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DRC-2019-006502

# MEMORANDUM

TO: File

THROUGH: Phil Goble, Manager PRG 7/8/19

FROM: Tom Rushing, P.G. JR 7-8-19

DATE: July 8, 2019

SUBJECT: Review of the Energy Fuels Resources (USA) Inc. (EFR), White Mesa Uranium Mill, Blanding, Utah January 15, 2019 Source Assessment Report for Selenium, Uranium and pH in Monitoring Well MW-30
Ground Water Discharge Permit No. UGW370004 (Permit)

## Summary

A January 15, 2019 Source Assessment Report ("SAR") for Selenium, Uranium and pH in Monitoring Well MW-30 at the White Mesa Uranium Mill (Mill) was submitted to the Director by Energy Fuels Resources (USA) Inc. ("EFR"), and received by the Utah Division of Waste Management and Radiation Control (DWMRC) on January 17, 2019 for review and approval of proposed revised Ground Water Compliance Limits (GWCLs).

Additionally, based on a June 18, 2019 conference call between DWMRC and EFR regarding review of the SAR, an updated "Reanalysis of uranium data for the calculation of a groundwater compliance limit in MW-30" (Prepared by Intera), dated June 28, 2019 was submitted. This update is discussed in the last section of this memo below.

Monitoring well MW-30 is located on the southern berm of the Mill Tailings Cell 2 and is hydraulically downgradient from portions of Cell 2 and from the Mill processing areas. MW-30 is within the defined nitrate/chloride plume, and non-compliance for nitrate and chloride are regulated through a separate consent order (UGW12-04) issued by the Director.

The SAR is broken up into four primary sections, 1. Approach for analysis of potential sources of the contamination, 2. Results of the analysis (e.g. changes in groundwater in MW-30, indicator parameter analysis, pH analysis, sorption analysis and mass balance analysis), 3. Statistical evaluation and calculation of revised GWCL's for trending parameters, and, 4. Conclusions and recommendations.

The SAR notes that though uranium is the only parameter required for assessment (in out-of-compliance status) by Part I.G.2 of the White Mesa Mill Groundwater Discharge Permit (Permit), the EFR SAR is additionally addressing exceedances of the recalculated GWCL's, noting that increasing trends are also observed for these parameters (Se, SO4, TDS).

Figures below depict the rising concentration trends in monitoring well MW-30 for Se, U and decreasing Field pH using all available historical data.

Figure - Selenium Data Plot of Historical Data at MW-30

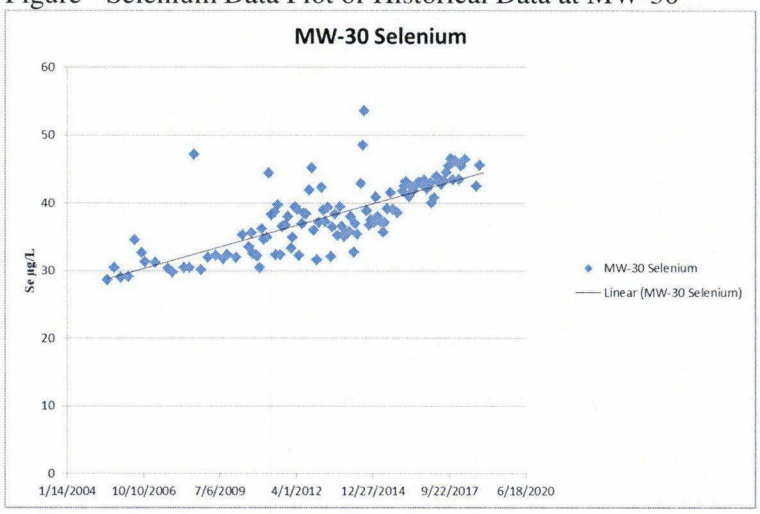



Figure – Uranium Data Plot of Historical Data at MW-30

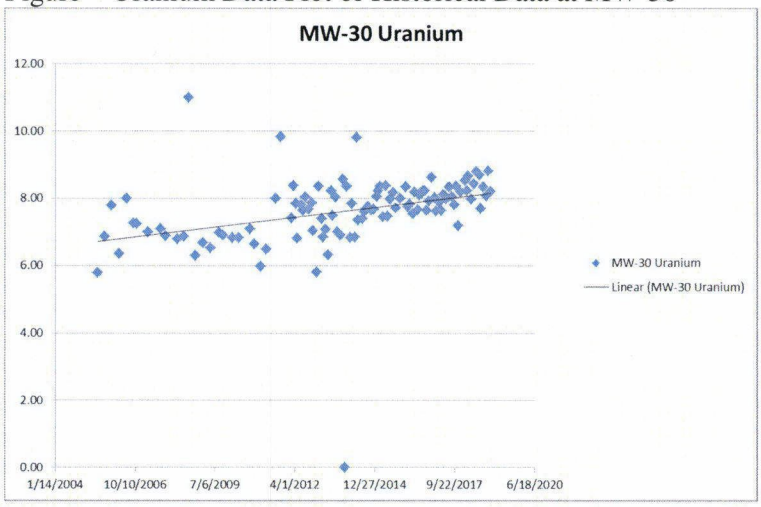
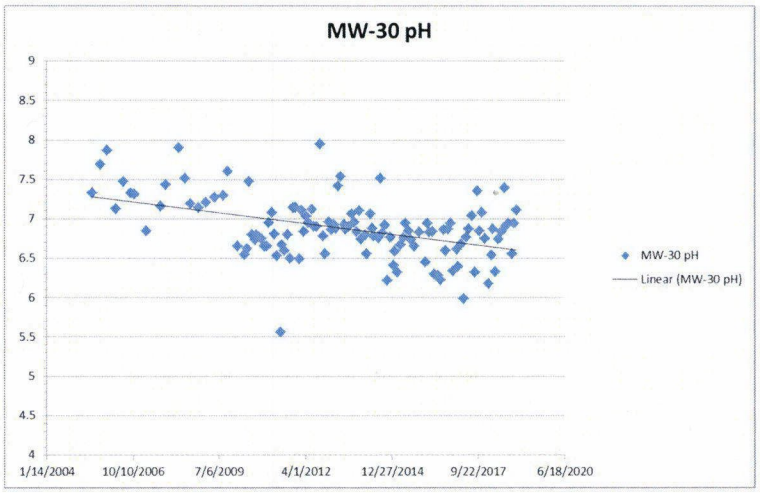



Figure – pH Data Plot of Historical Data at MW-30




The SAR findings are that the GWCL exceedances and data trends are not caused by mill activities (leakage from the tailings cells), and based on the increasing trends, EFR is proposing that highest historical values be used as a basis for revised selenium and uranium GWCL's. DWMRC review findings regarding the SAR and proposed revised GWCL's is discussed below.

**DWMRC Review of Compliance Data and Trends**

**Selenium** – DWMRC notes that the Permit GWCL was modified/raised to 47.2 µg/L (from 34 µg/L) in the January 19, 2018 Permit renewal. Measured concentrations of selenium remained below the modified GWCL until a first quarter 2019 exceedance. The well also exceeded the modified GWCL for the 2nd quarter 2019 and MW-30 is in Out-of-Compliance (OOC) Status for selenium. Per review of a time/concentration plot of selenium and as noted in the EFR Existing Wells Background Report, a long standing upward selenium trend is evident.

**Uranium** – Uranium in MW-30 went into Probable Out-of-Compliance (POOC) status per the 4th quarter 2011 sample result (9.83 µg/L) and accelerated monthly monitoring was started during the first quarter of 2012. Several stand-alone exceedances were noted since that time and subsequent consecutive exceedances of the GWCL were noted during May and June of 2018 putting MW-30 into OOC status and Permit requirements for an SAR. Per review of a time/concentration plot and as noted in the EFR Existing Wells Background Report, a long standing upward trend is evident.

**Field pH** – DWMRC notes that the GWCL (pH range) was modified to 6.47 S.U. – 8.5 S.U. (from 6.5 S.U. to 8.5 S.U.) in the January, 19, 2018 Permit renewal. Per review of the field pH monitoring data since the permit renewal Jan. 2018 through the 1st Quarter 2019 sampling (15 samples), the modified GWCL was exceeded for three of the fifteen samples (1/23/18, 4/12/18 and 2/13/19). It was noted that the monitoring results were within the modified GWCL's for nine consecutive samples prior to the most recent exceedance. DWMRC notes that two consecutive exceedances have not occurred and MW-30 is not in OOC for pH. Based on these findings, DWMRC does not see a current need to evaluate MW-30 for an additional modification until consecutive exceedances occur in the well. Quarterly monitoring will be required to continue to better evaluate the pH trend in the well.

**EFR Investigations of Potential Sources of Report Increasing Trends at Monitoring Well MW-30**

### *1. Tailings Solution Groundwater Indicator Parameters at Monitoring Well MW-30*

The SAR Section 3.5 discusses four primary indicator parameters (Chloride, Fluoride, Sulfate and Uranium) which would be detected in ground water in the event of a discharge from the Mill tailings cells.

Per the SAR it was noted "*chloride concentrations in MW-30 exhibit a statistically significant increasing trend, MW-30 is located at the margins of the nitrate/chloride plume which is actively being remediated according to the Corrective Action Plan. It is likely that groundwater in this well is being impacted by that plume; therefore, chloride is not an appropriate indicator parameter for potential tailings seepage in MW-30. Sulfate concentrations exhibit a statistically significant decreasing trend, fluoride concentrations also exhibit a decreasing trend (although not statistically significant), and uranium concentrations are relatively low for the Mill site but exhibit a statistically significant increasing trend.*" The SAR additionally presents data plots of historical data and evaluation of the indicators per historical data and as evaluated in the New Wells Background Report. Additional evaluation by DWMRC is included below:

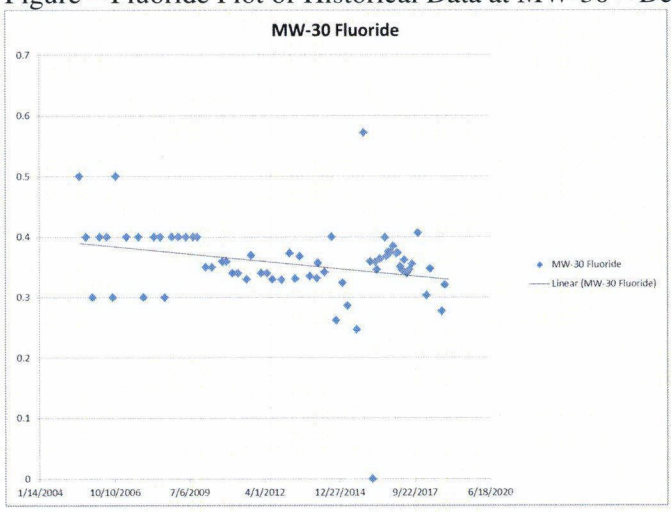
*Chloride*

Per the SAR, the use of chloride as an indicator parameter in the case of monitoring well MW-30 is complicated by the fact that MW-30 is screened within the margins of the nitrate/chloride plume, and chloride is therefore above background and is not a reliable primary indicator of cell leakage for MW-30. Chloride at monitoring well MW-30 is showing a significant increasing trend. The chloride plume has been delineated based on concentrations and plots clearly show that the plume originates hydraulically upgradient from the mill tailings cells and is not attributed to tailings cell leakage based on groundwater flow data and mass balance calculations.

*Fluoride*

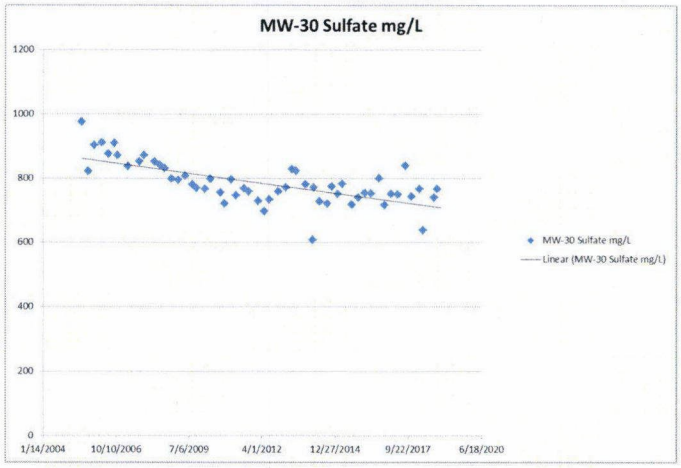
Fluoride is highly concentrated in tailings wastewater and per literature and mill groundwater transport modeling has been shown to be highly mobile in the vadose zone and groundwater beneath the tailings cells. Per the figure below, fluoride is showing a decreasing concentration trend in MW-30.

Figure – Fluoride Plot of Historical Data at MW-30 – Decreasing Trend




*Sulfate*

Sulfate is also abundant in the tailings wastewater and is a relatively mobile constituent in groundwater. Per the figure below sulfate is showing a decreasing trend in MW-30.




Additionally, sulfate concentrations in MW-30 are very low in comparison with other wells at the site. The average value of sulfate using all historic data is 784 mg/L. This concentration is compared with highest historical values of other site monitoring wells (nearby MW-31) on the table below:

| Monitoring Well No. | Location Relative to Tailings Cells | Average Sulfate Concentration (Complete Data Set) (mg/L) |
|---|---|---|
| MW-30 | Downgradient Cell 2 | 784 |
| MW-1 | Upgradient | 837 |
| MW-18 | Upgradient | 1,828 |
| MW-19 | Upgradient | 669 |
| MW-20 | Far Downgradient | 3,526 |
| MW-03A | Far Downgradient | 3,568 |
| MW-29 | Downgradient Cells 1 and 2 | 2704 |
| MW-11 | Downgradient Cells 2 and 3 | 1,105 |

In the case of MW-30, the relatively low concentration of sulfate and decreasing trends in sulfate and fluoride indicates that tailings wastewater is not the source of the uranium exceedances.

*Uranium*

Uranium concentrations in monitoring well MW-30 are similar to sulfate concentrations in that site-wide they are low. This is additionally evaluated by box plot evaluation comparing uranium concentration in MW-30 to all monitoring wells site wide (Appendix B-8 of the SAR).

Indicator parameter analysis supports the SAR finding that selenium and uranium exceedances and upward trends are not due to tailings cell leakage.

### 2. *University of Utah Study*

Monitoring well MW-30 was included in a University of Utah study conducted at the White Mesa Uranium Mill during 2007 (Final Report of Study Findings Dated May, 2008). Based on groundwater age dating at

monitoring well MW-30 [chlorofluorocarbon ("CFC") analysis], the groundwater was found to exhibit CFC recharge dates which predate the construction of the Mill in 1980.

*3. Source Assessment Conclusions*

In addition to those above, the SAR discussed several lines of evidence to support that mill activities are not the source of the selenium and uranium GWCL exceedances in monitoring well MW-30, including; 1. Decreasing pH effects on monitoring well geochemistry; 2. Evaluation of tailings solution indicator parameters (chloride, sulfate, fluoride and uranium); 3. Previous findings in the EFR Existing Wells Background Report that the SAR parameters showed long standing upward trends; 4. Potential effects of pyrite oxidation releasing selenium and other trace metals into solution; 5. Location of MW-31 within the nitrate/chloride plume, and, 6. Findings of the 2007/2008 University of Utah Groundwater Study.

Per DWMRC review, these findings are consistent with previous EFR SAR's and it does not appear that the GWCL exceedances are being caused by mill activities. Based on the increasing trends, adjustment of the GWCL's for selenium and uranium in the Permit is appropriate. Evaluation of the comprehensive list of monitoring parameters and evaluation of data by EFR and DWMRC at monitoring well MW-30 is ongoing.

**EFR Proposed Modified GWCL Statistical Evaluation of Data:**

Per the DWMRC approved statistical flow chart for the White Mesa Mill groundwater monitoring wells, it was noted that if an upward trend is apparent for an analyte then a modified approach should be considered. The modified approach should allow for a GWCL which considers the increasing concentrations. Based on this, EFR calculated GWCL's according to the highest historical value (HHV).

Based on DWMRC review of the proposed GWCL's it was noted that the HHV for uranium used was the 3rd quarter 2008 value of 11µg/L. DWMRC noted that at that time this value would have been a statistical outlier in the data set and is likely not a valid result. Per more recent and representative data, the HHV was 9.09 µg/L measured in February 2019. This value is included in the approval below.

The table below summarizes the EFR calculations and rationale for the proposed modified GWCL's.

***Table 1 – Table of EFR Proposed Revised GWCL for Selenium and Uranium at Monitoring Well MW-30:***

| Well Number | Parameter | Current GWCL | EFR Proposed GWCL Revision | Method to Determine GWCL | DWMRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart? | DWMRC Recommended Modified GWCL Based on SAR Review |
|---|---|---|---|---|---|---|
| MW-30 | Selenium | 47.2 µg/L | 53.6 µg/L | HHV | Increasing Trend allows for modified approach on Flow Chart (HHV). | 53.6 µg/L |
| MW-30 | Uranium | 8.32 mg/L | 11 µg/L | HHV | Increasing Trend allows for modified approach on Flow Chart (HHV). Per DWMRC findings the EFR proposed | 9.09 µg/L, based on HHV of last 50 sample results |

| Well Number | Parameter | Current GWCL | EFR Proposed GWCL Revision | Method to Determine GWCL | DWMRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart? | DWMRC Recommended Modified GWCL Based on SAR Review |
|---|---|---|---|---|---|---|
| | | | | | HHV of 11 µg/L is based on a 2008 measurement and would have been considered an outlier at that time. DWMRC review finds that a more recent HHV, within the last 50 samples is more appropriate. The recent data HHV is 9.09 µg/L. | |

**Updated June 28, 2019 "Reanalysis of uranium data for the calculation of a groundwater compliance limit in MW-30"**

A telephone conference was held between DWMRC and EFR on June 18, 2019 to discuss the findings of the SAR review above. It was discussed that per DWMRC findings, the proposed revised GWCL for uranium was based on what appeared to be an outlier in the data set. The DWMRC proposed HHV value based on the most recent 50 uranium data points was discussed. EFR noted that the most recent 50 data points may not be flexible enough and representative of the increasing trend and may cause unwarranted re-evaluation of the GWCL in the near future. It was also discussed that the data shows a point of inflection in 2012 which coincides with the EFR change in laboratory and analytical methods. DWMRC agreed that a re-evaluation based on data collected after the October 2012 laboratory change was appropriate and in conformance with the 2009 Environmental Protection Agency Statistical Guidance. A summary of the review and proposed HHV based on the revised data set is summarized on table 2 below:

***Table 2 – Reanalyzed Revised GWCL for Uranium at Monitoring Well MW-30:***

| Well Number | Parameter | Current GWCL | EFR Proposed GWCL Revision | Method to Determine GWCL | DWMRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart? |
|---|---|---|---|---|---|
| MW-30 | Uranium | 8.32 µg/L | 9.82 µg/L | HHV | Increasing Trend allows for modified approach on Flow Chart (HHV). The revised HHV value appears appropriate based on review of data since the EFR laboratory change in 2012. |

***Conclusions:***

Based on DWMRC review of the background statistics and confirmation that the proposed parameters for GWCL modifications are showing increasing trends not apparently associated with contamination from the

mill, it is appropriate to set GWCL's for these parameters at highest historical values. This review is consistent with the Director approved statistical flowchart which appreciates that a modified approach is appropriate for parameters showing upward trends.

Based on review a letter will be sent to EFR of initial approval of the modified GWCL's on the tables above (Selenium from Table 1 and Uranium from Table 2). The letter will include notification that the modifications are subject to public notice and public participation requirements, and that the modifications will not be effective until formal issuance of a modified Permit.

**References**

[1] Energy Fuels Resources (USA) Inc., January 15, 2019, *Transmittal of Source Assessment Report for MW-30 White Mesa Mill Groundwater Discharge Permit UGW370004*

[2] Energy Fuels Resources (USA) Inc., June 28, 2019, *Reanalysis of uranium data for the calculation of a groundwater compliance limit in MW-30*

[3] Energy Fuels Resources (USA) Inc., August 15, 2017, *White Mesa Uranium Mill Ground Water Monitoring Quality Assurance Plan (QAP), Revision 7.4*

[4] Energy Fuels Resources (USA) Inc., October 12, 2012, *Source Assessment Report*, Prepared by Intera

[5] Energy Fuels Resources (USA) Inc., November 9, 2012, *pH Report*, Prepared by Intera

[6] Hurst, T.G., and Solomon, D.K. University of Utah, 2008, *Summary of Work Completed, data Results, Interpretations and Recommendations for the July 2007 Sampling Event at the Denison Mines, USA White Mesa Uranium Mill Near Blanding,* Utah, Prepared by Department of Geology and Geophysics

[7] Hydro Geo Chem, December 7, 2012, *Pyrite Investigation Report*

[8] Intera, 2007, *Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site, San Juan County, Utah*

[9] United States Environmental Protection Agency, 2009, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance EPA530/R-09-007*

[10] Utah Department of Environmental Quality, January 19, 2018, Modified on March 19, 2019, *Utah Division of Radiation Control, Ground Water Discharge Permit, Permit No. UGW370004, Energy Fuels Resources (USA) Inc.*