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Director, Compliance and Permitting
Energy Fuels Resources (USA) Inc
225 Union Blvd , Suite 600
Lakewood, CO 80228

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April 25, 2013

CERTIFIED MAIL
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Jo Ann Tischler, Director, Compliance
Energy Fuels Resources (USA) Inc.
225 Union Boulevard, Suite 600
Lakewood, CO 80228

Subject: Energy Fuels Resources (USA) Inc. October 10, 2012 *Source Assessment Report White Mesa Uranium Mill* and associated pH assessment documents (dated November 9, 2012 *pH Report* and December 7, 2012 *Pyrite Investigation Report*):
DRC Findings

Dear Ms. Tischler:

The Utah Division of Radiation Control ("DRC") has completed review of the following Energy Fuels Resources (USA) Inc. ("EFR") documents:

1. The EFR, October 10, 2012, *Source Assessment Report White Mesa Uranium Mill*, prepared by Intera Geosciences & Engineering ("Intera"),
2. The EFR, November 9, 2012, *pH Report White Mesa Uranium Mill*, prepared by Intera,
3. The EFR, December 7, 2012, *Investigation of Pyrite in the Perched Zone White Mesa Uranium Mill Site*, prepared by Hydro Geo Chem., Inc. ("HGC").

The documents were submitted regarding ground water monitoring wells/parameters in out of compliance status (OOC) at the White Mesa Uranium Mill under Utah Ground Water Discharge Permit, Permit No. UGW370004 ("Permit") and to comply with Stipulation and Consent Agreement UGW12-03 (SCA). EFR has proposed modification to several Ground Water Compliance Limits ("GWCL's") based the study conclusions to address the OOC parameters/wells; and has proposed revised GWCL's for pH at all MW series wells. EFR additionally requested that and GWCL's be removed from the Permit at four monitoring wells.

A copy of the DRC Review Memo which details our findings during a review of the three reports listed above is attached. Based on the review findings, the following modifications will be made to the Permit during renewal.

DRC Conclusions:

Based on DRC review of the October 10, 2012 EFR Source Assessment Report and as documented in the State review memorandum, DRC concurs with the EFR justifications that OOC parameters are caused by background concentrations. The following modified GWCL's will be included in the upcoming Permit renewal.

Monitoring Well No.	Parameter	Current GWCL (mg/L)	Modified GWCL (mg/L)
MW-3	Fluoride	0.68	2
MW-3	Selenium	37	52.8
MW-3A	Selenium	89	109.58
MW-3A	Sulfate	3640	3949.27
MW-12	Selenium	25	39
MW-24	Cadmium	2.5	4.28
MW-24	Thallium	1	1.57
MW-25	Uranium	6.5	7.25
MW-26	Uranium	41.8	119
MW-27	TDS	1075	1185.72
MW-30	Selenium	34	47.2
MW-31	TDS	1320	1410.57

Based on DRC Review of the October 10, 2012 Source Assessment Report and as documented in the State review memorandum, it is recommended that GWCL's be **removed** from the permit for the following 3 monitoring wells:

Monitoring Well No.	Justification for Removal of GWCL's
MW-1	Located far upgradient from uranium mill facility and tailings disposal
MW-18	Located far upgradient from uranium mill facility and tailings disposal
MW-19	Located far upgradient from uranium mill facility and tailings disposal

*Note that current baseline monitoring frequencies for the monitoring wells, as listed in Table 2 of the Permit, will not change.

Based on DRC Review of the October 10, 2012 Source Assessment Report and as documented in the State review memorandum, it is agreed that DRC and EFR should meet to discuss alternate study and/or statistical measures to calculate GWCL's for Uranium at monitoring well MW-5, Manganese at monitoring well MW-11 and TDS at monitoring well MW-31 to account for EFR anticipated future increased concentrations above the proposed modified GWCL's. DRC notes that the current proposed EFR GWCL modification for monitoring well MW-5 is the same as the current GWCL included in the Permit, therefore, this GWCL will not be modified. DRC recommends that the following proposed GWCL's be modified in the permit in the interim, until an alternate method to calculating the GWCL can be agreed upon.

Monitoring Well No.	Parameter	Current GWCL (mg/L)	Modified GWCL (mg/L)
MW-11	Manganese	131.29	164.67
MW-31	Sulfate	532	552

Based on DRC review of the November 9, 2012 EFR pH Report and as documented in the State review memorandum, DRC concurs with the justification that OOC pH measurements are caused by background concentrations. The following modified GWCL's will be included in the upcoming Permit renewal.

Monitoring Well No.	Parameter	Current GWCL (S.U.)	Modified GWCL (S.U.)
MW-2	pH	6.5-8.5	6.72-8.5
MW-3	pH	6.5-.5	6.04-8.5
MW-3A	pH	6.5-8.5	5.84-8.5
MW-5	pH	6.5-8.5	7.04-8.5
MW-11	pH	6.5-8.5	6.25-8.5
MW-17	pH	6.4-8.5	6.27-8.5
MW-23	pH	6.5-8.5	5.97-8.5
MW-24	pH	6.5-8.5	5.55-8.5
MW-25	pH	6.5-8.5	5.77-8.5
MW-27	pH	6.5-8.5	6.47-8.5
MW-28	pH	6.1-8.5	5.58-8.5
MW-29	pH	6.46-8.5	5.94-8.5
MW-30	pH	6.5-8.5	6.47-8.5
MW-31	pH	6.5-8.5	6.57-8.5
MW-32	pH	6.4-8.5	5.31-8.5

*Note that several of the EFR modified GWCL requests are not related to wells in OOC status. As discussed above EFR notes in the November 9, 2012 pH report that "all current GWCL's for pH at the site were incorrectly set, based on laboratory pH."

Per DRC review, the proposed modified GWCL's for pH at the following three wells were not calculated in conformance with the Director approved statistical flowchart. The corrected GWCL's which follow the flowchart are shown below. The corrected GWCL's will be included in the upcoming groundwater permit renewal:

Monitoring Well No.	Parameter	Current GWCL (S.U.)	Modified GWCL (S.U.)	Corrected GWCL (S.U.)
MW-12	pH	6.5 - 8.5	5.86 - 8.5	6.21 - 8.5
MW-14	pH	6.5 - 8.5	5.42 - 8.5	5.93 - 8.5
MW-15	pH	6.62 - 8.5	5.88 - 8.5	6.34 - 8.5
MW-26	pH	6.74 - 8.5	5.61 - 8.5	5.92 - 8.5

If you have any questions regarding this letter or the attached memo, please contact Tom Rushing at (801) 536-0080.

Sincerely,



Rusty Lundberg
Director

RL:TR:tr

Enclosure: DRC April 22, 2013 Review Memo

cc: John Hultquist, Manager, DRC Licensing Section (Without Enclosure)
Charles Bishop, DRC Licensing Section (With Enclosure)



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DIVISION OF RADIATION CONTROL
Rusty Lundberg
Director

MEMORANDUM

TO: File

THROUGH: Phil Goble, Compliance Section Manager PRG 4/23/2013

FROM: Tom Rushing P.G. JR 4/23/2013

DATE: April 23, 2013

SUBJECT: DRC Staff Review of Energy Fuels Resources (USA) Inc. October 10, 2012 *Source Assessment Report White Mesa Uranium Mill* and associated pH assessment documents (dated November 9, 2012 *pH Report* and December 7, 2012 *Pyrite Investigation Report*).

Summary

This memo is to provide Utah Division of Radiation Control ("DRC") staff findings and recommended actions regarding review of three documents submitted by Energy Fuels Resources (USA) Inc. ("EFR"). The documents are regarding ground water monitoring parameters in out of compliance status at the White Mesa Uranium Mill under Utah Ground Water Discharge Permit, Permit No. UGW370004 (Permit), and include:

1. The EFR, October 10, 2012, *Source Assessment Report White Mesa Uranium Mill*, prepared by Intera Geosciences & Engineering ("Intera"),
2. The EFR, November 9, 2012, *pH Report White Mesa Uranium Mill*, prepared by Intera, and,
3. The EFR, December 7, 2012, *Investigation of Pyrite in the Perched Zone White Mesa Uranium Mill Site*, prepared by Hydro Geo Chem, Inc. ("HGC").

Background

The documented studies, findings and actions in the three reviewed documents are under purview of conditions and timelines outlined in the *Utah Department of Environmental Quality Stipulated Consent Agreement Docket No. UGW12-03* ("SCA UGW12-03"). UGW12-03 additionally provides for associated stipulated penalties for non-conformance with the study objectives and timelines outlined therein.

The three listed reports provide justification for the findings and proposals related to out-of-compliance (“OOC”) parameters at certain monitoring wells and for certain parameters at the White Mesa Uranium Mill (“Mill”) which were originally identified and enforced through DRC Notice of Violation and Order Docket No UGW11-02.

Findings and proposals regarding EFR proposed modified GWCLs or removal of GWCLs at certain monitoring wells, pursuant to the three documents, are justified by study evidence showing that the OOC wells are due to groundwater background influences in the shallow Burro Canyon Formation Aquifer and not due to discharges from the Mill. The three listed reports are related and are required in order to provide adequate support that the OOC status is due to background.

The boxes below summarize the objective of the three listed reports as follows:

October 10, 2012 EFR Source Assessment Report – Provides explanation and source assessment study of OOC exceedances except for pH. Provides statistical analysis of data and includes graphs and tables of analysis. Proposes modified Groundwater Compliance Limits for OOC Parameters, except pH.

November 9, 2012 pH Report – Provides source assessment study for monitoring wells in OOC for pH. Proposes modified pH Groundwater Compliance Limits for pH for all MW series monitoring wells based on field measurements.

December 7, 2012 EFR Pyrite Investigation Report – Provides findings of a study to support the regional geochemical process explaining decreasing pH trends at monitoring wells. Study analyzes quantities of iron pyrite (from monitoring well cores and cuttings) and models dissolution in the Burro Canyon Formation.

Discussion of a Previous University of Utah Study to Determine if the Mill Tailings Cells were Leaking

During July 17, 2007 through July 26, 2007, the University of Utah conducted field work for a study to evaluate whether increasing trace metal (e.g. uranium) concentration in ground water at several of the White Mesa Uranium Mill were being caused by leakage from the on-site tailings cells. The results of the study were published in the May 18, 2008 “*Evaluation of Solute Sources at Uranium Processing Site*” (U of U Study) and were used to justify modifications to the facility groundwater water permit in January 2010 which included approval of Energy Fuels Resources Background Ground Water Quality Reports dated October 2007 and April 30, 2008 and subsequent approval of revised Ground Water Compliance Limits.

The Study findings were related to: 1. Local groundwater flow, 2. The chemical composition of the groundwater, 3. Isotopic composition of the groundwater, 4. Evaluation of noble gas composition of the groundwater, and 5. Age of the groundwater at the Mill monitoring wells (Study wells).

The Study concluded that excess total uranium concentrations in downgradient monitoring wells MW-3, MW-14, MW-15 and MW-17 are likely the product of changing geochemical conditions induced by artificial recharge from the wildlife ponds and not due to tailings cell leakage.

These conclusions were largely based on isotopic analysis results of groundwater samples collected by the University of Utah. Specifically, the study evaluated ratios of Tritium, Deuterium, Oxygen-18 and Sulfur-34 in ground water.

Part 3.3 of the EFR October 10, 2012 Source Assessment Report additionally summarizes the Study and cites the Study in support of the determination that current OOC wells/parameters are due to background influences and are not due to tailings cell leakage.

Discussion of Tailings Solution Groundwater Indicator Parameters

The November 9, 2012 pH Report Section 2.5 discusses indicator parameters which would be detected in ground water in the event of discharge from the Mill tailings impoundments. Section 2.5 discusses that such discharge would be indicated by rising concentrations of chloride, sulfate, fluoride and uranium as these potential contaminants are abundant in the tailings wastewater and are relatively mobile and conservative in groundwater systems.

Per the November 9, 2012 pH report, the indicator parameters are ordered as the best indicators as follows; chloride, then fluoride, then sulfate, then uranium. It is noted that, in terms of metals and radionuclides, uranium is the most mobile and best indicator parameter.

1. Chloride -- Chloride is listed as the best indicator of tailings solution release since the retardation Factor (Rf) equals 1 (transported in saturated zone at the same velocity as the groundwater). High concentrations of chloride are present in the tailings solution with an average concentration of approximately 20,752 mg/L using 2012 data from Cell 1, Cell 2 Slimes Drain, Cell 3 and Cells 4A and 4B. Per the pH Report, this concentration is "*sufficient to guarantee*" that chloride would be measurable in groundwater before any substantial volume had entered the system.
2. Fluoride – Fluoride shares similar chemical properties and transport velocity as chloride. However it is noted that fluoride is in the tailings impoundment solution at a lower concentration than chloride, approximately 486 mg/L based on 2012 concentrations measured in Cell 1, Cell 2 Slimes Drain, Cell 3 and Cells 4A and 4B. Additionally, apatite acts as a solubility control and can reduce fluoride concentrations along a ground water flow path (higher Rf). The pH Report notes that fluoride is secondary to chloride as an indicator of discharge of tailings solution.
3. Sulfate – Sulfate is present in ambient groundwater at proportionally higher concentrations than chloride. Calcium sulfate minerals are more soluble than chloride minerals which

limit the amount of sulfate that can remain dissolved and subsequently retards sulfate concentrations along a flow path. The tailings cells contain an average concentration of approximately 96,040 mg/L calculated from 2012 samples of Cell 1, Cell 2, Slimes Drain, Cell 3 and Cells 4A and 4B. Given these high concentrations in the tailings solution, sulfate is still a good indicator parameter of discharge.

4. Uranium – Uranium is the most mobile of trace (metal) elements. Uranium is more mobile in ground water with low pH values and typically the retardation coefficient is significantly higher at pH values above the 3 to 4.5 range.

DRC Review - October 10, 2012 EFR Source Assessment Report

Summary:

The October 10, 2012 Source Assessment Report evaluates wells/parameters currently in OOC status which were cited in a DRC Notice of Violation Docket Number UGW11-02 (“NOV”), dated May 9, 2011 for failure on the part of EFR to conduct a source assessment study per provisions of the Permit. Subsequently, the SCA UGW12-03 was issued to agree upon, and approve, details required to be included in the study.

EFR, therefore, provided the October 10, 2012 Source Assessment Study to address the agreed upon studies for the wells/parameters in OOC, which were cited in the NOV as follows:

Parameter	Monitoring Well Number
Cadmium	MW-24
Manganese	MW-11
Selenium	MW-12 MW-30 MW-3 MW-3A
Thallium	MW-18 MW-24
Uranium	MW-26 MW-5 MW-25
TDS	MW-18 MW-27 MW-31
Sulfate	MW-31 MW-3A
Fluoride	MW-3

Per DRC review of the October 10, 2012 Source Assessment Report it appears that the agreed upon studies outlined in SCA UGW12-03 were included. The Report evaluates the well parameters based on their status as either: 1. Parameters in wells with previously identified rising trends, 2. Parameters in pumping wells, 3. Parameters impacted by site-wide pH trends, 4.

Parameters in newly installed wells with interim GWCL's, and 5. Other parameters. The Report additionally evaluates whether background influences are the cause of the exceedances and recommends revised GWCL's based on the Director approved flowsheet associated with the Background Groundwater Monitoring Report (Intera 2007).

DRC noted that per Part 3.2 of the October 10, 2012 Source Report, EFR states that the Director approved statistical flowsheet does not allow the revised GWCL's to be set high enough for anticipated "near future" trends which EFR anticipates will cause the well/parameter to enter a renewed out-of-compliance status for: 1. Uranium in well MW-5, 2. Manganese in Well MW-11, and, 3. TDS in Well MW-31. EFR therefore proposes that DRC and EFR "enter into discussions to determine if there are approaches that will allow the GWCL's to be set in a manner that better reflects changing background conditions" at those wells/parameters.

As discussed below, EFR additionally proposes to remove GWCL's at four monitoring wells, well numbers MW-1, MW-18, MW-19, and MW-26, based on their location or use as a pumping well for chloroform plume remediation. DRC notes that EFR did calculate potential proposed modifications for the TDS and Thallium GWCLs at well MW-18 and for Uranium at well MW-26 (current wells parameters in OOC) in the event that removing the GWCLs at those wells is not approved by the Director.

EFR Request to Remove GWCL's at Monitoring Wells MW-1, MW-18, MW-19, and MW-26:

Per Part 3.2 of the October 10, 2012 Report EFR proposes that the GWCL's in upgradient monitoring wells MW-1, MW-18 and MW-19 be eliminated, as well as the GWCL's in pumping well MW-26. EFR proposes the removal of GWCL's from upgradient wells MW-1, MW-18 and MW-19 since they are far upgradient from the Mill and cannot be impacted by Mill activities, and from pumping well MW-26 on the basis that the well is being manipulated, and the impact on ground water quality "cannot be predicted with enough certainty to establish a compliance standard" in the Permit. Additionally, per Part 3.2 of the October 10, 2012 Report EFR "proposes to continue monitoring those wells at their normal, unaccelerated frequency for informational purposes only, and to help define background conditions at the site."

EFR did calculate revised GWCL's for monitoring wells MW-26 and MW-18 for the OOC parameters, based on the SCA requirements, and included those revisions with the October 10, 2012 Source Assessment Report. Additionally, EFR calculated revised GWCL's for pH as included in the November 9, 2012 pH Report for the four wells requested to have the GWCLs removed.

DRC agrees with the justifications provided by EFR, that far-upgradient wells are not likely to be impacted by current Mill activities based on review of kriged water level maps included with the Mill Quarterly Ground Water Reports. Specifically, per DRC review of the water level elevations, the elevations at monitoring wells MW-1, MW-18 and MW-19 are higher than water elevations in the Burro Canyon Aquifer beneath all of the Mill tailings cells. Additionally, those monitoring wells are located north and northeast of the tailings cells, local groundwater flow is to the south-southwest. If future groundwater gradients change such that there is reasonable evidence to

suggest that any of the upgradient wells MW-1, MW-18 or MW-19 may be impacted by tailings cell discharge or other Mill related activities, then the Director will re-institute GWCL's in the Permit at any or all of the monitoring wells. Continued semi-annual (baseline) monitoring for all contaminants listed in Table 2 of the current Permit (Current - DRC 8/24/2012) will be required to continue for continued assessment of background groundwater quality at monitoring wells MW-1, MW-18 and MW-19.

Specifically, DRC justifications to allow removal of GWCL's at wells MW-1, MW-18 and MW-19 are as follows:

1. Per DRC review of water elevation maps and expected groundwater flow directions, wells MW-1, MW-18, and MW-19 are hydraulically upgradient from the Mill,
2. Groundwater monitoring for all currently monitored parameters listed on Table 2 of the permit will continue at baseline monitoring frequencies and will be submitted with the Mill Quarterly Ground Water Monitoring Reports,
3. Continuation of GWCL's at upgradient monitoring wells may result in unnecessary enforcement action and source assessment.

DRC also agrees that the MW-26 pumping well monitoring data is not predictable and does not allow establishment of dependable GWCLs, however, DRC notes that actions related to the chloroform plume pumping remediation project have not been formalized and that the removal of GWCL's prior to emplacement of performance guidelines, penalties, and regulatory conditions for pumping well MW-26 is premature. Therefore, removal of GWCL's at monitoring well MW-26 is not approved. EFR may re-apply for removal of GWCL's at well MW-26 after approval and execution of a corrective action plan ("CAP") for the chloroform contaminant plume.

Specifically, DRC denial of the request to remove GWCL's at pumping well MW-26 is as follows:

1. Well MW-26 has not been formalized as a pumping well under the chloroform ground water remediation project and specific pump performance requirements, including continued maintenance of a capture zone on the eastern margins of tailings cells 2 and 3, are not under regulatory enforcement requirements,
2. Well MW-26 is the current compliance monitoring detection point, and regulatory tool to require source assessment, for potential tailing solution release on the eastern margins of tailings cells 2 and 3.
3. EFR may submit a separate proposal to remove Permit GWCL's at pumping well MW-26 after execution of a Stipulated Consent Agreement for the chloroform plume remediation program.

OOO Wells/Parameters with Previously Identified Rising Trends:

EFR evaluation of previous rising trends applies to the following wells/parameters:

Manganese in well MW-11

Selenium in wells MW-12 and MW-3

Thallium in well MW-18

Uranium in well MW-26

The current data for these wells/parameters were compared with historic data used for analysis of the background reports to determine if significant statistical changes were occurring. Based on the EFR analysis as well as geochemical evaluation and supported by the findings of the University of Utah Study, EFR concludes that these exceedances are in conformance with identified historical trends and proposes revised GWCL's for the wells/parameters.

OOO Wells/Parameters Pumping Wells:

EFR evaluation of pumping wells applies to uranium in well MW-26. The October 10, 2012 Source Assessment Report additionally notes that results of the Mann-Kendall trend test concluded that the uranium data and pH data is not showing a statistically significant increasing trend (only the chloride indicator parameter shows a significant trend at the well). EFR additionally notes that pH at the well is not showing an increasing trend. EFR additionally notes that the variability of concentrations for all parameters at well MW-26 was noted by DRC in the September 2009 Statement of Basis for the Groundwater Permit.

OOO Wells/Parameters pH Impacts:

EFR evaluation of constituents potentially impacted by site-wide decreasing pH trends applies to the wells/parameters listed below. Also note that the pH trends and potential geochemical processes are outlined in the EFR November 9, 2012 pH Report.

Cadmium in well MW-24

Manganese in well MW-11

Selenium in Wells MW-3, MW-3A, MW-12 and MW-30

Thallium in wells MW-18 and MW-24

Uranium in wells MW-5, MW-25 and MW-26

Per the EFR conclusions for these OOO wells/parameters, including evaluation of the indicator parameters (discussed above) and discussion of expected concentrations (dissolution and mobility) of the OOO parameters due to decreases in pH, EFR concludes that the exceedances for the wells/parameters listed above are due to the site-wide pH decreases and is therefore attributed to natural background concentrations in the aquifer.

EFR proposes revised GWCL's for these wells/parameters as discussed below. As discussed above, EFR projects that the proposed revised GWCL's for uranium in well MW-5 and Manganese in well MW-11 will be exceeded in the near future (due to ongoing projected decreases in pH due to potential pyrite dissolution in the aquifer). EFR recommends additional discussion between DRC and EFR to determine if alternate methods of GWCL calculation may be utilized for these wells. DRC staff will recommend that the EFR proposed modified GWCLs for

wells MW-5 and MW-11 be included in the Permit renewal in the interim, until an alternate method to set GWCLs can be agreed upon.

OOC Wells/Parameters New Wells – Interim GWCL’s:

EFR evaluation of constituents in newly installed wells with interim GWCL’s applies to Manganese, Selenium, Thallium, Uranium and Gross Alpha in well MW-35

EFR notes that a background report is currently being prepared for the setting of GWCL’s at this well (being prepared concurrently with the Source Assessment Report). Therefore, proposed GWCL’s are not included in the October 10, 2012 Source Assessment Report for well GW-35 but will be based on the comprehensive background determination for the well for all constituents in Table 2 of the Permit.

OOC Wells/Parameters Other Constituents and Wells:

EFR evaluation of other constituents and wells applies to the wells/parameters listed below:

- TDS in wells MW-18, MW-27 and MW-31
- Sulfate in wells MW-31 and MW-3A
- Fluoride in well MW-3

Per EFR source assessment study of these wells/parameters the following conclusions were made

Well	Parameter	Summary of Findings
MW-3	Fluoride	Far downgradient, no significant increasing trend in chloride, consistent with background conditions
MW-3A	Sulfate	No consistent increasing trend in sulfate or any other indicator parameters, far downgradient, consistent with background conditions
MW-18	TDS	Far upgradient, consistent with background conditions
MW-27	TDS	Located at the margin of the nitrate/chloride plume, mass balance determine unfeasible tailings leakage, University of Utah Study supports natural background
MW-31	TDS	Located at the margin of the nitrate/chloride plume, mass balance determine unfeasible tailings leakage, University of Utah Study supports natural background
MW-31	Sulfate	Located at the margin of the nitrate/chloride plume, mass balance determine unfeasible tailings leakage, University of Utah Study supports natural background

EFR Study concerning the source of the OOC at these wells included geochemical analysis of indicator parameters, mass balance determination done with the nitrate contamination investigation (dated December 30, 2009) which calculated an approximate volume of tailings solution discharge needed to produce the observed groundwater concentrations, potential time

needed to transport contamination to the monitoring wells, and conclusions of the University of Utah Study (isotopic evidence) that tailings cell leakage has not been detected at studied site monitoring wells. Additionally, EFR concludes that increases in TDS at monitoring wells MW-27 and MW-31 are related to the nitrate/chloride plume.

Therefore, based on the EFR conclusions the OOC wells/parameters for "other constituents" are attributable to geochemical processes in the aquifer or in the case of TDS at wells MW-27 and MW-31, are related to the nitrate/chloride plume which is being addressed under a separate action.

Statistical Methods:

Appendix B-1 of the October 10, 2012 Source Assessment Report includes a spreadsheet which summarizes the statistical analysis for each well/parameter evaluated. Included are summaries for:

Data population
% Non-detected values
Mean Calculation
Standard Deviation Calculation
Shapiro-Wilk Test for Normality
Least Squares Regression Analysis – Where appropriate
Mann-Kendal Trend Analysis – Where appropriate
Summaries where trends were identified – Based on recent data

Data which had an insensitive detection limit, was a zero value or was determined to be an extreme outlier was culled from the data set. Additionally, no duplicate values (e.g. blind duplicates) were included in the evaluated data sets. Appendix B-5 summarizes the data culled. Data distribution for wells/parameters with consecutive exceedances is represented by box plots (Appendix B-6) to justify outliers (extreme values) in the data sets and support subsequent evaluation to determine whether there is a normal distribution of data. The plots and culled data are in conformance with Director approved statistical process flowchart.

In all cases of data evaluation the data population consisted of at least 8 data points (after culling outliers) in conformance with the approved flowchart. The generation of the data populations appears appropriate for the evaluated wells/parameters based on DRC review.

The Appendix B-1 flow chart additionally includes a summary of % non-detected values in the culled data population used for statistical evaluation. Based on the approved flow chart the remaining evaluation is based on the number of non-detects in the data population. None of the data sets used during the statistical evaluation for each well/parameter exceeded 50%, therefore EFR was required to test for normality for all data populations using the Shapiro-Wilk Test (log-normal or normal).

Per DRC review it was verified that the Shapiro-Wilk Test was performed for each well/parameter and that in cases where the data was not determined to be log-normal or normally distributed, a

Mann-Kendall Trend Analysis was performed. In cases where the data was determined to be normally distributed, least squares trend analysis was performed.

The table below summarizes each well/parameter including the EFR proposed GWCL revision and the DRC review regarding whether the calculated proposed revision is in compliance with the Director approved flowchart method. Note that a modified approach to setting the GWCL (other than calculation of Mean + 2σ can be used in any well where a significant upward trend is identified with DRC Director approval.

Table of EFR Proposed Revised GWCL's:

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
MW-3	Fluoride	Far Down-gradient	0.68	2	Not identified in Background Report but no increase in chloride Travel time from cell 4B over 2,000 years No chloride trend U of U 0-18 no evaporated stable isotope Previously Identified Trends Decreasing pH Trend	Fraction GWCL	Yes 1% Non-Detects, Calculate Mean + 2σ, however, significant increasing trend detected
MW-3	Selenium	Far Down-gradient	37	52.8 Above State Std.	U of U Study trace metals and depleted Oxygen-18 Decreasing pH Trend	HHV	Yes

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 EFR Source Assessment Reports
 DRC Review Memo

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
MW-3A	Selenium	Far Down-gradient	89	109.58	No Indicator Parameters Show Increasing Trend Decreasing pH Trend	Mean + 2 σ	Yes
MW-3A	Sulfate	Far Down-gradient	3640	3949.27	Chloride, Fluoride and Uranium do not show significant increasing trend 2,000 ft downgradient from tailings cells	Mean + 2 σ	Yes
MW-5	Uranium	Down-gradient Cell 3 South Embankment	7.5	7.5 Same as current EFR proposes further study for uranium to determine variability	Chloride and Sulfate not significantly increasing After outliers removed uranium data showed a decreasing trend U of U trace metals concentrations Decreasing pH Trend	Fraction GWCL	Proposed GWCL is the same as the current GWCL in the Groundwater Permit.
MW-11	Manganese	Down-gradient Cell 3 South	131.29	164.67 EFR proposes further	Background Report Same Behavior No Chloride,	Mean + 2 σ	Yes

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
		Embankment		study for manganese to determine variability	Fluoride or Uranium Trend U of U old water terrigenous helium Previously Identified Trends Decreasing pH Trend		
MW-12	Selenium	Down-gradient Cell 3 South Embankment	25	39	Background Report Same Behavior also Uranium and Sulfate Increasing no other indicators increasing Previously Identified Trends Decreasing pH Trend	HHV	Yes, 36% Non-Detects, Calculate Mean + 2 σ , However, significant increasing trend detected
MW-18	TDS	Up-gradient	3198.77	3280, EFR Request to Remove	Upgradient from Mill Site Upward trends for sulfate and uranium identified during background report U of U study	HHV	Yes, 0% Non-Detects, Calculate Mean + 2 σ , However, significant increasing trend detected

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
					for trace metals concentrations Nitrate and Chloride Plume		
MW-18	Thallium	Up-gradient	1.95	4.00, Above State Std. EFR Request to Remove	Located far upgradient of Mill Activities U of U study trace metal concentrations similar to historically-observed concentrations Possibly impacted by rising water levels due to Wildlife Ponds Previously Identified Trends Decreasing pH Trend	HHV	Yes, 0% Non-Detects, Calculate Mean + 2σ, However, significant increasing trend detected ?HHV 3.91
MW-24	Cadmium	Down-gradient Cell 1	2.5	4.28	Early non-detects due to RL of 0.5 μL No increasing trends for chloride,	HHV	Yes, 44% Non-Detects, Calculate Mean + 2σ, However significant increasing trend detected

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
					sulfate, fluoride or uranium Downward pH Trend Decreasing pH Trend		
MW-24	Thallium	Down-gradient Cell 1	1	1.57	Early non-detect values at high RL Indicator Parameters Chloride, Fluoride, Sulfate, Uranium do not show significant increasing trends. Decreasing pH Trend	HHV	Yes
MW-25	Uranium	Lateral Cell 3 East	6.5	7.25	Chloride, Fluoride and Sulfate do not exhibit statistically significant increasing trends Decreasing pH Trend	Mean + 2 σ	Yes
MW-26	Uranium	Lateral Cell 2 East Pumping Well	41.8	119, EFR Request to Remove	Chloroform Plume Pumping Well Previously Identified	HHV	Yes, 0% Non-Detects, Calculate Mean + 2 σ , however,

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Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
					Trends		significant increasing trend detected
MW-27	TDS	Upgradient Cell 1 North Embankment	1,075	1185.72	New identified trend Chloride and Sulfate Show Increasing Trends Fluoride and Uranium Downward Trends Mass balance for Nitrate Contamination Study Eliminated Tailings Cell U of U Study Nitrate and Chloride Plume	Mean + 2 σ	Yes
MW-30	Selenium	Down-gradient Cell 2	34	47.2	Located at Margin of nitrate/chloride plume – increasing chloride concentrations U of U Study trace metal concentrations and depleted Oxygen-18	HHV	Yes, 0% Non-Detects, Calculate Mean + 2 σ , however, significant increasing trend detected

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
					Decreasing pH Trend		
MW-31	Sulfate	Down-gradient Cell 2	532	552 EFR proposes further study for uranium to determine variability	Located on the downgradient margin of the nitrate and chloride plume TDS and Chloride also showing significant increasing trends Fluoride showing significant decreasing trend Uranium trending downward Sulfate in MW-31 are among the lowest at the site Highest result is 7 percent higher than the average well concentration (517 mg/L)	HHV	Yes, 0% Non-Detects, Calculate Mean + 2 σ , however, significant increasing trend detected ?HHV 41.9
MW-31	TDS	Down-gradient	1,320	1410.57	New identified	Mean + 2 σ	Yes

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
		Cell 2			trend Chloride and Sulfate Show Increasing Trends Fluoride and Uranium Downward Trends Mass balance for Nitrate Contaminati on Study Eliminated Tailings Cell U of U Study Nitrate and Chloride Plume		

October 10, 2012 EFR Source Assessment Report DRC Conclusions:

Based on DRC review of the October 10, 2012 EFR Source Assessment Report, DRC concurs with justification for determination that OOC parameters are caused by natural background fluctuation and proposed GWCL modification request, it is recommended that the following modified GWCL's be included in the upcoming groundwater permit renewal.

Monitoring Well No.	Parameter	Current GWCL (mg/L)	Modified GWCL (mg/L)
MW-3	Fluoride	0.68	2
MW-3	Selenium	37	52.8
MW-3A	Selenium	89	109.58
MW-3A	Sulfate	3640	3949.27
MW-12	Selenium	25	39
MW-24	Cadmium	2.5	4.28
MW-24	Thallium	1	1.57
MW-25	Uranium	6.5	7.25

MW-26	Uranium	41.8	119
MW-27	TDS	1075	1185.72
MW-30	Selenium	34	47.2
MW-31	TDS	1320	1410.57

Based on DRC Review of the October 10, 2012 Source Assessment Report it is recommended that GWCL's be removed from the permit for the following 3 monitoring wells.

Monitoring Well No.	Justification for Removal of GWCL's
MW-1	Located upgradient from uranium mill facility and tailings disposal
MW-18	Located upgradient from uranium mill facility and tailings disposal
MW-19	Located upgradient from uranium mill facility and tailings disposal

Based on DRC Review of the October 10, 2012 Source Assessment Report it is recommended that DRC and EFR meet to discuss alternate study and/or statistical measures to calculate GWCL's for Uranium at monitoring well MW-5, Manganese at monitoring well MW-11 and TDS at monitoring well MW-31 to account for EFR anticipated future increased concentrations above the proposed GWCL's. DRC notes that the current proposed GWCL for monitoring well MW-5 is the same as the current GWCL included in the groundwater permit. DRC recommends that the following proposed GWCL's be modified in the permit in the interim, until an alternate method to calculating the GWCL can be agreed upon.

Monitoring Well No.	Parameter	Current GWCL (mg/L)	Modified GWCL (mg/L)
MW-11	Manganese	131.29	164.67
MW-31	Sulfate	532	552

November 9, 2012 pH Report

Summary:

Study assesses the source of decreasing pH to determine whether it is from natural background or tailings solution discharge.

Achieves studies through:

1. Geochemical analysis of indicator parameters (chloride, sulfate, fluoride and uranium)
2. Review of the potential for tailings cell discharge including mass balance calculation
3. Whether or not trends in other parameters (including other OOC parameters) is due to decreases in pH at MW series monitoring wells

The study aimed to provide a site-wide analysis of pH trends and includes an analysis of trends at all monitoring wells onsite, including chloroform (TW-4) and nitrate (TWN) ground water sampling. The Report includes statistical evaluation and histograms of pH at those wells. Of the

twenty-five chloroform monitoring wells, all but two indicated a downward pH trend. Of the nineteen nitrate monitoring wells, twelve showed a general upward pH trend, four showed a general downward trend and three showed a flat trend.

DRC notes that the nitrate monitoring wells are primarily located upgradient of the uranium mill site. Additionally, the nitrate monitoring wells were installed in 2009 and there are fewer pH measurements at these wells than at other monitoring wells at the site. EFR additionally notes that the data at these wells is not showing a significant trend in either direction and that the wells may have been installed after trending occurred.

The study was conducted in largely the same manner as the October 10, 2012 Source assessment report, using geochemical and supporting evidence to show that the pH decreases are due to natural occurrences and not to tailings cell leakage. In cases where applicable, the November 9, 2012 report uses indicator parameters to show that pH declines are not due to cell leakage. Per the discussion of indicator parameters above, chloride is considered the best indicator (most conservative) to determine tailings cell leakage. Per the November 9, 2012 Report, if the pH decreases were due to tailing cell leakage then, given the chloride concentrations in the tailing cell solution and the non-reactive ($R_f = 1$) nature of chloride, an increasing trend in chloride would precede a declining pH trend. DRC concurs with this factor in determination of the potential tailings cell source. Where chloride concentration trends existed in monitoring wells at the site, Intera utilized geochemical information for other indicator parameters (e.g. sulfate). It is also noted that decreasing pH trends are observed in monitoring well hydraulically upgradient and far downgradient from the mill facility (appears to be site-wide process).

Additionally, the November 9, 2012 pH Report cites the University of Utah isotopic study, that previously identified trends in the background report, and site hydrogeological reports to justify that the pH declines are due to natural background. Based on review of the pH study, DRC staff concur that the decreasing pH trends appear to be due to variations of natural background, potentially/possibly caused by the dissolution of pyrite in the formation as discussed in DRC review comments related to the December 7, 2012 EFR Pyrite Investigation Report in the section below. EFR maintains that areas of the Burro Canyon Aquifer are being oxygenated due to infiltration from the wildlife ponds and/or pumping of the monitoring wells.

Statistical and Geochemical Evaluation:

The Report includes a summary of proposed revised GWCL's for all MW monitoring well (not limited to pH in wells with current OOC status) since the current pH background limits were based on laboratory and not field pH values.

Statistical evaluation is conducted according to the Director approved flowchart (Intera 2007) and includes the following analysis techniques:

1. Box plot analysis to identify outliers
2. Histograms using the Shapiro-Wilk test to determine if the data are normally or log-normally distributed,

3. Mann-Kendall test if the data is not normally or log-normally distributed to determine data trends
4. Linear regression charts of field pH data to determine normality of the data (since there are no non-detects in the data sets) based on the square of the correlation coefficient (R) and statistical significance (p-level)

Statistical analysis is also included for pH trends in all chloroform and nitrate wells.

DRC staff verified that the statistical process appears to be in conformance with the Director approved flowchart.

Table 3 of the November 9, 2012 pH Report provides a spreadsheet which includes:

1. A list of monitoring wells evaluated (excluding chloroform and nitrate monitoring wells)
2. Data population (N) used for the statistical evaluation
3. A list of out-of-compliance status for other parameters at the monitoring well
4. A list of indicator parameters showing significant increasing trends at the monitoring well
5. Results of the Shapiro-Wilk test for normality
6. Results of the Least Squares Regression Trend Test
7. Results of the Mann-Kendall Trend Analysis (where applicable per flow chart)
8. Mean and standard deviation calculation results
9. Minimum and Maximum measured pH values for each monitoring well evaluated
10. Mean - 2σ calculation
11. Current and proposed GWCL's
12. A list of the rationale for the proposed GWCL

Appendices to the November 9, 2012 pH report include plots and tables regarding statistical analysis and extreme outliers for: 1. Statistical Analysis of Field pH in Groundwater Monitoring Wells (Appendix A), 2. Exploratory Linear Regressions for Field pH in Groundwater Monitoring Wells (Appendix B), 3. Groundwater Elevation and Field pH in all Wells (Appendix C), 4. Indicator Parameters Analysis for Wells with Out-of-Compliance Status or Statistically Significant Decreasing Trends in Field pH (Appendix D), 5. Statistical Analysis of Field pH in Chloroform Wells (Appendix E), 6. Statistical Analysis of Field pH in Nitrate Wells (Appendix F), and 7. Electronic Input and Output Files.

Groundwater Elevation and Field pH Plots of Data

The November 9, 2012 pH Report notes that increasing water levels are a possible explanation for decreasing pH at the site as discussed above. Per the plots included in Appendix C, which include plots of water level fluctuations with time and field pH over time, all MW and TW4 plots show rising water levels correlated with decreasing pH, with the exception of two plots (wells TW4-12 and TWN-2). Issues related to oxygenation of the aquifer and dissolution of pyrite is discussed in more detail in the DRC review comments related to the December 7, 2012 Pyrite investigation report in sections below.

Data Omitted Prior to Statistical Analysis

Appendix A-6 of the November 9, 2012 lists data which was omitted prior to statistical analysis. The values which were excluded are considered to be extreme outliers in the data set. Per DRC review of the omitted data, DRC staff concurs that the omitted data appears to include only extreme values.

Per Section 2.3 of the November 9, 2012 pH Report, it is also noted that Intera performed data exploration using different time period to determine if certain monitoring wells show past or present declining trends for pH. Intera used two categories for the data exploration: 1. Measurements collected prior to 2005, and 2. Measurements collected from 2005 through the second half of 2012.

Data was similarly culled for pH data sets related to the TWN and TW4 statistical analysis.

EFR Recommendations:

The November 9, 2012 pH Report recommends elimination of all GWCL's for chloroform pumping well MW-26 and up gradient monitoring wells MW-1, MW-18, and MW-19. Per discussion in the DRC review comments related to the October 10, 2012 Source Assessment Report above, the same request was made regarding the removal of all GWCL's for these wells in that report. Since the request was addressed during that review, additional actions regarding the pH Report request are not included.

EFR Proposed Modified GWCL's for pH

Table – Proposed GWCL's for pH

Well Number	Location	Previous pH GWCL (s.u.)	EFR Proposed GWCL Revision (s.u.)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding - Is Proposed GWCL in Conformance with the Statistical Flow Chart?*
MW-1	Upgradient	6.77-8.5	6.68-8.5, EFR Request to Remove	Not in OOC	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart

MW-2	Lateral Gradient W. Cell 2	6.5-8.5	6.72-8.5	Not in OOC	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart
MW-3	Far Downgradient	6.5-8.5	6.04-8.5	No Chloride Trend Travel Time to MW-3 No Upward Trends in Indicator Parameters U of U Study	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart
MW-3A	Far Downgradient	6.5-8.5	5.84-8.5	No increasing trends in indicator parameters Travel time to MW-3A U of U Study	Mean - 2σ	Down Trend Mean - 2σ Consistent With Flow Chart
MW-5	Downgradient Cell 3 South Embankment	6.5-8.5	7.04-8.5	Chloride and Sulfate are not increasing Chloride shows a decreasing trend	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart
MW-11	Downgradient Cell 3 South Embankment	6.5-8.5	6.25-8.5	Chloride decreasing trend Sulfate Increasing, Sulfate and Chloride should rise together U or U study – terrigenous behavior indicates old ground water	LHV	Sig. Down Trend Modified Approach LHV Consistent With Flow Chart

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MW-12	Downgradient Cell 3 South Embankment	6.5-8.5	5.86-8.5	Decreasing chloride trend No change in behavior since existing wells background report	LHV	NS Down Trend Not Consistent With Flow Chart, Should be Mean - 2 σ
MW-14	Downgradient Cell 4A	6.5-8.5	5.42-8.5	No change in behavior since existing wells background report No indicators except Uranium show increasing trend.	LHV	NS Down Trend Not Consistent With Flow Chart, Should be Mean - 2 σ
MW-15	Downgradient Cell 4A	6.62-8.5	5.88-8.5	Not in OOC but showing significant decreasing trend Chloride and Fluoride show decreasing trends Sulfate Increasing trend in Uranium identified with background report	LHV	NS Down Trend Not Consistent With Flow Chart, Should be Mean - 2 σ
MW-17	Downgradient 500' Cell 4A Southeast Corner	6.4-8.5	6.27-8.5	Not in OOC	Mean - 2 σ	NS Down Trend Mean - 2 σ Consistent With Flow Chart

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MW-18	Upgradient	6.25-8.5	5.87-8.5, EFR Request to Remove		Mean - 2 σ	Sig. Down Trend Mean - 2 σ Consistent With Flow Chart
MW-19	Upgradient	6.78-8.5	6.27-8.5, EFR Request to Remove	Not in OOC	Mean - 2 σ	Sig. Down Trend Mean - 2 σ Consistent With Flow Chart
MW-23	Downgradient Cell 3	6.5-8.5	5.97-8.5	No change in behavior since existing wells background report	Mean - 2 σ	NS Down Trend Mean - 2 σ Consistent With Flow Chart
MW-24	Downgradient Cell 1	6.5-8.5	5.55-8.5	No increasing trends in any indicator parameter including chloride	Mean - 2 σ	Sig. Down Trend Mean - 2 σ Consistent With Flow Chart
MW-25	Lateral Cell 3 East	6.5-8.5	5.77-8.5	No increasing trend in chloride	LHV	Sig. Down Trend Modified Approach LHV Consistent With Flow Chart
MW-26	Lateral Cell 2 East Pumping Well	6.74-8.5	5.61-8.5, EFR Request to Remove	Pumping well No decreasing trend in pH	LHV	None Not Consistent With Flow Chart, Should be Mean - 2σ

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MW-27	Upgradient Cell 1 North Embankment	6.5-8.5	6.47-8.5	Located at the margin of the nitrate/chloride plume Mass balance of potential tailings solution discharge is unfeasible	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart
MW-28	Downgradient Cell 1	6.1-8.5	5.58-8.5	Potentially influenced by the nitrate/chloride plume No increasing trends in any other indicator parameters except chloride.	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart
MW-29	Downgradient Cell2	6.46-8.5	5.94-8.5	Chloride, fluoride and sulfate are exhibiting downward trends	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart
MW-30	Downgradient Cell 2	6.5-8.5	6.47-8.5	Located at the margin of the nitrate/chloride plume Nitrate/chloride ratio in groundwater is not indicative of tailings solution discharge	Mean - 2σ	Sig. Down Trend Mean - 2σ Consistent With Flow Chart

MW-31	Downgradient Cell 2	6.5-8.5	6.57-8.5	Located at the downgradient margin of the nitrate/chloride plume Chloride/nitrate ratio of groundwater is not indicative of tailings solution discharge U of U Study discounted tailings-discharge as a source at this well	Mean - 2σ	NS Down Trend Mean - 2σ Consistent With Flow Chart
MW-32	Lateral Cell 2 East Embankment	6.4-8.5	5.31-8.5	No increasing trends in indicator parameters	LHV	Sig. Down Trend Modified Approach LHV Consistent With Flow Chart

Conclusions

Based on DRC review of the November 9, 2012 EFR pH Report, concurrence with justification for determination that OOC pH measurements are caused by natural background fluctuation and proposed GWCL modification request, it is recommended that the following modified GWCL's be included in the upcoming groundwater permit renewal.

Monitoring Well No.	Parameter	Current GWCL (S.U.)	Modified GWCL (S.U.)
MW-2	pH	6.5-8.5	6.72-8.5
MW-3	pH	6.5-.5	6.04-8.5
MW-3A	pH	6.5-8.5	5.84-8.5
MW-5	pH	6.5-8.5	7.04-8.5
MW-11	pH	6.5-8.5	6.25-8.5
MW-17	pH	6.4-8.5	6.27-8.5
MW-23	pH	6.5-8.5	5.97-8.5
MW-24	pH	6.5-8.5	5.55-8.5

MW-25	pH	6.5-8.5	5.77-8.5
MW-27	pH	6.5-8.5	6.47-8.5
MW-28	pH	6.1-8.5	5.58-8.5
MW-29	pH	6.46-8.5	5.94-8.5
MW-30	pH	6.5-8.5	6.47-8.5
MW-31	pH	6.5-8.5	6.57-8.5
MW-32	pH	6.4-8.5	5.31-8.5

*Note that several of the EFR modified GWCL requests are not related to wells in OOC status. As discussed above EFR notes in the November 9, 2012 pH report that “all current GWCL’s for pH at the site were incorrectly set, based on laboratory pH.”

Per DRC review, the proposed modified GWCL’s for pH at the following three wells were not calculated in conformance with the Director approved statistical flowchart. The corrected GWCL’s following the flowchart are shown below:

Monitoring Well No.	Parameter	Current GWCL (S.U.)	Modified GWCL (S.U.)	Corrected GWCL (S.U.)
MW-12	pH	6.5 – 8.5	5.86 – 8.5	6.21 – 8.5
MW-14	pH	6.5 – 8.5	5.42 – 8.5	5.93 – 8.5
MW-15	pH	6.62 – 8.5	5.88 – 8.5	6.34 – 8.5
MW-26	pH	6.74 - 8.5	5.61 - 8.5	5.92 - 8.5

December 7, 2012 Pyrite Investigation Report

Summary:

Evaluations of field data and other indicator parameters identified and discussed in the November 9, 2012 pH report is dependent on an evaluation of the local Burro Canyon formation mineralogy and deposition characterization to verify that concentrations of iron pyrite within the Burro Canyon aquifer are high enough to substantiate the systemic pH decreases due to oxygenation of the aquifer.

Sample Collection, Screening and Analysis:

DRC staff attended the HGC core/cuttings sample collection for the pyrite investigation on August 24, 2012. A copy of the review memo which summarizes the inspection is attached to this memo (Attachment 1).

Screening Level Calculations:

HGC states in the December 7, 2012 Pyrite Report that monitoring wells MW-3A, MW-24 and MW-27 are considered representative of the site since they are located far downgradient, immediately downgradient and immediately upgradient of the tailings cells. HGC therefore

performs calculations and modeling based on the core/cuttings results from these three monitoring wells. HGC notes that monitoring well MW-3A *“can be considered a worst case example because of the relatively low detected pyrite concentrations in this well boring, a change in sulfate concentrations (hundreds of milligrams per liter) which implies a relatively large mass of pyrite has been oxidized, and because of the presence of calcite which will buffer pH changes...That the calculations and modeling described below demonstrate that pyrite exists in sufficient quantity to explain changes in pH and sulfate concentrations for a worst case example implies that the mechanism will be valid for other wells at the site.”* Per the December 7, 2012 Pyrite report, pyrite within the screened intervals of MW-3A, MW-24 and MW-27 were detected at concentrations of 0.1%, 0.8%, and 0.4% by weight respectively.

The December 7, 2012 Pyrite Report summarizes that: 1 mole of pyrite (FeS_2) releases 1 mole of iron hydroxide, 2 moles of sulfate, and 4 moles of hydrogen ions. Most of the sulfate generated from the oxidation of pyrite is expected to be retained in solution which will raise the concentration accordingly. Not all hydrogen ion released will lower the pH as it will react with carbonate species in the water which will buffer the pH. Therefore, the more carbonate species present, the more pyrite is needed to be oxidized to produce a change in pH.

If carbonate species are present there will be an impact in the ratio of sulfate concentration to the change in pH. HGC notes that carbonate species are known to exist in the perched water and at these locations; therefore, small changes in pH may be accompanied by relatively large changes in sulfate concentrations.

HGC notes that the screening level calculations included in the report are calculated under ideal conditions and may result in an overestimation of the actual pH decrease since the hydrogen ion generated may react with other species. HGC conclusions, therefore, are useful to potentially rule out pyrite oxidation as the sole mechanism for pH decrease if insufficient amount of pyrite are available for calculation under ideal conditions for dissolution.

Assumptions used in the screening-level calculations and preliminary PHREEQC modeling:

1. Oxygen is not limited in the screening level calculations.
2. Oxygen diffuses into the vadose zone via the unsaturated portions of the well screens, aided by barometric pumping, moving radially in all directions (including upgradient). Because the relevant reactions occur upgradient, and affect water moving into a particular well, groundwater flow and the potential resulting dilution from unaffected upgradient water can be ignored.
3. Pyrite occurs only in the depth interval represented by the sample submitted for analysis.

HGC uses a higher porosity in the calculations than normally used in groundwater modeling for the site (0.2 instead of 0.18). The higher porosity is considered conservative since a larger volume of water, per volume of aquifer solid is assumed (100 g of water per Kg of aquifer).

Monitoring Well MW-3A Calculation Results: The pH decrease in well MW-3A from 2005 until the 1st quarter 2011 was approximately 1 pH unit, and through the 2nd quarter 2012 was 0.4 pH

units (due to an upward data trend during the latter period). Per the November 9, 2012 pH Report, when the trend line is applied the change in pH is approximately 0.55 pH units. The HGC calculations use the larger 1 pH unit decrease as a conservative measure.

HGC calculations:

Pyrite concentration of 0.0056% calculated for MW-3A is equivalent to 5.6×10^{-5} g/g of the formation (0.056 g/Kg of the formation) or 0.56 g pyrite/L of water.

Assuming a 120 gram molecular weight for pyrite this equates to 0.0047 moles pyrite/L of water. Based on the molar release equation the maximum molar increase of pyrite in solution, based on 0.0047 moles pyrite/L water, is 0.019 moles/L.

HGC then calculates initial and potential maximum final concentrations of hydrogen ion for the 1 pH unit change, from pH 7.1 to pH 6.1 and found that the amount of hydrogen ion needed to decrease the pH 1 unit is approximately 4 orders of magnitude lower than the amount that can potentially be generated by pyrite oxidation per core sample analysis results.

HGC continued the evaluation to include sulfate concentrations, based on historical increases and molar concentrations and found that there is "*approximately 2 ½ times more sulfate than needed to account for the measured increase.*" The measured increase implies that only about 39% of the available pyrite is oxidized and hypothesizes a continued decrease in pH at the well.

Monitoring Well MW-24 Calculation Results: Calculations in monitoring well MW-24 were conducted in the same manner as well MW-3A. Per the HGC conclusions, the amount of hydrogen ion required to lower the pH to the conservative historical change, from 7.3 to 5.9 (1.4 pH units), is presently approximately 5 orders of magnitude lower than the amount available for release through pyrite oxidation.

Based on evaluation of sulfate concentrations there is approximately 40 times more sulfate than needed to account for the measured increase. The increase of sulfate of 310 mg/L is therefore calculated to require approximately 3% of the pyrite available for oxidation. HGC concludes that trends in pH and related parameters may be expected to continue.

Monitoring Well MW-27 Calculation Results: Calculations in monitoring well MW-27 were conducted in the same manner as wells MW-3A and MW-24. Per the HGC conclusions the amount of free hydrogen available at the location through pyrite oxidation to lower the pH from 7.3 to 6.7 is 5 orders of magnitude lower than what is available.

Sulfate calculation shows that there is approximately 60 times more sulfate than needed to account for the measured increase of 70 mg/L. Per HGC this implies that only approximately 2% of the available pyrite is oxidized and that trends in pH and related parameters may continue.

HGC additionally notes that the above calculations assume that all of the hydrogen ions released by pyrite oxidation contribute to pH changes but that much of the hydrogen ions action will be reduced by interaction with the aquifers dissolved carbonate species, including dissolved bicarbonate and carbonate.

PHREEQC Geochemical Preliminary Modeling Summary and HGC Conclusions:

Based on the visual and quantitative analysis, HGC additionally performed geochemical modeling using the PHREEQC modeling platform to evaluate whether measured pyrite concentrations contained enough pyrite to produce the observed pH declines. The modeling simulates a period of 25 years with anoxic conditions in the shallow aquifer (years 0-25) followed by 5 years of oxic conditions (years 25-30). Model simulations account for formation porosity and notes that at well MW-3A where formation porosity is lowest, there is a greater amount of oxygen supplied by groundwater than by air.

Pyrite consumption predicted by the second (oxic) set of simulations range from 3% to 33%, based on the PHREEQC simulations most mineral phases remain stable while others tend to change from unhydrated to hydrated forms (e.g. anhydrite tends to convert to gypsum and kaolinite tends to convert to pyrophyllite).

The preliminary simulations predict changes in pH and sulfate concentrations similar to the measured changes and also support pyrite oxidation as a mechanism for pH decrease and sulfate increase in the site monitoring wells. The simulations also suggest that only a portion of the pyrite has been consumed and that trends may continue in the future.

Monitoring Well MW-3A PHREEQC Preliminary Model Simulation

First anoxic run – Per the HGC conclusions, pyrite was stable in the anoxic simulation. The second run by HGC which simulated oxic conditions indicated a decrease in pH of 0.4 su and an increase in sulfate of approximately 330 mg/L. HGC notes that the simulated pH decrease is “*approximately equal to the change in pH suggested by the trend line in INTERA (2012b) and the change in sulfate is similar to that used in the screening level calculation presented in Section 4.3.2.1.*” Based on the findings HGC concludes that these preliminary simulations support pyrite oxidation as the mechanism for pH decreases at MW-3A (33% of available pyrite consumed).

Monitoring Well MW-24 PHREEQC Preliminary Model Simulation

HGC preliminary results at well MW-24 showed pyrite stable in the anoxic run and a pH decrease of 1.2 standard units and increase in sulfate of 225 mg/L during the oxic run. HGC notes that the preliminary results are consistent with screening level calculations presented in Section 4.3.2.2 and that the conclusions support pyrite oxidation as the mechanism for pH decreases at MW-24 (6% of the available pyrite consumed).

Monitoring Well MW-27 PHREEQC Preliminary Model Simulation

HGC preliminary results at well MW-27 showed pyrite was stable in the anoxic simulation. The oxic simulation showed a pH decrease of approximately 0.4 standard units and a sulfate increase of approximately 60 mg/L. HGC notes that the pH changes are “*similar to that suggested by the trendline provided in INTERA (2012b) and the change in sulfate is similar to the value of 70 mg/L*”

used in the screening level calculations provided in Section 4.3.2.3). Per HGC conclusions regarding the preliminary simulation pyrite oxidation is supported as the mechanism for measured pH decrease and sulfate increase at MW-27 (3% of available pyrite consumed).

HGC additionally notes that in cases where the aquifer contains large concentrations of carbonate species, a large difference in dissolved sulfate concentrations will occur, whereas if the aquifer contains low concentrations of carbonate then large changes in pH will cause relatively large changes in pH sensitive analytes such as metals.

HGC concludes that pyrite oxidation “*plays a significant role in perched water chemistry at the site*” and that changes in chemical species are dependent on the variable oxygen transport and carbonate species concentrations in the aquifer matrix.

HGC Hypothesized Impact of Pyrite Concentrations on the Natural Attenuation of Nitrate

HGC hypothesizes that an additional factor in the natural attenuation of nitrate in the Burro Canyon Aquifer is due to off-gassing of nitrogen (nitrogen reduction) by the oxidation of pyrite and suggests that this mechanism may “*help explain*” the apparent stability of the trailing edge of the plume.

Overall HGC Conclusions Related to the Pyrite Investigation

HGC considers the pyrite matrix concentrations and evaluation at monitoring well MW-3A to be a worst case example due to “*relatively low detected pyrite concentrations (hundredths of mg/L) which implies a relatively large mass of pyrite has been oxidized, and because of the presence of calcite (Table 4) which will buffer pH changes.*” HGC notes that even with these limitations the preliminary geochemical modeling indicates sufficient pyrite to explain observed changes in pH and sulfate concentrations and that this implies that the oxidation of pyrite at other locations within the aquifer will be valid.

HGC notes that the preliminary PHREEQC geochemical modeling supports pyrite oxidation as the mechanism for pH decrease since the results correspond to actual observed decreases and that pyrite oxidation can be reasonably expected to have caused or contributed to rising trends for other parameters (e.g. sulfate, TDS and metals).

HGC concludes that the oxidation of pyrite is driven by significant sources of oxygenated water from the wildlife ponds as well as “*enhanced oxygen transport into the vadose zone in the vicinities of perched wells having screens extending above the water table.*” HGC additionally notes that the low rates of perched water movement increase the residence time of groundwater in contact with oxygenated vadose areas near the wells which will increase oxygen transport to groundwater.

DRC Findings Regarding the October 10, 2012 HGC Pyrite Report

Per DRC staff review of the Pyrite Report, it appears that the study was conducted in conformance with Stipulated Consent Agreement Docket No. UGW12-03 which approved the EFR Pyrite study as outlined in an April 13, 2012 "Plan and Time Schedule." Per review of the laboratory analysis and conclusions of visual examination of polished sections as well as analysis of sulfur content using an induction furnace, it was noted that Pittsburgh Mineral & Environmental Technology, Inc. concluded that "*pyrite cemented sandstone probably forms thin beds or lenses in this formation. The pyrite usually forms massive cement that makes it difficult to determine the mineral body size. It is also present as characteristic small cubes in the matrix between the sand grains. Average Iron sulfide content is 5.8 volume %.*"

Results of the pyrite study were limited to 3 well boring locations which were assumed by HGC to provide a representative sample of the entire Burro Canyon Aquifer. Although the study did not provide a laterally extensive sampling of the aquifer matrix it is noted that the preliminary investigation of the HGC worst case example (well boring MW-3A) does provide evidence that the oxidation of pyrite is a legitimate process, given a relatively low % of matrix pyrite, for significant impact to geochemical processes and potential to induce chemical trends associated with declining pH and associated increases in sulfate and indicator parameters.

The HGC mechanisms for introduction of oxygen into the groundwater are reasonable, based on site characterization and well construction. The Pyrite Report therefore provides a reasonable and possible explanation for the decreasing pH trends and observed increasing trends in indicator parameters.

The Pyrite Report does not propose changes in Permit GWCL's, but does provide support for the determination that current out-of-compliance parameters are due to background chemical concentrations within the aquifer matrix and are not caused by the release of tailings solution to the environment.

References:

Intera, October 2007, *A Revised Background Groundwater Quality Report: Existing Wells for Denison Mines (USA) Corp.'s Mill Site, San Juan County, Utah*, Prepared by Intera Incorporated

United States Environmental Protection Agency 2009 *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance, EPA 530/R-09-007.*

Utah Division of Radiation Control, August 24, 2012, *Groundwater Discharge Permit No. UGW370004*

Utah Division of Radiation Control, September 2009, *Statement of Basis for Ground Water Quality Discharge Permit UGW370004*

Attachment 1
DRC HGC Core Screening and Collection Memo

MEMORANDUM

TO: File

THROUGH: Phil Goble, Compliance Section Manger

FROM: Tom Rushing, P.G.

DATE: September 10, 2012

SUBJECT: Utah Division of Radiation Control Inspection of the Energy Fuels Resources (USA) Inc. Core Inspection and Sample Collection, regarding the pH Study, for Monitoring Wells MW-23, MW-24, MW-28, MW-29 and MW-3A

Summary:

Utah Division of Radiation Control (DRC) staff (Tom Rushing) met with Hydro Geo Chem. (HGC) Representative (Stewart Smith) during the morning of Tuesday, August 14, 2012 to observe the analysis of core samples and cuttings and collection of samples for the analysis of iron pyrite. Specifically, it was DRC intention during this inspection to:

- Observe the cores available for sample collection at the subject monitoring locations
- Observe the screening process for core collection
- Observe the calibration and use of the X-Ray Fluorescence Metal Analyzer (XRF) Gun for on-site environmental metals analysis of core and cuttings samples
- Observe the collection and logging of the cores
- Clarify laboratory analysis of the cores and cuttings

Core Investigation:

In relation to the preliminary screening of the cores and cuttings, DRC observed the following practices to determine which intervals were considered most representative:

- Interval – initially all core boxes or bagged cuttings sample boxes were pulled from the onsite core storage area, cargo boxes located west of the Mill office, and organized so that the evaluation concentrated on core and cuttings within the vertical screened interval of the corresponding monitoring well.
- Color – The core and cuttings samples were screened based on the color, core and cuttings which were green/grey and grey were prioritized for further evaluation.
- Odor – It was noted that some intervals of core had an ammonia like smell which indicated a reducing environment, these intervals were prioritized for collection.
- Appearance – Some intervals of core had yellowish or black flecking which were potentially pyrite, and/or carbonaceous material and those intervals were prioritized based on a possible reducing environment during deposition and more likelihood of higher pyrite concentrations.

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DRC HGC Core Screening and Collection Memo

- On site metals analysis – The XRF gun was used on priority sample intervals to determine the concentration of iron in the core or cuttings sample. It was noted during the investigation that the XRF gun did not have the capability to measure sulfur in the samples and readings could not distinguish between iron oxide and iron sulfide (or other iron minerals).

Per results of the screening, the HGC determined core intervals which were thought to have a greater potential of higher pyrite concentrations.

XRF Gun Screening:

Per DRC observations the following was noted:

- The XRF Gun which was used onsite was rented from Geotech and was the Innov-X Alpha Series with the capability to measure iron in the core and cuttings samples (parts per million). DRC notes that it was HGC's understanding from Geotech that the XRF Gun could also measure sulfur, however, a calibration standard was not included for sulfur and upon follow-up with the company the XRF gun did not have that capability.
- The XRF Gun source was an X-ray tube W anode, 10-40 kV up to 5 selectable filters.
- HGC representatives calibrated the XRF Gun using the supplied source for iron.
- HGC representatives shot readings for all prioritized core intervals and compared the readings.
- The highest reading noted was 9,770 ppm (monitoring well core MW-24)
- Readings generally ranged between 200 ppm to 3,000 ppm

Sample Collection:

Per the results of the screening, HGC collected samples at the intervals showing the highest likelihood of pyrite concentrations, the following samples were observed:

Monitoring Well Location	Collection Interval	Type of Sample
MW-23	108' BGS	Core
MW-24	118.5' BGS	Core
MW-28	88.5' BGS	Core
MW-29	102' – 103' BGS	Cuttings
MW-3A	89.5' BGS	Core

Samples were placed into ziploc bags and labeled accordingly.

Laboratory Analysis:

It was noted per discussion with HGC that the laboratory to be used for pyrite analysis had changed since finalization of the 4/13/2012 work plan in groundwater monitoring wells. DRC notes that the laboratory to be used was not included in the approved work plan.

Attachment 1
DRC HGC Core Screening and Collection Memo

Samples will be sent to a lab for visual examination and quantification of pyrite through the creation of sample thin sections per methodologies outlined in the Stipulated Consent Agreement, Docket No. UGW12-03.

Conclusions:

Per DRC review of the core collection methods, it was noted that cores required by Stipulated Consent Agreement, Docket No. UGW12-03, screening, collection, labeling and photographing appeared to be consistent with the approved work plan.

Attachments:

Attachment 1 – Photographs Taken During the August 14, 2012 Inspection

Attachment 2 – Geotech Handheld X-Ray Fluorescence Metal Analyzer Fact Sheet

Attachment 1

Utah Division of Radiation Control Inspection
White Mesa Uranium Mill
August 14, 2012 Core Inspection and Sample Collection for pH Study



Photo 1 – Example of intact core sample



Photo 2 – Example of HGC Representative using the XRF Gun

Attachment 1
DRC HGC Core Screening and Collection Memo



Photo 3 – Example of bagged cuttings sample (MW-29)

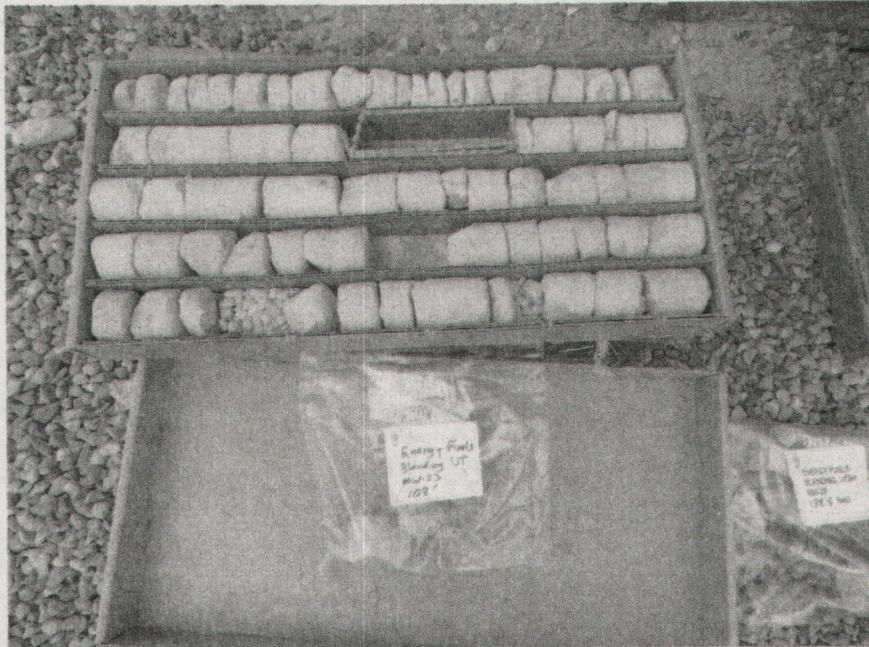


Photo 4 – MW-23 Final Bagged Sample (108' BGS) and Core Box

Attachment 1
DRC HGC Core Screening and Collection Memo



Photo 5 – Final Bagged Core Sample MW-24 (118.5' BGS) and Core Box



Photo 6 – Final Bagged Sample MW-28 (88.5' BGS) and Core Box

Attachment 1
DRC HGC Core Screening and Collection Memo



Photo 7 – Final Bagged Sample (MW-3A 89.5' BGS) and Core Box



Photo 8 – Final Samples for all collected during inspection (MW-29, MW-28, MW-24, MW-23, MW-3A)

Attachment 2 – Geotech X-Ray Fluorescence Metal Analyzer Fact Sheet

Rental – Handheld X-Ray Fluorescence Metal Analyzer

geotech

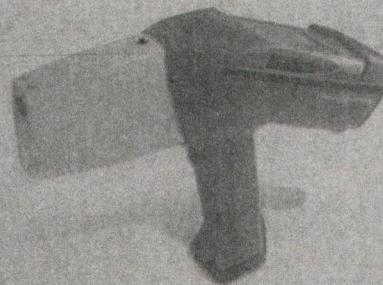
Innov-X Alpha Series XRF

The Innov-X tube-based Alpha Series™ takes on-site environmental metals analysis to a new level. It features a miniature, rugged X-ray tube. The Alpha Series™ provides reliable analysis on RCRA, Priority Pollutant metals and other elements in soils, liquids, coatings, etc. Meets EPA Method 8200 for metals in soils, NIOSH Method 7702 for lead in air filters, OSHA Methods O9S1 and O9A1 for lead in surface wipes and air filters.

The Alpha Series XRF is used for a wide variety of on-site environmental analyses. These include in-situ analysis for rapid site investigations and remediation projects. Operators may test directly on the ground or through bagged samples. By collecting and preparing soil samples you can achieve laboratory quality results in the field. The Alpha Series™ can be pre-calibrated for filters, coatings, CCA-treated wood and many other sample types.

FEATURES

- Superior performance on Cr and other metals. Light Element Analysis Program (LEAP) analyzes P, S, Cl, K and Ca.
- Utilizes advanced and universal XRF data modeling:
 - Compton Normalization – "Internal Standard" provides for quantitative analysis without site-specific calibrations.
 - Fundamental Parameters – Standardless, ideal for samples with high and low concentrations of several elements.
 - Empirical Calibrations – "Calibration Curves", allows user generated calibration curves.
- Add new elements and calibrations easily. Innov-X analyzers will meet your requirements today and in the future.
- View spectra on screen.
- Compare spectra for comparative analysis and display results versus standards.
- Stored tests can be re-run with new parameters or models.
- Data Security: stored in binary format for data integrity.



SPECIFICATIONS

Weight	2.025 lbs (base wt) 3.875 lbs (1.6 kg) with batteries.
Excitation Source	X-ray tube, W anode, 15-40 kV, 10-40 µA, up to 5 selectable filters.
LEAP	Delivers industry-leading detection limits on critical elements Cr, Cl, P, S, Ti, S, Ca, K.
Detector	Si PIN diode detector, 4.730 eV FWHM at 5.95 keV Mn K-alpha line. Temperature Range: -10°C to +50°C.
Operation	Trigger or StandBy/Scan, One-touch trigger or "deadman" trigger option. Optional control from external PC.
Power	Li-ion batteries, rechargeable (charger included). Powers analyzer and PQA simultaneously. AC Adapter optional.
Battery Life	8 hours typical duty cycle using built-in, optional multiple battery pack.
Number of Elements	Standard packages include 21 elements.
Standard Elements	Pb, Cr, Hg, Cd, Bi, Ti, Mn, Fe, Ni, Cu, Zn, Sn, Ag, Au, Ba, Be, Co, Zr, Rb, Mo, Sr.
Display Screen	Color, high resolution touchscreen. Variable brightness provides easy viewing in all ambient lighting conditions.
Data Display	Concentrations in ppm, spectra, peak identifies (count rate) or user-specified units, depending on software mode selected.
Memory/Data Storage	128 Mb standard memory, 20,000 test results with spectra, upgrade to >100,000 with optional 1 Gb flash card.
Processor	Intel 400 MHz StrongARM processor or higher.
Operating System	Microsoft Windows CE (portable system) or Windows (PC-based). Software Modes: Soil, Filter/Wipes, Empirical. Others available upon request.

CALL GEOTECH TODAY (800) 833-7958

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