Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513
(859) 219-4000

OCT 22 2010

Ms. Jennifer Tufts
U.S. Environmental Protection Agency, Region 4
Federal Facilities Branch
61 Forsyth Street
Atlanta, Georgia 30303

PPPO-02-967898-11C

Mr. Edward Winner, FFA Manager
Kentucky Department for Environmental Protection
Division of Waste Management
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

Dear Ms. Tufts and Mr. Winner:

REMOVAL ACTION REPORT FOR CONTAMINATED SEDIMENT ASSOCIATED WITH THE SURFACE WATER OPERABLE UNIT (ON-SITE) AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-0357&D1)

Please find enclosed the Removal Action Report for the Surface Water Operable Unit Removal Action at the Paducah Gaseous Diffusion Plant. This secondary document satisfies the requirement for a Removal Action Completion Report as identified in the *Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0221&D2/R1. As discussed during the April 14, 2010, Federal Facility Agreement Managers meeting, the contents of this report satisfy Section X.A of the FFA. Mobilization occurred on October 22, 2009, and final demobilization took place on September 16, 2010.

If you have any questions or require additional information, please contact me at (270) 441-6825.

Sincerely,

Reinhard Knerr
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosure:
Removal Action Report DOE/LX/07-0357&D1

cc w/enclosure:
DMC/Kevil

e-copy w/enclosure:
ballard.turpin@epa.gov, EPA/Atlanta
craig.jones@lataky.com, LATA/Kevil
edward.winner@ky.gov, KDEP/Frankfort
frank.overby@layaky.com, LATA/Kevil
gaye.brewer@ky.gov, KDEP/PAD
jana.white@lataky.com, LATA/Kevil
jeffrey.gibson@ky.gov, KDEP/Frankfort
john.morgan@lataky.com, LATA/Kevil
leo.williamson@ky.gov, KDEP/Frankfort
myrna.redfield@lataky.com, LATA/Kevil
reinhard.knerr@lex.doe.gov, PPPO/PAD
rich.bonczek@lex.doe.gov, PPPO/LEX
rob.seifert@lex.doe.gov, PPPO/PAD
tracey.duncan@lex.doe.gov, PRC/PAD
tufts.jennifer@epa.gov, EPA/Atlanta

REMOVAL ACTION REPORT FOR CONTAMINATED SEDIMENT ASSOCIATED WITH THE SURFACE WATER OPERABLE UNIT (ON-SITE) AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY

Description of the Removal Action Implemented

As documented in the approved *Removal Notification for the Surface Water Operable Unit Removal Action Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0011; the *Engineering Evaluation/Cost Analysis for Contaminated Sediment Associated with the Surface Water Operable Unit Removal Action Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0012; and the subsequent *Action Memorandum for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* DOE/LX/07-0119&D2/R1, a non-time-critical removal action for the Surface Water Operable Unit (SWOU) (On-Site) was warranted. The specific areas or defined units called exposure units[1] (EUs) are located within the Paducah Gaseous Diffusion Plant (PGDP) at PGDP Outfalls 001, 008, 010, 011, and 015 and their associated internal ditches and specific areas or EUs located within the North-South Diversion Ditch (NSDD) Sections 3 and 5 that contained contaminated soils and sediments. Each EU is further subdivided into remediation units[2] (RUs) and the RUs are further divided into survey units[3] (SUs).

In support of this report, the following appendices are included.

- Appendix A Figures (e.g., Excavation Locations)
- Appendix B Data Tables
- Appendix C Residual Risk Evaluation
- Appendix D Clean Fill Vendor Certification
- Appendix E Photographs

As documented in the Engineering Evaluation/Cost Analysis, direct contact with sediment was the exposure pathway of concern at the site, and, as a result, removal of contaminated sediment was the primary focus of the removal action. A complete listing of the contaminants of concern (COCs) can be found in Appendix C, Residual Risk Evaluation, Table C.1, of this report. In addition to removal of sediment contaminated with COCs, areas from which total excess lifetime cancer risk (ELCR) exceeded a target of 1E-05 also were removed.

The Removal Action Objectives (RAOs) for this removal action are consistent with the overall RAOs for the SWOU and meet the intent of the Section X, Removal Actions, of the Federal Facility Agreement (FFA). The RAOs for this action are as follows:

[1] An EU is defined as approximately 0.5 acres.
[2] An RU is defined as approximately 1,225 ft^2 (100m^2).
[3] An SU is defined as approximately one-fourth of a RU or 269 ft^2 (25m^2).

- Ensure direct contact risk at the on-site ditches for the current industrial worker falls within the U.S. Environmental Protection Agency (EPA) risk range.

- Ensure direct contact risk at the NSDD for both the current industrial worker and recreational user falls within the EPA risk range.

Completion of this removal action reduces the risk to current and future workers, excavation workers, and recreators from direct contact by removing known sources of contamination. Appendix C provides the residual risk analysis for the complete listing of COCs, as found in Table C.1.

Summaries of Results

Under this action, identified hot spots were removed and verification of cleanup was conducted.

As documented in the RAWP, Appendix F, F.3. Field Sampling Plan, surrogate COCs were used during the removal action surveys. This decision is supported by *Co-Contamination Study for the Removal of Contaminated Soil and Sediment Associated with the Surface Water On-Site.* This study indicates that the surrogate use of the chemicals and action levels listed in Table 1 during the evaluation of postexcavation samples provides an acceptably low-level of failure during the evaluation of verification samples to be performed. (Failure is defined as the chance that postexcavation samples will contain COCs at concentrations that exceed cleanup levels.)

Table 1. Surrogate COCs

On-Site Ditches	
Total PCB	10 mg/kg
Cesium-137	5 pCi/g
Uranium-238	65 pCi/g
Uranium	150 mg/kg
NSDD	
Total PCB	10 mg/kg
Thorium-230	100 pCi/g
Uranium	150 mg/kg

Once all the surrogate COC concentrations were less than or equal to the action levels in postexcavation samples, excavation was deemed complete and cleanup level samples were obtained for verification that the cleanup level for all COCs have been achieved.

Each outfall (001, 008, 010, 011, and 015, and its associated internal ditches and areas within PGDP) and the NSDD are discussed here. Figures showing the site locations are included in Appendix A. The following discussion refers to many units and subunits within each outfall and/or ditch, and the enclosed figures can be used in conjunction with the text to aid in understanding the discussion.

Outfall 001

At Outfall 001, one EU, containing 10 RUs over an area of approximately 1,240 yd^2, was to be excavated. Prior to conducting work at this location, additional preexcavation samples similar to those specified in the removal action work plan (RAWP) were collected to confirm the presence of contamination within the 10 RUs of Outfall 001and, as a result, four of the 10 RUs were not excavated. This methodology was discussed and agreed upon with the regulators during an FFA Managers Meeting.

Uranium was the surrogate COC at Outfall 001, EU 15, Area 2 [at Area 1, polychlorinated biphenyl (PCB) was the surrogate COC] and during the planning process, the extent of contamination in Area 2 had been established based on just two total uranium results, one elevated and one not elevated (642 mg/kg and 8 mg/kg, as compared to a cleanup criteria of 227 mg/kg). In an effort to define more clearly the horizontal extent of contamination at Area 2, sampling was undertaken in this area utilizing the postexcavation sampling protocol specified in the RAWP. The results of this sampling effort indicated that contamination above the total uranium action limit of 150 mg/kg was limited to the northern half of RU 03 and RUs 04–07. Verification sample results for uranium confirmed that RUs 02 and 08–10, as well as the southern half of RU 03, are not impacted above the cleanup level of 227 mg/kg total uranium. Additionally, sample results indicated that in all RUs within Area 2, all COCs, except uranium and uranium-238 (U-238), were below their respective cleanup levels. Appendix A contains a figure showing the results of this sampling effort, and Appendix B includes the data results in Tables B.1.1 and B.1.2.

In light of the foregoing, a revised approach to Outfall 001, Area 2, was proposed and agreed to at the June 17, 2010, FFA Managers Meeting. Excavation would be limited to those RUs that were impacted above the action limit of 150 mg/kg for total uranium. This included the northern half of RU 03 and RUs 04, 05, 06, and 07. The southern half of RU 03 and RUs 02, 08, 09, and 10 were not excavated because the data show that these areas are not impacted above the action limits or the cleanup levels.

At the five RUs addressed under this action, one RU was excavated to 2 ft. The remaining RUs were excavated to 3 ft at some SUs and 4 ft at other SUs. The walkover survey results and the field screening results indicate that all RUs were remediated to below their respective action levels (65 pCi/g for U-238, 5 pCi/g for Cs-137, 150 mg/kg for total uranium, and 10 mg/kg for PCBs), and verification sample results indicate that the cleanup levels have been achieved. Additionally, two field screen samples collected from the surface at the southern half of RU 03 (the portion not excavated) indicate that the surrogate COC concentrations are below the action levels. Appendix A includes a figure showing the final excavation limits, and the data results are included in Appendix B, Tables B.1.1 and B.1.2.

At Outfall 001, 926 yd^3 of soils were removed; 501 yd^3 were disposed of at Energy*Solutions* in Clive, Utah; and 425 yd^3 were disposed of at the C-746-U Landfill.

Outfall 008

At Outfall 008, one EU containing two RUs, over an area of approximately 200 yd^2, was excavated. Soils were removed to a depth of 2 ft at this location.

At the two RUs excavated under this action, the walkover survey results and the field screening results indicate that all RUs were remediated to below their respective action limits, and verification sample results indicate that the cleanup levels have been achieved. Appendix A contains a figure showing the final excavation limits, and Appendix B includes the data results in Tables B.2.1 and B.2.2.

At Outfall 008, 244 yd^3 of soils were removed and disposed of at Energy*Solutions* in Clive, Utah.

No problems were encountered at Outfall 008, and no deviations from the Work Plan were required during performance of the work.

Outfall 010

At Outfall 010, one EU containing four RUs over an area of approximately 400 yd^2, was excavated. Soils were removed to a depth of 2.5 ft at three of the RUs, and 2 ft at one RU.

A French drain was encountered at the south end of the outfall (along Tennessee Avenue) at a depth of 2 ft-6 inches. As a result, work at Outfall 010 was suspended until repair/replacement could be arranged. Repair/replacement was considered necessary to ensure the continued stability of Tennessee Avenue. When work resumed at the site in June 2010, the decision was made to remove an additional 6 inches from the three RUs that had been remediated in January and to resample each. The French drain also was removed at this time (to native soils or 2 ft-6 inches below ground surface).

The walkover survey results and the field screening results indicate that all RUs were remediated to below respective action limits, and verification sample results indicate that the cleanup levels had been achieved. Twelve samples also were collected beneath the French drain (one every 10 ft). One sample exceeded 10 ppm PCB (as indicated by field analyses), resulting in an additional 6 inches of excavation, subsequently followed by a sample that was below 10 ppm PCB (as indicated by field analyses). The additional excavation was from one clean sample to the next clean sample, encompassing the one area that exceeded the PCB thresholds of 10 ppm. One verification sample also was collected beneath the former French drain. These results likewise show that this area was remediated to below action limit and cleanup levels for the site. Appendix A includes a figure showing the final excavation limits, and the data results are included in Appendix B, Tables B.3.1 and B.3.2.

At Outfall 010, 642 yd^3 of soils were removed and disposed of at Energy*Solutions* in Clive, Utah.

Outfall 011

At Outfall 011, one EU containing 14 RUs, over an area of approximately 1,500 yd^2, was excavated. Initially, soil/sediment was removed to 2 ft below grade. During Activity 1 (i.e., field screening) sampling, the walkover surveys indicated that consistently elevated levels of uranium were present at 2 ft below grade. A decision was made to excavate all 14 RUs identified within Outfall 011 an additional ft to 3 ft below grade before conducting additional Activity 1 sampling.

After excavation to 3 ft, 13 of the 14 RUs had achieved the site cleanup goals. One SU, within RU 01, at the northwest corner of Outfall 011, did not. Excavation of an additional ft, to a depth of 4 ft, was performed within this SU. While field screen results at the 4-ft depth indicated that uranium levels continued to exceed the action limits, the verification sample results show that the RU had achieved cleanup goals. Walkover survey results at RU 01 indicated that contamination extended further to the west than the defined limits of excavation (i.e., beyond the bounds of RU 01). Excavation of this area was postponed until such time as a path forward was determined. Once a plan was developed to address the contamination outside the boundary of RU 01, excavation on the west side of Outfall 011 resumed on June 9, 2010. At this time, an additional 76 cy of soils were removed, and additional field screens and verification samples were collected. The results indicate that action limit and cleanup goals were achieved in this area outside the boundary of RU 01, west of RU 01.

Appendix A includes a figure showing the final excavation limits, and the data results are included in Appendix B, Tables B.4.1 and B.4.2.

In Outfall 011, 3,900 yd^3 of soil, sediment, and debris were removed. Of this, 457 yd^3 was disposed of at Energy*Solutions* in Clive, Utah; and 3,443 yd^3 was disposed of at the C-746-U Landfill.

Outfall 015

At Outfall 015, five EUs containing 67 RUs, over an area of approximately 8,800 yd^2, were excavated. At the majority of the RUs, soil/sediment was removed to a depth of 2 ft. Some RUs were excavated to

3–4 ft. Specifically, RU 03 in EU 03 was excavated an additional 1 ft due to elevated cesium at the 2-ft depth; RU 12 in EU 02 was excavated an additional 1 ft due to elevated uranium (total and U-238); and RUs 14–18 (inclusive) in EU 07 were excavated an additional 2 ft due to elevated uranium in the field screen samples. Additionally, some SUs were excavated an additional 1 ft based on walkover survey results.

Upon completion of excavation, the X-ray fluorescence (XRF) and PCB field screening results indicate that the all RUs were remediated to below respective action limits of 150 mg/kg uranium and 10 mg/kg total PCB, with the exception of one SU at EU 07, RU 17, which had an XRF result for uranium of 349 mg/kg at 4 ft (the verification result for uranium for this RU indicated 2.4 mg/kg uranium).

Walkover surveys were not performed at EU 03, RUs 09–14, because the banks were considered unstable and not safe for workers.

No problems were encountered and no deviations were required from the RAWP for EU 04 and EU 08. EU 04 was excavated for total ELCR and EU 8 was excavated for PCB contamination.

Verification sample results indicate that the cleanup levels had been achieved at all RUs at Outfall 015. Appendix A includes a figure showing the final excavation limits, and the data results are included in Appendix B, Tables B.5.1 and B.5.2.

Yellow/green-stained soils and gravel were encountered on the south wall of the excavation at Outfall 015, EU 07, RU 16. After the excavation was backfilled, the seam was delineated on August 31, 2010, by using direct push technology. Cores from 11 locations at depths of approximately 10 ft each, south of the excavated area, were collected. The cores were surveyed radiologically and visually, and only one of the 11 cores (closest to the previously exposed seam) identified the yellow/green stained soils with radiological readings above instrument background (seam was present in the 2–4 ft level below ground surface). The area investigated was less than 500 ft^2 and resulted in identifying the seam approximately 8 ft by 3 ft by 1 ft adjacent to the previously exposed excavation at Outfall 015, EU 07, RU 16. Removal of these soils took place on September 14/15, 2010, and resulted in an additional 34 yd^3 of soil that was disposed of at Energy*Solutions* facility in Clive, Utah. XRF and PCB samples were collected below the excavation and resulted in less than 150 pCi/g uranium and less than 10 ppm PCBs.

At Outfall 015, 10,009 yd^3 of soil, sediment, and debris was removed. Of this, a total of 4,983 yd^3 was disposed of at Energy*Solutions* in Clive, Utah; and a total of 5,026 yd^3 was disposed of at the C-746-U Landfill.

NSDD Sections 3 and 5

At NSDD, four EUs containing 40 RUs, over an area of approximately 5,200 yd^2, was addressed. At the majority of the RUs, soil/sediment was removed to a depth of 2 ft. Two RUs (RUs 11 and 12 at EU 03), were excavated to 3 ft based on elevated gross alpha results. RU 12 was excavated an additional ft upon receipt of verification sample results that indicated Th-230 levels were present in the area above the cleanup goals. One RU (RU 12 at EU 02) was not addressed due to the presence of a high pressure gas line immediately underneath. Lastly, RUs that extended into Ogden Landing Road (including RUs 08, 09, and 11 in EU 03) were excavated by sloping at 1:1 from the edge of the road so as not to impair the stability of the road.

Activity 1 (i.e., field screening) uranium and PCB field screening sampling was performed at NSDD, as described in the RAWP; however, gross alpha analyses, from samples collected from the center of each SU, with the application of a conservative assumption that all gross alpha activity be considered Th-230,

were substituted for the walkover surveys that were specified in the Work Plan. This modification was implemented because of the inability to reliably quantify Th-230 at the action limit of 100 pCi/g. The following is the reason Th-230 cannot be quantified reliably, as described in the Work Plan.

Typical radiological methods for detection of radionuclides in a field setting depend upon the ability to detect gamma radiation emitted from a radionuclide or its daughters. Th-230, which primarily decays by the emission of an alpha particle, does not emit gamma or X-ray radiation at a sufficient quantity or energy to facilitate its direct detection in a field setting. Alpha particles are attenuated by soil, moisture, and debris and, when coupled with their very short range, this makes them unsuitable for measurement of radioactivities in a field setting. While Th-230 does not emit reliably detectable gamma radiation, its daughter, Ra-226, has a very high energy gamma ray that is emitted at a readily usable yield. Because of the detectability of Ra-226, it is possible to use field techniques to quantify *naturally occurring* Th-230 using the Ra-226 daughter which, in nature, exists in equilibrium with the Th-230 parent (i.e., Ra -226 is used as a surrogate for Th-230 because the equilibrium is constant).

PGDP received uranium feed material that had been separated chemically and converted from its natural form. As a result of the separation and conversion process, the uranium daughters, which naturally are found to be in equilibrium, were separated and removed from the feed stream. Additionally, the processes employed at PGDP produced uranium residuals from the feed stream that generated various radionuclides in various proportions generally not found in nature. The U-234 and Th-230 daughters (including Ra-226) that ultimately will equilibrate with the parent are produced slowly and will not reach equilibrium for many thousands of years. In other words, the processes imposed upon the uranium utilized at PGDP that resulted in the generation of Th-230 disrupted the natural equilibrium between the Th-230 parent and its daughter Ra-226.

While it may be possible to quantify *naturally occurring* levels of Th-230 through the detection of gamma rays emitted by the Ra-226 daughter, in the case of NSDD, this does not provide a reliable mechanism for quantification of PGDP-derived (i.e., not naturally occurring) Th-230. Due to the separation and conversion processes, equilibrium of long-lived daughters, such as Th-230 and Ra-226, has not been achieved; therefore, any measurement of Th-230 using Ra-226 as a surrogate would bias negatively the reported activity of Th-230.

To illustrate this point, an analysis was performed to calculate the activity of Ra-226 from a Th-230 parent, assuming a 50-year in-growth period. For a Th-230 activity of 100 pCi, the Ra-226 activity after 50 years would be 2.1 pCi. This level is comparable to naturally occurring Ra-226 and is not practically achievable in a field setting as that found in the NSDD. A review of sampling data for Ra-226 in the NSDD confirms that there are no areas of detectable Ra-226 in excess of 2.2 pCi/g.

At the completion of excavation activities, the gross alpha and field screening results indicated that all RUs that were excavated were below the respective action limits, and verification sample results indicated that the cleanup levels had been achieved. A figure showing the final excavation limits is included in Appendix A. Appendix B includes the data results in Tables B.6.1 and B.6.2.

From NSDD Sections 3 and 5, a total of 6,956 yd^3 of soil, sediment, and debris was removed. Of this, 5,690 yd^3 was disposed of at Energy*Solutions* in Clive, Utah; and 1,266 yd^3 was disposed of at the C-746-U Landfill.

General

Backfilling and site restoration were conducted following excavation. Areas where the existing slope had been too steep to allow for placement of soil were backfilled with riprap. Riprap was used for portions of Outfall 011 and NSDD Section 3 and all of NSDD Section 5.

Clean backfill that was generated as part of the construction of the Northwest Storm Water Collection Basin in 2001 was brought in for site restoration. The backfill material utilized for the SWOU Remedial Action was the same material as referenced in the Soils Operable Unit Inactive Facilities Removal Action Report D1 as submitted on August 4, 2010.

Clean riprap was used at Outfall 001, Outfall 011, and NSDD. The vendor of this product provided certification as to the uncontaminated nature of the fill. This certification is included as Appendix D. Restoration also included replacement of the French drain at Outfall 010. In addition, off-site clean fill (soil) was brought in for backfilling the seam area at Outfall 015 ditch, EU 07, RU 16, and a certification is included in Appendix D.

Refer to Appendix E for photographs showing the condition of the excavation areas following restoration. Consistent with the RAWP, inspections and site maintenance will continue to control erosion until the affected areas are stable.

Verification of Cleanup

The enclosed data tables (Appendix B) show a comparison of the ELCR-based and hazard index (HI)-based cleanup levels to the sampling results. Appendix C addresses residual risk associated with the excavated EUs.

Comparison of Cleanup Levels to Sampling Results

At Outfalls 001, 008 and 010, all sample results show that cleanup levels had been met at these locations.

One sample at Outfall 011 did not achieve the cleanup levels (OF011-01-01-V-3). This area subsequently was excavated one additional ft. Sample OF011-01-01-V-4a, collected at the 4-ft depth, at the completion of excavation, is representative of the soils remaining at RU 01. This sample indicates that the area achieved the cleanup goals for the site.

At Outfall 015, two samples, OF015-07-12-V-2 and OF015-03-03-V-2, did not achieve the cleanup levels. These areas subsequently were excavated one additional ft, and samples OF015-07-12-V-3 and OF015-03-03-V-3, collected at the 3-ft depth at the completion of excavation, are representative of the soils remaining at EU 07, RU 12 and EU 03, RU 03, respectively. These sample results indicate that the area achieved the cleanup goals for the site.

Yellow/green-stained soils and gravel were encountered on the south wall of the excavation at Outfall 015, EU 07, RU 16. XRF and PCB samples were collected below the excavation and resulted in less than 150 pCi/g uranium and less than 10 ppm PCBs.

At NSDD, only two samples did not achieve the cleanup levels (NSDD3-03-12-V-2 and NSDD3-03-12-V-3). Both of these samples were collected at RU12 at EU 03 in the NSDD (one at the 2-ft depth, the other at the 3-ft depth). This area subsequently was excavated one additional ft. Sample NSDD3-03-12-V-4, collected at the 4-ft depth at the completion of excavation, is representative of the soils remaining at RU12 at EU 03. This sample indicates that the area achieved the cleanup goals for the site.

In summary, upon completion of all excavation activities, all RUs that were addressed under this removal action were remediated to below the cleanup levels established for this action for all COCs, as specified in Table 1 of the RAWP.

Risk Evaluation

Appendix C presents the residual risk that remains at PGDP Outfalls 001, 008, 010, 011, and 015, and their associated internal ditches, and Sections 3 and 5 of the NSDD after completion of the removal action. Results of the risk evaluation indicate that the cumulative ELCR and HI for COCs from EUs with excavated hot spots and areas identified in the RAWP within PGDP Outfalls 001, 008, 010, 011, and 015, and their associated internal ditches, and Sections 3 and 5 of the NSDD achieved the RAO of a cumulative ELCR of 1E-05 and a cumulative HI of 1.0. A complete listing of the COCs can be found in Appendix C, Residual Risk Evaluation, Table C.1 of this report.

As a result, the overall RAO for this project, to reduce the direct contact risk to the current and future industrial worker and recreational user within the EPA risk range, was achieved.

Summaries of Problems Encountered

Deviations from the RAWP were minor field changes as discussed above and as summarized below.

Outfall 001

No problems were encountered during excavation of Outfall 001. As indicated previously, with concurrence of the FFA managers, RUs 02, 08, 09, and 10 in Area 2 were not excavated because the data show that these areas are not impacted above the action limits or cleanup levels.

Outfall 008

No problems were encountered at Outfall 008, and no deviations from the Work Plan were required during performance of the work.

Outfall 010

A French drain was encountered at the south end of the outfall (along Tennessee Avenue) at a depth of 2 ft-6 inches. The French drain was removed to a depth of 2 ft-6 inches; samples were collected from underneath the system; and the French drain replaced with 4-inch perforated PVC surrounded by #9 gravel, fabric filter, and flowable fill.

Due to the length of time between beginning and completing excavation in this area, the three RUs that were excavated in January were excavated an additional 6 inches and resampled to ensure that any contamination that had moved between RUs was removed.

Outfall 011

Contamination extended beyond the bounds defined in the Work Plan at the west end of the outfall. The contamination was addressed by removing soils/sediments in this area and extending the horizontal limits of excavation outside the bounds of RU 01. See figure for actual excavation limits (Appendix A).

Often there was a discrepancy between the walkover survey results for uranium and the XRF results for uranium. It has been speculated that lack of reliability of the walkover survey may be due to the walkover results being biased high, and geometry of Outfall 011 (i.e., steep sidewalls) can elevate the results from field instruments and provide false positives. In all cases where the walkover survey results and the XRF results did not agree, the XRF results were considered the valid results.

Outfall 015

Yellow/green stained soils and gravel were encountered on the south wall of the excavation at Outfall 015, EU 07, RU 16. These soils, as discussed previously, were delineated and removed. After excavation to 4 ft at Outfall 015, EU 07, RU 16, field screen sample results and the verification sample indicate that action limits and cleanup goals were achieved at this RU, as well at as the surrounding RUs.

In some cases, the walkover survey results were ambiguous. It is believed that walkover results are biased high, and geometry, such as steep banks, can elevate the results from field instruments and provide false positives. Consequently, when there was a discrepancy between the walkover survey results for uranium and the XRF results for uranium, the XRF results were considered the more accurate of the two field screening methods.

NSDD

As previously described, Activity 1 sampling at NSDD was modified such that gross alpha analyses, instead of walkover surveys, was used to determine if the action limit of 100 pCi/g for Th-230 had been met.

One RU (RU 12 at EU 02) was not addressed due to the presence of a high pressure gas line immediately underneath.

RUs that extended into Ogden Landing Road (including RUs 08, 09, and 11 in EU03) were excavated by sloping at 1:1 from the edge of the road so as not to impair the stability of the road.

General

In all instances, the walkover surveys impeded the timely execution of the work. Consequently, excavations that might have been backfilled were left open for several days. This occasionally resulted in the excavations filling with water. The fact that excavations had filled with water delayed collection of field screening and verification samples and delayed overall progress of work because man-power was diverted from excavating soils to managing water in accordance with the approved Work Plan.

Actual excavation volumes exceeded planning estimates by nearly 50%. This is believed to be due primarily to two factors:

(1) Volume estimates were developed using areas calculated based on plan views multiplied by a depth of 2 ft. Most excavation areas associated with the removal action were not flat, but were U- or V-shaped. As such, the method of calculating the area of each ditch should have been based on cross sections, multiplying the area of the face of each surface times a depth of 2 ft.

(2) The Site Investigation collected samples at 1- and 2-ft depths; consequently, volume estimates were based on an excavation depth of 2 ft. However, at several locations, excavation proceeded to 3 and 4 ft before cleanup could be considered complete.

Due to contamination levels being at a higher percentage than forecast, more waste was generated than anticipated that could not be disposed of in the on-site C-746-U Landfill. As a result more waste and a higher percentage of all waste generated was disposed of at the off-site waste disposal facility in Clive, Utah.

Summaries of Accomplishments and/or Effectiveness of the Removal Action

The overall RAO for this project, to reduce the direct contact risk to the current and future industrial worker and recreational user within the EPA risk range, was achieved. Table 2 depicts volumes removed from each location.

Table 2. Volumes of Contaminated Sediments Dispositioned

Location	Disposition (yd^3)	
	C-746-U Landfill	Energy*Solutions*, Clive, UT
Outfall 001	425	501
Outfall 008	0	244
Outfall 010	0	642
Outfall 011	3,443	457
Outfall 015	5,026	4,983
NSDD Section 3	1,266	5,287
NSDD Section 5	0	403
Total	10,160	12,517

Copies of Relevant Laboratory/Monitoring Data

Relevant laboratory/monitoring data are included as Appendix B.

Summary of Project Costs

Table 3 below depicts project costs.[4]

Table 3. Costs Associated with Project

Activity	Cost
Excavation	$14,458,980
Waste Management	$ 681,534
Off-Site Disposal	$ 3,171,849
Total	**$18,312,363**

These costs are higher than the estimate provided in the EE/CA of $7,635,816. The higher costs can be directly attributed to the deviations and project problems discussed on pages 8, 9, and 10 of this report.

[4] The accounting of expenditures is based on an estimate governed by figures known at the time the report was written.

APPENDIX A

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

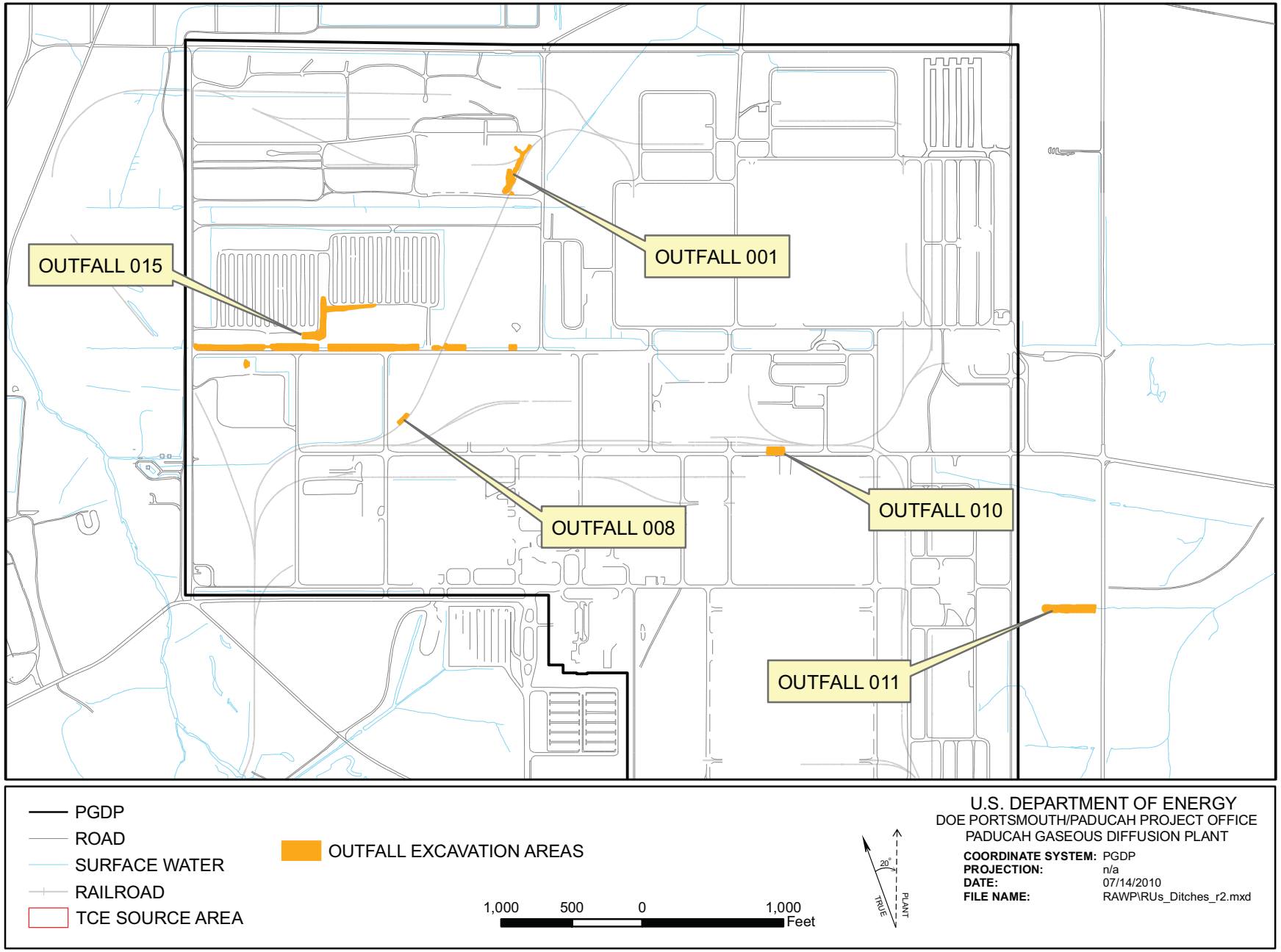

Figure A.1. Location of Outfalls for On-Site Ditches

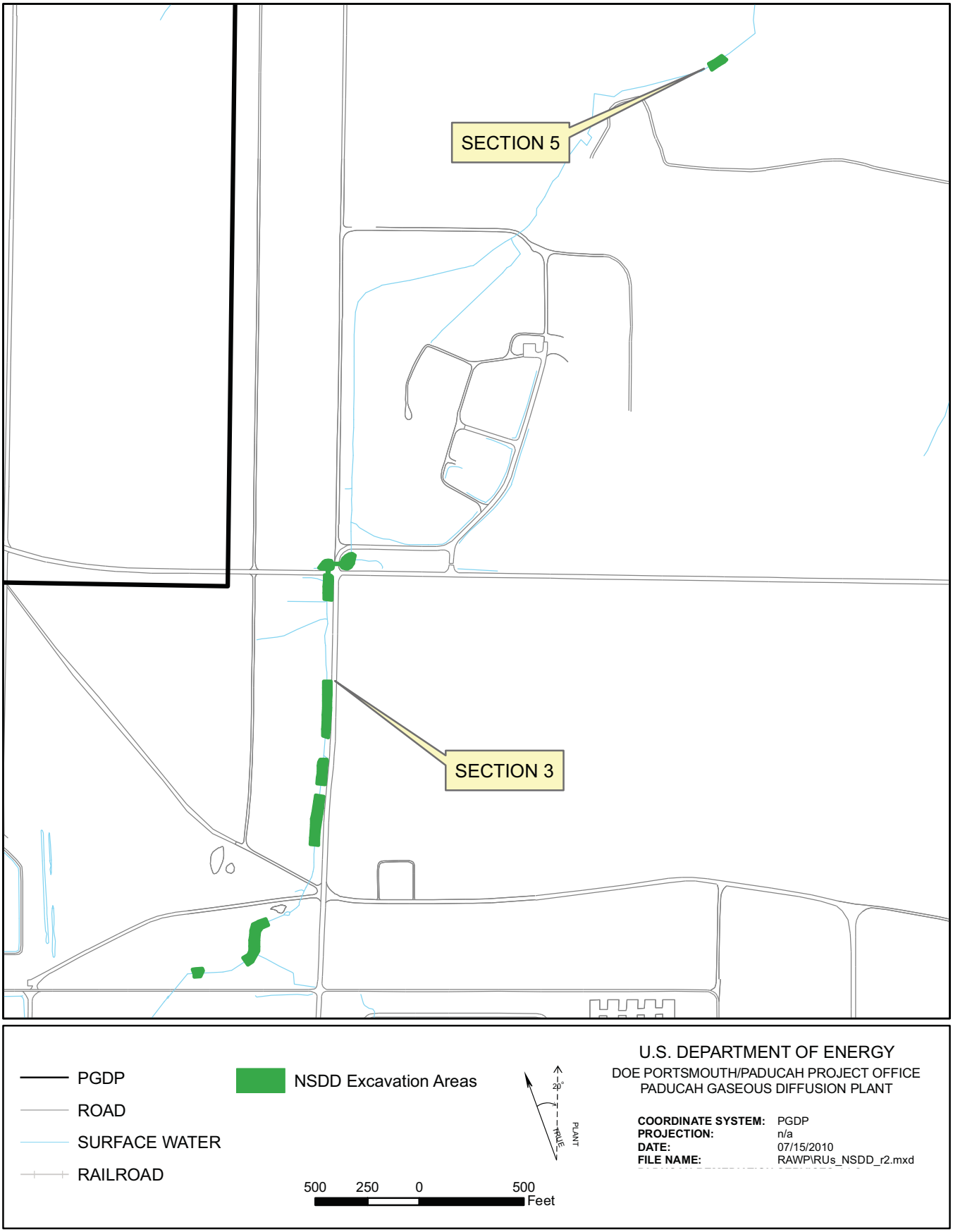

Figure A.2. Location of NSDD Sections 3 and 5

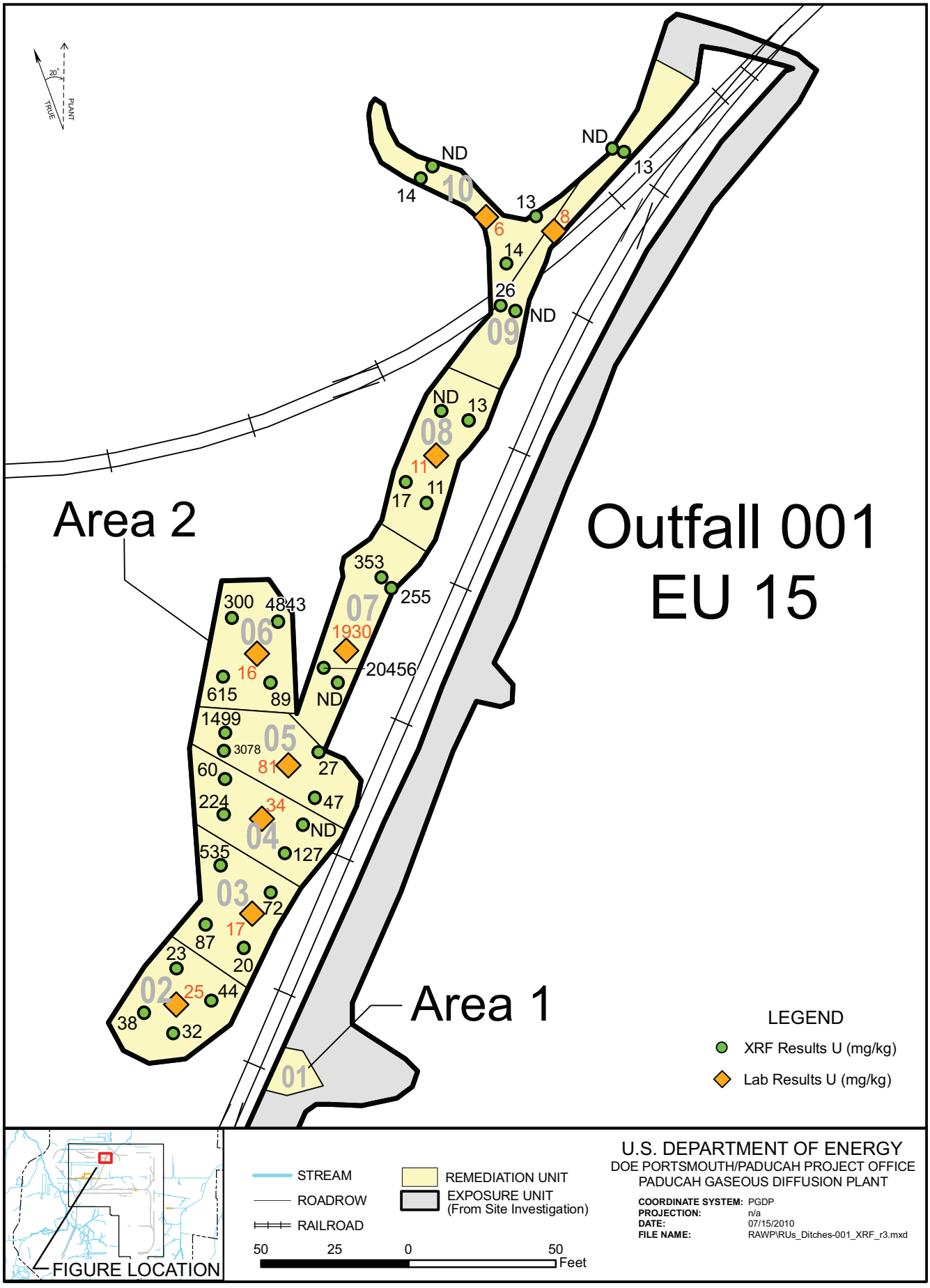

Figure A.3. Outfall 001 Preexcavation (5/18/10) Sample Results

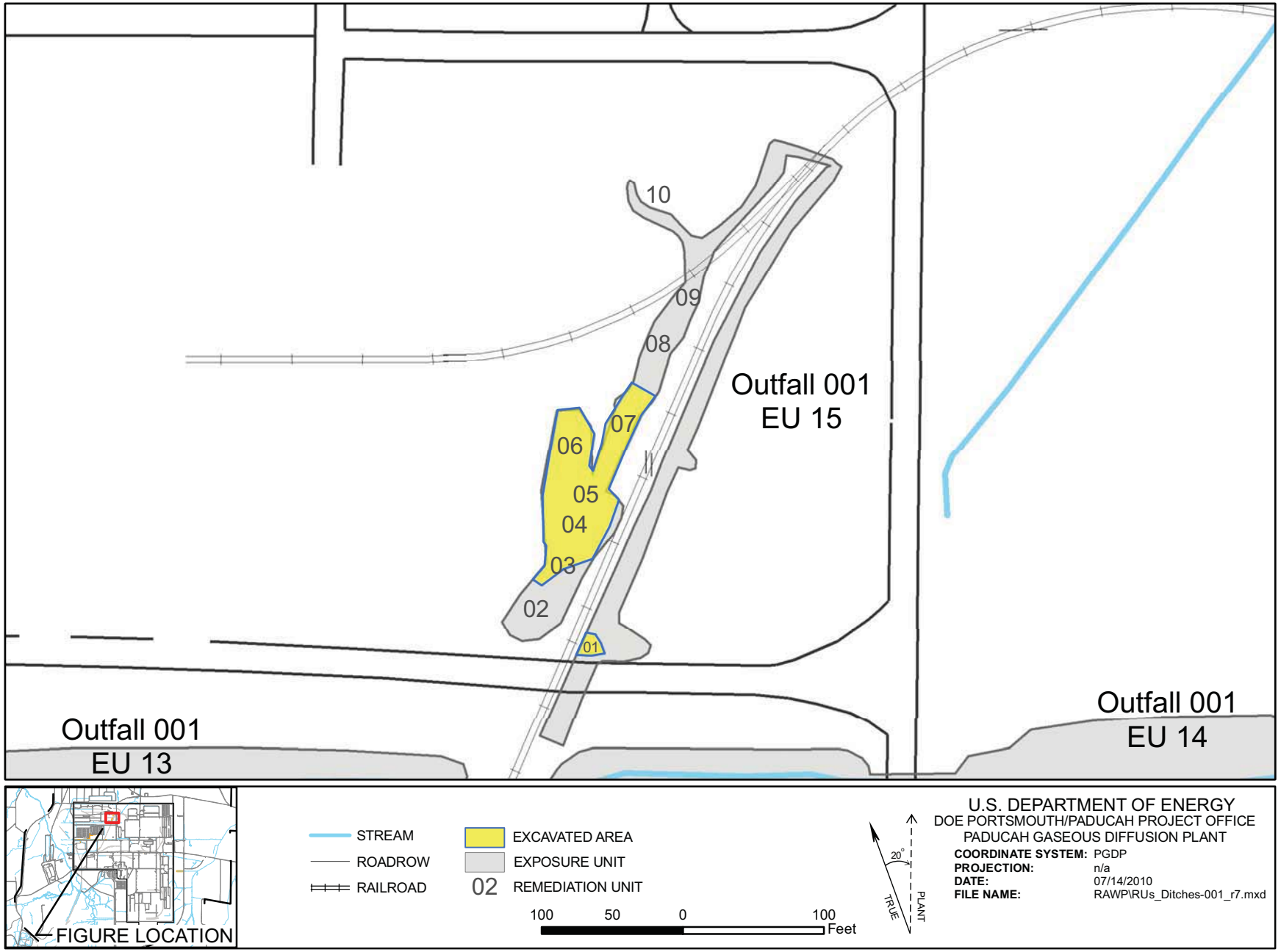

Figure A.4. Outfall 001 Actual Excavation Limits

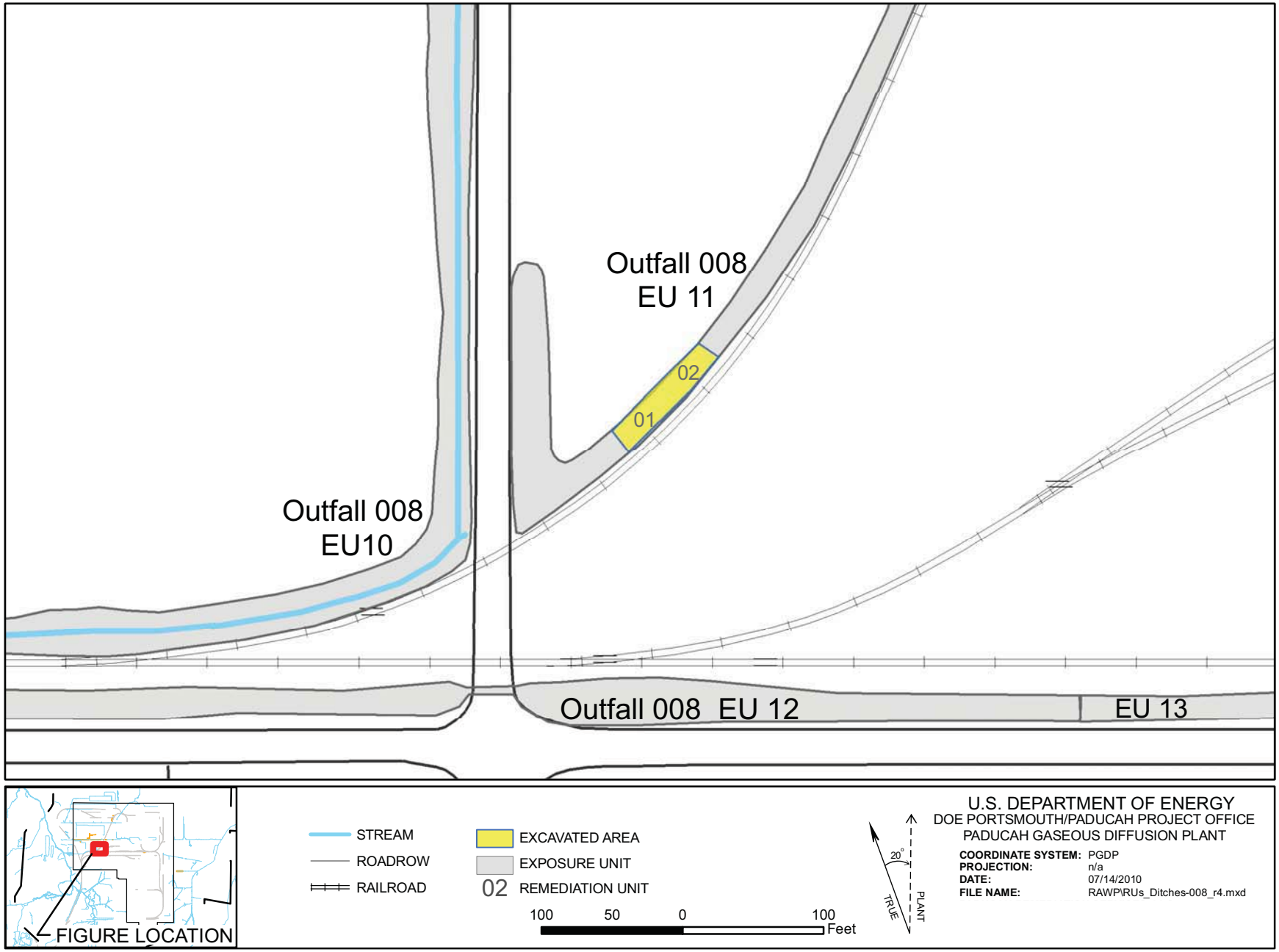

Figure A.5. Outfall 008 Actual Excavation Limits

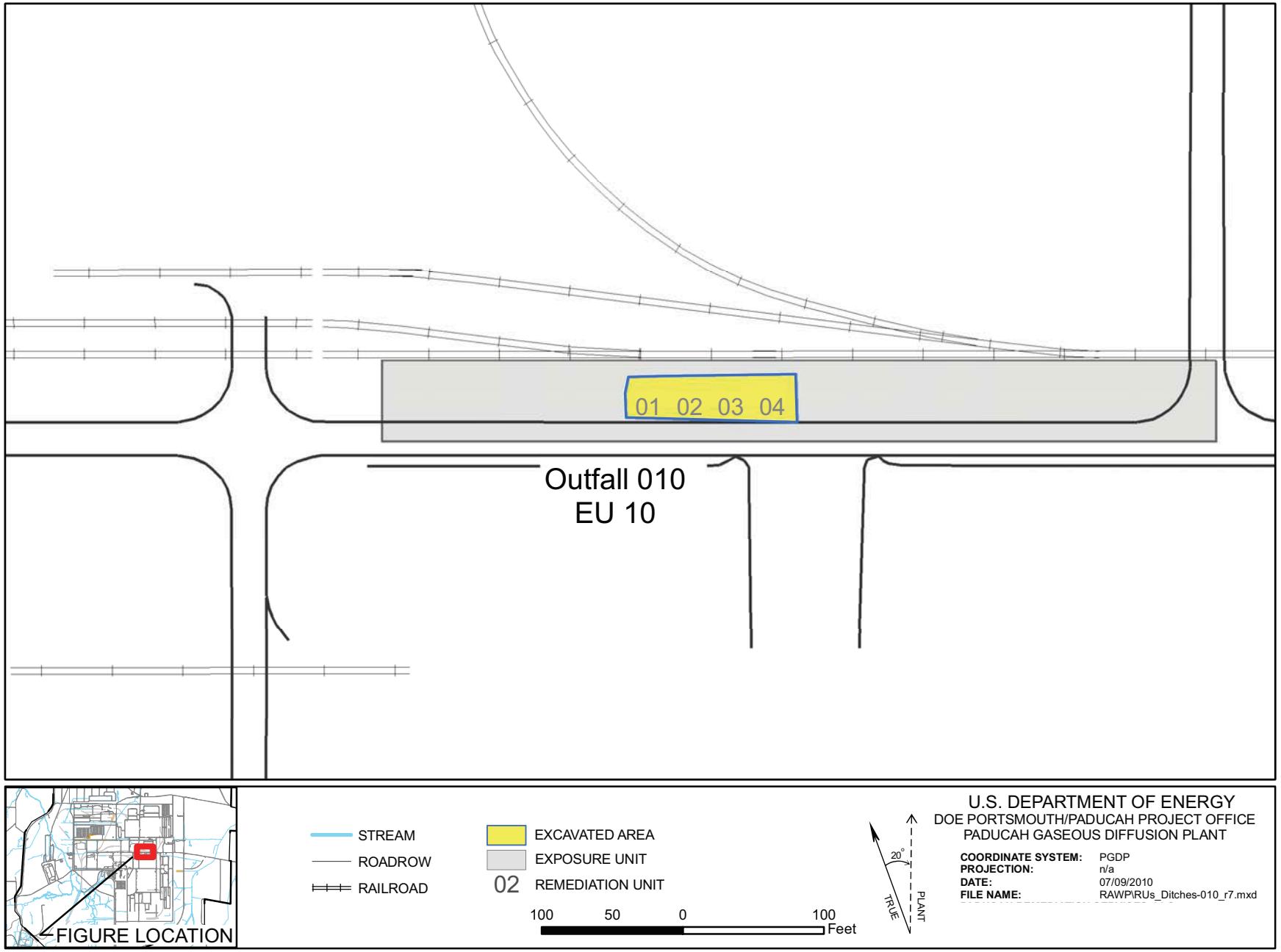

Figure A.6. Outfall 010 Actual Excavation Limits

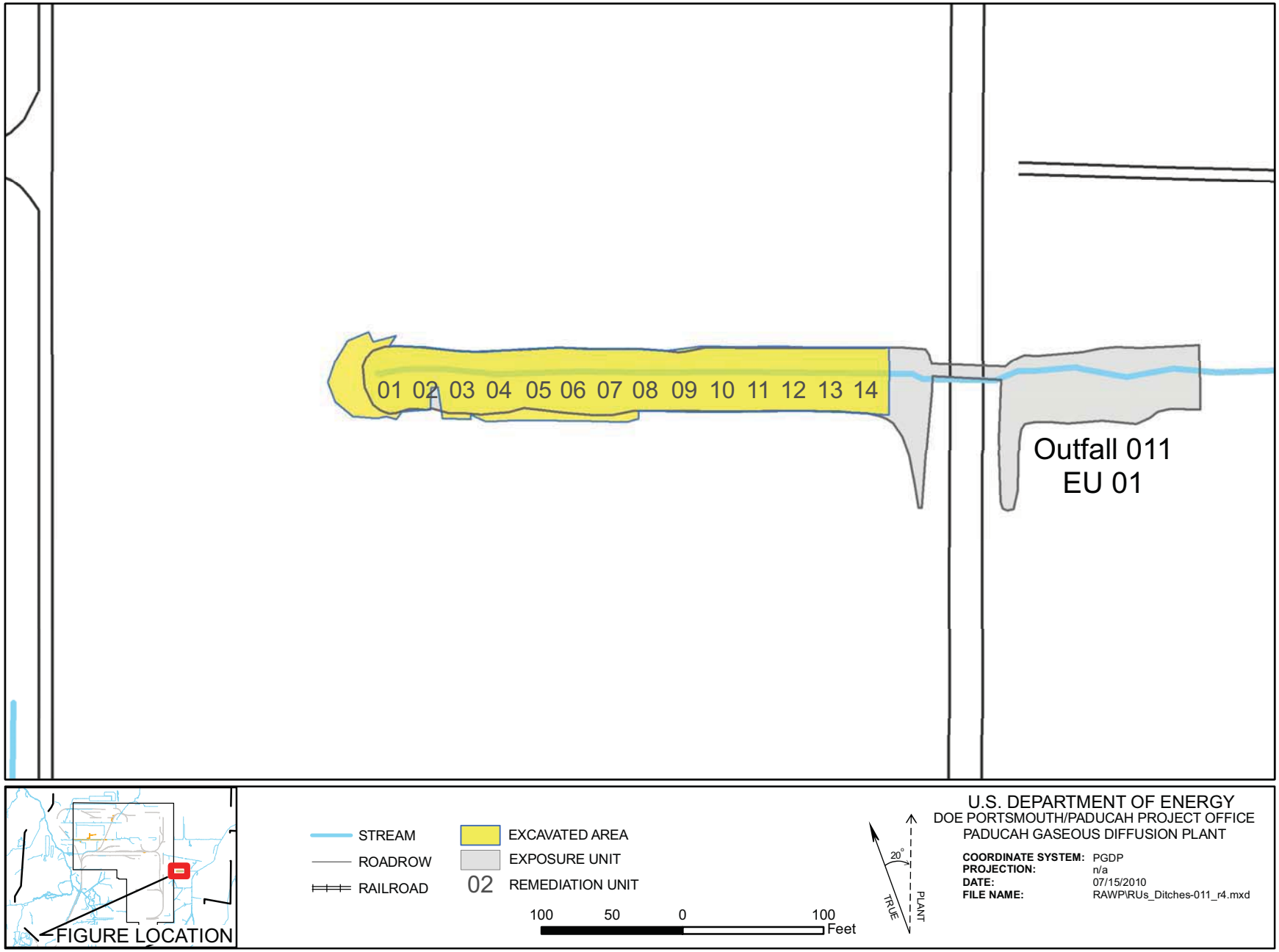

Figure A.7. Outfall 011 Actual Excavation Limits

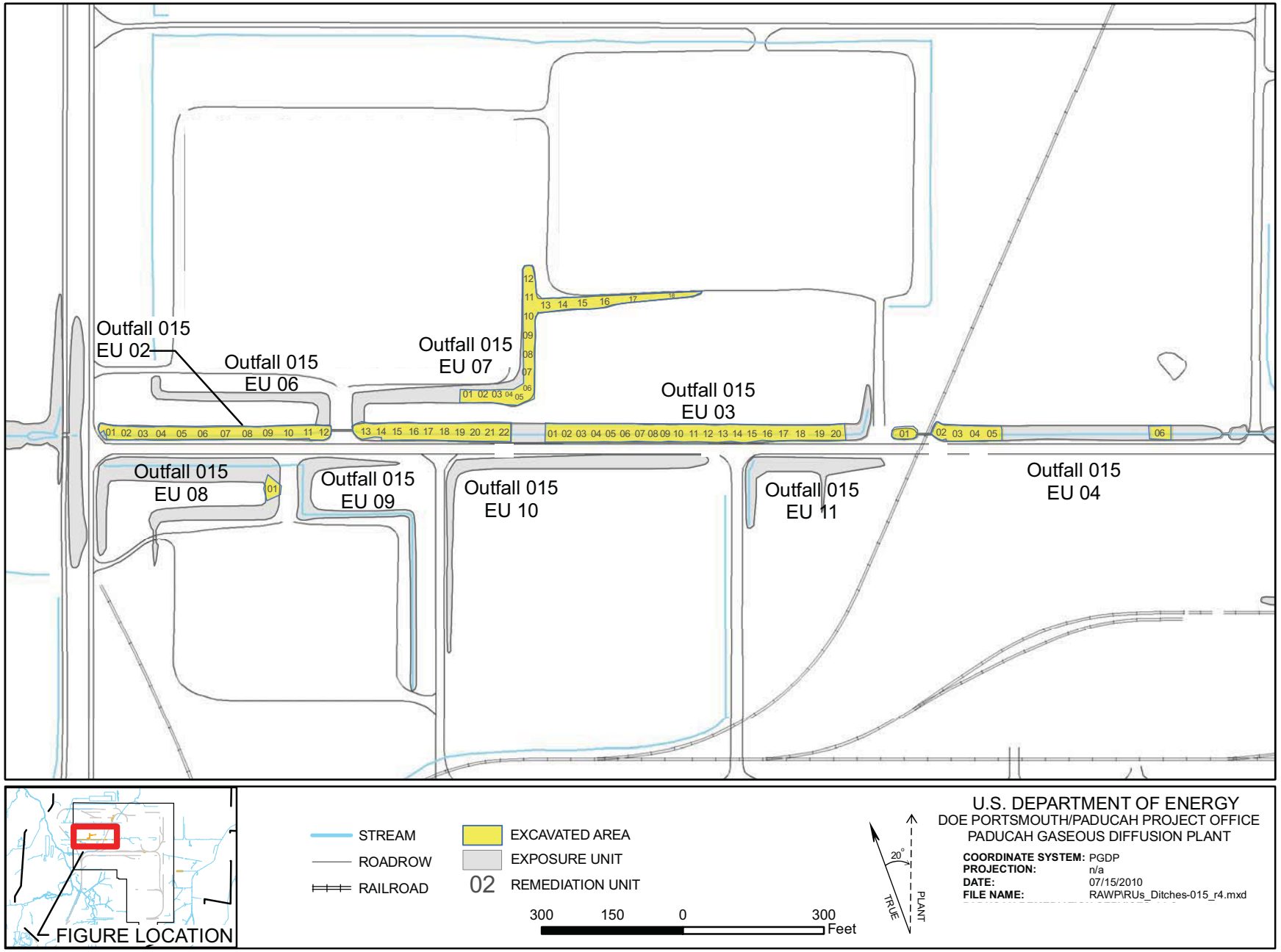

Figure A.8. Outfall 015 Actual Excavation Limits

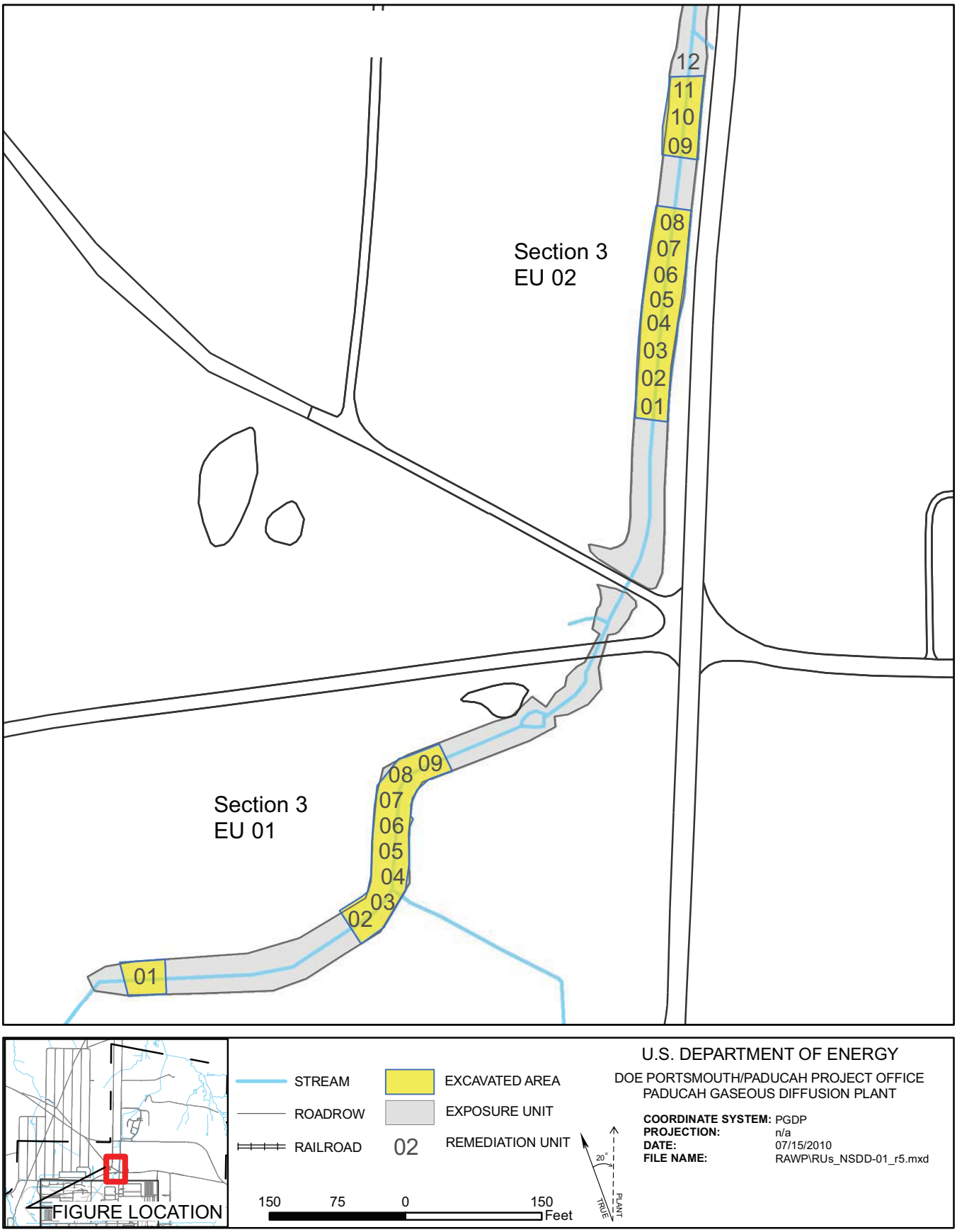

Figure A.9. NSDD Section 3 EUs 01 and 02 Actual Excavation Limits

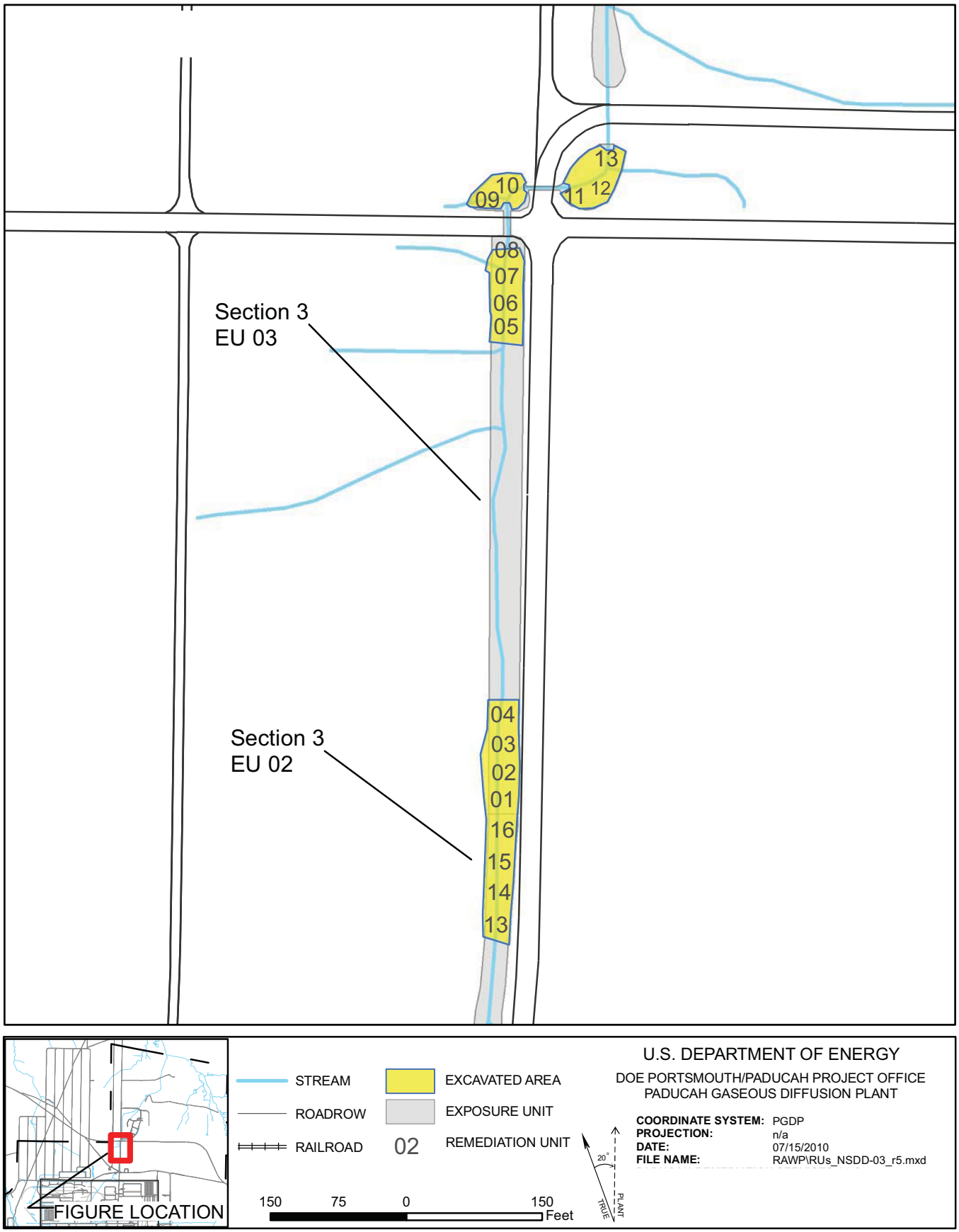

Figure A.10. NSDD Section 3 EUs 02 and 03 Actual Excavation Limits

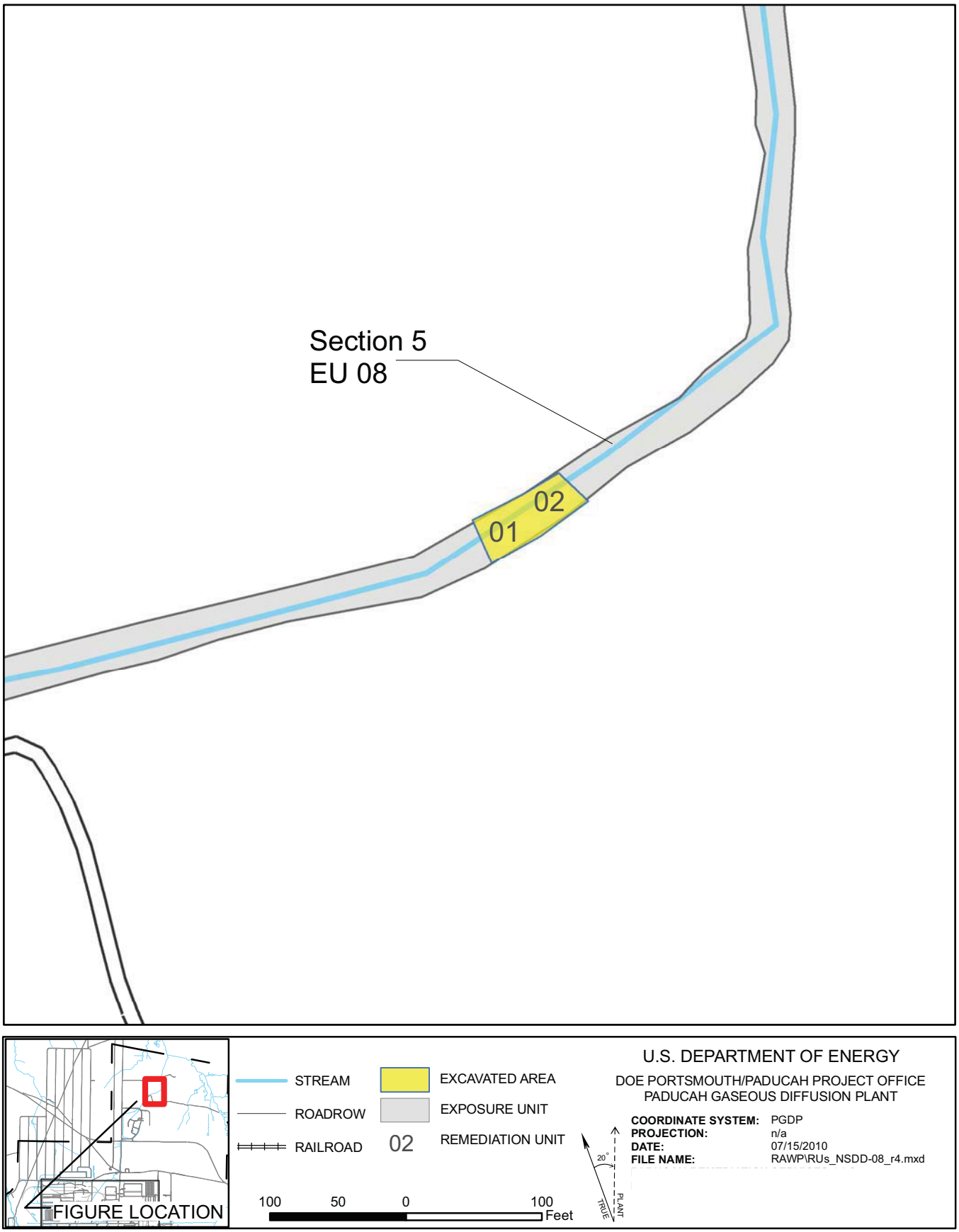

Figure A.11. NSDD Section 5 Actual Excavation Limits

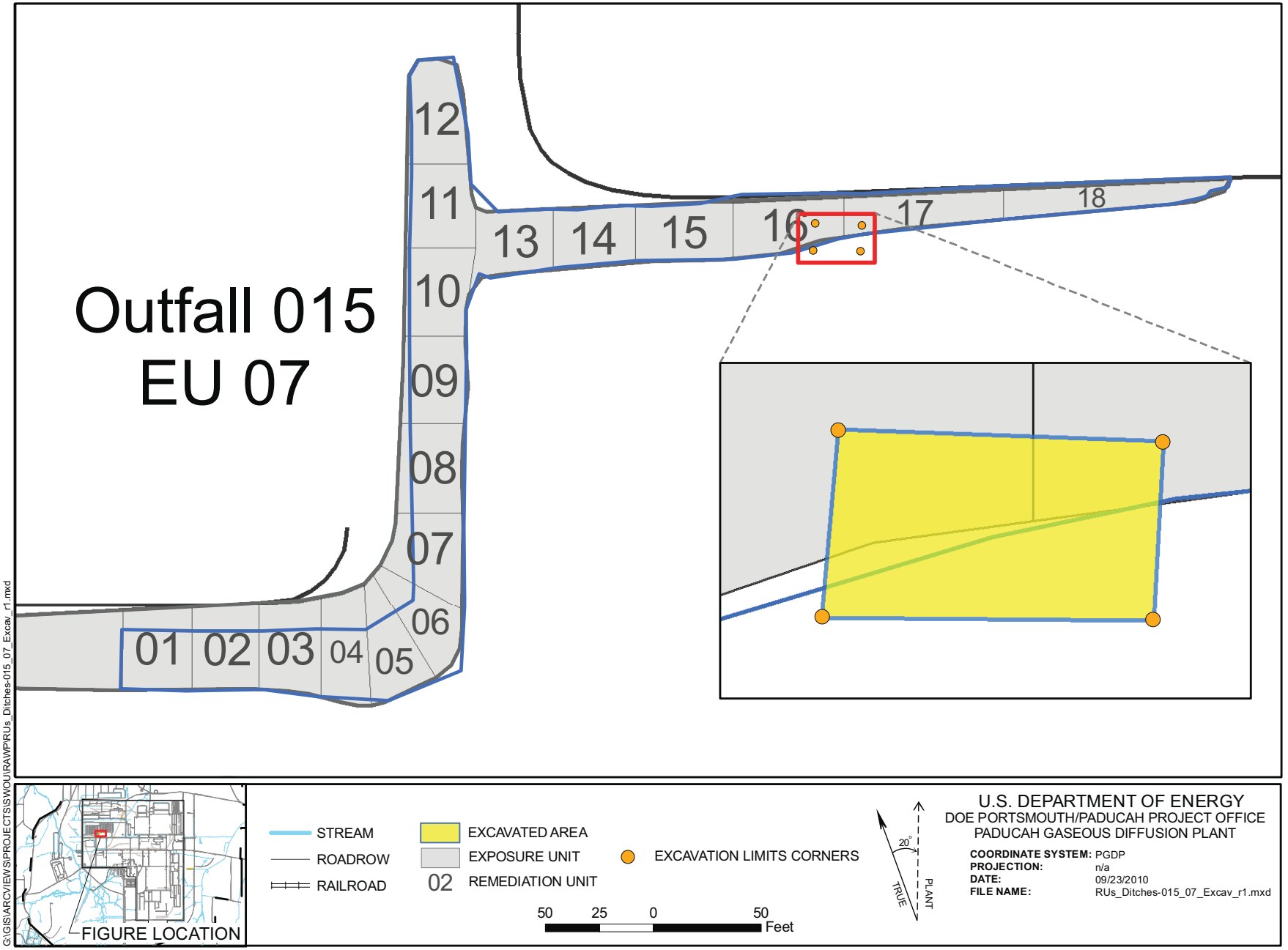

Figure A.12. Outfall 015 "Seam" Excavation

APPENDIX B

DATA TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B

DATA TABLES (ON CD)

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C

RESIDUAL RISK EVALUATION

THIS PAGE INTENTIONALLY LEFT BLANK

RESIDUAL RISK EVALUATION FOR THE SWOU REMOVAL ACTION

In accordance with the *Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* (DOE 2009) hot spots were removed. These areas were identified in the Removal Action Work Plan (RAWP) using a cumulative excess lifetime cancer risk (ELCR) of 1E-05 and a cumulative hazard index (HI) of 1.0 based upon the information presented in Appendix F, "Risk-Based Cost-Benefit Analysis," of the Engineering Evaluation/Cost Analysis. The risk evaluation calculates the cumulative residual risk and hazard for exposure units with excavated hot spots within Surface Water Operable Unit (SWOU) Removal Action for the industrial worker at all locations and for the recreational user at the North-South Diversion Ditch (NSDD). This enclosure serves to provide verification of cleanup to a cumulative excess lifetime cancer risk (ELCR) of 1E-05 and a cumulative HI of 1.0. Consistent with the results of the risk-based cost-benefit analysis, verification of cleanup are based upon comparisons between sampling results and chemical-specific ELCR-based cleanup levels. The ELCR and HI target used in deriving the cleanup levels are 5E-06 and 1.0, respectively, for individual contaminants of concern (COCs) in order to ensure the cumulative values were reached. The cancer risk-based and hazardous-based cleanup levels that are used in the comparison for the SWOU On-Site Project are shown in Table C.1.

Table C.1. Cleanup Levels Based on Carcinogenic Risk and Hazard

COC	Risk-Based Concentration	
Arsenic	27	mg/kg
Beryllium	50,000	mg/kg
Total PCB	16	mg/kg
Americium-241	115	pCi/g
Cesium-137	8	pCi/g
Neptunium-237	22	pCi/g
Plutonium-239/240	108	pCi/g
Technetium-99	3,825	pCi/g
Thorium-230	147	pCi/g
Thorium-232	129	pCi/g
Uranium-234	188	pCi/g
Uranium-235	30	pCi/g
Uranium-238	94	pCi/g
COC	**Hazard-Based Concentration**	
Uranium	227	mg/kg

Table C.1 is taken from the *Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0221&D2/R1, December 2009.

Exposure units (EUs) were developed for the SWOU Site Investigation. Each EU is approximately 0.5 acres and is consistent with the area defined in the Risk Methods Document (DOE 2001) for determining risk. Each outfall and NSDD EU that required excavation is evaluated separately. For each COC, the exposure concentration was the maximum detected concentration remaining in place (i.e., concentrations from removed soil were not used) if fewer than 10 results were available for the EU. For EUs with 10 or more results available, the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean of the appropriate distribution was used as the exposure concentration (DOE 2010). The U.S. Environmental Protection Agency (EPA) software program ProUCL was used for determining the appropriate 95% UCL value. The attachment (Exposure Unit Sample Locations, Figures C1.1 through C1.13) to this risk evaluation shows the locations of the EUs and the sample locations from which the exposure concentrations were derived.

The equation used to derive the risk estimate for each COC (i.e., chemical-specific cancer risk or hazard) is as follows:

$$\textbf{Risk} = \frac{\textbf{Exposure Concentration}}{\textbf{Cleanup Value}} \times \textbf{Target Risk Value}$$

where:

Risk = calculated chemical-specific cancer risk or hazard value.
Exposure Concentration = Maximum or 95% UCL concentration taken from Table C.2.
Cleanup Value = Risk-based or hazard-based concentration taken from Table C.1. For the recreational scenario calculations, the values are taken from Tables E.1 and E.2 of the *Engineering Evaluation/Cost Analysis for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0012&D2, September 2008, and are shown below.

COC	Recreational User ELCR=1E-5	
Arsenic	18.1	mg/kg
Beryllium	100,000	mg/kg
Total PCB	6.44	mg/kg
Americium-241	811	pCi/g
Cesium-137	11.9	pCi/g
Neptunium-237	37.8	pCi/g
Plutonium-239/240	2,370	pCi/g
Technetium-99	70,600	pCi/g
Thorium-230	3,020	pCi/g
Thorium-232	2,790	pCi/g
Uranium-234	4,070	pCi/g
Uranium-235	55.3	pCi/g
Uranium-238	246	pCi/g
COC	**Recreational User HI=1**	
Uranium	5,310	mg/kg

Target Risk Value = Cancer risk 5E-06 or hazard (1) upon which the target cleanup value is based. For the recreational scenario calculations, the values are cancer risk 1E-05 or hazard (1), upon which the target cleanup value is based.

Results of the application of this equation are presented in Table C.3. After risk estimates for each COC were determined, a cumulative risk for each EU was calculated as follows:

$$\text{Total Risk} = \sum \text{Analyte-specific Risks}$$

The cumulative hazard and cancer risk for the EUs are listed in Table C.4.

Table C.2. Exposure Concentrations for SWOU EUs

EU	Arsenic (mg/kg)	Beryllium (mg/kg)	Total PCB (mg/kg)	Uranium (mg/kg)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Np-237 (pCi/g)	Pu-239/240 (pCi/g)	Tc-99 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
Outfall 001														
15	5.381	0.459	10.5	16.53	0.223	0.115	0.135	0.15	16.09	1.809	0.806	3.252	0.197	5.907
Outfall 008														
11	4.91	0.491	9.22	15.9	0.0972	0.45	0.152	0.274	7.76	2.08	0.883	2.54	0.156	3.76
Outfall 010														
10	12.6	0.58	3.36	12	0.198	0.726	0.172	0.109	8.44	1.23	0.934	2.47	0.155	4.66
Outfall 011														
01	3.561	0.495	1.338	65.86	0.0752	0.0669	0.0108	0.0275	3.761	0.891	0.705	3.11	0.238	47.64
Outfall 015														
02	4.626	0.409	0.0754	22.29	0.153	1.17	0.157	0.214	4.65	8.607	0.919	3.294	0.386	6.357
03	3.724	0.391	0.08	27.14	0.128	0.646	0.12	0.392	0.816	10.31	0.922	3.792	0.271	9.092
04	10.4	1.08	0.81	36.1	0.184	11.2[a]	0.527	2.42	21.6	8.73	1.03	2.36	0.171	9.64
07	6.088	0.55	0.0813	30.5	0.129	0.125	0.0167	0.174	0.882	1.236	0.932	3.869	0.216	25.57
08	46.9[b]	0.495	0.13	55.7	0.083	0.443	0.0638	0.0434	3.31	1.43	0.989	0.588	0.0405	0.843
NSDD, Section 3														
01	4.315	0.5	0.979	35.8	0.713	0.593	0.802	2.236	40.86	26.42	0.879	9.106	0.848	13.11
02	4.213	0.504	0.729	27.38	1.633	0.774	1.898	8.277	105.3	54.99	0.938	6.194	0.389	8.533
03	4.268	0.44	0.583	45.23	1.99	1.516	1.382	9.512	306.4	101.2	0.914	6.525	0.389	8.171
NSDD, Section 5														
08	15.99	0.695	0.798	87.8	0.694	1.667	0.199	2.027	24.62	26.05	0.646	3.385	0.235	4.956

Am-241 = Americium-241 Cs-137 = Cesium-137 Np-237 = Neptunium-237 Pu-239/240 = Plutonium-239/240 Tc-99 = Technetium-99 Th-230 = Thorium-230
Th-232 = Thorium-232 U-234 = Uranium-234 (reported as Uranium-233/234) U-235 = Uranium-235 U-238 = Uranium-238

[a] The value shown is above the chemical-specific cleanup level as shown in Table C.1 because it is the maximum value for the EU and is from a historical data sample. The area from which the historical data sample was collected was not excavated because the Cs-137 value was not higher than the individual 1E-5 ELCR value defined in the Engineering Evaluation/Cost Analysis (15.2 pCi/g) (DOE 2008).

[b] The value shown is above the chemical-specific cleanup level as shown in Table C.1 because it is the maximum value for the EU and is from a historical data sample. The area from which the historical data sample was collected was not excavated because the arsenic value was not higher than the individual 1E-5 ELCR value defined in the Engineering Evaluation/Cost Analysis (54.8) (DOE 2008).

Table C.3. Risk and Hazard Estimates for SWOU EUs

EU	Arsenic	Beryllium	Total PCB	Uranium	Am-241	Cs-137	Np-237	Pu-239/240	Tc-99	Th-230	Th-232	U-234	U-235	U-238
INDUSTRIAL WORKER														
							Outfall 001							
15	9.96E-07	4.59E-11	3.28E-06	0.1	9.70E-09	7.19E-08	3.07E-08	6.94E-09	2.10E-08	6.15E-08	3.12E-08	8.65E-08	3.28E-08	3.14E-07
							Outfall 008							
11	9.09E-07	4.91E-11	2.88E-06	0.1	4.23E-09	2.81E-07	3.45E-08	1.27E-08	1.01E-08	7.07E-08	3.42E-08	6.76E-08	2.60E-08	2.00E-07
							Outfall 010							
10	2.33E-06	5.80E-11	1.05E-06	0.1	8.61E-09	4.54E-07	3.91E-08	5.05E-09	1.10E-08	4.18E-08	3.62E-08	6.57E-08	2.58E-08	2.48E-07
							Outfall 011							
01	6.59E-07	4.95E-11	4.18E-07	0.3	3.27E-09	4.18E-08	2.45E-09	1.27E-09	4.92E-09	3.03E-08	2.73E-08	8.27E-08	3.97E-08	2.53E-06
							Outfall 015							
02	8.57E-07	4.09E-11	2.36E-08	0.1	6.65E-09	7.31E-07	3.57E-08	9.91E-09	6.08E-09	2.93E-07	3.56E-08	8.76E-08	6.43E-08	3.38E-07
03	6.90E-07	3.91E-11	2.50E-08	0.1	5.57E-09	4.04E-07	2.73E-08	1.81E-08	1.07E-09	3.51E-07	3.57E-08	1.01E-07	4.52E-08	4.84E-07
04	1.93E-06	1.08E-10	2.53E-07	0.2	8.00E-09	7.00E-06	1.20E-07	1.12E-07	2.82E-08	2.97E-07	3.99E-08	6.28E-08	2.85E-08	5.13E-07
07	1.13E-06	5.52E-11	2.54E-08	0.1	5.61E-09	7.81E-08	3.80E-09	8.06E-09	1.15E-09	4.20E-08	3.61E-08	1.03E-07	3.60E-08	1.36E-06
08	8.69E-06	4.95E-11	4.06E-08	0.2	3.61E-09	2.77E-07	1.45E-08	2.01E-09	4.33E-09	4.86E-08	3.83E-08	1.56E-08	6.75E-09	4.48E-08
							NSDD, Section 3							
01	7.99E-07	5.00E-11	3.06E-07	0.2	3.10E-08	3.71E-07	1.82E-07	1.04E-07	5.34E-08	8.99E-07	3.41E-08	2.42E-07	1.41E-07	6.97E-07
02	7.80E-07	5.04E-11	2.28E-07	0.1	7.10E-08	4.84E-07	4.31E-07	3.83E-07	1.38E-07	1.87E-06	3.64E-08	1.65E-07	6.48E-08	4.54E-07
03	7.90E-07	4.40E-11	1.82E-07	0.2	8.65E-08	9.48E-07	3.14E-07	4.40E-07	4.01E-07	3.44E-06	3.54E-08	1.74E-07	6.48E-08	4.35E-07
							NSDD, Section 5							
08	2.96E-06	6.95E-11	2.49E-07	0.4	3.02E-08	1.04E-06	4.52E-08	9.38E-08	3.22E-08	8.86E-07	2.50E-08	9.00E-08	3.92E-08	2.64E-07

Table C.3. Risk and Hazard Estimates for SWOU EUs (Continued)

RECREATIONAL USER

NSDD, Section 3														
01	2.38E-06	5.00E-11	1.52E-06	<0.1	8.79E-09	4.98E-07	2.12E-07	9.43E-09	5.79E-09	8.75E-08	3.15E-09	2.24E-08	1.53E-07	5.33E-07
02	2.33E-06	5.04E-11	1.13E-06	<0.1	2.01E-08	6.50E-07	5.02E-07	3.49E-08	1.49E-08	1.82E-07	3.36E-09	1.52E-08	7.03E-08	3.47E-07
03	2.36E-06	4.40E-11	9.05E-07	<0.1	2.45E-08	1.27E-06	3.66E-07	4.01E-08	4.34E-08	3.35E-07	3.28E-09	1.60E-08	7.03E-08	3.32E-07
NSDD, Section 5														
08	8.83E-06	6.95E-11	1.24E-06	<0.1	8.56E-09	1.40E-06	5.26E-08	8.55E-09	3.49E-09	8.63E-08	2.32E-09	8.32E-09	4.25E-08	2.01E-07

Am-241 = Americium-241 Cs-137 = Cesium-137 Np-237 = Neptunium-237 Pu-239/240 = Plutonium-239/240 Tc-99 = Technetium-99 Th-230 = Thorium-230
Th-232 = Thorium-232 U-234 = Uranium-234 (reported as Uranium-233/234) U-235 = Uranium-235 U-238 = Uranium-238

Table C.4. Cumulative ELCR and HI for SWOU EUs

Outfall/ NSDD Section	EU	ELCR (Cancer)	HI (Hazard)
INDUSTRIAL WORKER			
Outfall 001	15	4.9E-06	0.1
Outfall 008	11	4.5E-06	0.1
Outfall 010	10	4.3E-06	0.1
Outfall 011	1	3.8E-06	0.3
Outfall 015	2	2.5E-06	0.1
	3	2.2E-06	0.1
	4	1.0E-05	0.2
	7	2.8E-06	0.1
	8	9.2E-06	0.2
Section 3	1	3.9E-06	0.2
	2	5.1E-06	0.1
	3	7.3E-06	0.2
Section 5	8	5.8E-06	0.4
RECREATIONAL USER			
Section 3	1	5.4E-06	<0.1
	2	5.3E-06	<0.1
	3	5.8E-06	<0.1
Section 5	8	1.2E-05	<0.1

UNCERTAINTIES IN CALCULATION OF CUMULATIVE RESIDUAL RISK AND HAZARDS FOR COCs

Several uncertainties should be taken into account when considering the calculation of cumulative residual risk and hazards for COCs for excavated hot spots within SWOU internal ditches and the NSDD.

One uncertainty for consideration is that the laboratory-reported results from samples collected during the SWOU Site Investigation for uranium isotopes present at or near background values may be biased low based on the extraction method the laboratory historically has used. It should be noted that this uncertainty occurs only when using SWOU Site Investigation data (not removal verification data). Estimated risk from uranium isotopes are well within acceptable ranges; thus, this uncertainty is not considered significant.

Only risk and hazard contributed by chemicals considered COCs and listed in the Table C.1 were included in the calculation, as specified in the RAWP.

Chemicals not detected at their laboratory sample quantitation limit (SQL) were used in the calculation at the full SQL value. Additionally, results detected below site background were included in the calculation. This may have resulted in an exaggerated value of cumulative risk and hazard.

Any risk or hazard associated with the removal of the French drain within Outfall 010 was not considered in this evaluation. All laboratory data associated with this removal were well below cleanup levels, so this area is not expected to have any adverse effect to the cumulative risk or hazard for Outfall 010, EU 10.

RESULTS OF CALCULATION OF CUMULATIVE RESIDUAL RISK AND HAZARDS FOR COCs FROM EXPOSURE UNITS WITH EXCAVATED HOT SPOTS WITHIN SWOU REMOVAL ACTION

The calculation of cumulative residual risk and hazard for COCs from EUs with excavated hot spots within SWOU Removal Action indicates that the removal goal of cleanup to a cumulative ELCR of 1E-05 and a cumulative HI of 1.0 was achieved.

REFERENCES

DOE 2001. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky Volume 1, Human Health,* DOE/OR/07-1506&D2, December.

DOE 2008. *Engineering Evaluation/Cost Analysis for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0012&D2, September.

DOE 2009. *Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0221&D2/R1, December.

DOE 2010. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky Volume 1, Human Health,* DOE/LX/07-0107&D2/V1, July.

EPA 2010. ProUCL Version 4.00.05 Technical Guide (Draft). EPA/600/R-07/041 Technical Support Center, Characterization and Monitoring Branch, Las Vegas, NV, May. (Model available at www.epa.gov/nerlesd1/tsc/software.htm)

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT

EXPOSURE UNIT SAMPLE LOCATIONS

THIS PAGE INTENTIONALLY LEFT BLANK

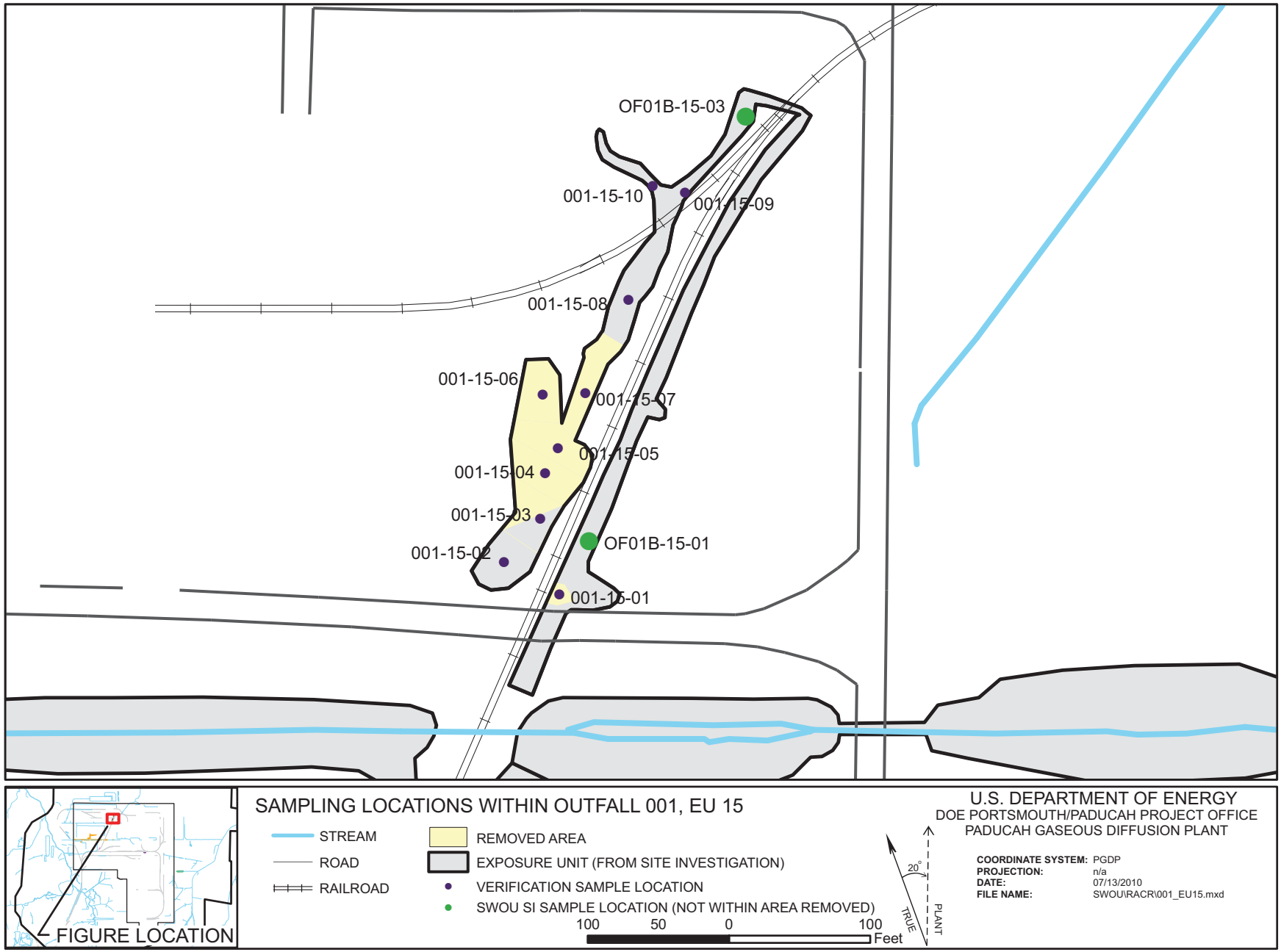

Figure C1.1. Sampling Locations within Outfall 001, EU 15

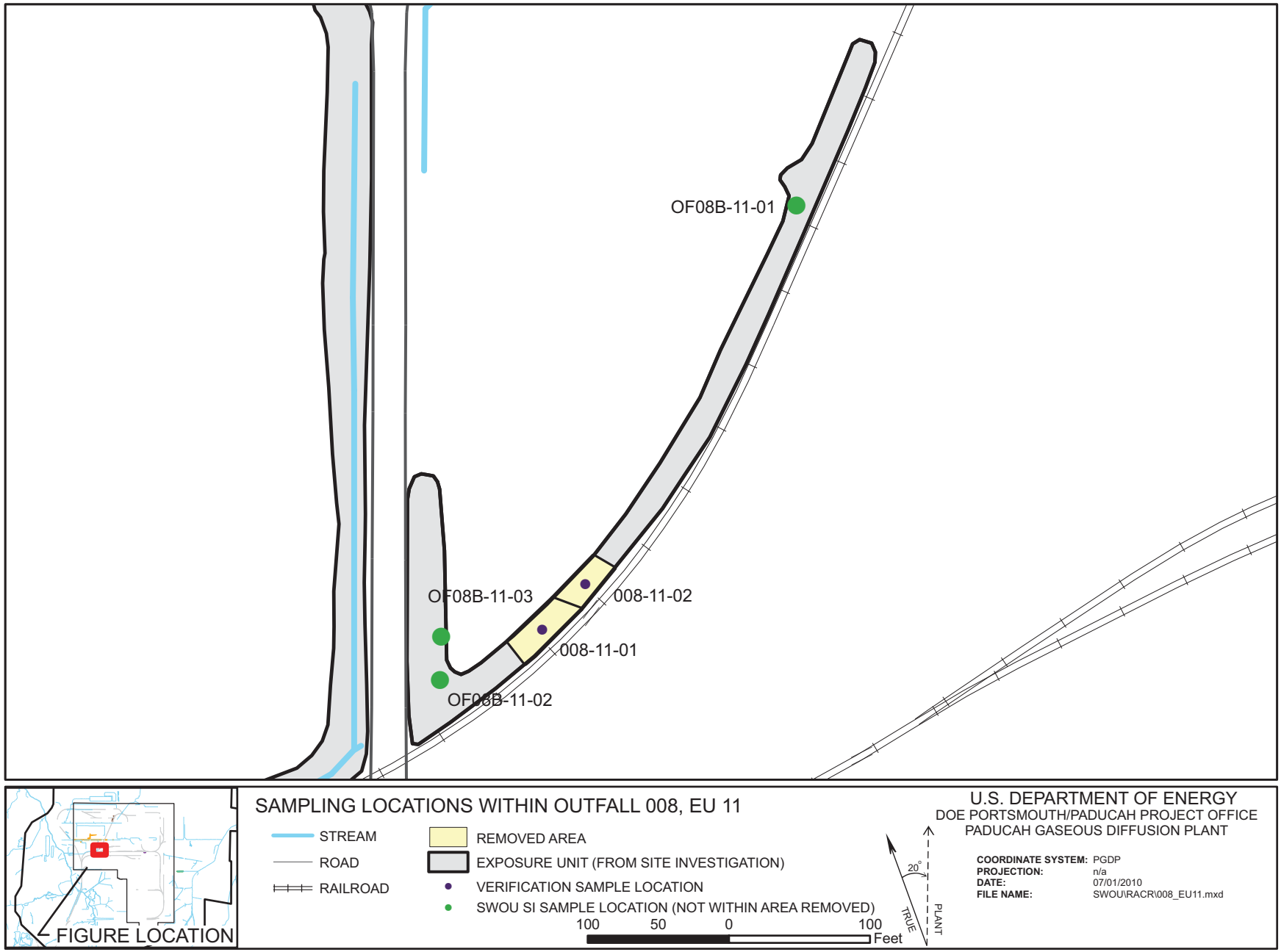

Figure C1.2. Sampling Locations within Outfall 008, EU 11

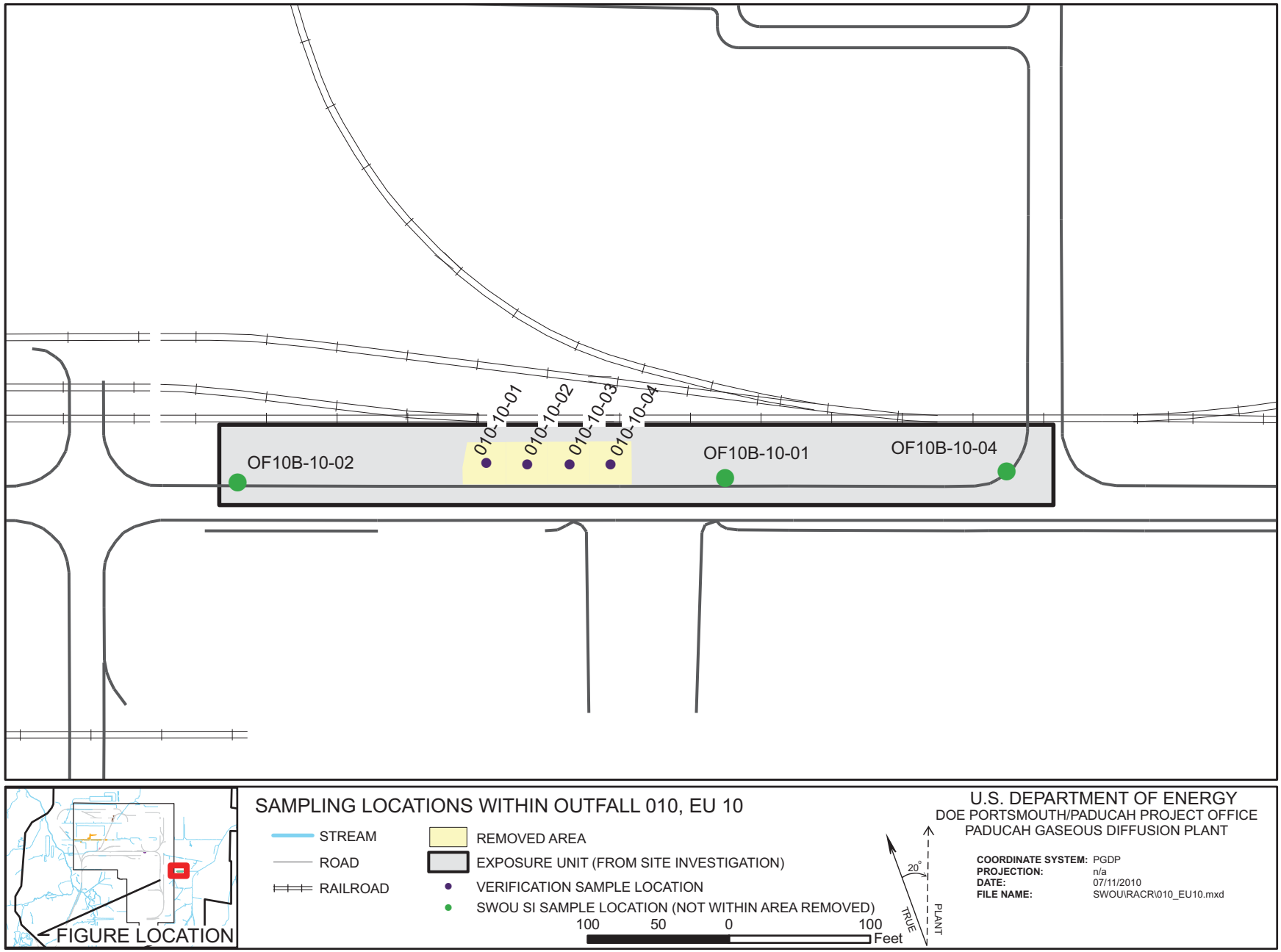

Figure C1.3. Sampling Locations within Outfall 010, EU 10

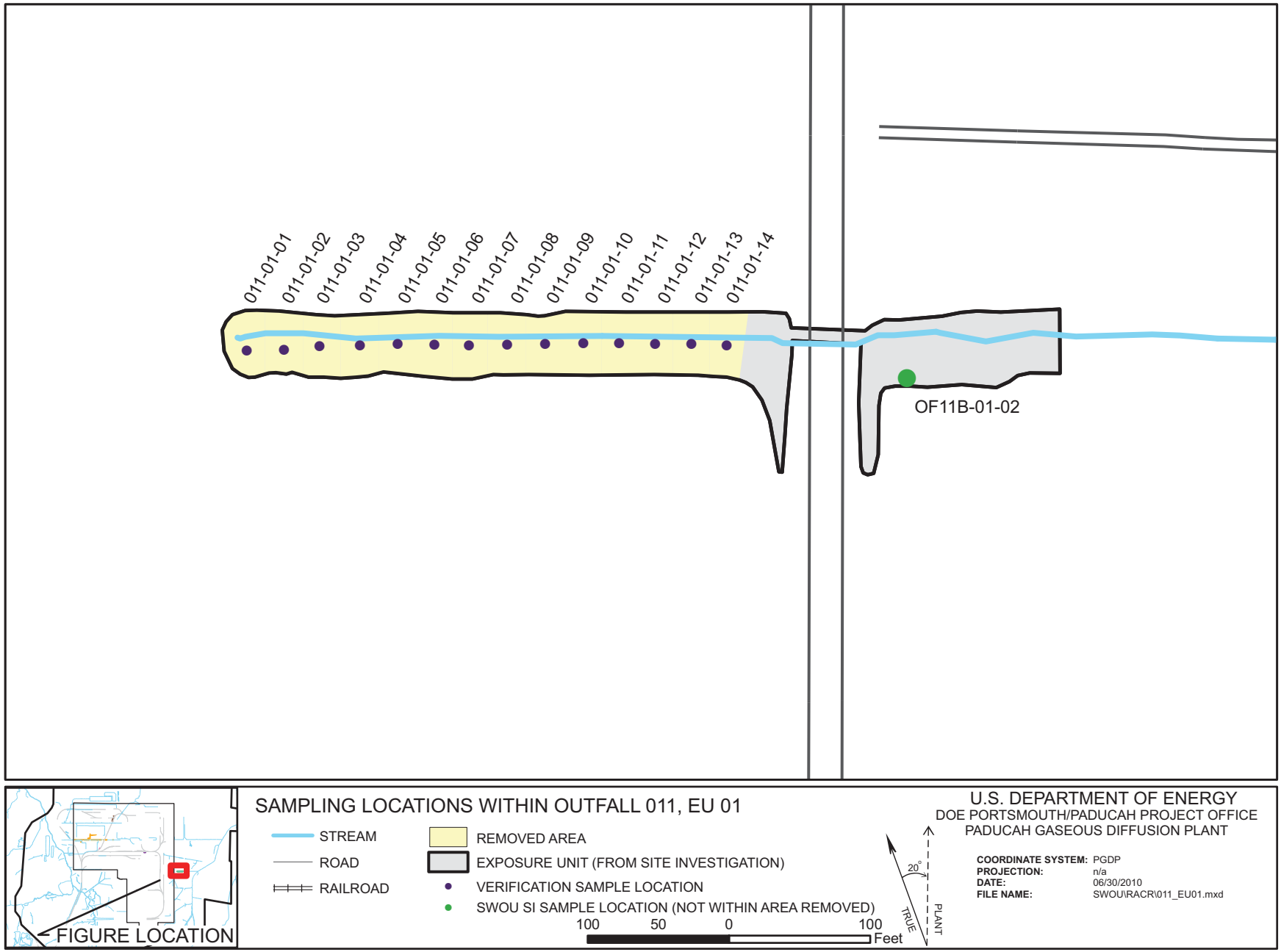

Figure C1.4. Sampling Locations within Outfall 011, EU 01

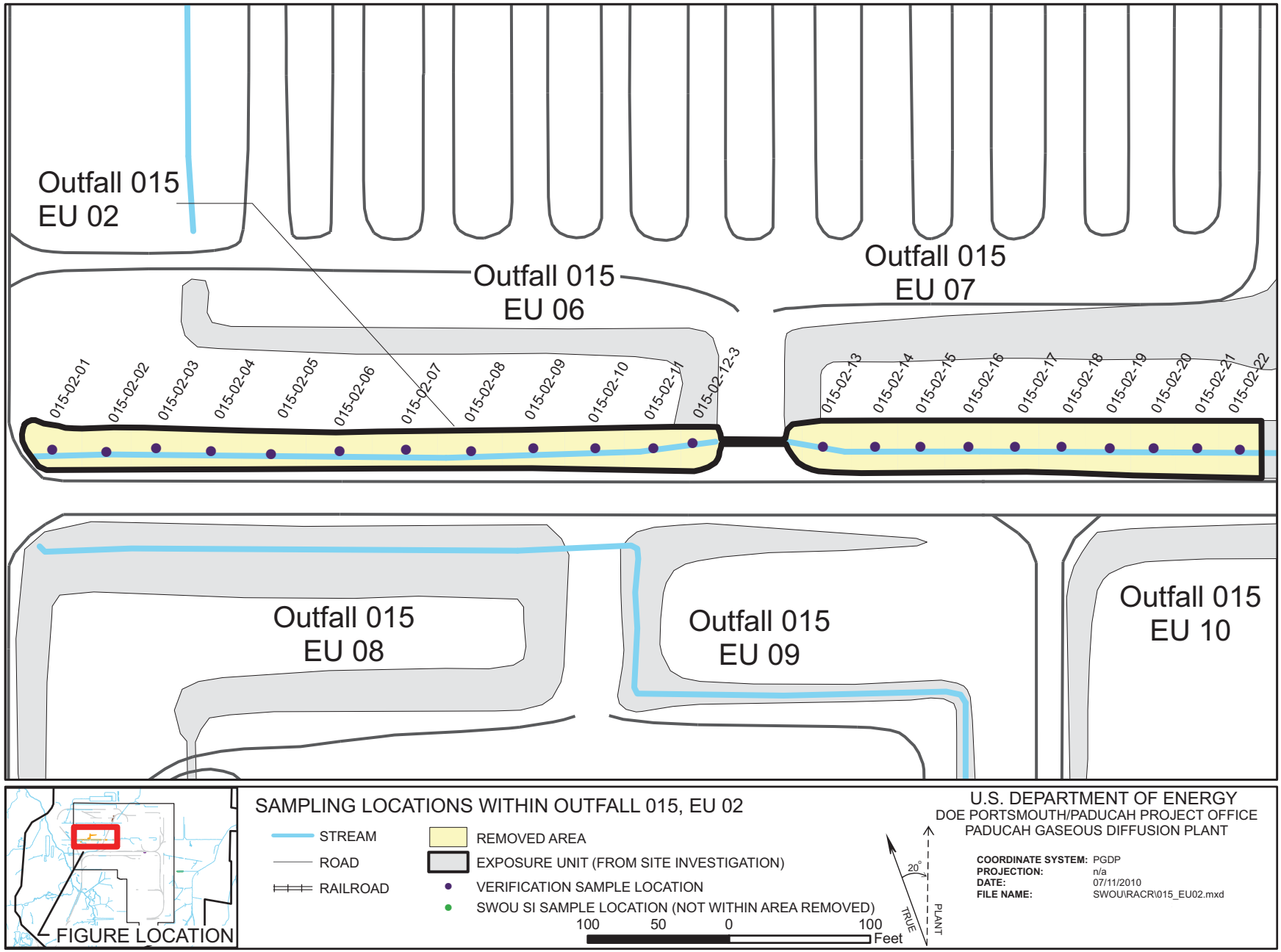

Figure C1.5. Sampling Locations within Outfall 015, EU 02

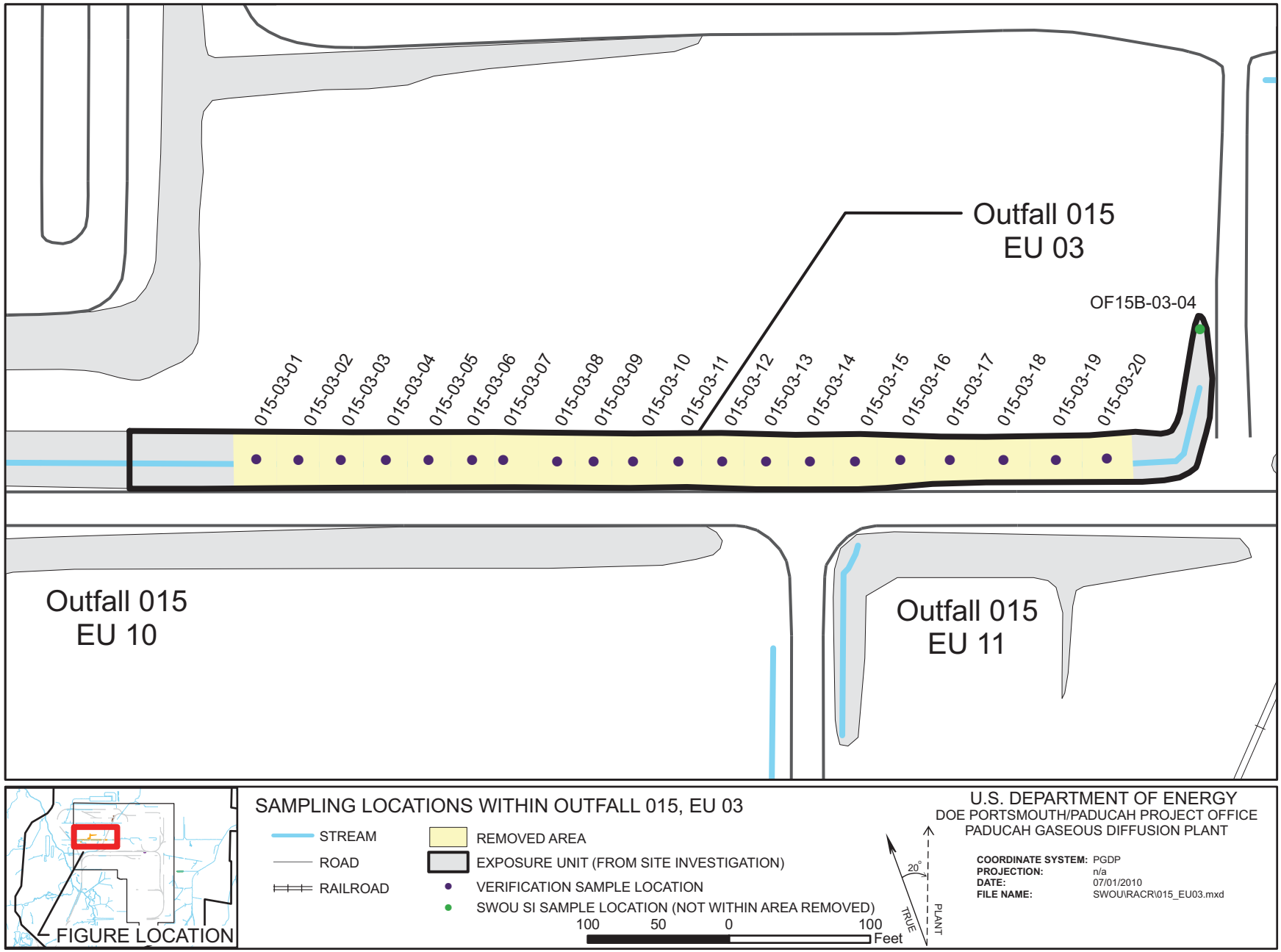

Figure C1.6. Sampling Locations within Outfall 015, EU 03

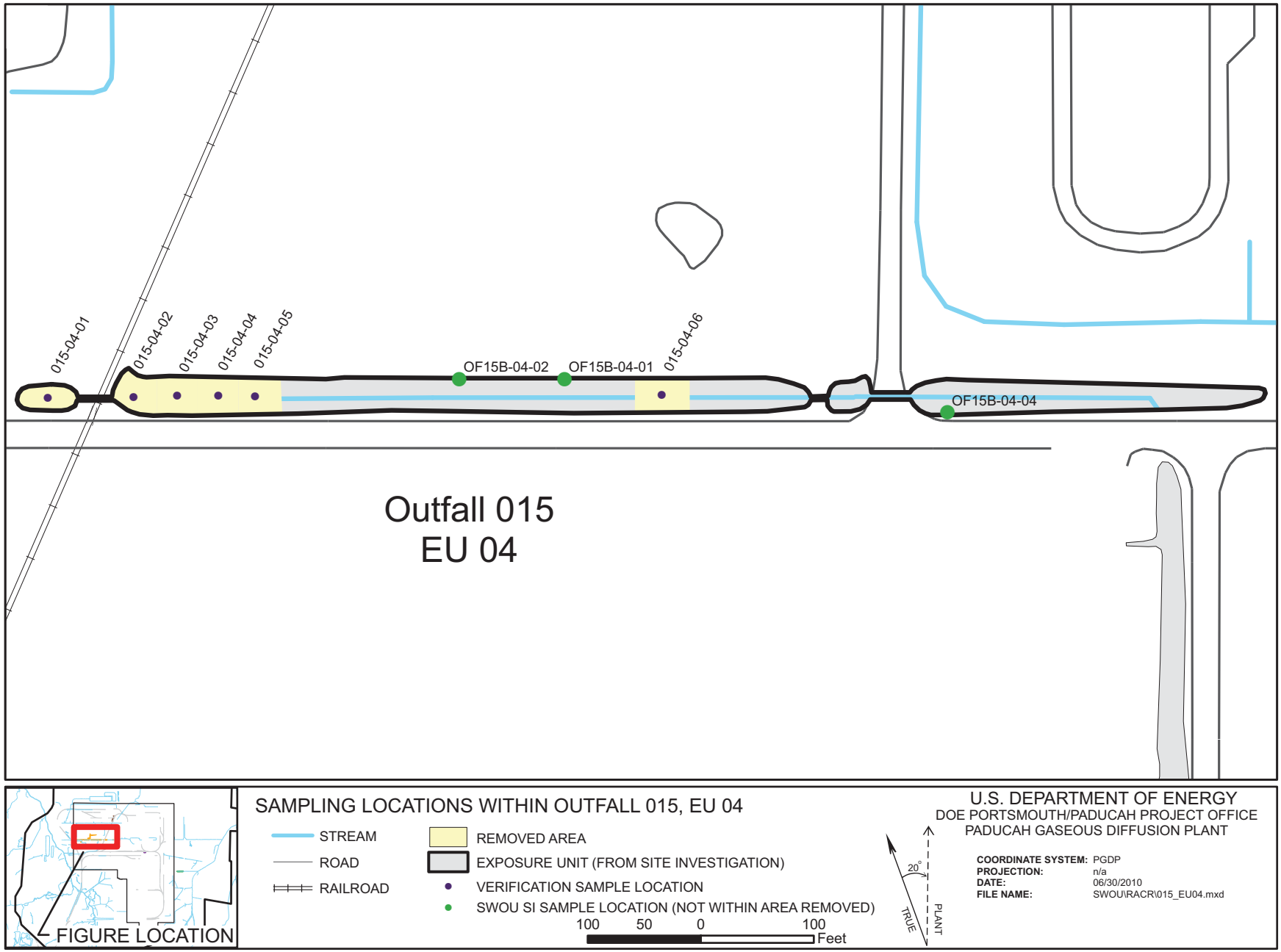

Figure C1.7. Sampling Locations within Outfall 015, EU 04

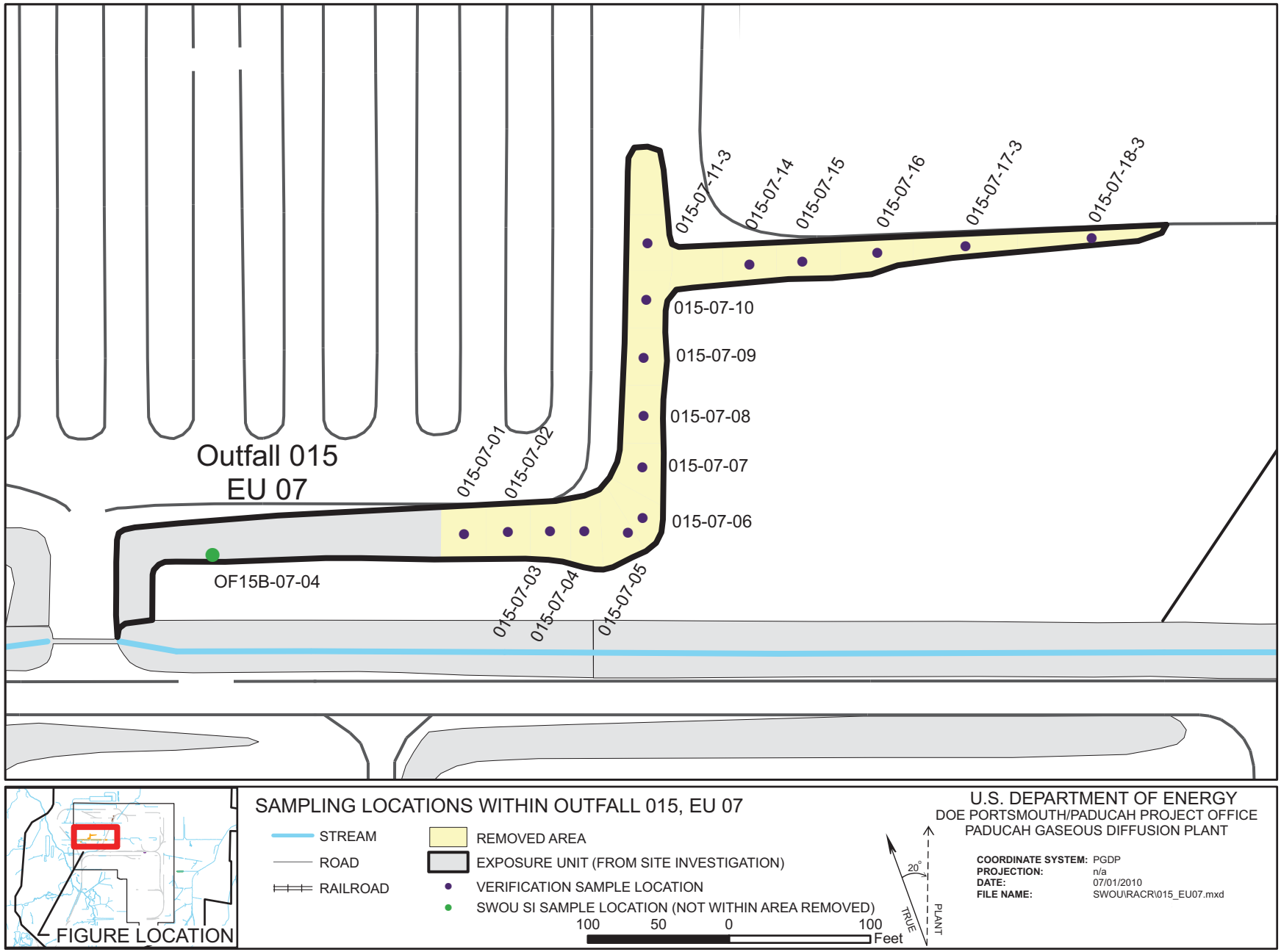

Figure C1.8. Sampling Locations within Outfall 015, EU 07

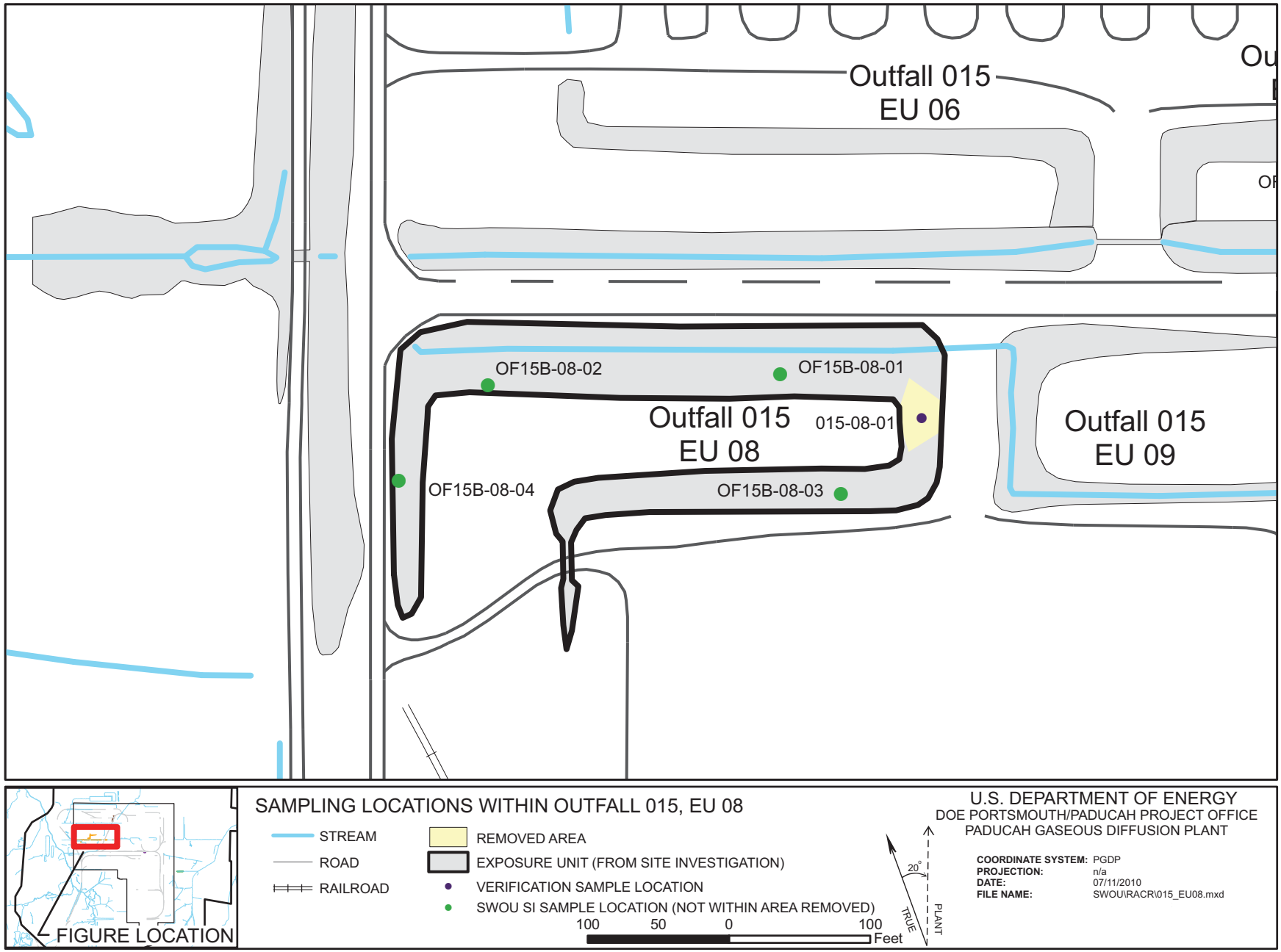

Figure C1.9. Sampling Locations within Outfall 015, EU 08

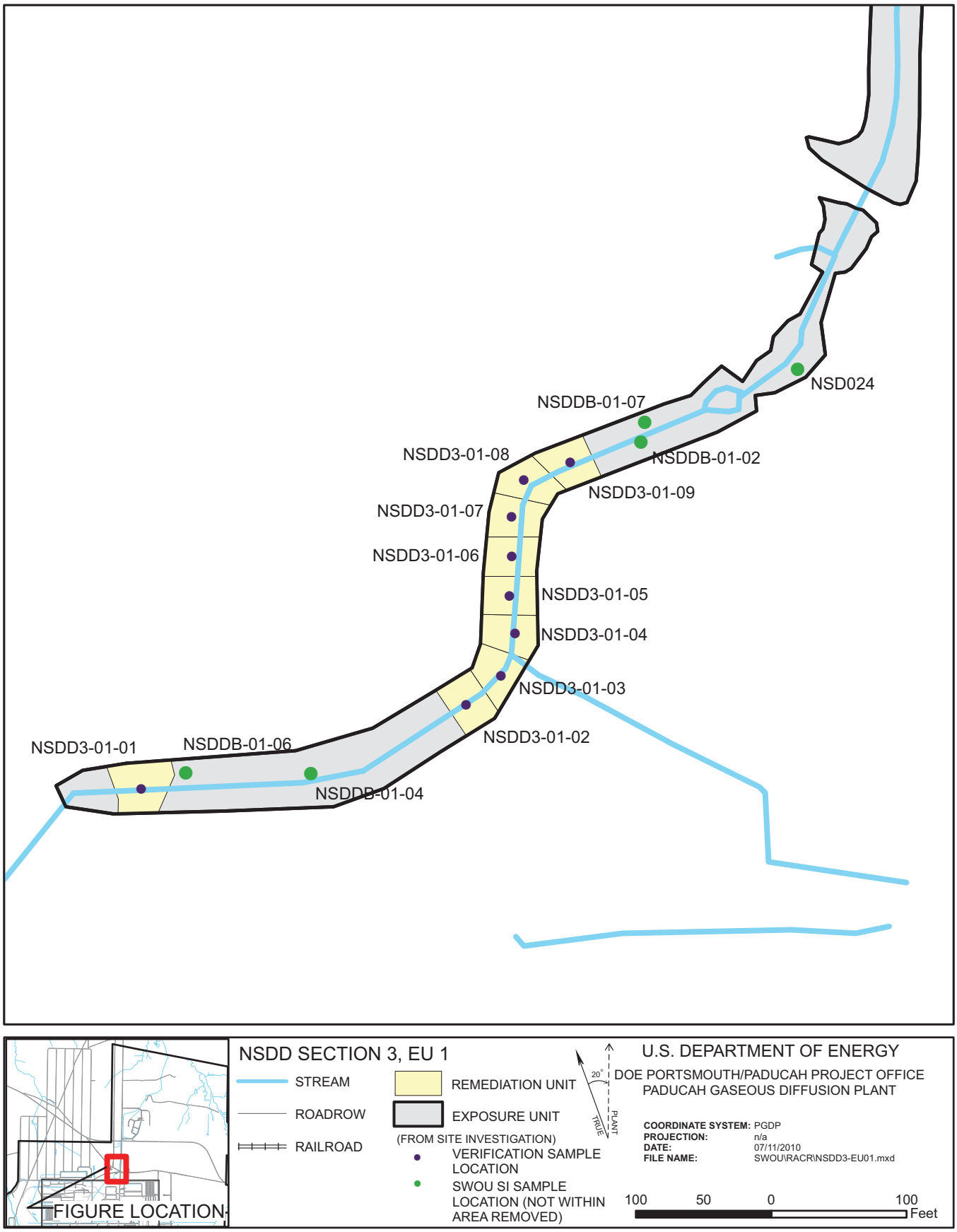

Figure C1.10. NSDD Section 3, EU 1

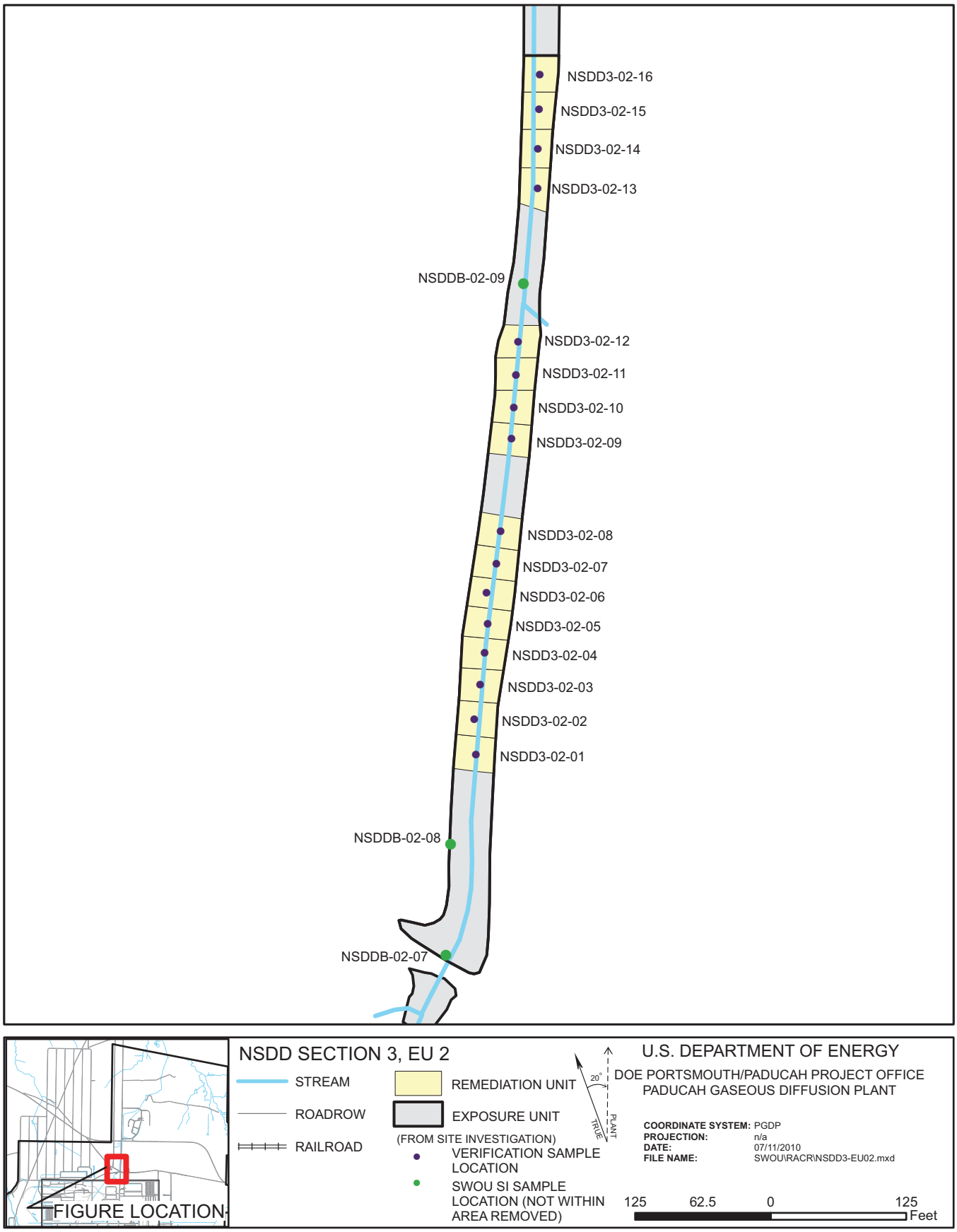

Figure C1.11. NSDD Section 3, EU 2

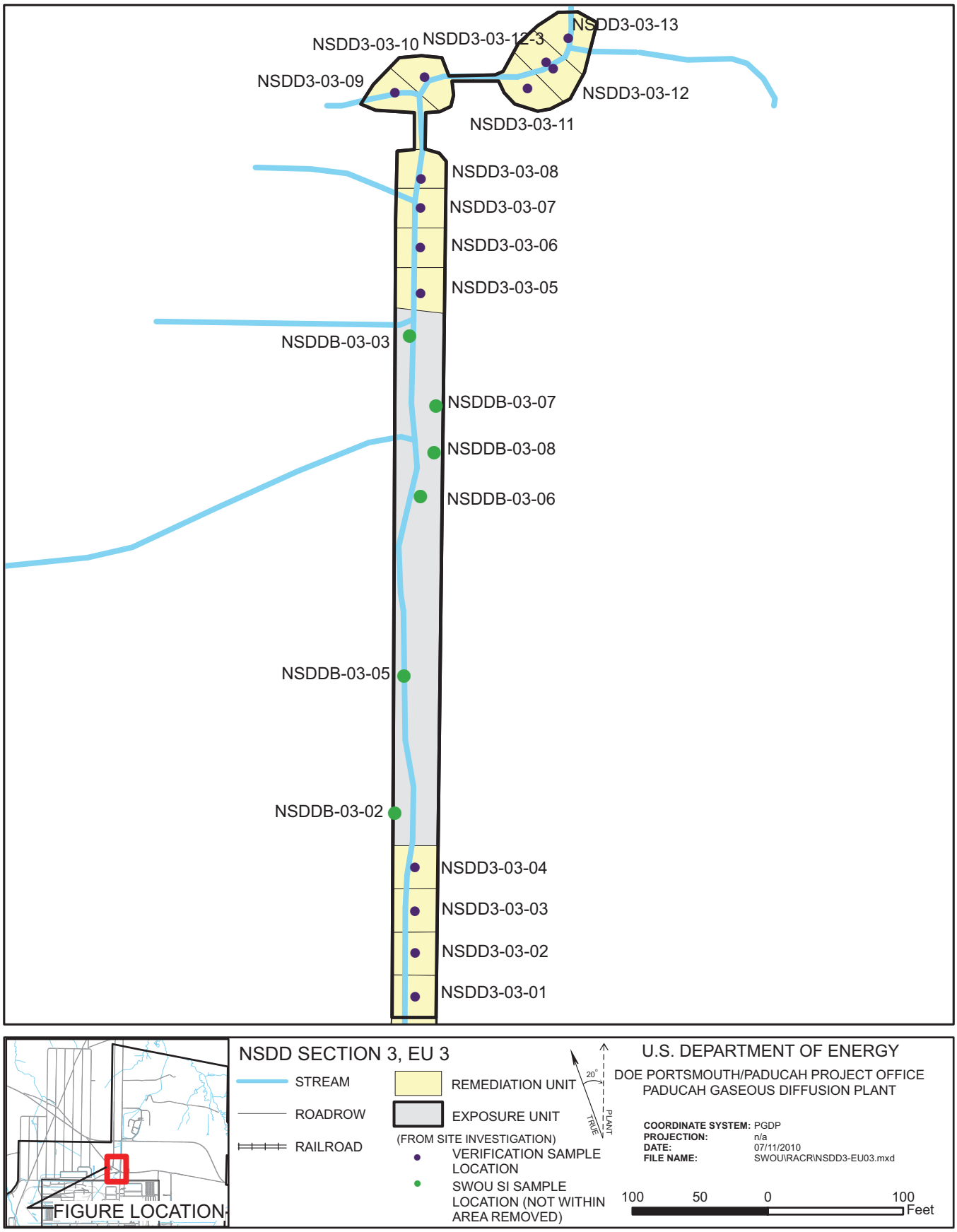

Figure C1.12. NSDD Section 3, EU 3

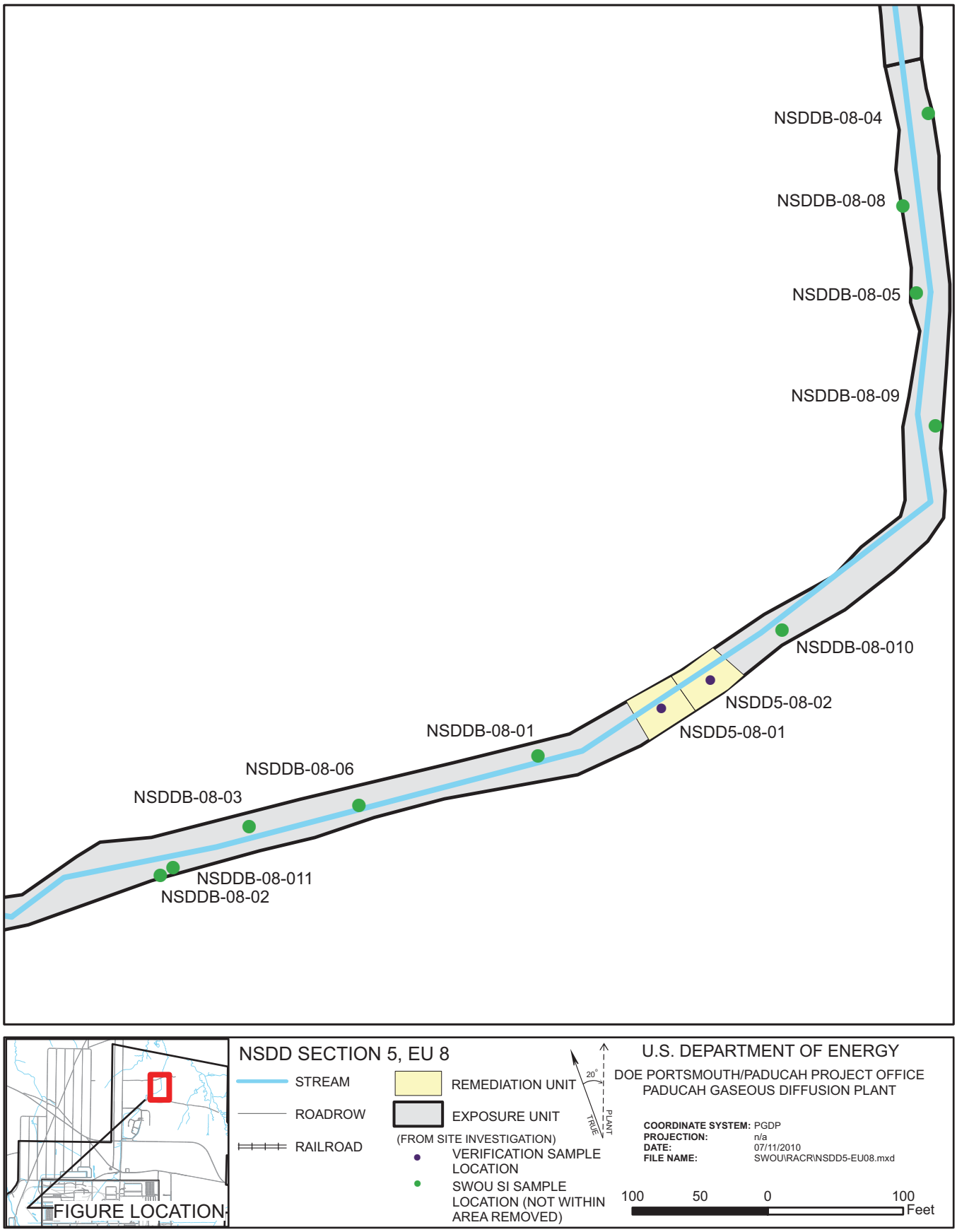

Figure C1.13. NSDD Section 5, EU 8

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D

CLEAN FILL VENDOR CERTIFICATION

THIS PAGE INTENTIONALLY LEFT BLANK

Martin Marietta Materials

3565 Lone Oak Road, Suite 4
Paducah, Kentucky 42003

Johnny L. Boyd
Sales Representative

Thursday, February 18, 2010

Dear Valued Customer:

We would like to thank you for the recent purchase of the channel lining rip rap being produced at our three Rivers Quarry located in Smithland KY. The Three Rivers Quarry is approved by several different states as well as the Corps of Engineers. The material is produced form state approved formations and is a well graded material free from any chemical contamination. If you have any other questions please feel free to contact me.

Sincerely,

Johnny L. Boyd
Martin Marietta Materials

THIS PAGE INTENTIONALLY LEFT BLANK

API Contractors

2950 Little Cypress Rd. • Calvert City, KY 42029
(270) 898-8090 • Fax (270) 898-8910

Submitted To	Phone	Date
LATA of Kentucky		**September 16, 2010**
Street	Job Name	
City, State, and Zip Code	Job Location	
Kevil, KY	**PGDP**	

Attn: Frank Overby

RE: Soil Letter

Frank,

The soil we are furnishing to LATA is excavated from a site we own that is original undisturbed soils. To the best of my knowledge, there is nothing that could be considered contaminated or debris containing. The only thing other than soils would be organic matter, weeds, grass, sticks, etc.

Sincerely,

Van Rudolph

VR:wd

Excel/MSJobs/LATA-General/Soil Letter 09-16-10

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX E

PHOTOGRAPHS

THIS PAGE INTENTIONALLY LEFT BLANK

Outfall 001 11-12-09 (Before)

Outfall 001 11-12-09 (Before)

Outfall 001 07-12-10 (During)

Outfall 001 07-12-10 (During)

Outfall 001 07-22-10 (After)

Outfall 001 07-22-10 (After)

Outfall 010 11-12-09 (Before)

Outfall 010 06-25-10 (During)

Outfall 010 07-12-10 (After)

Outfall 011 11-12-09 (Before)

Outfall 011 02-24-10 (During)

Outfall 011 07-12-10 (After)

Outfall 015, EU02 11-12-09 (Before)

Outfall 015, EU02 11-12-09 (Before)

Outfall 015 EU03 11-12-09 (Before)

Outfall 015 EU03 11-12-09 (Before)

Outfall 015 EU04 11-12-09 (Before)

Outfall 015 EU04 11-12-09 (Before)

Outfall 015 EU04 11-12-09 (Before)

Outfall 015 EU07 11-12-09 (Before)

Outfall 015 EU08 11-12-09 (Before)

Outfall 015, EU 03 04-28-10 (During)

Outfall 015, EU 03 04-28-10 (During)

Outfall 015, EU 02 04-28-10 (During)

Outfall 015, EU 02 07-12-10 (After)

Outfall 015, EU 02/03 07-12-10 (After)

Outfall 015, EU 03 07-12-10 (After)

Outfall 015, EU 04 07-12-10 (After)

North-South Diversion Ditch Section 3, EU 01 11-12-09 (Before)

North-South Diversion Ditch Section 3, E U01 11-12-09 (Before)

North-South Diversion Ditch Section 3, EU 02 11-12-09 (Before)

North-South Diversion Ditch Section 3, EU 03 11-12-09 (Before)

North-South Diversion Ditch Section 3, EU 03 11-12-09 (Before)

North-South Diversion Ditch Section 3, EU 03 11-12-09 (Before)

North-South Diversion Ditch Section 5 11-12-09 (Before)

North-South Diversion Ditch Section 3 EU 02 3-26-10 (During)

North-South Diversion Ditch Section 3 EU 02/03 03-26-10 (During)

North-South Diversion Ditch Section 3 EU 03 03-26-10 (During)

North-South Diversion Ditch Section 3 EU 01 07-13-10 (After)

North-South Diversion Ditch Section 3 EU 02 07-13-10 (After)

North-South Diversion Ditch Section 3 EU 03 07-13-10 (After)

North-South Diversion Ditch Section 5 07-13-10 (After)

THIS PAGE INTENTIONALLY LEFT BLANK