



STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF REMEDIATION - DOE OVERSIGHT OFFICE
761 EMORY VALLEY ROAD
OAK RIDGE, TN 37830

July 1, 2016

Mr. John Michael Japp
DOE FFA Project Manager
PO Box 2001
Oak Ridge, TN 37831-8540

Dear Mr. Japp

TDEC Comments

**Fiscal Year 2016 Phased Construction Completion Report for the Oak Ridge Reservation
Environmental Management Waste Management Facility**

DOE/OR/01-2709&D1

March 2016

The Tennessee Department of Environment and Conservation (TDEC) Division of Remediation has reviewed the above-referenced document pursuant to the Federal Facility Agreement (FFA) for the Oak Ridge Reservation (ORR). Based on that review, TDEC provides the enclosed comments.

Questions or comments concerning the enclosed comments should be directed to Howard Crabtree at the address above or by phone at (865) 220-6571.

Sincerely

CR Thompson for Randy Young

Randy Young
FFA Manager

Enclosure

xc Patricia Halsey, DOE
Brian Henry, DOE
Jeff Crane, EPA
Shari Meghreblian, TDEC

General Comments

1. This comment may not require modification of the document, but it is intended to call attention to unresolved issues with operations and environmental monitoring that have persisted at the facility for more than a decade. Until these issues are resolved, compliance with a number of the applicable or relevant and appropriate requirements (ARARs) listed in Appendix A of the document cannot be demonstrated definitively.

Protocols for environmental monitoring at the Environmental Management Waste Management Facility (EMWMF) have changed significantly since last receiving formal approval in a primary Federal Facilities Agreement (FFA) document. Documentation that prescribes environmental monitoring requirements, including a sampling and analysis plan and quality assurance project plan, are to be addressed in the Remedial Action Work Plan that is currently being revised. Little formal progress has been made toward resolving these issues over the past year.

Questions remain about the quality of analytical data, particularly radiochemical analyses of groundwater samples gathered since the facility began operations. No formalized procedures or guidance have been approved for demonstration of false positives in EMWMF environmental monitoring data, although the data indicate detection of a number of man-made radionuclides in groundwater. While some progress is now being made on evaluation of historical data and development of a Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP), the EMWMF has operated for over a decade without a scientific basis to establish consensus concerning potential releases to the environment.

DOE should prioritize establishing and formalizing operational and monitoring requirements such that there will be, in the near future, a defensible technical basis for interpretation of environmental data. These on-going issues should reach closure before the facility is closed and before any additional waste disposal units are approved under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

2. The PCCR indicates that monitoring reported in the document was implemented in accordance with *Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) for Environmental Monitoring at the Environmental Management Waste Management Facility, Oak Ridge, Tennessee* (UCOR-4156/R2). UCOR-4156/R2 was an appendix to a Remedial Action Work Plan that is currently in dispute. On June 16, 2014, TDEC received the same SAP/QAPP (i.e., UCOR-4156/R2) for review and provided comments to the Department of Energy on September 16, 2014. As DOE has apparently moved forward in implementing SAP/QAPP without responding to TDEC comments or addressing associated issues, it does so without TDEC approval. DOE needs to resolve these issues and TDEC has provided a second copy of the September 16, 2014 comments on the SAP/QAPP as an attachment for DOE's further consideration.

3. Has DOE performed any activities to support the maintenance of the facility Performance Assessment during 2016? If so, please include a summary of these activities in the PCCR.
4. There is an algae problem in the sediment basin causing potential high PH releases into Bear Creek. While the cause of the problem is understood, what remedies have been implemented to reduce the pH levels below the releasable limit of 9?
5. TDEC commends DOE for placing interim cover on Cells 1-4, thereby greatly reducing generation of leachate and contact water.

Specific Comments

1. **Page 13, Figure 4:** Please define *UCL – 95 Allowance*.
2. **Page 15, Figure 5:** Please define *CA/VWSF* and *HI/VWSF*.
3. **Page 16, Paragraph 3, Line 1:** According to Table 7, the word *nearly* should be replaced with *more than*.
4. **Page 16, Paragraph 4:** The text mentions that leachate generation decreased in 2014, but the discharge volumes are not stated. The values should be presented, as it is difficult to infer them from Figure 6.
5. **Page 18, Section 3.8.3:** Please add two additional bullets to this section:
 - Rain/surface water is collected in Cell 6. This water is held back, allowing suspended solids to settle out prior to its release to EMWMF 4B and the ditch leading to the sediment basin.
 - The area adjacent to the steps leading to the underdrain released sediment to NT-4 due to erosion during rain events. This area has been covered with cement to reduce sediment loading to Bear Creek.
6. **Page 22, Section 3.9.2:**

The Environmental Management Waste Management Facility (EMWMF) Record of Decision (ROD), EPA/ROD/R04-00/028, does not include the following federal regulation as an ARAR.

40 CFR 264.301(c)(2): The leachate collection and removal system immediately above the top liner must be designed, constructed, operated, and maintained to collect and remove leachate from the landfill during the active life and post-closure care period. The Regional Administrator will specify design and operating conditions in

the permit to ensure that the leachate depth over the liner does not exceed 30 cm (one foot). The leachate collection and removal system must comply with paragraphs (c)(3) (iii) and (iv) of this section.

Also, the following state regulation is omitted from the ROD.

TDEC Rule 0400-11-01-.04(4)(b): Class II Disposal Facilities must be located, designed, constructed, operated, and maintained in accordance with the standards for Class I disposal facilities in subparagraph (a) of this paragraph unless a waiver from one or more of those standards is obtained as set forth in paragraph (5) of Rule 0400-11-01-.01.

This state regulation cites Rule 0400-11-01-.01, which references TDEC Rule 0400-11-01-.04, (4) Leachate Migration Control Standards:

(a) Class I Disposal Facilities

7. The leachate collection and removal system must, at a minimum, meet the following requirements:

(i) The leachate collection and removal system must be designed, constructed, operated, and maintained such that the leachate depth over the liner does not exceed one foot as calculated referencing the infiltration volume of the 25-year 24-hour storm through the intermediate cover.

Normally, closure of valves in the leachate collection system, and particularly in the leak detection system, would imply a violation of these regulations—even at a municipal solid waste disposal facility. The EMWMF ROD omits these fundamental landfill regulations. Therefore, the EMWMF is not required to self-report ROD violations when leachate collection and/or leak detection valves are closed, as described in Section 3.9.2, *Closure of Leachate Collection System Valves*, of the *Phased Construction Completion Report* (PCCR).

However, as noted in Table 2.7 of the PCCR, the ROD does include a related but less specific applicable requirement from 40 CFR 264.301(c)(4):

The owner or operator shall collect and remove pumpable liquids in the leak detection system sumps to minimize the head on the bottom liner.

The EMWMF has a low-permeability protective layer that may allow water to pond in the EMWMF waste cells without creating hydrostatic pressure on the liner. In the absence of the more stringent and prescriptive requirements in the ROD, the PCCR should provide more detailed data (e.g., daily leachate collection and leak detection system discharges immediately before and after opening the valves) to support the statement that this

requirement was not violated. Alternatively, DOE should self-report a potential ROD violation.

7. **Page 27, Section 3.11, Last Paragraph:** The hyperlink is not accessible externally. TDEC requests access to the implementing documents—ideally through the SharePoint site where current versions are maintained (as described on Page A-3).
8. **Page 28, Section 3.12.4:** *"The other changes incorporated from the SAP/QAPP were as follows: changing the groundwater (shallow wells) and surface water sample collection from quarterly to semi-annually, changing the sample frequency for the deep groundwater wells (GWs) from quarterly to biennially, changing the leachate sampling from quarterly to semi-annually for the large COC list, changing the frequency of sample collection from every 140,000 gal to 120,000 gal, and collecting the sample from a single inlet port instead of from each leachate tank."*

Reducing sampling frequency reduces early detection of contaminant migration. As stated in General Comment 1 in TDEC comments on the SAP/QAPP (attached), the state does not agree to reducing the sampling frequency from quarterly to semiannual.

9. **Page 29, Section 3.13, 3rd Bullet:** TDEC is willing to meet with DOE to discuss refining the list of analytes, as discussed during the May 3, 2016 project team meeting regarding wastewater management for the EMWMF and the proposed Environmental Management Disposal Facility (EMDF).
10. **Page 29, Section 3.14, 6th Bullet:** The text notes that the leak detection system (LDS) inflow exceeded the notification leakage rate on three occasions. It should also state that two of those *occasions* lasted for three weeks.
11. **Pages 33-34, Section 5.2, Third Paragraph:** Please document the methodology or decision rules used to identify concentrations of volatile organic compounds and semi-volatile organic compounds considered to be *false positive results* and results suspected to be outliers.
12. **Page 38, Table 13:** Please review the following issues and correct as appropriate.

GW-639: This well is designated as both *Across geologic strike* and *Along geologic strike*. It cannot be both, and it appears that GW-639 lies across strike—not along strike.

GW-916: Indicate whether this well is across or along strike.

GW-924/GW-926: This well pair is designated as both *Across geologic strike* and *Along geologic strike*. It cannot be both, and it appears they lie across strike—not along strike.

13. **Pages 40-41, Figures 12-13, Legend:** Should *Upper Gradient Well* be *Upgradient Well*?

14. **Page 42, First Paragraph:** The report states that groundwater flow rates¹ in fractured rock are estimated using a modification of the Darcy equation. This approach is based on the assumption that *"the continuum of saturated interconnected fractures can be considered an equivalent porous medium"*. TDEC believes that the porous medium assumption is invalid. This position is explained in Specific Comment 7 of the May 16, 2016 TDEC Comment Letter on the *Remedial Investigation/Feasibility Study for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal, Oak Ridge, TN* (DOE/OR/01-2535&D4).

After noting that groundwater flow rates (velocities) in the deep bedrock were not estimated, the report cites a reference and speculates that the rates are *"probably as low as a few centimeters per year"*. This phrase is misleading because the range of velocities in deep bedrock at the EMWMF is unknown. It is acceptable to cite the reference to provide a regional context for the *lower* endpoint of groundwater velocity in the intermediate and deep zones. However, the cited references does not document the upper end of the spectrum, which is more relevant for characterizing groundwater flow and contaminant fate and transport.

15. **Page 43, Table 16, Title:** Change *calculated* to *estimated* to be consistent with the text on Page 42, which is more accurate. *Estimated* is more accurate because of 1) the (questionable) assumption that fractured bedrock at EMWMF can be considered equivalent to a porous medium and 2) the potential for higher groundwater velocities, as described in the paragraph that precedes Table 16.
16. **Page 45, Bullet beginning with *Uranium*:** *"The highest concentrations of U-233/234 (0.827 pCi/L), U-235/236 (0.511 pCi/L), and U-238 (0.453 pCi/L) were reported for groundwater samples from the EMWMF underdrain (U-233/234 and U-238) and GW-363 (U-235/236) are substantially below the groundwater threshold values for U-233/234 (2 pCi/L), U-235/236 (1 pCi/L), and U-238 (1.7 pCi/L)."*

This sentence is unclear. It appears that *and* should be inserted before *are*. Alternatively, the sentence may need to be broken into two sentences for clarity.

17. **Page 45, Bullet beginning with *Isotopes*:** *"Sr-90, tritium (H-3), uranium (U)-233/234, U-235/236, and U-238 are the isotopes designated as indicator contaminants that were detected (i.e., > minimum detectable activity [MDA] and total propagated uncertainty [TPU]) in one or more groundwater samples collected from the EMWMF underdrain and shallow and deep downgradient wells during FY2015 (Table 18)."*

¹ Flow rate is an imprecise term. The use of an *effective porosity* implies velocity. The Darcy flux in the deep system can be quite low, even though velocities may be quite high.

This paragraph needs to be rewritten to reflect that the threshold limit for tritium (H-3) is 500, but the threshold limit for Sr-90 is 4.

18. **Page 45, Last Bullet:** *"Comparison of the surface water results to the groundwater threshold values is a Best Management Practice, and an exceedance in surface water potentially reflects impacts from operations at the EMWMF and not a release to the uppermost aquifer."*

Clarify the meaning of *impacts from operations*. Is the intent to state that operations are impacting surface water directly (e.g., through runoff or airborne deposition) without impacting groundwater?

19. **Page 46, Last Sentence before Table 18:** *"Accordingly, the FY2015 detection monitoring data do not indicate that contaminants derived from wastes disposed at EMWMF have been released to the uppermost aquifer."*

This statement is not be supported by the available data, given uncertainties regarding the methodology or decision rules used to identify *false positive results* and *suspected outliers*, not to mention the lack of groundwater monitoring wells downgradient of EMWMF along strike.

20. **Page 48, Table 19:** What is the data assessment (Assmt)? Is this a data usability evaluation? Please document the methodology or decision rules used.

21. **Pages 51-54, Figures 16-19:** Graph legends should define the solid/filled symbol for >MDA.

22. **Page 56, Section 5.5.2.1:** *"Operational data have demonstrated the effectiveness of these layers in collecting and removing leachate from the disposal cells. As a result, it is highly improbable for any significant quantity of groundwater to infiltrate through these geomembranes and into the waste cells."*

The data do not conclusively support the statement made in the first sentence or the conclusion drawn in the second sentence. Operational data demonstrate that leachate has been collected and removed, but uncertainties exist regarding the amount of leachate that may have penetrated the liner. It is not clear whether any of the analytical results designated as *false positive results* and *suspected outliers* represent leakage of the liner and geologic buffer. Moreover, it is unclear what quantity of water would be considered *significant*.

23. **Page 57, Section 5.5.2.1:** *"As described in UCOR-4517, Engineering Feasibility Plan for the Elevated Groundwater Levels in the Vicinity of PP-01, EMWMF, Oak Ridge, Tennessee, the increased calculated water level readings at PP-01 and PP-02 may be the result of several conditions, including greater recharge from increased amounts of precipitation over the past*

several years, localized (anomalous) hydrogeologic conditions near these PPs, and increased saturated pore pressures resulting from Cell 3 waste loading. It is also possible, as noted in the Engineering Feasibility Plan, that because water levels are measured indirectly using pressure measurements as an indicator of water levels, the data reflect subsurface pressures and may not reflect increased groundwater levels into the geologic buffer zone. Additional evaluation is planned for FY2016 to better understand the subsurface conditions."

TDEC's interpretation of the causes of elevated water level readings is not entirely consistent with those of DOE, as explained in the following comments.

- Water level at PP-01: If there is an upward gradient at PP-01, as there is elsewhere around EMWMF, then the component of vertical flow results in hydraulic head that decreases upward. In this case, the water level measured in a hypothetical well at that location would be slightly lower than the level inferred from the pore pressure measured by the pneumatic piezometer. The difference is probably small, given that the upward gradient around EMWMF is typically a few feet per hundred feet.
- Pore pressure increased by loading of the cell: Loading a porous medium results in a temporary pore pressure increase. The question is whether loading changed the pressure at PP-01 significantly. Pressure data indicate that water levels were below the base of the geologic buffer at PP-01 when loading started. Thus, even if the buffer is sufficiently tight to serve as a confining layer, the initial response would have been compression and displacement of air in the underlying material. The loading over this piezometer occurred primarily during the 2007-2011 timeframe, but pore pressure continued to climb after 2011. Pressure readings fell during the second half of 2008, when the most rapid cell loading occurred. Pressure due to loading propagates rapidly, so the effects of loading were likely minimal.
- Causes for water level rise: Water levels on the north side of EMWMF have increased over time and may cause groundwater to intrude into the geologic buffer at PP-01 and PP-02. We believe this to be the case and agree with DOE on this point. Given the very good correlation inferred water levels at PP-01 with those near the northern boundary of the disposal facility, TDEC believes other causes of groundwater intrusion are small compared with the effect of increasing water levels between Pine Ridge and EMWMF. The causes for rising water levels include increased rainfall since the dry years of 2005-2007, increased runoff upgradient of the piezometers due to recent stormwater diversion off the landfill surface, and local hydrogeologic changes caused by EMWMF construction. There may be other causes for rising water levels along the northern facility boundary, but the most significant reason appears to be hydraulic head increase in the recharge area.

During 2016, DOE, TDEC, and EPA have held meetings to discuss ways to better monitor water levels and, if necessary, deploy corrective actions to lower groundwater under the northeast corner of EMWMF. The FFA parties should reach consensus on causes of elevated groundwater levels at EMWMF, approaches to monitoring water levels, and strategies to mitigate problems resulting from groundwater intrusion before finalizing plans for additional CERCLA waste disposal in Bear Creek Valley—e.g., the proposed EMDF.

24. **Page 62, Paragraph before Table 24:** *"The ammonia exceedance for NT-04, which the laboratory qualified as an estimated value, does not appear to be related to EMWMF Operations as previous stormwater sampling/analysis results for NT-04 were below the AWQC. The TSS exceedance at EMWNT-03A is probably a sampling artifact. The estimated flow rate when the sample was collected was 1283 L/min. Lower TSS levels were reported for previous stormwater samples collected under equivalent or higher flow rates (e.g., TSS of 6.8 mg/L in stormwater sample collected at estimated flow rate of 3227 L/min in January 2015). It is possible that some sediment was disturbed during this sampling event."*

Further clarification is needed to explain how previous results indicate that exceedances are not related to EMWMF.

25. **Page 64, Section 5.5.7:** The PCCR should provide more detail regarding the sampling and averaging methodology if batch limits for ambient water quality criteria are applied after dilution with storm water, rather than at the source of the discharge. The current working version of the SAP/QAPP has yet to be approved by the regulators.
26. **Page 64 (Last Paragraph) and Page 66 (Figure 23):** *"None of the calculated SOF values exceed the 25 mrem SOF limit of 1 established by DOE and TDEC...."*

The text says the SOF is 1; Figure 23 shows a value >1. If these values are correct, please explain this apparent discrepancy in the text. If not, please correct as appropriate.

27. **Page 69, Section 5.7, First and Second Bullets:** TDEC does not agree that either of these conclusions can be made definitively:
- The FY2015 detection monitoring results do not indicate that contaminants potentially derived from wastes disposed in EMWMF have entered the uppermost aquifer.
 - Groundwater elevations were below the bottom of the 10-ft geologic buffer everywhere, except for an area with calculated groundwater readings elevated near PP-01 and PP-02.

While the 2015 analytical results show no contaminants above the threshold levels for detection monitoring, as stated on page 46, there are detections of manmade

radionuclides in groundwater (such as strontium) that have no known sources in Bear Creek Valley except EMWMF. As indicated in Table 28 on page 70, assessment of these data is ongoing.

The statement concerning groundwater elevations is overly optimistic. While it is generally true that groundwater elevations do not intrude into the geologic buffer over the majority of the EMWMF (as supported by piezometer data), there may be groundwater intrusion into the buffer, or even the liner, in Cells 1 and 2, where groundwater levels are not monitored.

TDEC notes that the EMWMF ROD includes the following, as required by 40 CFR 264.301(c)(5): If the leak detection system is located below the seasonal high water table, a demonstration must be made that the system will not be adversely affected by groundwater. TDEC encourages ongoing efforts to initiate water level monitoring in this area. Evaluation of discharges from the leak detection system might also be required to provide evidence of ROD compliance.

28. **Page 47, Table 18:** The purpose of detection monitoring is to determine if there have been releases from the waste disposal facility. The detection of man-made radionuclides in groundwater, barring another source of contamination) would be indicative of a release from the facility. Please explain, why strontium-90, a man made radionuclide, would be detected in five of the EMWMF groundwater monitoring wells. Is the EMWMF leaking?
29. **Page 48, Table 19:** Please explain, why Strontium-90, Uranium-234, and uranium-238 would be detected above threshold values in EMWNT-03A.

Editorial Comments

1. **Page 29, Section 3.13, First Bullet:** Consider adding *during FY2015* to the end of the sentence for clarity.
2. **Page 38, Table 13, Third Column Header:** Consider adding *Screen* before *Mid-point*.
3. **Page 60, Section 5.5.3, First Sentence:** "*Sampling/analysis of surface water monitoring at stations EMWNT-03A, EMWNT-05, and EMW-VWEIR (Fig. 8) was performed monthly for EMWMF Operations monitoring during FY2015.*"

This is an awkward sentence. This phrase seems redundant: "*Sampling/analysis of surface water monitoring*". Also, consider removing the second use of monitoring, which seems unnecessary.

4. **Page 60, Table 22, Units:** In the lower part of the table, consider changing *Ppm* to *ppm* to be consistent with usage in the upper part of the table.

5. **Page 60, Table 22, Footnotes:** Capitalization is inconsistent for *Degrees Celsius* and *ambient water quality Criteria*.
6. **Page 61, Table 23:** Consider using *Semiannually* (adverb) instead of *Semiannual* (adjective).
7. **Page 64, Section 5.5.7:** The SOF is a dimensionless quantity, so the use of *pCi/L* units appears to be an error.