reservoir. Water from this reservoir is conveyed to the IUC facility via a buried pipeline, where part of the supply is used in milling operations, and another part is diverted to the wildlife ponds to support aquatic life and habitat for migrating waterfowl (personal communication, Mr. Harold Roberts, IUC). No lining system was constructed under any of the wildlife ponds (ibid.). As a result, the wildlife ponds provide a nearly constant source of high quality recharge to the shallow aquifer at the site. Therefore, it is possible that this recharge has significantly improved localized water quality conditions in the shallow aquifer; thereby encouraging a wide variability in quality conditions. This and other sources of water quality variation give rise to the need for well-by-well protection of groundwater quality at this site.

C. TDS Basis for Classification – one key element in determination of groundwater class is the TDS content of the groundwater, as outlined in the GWQP Rules, see Utah Administrative Code (UAC), R317-6-3. Groundwater quality data collected by both IUC and the DRC show the shallow aquifer at White Mesa has a highly variable total dissolved solids (TDS) content, ranging from about 600 to over 5,300 mg/l (see Attachment 2, below).

Using all available TDS data, and after calculation of average TDS concentration for 33 wells including both POC and temporary wells, the Executive Secretary determined that 16 wells at the facility appear to exhibit Class II or drinking water quality groundwater. Seventeen (17) other wells appear to exhibit Class III or limited use groundwater at the site. For details, see Attachment 2, below.

Close review of the available data shows that the historical IUC data, the recent IUC split sampling data, and the corresponding DRC split sample results are largely comparable, with a few exceptions. In the case of historical IUC well MW-19, the IUC historical TDS data (10/79 thru 5/99) produced an average TDS that was significantly lower than the average TDS based on the recent DRC or IUC split sampling data (5/99 thru 9/02). Because the older IUC data are conservatively lower, the Executive Secretary chose to rely on the older IUC TDS data to determine groundwater class for well MW-19.

D. GWQS Basis for Classification – another key element in determination of groundwater class is the presence of naturally occurring contaminants in concentrations that exceed their respective GWQS. In such cases, the Executive Secretary has cause to downgrade aquifer classification from Class II to Class III (see UAC R317-6-3.6). Historic IUC data and more recent split sampling data suggest that several groundwater contaminants may be found with concentrations above their respective GWQS in a number of wells at the site. These wells and parameters from recent split sampling are summarized in Attachment 3, below. Some of these wells with excess contaminant concentrations are associated with the on-going chloroform investigation at the east margin of the site (see 8/23/99 Ground Water Corrective Action Order). With regard to historic excess concentrations found at the site, the NRC previously deemed these to be of natural origin. While some or all of these excess concentrations may be natural, the Executive Secretary has not yet fully evaluated the available data.

For this and other reasons, the Executive Secretary has required IUC to evaluate groundwater quality data from the existing wells on site, and prepare and submit for approval a Background Groundwater Quality Report, in Part I.H.3 of the Permit. After review and approval of this report the Executive Secretary may determine the origin of these excess contaminant concentrations, and an appropriate groundwater classification(s) for the White Mesa facility.

2. Background Ground Water Quality (Part I.B, I.H.3, and I.H.4) – a significant amount of historic groundwater quality data has been collected by IUC for many wells at the facility. In some cases, these data extend back about 25 years to September, 1979.

However, the Executive Secretary has not yet completed an evaluation of the historic IUC data, particularly with regards to data quality, and quality assurance issues. Such an examination needs to include, but is not limited to: justification of any zero concentration values reported, adequacy of minimum detection limits provided (particularly with respect to the corresponding GWQS), adequacy of laboratory and analytical methods used, consistency of laboratory units of reporting, internal consistency between specific and composite types of analysis (e.g. major ions and TDS), identification and justification of concentration outliers, and implications of concentration trends (both temporal and spatial).

During the review conducted to date, several groundwater quality issues came to the attention of the Executive Secretary that also need to be addressed and resolved by the Permittee in the Background Groundwater Quality Report. Some of these issues, include the following:

A. Several Contaminants Recently Found to Exceed Respective GWQS – recent DRC split–sampling of groundwater at the IUC facility has found that several contaminants exceeded their respective GWQS during one or more of the four (4) split sampling events conducted by the DRC between May, 1999 and September, 2002. With regards to those wells considered for tailings cell monitoring, the contaminants with excess concentrations include the following (see Attachment 3, below):

1) Manganese (MW-3, MW-14, MW-32 [formerly TW4-17])

2) Nitrate (MW-4),

3) Selenium (MW-1, MW-4, MW-15, MW-17), and

4) Uranium (MW-3, MW-4, MW-14, MW-15, MW-17, and MW-18).

The exceedances found in well MW-4 appear to be related to the chloroform contamination. While the remaining exceedances may be due to natural causes, the Executive Secretary has not fully evaluated the available data, and has therefore required IUC to perform this evaluation.

B. Long-Term Increasing Uranium Trend: Downgradient Wells – while recent groundwater quality data from the last 18-months suggests a stable or decreasing trend, the long-term uranium concentrations for the last 11 to 15 years indicate an increasing trend exists in three (3) downgradient wells at the IUC facility, including: MW-14, MW-15, and MW-17 (Attachment 4, below). IUC believes that the cause for these increasing uranium trends is due to geochemical changes brought on by the effects of the groundwater mound created by the nearby wildlife ponds. While evidence to substantiate this has yet to be provided to and approved by the Executive Secretary, the exact cause for these long-term increasing trends is currently unknown, and may be due to a variety of factors that deserve further study and explanation.

C. Downgradient Uranium Spatial Concentration High - the same three (3) downgradient wells that exhibit a long term increasing uranium trend are also found near a spatial concentration high, located downgradient of Tailings Cell 4A. A fourth well, MW-3 is also found inside this concentration high and exceeds the State GWQS (30 ug/l). For details, see the uranium isoconcentration map based on September, 2002 DRC split sampling results in Attachment 5, below (DRC map U238_9-02.srf). As shown there, well MW-14 represents the maximum uranium concentration during the September, 2002 split sampling event (56.7 ug/l). It is interesting to note that the average linear groundwater velocity (hereafter velocity) found in well MW-14 is one of the highest on site, 62 feet/year (10/19/04 Hydro Geo Chem, Inc [HGC] Report, Table 1). Furthermore, well MW-14 appears to be located on an apparent preferred groundwater flow path found between it and well MW-11 which has the highest velocity at the site, 135 feet/year (ibid., and Attachment 12, DRC groundwater velocity contour map gwflowrate.srf, below).

Two other uranium concentration high points exist at the White Mesa site where uranium exceeds the State GWQS, including IUC wellsTW4-19 and TW4-11 (see Attachment 5, DRC mapU238_9-02b.srf). However, these two wells appear to be associated with the chloroform contamination plume.

The cause for the uranium concentration highs found downgradient of Cell 4A and its coincidence with an apparent preferred groundwater flow path is unknown at this time, and may be due to a variety of factors that deserve further study. These observations and others indicate that great care must be taken by the Executive Secretary in determination of background groundwater quality for the compliance monitoring wells at the site; in order to ensure that any GWCL established by Permit has not been affected by historic facility operations. As a result, a detailed evaluation of these and other ground water quality concerns was added to the Permit in Part I.H.3 (Background Groundwater Quality Report). After submittal of this report and resolution of these and other groundwater quality issues, an agreement can be reached regarding descriptive groundwater quality statistics and determination of background groundwater quality at the IUC facility. At that point, the Permit will be re-opened and the background groundwater concentrations and related compliance limits modified, see discussion below.

Because Part I.H.1 of the Permit calls for installation of several new monitoring wells around the tailings cells, background groundwater quality will also need to be determined for these monitoring points. To this end, Part I.H.4 was created to require IUC to collect at least eight (8) quarters of groundwater quality data, and submit a second report for Executive Secretary approval to establish background groundwater quality for these wells. Upon approval of this report, the Executive Secretary will re-open the Permit and establish groundwater classifications, background ground water quality concentrations, and compliance limits, as appropriate and authorized by Part IV.N.2 and 3.

3. <u>Ground Water Compliance Limits (Part I.C.1)</u> – the GWQP Rules provide for the determination of Ground Water Protection Levels (GWPLs) to be used as early-warning indicators of impending groundwater pollution. Under this approach, compliance is determined after comparison of groundwater quality monitoring results with the GWPLs in each well and for each parameter. Said GWPLs are set in the Permit after determination that the particular contaminant is detectable in groundwater at the facility, its corresponding GWQS, and its analytical Minimum Detection Limit (MDL). As provided in the GWQP Rules, these GWPLs are calculated as outlined in Table 1, below.

Because background groundwater quality at the IUC facility has not yet been approved, the Executive Secretary cannot determine if any contaminant is naturally occurring and therefore detectable or undetectable for purposes of selecting GWPLs in each well. Consequently, the Executive Secretary will initially assign the GWPLs as if they were "undetectable". After submittal and Executive Secretary approval of the existing well Background Ground Water Quality Report, pursuant to Part I.H.3, the Permit can be re-opened and the GWPLs modified, see discussion below. Accordingly, the GWPLs set today in Table 2 of the Permit were calculated by use of the classification factors, being 0.25 and 0.5 times the GWQS for Class II and III groundwater respectively.

Table 1. General Ground Water Protection Level Determinations

Groundwater Class	TDS Limit	Groundwater Protection Levels			
		Undetectable Contaminant (greatest of)		Detectable Contaminant (greatest of)	
II	1.25 * BG [1]	0.25 * GWQS	MDL [2]	1.25 * BG	0.25 * GWQS
III	1:25 * BG	0.5 * GWQS	MDL	1.5 * BG	0.5 * GWQS

Footnotes:
1) BG = background concentration
2) MDL = minimum detection limit

During a meeting of August 12, 2003, IUC staff expressed a concern with this approach in that it does not recognize spatial variability of groundwater quality in the aquifer. Accordingly, IUC asked the Executive Secretary to downgrade the aquifer classifications for the White Mesa Facility, from Class II to Class III, in order to ensure that a large enough factor is used in determination of the GWPL, so that natural temporal variations in groundwater quality at each well do not cause unnecessary non-compliance under the Permit. At the heart of this concern is the need to avoid false positive violations of the GWPLs assigned under the Permit; unnecessary groundwater monitoring and analytical costs; unneeded enforcement efforts; and undue public concern.

The Executive Secretary acknowledges these concerns, and in an effort to address them has arrived at an alternative approach to groundwater quality compliance that will recognize natural variations and still protect the groundwater resource. This approach incorporates the use of Ground Water Compliance Limits (GWCL) on a well-by-well basis, instead of GWPLs. Under the GWQP Rules, groundwater quality compliance is determined in a step-wise fashion, as follows [see UAC R317-6-6.16(A) and (B)]:

A. Accelerated Monitoring [UAC R317-6-6.16(A)] – if the concentration of a contaminant in any sample exceeds the Permit limit, then the Permittee is required to initiate more frequent groundwater quality monitoring to determine the compliance status of the facility. Because this section generically refers to a "permit limit" and not specifically to the GWPLs defined in UAC R317-6-4, the Executive Secretary has the latitude to use another basis to determine a maximum contaminant concentration for groundwater quality compliance purposes at a permitted facility.

This maximum contaminant concentration is referred to in the IUC Permit as a Ground Water Compliance Limit (GWCL), and will be defined as the mean concentration plus the second standard deviation ($X+2\sigma$). This GWCL will be defined on a well-by-well basis for each key indicator parameter required for groundwater quality monitoring at the IUC facility. On a statistical basis, and after collection of a sufficient number of samples, the $X+2\sigma$ concentration corresponds to the 95% upper confidence limit; which equates to a 2.5% (0.025) probability of any parameter in any well falsely exceeding its GWCL during any given sampling event.

B. Non-Compliance Status [UAC R317-6-6.16(B)] – the IUC facility will be considered to be out of compliance when two (2) consecutive groundwater quality samples exceed the respective GWCL (X+2σ concentration) for each well and contaminant in question. On a statistical basis, and after collection of a sufficient number of samples, this equates to a 0.062% (0.025^2) probability that any given well and parameter will twice, consecutively, falsely exceed its respective GWCL[1].

Pursuant to these considerations, Table 2 of the Permit has been structured to provide the mean concentration, the standard deviation, and the GWCL (X+2σ) for each compliance monitoring well and monitoring parameter required at the facility. The Executive Secretary believes that this approach will protect the local groundwater resource, in that it: 1) recognizes the heterogeneity in groundwater quality apparent at the White Mesa site by assigning GWCLs on a well-by-well and contaminant specific basis, and 2) allows for natural temporal variation in the groundwater quality by use of the X+2σ concentration limit.

It is important to note that the X+2σ concentration for each compliance monitoring well and contaminant must be based on the natural variance of groundwater quality at that location, and not on concentrations that have been altered by man thru pollution. This issue is especially important for facilities that pre-existed the GWQP Rules, which were adopted in 1989. For this reason, the Permit requires IUC to prepare and submit for approval a Background Groundwater Quality Report for existing monitoring wells at the facility (see Part I.H.3). After review and approval of this report, the Executive Secretary will determine the mean concentration, standard deviation, and X+2σ GWCL for each well and contaminant listed in the Permit. In the meantime, the Executive Secretary has set the GWCL concentrations in Table 2 of this Permit as the GWPL concentrations determined by the formulas outlined in Table 1, above. Three (3) exceptions to this include chloride, sulfate, and TDS, which have no corresponding GWQS and therefore require pre-determination of background concentrations for each parameter and well. Consequently, the GWCL for these three (3) parameters will be determined later after approval of the Background Groundwater Quality Report required by Part I.H.3 of the Permit. The Executive Secretary recognizes that the fractions approach used to set the GWCLs in this Permit does not account for natural variations in groundwater quality. Hence, false positives in the groundwater monitoring data may occur until the Background Groundwater Quality Report, required by Part I.H.3 is submitted, approved by the Executive Secretary and the GWCLs re-established in the Permit.

4. Number and Types of GWCL Parameters (Permit Table 2) – the process of selecting the groundwater quality monitoring parameters for the permit included examination of several technical factors. Each of these is discussed below.

A. Feedstock Materials – one source of contaminants that may be discharged from the White Mesa facility is the number and type of contaminants that might occur in feedstock materials processed at the mill. During early operation of the White Mesa mill, it is anticipated that uranium ores were primarily derived from two (2) main sources: strata-bound deposits of the Colorado Plateau region, and solution breccia pipe deposits from the Arizona Strip. Natural contaminants known to

[1] The Executive Secretary recognizes that this probability for a false positive result applies to a given parameter in a given well, and that the probability for false positives is higher when considering a group of wells that are sampled for collection of parameters in the same monitoring event.

occur in these uranium ore deposits have been determined by the U.S. Environmental Protection Agency (EPA), as summarized in Table 2, below (EPA, 1995, p. 11). From this research it appears that 12 metals are common to the uranium ores processed by the IUC White Mesa facility. Consequently, all of these metals have been listed in Table 2 of the Permit as groundwater compliance monitoring parameters.

Table 2. Reported Uranium Ore Contaminants Near White Mesa [1]

Ore Source	Known Contaminants		
Colorado Plateau (strata-bound)	Arsenic	Lead	Silver
	Chromium	Molybdenum	Vanadium
	Cobalt	Nickel	Zinc
	Copper	Selenium	
Arizona Strip (solution breccia pipes)	Copper sulfides	Lead sulfides	
	Iron sulfides	Zinc sulfides	

Footnote: 1) Data from EPA, 1995, p. 11.

Other contaminants may also have been added to the tailings waste via processing of alternate feedstocks authorized by the U.S. Nuclear Regulatory Commission (NRC). However, any evaluation made to date by the Executive Secretary regarding the number or types of contaminants that might be present in these alternate feed materials has not been considered here for inclusion as groundwater compliance monitoring parameters.

B. Process Reagents – another source of contaminants that could be discharged to groundwater from the facility include mill process reagents. Information provided by EPA for acid leach processing at conventional uranium mills has been combined with process information from IUC in Table 3, below. Quantities of reagents actually used by IUC at the White Mesa mill are listed in Table 3 in bold face type. Daily volumes of reagents actually used by IUC are summarized and ranked in Table 4, below. From this information it is clear that the tailings wastewater disposed at the IUC White Mesa mill should have an extremely low pH, and contain significant quantities of sodium, chloride, ammonia, and kerosene.

C. Source Term Abundance – some limited historic wastewater quality sampling and analysis has been done at the IUC White Mesa tailings cells. Some of this work included pre-construction laboratory bench top testing by IUC to estimate the possible contaminants that might be discharged in the tailings wastewater. The NRC also published other estimates of expected tailings wastewater chemistry. Several historical samples of the tailings effluent have been collected and analyzed by both the NRC and IUC to determine the chemical properties of the tailings wastewater for a limited number of parameters (see Attachment 6, below). Little information is available regarding organic contaminants in the tailings effluent. All information available to the DRC is summarized in Table 5, below.

Table 3. Summary of White Mesa Milling Processes and Reagents Added.

	Process Step	Actual and Potential Contaminants Added		
Uranium Milling Operations (1)	Ore Oxidation		Sodium chlorate ($NaClO_3$) **[6,000 lb/day]** (2)	
	Uranium Leaching and Clarification (3)	Sulfuric acid (H_2SO_4) **[392,000 lb/day]** (2)	Flocculants **[600 lb/day]** (2)	
	Solvent Extraction	Secondary amines with aliphatic side chains **[84 lb/day]** (4)	High molecular weight tri-alkyl amines	Quaternary ammonium compounds
		Kerosene **[1,596 lb/day]** (4)	Tributyl phosphate modifier	Long chain alcohols
	Pregnant Liquor Stripping	Chlorides (NaCl) **[15,000 lb/day]** (2)	Sulfates	
	Yellowcake Precipitation	Ammonia hydroxide (NH_3OH) **[2,000 lb/day]** (5)	Sodium hydroxide (NaOH)	
Copper Recovery (6)				
Vanadium Recovery (7)	Redox / pH Adjustment	Sodium chlorate ($NaClO_3$) **[6,000 lb/day]** (2)		
	Solvent Extraction	Kerosene **[1,596 lb/day]** (4)	Secondary amines with aliphatic side chains **[84 lb/day]** (4)	
	Pregnant Liquor Stripping	Soda Ash (Na_2CO_3) solution **[10,000 GWQS (1) lb/day]** (2)		
	Vanadium Precipitation	Ammonia hydroxide (NH_3OH) **[2,000 lb/day]** (5)		

Footnotes:

1) For additional information on common acid leach circuit processes at conventional uranium mills, see EPA, 1995, pp. 22-25.
2) Total daily pounds used of each reagent at the IUC White Mesa uranium mill is listed in brackets [], as provided in the 5/28/99 IUC report, p. A-8, Table A-1 and the 1/30/78 Dames and Moore Report, p. 3-5 and Plates 3.2-1 (uranium milling process), 3.2-2 (copper recovery), and 3.2-3 (vanadium recovery). Both of these documents detail use of manganese oxide [30,000 lb/day] in three process steps, including: 1) uranium ore oxidation, 2) uranium leaching and clarification, and 3) copper recovery (leaching). However, use of manganese oxide was listed in these original mill documents as an option in case the preferred oxidizer, sodium chlorate, was not available or was not economic. History of the mill shows that concerns about price or availability of sodium chlorate never materialized, hence manganese oxide was never used in any of these three process (personal communication, Mr. Harold Roberts, 11/15/04).
3) Also known as the uraniferous ion stabilization step (EPA, 1995, pp. 22-25).
4) Total "organic" used daily = 1,680 lb/day, of which kerosene is reported to be 95% (ibid.). DRC staff then assumed that remainder of the "organic" used in the solvent extraction circuit = amine type compounds used for anionic solvent extraction in the kerosene carrier (84 lb/day).
5) IUC reports only ammonia (NH^3) used in the yellowcake precipitation step [5/28/99 IUC report, p. A-8, Table A-1 and 1/30/78 Dames and Moore Report, p. 3-5 and Plate 3.2-1 (uranium milling process)]. However, once in an aqueous form, the ammonia likely occurs as ammonia hydroxide in solution.
6) Copper recovery was once envisioned for the White Mesa mill (1/30/78 Dames and Moore Report, pp. 3-6 and 7, and Plate 3.2-2), however it was never implemented (personal communication, Mr. Harold Roberts, 10/15/04).
7) Vanadium recovery information for White Mesa mill from 1/30/78 Dames and Moore Report, pp. 3-7 to 10, and Plate 3.2-3.

Table 4. Ranking of Reported White Mesa Mill Reagents*

Reagent	Daily Consumption (lb/day)
Sulfuric acid (H_2SO_4)	392,000
Chlorides (NaCl)	15,000
Soda Ash (Na_2CO_3)	10,000
Sodium chlorate ($NaClO_3$)	6,000
Ammonia	2,000
Kerosene	1,596
Flocculants	600
Amines (uranium extraction solvent)	84

* From Table 3, above.

Table 5. Summary of Estimated and Measured IUC Tailings Wastewater Quality

Contaminant	State GWQS (mg/L)	1979 IUC Bench-top Estimate[1] (mg/L)	1980 NRC Generic EIS Estimate[2] (mg/L)	September, 1980 – March, 2003 IUC / NRC Tailings Wastewater Samples[3] Reported Concentrations Min. (mg/L)	Max. (mg/L)	**Average (mg/L)**	Std. Dev. (mg/L)	Sample Count	Avg / GWQS Ratio
PH (std units)	6.5 – 8.5	1.8 – 2.0	2.0	0.7	2.33	1.83	0.52	16	
Nutrients (mg/l)									
Ammonia (N)	25	65	500	3.0	13,900	3,130.65	3,318.40	17	**125.2**
Nitrite (N)	10			< 100	< 100	< 100		2	
Nitrate (N)	10			24	24	24		1	2.4
Nitrite+Nitate (N)	10			17.0	49.2	30.91	12.53	12	3.1
Phosphorus-total				88.1	620	273.03	171.23	17	
TKN (N)				4,900	5,300	5,100	282.84	2	
Inorganics (mg/l)									
Bicarbonate (HCO3)	n/a			< 5	< 5	< 5		2	
Bromide				< 500	< 500	< 500		1	
Carbonate (CO3)				< 1	< 5	< 1.3		13	
Chloride	N/a	3,050	300	2,110	8,000	4,608.44	2,372.39	16	
Cyanide – total	0.2			0.022	0.022	0.02		1	0.11
Fluoride	4	1.4	5	0.02	4,440	1,694.7	1,449.21	13	**423.7**
Phosphate				< 500	< 500	< 500		2	
Silica	N/a	300		110	400	210.0	164.62	3	
Sulfate	N/a	82,200	30,000	29,800	190,000	64,913.9	48,361.6	17	
Sulfide				< 5	< 5	< 5		2	
TDS	n/a	n/a	35,000	43,100	189,000	85,960	40,645.55	17	
TOC				76.0	81	78.50	3.54	2	
TSS				31.0	115	73.00	59.40	2	
Metals (mg/l)									
Aluminum	N/a	4,260	0	330.0	2530	1,826.9	591.63	16	
Antimony	0.006			< 20	< 20	< 20		3	
Arsenic	0.05	52	0.2	0.3	440	149.1	148.18	22	**2,981.3**
Barium	2	0.3		0.021	0.10	0.048	0.02	13	0.02
Beryllium	0.004			0.347	0.78	0.502	0.13	15	**125.6**
Boron	0.6			3.5	11.3	6.9	2.83	16	11.6
Cadmium	0.005	1.7	0.2	1.64	6.6	3.4	1.58	17	**684.6**
Calcium	N/a	480	500	90.0	630	367.7	124.70	18	
Chromium	0.1	6		1.0	13	6.2	3.38	17	**61.7**
Cobalt	0.73	N/a	N/a	14.0	120	60.7	54.12	3	**83.1**
Copper	1.3	1,620	50	72.2	740	234.4	206.02	17	**180.3**
Iron	11	n/a	1,000	1080.0	3400	2,211.9	887.56	16	**201.1**
Gallium				< 30	< 30	< 30		3	
Lead	0.015	1	0.7	0.21	6.0	3.0	1.26	14	**198.1**
Lithium	0.73			< 10	< 20	< 17.5	< 5.0	4	
Magnesium	N/a	4,060		1,800	7,900	4,773.7	1,871.03	19	
Manganese	0.8	4,580	500	74.0	222	145.8	34.76	18	**182.3**
Mercury	0.002	0.001	0.007	0.0008	17.6	3.5	7.87	5	**1,760.6**
Molybdenum	0.04	7	100	0.44	240	52.8	71.17	18	**1,320.3**
Nickel	0.1	N/a	N/a	7.2	370	82.6	115.40	17	**826.1**
Potassium				219.0	828	433.1	215.70	14	
Selenium	0.05	0.56	20	0.18	2.4	1.4	0.67	18	27.0
Silver	0.1	0.06		0.005	0.14	0.1	0.10	2	0.7

Contaminant	State GWQS (mg/L)	1979 IUC Bench-top Estimate[1] (mg/L)	1980 NRC Generic EIS Estimate[2] (mg/L)	September, 1980 – March, 2003 IUC / NRC Tailings Wastewater Samples[3] — Reported Concentrations: Min. (mg/L)	Max. (mg/L)	**Average (mg/L)**	Std. Dev. (mg/L)	Sample Count	Avg / GWQS Ratio
Sodium	N/a	4,900	200	1,400	10,000	5,808.7	3,072.10	19	
Strontium	4			3.6	14	7.0	4.74	4	1.8
Thallium	0.002			0.7	45	16.0	20.54	8	**7,988.1**
Tin	22,000			< 5	< 5	< 5	#DIV/0!	3	
Titanium	150			6.5	33.3	19.1	11.70	12	0.13
Uranium	0.03	2.5		5.0	154	93.6	41.20	17	**3,120.6**
Vanadium	0.06	240	0.1	136	510	263.1	111.91	17	**4,385.3**
Zinc	5	90	80	50	1300	640.6	598.48	5	**128.1**
Zirconium				2.3	38.5	12.2	12.00	14	
Radiologics (pCi/L)									
Gross Alpha	15	250,000		14,000	189,000	120,493	50,345.1	15	**8,032.9**
Gross Beta				74	116,000	68,942	35,918.8	15	#DIV/0!
Lead-210	2.0			680	20,700	3,385	4,660.1	17	**1,692.6**
Thorium-230	18			3,650	76,640	21,748	15,394.8	18	**1,208.2**
Thorium-232	16			49	121	87	27.9	12	5.4
Polonium-210	1.0			1,410	1,410	1,410		1	**1,410**
Radium-226				40	1,690	1,027	497.2	15	
Radium-228				1.9	1.9	1.9	#DIV/0!	1	
Total Radium	5			42	1,700	942	553.2	19	**188.4**
Selected VOCs (ug/l)									
Acetone	700			28	514	192	278.4	3	0.3
Benzene	5			< 5	< 5	< 5		2	
2-butanone (MEK)	4,000			11	15.13	13.38	2.13	3	0.003
Carbon Disulfide	700			16	16	16	#DIV/0!	1	0.02
Carbon tetrachloride	5			< 5	< 5	< 5		2	
Chloroform	70			6	16.84	10.28	5.77	3	0.15
1,1-Dichloroethane	n/a			< 5	< 5	< 5		2	
1,2-Dichloroethane	5			< 5	< 5	< 5		2	
Dichloromethane	**5**			10	11	10.5	0.71	2	2.1
Tetrahydrofuran	46			n-a	n-a	n-a	n-a	n-a	n-a
Toluene	1,000			< 5	6.25	< 5.62		2	
Vinyl chloride	2			< 10	< 10	< 10		2	
Xylene (total)	10,000			< 5	< 5	< 5		2	
Selected Semi-VOCs (ug/l)									
Benzo(a)pyrene	**0.2**			< 10	< 10	< 10		2	
Bis(2-ethylhexyl)phthalate	6.0			1	1	1		3	0.2
Chrysene	48			< 10	< 10	< 10		2	
Diethyl phthalate	5,000			< 10	18.1	18.1		3	0.004
Dimethylphthalate	N/a			2.7	2.7	2.7		3	
Di-n-butylphthalate	700			1.08	1.08	1.08		3	0.002
Fluoranthene	280			< 10	< 10	< 10		2	
2-Methylnaphthalene	4			< 10	< 10	< 10		2	
Naphthalene	100			2.44	2.44	2.44		3	0.024
Phenol	4,000			< 10	38.4	38.4		3	0.01

Footnotes:
1) From May, 1979 NRC Final Environmental Statement, p. 3-11, Table 3.1. Original concentrations reported in units of gm/liter, converted here to mg/liter.
2) From September, 1980 NRC Final Generic EIS, p. M-5, Table M.3. Original concentrations reported in units of ug/liter, converted here to mg/l.
3) Based on samples collected by IUC and the U.S. NRC between September, 1980 and March, 2003. For details see Attachment 6, below.

From this information it appears that the pre-construction laboratory testing under-estimated the actual concentration of several contaminants that would accumulate over time in the tailings wastewater, including: ammonia, chloride, fluoride, TDS, arsenic, cadmium, iron, lead, mercury, sodium, uranium, vanadium, and zinc. In some cases these estimates under-predicted the average measured concentrations by 3-orders of magnitude, e.g., mercury, molybdenum, uranium, and vanadium. Other pre-construction estimates over-predicted the average measured concentrations, including: silica, barium, calcium, manganese, and gross alpha. These concentration differences are indicative of either variability of the feedstocks input to the White Mesa mill, the variability of the milling process itself, and/or recycling of process fluids from Cell 1 back into the milling process combined with the effects of seasonal evaporation. In order to better define the tailings wastewater source term concentrations and characteristics, the Executive Secretary has added a requirement to the Permit in Part I.E.8 to mandate periodic sampling and analysis of this wastewater.

Review of the available data shows that many of the tailings wastewater contaminants have had an average concentration that was 50-times greater or more than the corresponding GWQS, including (see bold values in Table 5, above): ammonia (N), 16 heavy metals (arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, thallium, uranium, vanadium, and zinc), fluoride, gross alpha, lead-210, thorium-230, polonium-210, and total radium. Of these, ammonia has been introduced as a reagent in the milling process. Of the 16 heavy metals, 11 appear to be derived from the Colorado Plateau ore feedstocks, including: arsenic, chromium, cobalt, copper, iron, lead, molybdenum, nickel, uranium, vanadium, and zinc (see Table 2, above). Manganese is also a common contaminant in Colorado Plateau ores (personal communication, Mr. Harold Roberts, 10/18/04). The beryllium, cadmium, fluoride, mercury, and thallium concentrations seen in the IUC tailings wastewater in excess of 50-times the respective GWQS, appear to be derived from Arizona Strip ores and alternate feed materials (ibid.). Based on their elevated source term concentrations, all of these contaminants should be considered as potential groundwater monitoring parameters for the White Mesa facility.

As for organic contaminants that might be found in the tailings wastewater, kerosene is probably the most significant in terms of IUC's reported daily mill consumption, about 1,600 lb/day, see Tables 3 and 4, above. Kerosene is a mixture of many petroleum distillates, generally composed of hydrocarbons in the range of C_9 to C_{16} (Risher and Rhodes, p. 105). Researchers who have studied environmental releases of kerosene to groundwater have recommended use of several groundwater monitoring parameters, including: benzene, toluene, xylenes (ortho, meta, and para), ethylbenzene, naphthalene, etc (Thomas and Delfino, p, 96). These VOCs generally constitute the most soluble components of kerosene (Deutsch and Longmire, Chp. 10, p. 19). Of these compounds, all have been detected in groundwater at IUC in the area associated with the on-going chloroform investigation, with the exception of ethylbenzene, see discussion below. It is also important to note that these and other aromatic hydrocarbons commonly comprise about 10-20% of the total content of kerosene, (Risher and Rhodes, p. 105). On its own merits, naphthalene has been found to constitute about 3% of kerosene by volume (ibid., p. 107). Based on this information, the Executive Secretary has decided to add four (4) of these VOCs as groundwater monitoring and compliance parameters in Table 2 of the Permit: benzene, toluene, xylenes (total), and naphthalene.

D. Contaminant Mobility – during selection of the groundwater monitoring parameters to be required by the Permit, it is important to consider a contaminant's ability to travel in a groundwater environment. For most contaminants this is controlled by its soil-water partitioning (K_d) coefficient. Ideally these K_d values are determined independently for each Permitted facility, using laboratory or field-scale tests with site-specific groundwater and soils and/or aquifer materials. In cases where site-specific K_d information is not available, the Executive Secretary has set a precedence of using the lowest K_d values available in the literature to represent the site in question. A summary of literature K_d values is found in Attachments 7 and 8, below.

1) Anionic Contaminants – anions generally exhibit very low K_d values and need to be considered as groundwater monitoring parameters at the IUC facility. These anions include: chloride, fluoride, and sulfate. Chloride is currently a groundwater monitoring parameter required under the NRC license, and has been included as a compliance monitoring parameter in Table 2 of the Permit.

Fluoride, as mentioned above, has been found in the tailings wastewater with an average concentration that is more than 400-times its respective GWQS, and therefore is also included as a GWCL parameter.

Sulfate is a byproduct of the large daily volumes of sulfuric acid used in the uranium leaching stage of milling (see Table 3, above, and EPA, 1995, p. 22). As a parent contaminant, sulfuric acid is the most predominant reagent used in the mill where it is consumed at a rate of 392,000 lb/day (see Table 4, above). Accordingly, sulfate is extremely abundant in the IUC tailings wastewater with an average concentration of almost 65,000 mg/l (see Attachment 6, below). At this average level, sulfate is more than 14-times more abundant in the tailings wastewater than chloride, which has been a historical groundwater monitoring parameter under the NRC license.

2) Heavy Metals – of the heavy metals known to exist in uranium ores, all were found to have a lowest literature K_d value of less than 2.0 l/kg, with the exception of lead (4.5 l/kg) and vanadium (50 l/kg), see Attachment 7, below. However, after consideration of the high acid conditions found in the tailings wastewater, with an average pH of 1.83, all these heavy metals could easily stay in solution and not partition on aquifer materials. To date, no information has been provided by IUC regarding site-specific K_d data for White Mesa soils and rock. Neither has any quantitative, site-specific information been submitted regarding the bulk or trace mineral composition of soils and bedrock at the site that could provide buffering capacity for any low-pH tailings solutions. Consequently, the Executive Secretary believes it is not appropriate to eliminate any of the uranium ore related heavy metals as groundwater compliance monitoring parameters. Therefore, 14 ore related metals were included in the Permit as GWCL

parameters, including: arsenic, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, uranium, vanadium, and zinc.

Four (4) other heavy metals found in the IUC tailings wastewater appear to be derived from Arizona Strip ores and alternate feed materials, including: beryllium, cadmium, mercury, and thallium. All four (4) of these metals have average tailings wastewater concentrations in excess of 50-times the respective GWQS, ranging between 126-times (beryllium) to 7,988-times (thallium), see Attachment 6, below. Literature low K_d values for these four (4)metals also vary widely, ranging from 0.0 l/kg (thallium) to 322 l/kg (mercury). Again, based on the high acid environment known to exist in the tailings wastewater and the unknown buffering potential expected in the subsurface formations, the Executive Secretary believes it prudent to include all of these four (4) metals as GWCL parameters in the Permit (Table 2).

In the future, IUC may provide additional site specific information regarding contaminant K_d values, and soil and aquifer geochemical composition and buffering capacity information as a part of the contaminant transport modeling report required by Part I.H.11. After review and approval of this supporting information and the report, the Executive Secretary will re-evaluate the need to retain all heavy metals listed above as GWCL parameters.

3) Volatile Organics in Tailings Wastewater – at least five (5) volatile organic contaminants (VOC) have been found in the tailings wastewater, including acetone, 2-butanone (methyl ethyl ketone or MEK), chloroform, naphthalene, and toluene (see Attachment 6, below). None of these contaminants exceeded their respective GWQS. However, relatively significant concentrations of acetone were detected.

The possible source term for naphthalene and toluene may be the large daily volumes of kerosene used in the solvent extraction circuit, see Tables 3 and 4 above. Research by others has found that aromatic hydrocarbons, such as benzene and related compounds (toluene, xylenes, etc.), commonly constitute 10-20% of kerosene fuel oil (Risher and Rhodes, p. 105). By itself, naphthalene has also been found to constitute about 3% of kerosene by volume (ibid., p. 107). Naphthalene and toluene have also been found to have low K_d values, 0.398 and 0.009 L/Kg, respectively (see Attachment 8). These data support the use of naphthalene and toluene as groundwater compliance monitoring parameters under the Permit.

As for the remaining tailings wastewater VOCs, the source term may be wastewater from the mill's on-site laboratory, which began operation in 1977, but did not begin to discharge to Tailings Cell 1 until June, 1980 (9/30/99 IUC Report, p. 6). These remaining VOC's also have very low literature K_d values of 0.001, 0.015, and 0.024 L/Kg for acetone, 2-butanone, and chloroform, respectively.

Unfortunately, the IUC VOC data in question is not considered representative of actual field wastewater conditions in the tailings disposal cells, for several reasons, including

a) Single Sample – the data available is derived from only 1 sample collected from the slimes drain, and may not be representative of concentrations in all the tailings cells over the operating history of the facility (see Attachment 6, page 2),

b) Unknown Sample Date - no sample date was provided for the IUC sample. Consequently, it is difficult to know just when in the history of the facility the sample was collected, and

c) Missing Sample Information - no information was available regarding how the sample was collected, preserved, and analyzed.

Based on this lack of source term characterization, the Executive Secretary took a conservative approach and has required all five (5) of these VOC's as GWCL parameters in Table 2 of the Permit. Furthermore, a compliance schedule item has been added to the Permit to require IUC to better characterize the tailings wastewater quality conditions, see Parts I.E.8 and I.H.5.

4) Volatile Organics Found in Site Groundwater – 13 volatile compounds have been found in detectable concentrations in IUC groundwater since May, 1999, see Attachment 9, below. Of these, 12 were organic compounds including: six (6) chlorinated solvents, five (5) petroleum distillates, and one (1) non-chlorinated organic solvent (tetrahydrofuran). Of these 12 VOCs, all appear to have very low K_d values, ranging from 0.009 (tetrahydrofuran) to 0.398 (naphthalene) L/Kg, and would therefore be very mobile in a groundwater environment, see Attachment 8. Consequently, if any of these contaminants have potential to be found wastewaters generated at the IUC facility, they should be considered as GWCL parameters under the Permit.

a) Chlorinated Solvents - the source term for the chlorinated solvents may have been pre-operational laboratory wastewaters discharged to septic tank leachfields at the mill site. Since about June, 1981 these wastewaters have been discharged to Tailings Cell 1. Of these six (6) chlorinated solvents, three (3) have been found with groundwater concentrations that exceed their respective GWQS, including: chloroform, carbon tetrachloride, and dichloromethane (see Attachments 3 and 10, below). In order to ensure an adequate characterization is completed and to better coordinate groundwater monitoring for both the tailings cells and the chloroform investigation, all three of these chlorinated VOCs were included as groundwater monitoring parameters in Table 2 of the Permit.

b) Petroleum Distillates - for the five (5) petroleum distillates detected in site groundwater, all are aromatic hydrocarbons, with four (4) derivatives of benzene (benzene, toluene, xylene, and 1,2,4-trimethylbenzene), and one (1) polynuclear aromatic (naphthalene). As discussed above, the source term for these compounds may be small quantities of kerosene found in laboratory wastewater discharged historically to septic tank leachfields. Large quantities of kerosene are also used in the mill's solvent extraction circuit and are discharged to the tailings cells. Of these five (5), only one (1), benzene, has been found in excess of its 5 ug/l GWQS (see Attachment 10, below). For reasons discussed above, toluene, and naphthalene were added to the Permit as groundwater monitoring parameters. However, because benzene and xylene are also related to kerosene, and have been detected in groundwater at the facility; these compounds have also been added as GWCL parameters in Table 2 of the Permit. For the time being 1,2,4-trimethylbenzene was omitted as a monitoring parameter. However, should it be necessary it can be added to the Permit later under provisions found in Part IV.N.3.

c) Tetrahydrofuran - detectable concentrations of tetrahydrofuran (THF) have been found in four (4) wells at the facility, including up gradient well MW-1, and downgradient wells MW-2, MW-3, and MW-12 (see Attachment 10, below). Two (2) of these wells have THF concentrations that exceed the State GWQS (46 ug/l), including upgradient well MW-1 and downgradient well MW-3 (ibid.). The two (2) other downgradient wells, MW-2 and MW-12, exhibited detectable THF concentrations that did not exceed the GWQS.

As a part of the chloroform contaminant investigation, DRC staff asked IUC to evaluate possible sources of THF at the facility (1/22/02 DRC Request for Additional Information, p. 3) In response, IUC claimed that this organic solvent may have been derived from PVC glues and solvents used during construction of the PVC well casings found in several monitoring wells at the facility (12/20/02 IUC Letter, p. 2). This claim appears consistent with the occurrence of THF in both up and downgradient wells. However, further evaluation is required to determine why three (3) other IUC wells installed at the same time do not exhibit detectable THF concentrations, including lateral gradient well MW-4, and downgradient wells MW-5, and MW-11.

THF is a contaminant of concern, in that one of its major use is as a Grignard reagent in the synthesis of motor fuels (National Library of Medicine [NLM] Hazardous Substances Data Bank). Therefore, it may be possible that THF is a trace contaminant in petroleum products such as kerosene, which is used in large quantities at the White Mesa mill (see Table 3, above). Further, THF has unique chemical properties in that it is soluble in both water and hydrocarbons. Because it has a high water solubility, THF may be a very mobile groundwater contaminant.

During preparation of the Permit, IUC offered to: 1) continue monitoring THF in all the monitoring wells at the facility, 2) include THF as part of the routine tailings wastewater sampling and analysis, 3) submit a work plan for additional study and 4) complete the study and report the results thereof to resolve this issue. Accordingly, a condition has been added to the Permit's compliance schedule in Part I.H.19. If after review and approval of this report, the Executive Secretary determines that THF is not a result of mill operations, then the Permit will be re-opened and modified to remove it as a groundwater compliance monitoring parameter (Table 2).

5) Semi-VOCs Found in Tailings Wastewater – IUC has detected five (5) semi-VOC contaminants in tailings cell wastewater, including: bis(2-ethylhexyl)phalate; diethyl phthalate; dimethylphthalate; di-n-butylphthalate; and phenol (see Attachment 6, below). Four (4) of these compounds may be mobile in groundwater environments, based on their estimated K_d values, including: diethyl phthalate (0.07 L/Kg); dimethylphthalate (0.04 L/Kg); di-n-butylphthalate (0.16 L/Kg); and phenol (0.016 L/Kg), see Attachment 8, below. However, none of these semi-VOC contaminants were included as compliance monitoring parameters in the Permit, for the following reasons:

a) Several VOC contaminants have already been proposed as compliance monitoring parameters that have lower K_d values than the semi-VOC parameters in question. Examples of these include, but are not limited to: acetone, chloromethane, dichloromethane, and toluene. Consequently, these VOC parameters should be detected at the compliance monitoring well before any arrival of the semi-VOC contaminants.

b) Focusing on the VOC contaminants will streamline groundwater monitoring efforts and reduce associated sampling and analysis costs for both IUC and the Executive Secretary,

c) The Executive Secretary can add new compliance monitoring parameters at any time, if needed to protect human health and the environment, pursuant to Part IV.N.3 of the Permit.

6) Semi-VOCs Found in Site Groundwater – only one (1) split sampling event included analysis of semi-VOC parameters, May, 1999. During this event which was conducted as a part of the chloroform investigation, only one (1) semi-VOC contaminant was detected in the IUC set of groundwater samples at the White Mesa facility, including: Bis(2-ethylhexyl)phthalate. Unfortunately, a problem with a laboratory blank forced the DRC to discount all its split sample results for this parameter. Follow-up sampling for semi-VOCs was not undertaken by DRC staff, primarily because the VOC contaminants detected are known to generally be much more mobile in groundwater environments. The Executive Secretary will continue with this approach to semi-VOC contaminants as compliance monitoring parameters under the Permit.

E. Contaminant Persistence / Transformation – the transformations or decay of contaminants that would alter the physical properties or reduce the concentration of contaminants found in the tailings wastewater is another key consideration in selection of contaminants for groundwater monitoring. In cases where a contaminant is transformed to a reaction or decay product, it may be preferable to monitor groundwater quality for the degradation products instead of the parent contaminant. Several tailings wastewater contaminants were examined with respect to their persistence in groundwater environments. Each of these parameters are discussed below:

1) Nitrate and Nitrite – both of these compounds are oxidation or degradation products of ammonia, which is one of the top six (6) reagents added during the milling process (see Table 4, above). As anions, both nitrate and nitrite are readily mobile in groundwater environments. For these reasons, Nitrate + Nitrite (as N) was added to the list of groundwater compliance monitoring parameters in Table 2 of the Permit.

2) Chloroform Daughters – chloroform has been found both in the tailings wastewater (see Attachment 6) and in shallow groundwater primarily in the area of the chloroform investigation (see Attachment 3) at the site. As a result, the Executive Secretary has added this volatile organic compound (VOC) to the list of required groundwater monitoring parameters in Table 2 of the Permit. Under anaerobic conditions, chloroform is degraded to dichloromethane (or methylene chloride) and then to chloromethane (see Pankow and Cherry, p. 80). Both of these daughter products have low soil K_d values of 0.10 and 0.06 L/Kg, respectively (see Attachment 8). For these reasons, all three (3) of these VOCs have been required for groundwater monitoring at the facility after addition to Table 2 of the Permit.

F. Detectability – the ability of common environmental laboratory equipment and technology to detect and quantify contaminant concentrations in groundwater is another important issue to consider when selecting parameters for groundwater compliance monitoring. Executive Secretary review has found that standardized, EPA approved laboratory methods are available to provide minimum detection limits that are lower than the GWQS discussed below for each compliance monitoring parameter.

5. Ground Water Quality Standards (Permit Table 2) – the Executive Secretary has determined GWQS for each of the groundwater compliance monitoring parameters listed in Table 2 of the Permit. The source or reference for each of these contaminant's GWQS is discussed below.

Nutrients and Inorganics

A. Ammonia (as N) – the 25 ug/l ad-hoc GWQS found in Table 2 of the Permit was derived from a 30 ug/l EPA final drinking water lifetime health advisory (LHA) for ammonia (NH_3) [see EPA, Summer, 2002, p. 8]. This value was then converted to an equivalent concentration for ammonia as nitrogen (NH_3 as N), as follows:

$$\text{NH3 (as N) GWQS} = \text{NH3 GWQS} * \frac{\text{Atomic Weight of N}}{\text{Atomic Weight of NH3}}$$
$$= 30 \text{ mg/l} * 14.0067 / [14.0067 + 3 * 1.0079)]$$
$$= 30 \text{ mg/l} * 14.0067 / 17.0304$$
$$= 24.67 \text{ mg/l, round to 25 mg/l.}$$

B. Fluoride – the 4.0 mg/l value is a promulgated GWQS under the Utah GWQP Rules found in UAC R317-6-2, Table 1.

C. Nitrate + Nitrite (as Nitrogen) – the 10 mg/l GWQS comes directly from the Utah GWQP Rules found in UAC R317-6-2, Table 1.

Metals

D. Arsenic – the 50 ug/l GWQS comes from the Utah GWQP Rules found in UAC R317-6-2, Table 1. However, the EPA drinking water final maximum concentration limit (MCL) has been recently changed to 10 ug/l (see EPA, Summer, 2002, p. 8). At some point in the future, the Executive Secretary may re-open the Permit and revise this GWQS accordingly, pursuant to Part IV.N.1.

E. Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Selenium, Silver, and Thallium – all of these GWQS come from the Utah GWQP Rules found in UAC R317-6-2, Table 1.

F. Cobalt and Iron – the ad-hoc GWQS for these two (2) metals, 730 and 11,000 ug/l, respectively, were derived from the tap water concentration limits found in the EPA Region 3 Superfund Risk Based Concentration (RBC) Table. This EPA reference is available on the Internet at http://www.epa.gov/reg3hwmd/risk/index.htm.

G. Manganese – the 800 ug/l ad-hoc GWQS was derived from an ad-hoc drinking water LHA provided by EPA Region 8 (see 1/4/00 EPA Region 8 letter, p. 1). In turn, this LHA was based on the most current reference dose (RfD) in the EPA Integrated Risk Information System (IRIS) database.

H. Molybdenum and Nickel – the ad-hoc GWQS of 40 and 100 ug/l, respectively, were derived from EPA final LHA for these metals (see EPA, Summer, 2002, p. 8).

I. Uranium – the 30 ug/l ad-hoc GWQS was derived from a final EPA drinking water MCL (see EPA, Summer, 2002, p. 8). This MCL was re-affirmed by the United States Court of Appeals on February 25, 2003 (see District of Columbia Circuit, Docket No. 01-1028, etc, p. 49).

J. Vanadium – an ad-hoc GWQS of 60 ug/l was calculated by DRC staff with the assistance of Mr. Bob Benson, EPA Region 8 drinking water toxicologist using an EPA RfD for vanadium pentoxide (V_2O_5) of 9 ug/kg/day (see 7/18/96 Utah Department of Environmental Quality [DEQ] Information Needs Summary, Table 1, Footnote 5).

K. Zinc – the 5,000 ug/l ad-hoc GWQS comes directly from the Utah GWQP Rules found in UAC R317-6-2, Table 1. However, the final EPA drinking water LHA is currently 2,000 ug/l (see EPA, Summer, 2002, p. 9). Consequently, the Executive Secretary at some point may re-open the Permit and adjust the zinc GWQS accordingly, pursuant to Part IV.N.1.

Radiologics

L. Gross Alpha – this 15 pCi/l GWQS is directly from the Utah GWQP Rules found in UAC R317-6-2, Table 1.

VOC Contaminants

M. Acetone – the 0.7 mg/l (700 ug/l) ad hoc GWQS was derived from lifetime health advisory calculations by Utah DWQ staff, with the assistance of Mr. Bob Benson, EPA Region 8 Drinking Water Program Toxicologist. For additional details, see the August 8, 1994 DWQ Report (pp. 3-5 and Attachment 1). This 700 ug/l value was based on an oral exposure reference dose (RfD) from the EPA Integrated Risk Information System (IRIS) database of 0.1 mg/kg/day. This same ad hoc GWQS has been used at another 11e.(2) waste disposal facility in Utah.

N. Benzene, Carbon Tetrachloride, Toluene, and Xylenes (total) – the GWQS values for all of these contaminants came from the Utah GWQP Rules found in UAC R317-6-2, Table 1.

O. 2-Butanone (MEK), Chloromethane (Methyl Chloride), and Naphthalene – these ad hoc GWQS are based on final EPA drinking water LHA for 2-butanone [4 mg/l or 4,000 ug/l]; chloromethane [0.03 mg/l or 30 ug/l]; and naphthalene [0.1 mg/l or 100 ug/l], see EPA, Summer, 2002 (pp. 2, 5, and 6).

P. Chloroform –previously the Executive Secretary relied on an EPA drinking water MCL for total trihalomethanes, which includes chloroform and 3 other VOC contaminants, to establish an ad hoc GWQS for chloroform (0.8 mg/l). However, recently DRC staff became aware of a new and discrete chloroform RfD established in the EPA IRIS database. With the help of EPA Region 8 toxicology staff, an ad hoc drinking water LHA of 0.7 ug/l was established for chloroform on the basis of the compound's non-cancer risk (see 5/29/03 EPA memorandum). Later this value was approved for use at the IUC White Mesa facility by the Utah DWQ (see 6/12/03 DWQ Memorandum).

Q. Dichloromethane (Methylene Chloride) – this ad hoc GWQS was derived from a final EPA drinking water MCL (see EPA, Summer, 2002, p. 3).

R. Tetrahydrofuran – the 0.046 mg/ (46 ug/l) ad hoc GWQS for tetrahydrofuran (THF) is based on an ad hoc EPA Region 8 drinking water LHA (see 8/24/99 EPA Region 8 memorandum). In turn, the EPA ad hoc LHA was based on a provisional oral cancer slop factor of 7.6E-3 mg/kg/day. From calculations provided by EPA Region 8, three values of cancer risk and corresponding THF concentrations were determined, as summarized in Table 6, below. After review of these data, the Executive Secretary has determined that the mid-range value, 46 ug/l, is appropriate as an ad hoc THF GWQS for the IUC White Mesa site, based on the following findings:

1) Groundwater Classification – the shallow aquifer consists of a combination of Class II (drinking water quality) and Class III (limited use quality), and

2) Lack of Current Use for Drinking Water – review of nearby groundwater use has shown that no existing groundwater supply wells or springs are currently found downgradient of the IUC facility on White Mesa that exclusively use the shallow aquifer for drinking water.

Table 6. Summary of Tetrahydrofuran Cancer Risk And GWQS Concentrations

Cancer Risk	THF Concentration [1]	
	(mg/l)	(ug/l)
1:10,000	0.46 mg/l	460
1:100,000	0.046	46
1:1,000,000	0.0046	4.6

Footnote:
1) From 8/24/99 EPA Region 8 memorandum by Robert Benson.

6. Future Monitoring Wells (Permit Table 2 and Part I.H.1) – recent water table contour maps of the shallow aquifer have identified a significant westerly component to groundwater flow at the White Mesa facility, see Attachment 1, below. This change in groundwater flow directions appears to be the result of wildlife pond seepage and groundwater mounding discussed above. As a consequence, new groundwater monitoring wells are necessary at the IUC facility, particularly along the western margin of the tailings cells. New wells are also needed for Discharge Minimization Technology (DMT) purposes that provide discrete monitoring of each tailings cell, as discussed below. During meetings in August, 2003 and February, 2004, IUC proposed the installation of these new groundwater monitoring wells near the tailings cells, as summarized in Table 7. Later, IUC submitted a map to confirm the locations of these new wells, see Attachment 11, below:

Table 7. Summary of Proposed IUC Monitoring Well Locations

Well ID	Approximate Location
MW-23	Near southwest corner of Tailings Cell 3
MW-24	Near southwest corner of Tailings Cell 1
MW-25	Near southeast corner of Tailings Cell 3
MW-26	Near northeast corner of Tailings Cell 2 (existing chloroform investigation well TW4-15)
MW-27	Near northeast corner of Tailings Cell 1
MW-28	Near mid-point of south dike at Tailings Cell 1
MW-29, MW-30, and MW-31	Spaced approximately equidistant on south dike of Tailings Cell 2
MW-32	Near southeast corner of Tailings Cell 2 (existing chloroform investigation well TW4-17)

These general locations were found acceptable. If after review of the hydrogeologic report required by Part I.H.2 of the Permit, the Executive Secretary determines additional information is needed, IUC will be asked to provide more information. The short 60-day compliance schedule for IUC to install the new wells after Executive Secretary approval of the plan was set in order to expedite both the collection of groundwater quality information from these new wells, and preparation and submittal of the new well Background Groundwater Quality Report (Part I.H.4).

7. Revised Hydrogeologic Report (Part I.H.2) – after installation of the new monitoring wells required by Part I.H.1, it will be important to evaluate the new hydrogeologic information collected, and consider it in context with existing information collected to date at the facility. In order to ensure evaluation is done and easily tracked by both IUC and DRC, the Executive Secretary added this requirement to Part I.H.2. At a minimum, the following types of hydrogeologic information will be included in the Revised Hydrogeologic Report:

   A. Monitoring Well As-Built Information – including geologic logs, well completion diagrams, and aquifer hydraulic analysis as required by Part I.F.5 of the Permit,

   B. Revised Structural Contour Map – of the geologic contact between the Brushy Basin Member of the Morrison Formation, and the overlying Burro Canyon Formation.

   C. Aquifer Saturated Thickness Map – including a contour map to illustrate the local distribution of the thickness of the perched aquifer.

   D. Water Table Contour Map – based on groundwater elevation measurements of all wells and piezometers at the site to illustrate local groundwater flow directions.

   E. Historic Aquifer Permeability Data – aquifer permeability data collected from the new monitoring wells needs to be evaluated in context with existing slug and/or aquifer pump test analysis to determine if any preferred groundwater flow pathways exist.

   F. Multi-well Aquifer Test Results – long-term any new multi-well aquifer testing done to determine local hydraulic properties, including permeability, needs to be included. One purpose of this testing would include determination if any preferred directions of groundwater flow exist at the facility, i.e., aquifer permeability heterogeneity and anisotropy. .

   G. Aquifer Permeability Distribution Map – based on all reliable and representative aquifer permeability available to date, IUC will provide a contour map to illustrate the distribution of permeability of the perched aquifer at the site.

   If after review of the Revised Hydrogeologic Report it is determined that additional information is needed, the Executive Secretary will ask IUC to provide it.

8. Tailings Cells Operations Limits and Prohibited Discharges (Parts I.C.2 and I.C.3) – these requirements have been added to the Permit to confirm that only 11e.(2) byproduct material, including various wastes listed by NRC, may be disposed of in the Mill's tailings cells.

9. Tailings Cell Discharge Minimization Technology and Authorized Design and Construction (Parts 1.D.1 and 2) –information provided by IUC shows that Tailings Cells 1, 2, and 3 were constructed more than 20 years ago, as summarized in Table 8, below:

Table 8. Summary of Tailings Cell Completion Dates

Tailings Cell	Completion Date	Reference
1	June 29, 1981	5/28/99 IUC Groundwater Information Report, p. A-11
2	May 3, 1980	2/82 D'Appolonia Engineers Construction Report, p. 3-1
3	September 15, 1982	3/83 Energy Fuels Nuclear Construction Report, p. 1-2
4A	November 30, 1989	8/00 IUC Construction Report, p. 1

After review of the existing design and construction and consultation with the DWQ, the Executive Secretary has determined that the Discharge Minimization Technology (DMT) required under the GWQP Rules [UAC R317-6-6.4(C)(3)] for IUC disposal Cells 1, 2, and 3 that pre-dated the 1989 GWQP Rules will be defined by the current or existing disposal cell construction, with a few modifications. This approach is reasonable, practical, and acceptable for the following reasons:

A. Existing Conditions – Tailings Cells 1, 2, and 3 have been in existence in their current state for more than 20 years. Over the course of this time, a significant amount of tailings have been disposed in Cells 2 and 3.

B. Current Stage in Design Life – Tailings Cell 2 has nearly reached its maximum waste height and capacity, in that temporary soil cover has been advanced over 99.8% of the disposal cell. As a result, the remaining disposal capacity in Cell 2 is only about 5,000 dry tons out of 2,352,000 dry tons of total design capacity (personal communication Harold Roberts, IUC) . At Tailings Cell 3, about 67% of the total design capacity has already been used (1,825,000 out of 2,725, 000 dry tons total), and temporary soil cover has been advanced over about 40% of the cell (ibid.).

C. Retrofit Construction Impractical – due to the advanced age of the disposal Cells 2 and 3 and their near-full capacity, little can be done to retrofit, re-construct, or modify the under liner systems.

The improvements required under DMT for Tailings Cells 1, 2 and 3 will focus on changes in monitoring requirements, and on improvements to facility closure, if needed. The goal for these changes is to ensure that potential wastewater losses are minimized and local groundwater quality is protected. These changes include:

D. Improved Groundwater Monitoring – improvements to the existing monitoring well network are needed to meet the following performance goals:

1) Early Detection – the ability to detect a release as early as practicable is important, and is accomplished by locating wells immediately adjacent to and downgradient of each disposal cell. To satisfy this requirement the Executive Secretary has required three new DMT monitoring wells (MW-24, MW-27, and MW-28) be installed immediately adjacent to Cell 1, see Part I.H.1.

2) Discrete Monitoring – the ability to individually monitor each disposal cell at the facility is also important to allow the Executive Secretary to pin point the source of any groundwater contamination that might be detected. The DMT monitoring wells required for Cell 1 in Part I.H.1 will help meet

this requirement. Also, IUC will be required to install three (3) additional monitoring wells between Cell 2 and 3 to allow discrete monitoring of Cell 2 (MW-29, MW-30, and MW-31).

E. Operational Changes and Improved Operations Monitoring – changes to disposal cell operation that can increase efforts to minimize potential seepage losses, and thereby improve protection of local groundwater quality are also important. Related requirements for monitoring are also added to confirm that these changes are in place and are actively being used by IUC. Examples of some of these changes include:

1) Maximum Waste and Wastewater Pool Elevations – imposed in Part I.D.3 for all the tailings cells and Roberts Pond to require that IUC continue to ensure that impounded wastes and wastewaters are held and maintained over a flexible membrane liner (FML).

2) Slimes Drain Maximum Allowable Head – required for Tailings Cells 2 and 3 in Part I.D.3(b) to ensure that IUC provides constant pumping efforts to minimize the accumulation of leachates over the FML, and thereby minimize potential FML leakage to the foundation and groundwater. This requirement was immediately imposed in the Permit for Cell 2, because IUC is already actively dewatering that cell. Imposition at Cell 3 was delayed by the Executive Secretary in response to IUC arguments that premature slimes drain pumping poses a risk that the layer will plug with sulfate salts during tailings cell operation, and not be available for slimes de-watering when IUC is ready to advance a cover over the tailings cell. Such untimely loss of the slimes drain layer would greatly complicate and delay cover construction, and in turn increase the overall potential for leachates to be released from the final waste embankment. Details as to an appropriate average wastewater head in the slimes drain layer at both Cells 2 and 3 are to be proposed by IUC and approved by the Executive Secretary in development of a DMT Monitoring Plan required by Part I.H.13 of the Permit.

3) Feedstock Storage – in order to constrain and minimize potential generation of contaminated stormwater or leachates the Permit requires IUC to continue it existing practice of [see Part I.D.3(d)]: 1) limiting open air storage of feedstock materials to the historical storage area found along the eastern margin of the mill site (as defined by the survey coordinates found in Permit Table 5), and 2) maintaining water-tight containerized storage of feedstock material found anywhere else at the IUC facility.

4) Mill Site Reagent Storage – is of potential concern for groundwater quality in the event that reagent storage tank leaks or spills could release contaminants to site soils or groundwater. In an effort to prevent this possible problem, and provide proper spill prevention and control, Part I.D.3(e) requires IUC to demonstrate that it has adequate provisions for spill response, cleanup, and reporting for reagent storage facilities, and to include these in the Stormwater Best Management Practices Plan. Content of this plan is stipulated in Part I.D.8, and submittal and approval of the plan required under Part I.H.17.

At new facilities, the performance goal for secondary containment should include prevention of spills from contacting the ground surface. During discussion with IUC, the company responded that this was impractical in that the existing reagent storage facilities had been in existence for decades. Further, IUC contended that: 1) secondary containment had been designed and constructed at each of the existing reagent storage facilities, albeit it earthen lined, 2) any soils affected by spills could be easily excavated and disposed in the tailings cells should a spill occur, 3) after removal of the soils affected by major spills, new construction could be completed to replace and restore the secondary containment; which at that time could meet the new performance criteria for prevention of ground contact, and 4) any required improvements for chemical reagent storage should focus on changes to operational and/or spill response measures, and not on re-design or re-construction of these facilities. Because the IUC facility is a pre-existing operation under the Ground Water Quality Protection Regulations, DRC staff agreed with these arguments, and wrote the requirements of Part I.D.3(e) accordingly. However, should any of the existing reagent storage facilities be re-built, provisions were added to the Permit to require the higher standard at re-construction, that being secondary containment that would prevent contact of any spill with the ground surface.

F. Evaluation of Tailings Cell Cover System Design –cover system design and construction needs to be evaluated in order to ensure that infiltration into the tailings waste is minimized and groundwater quality protected during the post-closure period. To this end, Part I.H.11 of the Permit requires IUC to submit an Infiltration and Contaminant Transport Modeling report for Executive Secretary review and approval. After review of this report, the Executive Secretary will determine if any changes are need in the proposed cover system. Minimum cover system performance criteria are stipulated in Part I.D.6 of the Permit.

10. Existing Tailings Cell Design / Construction Findings –during review of the existing tailings cell design and construction the Executive Secretary found that construction documentation for Tailings Cell 1 is limited to one (1) as-built report dated February, 1982 by D'Appolonia Consulting Engineers (p. 3-1). In this report the as-built information is limited to only a topographic map of the Cell 1 floor prior to FML installation (ibid., Fig. 12). Authors of the report state that they were involved in construction of Cell 2, and that Tailings Cell 1 construction was done by the previous White Mesa owner, Energy Fuels Nuclear (EFN). No other Cell 1 as-built information is available, nor is there any documentation of any Cell 1 construction quality assurance / quality control. DRC field inspections have confirmed the existence of an earthen dike at the south margin of Cell 1 and a FML liner inside this cell. Without any other information, the Executive Secretary has assumed that the Cell 1 construction largely followed the cell's original design found in a June, 1979 D'Appolonia Engineers Report. From IUC plan maps the Executive Secretary estimated the Cell 1 footprint area to be about 57 acres.

As for Tailings Cells 2 and 3, as-built reports were found and reviewed by DRC staff; findings from which are found in a June 27, 2000 DRC Memorandum. These reviews resulted in a summary description of the liner technology for these two (2) disposal cells, as outlined in Part I.D.1(b) and (c) of the Permit. From IUC plan maps the Executive Secretary estimated the footprint area to be about 68 and 55 acres for Cells 2 and 3, respectively.

From this review it appears that the design and construction of all three (3) existing tailings cells consists of a single PVC FML liner and a limited leak detection system under the primary liner comprised of a single pipe at the toe of the southern dike within a permeable sand layer that extends across the cell floor. While outdated, this construction appears to have been common technology for the time (1980-1982). Since then, FML technology has greatly advanced both in materials used, designs produced, construction methods practiced, and quality assurance / quality control measures applied. Modern designs include multiple FMLs (e.g., primary, secondary, tertiary, etc), and a leachate removal system over and multiple leak detection layers under the primary FML. Such advanced designs provide effective leachate head control at the primary FML, thereby minimizing leakage rates and providing sensitive leak detection; and efficient leakage collection and removal systems. In cases where facilities have deployed modern waste containment and leak detection / control technology, the Executive Secretary has allowed the leak detection system to be the primary means of compliance determination for the facility.

However, this is not case for the existing tailings cells at IUC. Therefore, for purposes of defining the DMT standard for IUC, the Executive Secretary is left with only one option, that of improving detection of potential tailings cell leakage by installation of discrete monitoring wells. To this end, IUC has agreed to install eight (8) new monitoring wells immediately adjacent to the tailings cells, as follows (see Attachment 11, below):

A. Tailings Cell 1 – wells MW-24, MW-27, and MW-28,

B. Tailings Cell 2 – wells MW-29, MW-30, and MW-31, and

C. Tailings Cell 3 – wells MW-23 and MW-25.

11. Existing Cell 4A: Omission of Approval (Part I.D), and Requirements for a Contaminant Removal Schedule (Part I.H.14), and Cell Redesign and Reconstruction (Part I.H.15) - engineering design for Tailings Cell 4A is found in two Umetco Minerals Corporation (hereafter Umetco) reports dated August, 1988 and April 10, 1989. Cell 4A construction was completed on or about November 30, 1989, see Table 8, above. Later, IUC completed an as-built report and submitted it for Executive Secretary review (see 8/00 IUC Tailings Cell 4A Construction Report). Review of the engineering design and as-built reports , shows that an improvement was made to the leak detection system in Cell 4A, compared to the older cells, in that a secondary FML was installed immediately underneath the leak detection piping system. Unfortunately, this secondary FML was very limited in horizontal extent, in that it was only 2-feet wider than the graded trench for each leak detection pipe (8/88 Umetco Report, Sheet C4-3). As a result, very large areas exist between the leak detection pipes where the primary FML has no underlying membrane to divert leakage to the detection pipe. Consequently, 98% of the Cell 4A floor area does not have a secondary FML present to divert leakage to the leak detection collection pipes (6/27/00 DRC memorandum, p. 10). As a result, the existing design and construction of this disposal cell could allow a significant volume of leakage to escape undetected and possibly contaminate underlying groundwater resources.

However, unlike Cells 1, 2, and 3, Cell 4A has a 12-inch clay liner under the primary FML. Therefore, leakage from the primary FML would necessarily have to penetrate and escape this clay layer before it could infiltrate the cell foundation and possibly contaminate underlying groundwater. While this clay liner represents a significant improvement in facility tailings cell design, DRC review of the as-built report, referenced above, found very little clay liner construction quality assurance / quality control information to substantiate any in-place or field permeability for this clay layer. As a result, the DRC is unable to quantify the rate of any possible leakage from this clay layer, or confirm the degree of control this layer may have had on said leachate.

Despite this lack of information, Cell 4A has never been used for tailings disposal, but instead was used only for storage and evaporation of vanadium process solutions (5/29/01 IUC Cell 4A Leak Detection Report, p. 1). IUC has advised DRC staff that no tailings waste or wastewater have been deposited in Cell 4A since the early 1990's. This lack of waste disposal, and exposure of the FML to the elements has caused Cell 4A to fall into disrepair over the years. DRC staff site visits between 1995 and 2003 have observed failure of several FML panels on the interior sideslope; thereby exposing large areas of the sideslope subsoils. IUC acknowledges this damage and the general disrepair of Cell 4A.

In addition, the existing NRC License requires IUC to submit verbal and written reports when flow rates from the leak detection system exceed 1 gallon per minute (gpm) [NRC 9/23/02 License, Condition 11.3(D)]. In a May 29, 2001 letter, IUC notified the NRC that LDS flows at Tailings Cell 4A had exceeded the 1.0 gpm rate at Cell 4A. Based on these findings, it appears that the FML has failed to control the process fluids maintained across the floor of Cell 4A, thereby causing reliance on the clay sub-liner to prevent contact with the underlying sub-soils. Since that time IUC has begun the process of removing the materials once stored there, in preparation of re-lining the cell prior to re-use.

The raffinates and salts once stored in Cell 4A may have similar chemical characteristics as the uranium raffinate in the Mill, in that the vanadium raffinate is derived from the outfall of the uranium extraction circuit in the IUC milling process (5/28/99 IUC Groundwater Information Report, p. A-7 and Figure B-2). Consequently, these fluids may contain significant concentrations of many contaminants of concern, including: low pH fluids, heavy metals, uranium, high sulfates and TDS levels, and organic contaminants.

Considering the FML damage acknowledged by IUC, the general state of disrepair discussed above, and the lack of tailings solids disposed to date; major improvements in the design and construction of Cell 4A are warranted prior to re-use of the cell. For this reason, the existing Cell 4A design and construction were not approved in Part I.D of the Permit. IUC has also agreed and Part I.H.14 of the Permit has been crafted to require submittal of a Cell 4A contaminant removal schedule for Executive Secretary approval, which would include periodic progress reports of said contaminant removal. Requirements are also provided for IUC to complete removal of all fluids and salts stored there, the FML liner and LDS layer, and any contaminated underlying clay or sub-soils, pursuant to Part I.H.14. Furthermore, if IUC desires to reconstruct and re-line Cell 4A, the Permit also requires IUC to submit new engineering design and specifications for Cell 4A that meet BAT design and construction requirements, and secure prior approval, pursuant to Part I.H.15.

12. Omission of Design / Construction Approval: Roberts Pond (Part I.H.18) – this pond was originally installed as a part of the initial Mill construction approved by the NRC, and is located in the western portion of the mill site a short distance east of Cell 1. This pond was designed as an emergency catchment basin for major tank failure or process upset from the mill. In May, 2002 IUC made the decision to clean out the existing Pond and

replace the former Hypalon liner with a new High Density Polyethylene (HDPE) membrane. To date, no IUC engineering design or as-built drawings have been provided for re-construction of the Roberts Pond, but IUC has committed to provide this information in the near future. A brief description of the FML retrofit construction was provided in a February 19, 2004 IUC email, details of which are outlined below:

A. The Roberts Pond is relatively small, less than 0.4 acres in size.

B. After 25 years of service the Hypalon liner in the Roberts Pond was removed and replaced with a single membrane, 60 mil HDPE liner.

C. After removal of the former Hypalon FML, IUC conducted radiological surveys with both field instruments and uranium soil sampling and analysis to determine soil areas with concentrations that were above "background".

D. Contaminated soils were excavated and moved to the ore storage pad for re-processing in the mill.

E. Foundation preparation included gleaning the sub-grade to remove oversize rock, rolling the sub-grade with a smooth drum roller, raking pond sideslopes to remove oversize rock or other material, installation of a geotextile material over the entire footprint as a protective layer under the FML.

F. Construction quality assurance / quality control (QA/QC) measures performed included three (3) destructive tests on FML seams (1 per 500 linear feet), followed by air pressure tests and vacuum box tests where needed.

Without having reviewed the IUC As-Built report, the Executive Secretary cannot approve either the design or the construction of the re-built pond. However, the Executive Secretary has decided to accept the pond as it is, regulate it under the Permit, including imposition of DMT monitoring requirements, based on the following findings:

1) The Roberts Pond is small in size, about 0.4 acres, compared to the tailings cells, and

2) The Roberts Pond is used to store intermittent wastewater flows, and therefore may not be a constant head source

3) At the time mill site decommissioning, detailed radiologic surveys will be conducted of the entire area, and contaminated soils removed and placed for disposal in the tailings cells. All of these activities are regulated by the Executive Secretary under the Radioactive Materials License

Therefore, Part I.H.18 has been added to the Permit's compliance schedule to require submittal of an As-Built report to document the recent design and re-construction. After review of this report, the Executive Secretary will determine if additional measures are necessary to protect public health and the environment. Such changes, if needed, would be implemented as a part of the Reclamation Plan required by the License.

13. Existing Facility DMT Operations Standards (Part I.D.3) – in lieu of major engineering design or construction changes, several new operational requirements were imposed by the Permit to minimize the potential for release of contaminants to the groundwater from the tailings cells and facilities at the mill site, including:

A. Slimes Drain Maximum Head: Cells 2 and 3 – this performance criteria was added so as to require IUC to install, operate, and maintain automated pump control systems inside the slimes drain access pipe for both Tailings Cells 2 and 3. The intent of this requirement is to ensure that the average wastewater head in this layer is maintained as low as reasonably achievable, and thereby minimize leakage from the primary FML. Determination of the wastewater level that meets this criteria will be made by IUC and approved by the Executive Secretary later as a part of the DMT Monitoring Plan, pursuant to Part I.H.13. Similar head control requirements have been stipulated by the Executive Secretary for other facilities.

B. Maximum Wastewater Pool Elevation: Cells 1, 2, and 3 – this requirement applies to all tailings cells at the IUC facility. The Utah Water Quality Regulations require a minimum 3-foot freeboard for wastewater impoundments that treat 50,000 gallons or more per day [UAC R313-10.3(C)]. IUC has reported that the tailings disposal system is expected to average 335 gal/min, which equates to a daily rate of 482,400 gal/day (5/28/99 IUC Groundwater Information Report, p. A-9). Assuming that this rate is evenly distributed between all Cells 1, 2, and 3, this flow would equate to a daily rate of 160,800 gal/day/cell, which is well above the 50,000 gal/day limit established by State rule. As a result, the 3-foot minimum freeboard limit applies to the IUC tailings cells, and such a requirement was stipulated in Part I.D.2 of the Permit. The Executive Secretary recognizes that the NRC License already requires IUC to make an annual determination of the minimum freeboard required at the tailings cells to control the Potential Maximum Precipitation (PMP). This annual evaluation includes calculations to determine the necessary freeboard required in the tailings cells to control any upslope run-off that could impinge on the tailings area, and would have to be maintained behind the tailings dikes. Consequently, the State's 3-foot freeboard requirement imposed in Part I.D.2 is designed to compliment and not replace the existing License freeboard requirement.

C. Maximum Tailings Waste Elevations: Cells 1, 2, and 3 – during review of the IUC design and as-built reports it was clear that Tailings Cells 1 and 2 share a common dike, and Cells 2 and 3 share a dike in common. The construction originally approved by the NRC and the IUC design and as-built reports provided show different elevations for the top of the FML liner at both the north and south sides of each of these intervening dikes. Consequently, it appears possible for waste to be disposed at an elevation where the FML does not exist. The original NRC approval stipulated that tailings material was to be deposited only to the top of the FML (personal communication, Mr. Harold Roberts, 10/15/04). To continue this restriction and prevent unacceptable tailings placement above the FML, an additional performance criteria was added to the Permit to require that the final tailings waste elevation, before cover system emplacement, always be below the maximum FML liner elevation in each disposal cell. Although Cell 1 is currently used for process wastewater storage and not for tailings solids disposal, this requirement would still apply at Cell 1 at some future time when under the current NRC approved reclamation plan requires Cell 1 be used for disposal of demolition debris from the mill and decommissioning wastes from the mill site.

D. Tailings Cell 1 DMT Monitoring Wells [Part I.D.3(a)(2)] – as discussed above, the Executive Secretary has determined it necessary and IUC has agreed to install discrete groundwater monitoring wells around each tailings cell as a means to satisfy the DMT requirements of the GWQP Rules [UAC R317-6-6.4(C)(3)]. DMT performance standards stipulated in Part I.D.3(a)(2) of the permit requires

IUC to operate and maintain the tailings cells in such a manner as to prevent groundwater conditions in any nearby wells from exceeding the Groundwater Compliance Limits established in Table 2 of the Permit

E. Roberts Pond [Part I.D.3(c)] – as described above, little documentation has been provided by IUC regarding the design and construction of this mill site wastewater catchment pond. This pond, is about 0.40 acres in size, and found approximately 180 feet west of the mill building and about 200 feet east of the northeast corner of Tailings Cell 1 (see 6/22/01 IUC Response, Attachment K, Site Topographic Map, Revised 6/01). This wastewater pond apparently receives periodic floor drainage and other wastewaters from the mill, is frequently empty, and was re-lined with a new FML in May, 2002.

In order to minimize any seepage release from this wastewater pond, the Executive Secretary has determined that an appropriate DMT operations standard would be two-fold:

1) A stipulation that IUC maintain a minimal wastewater head in this pond based on a 2-foot freeboard and a 1-foot additional operating limit. Since the top of FML in this pond is about 5,626 feet above mean sea level (ft amsl), the maximum operating solution limit in the Roberts Pond was set in the Permit at 5,624 ft amsl. Because the lowest point on the FML is found at 5,618 ft amsl, this would allow the pond to be operated with a 5-foot maximum head, and

2) At the time of mill site closure IUC will excavate and remove the liner, berms, and all contaminated subsoils in compliance with an approved final Reclamation Plan under the Radioactive Materials License (hereinafter Reclamation Plan). Since the Executive Secretary now has Agreement State status for uranium mills, the DRC will closely examine decommissioning of this pond at the appropriate time.

F. Feedstock Storage Area [Part I.D.3(d) and Table 5] – for new facilities, the GWQP Rules require that a potential discharging facility meet BAT requirements. At other permitted facilities, BAT for waste storage areas has been defined as storage over a hardened concrete or asphalt surface. For existing facilities that predated the GWQP Rules, less stringent design requirements, called DMT standards, are imposed [see UAC R317-6-6.4(C)]. For the IUC facility, the Executive Secretary has decided to define DMT for the feedstock storage area by restricting the locations where this activity can be done, and by requiring that certain feedstock materials be maintained in water-tight containers, as described below.

1) Restricted Area for Open Air Feedstock Storage –historically feedstock materials for the mill have been stored under open-air conditions in an area found along the eastern margin of the mill site. In order to minimize the potential for groundwater and surface water pollution at the facility, the Executive Secretary has decided to restrict feedstock storage to the existing area, thereby constraining the size and location of these activities in the future. The Executive Secretary determined that this approach to DMT is appropriate, not only because the practice has a historical precedence, but also because IUC has a commitment under the

Radioactive Materials License to decommission and decontaminate this area at the time of closure, in accordance with a July 7, 2000 IUC Reclamation Plan. During preparation of the Permit, IUC staff explained that this reclamation plan includes radiologic soil surveys of uranium to determine the depth to which excavation would be conducted, and contaminated soils removed and disposed of in the tailings cells. Although DRC staff has yet to review and evaluate the content the IUC Reclamation Plan, we anticipate this would be done as a part of the next License renewal, scheduled for sometime on or near March 31, 2007.

State plane coordinates for the Feedstock Storage Area are defined in Table 5 of the Permit, as a means to constrain where open-air storage can be done. These coordinates were initially estimated by DRC staff from a June, 2001 IUC topographic map (ibid.), and later refined by IUC in a February 19, 2004 email.

Designation of only one (1) open-air feedstock storage area will also facilitate IUC and DRC compliance inspections by allowing ready identification of feedstocks stored at the mill site.

2) Containerized Storage for Feedstock – during Permit preparation it was agreed that if IUC chose to store feedstock materials anywhere else at the facility, other than the feedstock storage area defined in Permit Table 5, that this storage would be conducted only in closed, water-tight containers. This more stringent requirement is appropriate in order to protect these other areas from contamination by contact stormwater runoff or feedstock leachates that might be generated by open-air storage.

3) Alternate Feedstock Storage – IUC will be required to obtain an amendment to its Radioactive Materials License before it will be authorized to receive and process any new alternate feed materials. This allows the Executive Secretary prior opportunity to review each license amendment application and determine if any special storage precautions are needed to protect groundwater quality, public health and the environment.

G. Secondary Containment for Chemical Reagent Storage [Part I.D.3(e)] – significant quantities of chemical reagents are stored on the mill site for use in the uranium milling process. In order to minimize the potential for discharge to native soils and groundwater, a DMT performance standard was added to this section of the Permit to require IUC to continue to maintain secondary containment around exiting storage areas and to require that any new or replacement storage facilities meet current BAT standards. Resolution of this requirement should be provided by IUC after submittal of the DMT Monitoring Plan required by Part I.H.13.

14. Best Available Technology Requirements for New Construction (Part I.D.4) – this section has been added to the Permit to ensure that all new construction, modification, or operation of waste or wastewater disposal, treatment, or storage facilities requires submittal of engineering plans and specifications and prior Executive Secretary review and approval. In these plans and specifications the Permittee is required to demonstrate how the Best Available Technology (BAT) requirements of the GWQP Rules have been

met. After Executive Secretary approval a Construction Permit may be issued, and the Ground Water Discharge Permit modified.

15. Definition of 11e.(2) Waste (Part I.D.5) – this definition was added to the Permit for purposes of clarity, as it regards prohibited discharges defined in Part I.C.1(c). The Executive Secretary has determined that constraining the types of contaminants authorized for disposal is consistent with discharge minimization and groundwater quality protection. Regulatory definition of 11e.(2) waste is found in Section 11e.(2) of the U.S. Atomic Energy Act, 1954, as amended, and includes: *"the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content"*. In addition to mill tailings solids and wastewaters, the NRC considers other process related wastes to also be 11e.(2) by-product material, including (see 3/7/03 NRC letter):

   A. Solid waste from facility office buildings,

   B. Spent chemicals used in ongoing process operations, including laboratory chemicals used for ore assay,

   C. Virgin chemicals intended for use at the facility, but not consumed in process operations, including laboratory chemicals intended for use in ore assay,

   D. Non-uranium bearing structural or other debris found in alternate feedstock materials accepted for on-site processing.

   E. Contaminated groundwater from the on-going chloroform groundwater corrective action project at the facility. This wastewater has been deemed as 11e.(2) waste in that it originated from on-site disposal of spent laboratory chemicals used for ore assay.

16. Post-Closure Performance Requirements (Part I.D.6) – currently a Reclamation Plan has been approved by the NRC under the existing License. Soon the NRC License will be converted to a State License as a part of the Agreement State transfer process. At the time of the next License renewal, scheduled for sometime around March, 2007, DRC staff will re-examine the Reclamation Plan for content and adequacy. New requirements were added to the Permit at this time to ensure that the final reclamation design provided adequate performance criteria to protect local groundwater quality. This is appropriate, as discussed above, in that the cover system design and construction is the only means available to the Executive Secretary to improve the existing facility and protect underlying groundwater resources, if determined necessary. These new performance criteria will also guide the infiltration and contaminant transport modeling to be done shortly by IUC in response to requirements found in Part I.H.11. To this end, three (3) requirements were added to ensure that the cover system for each tailings cell will be designed and constructed to:

   A. Minimize the infiltration of water into radon barrier and underlying tailings waste,

   B. Prevent the accumulation of leachates within the tailings that might create a bathtub effect and thereby spill over the maximum elevation of the FML inside any disposal cell; thereby causing a release of contaminants to the environment, and

   C. Protect groundwater quality at the compliance monitoring wells by ensuring that contaminant concentrations there do not exceed their respective GWQS or GWCL defined in Part I.C.1 and Table 2.

To provide consistency with the performance criteria stipulated by the Executive Secretary at other 11e.(2) disposal operations, a 200-year minimum performance period was required for all three (3) of these criteria.

17. Facility Reclamation Requirements (Part I.D.7 and I.H.11) – Part I.D.7 has been added to the Permit to provide the Executive Secretary an opportunity to ensure that:

A. The post-closure performance requirements for the tailings cell cover system in Part I.D.6 is fully and adequately integrated into the Reclamation Plan. Because DRC evaluation of this Reclamation Plan will be done at the time of the next License renewal, scheduled on or around March, 2007; Part I.H.11 has been added to the Permit to require that IUC complete an infiltration and contaminant transport model of the final tailings cell cover system to demonstrate the long-term ability of the cover to protect nearby groundwater quality. As a part of this cover system performance modeling required by Part I.H.11, the Executive Secretary will determine if changes to cover system are needed to ensure compliance with the Part I.D.6 performance criteria.

B. All other facility demolition and decommissioning activities outlined in the Reclamation Plan will be done in a manner adequate to protect local groundwater quality. Issues or concerns to be considered and resolved include, but are not limited to:

1) Identification, isolation, and authorized disposal of any un-used chemical reagents held in storage at the mill site at the time of closure.

2) Demolition, excavation, removal, and authorized disposal of all contaminated man-made structures, including, but not limited to: buildings, pipes, power lines, tanks, access roads, drain fields, leach fields, fly-ash disposal ponds, feedstock storage areas, mill site wastewater storage ponds, solid waste disposal landfills, and all related appurtenances.

3) Excavation, removal, and authorized disposal of all contaminated soils found anywhere outside of the tailings cells at the facility.

Through this process the Executive Secretary aims to ensure that DMT has been adequately established for both the final tailings cell cover system and reclamation of the facility.

18. Stormwater Management and Spill Control Plan (Parts I.D.8 and I.H.17) – one aspect of DMT is preventing and controlling contaminated stormwater and chemical spills from mill site activities. In July, 2001 IUC provided the DRC a draft copy of a July 17, 2001 Spill Management Plan. Said plan included a section on stormwater management. During a meeting in February, 2004 IUC explained that they had submitted this plan for NRC approval. IUC also submitted a copy of the plan to DRC on July 17, 2001 and later provided a second copy, which contained additional minor revisions on April 26, 2004. Subsequent DRC research found that the July 17, 2001 draft plan had not yet been approved by the NRC. Currently, DRC staff are in review of this plan and will provide comments to IUC shortly. With respect to this issue, IUC and DRC reached the following agreements:

A. IUC is an existing facility under the GWQP Rules. Therefore, the existing stormwater management system and chemical / reagent storage facilities would be accepted "as is" under the Permit.

B. In the future, any construction of new reagent storage facilities or major re-construction of existing facilities will meet current BAT design and operation standards.

C. Re-construction of reagent storage facilities may be required by the DRC after a major spill or catastrophic failure of existing storage facilities, pursuant to the Permit re-opener provisions in Part IV.N.3.

D. IUC will revise both plans submitted to take into account and resolve any Executive Secretary comments, and re-submit a final Stormwater Management and Spill Control Plan for approval. The final plan will establish acceptable operational, maintenance, monitoring, and reporting requirements for stormwater management and spill prevention and control. The final plan will also provide specific actions to prevent, respond to, control, and remediate spills of chemical reagents at the mill site.

To this end Part I.D.8 was added to the Permit to require IUC to conduct its activities in compliance with an approved Stormwater Management and Spill Control Plan. Part I.H.17 was added to require IUC to submit a final version of this plan for Executive Secretary approval.

19. <u>Routine Groundwater Compliance Monitoring (Part I.E.1)</u> – this section prescribes the monitoring requirements for groundwater monitoring wells at the facility, including upgradient, downgradient, and lateral gradient wells. Some of the specific requirements are described below:

A. <u>Monitoring Frequency [Parts I.E.1(a and b) and I.G.1]</u> – routine groundwater quality monitoring is commonly done on a quarterly basis (4-times/year). However, the Executive Secretary may allow a reduced frequency of routine groundwater sampling if site specific groundwater conditions warrant [see UAC R317-6-6.16(A)(2)]. For certain sites where groundwater velocities have been found as low as one to two feet per year, the Executive Secretary has approved a semi-annual sampling frequency (2-times/year) in order to avoid statistical problems such as auto-correlation, and allow a better measure of natural groundwater quality variations.

During preparation of the Permit, IUC submitted a March 25, 2004 Hydro Geo Chem (HGC) letter and a January 30, 2003 HGC groundwater velocity report wherein IUC suggested that local groundwater velocity at White Mesa was about 1.1 to 2.8 feet/year. Detailed DRC review found the January 30, 2003 HGC analysis to be based on an area between the tailings cells and Ruin Spring, and not focused on each individual monitoring well at the facility (see 9/21/04 DRC Memorandum).

On October 15, 2004 a conference call was held between DRC staff and representatives of IUC and HGC. During this call, DRC staff asked that additional work be done to determine local groundwater velocity at each monitoring well at the site, where velocity would be calculated on well specific hydraulic conductivity and hydraulic gradient data. On this same date, IUC staff proposed that there be two (2) different frequencies of routine groundwater monitoring at White Mesa, as follows:

- Semi-annual (2 times/year) where groundwater velocity is less than 10 feet/year, and
- Quarterly (4 times/year) where groundwater velocity is equal to or greater than 10 feet/year.

Later IUC provided an October 19, 2004 HGC letter report that revised previous HGC groundwater velocity calculations by providing well specific values. After review of this HGC report, DRC staff found four (4) tailings wells at the White Mesa facility exhibit local groundwater flow velocity equal to or greater than 10 feet/year, including (see 11/23/04 DRC Memorandum, Tables 1 and 2):

- Cross-gradient Wells: MW-26 (14 feet/year) and MW-32 (19 feet /year). Previously these wells were named TW4-15 and TW4-17, respectively, and
- Downgradient Wells: MW-11 (135 feet/year) and MW-14 (62 feet/year)

All other existing IUC tailings cell monitoring wells were found with local groundwater velocities of less than 10 feet/year (ibid.). Based on this information, the Executive Secretary has agreed to accept IUC's proposal for two (2) different routine groundwater monitoring schedules at the facility, based on the following findings:

1) Areas of high groundwater velocity deserve more frequent sampling in order to rapidly detect contamination and remediate it earlier while the problem is smaller and closer to the source. To do otherwise is not protective of groundwater quality resources, and serves only to make the problem more expensive before it is discovered and corrected.

2) At IUC wells where groundwater velocity is equal to or above 10 feet/year, groundwater will travel more than 2.5 feet between **quarterly** sampling events. At the highest velocity tailings well, MW-11 (135 feet/year), groundwater at this downgradient location will travel about 34 feet between quarterly sampling events. The Executive Secretary believes that this provides sufficient reaction time to confirm any contaminant exceedance and regain control thereof.

3) At IUC wells where groundwater velocity is less than 10 feet/year, groundwater will travel less than 5 feet between each **semi-annual** sampling event. At the tailings well with the lowest velocity, MW-1 (0.026 feet/year) groundwater at this upgradient location will travel a very short distance between each semi-annual sampling event (0.01 feet), and auto-correlation will likely occur. Despite this statistical drawback, the Executive Secretary believes that semi-annual sampling at this and other low velocity locations is protective of the environment.

4) Above and beyond these baseline frequencies, the Permit contains provisions for accelerated groundwater monitoring to confirm the presence of groundwater contamination, see Part I.G.1. Under these requirements, IUC is mandated to accelerate its monitoring frequency when any pollutant in any well exceeds its respective GWCL in Table 2 of the Permit. For those wells with a semi-annual baseline frequency, quarterly accelerated monitoring is required. For wells with a quarterly baseline schedule, monthly accelerated sampling is required. In summary, a single

exceedance in a single well will result in a much higher sampling frequency in order to confirm the apparent problem, and pursuant to Part I.G.1, this accelerated monitoring will continue until the Executive Secretary can determine the compliance status of the facility.

5) If groundwater contamination is detected and confirmed in the future, technology is available to control the contamination, and even reverse its flow and thereby contain it near its source.

6) IUC owns and controls a large area of land downgradient of the tailings cells where it can control public access to groundwater. Further, the seeps and springs found at the edge of White Mesa where the public could be exposed to contaminated groundwater are even more removed from the tailings cells. These long distances appear to provide ample reaction time to detect and confirm the presence of contamination, and design and implement corrective actions to regain control of said releases, should they occur.

B. Monitoring Parameters [Part I.E.1(c)] – both field and laboratory parameters are specifically identified to ensure compliance. The need for laboratory analysis for the Table 2 compliance parameters is self-evident. Certain other groundwater quality parameters were added to assist in interpretation of general geochemical conditions present in the aquifer, including the major anions and cations. Due to the limited information available and uncertainty in the characterization of the tailings cells contaminant source terms, a broad suite of VOCs are also required under the Permit (EPA Method 8260). In general, many VOC parameters may be key indicators of groundwater pollution, in that they are man-made and are mobile in groundwater environments, see discussion above.

C. Special Provisions [Part I.E.1(d)] – during review of the data from several split sampling events since May, 1999, certain quality assurance issues have been identified by the Executive Secretary. In order to ensure that these issues are resolved in the future, special provisions have been added to the Permit to draw attention to them.

20. Groundwater Head Monitoring (Part I.E.2) – certain wells and piezometers exist at the IUC facility that are completed in the shallow aquifer, but are not listed in Table 2 as compliance monitoring wells for the tailings cells. These include five (5) piezometers associated with the wildlife ponds (P-1 thru P-5), two (2) existing wells outside the IUC restricted area (MW-20 and MW-22), and several wells related to the chloroform investigation. Currently these chloroform investigation wells include MW-4A, TW4-1 thru TW4-14, TW4-16, TW4-18, and TW4-19, but may change as the investigation and corrective action project progresses. Depth to groundwater or head monitoring is required of these wells in order to maximize our understanding of local groundwater flow directions at the facility. To this end, a requirement was added to do this extra head monitoring at these existing wells and piezometers at the same frequency as the compliance monitoring wells.

21. Monitoring Well Design and Construction Criteria (Part I.E.3) – in order to provide an adequate monitoring well network, the Permit requires that a number of new monitoring wells be installed, see Part I.H.1. To ensure that these new wells are properly located and constructed, certain performance criteria have been added to the Permit in this section.

22. Monitoring Procedures for Wells (Part I.E.4) – this section has been added to the Permit to provide general performance criteria for groundwater sampling. Most important of these is the requirement that all groundwater monitoring comply with a quality assurance (QA) plan, such as will be submitted by IUC for Executive Secretary approval, pursuant to Part I.H.6. In order to comply with requirements found in the GWQP Rules [UAC R317-6-6.3(I) and (L)], IUC will need to submit its existing QA plan to ensure that it is consistent with EPA guidance found in the RCRA Ground Water Monitoring Technical Enforcement Guidance (TEGD) document (EPA, 1986).

23. White Mesa Seep and Spring Monitoring and Reporting (Parts I.E.5, I.F.6, and I.H.9) – as described below, monitoring of the contact seeps and springs at the edge of White Mesa is important because these locations are where the shallow aquifer discharges, and hence form points of exposure for wildlife and the public for any groundwater contamination that may be released from the facility. This monitoring will not replace the compliance well monitoring required by Part I.E.1, which will provide a much earlier warning of a release. Instead, the seep and spring monitoring is designed to compliment the IUC monitoring well data, and confirm that activities at the IUC facility have not adversely impacted local surface water quality. Under the requirements of these two (2) sections of the Permit this sampling and reporting will be completed on an annual basis. Determination of those seeps or springs selected for sampling will be completed after Executive Secretary approval of the White Mesa Seep and Spring Sampling Report required by Part I.H.9. Commencement of this annual surface water monitoring will then begin after modification of the Permit accordingly.

24. DMT Performance Standard Monitoring (Part I.E.6 and I.H.13) – Part I.E.6 stipulates the monitoring requirements needed to demonstrate compliance with the DMT performance standards set forth in Part I.D.2 and 3 of the Permit, as summarized below:

    A. Tailings Cell 1 - including weekly wastewater pool level monitoring to determine compliance with the minimum freeboard requirement in Part I.D.2. Again, if the maximum wastewater pool elevation is exceeded, IUC is required to immediately notify the Executive Secretary under the provisions of Parts I.F.3 and I.G.3.

    Quarterly depth to groundwater and groundwater quality sampling and analysis is also required from three (3) discrete monitoring wells immediately adjacent to Cell 1. DMT compliance is maintained at Cell 1 when the groundwater quality in these three (3) monitoring wells does not exceed their respective GWQS in Table 2 of the Permit. In the event that any groundwater contaminant in these wells exceeds a GWQS, IUC will be required to report the non-compliance pursuant to Parts I.G.1 and 2. A compliance schedule requirement has been added to Part I.H.1 to ensure the DMT monitoring wells are installed properly at Cell 1.

    B. Tailings Cells 2 and 3 – including weekly wastewater pool elevation and slimes drain water level monitoring. DMT compliance is maintained when the water levels in the wastewater pools and in the slimes drain layers are below their respective maximums specified in Part I.D.2. In the event that either of these wastewater levels exceeds the requirements, IUC is required to report them immediately to the Executive Secretary in accordance with Part I.F.3 and I.G.3.

    C. Roberts Pond – including weekly monitoring of wastewater levels in the Roberts Pond at the mill site to verify that the wastewater head is maintained so as to provide the minimum 2-foot freeboard required by Part I.D.3(c).

D. Feedstock Storage Area – including weekly monitoring to ensure that:

1) Bulk feedstocks are located and stored only inside the approved Feedstock Storage Area, and that

2) Containerized feedstocks located outside the approved Feedstock Storage Area are maintained in closed, water-tight containers.

In order to ensure that IUC provides appropriate monitoring equipment, and adequate operation and maintenance procedures for DMT monitoring, a compliance schedule requirements has been added to Part I.H.13 to require submittal and approval of a DMT Monitoring Plan.

25. On-site Chemicals Inventory and Reporting (Parts I.E.7, I.F.7, and I.H.10) – much of the discussion above regarding determination of groundwater monitoring parameters is intimately related to the type of ore or feedstock material being processed, and the types and concentrations of chemicals used on-site in the milling process, on-site laboratory, etc. For this reason, the Executive Secretary has determined it critical to maintain an inventory of chemicals in storage and used at the facility in order to determine at some future date the appropriate parameters that should be considered both for characterization of the tailings cells wastewaters, and for groundwater monitoring parameters.

To this end, monitoring requirements were added to Part I.E.7 to require IUC to maintain a current chemical inventory on site. The Executive Secretary recognizes that some chemicals may be used at such a small rate that they do not constitute a potential risk to groundwater quality. In order to address this issue, an annual consumption rate of 100 kg/yr was specified. Using this provision, IUC need not inventory those compounds whose annual consumption is less than this amount.

Reporting requirements for this inventory were also added to Part I.F.7, where IUC will be required to submit a report at the time of Permit renewal, i.e., 180 days before expiration of the current Permit.

The Executive Secretary has determined it important to establish a baseline inventory of historical and current chemicals used at the facility. To this end, a new Permit requirement was added to the Permit's compliance schedule in Part I.H.10.

26. Tailings Cell Wastewater Quality Monitoring, Reporting, and Sampling Plan (Parts I.E.8, I.F.8, and I.H.5) – after review of the historic tailings cell wastewater quality samples collected to date by IUC, it appears that IUC's tailings wastewater sampling and analysis has been focused on process control and not environmental considerations (see Attachment 6, below). Historically, IUC has not been required to conduct any comprehensive analysis of this tailings wastewater for environmental purposes. Consequently, the available data are limited both in the number of samples and parameters. Little information is also available regarding quality assurance issues for said sampling and analysis. In light of this situation a new requirement has been added to the Permit to require a comprehensive and routine examination of tailings wastewater quality for environmental purposes. To facilitate this, a compliance schedule item was added to Part I.H.5 to require IUC to submit a plan for Executive Secretary approval for routine tailings cell wastewater monitoring. The purpose of this sampling plan is to identify the distinct sources of tailings wastewater that will be sampled (wastewater pool, slimes drain, etc), standardize all sampling and analytical procedures, and provide an

outline for compliance with all related monitoring and reporting requirements in Parts I.E.8 and I.F.8 of the Permit.

This approach of annual sampling assumes that over several years a sufficient number of samples will be available to adequately describe the average chemical conditions of these wastewaters.

Further, the approach in Part I.E.8 also specifies that the samples be collected in August, at the peak of the evaporation season in order to measure the highest contaminant concentrations in the system.

Other approaches to sampling frequency could have been used, such as: 1) a minimum number of days of mill operation, 2) sampling after a change in feedstocks processed, or 3) multiple samples for each season of the year, etc. However, all of these have drawbacks, in that they: 1) ignore the dynamics of local weather conditions which change from year to year, 2) ignore processing schedule dynamics which are also variable, 3) require more samples to be collected, 4) mandate tedious monitoring and reporting to document and justify the frequency used, and 5) result in increased sampling costs with little apparent benefit. In the end, the Executive Secretary chose a simple approach of one (1) annual sample from each tailings wastewater source to be collected when contaminant concentrations should be highest.

The information generated by this routine monitoring will also be helpful in the on-going chloroform contaminant investigation. In an April 11, 2002 Technical Information Request, DRC staff asked IUC to fully characterize the contaminants in this wastewater, and allow the State to collect split samples in this process (ibid., pp. 15-16). The need for this characterization was discussed with IUC in meetings of April 17 and 24, 2002. In the latter meeting, IUC agreed to sample and analyze the tailings wastewater for a comprehensive suite of contaminants, including, but not limited to: metals, VOCs, Semi-VOCs, etc. It was also agreed that a sampling plan would be submitted for DRC approval before sampling began. Later, IUC provided a May 31, 2002 work plan for this sampling. DRC staff reviewed the sampling plan and requested additional information in a July 3, 2002 email. Because discussions about the content of this sampling plan are on-going, Part I.H.5 has been added to the Permit to require IUC to submit a tailings cell wastewater sampling plan for Executive Secretary approval.

Pending completion of this sampling plan, on August 12, 2003 IUC voluntarily submitted results of several grab samples collected from the tailings cells in March, 2003, which are summarized in Attachment 6, below. Preliminary DRC review shows the following:

1) IUC samples were collected from impounded wastewaters in Tailings Cells 1 and 3 and analyzed for a partial list of the analytes previously agreed to in the plan, including: major ions, nutrients, metals, and radiologics,

2) No sampling was conducted of impounded wastewater at either Tailings Cells 2 or 4A because no exposed solution was available at the time of sampling (March, 2003),

3) No samples were collected from the slimes drain layers or leak detection systems in Cells 2, 3, or 4A,

4) No analysis was made for any VOC or Semi-VOC contaminants in any sample.

This March, 2003 IUC data may be used at sometime in the future by the Executive Secretary in his review of routine monitoring data to be collected under the Permit. In the meantime, the Permit will require routine monitoring in order that a defensible and representative characterization of tailings wastewater quality be completed.

Part I.E.8 of the Permit also requires IUC to provide 30-day prior notice, so as to allow the Executive Secretary an opportunity to collect split samples of these tailings cell wastewaters. DRC staff intend to periodically conduct such split sampling as a means of verification of IUC's tailings wastewater characterization.

Reporting requirements in Part I.F.8 mandate that IUC report the annual tailings wastewater quality results with the 3rd quarter groundwater monitoring report, due each year on December 1. This section also requires that the content of these reports be similar to the quarterly groundwater monitoring reports, by providing the field data sheets, copies of the laboratory reports, a quality assurance evaluation and data validation, and reporting in electronic format, pursuant to Part I.F.1(a), (b), (d), and (e).

27. Groundwater Reporting Requirements (Part I.F.1 and Table 6) – this section was added to the Permit to provide a schedule for reporting and to detail the types of routine quarterly groundwater monitoring data required. The schedule provided in Table 6 of the Permit allows IUC 45 days after the end of each quarter to submit the required information. Most of the data requirements are self-explanatory, but are specifically listed in the Permit to assist IUC in providing complete submittals. The list of required information will also provide a guide for the types of information that must be considered in preparation of the Groundwater Monitoring Quality Assurance Plan, required by Part I.H.6.

In addition, the Executive Secretary has required the submittal of quarterly water table contour maps to emphasis the need to understand groundwater flow directions at the facility. Pursuant to Part IV.N.3, these contour maps will allow the Executive Secretary to require new compliance monitoring wells should it be discovered that groundwater flow directions have changed.

A section has also been added to require IUC to provide the groundwater quality results in an electronic format, which will allow the Executive Secretary ready access to the information and will speed review of the data.

28. Routine DMT Performance Standard Monitoring Requirements (Part I.F.2 and I.G.3) – Part I.F.2 has been added to the Permit to require quarterly reporting for all monitoring related to the DMT standards specified in Part I.E.6, including wastewater pool elevations in all three (3) tailings cells, slimes drain head for Tailings Cells 2 and 3, and a summary table of weekly wastewater levels measured by IUC at the Roberts Pond in the mill site area.

In the event that IUC discovers an upset condition, where the DMT performance standard has been violated, they are required to notify the Executive Secretary within 24-hours of discovery (verbal) and 5 days (written) of the problem. Examples of these types of problems, include, but are not limited to:

- Excess wastewater head at any of the tailings cells or the Roberts Pond,
- Excess leachate head in the slimes drain layer at Tailings Cells 2 or 3;

29. DMT Performance Upset Reports (Part I.F.3) – this requirement was added to the Permit for clarification purposes to distinguish this reporting from the routine DMT performance reporting to be submitted quarterly under Part I.F.2. Examples of DMT failures that need

to be reported under this section include, but are not limited to: excess wastewater pool elevations in Tailings Cells1, 2, 3, and the Roberts Pond; excess slimes drain leachate heads at Tailings Cells 2 and 3; bulk feedstock materials stored outside the approved storage area; and leaking containers of alternate feedstock materials, etc.

30. Other Information (Part I.F.4) – in the event that the Permittee omits information, or discovers incorrect information was reported, this section provides a timeline by which IUC must correct or complete the respective report.

31. Groundwater Monitoring Well As-Built Reports (Part I.F.5) –this section has been added to the Permit to provide specific guidelines on what kinds of information are required for monitoring well as built reports. The Executive Secretary deems it necessary to provide these details, in light of the need for additional monitoring wells at the facility, as mandated by Part I.H.1 of the Permit.

Part of the requirements mandated here require the geologic log for each monitoring well be prepared by a Professional Geologist licensed by the State. This requirement was added in order to comply with the recent Professional Geologist Licensing Act, enacted by the Utah State Legislature in 2002, and the attending Professional Geologist Licensing Rules (UAC R156-76). The requirement that the survey coordinates for each monitoring well be prepared by a Utah licensed land surveyor or engineer was added to the Permit in order to ensure accuracy for the survey coordinates reported.

32. Accelerated Monitoring Status (Part I.G.1) – this section of the Permit is taken almost verbatim from the GWQP Rules in UAC R317-6-6.16(A). It requires the Permittee to accelerate the frequency of monitoring in the event that any pollutant in any well exceeds its corresponding GWCL, as defined in Table 2 of the Permit, and to continue that accelerated monitoring frequency until such time as the Executive Secretary can determine the compliance status of the facility. Because semi-annual and quarterly groundwater monitoring have been defined as the routine frequencies in Part I.E.1, this accelerated monitoring status would require quarterly and monthly groundwater quality sampling, respectively.

33. Violation of Permit Limits (Part I.G.2) – this section is taken almost verbatim from the GWQP Rules, found in UAC R317-6-6.16(B).

34. Failure to Maintain Discharge Minimization Technology Required by Permit (Part I.G.3) – this section of the Permit is taken almost verbatim from the GWQP Rules found in UAC R317-6-6.16(C)

35. Facility is Out-of-Compliance (Parts I.G.4 and I.H.16) – general requirements to address facility out-of-compliance status are found in Part I.G.4 of the Permit, which is taken almost verbatim from the GWQP Rules (UAC R317-6-6.17). This section of the Permit references the ability of the Executive Secretary to require immediate implementation of the Contingency Plan to regain and maintain compliance with the Permit, should the Permittee fail to act [see Part I.G.4 (d)]. Such Executive Secretary action is authorized by the GWQP Rules [UAC R317-6-6.17(A)(4)]. This plan is also required as a part of a Permit application in the GWQP Rules [UAC R317-6-6.3(N)]. To date, IUC hasn't submitted a Contingency Plan for Executive Secretary approval. The overall goal for this plan is to provide the necessary actions for IUC to re-gain compliance in several areas regulated by the Permit, including: groundwater quality, limitations or prohibitions on contaminants discharged to the tailings cells, and/or Discharge Minimization Technology performance standards (e.g. tailings cell solids and wastewater elevations, slimes drain

operation, etc). For this reason a compliance schedule item in Part I.H.16 has been added to the Permit to require IUC to provide a final plan for Executive Secretary approval.

36. Accelerated Monitoring Status for New Wells (Part I.G.5) – this section was added to the Permit to clarify that compliance monitoring of the new tailings cell monitoring wells required by Part I.H.1 does not begin until after Executive Secretary approval of the Background Groundwater Quality Report required by Part I.H.4. As a result, IUC will not be required to accelerate their monitoring frequency, as per Parts I.G.1 (Probable Out-of-Compliance), or I.G.2 (Out-of-Compliance), until after approval of this report.

37. Groundwater Monitoring Quality Assurance Plan (Part I.H.6) – the GWQP Rules require that the Permit application include several information items regarding quality assurance and quality control for groundwater monitoring [UAC R317-6-6.3(I) and (L)]. Part of this requirement mandates that groundwater sampling conform to the EPA RCRA Ground Water Monitoring Technical Enforcement Guidance (TEGD) document (EPA, 1986). Prior to the May, 1999 split sampling event, IUC provided a Groundwater Quality Assurance Project Plan to the DRC (3/90 IUC Groundwater QA Project Plan, Rev. 2). However, this plan was written for purposes of the NRC radioactive materials license, and did not specifically rely on the EPA RCRA TEGD (ibid., p. 3). In order to provide IUC the opportunity to modify their existing plan to conform to the State requirements, a new compliance schedule item was added to Part I.H.6 of the Permit, which mandates a revised plan be submitted for Executive Secretary approval. After review and approval of this modified plan, the Permit will be re-opened and modified to require that all future groundwater sampling comply with the new plan.

38. Monitoring Well Remedial Construction and Repair Report (Part I.H.7) – during several sites visits and four (4) split groundwater quality sampling events since May, 1999, DRC staff have noted the need for remedial construction, maintenance, or repair at several monitoring wells at the IUC facility, including:

   A. Well Development - 16 of the existing monitoring wells at the IUC facility fail to produce clear groundwater in conformance with the EPA RCRA TEGD. The observed groundwater turbidity appears to be the product of incomplete well development, and poses a potential for bias of the groundwater quality analytical results, particularly for metals and nutrients. Consequently, the Executive Secretary has determined it necessary to require IUC to develop these wells in order to ensure they meet the EPA RCRA TEGD turbidity criteria of 5 nephelometric turbidity units (NTU), to the extent reasonably practicable.

   B. Protective Surface Casings: Piezometers – in response to a DRC request for additional hydrogeologic information, IUC installed five (5) piezometers at the White Mesa facility in December, 2001 (5/8/02 Hydro Geo Chem Report, p.1). While no protective steel surface casings were called for in the original approved installation plan, it is important to protect these piezometers because they are used for groundwater head monitoring under Part I.E.2. The lack of protective casing poses a problem because the 1-inch diameter PVC piezometer casings could be easily broken by surface activities. Also, PVC is prone to degradation by ultraviolet light, and could be easily degraded.

In order to ensure that the monitoring wells are properly repaired and developed in a timely manner these requirements have been added to Part I.H.7.

39. Monitoring Well MW-3 Verification, Retrofit or Reconstruction Report (Part I.H.8) – during recent split sampling events and after review of available well MW-3 as-built information, DRC staff have found several problems with the construction of this well, including:

A. Missing Geologic Log – review of the MW-3 well as-built diagram shows that no geologic log was provided at the time of well installation (7/94 Titan Environmental Report, Appendix A, as-built diagram). Consequently, it is impossible to ascertain if the screened interval was adequately located across the base of the shallow aquifer, i.e., at or below the upper contact of the Brushy Basin Member of the Morrison Formation.

B. Lack of Filter Media – well MW-3 was constructed without any filter media or sand pack across the screened interval.

C. Excessively Long Casing Sump – a 9 or 10-foot long non-perforated section of well casing was constructed at the bottom of this well.

D. Poor Positioning of Well Screen Apparent – about 2 week after installation of well MW-3, mill staff found the well to be dry (ibid., Appendix A, 9/14/79). However, in late September, 1979 mill staff measured the static water level at a depth of 83.4 ft (ibid., Appendix B, 9/25/79). Recent DRC water level measurements show that the water table surface is found at a similar depth, 83.6 feet below the water level measuring point (ft bmp, 9/9/02). After consideration of the well's measuring point stickup, 1.95 feet, the September, 2002 water level was only about 5.3 feet above the base of the well screen. This well construction and water table depth poses a problem in that at the IUC purge rate of 2 gallons per minute (gpm), the well is rapidly purged dry and IUC is unable to complete both purging and sample collection in one continuous process.

Arguments have been made by IUC that the well screen in MW-3 was properly set based on the local geology found there. However, no geologic or geophysical logs exist to support this assertion. Consequently, the Executive Secretary has determined it necessary to verify, retrofit or reconstruct this well. Key to this mandate is the requirement to determine the total saturated thickness of the aquifer at well MW-3, which will require determination of the depth of the upper contact of the Brushy Basin Member of the Morrison Formation at this location. This can be done either by geophysical logging and/or drilling of a confirmation boring in the immediate vicinity of the well. After determination of the complete saturated thickness of the aquifer at well MW-3, the Permittee is required to retrofit or re-construct the well to ensure the well screen fully penetrates the saturation. Thereafter, a new well as-built report must be submitted. After approval of the replacement well, if needed, the Executive Secretary may require plugging and abandonment of the former well. The Permittee is also required to provide at least a 7-day notice of all field activities, so as to allow the Executive Secretary to observe these activities and participate in decisions regarding the fate of well MW-3.

40. White Mesa Seeps and Springs Sampling Report (Part I.H.9) – in a February 7, 2000 request for information, IUC was asked to provide a hydrogeologic study of the contact seeps and springs found at the edge of White Mesa (see 2/7/00 DRC Request for Information, p. 13). The purpose of this study was to establish background groundwater flow and water quality conditions at these discharge points, and included a request for:

A. Land Survey - of the seeps/springs,

B. Water Table Contour Map - of both the IUC monitoring wells and the contact seeps/springs, and

C. Groundwater Quality Sampling - and analysis of said seeps/springs.

IUC responded to portions of this request in a September 8, 2000 submittal. Later the DRC renewed its request for survey coordinates for these seeps and springs in a March 20, 2001 letter to IUC (3/20/01 DRC Request for Information, p. 6). Subsequently, IUC provided survey coordinates for three (3) contact seeps at the edge of White Mesa, including elevation data (9/7/01 IUC letter, attached spreadsheets).

Subsequently, other parties expressed interest and concern in the groundwater hydrology and water quality of these seeps and springs at the edge of White Mesa, including the Moab office of the Bureau of Land Management (BLM), and White Mesa band of the Ute Mountain Ute Tribe (Ute Tribe). In June, 2002 the DRC proposed a collaboration between the BLM, Ute Tribe, IUC and DRC to study the hydrogeology of the White Mesa contact seeps and springs. In subsequent discussions it was agreed that: 1) the Ute Tribe, with BLM assistance, would complete a detailed reconnaissance of all the seeps and springs found downgradient of the IUC tailings cells at the edge of White Mesa, 2) IUC would provide a land survey to accurately locate and determine the elevation of all the seeps and springs identified by the Ute Tribe, and 3) DRC would provide analytical services for the groundwater quality samples collected.

Later, on September 20, 2002 DRC and Ute Tribe staff conducted a preliminary field survey of seeps and springs in the area, and located six (6) different discharge points at the edge of White Mesa, all of which appear to be hydraulically downgradient of the IUC facility. These seeps and springs are summarized in Table 10, below.

Table 10. Known White Mesa Perimeter Seeps and Springs as of September, 2002

Seep or Spring Name	USGS 7.5 Minute Quadrangle	Approximate Location Relative to IUC Tailings Cells (1)		Approximate Map Location
		Direction	Distance (ft)	
Entrance Seep	Black Mesa Butte	East	4,700	~300 ft E., 0 ft S., NW Corner, Sec. 34, T. 37 S., R. 22 E.
Westwater Seep	Black Mesa Butte	West	5,200	~1,000 ft E., 200 ft S., NW Corner, Sec. 32, T. 37 S., R. 22E.
Cottonwood Seep	Black Mesa Butte	Southwest	9,400	~1,500 ft N, 2,200 ft W., SE Corner, Sec. 31, T. 37 S., R. 22E.
Ruin Spring	Black Mesa Butte	Southwest	13,000	~2,200 ft E., 1,200 ft S., NW Corner, Sec. 8, T. 38 S., R. 22 E.
Corral Seep	Big Bench	South	16,200	~300 ft E., 1,200 ft N., SW Corner, Sec. 10, T. 38 S., R.22 E.
Tank Seep	Big Bench	Southeast	21,400	~2,300 ft N., 400 ft W., SE Corner, Sec. 15, T. 38 S., R. 22 E.

Footnotes:
1) Generalized compass direction and approximated distance from estimated center of IUC Tailings Cell 1.

During a May 21, 2003 conference call between BLM, Ute Tribe, IUC and DRC staff several other aspects of this hydrogeologic study were discussed, including: goals and objectives of the study, need for an upgradient reference seep, field and laboratory parameters to sample and analyze, field sampling equipment and methods, data quality assurance measures needed, and capability for split sampling. At the conclusion of this meeting, the parties agreed to convene again after the Ute Tribe completed its detailed field survey of White Mesa seep and spring locations. On July 1, 2003, the Ute Tribe reported that the field survey was about half done (7/1/03 Ute Tribe email). To date, it is unknown if the Ute Tribe field survey has been completed.

After all of these considerations, the Executive Secretary has determined it appropriate for IUC to bear the responsibility for this study, by adding a Permit requirement for a White Mesa Seeps and Springs Sampling Report in Part I.H.9. This is done not only to ensure IUC participation, but to accelerate completion of the study, and provide timely resolution of concerns held by local citizens and tribal members regarding the potential for pollution from the tailings cells to adversely affect nearby surface water quality.

A provision has also been added to Part I.H.9 to allow the Executive Secretary to re-open and modify the Permit after approval of said sampling report, in particular Parts I.E.5 and I.F.6. The purpose of this action is to allow the collection of background groundwater head, flow, and water quality data during the operating life of the facility. This is important in that these seeps and springs form points of exposure for wildlife and the public where offsite groundwater contamination could be discharged. By way of clarification, it is not the Executive Secretary's intent to use this seep and spring sampling in lieu of compliance monitoring well sampling at the facility. Instead, it is to be used to complement that data collected from wells at the IUC facility, with the intent of establishing background water quality conditions at these surface water locations.

Recently IUC initiated its own sampling of Ruin Spring and sampled Cottonwood Spring on one occasion when water was available. At the time these samples were collected, these were the only seeps and springs IUC considered to have sufficient flow to allow sampling. Results of this sampling have yet to be reviewed by the DRC.

41. Deep Supply Well Plugging and Abandonment Plan (Part I.H.12) – after review of available well completion information, IUC was informed that the construction of a deep supply well, WW-2, located hydraulically upgradient of the mill site, was inadequate, in that it failed to provide an annular seal that would isolate the deep confined aquifer from the shallow unconfined aquifer (see 2/7/00 DRC Request for Additional information, pp. 7-9). This same DRC request also asked that this problem be investigated for all other deep supply wells at the IUC facility (ibid., p. 9). In response IUC agreed to consider several alternatives for well WW-2 at the time of mill decommissioning (9/8/00 IUC Response, p. 20). To this end, a new condition was added to the Permit in Part I.H.12 to require submittal of a work plan within 1 year of Permit issuance that would apply to all the deep supply wells at the facility. This mandate also provides: 1) a performance objective to ensure that both physical and hydraulic barriers are constructed in the deep supply wells at the time of plugging and abandonment to prevent hydraulic communication between the shallow unconfined and the deep confined aquifers, and 2) a requirement that the provisions of the approved plugging and abandonment plan on or before decommissioning of the uranium mill.

42. Facility DMT Monitoring Plan (Part I.H.13) – as described above, the Executive Secretary in issuance of this Permit has reviewed the existing engineering design and construction, determined the DMT design and performance standards (Parts I.D.1 and I.D.3), established DMT monitoring criteria (Part I.E.6), and established DMT reporting requirements (Part I.F.2). However, the Executive Secretary has not yet had the opportunity to review and approve the specific activities, procedures, and equipment that IUC will use to monitor and verify DMT compliance. In order to provide for this

opportunity, Part I.H.13 has been added to the Permit. Facilities that need to be examined in this plan include, but are not limited to: various wastewater level criteria for Tailings Cells 1, 2, 3 and the Roberts Pond; the Feedstock Storage Area restrictions, and secondary containment for mill site reagent storage.

Relatively short timeframes have been provided in order to accelerate IUC's implementation of DMT. Provisions have also been included in Part I.H.13 to allow the Executive Secretary to re-open and modify the Permit, so as to include all necessary monitoring procedures and equipment.

43. Tailings Cell 4A Reconstruction Schedule and Report (Part I.H.14) – as discussed above the Executive Secretary has determined it necessary to require IUC to continue to complete its removal of the contaminated materials and liner system in existing tailings Cell 4A. Over the past two (2) years IUC has been removing the raffinates and salts that have been stored in the cell, and disposing of them in tailings Cell 3. To ensure that this process is completed in a timely manner, a requirement has been added to Part I.H.14 to require IUC to submit a contaminant removal schedule for completion of this work for Executive Secretary approval. This new requirement also mandates periodic progress reports, and a final completion report that is to be submitted after contaminant removal is finished, for Executive Secretary approval. It is anticipated that adequate contaminant removal will include removal of all fluids, any residual salts or solids, the FML liner system, any underlying LDS, and all contaminated clay sub-liner and any contaminated sub-soils. During Permit preparation, it was agreed that IUC will perform a radiologic survey and/or uranium laboratory analysis of the clay sub-liner and if necessary any underlying soils found under Tailings Cell 4A to determine the total extent of any clay sub-liner or subsoil contamination. This approach is justified, in that under oxidizing or acidic conditions uranium is expected to by highly mobile in soils. Consequently, the Executive Secretary believes that uranium soil concentrations can be used as a tracer to estimate the vertical penetration of contaminants in the raffinates and salts once stored in Cell 4A. No approval of the final contamination removal report will be issued until the Executive Secretary is satisfied that any contaminants potentially released to the clay sub-liner or sub-grade soils via the FML leakage discussed above, have been adequately recovered and placed back into appropriate engineering control.

44. Tailings Cell 4A Redesign and Reconstruction (Part I.H.15) – although somewhat redundant with the provisions of Part I.D.4, this requirement has been added to emphasize the need for Executive Secretary approval before any re-construction of tailings Cell 4A, including: soil foundation or sub-base preparation, liner construction, or leak detection system construction. This section also allows the Executive Secretary to re-open and modify the Permit to add any necessary design, construction, operation, monitoring or reporting requirements for the revised cells.

45. Executive Secretary Findings Regarding Existing Facility Requirements – the GWQP Rules mandate that the Executive Secretary may issue a Permit for a facility that was constructed before adoption of the GWQP Rules in 1989, i.e., an "existing" facility, that certain provisions are met by the applicant, including [UAC R317-6-6.4(C)]:

"*...1. the applicant demonstrates that the applicable class TDS limits, ground water quality standards and protection levels will be met;*

2. the monitoring plan, sampling and reporting requirements are adequate to determine compliance with applicable requirements;

3. *the applicant utilizes treatment and discharge minimization technology commensurate with plant process design capability and similar or equivalent to that utilized by facilities that produce similar products or services with similar production process technology; and,*
4. *there is no current or anticipated impairment of present and future beneficial uses of the ground water."*

After consideration of the above discussion, the Executive Secretary believes the GWQP Rule requirements have been or will be met by the provisions of the draft Permit, as described below:

A. Applicable TDS Limits, GWQS, and GWPLs – the draft Permit establishes both GWQS and GWCLs for all related contaminants known to exist in the tailings wastewater effluent. On an interim basis, the GWCLs assigned herein were based on the factoring approach allowed in the GWQP Rules. Later, after completion and approval of the existing well Background Groundwater Quality Report (Part I.H.3), the Executive Secretary will establish a GWCL based on descriptive statistics ($X+2\sigma$) for all compliance parameters in Table 2 in each monitoring well. Future compliance monitoring at the facility will verify if IUC continues to meet these GWCLs at each well. If at sometime, one of more wells exceed its GWCL for TDS or any other Table 2 contaminant, enforcement action will be taken to ensure local groundwater quality is restored.

B. Monitoring Plan, Sampling and Reporting Requirements – groundwater monitoring at the facility is adequate in that all related contaminants known to exist in the tailings effluent at elevated concentrations have been selected for compliance sampling, and respective GWQS and GWCL have been established. DMT monitoring requirements have also been determined for each potential contaminant source at the facility. Although a certain number of monitoring wells need to be installed, and groundwater compliance and DMT monitoring plans need to be finalized and approved, the Executive Secretary has required these activities to be completed and the missing plans submitted for approval. Upon approval of these activities, completion by IUC, and submittal and approval of the required monitoring plans, the Executive Secretary will re-open and modify the permit to incorporate all necessary requirements. At that point, the approved monitoring plans will become enforceable appendices to the Permit, and the Permit will be complete in terms of providing adequate monitoring and reporting.

C. Satisfactory DMT – the review conducted herein has identified those aspects of existing facility design and construction that do not meet current standards. In turn, the Permit specifies new monitoring and operational improvements to minimize the potential for discharge of contaminants to native soils and groundwater from several potential sources at the facility, including the tailings cells, wastewater ponds, feedstock storage areas, etc.

D. Impairment of Beneficial Uses of Groundwater –This determination will be made by the Executive Secretary after IUC completes two major efforts: 1) Improvements to the existing monitoring well network, including addition of new wells to provide more discrete and more rapid detection of potential seepage release from the tailings cells, and establishment of an approved groundwater monitoring quality assurance plan to enhance reliability of reported monitoring results, and 2) Submittal of a Background Groundwater Quality Report to provide a comprehensive evaluation of local groundwater quality conditions. After review of this report, the Executive Secretary will re-open the Permit and modify the GWCLs to reflect natural groundwater conditions, or may take enforcement actions as necessary to protect local groundwater quality and all related current or future beneficial uses of groundwater. In either case, a public review and comment period will be provided, either for a modified Permit, or at the time of approval of any groundwater corrective action plan that may be required.

With regards to possible future groundwater quality impairment, infiltration, groundwater flow, and contaminant transport modeling will be provided by IUC to predict future compliance by the facility. The Permit requires that these types of models be used to evaluate the existing NRC approved Reclamation Plan for the facility, and stipulates minimum performance criteria for the same. If the modeling indicates that these minimum performance criteria will not be met, then:

1. Changes to the tailings cell cover design will be implemented by the Executive Secretary in the Reclamation Plan under the State License, and
2. The input values to these models will become the design basis for the final engineering design, specifications, and construction parameters for the cover system at the reclaimed facility.

Attachments (11)

F:/.../IUCgwpSOB2f.doc
File: IUC Ground Water Permit

LBM:lm

References

D'Appolonia Consulting Engineers, Inc., February, 1982, "Construction Report Initial Phase - Tailings Management System White Mesa Uranium Project Blanding, Utah Energy Fuels Nuclear Inc. Denver, Colorado", unpublished consultants report, approximately 7 pp., 6 tables, 13 figures, 4 appendices.

Dames & Moore, January 30, 1978, "Environmental Report White Mesa Uranium Project San Juan County, Utah for Energy Fuels Nuclear, Inc., unpublished consultants report, approximately 549 pp., 9 appendices.

Deutsch, W. and P. Longmire, February, 1997, "Practical Applications of Groundwater Geochemistry", National Ground Water Association seminar proceedings, Denver, CO, approximately 988 pp.

Energy Fuels Nuclear, Inc., March, 1983, "Construction Report Second Phase Tailings Management System White Mesa Uranium Project Energy Fuels Nuclear, Inc.", unpublished company report, 18 pp., 3 tables, 4 figures, 5 appendices.

Hem, J.D., 1985, Study and Interpretation of the Chemical Characteristics of Natural Water", 3rd Edition, USGS Water Supply Paper 2254, 264 pp.

Hintze, L.F., 1988, Geologic History of Utah, Brigham Young University Geology Studies Special Publication 7, 202 pp.

Hydro Geo Chem, Inc., May 8, 2002, letter report of as-built details for monitoring wells and piezometers at the IUC White Mesa uranium mill, unpublished consultants report from Stewart J. Smith to Michelle Rehmann, includes May 9, 2002 transmittal letter by David C. Frydenlund of International Uranium Corporation to William J. Sinclair, 2 pp.

Hydro Geo Chem, Inc., January 30, 2003,"Site Hydrogeology and Estimation of Groundwater Travel Times in the Perched Zone White Mesa Uranium Mill Site Near Blanding, Utah", unpublished consultants report, 18 pp., 2 tables, 7 figures.

Hydro Geo Chem, Inc., March 25, 2004, untitled letter from Stewart Smith to Harold Roberts, 4 pp.

Hydro Geo Chem, Inc., October 19, 2004, letter report from Stewart Smith to Harold Roberts on well specific groundwater average linear velocity, 3 pp., 1 table, 2 figures; includes an October 20, 2004 International Uranium (USA) Corporation transmittal letter from David C. Frydenlund to Loren Morton, 1 p.

International Uranium Corporation, March, 1990, "White Mesa Mill's Ground Water QA Project Plan, Rev. 2", unpublished company plan, 17 pp., includes February 24, 1999 transmittal letter from Michelle R. Rehmann to William J. Sinclair, 2 pp.

International Uranium Corporation, May 28, 1999, "Groundwater Information Report White Mesa Uranium Mill Blanding, Utah", unpublished company report, 113 pp., 12 tables, 15 figures, 8 attachments.

International Uranium Corporation, September 30, 1999, "Chloroform Source Assessment Report", unpublished company report by Michelle Rehmann, 13 pp., 2 figures, and 2 appendices.

International Uranium Corporation, August, 2000, "Construction Report Tailings Cell 4A White Mesa Uranium Mill – Tailings Management System", unpublished company report, 13 pp., 2 figures, 12 attachments, 14 photographs.

International Uranium Corporation, September 8, 2000, "Groundwater Information Report Revision Package", unpublished company report, 31 pp., 11 attachments, includes September 8, 2000 transmittal letter from David C. Frydenlund to William J. Sinclain, 2 pp.

International Uranium Corporation, June 22, 2001, "March 20, 2001 UDEQ Letter and Request for Additional Site Hydrogeology Information in Response to IUSA September 8, 2000 Revised Groundwater Information Report; Groundwater Discharge Permit for White Mesa Mill; Followup to May 11, 2001 Letter from David C. Frydenlund to William J. Sinclair", unpublished company response, 20 pp., 14 attachments.

International Uranium Corporation, July 17, 2001, "Draft Spill Management Plan, Groundwater Discharge Permit Application for White Mesa Mill", includes three plans: 1) July 17, 2001 Stormwater Best Management Practices Plan, 7 pp., 4 figures, 1 table, and 2 Appendices (Appendix 1: July 17, 2001 :Spill Prevention, Control, and Countermeasures for Chemicals and Petroleum Products", 14 pp., 6 tables, 2 figures; and Appendix 2: April 29, 1998 "Emergency Response Plan", 15 pp., 4 exhibits, 2 appendices, 1 figure, 1 table).

International Uranium Corporation, September 7, 2001, "Updated Topographic Map, Groundwater Discharge Permit Application for White Mesa Mill", unpublished company letter from Harold R. Roberts to William J. Sinclair, 1 p., includes map and 4 spreadsheets.

International Uranium Corporation, May 31, 2002, "Pond Solution Sampling Workplan White Mesa Uranium Mill Site Near Blanding, Utah", unpublished company work plan, 4 pp., includes May 31, 2002 transmittal letter from Michelle Rehmann to William J. Sinclair, 2 pp.

International Uranium Corporation, September 6, 2002, "Transmittal of Brushy Basin Contour Map, White Mesa Mill Site Utah DEQ Notice of Violation and Groundwater Corrective Action Order UDEQ Docket No. UGQ-20-01 of August 23, 1999", transmittal letter (2 pp.) and unpublished company contour map.

International Uranium Corporation, October 15, 2002, "Water Level Map and Resolution of Increasing Water Levels Observed in MW-4, Utah DEQ Notice of Violation and Groundwater Corrective Action Order, UDEQ Docket No. UGQ-20-01 of August 23, 1999", unpublished company submittal, 2 pp., 1 map, 50 pages of water level data.

International Uranium Corporation, December 20, 2002, "November, 2002 Letter from Utah Department of Environmental Quality to International Uranium Corporation Regarding November, 2001 Split Sampling Results for the White Mesa Uranium Mill", unpublished company response, 4 pp., 2 attachments.

International Uranium Corporation, August 31, 2004, "International Uranium (USA) Corporation Source Material License No. SUA-1358 White Mesa Mill, Blanding, Utah Semi-Annual Effluent Monitoring Report for Period January 1, 2004 through June 30, 2004", unpublished company monitoring report, 3 pp., 7 attachments, includes transmittal letter from Ron Berg to Mr. Dane Finerfrock, 2 pp.

International Uranium Corporation, October 17, 2003, "September 16, 2003 Letter from the Utah Department of Environmental Quality, Division of Water Quality to International Uranium (USA) Corporation", unpublished company response, 3 pp., 2 attachments.

International Uranium Corporation, February 19, 2004, "Supporting Information for GWDP", email correspondence from Harold Roberts to Loren Morton, 1 p. 3 attachments.

National Library of Medicine, Hazardous Substances Data Bank, part of the Toxnet System, found on the internet at: http://toxnet.nlm.nih.gov/.

Pankow, J.F. and J.A. Cherry, 1996, Dense Chlorinated Solvents and Other DNAPLs in Groundwater, Waterloo Press, Portland, Oregon, 522 pp.

Risher, J.F. and S.W. Rhodes, June, 1995, "Toxicological Profile for Fuel Oils", U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, 231 pp., 2 appendices, found on internet at: www.atsdr.cdc.gov/toxprofiles/tp75-c3.pdf.

Thomas, D. and J.J. Delfino, Fall, 1991, "A Gas Chromatographic / Chemical Indicator Approach to Assessing Groundwater Contamination by Petroleum Products", Ground Water Monitoring Review, National Ground Water Association, pp. 90-100.

Titan Environmental Corporation, July, 1994, "Hydrogeologic Evaluation of White Mesa Uranium Mill", unpublished consultants report, approximately 51 pp., 5 tables, 19 figures, 7 appendices.

Titan Environmental Corporation, September, 1994, "Points of Compliance White Mesa Uranium Mill", unpublished consultants report, 13 pp., 1 table, 4 figures, 3 appendices.

Umetco Minerals Corporation, April 10, 1989, "Cell 4 Design", unpublished company report, includes: 1) April 10, 1989 letter from Curtis O. Sealy to Edward F. Hawkins, 1 pp., with 60 pp. of technical response materials, and 2) August, 1988 Umetco Minerals Corporation "Cell 4 Design Tailings Management System", unpublished company report, 17 pp., 2 attachments, and 2 appendices.

Umetco Minerals Corporation and Peel Environmental Services, January, 1993, "Groundwater Study White Mesa Facility Blanding, Utah", unpublished company and consultants report, approximately 54 pp., 5 appendices.

Umetco Minerals Corporation, June, 1994, "Groundwater Study 1994 Update White Mesa Facility Blanding, Utah", unpublished company report, 51 pp., 6 appendices.

United States Code of Federal Regulations, Title 10, Chapter 1 – Energy, "Domestic Licensing of Source Material", Part 40 (10 CFR 40), Appendix A "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content", available on the internet at: http://www.nrc.gov/reading-rm/doc-collections/cfr/.

United States Court of Appeals, District of Columbia Circuit, February 25, 2003, Docket Nos. 01-1028, 01-1033, 01-1034, and 01-1037, City of Waukesha; Village of Sussex Water Commission; Radiation, Science & Health; Nuclear Energy Institute, Inc.; and the National Mining Association versus Environmental Protection Agency, 49 pp., available on the Internet at: http://www.epa.gov/newsroom/headline_022603.htm, and at http://pacer.cadc.uscourts.gov/docs/common/opinions/200302/01-1028a.pdf

United States Environmental Protection Agency, September, 1986, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, Office of Solid Waste and Emergency Response, OSWER-9950.1, 208 pp., 3 appendices.

United States Environmental Protection Agency, February, 1989, "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance", Office of Solid Waste, approximately 146 pp.

United States Environmental Protection Agency, January, 1995, "Technical Resource Document Extraction and Beneficiation of Ores and Minerals Volume 5 Uranium", EPA 530-R-94-032, 74 pp., 3 appendices.

United States Environmental Protection Agency, Region 8, August 24, 1999, "Toxicity of Tetrahydrofuran", unpublished agency memo from Robert Benson, Ph.D. to Loren Morton, Utah DEQ, 1 p., 2 attachments.

United States Environmental Protection Agency, January 4, 2000, technical correspondence letter from Mr. Robert Benson, EPA Region 8 drinking water program toxicologist to Loren Morton, Utah Division of Radiation Control, 2 pp.

United States Environmental Protection Agency, Summer, 2002 "Drinking Water Standards and Health Advisories", EPA 822-R-02-038, 12 pp., available on the Internet at http://www.epa.gov/waterscience/drinking/standards/dwstandards.pdf.

United States Environmental Protection Agency, Region 8, May 29, 2003, "Lifetime Health Advisory and Cancer Risk for Chloroform", unpublished agency memorandum from Robert Benson, Ph.D. to Loren Morton, Utah DEQ, 2 pp.

United States Nuclear Regulatory Commission, May, 1979, "Final Environmental Statement Related to Operation of White Mesa Uranium Project Energy Fuels Nuclear, Inc., Docket

No. 40-8681", NUREG-0556, Office of Nuclear Material Safety and Safeguards, approximately 290 pp.

United States Nuclear Regulatory Commission, September, 1980, "Final Generic Environmental Impact Statement on Uranium Milling Project M-25, Appendices G-V", NUREG-0706, Vol. III, Office of Nuclear Material Safety and Safeguards, approximately 238 pp.

United States Nuclear Regulatory Commission, September 23, 2002, "Source Material License No. SUA-1358, Docket No. 040-8681, Amendment No. 22", agency license to International Uranium Corporation for Uranium Mill at White Mesa, Utah, 11 pp.

United States Nuclear Regulatory Commission, March 7, 2003, "Response to Questions in January 14, 2003 Letter from William Sinclair", agency response letter from Paul H. Lohaus to William J. Sinclair, 3 pp.

Utah Department of Environmental Quality, July 18, 1996, "Information Needs Summary for Atlas Corporation Moab Uranium Mill Ground Water Contaminant Investigation Report and Ground Water Corrective Action Plan, as found in the Utah Ground Water Quality Protection Regulations (UAC R317-6-6.15)", 24 pp., found as an attachment to a September 12, 1996 Utah Division of Radiation Control letter from William J. Sinclair and Don A. Ostler to Richard E. Blubaugh, 6 pp.

Utah Division of Radiation Control, February 7, 2000, "May, 1999 IUC Groundwater Information Report: DRC Request for Additional Information Related to Site Hydrogeology", unpublished agency request, 2 pp. transmittal letter, includes Utah Division of Radiation Control technical information request of February 7, 2000 "Request for Additional Information Related to Site Hydrogeology", 18 pp., 2 attachments.

Utah Division of Radiation Control, June 27, 2000, "International Uranium Corporation White Mesa Uranium Tailings Facility: Engineering Design and As-Built Reports; Staff Findings, Conclusions, and Recommendations", unpublished agency technical memorandum, 29 pp., 5 attachments.

Utah Division of Radiation Control, March 20, 2001, "September 8, 2000 IUC Revised Groundwater Information Report: Ground Water Discharge Permit Application for White Mesa Mill: Request for Additional Site Hydrogeology Information", unpublished agency request for information, 10 pp., 3 attachments.

Utah Division of Radiation Control, June 7, 2001, "October 4, 2000 IUC and HGC Investigation of Elevated Chloroform Concentrations in Perched Groundwater at the White Mesa Uranium Mill Near Blanding, Utah: August 23, 1999 Utah Division of Water Quality Notice of Violation and Groundwater Corrective Action Order; Docket No. UGW20-01: Request for Additional Information.", unpublished agency information request, 12 pp., 8 attachments.

Utah Division of Radiation Control, October 26, 2001, "September 21, 2001 NRC Draft Environmental Assessment Regarding Maywood New Jersey FUSRAP Site: IUC White

Mesa Uranium Mill Near Blanding, Utah", unpublished agency comment letter from William J. Sinclair to Melvyn Leach, U.S. NRC, 5 pp.

Utah Division of Radiation Control, November 15, 2001, "Recent Meetings and Conference Call with International Uranium Corporation Regarding Hydrogeologic Conditions at White Mesa Mill, October 4, 18, and 24, 2001", unpublished agency technical memorandum, 16 pp., 3 attachments.

Utah Division of Radiation Control, April 11, 2002, "November 9, 2001 IUC Update Report on Ongoing Chloroform Investigation at White Mesa Uranium Mill; August 23, 1999 Division of Water Quality Notice of Violation and Groundwater Corrective Action Order, Docket No. UGW20-01: Request for Additional Information", unpublished agency information request, 18 pp., 5 attachments.

Utah Division of Radiation Control, July 3, 2002, "IUC: 5/31/02 Tailings Pond Wastewater Sampling Workplan – DRC Comments", unpublished agency comments, email transmittal from Loren Morton to Harold Roberts, 2 pp.

Utah Division of Radiation Control, November 22, 2002, "November, 2001 Groundwater Split Sampling Event at IUC White Mesa Uranium Mill Near Blanding, Utah: Utah DEQ Request for Additional Information", unpublished agency information request, 4 pp., 7 attachments.

Utah Division of Radiation Control, April 30, 2003, "November, 2001 Split Sampling Event at IUC White Mesa Uranium Mill: DRC Staff Review and Conclusions", unpublished agency memorandum report, 44 pp., 7 tables, 29 attachments.

Utah Division of Radiation Control, September 16, 2003, "December 20, 2002 IUC Response Regarding Recent Detection of Tetrahydrofuran Concentrations in Groundwater at the White Mesa Uranium Mill: Request for Work Plan", unpublished agency information request, 3 pp., 2 attachments.

Utah Division of Radiation Control, November 12, 2003, "October 17, 2003 IUC Response to September 16, 2003 DRC Request for Work Plan; THF Contamination of Several Monitoring Wells at White Mesa Uranium Mill: Request for Work Plan", 5 pp, 5 attachments.

Utah Division of Radiation Control, November 26, 2003, "IUC: Groundwater Protection Level Statistics and Accelerated Monitoring Frequency", email correspondence from Loren Morton to David Frydenlund, 2 pp.

Utah Division of Radiation Control, September 21, 2004, "Review of IUC Report – 'Site Hydrogeology and Estimation of Groundwater Travel Times in the Perched Zone White Mesa Uranium Mill Site Near Blanding, Utah', January 30, 2003 by Hydro Geo Chem, Inc.", unpublished agency technical memorandum, 6 pp., 4 figures, 7 tables.

Utah Division of Radiation Control, November 23, 2004, "Review of Hydro Geo Chem Inc Report – Report on Perched Zone Water Movement, White Mesa Uranium Mill Site Near

Blanding, Utah, October 20, 2004", unpublished agency technical memorandum, 4 pp., 2 tables, 5 figures.

Utah Division of Water Quality, August 8, 1994, "Basis for Revised Ground Water Protection Levels: New Parameters and Revised Shallow Ground Water Quality Statistics", unpublished staff report, 39 pp., 23 attachments.

Utah Division of Water Quality, August 23, 1999, "Notice of Violation and Groundwater Corrective Action Order; Docket No. UGW20-01: Request for Additional Information.", unpublished agency order and information request, 12 pp., 8 attachments.

Utah Division of Water Quality, June 12, 2003, "Chloroform Standard for White Mesa Mill Corrective Action", unpublished agency memorandum from Don Ostler to Bill Sinclair, 1 p.

Utah Division of Water Quality, September 16, 2003, "December 20, 2002 IUC Response Regarding Recent Detection of Tetrahydrofuran Concentrations in Groundwater at the White Mesa Uranium Mill: Request for Work Plan", unpublished agency information request from William J. Sinclair to Harold Roberts, 3 pp., 2 attachments.

Ute Mountain Ute Tribe, July 1, 2003, "White Mesa Seep Sampling", unpublished tribal email from Scott Clow to Loren Morton, 2 pp.

DRAFT

ATTACHMENT 1

<u>Utah Division of Radiation Control</u>

Water Table Contour Maps
For the September, 2002 Split Sampling Event
At the IUC White Mesa Uranium Mill
Near Blanding Utah.

DRC Surfer Maps: 9-02h.srf, 9-02h_b.srf, and 9-02h_c.srf,
and DRC spreadsheet GWHEAD.XLS, tabsheet 9-02

DRAFT

ATTACHMENT 2

Utah Division of Radiation Control

Summary of Shallow Aquifer TDS Concentrations
At the IUC White Mesa Uranium Mill
Near Blanding Utah.

DRC Spreadsheet GWclass.xls, tabsheets Sum, HistSum, and HistSumELI

DRAFT

ATTACHMENT 3

Utah Division of Radiation Control

Summary of IUC Wells and Parameters
That Exceed their Respective GWQS
At the IUC White Mesa Uranium Mill
Near Blanding Utah.
(based on DRC/IUC split sampling results)

DRC spreadsheet GWclass.xls, tabsheet Exceed

DRAFT

ATTACHMENT 4

<u>Utah Division of Radiation Control</u>

Time Series Concentration Graphs of
Natural Uranium Contamination in
IUC White Mesa Mill
Groundwater Monitoring Wells
MW-14, MW-15, and MW-17

From August 31, 2004 IUC Semi-Annual Effluent Monitoring Report,
Groundwater Statistical Analysis by Shewhart-Cusum Method June 30, 2004 Section

DRAFT

ATTACHMENT 5

Utah Division of Radiation Control

Shallow Aquifer Uranium 238 Isoconcentration Map
For the September, 2002 Groundwater Split Sampling Event at the
IUC White Mesa Uranium Mill Facility
Near Blanding, Utah

DRC Surfer Contour Maps: U238_9-02.srf and U238_9-02b.srf
DRC Excel spreadsheet U-238.xls, tabsheet 9-02

DRAFT

ATTACHMENT 6

Utah Division of Radiation Control

Summary of IUC Tailings Cells
Historic Wastewater Quality Data
From the White Mesa Uranium Mill
Near Blanding Utah.

DRC spreadsheet TailsWQ.xls, tabsheet NewSum

DRAFT

ATTACHMENT 7

Utah Division of Radiation Control

Summary of Literature Values for
Soil-Water Partitioning (K_d) Coefficients for Metals

DRC spreadsheet 11E2KdSum.xls
Tabsheet: Metals

DRAFT

ATTACHMENT 8

Utah Division of Radiation Control

Summary of Literature Values for
Organic Carbon Partitioning Coefficients (K_{oc})
Soil-Water Partitioning (K_d) Coefficients for Organics

DRC spreadsheet 11E2KdSum.xls
Tabsheet: Org-Koc

DRAFT

ATTACHMENT 9

Utah Division of Radiation Control

Summary of Detectable Organic Contaminants
Found in Utah DRC Split Groundwater Samples
Colleted from the IUC White Mesa Uranium Mill Site
From May, 1999 thru September, 2002

DRC spreadsheet Splitsum.xls
Tabsheet: Organics

DRAFT

ATTACHMENT 10

Utah Division of Radiation Control

Summary of Groundwater Quality
Split Sampling Results
For Selected Volatile Organic Contaminants
From the IUC White Mesa Uranium Mill,
May, 1999 thru September, 2002

DRC spreadsheets: Benzene.xls, CTC.xls, and THF.xls
Tabsheets: HistSum

DRAFT

ATTACHMENT 11

International Uranium (USA) Corporation

April 16, 2004
Proposed Groundwater Monitoring Well Location Map

Received by the
Utah Division of Radiation Control
On April 20, 2004

DRAFT

ATTACHMENT 12

Utah Division of Radiation Control

Groundwater Velocity Contour Map
(based on IUC velocity data)

From November 23, 2004
Utah Division of Radiation Control
Memorandum, Figure 2

DRAFT

ATTACHMENT 1

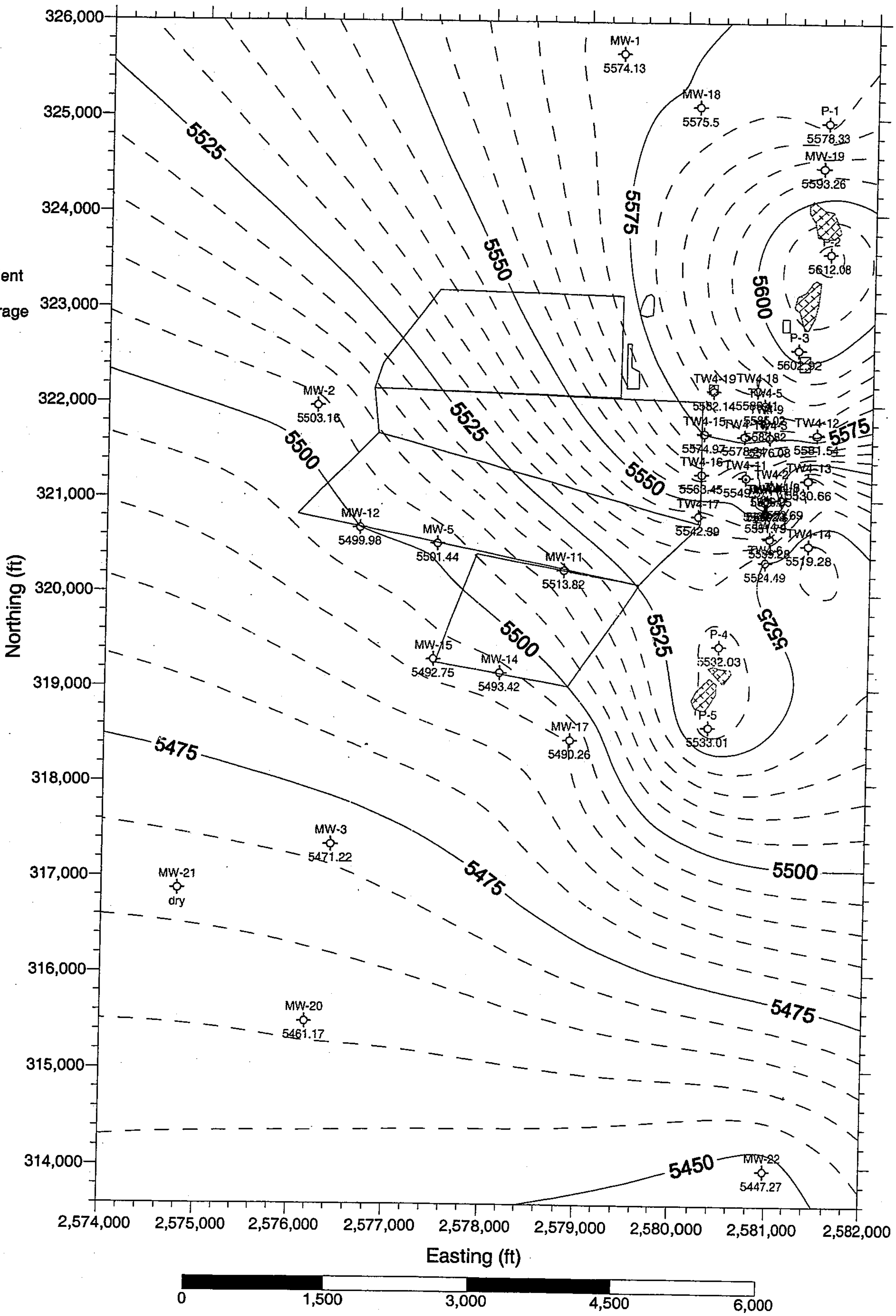
Utah Division of Radiation Control

Water Table Contour Maps
For the September, 2002 Split Sampling Event
At the IUC White Mesa Uranium Mill
Near Blanding Utah.

DRC Surfer Maps: 9-02h.srf, 9-02h_b.srf, and 9-02h_c.srf,
and DRC spreadsheet GWHEAD.XLS, tabsheet 9-02

IUC White Mesa Mill
Water Table Contour Map: September, 2002
Interpolation Method: Kriging (omni-directional)

No Downgradient Monitoring Well Coverage at Tailings Cell 1.



Groundwater Flow Direction Reversal Apparent at Both Mounds, Near P-4 and P-1/MW-19/P-2.

Checkered Figures = Wildlife Ponds

Diagonal Stripes = Leachfields

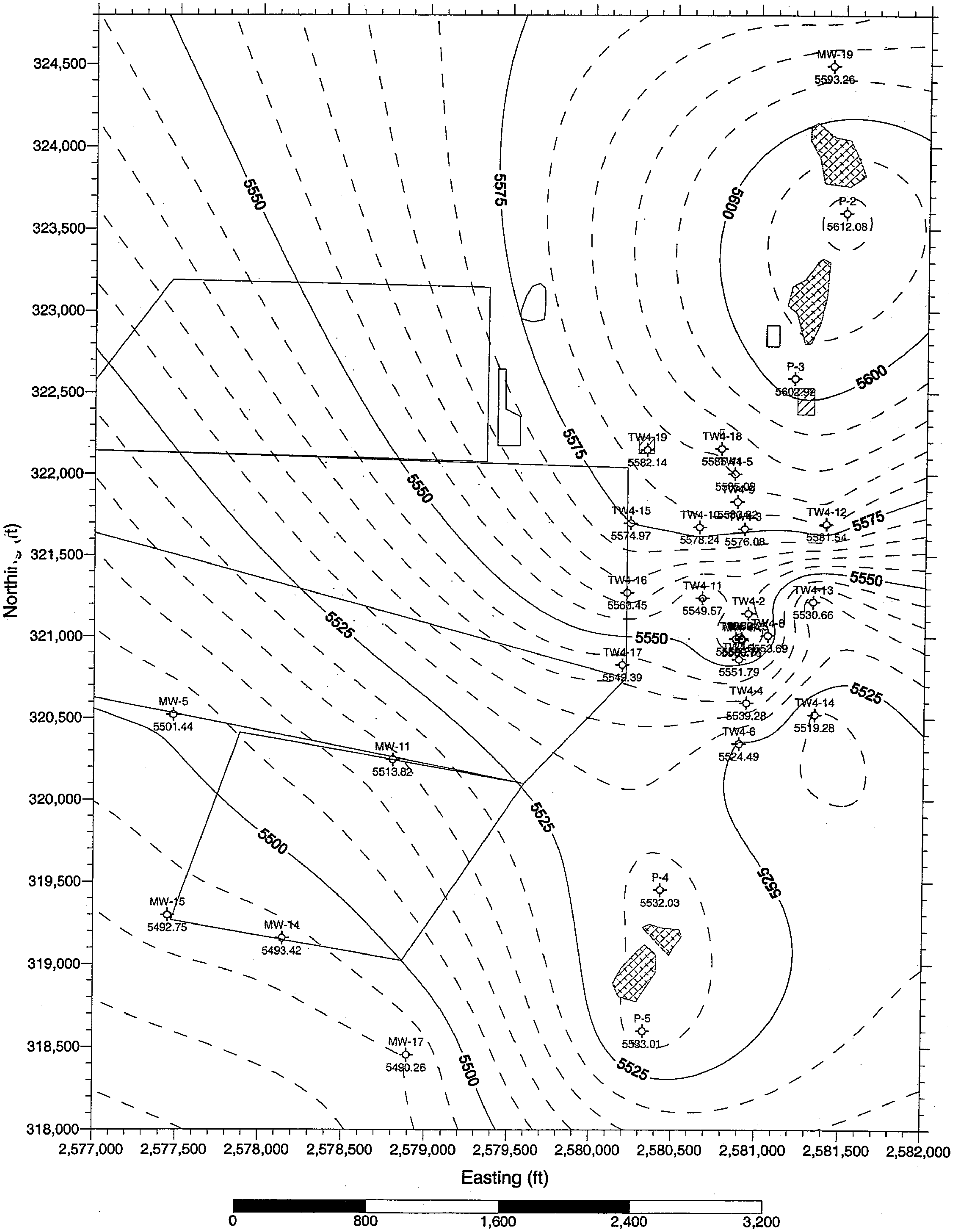
Water Table "Highs" at wells (ft amsl): P-2 (5,612.08), P-4 (5,532.03), P-5 (5,533.01)

Contour Interval = 5 feet

9-02h.srf

IUC White Mesa Mill
Water Table Contour Map: September, 2002

Interpolation Method: Kriging (omni-directional)



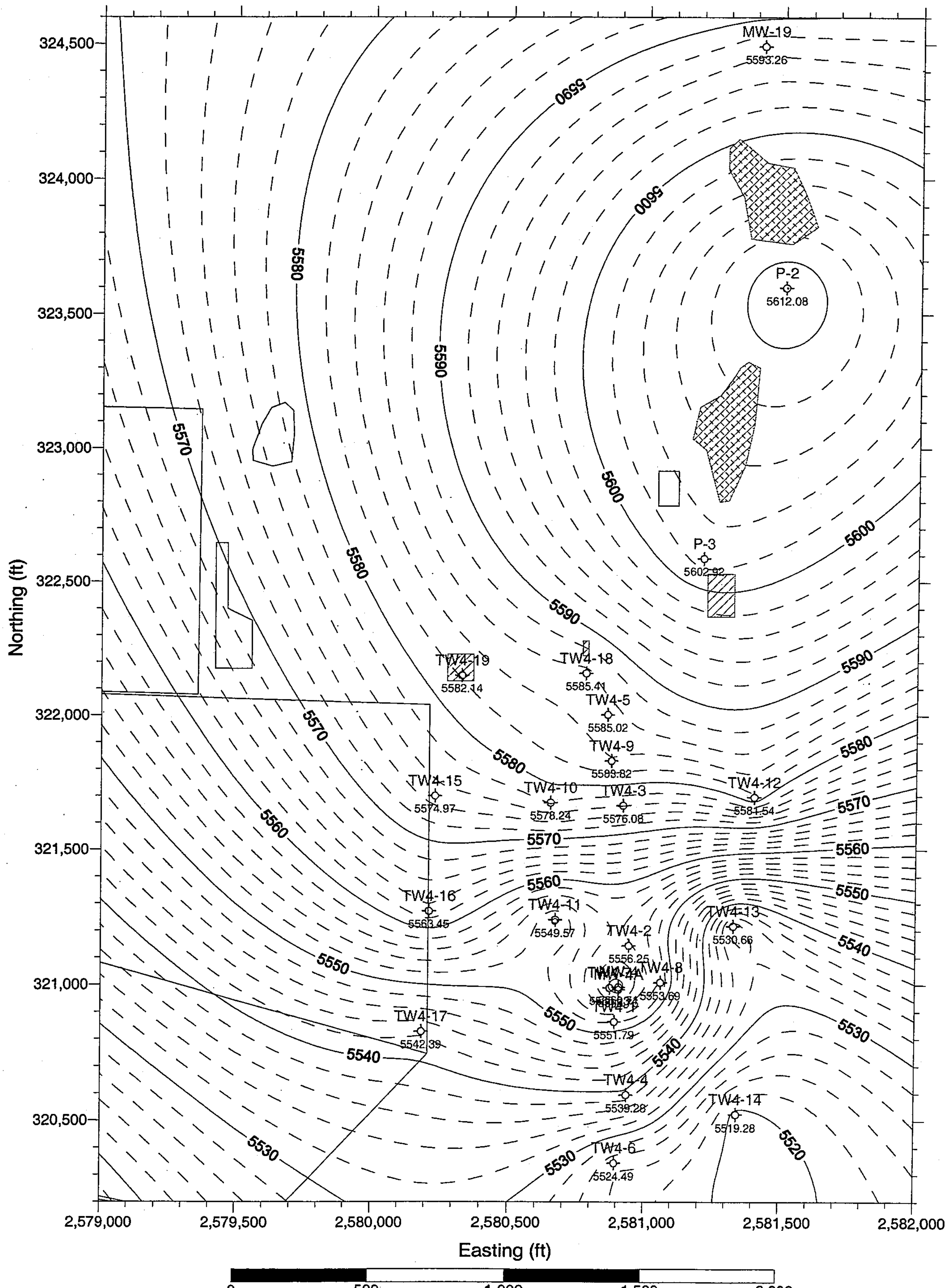
Checkered Figures = Wildlife Ponds

Diagonal Stripes = Leachfields

Contour Interval = 5 feet

9-02h_b.srf

IUC White Mesa Mill
Water Table Contour Map: September, 2002
Interpolation Method: Kriging (omni-directional)



Checkered Figures = Wildlife Ponds

Diagonal Stripes = Leachfields

GW "Lows" apparent at: TW4-18, TW4-11, TW4-13, & TW4-14

GW "Highs" Apparent at P-2, MW-4, MW-4A, & TW4-7

Contour Interval = 2 feet

9-02h_c.srf

	A	B	C	D	E	F	G	H	I
1	**International Uranium Corporation: Groundwater Water Level Elevations**								
2	Sample Date = 9/9-13/02			W.L. Meas.					
3	Well	Easting	Northing	Pt. Elev.	GW Depth	GW Elev.	Sample		
4	ID	(ft)	(ft)	(ft amsl)	(ft bmp)	(ft amsl)	Date		
5	MW-1	2,579,330.42	325,671.85	5,647.63	73.50	5,574.13	9/9/02		
6	MW-2	2,576,209.93	321,969.45	5,613.14	109.98	5,503.16	9/10/02		
7	MW-3	2,576,417.05	317,340.58	5,554.83	83.61	5,471.22	9/9/02		
8	MW-4	2,580,905.96	320,991.17	5,622.33	61.62	5,560.71	9/12/02		
9	MW-4A	2,580,906.21	320,981.40	5,622.31	61.55	5,560.76	9/13/02		
10	MW-5	2,577,478.42	320,519.12	5,608.97	107.53	5,501.44	9/9/02		
11	MW-11	2,578,798.10	320,245.47	5,610.80	96.98	5,513.82	9/10/02		
12	MW-12	2,576,665.06	320,683.29	5,609.15	109.17	5,499.98	9/9/02		
13	MW-14	2,578,142.39	319,156.70	5,598.14	104.72	5,493.42	9/10/02		
14	MW-15	2,577,451.00	319,296.30	5,599.91	107.16	5,492.75	9/10/02		
15	MW-17	2,578,892.21	318,453.44	5,575.09	84.83	5,490.26	9/9/02		
16	MW-18	2,580,133.04	325,121.34	5,657.51	82.01	5,575.50	9/9/02		
17	MW-19	2,581,423.33	324,491.73	5,654.96	61.70	5,593.26	9/9/02		
18	MW-20	2,576,169.80	315,490.81	5,540.60	79.43	5,461.17	9/12/02		
19	MW-21	2,574,794.90	316,871.69	5,562.35		dry			
20	MW-22	2,580,981.05	313,968.74	5,517.47	70.20	5,447.27	9/12/02		
21	P-1	2,581,464.43	324,962.43	5,655.46	77.13	5,578.33	9/9/02		
22	P-2	2,581,506.11	323,598.63	5,628.68	16.60	5,612.08	9/9/02		
23	P-3	2,581,209.74	322,587.47	5,637.96	35.04	5,602.92	9/9/02		
24	P-4	2,580,427.43	319,451.42	5,591.33	59.30	5,532.03	9/9/02		
25	P-5	2,580,325.62	318,598.20	5,584.38	51.37	5,533.01	9/9/02		
26	TW4-1	2,580,890.59	320,862.99	5,618.58	66.79	5,551.79	9/11/02		
27	TW4-2	2,580,943.64	321,143.99	5,624.72	68.47	5,556.25	9/11/02		
28	TW4-3	2,580,918.88	321,663.86	5,632.23	56.15	5,576.08	9/10/02		
29	TW4-4	2,580,936.51	320,594.77	5,613.49	74.21	5,539.28	9/11/02		
30	TW4-5	2,580,859.24	322,002.88	5,640.70	55.68	5,585.02	9/11/02		
31	TW4-6	2,580,893.58	320,343.83	5,608.78	84.29	5,524.49	9/10/02		
32	TW4-7	2,580,872.64	320,988.26	5,621.07	60.84	5,560.23	9/13/02		
33	TW4-8	2,581,060.74	321,007.97	5,621.40	67.71	5,553.69	9/11/02		
34	TW4-9	2,580,874.19	321,831.07	5,637.59	53.77	5,583.82	9/11/02		
35	TW4-10	2,580,649.25	321,674.47	5,634.24	56.00	5,578.24	9/11/02		
36	TW4-11	2,580,669.10	321,238.89	5,623.62	74.05	5,549.57	9/12/02		
37	TW4-12	2,581,403.10	321,694.82	5,624.23	42.69	5,581.54	9/12/02		
38	TW4-13	2,581,328.24	321,215.86	5,619.94	89.28	5,530.66	9/12/02		
39	TW4-14	2,581,342.44	320,523.11	5,612.77	93.49	5,519.28	9/12/02		
40	TW4-15	2,580,231.28	321,699.03	5,625.45	50.48	5,574.97	9/13/02		
41	TW4-16	2,580,212.11	321,271.06	5,624.02	60.57	5,563.45	9/13/02		
42	TW4-17	2,580,186.31	320,826.86	5,625.24	82.85	5,542.39	9/13/02		
43	TW4-18	2,580,777.15	322,157.43	5,641.28	55.87	5,585.41	9/12/02		
44	TW4-19	2,580,327.20	322,149.35	5,631.39	49.25	5,582.14	9/12/02		
45									TW Wells
46	Min:	2,574,794.90	313,968.74		16.60		9/9/02		42.69
47	Max:	2,581,506.11	325,671.85		109.98		9/13/02		93.49
48	Avg.:				71.18				
49	Count:		40		39				
50									
51	delta (ft)	6,711.21	11,703.11		93.38				50.80

DRAFT

ATTACHMENT ~~1~~2

Utah Division of Radiation Control

Summary of Shallow Aquifer TDS Concentrations
At the IUC White Mesa Uranium Mill
Near Blanding Utah.

DRC Spreadsheet GWclass.xls, tabsheets Sum, HistSum, and HistSumELI

Groundwater Classification Summary: Shallow Aquifer TDS Concentrations at IUC White Mesa Uranium Mill

[...]s based on both historic IUC and recent IUC and DRC groundwater quality data

Class II Groundwater
(500 mg/l > TDS < 3,000 mg/l)

	Average TDS (mg/l)					
	IUC Data (1)			Recent DRC Data (2)		
Well ID	Avg. Conc.	Std. Dev.	No. of Samples (3)	Avg. Conc.	Std. Dev.	No. of Samples (3)
Historic or Original IUC Monitoring Wells						
MW-1	1,276	101.8	68	1,268	22.3	4
MW-5	2,081	210.9	69	2,068	138.6	4
MW-11	1,834	238.4	50	2,039	155.1	4
MW-18	2,545	280.7	9	2,611	232.6	4
MW-19 (4)	2,697	765.4	9	3,120	467.1	4
MW-20	2,977	n/a	1	n/a	n/a	n/a
Recently Installed IUC Monitoring Wells (5)						
MW-4A	2,410	n/a	1	2,740	n/a	1
TW4-2	2,967	251.1	3	2,997	222.7	4
TW4-5	2,423	362.0	3	2,441	392.3	3
TW4-8	2,640	158.7	3	2,767	89.3	3
TW4-9	2,523	120.1	3	2,608	113.0	3
TW4-10	2,490	n/a	1	2,846	n/a	1
TW4-12	597	n/a	1	608	n/a	1
TW4-13	891	n/a	1	942	n/a	1
V4-14 (5)	TBD					
TW4-18	2,700	n/a	1	2,798	n/a	1
TW4-19	2,250	n/a	1	2,600	n/a	1

Class III Groundwater
(TDS > 3,000 mg/l)

	Average TDS (mg/l)					
	IUC Data (1)			Recent DRC Data (2)		
Well ID	Avg. Conc.	Std. Dev.	No. of Samples (3)	Avg. Conc.	Std. Dev.	No. of Samples (3)
MW-2	3,031	286.3	67	3,103	47.0	4
MW-3	5,200	310.2	67	5,289	103.0	4
MW-4	3,408	205.8	68	3,134	286.5	4
MW-12	3,939	244.7	50	3,756	209.2	4
MW-14	3,582	268.5	30	3,589	85.7	4
MW-15	3,855	264.4	30	3,847	110.5	4
MW-17	4,538	298.0	11	4,542	70.7	4
MW-22	5,105	n/a	1	n/a	n/a	n/a
TW4-1	3,240	330.5	3	3,306	420.8	4
TW4-3	3,287	116.8	3	3,302	102.3	3
TW4-4	3,085	473.8	2	3,326	130.1	2
TW4-6	3,443	379.0	3	3,763	77.1	3
TW4-7	3,643	204.3	3	3,790	38.2	3
TW4-11	3,020	n/a	1	3,402	n/a	1
TW4-15	3,120	n/a	1	3,206	n/a	1
TW4-16 (6)	2,930	n/a	1	3,430	n/a	1
TW4-17	3,190	n/a	1	3,650	n/a	1

Count of Wells:

Class II	16
Class III	17

Footnotes:

1) For the historic or original IUC wells, the average total diissolved solids (TDS) concentration and standard deviation are based on historic IUC groundwater quality data for the period of October, 1979 thru May, 1999. For details, see a November 29, 1999 DRC memorandum (Table 2 and Attachment 2). For the recently installed IUC monitoring wells, the average concentration and standard deviation were calculated from IUC split sample results, collected between May, 1999 and September, 2002, as provided to the DRC in several different IUC submittals, as summarized in DRC tabsheet HistSumELI.
2) Based on average of several DRC split samples collected from the IUC facility between May, 1999 and September, 2002. For additional details, see DRC tabsheet HistSum.
3) Number of IUC or DRC samples used in DRC evaluation of average TDS concentration and standard deviation.
4) Well MW-19 classified as Class II groundwater because the average TDS based on historical IUC data (period of record = 3/93 - 5/99) yielded a lower TDS value than more recent data. Recent IUC split sampling data produced an average TDS of 3,105 mg/l (see DRC tabsheet HistSumELI, sample dates 5/99 thru 9/02). Whereas, the DRC split sampling data for same recent period produced an average TDS of 3,258 mg/l. No explanation has been provided by IUC for the increased TDS values apparent in the more recent data. Consequently, it is both conservative and protective of the resource to classify the groundwater at well MW-19 based on the historic IUC data.
5) Determination of groundwater class at well TW4-14 to be done at a later date, after sample data is available.
6) Well TW4-16 was determined to be a Class II groundwater, based on the lower reported TDS value by IUC.

IUC: TDS Concentrations

State Health Lab Results

GWQS = none

Well ID	Lab	<	May 11 & 12, 1999 Conc. (mg/l)	QA Flag	<	Nov. 27- Dec. 1, 2000 Conc. (mg/l)	QA Flag	<	Nov. 5 thru 8, 2001 Conc. (mg/l)	QA Flag	<	Sept. 9 thru 13, 2002 Conc. (mg/l)	QA Flag	Avg. TDS (mg/l)	Std. Dev. (mg/l)
MW-1	SHL		1,244			1,254			1,280			1,292		1,268	22.3
MW-2	SHL		3,056			3,124			3,072	H		3,158		3,103	47.0
MW-3	SHL		5,156			5,266			5,340	H		5,394		5,289	103.0
MW-4	SHL		3,414			3,212			3,176			2,734		3,134	286.5
MW-4A												2,740		2,740	#DIV/0!
MW-5	SHL		1,910			2,152			1,998	H		2,212		2,068	138.6
MW-11	SHL		1,806			2,122			2,108	H		2,118		2,039	155.1
MW-12	SHL		3,738			3,904			3,466	H		3,914		3,756	209.2
MW-14	SHL		3,472			3,652			3,576	H		3,654		3,589	85.7
MW-15	SHL		3,768			3,944			3,736	H		3,940		3,847	110.5
MW-17	SHL		4,464			4,506			4,572	H		4,624		4,542	70.7
MW-18	SHL		2,488			2,762			2,348	H		2,846		2,611	232.6
MW-19	SHL		3,664			3,354			2,756	H		2,706		3,120	467.1
TW4-1	SHL		n/a			3,752			3,250			2,916		3,306	420.8
TW4-2	SHL		n/a			3,234			2,966			2,792		2,997	222.7
TW4-3	SHL		n/a			3,184			3,366			3,356		3,302	102.3
TW4-4	SHL		n/a			r1508			3,418			3,234		3,326	130.1
TW4-5	SHL		n/a			2,002			2,562			2,758		2,441	392.3
TW4-6	SHL		n/a			3,704			3,734			3,850		3,763	77.1
TW4-7	SHL		n/a			3,794			3,750			3,826		3,790	38.2
TW4-8	SHL		n/a			2,668			2,790			2,842		2,767	89.3
TW4-9	SHL		n/a			2,496			2,606			2,722		2,608	113.0
TW4-10	SHL											2,846		2,346	#DIV/0!
TW4-11	SHL											3,402		3,402	#DIV/0!
TW4-12	SHL											608		608	#DIV/0!
TW4-13	SHL											942		942	#DIV/0!
TW4-14	SHL											N.S.		N.S.	N.S.
TW4-15	SHL											3,206		3,206	#DIV/0!
TW4-16	SHL											3,430		3,430	#DIV/0!
TW4-17	SHL											3,650		3,650	#DIV/0!
TW4-18	SHL											2,798		2,798	#DIV/0!
TW4-19	SHL											2,600		2,600	#DIV/0!
	Min:		1,244			1,254			1,280			608		608	
	Max:		5,156			5,266			5,340			5,394		5,289	
Equip. Blank	SHL		n/a			n/a			n/a			24			
Trip Blank	SHL		n/a		<	10			46	H		10			
Duplicate	SHL		n/a			n/a			2548			2,114			

Notes:

1) RCRA TEGD, p. 119: if concentrations in trip blank are within 1-order of magnitude of the well sample results, then the wells should be re-sampled.

[shaded] = sample results w/in 1-order of magnitude of trip blank concentration

Key to QA Flags:

- B = rejected value due to trip blank / field / equipment blank concentrations
- J = an estimated value
- n/a = not sampled or analyzed
- H = holding time exceeded before analysis; value = estimated quantity

Key to Abbreviations

- n/a = not available
- N.S. = not sampled

IUC: TDS Concentrations

Energy Laboratories Inc. Results

GWQS = none

Well ID	Lab	<	May 11 & 12, 1999 Conc. (mg/l)	QA Flag	<	Nov. 27- Dec. 1, 2000 Conc. (mg/l)	QA Flag	<	Nov. 5 thru 8, 2001 Conc. (mg/l)	QA Flag	<	Sept. 9 thru 13, 2002 Conc. (mg/l)	QA Flag	Avg. TDS (mg/l)	Std. Dev. (mg/l)
MW-1	ELI		N.R			1,270			1,360	H		1,120		1,250	121.2
MW-2	ELI		N.R			3,130			3,150	H		3,150		3,143	11.5
MW-3	ELI		N.R			5,320			5,380	H		5,410		5,370	45.8
MW-4	ELI		N.R			3,200			3,090			2,520		2,937	365.0
MW-4A												2,410		2,410	#DIV/0!
MW-5	ELI		N.R			2,160			2,030	H		1,970		2,053	97.1
MW-11	ELI		N.R			2,130			2,100	H		1,850		2,027	153.7
MW-12	ELI		N.R			3,860			3,900	H		3,740		3,833	83.3
MW-14	ELI		N.R			3,590			3,650	H		3,720		3,653	65.1
MW-15	ELI		N.R			lost			3,920	H		3,310		3,615	431.3
MW-17	ELI		N.R			4,290			4,670	H		4,690		4,550	225.4
MW-18	ELI		N.R			2,770			2,460	H		2,350		2,527	217.8
MW-19	ELI		N.R			3,420			2,790	H		2,690		2,967	395.8
TW4-1	ELI		n/a			3,560			3,260			2,900		3,240	330.5
TW4-2	ELI		n/a			3,230			2,940			2,730		2,967	251.1
TW4-3	ELI		n/a			3,160			3,390			3,310		3,287	116.8
TW4-4	ELI		n/a			lost			3,420			2,750		3,085	473.8
TW4-5	ELI		n/a			2,020			2,530	H		2,720		2,423	362.0
TW4-6	ELI		n/a			3,250			3,880	H		3,200		3,443	379.0
TW4-7	ELI		n/a			3,410			3,790			3,730		3,643	204.3
TW4-8	ELI		n/a			2,700			2,760	H		2,460		2,640	158.7
TW4-9	ELI		n/a			2,530			2,640	H		2,400		2,523	120.1
TW4-10	ELI		n/a			n/a			n/a			2,490		2,490	#DIV/0!
TW4-11	ELI		n/a			n/a			n/a			3,020		3,020	#DIV/0!
TW4-12	ELI		n/a			n/a			n/a			597		597	#DIV/0!
TW4-13	ELI		n/a			n/a			n/a			891		891	#DIV/0!
TW4-14	ELI		n/a			n/a			n/a			N.S.		N.S.	N.S.
TW4-15	ELI		n/a			n/a			n/a			3,120		3,120	#DIV/0!
TW4-16	ELI		n/a			n/a			n/a			2,930		2,930	#DIV/0!
TW4-17	ELI		n/a			n/a			n/a			3,190		3,190	#DIV/0!
TW4-18	ELI		n/a			n/a			n/a			2,700		2,700	#DIV/0!
TW4-19	ELI		n/a			n/a			n/a			2,250		2,250	#DIV/0!
	Min:		0			1,270			1,360			597		597	
	Max:		0			5,320			5,380			5,410		5,370	
Equip. Blank	ELI		n/a					<	10						
Trip Blank	ELI		n/a		<	2			n/a						
Duplicate	ELI		n/a						2,520	H					

Notes:

1) RCRA TEGD, p. 119: if concentrations in trip blank are within 1-order of magnitude of the well sample results, then the wells should be re-sampled.

[shaded] = sample results w/in 1-order of magnitude of trip blank concentration

Key to QA Flags:

B = rejected value due to trip blank / field / equipment blank concentrations
J = an estimated value
n/a = not sampled or analyzed
H = holding time exceeded before analysis; value = estimated quantity

Key to Abbreviations

n/a = not available
N.S. = not sampled
N.R. = no sample results reported by IUC

DRAFT

ATTACHMENT 3

Utah Division of Radiation Control

Summary of IUC Wells and Parameters
That Exceed their Respective GWQS
At the IUC White Mesa Uranium Mill
Near Blanding Utah.
(based on DRC/IUC split sampling results)

DRC spreadsheet GWclass.xls, tabsheet Exceed~~GWQS~~

IUC White Mesa: Summary of Wells and Parameters in Excess of Their Respective GWQS															
Review of DRC and IUC Split Samples Results						Relative									
Sorted by Event and Contaminant						Ground-	Possible	DRC Conc.				IUC Conc.			
Split Sampling		Utah GWQS				water	Upgradient			Radiologics				Radiologics	
Event	Contaminant	(mg/l)	(ug/l)	(pCi/l)	Well ID	Position	Sources	(mg/l)	(ug/l)	(pCi/l)	+/-	(mg/l)	(ug/l)	(pCi/l)	+/-
May, 1999	Nitrate + Nitrite (N)	10.0			MW-4	D	LF	**10.005**				**10.3**			
	Manganese	0.8	800		MW-3	D	C1-C4A		**1,700**				**2,020**		
					MW-14	D	C1-C4A		**1,900**				**2,000**		
	Selenium	0.05	50		MW-15	D	C1-C4A		**69**				**59**		
	Uranium	0.03	30		MW-3	D	C1-C4A		25.7				**41**		
					MW-14	D	C2-C4A		**48.4**				**70**		
					MW-15	D	C2-C4A		13.1				**49**		
					MW-17	L	Unk		25.2				**36**		
	Chloroform	0.07	70		MW-4	D	LF		**4,700**				**4,520**		
	Gross Alpha			15.0	MW-2	D	C1			**20.3**	1.6			n/a	n/a
					MW-3	D	C1-C4A			**45.4**	1.8			n/a	n/a
					MW-4	D	LF			**28.1**	1.6			n/a	n/a
					MW-12	D	C1-C3			**15.9**	1.3			n/a	n/a
					MW-14	D	C2-C4A			**48**	2			n/a	n/a
					MW-15	D	C2-C4A			**42.3**	1.7			n/a	n/a
					MW-17	L	Unk			**37.4**	1.9			n/a	n/a
					MW-18	U	Unk			**26**	1.4			n/a	n/a
					MW-19	U	Unk			**29.6**	1.8			n/a	n/a
November, 2000	Nitrate + Nitrite (N)	10.0			TW4-2	D	LF	**10.1**				**10.7**			
	Manganese	0.8	800		MW-3	D	C1-C4A		**3,470**				16		
					MW-14	D	C2-C4A		**2,060**				**1,680**		
					TW4-5	D	LF		**1,050**				lost		
					TW4-6	D	LF		**2,800**				**2,370**		
					TW4-9	D	LF		**1,330**				**1,060**		
	Selenium	0.05	50		MW-1	U	Unk		1.1				**52**		
					MW-17	L	Unk		2.7				**55**		
	Uranium	0.03	30		MW-3	D	C1-C4A		**31.3**				**46.0**		
					MW-4	D	LF		24.4				**35.0**		
					MW-14	D	C2-C4A		**58.6**				**76.0**		
					MW-15	D	C2-C4A		**38.1**				**53.0**		
					MW-17	L	Unk		28				**44.0**		
					MW-18	U	Unk		29.9				**34.0**		
	Chloroform	0.07	70		MW-4	D	LF		**5,030**				**6,470**		
					TW4-1	D	LF		**2,550**				**3,440**		
					TW4-2	D	LF		**4,250**				**4,220**		
					TW4-3	D	LF		**770**				**836**		
					TW4-5	D	LF		**250**				**255**		
					TW4-7	D	LF		**610**				**684**		
					TW4-8	D	LF		**130**				**107**		
	Dichloromethane		5		TW4-8	D	LF		**5**				<5		
	Tetrahydrofuran		46		MW-1	U	Unk		**310**				n/a		
					MW-3	D	C1-C4A		**210**				n/a		
	Gross Alpha			15.0	MW-3	D	C1-C4A			**26**	1.4			< 11.3	n/r
					MW-4	D	LF			**20.6**	1.3			13.9	5.7
					MW-14	D	C2-C4A			**26.9**	0.9			**27.5**	5.7
					MW-15	D	C2-C4A			14.1	0.7			**25.8**	5.7
					MW-17	L	Unk			**25.8**	0.8			12.7	5.7
					MW-18	U	Unk			**16.6**	1.2			12	3.8
					MW-19	U	Unk			12.9	0.7			**15.4**	5.7
					TW4-1	D	LF			**20.8**	1.6			lost	n/r
November, 2001	Nitrate + Nitrite (N)	10.0			MW-4	D	LF	**11.6**				8			
					TW4-1	D	LF	**10.8**				**12.4**			
					TW4-2	D	LF	9.44				**10.1**			
					TW4-4	D	LF	**11.9**				**15.0**			
	Manganese	0.8	800		MW-3	D	C1-C4A		**2,150**				**2,040**		
					MW-14	D	C2-C4A		**1,940**				**1,710**		
					TW4-5	D	LF		**1,150**				**1,160**		
					TW4-6	D	LF		**2,470**				**2,260**		
					TW4-9	D	LF		**1,210**				**1,180**		

IUC White Mesa: Summary of Wells and Parameters in Excess of Their Respective GWQS															
Review of DRC and IUC Split Samples Results						Relative									
Sorted by Event and Contaminant						Ground-	Possible	DRC Conc.				IUC Conc.			
Split Sampling		Utah GWQS				water	Upgradient			Radiologics				Radiologics	
Event	Contaminant	(mg/l)	(ug/l)	(pCi/l)	Well ID	Position	Sources	(mg/l)	(ug/l)	(pCi/l)	+/-	(mg/l)	(ug/l)	(pCi/l)	+/-
	Selenium	0.05	50		MW-4	D	LF		55				54		
					MW-15	D	C2-C4A		84.4				92		
					TW4-1	D	LF		100				94		
					TW4-4	D	LF		104				104		
	Uranium	0.03	30		MW-3	D	C1-C4A		34.7				53.4		
					MW-14	D	C2-C4A		62.4				83.2		
					MW-15	D	C2-C4A		43				50.7		
					MW-17	L	Unk		33.9				40.3		
					MW-18	U	Unk		27.7				33.6		
	Chloroform	0.07	70		MW-4	D	LF		5,800				5,200		
					TW4-1	D	LF		4,020				3,200		
					TW4-2	D	LF		6,650				5,300		
					TW4-3	D	LF		250				170		
					TW4-4	D	LF		3,570				2,900		
					TW4-5	D	LF		320				260		
					TW4-7	D	LF		1,350				1,100		
					TW4-8	D	LF		255				180		
	Tetrahydrofuran		46		MW-3	D	C1-C4A		120				130		
	Gross Alpha			15.0	MW-3	D	C1-C4A			26.4	0.8			1.2	1
					MW-14	D	C2-C4A			20.1	0.9			< 1	n/r
					MW-15	D	C2-C4A			34	1.3			< 1	n/r
					MW-17	L, D	C2, LF			35.3	1.6			1.2	1
					MW-18	U	Unk			24.6	1.1			< 1	n/r
					MW-19	U	Unk			24.9	1.3			1.3	1
September, 2002	Nitrate + Nitrite (N)	10.0			TW4-1	D	LF	11.7				12.8			
					TW4-4	D	LF	13.8				12.6			
					TW4-19	D	LF	46.6				47.6			
	Manganese	0.8	800		MW-3	D	C1-C4A		1,400				2,010		
					MW-14	D	C2-C4A		2,290				2,060		
					TW4-5	D	LF		1,520				n/a		
					TW4-6	D	LF		3,170				n/a		
					TW4-9	D	LF		1,414				n/a		
					TW4-11	D	LF		841				n/a		
					TW4-16	L, D	C2, LF		3,040				2,470		
					TW4-17	L, D	C2, LF		4,690				3,660		
					TW4-18	D	LF		1,500				1,100		
	Selenium	0.05	50		MW-4	D	LF		54.3				60		
					MW-4A	D	LF		52.1				66		
					MW-15	D	C2-C4A		58				75		
					TW4-1	D	LF		104				n/a		
					TW4-2	D	LF		54.8				n/a		
					TW4-3	D	LF		51.5				n/a		
					TW4-4	D	LF		96.1				n/a		
	Uranium	0.03	30		MW-3	D	C1-C4A		31.9				46		
					MW-14	D	C2-C4A		56.7				72		
					MW-15	D	C2-C4A		37.8				49		
					MW-17	L	Unk		29.9				40		
					MW-18	U	Unk		15.8				40		
					TW4-11	D	LF		31.7				n/a		
					TW4-19	D	LF		30.3				35		
	Chloroform	0.07	70		MW-4	D	LF		5,190				6,000		
					MW-4A	D	LF		4,840				5,700		
					TW4-1	D	LF		2,290				3,300		
					TW4-2	D	LF		8,430				6,000		
					TW4-4	D	LF		3,770				4,000		
					TW4-5	D	LF		450				330		
					TW4-7	D	LF		1,380				1,500		
					TW4-8	D	LF		300				300		
					TW4-11	D	LF		5,000				6,200		
					TW4-16	L, D	C2, LF		146				140		
					TW4-18	D	LF		600				440		

IUC White Mesa: Summary of Wells and Parameters in Excess of Their Respective GWQS

Review of DRC and IUC Split Samples Results

Sorted by Event and Contaminant

Split Sampling Event	Contaminant	Utah GWQS (mg/l)	Utah GWQS (ug/l)	Utah GWQS (pCi/l)	Well ID	Relative Ground-water Position	Possible Upgradient Sources	DRC Conc. (mg/l)	DRC Conc. (ug/l)	DRC Conc. Radiologics (pCi/l)	DRC Conc. Radiologics +/-	IUC Conc. (mg/l)	IUC Conc. (ug/l)	IUC Conc. Radiologics (pCi/l)	IUC Conc. Radiologics +/-
					TW4-19	D	LF		**3,540**				**7,700**		
	Dichloromethane	0.005	5		TW4-8	D	LF		**5.5**				2.8		
					TW4-11	D	LF		**14**				< 25		
					TW4-16	L, D	C2, LF		**110**				**44**		
	Carbon Tetrachloride	0.005	5		TW4-19	D	LF		**12**				< 25		
	Benzene	0.005	5		TW4-5	D	LF		**8.6**				3.6		
	Tetrahydrofuran		50		MW-1	U	Unk		**130**				n/a		
					MW-3	D	C1-C4A		**83**				n/a		
	Gross Alpha			15.0	MW-3	D	C1-C4A			**24.7**	0.8			**46.6**	10.5
					MW-4A	D	LF			11.5	0.6			**16.9**	3.5
					MW-14	D	C2-C4A			**18.7**	0.8			**23.2**	5.2
					MW-15	D	C2-C4A			**18.2**	0.7			**16.8**	4.9
					MW-17	L	Unk			**16.7**	0.8			**23.5**	5.1
					TW4-11	D	LF			**24.6**	0.8			n/a	n/a

Footnotes:

n/a	= no analysis conducted by IUC
Bold	= value that exceeds the respective Utah GWQS

Key to Groundwater Position

D	= downgradient
U	= upgradient
	= lateral gradient from tailings cells

Key to Possible Contaminant Sources

C1	= IUC Tailings Cell 1
C2	= IUC Tailings Cell 2
C3	= IUC Tailings Cell 3
C4A	= IUC Tailings Cell 4A
Unk	= unknown source(s)
LF	= on-site leachfield (current or abandoned)

Cell: H5
Comment: Groundwater Flow System Position: relative to DRC water table contour map from the September, 2002 split sampling event.

Cell: I5
Comment: Possible Upgradient Sources of Contamination: based on review of major site features at the IUC facility and the DRC water table contour map from the September, 2002 split sampling event.

Cell: D7
Comment: Manganese (Mn) GWQS: is based on EPA DW draft Health Advisary Reference Dose (RfD), RfD = 0.14 mg/kg/day for the consumption of food and water (see summary entitled "Drinking Water Regulations and Health Advisories", October, 1996, EPA Office of Water, EPA 822-B-96-002, p. 8). For a 70-kg adult, the RfD can be expressed as: 0.14 mg/kg/day * 70 kg = 9.8 mg/day Mn (see 12/1/96 EPA IRIS database printout on Manganese, p. 4). Now to convert the RfD to a health advisory, do as follows:

(RfD - 5 mg/day) / (3 * 2 liter/day intake) = 0.8 mg/l, where:

5 mg/day = National Research Council's "estimated safe and adequate daily dietary intake" for manganese (ESADDI), and
Factor of 3 = to protect infants
(see 1/3/00 EPA Region 8 letter from Bob Benson (toxicologist) to Loren Morton Utah DEQ/DRC, and 12/1/96 EPA IRIS database printout on Manganese, pp. 3-5).

Note that this concentration, 0.8 mg/l, is GREATER than the EPA secondary DW MCL of 0.05 mg/l, which was set primarily on the fact that manganese concentrations above this value tend to stain laundry (personal communication, Mr. Bob Benson, EPA Region 8 DW toxicologist).

Previously the State's Ad Hoc GWQS for manganse was proposed at 0.04 mg/l, based on a former RfD value and calculations by EPA Region 8 toxicologist, Bob Benson (personal communication, 2/17/95). However, the ingestion RfD was revised in the EPA IRIS database on 11/1/95. Thus it was necessary to now update the State's Ad Hoc GWQS.

Cell: D10
Comment: Uranium GWQS (0.03 mg/l or 30 ug/l): based on final EPA drinking water MCL for radionuclides (see 12/7/00 Federal Register, p. 76750). This value can also be expressed in activity units, pCi/l, as follows:
GWQS = 0.03 mg/l * 677 pCi/mg of U-nat = 20.31 pCi/l
Which can then be rounded down to 20 pCi/l.

Cell: D14
Comment: Chloroform: an ad-hoc lifetime health advisory (LHA) for chloroform was determined by Mr. Bob Benson in a May 29, 2003 memorandum. Said LHA, 0.07 mg/l, was based on chloroform's non-cancer risk, as set forth in the EPA IRIS database. This value was then approved by the Utah Division of Water Quality for application to the IUC White Mesa uranium mill in a June 12, 2003 memorandum to DRC.

Cell: D26
Comment: Manganese (Mn) GWQS: is based on EPA DW draft Health Advisary Reference Dose (RfD), RfD = 0.14 mg/kg/day for the consumption of food and water (see summary entitled "Drinking Water Regulations and Health Advisories", October, 1996, EPA Office of Water, EPA 822-B-96-002, p. 8). For a 70-kg adult, the RfD can be expressed as: 0.14 mg/kg/day * 70 kg = 9.8 mg/day Mn (see 12/1/96 EPA IRIS database printout on Manganese, p. 4). Now to convert the RfD to a health advisory, do as follows:

(RfD - 5 mg/day) / (3 * 2 liter/day intake) = 0.8 mg/l, where:

5 mg/day = National Research Council's "estimated safe and adequate daily dietary intake" for manganese (ESADDI), and
Factor of 3 = to protect infants
(see 1/3/00 EPA Region 8 letter from Bob Benson (toxicologist) to Loren Morton Utah DEQ/DRC, and 12/1/96 EPA IRIS database printout on Manganese, pp. 3-5).

Note that this concentration, 0.8 mg/l, is GREATER than the EPA secondary DW MCL of 0.05 mg/l, which was set primarily on the fact that manganese concentrations above this value tend to stain laundry (personal communication, Mr. Bob Benson, EPA Region 8 DW toxicologist).

Previously the State's Ad Hoc GWQS for manganse was proposed at 0.04 mg/l, based on a former RfD value and calculations by EPA Region 8 toxicologist, Bob Benson (personal communication, 2/17/95). However, the ingestion RfD was revised in the EPA IRIS database on 11/1/95. Thus it was necessary to now update the State's Ad Hoc GWQS.

Cell: O28
Comment: 11/29/00 TW4-5, ELI Sample: IUC reported that this sample was lost sometime after collection, presumably to freezing/breakage during transport (see 9/6/02 IUC submittal, split sampling matrix; and 9/30/02 email from Harold Roberts).

Cell: D33
Comment: Uranium GWQS (0.03 mg/l or 30 ug/l): based on final EPA drinking water MCL for radionuclides (see 12/7/00 Federal Register, p. 76750). This value can also be expressed in activity units, pCi/l, as follows:
GWQS = 0.03 mg/l * 677 pCi/mg of U-nat = 20.31 pCi/l
Which can then be rounded down to 20 pCi/l.

Cell: O35

Comment: IUC POC Sample Results: a separate set of samples were collected by IUC for the NRC. Results of these samples were as follows (see 10/26/01 IUC data submittal):

Well	Lab No.	-----U-total----- mg/l	ug/l
MW-5	00-38308-5	0.0022	2.2
MW-11	00-38308-8	0.0023	2.3
MW-14	00-38308-9	0.0760	76.0
MW-15	00-38308-6	0.0474	47.4
MW-17	00-38308-10	0.0400	40.0

Cell: O36

Comment: IUC POC Sample Results: a separate set of samples were collected by IUC for the NRC. Results of these samples were as follows (see 10/26/01 IUC data submittal):

Well	Lab No.	-----U-total----- mg/l	ug/l
MW-5	00-38308-5	0.0022	2.2
MW-11	00-38308-8	0.0023	2.3
MW-14	00-38308-9	0.0760	76.0
MW-15	00-38308-6	0.0474	47.4
MW-17	00-38308-10	0.0400	40.0

Cell: O37

Comment: IUC POC Sample Results: a separate set of samples were collected by IUC for the NRC. Results of these samples were as follows (see 10/26/01 IUC data submittal):

Well	Lab No.	-----U-total----- mg/l	ug/l
MW-5	00-38308-5	0.0022	2.2
MW-11	00-38308-8	0.0023	2.3
MW-14	00-38308-9	0.0760	76.0
MW-15	00-38308-6	0.0474	47.4
MW-17	00-38308-10	0.0400	40.0

Cell: D39

Comment: Chloroform: an ad-hoc lifetime health advisory (LHA) for chloroform was determined by Mr. Bob Benson in a May 29, 2003 memorandum. Said LHA, 0.07 mg/l, was based on chloroform's non-cancer risk, as set forth in the EPA IRIS database. This value was then approved by the Utah Division of Water Quality for application to the IUC White Mesa uranium mill in a June 12, 2003 memorandum to DRC.

Cell: P56

Comment: 11/27/00 TW4-1, ELI Sample: IUC reported that this sample was lost sometime after collection, presumably to freezing/breakage during transport (see 9/6/02 IUC submittal, split sampling matrix; and 9/30/02 email from Harold Roberts).

Cell: D62

Comment: Manganese (Mn) GWQS: is based on EPA DW draft Health Advisary Reference Dose (RfD), RfD = 0.14 mg/kg/day for the consumption of food and water (see summary entitled "Drinking Water Regulations and Health Advisories", October, 1996, EPA Office of Water, EPA 822-B-96-002, p. 8). For a 70-kg adult, the RfD can be expressed as: 0.14 mg/kg/day * 70 kg = 9.8 mg/day Mn (see 12/1/96 EPA IRIS database printout on Manganese, p. 4). Now to convert the RfD to a health advisory, do as follows:

(RfD - 5 mg/day) / (3 * 2 liter/day intake) = 0.8 mg/l, where:

5 mg/day = National Research Council's "estimated safe and adequate daily dietary intake" for manganese (ESADDI), and
Factor of 3 = to protect infants
(see 1/3/00 EPA Region 8 letter from Bob Benson (toxicologist) to Loren Morton Utah DEQ/DRC, and 12/1/96 EPA IRIS database printout on Manganese, pp. 3-5).

Note that this concentration, 0.8 mg/l, is GREATER than the EPA secondary DW MCL of 0.05 mg/l, which was set primarily on the fact that manganese concentrations above this value tend to stain laundry (personal communication, Mr. Bob Benson, EPA Region 8 DW toxicologist).

Previously the State's Ad Hoc GWQS for manganse was proposed at 0.04 mg/l, based on a former RfD value and calculations by EPA Region 8 toxicologist, Bob Benson (personal communication, 2/17/95). However, the ingestion RfD was revised in the EPA IRIS database on 11/1/95. Thus it was necessary to now update the State's Ad Hoc GWQS.

Cell: D71

Comment: Uranium GWQS (0.03 mg/l or 30 ug/l): based on final EPA drinking water MCL for radionuclides (see 12/7/00 Federal Register, p. 76750). This value can also be expressed in activity units, pCi/l, as follows:
GWQS = 0.03 mg/l * 677 pCi/mg of U-nat = 20.31 pCi/l
Which can then be rounded down to 20 pCi/l.

Cell: D76
Comment: Chloroform: an ad-hoc lifetime health advisory (LHA) for chloroform was determined by Mr. Bob Benson in a May 29, 2003 memorandum. Said LHA, 0.07 mg/l, was based on chloroform's non-cancer risk, as set forth in the EPA IRIS database. This value was then approved by the Utah Division of Water Quality for application to the IUC White Mesa uranium mill in a June 12, 2003 memorandum to DRC.

Cell: K81
Comment: TW4-5 Duplicate Sample (TW4-10): chloroform concentration reported was 375 ug/l.

Cell: O81
Comment: TW4-5, 11/8/01 ELI Sample: a ELI duplicate sample reported a chloroform concentration of 270 ug/l.

Cell: K84
Comment: 11/5/01 MW-3 Sample by SHL: originally SHL reported the THF concentration as below the MRL (non-detected). However, this result was revised after subsequent SHL review to 120 ug/l (see 11/8/02 fax from Jack Oman at SHL).

Cell: D95
Comment: Manganese (Mn) GWQS: is based on EPA DW draft Health Advisary Reference Dose (RfD), RfD = 0.14 mg/kg/day for the consumption of food and water (see summary entitled "Drinking Water Regulations and Health Advisories", October, 1996, EPA Office of Water, EPA 822-B-96-002, p. 8). For a 70-kg adult, the RfD can be expressed as: 0.14 mg/kg/day * 70 kg = 9.8 mg/day Mn (see 12/1/96 EPA IRIS database printout on Manganese, p. 4). Now to convert the RfD to a health advisory, do as follows:

(RfD - 5 mg/day) / (3 * 2 liter/day intake) = 0.8 mg/l, where:

5 mg/day = National Research Council's "estimated safe and adequate daily dietary intake" for manganese (ESADDI), and
Factor of 3 = to protect infants
(see 1/3/00 EPA Region 8 letter from Bob Benson (toxicologist) to Loren Morton Utah DEQ/DRC, and 12/1/96 EPA IRIS database printout on Manganese, pp. 3-5).

Note that this concentration, 0.8 mg/l, is GREATER than the EPA secondary DW MCL of 0.05 mg/l, which was set primarily on the fact that manganese concentrations above this value tend to stain laundry (personal communication, Mr. Bob Benson, EPA Region 8 DW toxicologist).

Previously the State's Ad Hoc GWQS for manganse was proposed at 0.04 mg/l, based on a former RfD value and calculations by EPA Region 8 toxicologist, Bob Benson (personal communication, 2/17/95). However, the ingestion RfD was revised in the EPA IRIS database on 11/1/95. Thus it was necessary to now update the State's Ad Hoc GWQS.

Cell: D111
Comment: Uranium GWQS (0.03 mg/l or 30 ug/l): based on final EPA drinking water MCL for radionuclides (see 12/7/00 Federal Register, p. 76750). This value can also be expressed in activity units, pCi/l, as follows:
GWQS = 0.03 mg/l * 677 pCi/mg of U-nat = 20.31 pCi/l
Which can then be rounded down to 20 pCi/l.

Cell: D118
Comment: Chloroform: an ad-hoc lifetime health advisory (LHA) for chloroform was determined by Mr. Bob Benson in a May 29, 2003 memorandum. Said LHA, 0.07 mg/l, was based on chloroform's non-cancer risk, as set forth in the EPA IRIS database. This value was then approved by the Utah Division of Water Quality for application to the IUC White Mesa uranium mill in a June 12, 2003 memorandum to DRC.

DRAFT

ATTACHMENT 4

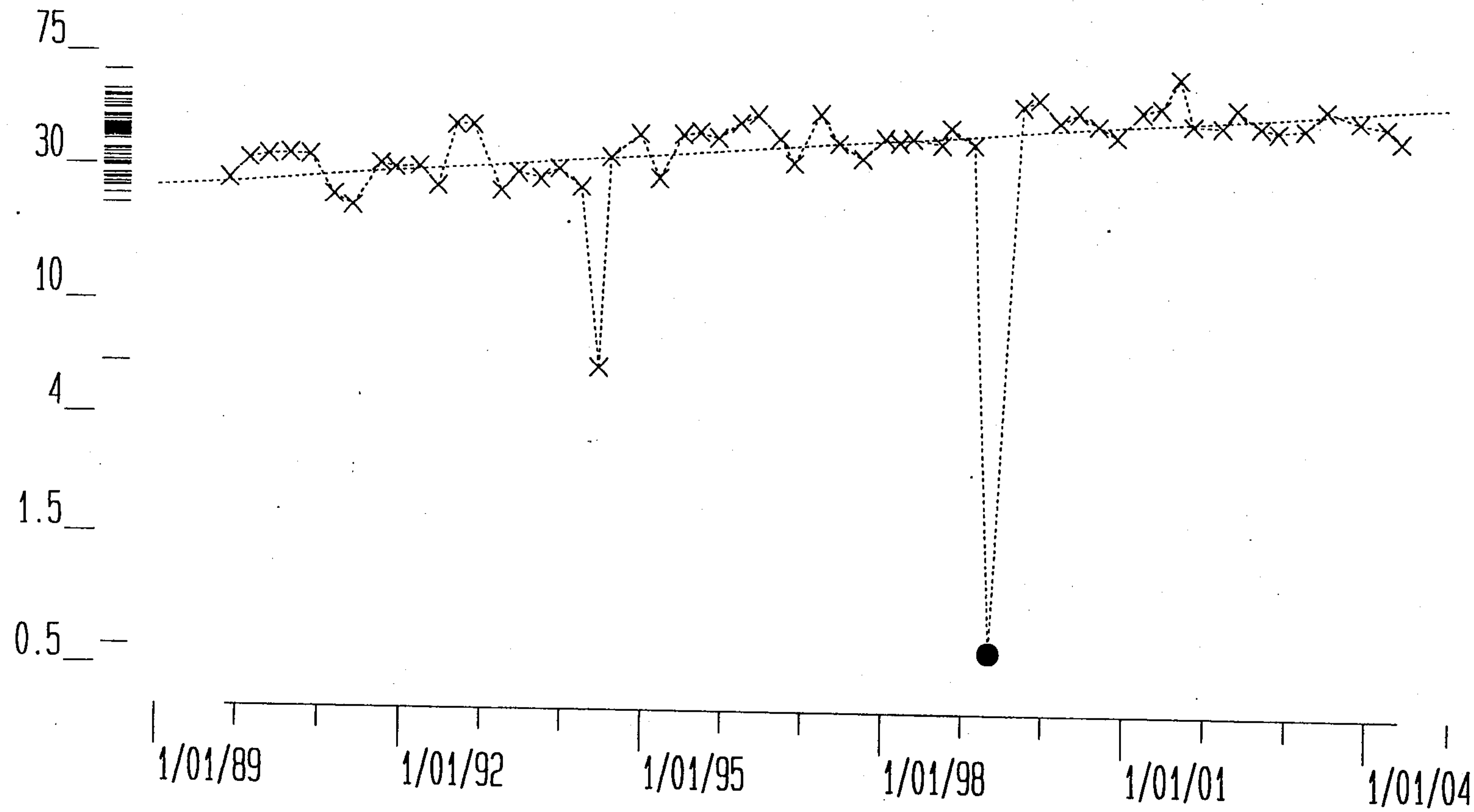
Utah Division of Radiation Control

Time Series Concentration Graphs of
Natural Uranium Contamination in
IUC White Mesa Mill
Groundwater Monitoring Wells
MW-14, MW-15, and MW-17

From August 31, 2004 IUC Semi-Annual Effluent Monitoring Report,
Groundwater Statistical Analysis by Shewhart-Cusum Method June 30, 2004 Section

Well WMMW-14

U-Nat



Rate constant of regression line is 0.0202 pCi/l per year.

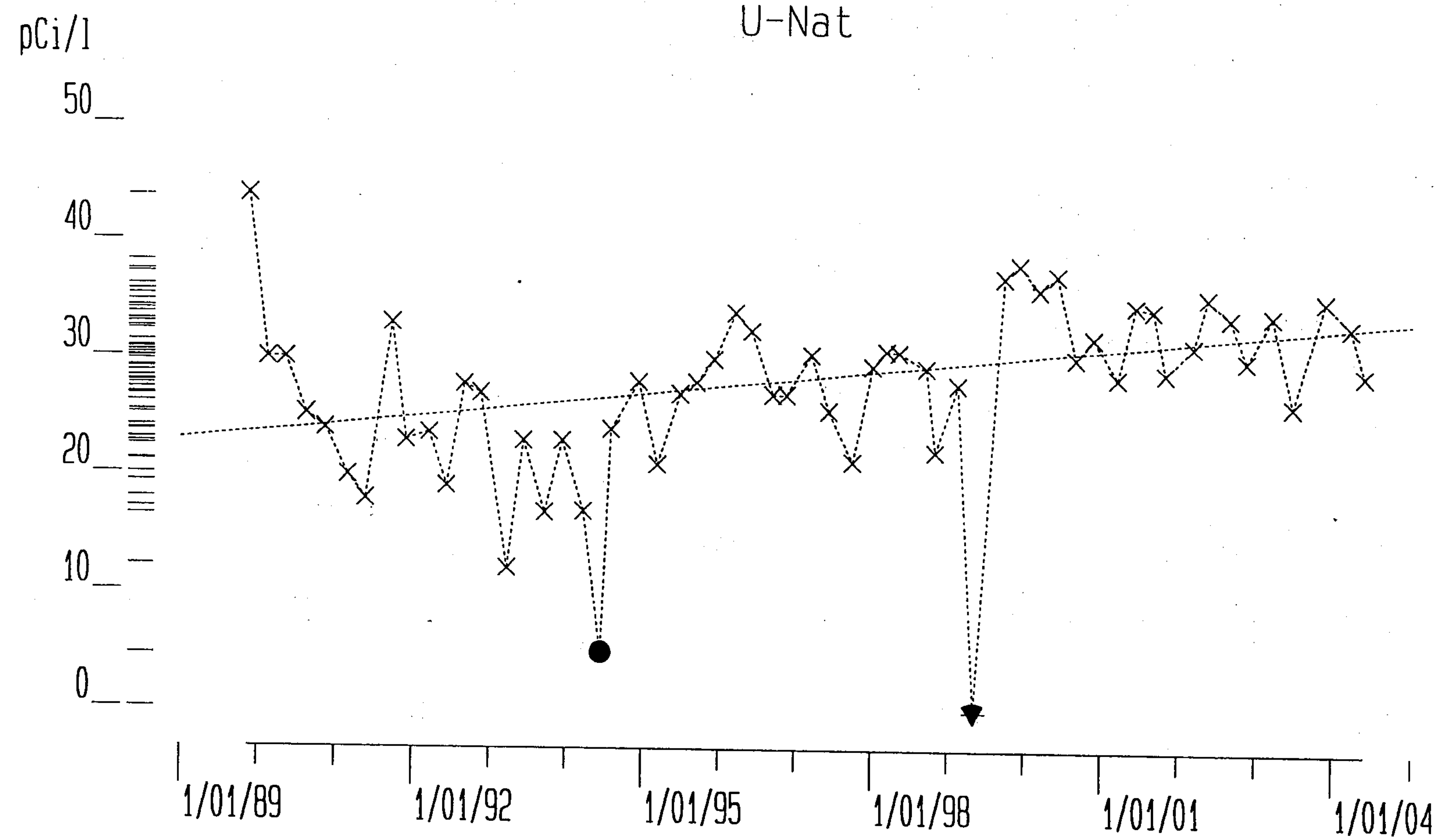
All calculations based on log(10) of actual values

Warning: High serial correlation.

August 13, 2004

White Mesa Mill

Well WMMW-15
U-Nat

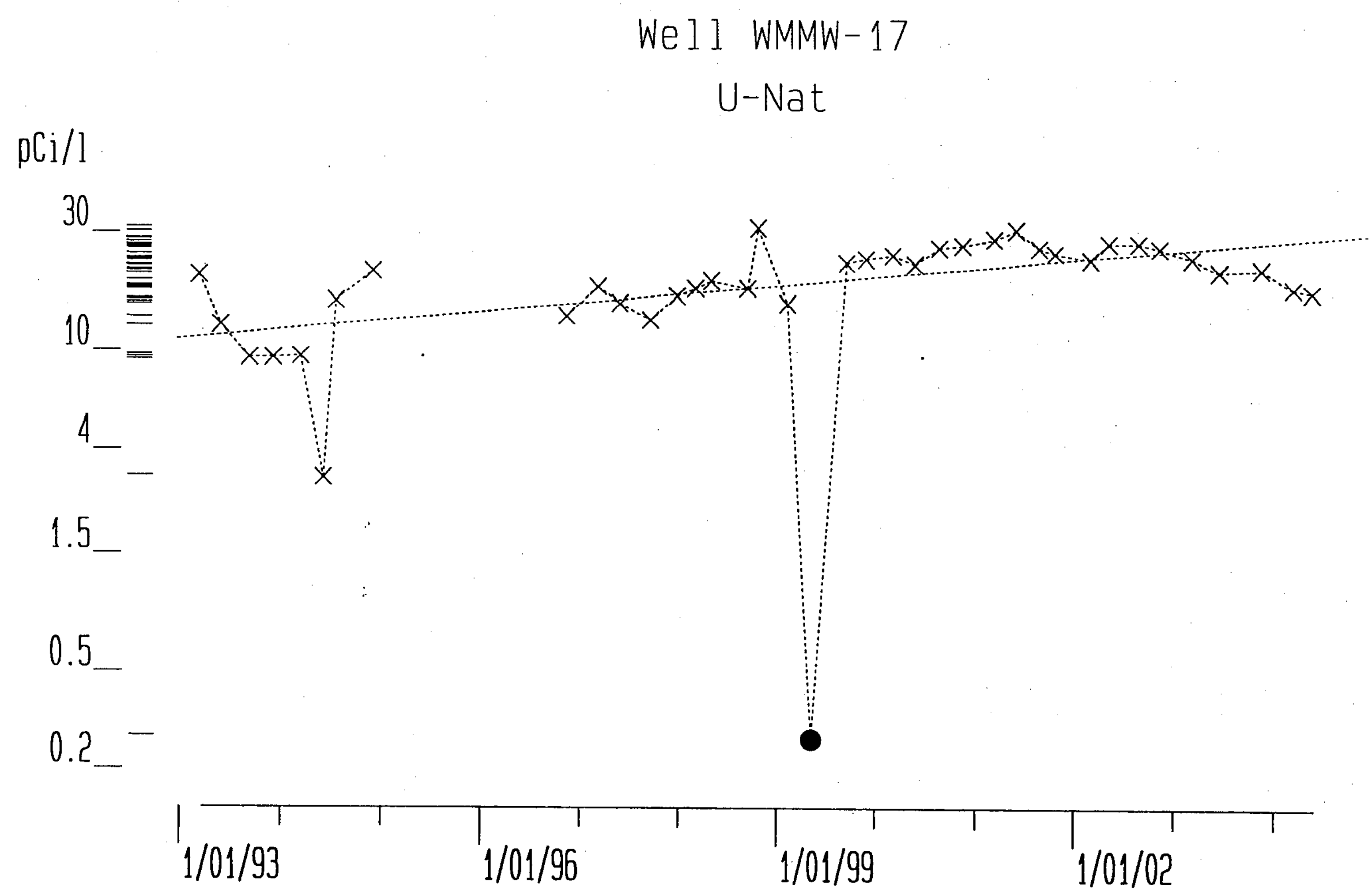


Slope of regression line is 0.6602 pCi/l per year.

Warning: High serial correlation.

August 13, 2004

White Mesa Mill



Rate constant of regression line is 0.0361 pCi/l per year.

All calculations based on log(10) of actual values

Warning: High serial correlation.

August 13, 2004

White Mesa Mill

DRAFT

ATTACHMENT 5

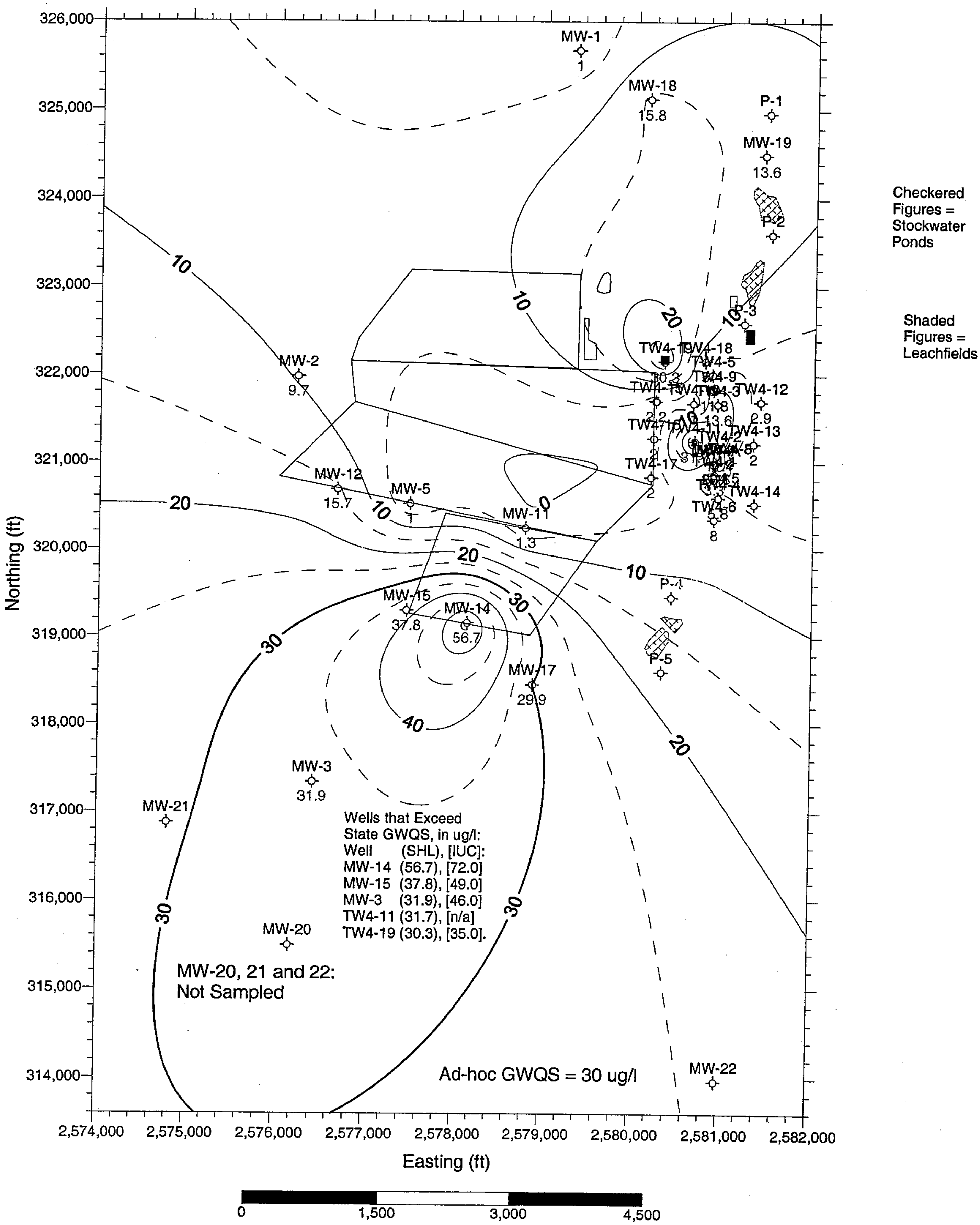
Utah Division of Radiation Control

Shallow Aquifer Uranium 238 Isoconcentration Map
For the September, 2002 Groundwater Split Sampling Event at the
IUC White Mesa Uranium Mill Facility
Near Blanding, Utah

DRC Surfer Contour Maps: U238_9-02.srf and U238_9-02b.srf
DRC Excel spreadsheet U-238.xls, tabsheet 9-02

IUC Uranium-238 Concentrations (ug/l)
9/02 Split Sampling Event - DEQ Results

Interpolation Method: Kriging (omni-directional)

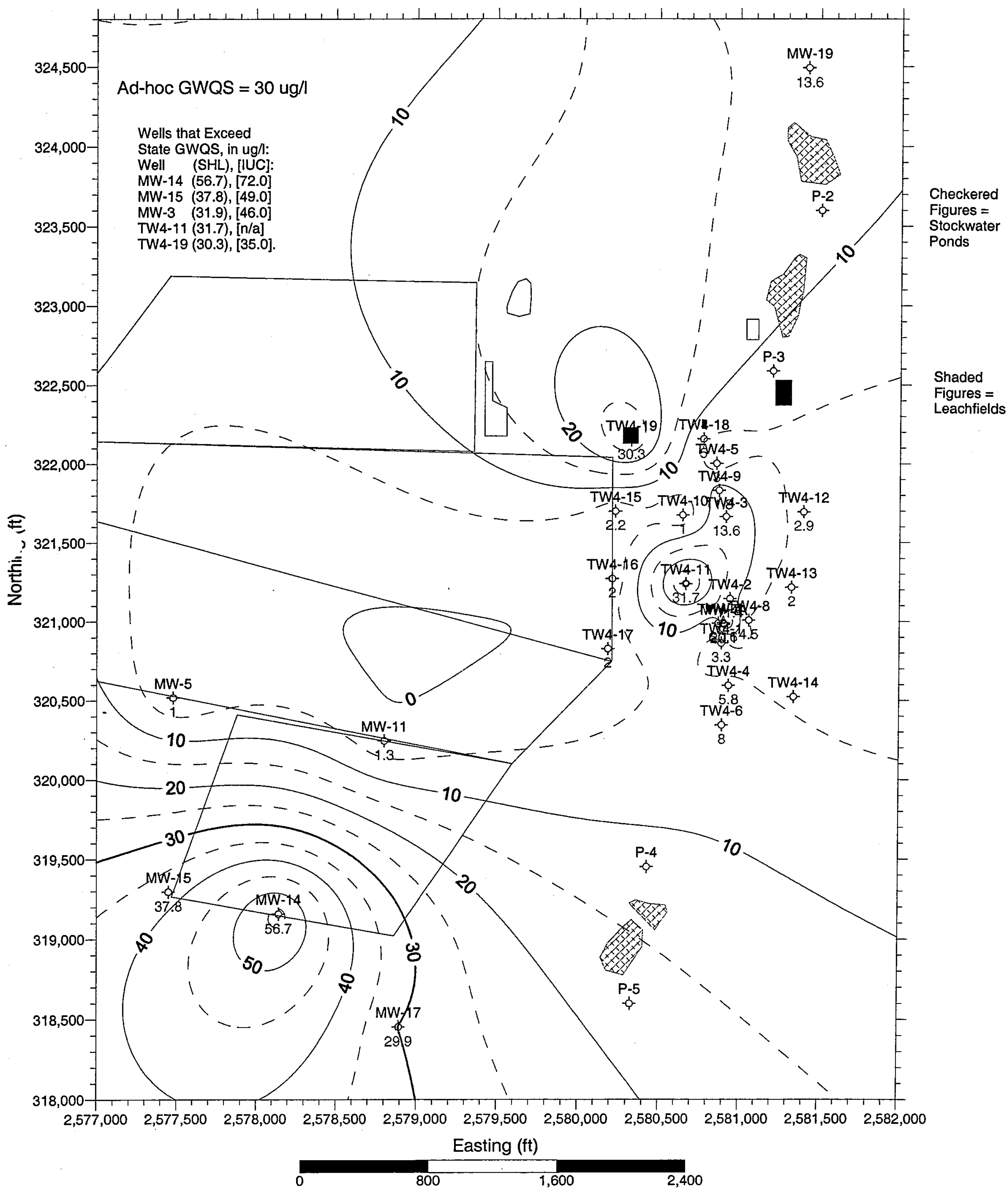


Contour Interval = 5 ug/l

U238_9-02.srf

IUC Uranium-238 Concentrations (ug/l)
9/02 Split Sampling Event - DEQ Results

Interpolation Method: Kriging (omni-directional)



Contour Interval = 5 ug/l

U238_9-02b.srf

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	JC: 9/02 DEQ Split Groundwater Samples - U-238 (by ICP-MS)									GWQS = 30 ug/l											
2	Sample Date = 9/9/02 thru 9/13/02																				
3		9/7/01 IUC Coordinates						Sample		SHL Data							IUC Data				
4	Well	Easting	Northing		Lab	Sample	Sample	Coll.		U-238		QA	Conc.				U-total		QA	Conc.	
5	ID	(ft)	(ft)	Lab	No.	Date	Time	Order	<	(ug/l)	MRL	Flag	Rank	Comments		<	(ug/l)	MRL	Flag	Rank	Comments
6	MW-1	2,579,330.42	325,671.85	SHL	2002-07319	9/9/02	14:00	2	<	1	1		29			<	1	1		17	
7	MW-2	2,576,209.93	321,969.45	SHL	2002-07320	9/10/02	15:00	10		9.7	1		15				12	1		11	
8	MW-3	2,576,417.05	317,340.58	SHL	2002-07440	9/12/02	12:20	22		**31.9**	1		3				**46**	1		3	
9	MW-4	2,580,905.96	320,991.17	SHL	2002-07441	9/12/02	8:05	20		20.6	1		7				23	1		8	
10	MW-4A	2,580,906.21	320,981.40	SHL	2002-07443	9/13/02	12:30	31		20.1	1		8				25	1		7	
11	MW-5	2,577,478.42	320,519.12	SHL	2002-07322	9/10/02	9:40	5	<	1	1		29			<	1	1		15	
12	MW-11	2,578,798.10	320,245.47	SHL	2002-07324	9/10/02	8:55	4		1.3	1		28				1	1		15	
13	MW-12	2,576,665.06	320,683.29	SHL	2002-07325	9/10/02	10:30	6		15.7	1		10				19	1		8	
14	MW-14	2,578,142.39	319,156.70	SHL	2002-07327	9/10/02	13:30	8		**56.7**	1		1				**72**	1		1	
15	MW-15	2,577,451.00	319,296.30	SHL	2002-07328	9/10/02	14:20	9		**37.8**	1		2				**49**	1		2	
16	MW-17	2,578,892.21	318,453.44	SHL	2002-07329	9/10/02	11:30	7		29.9	1		6				**40**	1		2	
17	MW-18	2,580,133.04	325,121.34	SHL	2002-07330	9/9/02	11:30	1		15.8	1		9				**40**	1		2	
18	MW-19	2,581,423.33	324,491.73	SHL	2002-07331	9/10/02	7:25	3		13.6	1		11				18	1		4	
19	MW-20	2,576,169.80	315,490.81	SHL	W.L. Only	9/12/02	12:43														
20	MW-21	2,574,794.90	316,871.69	SHL	no sample collected (dry?)																
21	MW-22	2,580,981.05	313,968.74	SHL	W.L. Only	9/12/02	12:50														
22	P-1	2,581,464.43	324,962.43	SHL	W.L. Only	9/9/02	10:25														
23	P-2	2,581,506.11	323,598.63	SHL	W.L. Only	9/9/02	12:00														
24	P-3	2,581,209.74	322,587.47	SHL	W.L. Only	9/9/02	12:05														
25	P-4	2,580,427.43	319,451.42	SHL	W.L. Only	9/9/02	5:15														
26	P-5	2,580,325.62	318,598.20	SHL	W.L. Only	9/9/02	5:10														
27	TW4-1	2,580,890.59	320,862.99	SHL	2002-07420	9/11/02	15:00	17		3.3	1		21				n/a				
28	TW4-2	2,580,943.64	321,143.99	SHL	2002-07421	9/11/02	17:20	19		11.4	1		14				n/a				
29	TW4-3	2,580,918.88	321,663.86	SHL	2002-07321	9/10/02	17:10	12		13.6	1		11				n/a				
30	TW4-4	2,580,936.51	320,594.77	SHL	2002-07423	9/11/02	15:55	18		5.8	1		18				n/a				
31	TW4-5	2,580,859.24	322,002.88	SHL	2002-07424	9/11/02	13:55	16		3	1		22				n/a				
32	TW4-6	2,580,893.58	320,343.83	SHL	2002-07323	9/10/02	16:15	11		8	1		16				n/a				
33	TW4-7	2,580,872.64	320,988.26	SHL	2002-07426	9/13/02	11:50	30		6.1	1		17				n/a				
34	TW4-8	2,581,060.74	321,007.97	SHL	2002-07427	9/11/02	11:30	15		4.5	1		20				n/a				
35	TW4-9	2,580,874.19	321,831.07	SHL	2002-07428	9/11/02	10:05	14		11.8	1		13				n/a				
36	TW4-10	2,580,649.25	321,674.47	SHL	2002-07429	9/11/02	8:40	13	<	1	1		29				n/a				
37	TW4-11	2,580,669.10	321,238.89	SHL	2002-07430	9/12/02	10:30	21		**31.7**	1		4				n/a				
38	TW4-12	2,581,403.10	321,694.82	SHL	2002-07431	9/12/02	14:15	23		2.9	1		23				3	1		5	
39	TW4-13	2,581,328.24	321,215.86	SHL	2002-07432	9/13/02	11:05	29	<	2	1		25				2	1		6	
40	TW4-14	2,581,342.44	320,523.11	SHL	no sample collected																
41	TW4-15	2,580,231.28	321,699.03	SHL	2002-07433	9/13/02	8:00	26		2.2	1		24				2	1		6	
42	TW4-16	2,580,212.11	321,271.06	SHL	2002-07434	9/13/02	8:50	27	<	2	1		25				1	1		6	
43	TW4-17	2,580,186.31	320,826.86	SHL	2002-07435	9/13/02	9:40	28	<	2	1		25				3	1		5	
44	TW4-18	2,580,777.15	322,157.43	SHL	2002-07436	9/12/02	18:50	25	<	5	1		19				6	1		4	
45	TW4-19	2,580,327.20	322,149.35	SHL	2002-07437	9/12/02	18:00	24		**30.3**	1		5				**35**	1		2	
46																					
47								Min:		1.0							1.0				
48								Max.:		56.7							72.0				
49								Count:		31							20				
50																					
51		Field ID	True ID																		
52	Trip Blank #2	hand-delivered to SHL			2002-07453	9/5/02	16:30		<	1	1					<	1	1			
53	Equip. Blank				2002-07452	9/12/02	8:10		<	1	1										
54	Duplicate	MW-13A	MW-11		2002-07326	9/10/02	8:00			1.3	1						1	1			

DRAFT

ATTACHMENT 46

Utah Division of Radiation Control

Summary of IUC Tailings Cells
Historic Wastewater Quality Data
From the White Mesa Uranium Mill
Near Blanding Utah.

DRC spreadsheet TailsWQ.xls, tabsheet NewSum

IUC White Mesa Tailings Cells Wastewater Quality Data

Data Source:		1	2	3	4		5	5	5	5	5	5	5	5	6
Sample Date:				Sep-80	1981		1987	1987	1987	1987	1987	1987	1987	1987	Sep-91
	Lab:			D'A	Core		ORNL	ORNL	ORNL	ORNL	ORNL	ORNL	ORNL	ORNL	n/a
blank cell = no analysis		1979 IUC	1980 NRC	D'Appolonia Engineers			1987 NRC Samples (ORNL Analysis)								
	State	Benchtop	Generic	Tailings			Cell 1				Cell 3				Slimes
	GWQS	Estimate	Estimate	Cell 2	Tailings Liquid		Total		Dissolved		Total		Dissolved		Drain
Contaminant	(mg/L)	(mg/L)	(mg/L)	Conc.	Conc.		Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.
pH (std units)	6.5 – 8.5	1.8 – 2.0	2	1.1	1.8				0.7				0.82		
Nutrients (mg/l)															
Ammonia (N) [(4)]	25	65	500	3	1827				7,800				13,900		1,761
Nitrite (N)	10								< 100				< 100		
Nitrate (N)	10			24					< 500				< 500		
Nitrite+Nitate (N)	10														
Phosphorus-total				160			620		610		370		430		
TKN (N)								5,300				4,900			
Inorganics (mg/l)															
Bicarbonate (HCO3)	n/a								< 5				< 5		
Bromide									< 500						
Carbonate (CO3)									< 5						
Chloride	N/a	3,050	300	2,200	5,214				8,000						3,191
Cyanide - total	0.2								0.022				< 0.002		
Fluoride	4	1.4	5		0.02				< 100				< 100		
Phosphate									< 500				< 500		
Silica	N/a	300			400		< 20		120				110		
Sulfate	N/a	82,200	30,000	35,000	77,732				190,000				180,000		38,404
Sulfide									< 5				< 5		
TDS	n/a	n/a	35,000	58,100	148,510				120,000				189,000		67,710
TOC								76				81			
[illegible]									31				115		
Metals (mg/l)															
Aluminum	N/a	4,260	0		330		2,200				2,100				2,450
Antimony	0.006						< 20		< 20				< 20		
Arsenic	0.05	52	0.2	35.80	5.90		440	422	440	384	190	274		163	0.28
Barium	2	0.3			0.1		< 2		< 2		< 1				
Beryllium	0.004						0.78		0.78		0.54				
Boron	0.6						9.2		10		4				3.5
Cadmium	0.005	1.7	0.2		2.6		6.5		6.6		2.6				4.2
Calcium	N/a	480	500	90	560		210		630		300				474
Chromium	0.1	6			6.2		12		13		12				1.0
Cobalt	0.73	N/a	N/a				120		120?		48				14
Copper	1.3	1,620	50		265		740		740		360				177
Iron	11	n/a	1,000				3,300		3,400		2,000		2,100		
Gallium							< 30		< 30		< 15		< 30		
Lead	0.015	1	0.7		6.0		< 20		< 20				< 20		0.21
Lithium	0.73						< 20		< 20		< 10		< 20		
Magnesium	N/a	4,060		1,800	4,000		7,900		7,900		5,000		5,400		2,450
Manganese	0.8	4,580	500		222		140		140		74		82		128
Mercury	0.002	0.001	0.007		17.6			0.002		0.002		0.0008		0.0014	
Molybdenum	0.04	7	100		1.30		240		240		40		52		0.44
Nickel	0.1	N/a	N/a				360		370		150		170		7.2
Potassium				405											251
Selenium	0.05	0.56	20		0.18		< 20	2.4	< 20	2.4		1.1	< 20	0.97	0.64
Silver	0.1	0.06			0.14		< 5				< 2.5				0.005
Sodium	N/a	4,900	200	1,400	4,200		9,700		10,000		5,800		5,900		2,345
Strontium	4						3.6		5.8				4.7		14
Thallium	0.002						44	1.6	45	2.5		0.93	32	0.68	1.1
[illegible]	22,000						< 5		< 5				< 5		
Titanium	150														
Uranium	0.03	2.5		87	5		62.1		105				118		
Vanadium	0.06	240	0.1		510		270		280				210		165
Zinc	5	90	80		63		1,200		1,300				590		50
Zirconium							2.3		3				< 2		

IUC White Mesa Tailings Cells Wastewater Quality Data

Data Source:		1	2	3	4		5	5	5	5	5	5	5	5	6
Sample Date:				Sep-80	1981		1987	1987	1987	1987	1987	1987	1987	1987	Sep-91
Lab:				D'A	Core		ORNL	ORNL	ORNL	ORNL	ORNL	ORNL	ORNL	ORNL	n/a
b[illegible]k cell = no analysis		1979 IUC	1980 NRC	D'Appolonia Engineers			1987 NRC Samples (ORNL Analysis)								
	State	Benchtop	Generic	Tailings			Cell 1				Cell 3				Slimes
	GWQS	Estimate	Estimate	Cell 2	Tailings Liquid		Total		Dissolved		Total		Dissolved		Drain
Contaminant	(mg/L)	(mg/L)	(mg/L)	Conc.	Conc.		Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.
Radiologics (pCi/L)					Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.
Gross Alpha	15	250,000		114,000	53,900	3,800									14,000
Gross Beta				74	84,350	3,900									6,200
Lead-210	2.0				20,700	800	**2,600**	500	**2,300**	500	**2,100**	400	**2,000**	400	
Thorium-230	18				76,640	1,640	**26,000**	1,000	**24,000**	1,000	**23,000**	1,000	**23,000**	1,000	3,650
Thorium-232	16														
Polonium-210	1.0				1,410	64									
Radium-226				180	529	7									40
Radium-228															1.9
Total Radium	5			180	529		**1,700**	400	**300**	60	**240**	50	**260**	50	41.9
Selected VOCs (ug/l)															
Acetone	700						35				28				513.61
Benzene	5						< 5				< 5				
2-butanone (MEK)	4,000						14				11				15.13
Carbon Disulfide	700						< 5				16				
Carbon tetrachloride	5						< 5				< 5				
Chloroform	70						8				6				16.84
1,1-Dichloroethane	n/a						< 5				< 5				
1,2-Dichloroethane	5						< 5				< 5				
Dichloromethane	5						11				10				
Tetrahydrofuran	46						n-a				n-a				
Toluene	1,000						< 5				< 5				6.25
Vi[illegible]l chloride	2						< 10				< 10				
[illegible]e (total)	10,000						< 5				< 5				
Selected Semi-VOCs (ug/l)															
Benzo(a)pyrene	**0.2**						< 10				< 10				nd
Bis(2-ethylhexyl)phtha	6.0						< 10				< 10				1.13
Chrysene	48						< 10				< 10				nd
Diethyl phthalate	5,000						< 10				< 10				18.1
Dimethylphthalate	n/a						< 10				< 10				2.7
Di-n-butylphthalate	700						< 10				< 10				1.08
Fluoranthene	280						< 10				< 10				nd
2-Methylnaphthalene	4						< 10				< 10				n-a
Naphthalene	100						< 10				< 10				2.44
Phenol	4,000						< 10				< 10				38.4

Key to Data Sources:

1 = May, 1979 NRC Final Environmental Statement, p. 3-11, Table 3.1. Original lab concentrations reported in units of gm/liter, converted here to mg/liter

2 = September, 1980 NRC Final Generic EIS, p. M-5, Table M.3. Original lab concentrations reported in units of ug/liter, converted here to mg/l.

3 = September 9, 1981 D'Appolonia Consulting Engineers Inc. Letter Report by C.E. Oldweiler and R.L. Olsen to Dr. C.E. Baker (p.9 and Table 2), as found in 6/22/01 IUC hydrogeology response, Attachment F.

4 = November 30, 1981 D'Applonia Consulting Engineers Inc. Letter Report by R.L. Olsen and C.E. Oldweiler to Dr. C.E. Baker (Table 1), as found in the 6/22/01 IUC hydrogeology response, Attachment H.

5 = October 21, 1987 NRC Letter from E.F. Hawkins to Umetco Minerals Corporation, 1 p. 8 attachments

6 = July, 1994 Titan Environmental hydrogeologic report, Appendix B, Table 1 (7/22/94 facisimile from Concord/Energy Fuels)

7 = September 16, 2003 IUC letter (1 p.), includes analytical results by Energy Laboratories Inc. for six (6) Tailings Cell 1 and six (6) Tailings Cell 3 wastewater samples

IUC White Mesa Tailings Cells							
Data Source:		7	7	7	7	7	7
Sample Date:		Mar-03	Mar-03	Mar-03	Mar-03	Mar-03	Mar-03
Lab:		ELI	ELI	ELI	ELI	ELI	ELI
blank cell = no analysis		March, 2003 IUC Grab Samples (Energy Laboratories Inc. Analysis)					
	State	Cell 1, samples (a) thru (f)					
	GWQS	(a)	(b)	(c)	(d)	(e)	(f)
Contaminant	(mg/L)	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.
pH (std units)	6.5 – 8.5	1.8	1.94	2.00	1.81	1.83	1.87
Nutrients (mg/l)							
Ammonia (N) (4)	25	3,510	2,350	2,140	4,520	3,410	4,190
Nitrite (N)	10						
Nitrate (N)	10						
Nitrite+Nitate (N)	10	47.0	35.5	29.8	46.6	49.2	42.7
Phosphorus-total		353	246	200	344	341	318
TKN (N)							
Inorganics (mg/l)							
Bicarbonate (HCO3)	n/a						
Bromide							
Carbonate (CO3)		< 1	< 1	< 1	< 1	< 1	< 1
Chloride	N/a	7,690	5,420	4,630	7,720	8,000	6,910
Cyanide - total	0.2						
Fluoride	4	1,780	2,330	2,240	4,440	4,010	3,230
Phosphate							
Silica	N/a						
Sulfate	N/a	72,900	52,000	44,900	73,700	71,300	67,200
Sulfide							
TDS	n/a	110,000	76,600	64,700	109,000	109,000	98,900
TOC							
TSS							
Metals (mg/l)		Total Metals					
Aluminum	N/a	2,460	1,790	1,560	2,530	2,480	2,340
Antimony	**0.006**						
Arsenic	0.05	146	104	83.6	142	141	111
Barium	2	0.036	0.055	0.093	0.035	0.039	0.070
Beryllium	**0.004**	0.499	0.402	0.347	0.532	0.545	0.527
Boron	0.6	8.04	8.33	6.93	11.3	11.30	10.4
Cadmium	0.005	4.41	3.27	2.66	4.40	4.48	4.72
Calcium	N/a	343	291	285	308	297	320
Chromium	0.1	7.07	5.46	4.77	7.13	7.17	6.59
Cobalt	0.73						
Copper	1.3	227	168	140	233	237	175
Iron	11	3,220	2,300	1,940	3,290	3,190	2,980
Gallium							
Lead	0.015	3.17	3.42	3.60	3.21	3.15	3.81
Lithium	0.73						
Magnesium	N/a	6,800	4,940	4,220	6,950	6,720	6,300
Manganese	0.8	179	139	126	178	181	172
Mercury	0.002						
Molybdenum	0.04	56.6	41.1	34.2	58.4	59.2	53.8
Nickel	0.1	42.7	31.4	26.7	43.5	44.4	33.0
Potassium		828	522	441	718	712	661
Selenium	0.05	2.24	1.65	1.39	2.10	2.03	1.76
Silver	0.1						
Sodium	N/a	9,950	7,160	6,150	9,910	9,630	9,030
Strontium	4						
Thallium	**0.002**						
Tin	22,000						
Titanium	150	33.2	25.7	20.9	33.2	33.3	31.9
Uranium	0.03	154	112	95.1	151.0	151.0	144.0
Vanadium	0.06	393	301	257	392	389	356
Zinc	5						
Zirconium		38.5	21.2	13.5	25.7	22.9	23.9

IUC White Mesa Tailings Cells													
Data Source:		7		7		7		7		7		7	
Sample Date:		Mar-03		Mar-03		Mar-03		Mar-03		Mar-03		Mar-03	
Lab:		ELI		ELI		ELI		ELI		ELI		ELI	
blank cell = no analysis		March, 2003 IUC Grab Samples (Energy Laboratories Inc. Analysis)											
	State	Cell 1, samples (a) thru (f)											
	GWQS	(a)		(b)		(c)		(d)		(e)		(f)	
Contaminant	(mg/L)	Conc.		Conc.		Conc.		Conc.		Conc.		Conc.	
Radiologics (pCi/L)		Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-
Gross Alpha	15	185,000	1,540	135,000	1,100	142,000	1,160	189,000	1,570	188,000	1,550	177,000	1,540
Gross Beta		114,000	898	89,700	664	78,200	630	110,000	884	116,000	903	105,000	870
Lead-210	2.0	4,700	43	3,800	39	2,900	34	3,500	37	4,000	40	4,000	40
Thorium-230	18	23,700	480	21,800	475	15,900	399	27,500	620	26,500	599	25,500	573
Thorium-232	16	109	32.9	105	33.4	62.5	25.5	113	40.4	116	40.2	121	40
Polonium-210	1.0												
Radium-226		1,690	60.7	1,210	43.5	1,070	38.4	1,590	56.9	1,620	58.2	1,470	52.8
Radium-228													
Total Radium	5	1,690.0		1,210.0		1,070.0		1,590.0		1,620.0		1,470.0	
Selected VOCs (ug/l)													
Acetone	700												
Benzene	5												
2-butanone (MEK)	4,000												
Carbon Disulfide	700												
Carbon tetrachloride	5												
Chloroform	70												
1,1-Dichloroethane	n/a												
1,2-Dichloroethane	5												
Dichloromethane	5												
Tetrahydrofuran	46												
Toluene	1,000												
Vinyl chloride	2												
Xylene (total)	10,000												
Selected Semi-VOCs (ug/													
Benzo(a)pyrene	**0.2**												
Bis(2-ethylhexyl)phtha	6.0												
Chrysene	48												
Diethyl phthalate	5,000												
Dimethylphthalate	n/a												
Di-n-butylphthalate	700												
Fluoranthene	280												
2-Methylnaphthalene	4												
Naphthalene	100												
Phenol	4,000												
	1												
	2												
	3												
	4												
	5												
	6												
	7												

IUC White Mesa Tailings Cells							
Data Source:		7	7	7	7	7	7
Sample Date:		Mar-03	Mar-03	Mar-03	Mar-03	Mar-03	Mar-03
Lab:		ELI	ELI	ELI	ELI	ELI	ELI
blank cell = no analysis		March, 2003 IUC Grab Samples (Energy Laboratories Inc. Analysis)					
	State	Cell 3, samples, (a) thru (f)					
	GWQS	(a)	(b)	(c)	(d)	(e)	(f)
Contaminant	(mg/L)	Conc.	Conc.	Conc.	Conc.	Conc.	Conc.
pH (std units)	6.5 – 8.5	2.3	2.26	2.26	2.33	2.29	2.24
Nutrients (mg/l)							
Ammonia (N) [(4)]	25	1,390	1,480	1,420	1,160	1,110	1,250
Nitrite (N)	10						
Nitrate (N)	10						
Nitrite+Nitate (N)	10	21.0	20.9	21.5	17.0	19.1	20.6
Phosphorus-total		124	120	120	89	88	108
TKN (N)							
Inorganics (mg/l)							
Bicarbonate (HCO3)	n/a						
Bromide							
Carbonate (CO3)		< 1	< 1	< 1	< 1	< 1	< 1
Chloride	N/a	2,770	2,670	2,670	2,110	2,140	2,400
Cyanide - total	0.2						
Fluoride	4	709	759	733	615	580	605
Phosphate							
Silica	N/a						
Sulfate	N/a	37,100	37,300	32,800	29,800	29,800	33,600
Sulfide							
TDS	n/a	57,800	57,300	56,400	43,100	44,400	50,800
TOC							
TSS							
Metals (mg/l)							
Aluminum	N/a	1,640	1,640	1,570	1,330	1,330	1,480
Antimony	**0.006**						
Arsenic	0.05	38	39	36.2	26	26	32
Barium	2	0.021	0.035	0.032	0.028	0.046	0.039
Beryllium	**0.004**	0.462	0.464	0.461	0.373	0.386	0.435
Boron	0.6	5.24	5.23	4.94	4.0	4.00	4.6
Cadmium	0.005	2.24	2.13	2.04	1.64	1.64	2.06
Calcium	N/a	406	429	397	413	432	433
Chromium	0.1	4.12	4.12	3.90	3.20	3.28	3.83
Cobalt	0.73						
Copper	1.3	98	100	96	72	73	85
Iron	11	1,440	1,430	1,360	1,080	1,100	1,260
Gallium							
Lead	0.015	2.03	2.27	2.01	2.81	2.94	2.98
Lithium	0.73						
Magnesium	N/a	3,850	3,830	3,640	3,100	2,500	3,400
Manganese	0.8	152	156	149	131	130	146
Mercury	0.002						
Molybdenum	0.04	14.3	14.0	13.0	9.6	10.0	12.6
Nickel	0.1	23.3	23.6	22.4	17.8	17.9	20.5
Potassium		285	283	268	219	221	250
Selenium	0.05	1.12	0.98	0.95	0.81	0.65	0.95
Silver	0.1						
Sodium	N/a	3,820	3,770	3,270	2,620	2,660	3,050
Strontium	4						
Thallium	**0.002**						
Tin	22,000						
Titanium	150	9.6	9.6	9.0	6.5	7.1	8.7
Uranium	0.03	78	77	70.3	56.1	56.7	68.9
Vanadium	0.06	174	173	165	136	140	162
Zinc	5						
Zirconium		4.1	3.1	3.0	2.3	4.9	2.8

IUC White Mesa Tailings Cells													
Data Source:		7		7		7		7		7		7	
Sample Date:		Mar-03		Mar-03		Mar-03		Mar-03		Mar-03		Mar-03	
	Lab:	ELI		ELI		ELI		ELI		ELI		ELI	
blank cell = no analysis		March, 2003 IUC Grab Samples (Energy Laboratories Inc. Analysis)											
	State	Cell 3, samples, (a) thru (f)											
	GWQS	(a)		(b)		(c)		(d)		(e)		(f)	
Contaminant	(mg/L)	Conc.		Conc.		Conc.		Conc.		Conc.		Conc.	
Radiologics (pCi/L)		Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-	Conc.	+/-
Gross Alpha	15	105,000	1,000	107,000	1,010	111,000	1,030	96,500	983	96,000	983	94,000	961
Gross Beta		63,600	572	60,000	557	59,800	556	46,900	504	47,500	507	52,800	529
Lead-210	2.0	880	21	870	20	990	22	750	19	680	19	780	20
Thorium-230	18	13,700	457	15,100	501	14,100	501	8,980	358	10,400	408	12,000	436
Thorium-232	16	91	38.0	65	33.8	102.0	43.6	52	28.1	54	30.5	49	29
Polonium-210	1.0												
Radium-226		970	34.9	1,190	42.8	1,200	43.0	818	29.4	751	27.0	1,070	38.6
Radium-228													
Total Radium	5	970.0		1,190.0		1,200.0		818.0		751.0		1,070.0	
Selected VOCs (ug/l)													
Acetone	700												
Benzene	5												
2-butanone (MEK)	4,000												
Carbon Disulfide	700												
Carbon tetrachloride	5												
Chloroform	70												
1,1-Dichloroethane	n/a												
1,2-Dichloroethane	5												
Dichloromethane	5												
Tetrahydrofuran	46												
Toluene	1,000												
Vinyl chloride	2												
Xylene (total)	10,000												
Selected Semi-VOCs (ug/l													
Benzo(a)pyrene	**0.2**												
Bis(2-ethylhexyl)phtha	6.0												
Chrysene	48												
Diethyl phthalate	5,000												
Dimethylphthalate	n/a												
Di-n-butylphthalate	700												
Fluoranthene	280												
2-Methylnaphthalene	4												
Naphthalene	100												
Phenol	4,000												
	1												
	2												
	3												
	4												
	5												
	6												
	7												

IUC White Mesa Tailings Cells							
Data Source:							
Sample Date:							
Lab:							
blank cell = no analysis		1980 - 2003 IUC / NRC Tailings Wastewater Samples					
	State	Reported Concentrations					Avg /
	GWQS	Minimum	Maximum	**Average**	Std. Dev.	Sample	GWQS
Contaminant	(mg/L)	(mg/L)	(mg/L)	**(mg/L)**	(mg/L)	Count	Ratio
pH (std units)	6.5 – 8.5	0.7	2.33	1.83	0.52	16	
Nutrients (mg/l)							
Ammonia (N) [4]	25	3.0	13,900	3,130.65	3,318.40	17	125.2
Nitrite (N)	10	< 100	< 100	< 100		2	
Nitrate (N)	10	24	24	24		1	2.4
Nitrite+Nitate (N)	10	17.0	49.2	30.91	12.53	12	3.1
Phosphorus-total		88.1	620	273.03	171.23	17	
TKN (N)		4,900	5,300	5,100	282.84	2	
Inorganics (mg/l)							
Bicarbonate (HCO3)	n/a	< 5	< 5	< 5		2	
Bromide		< 500	< 500	< 500		1	
Carbonate (CO3)		< 1	< 5	< 1.3		13	
Chloride	N/a	2,110	8,000	4,608.44	2,372.39	16	
Cyanide - total	0.2	0.022	0.022	0.02		1	0.11
Fluoride	4	0.02	4,440	1,694.7	1,449.21	13	423.7
Phosphate		< 500	< 500	< 500		2	
Silica	N/a	110	400	210.0	164.62	3	
Sulfate	N/a	29,800	190,000	64,913.9	48,361.6	17	
Sulfide		< 5	< 5	< 5		2	
TDS	n/a	43,100	189,000	85,960	40,645.55	17	
TOC		76.0	81	78.50	3.54	2	
TSS		31.0	115	73.00	59.40	2	
Metals (mg/l)							
Aluminum	N/a	330.0	2530	1,826.9	591.63	16	
Antimony	**0.006**	< 20	< 20	< 20		3	#VALUE!
Arsenic	0.05	0.3	440	149.1	148.18	22	2981.3
Barium	2	0.021	0.10	0.048	0.02	13	0.0
Beryllium	**0.004**	0.347	0.78	0.502	0.13	15	125.6
Boron	0.6	3.5	11.3	6.9	2.83	16	11.6
Cadmium	0.005	1.64	6.6	3.4	1.58	17	684.6
Calcium	N/a	90.0	630	367.7	124.70	18	
Chromium	0.1	1.0	13	6.2	3.38	17	61.7
Cobalt	0.73	14.0	120	60.7	54.12	3	83.1
Copper	1.3	72.2	740	234.4	206.02	17	180.3
Iron	11	1080.0	3400	2,211.9	887.56	16	201.1
Gallium		< 30	< 30	< 30		3	
Lead	0.015	0.21	6.0	3.0	1.26	14	198.1
Lithium	0.73	< 10	< 20	< 17.5	< 5.0	4	
Magnesium	N/a	1,800	7,900	4,773.7	1,871.03	19	
Manganese	0.8	74.0	222	145.8	34.76	18	182.3
Mercury	0.002	0.0008	17.6	3.5	7.87	5	1,760.6
Molybdenum	0.04	0.44	240	52.8	71.17	18	1,320.3
Nickel	0.1	7.2	370	82.6	115.40	17	826.1
Potassium		219.0	828	433.1	215.70	14	
Selenium	0.05	0.18	2.4	1.4	0.67	18	27.0
Silver	0.1	0.005	0.14	0.1	0.10	2	0.7
Sodium	N/a	1,400	10,000	5,808.7	3,072.10	19	
Strontium	4	3.6	14	7.0	4.74	4	1.8
Thallium	**0.002**	0.7	45	16.0	20.54	8	7,988.1
Tin	22,000	< 5	< 5	< 5	#DIV/0!	3	
Titanium	150	6.5	33.3	19.1	11.70	12	0.13
Uranium	0.03	5.0	154	93.6	41.20	17	3,120.6
Vanadium	0.06	136	510	263.1	111.91	17	4,385.3
Zinc	5	50	1300	640.6	598.48	5	128.1
Zirconium		2.3	38.5	12.2	12.00	14	

IUC White Mesa Tailings Cells							
Data Source:							
Sample Date:							
Lab:							
blank cell = no analysis		1980 - 2003 IUC / NRC Tailings Wastewater Samples					
	State	Reported Concentrations					Avg /
	GWQS	Minimum	Maximum	**Average**	Std. Dev.	Sample	GWQS
Contaminant	(mg/L)	(mg/L)	(mg/L)	**(mg/L)**	(mg/L)	Count	Ratio
Radiologics (pCi/L)							
Gross Alpha	15	14,000	189,000	120,493	50,345.1	15	8,032.9
Gross Beta		74	116,000	68,942	35,918.8	15	#DIV/0!
Lead-210	2.0	680	20,700	3,385	4,660.1	17	1,692.6
Thorium-230	18	3,650	76,640	21,748	15,394.8	18	1,208.2
Thorium-232	16	49	121	87	27.9	12	5.4
Polonium-210	1.0	1,410	1,410	1,410		1	1,410
Radium-226		40	1,690	1,027	497.2	15	
Radium-228		1.9	1.9	1.9	#DIV/0!	1	
Total Radium	5	42	1,700	942	553.2	19	188.4
Selected VOCs (ug/l)							
Acetone	700	28	514	192	278.4	3	0.3
Benzene	5	< 5	< 5	< 5		2	
2-butanone (MEK)	4,000	11	15.13	13.376667	2.134393	3	0.003344
Carbon Disulfide	700	16	16	16	#DIV/0!	1	0.022857
Carbon tetrachloride	5	< 5	< 5	< 5		2	
Chloroform	70	6	16.84	10.28	5.768466	3	0.146857
1,1-Dichloroethane	n/a	< 5	< 5	< 5		2	
1,2-Dichloroethane	5	< 5	< 5	< 5		2	
Dichloromethane	**5**	10	11	10.5	0.7071068	2	2.1
Tetrahydrofuran	46	n-a	n-a	n-a	n-a	n-a	n-a
Toluene	1,000	< 5	6.25	< 5.62		2	
Vinyl chloride	2	< 10	< 10	< 10		2	
Xylene (total)	10,000	< 5	< 5	< 5		2	
Selected Semi-VOCs (ug/							
Benzo(a)pyrene	**0.2**	< 10	< 10	< 10		2	
Bis(2-ethylhexyl)phtha	6.0	1	1	1		3	0.2
Chrysene	48	< 10	< 10	< 10		2	
Diethyl phthalate	5,000	< 10	18.1	18.1		3	0.004
Dimethylphthalate	n/a	2.7	2.7	2.7		3	
Di-n-butylphthalate	700	1.08	1.08	1.08		3	0.002
Fluoranthene	280	< 10	< 10	< 10		2	
2-Methylnaphthalene	4	< 10	< 10	< 10		2	
Naphthalene	100	2.44	2.44	2.44		3	0.024
Phenol	4,000	< 10	38.4	38.4		3	0.0
	1						
	2						
	3						
	4						
	5						
	6						
	7						

DRAFT

ATTACHMENT ~~5~~7

Utah Division of Radiation Control

Summary of Literature Values for
Soil-Water Partitioning (K_d) Coefficients for Metals

DRC spreadsheet 11E2KdSum.xls
Tabsheet: Metals

Summary of Kd Values for Metals

Comparison of Literature Kd Values

	Thibault, et. al., 5/90, Tables 4 thru 7[1]															
	Sand Soil				Silt Soils				Clay Soils				Organic Soils			
Metal	Low	High	Geo-mean	N	Low	High	Geo-mean	N	Low	High	Geo-mean	N	Low	High	Geo-mean	N
Ag	2.7	1,000	90	12	28	333	120	4	100	300	180	5	4,400	33,000	15,000	4
Al																
Am	8	300,000	1,900	29	400	48,309	9,600	20	25	400,000	8,400	11	6,398	450,000	112,000	5
As			250													
As (III)																
As (V)																
B																
Ba																
Be																
Ca			5				30				50				90	
Cd	2.7	625	80	14	7	962	40	8	112	2,450	560	10	23	17,000	800	9
Ce	**40**	3,968	500	12	1,200	56,000	8,100	5	12,000	31,623	20,000	4			3,300	1
Cm	780	22,970	4,000	2	7,666	44,260	18,000	4			6,000				6,000	1
Co	**0.07**	9,000	60	33	100	9,700	1,300	23	20	14,000	550	15	120	4,500	1,000	6
Cr	**1.7**	1,729	70	15	2.2	1,000	30	4			1,500		6.0	2,517	270	4
Cr (II)																
Cr (III)																
Cr (VI)																
Cs	**0.2**	10,000	280	81	560	61,287	4,600	54	37	31,500	1,900	28	0.4	145,000	270	9
Cu																
Fe	5	6,000	220	16	290	2,240	800	18	15	2,121	165	7			600	1
Hg																
K			15				55				75				200	
Mg																
Mn	6.4	5,000	50	54	40	77,079	750	38	23.6	48,945	180				150	1
Mo	1	52	10	15			125		13	400	90	7	18	50	25	3
Na																
Ni	60	3,600	400	11			300		305	2,467	650	10	360	4,700	1,100	6
Np	0.5	390	5.0	16	1.3	79	25	11	0.4	2,575	55	4	857	1,900	1,200	3
Pb	19	1,405	270	3	3500	59,000	16,000	3			550		9,000	31,590	22,000	6
Po	**9**	7,020	150	36	24	1,830	400	13			3,000				7,300	
Pu	27	36,000	550	39	100	5,933	200	21	316	190,000	5,100	18	60	62,000	1,900	7
Ru	**5**	490	55	7			1,000				800		39,000	87,000	66,000	5
Sb			45				150				250				550	
Se			150				500				740				1,800	
Se (IV)																
Se (VI)																
Sr	0.05	190	15	81	**0.01**	300	20	43	3.6	32,000	110	24				
Tc	0.01	16	0.1	19	0.01	0.4	0.1	10	1.16	1.32	1	4	0.02	340	1	24
Ti																
Th	207	150,000	3,200	10			3,300		244	160,000	5,800	5	1,579	13,000,000	89,000	3
Tl																
U	0.03	2,200	35	24	0.2	4,500	15		46	395,100	1,600	7	33	7,350	410	6
V																
Zn	0.1	8,000	200	22	3.6	11,000	1,300	12	200	100,000	2,400	23	70	13,000	1,600	8
Zr			**600**				2,200				3,300				7,300	

	Baes & Sharp, 1983, Table 4[2]				Battelle, 1989[3]		EPA 4/91 STF Database[4]				EPA 8/99 Kd Report[5]			
	Agricultural soils and clays (pH 4.5-9.0)				No Soil Texture Descrimination		No soil texture discrimination				No soil texture discrimination			
Metal	Low	High	Geo-mean	N	Low	High	Low	High	Geo-mean	N	Low	High	Median	N
Ag	10	1,000	110	16	**0.4**	40	79.4	50,118.7		2				
Al														
Am	**1.0**	47,230	810	46										
As					5.9	19.4								
As (III)	**1.0**	8.3	3.3	19			15.8			1				
As (V)	**1.9**	18	6.7	37			79.4			1				
B														
Ba					**530**	16,000								
Be					**70**	8,000								
Ca	**1.2**	9.8	4.1	10										
Cd	1.26	26.8	6.7	28	14.9	567	0.74	478.6	27.0	17	**0.5**	4,360	121.8	174
Ce	58	6,000	1,100	16										
Cm	**93.3**	51,900	3,300	31										
Co	0.2	3,800	55	57										
Cr							3.31	229.1	31.9	11				
Cr (II)	**470**	150,000	2,200	15										
Cr (III)					**168**	3,600		50,118,723		1				
Cr (VI)	1.2	1,800	37	18	16.8	360		3,981		1	**0.25**	135,160		197
Cs	10	52,000	1,110	135							0.6	52,000	247	177
Cu	**1.4**	333	22	55										
Fe	**1.4**	1,000	55	30										
Hg					**322**	5,280								
K	**2.0**	9	5.5	10										
Mg	**1.6**	13.5	5.5	58										
Mn	**0.2**	10,000	150	45										
Mo	**0.37**	400	20	17										
Na														
Ni					12.2	650	**1.05**	63.1	6.13	11				
Np	**0.16**	929	11	44										
Pb	**4.5**	7,640	99	125			7.59	39,810.7	201.3	13	19	79,000		n/a
Po	196	1,063	540	6										
Pu	**11**	300,000	1,800	40							80	2,200		16
Ru	48	1,000	220	17										
Sb					**2.0**	15.9	13.5	707.9	182.0	11				
Se					**5.9**	15								
Se (IV)	**1.2**	8.6	2.7	19			10			1				
Se (VI)							**0.01**	0.051	0.033	9				
Sr	0.15	3,300	27	218							1.6	10,200	15	63
Tc	**0.0029**	0.28	0.033	24										
Ti					**0.0**	0.8								
Th	2,000	510,000	60,000	17							**100**	500,000	5,000	17
Tl					**0.0**	0.8								
U	10.5	4,400	45	24							**0.3**	1,400	n/a	n/a
V					**50**	100								
Zn	**0.1**	8,000	16	146										
Zr														

Bold = minimum Kd value for each element

Key to Data Sources:

1) Thibault, D.H., M.I. Sheppard, P.A. Smith, March, 1990, "A Critical Compilation and Review of Default Soil Solid / Liquid Partition Coefficients, Kd, for Use in Environmental Assessments", Whiteshell Nuclear Research Establishment for Atomic Energy of Canada, AECL-10125, 112 pp.

2) Baes, C.F., III, and R.D. Sharp, 1983, "A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models", Journal of Environmental Quality, Vol. 12, No. 1, pp. 17-28.

3) Battelle Memorial Institute, 1989, "Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS): Version 1", prepared for the U.S. Department of Energy under Contract DE-AC06-76RKI 1830, by Pacific Northwest Laboratory, operated by Battelle Memorial Institute [as found in U.S. EPA, "Soil Screening Guidance: Technical Background Document", May, 1996, EPA/540/R95/128, Table 43].

4) U.S. Environmental Protection Agency, April, 1991, "Soil Transport and Fate Database, Version 2.0", written by R.C. Sims, J.L. Sims and S.G. Hansen, Department of Civil and Environmental Engineering, Utah State University, Project CR-813211 for the Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma.

5) U.S. Environmental Protection Agency, August, 1999, "Undertanding Variation in Partition Coefficient, Kd, Values, Vol. II, Review of Geochemistry and Available Kd Values for Cadmium, Cesium, Chromium, Lead, Plutonium, Radon, Strontium, Thorium, Tritium (3H), and Uranium", EPA 402-R-99-004B, approx. 332 pp.

Cell: E6
Comment: N = sample size

Cell: A22
Comment: Cr (II): Baes and Sharp, 1983 list the valence state as Cr +2. However, chromium speciation and mineral equilibrium suggests that only 2 valence states are possible, Cr (III) and Cr (VI), see W.J. Deutsch, 1997, "Groundwater Geochemistry Fundamentals and Applications to Contamination", Lewis Publishers, Boca Raton, FL, p. 168, Fig. 11-1. Consequently the Baes and Sharp listing may have been a typographical error, and perhaps should be corrected to read Cr (III).

Cell: AF24
Comment: EPA 8/99 Kd Report, Cr (VI) Data: 197 different test result available from for Cr (VI) from the following tables in this report:

Table	N
E.1	N=27
E.2	N=76
E.4	N= 61
E.5	N=33

DRAFT

ATTACHMENT ~~6~~8

Utah Division of Radiation Control

Summary of Literature Values for
Organic Carbon Partitioning Coefficients (K_{oc})
Soil-Water Partitioning (K_d) Coefficients for Organics

DRC spreadsheet 11E2KdSum.xls
Tabsheet: Org-Koc

K_{oc} and K_d values: Selected Organics in 11e.(2) Materials

Comparison of Literature Kd Values

Estimated White Mesa Soil & Aquifer Organic Carbon Fraction (foc): 0.001

Contaminant	CAS No.	DRC Research: Sources 1 & 2 — 1996 EPA Soil Screening Guidance — May-96 Technical Background Document — Directly Measured Koc, Table 38 (L/kg): Geomean	Avg.	Low	High	N	Calc. Koc Table 39 (L/kg)	Jul-96 User's Guide Koc (L/kg)	DRC Research: Source 3 — 4/91 EPA STF Database — Log Koc (L/kg): Low	High	Calculated Koc (L/kg): Low	High	DRC Research: Sources 4 & 5 — 12/00 NLM Toxnet Haz. Sub. Databank Koc (L/kg): Low	High	Dragun, 1988 Koc (L/kg): Low	High	Range of Available Koc Data from 5 DRC Sources (at Left): Lowest (L/Kg)	Highest (L/Kg)	Delta (L/Kg)	Ratio of High / Low	DRC Est. Kd (L/Kg)
VOC's																					
Acetone	67-64-1	n/a	n/a	n/a	n/a	n/a	0.575	0.575	1.17	n/a	14.79	n/a	1.0	n/a	n/a	n/a	0.575	15	14.2	25.72	0.001
Benzene	71-43-2	62	66	31	100	13	58.9	58.9	1.44	2.0	27.54	100.00	85	n/a	31	n/a	27.54	100.0	72.5	3.63	0.028
2-Butanone (MEK)	78-93-3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.18	1.71	15.14	51.29	29	34	n/a	n/a	15.14	51	36.2	3.39	0.015
Carbon Disulfide	75-15-0	n/a	n/a	n/a	n/a	n/a	45.7	45.7	n/a	n/a	n/a	n/a	270	n/a	n/a	n/a	45.7	270	224.3	5.91	0.046
Carbon Tetrachloride	56-23-5	152	158	123	224	3	152	174	1.33	2.36	21.38	229.09	71	n/a	n/a	n/a	21.38	229.1	207.7	10.72	0.021
Chloroform	67-66-3	53	57	28	81	5	39.8	39.8	1.38	1.78	23.99	60.26	34	196	n/a	n/a	23.99	196	172.01	8.17	0.024
Chloromethane (MC)	74-87-3	6	6	6	6	1	n/a	n/a	n/a	n/a	n/a	n/a	14	n/a	n/a	n/a	6.00	14.0	8.0	2.33	0.006
2-Chlorotoluene	95-49-8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	170	880	n/a	n/a	170	880	710	5.18	0.170
1,1-Dichloroethane	75-34-3	53	54	46	62	2	31.6	31.6	1.12	n/a	13.18	n/a	30	n/a	n/a	n/a	13.18	62.0	48.8	4.70	0.013
1,2-Dichloroethane	107-06-2	38	44	22	76	3	17.4	17.4	1.28	1.5	19.05	31.62	33	n/a	32	n/a	17.4	76	58.6	4.37	0.017
Ethylbenzene	100-41-4	204	207	165	255	5	363	363	n/a	n/a	n/a	n/a	520	n/a	163.8	n/a	163.8	520	356.22	3.17	0.164
Methylene Chloride (DCM)	75-09-2	10	10	10	10	1	11.7	11.7	1.44	1.49	27.54	30.90	24	n/a	n/a	n/a	10.0	31	20.9	3.09	0.010
Naphthalene	91-20-3	1,191	1,231	830	1,950	20	2,000	2000	2.6	4.43	398.11	26,915.3	812	4,100	1,300	n/a	398.11	26,915	26,517	67.61	0.398
Tetrahydrofuran	109-99-9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.96	1.44	9.12	27.54	18	23	n/a	n/a	9.12	27.54	18.42	3.02	0.009
Toluene	108-88-3	140	145	94	247	12	182	182	1.13	2.21	13.49	162.18	37	178	n/a	n/a	13.49	247.0	233.5	18.31	0.013
1,1,2-Trichloroethane	79-00-5	75	77	60	108	4	50.1	50.1	1.74	2.05	54.95	112.20	70	209	n/a	n/a	50.1	209	158.9	4.17	0.050
1,2,4-Trimethylbenzene	95-63-6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	720	n/a	n/a	n/a	720	720	0	1.00	0.720
Vinyl Chloride	75-01-4	n/a	n/a	n/a	n/a	n/a	18.6	18.6	1	1.75	10.0	56.23	56	n/a	n/a	n/a	10.0	56	46.2	5.62	0.010
m-Xylene	108-38-3	196	204	158	289	3	407	407	n/a	n/a	n/a	n/a	166	182	n/a	n/a	158.0	407	249.0	2.58	0.158
o-Xylene	95-47-6	241	241	222	258	4	363	363	2.34	2.73	218.78	537.03	25.4	130	n/a	n/a	25.4	537	511.6	21.14	0.025
p-Xylene	106-42-3	311	313	260	347	3	389	389	2.01	2.92	102.33	831.76	246	540	n/a	n/a	102.3	832	729.4	8.13	0.102
Semi-VOC's																					
Aldrin	309-00-2	48,685	48,686	48,394	48,978	2	2.45E+06	2.45E+06	0.49	5.44	3.09	275,423	407	28,184	410	n/a	3.09	2.45E+06	2.45E+06	792,804	0.003
Benzo(a)anthracene	56-55-3	357,537	459,882	150,000	840,000	4	398,000	398,000	5.2	5.27	158,489	186,209	545,000	1.87E+06	n/a	n/a	150,000	1.87E+06	1.72E+06	12.47	150.0
Benzo(a)pyrene	50-32-8	968,774	1.17E+06	478,947	2.13E+06	3	1.02E+06	1.02E+06	4.5	6.65	31,623	4.47E+06	930	1.90E+06	n/a	n/a	930	4.47E+06	4.47E+06	4,803	0.93
Benzo(b)fluoranthene	205-99-2	n/a	n/a	n/a	n/a	n/a	1.23E+06	1.23E+06	5.8	6.15	630,957	1.41E+06	1.29E+06	5.01E+06	n/a	n/a	630,957	5.01E+06	4.38E+06	7.94	631
Benzo(g,h,i)perylene	191-24-2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	96,000	n/a	n/a	n/a	96,000	96,000	0	1.00	96.0
Benzo(k)fluoranthene	207-08-9	n/a	n/a	n/a	n/a	n/a	1.23E+06	1.23E+06	n/a	n/a	n/a	n/a	330,000	8.70E+06	n/a	n/a	330,000	8.70E+06	8.37E+06	26.36	330.0
Bis(2-ethylhexyl)phthalate	117-81-7	111,123	114,337	87,420	141,254	2	1.51E+07	1.51E+07	4.0	5.0	10,000	100,000	10,000	1.00E+06	n/a	n/a	10,000	1.51E+07	1.51E+07	1,510	10.0
alpha-chlordane	5103-71-9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
gamma-chlordane	5103-74-2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chlordane	57-74-9	51,310	51,798	44,711	58,884	2	1.20E+05	120,000	1.58	5.15	38.02	141,254	1,720	24,600	n/a	n/a	38.02	141,254	141,216	3,715	0.04
Chrysene	218-01-9	n/a	n/a	n/a	n/a	n/a	398,000	398,000	5.2	5.27	158,489	186,209	31,000	58,000	n/a	n/a	31,000	398,000	367,000	12.84	31.00
Dibenz(a,h)anthracene	53-70-3	1.79E+06	2.03E+06	565,014	3.06E+06	14	3.80E+06	3.80E+06	5.56	6.5	363,078	3.16E+06	570,000	3.00E+06	2.03E+06	n/a	363,078	3.80E+06	3.44E+06	10.47	363.1
Diethyl Phthalate	84-66-2	82	84	69	98	2	288	288	1.84	2.72	69.18	524.81	69.0	1,726	n/a	n/a	69.0	1,726	1,657	25.01	0.07
Dimethylphthalate	131-11-3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.64	2.49	43.65	309.03	80.0	160,000	n/a	n/a	43.65	160,000	159,956	3665.39	0.04
Di-n-Butylphthalate	84-74-2	1,567	1,580	1,384	1,775	2	3.39E+04	3.39E+04	2.2	3.81	158.49	6,456.5	1,122.0	1,380	n/a	n/a	158.49	33,900	33,742	213.89	0.16
4,4'-DDD	72-54-8	45,800	45,800	45,800	45,800	1	1.00E+06	1.00E+06	5.38	n/a	239,883	n/a	80,500	n/a	n/a	n/a	45,800	1.00E+06	954,200	21.83	45.80
Fluoranthene	206-44-0	49,096	49,433	41,687	54,954	3	107,000	107,000	3.65	4.93	4,467	85,114	29,500	295,000	n/a	n/a	4,467	295,000	290,533	66.04	4.47
Indeno(1,2,3-cd)pyrene	193-39-5	n/a	n/a	n/a	n/a	n/a	3.47E+06	3.47E+06	6.33	7.23	2.14E+06	1.70E+07	110,000	6.92E+06	n/a	n/a	110,000	1.70E+07	1.69E+07	154.39	110.0
2-Methylnaphthalene	91-57-6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8,500	n/a	8,500	n/a	8,500	8,500	0	1.00	8.50
Phenanthrene	85-01-8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.57	4.36	3,715	22,909	22,909	n/a	23,000	n/a	3,715	23,000	19,285	6.19	3.72
Phenol	108-95-2	n/a	n/a	n/a	n/a	n/a	28.8	28.8	1.21	3.46	16.2	2,884.0	16.0	91.0	27	n/a	16	2,884	2,868	180.25	0.016
PCB-1254	11097-69-1	n/a	n/a	n/a	n/a	n/a	309,000	n/a	4.22	5.19	16,596	154,882	42,500	1,258,925	n/a	n/a	16,596	1.26E+06	1.24E+06	75.86	16.60
Pyrene	129-00-0	67,992	70,808	43,807	133,590	27	105,000	105,000	4.04	5.81	10,965	645,654	59,675	251,189	62,700	84,000	10,965	645,654	634,689	58.88	10.96

Key to Notes / Highlights

- (shaded) = calculated cells
- *italics* = estimated Koc values
- **Bold** = lowest Koc value available in literature
- = contaminants detected in IUC groundwater
- (dark shading) = contaminants detected in IUC groundwater with concentrations > GWQS
- underline = contaminants detected in IUC tailings wastewater (IUC analysis)
- = possible groundwater monitoring parameters (shading on CAS Nos.)

Koc Literature Sources:

1) EPA "Soil Screening Guidance: Technical Background Document", May, 1996, EPA/540/R956/128, Tables 38 and 39.
2) EPA "Soil Screening Guidance: User's Guide", July, 1996, EPA/540/R-96/018, Table C-1
3) EPA Soil Transport and Fate Database, April, 1991.
4) National Library of Medicine Toxnet Hazardous Substances Databank @ http://toxnet.nlm.nih.gov
5) Dragun, 1988, "The Soil Chemistry of Hazardous Materials", Hazardous Materials Control Research Institute, 458 pp.

Cell: V2
Comment: White Mesa Soil & Aquifer Organic Carbon Fraction (foc): no information provided to date by IUC on the foc content of White Mesa soil and aquifer matrix. Typical sand aquifers have a foc value that ranges from 0.0001 to 0.0075 (Pankow and Cherry, 1996, p. 247). However, research suggests that the organic carbon content of the aquifer doesn't control contaminant sorption until foc > 0.001. Consequently, DRC staff assumed that the foc = 0.001.

Cell: C3
Comment: Chemical Specific Koc: from 5/96 EPA "Soil Screening Guidance: Technical Background Document", 2nd Ed., EPA/540/R-95/128. Measured Koc values from Table 38, calculated values from Table 39.

Cell: H5
Comment: EPA Calculated Koc Values: based on apparent relationship between octanol / water partitioning coefficient (Kow) and Koc, see EPA Soil Screening Guidance: Technical Background Document, July, 1996, EPA/540/R95/128, Table 39 and pp. 140-141.

Cell: N5
Comment: National Library of Medicine TOXNET internet Hazardous Substances Databank, found at: http://toxnet.nlm.nih.gov/. Reports run by DRC staff on 12/21/00.

Cell: P5
Comment: Dragun, 1988, "The Soil Chemistry of Hazardous Materials", Hazardous Materials Control Research Institute, Silver Spring, Maryland, 458 pp.

Cell: I6
Comment: Chemical Specific Koc: from 7/96 EPA "Soil Screening Guidance: User's Guide", 2nd Ed., EPA/540/R-96/018, Table C-1.

Cell: V6
Comment: Estimated Contaminant Kd: DRC staff assumed that the sorption of the organic contaminants at the White Mesa facility is controlled by the fraction of organic carbon (foc) found in the soil and aquifer materials underlying the site. The sorption Kd was then determined as follows (Domenico & Schwartz, 1990, p. 443):
Kd = Koc * foc
where Koc = the organic carbon partitioning coefficient for each individual organic compound (L/Kg).

For the IUC facility, the Koc value was taken from the LOWEST available Koc value found in the literature, see Column Y.

Cell: G7
Comment: N = sample size

Cell: A9
Comment: Acetone: chemical synonym = 2-Propanone.

Cell: J9
Comment: Acetone: only 1 Koc value available in the EPA STF database.

Cell: A10
Comment: Benzene: chemical synonyms/tradenames = Benzol 90, Pyrobenzol, polystream, coal naphtha, and Phene.

Cell: P10
Comment: Benzene Koc (Dragun): Table 6.3 provides a Kom (organic matter) value for benzene, 18. DRC staff then converted this to a Koc value using an equation provided by Dragun (p. 235), where:
Koc = 1.724 * Kom
= 1.724 * 18
= 31.032

Cell: A11
Comment: 2-Butanone: chemical synonym = Methyl Ethyl Ketone.

Cell: A13
Comment: Carbon Tetrachloride Synonym = tetrachloromethane.

Cell: J13
Comment: Log Koc (L/Kg) from EPA STF Database:

Low	High	Source
1.77	2.36	Walton, et. al. (experimental results)
1.33	1.88	Walton, et. al. (experimental results)

3.50 Bahnick & Doucette (compilation of literature sources)

Cell: A14
Comment: Chloroform: chemical synonyms = trichloromethane, methyl trichloride, or methane trichloride. CAS No. = 67-66-3.

Cell: N14
Comment: Chloroform (National Library of Medicine Hazardous Substance DataBank): tests run on 5 soil samples showed Koc = 34 for 2 samples, with "no appreciable adsorption" for 3 others. Kd tests were also run on 3 other soils samples from Missouri, California, and Florida. After determination of the soil organic carbon content, Koc was determined to range between 153 - 196 L/kg.

Cell: A15
Comment: Chloromethane (CAS No. 74-87-3): synonym = methyl chloride.

Cell: N15
Comment: Chlormethane Koc (Toxnet): reported Koc value, 14 L/Kg, is an estimated value.

Cell: A16
Comment: 2-Chlorotoluene Synonyms (CAS No. 95-49-8):
2-CHLORO-1-METHYLBENZENE
ORTHO-CHLOROTOLUENE
2-CHLOROTOLUENE
1-METHYL-2-CHLOROBENZENE
TOLUENE, O-CHLORO-
O-TOLYL CHLORIDE

Cell: N16
Comment: 2-Chlorotoluene Koc Values (Toxnet): range of reported values = 170 - 880, with an average of 370 L/Kg.

Cell: A17
Comment: 1,1-Dichloroethane Synonyms (CAS No. 75-34-3):
AETHYLIDENCHLORID (GERMAN)
CHLORURE D'ETHYLIDENE (FRENCH)
CLORURO DI ETILIDENE (ITALIAN)
1,1-DICHLOORETHAAN (DUTCH)
1,1-DICHLORAETHAN (GERMAN)
1,1-DICHLORETHANE
Alpha Alpha dichloroethane
1,1-DICLOROETANO (ITALIAN)
ETHANE, 1,1-DICHLORO-
ETHYLIDENE CHLORIDE
ETHYLIDENE DICHLORIDE
NCI-C04535

Cell: A18
Comment: 1,2-Dichloroethane: chemical synonym = Ethylene Dichloride.

Cell: P18
Comment: 1,2-Dichloroethane: only 1 Koc value listed in Dragun, 1988.

Cell: A19
Comment: Ethylbenzene: chemical synonyms = Ethylbenzol, and Phenylethane.

Cell: P19
Comment: Ethylbenzene Koc (Dragun): Table 6.3 provides a Kom (organic matter) value for benzene, 18. DRC staff then converted this to a Koc value using an equation provided by Dragun (p. 235), where:
Koc = 1.724 * Kom
= 1.724 * 18
= 163.78

Cell: A20

Comment: Methylene Chloride: chemical synonym = Dichloromethane or Methylene Chloride Dichloromethane.

Cell: P21
Comment: Naphthalene: only 1 Koc value listed in Dragun, 1988.

Cell: A22
Comment: Tetrahydrofuran Synonyms (see EPA STF Database and NIOSH at www.cdc.gov/niosh/ipcsneng/neng0578.html):
Oxolane,
THF,
Diethyleneoxide,
Diethylene oxide,
Tetramethyleneoxide,
Tetramethylene oxide,
1,4-Epoxybutane, and
Oxacyclopentane

Cell: A23
Comment: Toluene: chemical synonyms/trade names = methyl benzene, Methacide, Phenylmethane, Toluol, and Antisal 1A.

Cell: A24
Comment: 1,1,2-Trichloroethane Synonyms (CAS No. 79-00-5:
BETA-T
ETHANE, 1,1,2-TRICHLORO-
BETA-TRICHLOROETHANE
Vinyl Trichloride

Cell: A25
Comment: 1,2,4-Trimethylbenzene Synonyms (CAS No. 95-63-6):
S-TRIMETHYLBENZENE
ASYMMETRICAL TRIMETHYLBENZENE
BENZENE, 1,2,4-TRIMETHYL-
BENZENE, 1,2,5-TRIMETHYL-
PSI-CUMENE
PSEUDOCUMENE
PSEUDOCUMOL
UNS-TRIMETHYLBENZENE
1,2,5-TRIMETHYLBENZENE
1,3,4-TRIMETHYLBENZENE

Cell: A27
Comment: Xylene: chemical synonyms/trade names = dimethyl benzene, Xylol, Methyltoluene, and Violet 3.

Cell: N28
Comment: o-Xylene Koc Values (Toxnet): reported values were as follows:

Low	High	Soil Type
48	129	soils
48	130	soils
210	---	river sediments
250	---	coal sediments
48	68	soils
129	---	sandy aquifer materials
25.4	---	estuary surface sediments

Cell: A31
Comment: Aldrin synonyms: include:
Aldrex;
Aldrite;
Aldrosol;

1,4:5,8-Dimetnanonaphthalene, 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-
1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-, (1 alpha, 4 alpha, 4a beta, 5 alpha, 8 alpha, 8a beta)-;
Drinox;
ENT 15, 949:
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-1,4,5,8-Dimethanonaphthalene;
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-1,4-endo-exo-5,8-Dimethanonaphthalene;
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-exo-1,4-endo-5,8-Dimethanonaphthalene;
Hexachlorhexahydro-endo-exo-Dimethanonaphthalene;
HHDN

Cell: N31
Comment: Aldrin [National Library of Medicine Toxnet Hazardous Substance DataBank]: log Koc values reported = 2.61 (407.38) to 4.45 (28,184) L/kg.

Cell: P31
Comment: Aldrin: only 1 Koc value listed in Dragun, 1988.

Cell: A32
Comment: Benzo(a)anthracene: chemical synonyms = Benzanthracene or Benz[a]anthracene, or 1,2-Benzanthracene.

Cell: A33
Comment: Benzo(a)pyrene: chemical synonyms = 3,4-Benzo-pyrene, or Benzo[A]pyrene, BaP, or BP.

Cell: A34
Comment: Benzo(b)fluoranthene: chemical synonyms = Benz[e]acephenanthrylene, or 3,4-Benzofluoranthene.

Cell: N34
Comment: Benzo(b)fluoranthene [National Library of Medicine Toxnet Hazardous Substances DataBank): log Koc reported to range between 6.11 and 6.7.

Cell: A35
Comment: Benzo(g,h,l)perylene: chemical synonym = Benzo(ghi)perylene.

Cell: A36
Comment: Benzo(k)fluoranthene: chemical synonynm = 11,12-Benzofluoranthene.

Cell: A37
Comment: bis(2-ethylhexyl)phthalate: synonym = Di(2-ethylhexyl)phthalate. CAS No. = 117-81-7.

Cell: B40
Comment: CAS Nos. for other Chlordane species are as follows:
alpha-Chlordane = 5103-71-9,
gamma-Chlordane = 5103-74-2, and
Chlordane (technical) = 12789-03-6.

Cell: A41
Comment: Chrysene: chemical synonym = 1,2-Benzphenanthracene.

Cell: A42
Comment: Dibenz(a,h)anthracene: chemical synonymn = 1,2,5,6-Dibenzathracene.

Cell: P42
Comment: Dibenz(a,h)anthracene: only 1 Koc value found in Dragun, 1988; listed under synonym, 1,2,5,6-dibenzanthracene.

Cell: A43
Comment: Diethyl Phthalate: chemical synonym = 1,2-Benzenedicarboxylic Acid or Diethyl Ester, or Diethylphthalate.

Cell: A44
Comment: Dimethylphthalate Synonyms (NLM Toxnet HSDB database):
AI3-00262

AVOLIN
1,2-BENZENEDICARBOXYLIC ACID, DIMETHYL ESTER
Caswell No 380
DIMETHYL 1,2-BENZENEDICARBOXYLATE
DIMETHYL BENZENEORTHODICARBOXYLATE
DIMETHYL PHTHALATE
o-Dimethyl phthalate
DMF (INSECT REPELLANT)
DMP
ENT 262
EPA Pesticide Chemical Code 028002
FERMINE
METHYL PHTHALATE
MIPAX
NTM
PALATINOL M
PHTHALIC ACID, DIMETHYL ESTER
PHTHALIC ACID METHYL ESTER
PHTHALSAEUREDIMETHYLESTER (GERMAN)
REPEFTAL
SOLVANOM
SOLVARONE

Cell: A45
Comment: Di-n-Butylphthalate Synonyms (NLM Toxnet HSDB database):
AI-3-00283
O-BENZENEDICARBOXYLIC ACID, DIBUTYL ESTER
BENZENE-O-DICARBOXYLIC ACID DI-N-BUTYL ESTER
1,2-BENZENEDICARBOXYLIC ACID, DIBUTYL ESTER
BUTYL PHTHALATE
N-BUTYL PHTHALATE
Caswell no 292
CELLUFLEX DPB
DBP
DBP (ester)
DIBUTYL 1,2-BENZENEDICARBOXYLATE
DI-N-BUTYL PHTHALATE
DIBUTYL-O-PHTHALATE
ELAOL
EPA Pesticide Chemical Code 028001
ERGOPLAST FDB
Ersoplast FDA.
GENOPLAST B
HEXAPLAS M/B
PALATINOL C
PHTHALIC ACID, DIBUTYL ESTER
POLYCIZER DBP
PX 104
RC PLASTICIZER DBP
STAFLEX DBP
Uniflex DBP
UNIMOLL DB
WITCIZER 300

Cell: N45
Comment: Di-n-Butylphthalate Koc Values (Toxnet): were reported with the following range of values:
Low Log Koc = 3.05 = 1,122 ml/gm (unsaturated soil column), and
High Log Koc = 3.14 = 1,380 ml/gm (soil samples from Broome Co., N.Y.)

Cell: A46
Comment: 4,4'-DDD: synonums include,
DDD;
p,p'-DDD;
1,1-bis(4-chlorophyenyl)-2,2-dichloroethane;
1,1-bis(p-chlorophyenyl)-2,2-dichloroethane;
2,2-bis(p-chlorophyenyl)-1,1-dichloroethane;
1,1-dichloro-2,2-bis(p-chlorophenyl)ethane;
dichlorodiphenyl dichlorethane
P,P'-Dichlorodiphyenyldichlorethane;
Dilene;
Rothane;
TDE;
p,p'-TDE
or Benzene, 1,1'-(2,2-Dichloroethylidene)bis.(.4-Chloro-

Cell: J46
Comment: 4,4'-DDD: only 1 Koc value available in EPA STF database.

Cell: A47
Comment: Fluoranthene: chemical synonyms/trade names = 1,2-Benzacenaphthene, 1,2-(1,8-Naphthalenediyl)Benzene, or 1,2-(1,8-Naphthylene)Benzene, or Benzo(jk)fluorene, or HSDB 5486, or IDRYL, or NSC 6803.

Cell: A48
Comment: Indeno(1,2,3-cd)pyrene: chemical synonyms/trade names = o-phenylenepyrene, or HSDB 5101, or 1,10-(o-phenylene)pyrene, or 2,3-o-phenylenepyrene, or 2,3-phenylenepyrene.

Cell: O48
Comment: Indeno(1,2,3-cd)pyrene [National Library of Medicine Toxnet Hazardous Substances DataBank]: high Koc value determined using dissolved contaminant in contact with lakebed sediments (log Koc = 6.84).

Cell: P49
Comment: 2-Methylnaphthalene: only 1 Koc value listed in Dragun, 1988.

Cell: A50
Comment: Phenanthrene: chemical synonyms/trade names = HSDB 2166, or NSC 26256.

Cell: P50
Comment: Phenanthrene: only 1 Koc value listed in Dragun, 1988.

Cell: A52
Comment: PCB-1254 synonym = Arochlor 1254

Cell: J52
Comment: PCB-1254: lowest Koc value from EPA STF database was apparently for a mixture of PCB compounds (CAS No. 1336-36-3). High Koc value was calculated from other physical properties for PCB-47 (CAS No. 2437-79-8).

Cell: N52
Comment: PCB-1254 [National Library of Medicine Toxnet Hazardous Substances DataBank]: lowest Koc value reported = 42,500 L/kg. A second source quoted with log Koc values ranging between 5.0 (100,000) and 6.1 (1,258,925) L/kg.

Cell: P52
Comment: PCBs: Dragun, 1988 does list a Koc (42,500 L/kg) value for one PCB compound, PCB-101 (2,2',4,5,5'-pentachlororbiphenyl).

Cell: A53
Comment: Pyrene: chemical synonyms/trade names = Benzo(def)phenanthrene, or HSDB 4023, or NSC 17534, or Beta-pyrene.

Cell: N53
Comment: Pyrene [National Library of Medicine Toxnet Hazardous Substances DataBank]: 8 different researchers reported Koc values for pyrene which ranged from 59,675 to 251,189 (log Koc = 5.4) L/kg.

DRAFT

ATTACHMENT ~~7~~9

Utah Division of Radiation Control

Summary of Detectable Organic Contaminants
Found in Utah DRC Split Groundwater Samples
Colleted from the IUC White Mesa Uranium Mill Site
From May, 1999 thru September, 2002

DRC spreadsheet Splitsum.xls
Tabsheet: Organics

Summary of DRC Split Sampling @ IUC White Mesa Uranium Mill

Detectable Organics in Groundwater

Based on DRC Sample Results

		Detectable Concentrations[1] Found in Any Well?											
		Split Sampling Event											
		May-99			Nov-00			Nov-01			Sep-02		
	CAS	NS = 12[2]		MRL[4]	NS = 21		MRL	NS = 21		MRL	NS = 31		MRL
Contaminant	No.	Detected?	N[3]	(ug/l)	Detected?	N	(ug/l)	Detected?	N	(ug/l)	Detected?	N	(ug/l)
VOCs													
Benzene	71-43-2										Yes	2	1.0
Carbon Tetrachloride	56-23-5	Yes	1	1.0	Yes	2	1.0	Yes	4	0.5	Yes	7	1.0
Chloroform	67-66-3	Yes	3	1.0	Yes	10	1.0	Yes	13	0.5	Yes	19	1.0
1,1-Dichloroethane	75-34-3							Yes	2	0.5	Yes	1	1.0
Methylene Chloride (DCM)	75-09-2	Yes	1	1.0	Yes	2	1.0	Yes	7	0.5	Yes	9	1.0
Naphthalene	91-20-3										Yes	1	1.0
o-Chlorotoluene	95-49-8										Yes	1	1.0
Sulfur Dioxide	7446-09-5				Yes[6]	1	~ 1						
Tetrahydrofuran	109-99-9	Yes[5]	3	~ 1	Yes[5]	3	~ 1	Yes	5	~ 1	Yes	3	5.0
Toluene	108-88-3										Yes	8	1.0
1,2,4-Trimethylbenzene	95-63-6										Yes	1	1.0
Vinyl Chloride	75-01-4										Yes	1	1.0
Total Xylenes	1330-20-7										Yes	1	1.0
13	: Count												
Semi-VOCs													
Bis(2-ethylhexyl)phthalate	117-81-7	Yes[7]	4	2.0	n/a[8]			n/a[8]			n/a[8]		
Contaminants Detectable:		5			5			5			12		

Footnotes:

1) Detectable concentrations used by DRC were well below the respective GWQS for each contaminant.
2) NS = total number of shallow aquifer monitoring wells sampled during each split sampling event.
3) N = number of wells with detectable concentrations found during each respective split sampling event.
4) MRL = laboratory's minimum reporting limit concentration for each contaminant, respectively.
5) Tetrahydrofuran was a tentatively identified compound during the 5/99 and 11/00 split sampling events.
6) Sulfur Dioxide was a tentatively identified compound in one well during the 11/00 split sampling event.
7) Due to a problem with a laboratory blank, this contaminant only detected in the IUC split samples for the 5/99 event.
8) No analysis made by either DRC or IUC for semi-VOC compounds after the 5/99 sampling event.

Key to Shading:

Bold	= petroleum distillates
(shaded)	= chlorinated solvents

DRAFT

ATTACHMENT ~~8~~10

Utah Division of Radiation Control

Summary of Groundwater Quality
Split Sampling Results
For Selected Volatile Organic Contaminants
From the IUC White Mesa Uranium Mill,
May, 1999 thru September, 2002

DRC spreadsheets: Benzene.xls, CTC.xls, and THF.xls
Tabsheets: HistSum

IUC: Benzene Concentrations														CAS No.:	71-43-2
State Health Lab Results															
			May 11 & 12, 1999			Nov. 27- Dec. 1, 2000			Nov. 5 thru 8, 2001			Sept. 9 thru 13, 2002			9/02 Sample
GWQS = 5 ug/l															
Well ID	Lab	<	Conc. (ug/l)	QA Flag	<	Conc. (ug/l)	QA Flag	<	Conc. (ug/l)	QA Flag	<	Conc. (ug/l)	QA Flag	Apparent Trend	Exceeds GWQS?
Existing Monitoring Wells															
MW-1	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-2	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-3	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-4	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-4A	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
MW-5	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-11	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-12	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-14	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-15	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-17	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-18	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
MW-19	SHL	<	1.0		<	1.0		<	0.5		<	1.0		N.D.	no
Chloroform Investigation Wells															
TW4-1	SHL		n/a		<	1.0		<	0.5		<	1.0		N.D.	no
TW4-2	SHL		n/a		<	1.0		<	0.5		<	1.0		N.D.	no
TW4-3	SHL		n/a		<	1.0		<	0.5		<	1.0		N.D.	no
TW4-4	SHL		n/a		<	1.0		<	0.5		<	1.0		N.D.	no
TW4-5	SHL		n/a		<	1.0		<	0.5			**8.6**		NTA	**YES**
TW4-6	SHL		n/a		<	1.0		<	0.5		<	1.0		N.D.	no
TW4-7	SHL		n/a		<	1.0		<	0.5			0.5	J	N.D.	no
TW4-8	SHL		n/a		<	1.0		<	0.5		<	1.0		N.D.	no
TW4-9	SHL		n/a		<	1.0		<	0.5		<	1.0		N.D.	no
TW4-10	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-11	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-12	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-13	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-14	SHL		n/a			n/a			n/a			n/a		n/a	no
TW4-15	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-16	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-17	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-18	SHL		n/a			n/a			n/a		<	1.0		N.D.	no
TW4-19	SHL		n/a			n/a			n/a			1.5		NTA	no
Trip Blank #1	SHL	<	1.0		<	1.0		<	0.5		<	1.0			
Trip Blank #2	SHL										<	1.0			
Equip. Blank	SHL										<	1.0			
Duplicate	SHL							<	0.5		<	1.0			

Notes:

1) RCRA TEGD, p. 119: if concentrations in trip blank are within 1-order of magnitude of the well sample results, then the wells should be re-sampled.

[shaded] = sample results w/in 1-order of magnitude of trip blank concentration

Notes

Bold = concentration > GWQS

[boxed] = detectable concentrations

n/a = not sampled or analyzed

Key to QA Flags:

B = rejected value due to trip blank and/or field (equipment) blank concentrations

J = an estimated value

N.D. = no trend apparent because all concentrations < MDL

NTA = no trend apparent

IUC: Carbon Tetrachloride Concentrations															CAS No.:	56-23-5
State Health Lab Results																
			May 11 & 12, 1999			Nov. 27- Dec. 1, 2000			Nov. 5 thru 8, 2001			Sept. 9 thru 13, 2002				9/02 Sample Exceeds GWQS?
GWQS = 5 ug/l																
Well ID	Lab	<	Conc. (ug/l)	QA Flag	<	Conc. (ug/l)	QA Flag	<	Conc. (ug/l)	QA Flag	<	Conc. (ug/l)	QA Flag		Apparent Trend	
Existing Monitoring Wells																
MW-1	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-2	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-3	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-4	SHL		3.3		<	1.0			3.7			*3.7*			~ stable	no
MW-4A			n/a			n/a			n/a			*3.1*			NTA	no
MW-5	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-11	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-12	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-14	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-15	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-17	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-18	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
MW-19	SHL	<	1.0		<	1.0		<	0.5		<	1.0			N.D.	no
Chloroform Investigation Wells																
TW4-1	SHL		n/a			1.2			1.9			*1.2*			~ stable	no
TW4-2	SHL		n/a			3.1			4.1			*4.0*			INCREASING?	no
TW4-3	SHL		n/a		<	1.0		<	0.5		<	1.0			N.D.	no
TW4-4	SHL		n/a		<	1.0			1.2			*1.8*			INCREASING?	no
TW4-5	SHL		n/a		<	1.0		<	0.5		<	1.0			N.D.	no
TW4-6	SHL		n/a		<	1.0		<	0.5		<	1.0			N.D.	no
TW4-7	SHL		n/a		<	1.0		<	0.5			0.4	J		N.D.	no
TW4-8	SHL		n/a		<	1.0		<	0.5		<	1.0			N.D.	no
TW4-9	SHL		n/a		<	1.0		<	0.5		<	1.0			N.D.	no
TW4-10	SHL		n/a			n/a			n/a		<	1.0			N.D.	no
TW4-11	SHL		n/a			n/a			n/a			*1.5*			NTA	no
TW4-12	SHL		n/a			n/a			n/a		<	1.0			N.D.	no
TW4-13	SHL		n/a			n/a			n/a			0.3	J		N.D.	no
TW4-14	SHL		n/a			n/a			n/a			n/a				no
TW4-15	SHL		n/a			n/a			n/a			0.2	J		N.D.	no
TW4-16	SHL		n/a			n/a			n/a		<	1.0			N.D.	no
TW4-17	SHL		n/a			n/a			n/a		<	1.0			N.D.	no
TW4-18	SHL		n/a			n/a			n/a		<	1.0			N.D.	no
TW4-19	SHL		n/a			n/a			n/a			**12**			NTA	**Yes**
Trip Blank #1	SHL	<	1.0		<	1.0		<	0.5		<	1.0				
Trip Blank #2	SHL										<	1.0				
Equip. Blank	SHL		n/a			n/a			n/a		<	1.0				
Duplicate	SHL		n/a					<	0.5	ug/l	<	1.0				

Notes:

1) RCRA TEGD, p. 119: if concentrations in trip blank are within 1-order of magnitude of the well sample results, then the wells should be re-sampled.

= sample results w/in 1-order of magnitude of trip blank concentration

Notes

Bold = concentration > GWQS

= detectable concentrations

n/a = not sampled or analyzed

Key to QA Flags:

B = rejected value due to trip blank and/or field (equipment) blank concentrations

J = an estimated value

N.D. = no trend apparent because all concentrations < MDL

NTA = no trend apparent

IUC: Tetrahydrofuran Concentrations CAS No.: 109-99-9

State Health Lab Results

GWQS = 46 ug/l

Well ID	Lab	<	May 11 & 12, 1999 Conc. (ug/l)	QA Flag	<	Nov. 27- Dec. 1, 2000 Conc. (ug/l)	QA Flag	<	Nov. 5 thru 8, 2001 Conc. (ug/l)	QA Flag	<	Sept. 9 thru 13, 2002 Conc. (ug/l)	QA Flag	Apparent Trend	9/02 Sample Exceeds GWQS?
MW-1	SHL		3.7	TIC		**310**			18			**130**		undetermined	**YES**
MW-2	SHL		nd			nd			20		<	5		decreasing?	no
MW-3	SHL		37.0	TIC		**210**			**120**			**83**		undetermined	**YES**
MW-4	SHL		nd			nd			nd		<	5		NTA	no
MW-4A	SHL		n-a			n-a			n-a		<	5		NTA	no
MW-5	SHL		nd			nd			3.6	J		4	J	NTA	no
MW-11	SHL		nd			nd			nd		<	5		NTA	no
MW-12	SHL		3.4	TIC		22			14			20	TB#1	undetermined	no
MW-14	SHL		nd			nd			nd		<	5		NTA	no
MW-15	SHL		nd			nd			nd		<	5		NTA	no
MW-17	SHL		nd			nd			nd		<	5		NTA	no
MW-18	SHL		nd			nd			nd			4.7	J	NTA	no
MW-19	SHL		nd			nd			nd		<	5		NTA	no
TW4-1	SHL		n-a			nd			nd		<	5		NTA	no
TW4-2	SHL		n-a			nd			nd		<	5		NTA	no
TW4-3	SHL		n-a			nd			nd		<	5		NTA	no
TW4-4	SHL		n-a			nd			nd		<	5		NTA	no
TW4-5	SHL		n-a			nd			nd		<	5		NTA	no
TW4-6	SHL		n-a			nd			nd		<	5		NTA	no
TW4-7	SHL		n-a			nd			nd		<	5		NTA	no
TW4-8	SHL		n-a			nd			nd		<	5		NTA	no
TW4-9	SHL		n-a			nd			nd		<	5		NTA	no
TW4-10	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-11	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-12	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-13	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-14	SHL		n-a			n-a			n-a			not sampled		NTA	no
TW4-15	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-16	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-17	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-18	SHL		n-a			n-a			n-a		<	5		NTA	no
TW4-19	SHL		n-a			n-a			n-a		<	5		NTA	no
Trip Blank #1	SHL		nd			nd			nd			7.3			
Trip Blank #2	SHL		n-a			n-a			n-a		<	5			
Equip. Blank	SHL		n-a			n-a			n-a		<	5			
Duplicate	SHL		n-a			n-a			nd		<	5			

Notes:

1) RCRA TEGD, p. 119: if concentrations in trip blank are within 1-order of magnitude of the well sample results, then the wells should be re-sampled.

(shaded) = sample results w/in 1-order of magnitude of trip blank concentration

Bold = sample concentration > GWQS

Key to QA Flags:

- B = rejected value due to trip blank and/or field (equipment) blank concentrations
- J = an estimated value
- n-a = not sampled or analyzed
- (boxed) = detectable concentrations
- nd = not detected by SHL
- TIC = tentaively identified compound (estimated concentration)
- NTA = no trend apparent because all concentrations < MDL

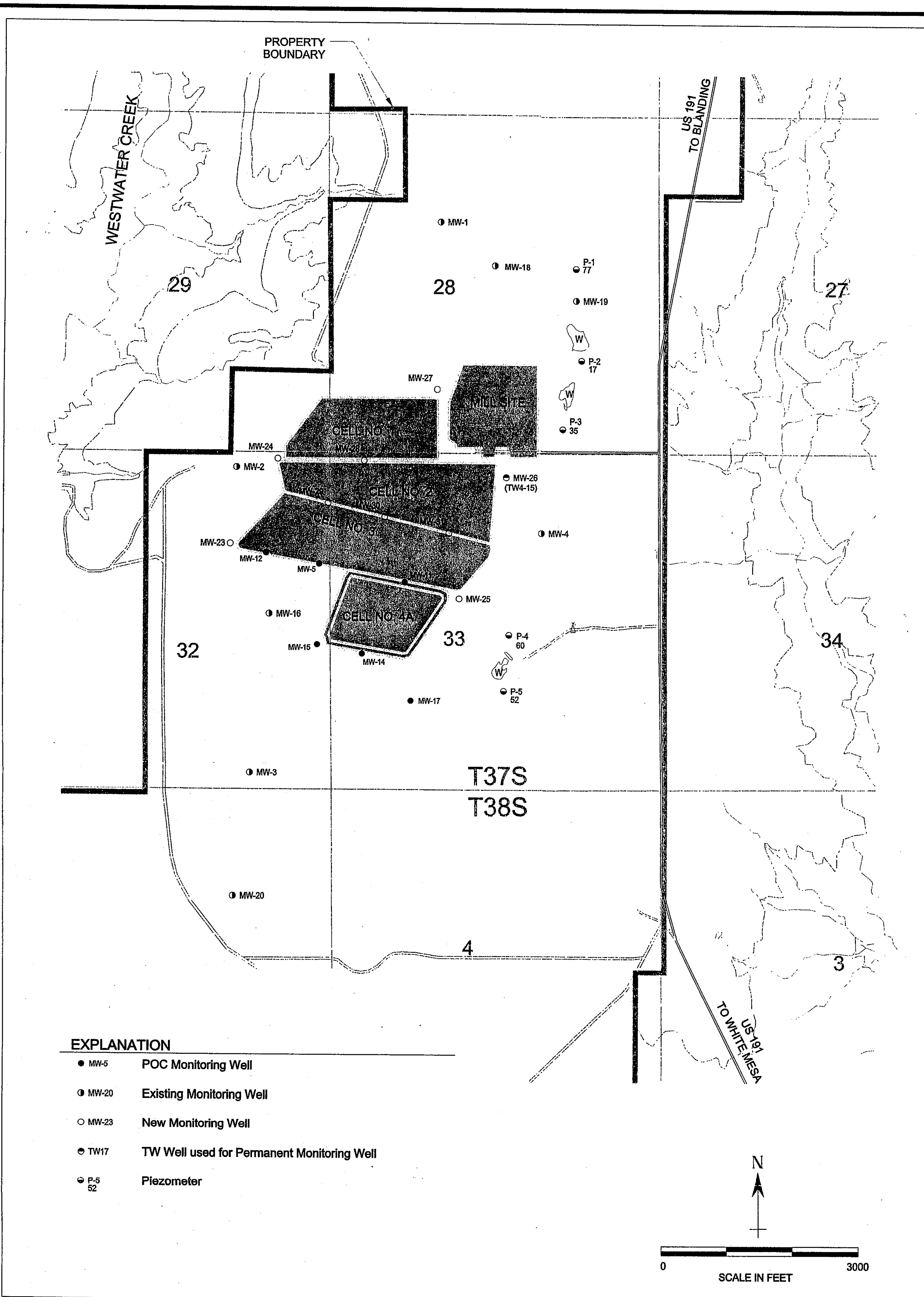
DRAFT

ATTACHMENT 11

International Uranium (USA) Corporation

April 16, 2004
Proposed Groundwater Monitoring Well Location Map

Received by the
Utah Division of Radiation Control
On April 20, 2004



International Uranium (USA) Corporation

Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 2 Propsed Groundwater Permit Monitoring Points		
Scale: as shown	Date: AUGUST, 2003	figure 2.dwg	
Author: HRR	Drafted By: BM		

Public Participation Summary
For the
IUC White Mesa
Draft Groundwater Discharge Permit
No. UGW370004

Introduction
The purpose of this document is to summarize public comments received by the Utah Division of Radiation Control (DRC) regarding the International Uranium (USA) Corporation (hereafter IUC) uranium mill facility at White Mesa, Utah. Three sets of comments were received from the public during the comment period that ended on Friday, January 7, 2005. Each of these comments is listed below in italics, followed by a DRC response.

Comments From Envirocare of Utah, Inc. (see Attachment 1)

1. *Condition I.A Groundwater Classification*
The Permit lists two data sets for the purpose of classifying groundwater at the IUC facility. What is the purpose of providing both data sets?

DRC Response: Substantive Comment. They were presented to disclose the differences in the split sampling total dissolved solids (TDS) data (see Statement of Basis (SOB), p. 5). As explained in the SOB, the Executive Secretary used the lowest values from either set of data to classify shallow groundwater at the site (ibid). This approach is protective of the groundwater quality resource.

2. *Table 2.*
Based on the information provided in Table 2, the only radiologic parameter the Permittee is required to analyze is Gross Alpha. Envirocare is required to analyze for Radium-226, Radium-228, Thorium-230, and Thorium-232 at is 11e.(2) disposal cell. UAC R313-6-2.1 identifies a combined Groundwater Quality Standard for Radium 226 + 228 at 5 uCi/L (sic). Will these parameters also be evaluated at the IUC facility?

DRC Response: Substantive Comment. We acknowledge that significant concentrations of radium and thorium are found in the tailings material. Elevated concentration of total radium and thorium-230 are also found in tailings wastewaters at levels that about 188 and 1,208 times their respective State Ground Water Quality Standards (GWQS, see SOB, Table 5). We recognize that the DRC process used to select the GWPL parameters focused on contaminants that had tailings wastewater concentrations that were equal to or greater than 50-times their respective GWQS (SOB, p. 14). It is important to note that this selection process also relied on a review of each contaminant's soil-water partitioning (K_d) coefficient, as defined by the lowest available value found in the technical literature (SOB, p. 15). Additional review shows that radium was omitted from consideration in the K_d table found in Attachment 7 of the SOB. This oversight has been corrected, and the revised table is found below in Attachment 2 of this document. From this information, the lowest literature K_d values for radium and thorium are 57 and 100 L/Kg, respectively. These values indicate that radium and thorium tend to partition to soils and rock and not travel far in groundwater environments. As a result, other contaminants are expected to be the leading edge of a contaminant plume, if it occurs, and thereby arrive at nearby monitoring wells much earlier than radium and thorium. This finding reinforces the original decision not to include them in the Permit as GWPL parameters.

The situation at Envirocare is different, in that a high chloride environment exists in the shallow groundwater there. Also, radium has been found to be mobile in saline groundwater environments, as illustrated by the accumulation of radium pipe scale deposits in oil field pipelines in Texas. Under these circumstances radium should be considered as an important groundwater monitoring parameter.

This decision about not using radium as an indicator parameter at the IUC facility can be changed in the future. If at sometime, the Executive Secretary discovers the tailings cells have released contaminants to the shallow groundwater system, the Permit can be re-opened and additional groundwater contaminants required for monitoring and GWPL established pursuant to Part IV.N.3.

3. *Condition I.D.1 DMT Design Standards for Existing Tailings Cells*
Has an evaluation been performed to demonstrate liner compatibility of the Flexible Membrane Liner with the 11e.(2) materials being disposed of in the cells?

DRC Response: Substantive Comment. With respect to existing IUC Tailings Cells 1,2, and 3 this evaluation has not been made. Evaluations of this kind are mandated by the NRC regulations found in 10 CFR 40, Appendix A, Criterion 5E. Unfortunately, these NRC rules were not established until 1987, long after the IUC tailings cells were constructed.

Under the State Ground Water Quality Protection (GWQP) Rules, discharge minimization technology (DMT) has to consider existing process design capability [UAC R317-6-6.4(C)]. As explained in the SOB, the Executive Secretary decided to focus on operational changes, and design and construction improvements for the cover system, which has yet to be built at Tailings Cells 1,2, and 3. This is appropriate in that these tailings cells have been in existence for more than 20 years and their liners long covered by many tons of tailings.

For Tailings Cell 4A, the Permit requires it to be re-constructed in order to meet BAT mandates (Parts I.H.14 and 15). During design review and approval for this new construction, the DRC will evaluate this issue to ensure that the BAT requirements of the State GWQP Rules are met [see UAC R317-6-6.4(A)].

4. *Condition I.D.3.b.1. Discharge Minimization Technology Standard*
The average wastewater head in the slimes drain access pipe is to be "as low as reasonably achievable" in each tailings disposal cell. How will state inspectors make a determination on this criteria?

DRC Response: Substantive Comment. The exact criteria will be worked out during the Executive Secretary review and approval process for the DMT Monitoring Plan (Part I.H.13). It is anticipated that this criteria will be established by the Executive Secretary after IUC provides information on historic water levels at this access pipe, explains what kind of pumping and control equipment has and is currently used, and evaluates what type of pumping and control technology is available and can be readily deployed. After approval of this plan, compliance criteria can be determined for IUC to operate by, and DRC staff to inspect against.

5. *Condition I.D.3.c. Roberts Pond*
An as-built is required as Condition H.H.18 of this GWQDP. How is this pond constructed? For consistency with ponds used at Envirocare, this wastewater pond should have a minimum of two FMLs and a leak detection system. In addition, what system is in place to confirm compliance with the two foot freeboard required in this condition?

DRC Response: Substantive Comment. As for a compliance confirmation system, that is to be proposed by IUC and approved at a future date by the Executive Secretary during development of the DMT Monitoring Plan required under Part I.H.13 of the Permit. Regarding the requirements for double flexible membrane liner (FML) and leak detection systems, this pond has existed at the facility since the early 1980's and was clearly an existing facility under the GWQP rules (UAC R317-6-1.14), which were not promulgated until 1989. IUC's decision to replace the liner in 2002 with another single membrane constitutes modification of the existing pond, and therefore should have been done under the authority of a Permit (ibid.). Unfortunately, IUC did not notify the DRC of this construction activity until 2004, well after it was re-lined (SOB, p. 30). Upon receipt of this information the Executive Secretary determined that it was more important secure a Permit for the tailings cells. Several other factors were considered to support the decision to use enforcement discretion and consider the pond as an existing facility, as explained in the SOB (pp. 29-30), namely that it is small in size (0.4 acres), is used for intermittent wastewater storage, and that the existing Reclamation Plan required under the Radioactive Materials License (License) mandates that any contaminated subsoils beneath the liner be excavated and moved to disposal in the tailings cells at the time of facility reclamation (ibid.). No change will be made to the IUC Permit

6. *Condition I.D.3.d. Feedstock Storage Area*
The introductory paragraphs of this GWQDP state that the permit is for a uranium milling and tailings disposal facility, not a storage facility. How is the feedstock area constructed? How long can stored materials remain in this area? Is there a stormwater management plan for water that accumulates in this area? Is there a DMT criteria for this area? Except in the dig (sic) cell, open air storage is prohibited at Envirocare.

DRC Response: Substantive Comments. Again, the IUC facility, including the open air feedstock storage area at the eastern margin of the mill site, pre-existed the GWQP rules, and is consequently an existing facility under UAC R317-6-1.14. To avoid proliferation of possible contamination from such storage, the Permit limited this activity to only the historic area defined by the survey coordinates in Table 4. As for construction details, this area is underlined by a compacted native soil surface, however, no reliable information is available regarding the permeability of the compacted soils in this area.

Storage in containers is also allowed elsewhere at the facility under the Permit Part I.D.3(d). No time limits are stipulated in the Permit for any feedstock storage. However, performance criteria are mandated for this containerized storage, in that the containers must be maintained closed and water-tight (ibid.).

As for a stormwater management plan, Part I.H.17 requires that IUC submit one and secure Executive Secretary approval. Stormwater that accumulates on the historic feedstock pad drains to Tailings Cell 1, along with other mill site stormwater. The only DMT performance criteria for this area, is that all open-air feedstock storage be restricted to only the historic pad location, as defined by Table 4 of the Permit [Part I.D.3(d)], as a means of preventing proliferation of possible contamination. No change will be made to the IUC Permit.

7. *Condition I.E.2. Groundwater Head Monitoring*
Total Dissolved Solids (TDS) range from 1,276 to 5,200 mg/L. Will the groundwater elevations be adjusted to a freshwater equivalent head to account for an almost 5-fold variation in salinity? In addition, Envirocare is required to conduct monthly groundwater elevations due to a groundwater mound, much like the mound beneath the IUC facility. For consistency, groundwater elevations, freshwater correction, contour maps, etc., should be performed on a monthly basis.

DRC Response: Substantive Comment. The TDS or salinity contrast between groundwater in the shallow aquifer and the source of the groundwater mound at the IUC facility is expected to be relatively low. The range of the TDS in IUC's shallow groundwater is as stated, and when averaged across all monitoring wells at the facility the combined average is about 3,000 mg/l. As a result, we anticipate the contrast between this average TDS and the average water quality expected in the eastern wildlife ponds, which recharge the IUC groundwater mound (see SOB, p. 4), is closer to about 3-fold. Higher TDS contrasts are expected in stormwater induced groundwater mounds at Envirocare, in that natural TDS found in the shallow aquifer ranges from 20,000 to over 70,000, with an average of more than 40,000 mg/l.

As for the suggested need for monthly groundwater head monitoring at IUC, the Executive Secretary agrees it is necessary in those wells where transient conditions exist or could exist. Such is the case in all the IUC wells related to the chloroform investigation and pump and treat system, where an appropriate frequency will be set in the future as a part of an approved Groundwater Corrective Action Plan. That frequency and all other necessary monitoring requirements will also be exposed to a public comment period sometime in the future. For purposes of this Permit, the baseline groundwater head monitoring frequency will continue as quarterly (Part I.E.2). If non-compliance with GWPLs is detected, more frequent head monitoring will be conducted in accordance with the requirements of Part I.G.1.

8. *Condition I.H.1. Installation of New Groundwater Monitoring Wells*
How were the locations of the new monitoring wells determined? Monitoring wells at Envirocare were located using a computer model to demonstrate that should a release occur, the groundwater monitoring well network would detect that release. Will a well spacing evaluation be required by the Permittee?

DRC Response: Substantive Comment. The number and location of wells was arrived at after consideration of site hydrogeologic conditions and after negotiation with IUC. Unique hydrogeologic conditions exist at the White Mesa in that the shallow aquifer is a perched system found about 100 feet below the tailings cells, and located in a consolidated geologic formation deposited by an ancient fluvial environment. In contrast the aquifer at Envirocare is found 15 feet below the disposal cell in unconsolidated lake deposited sediments.

Despite these differences new wells are to be added at the IUC facility, including two new wells south of Tailings Cell 1 (MW-24 and MW-28) and the three new wells south of Tailings Cell 2 (MW-29, MW-30, and MW-31). These were spaced in a similar manner as the three existing wells found south of Tailings Cell 3 (see SOB, Attachment 11). Because there is a strong East-West groundwater flow direction near Cell 1, additional wells were required upgradient (MW-27) and downgradient (MW-24) on the Northeast and Southwest corners respectively. For Cell 2, two upgradient wells MW-26 and MW-32 (formerly TW4-15 and TW4-17) already existed and were included under the Permit. A new downgradient well for both Cells 2 and 3 will also be installed off the Southwest corner of Cell 3 (MW-23). For Tailings Cell 3, it is anticipated that the three new wells proposed on the northern dike will also serve as upgradient wells. The existing Cell 3 downgradient wells, MW-5, MW-11, and MW-12 have been in place on the south dike since October, 1982 or earlier. A new upgradient well will also be installed off the Northeast corner of Cell 4A (MW-25).

No computer modeling was done by IUC to justify the spacing intervals selected. Such models estimate the required well spacing interval from several hydrogeologic assumptions, including but not limited to: local groundwater velocity and flow directions, existence of isotropic and homogeneous aquifer conditions (including aquifer dispersivity and permeability), and a presumed minimum footprint or size of a leak from the embankment. The Executive Secretary acknowledges that such models are useful tools to determine the minimum well spacing for a facility, but believes it premature to perform such modeling at the IUC facility until after local hydrogeologic conditions are better established in the immediate vicinity of the tailings cells. This evaluation will need to consider several factors, including, but not limited to local:

1) Elevation and configuration of the upper geologic contact of the Brushy Basin Member of the Morrison Formation, which perches the shallow groundwater system.
2) Distribution and spatial trends of shallow aquifer permeability that could provide preferred groundwater flow paths.
3) Distribution of shallow groundwater head and flow directions.
4) Distribution and spatial trends of groundwater quality in the shallow aquifer.

For this reason, the Permit requires IUC to submit a Revised Hydrogeologic Report for Executive Secretary approval (see Part I.H.2). In the event that the Executive Secretary determines that additional information is needed, including additional borings, monitoring wells, or any other pertinent data needed to characterize the local groundwater system, IUC will be requested to provide this information (SOB, p. 23). If at that point the Executive Secretary determines the characterization is complete, a well spacing model may be required to evaluate the need for additional wells. If additional monitoring wells are needed, and after the Executive Secretary has determined the proposed monitoring well network is satisfactory, the Permit can be re-opened and these new wells established as point-of-compliance wells under Part IV.N.3 of the Permit.

9. *Condition I.H.11. Infiltration and Contamination Transport Modeling Work Plan and Report.*
This condition requires an infiltration and contaminant transport model. Since the proposed Permit does not have a cover design, it is assumed that a design will come from the required modeling. For consistency with Envirocare, even though the cover will need to incorporate an FML to prevent the bathtub effect (See Condition I.D.6.b), the Permittee should not be able to take credit for either the upper or lower FMLs in the modeling effort. In addition, it is unclear if the Modeling Work Plan is part of the Report or a separate submittal which will require Executive Secretary approval.

To evaluate the assumption found in the model, will the Permittee be required to prepare a Post-Model Audit Plan?

DRC Response: Substantive Comment. Because the tailings cell cover design has already been approved by the NRC as a part of the Reclamation Plan under the License (SOB, p. 35), the purpose of the modeling report is to evaluate if any design changes are needed to ensure the tailings cells meet the long-term performance standards set in Part I.D.6 of the Permit.

As for the need for a FML in the cover system to prevent a bathtub effect, such a membrane would appear to be in order; but the Executive Secretary will await the outcome of the modeling report before making any decision in this matter. With regards to any credit given to the long-term performance of FMLs in the infiltration and transport modeling report, the Executive Secretary will take this suggestion under advisement. However, it is important to note that the NRC policy referred to applies only to Low-Level Radioactive Waste facilities (see 10 CFR Part 61), and not to uranium mill operations. In fact, no performance assessment modeling is required by NRC for any 11e.(2) facility (see 10 CFR 40, Appendix A). Instead, at IUC, and other uranium mill operations in Utah, this performance assessment is mandated as a means to establish BAT or DMT under the State GWQP rules. Precedence has been set at other Utah uranium mill operations that utilize FMLs as a means to meet the BAT design standards. One example is Plateau Resources' facility near Ticaboo, where a new tailings cell facility was proposed with double FMLs and leak detection systems were as a means to meet the BAT design standard during the operational phase of the project (see 12/28/98 DRC Draft GWQD Permit No. UGW170003 and related SOB [pp. 5-7] for Plateau Resources). Consistency with the Envirocare 11e.(2) facility has been provided in the IUC Permit in that a 200 year performance standard has been established (Part I.D.6), and an infiltration and contaminant transport performance model required.

As stipulated in the Permit, the work plan and the modeling report are two separate documents, with two separate 180-day deadlines mandated (Part I.H.11). For the first deadline, IUC is given 180 days after issuance of the Permit to prepare and submit a work plan for the performance modeling for Executive Secretary approval. Thereafter, when the Executive Secretary approves this work plan, a second 180-day deadline is set for IUC to complete the modeling effort, write a report, and submit it for Executive Secretary approval.

As for any post-model audit plan, no specific compliance schedule requirement is currently mandated in the Permit. However, existing language at the end of Part I.H.11 allows the Executive Secretary to require one if found necessary, as follows:

> "...Upon Executive Secretary approval of the final infiltration and contaminant transport report, the Reclamation Plan may be modified to accommodate necessary changes to protect public health and the environment."

The changes to the Reclamation Plan could include not only cover design and construction specifications, put also plans to monitor the tailings cover system and/or groundwater quality to confirm the modeling assumptions.

<u>Comments from Ms. Sarah Fields</u> (see Attachment 1)

1. *Draft Groundwater Discharge Permit (Permit), page 1:...*
The facility is also (sic) includes IUC land in Sections 21, 22, 27, Township 37 South, Range 22 East, that are up-gradient from the mill and tailings cells. It also includes down-gradient land in Sections 4, 5, 6, 8, 9, and 16, Township 38 South, Range 22 East, Salt Lake Base (sic) and Meridian, San Juan County, Utah. An explicit "legal" description of the mill property must be included in the permit.

   <u>DRC Response</u>: Nonsubstantive Comment. The Permit's description list those sections currently disturbed by construction and occupied by the mill site and tailings disposal cells. While it is true that IUC owns or controls other nearby tracts of land, the Executive Secretary will not authorize or imply any approval for disposal activities outside the bounds of lands currently disturbed.

2. *Part I, page 8: D. Discharge Minimization Technology Standard - ...*
This section is vague regarding the actual design and construction information that the Division of Radiation Control (DRC) is relying on. There is no mention of the December 31, 1998 Knight Piesold Report on the Seepage Flux from Tailings Cell 3 Liner submitted to the DRC by the Permittee. There is no mention of the numerous questions that the DRC had about the actual design and construction of Cell 3, as expressed in the (apparently) unanswered November 28, 2001, DRC Request for Additional Information (RAI).

   The DRC must not rely on cell design and construction information that it has already found questionable. This section must include more detailed cell design and construction date (sic). This section must also be amended based on the Permittee's reply to the November 28, 2001, RAI which was part of the Permit process.

   <u>DRC Response</u>: Substantive Comments. The Permit references all design and construction information that has been made available to DRC. We acknowledge that DRC has had major concerns about the infiltration modeling found in the December 31, 1998 Knight-Piesold Report. DRC omission of any discussion in the SOB regarding this modeling report was intentional for the following reasons:

   1) The report is a infiltration and seepage simulation of the open cell conditions for Tailings Cell 3 only. It does not represent infiltration or seepage conditions for Cell 1 or Cell 4A which have different engineering design and construction characteristics. Further, the report does not simulate contaminant transport which is essential to an assessment of tailings system performance. Simply said the Knight-Piesold report is incomplete.

   2) Any open cell infiltration modeling would be based on a series of assumptions, many of which would be difficult to verify given the age of the construction and the lack of ability to sample and confirm certain construction details that are now covered by tailings. As a result, the model predictions would be subjective to interpretation. Direct and discrete groundwater monitoring of each disposal cell is a much more effective means to determine if the tailings system has or will discharge contaminants to groundwater.

3) Should groundwater monitoring find that the tailing cells have leaked, active means can be taken to intercept and control this leakage thru various groundwater remediation technologies that are available.

4) Design and construction of an improved cover system is the most practical means of preventing and controlling possible future tailings cell leakage. It is not practical, nor feasible to require IUC to move the existing tailings wastes into new tailings cells.

As a result, neither the Permit or the SOB relied in any way upon the Knight-Piesold report referenced. Instead, the Permit outlined a new path of activities to provide an objective evaluation of the future cover system design, and opportunities for improvement to said design in order that local groundwater resources be protected.

3. *Part I, page 1: D.2(d) Feedstock Storage Area - ...*
There is no indication in the Permit as to how the Permittee will monitor the groundwater underneath and in the vicinity of the Feedstock Storage Area to guarantee that the materials stored there will not contaminate ground and surface water. The feedstock is sometimes stored for years out in the open where it is subject to dispersion and leaching by wind and water, and surface water.
This must be corrected.

<u>DRC Response</u>: Substantive Comments. The IUC facility, including the open air feedstock storage area at the eastern margin of the mill site, pre-existed the GWQP rules, and is consequently an existing facility under UAC R317-6-1.14. As a result, IUC is held to a DMT standard instead of the more rigorous BAT standard [see UAC R317-6-6.4(c)]. In addition, the facility reclamation requirements (see Part I.D.7) would require reclamation of the Feedstock Storage Area. DRC will evaluate the Reclamation Plan at the time of the next License renewal scheduled on or around March, 2007. For other relevant details, see the DRC response to Envirocare Comment No. 6, above.

4. *Part I, page 20: G. Out of Compliance Status, 4.(e) - ...*
The DRC does not define "feasible." Does feasibility include economic feasibility? Who decides if a ground water corrective action plan is "unfeasible"?

There is no mention of the standards that must be met by the Permittee when proposing alternative concentration limits (ACLs). Are the standards for establishing ACLs outlined in 10 C.F.R. Part 40, Appendix A, applicable here? What criteria will the Executive use in reviewing applications for the establishment of ACLs?
The term "feasible" must be defined. The standards for the establishment of ACLs must be spelled out in the Permit.

There is no mention in the Permit of any necessity for the Permittee to increase the reclamation surety to cover ground water remediation when the Permittee is out of compliance. NRC and State regulations require a surety to cover the costs of reclamation, including any ground water remediation. This requirement must be included in the permit.

<u>DRC Response</u>: Substantive Comments. The Permit Part 1.G.4.(e) corresponds to UAC R317-6-6.17(A)(5), in which the term "infeasible" is used. DMT is implemented instead of BAT because the IUC facility pre-existed the GWQP rules (UAC R317-6-1.14). In addition, Part 1.G.4(e) of the Permit applies to DMT and not groundwater corrective

action. The Executive Sectary decides on feasibility issues, which could include economic feasibility issues.

As for ACLs, these are approved only by the Utah Water Quality Board (Board) as per UAC R317-6-6.15 (A) thru (G). The NRC ACL process is not applicable. In the State ACL process the Board considers factors, including but not limited to protection of human health and the environment, permanent effect, cost effectiveness, etc. For details refer to R317-6-6.15(G). Under the State regulatory process, Permits are issued first with their respective Ground Water Compliance Limits (GWCL) established. Then if the GWCLs are exceeded the Executive Secretary initiates a compliance action against the permittee. In this process an ACL may be considered, but it is only the Board that can approve it.

The reclamation surety to cover ground water remediation is not an issue of a Ground Water Discharge Permit, but instead is managed under the Radioactive Materials License. At this point it is premature to conclude if non-caused pollution has occurred at this site. This is one of the reasons for the Background Groundwater Monitoring Report required in Part I.H.3 & 4. If later we determine that groundwater pollution has occurred, Executive Sectary well take appropriate action to protect the groundwater resources. This would include development of a groundwater corrective action plan for the facility under the auspices of UAC R317-6-F-6.15.

5. *Part I, page 20: H. Compliance Schedule Requirements ...*
Nowhere in the extensive list of Compliance Schedule Requirements is there any requirement for the Permittee to respond to the 8-page November 28, 2001, DRC Request for Additional Information, regarding December 31, 1998, Knight Piesold Report on Seepage Flux from Tailings Cell 3 Liner, White Mesa Mill.
Has the Permittee responded to this RAI? If not, has the DRC notified the Permittee that they don't have to respond?
It was definitely my understanding, based on correspondence with the DRC, that a schedule for the Permittee's long-delayed response to the 2001 request would be part of the Permit requirements. Is this no longer the case? If so, why?
There must be a full explanation of this situation.
In addition, the DRC must review all previous requests for information and make a determination that they have all been fully responded to or a schedule for response has been established in the context of the Permit.

DRC Response: Substantive Comments. See DRC response given for, Comments from Ms. Sarah Fields, Comment 2, pages 8 and 9 of this Public Participation Summary.

6. *There is no discussion in the Permit of other types of contamination to ground and surface water by activities on the land owned by the Permittee at the facility. The Permittee currently allows cattle to graze on some of the mill property. These cattle can and do access Ruin Spring. Ruin Spring is on U.S. Department of Interior, Bureau of Land Management, property that abuts the mill property. The Ruin Spring area is trampled and contaminated by wastes from the cattle. The spill-over from a tank below the spring (which has not been cleaned in years) feeds a desert riparian area. The spring is used by wildlife.*

Does the Permittee have any responsibility for the ruin of Ruin Spring by the cattle that graze on its mill facility property?

DRC Response: Nonsubstantive Comments. IUC owns neither the cattle or Ruin Spring. Hence they have no responsibility for damage the cattle may pose to the spring of its riparian habitat. Possible contamination to Ruin Springs from cattle wastes is not a Permit issue. Concerns in this regard need to be directed to the cattle owners and/or the Bureau of Land Management.

7. *Part I, page 12: D.5. Definition of 11e.(2) Waste - ...*
There is absolutely no statutory or regulatory basis for the State of Utah to authorize the processing of "alternate feed material" at the IUC mill. There is no statutory or regulatory basis for the State of Utah to include the "process related wastes and waste streams" from the processing of materials other than natural ore ("alternate feed material") in the statutory and regulatory definition of 11e.(2) byproduct material.

The Ground Water Discharge Permit must not authorize the processing of "alternate feed material." The Ground Water Discharge Permit must not authorize the disposal of waste streams from the processing of "alternate feed material" as 11e.(2) byproduct material. Such authorization is not permitted by any statute or regulation.

Any request by the Permittee for such authorization must be denied.

The following (including Attachment A) are comments that support these statements.

A. *The March 7, 2003, NRC letter from Paul H. Lohaus to William J. Sinclair is not an NRC legal opinion and has no legal effect. See10 C.F.R.Part 40, Sec. 40.6, Interpretations, which states:*

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

B. *There is no legal basis under and Atomic Energy Act of 1954 (AEA), as amended, to consider so called "alternate feed material" and various debris accompanying such material (at times constituting 40% of the "alternate feed material") as "ore," as the term "ore" is used in the definition of 11e.(2) byproduct material.*

The Permit must not include any statement that would imply processing of feed material other than natural ore ("alternate feed material") is the same as the processing of "any ore," and that the debris, tailings, or wastes from such processing constitute 11e.(2) byproduct material.

The State of Utah cannot and must not include any reference to the letter from the March 7, 2003, NRC in the Permit.

See Attachment A hereto for a full discussion and comments on this matter.

C. *The Permit does not define so-called "alternate feed material." There is no indication in the Permit that "alternate feed material" is made up of processing wastes from other mineral processing operations that are commingled with* *contaminated debris and soils. Why is there no definition of "alternate feed material" in the Permit.*

D. *The State of Utah must only rely on the common, historical meaning of the word "ore."*

What does "ore" mean? The word, or term, "ore," as defined in several sources:

- *"Ore—a naturally occurring solid material from which metal or other valuabe minerals may be extracted." [Illustrated Oxford Dictionary, DK Pub. 1998.]*
- *"Ore—A native mineral containing a precious or useful metal in such quantity and in such chemical combination as to make its extraction profitable. Also applied to minerals mined for their content of non-metals." [The Compact Oxford English Dictionary, Second Edition, Oxford University Press, 2000, p. 1224:915-916.]*
- *"Ore—a. A natural mineral compound of the elements of which one at least is a metal. Applied more loosely to all metaliferous rock, though it contains the metal in a free state, and occasionally to the compounds of nonmetallic substances, as sulfur ore. . . . Fay b. A mineral of sufficient value as to quality and quantity that may be mined for profit. Fay." [A Dictionary of Mining, Mineral, and Related Terms, compiled and edited by Paul W. Thrush and Staff of the Bureau of Mines, U.S. Dept. of Interior, 1968.]*

The Oxford English Dictionary points out that the current usage of the word "ore" goes back several hundred years. A Dictionary of Mining, Mineral, and Related Terms lists over 65 compound words using the word "ore," such as ore bin, ore body, ore deposit, ore district, ore geology, ore grader, ore mineral, ore reserve, ore zone. All of these terms incorporate the word "ore" as it relates to the mining of a native mineral. The term "ore," without explanation, has for many years been used in millions of instances in thousands of mining, milling, geological, mineralogical, radiochemical, engineering, environmental, and regulatory publications. "Ore" like the word "water," is a word of common and extensive usage with a clear and accepted meaning.

The State of Utah must explain what the statutory and regulatory basis is for calling wastes from other mineral processing operations "ore." A policy, whether federal or state, is not a statutory or legal basis.

E. *In the past, debris associated with the processing of "alternate feed material" has been received at the IUC mill. Thousands of tons of such debris have been disposed of at the mill. IUC was paid to receive and dispose of this material. Some of the material was apparently washed (i.e., decontaminated), and the wash water was subsequently processed for its minimal source material content.*

The debris that sometimes accompanies natural ore when it is processed at a licensed uranium or thorium mill has no economic value to the licensee of a uranium or thorium mill. A mill owner would not pay for or be paid to receive such debris and, in fact, would pay less for ore contaminated with a lot of debris.

However, the licensee will be paid to receive and dispose of debris accompanying "alternate feed material." What is really occurring is that the licensee is getting paid to directly dispose of contaminated (or decontaminated) low level radioactive waste.

There are no similarities between the debris associated with ore mined from the ground and debris accompanying wastes and contaminated materials from other mineral processing operations.

This debris must have been separated from any material that was going to be processed at the mill prior to shipping to the mill. This could have been easily accomplished, but was not because it was in the interest of originator of the waste to get rid of it, and it was in the interest in the mill operator to get paid for accepting it.

The State of Utah is in no way obligated to agree with the NRC on this question.

F. *The March 7 NRC letter states that "the alternate feed material is regulated in mass as ore." There is conflict, confusion, and inconsistency in this statement.*

Who, exactly, regulates alternate feed material as "ore," and what is the basis of such regulation?

The AEA does not mention "alternate feed material" and it's regulation. I can find no NRC or EPA regulations related to the regulation of "alternate feed material." There are no NRC generic or site specific environmental impacts statements related to the regulation of "alternate feed material" or feed materials other than natural ore.

How can the NRC regulate alternate feed material "in mass as ore" when the NRC has no statutory or regulatory jurisdiction over "alternate feed material" or uranium and thorium "ore"?

NRC regulation at 10 C.F.R. § 40.13 establishes unimportant quantities of source material that are outside of regulatory concern under the AEA. NRC regulation at Section 40.4 states that "Source Material means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof."

Section 40.13(b) says that any "ore" containing source material, whether or not it meets the definition of source material (i.e., contains uranium and/or thorium of 0.05% by weight) is exempt from regulation under Part 40. Section 40.13(b) states:

> *(b) Any person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the act to the extent that such person receives, possesses, uses, or transfers unrefined and unprocessed ore containing source material; provided, that, except as authorized in a specific license, such person shall not refine or process such ore*

The NRC has exempted "ore," either source material ore (over .05% uranium or thorium by weight) or non-source material ore (less than .05 % uranium and/or thorium by weight). The NRC regulates facilities that process and refine "ore," under its regulation of 11e.(2) byproduct material, but it does not regulate "ore" as such.

There is nothing in the AEA that authorizes the transfer to the State of Utah of regulatory responsibility over uranium or thorium "ore."

<u>DRC Response</u>: Nonsubstantive Comments. Issues regarding "alternate feed material" at the IUC facility are regulated by the Radioactive Materials License and not the Ground Water Discharge Permit.

<u>Comments from Mr. Ivan Weber</u> (see Attachment 1)

1. *May I please echo the critique submitted by Ms. Sarah Fields, and incorporate it by reference into my own reflections. In particular:*

   I share her apprehension, expressed in her questioning of the meaning of "infeasible" DMT as rationale for IUC submittal of "alternative DMT" to the Executive Secretary of DRC (page 20 of draft Permit, 4. "Facility Out of Compliance Status...," e. "Where it is infeasible to reestablish DMT..."). This appears to be a loophole of magnitude proportional to the holes we suspect to exist in the cells liner systems. Please tighten this allowance by defining terms rigorously, if not by eliminating 4.e altogether.

   <u>DRC Response:</u> Substantive Comments. See DRC response to Ms. Sarah Field's Comment No. 4, above.

2 *Also on page 20, under H. "Compliance Schedule Requirements," I join Ms. Fields in incredulity that IUC has not been allowed not to respond to the November 28, 2001 DRC Request for Additional Information. At the time, the RAI was reasonable, legitimate and completely necessary. It remains reasonable, legitimate and completely necessary in order to proceed with State of Utah regulatory authority. Whether neglect, inadvertent oversight or strategic contempt for authority, this IUC failure is an outrage, warranting draconian response at the outset of State assertion of control over waters of the US delegated to State administration. Either IUC must respond seriously to the 2001 RAI according to stipulated schedule, or IUC should suspend operations. This point alone is grounds for a formal request for a hearing, which I hereby submit.*

   <u>DRC Response:</u> Substantive Comments. See DRC response to Ms. Sarah Field's Comment No. 2, above.

3. *As a point of inquiry, we wonder what and when will be the implications of recent State Implementation of SWAP," the Source Water Assessment and Protection" Plan, pursuant to Safe Drinking Water Act Amendments of 1996, and subsequent adaptation into Utah Code. As a member of the SWAP Advisory Committee in 1998-99, I became aware of the comprehensive nature of SWAP's simultaneous protection of wellheads, surface water and emerging ground water. It seems obvious to this observer that there are inevitable effects of past IUC ground water contamination, most of which could easily escape (and probably has done) the rather pathetic monitoring of the facility heretofore. For the sake of neighboring communities and isolated native populations, as well as for area wildlife, all that can be done to answer the question. "What can go wrong?" and to see to it that these faults are investigated, characterized and remediated scientifically, should be done without delay.*

   <u>DRC Response:</u> Substantive Comments. The Permit addresses ground water compliance limits, ground water compliance, monitoring, and reporting requirements that DRC will use to protect local ground water resources. Many significant improvements to the ground water protection have been made thru the Permit that the Executive Secretary considers sufficient. These include but not limited to requiring: The installation of additional monitoring wells at the tailing cells, new hydrogeologic evaluations, development and application of a ground water monitoring quality assurance plan,

submittal of a ground water performance assessment model, application of a ground water performance standard, addition of many new ground water quality monitoring parameters, improvement in format and content of ground water monitoring reports, periodic monitoring of ground water seeps and springs of the edge of the mesa, and reporting thereof, etc.

<u>References</u>

Envirocare of Utah, Inc., January 7, 2005, "Comments on International Uranium Corporation Proposed Groundwater Quality Discharge Permit (Permit No. UGW370004)", unpublished company comments, 2 pp.

Utah Division of Radiation Control, December 28, 1998, "Ground Water Quality Discharge Permit No. UGW170003 Statement of Basis", 8 pp.

Attachment 1

Public Comments Received from Three Parties:

January 7, 2005 Envirocare of Utah, Inc. Comments (Received January 7, 2005)

January 7, 2005 Glen Canyon Group / Sierra Club Comments (Received January 11, 2005)

January 7, 2005 Ivan Weber Comments (Received via email on January 7, 2005)

ENVIROCARE OF UTAH, INC.

THE SAFE ALTERNATIVE

CD05-0015

HAND DEL
JAN -7 2005
DIV OF RADIATION

January 7, 2005

Dane Finerfrock
Co-Executive Secretary
Utah Water Quality Board
168 North 1950 West
P.O. Box 144850
Salt Lake City, UT 84114-4850

Subject: Comments on International Uranium Corporation Proposed Groundwater Quality Discharge Permit (Permit No. UGW370004)

Dear Mr. Finerfrock;

Envirocare of Utah, Inc. (Envirocare) provides the following comments on the International Uranium Corporation proposed Groundwater Quality Discharge Permit (GWQDP) (Permit No. UGW370004).

Condition I.A Groundwater Classification
The Permit lists two data sets for the purpose of classifying groundwater at the IUC facility. What is the purpose of providing both data sets?

Table 2
Based on the information provided in Table 2, the only radiologic parameter the Permittee is required to analyze is Gross Alpha. Envirocare is required to analyze for Radium-226, Radium-228, Thorium-230, and Thorium-232 at its 11e.(2) disposal cell. UAC R313-6-2.1 identifies a combined Groundwater Quality Standard for Radium 226 + 228 at 5 µCi/L. Will these parameters also be evaluated at the IUC facility?

Condition I.D.1. DMT Design Standards for Existing Tailings Cells
Has an evaluation been performed to demonstrate liner compatibility of the Flexible Membrane Liner (FML) with the 11e.(2) materials being disposed in the cells?

Condition I.D.3.b.1. Discharge Minimization Technology Standard
The average wastewater head in the slimes drain access pipe is to be "as low as reasonably achievable" in each tailings disposal cell. How will state inspectors make a determination on this criteria?

Condition I.D.3.c. Roberts Pond
An as-built is required as Condition I.H.18 of this GWQDP. How is this pond constructed? For consistency with ponds used at Envirocare, this wastewater pond should have a minimum of two FMLs and a leak detection system. In addition, what system is in place to confirm compliance with the two foot freeboard required in this condition?

Condition I.D.3.d. Feedstock Storage Area
The introductory paragraphs of this GWQDP state that the permit is for a uranium milling and tailings disposal facility, not a storage facility. How is the feedstock area constructed?

605 NORTH 5600 WEST • SALT LAKE CITY, UTAH 84116 • TELEPHONE (801) 532-1330

ENVIROCARE

How long can stored materials remain in this area? Is there a stormwater management plan for water that accumulates in this area? Is there a DMT criteria for this area? Except in the dig cell, open air storage is prohibited at Envirocare.

Condition I.E.2. Groundwater Head Monitoring
Total Dissolved Solids (TDS) range from 1,276 mg/L to 5,200 mg/L. Will the groundwater elevations be adjusted to a freshwater equivalent head to account for an almost 5 fold variation in salinity? In addition, Envirocare is required to conduct monthly groundwater elevations due to a groundwater mound, much like the mound beneath the IUC facility. For consistency, groundwater elevations, freshwater correction, contour maps, etc., should be performed on a monthly basis.

Condition I.H.1. Installation of New Groundwater Monitoring Wells
How were the locations of the new monitoring wells determined? Monitoring wells at Envirocare were located using a computer model to demonstrate that should a release occur, the groundwater monitoring network would detect that release. Will a well spacing evaluation be required by the Permittee?

Condition I.H.11. Infiltration and Contamination Transport Modeling Work Plan and Report
This condition requires an infiltration and contaminant transport model. Since the proposed Permit does not have a cover design, it is assumed that a design will come from the required modeling. For consistency with Envirocare, even though the cover will need to incorporate an FML to prevent the bathtub effect (See Condition I.D.6.b.), the Permittee should not be able to take credit for either the upper or lower FMLs in the modeling effort. In addition, it is unclear if the Modeling Work Plan is part of the Report or a separate submittal which will require Executive Secretary Approval.

To evaluate the assumptions found in the model, will the Permittee be required to prepare a Post-Model Audit Plan?

Please contact me at (801) 532-1330 with any questions regarding this issue.

Sincerely,

Tye Rogers
Vice President of Compliance and Permitting

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Glen Canyon Group/Sierra Club
P.O. Box 622
Moab, Utah 84532

January 7, 2005

Mr. Dane Finerfrock, Director
Division of Radiation Control
Utah Department of Environmental Quality
P.O. Box 144850
Salt Lake City, Utah 84114-4850.

Subject: Comments on Draft Ground Water Discharge Permit No. UGW370004, International Uranium (USA) Corporation (IUC) Uranium Mill, White Mesa, Utah.

Below please find the comments of the Glen Canyon Group of the Sierra Club on ~~the State of Utah, Division of Radiation Control Draft Ground Water Discharge Permit~~ No. UGW370004.

1. Draft Ground Water Discharge Permit (Permit), page 1: *The facility is located on a tract of land in Sections 28, 29, 32, and 33, Township 37 South, Range 22 East, Salt Lake Base and Meridian, San Juan County, Utah.*

Comment: The facility is also includes IUC land in Sections 21, 22, and 27, Township 37 South, Range 22 East, that are up-gradient from the mill and tailings cells. It also includes down-gradient land in Sections 4, 5, 6, 8, 9, and 16, Township 38 South, Range 22 East, Salt Lake Base and Meridian, San Juan County, Utah. An explicit "legal" description of the mill property must be included in the permit.

2. Part I, page 8: *D. DISCHARGE MINIMIZATION TECHNOLOGY STANDARD - the tailings disposal facility must be built and operated according to the following Discharge Minimization Technology (DMT) standards:*

1. DMT Design Standards for Existing Tailings Cells 1, 2, and 3 - shall be based on existing construction as described by design and construction information provided by the Permittee, as summarized in Table 3 below for Tailings Cells 1, 2, and 3:

Comment: This section is vague regarding the actual design and construction information that the Division of Radiation of Control (DRC) is relying on. There is no mention of the December 31, 1998, Knight Piesold Report on the Seepage Flux from Tailings Cell 3 Liner submitted to the DRC by the Permittee. There is no mention of the numerous questions that the DRC had about the actual design and construction of Cell 3, as expressed in the (apparently) unanswered November 28, 2001, DRC Request for Additional Information (RAI).

The DRC must not rely on cell design and construction information that it has already found questionable. This section must include more detailed cell design and construction date. This section must also be amended based on the Permittee's reply to the November 28, 2001, RAI, which was part of the Permit process.

3. Part I, page 11: *D. 2(d) Feedstock Storage Area –open-air or bulk storage of all feedstock materials at the facility awaiting mill processing shall be limited to the eastern portion of the mill site area described in Table 4, below.*

Comment: There is no indication in the Permit as to how the Permittee will monitor the groundwater underneath and in the vicinity of the Feedstock Storage Area to guarantee that the materials stored there will not contaminate ground and surface water. The feedstock is sometimes stored for years out in the open where it is subject to dispersion and leaching by wind and water, and surface water.

This must be corrected.

4. Part I, page 20: *G. OUT OF COMPLIANCE STATUS, 4. (e), Where it is infeasible to reestablish DMT as defined in the permit, the Permittee may propose an alternative DMT for approval by the Executive Secretary.*

Comment: The DRC does not define "feasible." Does feasibility include economic feasibility? Who decides if a ground water corrective action plan is "unfeasible"? There is no mention of the standards that must be met by the Permittee when proposing alternative concentration limits (ACLs). Are the standards for establishing ACLs outlined in 10 C.F.R. Part 40, Appendix A, applicable here? What criteria will the Executive use in reviewing applications for the establishment of ACLs?

The term "feasible" must be defined. The standards for the establishment of ACLs must be spelled out in the Permit.

There is no mention in the Permit of any necessity for the Permittee to increase the reclamation surety to cover ground water remediation when the Permittee is out of compliance. NRC and State regulations require a surety to cover the costs of reclamation, including any ground water remediation. This requirement must be included in the permit.

5. Part I, page 20: *H. COMPLIANCE SCHEDULE REQUIREMENTS. The Permittee will comply with the schedules as described and summarized below:*

Comment: Nowhere in the extensive list of Compliance Schedule Requirements is there any requirement for the Permittee to respond to the 8-page November 28, 2001, DRC Request for Additional Information, regarding December 31, 1998, Knight Piesold Report on Seepage Flux from Tailings Cell 3 Liner, White Mesa Mill.

Has the Permittee responded to this RAI? If not, has the DRC notified the Permittee that they don't have to respond?

It was definitely my understanding, based on correspondence with the DRC, that a schedule for the Permittee's long-delayed response to the 2001 request would be part of the Permit requirements. Is this no longer the case? If so, why?

There must be a full explanation of this situation.

In addition, the DRC must review all previous requests for information and make a determination that they have all been fully responded to or a schedule for response has been established in the context of the Permit.

6. There is no discussion in the Permit of other types of contamination to ground and surface water by activities on the land owned by the Permittee at the facility. The Permittee currently allows cattle to graze on some of the mill property. These cattle can and do access Ruin Spring. Ruin Spring is on U.S. Department of Interior, Bureau of Land Management, property that abuts the mill property. The Ruin Spring area is trampled and contaminated by wastes from the cattle. The spill-over from a tank below the spring (which has not been cleaned in years) feeds a desert riparian area. The spring is used by wildlife.

Does the Permittee have any responsibility for the ruin of Ruin Spring by the cattle that graze on its mill facility property?

7. Part I, page 12: D. *5. Definition of 11e.(2) Waste – for purposes of this Permit, 11e.(2) waste is defined as: "... tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content", as defined in Section 11e.(2) of the U.S. Atomic Energy Act of 1954, as amended; which includes other process related wastes and waste streams described by a March 7, 2003 NRC letter from Paul H. Lohaus to William J. Sinclair.*

The March 7, 2003, NRC letter from Paul H. Lohaus, Director, Office of State and Tribal Programs, Nuclear Regulatory Commission (NRC) to William J. Sinclair, Director, Division of Radiation Control, (in response to questions in the January 14, 2003, letter from William Sinclair) states in part:

> *Question 4: As alternate feed material arrives at the White Mesa facility, it can be soil co-mingled with debris such as concrete, plastic, and bricks. These materials maybe non-uranium bearing and are "along for the ride" as a result of any particular remediation project. These materials may be separated at the time of introduction into the uranium recovery process and eventually disposed of in the tailings impoundments. Would these materials be classified as 11e.(2) byproduct material?*
>
> *Response: Yes. The alternate feed material is regulated in mass as ore; therefore, the material not amenable to processing, i.e., debris*

associated with it that must be separated at the time of uranium recovery, is a waste from ore processing that meets the definition of 11e.(2) byproduct material.

Comment:

There is absolutely no statutory or regulatory basis for the State of Utah to authorize the processing of "alternate feed material" at the IUC mill. There is no statutory or regulatory basis for the State of Utah to include the "process related wastes and waste streams" from the processing of materials other than natural ore ("alternate feed material") in the statutory and regulatory definition of 11e.(2) byproduct material.

The Ground Water Discharge Permit must not authorize the processing of "alternate feed material." The Ground Water Discharge Permit must not authorize the disposal of waste streams from the processing of "alternate feed material" as 11e.(2) byproduct material. Such authorization is not permitted by any statute or regulation.

Any request by the Permittee for such authorization must be denied.

The following (including Attachment A) are comments that support these statements.

A. The March 7, 2003, NRC letter from Paul H. Lohaus to William J. Sinclair is not an NRC legal opinion and has no legal effect. See10 C.F.R.Part 40, Sec. 40.6, Interpretations, which states:

> Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

B. There is no legal basis under and Atomic Energy Act of 1954 (AEA), as amended, to consider so called "alternate feed material" and various debris accompanying such material (at times constituting 40% of the "alternate feed material") as "ore," as the term "ore" is used in the definition of 11e.(2) byproduct material.

The Permit must not include any statement that would imply processing of feed material other than natural ore ("alternate feed material") is the same as the processing of "any ore," and that the debris, tailings, or wastes from such processing constitute 11e.(2) byproduct material.

The State of Utah cannot and must not include any reference to the letter from the March 7, 2003, NRC in the Permit.

See Attachment A hereto for a full discussion and comments on this matter.

C. The Permit does not define so-called "alternate feed material." There is no indication in the Permit that "alternate feed material" is made up of processing wastes from other mineral processing operations that are commingled with contaminated debris and soils. Why is there no definition of "alternate feed material" in the Permit.

D. The State of Utah must only rely on the common, historical meaning of the word "ore."

What does "ore" mean? The word, or term, "ore," as defined in several sources:

> • "Ore—a naturally occurring solid material from which metal or other valuabe minerals may be extracted." [Illustrated Oxford Dictionary, DK Pub. 1998.]
>
> • "Ore—A native mineral containing a precious or useful metal in such quantity and in such chemical combination as to make its extraction profitable. Also applied to minerals mined for their content of non-metals." [The Compact Oxford English Dictionary, Second Edition, Oxford University Press, 2000, p. 1224:915-916.]
>
> • "Ore—a. A natural mineral compound of the elements of which one at least is a metal. Applied more loosely to all metaliferous rock, though it contains the metal in a free state, and occasionally to the compounds of nonmetallic substances, as sulfur ore. . . . *Fay* b. A mineral of sufficient value as to quality and quantity that may be mined for profit. *Fay*." [A Dictionary of Mining, Mineral, and Related Terms, compiled and edited by Paul W. Thrush and Staff of the Bureau of Mines, U.S. Dept. of Interior, 1968.]

The Oxford English Dictionary points out that the current usage of the word "ore" goes back several hundred years. A Dictionary of Mining, Mineral, and Related Terms lists over 65 compound words using the word "ore," such as ore bin, ore body, ore deposit, ore district, ore geology, ore grader, ore mineral, ore reserve, ore zone. All of these terms incorporate the word "ore" as it relates to the mining of a native mineral. The term "ore," without explanation, has for many years been used in millions of instances in thousands of mining, milling, geological, mineralogical, radiochemical, engineering, environmental, and regulatory publications. "Ore" like the word "water," is a word of common and extensive usage with a clear and accepted meaning.

The State of Utah must explain what the statutory and regulatory basis is for calling wastes from other mineral processing operations "ore." A policy, whether federal or state, is not a statutory or legal basis.

E. In the past, debris associated with the processing of "alternate feed material" has been received at the IUC mill. Thousands of tons of such debris have been disposed of at the mill. IUC was paid to receive and dispose of this material. Some of the material was apparently washed (i.e., decontaminated), and the wash water was subsequently processed for its minimal source material content.

The debris that sometimes accompanies natural ore when it is processed at a licensed uranium or thorium mill has no economic value to the licensee of a uranium or thorium mill. A mill owner would not pay for or be paid to receive such debris and, in fact, would pay less for ore contaminated with a lot of debris. However, the licensee will be paid to receive and dispose of debris accompanying "alternate feed material." What is really occurring is that the licensee is getting paid to directly dispose of contaminated (or decontaminated) low level radioactive waste.

There are no similarities between the debris associated with ore mined from the ground and debris accompanying wastes and contaminated materials from other mineral processing operations.

This debris must have been separated from any material that was going to be processed at the mill prior to shipping to the mill. This could have been easily accomplished, but was not because it was in the interest of originator of the waste to get rid of it, and it was in the interest in the mill operator to get paid for accepting it.

The State of Utah is in no way obligated to agree with the NRC on this question.

F. The March 7 NRC letter states that "the alternate feed material is regulated in mass as ore." There is conflict, confusion, and inconsistency in this statement.

Who, exactly, regulates alternate feed material as "ore," and what is the basis of such regulation?

The AEA does not mention "alternate feed material" and it's regulation. I can find no NRC or EPA regulations related to the regulation of "alternate feed material." There are no NRC generic or site specific environmental impacts statements related to the regulation of "alternate feed material" or feed materials other than natural ore.

How can the NRC regulate alternate feed material "in mass as ore" when the NRC has no statutory or regulatory jurisdiction over "alternate feed material" or uranium and thorium "ore"?

NRC regulation at 10 C.F.R. § 40.13 establishes unimportant quantities of source material that are outside of regulatory concern under the AEA. NRC regulation at Section 40.4 states that "Source Material means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof."

Section 40.13(b) says that any "ore" containing source material, whether or not it meets the definition of source material (i.e., contains uranium and/or thorium of 0.05% by weight) is exempt from regulation under Part 40. Section 40.13(b) states:

> (b) Any person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the act to the extent that such person receives, possesses, uses, or transfers unrefined and unprocessed ore containing source material; provided, that, except as authorized in a specific license, such person shall not refine or process such ore

The NRC has exempted "ore," either source material ore (over .05% uranium or thorium by weight) or non-source material ore (less than .05 % uranium and/or thorium by weight). The NRC regulates facilities that process and refine "ore," under its regulation of 11e.(2) byproduct material, but it does not regulate "ore" as such.

There is nothing in the AEA that authorizes the transfer to the State of Utah of regulatory responsibility over uranium or thorium "ore."

Thank you for providing this opportunity to present comments.

Sincerely,

Sarah M. Fields

Sarah M. Fields, Chair
Nuclear Waste Committee
Glen Canyon Group/Sierra Club

Enclosure: Attachment A

Comments on Draft Ground Water Discharge Permit No. UGW370004, International Uranium (USA) Corporation (IUC) Uranium Mill, White Mesa, Utah.

Attachment A

There is absolutely no statutory or regulatory basis for the State of Utah to authorize the processing of "alternate feed material" at the IUC mill. There is no statutory or regulatory basis for the State of Utah to include the "process related wastes and waste streams" from the processing of materials other than natural ore ("alternate feed material") in the statutory and regulatory definition of 11e.(2) byproduct material.

The Ground Water Discharge Permit must not authorize the processing of "alternate feed material." The Ground Water Discharge Permit must not authorize the disposal of waste streams from the processing of "alternate feed material" as 11e.(2) byproduct material. Such authorization is not permitted by statute or regulation.

Any request by the Permittee for such authorization must be denied.

The following discussion of the history of the statutes and regulations applicable to the processing of ores for their source material content at licensed uranium and thorium mills will support these statements.

1. Statutes

A. Uranium Mill Tailings Radiation Control Act of 1978

Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) (Public Law 95-604, 92 Stat. 3033 *et seq.*), amended the Atomic Energy Act (AEA) of 1954 (Public Law 83-703, 68 Stat. 919 *et.seq.*). The AEA of 1954 was an amendment to the Atomic Energy Act of 1946 (Public Law 79-385, 60 Stat. 755 *et seq.*).

There is no evidence that the AEA, as amended by UMTRCA, anticipated and sanctioned the processing of feed materials other than natural ores and the disposal of wastes from such processing at licensed uranium and thorium processing facilities. There is no evidence that the AEA gave the Nuclear Regulatory Commission (NRC) or NRC Agreement States the broad authority to authorize the processing of feed materials other than natural ores as "ore." There is no evidence that the AEA gave the NRC and NRC Agreement States the broad authority to authorize the disposal of wastes from such processing at licensed uranium and thorium processing facilities as "11e.(2) byproduct material."

So-called "alternate feed material" is the wastes, contaminated debris, and contaminated soils from other mineral processing operations. This material has been deemed "feed material other than natural ore." It is not "natural ore." It is not "any ore." And, it is not "ore." There is no evidence that UMTRCA sanctioned the processing of "alternate feed material," as " any ore," at licensed uranium or thorium extraction facilities. There is no evidence that under UMTRCA materials other than natural ore were ever considered to be "ore." There is no evidence that UMTRCA gave any federal or state agency the discretion alter the definition of "ore" to include materials that are not natural ore. There is no evidence that UMTRCA gave any federal or state agency the discretion to alter the definition of "any ore" as that term is used in the definition of "11e.(2) byproduct material."

In fact, there is specific evidence that Congress, the Atomic Energy Commission (AEC), the NRC, and the Environmental Protection Agency (EPA) explicitly determined that the processing feed material other than natural ore was not sanctioned by applicable statute or regulation.

The regulatory history of UMTRCA, found in the two Congressional reports, provides information with respect "uranium mill tailings" and "ore." The Congressional Reports clearly stated what was contemplated by Congress (known as the intent of Congress) when Congress established a program for the control of "uranium mill tailings" from the processing of "uranium ore" at inactive (Title I of UMTRCA) and active (Title II of UMTRCA) uranium and thorium processing facilities. House Report (Interior and Insular Affairs Committee) No. 95-1480 (I), August 11, 1978, and House Report (Interstate and Foreign Commerce Committee) No. 95-1480 (II), September 30, 1978.

Under "Background and Need," HR No. 95-1480 (I) states:

> Uranium mill tailings are the sandy waste produced by the uranium ore milling process. Because only 1 to 5 pounds of useable uranium is extracted from each 2,000 pounds of ore, tremendous quantities of waste are produced as a result of milling operations. These tailings contain many naturally-occurring hazardous substances, both radioactive and nonradioactive. . . . As a result of being for all practical purposes, a perpetual hazard, uranium mill tailings present the major threat of the nuclear fuel cycle.
>
> In its early years, the uranium milling industry was under the dominant control of the Federal Government. At that time, uranium was being produced under Federal Contracts for the Government's Manhattan Engineering District and Atomic Energy Commission program. . . .
>
> The Atomic Energy Commission and its successor, the Nuclear Regulatory Commission, have retained authority for licensing uranium mills under the Atomic Energy Act since 1954. [HR No. 95-1480 (1) at 11.]

The second House Report, under "Need for a Remedial Action Program" states:

> Uranium mills are a part of the nuclear fuel cycle. They extract uranium from ore for eventual use in nuclear weapons and power-plants, leaving radioactive sand-like waste—commonly called uranium mill tailings—in generally unattended piles. [HR No. 95-1480 (2) at 25.]

B. Atomic Energy Commission and the AEA of 1946

As indicated above, the domestic uranium mining and milling industry was established at the behest of the Manhattan Engineer District and the AEC. The AEC regulated uranium mines and uranium processing facilities, established ore buying stations, and bought ore. Mining and milling of uranium ore was done under contract to the AEC. AEC purchased uranium ore under the Domestic Uranium Program. Regulations related to the AEC's uranium procurement program were set forth in 10 C.F.R. Part 60. Part 60 was deleted from Title10 of the Code of Federal Regulations on March 3, 1975, after the establishment of the NRC.

The AEC published a number of circulars related to their Domestic Uranium Program that discuss the various types of uranium ores. The Domestic Uranium Program—Circular No. 3—Guaranteed Three Year Minimum Price—Uranium-Bearing Carnotite-Type or Roscoelite-Type Ores of the Colorado Plateau Area" (April 9, 1948) amended 10 C.F.R. Part 60). The Circular states:

> § 60.3 *Guaranteed three years minimum price for uranium-bearing carnotite-type or roscoelite-type ores of the Colorado Plateau—(a) Guarantee*. To stimulate domestic production of uranium-bearing ores of the Colorado Plateau area, commonly known as carnotite-type or roscoelite-type ores, and in the interest of the common defense and security the United States Atomic Energy Commission hereby establishes the guaranteed minimum prices specified in Schedule 1 of this section, for the delivery of such ores to the Commission, at Monticello, Utah, and Durango, Colorado, in accordance with the terms of this section during the three calendar years following its effective date.
> *Note:* In §§ 60.1 and 60.2 (Domestic Uranium Program, Circulars No. 1 and 2), the Commission has established guaranteed prices for other domestic uranium-bearing ores, and mechanical concentrates, and refined uranium products.
> *Note*: The term "domestic" in this section, referring to uranium, uranium-bearing ores and mechanical concentrates, means such uranium, ores, and concentrates produced from deposits within the United States, its territories, possessions and the Canal Zone.

10 C.F.R. Part 60—Domestic Uranium Program at § 60.5(c) states:

> Definitions. As used in this section and in § 60.5(a), the term "buyer' refers to the U.S. Atomic Energy Commission, or its authorized purchasing agent. <u>The term "ore" does not include mill tailings or other mill products</u>. . . . [Circular 5, 14 Fed. Reg. 731 (February 18, 1949).] [Emphasis added.]

It is clear that the AEC was the primary mover in the domestic uranium mining and milling program. Under the Atomic Energy Acts of 1946 and 1954, the AEC regulated uranium mining and milling and established a uranium ore-buying program. From the 1940's to 1975, the regulations in 10 C.F.R. Part 60 clearly discussed what uranium ore was and was not and clearly stated that "ore" did not include mill tailings or other mill products. In other words, "ore" did not include materials that had already gone through a mineral processing operation. It did not include materials other than natural ore.

From the very beginning of the AEA, the AEC was explicit about what uranium ore was. Ore specifically did not include tailings, wastes, and products from mineral processing operations. Nothing has changed in the use of the term "ore" in the statutes or regulations pertaining to the processing of uranium and thorium ore since that time.

C. Statutory Definition of Source Material

The AEA of 1946, under "Control of Materials," Sec. 5 (b), "Source Materials," (1), "Definition," provides the definition of "source material." Section 5(b)(1) states:

> Definition. — As used in this Act, the term "source material" means uranium, thorium, or any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable materials; but includes ores only if they contain one or more of the foregoing materials in such concentration as the Commission may by regulation determine from time to time.

The AEA of 1954, Chapter 2, Section 11, "Definitions," sets forth the current statutory definition of "source material " at Sec. 11(s):"

> The term "source material" means (1) uranium, thorium, or any other material which is determined by the Commission pursuant to the provisions of section 61 to be source material; or (2) ores containing one or more of the foregoing materials, in such concentrations as the Commission may by regulation determine from time to time.
> [42 U.S.C. Sec. 2014(z).]

Responsive to this statutory definition, in 1961 the AEC established the following regulatory definition at 10 C.F.R. § 40.4:

> Source Material means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof. Source material does not include special nuclear material. [26 Fed. Reg. 284 (Jan. 14, 1961).]

Therefore, the AEC made a determination, in accordance with the mandate of the AEA of 1954, that ores containing 0.05% thorium and/or uranium would meet the statutory definition of source material. For materials other than natural ore, only the uranium and or thorium content (no matter what the concentration) met the statutory definition of source material. There was a clear differentiation between the two types of source material.

At the same time that they made that determination, the AEC had a regulation that clearly stated that "ore" does not include mill tailings or other mill products. Surely, the AEC, as the administrator of a uranium ore procurement program and the developer of the uranium mining and milling industry knew what they were referring to when they used the term "ore." There was no need to define "ore" in the statute or regulations because that term had an unquestionable commonly accepted meaning within the mining and milling industry. It was not part of the new regulatory terminology. On the other hand, "source material" and "special nuclear material" were defined because they were new regulatory terms.

The AEC set forth certain exemptions to the regulations in 10 C.F.R. Part 40. The proposed rule, which was later finalized in January 1961, states in pertinent part:

> The following proposed amendment to Part 40 constitutes an over-all revision of 10 CFR Part 40, "Control of Source Material."
>
> With certain specified exceptions, the proposed amendment requires a license for the receipt of title to, and the receipt, possession, use, transfer, import, or export of source material. . . .
>
> Under the proposed amendment, the definition of the term "source material": is revised to bring it into closer conformance with that contained in the Atomic Energy Act of 1954. "Source Material" is defined as (1) uranium or thorium, or any combination thereof, in any physical or chemical form, but does not include special nuclear material, or (2) ores which contain by weight one-twentieth of one percent (0.05 percent) or more of (a) uranium, (b) thorium or (c) any combination thereof. The amendment would exempt from the licensing requirements chemical mixtures, compounds, solutions or alloys containing less than 0.05 percent source material by weight. As a result of this exemption, the change in the definition of source material is not expected to have any effect on the licensing program. . . .
>
> Section 62 of the Act prohibits the conduct of certain activities relating to source material "after removal from its place of deposit in nature" unless such activities are authorized by license issued by the Atomic Energy Commission. The Act does not, however, require a license for the mining of source material, and the proposed regulations, as in the case of the current regulations, do not require a license for the conduct of mining activities. Under the present regulation, miners are required to have a license to transfer the source material after it is mined. Under the proposed regulation below, the possession and transfer of

unrefined and unprocessed ores containing source material would be exempted. [47 Fed. Reg. 8619 (September 7, 1960).]

Here, the regulation makes clear that "source material ore" is something that has been removed from its place of deposit in nature." It is something that is mined from the ground by miners.

Therefore, the AEC established, via a rulemaking, exemptions for source material, as defined in Sec. 2014(z)(1), related to mixtures, compounds, solutions, or alloys containing uranium and/or thorium:

> (a) Any person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the Act to the extent that such person receives, possesses, uses, transfers or delivers source material in any chemical mixture, compound, solution, or alloy in which the source material is by weight less than one-twentieth of 1 percent (0.05 percent) of the mixture, compound, solution or alloy. The exemption contained in this paragraph does not include byproduct material as defined in this part. [10 C.F.R. § 40.13(a), 26 Fed. Reg. 284 (Jan. 14, 1961).]

The AEC also established, via a rulemaking, exemptions for source material, as defined in Sec. 2014(z)(2), related to "ore":

> (b) Any person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the act to the extent that such person receives, possesses, uses, or transfers unrefined and unprocessed ore containing source material; provided, that, except as authorized in a specific license, such person shall not refine or process such ore. [10 C.F.R. 40.13(b), 26 Fed. Reg. 284 (Jan. 14, 1961).]

The definition of "source material" and the exemptions that are related to those definitions stand today, over forty years later. These regulatory definitions and exemptions did not change when the NRC was established in 1975 and took on the regulatory responsibility for "source material." These regulatory definitions and exemptions did not change when the AEA was amended by UMTRCA in 1978. These regulations and definitions did not change when the NRC developed their policy guidances related to the processing of feed material other than natural ore at licensed uranium recovery operations.

Alternate feed material that contains uranium and thorium contains "source material" under the first definition of "source material." However, it is not "source material" under the second definition, because it is not "ore" under the applicable statutes and regulations.

D. Definition of 11e.(2) byproduct material.

UMTRCA, among other things, amended the AEA of 1954 by adding a new definition—the definition of 11e.(2) byproduct material:

> Sec. 201. Section 11e. of the Atomic Energy Act of 1954, is amended to read as follows:
> "e. The term 'byproduct material' means (1) any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material, and (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." [42 U.S.C. Sec. 2014 (e).]

There is no evidence in the regulatory history of UMTRCA that Congress, in defining "11e.(2) byproduct material" intended to also amend the statutory definition of "source material." The "any ore" in the definition of 11e.(2) byproduct material is 1) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) uranium,(ii) thorium or (iii) any combination thereof (source material); and 2) ores which contain less than by weight one-twentieth of one percent (0.05%) or more of: (i) uranium,(ii) thorium or (iii) any combination thereof. If the term "any ore" was meant to include materials other than "ore" in the definition of "any ore," the result would be an amendment to the definition of "source material." There was no such amendment to the statutory definition of "source material."

There is no evidence in the regulatory history of UMTRCA that the term "any ore" does not mean "any type of uranium ore" (i.e., ore containing less than .05% uranium and/or thorium and the numerous types of natural uranium-bearing minerals that are mined at uranium mines and milled at uranium mills).

There is no evidence in the regulatory history of UMTRCA that Congress intended the term "any ore" to mean anything that the NRC or an Agreement State wanted it to mean. There is no evidence that UMTRCA intended that "ore" included wastes from mineral processing operations mixed with wastes and debris from other sources, even if those wastes were processed for their source material content at a licensed uranium or thorium mill.

2. NRC Regulations

A. Mandate of UMTRCA

UMTRCA required that the EPA and the NRC promulgate rules and regulations implementing the statute.

Both the EPA and the NRC established a regulatory program for uranium milling and the processing of ores. Neither the EPA nor the NRC contemplated the processing of materials that were not "natural ore" when they developed and promulgated their regulations.

Neither the EPA nor the NRC considered wastes from other mineral processing operations in their concept of "ore," and they did not address in any manner the processing of such wastes when promulgating their regulatory regimes for active uranium processing facilities.

Further, during the various rulemaking proceedings, the public was never informed that wastes from other mineral processing operations, no matter how they were defined, would be processed at licensed uranium or thorium mills. Therefore the public was given absolutely no opportunity to comment on such processing activities at licensed uranium or thorium facilities.

The public has never been given this opportunity in any NRC, EPA, or State of Utah rulemaking proceeding.

B. NRC Regulatory Program, 10 C.F.R. Part 40

Responsive to UMTRCA, the NRC incorporated the UMTRCA definition of 11e.(2) byproduct material (with clarification) into their regulations at 10 C.F.R. § 40.4:

> "Byproduct Material" means the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by such solution extraction operations do not constitute "byproduct material" within this definition. [44 Fed. Reg. 50012-50014 (August 24, 1979).]

The NRC also explained the need for the new definition:

> Section 40.4 of 10 CFR Part 40 is amended to include a new definition of "byproduct material." This amendment, which included uranium and thorium mill tailings as byproduct material licensable by the Commission, is required by the recently enacted Uranium Mill Tailings Radiation Control Act. [44 Fed. Reg. 50012-50014 (August 24, 1979.]

The NRC promulgated further regulations amending Part 40, in 1980. In the Federal Register Notice (FRN) summary, the NRC states:

> The U.S. Nuclear Regulatory Commission is amending its regulations to specify licensing requirements for uranium and thorium milling activities, including tailings and wastes generated from these activities. The amendments to parts 40 and 150 take into account the conclusions reached in a final generic environmental impact statement on uranium milling and the requirements mandated in the Uranium Mill

> Tailings Radiation Control Act of 1978, as amended, public comments received on a draft generic environmental impact statement on uranium milling, and public comments received on proposed rules published in the Federal Register. [Footnotes omitted.] [45 Fed. Reg. 65521-65538 (October 3, 1980).]

There is no statement in any of the NRC regulations in 10 C.F.R. Part 40 or in any of rulemaking proceedings promulgating those regulations that, under any circumstances, wastes from other mineral processing operations can be considered to be "ore". There is no statement that, under any circumstances, such wastes would be processed at licensed uranium or thorium mills and the tailings or wastes would be disposed of as 11e.(2) byproduct material in the mill tailings impoundments. The regulations promulgated by the NRC and the EPA did not contemplate this kind of mill processing activity.

The National Environmental Policy Act ("NEPA") document in support of the promulgation of the NRC regulatory program for uranium mills did not contemplate this kind of uranium or thorium milling activity. In the rulemaking proceedings and NEPA proceeding the public did not have an opportunity to contemplate and comment on this kind of mineral processing activity at licensed uranium or thorium mills.

C. The Final Generic Environmental Impact Statement on Uranium Milling

In developing and adopting Part 40 regulations, the NRC relied upon the Final Generic Environmental Impact Statement on Uranium Milling ("GEIS"), NUREG-0706, September 1980. The GEIS makes a clear statement regarding the scope of the GEIS and its understanding of what uranium milling entails:

> As stated in the NRC Federal Register Notice (42 FR 13874) on the proposed scope and outline for this study, conventional uranium milling operations in both Agreement and Non-Agreement States, are evaluated up to the year 2000. Conventional uranium milling as used herein refers to the milling of ore mined primarily for the recovery of uranium. It involves the processes of crushing, grinding, and leaching of the ore, followed by chemical separation and concentration of uranium. Nonconventional recovery processes include in situ extraction or ore bodies, leaching of uranium-rich tailings piles, and extraction of uranium from mine water and wet-process phosphoric acid. These processes are described to a limited extent, for completeness. [GEIS, Volume I, at 3.]

The GEIS is very clear about what it considers "ore" to be and gives no indication whatsoever that materials other than ore, such as the tailings or waste from mineral processing operations (including debris, commingled contaminated soils and waste materials from other sources) are considered to be "ore." The processing of "alternate feed material" was not mentioned in the discussion of "nonconventional recovery proceses" in the GEIS.

The GEIS includes a discussion of "Past Production Methods." That discussion makes reference to "ore," "ore exploration," "pitchblende ore," "crude ore milling processes," "lower-grade ores," "uranium-bearing gold ores," "high-grade ores," "ore-buying stations," and "ore reserves." GEIS, Volume I, Chapter 2, at 2-1 to 2-2. There is a lengthy discussion of "Uranium Mining and Milling Operations" that provides a description of the commonly and less-commonly "used methods of mining uranium ores." GEIS, Volume II, at B-1 to B-2. Appendix 1.

In Chapter 6, "Environmental Impacts," there is a discussion of "Exposure to Uranium Ore Dust," which states, in part:

> Uranium ore dust in crushing and grinding areas of mills contains natural uranium (U-238, U-235, thorium-230, radium-226, lead-210, and polonium-210) as the important radionuclides. [GEIS, Volume I, at 6-41.]

There is also a table giving the "Average Occupational Internal Dose due to Inhalation of Ore Dust." GEIS at 6-41, Table 6.16. Further, the GEIS discusses "Shipment of Ore to the Mill" (GEIS at 7-11), "Sprinkling or Wetting of Ore Stockpile" (GEIS at 8-2), "Ore Storage" and "Ore Crushing and Grinding" (GEIS at 8-6), "Ore Pad and Grinding" (GEIS, Vol. 3, at G-2), "Ore Warehouse (GEIS, Vol. 3, at K-3) and "Alternatives to Control Dust from Ore Handling, Crushing, and Grinding Operations (GEIS, Vol. III, at K-3 to K-3). In the NRC responses to comments there are discussions of "Average Ore Grade, Uranium Recovery." GEIS, Vol. II, at A-12 to A-13.

Nowhere in these discussions of "ore" was it stated that materials other than natural ore were thought to be a type of "ore" and the processing of such materials would be addressed in the environmental review.

The GEIS did not consider the processing of alternate feed material, of whatever source and kind. The GEIS gives no indication whatsoever that such wastes are "ore," even if they were processed at a uranium or thorium recovery facility for their "source material content." Clearly, the GEIS did not contemplate a situation where wastes from the processing of feed material other than natural ore would meet the definition of 11e.(2) byproduct material.

Therefore, the GEIS did not evaluate, and the public did not have an opportunity to comment upon, any of the possible health, safety, and environmental impacts of the processing of other mineral processing wastes at uranium or thorium processing facilities. There was no evaluation of the transportation issues related to the transportation of such wastes, nor were reasonable alternatives to the transportation, receipt, processing, and disposal of such wastes at uranium or thorium mills ever evaluated.

The NRC has never supplemented the GEIS to include an environmental assessment of the processing of alternate feed materials. The NRC has never required a site-specific Environmental Impact Statement for any uranium mill, including the Permittee's mill, that evaluated the environmental impacts associated with the processing of "alternate feed material" at the mill. Most of the "alternate feed material" (including large amounts of debris) processed at the Permittee's uranium mill was received, processed, and disposed of without any type of environmental review whatsoever.

3. EPA Regulatory Standards
A. Mandate of UMTRCA

UMTRCA directed the EPA to establish standards for uranium mill tailings and directed the NRC to implement those standards. That statute, as codified in 42 U.S.C. 2022, states in pertinent part:

> Sec. 2022. Health and environmental standards for uranium mill tailings
>
> (b) Promulgation and revision of rules for protection from hazards at processing or disposal site.
> (1) As soon as practicable, but not later than October 31, 1982, the Administrator shall, by rule, propose, and within 11 months thereafter promulgate in final form, standards of general application for the protection of the public health, safety, and the environment from radiological and nonradiological hazards associated with the processing and with the possession, transfer, and disposal of byproduct material, as defined in section 2014(e)(2) of this title, at sites at which ores are processed primarily for their source material content or which are used for the disposal of such byproduct material. . . . [Emphasis added.]
> Requirements established by the Commission under this chapter with respect to byproduct material as defined in section 2014(e)(2) of this title shall conform to such standards. Any requirements adopted by the Commission respecting such byproduct material before promulgation by the Commission of such standards shall be amended as the Commission deems necessary to conform to such standards in the same manner as provided in subsection (f)(3) of this section. Nothing in this subsection shall be construed to prohibit or suspend the implementation or enforcement by the Commission of any requirement of the Commission respecting byproduct material as defined in section 2014(e)(2) of this title pending promulgation by the Commission of any such standard of general application. In establishing such standards, the Administrator shall consider the risk to the public health, safety, and the environment, the environmental and economic costs of applying such standards, and such other factors as the Administrator determines to be appropriate.
> * * *
> (d) Federal and State implementation and enforcement of the standards promulgated pursuant to subsection (b) of this section shall be the responsibility of the Commission in the conduct of its licensing activities under this chapter. States exercising authority pursuant to section 2021(b)(2) of this title shall implement and enforce such standards in

accordance with subsection (o) of such section. [42 U.S.C. 2022(b) and (d).]

Congress directed the EPA only to establish standards for "sites at which ores are processed primarily for their source material." The EPA, as mandated by UMTRCA, finalized the "Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites" in 1983. 48 Fed. Reg. 45925-45947, October 7, 1983. In the "Summary of Background Information" the EPA provides a discussion of "The Uranium Industry" (i.e., the industry that the regulations apply to):

> The major deposits of high-grade uranium ores in the United States are located in the Colorado Plateau, the Wyoming Basins, and the Gulf Coast Plain of Texas. Most ore is mined by either underground or open-pit methods. At the mill the ore is first crushed, blended, and ground to proper size for the leaching process which extracts uranium. . . . After uranium is leached from the ore it is concentrated . . . . The depleted ore, in the form of tailings, is pumped to a tailings pile as a slurry mixed with water.
>
> Since the uranium content of ore averages only about 0.15 percent, essentially all the bulk or ore mined and processed is contained in the tailings. [48 Fed. Reg. 45925, 45927, October 7,1983.]

Clearly, when the EPA developed its standards for uranium and thorium mills, they stated, with specificity and particularity, what uranium ore was, what uranium milling consisted of, and what uranium mill tailings consisted of. The EPA clearly stated that the standards applied to the processing of uranium and thorium ores at uranium and thorium mills. There is no reasonable evidence that would indicate that the standards promulgated by the EPA applied to the processing of wastes from other mineral processing operations at uranium and thorium mills (i.e., alternate feed material).

Additionally, the EPA incorporated UMTRCA's definition of 11e.(2) byproduct material, as clarified by the NRC in 10 C.F.R. 40.4, into their standards at 40 C.F.R. Subpart D, § 192.31(b). Since that time the EPA has not amended their definition of 11e.(2) byproduct material in a rulemaking proceeding, nor have they amended their definition via policy guidance. The EPA has not, in any manner, widened the use of the words "any ore" to include any type of mineral processing wastes that is currently termed "alternate feed material."

As will be discussed below, the EPA did not sanction the NRC's policy guidance with respect new definitions of "ore" and 11e.(2) byproduct material.

Clearly, the EPA, as directed by Congress, has not in any manner contemplated the processing of wastes from other mineral extraction operations at uranium or thorium mills when establishing the "Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites."

B. EPA Regulations

When compiling that list of hazardous materials and incorporating that list into 40 C.F.R. Part 192, the EPA did not in any manner contemplate the processing of wastes from other mineral extraction operations at the mills for which they were establishing standards. The EPA did not address in any manner effluents that might result from the processing of feed materials that were the tailings and other processing wastes from other mineral extraction facilities .

In the various rulemaking proceedings that have taken place for the establishment of the EPA standards, the public was given no opportunity to consider or comment on the possibility that the EPA standards would also apply to the processing of wastes from other mineral processing operations (including commingled debris, soils, and waste materials from other sources) at uranium and thorium mills.

It is true that the EPA and the NRC, in establishing their regulatory program, contemplated the processing of ores at uranium and thorium mills. However, as shown above, processing of wastes from other mineral processing operations at uranium and thorium mills was beyond the scope of the regulatory program established by the NRC and the EPA in response to UMTRCA.

Furthermore, 10 C.F.R. Part 40, Appendix A, Criterion 8, states in part:

> Uranium and thorium byproduct materials must be managed so as to conform to the applicable provisions of Title 40 of the Code of Federal Regulations, Part 440, "Ore Mining and Dressing Point Source Category: Effluent Limitations Guidelines and New Source Performance Standards, Subpart C, Uranium, Radium, and Vanadium Ores Subcategory," as codified on January 1, 1983.

There is no indication that these regulations applying to "ore" also apply to "alternate feed material." There is no evidence that "alternate feed material" was considered to be some new type of "ore."

There is no indication that this NRC regulation and the regulation in 40 C.F.R. Part 440 (and the enabling statute) have in any manner been amended or altered by subsequent NRC policy guidance. Therefore, any shift in the usage of the word "ore" would conflict with these statutory and regulatory authorities with respect this regulation.

3. Regulatory History of NRC's Alternate Feed Guidance

A. In the late 1980's the NRC was faced with a few requests to process material other than ore. At that time, and today, there are two statutes or regulations (implementing those statues) that are pertinent. First is the statutory definition of "source material" established in 1954 by the AEA, found at 42 U.S.C. Sec. 2014(z), and in the NRC regulatory definition of "source material" (established in 1961 pursuant Sec. 2014(z)), found at 10 C.F.R. 40.4:

Source Material means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof. Source material does not include special nuclear material.

The second is the definition of "byproduct material" in Section 11(e)(2) of the Atomic Energy Act of 1954, as amended, (42 U.S. C Sec. 2014(e)(2)) and the regulatory definition of "byproduct material" found in 10 C.F.R. 40.4:

Byproduct Material means the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by such solution extraction operations do not constitute "byproduct material" within this definition.

The NRC had several options, including the denial of the amendment requests. One option would have been to go to Congress and request that Congress change the definition of 11e.(2) byproduct material. NRC Staff made a determination that they would not go to Congress to seek an amendment to the AEA of 1954.

Instead, what the NRC did was to manipulate the use of the word " any ore" as it is used in the definition of 11e.(2) byproduct material. NRC proposed in a notice and comment proceeding, that a policy guidance be established for the purpose of interpreting the term "ore," as it is used in the definition of 11e.(2) byproduct material. ''Revised Guidance on Disposal of Non-Atomic Energy Act of 1954, Section 11e.(2) Byproduct Material in Tailings Impoundments'' and ''Position and Guidance on the Use of Uranium Mill Feed Materials Other Than Natural Ores,'' 57 Fed. Reg. 20525 (May 13, 1992).

The NRC did not institute a rulemaking proceeding to amend 10 C.F.R. Part 40.

The Final Position and Guidance gave a new definition of ore. "Final Position and Guidance on the Use of Uranium Mill Feed Materials Other than Natural Ores." 60 Fed. Reg. 49296 (September 25, 1995). "Interim Position and Guidance on the Use of Uranium Mill Feed Material Other than Natural Ores," Regulatory Issue Summary (RIS) 2000-23 (November 30, 2000). The new definition states:

Ore is a natural or native matter that may be mined and treated for the extraction or any of its constituents or any other matter from which source material is extracted in a licensed uranium or thorium mill. [60 Fed Reg. at 49,296 (September 22, 1995).]

Based on the new use of the term "ore" as put forth in the proposed guidance, not only would the definition of 11e.(2) byproduct material apply to "any ore processed primarily for its source material content" in a licensed uranium or thorium mill, but the definition of 11e.(2) byproduct material would also apply to any material (particularly wastes from various mineral extraction operations and various commingled wastes and debris) processed primarily for its source material content in a licensed uranium or thorium mill. In other words, NRC altered the accepted meaning of the word "ore" as that word ore was used in statutory definitions.

B. On May 14, 1992, NRC Staff, sent a letter to the EPA, enclosing a copy of the May 13 proposed rules and requested EPA comment on two proposed guidance documents and their associated staff analyses. Letter from Robert M. Bernero, Director, Office of Nuclear Material Safety and Safeguards, NRC, to Sylvia K. Lowrance, Director, Office of Solid Waste, EPA, May 14, 1992.

The EPA did not submit comments on the proposed policy guidances. The only documentation of EPA's response to that request for comment is quoted below and is found in the Commission Paper that forwarded the finalized guidances to the Commission for their approval"

> There was an issue that delayed finalization of the guidance documents. In an October 1992, mixed waste meeting between the NRC, the EPA, and DOE staff, EPA identified potential inconsistencies in NRC's interpretation of the definition of source material in conjunction with the exclusion of source material from the definition of solid waste in the Resource Conservation and Recovery Act (RCRA). In making its point, EPA cited the May 13, 1992, Federal Register notice on the disposal of non-11e.(2) byproduct material. The staff had delayed finalization of the uranium recovery policy guidance documents, pending resolution of the source material definition issue. However, the staff has now decided that these two policy guidance documents can be finalized, independent of the source material issue, because the guidance is not dependent on the interpretation of the definition of source material. ["Final 'Revised Guidance on Disposal of Non-Atomic Energy Act of 1954, Section 11e.(2) Byproduct Material in Tailings Impoundments' and Final 'Position and Guidance on the Use of Uranium Mill Feed Materials Other Than Natural Ores,'" SECY-95-221, August 15, 1995.]

The Proposed Position and Guidance and the Final Position and Guidance gave no indication that the NRC was amending, interpreting, or in any manner adjusting the accepted meaning of the term "ore" as that word is used in the statutory and regulatory definition of "source material." Nor was there any discussion in the various guidances related to the processing of material other than natural ore (i.e., material that is not ore at all) of how the exemptions set forth in 10 C.F.R. §40.13(a) and (b) would be impacted by guidance's new definition of "ore." There is no indication that the "source material definition issue" has ever been appropriately addressed or resolved. It is an issue that has lain in some pretty murky regulatory waters for quite some time.

That question is: Does the new use of the term "ore," put forth in the Final Position and Guidance, affect in any manner the definition of "source material" established in the Atomic Energy Act of 1954 or affect the exemptions set forth in § 40.13(a) and (b)?

It is plain from the Atomic Energy Act of 1946 and the legislative history of the AEA of 1954 and the Uranium Mill Tailings Radiation Control Act of 1978 and the regulatory history of the AEC, EPA, and NRC rules promulgated responsive to those laws, that the Policy Guidance's new use of the term "ore" goes far beyond the accepted meaning of that term and the clear intent of Congress. Therefore, NRC and the State of Utah cannot make use of the new definition of "ore" to claim that any alternate feed material is "ore" or "source material ore" or to claim that the wastes produced from the processing of that material meets the statutory definition of "11e.(2) byproduct material."

The applicability of various environmental regulations to a great degree depends upon definitions. Congress, in their legislative function, often specifically defines words or phrases related to the application of a statute to a particular material or circumstances—when there is a need for explanation. However, when using words or terms with a common and long accepted meaning, such as groundwater, mill, tailings, or "ore," no explanation or definition is necessary.

The NRC and the State of Utah is not authorized to shift these accepted definitions at will as an expression of their "regulatory flexibility." This is especially so when such shifts result in direct conflicts with NRC's own enabling statutes and regulations, as is the case with the use of the newly defined term "ore." Additionally, NRC and State of Utah is not authorized to shift definitions at will when such shifts directly conflict with the statutory authority and regulations of another federal agency, in this case, the EPA.

4. UMTRCA and the AEA

UMTRCA, as it amends the AEA, clearly specified what constitutes "any ore." What constitutes "any ore" is "any ore." It does not include material "other than natural ore." The plain language of the Act and the history of the implementation of the Atomic Energy Act of 1946, as amended by the Atomic Energy Act of 1954 and the Uranium Mill Tailings Act of 1978, is all that is needed to determine what "ore" or "any ore" is. As discussed above, clearly the legislative and regulatory history of the AEA and Title 10 of the Code of Federal Regulations make plan the meaning of the term "ore" and the term "any ore."

5. Conclusion

No federal agency or state agency can use a permit or a policy guidance to expand upon and substantively alter the explicit will of Congress when that will is explicitly set forth in stature. The State of Utah does not have the discretion to use this Ground Water Discharge Permit to substantively alter the statutory definition of "source material" or the statutory definition of 11e.(2) byproduct material.

None of the federal and State of Utah statutes and regulations pertaining to the regulation of ground and surface water at the Permittee's uranium recovery facility were promulgated contemplating the disposal of debris and wastes from the processing of feed materials other than natural ore. The receipt, processing, and disposal of these materials was never addressed in the original White Mesa Mill Environmental Statement or any subsequent EIS supplement.

There is no evidence that the Permittee' mill tailings impoundments were designed and constructed to receive the debris and wastes from the processing of feed materials other than natural ore.

Therefore, the Ground Water Discharge Permit must not in any manner authorize the acceptance, processing, and disposal of materials other than natural ore at the facility covered by the Permit. Such authorization is outside the scope of the enabling statutes and regulations for licensed uranium recovery facilities.

Sarah M. Fields, Chair
Nuclear Waste Committee
Glen Canyon Group/Sierra Club

From: "Ivan Weber" <ivan@webersustain.com>
To: <lmorton@utah.gov>
Date: 1/7/05 4:59PM
Subject: Ground water discharge permit, IUC White Mesa Mill

Dear Mr. Morton:

Please forgive the last-minute nature of my attempt to comment, however briefly, on the draft GWP for IUC/White Mesa, near Blanding, Utah. It is important, however, for citizens of Utah to note the significance of DRC's assumption of regulatory 'primacy' over IUC operations and facilities, and for us to observe the thoroughness attempted in the Statement of Basis, supporting documents and in the draft Ground Water Discharge Permit, itself. As one who has participated in earlier rounds of proceedings and reviews in IUC requests for 'alternate feed' permits under NRC in former years, I am very gratified that the State of Utah has embraced this task seriously, as evidenced by the substance and detail of the draft permit and the SOB.

May I please echo the critique submitted by Ms. Sarah Fields, and incorporate it by reference into my own reflections. In particular:

a.. I share her apprehension, expressed in her questioning of the meaning of "infeasible" DMT as rationale for IUC submittal of "alternative DMT" to the Executive Secretary of DRC (page 20 of draft Permit, 4. "Facility Out of Compliance Status...," e. "Where it is infeasible to reestablish DMT..."). This appears to be a loophole of magnitude proportional to the holes we suspect to exist in the cells' liner systems. Please tighten this allowance by defining terms rigorously, if not by eliminating 4.e altogether.

b.. Also on page 20, under H. "Compliance Schedule Requirements," I join Ms. Fields in incredulity that IUC has been allowed not to respond to the November 28, 2001 DRC Request for Additional Information. At the time, the RAI was reasonable, legitimate and completely necessary. It remains reasonable, legitimate and completely necessary in order to proceed with State of Utah regulatory authority. Whether neglect, inadvertent oversight or strategic contempt for authority, this IUC failure is an outrage, warranting draconian response at the outset of State assertion of control over waters of the US delegated to State administration. Either IUC must respond seriously to the 2001 RAI according to a stipulated schedule, or IUC should suspend operations. This point alone is grounds for a formal request for a hearing, which I hereby submit.

Rapid and regretably cursory review of the Statement of Basis affords considerable comfort with the Permit's comprehension of the woeful inadequacy of process cell liner technology, relative to 'best-available' liners now. In fact, the original liners were not "BAT" in the early '80s when the cells were built, though they were in the theoretical range of common practice. As indicated in my previous review of liner design, construction and QA/QC (or lack thereof), submitted with Sierra Club Glen Canyon Group comments in mid-2002, it is my considered view as an environmental technology professional that the careless nature of IUC construction procedures, particularly choice of bedding and cover soil materials --- which were anything but "sand," as evidenced by photographs taken during construction and included in IUC and consultant/contractor reports in the DRC record --- doomed all of these liners to failure before they were even completed. Penetrations of relatively weak liner membranes by angular rocks was inevitable, and has probably resulted in progressive leakage through tears of varying size and orientation. It is encouraging to read that HDPE liner material technology are reaching IUC, and especially that DRC is imposing awareness of state-of-the-art liners on the White Mesa Mill facility. The sooner these cells are shut down and replaced with redundant, carefully designed, constructed, field-tested, and QA/QC documented liner systems, complemented by strategic head reduction and monitoring systems, the better. For this facility to have been in use, allowing such extremely aggressive and highly contaminated process fluids to circulate and reside in these porous cells, is unconscionable. Continued use of these anachronistic cells must stop as quickly as possible, parsing of "infeasible" notwithstanding. This, too, is cause for requesting a hearing.

As a point of inquiry, we wonder what and when will be the implications of recent State implementation of "SWAP," the Source Water Assessment and Protection" Plan, pursuant to Safe Drinking Water Act Amendments of 1996, and subsequent adaptation into Utah Code. As a member of the SWAP Advisory Committee in 1998-99, I became aware of the comprehensive nature of SWAP's simultaneous protection of wellheads, surface water and emerging ground water. It seems obvious to this observer that there are inevitable effects of past IUC ground water contamination, most of which could easily escape (and probably has done) the rather pathetic monitoring on the facility heretofore. For the sake of neighboring communities and isolated native populations, as well as for area wildlife, all that can be done to answer the question, "What can go wrong?" and to see to it that these faults are investigated, characterized and remediated scientifically, should be done without delay.

All told, congratulations are due to Executive Director Nielson, DRC and particularly to you, Mr. Morton, for the intent and effect of this permit. It is a very positive step, desperately needed for a long, long time. Now it's time to follow through, firmly and resolutely. We hope that you will indulge further comments as opportunity presents to review the complex, extensive and generally thorough Permit, SOB and supporting documents within upcoming days. As you know, we ordinary citizens struggle to make time and create information access. The DRC website's presentation of key documents here has been extremely helpful. Thank you sincerely for the great competence, responsible effort and clear sense of DRC mission that these documents represent.

Gratefully yours,

Ivan Weber, Principal/Owner
Weber Sustainability Consulting
953 1st Avenue
Salt Lake City, Utah 84103
(801)355-6863 / (801)651-8841 cellular
ivan@webersustain.com
www.webersustain.com (under construction)

CC: "Sarah Fields" <sarahmfields@earthlink.net>

Attachment 2

Revised K_d Spreadsheet
To Replace
December 1, 2004 DRC
Statement of Basis, Attachment 7

DRC Spreadsheet 11E2KdSum.xls, tabsheet Metals

All values expressed in unit

Summary of Kd Values for Metals

Comparison of Literature Kd Values

Thibault, et. al., 5/90, Tables 4 thru 7 [1]

	Sand Soil				Silt Soils				Clay Soils				Organic Soils			
Metal	Low	High	Geo-mean	N	Low	High	Geo-mean	N	Low	High	Geo-mean	N	Low	High	Geo-mean	N
Ag	2.7	1,000	90	12	28	333	120	4	100	300	180	5	4,400	33,000	15,000	4
Al																
Am	8	300,000	1,900	29	400	48,309	9,600	20	25	400,000	8,400	11	6,398	450,000	112,000	5
As			250													
As (III)																
As (V)																
B																
Ba																
Be																
Ca			5				30				50				90	
Cd	2.7	625	80	14	7	962	40	8	112	2,450	560	10	23	17,000	800	9
Ce	**40**	3,968	500	12	1,200	56,000	8,100	5	12,000	31,623	20,000	4			3,300	1
Cm	780	22,970	4,000	2	7,666	44,260	18,000	4			6,000				6,000	1
Co	**0.07**	9,000	60	33	100	9,700	1,300	23	20	14,000	550	15	120	4,500	1,000	6
Cr	**1.7**	1,729	70	15	2.2	1,000	30	4			1,500		6.0	2,517	270	4
Cr (II)																
Cr (III)																
Cr (VI)																
Cs	**0.2**	10,000	280	81	560	61,287	4,600	54	37	31,500	1,900	28	0.4	145,000	270	9
Cu																
Fe	5	6,000	220	16	290	2,240	800	18	15	2,121	165	7			600	1
Hg																
K			15				55				75				200	
Mg																
Mn	6.4	5,000	50	54	40	77,079	750	38	23.6	48,945	180				150	1
Mo	1	52	10	15			125		13	400	90	7	18	50	25	3
Na																
Ni	60	3,600	400	11			300		305	2,467	650	10	360	4,700	1,100	6
Np	0.5	390	5.0	16	1.3	79	25	11	0.4	2,575	55	4	857	1,900	1,200	3
Pb	19	1,405	270	3	3,500	59,000	16,000	3			550		9,000	31,590	22,000	6
Po	**9**	7,020	150	36	24	1,830	400	13			3,000				7,300	
Pu	27	36,000	550	39	100	5,933	200	21	316	190,000	5,100	18	60	62,000	1,900	7
Ra	57	21,000	500	3	1,262	530,000	36,000	3	696	56,000	9,100	8			2,400	
Ru	**5**	490	55	7			1,000				800		39,000	87,000	66,000	5
Sb			45				150				250				550	
Se			150				500				740				1,800	
Se (IV)																
Se (VI)																
Sr	0.05	190	15	81	**0.01**	300	20	43	3.6	32,000	110	24				
Tc	0.01	16	0.1	19	0.01	0.4	0.1	10	1.16	1.32	1	4	0.02	340	1	24
Ti																
Th	207	150,000	3,200	10			3,300		244	160,000	5,800	5	1,579	13,000,000	89,000	3
Tl																
U	0.03	2,200	35	24	0.2	4,500	15		46	395,100	1,600	7	33	7,350	410	6
V																
Zn	0.1	8,000	200	22	3.6	11,000	1,300	12	200	100,000	2,400	23	70	13,000	1,600	8
Zr			**600**				2,200				3,300				7,300	

	Baes & Sharp, 1983, Table 4 [2] *Agricultural soils and clays (pH 4.5-9.0)*				Battelle, 1989 [3] *No Soil Texture Descrimination*		EPA 4/91 STF Database [4] *No soil texture discrimination*				EPA 8/99 Kd Report [5] *No soil texture discrimination*			
Metal	Low	High	Geo-mean	N	Low	High	Low	High	Geo-mean	N	Low	High	Median	N
Ag	10	1,000	110	16	**0.4**	40	79.4	50,118.7		2				
Al														
Am	**1.0**	47,230	810	46										
As					5.9	19.4								
As (III)	**1.0**	8.3	3.3	19			15.8			1				
As (V)	**1.9**	18	6.7	37			79.4			1				
B														
Ba					**530**	16,000								
Be					**70**	8,000								
Ca	**1.2**	9.8	4.1	10										
Cd	1.26	26.8	6.7	28	14.9	567	0.74	478.6	27.0	17	**0.5**	4,360	121.8	174
Ce	58	6,000	1,100	16										
Cm	**93.3**	51,900	3,300	31										
Co	0.2	3,800	55	57										
Cr							3.31	229.1	31.9	11				
Cr (II)	**470**	150,000	2,200	15										
Cr (III)					**168**	3,600		50,118,723		1				
Cr (VI)	1.2	1,800	37	18	16.8	360		3,981		1	**0.25**	135,160		197
Cs	10	52,000	1,110	135							0.6	52,000	247	177
Cu	**1.4**	333	22	55										
Fe	**1.4**	1,000	55	30										
Hg					**322**	5,280								
K	**2.0**	9	5.5	10										
Mg	**1.6**	13.5	5.5	58										
Mn	**0.2**	10,000	150	45										
Mo	**0.37**	400	20	17										
Na														
Ni					12.2	650	**1.05**	63.1	6.13	11				
Np	**0.16**	929	11	44										
Pb	**4.5**	7,640	99	125			7.59	39,810.7	201.3	13	19	79,000		n/a
Po	196	1,063	540	6										
Pu	**11**	300,000	1,800	40							80	2,200		16
Ra														
Ru	48	1,000	220	17										
Sb					**2.0**	15.9	13.5	707.9	182.0	11				
Se					**5.9**	15								
Se (IV)	**1.2**	8.6	2.7	19			10			1				
Se (VI)							**0.01**	0.051	0.033	9				
Sr	0.15	3,300	27	218							1.6	10,200	15	63
Tc	**0.0029**	0.28	0.033	24										
Ti					**0.0**	0.8								
Th	2,000	510,000	60,000	17							**100**	500,000	5,000	17
Tl					**0.0**	0.8								
U	10.5	4,400	45	24							**0.3**	1,400	n/a	n/a
V					**50**	100								
Zn	**0.1**	8,000	16	146										
Zr														

Bold = minimum Kd value for each element

Key to Data Sources:

1) Thibault, D.H., M.I. Sheppard, P.A. Smith, March, 1990, "A Critical Compilation and Review of Default Soil Solid / Liquid Partition Coefficients, Kd, for Use in Environmental Assessments", Whiteshell Nuclear Research Establishment for Atomic Energy of Canada, AECL-10125, 112 pp.

2) Baes, C.F., III, and R.D. Sharp, 1983, "A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models", Journal of Environmental Quality, Vol. 12, No. 1, pp. 17-28.

3) Battelle Memorial Institute, 1989, "Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS): Version 1", prepared for the U.S. Department of Energy under Contract DE-AC06-76RKI 1830, by Pacific Northwest Laboratory, operated by Battelle Memorial Institute [as found in U.S. EPA, "Soil Screening Guidance: Technical Background Document", May, 1996, EPA/540/R95/128, Table 43].

4) U.S. Environmental Protection Agency, April, 1991, "Soil Transport and Fate Database, Version 2.0", written by R.C. Sims, J.L. Sims and S.G. Hansen, Department of Civil and Environmental Engineering, Utah State University, Project CR-813211 for the Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma.

5) U.S. Environmental Protection Agency, August, 1999, "Undertanding Variation in Partition Coefficient, Kd, Values, Vol. II, Review of Geochemistry and Available Kd Values for Cadmium, Cesium, Chromium, Lead, Plutonium, Radon, Strontium, Thorium, Tritium (3H), and Uranium", EPA 402-R-99-004B, approx. 332 pp.

Cell: E6
Comment: N = sample size

Cell: A22
Comment: Cr (II): Baes and Sharp, 1983 list the valence state as Cr +2. However, chromium speciation and mineral equilibrium suggests that only 2 valence states are possible, Cr (III) and Cr (VI), see W.J. Deutsch, 1997, "Groundwater Geochemistry Fundamentals and Applications to Contamination", Lewis Publishers, Boca Raton, FL, p. 168, Fig. 11-1. Consequently the Baes and Sharp listing may have been a typographical error, and perhaps should be corrected to read Cr (III).

Cell: AF24
Comment: EPA 8/99 Kd Report, Cr (VI) Data: 197 different test result available from for Cr (VI) from the following tables in this report:

Table	N
E.1	N=27
E.2	N=76
E.4	N= 61
E.5	N=33

State of Utah

Department of Environmental Quality

Dianne R. Nielson, Ph.D.
Executive Director

DIVISION OF RADIATION CONTROL
Dane L. Finerfrock
Director

JON M. HUNTSMAN, JR.
Governor

GARY HERBERT
Lieutenant Governor

March 8, 2005

Tom Rice
Ute Mountain Environmental Department
PO Box 448
Towaoc, CO 81334

SUBJECT: Response to Comments by the Ute Mountain Ute Tribe Concerning the Draft Ground Water Discharge Permit, UGW370004, International Uranium (USA) Corporation.

Dear Mr. Rice:

The Division of Radiation Control (DRC) received your comments concerning the Draft Ground Water Discharge Permit (Permit), UGW370004, for the International Uranium (USA) Corporation (hereafter IUC) facility in a letter dated January 19, 2004. Because your letter arrived after the public comment period for the Permit of January 7, 2005 DRC did not include a response to the comments in the letter in the Public Participation Summary. However, DRC feels that it is important to respond to the Ute Mountain Ute Tribe comments and will do so in this letter.

The comments are listed below in italics followed by a DRC response.

1 *<u>Comments</u>: Our first concern is that the Ground Water Discharge permit does not distinguish between alternate feed and natural ore. It defers the matter to be defined under Nuclear Regulatory Commission regulations as defined in Section11e. (2) of the U.S. Atomic Energy Act of 1954.*

My 1/19/05 conversation with you clarified that distinguishing between alternate feed material and natural ore was a licensing issue and not a groundwater discharge permit issue. However, there is a concern on the part of the Tribe that we lose an additional tool to protect water resources. The Tribe is concerned that any new alternate feed materials will fall under a blanket discharge permit. It will not necessarily ensure that this permit is sufficient to protect groundwater resources. The Ute Mountain Ute Tribe respectfully requests that all alternate feed requests include review and revision of the Ground Water Discharge permit to ensure protection of ground water.

<u>DRC Response</u>: We acknowledge your concern about new alternate feed materials entering the IUC facility. The DRC will continue to work closely with both the Tribe and IUC to carefully characterize and review all proposed alternate feed materials before allowing the material to enter the facility. The Permit can be reopened (see Part IV.N.3) if the Executive Secretary determines that modifications need to be made to protect human health and the environment.

2. *<u>Comments</u>: Sub-Parts E.5, E.6 and H.9 of Part 1 refer to the White Mesa Seep and Spring Monitoring Program. The Ute Mountain Ute Tribe requests that there be a public review of the spring and seep survey to ensure that it was completed in a satisfactory matter and includes all springs and seeps laterally and down gradient from the IUC facility. This will help ensure that ground water movement is accurate. We also request that control*

samples be taken from up gradient sources in the Burro Canyon/Brushy Basin formations in order to compare water quality information.

DRC Response: The DRC has and will continue to coordinate with the BLM, IUC, and the Ute Mountain Ute Tribe concerning monitoring of the seeps and springs that may be effected by the IUC facility. The need for control samples can be discussed in the process of review and approval of the Plan required by Part I.H.9 of the Permit. In addition, all reports submitted (including White Mesa Seep and Spring Monitoring Reports, Part I.F.6) as required by the Permit will be available for public review through the Government Records Access and Management Act (GRAMA) UAC 63-2. The requirements in the Permit Part 1.E will ensure accurate ground water movement and upgradient sources in the shallow aquifer will be monitored so that local groundwater resources will be protected.

3. *Comments: Sub-part h.19 of part 1 discusses the Tetrahydrofuran Demonstration Study Work Plan and Report. The existing plume of contamination gets to the heart of the Tribe's concerns. How can licensing and operations continue to move forward when there is an unresolved contamination issue? This matter continues to cause trepidation that the existing cells are failing and continue to leak materials into the local perched aquifer. It potentially threatens the Navajo aquifer, the sole source of water for the White Mesa community.*

   DRC Response: The tetrahydrofuran (THF) source has not substantiated, hence the reason for the investigation. The requirements in the Permit Part I.E and H.19 will ensure that it is carefully examined to determine the cause of contamination. If concentrations of THF are verified to have caused by operation of the IUC facility, and pose an adverse effect impact on human health or environment, the Executive Secretary will take action to ensure that THF will be controlled and remediated. This action could be then either re-opening the Permit to mandate new requirements as per Part IV.N.3, or by a separate enforcement action.

4. *Comments: If the 1998 Knight Piesold Report on Seepage Flux from Tailings Cell #3 submitted by IUC to DRC is accurate there are leakage problems that have not been remedied. We question that even if the discharge permit is solid, not resolving existing leakage problems tests the strength of the permit's non-compliance arm while ignoring the fact that the cells are leaking and contaminating local water resources. Therefore we request that either the discharge permit or the states licensing procedure require the 1980s era liners be replaced with new liners properly bedded in sand rather than in angular rocks that may have punctured the cell liners.*

   DRC Response: See DRC response in the attached document: Public Participation Summary For the IUC White Mesa Draft Groundwater Discharge Permit No. UGW370004, Comments from Ms. Sarah Fields, DRC response to Comment No. 2 (pp. 8 and 9).

5. *Comments: Furthermore, although NRC approved financial assurance methods to fund any ground water clean up as well as final facility closure is the bond sufficient? If this is not addressed in the discharge permit will it be addressed in the licensing process?*

   DRC Response: Financial surety is managed under the Radioactive Materials License. We agree that financial surety is important for ground water remediation. Because of the dynamics associated with ground water remediation surety is difficult to determine. The DRC will evaluate surety issues at the next License renewal scheduled on or around March, 2007.

6. *Comments: Because cell construction in the past has been questionable the Tribe requests clarification as to the construction of "water tight cells" located in the Feed Stock Storage Area (Sub-part D.2(d)). My visits to the facility have demonstrated that there appears to be little site control in the area where materials are stockpiled and await processing. Furthermore, water is used on the piles to control dust. Additional design information explaining cell construction must be required by the state.*

   DRC Response: See DRC response in the document: Public Participation Summary For the IUC White Mesa Draft Groundwater Discharge Permit No. UGW370004, Comments from Ms. Sarah Fields, DRC response to Comment No. 3 (p.9).

7. *Comments: As stated earlier in the letter, the Ute Mountain Ute Tribe notes the significance of the State of Utah assuming regulatory compliance over the IUC facility. The increased requirements of the Division of Radiation Control are positive. However, it also raises a red flag to the Tribe. Previous regulators had less control over the IUC operation and it appears that less control has resulted in environmental problems such as leaking cells and ground water contamination.*

   DRC Response: We want to assure the Ute Mountain Ute Tribe that the Ground Water Discharge Permit, that addresses ground water compliance limits, ground water compliance, monitoring, and reporting requirements, will be used by DRC to protect the local ground water resources. If historic contamination has occurred best available technology will be used during selection of a remediation option [see UAC R317-6-6.15(A) thru (G)].

8 *Comments: The Tribe is concerned that these problems will go unsolved at the same time the IUC facility is courting the DOE for consideration as one of the disposal alternatives for the Atlas Mill Moab Project. It would be irresponsible for the State of Utah to support the IUC alternative before all ground water issues and Ground Water Discharge Permitting is completed.*

   DRC Response: In a letter dated February 15, 2005, from Utah Governor Jon M. Huntsman, Jr. declared that the Moab Tailings Pile be removed and transported to Klondike Flats. Attached is a copy of the Governor's letter.

If you have any questions concerning DRC responses to your comments please contact Loren Morton or Dean Henderson at (801) 536-4250 with any questions.

Dane L. Finerfrock, Director
Utah Division of Radiation Control

DLF/DCH:dh

Attachments: March7, 2005 Public Participation Summary
February 15, 2005 Governor Huntsman Letter

cc: David C. Frydenlund, IUC, with attachments
Harold R. Roberts, IUC with attachments

F/../tomrice_resp.doc