environmental
properties management, LLC

May 3, 2019

Mr. Paul Davis
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

Mr. Ken Kalman
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. Robert Evans
U.S. Nuclear Regulatory Commission
1600 East Lamar Blvd; Suite 400
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Re: Docket No. 70-925; License No. SNM-928
Potential Technetium 99 Impact to Influent, Waste, and Effluent

Dear Sirs:

Solely as Trustee for the Cimarron Environmental Response Trust (CERT), Environmental Properties Management LLC (EPM) attended meetings at the Nuclear Regulatory Commission (NRC) offices in Rockville, Maryland, on April 4th and 5th, 2019. During those meetings, discussions addressed the anticipated presence of technetium 99 (Tc-99) in groundwater that will be extracted and treated to remove uranium and nitrate during proposed remediation activities. Also discussed was the potential for Tc-99 to be present in spent ion exchange resin and/or biomass generated by the uranium and nitrate treatment processes, respectively, as well as in effluent that will be discharged or injected. This letter summarizes the issues discussed and a proposed path forward.

Background

Elevated concentrations of gross beta were discovered in groundwater at the Cimarron site in the 1990s in the Uranium Pond #1 (UP1) and Uranium Pond #2 (UP2) Areas, and at locations downgradient from these areas. The radionuclide Tc-99 was identified as the source of the elevated beta concentrations, and monitoring for Tc-99 began in 1996. Beginning in 1997, groundwater and surface water samples were collected and analyzed for Tc-99 at locations where the ratio of gross beta to gross alpha exceeded 3:1 ***and*** gross beta results exceeded 30 picoCuries/liter (pCi/L).

It was determined that Tc-99 was a contaminant in some of the uranium hexafluoride (UF_6) received at the facility; Tc-99 was present in the UF_6 generated by the processing of recycled nuclear material at the Department of Energy's Paducah, Kentucky facility. Tc-99, along with nitrates and fluoride, was present in the liquid waste stream that was discharged to UP1 and UP2.

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Consequently, groundwater and surface water samples that exceeded the gross beta criteria (and which were therefore analyzed for Tc-99) were generally located in, around, and downgradient of the UP1 and UP2 Areas.

Although groundwater samples collected from monitor wells located in Burial Area #1 (BA1) were analyzed for Tc-99, the reported Tc-99 concentrations were below laboratory detection limits. The December 30, 2003 *Tc-99 Groundwater Assessment Report*[1] concluded,

> "This characterization demonstrated that elevated levels of Tc-99 are present downgradient from the two former waste management areas of U-Pond #1 and U-Pond #2 within the shallow sandstones and at the seep outcrops and are not generally present at concentrations above laboratory detection limits anywhere else on site."

Tc-99 is a radionuclide that emits beta radiation, and The Environmental Protection Agency (EPA) has established a primary drinking water standard for beta emitters. The Maximum Contaminant Level (MCL) established by the EPA for beta emitters is a radiation dose of 4 millirem per year (mrem/yr). Other beta emitters are present at the Cimarron site; thorium 234 and protactinium 234 are daughters of uranium 238, but due to the extremely long half-life of their parent (uranium 238), the beta activity associated with these radionuclides is negligible. Consequently, the primary contributor to the beta activity detected in groundwater at the Cimarron site is believed to be Tc-99.

The NRC and the EPA have independently calculated activity concentration limits for beta emitting radionuclides that equate to 4 mrem/yr. The EPA calculated an activity concentration limit of 900 pCi/L for Tc-99, based on the *Report of Committee II on Permissible Dose for Internal Radiation*[2], and the NRC calculated an activity concentration limit of 3,790 pCi/L for Tc-99, based on *Limits for Intakes of Radionuclides by Workers*[3].

Prior to 2012, the concentration of Tc-99 had only exceeded the NRC criterion of 3,790 pCi/L at two locations: Monitor Well 1312 (located in UP1) and surface water sample location 1208 (located north of UP2). In addition, Tc-99 concentrations did not exceed the NRC criterion at any locations after March 2004. In 2012, groundwater samples were collected from four locations that had previously exhibited elevated concentrations of Tc-99. The results of those samples were as follows:

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[1] Cimarron Corporation, December 2003.
[2] International Commission on Radiological Protection, Publication 2, 1959.
[3] International Commission on Radiological Protection, Publication 30, 1979.

- 875 pCi/L at Monitor Well 1313 (UP1)
- 1,190 pCi/L at Monitor Well 1346 (UP2)
- 1,050 pCi/L at Monitor Well 1336A (UP2)
- 1,850 pCi/L at surface water location 1208 (north of UP2)

Because Tc-99 concentrations had not exceeded the NRC criterion at any groundwater or surface water sample location since 2004, and all 2012 groundwater sampling results were below the NRC criterion, the NRC approved the discontinuation of monitoring for Tc-99 in a letter dated April 22, 2013.

Evaluation of Available Tc-99 Groundwater Data

Unlike the historical groundwater concentration data sets available for other contaminants of concern at the Cimarron site (i.e., uranium, nitrate, and fluoride), the data available for Tc-99 is limited in the number, spatial distribution, and temporal distribution of data points. In addition, groundwater samples have not been analyzed for Tc-99 since 2012 and the data sets for several monitor wells exhibit significant variability over time. As stated above, Tc-99 had not been identified in groundwater until 1996 and an evaluation of gross alpha and beta results was performed to demonstrate that Tc-99 was the source of elevated beta emissions detected in groundwater. By 2004, Tc-99 concentrations in all but one monitor well sampled for Tc-99 (Monitor Well 1312) were well below the NRC criterion of 3,790 pCi/L. A Tc-99 concentration of 4,590 pCi/L was reported for a sample collected from Monitor Well 1312 in March 2004; however, this well was sampled 13 more times between May 2004 and June 2008 and the concentration never exceeded 1,150 pCi/L over this time period. The number of monitor wells included in Tc-99 groundwater monitoring events conducted since 2003 was very limited, and, as stated above, NRC approved the discontinuation of monitoring for Tc-99 in 2013. Consequently, comprehensive, synoptic monitoring for Tc-99 in groundwater has not been conducted and a data set that could be used to generate current representative Tc-99 concentrations in groundwater is not available.

To provide the best available estimates of Tc-99 groundwater concentrations for remediation areas and the Western Area Treatment Facility (WATF) influent stream, a cursory evaluation of available Tc-99 data was conducted. Groundwater sampling results from monitoring events conducted from 2005 through 2012 consisted of 40 data points (including four duplicate samples), of which 25 came from Monitor Wells 1312 and 1336A. Extending the data set back to 2003 added an additional 108 data points (including 7 duplicate samples). Consequently, groundwater sampling results from monitoring events conducted from 2003 through 2012 were used in this evaluation. In addition, the database records detection limits of 0.00 pCi/L for numerous samples which yielded low Tc-99 concentrations; that data was used although the quality of the data may be questionable.

In contrast to the Tc-99 data available for evaluation, representative groundwater concentrations for uranium, nitrate, and fluoride presented in the *Facility Decommissioning Plan – Rev 1*[4], submitted to the NRC and the DEQ in November 2018, were derived from the statistical evaluation of hundreds of sample results (generated only since the license was transferred to the CERT in 2011).

The following table presents average Tc-99 groundwater concentrations calculated for Western remediation areas from which groundwater will be extracted. The values presented in the table were calculated by averaging all available Tc-99 results for groundwater samples collected between 2003 and 2012, for monitor wells located in each of the corresponding remediation areas. The locations and extents of the Western remediation areas, including those presented in the table, are illustrated on Attachment 1 – a proposed revision of Figure 8-1 from *Facility Decommissioning Plan – Rev 1*.

Tc-99 Concentration Averages			
Remediation Area	**Average Concentration (pCi/L)**	**Nominal Cumulative Flow Rate (GPM)**	**Flow Rate Weighted Average Concentration (pCi/L)**
WU-PBA	300	5	6.00
WAA U>DCGL	346	99	137
WAA-EAST	62	20	4.96
WAA-BLUFF	750	104	312
1206-NORTH	27	8	0.86
WAA-WEST[1]	11	10	0.44
WU-1348[2]	300	4	4.80
Total		**250**	**466**

Notes:
[1]Tc-99 concentrations were not detected in the WAA-West remediation area. The lowest value reported for adjacent area WAA-EAST was used for the purpose of this evaluation.
[2]Tc-99 concentration data are not available for the WU-1348 remediation area; consequently, the Tc-99 concentration for the nearby WU-PBA remediation area was used for the purpose of this evaluation.
GPM – gallons per minute

[4] Environmental Properties Management LLC, November 2018.

The nominal groundwater extraction rate for each remediation area, based on the 60-percent remediation design effort, was used to develop flow-rate-weighted average Tc-99 concentrations for groundwater extracted from each Western remediation area. Both the nominal groundwater extraction rates and the flow-rate-weighted average Tc-99 concentration for each remediation area are presented in the table above. The sum of flow-rate-weighted average Tc-99 concentrations for each area represents the potential Tc-99 concentration in the combined WATF groundwater influent stream, also presented in the table above.

The table shown above reports only the concentrations of Tc-99 anticipated for remediation areas from which groundwater will be ***extracted***. Treated water will be ***injected*** into the following remediation areas:

1. WU-UP1
2. WU-UP2-SSA
3. WU-UP2-SSB
4. WU-BA3

Although there is no Tc-99 data available for monitor wells located in the following remediation areas: WAA-WEST, 1206-NORTH, WU-1348, or WU-BA3, approximately 50% of the Tc-99 concentration data available from 2003 through 2012 pertains to groundwater samples collected from monitor wells located in the first three injection areas listed above, as well as one monitor well screened in UP1 Sandstone B (SSB) .

During remediation activities, treated groundwater will be injected into WU-UP1, WU-UP2-SSA, and WU-UP2-SSB and subsequently recovered by extraction wells located within the WAA-BLUFF remediation area. The average Tc-99 concentration for these UP1 and UP2 remediation areas is approximately 707 pCi/L; less than the 750 pCi/L Tc-99 concentration calculated for the WAA-BLUFF remediation area (see table above). Because the Tc-99 in groundwater flushed from injection areas will be mixed with the injected water, the 750 pCi/L Tc-99 concentration calculated for the WAA-BLUFF area provides the most conservative (i.e., highest) estimate of the Tc-99 concentration anticipated for the WAA-BLUFF extraction wells.

As detailed in the table above, the estimated concentration of Tc-99 in the influent is approximately 466 pCi/L. The specific activity of Tc-99 is approximately 17,000 pCi per microgram (µg). The ***activity*** concentration of 466 pCi/L for Tc-99 in influent (see table above) would therefore be approximately equal to a ***mass*** concentration of 0.027 µg/L Tc-99.

Tc-99 in the Cimarron River

The Cimarron River was sampled for Tc-99 only once between 2003 and 2012. The sample was collected in May 2005 at Location 1202 – the sampling location representing the Cimarron River water quality downstream of the Cimarron site. The result for this sample was 300 pCi/L, with a detection limit of 300 pCi/L; the laboratory assigned a data qualifier of "U" (undetected) to the result.

The Oklahoma Water Resources Board (OWRB) has established water quality standards for designated beneficial uses of surface water. The OWRB determines what beneficial uses apply to various surface water bodies in the State of Oklahoma. There are no water quality standards for either Tc-99 or gross beta for any of the Cimarron River's designated beneficial uses. However, for a public water supply, the OWRB has established a water quality standard of 50 pCi/L for gross beta. The DEQ has informed the CERT that this value may be considered a relevant and appropriate discharge permit limit for the WATF effluent to Outfall 001.

Samples collected from Cimarron River locations 1201 (upstream of the Cimarron site near the Highway 74 bridge) and 1202 (downstream of the Cimarron site northeast of BA1) were analyzed for gross beta every year from 2003 through 2006, and from 2009 through 2018, as part of the license-required environmental monitoring program. Gross beta results have consistently been below or slightly above the laboratory detection limit of 10 pCi/L, with three exceptions – the sample collected from 1201 (upstream) in May 2005 yielded a gross beta concentration of 28.6 pCi/L, and samples collected from 1202 (downstream) in May 2005 and May 2006 yielded gross beta concentrations of 31.6 and 22.6 pCi/L, respectively. Due to the uncertainties associated with the analytical methods used for these samples, the results are considered essentially the same for the upstream and downstream samples. Based on available data there is no evidence of Tc-99 impact to the Cimarron River. From 2003 through 2018, there have been more gross beta detections in upstream samples than in downstream samples.

Tc-99 in Waste Materials

Facility Decommissioning Plan – Rev 1, submitted to the NRC and the DEQ in November 2018, proposes to dispose of spent resin generated by the ion exchange system at a facility licensed to receive low level radioactive waste (LLRW). It also proposes to dispose of biomass generated by the biodenitrification system at an industrial waste disposal facility.

The treatability test conducted in 2013 indicated that the ion exchange resin to be used for uranium removal will also remove Tc-99. Because the removal of Tc-99 was not considered to be a remediation objective, influent groundwater used during the treatability test was not analyzed for Tc-99; consequently, it is not known if all Tc-99 present in the groundwater routed to the WATF will be removed by the ion exchange resin.

If it is assumed that some of the Tc-99 in groundwater will pass through the ion exchange treatment systems, it is not known if that Tc-99 will accumulate in the biomass generated by the biodenitrification process that follows the ion exchange systems.

If it is assumed that a portion of the Tc-99 in the WATF influent passes through both the ion exchange and biodenitrification treatment systems Tc-99 and is present in the effluent, it appears that water quality standards for beneficial use designations for the Cimarron River do not include limits for either Tc-99 or gross beta concentrations. A similar situation exists for the injection of treated water into the Western Upland remediation areas.

Conclusion and Proposed Path Forward

Tc-99 may emerge from the WATF groundwater treatment systems in one of three ways:

1. It may be removed from the groundwater by the ion exchange resin and be disposed in the spent resin as LLRW.
2. If Tc-99 is present in the ion exchange treatment system effluent, some or all of it may be metabolized by microorganisms in the biodenitrification system, resulting in detectable Tc-99 concentrations in the waste generated as biomass. If Tc-99 ***is not*** detected in the biomass, the waste material will be disposed of in accordance with discharge permit OK0015010 in an industrial waste disposal facility. If Tc-99 ***is*** detected in the biomass, the disposition of the waste will need to be determined.
3. If Tc-99 passes through both the ion exchange and biodenitrification systems, it may be present in detectable concentrations in the WATF effluent. Most of the treated water will be discharged to the Cimarron River via Outfall 001, with the remainder injected into the Western Upland remediation areas as shown in the attached figure.

EPM proposes to conduct a comprehensive, synoptic sampling and analysis event to evaluate current gross beta and Tc-99 activity concentrations in groundwater at the Cimarron site. At least one monitor well within each Western and BA1 remediation area will be sampled and analyzed for gross beta and Tc-99 activity to provide a data set with adequate spatial distribution. Upon evaluation of the data generated by this sampling and analysis event, additional events may be conducted to provide a more extensive data set. Due to the temporal variability observed in historical Tc-99 groundwater data, multiple synoptic sampling events may be required to establish representative Tc-99 concentration values for each remediation area and the WATF influent stream.

EPM also proposes to conduct a treatability test using site-specific groundwater and the ion exchange resin selected for uranium removal to assess the potential for the ion exchange resin to remove Tc-99 from the influent groundwater.

EPM contacted the DEQ Water Quality Division to determine if an Oklahoma Pollution Discharge Elimination System (OPDES) permit modification should be requested to address the potential presence of Tc-99 in the discharge to Outfall 001. The DEQ requested a letter describing this issue. Based on the information provided in this letter, and/or data generated by the above-described sampling and analysis program, the DEQ will determine if a permit modification may be needed.

EPM also contacted the DEQ Underground Injection Control (UIC) Program to determine if the presence of Tc-99 in the treated water to be injected into Burial Area #3 and the UP1 and UP2 remediation areas must be included in the description of the injected water. The UIC Program staff requested information similar to that requested by the Water Quality Division. Based on the information provided in this letter, and/or data generated by the above-described sampling and analysis program, the UIC Program staff will determine if additional notification is needed.

A scope of work and proposed budget to conduct additional groundwater assessment and the ion exchange treatability study described above will be submitted to the NRC and the DEQ. Funding is already available in the proposed budget for 2019 in Task 6, "Unanticipated Work". However, the scope of work and allocation of costs must be approved to authorize this additional work.

Finally, *Facility Decommissioning Plan – Rev 1* will be revised to include statements addressing the potential presence of Tc-99 in the WATF influent, effluent, and spent ion exchange resin, as well as the disposition of biomass, should Tc-99 be detected in the biomass, at a facility that is licensed or permitted to receive this material. The analysis of both spent resin and biomass for Tc-99 will be added to Table 8-3b, In-Process Monitoring. The analysis of Tc-99 in WATF influent and ion exchange treatment system effluent will also be added to Table 8-3b. These revisions will be included in the responses to the NRC's February 28, 2019 request for supplemental information.

If the DEQ Water Quality Division determines that a modification to the OPDES permit is needed, and that the concentration of Tc-99 (or gross beta activity) in Outfall 001 must be included in monthly discharge monitoring reports, Table 8-3c will also be revised to address permit requirements. The revision of Table 8-3c to reflect the addition of Tc-99 to the discharge monitoring program will be made in accordance with License Condition 27(e).

Please call me at (405) 642-5152 or e-mail me at jlux@envpm.com if you have questions or desire clarification. Thank you.

Sincerely,

Jeff Lux, P.E.
Project Manager

cc: Michael Broderick, DEQ Land Protection Division (electronic copy only)
Carol Paden, DEQ Water Quality Division (electronic copy only)
Hillary Young, DEQ Land Protection Division (electronic copy only)
NRC Public Document Room (electronic copy only)

ATTACHMENT 1
PROPOSED REVISED FIGURE 8-1 FROM
FACILITY DECOMMISSIONING PLAN – REV 1

FIGURE 8-1
WESTERN AREA GROUNDWATER REMEDIATION AREAS
FACILITY DECOMMISSIONING PLAN
REVISION 1

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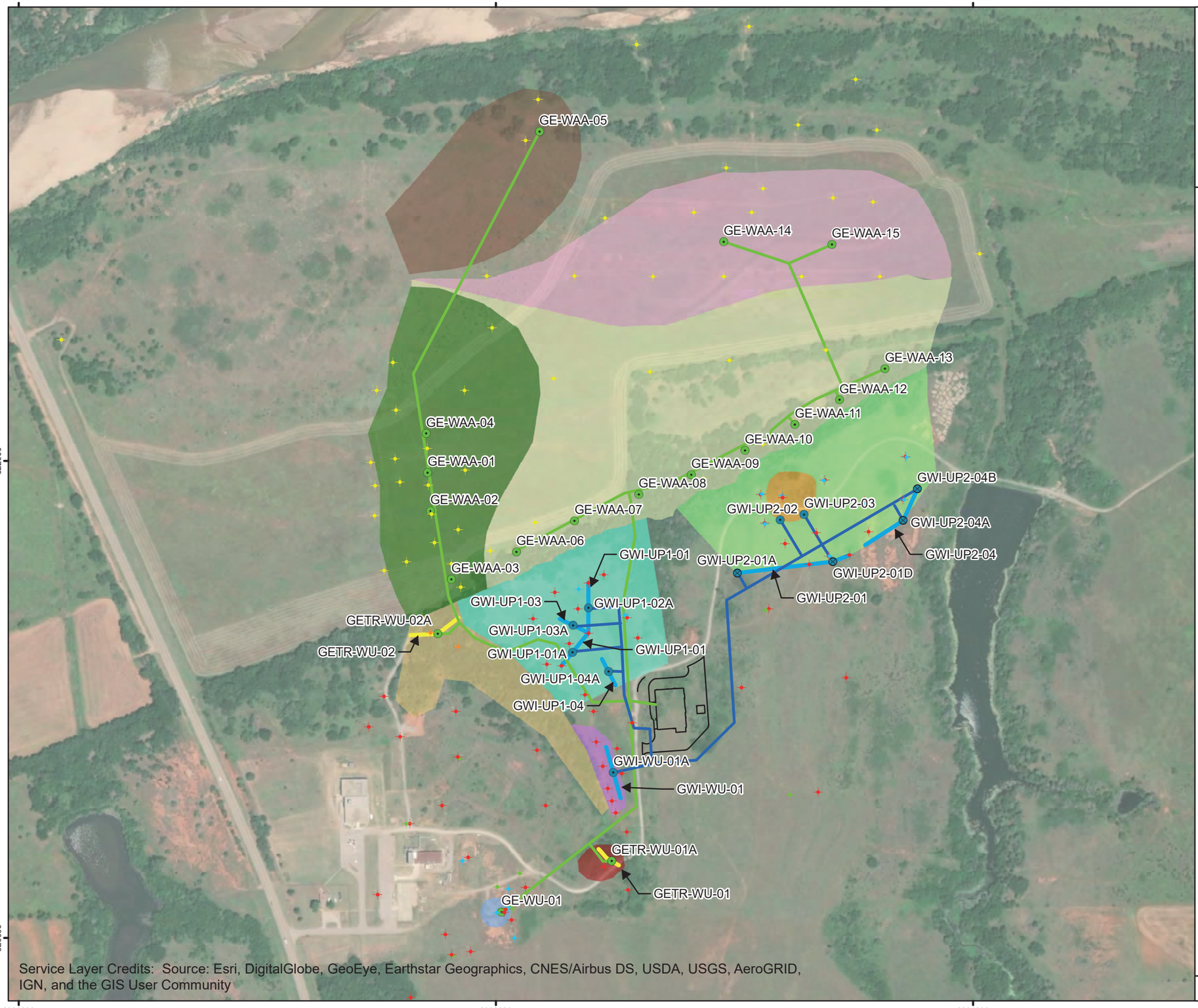

Legend

- MONITORING WELL IN ALLUVIUM
- MONITORING WELL IN SANDSTONE A
- MONITORING WELL IN SANDSTONE B
- MONITORING WELL IN SANDSTONE C
- MONITORING WELL IN TRANSITION ZONE
- EXTRACTION WELL (PLANNED)
- EXTRACTION WELL (INSTALLED)
- INJECTION WELL (PLANNED)
- INJECTION WELL (INSTALLED)
- GROUNDWATER EXTRACTION PIPES
- GROUNDWATER INJECTION PIPES
- GROUNDWATER EXTRACTION TRENCH
- TREATED WATER INJECTION TRENCH
- WESTERN AREA TREATMENT FACILITY
- WU-BA3 REMEDIATION AREA
- WAA-BLUFF REMEDIATION AREA
- WAA-EAST REMEDIATION AREA
- WAA-WEST REMEDIATION AREA
- WAA U>DCGL REMEDIATION AREA
- 1206-NORTH REMEDIATION AREA
- WU-UP2-SSB REMEDIATION AREA
- WU-PBA REMEDIATION AREA
- WU-UP1 REMEDIATION AREA
- WU-UP2-SSA REMEDIATION AREA
- WU-1348 REMEDIATION AREA

Notes:
1) Injection trenches GWI-UP1-01, GWI-UP1-02 and a portion of GWI-UP2-01 were installed in 2017.
2) Injection wells GWI-UP1-01A, GWI-UP1-02A, GWI-UP2-01D were installed in 2017.

0 210 420 840 Feet

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COORDINATES :
(NAD 83) STATE PLANE OKLAHOMA NORTH FEET

DATE :
MAP PRODUCED - 5/3/2019