

## 4.0 Surface Water and Treated Effluent Pathway

### Results in Brief: 2007 Surface Water and Treated Effluent Pathway

**Surveillance Monitoring**—No treated effluent analytical results from samples collected in 2007 exceeded the surface water FRL for total uranium, the primary site contaminant. One surface water analytical result from the approved sampling locations exceeded the surface water FRL for total uranium. Two surface water cross-media locations exceeded the groundwater FRL for total uranium.

**Uranium Discharges**—In 2007, 533 lb (242 kg) of uranium were discharged in treated effluent to the Great Miami River. Approximately 79 lb (36 kg) of uranium were released to the environment through uncontrolled storm water runoff. The estimated total pounds of uranium released through the surface water and treated effluent pathway (approximately 612 lb [266 kg]) increased 8 percent from the 2006 estimate.

This chapter presents the 2007 monitoring activities and results for surface water, treated effluent, and sediment to determine the effects of site activities on the surface water pathway.

In general, low levels of contaminants enter the surface water pathway at the Fernald Preserve by two primary mechanisms: treated effluent that is monitored as it is discharged to the Great Miami River, and uncontrolled runoff entering the site's drainages from areas that had remediation activities occurring that now are certified and restored. Because these discharges have continued through remediation and legacy management, the surface water and sediment pathways will continue to be monitored. Effective use of the site's wastewater treatment capabilities and implementation of runoff and sediment controls minimize the site's impact on the surface water pathway.

### 4.1 Summary of Surface Water and Treated Effluent Pathway

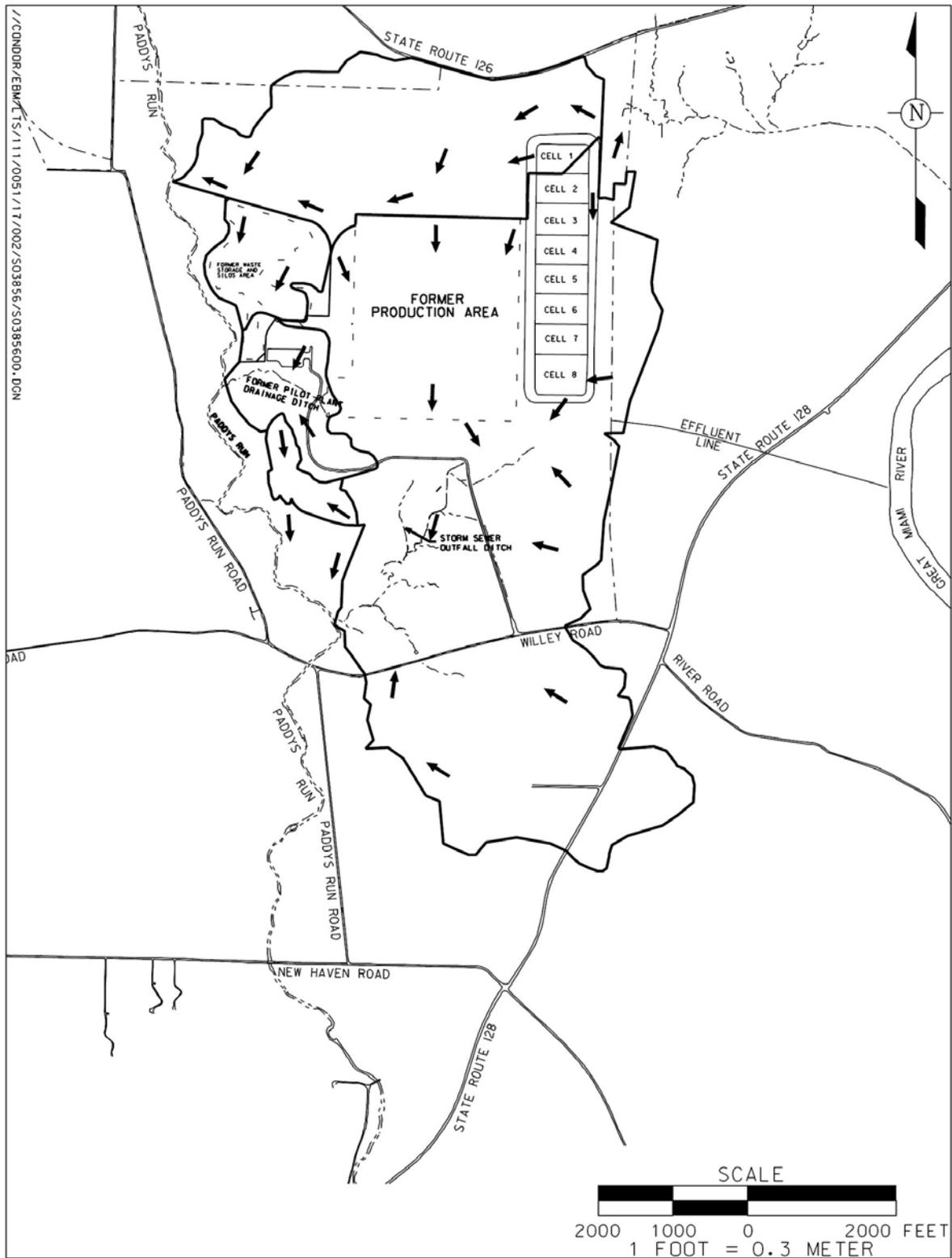
To assist in the understanding of this chapter, the following key definitions are provided:

- **Controlled runoff** is contaminated storm water that is collected and, under normal circumstances, treated and discharged to the Great Miami River as treated effluent. However, the only storm water controlled is currently that associated with the footprint of the outdoor processing activities at the wastewater treatment facility.
- **Uncontrolled runoff** is storm water that is not collected for treatment, but enters the site's natural drainages.
- **Treated effluent** is water that is treated through the site's wastewater treatment facility, then discharged to the Great Miami River.
- **Surface water** is water that flows within natural drainage features.

The treated effluent pathway consists of flows discharged to the Great Miami River via the Parshall Flume (PF 4001).

Discharges through this point are considered under the control of wastewater operations. With the completion of remediation activities under Operable Units 1, 2, 3, and 4 as well as the completion of the vast majority of soil remediation under Operable Unit 5 (with the exception of soils associated with the groundwater treatment infrastructure) in October 2006, treated effluent is composed of only treated and untreated groundwater and leachate from the on-site disposal facility.

The volume and flow rate of uncontrolled runoff depends on the amount of precipitation within any given period of time. Figure 1–10 in Chapter 1 shows monthly precipitation totals for 2007. Figure 4–1 shows the site's natural drainage features. The site's natural surface water drainages include several tributaries to Paddys Run (e.g., storm sewer outfall ditch) as well as the northeast drainage that flows to the Great Miami River. The arrows on Figure 4–1 indicate the general flow direction of uncontrolled runoff that is determined from the topography. Uncontrolled runoff from the Fernald Preserve leaves the property via two drainage pathways: Paddys Run and the northeast drainage ditch.



**LEGEND:**

- FERNALD SITE BOUNDARY
- DRAINAGE BASIN BOUNDARY
- ↖ RUNOFF FLOW DIRECTION

Figure 4-1. Controlled Surface Water Areas and Uncontrolled Runoff Flow Directions

## 4.2 Remediation Activities Affecting the Surface Water Pathway

Activities that had the potential to affect the surface water pathway included routine operation and maintenance activities of the on-site disposal facility and the converted advanced wastewater treatment facility, and ecological restoration activities conducted throughout the property, including repairing areas of erosion.

Now that remediation has been completed and the infrastructure to continue the groundwater remedy has been installed, the restored areas of the Fernald Preserve will be the primary focus relative to uncontrolled runoff. Controls to mitigate sediment leaving the site will be primarily based on the vegetation and stabilization practices within the restored areas.

In addition to the routine activities having a potential impact on surface water, a limited maintenance activity was conducted in a swale area adjacent to former waste pit 3. In late 2006, during the course of routine sampling of several surface water locations, Ohio EPA produced results which were above the surface water FRL for uranium. DOE generally confirmed these sampling results in early 2007.

The location in question is a series of small puddles and drainage ditches due west of the center of former waste pit 3, which drain generally south to a depression near the former cement pond. This area does not drain directly to Paddys Run. The area of impact at peak water retention is approximately one-half acre, and the actual surface water area is much less.

Even though the area in question underwent a rigorous soil certification process, and all certification samples from this area were well below the soil certification FRL, DOE proposed a study to investigate the leachability of the residual uranium present in the surface soils in the area to gain a better understanding of the reason for the persistently elevated concentrations of uranium in the ponded surface waters. The results of this study indicated that uranium in the area is more leachable than other areas of the Fernald Preserve. Further, because of these differing leachability characteristics, it was concluded that the possibility of an unknown source of uranium contamination in the area is unlikely.

Although certification had been achieved, compliance with the Operable Unit 5 Record of Decision was established, and the area of elevated uranium concentrations posed no off-site impacts, as a good faith effort to address OEPA concerns, DOE implemented a maintenance action. The scope of the maintenance action was to remove approximately 6 inches of soil from the surface of the area. The removed material was transported to a topographically higher location and distributed sufficiently to prevent extended contact time with ponding rain water and leaching of the residual uranium, treated with high phosphorus content fertilizer to further reduce leachability, and adequately revegetated to stop erosion and spread of this soil. The scraped area and nearby depressions were filled and graded to reduce or eliminate future ponding, and reseeded. This maintenance action was conducted between September 24 and October 3, 2007.

### 4.3 Surface Water, Treated Effluent, and Sediment Monitoring Program for 2007

Surface water, treated effluent, and sediment are sampled to determine the effect of the Fernald Preserve's activities on the environment. Surface water is sampled at several locations in the site's drainages and analyzed for various radiological and nonradiological constituents. Treated effluent is sampled prior to discharge into the Great Miami River. Sediment is sampled for total uranium in the Great Miami River.

The key elements of the surface water and treated effluent program design are:

- **Sampling**—Sample locations, frequency, and constituents were selected to address the requirements of the NPDES Permit, Federal Facility Compliance Agreement (FFCA), the Operable Unit 5 Record of Decision and to provide a comprehensive assessment of surface water quality at key locations, including two background locations (refer to Figure 4–2 and Figure 4–3). Surface water is monitored for 17 FRL constituents.
- **Data Evaluation**—The integrated data evaluation process focuses on tracking and evaluating data compared with background and historical ranges, FRLs, and NPDES limits. This information is used to assess impacts on surface water due to site remediation activities affecting uncontrolled runoff or treated effluent. The assessment also includes identifying the potential for impacts from surface water to the groundwater in the underlying Great Miami Aquifer. The ongoing data evaluation is designed to support remedial action decision-making.
- **Reporting**—Surface water and treated effluent data are reported through the annual site environmental report. Monthly discharge monitoring reports required by the NPDES Permit are submitted to OEPA.

The IEMP sediment monitoring program includes an annual sampling program with data reported through the annual site environmental report.

Data from samples collected under the IEMP are used to fulfill surveillance and compliance monitoring functions. Surveillance monitoring results of the IEMP surface water and treated effluent program are used to assess the collective effectiveness of site storm water controls and wastewater treatment processes in preventing unacceptable impacts to the surface water and groundwater pathways. Compliance monitoring includes sampling at storm water and treated effluent discharge points and is conducted to comply with provisions in the NPDES permit, the FFCA, and the Operable Unit 5 Record of Decision. The data are routinely evaluated to identify any unacceptable trends and to trigger corrective actions when needed to ensure protection of these critical environmental pathways. Figure 4–2 depicts IEMP/NPDES surface water and treated effluent sample locations; Figure 4–3 shows IEMP background sample locations. Note that five new surface water monitoring locations were added during 2007 (SWD-04, SWD-05, SWD-06, SWD-07, and SWD-08).

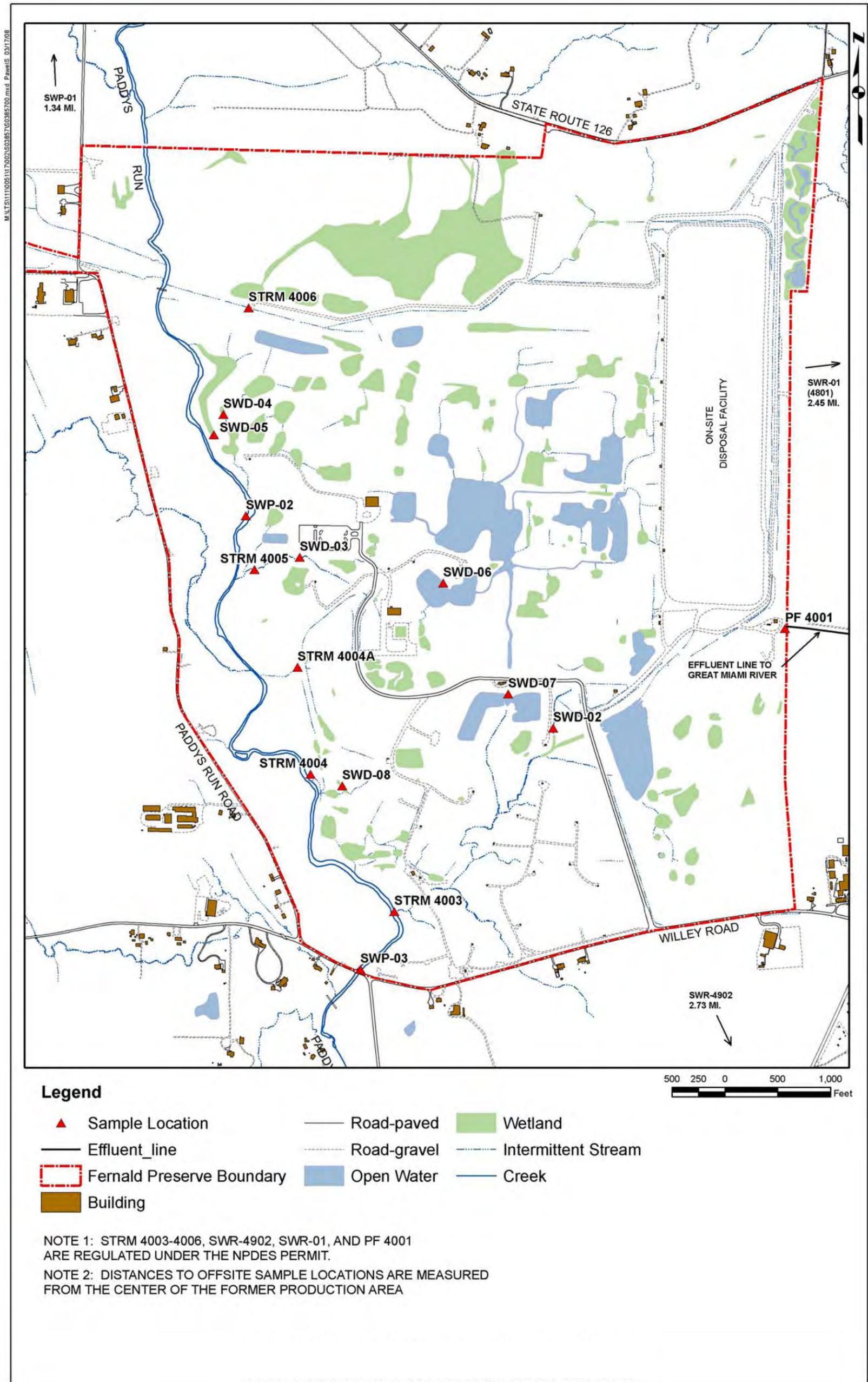


Figure 4-2. IEMP/NPDES Surface Water and Treated Effluent Sample Locations

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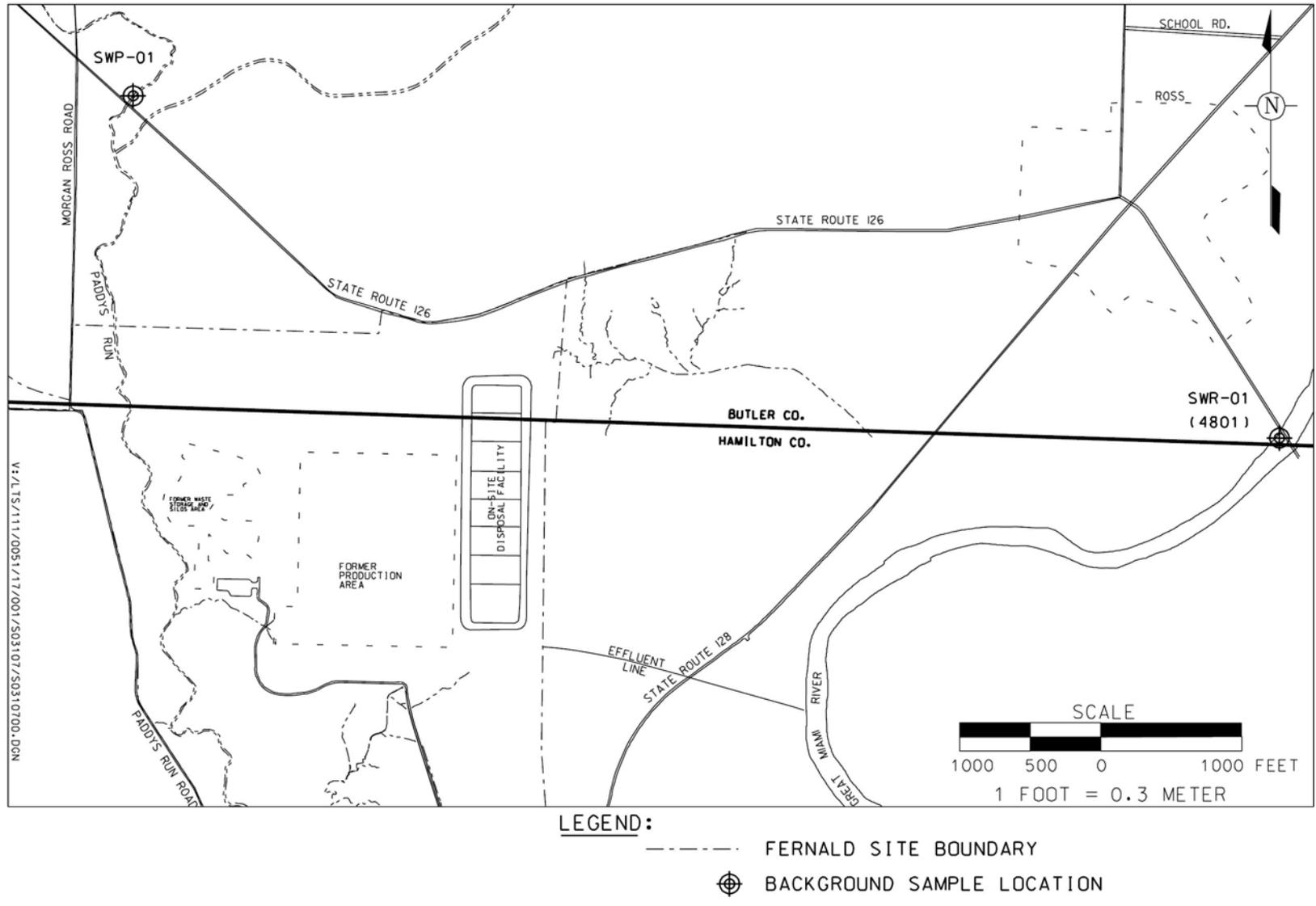


Figure 4-3. IEMP Background Surface Water Sample Locations

**Treated effluent** is discharged to the Great Miami River through the effluent line identified on Figure 4-1. Samples of the treated effluent are collected at the Parshall Flume (PF 4001). The resulting data are used to calculate the concentration of each FRL constituent after the effluent water mixes with the water in the Great Miami River.

### 4.3.1 Surveillance Monitoring

Data resulting from 2007 semiannual sampling events were evaluated to provide surveillance monitoring of site activities. This evaluation indicated that during 2007, one surface water analytical result from an established sampling location, SWD-05, exceeded the surface water FRL for total uranium ( $530 \mu\text{g/L}$ ). There were no exceedances of total uranium in any of the treated effluent samples.

The following two key sample locations represent points where surface water or treated effluent leaves the site:

- Paddys Run at the Willey Road property boundary (surface water sample location SWP-03).
- Parshall Flume (PF 4001) located at the entry point of the treated effluent line leading to the Great Miami River.

Evaluation of the data from these locations is important because they represent locations where direct exposure to the public is possible. There were no exceedances of the surface water FRLs during 2007 at these two locations.

The maximum total uranium concentration at SWP-03 during 2007 was  $3.8 \mu\text{g/L}$ , well below the surface water total uranium FRL of  $530 \mu\text{g/L}$ . Figure 4-4 shows the annual average total uranium concentration in Paddys Run at Willey Road for the period 1985 through 2007. This figure illustrates the decrease of the total uranium concentration in Paddys Run from 1986, following completion of the former storm water retention basin (SWRB), which collected contaminated storm water from the former production area during the later years of operation and through active remediation until they were removed from service in February 2006.

Samples collected at the Parshall Flume (PF 4001) are used in the surveillance evaluation because this is the last point where treated effluent is sampled prior to discharge to the Great Miami River. The maximum daily total uranium concentration at the Parshall Flume (PF 4001) in 2007 prior to discharge through the effluent line to the Great Miami River was  $37.3 \mu\text{g/L}$ , well below the surface water total uranium FRL of  $530 \mu\text{g/L}$ . Data collected from this location cannot directly be compared to the surface water FRL without considering the effect of the effluent waters mixing with the Great Miami River. This is done through the use of a mixing equation.

The maximum daily total uranium concentration at the Parshall Flume (PF 4001) in 2007 prior to discharge through the effluent line to the Great Miami River was  $37.3 \mu\text{g/L}$ . After the water from the Parshall Flume (PF 4001) mixed with the water in the Great Miami River, the concentration would have been approximately  $1 \mu\text{g/L}$ . Both concentrations, those from the Parshall Flume (PF 4001) and after mixing with the Great Miami River, were well below the surface water total uranium FRL of  $530 \mu\text{g/L}$ . Contaminant concentrations observed at the Parshall Flume (PF 4001) in 2007 are discussed further in Section 4.3.2, "Compliance Monitoring."

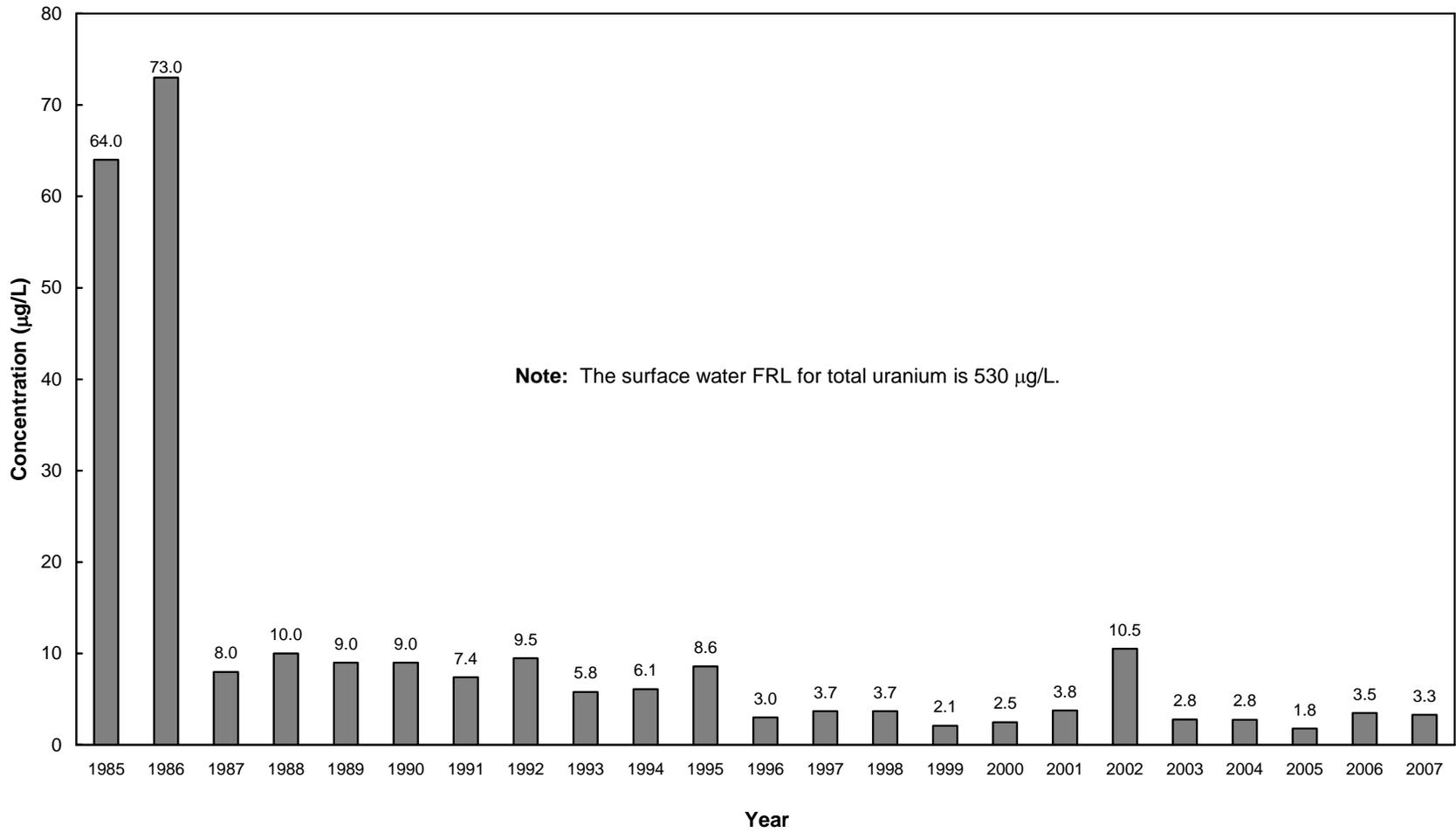


Figure 4-4. Annual Average Total Uranium Concentrations in Paddys Run at Willey Road (SWP-03) Sample Location, 1985-2007

In addition to the sampling conducted at official surface water locations established in the IEMP, a number of samples were collected from the small, standing pools of water in the swale area adjacent to waste pit 3 because of the elevated uranium concentrations discovered in this area (see Section 4.2). Approximately 340 samples were collected in this area, of which approximately 159 samples had concentrations above the surface water uranium FRL of 530 µg/L. Concentrations above the FRL ranged from 530.3 to 1,877.7 µg/L. As indicated previously, surface water from this area does not drain to Paddys Run. The water drains to a low spot and then either evaporates or infiltrates into the underlying groundwater. As discussed in Chapter 3, this area remains within the capture zone of the waste pits groundwater extraction module.

Evaluation of surface water data is also performed to provide an ongoing assessment of the potential for cross-media impacts from surface water to the underlying Great Miami Aquifer. In areas where there is no glacial overburden, a direct pathway exists for contaminants to reach the aquifer. This contaminant pathway to the aquifer was considered in the design of the groundwater remedy. The groundwater remedy includes placing groundwater extraction wells downgradient of these areas where direct infiltration occurs in order to mitigate any potential cross-media impacts during surface remediation. To provide this assessment, sample locations were selected to evaluate contaminant concentrations in surface water just upstream of, or within, those areas where site drainages have eroded through the protective glacial overburden. The locations are SWP-02, SWD-02, SWD-03, and STRM 4005.

During 2007, two of the four surface water cross-media impact locations evaluated had results that exceeded the total uranium groundwater FRL of 30 µg/L. Additional details of the FRL exceedances are presented in Appendix B, Attachment B.1.

## **4.3.2 Compliance Monitoring**

### **4.3.2.1 FFCA and Operable Unit 5 Record of Decision Compliance**

The Fernald Preserve is required to monitor treated effluent discharges at the Parshall Flume (PF 4001) for total uranium mass discharges and total uranium concentrations. This requirement is identified in the July 1986 FFCA and the Operable Unit 5 Record of Decision. The Operable Unit 5 Record of Decision requires treatment of effluent so that the mass of total uranium discharged to the Great Miami River through the Parshall Flume (PF 4001) does not exceed 600 lb (272 kg) per year. The Operable Unit 5 Record of Decision and subsequent approval of the Explanation of Significant Differences also require that the monthly average total uranium concentration in the effluent must be at or below 30 µg/L.

Figure 4–5 shows that the cumulative mass of total uranium discharged to the Great Miami River during 2007 was 533.45 lb (241.97 kg), which is below the annual discharge limit of 600 lb (272 kg). Figure 4–6 shows that the monthly average total uranium concentration was below the 30 µg/L limit every month during 2007.

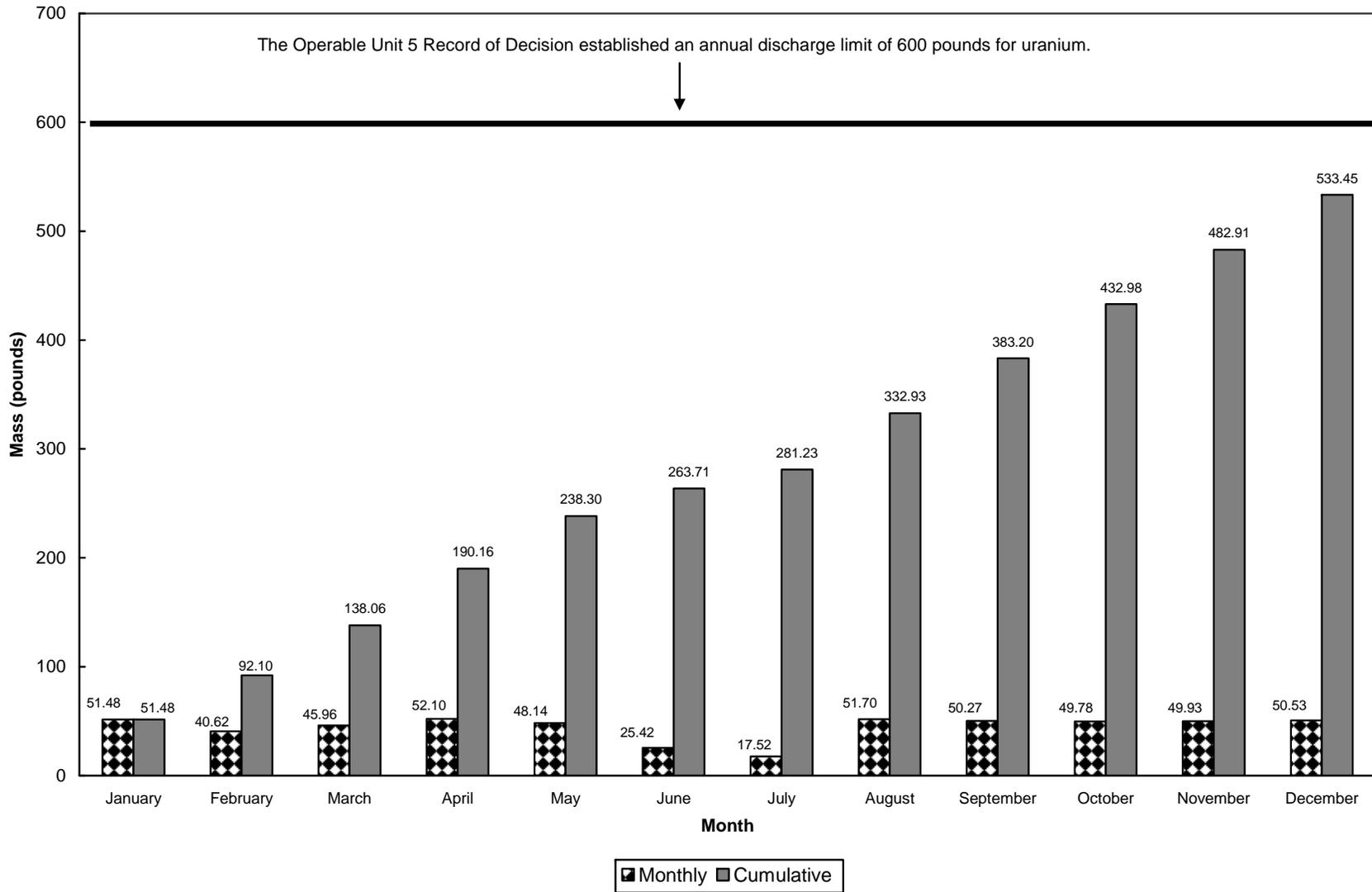


Figure 4-5. Pounds of Uranium Discharged to the Great Miami River Through the Parshall Flume (PF 4001) in 2007

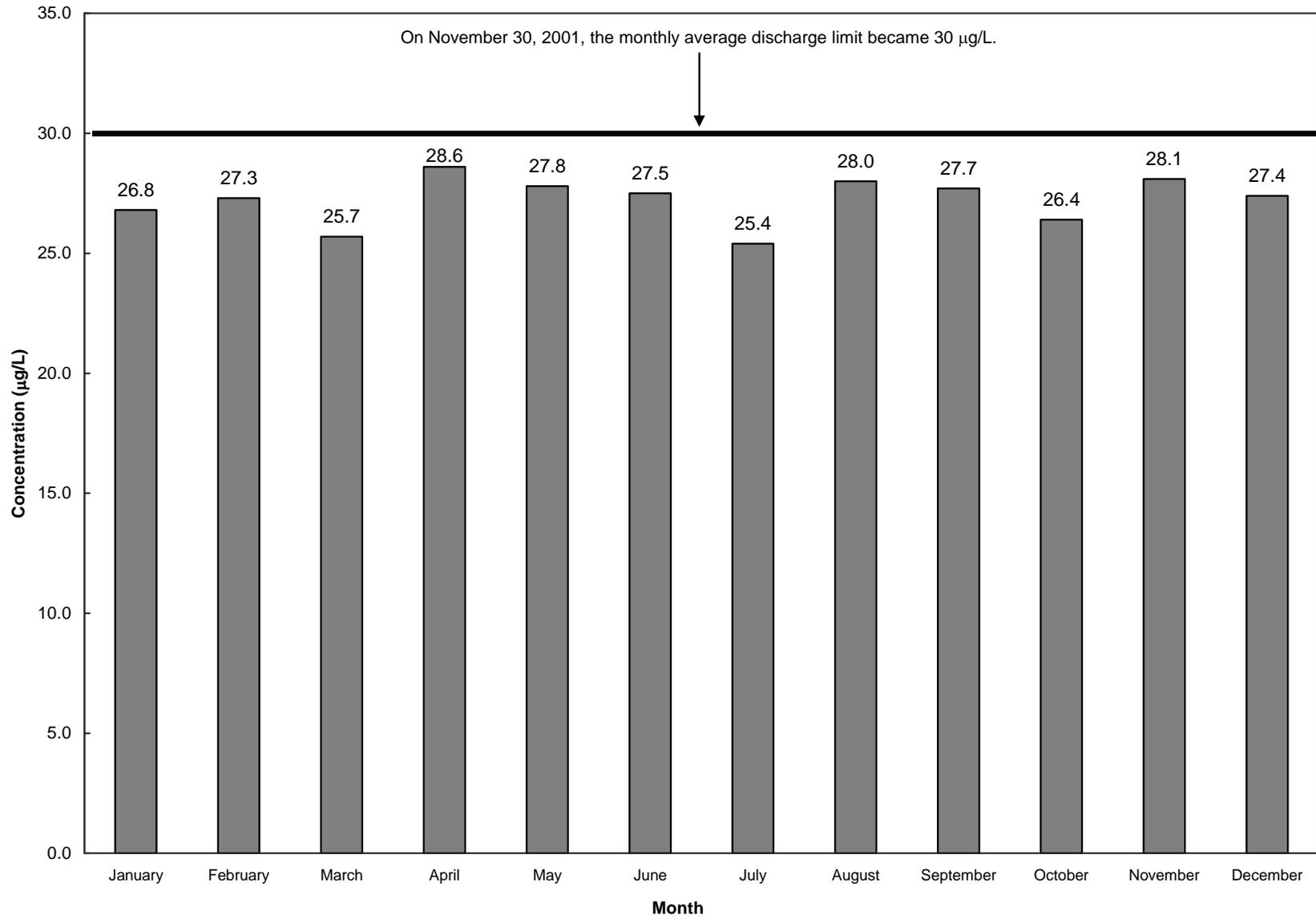


Figure 4-6. 2007 Monthly Average Total Uranium Concentration in Water Discharged Through the Parshall Flume (PF 4001) to the Great Miami River

#### 4.3.2.2 NPDES Permit Compliance

Compliance sampling, consisting of sampling for nonradiological pollutants from uncontrolled runoff and treated effluent discharges from the Fernald Preserve, is regulated under the state-administrated NPDES program. The current permit became effective on July 1, 2003, and expires on June 30, 2008. An NPDES permit renewal application was filed in December 2007. The permit specifies discharge and sample requirements and discharge limits for several constituents. No incidences of NPDES noncompliance occurred in 2007.

#### 4.3.3 Uranium Discharges in Surface Water and Treated Effluent

As identified in Figure 4–5, 533.45 lb (241.97 kg) of uranium in treated effluent were discharged to the Great Miami River through the Parshall Flume (PF 4001) in 2007. In addition to the treated effluent, uncontrolled runoff is also contributing to the amount of uranium entering surface water. Figure 4–7 presents the pounds of uranium from the uncontrolled runoff and controlled discharges from 1993 through 2007.

A loading term is used to estimate the pounds of uranium discharged to Paddys Run via uncontrolled runoff. This loading term was revised and approved in August 2004 based on total uranium data, which reflect the decreasing total uranium concentrations measured at points discharging to Paddys Run. Total uranium concentrations measured in Paddys Run were decreasing through remediation as a result of significant improvements in the capture of contaminated storm water and should remain low now that soil remediation has been completed. The loading term is 2.1 lb of uranium per inch of rainfall.

During 2007, 37.4 inches (94.9 cm) of precipitation fell at the Fernald Preserve; therefore, an estimated 78.5 lb (35.7 kg) of uranium entered the environment through uncontrolled runoff.

The estimated total amount of uranium discharged to the surface water pathway for the year, including controlled treated effluent discharges and uncontrolled runoff, was approximately 612 lb (266 kg).

#### 4.4 Sediment Monitoring

Sediment is a secondary exposure pathway and is monitored annually to assess the impact of remediation activities on sediments deposited along surface water drainages. For the IEMP, sediment samples were collected at strategic locations in the Great Miami River (i.e., upgradient and downgradient of the effluent line). Sediment samples analyzed for total uranium were collected in October 2007 at two locations in the Great Miami River (refer to Figure 4–8). Table 4–1 presents the 2007 results, which show that all uranium results were below the sediment FRL of 210 milligrams per kilogram (mg/kg). Appendix B, Attachment B.2 contains additional details of the IEMP and certification sediment monitoring results.

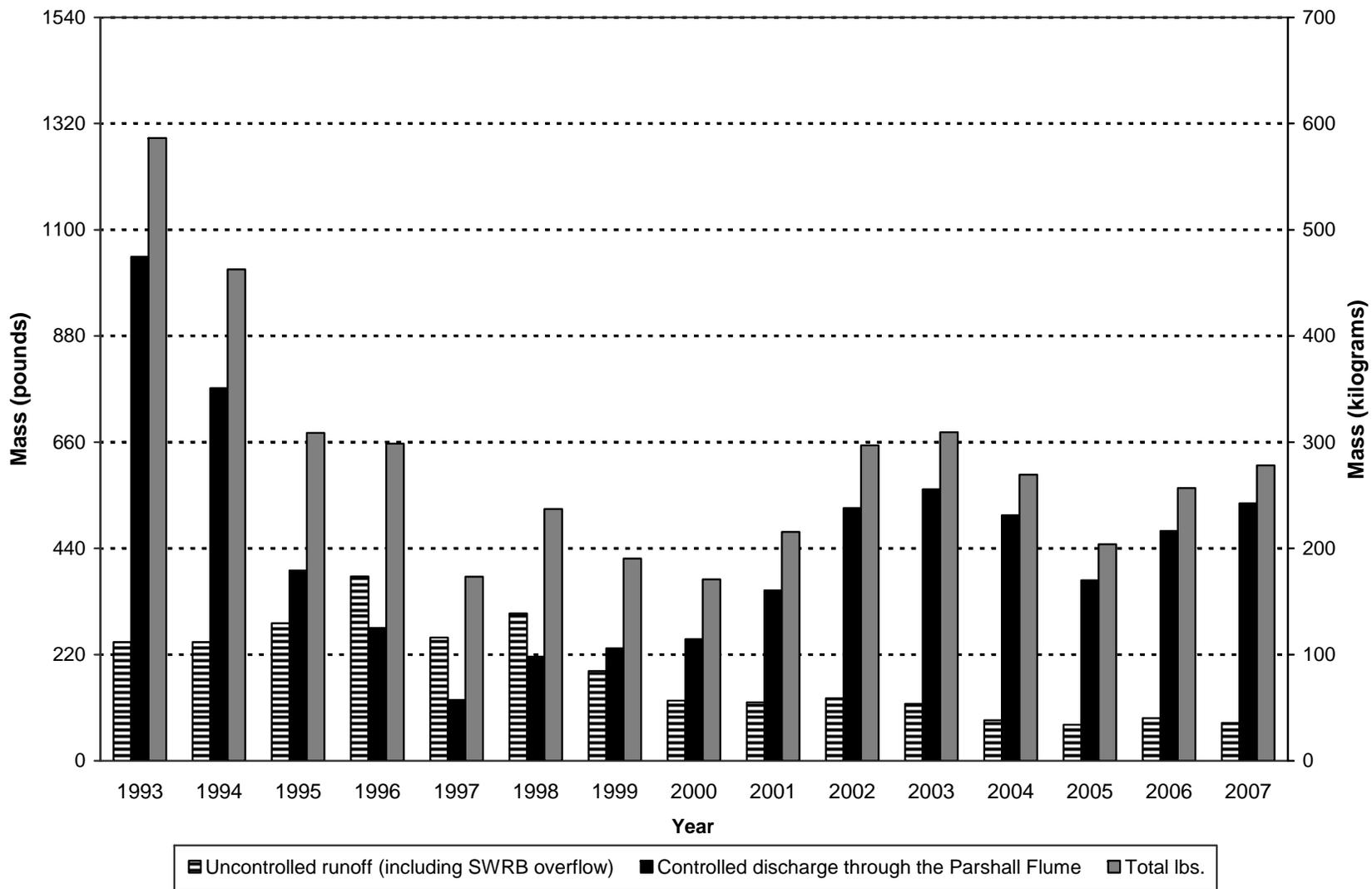


Figure 4-7. Uranium Discharged via the Surface Water Pathway, 1993-2007

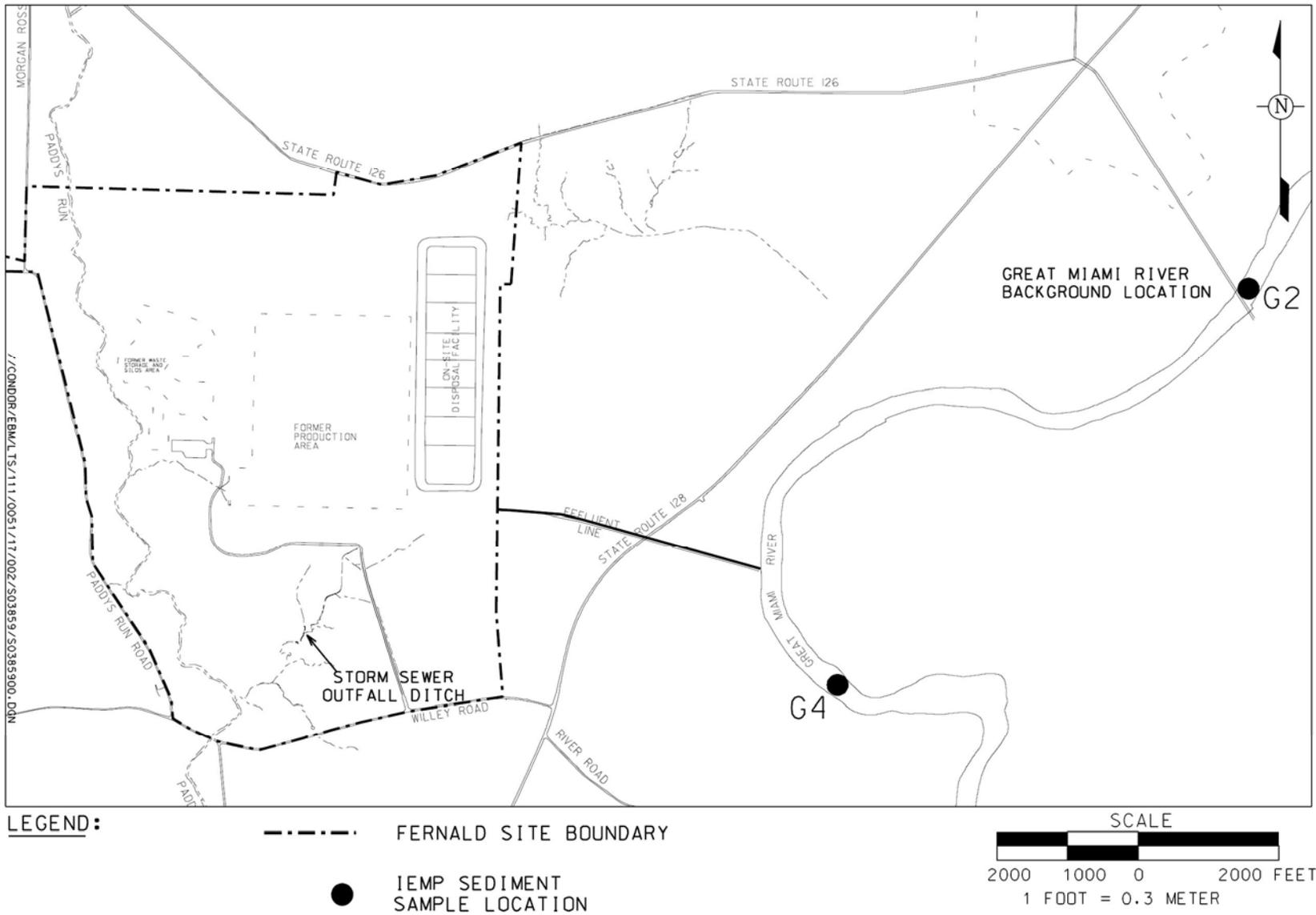


Figure 4-8. 2007 Sediment Sample Locations

*Table 4-1. 2007 Summary Statistics for the Sediment Monitoring Program*

<b>Radionuclide</b>	<b>Sediment FRL</b>	<b>No. of Samples</b>	<b>2007 Concentration (dry weight)</b>
<b>Great Miami River, North of the Effluent Line (G2)</b>			
Total Uranium	210 mg/kg	1	0.55 mg/kg
<b>Great Miami River, South of the Effluent Line (G4)</b>			
Total Uranium	210 mg/kg	1	0.75 mg/kg