Appendix B

Supplemental Surface Water and Treated Effluent Information
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Abbreviations

DOE  U.S. Department of Energy
FFCA  Federal Facilities Compliance Agreement
FRL  final remediation level
GMA  Great Miami Aquifer
IEMP  Integrated Environmental Monitoring Plan
LMICP  Comprehensive Legacy Management and Institutional Controls Plan
NPDES  National Pollutant Discharge Elimination System
OU5 ROD  Final Record of Decision for Remedial Actions at Operable Unit 5

Measurement Abbreviations

cfs  cubic feet per second
mg/L  milligrams per liter
pCi/L  picocuries per liter
µg/L  micrograms per liter
B.1.0 Surface Water and Treated Effluent

This appendix presents additional surface water and treated effluent data in support of Section 4 of this Fernald Preserve 2013 Site Environmental Report. This appendix provides an evaluation of the final remediation level (FRL) exceedances for surface water and treated effluent, including an assessment of potential cross-media impacts to the groundwater pathway. Surface water data are available through the U.S. Department of Energy (DOE) Office of Legacy Management’s Geospatial Environmental Mapping System (http://www.lm.doe.gov/Fernald/Sites.aspx).

Surface water and treated effluent samples are collected as required by the Integrated Environmental Monitoring Plan (IEMP), which is Attachment D of the Comprehensive Legacy Management and Institutional Controls Plan (LMICP) (DOE 2014). Figures B-1 and B-2 show all surface water monitoring locations. The following information is discussed in this attachment:

- Surveillance monitoring (see Section B.1.1).
- Federal Facilities Compliance Agreement (FFCA)/Final Record of Decision for Remedial Actions at Operable Unit 5 (OU5 ROD) (DOE 1996) compliance (see Section B.1.2).
- Controlled and uncontrolled areas (see Section B.1.3).

The National Pollutant Discharge Elimination System (NPDES) permit sampling is not discussed in this attachment because it is discussed in detail in Section 4, “Surface Water and Treated Effluent Pathway,” of this report.

B.1.1 Surveillance Monitoring

Surveillance monitoring is the comparison of surface water and treated effluent analytical results to the surface water FRLs to determine effects of remediation activities on the surface water pathway. Surveillance monitoring also includes an assessment of the effects surface water may have on the groundwater pathway (referred to as cross-media impacts).

All 2013 data were compared to FRLs. Samples collected at the Parshall Flume (PF 4001) are used in the surveillance evaluation because this is the last point treated effluent is sampled prior to discharge to the Great Miami River.

Water discharges to the Great Miami River are required to be below the FRLs at the point where discharged water is completely mixed with water in the Great Miami River (i.e., outside the mixing zone). In cases where the Parshall Flume data are already below the FRLs, no further action is taken. When the Parshall Flume data are above the FRLs, to make a determination of each constituent’s concentration at this point in the Great Miami River, the following calculation is applied:

$$C_{PF4001} = \frac{[Q_{10}][C_{GMR}]+[Q_{PF}][C_{PF}]}{[Q_{10}]+[Q_{PF}]}$$

where:

$$C_{PF4001} = \text{Flow-weighted average concentration outside the mixing zone in the Great Miami River, picocuries per liter (pCi/L), micrograms per liter (µg/L), or milligrams per liter (mg/L)}$$

$$Q_{10} = \text{7-day, 10-year low flow, 706 cubic feet per second (cfs)}$$
C_{GMR} = \text{Background concentration in Great Miami River from Table 4-2 in Attachment D of the 2013 LMICP (DOE 2013), pCi/L, µg/L, or mg/L (zero was used when no background concentration was available)}

Q_{PF} = \text{Daily flow at PF 4001, cfs}

C_{PF} = \text{Daily concentration at PF 4001, pCi/L, µg/L, or mg/L}

Note: Flow conditions at the Hamilton Dam gauge are periodically reviewed to determine if there is a lower flow than the 7-day, 10-year low flow of 706 cfs. The lowest daily flow measured at the Hamilton Dam gauge (if lower than 706 cfs) is used in the equation to see if an exceedance could potentially occur. The lowest daily flow recorded during 2013 was 540 cfs, which occurred on September 12. The low flow of 706 cfs went into effect during the 2003 NPDES permit renewal process.

B.1.1.1 Evaluation of Constituents above FRLs for 2013

As shown in Table B-1, there were 28 exceedances in 2013 of surface water FRLs. Below is a summary of the 2013 results:

- No FRL exceedances occurred at PF 4001, thus there was no need to calculate the concentration in the Great Miami River utilizing the mixing equation discussed above.

- Twenty-six results from sampling location SWD-09 exceeded the surface water FRL for total uranium (530 µg/L). Figure B-3 is a plot of the total uranium concentration versus time for sampling location SWD-09. Figures B-4 through B-22 are plots of the total uranium concentration versus time for all surface water sampling locations.

- One result from sampling location SWD-05 exceeded the surface water FRL for total uranium (530 µg/L). Figure B-7 is a plot of the total uranium concentration versus time for sampling location SWD-05.

- The overall statistical trend (Mann-Kendall) for FRL exceedances at SWD-05 is “Down,” for SWD-09 is “No Trend.”

As discussed in Section 4, surface water monitoring currently conducted in a small area west of the former waste pits continues to show elevated but slowly diminishing uranium concentrations. After a limited maintenance activity was completed in the fall of 2007, DOE committed to continued monitoring of the area. Two monitoring points (SWD-05 and SWD-09) were added to the surface water program to fulfill this monitoring commitment. These two locations are sampled weekly, when water is present. As shown in Table B-1, SWD-05 has been sampled 116 times, and SWD-09 has been sampled 184 times between January 2007 and December 2013. With regard to these two monitoring locations, 14 of the 116 samples collected at SWD-05, and 142 of the 184 samples collected at SWD-09 have exceeded the surface water FRL.

B.1.1.2 Evaluation of Cross-Media Impacts for 2013

Another objective of the IEMP surveillance monitoring program is to provide an ongoing assessment of the potential for cross-media impacts from surface water to the underlying Great Miami Aquifer (GMA). To conduct this assessment, sampling locations were selected to evaluate contaminant concentrations in surface water just upstream from those areas where site
drainages have eroded through the protective glacial overburden (e.g., the Storm Sewer Outfall Ditch, Pilot Plant Drainage Ditch, and certain reaches of Paddys Run). In areas where the glacial overburden is absent, a direct pathway exists for contaminants to reach the aquifer. Key sampling locations associated with these areas of direct infiltration are SWD-02, SWD-03, SWD-04, SWD-05, SWD-07, SWD-08, STRM 4005, and SWP-02 (Figures B-4 through B-11).

Because it is the primary contaminant at the site, total uranium is used as an indicator to evaluate the impact of surface water on the GMA. A conservative assumption is used in this assessment, which considers the total uranium concentration (and all other constituent concentrations) in the surface water to be at the same concentration when the water reaches the GMA through infiltration. However, the more likely scenario is that the total uranium concentration (and all other constituent concentrations) would decrease through dilution and adsorption as the water infiltrates through the ground and mixes with the groundwater in the GMA.

The results of the cross-media impact assessment for 2013 indicate that four of the eight surface water locations (SWD-04 [Figure B-6], SWD-05 [Figure B-7], SWD-08 [Figure B-9], and STRM 4005 [Figure B-10]) evaluated had results that exceeded the total uranium groundwater FRL of 30 µg/L. In addition, one sample collected from SWD-05 exceeded the thorium-232 groundwater FRL of 1.2 pCi/L for the second time (Figure B-61). It should be noted that all of these sampling locations are within capture of the groundwater remediation system. Sampling at these locations will continue to provide an assessment of the cross-media impacts.

Location SWD-05 is the point at which drainage from the swale area adjacent to former Waste Pit 3 collects and infiltrates into the underlying aquifer. As discussed in Attachment A.2, this may be contributing to increased uranium concentrations in adjacent groundwater monitoring wells. However, the area in question remains within the capture zone of Waste Storage Area Module extraction wells. The design of the groundwater restoration systems has accounted for this potential contaminant pathway by installing extraction wells downgradient of these areas where direct infiltration can occur.

**B.1.2 FFCA/OU5 ROD Compliance**

The OU5 ROD and subsequent *Explanation of Significant Differences for Operable Unit 5* (DOE 2001) stipulate compliance with a monthly flow-weighted average total uranium concentration of 30 µg/L at the Great Miami River via PF 4001. In addition to the concentration limitation, the OU5 ROD stipulated that the total mass discharged during a year not exceed 600 pounds.

During 2013, the total uranium concentrations were monitored daily at PF 4001 to demonstrate compliance with these limitations. The Fernald Preserve was in compliance with the total mass limitation, as uranium discharges totaled 484 pounds, which is below the 600-pound limit. The Fernald Preserve was in compliance with the monthly flow-weighted concentration limit every month in 2013, as identified on Figure B-80.

**B.1.3 Controlled and Uncontrolled Storm Water Runoff Areas**

In 2013, there were no previously uncontrolled areas that were added to the Fernald Preserve controlled storm water system (refer to Figure B-81). At the conclusion of remediation in
October 2006, control of storm water runoff is no longer required. The only storm water collected for treatment is that which falls on the controlled pad of the Converted Advanced Wastewater Treatment Facility.

B.2.0 References


Table B-1. Summary Statistics and Trend Analysis for Constituents with 2013 Results above Surface Water Final Remediation Levels

<table>
<thead>
<tr>
<th>Location</th>
<th>Constituent</th>
<th>No. of Samples</th>
<th>No. of Samples Above FRL</th>
<th>No. of Samples Above FRL for 2013</th>
<th>FRL (µg/L)</th>
<th>Min (µg/L)</th>
<th>Max (µg/L)</th>
<th>Avg (µg/L)</th>
<th>SD (µg/L)</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWD-05</td>
<td>Uranium</td>
<td>116</td>
<td>14</td>
<td>1</td>
<td>530 µg/L</td>
<td>4.4</td>
<td>988</td>
<td>268</td>
<td>213</td>
<td>Down</td>
</tr>
<tr>
<td>SWD-09</td>
<td>Uranium</td>
<td>184</td>
<td>142</td>
<td>26</td>
<td>530 µg/L</td>
<td>18</td>
<td>1900</td>
<td>806</td>
<td>352</td>
<td>No Trend</td>
</tr>
</tbody>
</table>

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* Refer to Figure B-1.
* Based on samples collected from January 3, 2007, through December 31, 2013.
* If more than one sample is collected per surface water location per day (e.g., duplicate, grab, composite), then only one sample is counted for the number of samples, and the sample with the maximum concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation), Mann-Kendall test for trend, and in determining FRL exceedances.
* Rejected data qualified with either an R or Z were not included in the count, the summary statistics, or Mann-Kendall test for trend.
* From OU5 ROD, Table 9–5.
* For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the method detection limit.
* If the number of samples is greater than or equal to four, then all of the summary statistics and the Mann Kendall test for trend are reported. If the total number of samples is equal to three, then the minimum, maximum, and average are reported. If the total number of samples is equal to two, then the minimum and maximum are reported. If the total number of samples is equal to one, then the data point is reported as the minimum.
Figure B-1. IEMP/NPDES Surface Water and Treated Effluent Sample Locations

Legend
- Sample Location
- Fernald Preserve Boundary
- Road-paved
- Road-gravel
- Wetland
- Creek
- Open Water
- Intermittent Stream

NOTE 1: STRM 4003, SWR-4902, SWR-01, 4007, AND PF 4001 ARE REGULATED UNDER THE NPDES PERMIT.
NOTE 2: DISTANCES TO OFFSITE SAMPLE LOCATIONS ARE MEASURED FROM THE CENTER OF THE FORMER PRODUCTION AREA.
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Figure B-36. Silver Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary)
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Figure B-38. Radium-226 Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary)
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Figure B-40. Technetium-99 Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary)
Figure B-41. Thorium-228 Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary)

Figure B-42. Thorium-230 Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary)
Figure B-43. Thorium-232 Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary)

Figure B-44. Radium-226 Concentration Versus Time Plot for Location SWD-03 (Former Waste Storage Area)
Figure B-45. Radium-228 Concentration Versus Time Plot for Location SWD-03 (Former Waste Storage Area)

Figure B-46. Technetium-99 Concentration Versus Time Plot for Location SWD-03 (Former Waste Storage Area)
Figure B-47. Thorium-228 Concentration Versus Time Plot for Location SWD-03 (Former Waste Storage Area)

Figure B-48. Thorium-230 Concentration Versus Time Plot for Location SWD-03 (Former Waste Storage Area)
Figure B-49. Thorium-232 Concentration Versus Time Plot for Location SWD-03 (Former Waste Storage Area)

Figure B-50. Radium-226 Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3)
Figure B-51. Radium Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3)

Figure B-52. Technetium-99 Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3)
Figure B-53. Thorium-228 Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3)

Figure B-54. Thorium-230 Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3)
Figure B-55. Thorium-232 Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3)

Figure B-56. Radium-226 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area)
Figure B-57. Radium-228 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area)

Figure B-58. Technetium-99 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area)
Figure B-59. Thorium-228 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area)

Figure B-60. Thorium-230 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area)
Figure B-61. Thorium-232 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area)

Note: The groundwater FRL for thorium-232 is 1.2 pCi/L.

Figure B-62. Radium-226 Concentration Versus Time Plot for Location SWD-06 (Former Pilot Plant)

Note: The surface water FRL for radium-226 is 38 pCi/L.
Figure B-63. Radium-228 Concentration Versus Time Plot for Location SWD-06 (Former Pilot Plant)

Figure B-64. Technetium-99 Concentration Versus Time Plot for Location SWD-06 (Former Pilot Plant)
Figure B-65. Thorium-228 Concentration Versus Time Plot for Location SWD-06 (Former Pilot Plant)

Figure B-66. Thorium-230 Concentration Versus Time Plot for Location SWD-06 (Former Pilot Plant)
Figure B-67. Thorium-232 Concentration Versus Time Plot for Location SWD-06 (Former Pilot Plant)

Figure B-68. Radium-226 Concentration Versus Time Plot for Location SWD-07 (Former Production Area Drainage)
Figure B-69. Radium-228 Concentration Versus Time Plot for Location SWD-07 (Former Production Area Drainage)

Figure B-70. Technetium-99 Concentration Versus Time Plot for Location SWD-07 (Former Production Area Drainage)
Figure B-71. Thorium-228 Concentration Versus Time Plot for Location SWD-07 (Former Production Area Drainage)

Figure B-72. Thorium-230 Concentration Versus Time Plot for Location SWD-07 (Former Production Area Drainage)
Figure B-73. Thorium-232 Concentration Versus Time Plot for Location SWD-07 (Former Production Area Drainage)

Figure B-74. Radium-226 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units)
Figure B-75. Radium-228 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units)

Figure B-76. Technetium-99 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units)
Figure B-77. Thorium-228 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units)

Figure B-78. Thorium-230 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units)
Figure B-79. Thorium-232 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units)
On November 30, 2001, the monthly average discharge limit became 30 µg/L.