PAD-ENM-0064/R1

Groundwater Assessment Report for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

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Groundwater Assessment Report for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

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Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
LATA ENVIRONMENTAL SERVICES OF KENTUCKY, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-10CC40020

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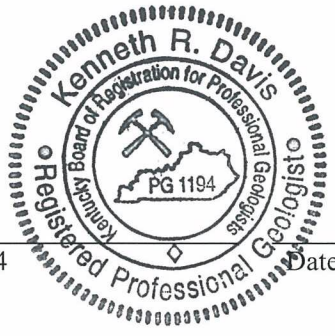
PROFESSIONAL GEOLOGIST AUTHORIZATION

DOCUMENT IDENTIFICATION: *Groundwater Assessment Report for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PAD-ENM-0064/R1

Stamped and signed pursuant to my authority as a duly registered geologist under the provisions of *KRS* Chapter 322A.



Kenneth R. Davis

Kenneth R. Davis PG1194 Date May 2, 2013

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CONTENTS

TABLES

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FIGURES

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ACRONYMS

COD	chemical oxygen demand
CSM	Conceptual Site Model
DAF	dilution attenuation factor
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
KAR	*Kentucky Administrative Regulations*
KDWM	Kentucky Division of Waste Management
LATA Kentucky	LATA Environmental Services of Kentucky, LLC
LCD	Lower Continental Deposits
LRGA	Lower Regional Gravel Aquifer
MCL	maximum contaminant level
MDA	minimum detectable activity
MW	monitoring well
N/A	not applicable
ND	nondetect
PGDP	Paducah Gaseous Diffusion Plant
RGA	Regional Gravel Aquifer
RSL	regional screening level
SMCL	secondary maximum contaminant level
TOC	total organic carbon
UCD	Upper Continental Deposits
UCRS	Upper Continental Recharge System
URGA	Upper Regional Gravel Aquifer

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EXECUTIVE SUMMARY

This *Groundwater Assessment Report for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, summarizes results of the activities conducted under the approved *Groundwater Assessment Plan for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (PRS 2008). The C-746-U Landfill was placed in assessment in response to the finding that some constituents were found in groundwater samples from monitoring wells (MWs) located in the vicinity of the C-746-U Landfill at above background levels. The C-746-U Landfill originally was placed into assessment on March 2, 1999.

Tables in the Executive Summary provide a summary of the conclusions from the evaluation of the groundwater data for parameters evaluated as part of the C-746-U Landfill monitoring program. These tables include those parameters (and associated wells) identified for assessment by the Kentucky Division of Waste Management (KDWM) in August 2006 as well as additional parameters (and wells) subsequently identified for assessment by the U.S. Department of Energy (DOE). The data used to support this assessment are groundwater analyses of quarterly and semiannual monitoring for the period 2002 through 2012 and the focused sampling of October 2006. Additional soils analyses from a polychlorinated biphenyls (PCBs) source investigation in 2008 and groundwater analyses from an overpumping test conducted during 2011 were used to support the assessment of Total PCBs.

Summary of the Screening against Benchmarks

To support the evaluation of whether there is evidence that the C-746-U Landfill is contributing to groundwater contamination, the concentrations (from samples from Regional Gravel Aquifer [RGA] wells in the vicinity of the C-746-U Landfill) of a broad range of parameters were screened against benchmarks.

Benchmarks: The following benchmarks were used in the screening:

- KY MCLs: Maximum contaminant levels (MCLs), as identified in 401 *KAR* 47:030;
- EPA MCLs: MCLs (primary) promulgated by U.S. EPA;
- Regional screening levels (RSLs) for tapwater, developed by EPA to use for screening;
- Secondary MCLs (SMCLs): EPA guidelines for constituents that may have an aesthetic impact on drinking water; and
- C-746-U Landfill background developed according to the permit as discussed further in the Results and Discussion section of this Executive Summary and in Section 2.1.

Concentrations of some constituents in some Regional Gravel Aquifer (RGA) wells continue to exceed benchmarks [Kentucky maximum contaminant levels (MCLs), U.S. Environmental Protection Agency (EPA) Drinking Water Standard MCLs, and EPA regional screening levels (RSLs) for tapwater], including C-746-U Landfill background concentrations developed in accordance with the permit. The concentrations of these constituents were reviewed with the principal focus on the results collected since January 2010 (that includes the most recent eight quarters of data). This report summarizes an evaluation of the C-746-U Landfill parameters, discusses each of the constituents, and describes the following:

- Whether concentrations of individual constituents are above benchmarks;
- Whether the concentrations are indicative of a C-746-U Landfill source. [NOTE: As discussed below, the constituent concentrations in Upper Continental Recharge System (UCRS) wells are considered to be representative only of the conditions local to the well or sourced from overlying soils. Thus, no discussion of potential "upgradient" sources is presented for the UCRS because the concept is not consistent with the site conceptual model.] The constituent concentrations found in the RGA wells are

evaluated while considering the potential for contributions of sources located upgradient (with respect to the C-746-U Landfill) of the monitored well];

- Suspected sources of the elevated concentrations of the specific constituent in the specific well; and
- Mechanisms for the release of these constituents, where these suspected sources are attributed to a particular mechanism.

FINDINGS

This groundwater assessment has determined that there is no evidence that would indicate a release from the C-746-U Landfill. The evaluation process used in this groundwater assessment and a summary of the findings that support this conclusion are detailed below.

EVALUATION PROCESS, SCREENING

The current and historical analytical results from Regional Gravel Aquifer (RGA) wells located in the vicinity of the C-746-U Landfill were screened against benchmarks, including Kentucky (KY) maximum contaminant levels (MCLs), U.S. Environmental Protection Agency (EPA) MCLs, and EPA regional screening levels (RSLs). Subsequently, those constituents without MCLs or RSLs were evaluated against EPA SMCLs and historical background levels (calculated in accordance with the C-746-U Landfill permit). Each result was compared with each benchmark concentration, and any exceedances of the benchmarks were tabulated with a special focus on those constituents that exceeded the benchmark over the past eight calendar quarters. Sixty-four parameters were evaluated with concentrations compared with benchmarks. The results of the screening are summarized as follows:

- Table 1 (and Table ES.1) summarizes the screening of 14 inorganic parameters against KY or EPA MCLs;
- Table 2 (and Table ES.2) summarizes the screening of 10 radionuclides against KY or EPA MCLs;
- Table 3 (and Table ES.3) summarizes the screening of 8 volatile organic compounds against KY or EPA MCLs;
- Table 4 (and Table ES.4) summarizes the screening of 9 PCBs against EPA MCLs (PCBs do not have a KY MCL);
- Table 5 (and Table ES.5) summarizes the screening of 15 parameters against RSLs or SMCLs (these parameters do not have primary MCLs); and
- Table 6 (and Table ES.6) summarizes the screening of 8 parameters (that don't have RSLs or MCLs) against historical C-746-U Landfill background calculated in accordance with the permit.

The screening results presented in these tables document those constituents that have not had a confirmed exceedance of any benchmark in any RGA well. The lack of any current or historical exceedance of a benchmark in an RGA well resulted in this constituent's being screened from further evaluation.

The evaluation continued for those constituents that have had an RGA exceedance of a benchmark, with particular focus on those constituents that had a confirmed exceedance of a benchmark over the past eight

calendar quarters. This subsequent evaluation into the source(s) of these constituents looked at the following:

- Spatial patterns of each constituent present above a benchmark;
- Identified plumes;
- Concentrations of these constituents in other Paducah Gaseous Diffusion Plant (PGDP) wells; and
- Concentrations of these constituents in C-746-U Landfill leachate.

The additional evaluation discusses sources of the constituents in RGA wells that were not screened out using the process described above.

EVALUATION PROCESS, ADDITIONAL DISCUSSION

For those constituents that exceeded benchmarks, the concentrations of these constituents were compared with the following:

- **Concentrations in RGA groundwater present in wells located upgradient of the C-746-U Landfill.** The concentration (and distribution) of each constituent was evaluated against the upgradient concentrations to identify whether the C-746-U Landfill contributed to the concentrations or whether upgradient sources could account for the constituent concentration.

- **Concentrations of naturally occurring constituents in RGA groundwater typical of the PGDP, but outside the vicinity of the C-746-U Landfill.** If concentrations of naturally occurring constituents found in the C-746-U Landfill RGA wells were within the range of concentrations found elsewhere at PGDP, the evaluation concluded that there was no indication of a statistically quantifiable contribution of RGA contamination from the C-746-U Landfill.

- **Concentrations of constituents present in leachate from both the C-746-U Landfill and the C-746-S Landfill to identify if the landfill leachate is a potential source.** This evaluation considered the fact that the dilution attenuation factor (DAF) through the Upper Continental Recharge System (UCRS) has been estimated at 58, through groundwater modeling conducted for other projects (see Section 4.8). Thus, for the leachate to be the source of the constituent concentrations, its concentration in the leachate would have to be ~58 times greater in the leachate than in the RGA groundwater. The relative concentrations of RGA groundwater constituents were compared to leachate concentrations in Appendix B.

- **Concentrations in UCRS groundwater.** As described in more detail in the discussion of the conceptual site model, migration of constituents occurs vertically through the UCRS. Thus, concentrations of constituents in the UCRS were evaluated to identify any potential UCRS sources of RGA contamination. Because of the vertical-only migration of constituents through the UCRS and the fact that there are no UCRS wells completed through the C-746-U Landfill, the presence of any constituents in a UCRS well could not be properly attributed to migration from the C-746-U Landfill operations (though constituents in these wells, if found, could be evidence of a secondary source of C-746-U Landfill-related contamination). The results of the UCRS well sampling were considered when evaluating the potential sources of constituents in RGA wells.

- **Concentrations during the past eight calendar quarters.** Those constituents that were infrequently detected historically ***and*** did not have an exceedance during the past eight calendar quarters typically

were screened from further evaluation; however, the summary tables provide information on the frequency and timing of the exceedances.

The comparisons listed above were used to identify potential source(s) of those constituents confirmed to be present at concentrations that were above benchmarks during the past eight calendar quarters.

In addition to the discussion of parameters found above benchmarks (as summarized above), the evaluation of the presence of polychlorinated biphenyls (PCBs) was much more thorough. Several additional investigations have been performed over the years to address the historical presence of PCBs in RGA wells in the vicinity of the C-746-U Landfill. Although PCB concentrations in RGA wells have been below EPA MCLs for the past eight calendar quarters, the information that supports the determination of the source of historical PCBs in RGA groundwater is summarized.

SUMMARY OF RESULTS

Screening Observations

Following are most of the constituents that were screened from further consideration, because they did not have any parameter concentrations above benchmarks for the past eight calendar quarters.

- Of the 41 constituents with EPA or Kentucky MCLs, only 2, beta activity and trichloroethene (TCE), had an exceedance of a benchmark in RGA wells over the past 8 calendar quarters (see Tables 1, 2, and 3). Beta activity and TCE are discussed further.

- Although the nine PCBs have not had a confirmed exceedance of the EPA MCL in RGA wells over the past eight calendar quarters, the source of the historical exceedances is further discussed (see Table 4).

- Only 3 of 15 constituents exceed their respective RSLs (e.g., cobalt, iron, and manganese) in RGA wells, but these constituents do not exceed the C-746-U Landfill background (see Table 5). Some additional discussion is provided.

- Three constituents exceed the C-746-U Landfill background or an SMCL (e.g., calcium, magnesium, and dissolved solids) in RGA wells, but these constituents exceed these benchmarks only in wells MW372 and MW373, wells located upgradient of the C-746-U Landfill. Additional discussion of the potential source(s) of these constituents is provided, along with additional discussion of other parameters that have similar patterns.

Additional Discussion/Summary of Conclusions

As summarized above, most of the 64 parameters evaluated as part of this groundwater assessment have concentrations in RGA groundwater that are below benchmarks. The few constituents that have exceeded benchmarks over the past 8 calendar quarters (or have historical exceedances) are not properly attributed to a C-746-U Landfill source as summarized below.

Beta Activity. Beta activity has exceeded the Kentucky MCL of 50 pCi/L in three wells in the vicinity of the C-746-U Landfill. An evaluation of the assessment data demonstrates that the beta activity in these wells apparently is sourced from upgradient of the C-746-U Landfill and is associated with migration of the historical Tc-99 plume, as follows:

- None of the other RGA wells in the vicinity of the C-746-U Landfill have beta activity that exceeds the KY MCL.

- Figure B.6 shows recent values for beta activity that demonstrate that beta activity is stable to declining in all wells and is greater in the upgradient well MW372 than in the two downgradient wells (MW366 and MW367) located along the same flow path.

- Figure B.7 also indicates that beta activity in these three wells is stable to declining, with the activity in the upgradient well MW372 decreasing at a slightly greater rate.

- The beta activity in leachate (see Tables B.2 and B.3) is not high enough to account for the beta activity found in the RGA wells given the DAF of 58 for UCRS materials.

- Tc-99 is a beta activity emitter. The Tc-99 concentrations are well-correlated to the beta activity as shown by the graphs of Tc-99 and beta activity for each of the C-746-U Landfill RGA wells depicted in Figures 5–15.

- The wells with beta activity exceedances of the KY MCL are immediately downgradient of an arm of the Tc-99 plume as shown in Figures 3 and 4.

In summary, the available data do not statistically support an interpretation of a release from the C-746-U Landfill. Rather, the upgradient Tc-99 plume is the most likely source of the beta activity found in RGA wells in the vicinity of the C-746-U Landfill. There is no statistically quantifiable contribution of Tc-99 to the RGA by the C-746-U Landfill.

TCE. TCE is the only volatile organic compound with concentrations that exceed the Kentucky and EPA MCL in wells in the vicinity of the C-746-U Landfill. An evaluation of the assessment data demonstrates that the TCE in these wells (MW357, MW358, MW361, MW372, and MW373) apparently is sourced from upgradient of the C-746-U Landfill and is associated with migration of the historical TCE plume, as follows.

- None of the other RGA wells in the vicinity of the C-746-U Landfill have TCE concentrations that exceed the KY MCL.

- Figure B.9 shows recent values for TCE that are generally within a factor of 2 of the MCL.

- TCE concentrations in upgradient wells MW372 and MW373 generally are higher than those in other C-746-U Landfill wells, as shown in Figure B.9.

- Recent values for TCE are greater in the upgradient wells MW372 and MW373 (and just above the MCL of 5 µg/L) than in the two downgradient wells (MW366 and MW367) located along the same flow path (where concentrations are below the MCL).

- There is no detectable TCE in leachate from the C-746-U Landfill, as summarized in Table B.2.

- TCE use at the site was discontinued prior to the opening of the C-746-U Landfill; thus, it would not have been used in ancillary operations at the C-746-U Landfill.

- The wells with TCE exceedances of the MCL are immediately downgradient of a portion of the historical TCE plume, as shown in Figure 1.

In summary, the available data do not support an interpretation of a statistically quantifiable release from the C-746-U Landfill to the RGA. Rather, the upgradient TCE plume is the most likely source of the TCE found in RGA wells in the vicinity of the C-746-U Landfill. There is no statistically quantifiable contribution of TCE to the RGA by the C-746-U Landfill.

PCBs. PCBs have not had a confirmed exceedance of the EPA MCL of 0.0005 mg/L in any of the RGA wells in the vicinity of the C-746-U Landfill over the past eight calendar quarters; however, PCBs have been a historical concern. An evaluation of the assessment data demonstrates that the historical PCB concentrations may be attributed to cross-contamination of wells with PCBs during well rehabilitation in 2003. The C-746-U Landfill is not the source of the historical PCB exceedances, as follows:

- Appendix E presents information on well sampling that demonstrates that PCBs were not an issue in C-746-U Landfill wells until 2003 (when the well rehabilitation program was performed). This appendix also demonstrates that PCB concentrations have decreased over the years.

- Figure 22 and Table 9 shows that PCBs have not been an issue in other RGA wells at PGDP. This is consistent with the fact that PCBs are not soluble in water; thus, though PCBs were historically used at PGDP, they are not found in RGA groundwater at locations across the site.

- Appendix F presents information on the results of the overpumping tests conducted on C-746-U Landfill wells. This overpumping has contributed to the finding that concentrations in RGA wells are below EPA MCLs. Once the RGA wells were rehabilitated to minimize the residual sediment, the PCB concentrations decreased to below the EPA MCL. Note: There is one UCRS well (MW365) that still has concentrations above the EPA MCL, but UCRS wells cannot be overpumped effectively to remove PCB-contaminated sediment to the same degree as RGA wells (well pumps dry)—a finding consistent with a historical (and not-continuing) PCB source.

- Appendix D summarizes the investigation of PCBs in soils conducted in the vicinity of UCRS well MW365 that did not find any PCB source in UCRS soils in the vicinity of the well.

These results support a finding that, regardless of the source of the detected PCBs, the levels have been below EPA MCLs for eight quarters, and currently there are no PCB values that represent exceedances attributable to the C-746-U Landfill. The historical PCB contamination may have been the result of cross-contamination of wells during rehabilitation that occurred in 2003.

Cobalt, Iron, and Manganese. Although cobalt, iron, and manganese were found in RGA wells above EPA RSLs, they were not found at concentrations above the C-746-U Landfill background (as determined in accordance with the permit requirements). In addition, the concentrations of these constituents are comparable to concentrations found in RGA wells at other locations at PGDP, as summarized in Table B.1. Thus, there is no indication of a statistically quantifiable C-746-U Landfill source, and the concentrations found in RGA wells are found in wells at PGDP locations well outside any potential influence of the C-746-U Landfill.

Dissolved Solids, Calcium, and Magnesium. These constituents do not have a primary MCL or RSL, but they are found in some C-746-U Landfill wells at concentrations that are elevated above background. These constituents (and other constituents that may be considered elevated) do not have the C-746-U Landfill as their source because of the following:

- The highest concentrations of these constituents are found in upgradient wells MW372 and MW373, as summarized in Tables 5 and 6; and

- The concentrations of these constituents are not sufficiently elevated in the leachate for the C-746-U Landfill to be a statistically quantifiable source, as summarized in Table B.2.

Potential Alternate Sources. The upgradient wells MW372 and MW373 have concentrations of a few constituents that are above benchmarks; however, other C-746-U Landfill upgradient wells do not have elevated concentrations so the source of the concentrations in these two wells cannot be pinpointed. The potential sources of these few exceedances are non-C-746-U sources, like biofouling, upgradient RGA sources, or excessive turbidity.

This evaluation found that there is no identified upgradient source that accounts for these constituents. For example, Table B.3 compares concentrations in C-746-S Landfill leachate to concentrations in MW372 and MW373 and finds that the C-746-S Landfill is not the source of the elevated concentrations in these wells. The constituents are not elevated in other wells located upgradient of the C-746-U Landfill and downgradient of the C-746-S Landfill.

Finally, there is no threat to human health from any constituents present in wells in the vicinity of the C-746-U Landfill because the C-746-U Landfill is located within the Water Policy Box created to support Comprehensive Environmental Response, Compensation, and Liability Act actions so that exposure to groundwater in this area is limited, irrespective of the source of constituents. The PGDP Action Memorandum for the Water Policy provides municipal water to users within the Water Policy Box, which includes all areas in the vicinity of the C-746-U Landfill.

In summary, the assessment has found that the few constituents that have concentrations above benchmarks do not have the C-746-U Landfill as their source. Some additional evaluation of the source(s) of elevated concentrations of constituents in upgradient wells MW372 and MW373 may be appropriate, but this evaluation can be performed outside of the assessment process. This report presents results of the evaluation as follows:

- Section 1 presents background information on the C-746-U Landfill and the groundwater assessment.
- Section 2 presents the basis for the assessment and preliminary screening of concentrations against benchmarks.
- Section 3 provides discussion of the nature of constituents present above benchmarks.
- Section 4 provides additional discussion on the potential source(s) of these constituents in C-746-U Landfill wells.
- Section 5 describes the hydrogeologic setting.
- Section 6 presents a summary of the enhanced sampling.
- Section 7 provides conclusions of the assessment.
- References are provided in Section 8.

The seven appendices to this document provide additional supporting information and data: Appendix A, Correspondence; Appendix B, Trend Charts; Appendix C, Home Site Well Water Sample Analytical Results; Appendix D, PCBs in Soils Field Investigation Summary; Appendix E, Assessment of Well Rehabilitation Source of PCB Contamination in C-746-U Landfill Wells; Appendix F, Assessment of

Impacts of Overpumping in Monitoring Wells in the Vicinity of the C-746-U Landfill on PCB Concentrations; and Appendix G, Lithologic Logs/Well Logs.

BACKGROUND

DOE owns and operates waste treatment, storage, and disposal units at PGDP near Paducah, Kentucky. Three of these units are landfills that are regulated by DOE, under the provisions of the Atomic Energy Act, and by the Commonwealth of Kentucky under the Resource Conservation and Recovery Act and the Kentucky Solid Waste Landfill Regulations.

The three landfills are located on approximately 80 acres of DOE-owned property immediately north of PGDP. The permitted landfills currently included within this property are the following:

- C-746-S Residential Landfill
- C-746-T Inert Landfill
- C-746-U Contained Landfill

Both C-746-S and C-746-T are permitted currently for post-closure activities only. The C-746-U Landfill is an operating solid waste landfill that covers an area of about 60 acres located directly north of the C-746-S&T Landfills. It is operated by LATA Environmental Services of Kentucky, LLC, (LATA Kentucky) and owned by DOE. KDWM issued Solid Waste Permit SW07300045 in November 1996 to allow construction and operation of the C-746-U Landfill and reissued combined Solid Waste Permits SW07300014, SW07300015, SW07300045, effective November 5, 2006, to allow continuing maintenance of the C-746-S&T Landfills and operation of the C-746-U Landfill.

KDWM issued correspondence August 29, 2006, that placed the C-746-U Landfill in groundwater assessment. In its correspondence, KDWM identified contaminants and wells that require assessment, based on quarterly groundwater monitoring reports that have been submitted by DOE. A Groundwater Assessment Plan is required by 401 *KAR* 48:300, Section 8, for facilities in groundwater contamination assessment. The *Groundwater Assessment Plan for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-PROJ/0006/R2, describes the steps used to perform the groundwater evaluations (PRS 2008). The plan contains additional information required by 401 *KAR* 48:300, Section 8. A groundwater assessment was performed in accordance with the approved plan and the results of this assessment are summarized below.

RESULTS AND DISCUSSION

Tables ES.1 through ES.6 summarize the results of the groundwater assessment. Although concentrations of some constituents in some wells continue to exceed benchmarks (including historical background levels), the concentration levels remain low and further evaluation of these concentrations indicate that the C-746-U Landfill is not the source of the elevated levels. The assessment of the RGA wells does not indicate any landfill-related above background levels of constituents present above MCLs or other risk-based levels of concern.

Table ES.1 summarizes the screening results that demonstrate that none of the inorganic parameters with a Kentucky or EPA primary MCL exceeds its MCL in RGA wells located in the vicinity of the C-746-U Landfill. Most inorganic constituents (antimony, barium, chromium, copper, lead, mercury, selenium, silver, uranium, nitrate, and fluoride) never have exceeded the MCL. Arsenic, beryllium, and cadmium have not had exceedances of a Kentucky MCL or EPA MCL since 2004.

Table ES.1. Summary of RGA Well Screening of Inorganic Parameters with Kentucky or EPA MCL

Parameter	Kentucky MCL	EPA MCL	Units	Exceeds?	Exceed Since 2010?	Comments
Antimony	N/A	0.006	mg/L		No	
Arsenic	0.05	0.01	mg/L	EPA MCL	No	No exceedance of Kentucky MCL. Last exceedance of EPA MCL in 2004.
Barium	2.0	2.0	mg/L		No	
Beryllium	N/A	0.004	mg/L	EPA MCL	No	Only exceedance of EPA MCL in 2003; newer results show no exceedances.
Cadmium	0.005	0.005	mg/L	KY/EPA MCL	No	Only exceedance 2003.
Chromium	0.100	0.100	mg/L		No	
Copper	N/A	1.3	mg/L		No	
Lead	0.05	0.015	mg/L		No	
Mercury	0.002	0.002	mg/L		No	
Selenium	0.05	0.05	mg/L		No	
Silver	0.05	N/A	mg/L		No	
Uranium	N/A	0.030	mg/L		No	
Nitrate (as N)	10.0	10.0	mg/L		No	
Fluoride	4.0	4.0	mg/L		No	

N/A = not applicable

Table ES.2 summarizes the screening results that demonstrate that beta activity is the only radionuclide that exceeds its MCL in the RGA wells located in the vicinity of the C-746-U Landfill. Additional discussion of the source of the beta activity is presented in the report. The EPA MCL for beta activity is 4 mrem/year. The dose level will vary depending upon the radionuclide that provides the activity. The derived MCL for beta activity from technetium-99 (Tc-99), for example, is 900 pCi/L (according to EPA methodology). Additional evaluation and discussion of the source of the beta activity is provided in this report. Most radionuclide parameters (alpha activity, strontium-90, tritium, iodine-131, radium, radium-224, radium-226, radium-228, and Tc-99) do not exceed the MCL.

Table ES.3. summarizes the screening results that demonstrate that TCE is the only organic compound that exceeds its MCL in the RGA wells located in the vicinity of the C-746-U Landfill. Additional discussion of the source(s) of the TCE is provided. Most organic compound parameters (i.e., benzene, carbon tetrachloride, 1,2-dichloroethane, p-dichlorobenzene, 1,1-dichloroethene, 1,1,1-trichloroethane, vinyl chloride) have never been detected in C-746-U Landfill wells.

Table ES.4. summarizes the screening results that demonstrate that the concentrations of PCBs in the RGA no longer exceed the EPA MCL. This report also summarizes additional discussion and evaluation that demonstrates that the historical PCB contamination is the likely result of cross-contamination from the 2003 well rehabilitation event.

Table ES.5. summarizes the screening results that demonstrate that the concentrations of cobalt, iron, and manganese are present above their RSL; however, these constituents are not present in concentrations above C-746-U Landfill background (as determined in accordance with the C-746-U Landfill permit). In addition, these constituents are present at concentrations within the range of concentrations found in other

Table ES.2. Summary of RGA Well Screening of Radionuclide Parameters with Kentucky or EPA MCL

Parameter	Kentucky MCL	EPA MCL	Units	Exceeds?	Exceed since 2010?	Comments
Alpha Activity	15	15	pCi/L	KY/EPA MCL	No	Only MCL exceedance in 2004.
Beta Activity	50	4 mrem	pCi/L	KY MCL	Yes	12 KY MCL exceedances since 2010; additional evaluation/discussion to ascertain source(s) .
Strontium-90	8	N/A	pCi/L	KY MCL	No	Only KY MCL exceedance in 2003.
Tritium	20,000	N/A	pCi/L		No	No KY MCL exceedance. Only detection in 2007.
Iodine-131	3	N/A	pCi/L	KY MCL	No	No exceedance. Single high result not confirmed upon resampling/analysis.
Radium	5	5[a]	pCi/L		No	
Radium-224	5	N/A	pCi/L		No	
Radium-226	5	5[a]	pCi/L	KY/EPA MCL	No	Exceeded in 2002 only.
Radium-228	5	5[a]	pCi/L	KY/EPA MCL	No	Not exceeded since 2008.
Technetium-99	N/A	4 mrem[b]	pCi/L		No	

N/A = not applicable
[a] EPA MCL for radium-226 and 228 combined
[b] EPA methodology equates 4 mrem to 900 pCi/L

Table ES.3. Summary of RGA Well Screening of Organic Compound Parameters with Kentucky MCL

Parameter	Kentucky MCL	EPA MCL	Units	Exceeds ?	Exceed since 2010?	Comments
Benzene	0.005	0.005	mg/L		No	
Carbon Tetrachloride	0.005	0.005	mg/L		No	
1,2-Dichloroethane	0.005	0.005	mg/L		No	
Trichloroethene	0.005	0.005	mg/L	KY/EPA MCL	Yes	Additional evaluation to ascertain source(s).
P-Dichlorobenzene	0.075	0.075	mg/L		No	
1,1-Dichloroethene	0.007	0.007	mg/L		No	
1,1,1-Trichloroethane	0.200	0.200	mg/L		No	
Vinyl Chloride	0.002	0.002	mg/L		No	

Table ES.4. Summary of RGA Well Screening of PCBs against EPA MCL

Parameter	Kentucky MCL	EPA MCL	Units	Exceeds?	Exceed since 2010?	Comments
PCB-1016	N/A	0.0005	mg/L	EPA MCL	No	
PCB-1221	N/A	0.0005	mg/L		No	
PCB-1232	N/A	0.0005	mg/L		No	
PCB-1242	N/A	0.0005	mg/L	EPA MCL	No	2010 high result not confirmed by resampling/analysis. Additional evaluation of PCBs summarized.
PCB-1248	N/A	0.0005	mg/L	EPA MCL	No	
PCB-1254	N/A	0.0005	mg/L		No	
PCB-1260	N/A	0.0005	mg/L		No	
PCB-1262	N/A	0.0005	mg/L		No	
PCB-1268	N/A	0.0005	mg/L		No	

N/A = not applicable

Table ES.5. Summary of RGA Well Screening of Parameters without Kentucky or EPA MCL, but with Tapwater RSL or EPA Secondary MCL

Parameter	EPA MCL	Tapwater RSL	Units	Exceeds?	Exceed since 2010?	Comments
1,2,4-Trimethylbenzene	N/A	0.015	mg/L		No	
Acetone	N/A	12	mg/L		No	
Aluminum	SMCL only	16	mg/L	RSL	No	One RSL exceedance in upgradient well MW373 in 2002.
Boron	N/A	3.1	mg/l		No	No RSL exceedance; however, 82 highest results from upgradient (MW372, MW373) wells.
Carbon Disulfide	N/A	0.72	mg/l		No	
Chloride	SMCL only	N/A	mg/L		No	No RSL. No exceedance of SMCL of 250 mg/L.
Cobalt	N/A	0.0047	mg/L	RSL	Yes	Concentrations exceed RSL, but are not above C-746-U Landfill background; additional discussion to ascertain source(s).
Dissolved Solids	SMCL only	N/A	mg/L	SMCL	Yes	500 mg/L (SMCL) exceeded only in upgradient MW373 since 2010 (exceed 10 times). Additional discussion to ascertain source(s).
Iron	SMCL only	11	mg/L	RSL	Yes	Above RSL concentrations, but not above C-746-U Landfill background; additional discussion.
Manganese	SMCL only	0.32	mg/L	RSL	Yes	Above RSL concentrations, but not above C-746-U Landfill background; additional discussion to ascertain source(s).
Molybdenum	N/A	0.078	mg/L		No	

Table ES.5. Summary of RGA Well Screening of Parameters without Kentucky or EPA MCL, but with Tapwater RSL or EPA Secondary MCL (Continued)

Parameter	EPA MCL	Tapwater RSL	Units	Exceeds?	Exceed since 2010?	Comments
Nickel	N/A	0.300	mg/L		No	No exceedance of RSL for nickel soluble salts
Sulfate	SMCL only	N/A	mg/L	SMCL	No	Last exceedance of SMCL (250 mg/L) in 2005; above C-746-U Landfill background concentrations in upgradient well MW372; additional discussion to ascertain source(s).
Vanadium	N/A	0.078	mg/L		No	No exceedance of RSL for vanadium and compounds.
Zinc	N/A	4.700	mg/L		No	

N/A = not applicable

wells from both affected and nonaffected PGDP areas. Thus, the concentrations of cobalt, iron, and manganese are consistent with both the C-746-U Landfill background and concentrations found in other areas of PGDP, although background concentrations may be elevated (as discussed in later sections of this report).

Other constituents (e.g., dissolved solids, sulfate) are below their SMCL; however, some of these constituents have concentrations that are above background. Both of these constituents have above background concentrations in upgradient wells MW372 and MW373. Additional discussion of the potential source(s) of dissolved solids and sulfate is provided.

Table ES.6. summarizes the comparison of constituents without MCLs or RSLs to background and demonstrates that the higher concentrations of calcium, magnesium, potassium, and sodium are more typically found in upgradient well locations, MW372 and MW373. In accordance with the permit, background concentrations were calculated based upon eight quarters of data collected from wells considered to be upgradient. The fact that several constituents have higher concentrations in upgradient wells establishes a background that is higher than concentrations found in other downgradient or sidegradient wells; thus, the C-746-U Landfill does not appear to be a source of statistically quantifiable incremental concentrations of these constituents. Additional discussion is provided that evaluates potential sources. Total organic carbon (TOC) concentrations are consistent with values seen in other wells at PGDP based upon data collected from the Groundwater Operable Unit, as updated during preparation of the Soils Operable Unit Remedial Investigation Report. A few excursions of TOC historically were seen in upgradient wells. There has been no above background concentration of TOC and no excursions since 2010.

PCBS AND THE WELL OVERPUMPING TEST

Beginning in July and October of 2003, groundwater monitoring at the C-746-S, -T, and -U Landfills detected PCBs. Subsequently, PCB levels have declined over time to levels below USEPA MCLs in RGA wells. Because detected concentrations of PCBs have been below USEPA MCLs for eight quarters, a continuing source of PCBs to the RGA wells in the vicinity of the C-746-U Landfill is unlikely. This groundwater assessment evaluated the potential historical source(s) of PCB contamination and

Table ES.6. Summary of RGA Well Screening of List of Parameters without Kentucky or EPA MCL and without Tapwater RSL or EPA Secondary MCL

Parameter	Maximum	Units	Number of Samples	Number of Detects	Comments
Calcium	85.2	mg/L	542	542	Above background concentrations in upgradient wells MW372 and MW373. Highest 39 results are all in MW373 (upgradient); thus, no indication of a C-746-U Landfill source.
Chemical Oxygen Demand	830	mg/L	537	36	No detections of COD since 2006.
Iodide	3.2	mg/L	537	6	Infrequently detected. No indication of a C-746-U Landfill source because of 4 detects since 2010, two in upgradient wells.
Magnesium	32.9	mg/L	542	542	Above background concentrations in upgradient well MW372 only. Highest 37 results all in MW373 (upgradient). No indication of a C-746-U Landfill source.
Potassium	4.34	mg/L	542	515	No above background concentrations; however, 38 of 52 highest results found in MW373 (upgradient); thus, no C-746-U Landfill source.
Sodium	128	mg/L	542	542	No above background concentrations; however, 28 of highest 40 results from upgradient wells (MW372, MW373, MW369) others from MW360.
Thorium-232	ND	pCi/L	215	0	
Total Organic Carbon	324	mg/L	537	263	No above background concentrations; concentrations consistent with non-C-746-U Landfill PGDP background.

determined that the PCB contamination in the C-746-U Landfill wells may have been the result of cross-contamination associated with well rehabilitation efforts conducted in April and May 2003.

To evaluate the theory that cross-contamination was the source of the earlier exceedances, an overpumping test of four C-746-U Landfill MWs was conducted beginning in March 2011 to stress the groundwater flow into the wells. Well purging associated with the overpumping and the associated (low flow) sampling demonstrated that none of the RGA wells have PCB concentrations greater than the EPA MCL. Although PCBs continue to be detected in a UCRS well in the vicinity of the C-746-U Landfill at concentrations just above the MCL, this report demonstrates that the PCBs in this well are not the result of migration from the C-746-U Landfill and may also be the result of historical cross-contamination during well rehabilitation. Concentrations in the UCRS well likely have not decreased to below the EPA MCL because the well cannot be purged effectively enough to remove the residual PCBs.

CONCEPTUAL MODEL

The conceptual model for the site describes how groundwater flow in the UCRS is vertically downward; thus, groundwater monitoring results from samples taken from the UCRS wells are indicative only of the conditions in the immediate vicinity of that particular well or sourced from affected soils located immediately above/near the well. In evaluating the concentrations in a UCRS well, the location of the well also is considered. For example, the UCRS well with PCB concentrations above the EPA MCL is located well-distal to the working areas of the C-746-U Landfill. Any contaminants identified in this

UCRS well are not representative of any C-746-U Landfill source. None of the constituents[1] present in the UCRS at above benchmark concentrations have a C-746-U Landfill source.

Nevertheless, this report evaluates those constituent/well pairs in both the UCRS and RGA that exceed benchmarks (including background) to potentially identify non-landfill sources of contaminants to the RGA groundwater. Of those constituents with RGA exceedances, there is no indication of a local-to-the-C-746-U Landfill UCRS source. The following are examples:

- TCE has not been detected in UCRS wells above the MCL.

- Only one UCRS well (MW362) had one detection of beta activity (out of 44 samples) above 50 pCi/L. Since that single exceedance in 2001, beta activity has not exceeded 6.77 pCi/L.

- Only sulfate has above background concentrations in UCRS wells MW362 and MW375; however, concentrations are well below the SMCL and also well below the concentrations seen in RGA wells; thus, the UCRS is not the source of the elevated above background sulfate concentrations seen in the RGA in the vicinity of the C-746-U Landfill.

CONCLUSIONS AND RECOMMENDATIONS

This assessment documents that the only constituents with confirmed above MCL concentrations in RGA well samples collected since 2010 are these:

- Beta activity in MW372 (upgradient), MW366, and MW367 exceed the Kentucky MCL of 50 pCi/L; MW366 and MW367 are on the same flow path as the upgradient well MW372. Additional evaluation demonstrates that the beta activity exceedances are attributable to and consistent with an upgradient source that is higher in the upgradient well MW372.

- TCE in MW372 (upgradient), MW373 (upgradient), MW357, MW358, and MW361 has exceeded the Kentucky/EPA MCL of 5 µg/L since January 2010. TCE in upgradient wells MW372 and MW373 is associated with an upgradient source; in addition, TCE in wells located along the northwestern edge of the landfill is associated with a different source located upgradient/cross-gradient of the C-746-U Landfill.

  NOTE: The most recent quarterly report [*C-746-U Contained Landfill Third Quarter Calendar Year 2012* (July-September) *Compliance Monitoring Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2012)] documents that only the upgradient wells MW372 and MW373 have TCE concentrations that exceed the MCL.

This assessment documents that the only constituents with confirmed above RSL concentrations (for those constituents without an MCL) in RGA well samples collected since 2010 are cobalt, iron, and manganese; however, none of these constituents has concentrations that are above the C-746-U Landfill background. In addition, the concentrations of cobalt, iron, and manganese are consistent with those found elsewhere in RGA groundwater on and off the PGDP site [as discussed in the Groundwater Operable Unit Feasibility Study (DOE 2001) as updated by the Soils Operable Unit Remedial Investigation Report (DOE 2013)]. Although the presence of these three constituents is consistent with

[1] This statement does not refer to statistical evaluation of field parameters like conductivity and oxidation-reduction potential.

C-746-U background levels and concentrations found at other PGDP locations, some additional discussion is presented regarding the presence of cobalt, iron, and manganese in upgradient well MW373.

This assessment documents that the only RGA constituents[2] with above background concentrations since 2010 are these:

- Calcium, dissolved solids, magnesium, and sulfate in upgradient well MW372; and
- Calcium and dissolved solids in upgradient well MW373.

The presence of these above background concentrations only in upgradient wells indicates that upgradient sources or other non-C-746-U-Landfill sources are responsible for these increases; and the fact that concentrations downgradient of the C-746-U Landfill are not elevated indicates that the C-746-U Landfill is not a source of statistically quantifiable incremental contamination to the RGA.

Some of the above background constituents identified in the RGA wells (TCE, beta activity) are the result of migration of contaminants through the RGA flowing into the C-746-U Landfill area from upgradient. The upgradient RGA groundwater contains TCE and Tc-99 (a source of beta activity). Although the RGA groundwater associated with the TCE and Tc-99 sources may contribute varying amounts of other constituents (e.g., calcium, dissolved solids, magnesium, sodium, sulfate, etc.), these contributions cannot be differentiated from the natural variation in concentration seen at other PGDP locations. In fact, elevated levels of constituents typically are seen only at upgradient wells MW372 and MW373—further indication of the fact that the C-746-U Landfill is not a source of RGA constituent concentrations.

Potential sources of these constituents are discussed, including upgradient RGA groundwater, incomplete well rehabilitation and biofouling, and natural variation in groundwater chemistry that was not effectively characterized by background monitoring. The potential alternate sources to benchmark exceedances are discussed.

This groundwater assessment report has been developed to satisfy the requirements for completion of the assessment of the C-746-U Landfill. Based on this assessment, one recommendation has been identified, as follows:

- Abandon the open well at the old home site (see Section 4.5.3). This well presents the potential for a contaminant pathway to the UCRS.

[2] This statement does not refer to statistical evaluation of field parameters like conductivity and oxidation-reduction potential.

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1. C-746-U LANDFILL GROUNDWATER BACKGROUND

1.1 C-746-U LANDFILL CONSTRUCTION HISTORY

The U.S. Department of Energy (DOE) owns and operates waste treatment, storage, and disposal units at the Paducah Gaseous Diffusion Plant (PGDP) near Paducah, Kentucky. Three of these units are landfills that are regulated by DOE under the provisions of the Atomic Energy Act, the Commonwealth of Kentucky under the Resource Conservation and Recovery Act, and the Kentucky solid waste landfill regulations.

Three permitted landfills are located on approximately 80 acres of DOE-owned property immediately north of the PGDP. The permitted landfills currently included within this property are these:

- C-746-S Residential Landfill
- C-746-T Inert Landfill
- C-746-U Contained Landfill

The C-746-U Landfill is an operating solid waste landfill located directly north of the C-746-S&T Landfills. Figure 1 presents the location of the C-746-U Landfill relative to PGDP, the S&T Landfills, and the trichloroethene (TCE) plume.

NOTE: These landfills are located well within the Water Policy Box—an area within which exposure to groundwater is limited. The PGDP Action Memorandum for the Water Policy was developed to support Comprehensive Environmental Response, Compensation, and Liability Act projects and outlines how municipal water is supplied to residents located within the Water Policy Box, which extends to all areas in the vicinity of the C-746-U Landfill.

Construction and operation of the C-746-U Landfill was permitted in November 1996 under Solid Waste Permit SW07300045. The permitted C-746-U Landfill area covers about 60 acres and includes a liner and leachate collection system. The C-746-U Landfill began receiving waste in 1997 and continues to receive waste. The Kentucky Division of Waste Management (KDWM) allows for continued operation of the C-746-U Landfill under the combined Solid Waste Landfill Permit SW07300014, SW07300015, SW07300045, effective November 5, 2006. Waste accepted includes construction debris, industrial waste, asbestos material, incinerator ash, cardboard, paper, plastics, and environmental media (e.g., soils). Materials delivered to the landfill may be in bulk form (e.g., soils in dump trucks) or containerized in boxes or drums of varying sizes.

Water that infiltrates the landfill drains to the landfill leachate collection system piping. These liquids drain, via gravity, to a belowground lift station that pumps the leachate into leachate storage tanks on the landfill property. Leachate from the C-746-U Landfill is treated in the on-site leachate treatment facility and the PGDP's C-615 Sewage Treatment Plant and discharged at an outfall in accordance with a Kentucky Pollutant Discharge Elimination System permit.

Twenty-two of the approximately 60 acres of the C-746-U Landfill are designated to be developed for waste disposal, with an ultimate disposal capacity of 1.5 million yd^3 of waste materials. The landfill area is divided into 23 phases to accommodate this amount of material. C-746-U Landfill currently is operating in Phases 4 and 5. Phases 1, 2, and most of Phase 3 have a long-term cover.

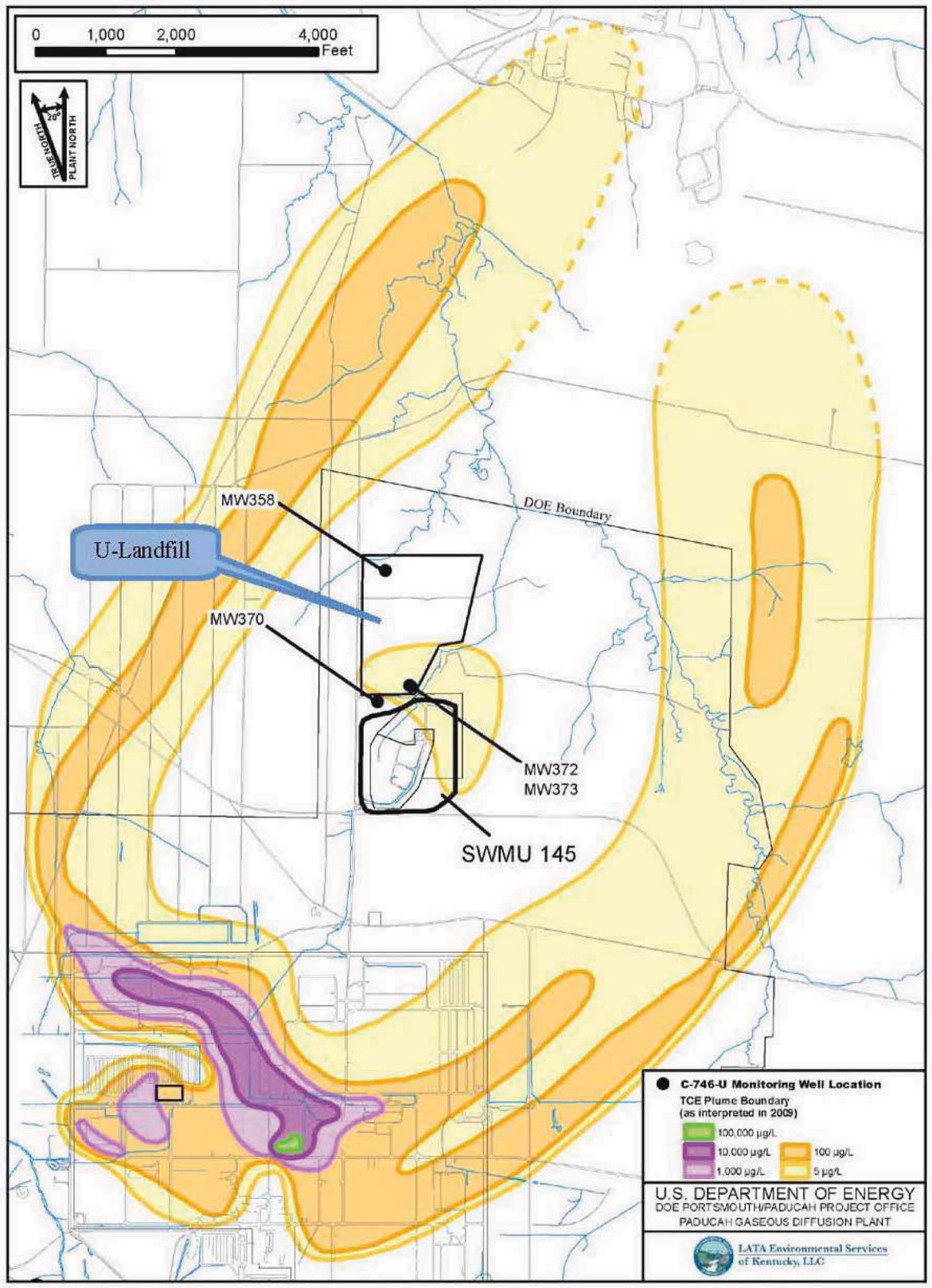

Figure 1. Location of the U-Landfill Depicted Relative to 2009 RGA TCE Plume Map

The landfill was constructed over a compacted subgrade and liner and leachate collection system that includes these elements (from bottom to top):

- Thirty-six inches of low permeability clay;
- An 80-mil thick polyethylene synthetic liner;
- Twelve inches of drainage material (which contains the leachate collection piping);
- A geotextile fabric; and
- Twelve inches of cushioning material.

The landfill liner system is constructed on a compacted and contoured surface to allow any infiltrating leachate to drain via gravity to the central leachate piping, then toward each cell's east end where it continues to drain to the lift station.

1.2 GROUNDWATER CHARACTERIZATION BEFORE OPERATION

An initial background groundwater characterization was performed in accordance with 401 *KAR* 47:180; 401 *KAR* 48:300, Section 3; and the original Groundwater Monitoring Plan provided in the Technical Permit Application. (See Section 5, Hydrogeologic Setting, for a description of the groundwater systems at the C-746-U Landfill.) Background groundwater characterization analysis was conducted during the course of one year before placement of waste in the landfill. Background groundwater characterization consisted of sampling performed on the original wells (MW269 through MW277). A second background determination was completed, consistent with permit requirements, after the wells located in the vicinity of the C-746-U Landfill were replaced due to corrosion of the wells.

1.3 GROUNDWATER MONITORING PLAN

The groundwater at the C-746-U Landfill is monitored in accordance with the *C-746-U Solid Waste Landfill Groundwater Monitoring Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-205/R1 (BJC 2001). The groundwater monitoring program included installation of new MWs that were needed because the previously installed wells were corroded. (The well corrosion threatened the integrity of the monitoring system, in part because well corrosion was contributing to increased chromium concentrations and turbidity levels.) Six clusters of wells were installed with corrosion resistant materials. Installation of the wells was completed in 2002. These new wells were sampled to establish background values for each well. These background values are used for comparison each time each well is sampled to identify above background constituent concentrations.

Figure 2 is a map of the C-746-U Landfill and the MWs located in the vicinity of the C-746-U Landfill. Soil boring logs, MW and piezometer water level records, soil geotechnical tests, and groundwater flow models of the area of the C-746-U Landfill provide sufficient data for the development of a Conceptual Site Model (CSM), described in Section 5. In general, groundwater flow is downward through the silts, clays, and fine sands of the Upper Continental Recharge System (UCRS). In contrast, the underlying Regional Gravel Aquifer (RGA) is conductive and provides the main conduit for lateral groundwater flow. Groundwater flow is in a north-northeasterly direction in the vicinity of the C-746-U Landfill. The Ohio River and lower reaches of Little Bayou and Bayou Creeks are the discharge areas for the RGA flow system.

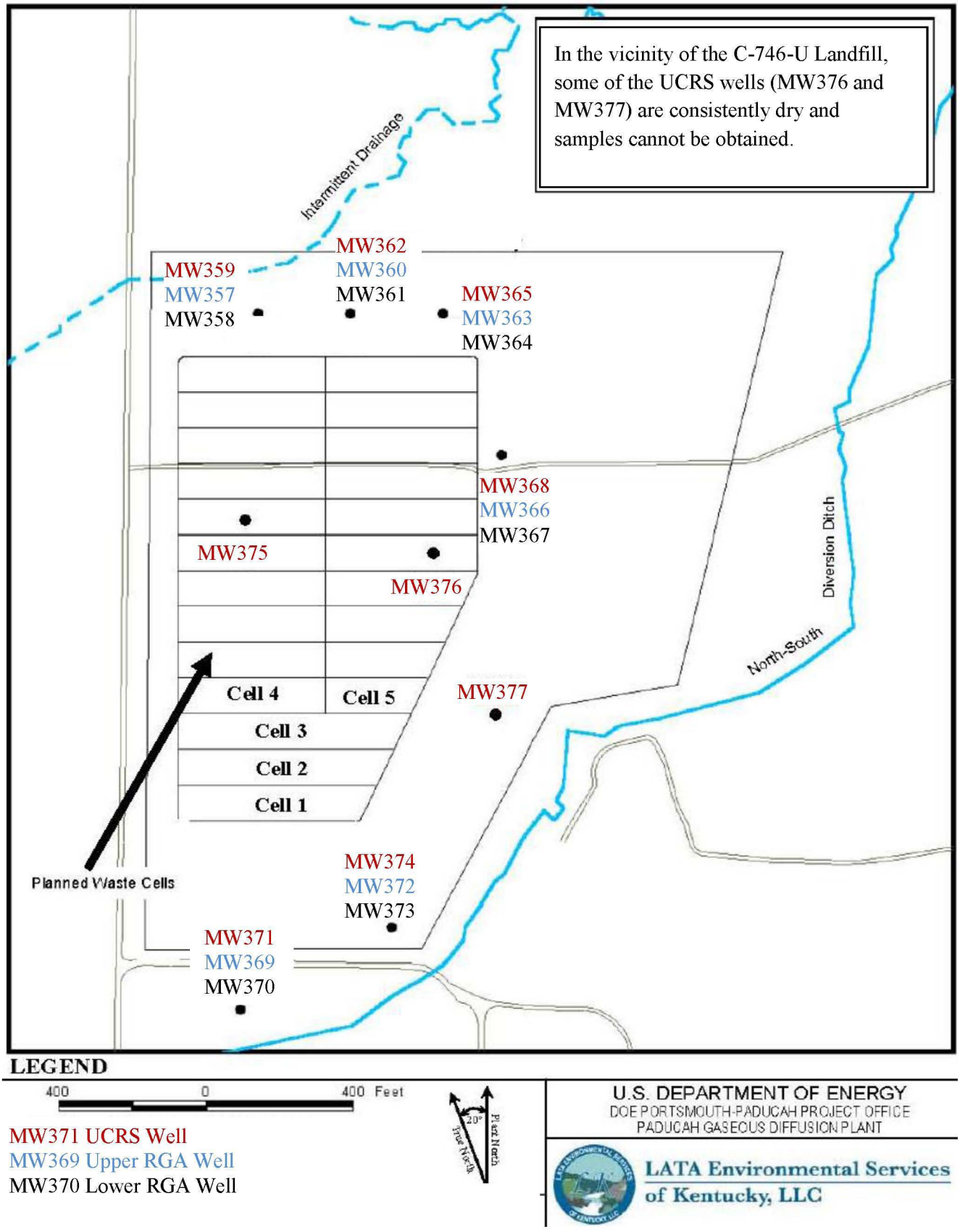

Figure 2. C-746U Landfill and Wells Located in the Vicinity

Consistent with this CSM, the constituent concentrations in UCRS wells are considered to be representative only of the conditions local to the well or sourced from overlying soils; thus, no discussion of potential "upgradient" sources is presented for the UCRS. The constituent concentrations found in the RGA wells are evaluated while considering the potential for contributions of sources located upgradient (with respect to the landfill) of the monitored well.

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2. BASIS FOR CONDUCTING ASSESSMENT/PRELIMINARY SCREENING

2.1 HISTORY

In 1999, the KDWM placed the C-746-U Landfill into groundwater contamination assessment, in accordance with 401 *KAR* 48:300, Section 8. The contaminants that exceeded statistical background that caused the C-746-U Landfill to be placed in assessment were chromium, gross beta, technetium-99 (Tc-99), total dissolved solids, total solids, and turbidity. The 1999 groundwater assessment demonstrated that the gross beta and Tc-99 represented a contaminant plume from PGDP that was migrating into the area of the C-746-U Landfill. Chromium, dissolved and total solids, and turbidity were attributed to corrosion of the stainless steel MW casings. As a result of these findings, the corroded MWs were replaced.

No further groundwater assessment was required until a statistically valid set of data had been collected from the new wells to establish background. DOE received a letter from KDWM on August 29, 2006, that again placed the C-746-U Landfill into groundwater contamination assessment. The letter stated that KDWM determined a statistically valid set of data now existed and contaminants had exceeded either maximum contaminant levels (MCLs) or statistical limits calculated relative to background concentrations (calculated in accordance with the permit from eight consecutive quarters of data from wells considered to be located upgradient of the C-746-U Landfill). The contaminants identified by KDWM for the assessment are those discussed in Section 3. KDWM approved the groundwater assessment plan required in accordance with 401 *KAR* 48:300, Section 8, on February 13, 2008. This approval letter is provided as Appendix A.

The data used to support all of the constituent assessments are groundwater analyses of quarterly and semiannual monitoring for the period 2002 through 2012 including the focused sampling of October 2006. In addition, other data were evaluated to support the assessment. For example, soils analyses from a polychlorinated biphenyls (PCBs) source investigation in 2008 and groundwater analyses from an overpumping test during 2011 support the assessment of Total PCBs.

Beginning in July and October of 2003, groundwater monitoring at the C-746-S, -T, and -U Landfills detected PCBs. Subsequently, PCB levels have declined in general, but continue to be detected in several wells. A July–August 2008 field investigation concluded the PCB contamination is not derived from a local contaminated soils source (Appendix D). The overpumping test conducted in 2011 supported this groundwater assessment that has determined the PCB contamination is likely the result of cross-contamination associated with well rehabilitation efforts conducted in April and May 2003 (Appendix E). With the consent of KDWM, LATA Environmental Services of Kentucky, LLC performed an overpumping test of four C-746-U Landfill MWs beginning in March 2011. The data from the overpumping activity (summarized in Appendix F) indicate the PCBs are associated with suspended solids in the wells and can be removed with effective well development. The fact that all of the RGA wells have been rehabilitated indicates that there is no continuing source of PCBs and is consistent with the determination that the contamination was likely the result of historical cross-contamination that occurred during well rehabilitation.

2.2 PURPOSE OF THE ASSESSMENT

In accordance with 401 *KAR* 48:300, Section 8, after the implementation of the groundwater assessment plan, the operator shall submit a groundwater assessment report containing the new data, analysis of the data, and recommendations on the necessity for abatement. This report fulfills this objective. This assessment seeks to identify the presence of constituents present in C-746-U Landfill wells and attribute the source(s) of those exceedances to determine if there is evidence that the C-746-U Landfill is leaking and is the cause of statistically quantifiable contamination.

Tables 1 through 6 summarize the results of the evaluation of the parameters under this assessment. This assessment includes an evaluation of a broad range of parameters, not just those identified for assessment. The following are the parameters required to be evaluated under the original assessment (August 2006).

- Gross Beta
- Carbon Disulfide
- Chemical Oxygen Demand
- Manganese
- Sulfate
- Tc-99
- Total PCBs
- Radium-228
- Total Organic Carbon (TOC)
- TCE

The following are the additional parameters added to the assessment, identified based on focused sampling conducted in October 2006.[3]

- Calcium
- Chloride
- Cobalt
- Dissolved Solids
- Iron
- Magnesium
- Sodium
- Uranium

2.3 SUMMARY OF THE ASSESSMENT SCREENING

Tables 1–6 list the parameters whose concentrations were screened against benchmarks (including background) to identify those that needed additional discussion. The current and historical analytical results from RGA wells located in the vicinity of the C-746-U Landfill were screened against benchmarks, including Kentucky MCLs, U.S. Environmental Protection Agency (EPA) MCLs, and EPA regional screening levels (RSLs). Subsequently, those constituents without MCLs or RSLs were evaluated against EPA secondary MCLs (SMCLs) and historical background levels (calculated in

[3] The DOE evaluation following the October 2006 focused sampling event also identified additional wells for assessment of some of the original parameters specified by KDWM in August 2006 (manganese, Total PCBs, sulfate, Tc-99, and TOC).

accordance with the C-746-U Landfill permit). Each result was compared against each benchmark concentration and any exceedances of the benchmarks were tabulated with a special focus on those constituents that exceeded the benchmark over the past eight calendar quarters.

The screening results presented in Tables 1–6 document those constituents that have not had a confirmed exceedance of any benchmark in any RGA well. The lack of any current or historical exceedance of a benchmark in an RGA well resulted in this constituent being screened from further evaluation.

The results of the screening are presented in the following sections. The evaluation continued for those constituents that have had an RGA exceedance of a benchmark with particular focus on those constituents that had a confirmed exceedance of a benchmark over the past eight calendar quarters. This subsequent evaluation into the source(s) of these constituents looked at the following:

- Spatial patterns of each constituent present above a benchmark;
- Identified plumes;
- Concentrations of these constituents in other PGDP wells; and
- Concentrations of these constituents in landfill leachate.

2.3.1 Inorganic Parameters Screening against Kentucky or EPA MCL

Table 1 provides a summary of the screening of C-746-U Landfill data for inorganic parameters in RGA wells against Kentucky or U.S. Environmental Protection Agency (EPA) MCL for all inorganic constituents that have an MCL. This table shows that antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, silver, uranium, nitrate, and fluoride have not exceeded either the Kentucky or EPA MCL since January 2010. Thus, the landfill is in compliance with respect to these parameters.

2.3.2 Radionuclide Parameters Screening against Kentucky or EPA MCL

Table 2 provides a summary of the screening of C-746-U Landfill data for radionuclide parameters in RGA wells against Kentucky or EPA MCLs. This table shows that alpha activity, strontium-90, tritium, iodine-131, radium, radium-224, radium-226, radium-228, and Tc-99 have not exceeded the respective MCL since January 2010. Thus, the C-746-U Landfill is in compliance with respect to these parameters. Additional discussion of beta activity is required because water from some of the wells has exceeded the Kentucky MCL for beta activity of 50 pCi/L since 2010. Some additional discussion of Tc-99 is included because Tc-99 is a source of beta activity and is present in RGA groundwater at locations upgradient to the C-746-U Landfill.

2.3.3 Organic Parameters Screening against Kentucky or EPA MCL

Table 3 provides a summary of the screening of C-746-U Landfill data for organic parameters in RGA wells against Kentucky or EPA MCLs. This table shows that benzene, carbon tetrachloride, 1,2-dicholoroethane, p-dichlorobenzene, 1,1-dichloroethene, 1,1,1-trichloroethane, and vinyl chloride never have been detected in C-746-U Landfill wells and have not exceeded the respective MCL since January 2010. Thus, the C-746-U Landfill is in compliance with respect to these parameters. In addition, none of these constituents ever have been detected in wells located in the vicinity of the C-746-U Landfill.

Table 1. Summary of RGA Well Screening of List of Inorganic Parameters with Kentucky or EPA MCL

Parameter	Kentucky MCL	EPA MCL	Maximum Detected Conc.	Units	Number of Samples	Number of Detects	Number Exceed MCL	Exceeds?	Exceed since 2010?	Comments
Antimony	N/A	0.006	ND	mg/L	542	0	0		No	
Arsenic	0.05	0.01	0.0146	mg/L	542	268	12	EPA MCL	No	No exceedance of KY MCL; last EPA MCL exceedance 2004.
Barium	2.0	2.0	1.22	mg/L	555	555	0		No	
Beryllium	N/A	0.004	0.00497	mg/L	542	1	1	EPA MCL	No	Only EPA exceedance 2003.
Cadmium	0.005	0.005	0.00511	mg/L	542	6	1	KY/EPA MCL	No	Only exceedance 2003.
Chromium	0.100	0.100	0.025	mg/L	554	1	0		No	Only detection in 2002; no exceedance.
Copper	N/A	1.3	0.026	mg/L	542	4	0		No	
Lead	0.05	0.015	0.0127	mg/L	542	16	0		No	
Mercury	0.002	0.002	ND	mg/L	540	0	0		No	
Selenium	0.05	0.05	0.0125	mg/L	542	154	0		No	
Silver	0.05	N/A	0.00146	mg/L	542	1	0		No	
Uranium	N/A	0.030	0.029	mg/L	546	9	0		No	
Nitrate (as N)	10.0	10.0	5	mg/L	511	94	0		No	
Fluoride	4.0	4.0	2.6	mg/L	537	511	0		No	

N/A = not applicable
ND = not detected at concentration less than the respective MCL

Table 2. Summary of RGA Well Screening of Radionuclide Parameters with Kentucky or EPA MCL

Parameter	Kentucky MCL	EPA MCL	Maximum Detected Conc.	Units	Number of Samples	Number of Detects	Number Exceed MCL	Exceeds?	Exceed Since 2010?	Comments
Alpha Activity	15	15	19	pCi/L	548	40	1	KY/EPA MCL	No	Only exceedance in 2004.
Beta Activity	50	4 mrem	137	pCi/L	548	492	60	KY MCL	Yes	12 KY MCL exceedances since 2010; additional evaluation needed to ascertain source(s).
Strontium-90	8	N/A	7.57	pCi/L	537	1	0		No	Only exceedance in 2003.
Tritium	20,000	N/A	641	pCi/L	536	1	0		No	No exceedance; only detection in 2007.
Iodine-131	3	N/A	10.6	pCi/L	514	1	1	KY MCL	No	Only result (7/14/2010) greater than minimum detectable activity (MDA) not confirmed by re-sampling/analysis.
Radium	5	5[a]	1.04	pCi/L	128	3	0		No	
Radium-224	5	N/A	Below MDA	pCi/L	77	0	0		No	
Radium-226	5	5[a]	12.4	pCi/L	486	31	1	KY/EPA MCL	No	Exceeded in 2002 only.
Radium-228	5	5[a]	8.63	pCi/L	302	14	4	KY/EPA MCL	No	Not exceeded since 2008.
Technetium-99	N/A	4 mrem[b]	179	pCi/L	561	352	0		No	

N/A = not applicable

[a] EPA MCL for radium-226 and 228 combined.

[b] EPA methodology equates 4 mrem to 900 pCi/L.

Table 3. Summary of RGA Well Screening of Organic Compound Parameters with Kentucky MCL

Parameter	Kentucky MCL	EPA MCL	Maximum Detected Conc.	Units	Number of Samples	Number of Detects	Number Exceed MCL	Exceeds?	Exceed since 2010?	Comments
Benzene	0.005	0.005	ND	mg/L	559	0	0		No	
Carbon Tetrachloride	0.005	0.005	ND	mg/L	559	0	0		No	
1,2-Dichloroethane	0.005	0.005	ND	mg/L	559	0	0		No	
Trichloroethene	0.005	0.005	0.022	mg/L	559	325	124	KY/EPA MCL	Yes	Additional evaluation needed to ascertain source(s).
p-Dichlorobenzene	0.075	0.075	ND	mg/L	554	0	0		No	
1,1-Dichloroethene	0.007	0.007	ND	mg/L	559	0	0		No	
1,1,1-Trichloroethane	0.200	0.200	ND	mg/L	559	0	0		No	
Vinyl Chloride	0.002	0.002	ND	mg/L	559	0	0		No	

ND = not detected at concentration less than the respective MCL

Table 4. Summary of RGA Well Screening of PCBs against EPA MCL

Parameter	Kentucky MCL	EPA MCL	Maximum Detected Conc.	Units	Number of Samples	Number of Detects	Number Exceed MCL	Exceeds?	Exceed since 2010?	Comments
PCB-1016	N/A	0.0005	0.0029	mg/L	465	50	9	EPA MCL	No	
PCB-1221	N/A	0.0005	ND	mg/L	465	0	0		No	
PCB-1232	N/A	0.0005	0.00045	mg/L	465	1	0		No	
PCB-1242	N/A	0.0005	0.00115	mg/L	465	42	8	EPA MCL	No	2011 result of 0.000592 in MW363 not confirmed with resampling/ reanalysis.
PCB-1248	N/A	0.0005	0.00062	mg/L	465	3	1	EPA MCL	No	
PCB-1254	N/A	0.0005	ND	mg/L	465	0	0		No	
PCB-1260	N/A	0.0005	0.00019	mg/L	465	3	0		No	
PCB-1262	N/A	0.0005	ND	mg/L	11	0	0		No	
PCB-1268	N/A	0.0005	ND	mg/L	460	0	0		No	

N/A = not applicable

ND = not detected at concentration less than the respective MCL

Table 5. Summary of RGA Well Screening of Parameters without Kentucky or EPA MCL, but with Tapwater RSL or EPA Secondary MCL

Parameter	Kentucky MCL	EPA MCL	Tapwater RSL (No MCL)	Maximum	Units	Number of Samples	Number of Detects	Number Exceed RSL	Exceeds?	Exceed since 2010?	Comments
1,2,4-Trimethylbenzene	N/A	N/A	0.015	0.00011	mg/L	7	1	0		No	
Acetone	N/A	N/A	12	11	mg/L	559	48	0		No	
Aluminum	N/A	SMCL only	16	22.7	mg/L	542	108	1	RSL	No	One RSL exceedance in upgradient MW373 in 2002.
Boron	N/A	N/A	3.1	1.95	mg/L	540	154	0		No	
Carbon Disulfide	N/A	N/A	0.72	0.025	mg/L	559	19	0		No	
Chloride	N/A	SMCL only	N/A	130	mg/L	511	511	N/A		No	No RSL; no exceedances of SMCL of 250 mg/L.
Cobalt	N/A	N/A	0.0047	0.86	mg/L	542	341	191	RSL	Yes	RSL exceedances, but concentrations not above C-746-U Landfill background; additional evaluation.
Dissolved Solids	N/A	SMCL only	N/A	1200	mg/L	537	469	N/A	SMCL	No/ Yes	No RSL. 500 mg/L (SMCL) exceeded only in upgradient MW373 since 2010 (exceed 10 times); additional evaluation.
Iron	N/A	SMCL only	11	62.2	mg/L	542	448	64	RSL	Yes	RSL exceedances, but concentrations not above C-746-U Landfill background; additional evaluation.
Manganese	N/A	SMCL only	0.32	24.2	mg/L	542	530	246	RSL	Yes	RSL exceedances, but concentrations not above C-746-U Landfill background; additional evaluation.
Molybdenum	N/A	N/A	0.078	0.00392	mg/L	540	4	0		No	
Nickel	N/A	N/A	0.300	0.0729	mg/L	542	95	0		No	No exceedances of RSL for nickel soluble salts.
Sulfate	N/A	SMCL only	N/A	809.6	mg/L	537	526	N/A	SMCL	No	No RSL; last exceedance of SMCL (250 mg/L) in 2005; above background concentrations in upgradient well MW372.
Vanadium	N/A	N/A	0.078	0.048	mg/L	542	20	0		No	No exceedance of RSL for vanadium and compounds.
Zinc	N/A	N/A	4.700	0.725	mg/L	542	17	0		No	

N/A = not applicable

Table 6. Summary of RGA Well Screening of List of Parameters without Kentucky or EPA MCL and without Tapwater RSL or EPA Secondary MCL

Parameter	Kentucky MCL	EPA MCL	Tapwater RSL (No MCL)	Maximum	Units	Number of Samples	Number of Detects	Number Exceed MCL	Exceeds ?	Exceed since 2010?	Comments
Calcium	N/A	N/A	N/A	85.2	mg/L	542	542	N/A	N/A	N/A	Above background concentrations only in upgradient wells MW372 and MW373. Highest 39 results all in MW373 (upgradient); thus, no indication of a C-746-U Landfill source.
Chemical Oxygen Demand (COD)	N/A	N/A	N/A	830	mg/L	537	36	N/A	N/A	N/A	No detections of COD since 2006.
Iodide	N/A	N/A	N/A	3.2	mg/L	537	6	N/A	N/A	N/A	Iodide infrequently detected. No apparent pattern to detections. Of 4 detects since 2010, two in upgradient wells; thus, no apparent C-746-U Landfill contribution.
Magnesium	N/A	N/A	N/A	32.9	mg/L	542	542	N/A	N/A	N/A	Above background concentrations only in upgradient MW372. Highest 37 results all in upgradient well MW373; thus, no indication of a C-746-U Landfill source.
Potassium	N/A	N/A	N/A	4.34	mg/L	542	515	N/A	N/A	N/A	Not above C-746-U Landfill background; however, 38 of 52 highest results in upgradient well MW373; no apparent pattern to detections that indicates a C-746-U Landfill contribution .
Sodium	N/A	N/A	N/A	128	mg/L	542	542	N/A	N/A	N/A	Not above C-746-U Landfill background. Of highest 40 results, 28 from upgradient (MW373, MW372, MW369) others from MW360; thus, no apparent pattern in detections that indicates a C-746-U Landfill source.
Thorium-232	N/A	N/A	N/A	ND	pCi/L	215	0	N/A	N/A	N/A	
Total Organic Carbon	N/A	N/A	N/A	324	mg/L	537	263	N/A	N/A	N/A	Values consistent with other PGDP areas; additional discussion.

N/A = not applicable

Additional discussion of the presence of TCE is required because water from some of the wells has TCE concentrations that have exceeded the MCL of 5 µg/L since January 2010. Additional discussion is also provided because of the presence of TCE in RGA groundwater at locations upgradient to the C-746-U Landfill.

2.3.4 PCBs Screening against EPA MCL

Table 4 provides a summary of the screening of C-746-U Landfill data for PCBs in RGA wells against the EPA MCL (Kentucky does not have an MCL). This table shows that none of the PCBs have had a confirmed result above the EPA MCL since 2010. In addition, no PCBs have had above background concentrations in RGA wells since January 2010. Thus, the C-746-U Landfill is in compliance with respect to these parameters. However, additional discussion about the presence of PCBs is presented in later sections of the report to explain the historical findings and the continued presence of PCBs above the EPA MCL in a UCRS well located distal to the C-746-U Landfill.

2.3.5 Parameters Screening against EPA RSLs and Secondary MCLs

Table 5 provides a summary of the screening of C-746-U Landfill data for parameters that do not have an MCL but do have an RSL or an SMCL. Of these parameters, only cobalt, iron, and manganese have exceeded the RSL since 2010; however, none of these constituents exhibits a concentration that is above background. There is no indication that the C-746-U Landfill is a source of constituents that cause an exceedance of the RSL for any of these parameters; however, some additional discussion of the source(s) of these constituents is presented.

Dissolved solids concentrations have exceeded the SMCL since January 2010; however, this exceedance is only in an upgradient well (MW373). Dissolved solids exhibit above background concentrations in two upgradient wells, MW372 and MW373. Additional discussion is provided on the potential source(s) of dissolved solids. Concentrations of sulfate have not exceeded the SMCL since January 2010; however, the concentrations of sulfate in several wells approach the SMCL, and upgradient well MW372 has above background concentrations. Chloride concentrations do not exceed the SMCL. Additional discussion is provided to account for the presence of sulfate, chloride, and dissolved solids at found concentrations.

2.3.6 Parameters without MCLs or RSLs

Table 6 provides a summary of the observations for C-746-U Landfill data for parameters that do not have an MCL or RSL for comparison. Because there is no MCL or RSL for comparison, additional discussion of these parameters (e.g., dissolved solids, sulfate, potassium, magnesium, boron, sodium) is included where that discussion potentially informs discussion of other parameters. For example, the highest 39 calcium concentrations all are found in upgradient well MW373. Thus, calcium in MW373 is discussed in the context of other constituents that have high concentrations in that well (e.g., dissolved solids, sulfate, potassium, magnesium, boron, sodium).

Although field parameters (e.g., oxidation reduction potential) are subjected to quarterly statistical analysis, the finding of above background values for field parameters are only discussed in this assessment where these findings are related to potential source(s) of other parameters.

2.3.7 Assessment Parameters Summary

Table 7 provides a summary of the observations of C-746-U Landfill data for parameters that were included for assessment using the screening summarized above to further evaluate these parameters.

Table 7. Summary of Conclusions for Assessment Parameters in All Wells Based on Screening

Parameter	Wells (Completion Unit)	Conclusion
Gross Beta	MW372 [Upgradient Upper Regional Gravel Aquifer (URGA)] and MW373 [Upgradient Lower Regional Gravel Aquifer (LRGA)]	Gross beta exceedances are further discussed in later sections of the report. Elevated beta levels apparently are coming from upgradient sources and are directly related to the Tc-99 that is migrating into the area.
Carbon Disulfide	MW362 (UCRS)	Concentration less than RSL since 2010. No further discussion.
Chemical Oxygen Demand	MW358 (LRGA)	No detectable COD since 2010. No further discussion.
Manganese	MW366 (URGA)	Manganese levels have been below the RSL in this well since 2010; however, other RGA wells have above RSL concentrations that are consistent with results in other PGDP RGA wells. Additional discussion is included.
Sulfate	MW359 (UCRS), MW365 (UCRS)	Sulfate levels are less than the SMCL. Additional discussion of the source(s) of sulfate is included.
	MW362 (UCRS)	Sulfate levels exceeded the SMCL one time (April 2003). Concentrations no longer exceed the SMCL. Additional discussion of the source(s) of sulfate is included.
Technetium-99	MW361 (LRGA), MW372 (URGA), MW373 (LRGA)	Tc-99 levels are less than the constituent-specific derived EPA MCL. Although less than the MCL, Tc-99 is a source of beta activity. Beta levels apparently are related to Tc-99 migrating into the area and are further discussed as a source of beta activity.
PCB, Total	MW361 (LRGA), MW363 (URGA), MW365 (UCRS)	PCB levels in MW361 and MW363 no longer exceed the EPA MCL for total PCBs. Thus, there is no current issue with the PCB concentrations. The historical source of the PCBs may be (2003) cross-contamination related to well rehabilitation activities. MW365 concentrations still exceed the MCL, in part, because the well cannot be completely rehabilitated due to low rates of purging/surging allowed by the UCRS well.
Radium-228	MW362 (UCRS), MW363 (URGA), MW364 (LRGA), MW369 (URGA)	Radium-228 levels do not exceed the MCL in the RGA. The last time MW362 had an exceedance was 1/5/2010; the last eight quarters have not had an exceedance.
TOC	MW358 (LRGA)	TOC levels no longer exceed background levels and have not since 2010. No further discussion.

Table 7. Summary of Conclusions for Assessment Parameters in All Wells Based on Screening (Continued)

Parameter	Wells (Completion Unit)	Conclusion
Trichloroethene	MW370 (LRGA), MW372 (URGA), MW373 (LRGA)	TCE levels exceed the MCL. Additional discussion of the source(s) of TCE is presented that shows TCE in RGA groundwater at locations upgradient of the C-746-U Landfill is the likely source of the TCE in C-746-U Landfill wells. No UCRS wells have TCE MCL exceedances.

2.3.8 Additional Assessment Parameters Summary

Table 8 provides a summary of the observations of C-746-U Landfill data for parameters that were included for assessment using the screening summarized above to further evaluate these parameters.

2.4 CONCLUSIONS OF THE ASSESSMENT SCREENING

Only two constituents (beta activity and TCE) are present in concentrations in RGA groundwater that are above MCLs and above background, and the exceedances of the MCLs for these parameters are apparently sourced from upgradient of the C-746-U Landfill, as discussed subsequently in this document.

Some additional discussion of the apparent historical source of PCBs (well rehabilitation) is presented; however, irrespective of potential sources, there have been no confirmed exceedances of the EPA MCL in RGA wells since January 2010.

Table 8. Summary of Conclusions for Additional Assessment Parameters in All Wells Based on Screening

Parameter	Wells (Completion Unit)	Conclusion
Calcium	MW371 (UCRS)	Calcium no longer has a statistical exceedance in MW371.
	MW372 (URGA) and MW373 (LRGA)	Calcium does not have an MCL or RSL. Additional discussion is provided in tables and text in subsequent sections of this report that notes that the highest 39 calcium concentrations are all in upgradient well MW373; thus, the C-746-U Landfill is not the source of the above background calcium. Potential alternate sources are discussed.
Chloride	MW374 (UCRS)	Chloride levels are not above background and are less than the SMCL.
Cobalt	MW369 (URGA)	Cobalt concentrations exceed the RSL; however, additional discussion is provided that indicates that concentrations are consistent with C-746-U background and concentrations of cobalt in other PGDP areas.

Table 8. Summary of Conclusions for Additional Assessment Parameters in All Wells Based on Screening (Continued)

Parameter	Wells (Completion Unit)	Conclusion
Dissolved Solids	MW362 (UCRS)	Dissolved solids levels are below the SMCL since 2010.
	MW372 (URGA) and MW373 (LRGA)	Dissolved solids levels in MW372 are less than the SMCL, but exceed the SMCL in MW373 since 2010. Both MW372 and MW373 have dissolved solids concentrations that show concentrations above background. Only upgradient well, MW373, has had levels over the SMCL; thus, the C-746-U Landfill cannot be the primary source of dissolved solids.
	MW374 (UCRS)	Dissolved solids levels have remained below the SMCL since October 2006.
Iron	MW369 (URGA)	Iron levels do not exceed the RSL in this well. Additional discussion of iron is provided to document that iron concentrations are within the range of background, though some alternate sources may be contributing incremental amounts.
	MW374 (UCRS)	Iron levels do not exceed the RSL in this well. Additional discussion of iron is provided to document that iron concentrations are within the range of background, though some alternate sources may be contributing incremental amounts.
Magnesium	MW358 (LRGA) and MW371 (UCRS)	No MCL or RSL. The highest 44 sample concentrations are associated with samples from upgradient wells MW372 and MW373; thus, the C-746-U Landfill is not the likely source of high magnesium levels. Additional discussion of the potential sources of magnesium concentrations in these wells is provided.
	MW372 (URGA) and MW373 (LRGA)	No MCL or RSL. The highest 44 concentrations are associated with samples from upgradient wells MW372 and MW373; thus, the C-746-U Landfill is not the likely source of high magnesium levels. Additional discussion of the potential sources of magnesium concentrations in these wells is provided.
Manganese	MW367 (LRGA)	Manganese levels exceed the RSL since 2010. Concentrations in this well are not above background. Some additional discussion of the mechanisms of manganese release from native materials is provided.
	MW369 (URGA)	Manganese levels do not exceed the RSL over the past eight quarters. Concentrations in this well are not above background. Some additional discussion of the mechanisms of manganese release from native materials is provided.

Table 8. Summary of Conclusions for Additional Assessment Parameters in All Wells Based on Screening (Continued)

Parameter	Wells (Completion Unit)	Conclusion
Manganese (Continued)	MW374 (UCRS)	Manganese levels do not exceed the RSL since 2010. Some additional discussion of the mechanisms of manganese release from native materials is provided.
PCB, Total	MW366 (URGA)	Total PCB concentrations do not exceed the EPA MCL since 2010. Additional discussion of the likely source of the historical contamination is provided. The C-746-U Landfill was not the source of the historical contamination.
Sodium	MW360 (URGA)	No MCL. Higher sodium concentrations more frequently seen in upgradient wells MW372 and MW373; thus, the pattern of higher concentrations is not consistent with a C-746-U Landfill source. Additional discussion of the potential source(s) is provided.
	MW369 (URGA)	No MCL. Higher sodium concentrations are seen more frequently in upgradient wells MW372 and MW373; thus, the pattern of higher concentrations is not consistent with a C-746-U Landfill source. Additional discussion of the potential source(s) is provided.
	MW362 (UCRS)	No MCL. A UCRS source is not needed to explain RGA well exceedances. Higher sodium concentrations are seen frequently in upgradient wells MW372 and MW373; thus, the pattern of higher concentrations is not consistent with a C-746-U Landfill source. Additional discussion of the potential source(s) is provided.
	MW372 (URGA)	No MCL. Higher sodium concentrations are seen more frequently in upgradient wells MW372 and MW373; thus, the pattern of higher concentrations is not consistent with a C-746-U Landfill source. Additional discussion of the potential source(s) is provided.
Sulfate	MW372 (URGA)	Sulfate levels are less than the SMCL; however, concentrations approach the SMCL and the highest sulfate concentration in C-746-U Landfill wells is associated with upgradient well MW373. A major C-746-U Landfill source is unlikely; however, additional discussion of the potential source(s) of sulfate is provided.
Technetium-99	MW357 (URGA)	Tc-99 levels are less than the constituent-specific derived EPA MCL. Additional discussion is provided because Tc-99 is a source of beta activity, and beta activity may be related to the Tc-99 present in upgradient RGA locations.

Table 8. Summary of Conclusions for Additional Assessment Parameters in All Wells Based on Screening (Continued)

Parameter	Wells (Completion Unit)	Conclusion
TOC	MW374 (UCRS) and MW362 (UCRS)	No MCL. Concentrations below background levels. Minimal additional discussion of the TOC levels is provided.
Uranium	MW362 (UCRS)	Uranium levels are less than the MCL.
	MW373 (LRGA)	Uranium levels are less than the MCL.

Some constituents do not have an MCL, but do have an RSL or an SMCL. Of these parameters, only cobalt, dissolved solids, iron, and manganese have exceeded the RSL since January 2010; however, the concentrations of these constituents are consistent with C-746-U background and with concentrations found in the RGA at other locations in the vicinity of PGDP. Thus, there is no indication of a statistically quantifiable C-746-U Landfill source of above RSL concentrations of these parameters; however, additional discussion of the source(s) of these constituents is presented.

Constituents with concentrations that are elevated above the C-746-U Landfill background are associated with upgradient RGA wells MW372 and MW373; thus, non-C-746-U Landfill sources for these constituents are apparent. Additional discussion of parameters without RSLs or MCLs is presented to identify and discuss these alternate sources. For example, the highest 39 calcium concentrations all are found in upgradient well MW373. Thus, calcium in MW373 is discussed in the context of other constituents that have high concentrations in that well (e.g., sulfate, potassium, magnesium, boron, sodium).

Although field parameters are subjected to statistical analysis as part of the quarterly monitoring, the finding of above background concentrations of field parameters only is discussed in this assessment report where their presence sheds light on the source(s) of other parameters.

Dissolved solids concentrations have exceeded the SMCL since January 2010; however, this exceedance is only in an upgradient well. Additional discussion is provided on the potential source(s) of dissolved solids. Concentrations of sulfate have not exceeded the SMCL since January 2010; however, the concentrations of sulfate in several wells have concentrations that approach the SMCL. Chloride concentrations do not exceed the SMCL. Additional discussion is provided as to the potential source(s) of sulfate, chloride, and dissolved solids.

3. DISCUSSION OF CONSTITUENTS NOT ELIMINATED BY SCREENING

This section provides an assessment of constituents present in C-746-U Landfill wells since 2010 at these concentrations:

- Above an MCL, including beta activity and TCE;
- Above an RSL, including cobalt, iron, and manganese;
- Below an RSL, but with concentrations that indicate the potential for a C-746-U Landfill or alternate source, including dissolved solids and sulfate; and
- Other constituents that may indicate the potential for a C-746-U Landfill or alternate source, including, calcium, dissolved solids, magnesium, and sodium.

This section provides a summary of the physical properties of each contaminant, the contaminant concentrations in C-746-U Landfill wells and other sample locations relative to benchmarks, and the conclusions regarding each contaminant.

3.1 BETA ACTIVITY

3.1.1 Physical Properties

Beta particles are subatomic particles ejected from some radioactive atoms. Beta particle emission occurs when a neutron transforms into a proton and a beta particle. The process decreases the number of neutrons in the nucleus by one and increases the number of protons by one. The beta emission changes the radionuclide to a different element. Often, gamma ray emission accompanies the emission of a beta particle.

Gross beta activity has been used as an indicator of beta-emitting radionuclides in water since at least the early 1950s. It is a measurement of all beta activity present, regardless of the specific radionuclide source. Gross measurements are used as a method to screen samples for relative levels of radioactivity.

There are many beta activity emitters. Common sources of beta activity in groundwater are potassium-40 and radium-228. Other beta activity sources include cesium-137, cobalt-60, iodine-129, strontium-90, Tc-99 (the primary source of beta activity in groundwater at PGDP), and tritium.

Direct exposure to beta particles is a hazard; however, emissions from inhaled or ingested beta particle emitters are the greatest concern. Some beta-emitters, such as carbon-14, distribute widely throughout the body. Others accumulate in specific organs and cause chronic exposures. Examples include iodine-131 (concentrates heavily in the thyroid gland) and strontium-90 (accumulates in bone and teeth).

3.1.2 Gross Beta Particle Activity C-746-U Landfill

Gross beta activity exceeds the Kentucky MCL of 50 pCi/L in groundwater samples from MW372—an RGA well located upgradient of the C-746-U Landfill. A plot of data points from this well is shown in Appendix B. The latest quarterly assessments also have identified gross beta activity above the MCL in wells MW366 and MW367. These wells are on the same RGA flow path as MW372. Various graphs of

the gross beta activity of these wells since 2010 are provided in Appendix B. These graphs demonstrate a historical source of beta activity from upgradient of the C-746-U Landfill; in addition, the graphs also show that the activity of that source is decreasing. A graph of beta activity (as a 4-event rolling average) presented in Appendix B on a semilog scale, in conjunction with the other observations, indicates that the C-746-U Landfill is not the source of a statistically quantifiable contribution to the beta activity results.

Tc-99 is a beta emitter. There is Tc-99 present in RGA groundwater at the PGDP site, as shown in Figure 3 (plume map established relative to the derived EPA MCL of 900 pCi/L). NOTE: Figure 3 also demonstrates that the C-746-U Landfill is located well within the boundaries of the Water Policy Box.

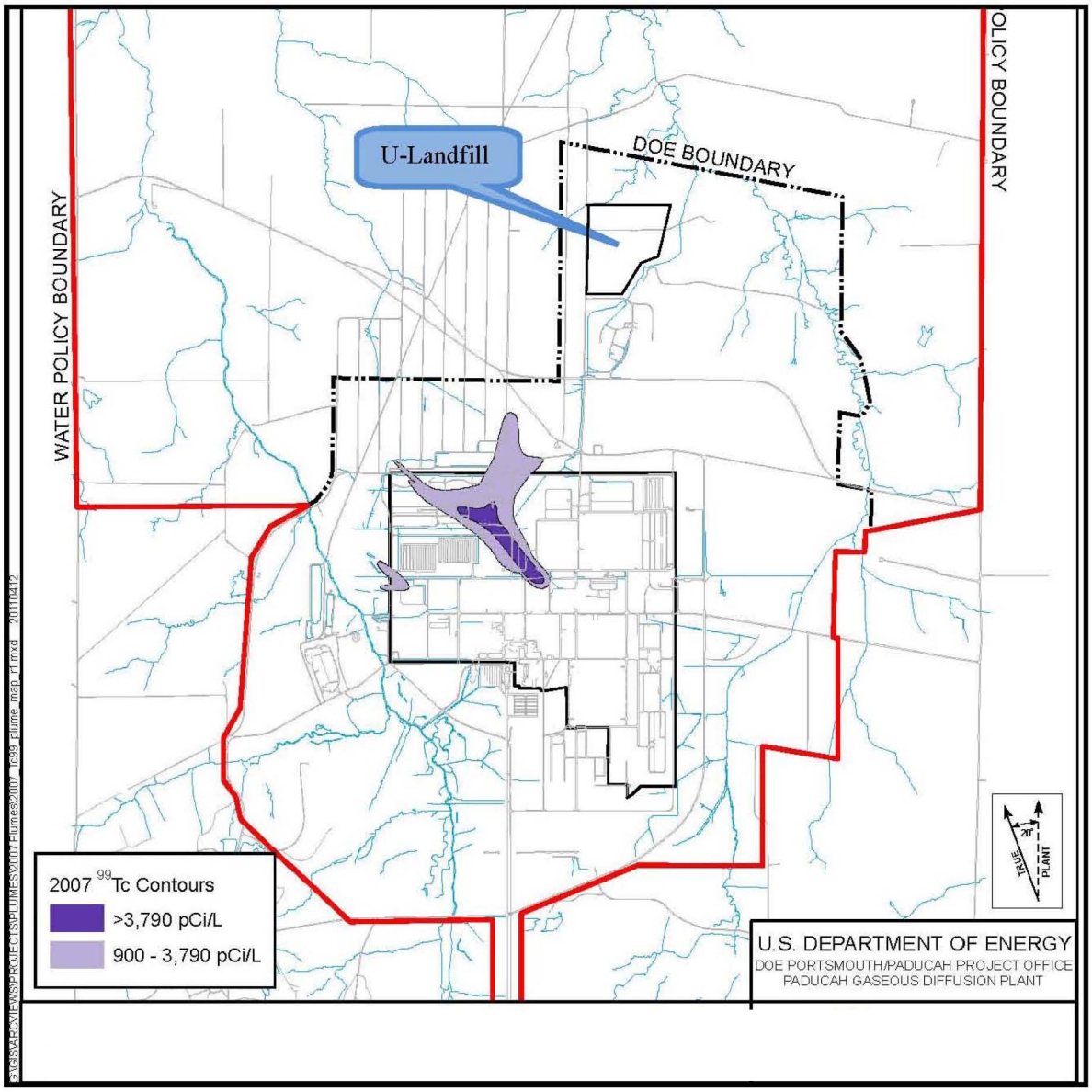

Figure 3. Location of C-746-U Landfill Relative to 2009 Tc-99 RGA Plume Map and Water Policy Boundary

Because Tc-99 can contribute to beta activity and also is measured in pCi/L, Figure 4 shows the Tc-99 plume contours to 100 pCi/L.

Figure 4 shows that the C-746-U Landfill RGA wells are located downgradient of a Tc-99 plume that originates from facilities upgradient of the C-746-U Landfill associated with the industrial area of PGDP. The maximum concentration of beta activity was seen in C-746-U Landfill well MW372 in 2007, a well located upgradient of the C-746-U Landfill.

Figures 5 through 15 show that beta activity is well correlated to Tc-99 in wells located in the vicinity of the C-746-U Landfill. These figures show that beta activity increases as Tc-99 concentrations increase for wells located in the vicinity of the C-746-U Landfill. The beta activity source is shown to be completely explained by the upgradient Tc-99 source. Section 4 presents additional information on what is known about the Tc-99/beta activity source(s) that contributes to the beta activity found in the RGA C-746-U Landfill wells.

3.2 TCE

3.2.1 Physical Properties

TCE is a volatile organic compound used mainly as a solvent in industrial degreasing and for cleaning metals, but it also is used as a solvent for waxes, fats, resins, oils, and in numerous other applications. Prior to 1977, TCE had been used as an anesthetic, grain fumigant, disinfectant, and extractant of spice oleoresins in food and of caffeine in the production of decaffeinated coffee.

PGDP used large volumes of TCE, primarily as a degreasing agent; however, use of TCE at PGDP ceased July 1, 1993, a time that is prior to construction of the C-746-U Landfill.

3.2.2 Mobility of TCE in the Terrestrial Environment

TCE is the primary contaminant in RGA groundwater at PGDP. The C-400 Cleaning Building is the largest source area of TCE contamination to groundwater at PGDP. TCE in the vicinity of the C-746-U Landfill migrates with the groundwater.

3.2.3 TCE Concentrations at C-746-U Landfill

Prior to operation of the C-746-U Landfill, TCE contamination was observed in groundwater samples in the vicinity of the C-746-U Landfill; however, the concentrations in just a few of the wells are occasionally just above the MCL of 5 µg/L. Migration of TCE occurs only in conjunction with migration of groundwater. Plots of TCE data over time for wells with concentrations above the MCL are shown in Appendix B.

3.2.4 TCE at the C-746-U Landfill

Three of the upgradient C-746-U Landfill MWs historically have yielded water with TCE levels greater than the MCL (5 µg/L): MW370 (LRGA) near the southwest corner of the C-746-U Landfill permit area and MW372 (URGA) and MW373 (LRGA) at the southeast corner of the C-746-U Landfill permit area.

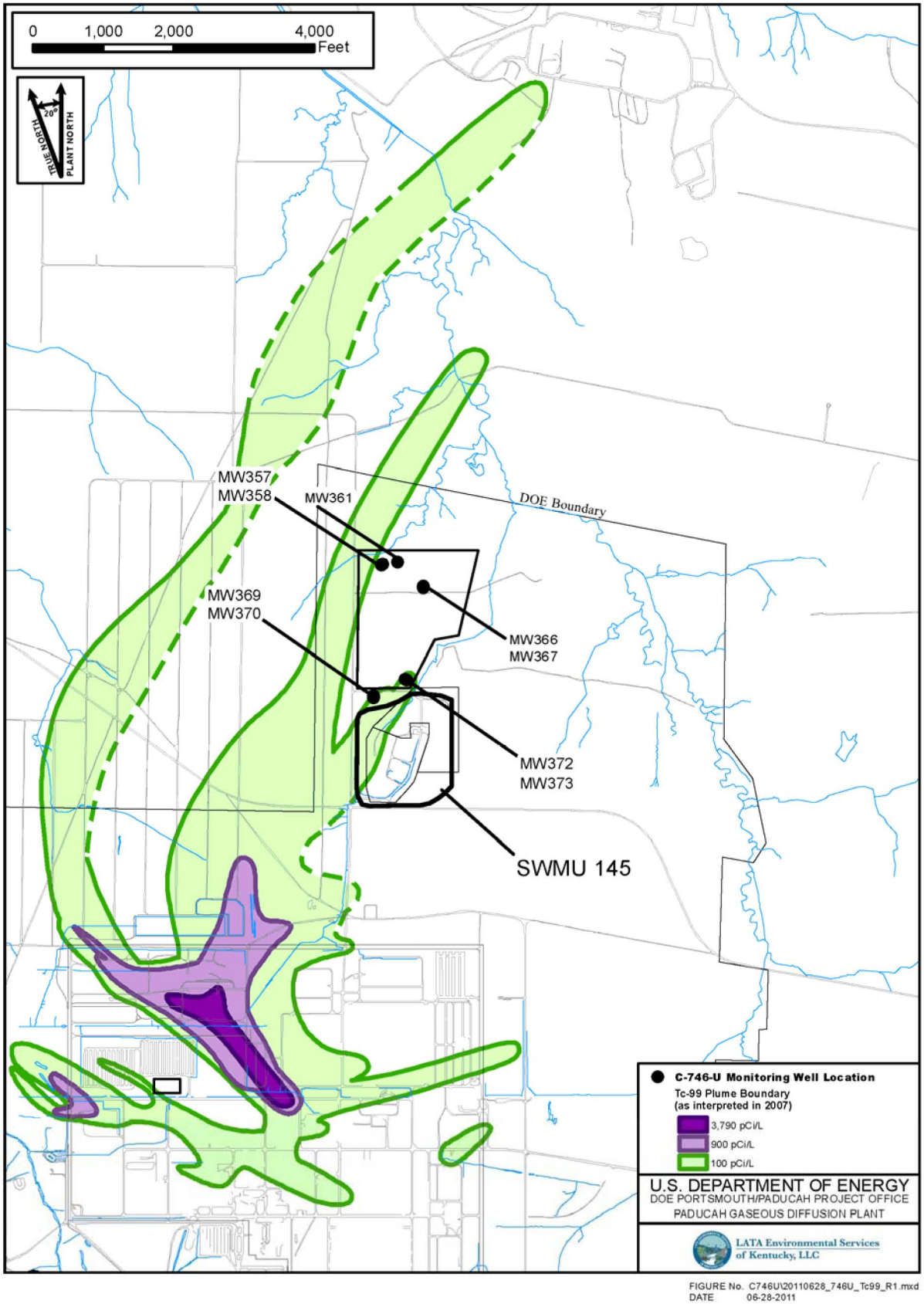

Figure 4. Technetium-99 Contours for the RGA

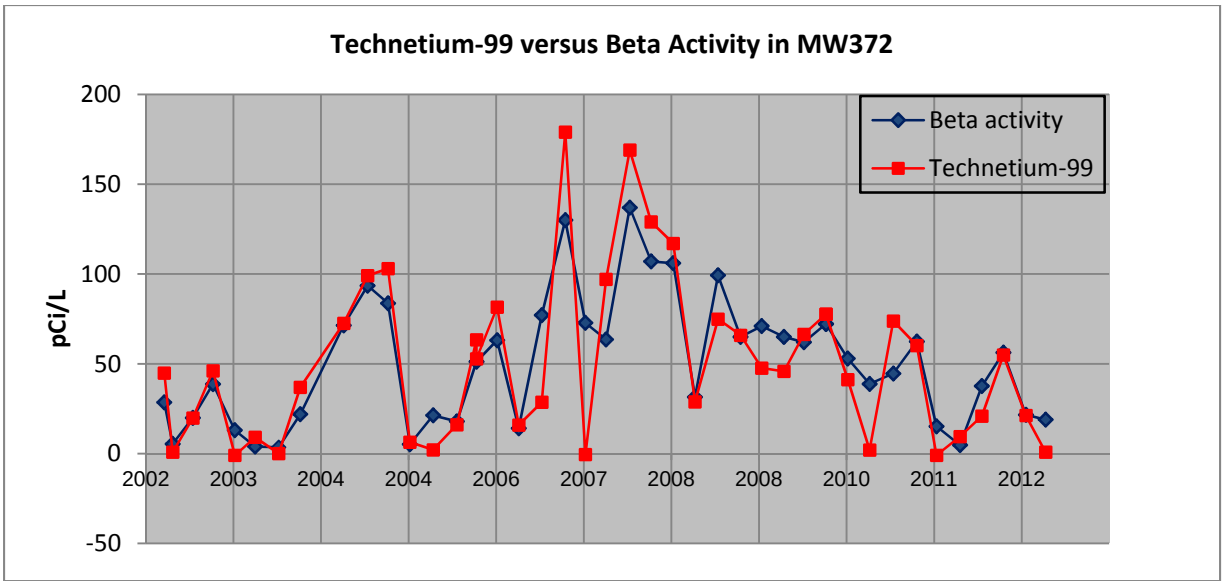

Figure 5. Technetium-99 versus Beta Activity in MW372 at the C-746-U Landfill

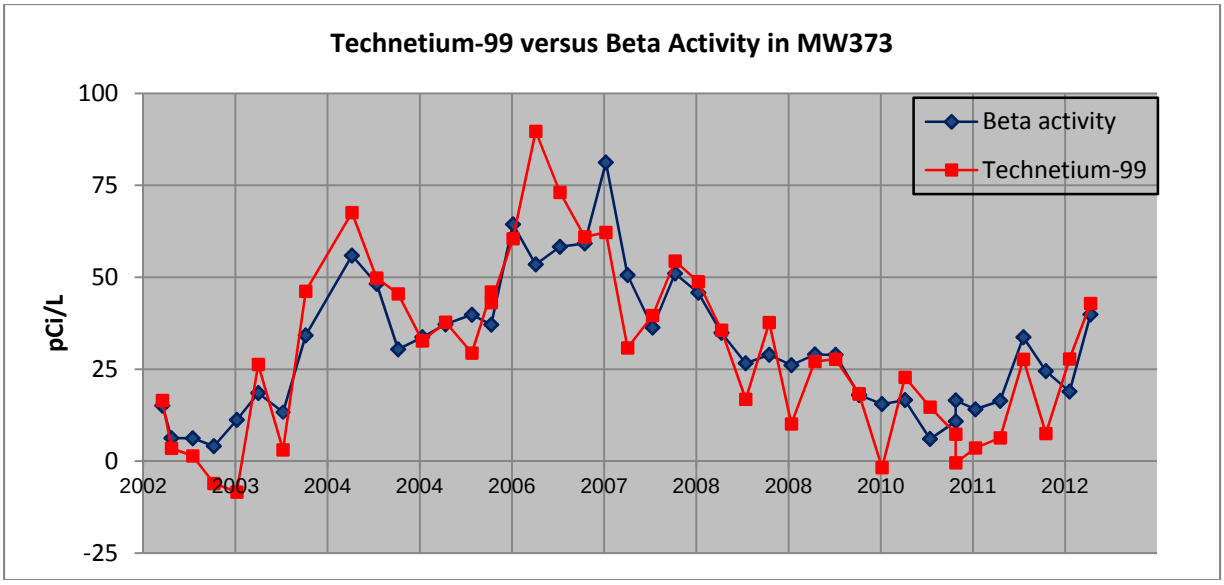

Figure 6. Technetium-99 versus Beta Activity in MW373 at the C-746-U Landfill

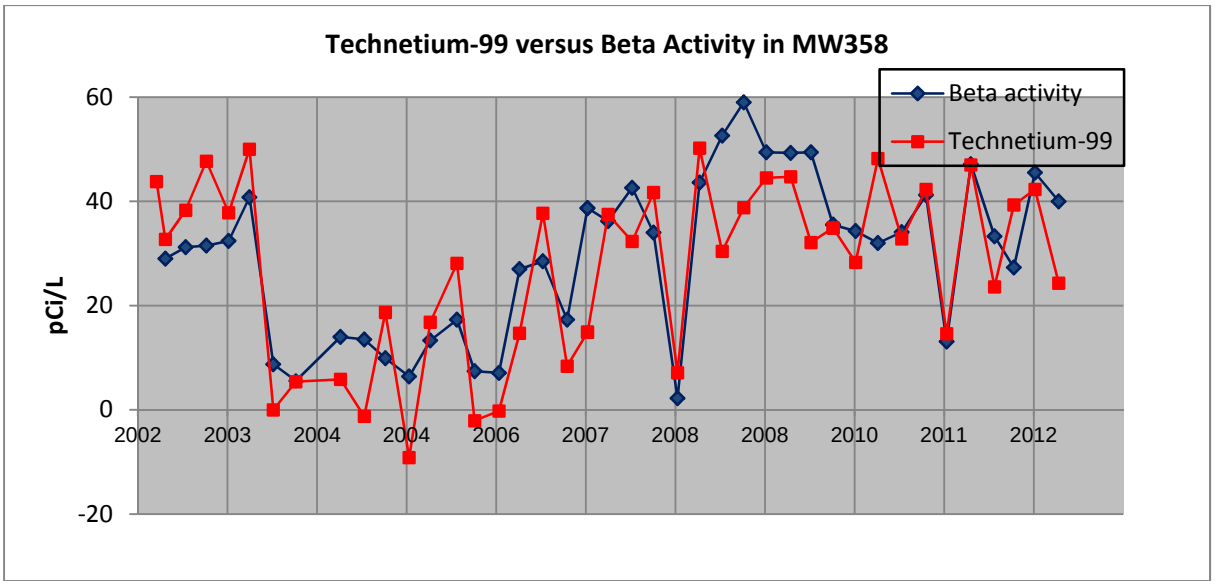

Figure 7. Technetium-99 versus Beta Activity in MW358 at the C-746-U Landfill

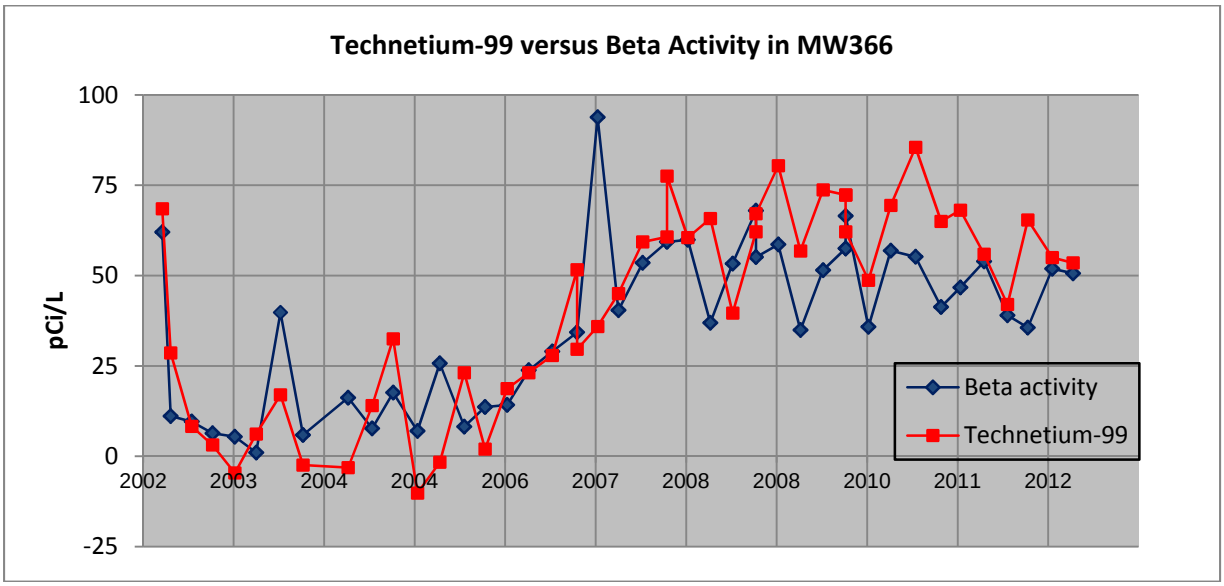

Figure 8. Technetium-99 versus Beta Activity in MW366 at the C-746-U Landfill

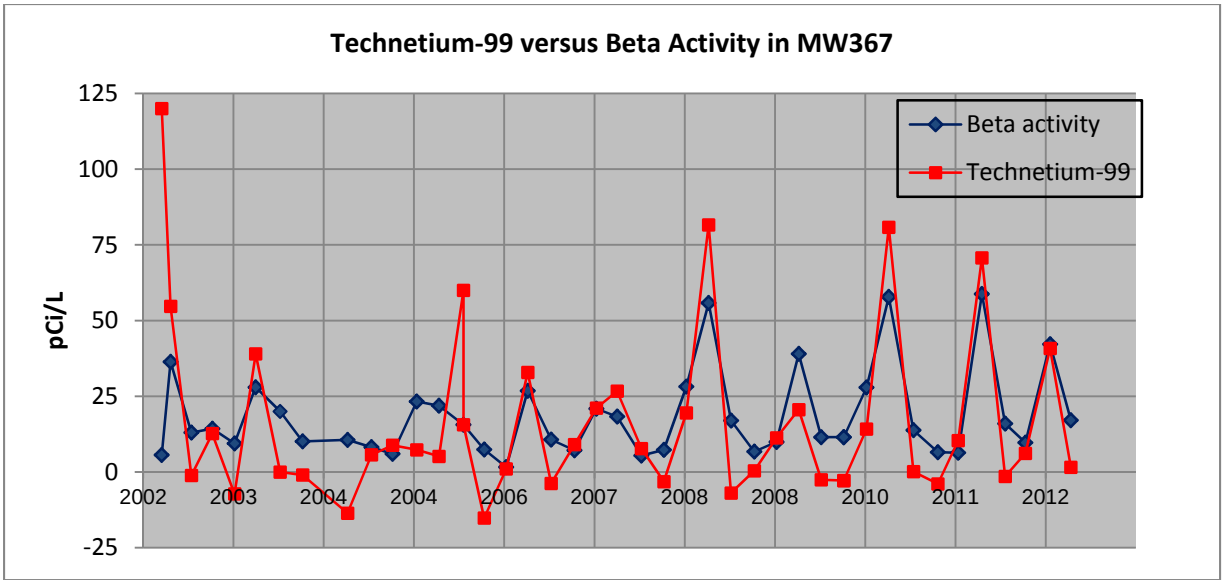

Figure 9. Technetium-99 versus Beta Activity in MW367 at the C-746-U Landfill

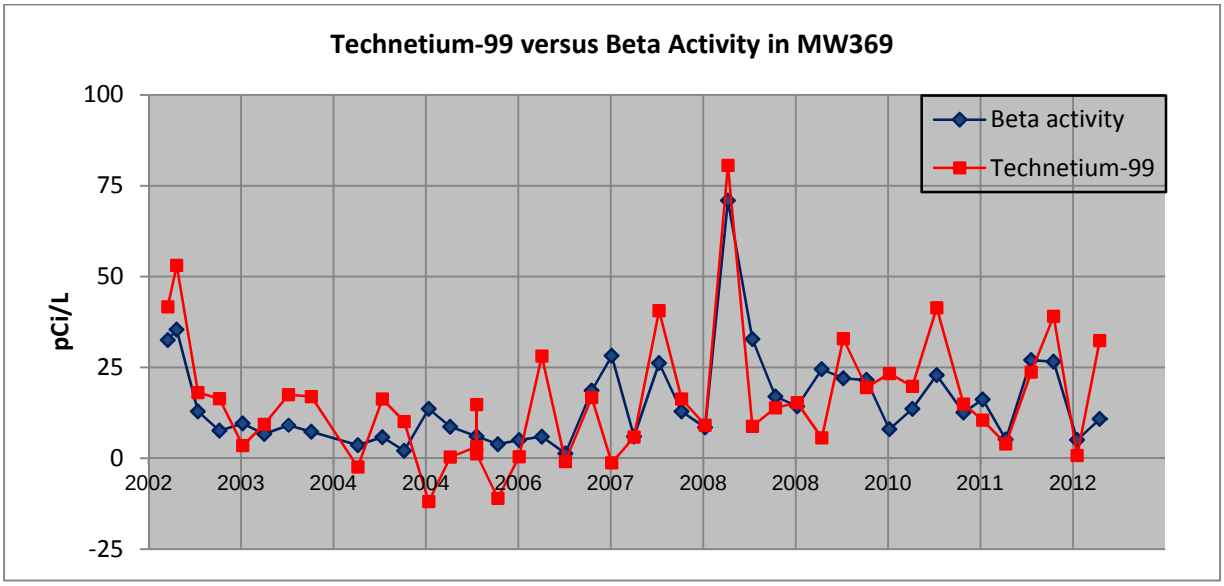

Figure 10. Technetium-99 versus Beta Activity in MW369 at the C-746-U Landfill

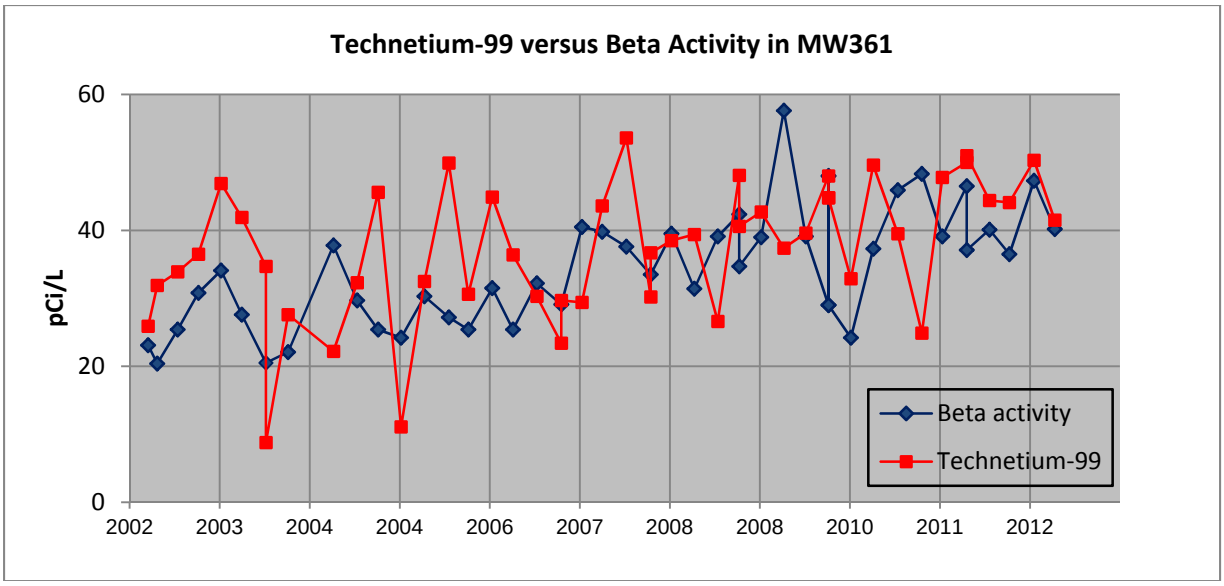

Figure 11. Technetium-99 versus Beta Activity in MW361 at the C-746-U Landfill

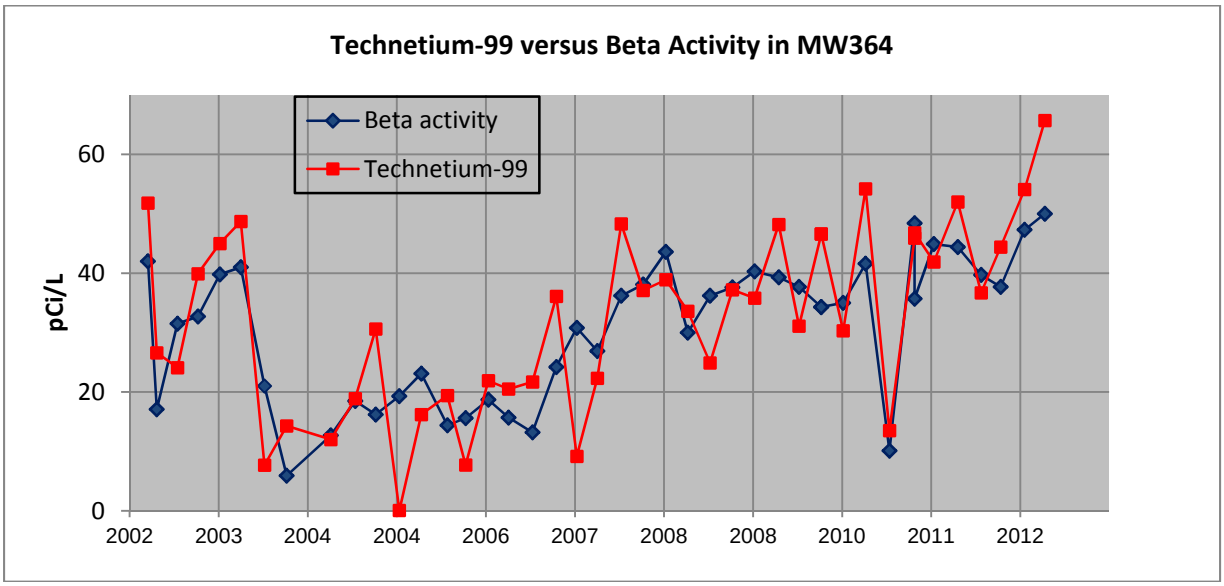

Figure 12. Technetium-99 versus Beta Activity in MW364 at the C-746-U Landfill

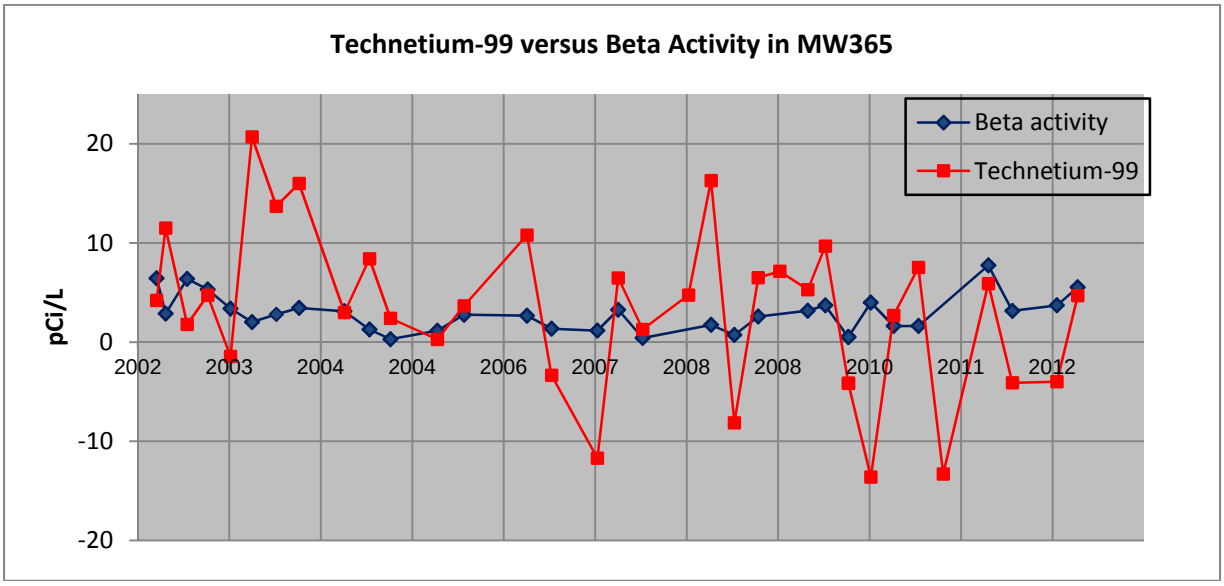

Figure 13. Technetium-99 versus Beta Activity in MW365 at the C-746-U Landfill

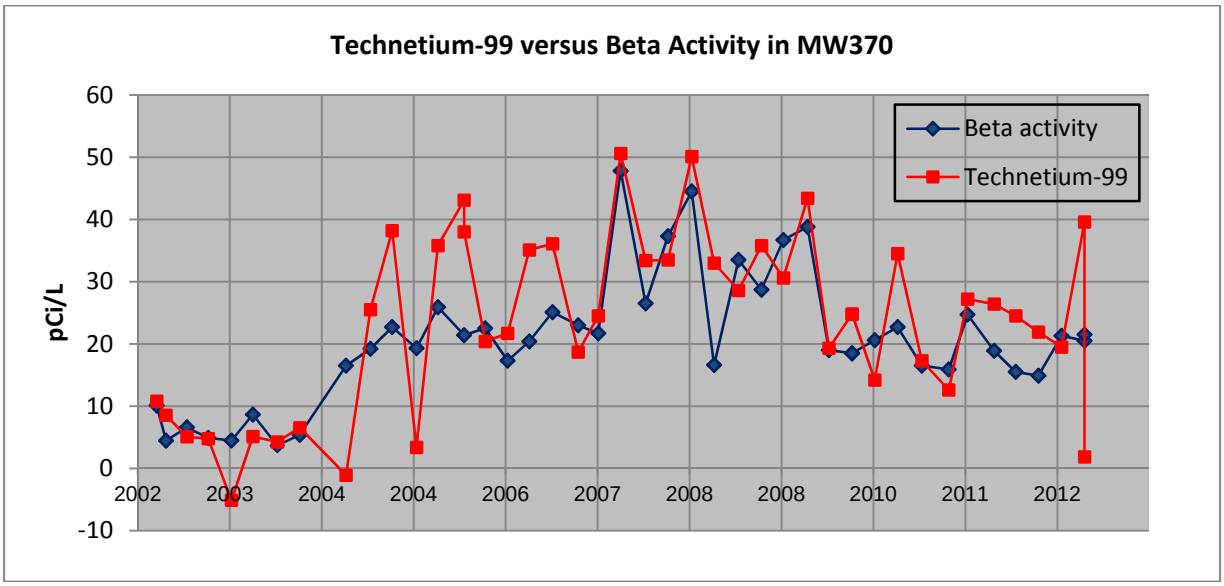

Figure 14. Technetium-99 versus Beta Activity in MW370 at the C-746-U Landfill

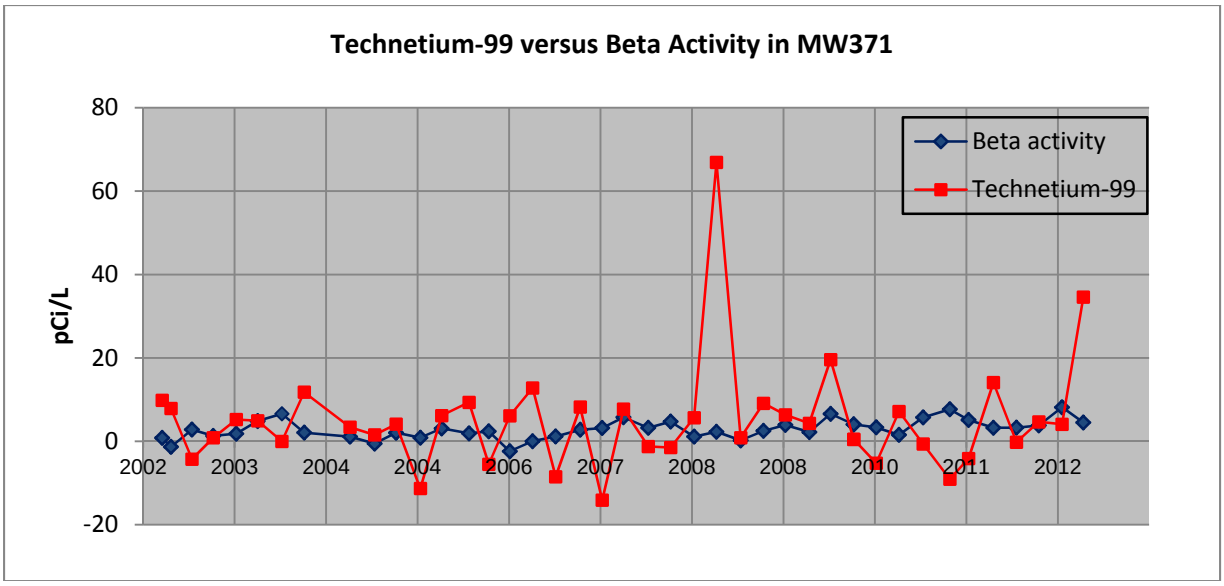

Figure 15. Technetium-99 versus Beta Activity in MW371 at the C-746-U Landfill

TCE levels in MW370 have declined steadily (to 3.2 µg/L, which is below the MCL of 5 µg/L) since the baseline samples of March and April 2002.

Both upgradient MW372 and MW373 have experienced above MCL TCE levels (up to 16 µg/L in MW372 and up to 15 µg/L in MW373) since the samples were collected to establish C-746-U Landfill background concentrations (see Appendix B for trend plots); however, the TCE concentrations in these wells are now generally decreasing. Subsequent compliance and assessment monitoring identified TCE in a well located in the northwestern portion of the landfill, MW357, with concentrations that have recently exceeded the MCL by a small amount. Concentrations in nearby MW358 and MW361 recently have exceeded the MCL. TCE levels in the C-746-U Landfill untreated leachate are less than the detection limit (1 µg/L), as shown in Table B.2.

Based upon the known distribution of TCE located upgradient of the C-746-U Landfill and the lack of detection of TCE in the C-746-U Landfill leachate, TCE concentrations in the C-746-U Landfill RGA wells are apparently the result of upgradient sources, as discussed further in Section 4.

3.2.5 Results of Assessment Actions

TCE is present in groundwater contaminant at PGDP, associated with spills related to past industrial practices and disposal in burial grounds (Figure 16 presents a map of the areas where RGA concentrations of TCE are greater than 5 µg/L). Analyses of untreated leachate of the C-746-U Landfill have not detected TCE.

A 2004 site investigation of the area of the C-746-S&T Landfills (located immediately upgradient of the C-746-U Landfill) identified a small area with TCE levels with a maximum value of 30 µg/L; however, the source(s) of this contamination were not determined, such that the TCE seen in upgradient C-746-U Landfill wells may be the result of multiple potential upgradient RGA TCE sources.

The plots presented in Appendix B document that the existence and extent of TCE contamination in the C-746-U Landfill wells results from migration of upgradient RGA TCE into the C-746-U Landfill area, as discussed further in Section 4.

The detections of TCE in groundwater in wells MW357, MW358, and MW361 are attributable to TCE migration from upgradient or cross-gradient of the C-746-U Landfill as further discussed in Section 4.

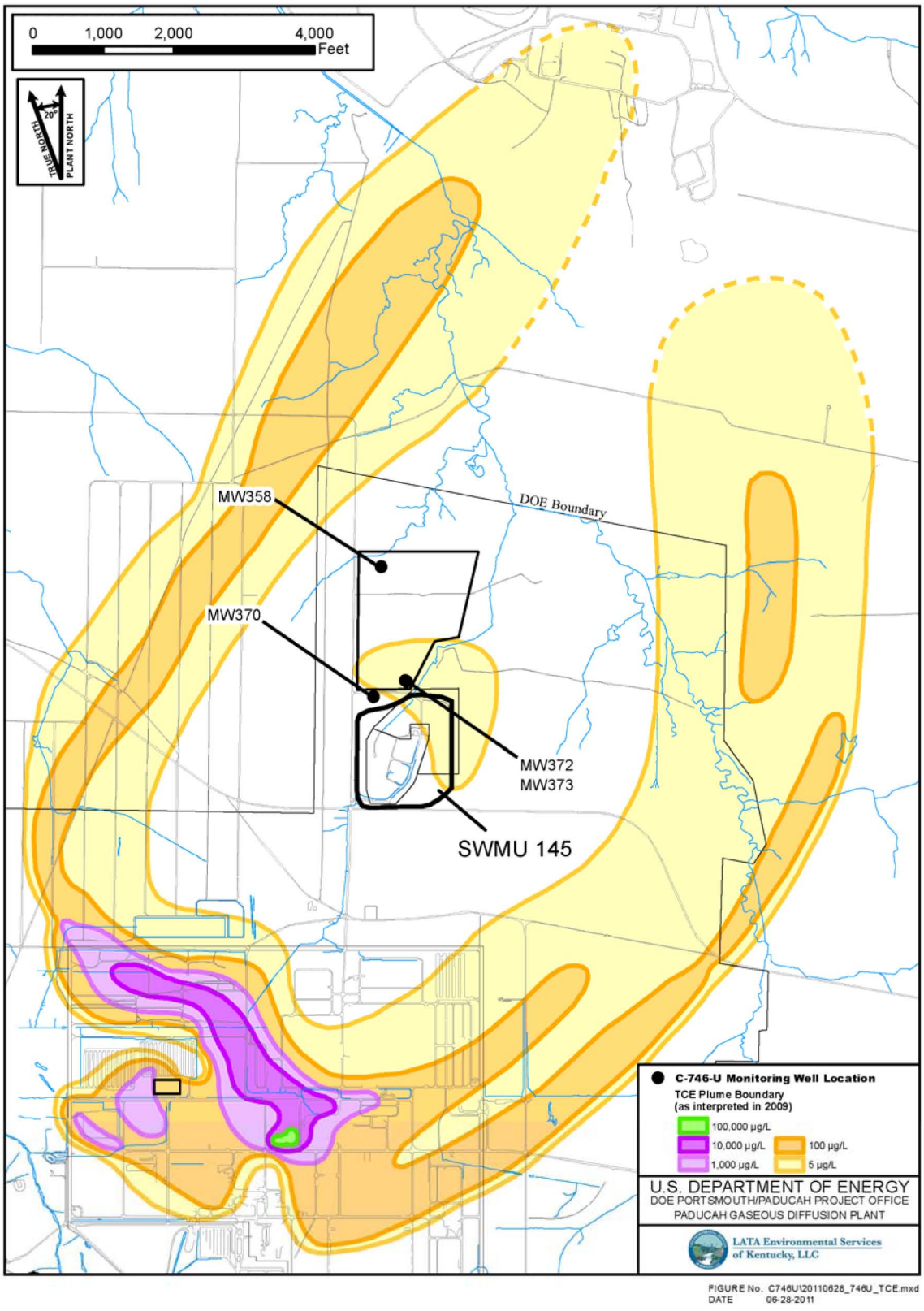

Figure 16. Composite Trichloroethene Contours for the RGA for Calendar Year 2009

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4. ADDITIONAL DISCUSSION OF CONSTITUENTS IN RGA WELL SAMPLES

In accordance with 401 *KAR* 48:300, Section 8, a large number of constituents have been analyzed as part of the groundwater assessment. As noted in the screening section, most of the analyzed constituents are not present above MCLs, RSLs, or above background levels. Constituents that were detected above benchmark concentrations (or approach these levels) have sources that are not related to the C-746-U Landfill. This section presents further discussion on the nature of constituents and their likely sources.

As discussed in Section 3, beta activity and TCE are present in wells located upgradient of the C-746-U Landfill. The presence of these constituents in C-746-U Landfill wells is related to migration of the Tc-99 and TCE from upgradient locations.

As summarized in Tables 1-6 and B.1–B.3, boron, calcium, cobalt, dissolved solids, iron, magnesium, sodium, and sulfate are found more frequently and at higher concentrations in RGA wells located upgradient of the C-746-U Landfill. Figure 17 shows the groundwater monitoring well network for the C-746-S&T Landfills that describes MW372 and MW373 as wells located downgradient of the C-746-S&T Landfills, but upgradient of the C-746-U Landfill. Although groundwater flow direction can be complex in the vicinity of the C-746-U Landfill, the general flow direction in the RGA is to the northeast.

NOTE: Figure 17 is reproduced from the C-746-S&T Landfill Third Quarter report and includes a designation of UCRS wells as "upgradient," sidegradient, and downgradient. As noted earlier, this Groundwater Assessment Report does not consider the characterization of UCRS wells as upgradient/sidegradient/downgradient appropriate, considering the CSM.

As noted in Sections 2 and 3, calcium, conductivity, dissolved solids, magnesium, and sulfate are present at above C-746-U Landfill background for one (or more) C-746-U Landfill upgradient wells (wells located downgradient of the C-746 S&T Landfill); however, none of the constituents present in other RGA wells (upgradient, sidegradient, or downgradient of the C-746-U Landfill) are present above background; thus, there is no C-746-U Landfill source that accounts for the upgradient concentrations and no C-746-S&T source that accounts for them either.

Tables B.1 through B.3 demonstrate that the C-746-U and C-746-S Landfills are not the source of the elevated concentrations discussed above in MW372 and MW373. The following are examples apparent in the review of results:

- The only RGA wells with above C-746-U background concentrations of calcium are MW372 and MW373; calcium concentrations in these wells are more than double the mean value in wells located further upgradient (upgradient of the C-746-S&T Landfill); and the concentrations in other wells located downgradient of the C-746-S&T Landfill do not have above background concentrations of calcium.

- The only RGA wells with above background levels of conductivity are upgradient wells MW372 and MW373; similarly, conductivity levels are more than double the mean for the wells located further upgradient (upgradient of the C-746-S&T Landfill). The concentrations in other wells located downgradient of the C-746-S&T Landfill do not have above C-746-S&T Landfill background conductivity.

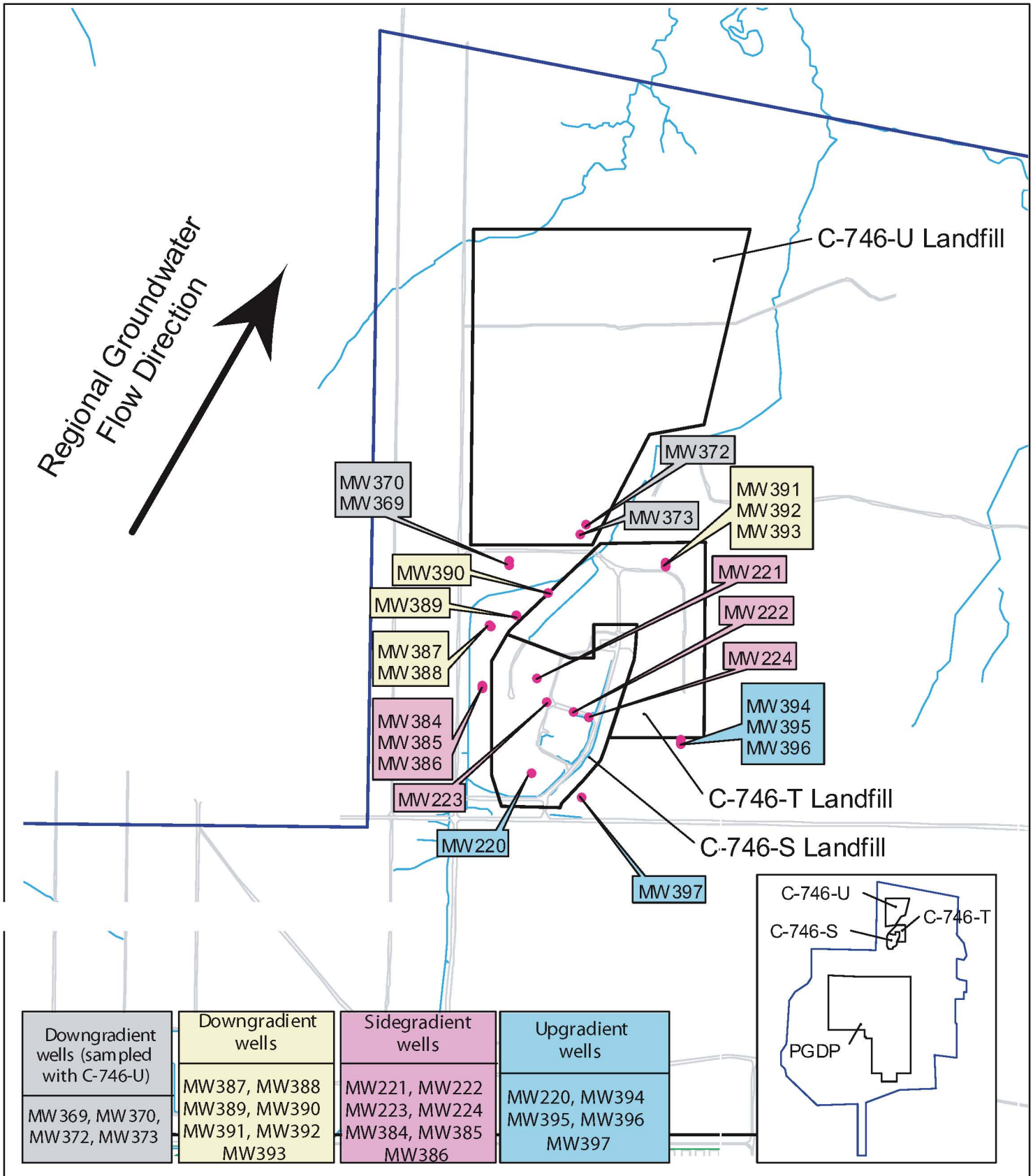

Figure 17. Groundwater Monitoring Well Network for the C-746-S&T Landfills

FIGURE No. c5ac90002sk149.apr
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- The only RGA well with above background concentrations of magnesium is upgradient MW372, with concentrations more than double the mean value for the wells located further upgradient (upgradient of the C-746-S&T Landfill). MW387, a downgradient C-746-S&T Landfill well, has magnesium values above the C-746-S&T background. The concentrations are lower in this well than in MW372 (located downgradient of the C-746-S&T Landfill), but upgradient of the C-746-U Landfill; thus, the source of the magnesium in the MW372 well cannot be pinpointed and is certainly not attributable to the C-746-U Landfill.

- The wells with dissolved solids levels greater than the SMCL of 500 mg/L are upgradient wells MW372 and MW373. MW387, located downgradient of the C-746 S&T Landfill, shows dissolved solids levels above the C-746-S&T background, but the concentration is less than 500 mg/L; thus the concentrations in this well do not allow the source of the dissolved solids in MW372 and MW373 to be pinpointed.

- The only RGA well with above background concentrations of sulfate is MW372; however, MW373 has "background" concentrations greater than the SMCL (as high as 810 mg/L) and averages more than an order of magnitude higher than the other background well completed at the same elevation. If a UCRS or landfill source close to these wells were causing the high sulfate levels, one would expect to find higher concentrations in the upper RGA well (MW372) rather than the lower RGA well (MW373); however, the lower RGA well has the higher concentration of this sulfate in this cluster, which is not consistent with a UCRS or C-746-U Landfill source.

These constituents are not found at levels above background in UCRS wells except for sulfate; and the sulfate concentrations in the UCRS are an order of magnitude (or more) less than the highest concentrations in RGA wells. Thus, the UCRS cannot account for all of the sulfate present in the RGA because concentrations in the UCRS would have to be 58 times higher than the RGA concentrations to account for all the sulfate. Though the UCRS is difficult to monitor, the UCRS and the C-746-U Landfill do not appear to be a statistically quantifiable source of the exceedances or elevated calcium, conductivity, dissolved solids, magnesium, or sulfate because elevated concentrations are not found in the UCRS, and the RGA concentrations downgradient of the C-746-S&T Landfill are generally well-explained, except as discussed herein. Thus, although the upgradient C-746-U Landfill wells MW372 and MW373 have higher than expected RGA concentrations of some constituents, no further upgradient sources of these constituents have been pinpointed. There is no indication of a C-746-S&T Landfill source for the constituents discussed above.

Concentrations of cobalt, iron, and manganese remain above the respective RSL, but the values are not above background. These constituents are not elevated above background in any of the C-746-S&T Landfill RGA wells or the C-746-U Landfill RGA wells; thus these constituents are not indicative of contamination from the C-746-U Landfill.

4.1 DISSOLVED SOLIDS

Dissolved solids concentrations exceed the EPA SMCL only in upgradient well MW373; however, concentrations remain high, especially in MW372 and MW373, the upgradient wells. The source(s) of these high concentrations in upgradient wells is not known. The other downgradient C-746-S&T wells do not have concentrations that exceed the SMCL of 500 mg/L; thus, sources located upgradient of the C-746-U Landfill cannot be pinpointed and cannot account for all of the dissolved solids seen in these C-746-U upgradient wells. With the failure to pinpoint an upgradient source, one possible explanation is well fouling that could result in increased dissolved solids concentrations; however, there is no independent evidence that these wells are fouled.

4.2 MAGNESIUM

Magnesium levels show an above background concentration in upgradient well MW372 (URGA). Magnesium levels are higher in MW373 than in other upgradient wells completed at the same elevation; however, the difference is not statistically significant (as determined by the quarterly C-746-U Landfill monitoring program). Similar to the calcium and dissolved solids results described above, the upgradient source(s) of magnesium, if present, cannot be pinpointed, thus, one possible explanation is well fouling that could result in increased dissolved solids concentrations. However, there is no independent evidence that these wells are fouled.

4.3 MANGANESE

Manganese is not found in RGA wells at above background concentrations, but is found at concentrations above its RSL. The concentrations found in the vicinity of the C-746-U Landfill are within the range of C-746-U Landfill background and also concentrations found elsewhere at PGDP as summarized in Appendix B; thus, there is no evidence of a C-746-U Landfill manganese source.

Manganese is a naturally occurring element that is widely distributed in nature. The most abundant manganese minerals are oxide compounds, followed by sulfides and carbonates. In any water sample, the soluble manganese content will depend on the geochemical characteristics of the soil matrix, environmental transformation of manganese compounds, activity of soil microorganisms, and uptake by plants. Some manganese compounds are soluble in water. The RSL for manganese is 0.032 mg/L. The secondary drinking water standard for manganese is 0.05 mg/L. Gradual weathering and conversion to soluble salts account for most of the manganese content in rivers, seawater, and groundwater. Manganese is a common component of well rehabilitation chemicals.

The influence of oxidation reduction potential (Eh) and pH are very important when considering the movement of manganese in the environment. At low Eh and pH, manganese is more likely to be extracted from a solid phase and kept in solution. At high Eh and pH, manganese is more easily precipitated as an oxide. Chelating agents may complex manganous manganese in solution so extensively that precipitation is inhibited, even under conditions favorable for precipitation. Activity of microbial organisms has been shown only to both dissolve and to precipitate manganese under certain environmental conditions.

Concentrations of manganese in C-746-U Landfill RGA wells vary due to the same conditions that affect other RGA PGDP well concentrations.

4.4 SULFATE

Sulfate is commonly found in air, soil, and water. Sulfate is soluble in water and can be found in variable concentrations in environmental media. It is second to bicarbonate as the major anion in hard water supplies. The most common form of sulfur in well-oxygenated waters is sulfate; the only RGA well with above background concentrations of sulfate is MW372—a well identified as upgradient to the C-746-U Landfill; however, MW373 has “background” concentrations greater than the SMCL (as high as 810 mg/L measured during sampling of this upgradient well during the background sampling program) and the concentrations in MW373, measured during the background sampling program for the C-746-U Landfill average more than an order of magnitude higher than the concentrations in the other background well completed at the same depth.

Similar to other constituents, the higher concentrations of sulfate in MW372 and MW373 cannot be attributed to specific upgradient sources. A possible source of sulfate is as a decomposition product of sulfamic acid historically used to rehabilitate wells; however, these wells have not been rehabilitated using sulfamic acid for more than seven years. Thus, one must consider the possibility that the dissolved solids concentrations may result from well fouling or other impacts that prevent obtaining a sample that is representative of the concentrations of these constituents in the RGA in the vicinity of the C-746-U Landfill.

4.5 PCBS

4.5.1 Physical Properties

PCBs refer to a group of chlorinated organic chemicals that are clear to pale yellow in color; odorless to mildly aromatic; and, depending on the percent of chlorination, can take the form of solids, waxy resins, or viscous oily liquids. PCBs were first synthesized in 1881, but did not become widely used until the 1930s.

Production of PCBs in quantity in the United States began in 1929 and continued until 1977. Total production of all forms of PCBs totals about 700,000 tons.

Today, PCBs are listed as a persistent organic pollutant and are found in the environment worldwide. Known mechanisms of transport include vapor transport in air (wind), precipitation as rain or snow, and transport in water when adsorbed on sediments. PCBs are not known to occur naturally in the environment.

If released into soil, PCBs become tightly adsorbed to the soil particles, with adsorption generally increasing with the degree of chlorination of the PCB. PCBs generally do not leach significantly in aqueous soil systems; when leaching does occur, the higher chlorinated congeners have a lower tendency to leach than the lower chlorinated congeners. In the presence of organic solvents, PCBs may leach quite rapidly through the soil. PCBs have superior physical properties that make them attractive for use in industrial products and processes. These include low flammability, high resistivity, low conductance, and high thermodynamic and chemical stability.

PCBs have a low solubility in water, but are known to be soluble in most organic solvents, oils, and fats.

Intentional methods of destruction of PCBs include incineration with high heat and catalytic processes plus certain chemical processes. Destruction by metabolic organisms and by environmental processes proceeds quite slowly.

Due to their unique physical properties, PCBs have been used in a wide variety of applications. These include hydraulic fluids, lubricants, cutting oils, dielectric fluids for transformers and capacitors, electric power cables, paints, inks, sealants, gasket materials adhesives, plasticizers, fire retardants, asphalt, brake linings, heat transfer systems, pesticide extenders, dedusting agents, carbonless reproductive paper, and a fixative for microscopy.

PGDP equipment that contains PCBs includes transformers and capacitors, electric power cables, asphalt roofing materials, hydraulic fluid, paint, and gaskets.

4.5.2 PCBs at C-746-U Landfill

PCBs that are the subject of this assessment are those that have been detected in three wells, MW361 (LRGA), MW363 (URGA), and MW365 (UCRS). The congeners PCB-1016 and PCB-1242 account for 28 of the 30 detections in these three wells. (PCB-1016 and PCB-1242 are similar, have 12 carbon atoms in the biphenyl skeleton and are composed of 42% chlorine by mass.) Single detections of PCB-1248 in wells MW363 and MW365 account for the other two detections.

All of these wells are located considerably north of active landfill phases (and well downgradient of the C-746-U Landfill in the RGA). The wells with detections are located near an abandoned homestead with an open water well that is 36 inches in diameter and approximately 47-ft deep. The top of the open water well has been covered as a safety precaution.

4.5.3 Results of Assessment Actions

The old, brick-lined homestead water well has been sampled and should be abandoned in accordance with regulatory requirements. This is a UCRS well located well distal to the C-746-U Landfill; thus, results from this well do not identify a C-746-U Landfill source. Nevertheless, analytical results for the water sample are reproduced in Appendix C for completeness. Attempts to obtain sediment samples from the homestead well were unsuccessful. The sampling attempts indicate a hard bottom to the well with insufficient sediment to obtain a sample. Appendix E describes the soil sampling event conducted in the vicinity of MW365 that did not identify any PCBs in soils.

4.6 PCB, TOTAL

PCBs (congeners PCB-1016 and PCB-1242) were detected in groundwater of MW366 at levels less than 0.001 mg/L in July 2003, October 2006, and July 2007. As with other C-746-U Landfill MWs, the source of the PCBs appears to be cross contamination associated with well rehabilitation activities. The first well rehabilitation action in MW366 was in April 2003. See Appendix E for further assessment of the source of PCBs in the C-746-U Landfill MWs.

4.7 TOTAL ORGANIC CARBON

EPA defines TOC in terms of mg/L of the amount of carbon that can be converted to carbon dioxide. TOC concentrations are lower than historical background levels; thus, there is no indication of any current above background sources of TOC. TOC concentrations are consistent with those found in RGA wells at PGDP; thus, they do not indicate any incremental contribution to concentrations from the C-746-U Landfill.

4.8 DISCUSSION OF LANDFILL SOURCES

Appendix B provides a review of the concentrations of constituents found in wells located in the vicinity of the C-746-U Landfill, compared to concentrations of constituents found in the C-746-U Landfill leachate. If the C-746-U Landfill had impacts on the RGA groundwater, one principal mechanism would be via migration of the landfill leachate. As shown in that table, there is no “fingerprint” that can be associated with the C-746-U Landfill leachate. Leachate concentrations of many constituents typically are the same order of magnitude as the mean concentrations found in RGA wells at PGDP.

Overall, none of the constituents present in leachate is found at a concentration that accounts for more than a fraction of the concentration of the RGA constituents because the dilution attenuation factor (DAF) estimated for native UCRS materials at PGDP is 58, and the DAF for a lined landfill (like the C-746-U Landfill) is expected to be orders of magnitude higher (DOE 2013, Attachment C2).

Constituents present in the UCRS have the potential to migrate to the RGA. This migration will be attenuated based upon the nature of the materials through which the migration is occurring. For example, migration through a clay matrix will be slower than through a sandy matrix. Modeling performed at PGDP has estimated the attenuation factor at 58 (UCRS concentrations are attenuated by a factor of 58 as the constituent migrates to the RGA). A landfill liner would attenuate the leachate better than the native clay, silt, and sand materials present in the UCRS. For the constituents present in leachate to account for the concentrations found in the RGA, the leachate concentrations would have to be orders of magnitude higher than they are. Thus, the C-746-U Landfill is not the source of the RGA groundwater constituents found in wells in the vicinity of the C-746-U Landfill.

Similarly, concentrations of constituents in the C-746-S leachate are the same order of magnitude as the C-746-U Landfill and the concentrations found in the RGA. Thus, there is no statistically quantifiable information supporting that leachate from the C-746-S Landfill is a source of the RGA groundwater constituents found in wells in the vicinity of the C-746-U Landfill.

There are other potential mechanisms for RGA groundwater to be affected by C-746-U Landfill operations, including migration of landfill gas, spills outside lined landfill areas, and interactions between landfill gas/leachate with native materials. However, the RGA results from the RGA wells do not indicate statistically quantifiable contributions to RGA wells from such C-746-U Landfill operations. Furthermore, it is unlikely that major impacts to RGA groundwater could occur without detection, as follows:

- Direct RGA groundwater contamination by landfill gas without impacts on landfill leachate concentrations would be unlikely because landfill gas is generated in the landfill cells where leachate is also generated. While leachate will flow downward under gravity, landfill gas will expand in all directions. It is unlikely that landfill gas can be so contaminated as to affect the RGA groundwater without it also being detected in the landfill leachate.

- Spills outside the lined area would have to be very large for constituents to migrate through the UCRS and impact the RGA groundwater, given the DAF of the UCRS at 58. Thus, it is unlikely that a large spill could have occurred without being detected. There is no indication of RGA impacts from the C-746-U from any source, including impacts that reasonably could be attributable to spills outside the lined area.

- Landfill gas and leachate can interact with groundwater and aquifer materials to liberate constituents present in native materials; however, there is no indication of RGA impacts from the C-746-U Landfill from any source, including impacts that reasonably could be attributable to impacts of landfill gas/leachate on native materials that are also not detectable in leachate. In addition, even if there are impacts on UCRS matrix materials by landfill gas/leachate, it is unlikely that these impacts would be seen in RGA groundwater due to the significant buffering capacity of the native UCRS materials.

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5. HYDROGEOLOGIC SETTING

PGDP lies in the Jackson Purchase Region of western Kentucky between the Tennessee and Mississippi Rivers, and is bounded on the north by the Ohio River. The confluence of the Ohio and Mississippi Rivers is approximately 35 miles downstream (southwest) from the site, and the confluence of the Ohio and Tennessee Rivers is approximately 15 miles upstream (east) from the site. PGDP is located approximately 3.5 miles south of the Ohio River and 10 miles west of the city of Paducah. Regional groundwater flow discharges to the main surface water features. In the PGDP area, the groundwater systems discharge to Bayou Creek and Little Bayou Creek, perennial watershed streams, and to the Ohio River.

PGDP is located in the northern tip of the Mississippi Embayment portion of the Coastal Plain physiographic province. The Mississippi Embayment is a large north-south tectonic and erosional trough filled with unconsolidated sediments derived from the middle of the North American continent. In the region, the stratigraphic sequence consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock.

5.1 PHYSICAL CHARACTERISTICS OF THE AREA

Locally, PGDP lies within the drainage areas of the Ohio River, Bayou Creek, and Little Bayou Creek. The plant is situated on the divide between the two creeks. Surface flow is east-northeast toward Little Bayou Creek and west-northwest toward Bayou Creek.

Local elevations range from 290 ft above mean sea level (amsl) along the Ohio River to 450 ft amsl in the southwestern portion of PGDP near Bethel Church Road. Generally, the topography in the PGDP area slopes toward the Ohio River at an approximate 27 ft per mile (ft/mile) gradient. The terrain in the vicinity of the plant is slightly modified by the dendritic drainage systems associated with the two principal streams in the area, Bayou Creek and Little Bayou Creek. These streams have eroded small valleys, which are about 20 ft below the adjacent plain.

5.2 GENERAL GEOLOGY

In the immediate vicinity of PGDP, Coastal Plain deposits unconformably overlie Mississippian carbonate bedrock. The full Coastal Plain stratigraphic sequence to the south of PGDP consists of the following units: sands and clays of the Clayton/McNairy Formations; the Porters Creek Clay; and Eocene sand and clay deposits (undivided Jackson, Claiborne, and Wilcox Formations). Continental Deposits unconformably overlie the Coastal Plain deposits, which are, in turn, covered by loess and/or alluvium. Both the loess and alluvium are composed of clayey silt and silty clay.

In the central and northern part of the PGDP site, including the area of the C-746-U Landfill, the lowermost Coastal Plain sediments are composed of unconsolidated, interbedded, fine-grained sand, silt and clay of the Upper Cretaceous-aged McNairy Formation (SAIC 1994; Woolery and Street 2002). The thickness of the McNairy Formation ranges from 221 to 247 ft.

A principal geologic feature in the PGDP area is the Porters Creek Clay Terrace, a subsurface terrace cut that trends approximately east to west across the southern portion of the plant. The Porters Creek Clay Terrace represents the southern limit of erosion or scouring of the ancestral Tennessee River. In the area

north of the subsurface terrace cut, including the C-746-U Landfill, Continental Deposits directly overlie the McNairy Formation.

The Continental Deposits resemble a large, low-gradient alluvial fan that covered much of the region and buried the erosional topography. Thicker sequences of Continental Deposits, as found underlying PGDP, represent valley fill deposits and can be divided informally into a lower unit (gravel facies) and an upper unit (silt facies). The Lower Continental Deposit (LCD) is a Pliocene (?)[4] to Pleistocene-aged gravel facies consisting of fine to coarse chert gravel in a matrix of very fine to medium sand and silt that rests on an erosional surface representing the beginning of the valley fill sequence. In total, the gravel units average approximately 30-ft thick, but some thicker deposits (as much as 50 ft) exist in deeper scour channels. The LCD is stratigraphically equivalent to the Mounds Gravel as designated by the Illinois Geological Survey (IGS) or the Lafayette Formation (Lafayette gravel) in other parts of the region (Sexton 2006) (Langston and Street 1998).

The alluvial gravels and sands of the LCD are overlaid by Late-Tertiary through Quaternary and Holocene aged sediments including the Plio-Pleistocene Metropolis Formation and Pleistocene loess units. These deposits are cumulatively identified as Upper Continental Deposits (UCD) and range between 30- and 60-ft thick beneath the PGDP site. Investigations conducted at PGDP and the C-746-U Landfill identified at least four separate loess depositional events in the site's stratigraphic sequence (KRCEE 2006).

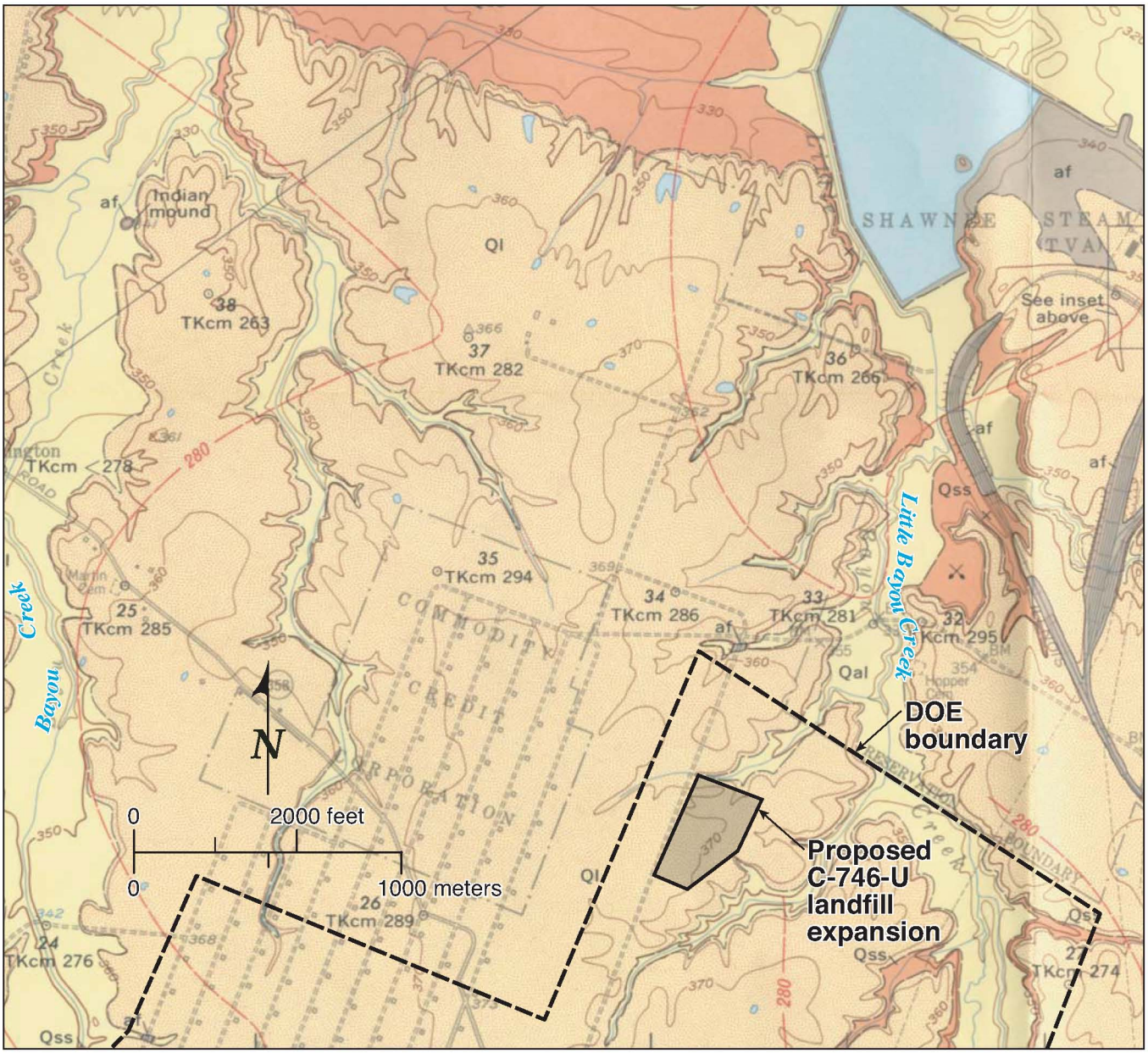
Subregional studies (McHaffie1983; Nelson et al. 1996; Kiefer 1996; Drahovzal and Hendricks 1997; SAIC 1994) and local studies in the vicinity of PGDP (Langston and Street 1996; Anderson-Blitz 2008) indicate that paleo-tectonic activity has impacted local bedrock and overlying unconsolidated strata upward through the Plio(?)-Pleistocene (late Quaternary) boundary (Langston and Street 1996; Anderson-Blitz 2008). Specifically within the area of the C-746-U Landfill, studies have shown that tectonic activities may have impacted bedrock up through the Pliocene-Late Quaternary Continental Deposits (KRCEE 2006; DOE 2003). These studies report that tectonic activities have not affected the most recent loess units (Late Quaternary-Holocene) and surficial soils in the area.

5.3 SUBSURFACE GEOLOGY AT THE C-746-U LANDFILL

The Holocene Fault Study provides information on the geologic setting in the vicinity of the C-746-U Landfill (KRCEE 2006). Figure 18 is a reproduction of Figure 5 from the Holocene Fault Study that describes the regional geologic map in the vicinity of the C-746-U Landfill. This figure is reproduced without editing to provide context for the discussion of the regional geology. Features marked on the figure may not be representative of current conditions. Figure 19 reproduces Figure 6 from the study that provides a schematic stratigraphic column. Figure 20 reproduces Figure 7 from the study that provides a geologic fault study. Figure 21 provides a copy of the relevant portion of Plate 1 from that study that provides the section location.

The area lithologic logs document that the LCD gravels directly overlie the McNairy Formation beneath the C-746-U Landfill on an erosional surface that occurs at depths of 70 to 86 ft beneath the C-746-U Landfill (elevations of 285 ft to 300 ft amsl). These LCD gravels vary from 29- to 39-ft thick. The depth of the top of the LCD gravels ranges from 42 to 52 ft below the ground surface (bgs). The LCD gravels, in turn, are overlaid by 42 to 52 ft of silts, sands, and clays of the UCD (including the Metropolis Formation and Pleistocene loess units).

[4] (?) Indicates uncertainty in the age of the geologic unit.



Explanation

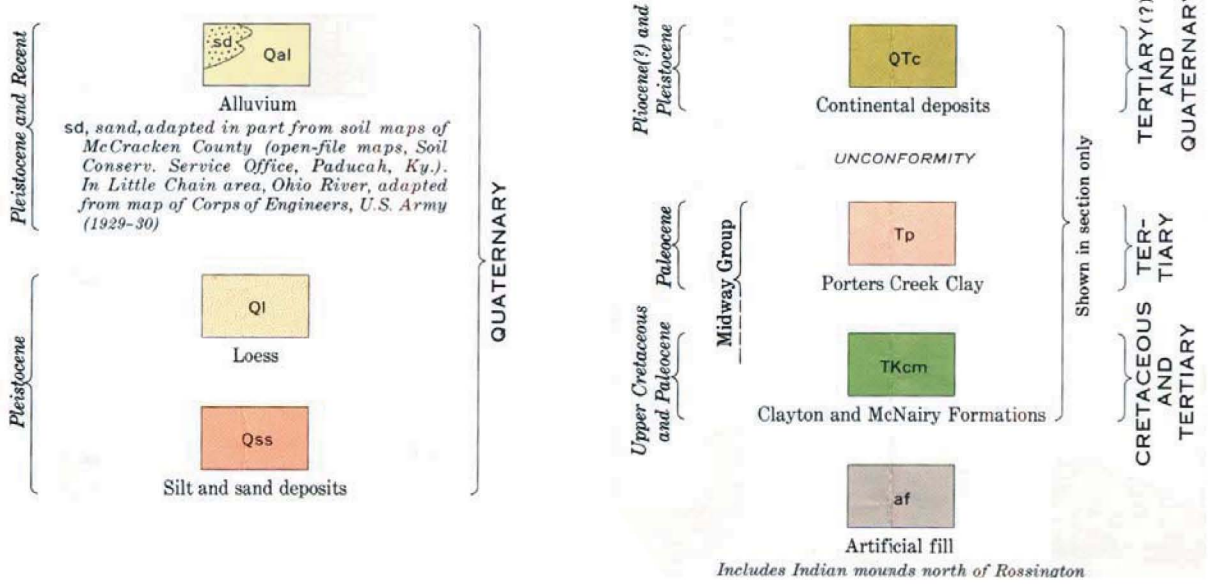


Figure 18. Regional Geologic Map (Modified from Finch 1967)

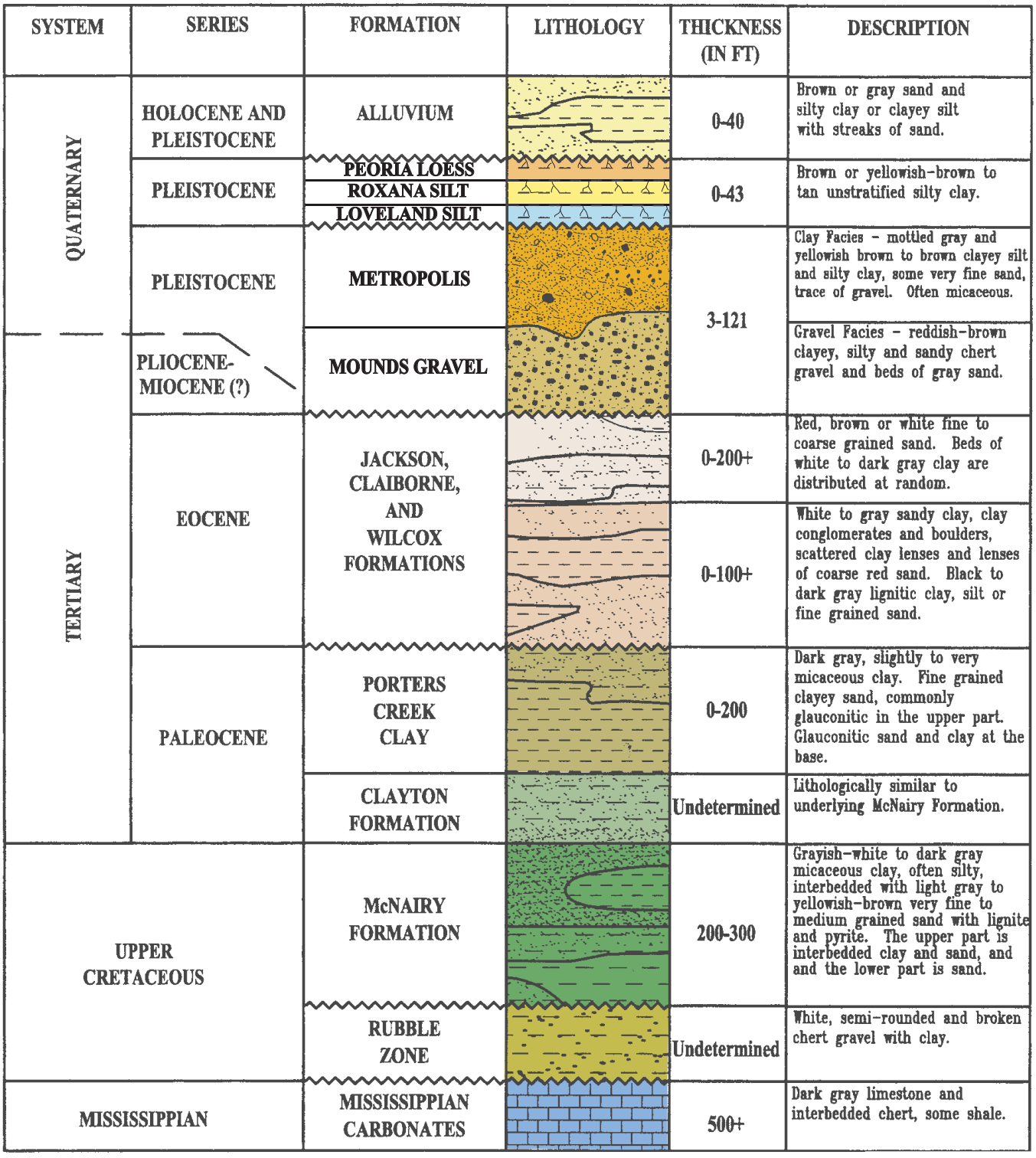


Figure 19. Schematic Stratigraphic Column of the PGDP Region

(Modified from Nelson et al. 2002 and SAIC 2004)

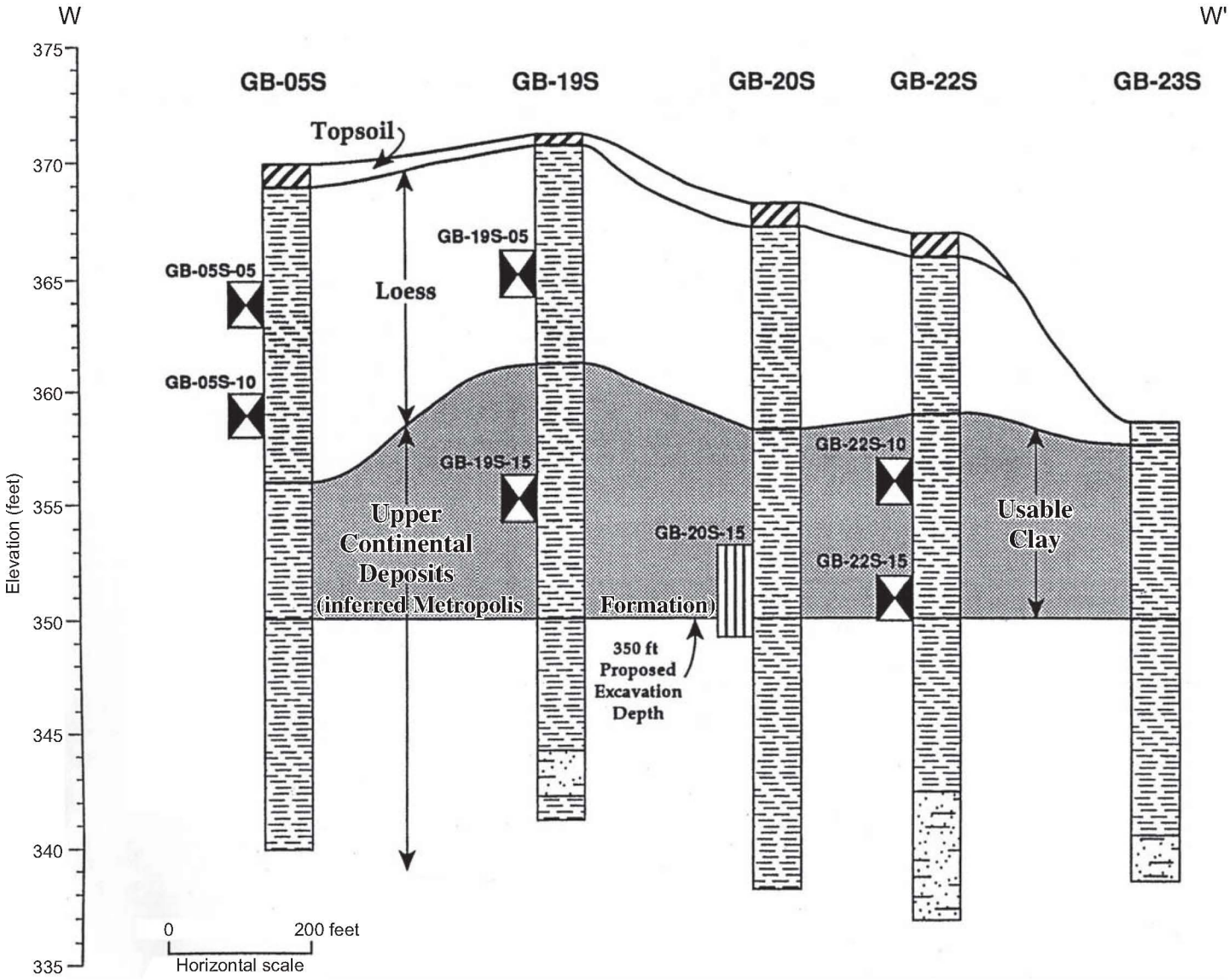


Figure 20. Geologic Section Depicting Generalized Stratigraphy Underlying C-764-U Landfill (from SAIC 1994)

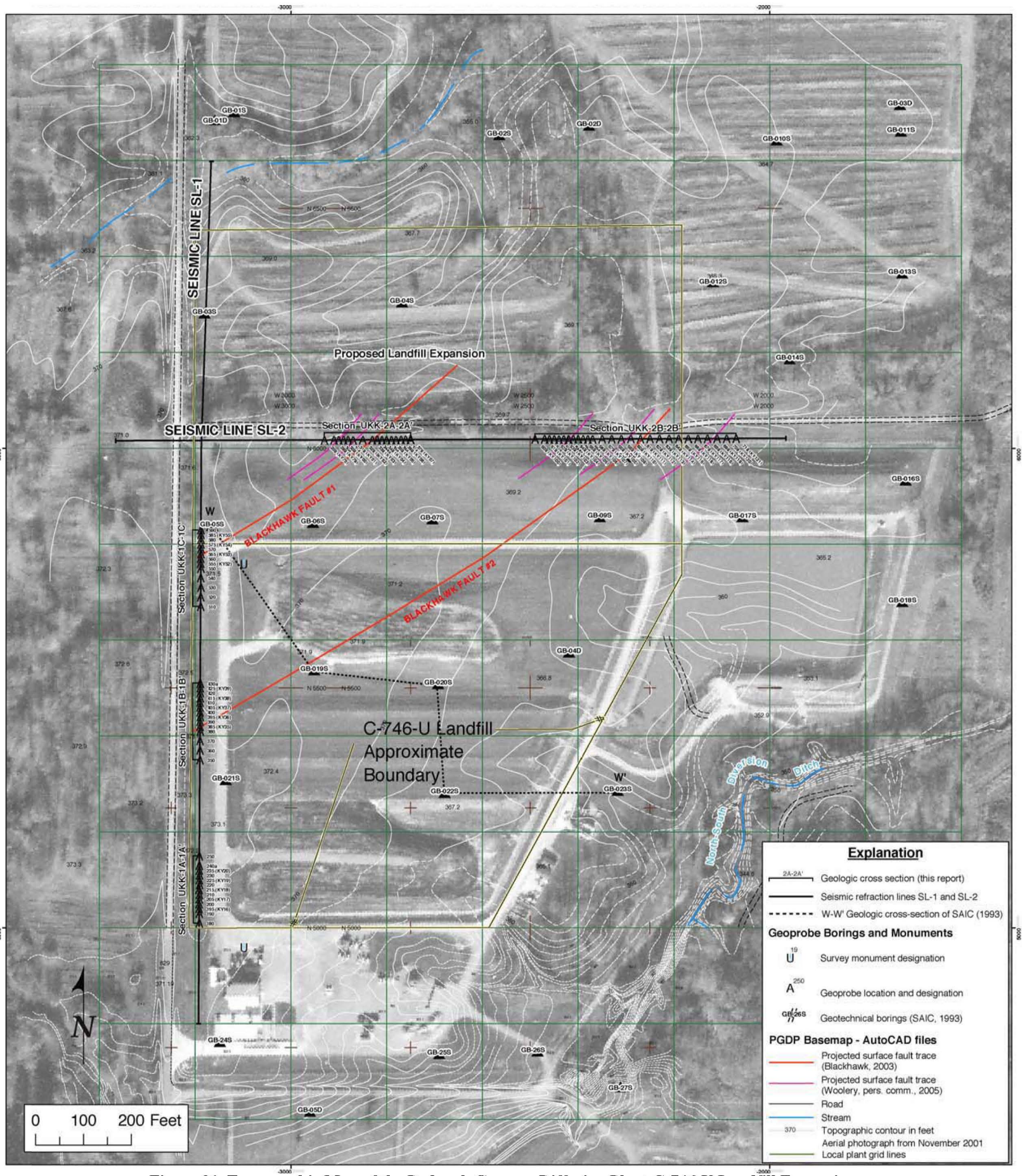


Figure 21. Topographic Map of the Paducah Gaseous Diffusion Plant C-746-U Landfill Expansion

5.4 HYDROGEOLOGY AT PGDP AND THE C-746-U LANDFILL

At PGDP, the unconsolidated sediments overlying the McNairy Formation have been divided into two primary hydrogeologic units, the UCRS and the RGA. In these divisions, the UCRS includes most of the Plio-Pleistocene Metropolis Formation and the Pleistocene loess packages. The RGA hydrogeologic unit consists of a basal sand (where present) of the Metropolis Formation and the gravels and sands of the Lower Continental Deposits. The McNairy Formation underlies the RGA and functions as a bottom aquitard to the RGA throughout the central and northern parts of the PGDP area.

Flow through the UCRS is downward into the RGA. Flow in the RGA is lateral beneath the landfill, toward the north-northeast. RGA groundwater flow from the C-746-U Landfill area ultimately discharges into the lower reaches of Bayou and Little Bayou Creeks and the Ohio River.

The lithologic and well construction logs for MW cluster MW371 (UCRS), MW369 (upper RGA), and MW370 (lower RGA) document the placement of MWs south/upgradient of the C-746-U Landfill and north/downgradient of the present North-South Diversion Ditch (see Figure 2 and Appendix G). At this location, the UCRS consists of a loess sequence, which extends to 19 ft bgs, and silts and fine sands of the Metropolis Formation, that extend to 43 ft bgs. The RGA in this well cluster consists of an upper, sandier member that extends to 54 ft bgs and a lower gravel-dominant member that extends to 76 ft bgs, the erosional surface in the top of the McNairy Formation. The UCRS well, MW371, is screened in a sand unit of the Metropolis Formation; MW369 is screened in the upper, sandier member of the RGA; and MW370 is screened in the lower, gravel-rich member of the RGA.

The logs of MW cluster MW359 (UCRS), MW357 (upper RGA) and MW358 (lower RGA) provide an example of the placement of MWs north/downgradient of the C-746-U Landfill. At this location, the UCRS consists of a loess package that extends to 28 ft bgs and clays and fine sands of the Metropolis Formation that extend to 45 ft bgs. The RGA in this downgradient well cluster consists of an upper sandier member that extends to 55 ft bgs and a lower gravel-dominant member that extends to 84 ft bgs, to the top of the McNairy Formation. (The RGA is 6 ft thicker in the north well cluster.) As in the downgradient well cluster, the UCRS well, MW359, is screened in sand units of the Metropolis Formation; MW357 is screened in sands and gravels of the upper RGA; and MW358 is screened in the lower, gravel-rich member of the RGA.

The logs of Appendix G document the lateral continuity of the primary hydrogeologic units beneath the C-746-U Landfill and consistency in the placement of the MWs.

5.5 CONCEPTUAL SITE MODEL

Soil boring logs, MW and piezometer water level records, soil geotechnical tests, and groundwater flow models of the area of the C-746-U Landfill provide sufficient data for the development of a CSM. In general, groundwater flow is downward through the silts, clays, and fine sands of the UCRS. In contrast, the underlying RGA is highly conductive and provides the main conduit for lateral groundwater flow. Groundwater flow is in a north-northeasterly direction in the vicinity of the C-746-U Landfill. The Ohio River and lower reaches of Little Bayou and Bayou Creeks are the discharge areas for the RGA flow system.

The fine sands, silts, and clays of the upper McNairy Formation in the C-746-U Landfill area have much lower hydraulic conductivity than the gravels and sands of the RGA. Given the slight downward vertical gradient that exists across the contact between the two units, there is little groundwater flow into the McNairy Formation.

The collective information about the units underlying the C-746-U Landfill provides the following conceptual model:

- Waste materials placed in the C-746-U Landfill can be a source of contamination to the landfill leachate. The landfill is designed to collect and treat generated leachate.

- Because water flows downward through the UCRS, the presence of contaminants in UCRS groundwater are related to sources in the immediate vicinity of the well, including soils located above the well screen.

- Naturally-occurring minerals in loess and the Metropolis Formation can be sources of elements and compounds in UCRS water well samples.

- Contaminants found in groundwater from RGA MWs of the C-746-U Landfill can have sources upgradient of the landfill. Potential sources upgradient of the C-746-U Landfill complex include these:

  - Infiltration from the North-South Diversion Ditch,
  - Migration through the RGA from upgradient/PGDP (primarily TCE and Tc-99), and
  - Other PGDP facilities, such as the C-616 lagoons.

6. ENHANCED SAMPLING OF EXISTING WELLS

The presence of PCBs detected in C-746-U Landfill MWs led to enhanced sampling at PGDP to evaluate potential impacts by PCBs on the RGA sitewide as shown in Figure 22.

6.1 EXISTING WELLS

In order to monitor groundwater quality, 35 MWs are sampled annually for geochemical environmental surveillance. Sampling of these wells is not driven by regulation, but is conducted in support of the Federal Facility Agreement investigations and DOE Order 450.1. In September and October 2008, these wells were sampled for PCBs, in addition to the parameters previously sampled in these wells. No PCBs were detected, documenting that there is no large PCB groundwater plume associated with the industrial area of PGDP. Table 9 and Figure 22 summarize the 35 wells and the C-746-U Landfill wells that were sampled for PCBs.

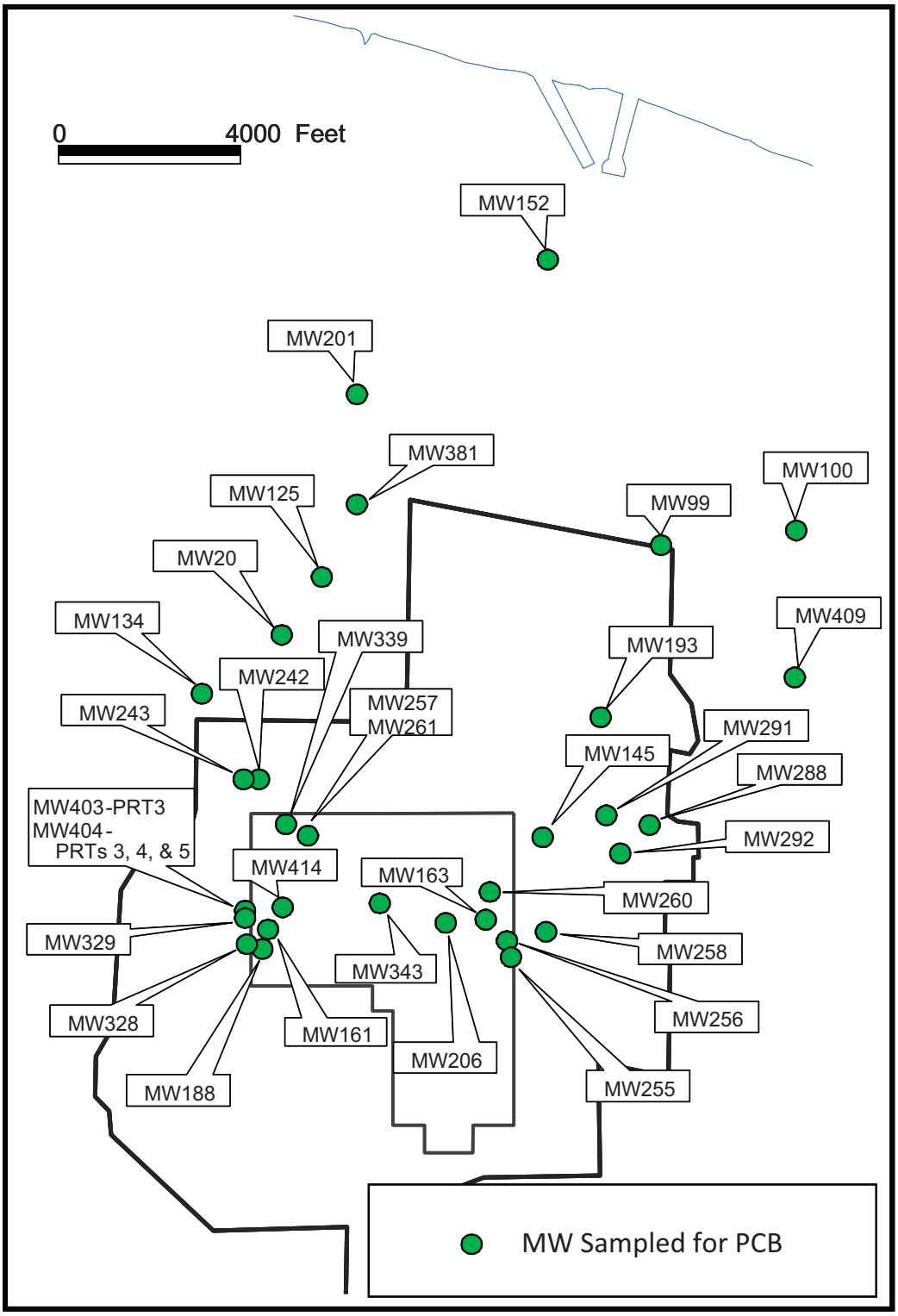


Figure 22. Location of RGA Wells with PCB Analyses to the C-746-S&T and C-746-U Landfill Wells

Table 9. PGDP RGA Wells with PCB Analyses and the C-746-S&T and C-746-U Landfill Wells

Well	Polychlorinated Biphenyl Analysis (mg/L)			Date Collected
	Result	Detection Limit	Detect?	
MW20	0.18	0.18	NO	10-Sep-08
MW99	0.18	0.18	NO	08-Sep-08
MW100	0.17	0.17	NO	08-Sep-08
MW125	0.17	0.17	NO	09-Sep-08
MW134	0.17	0.17	NO	16-Sep-08
MW145	0.17	0.17	NO	17-Sep-08
MW152	0.18	0.18	NO	08-Sep-08
MW161	0.18	0.18	NO	01-Oct-08
MW163	0.17	0.17	NO	11-Sep-08
MW188	0.17	0.17	NO	22-Sep-08
MW193	0.17	0.17	NO	10-Sep-08
MW201	0.18	0.18	NO	09-Sep-08
MW206	0.17	0.17	NO	22-Sep-08
MW242	0.17	0.17	NO	10-Sep-08
MW243	0.17	0.17	NO	10-Sep-08
MW255	0.17	0.17	NO	01-Oct-08
MW256	0.18	0.18	NO	01-Oct-08
MW257	0.17	0.17	NO	23-Sep-08
MW258	0.17	0.17	NO	17-Sep-08
MW260	0.17	0.17	NO	11-Sep-08
MW261	0.17	0.17	NO	23-Sep-08
MW288	0.17	0.17	NO	17-Sep-08
MW291	0.17	0.17	NO	17-Sep-08
MW292	0.18	0.18	NO	09-Sep-08
MW328	0.18	0.18	NO	04-Sep-08
MW329	0.17	0.17	NO	04-Sep-08
MW339	0.17	0.17	NO	23-Sep-08
MW343	0.17	0.17	NO	01-Oct-08
MW381	0.18	0.18	NO	09-Sep-08
MW403-PRT3	0.18	0.18	NO	30-Sep-08
MW404-PRT3	0.17	0.17	NO	30-Sep-08
MW404-PRT4	0.18	0.18	NO	30-Sep-08
MW404-PRT5	0.17	0.17	NO	30-Sep-08
MW409	0.17	0.17	NO	15-Sep-08
MW414	0.18	0.18	NO	22-Sep-08

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7. CONCLUSIONS

Based on this groundwater assessment, the above-benchmark (including background) constituent results found in groundwater from the vicinity of the C-746-U Landfill are from sources other than the C-746-U Landfill. None of the well samples indicate any landfill-related, above background levels of constituents present above MCLs or other risk-based levels of concern.

Only TCE and beta activity concentrations are persistently above MCLs in a few RGA wells; however, these concentrations are higher in the RGA wells located upgradient of the landfill and are attributable to migration from upgradient TCE and beta activity.

The assessment does identify the following apparent source(s) of the elevated above background levels.

- Constituents (present in the RGA wells) are migrating from upgradient sources, including RGA TCE and beta activity plumes.

- Constituents are present in upgradient to the C-746-U Landfill RGA wells at higher concentrations than in other wells in the vicinity of the landfill, including calcium, conductivity, dissolved solids, magnesium, potassium, and sulfate. Although potential sources of these constituents in the upgradient wells have been discussed, attributing the sources of these constituents continues to be uncertain because the concentrations of these constituents are higher in C-746-U Landfill upgradient wells, but lower in wells located further upgradient (i.e., upgradient of the C-746-S&T Landfill).

- Constituents (PCBs) apparently were introduced as a result of historical well rehabilitation efforts.

The possible sources are summarized in Table 10.

Table 10. Summary of Possible Contaminant Sources

Possible Source	Parameter
Underlying groundwater contamination associated with sources upgradient of C-746-U Landfill	Beta activity, TCE
Upgradient RGA Sources	Potentially calcium, dissolved solids, magnesium, sodium, sulfate, although attribution has uncertainty
Elevated levels resulting from MW fouling	Calcium, dissolved solids, magnesium, sodium, sulfate
Elevated levels resulting from MW contamination during rehabilitation activities	PCBs
Natural variability in the groundwater system	Except as noted, concentrations are within range of concentrations found in PGDP wells; thus, no indication of a C-746-U contribution

N/A = not applicable

7.1 RECOMMENDATIONS

Recommendations resulting from this groundwater assessment are as follows:

- Abandon the open well at the old home site. This well presents the potential for a direct contaminant pathway to the UCRS.

No additional assessment, monitoring, or abatement activities have been identified as needed to complete the groundwater assessment process.

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APPENDIX A

CORRESPONDENCE

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ENVIRONMENTAL AND PUBLIC PROTECTION CABINET

Steven L. Beshear
Governor

DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WASTE MANAGEMENT
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Robert D. Vance
Secretary

February 13, 2008

Mr. William E. Murphie, Manager
United States Department of Energy
Portsmouth Paducah Project Office
1017 Majestic Place, Suite 200
Lexington, Kentucky 40513

Certified Mail Number: 7005 3110 0000 3555 3435

Mr. Russell Boyd, Site Manager
Paducah Remediation Services, LLC
761 Veterans Avenue
Kevil, Kentucky 42053

Certified Mail Number: 7005 3110 0000 3555 3442

RE: Groundwater Assessment Plan
United States Department of Energy - Paducah Gaseous Diffusion Plant
Agency Interest No. 3059
C-746-U Solid Waste Contained Landfill
Application No. AIN20070003
Solid Waste Permit # 073-00045
McCracken County

Dear Mr. Murphie and Mr. Boyd:

The Kentucky Division of Waste Management, Solid Waste Branch (Division) has reviewed the Groundwater Assessment Plan received on January 9, 2008 for the C-746-U Solid Waste Contained Landfill. The Groundwater Assessment Plan (AIN20070003) is hereby approved.

Additional copies of the Groundwater Assessment Plan (AIN20070003) were received on January 15, 2008, and an approved copy is enclosed along with a revised TEMPO permit. The Division approved a minor modification for leachate storage (APE20060011) on February 12, 2008. An approved copy of the application for APE20060011 is also enclosed.

Be advised, if you consider yourself aggrieved by the issuance of this permit, you have a right pursuant to KRS 224.10-420 (2) and 401 KAR 47:130 Section 2 (3), to file with the cabinet a petition demanding a hearing. This right to demand a hearing shall be limited to a period of thirty (30) days after receipt of this permit.

Should you have any questions regarding this matter, please contact me at (502) 564-6716, extension 240 or Jeff Pratt, P.E. at extension 204.

Sincerely,

R.D. Gruzesky

Ronald D. Gruzesky, P.E.
Manager, Solid Waste Branch

Enclosures
RDG/rth/jnn

c: Reading File

APPENDIX B

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B.1. INTRODUCTION

This *Groundwater Assessment Report for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, summarizes results of the activities conducted under the approved *Groundwater Assessment Plan for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS/PROJ/0006/R2. The C-746-U Landfill was placed in assessment in response to the finding that some constituents were found in groundwater samples from monitoring wells (MWs) located in the vicinity of the landfill at above benchmark levels.

Only two constituents [beta activity and trichloroethene (TCE)] are present above their respective maximum contaminant level (MCL) in Regional Gravel Aquifer (RGA) groundwater in the vicinity of the C-746-U Landfill. Additional evaluation of the data for these constituents is presented in this appendix that demonstrates that these constituents are migrating from upgradient sources.

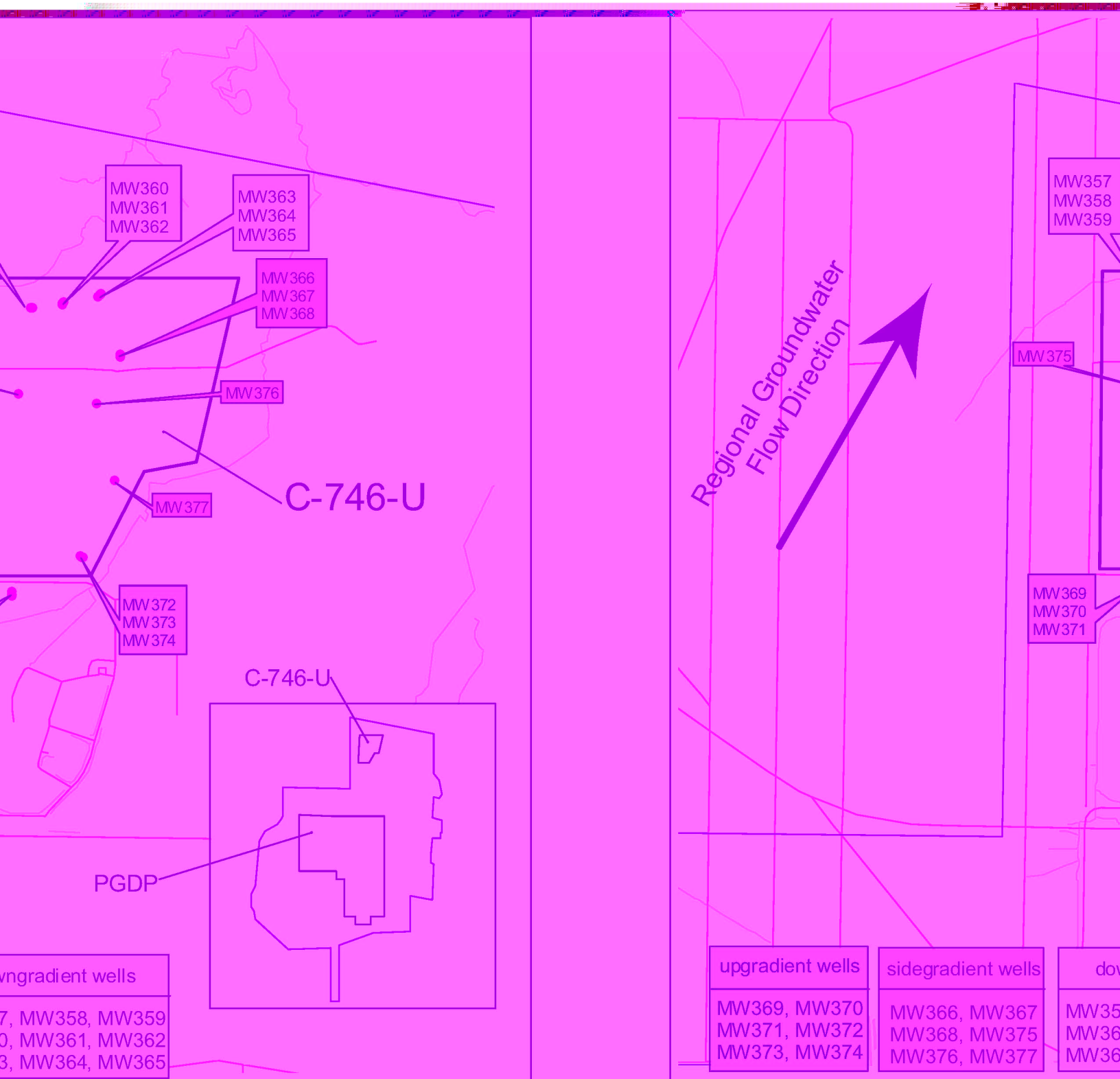
Although polychlorinated biphenyls (PCBs) historically have been present above the U.S. Environmental Protection Agency MCL, they have not exceeded the MCL in RGA wells since 2010. The studies undertaken to evaluate PCBs (as reported elsewhere in this report) demonstrate that the source of the historical PCBs was cross-contamination from well rehabilitation activities.

Other constituents that are present in RGA wells at above background levels or possibly above background levels include calcium, conductivity, dissolved solids, magnesium, sodium, and sulfate. The higher concentrations of these constituents typically are found in upgradient wells MW372 and MW373, and the concentrations in these upgradient wells are higher than concentrations present in wells located further upgradient, sidegradient, or downgradient of the C-746-U Landfill. Thus, there is no identified upgradient source that can account for the concentrations in MW372 and MW373, wells that are located upgradient of the C-746-U Landfill. Migration from potential sources (including migration from UCRS soils near the well, well fouling, compromised well completions, C-746-U Landfill leachate, and C-746-S leachate, etc.) has been considered. This appendix presents a discussion of the extent of constituents in wells located in the vicinity of the C-746-U Landfill and the potential sources for these constituents in RGA wells. Figure B.1 is a map of the wells located in the vicinity of the C-746-U Landfill. Figure B.2 is a map of the wells located further upgradient—those located in the vicinity of the C-746-S&T Landfills. MW372 and MW373 are shown on both figures in a location that is considered upgradient of the C-746-U Landfill and downgradient of the C-746-S&T Landfills.

B.2. BETA ACTIVITY

Figure B.3 is a graph of the beta activity over time in MW357. Beta activity in this well is above the C-746-U background, but stable to declining. Figure B.4 presents a similar graph for beta activity in MW372. This upgradient well has had beta activity exceeding the MCL during the past two years; however, concentrations appear to be decreasing. It appears that the source of this beta activity in the upgradient well MW372 is an upgradient source, technetium-99 (Tc-99), present at upgradient locations, as shown in Figure B.5.

Figure B.6 is a graph of beta activity concentrations for the three RGA wells with beta activity greater than the MCL over the past two years. MW366 and MW367 are on the same flow path as water passing through MW372. Concentrations in MW366 and MW367 are lower than in upgradient well MW372 and also are decreasing; thus, the concentrations in the downgradient wells are well-explained



vngradient wells

7, MW358, MW359
0, MW361, MW362
3, MW364, MW365

300 Feet

TRUE NORTH
20°
PLANT NORTH

Monitoring Network

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

LATA Environmental Services of Kentucky, LLC

Figure B.1. C-746-U Landfill Groundwater Wells New

FIGURE No. c5ac90002SK115.apr
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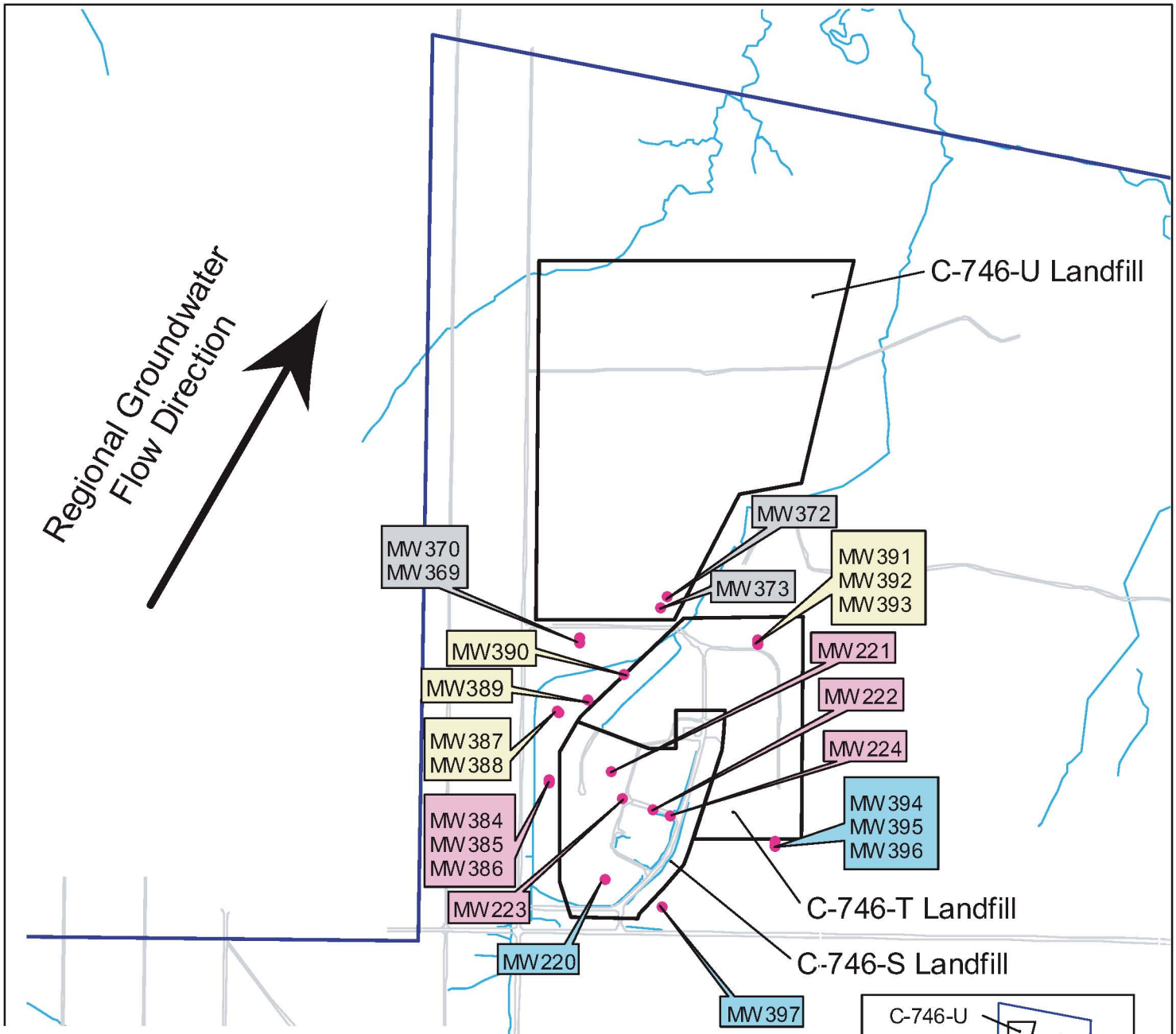

Downgradient wells (sampled with C-746-U)	Downgradient wells	Sidegradient wells	Upgradient wells
MW369, MW370,	MW387, MW388 MW389, MW390 MW391, MW39	MW221, MW222 MW223, MW224 MW384, MW385	MW220, MW394 MW395, MW396 MW397

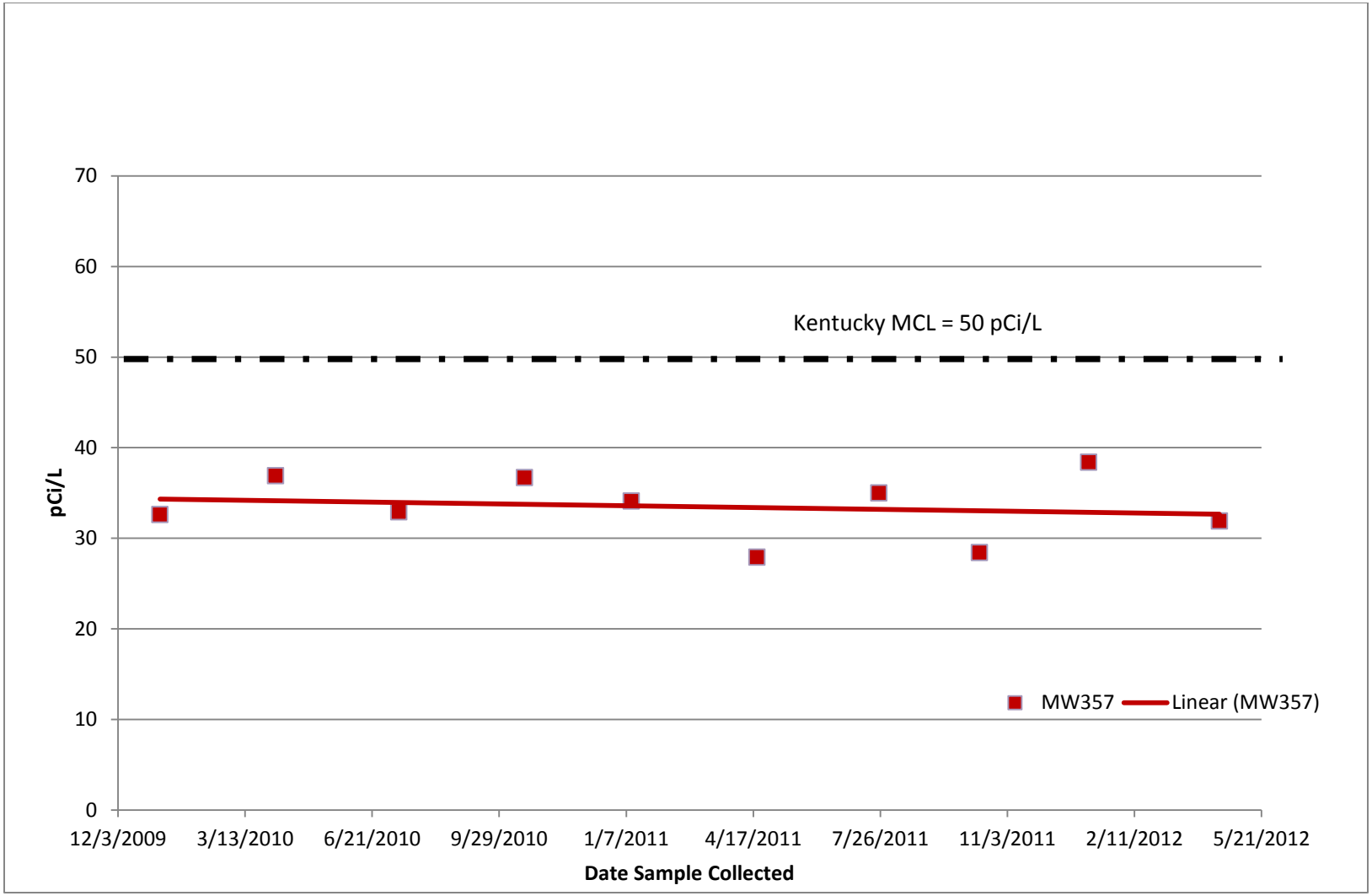

Figure B.3. MW357 Beta Activity since 2010

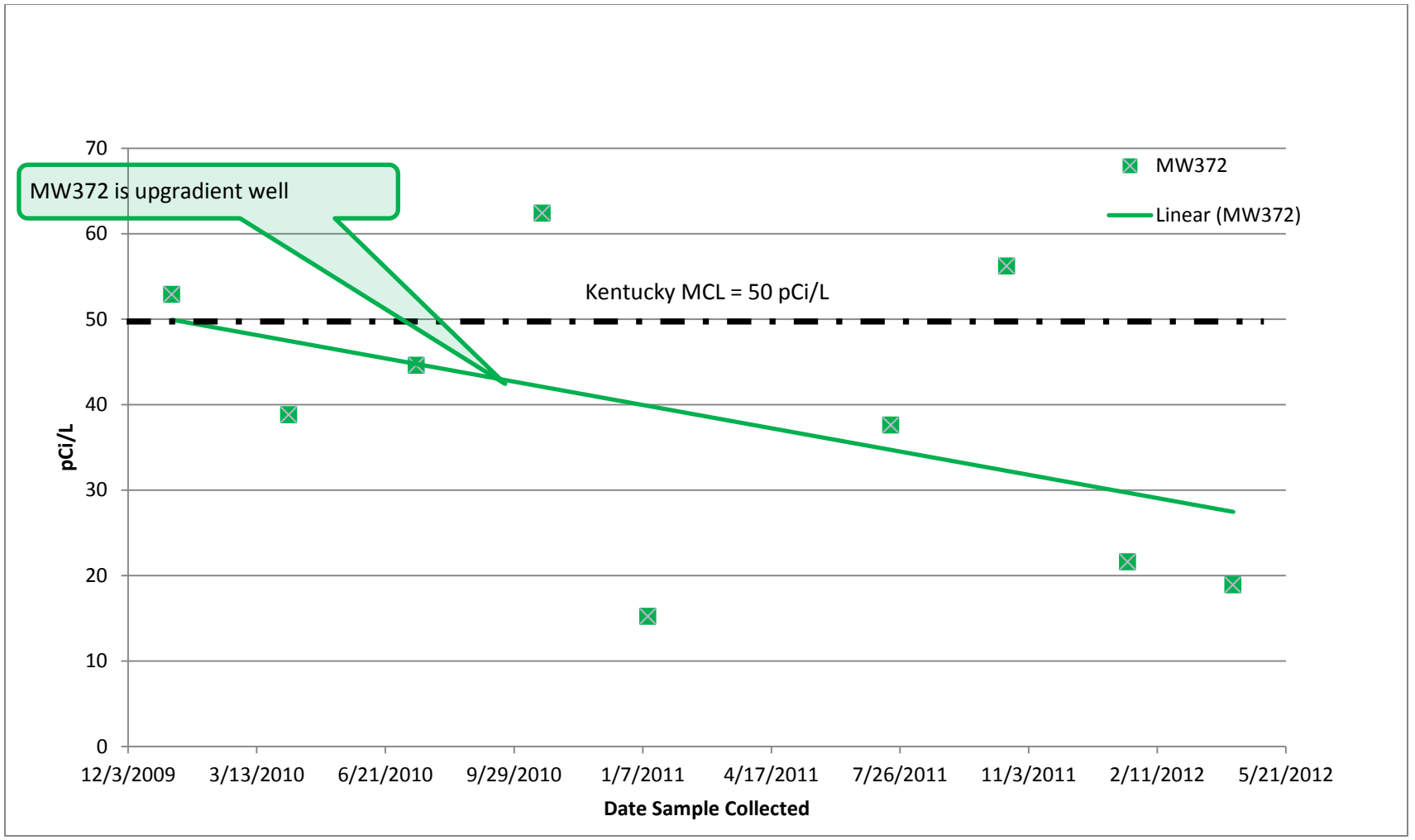

Figure B.4. Beta Activity since 2010 Upgradient Well Exceeds 50 pCi/L

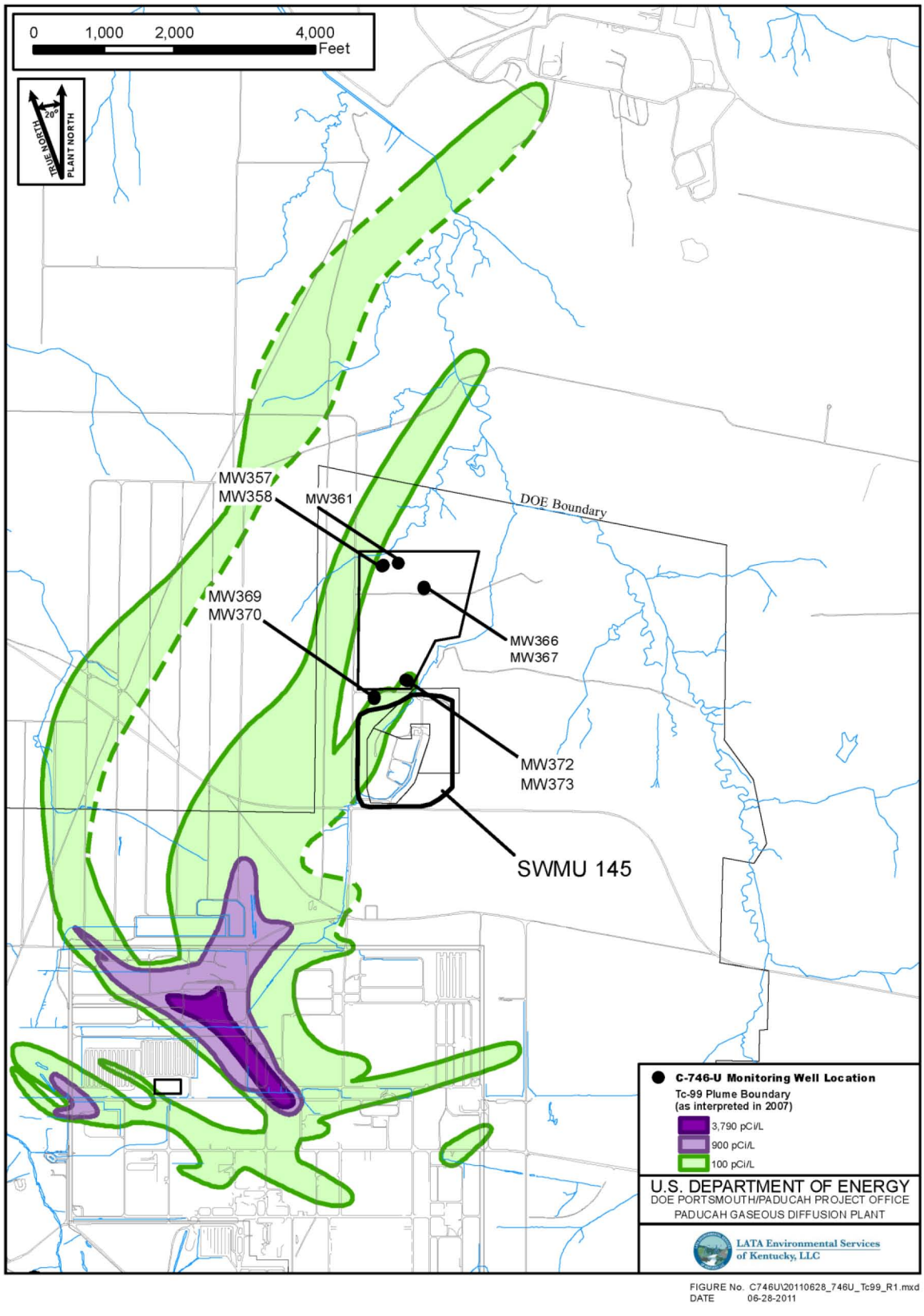

Figure B.5. Technetium-99 Contours for the RGA

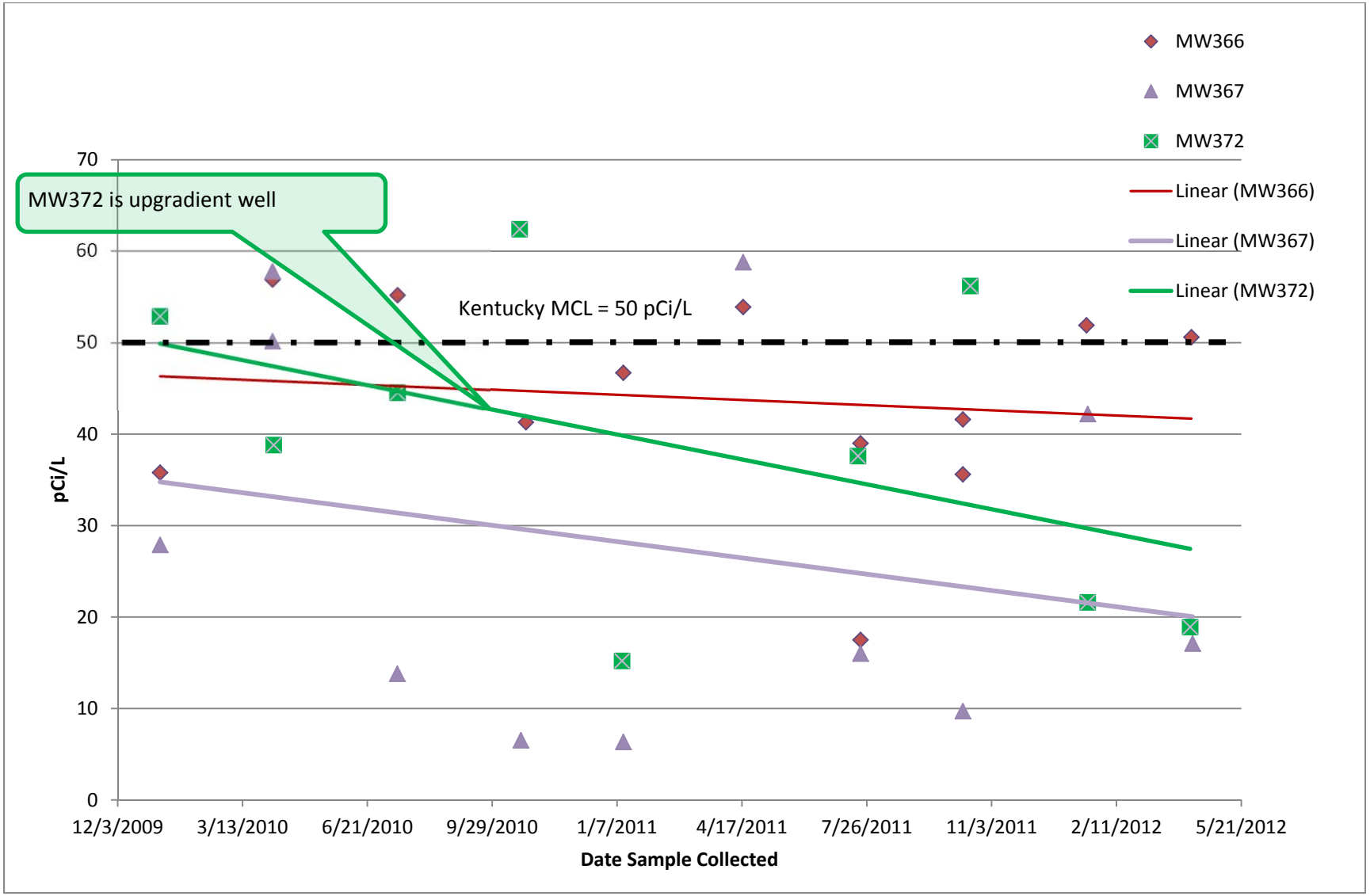

Figure B.6. Beta Activity since 2010 Wells with Any Exceedance of 50 pCi/L

by the upgradient source (that accounts for the MW372 concentrations). Consequently, the C-746-U Landfill is not contributing a measurable amount of beta activity to the RGA groundwater.

Figure B.7 graphs beta activity concentrations for all three wells using a four-event rolling average. The information summarized in these graphs indicates that concentrations increased first in the upgradient well and have increased more recently in MW366 and MW367, a pattern fully consistent with migration of beta activity from upgradient of the C-746-U Landfill into the C-746-U Landfill wells.

B.3. TCE CONCENTRATIONS

Figure B.8 is a graph of the TCE concentrations in upgradient wells MW372 and MW373. Concentrations in these wells exceed the MCL, but are stable to declining. TCE concentrations in wells located along the same flow path as MW372 and MW373 (but further downgradient) do not exceed the MCL.

Other TCE concentrations that have exceeded the MCL since 2010 are found in MW357, MW358, and MW361—wells located on a different flow path. Figure B.9 is a graph of recent concentrations. A comparison of this graph to the TCE plume map reproduced as Figure B.10 indicates that the sources of the TCE in both upgradient wells (MW372 and MW373) and other wells (MW357, MW358, and MW359) are migration from upgradient of the C-746-U Landfill.

B.4. SULFATE CONCENTRATIONS

Figures B.11 and B.12 present a summary of the statistical evaluation of sulfate concentrations in Upper RGA and Lower RGA wells in the vicinity of the C-746-U Landfill (DOE 2012). None of the wells has a concentration that exceeds the secondary MCL of 250 mg/L; however, the concentration in MW373 in the Third Quarter 2012 is close. The highest concentrations of sulfate in background wells are noted in upgradient wells MW372 and MW373. MW373 had a concentration of 810 mg/L in 2002. This well has been rehabilitated since then. In part because of the high concentrations in the upgradient well MW373, the only above background concentration of sulfate is at MW372.

Because of the presence of sulfate in upgradient wells, additional evaluation of the concentrations of sulfate in wells located further upgradient was conducted. Figures B.13 and B.14 present a similar statistical summary for wells located in the vicinity of the C-746-S&T Landfills. These figures demonstrate that concentrations of sulfate are much higher in MW372 and MW373 than in other upgradient, downgradient, or sidegradient wells. The C-746-S&T Landfill wells do not help pinpoint a source for the elevated concentrations in MW372 and MW373. The sulfate issues are confirmed to be associated only with the two wells located upgradient of the C-746-U Landfill (MW372 and MW373); no further upgradient source has been found sufficient to explain these concentrations.

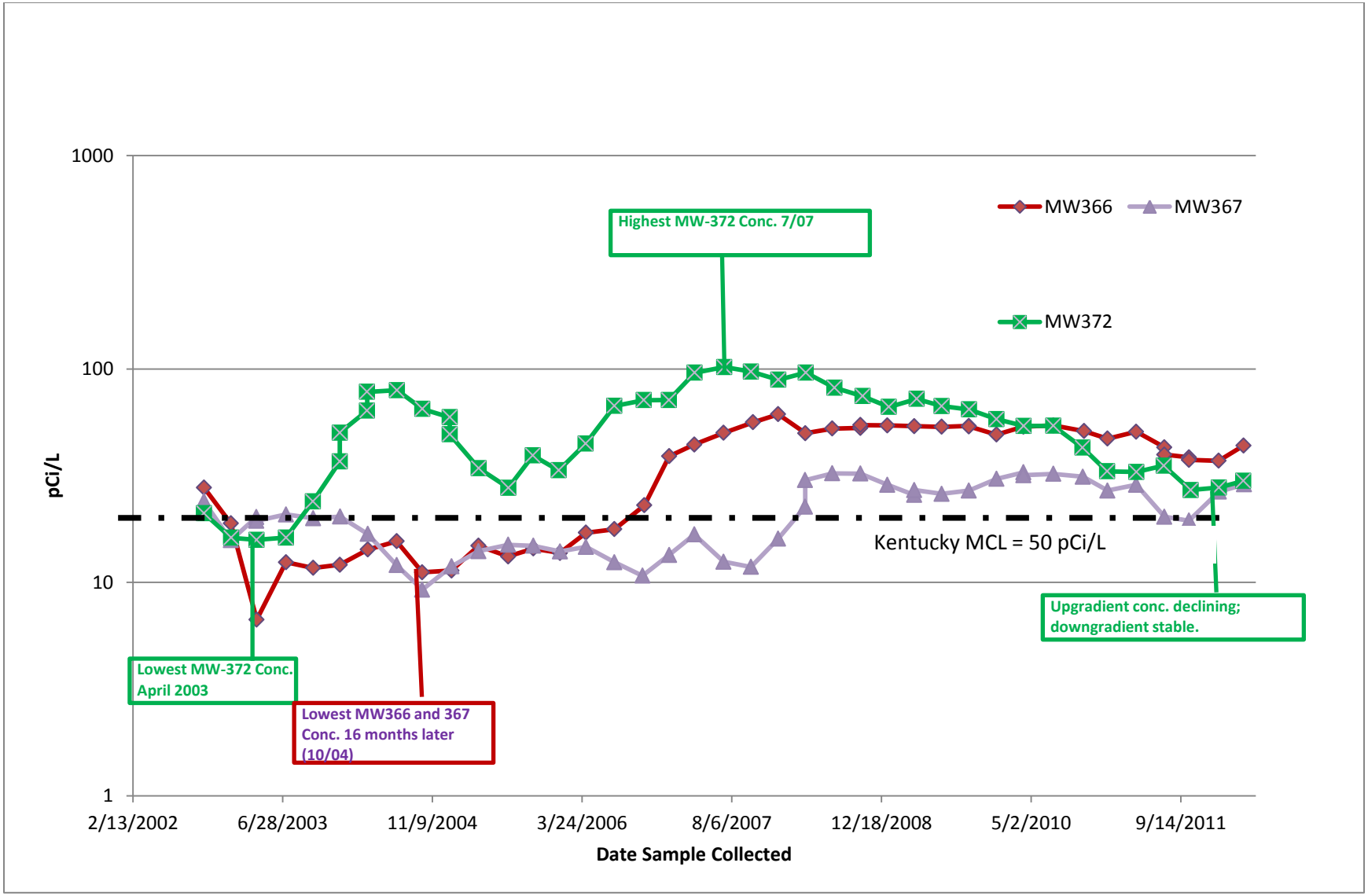

Figure B.7. Beta Activity 4 Event Rolling Average, Log Scale

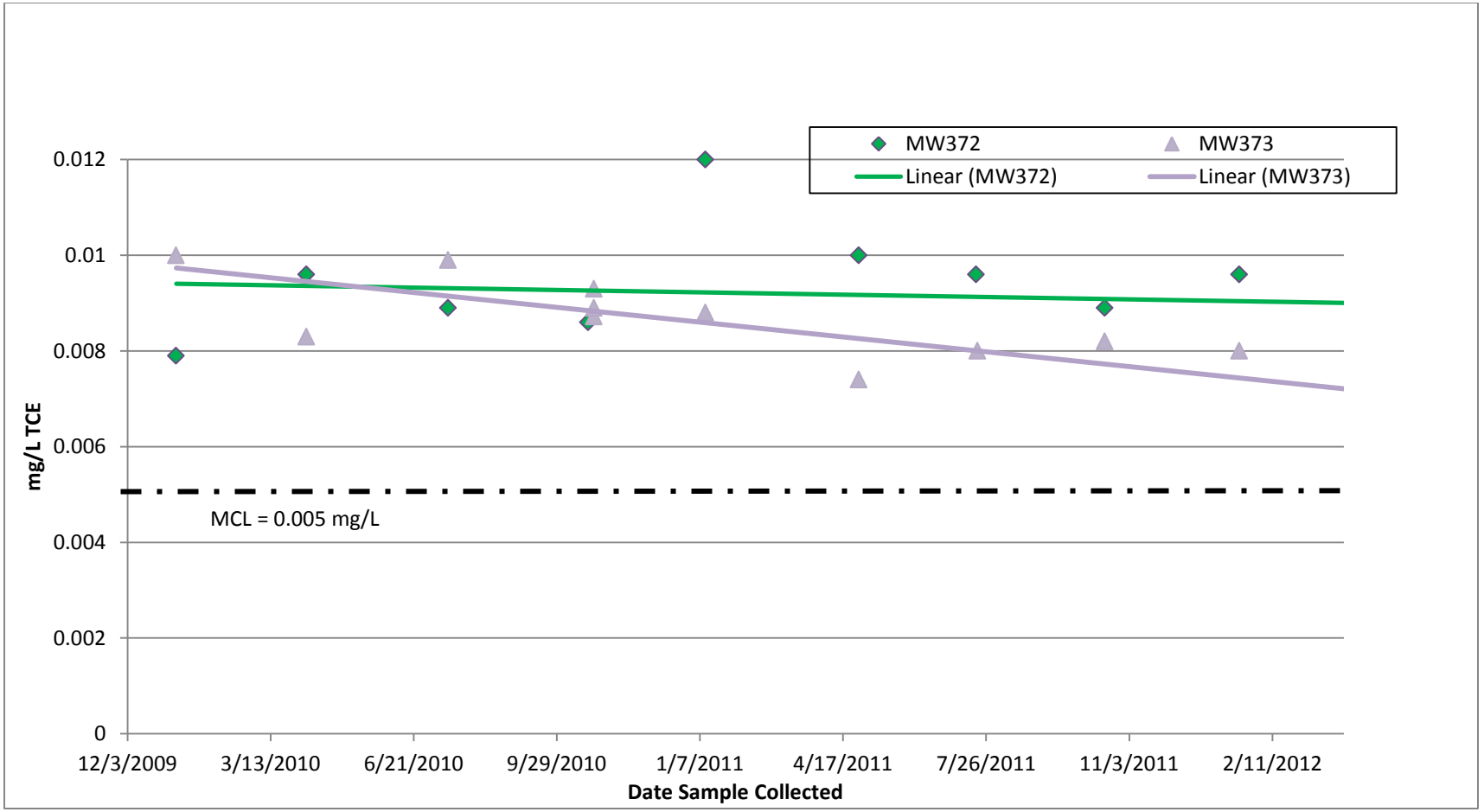

Figure B.8. TCE Concentration, Upgradient Wells

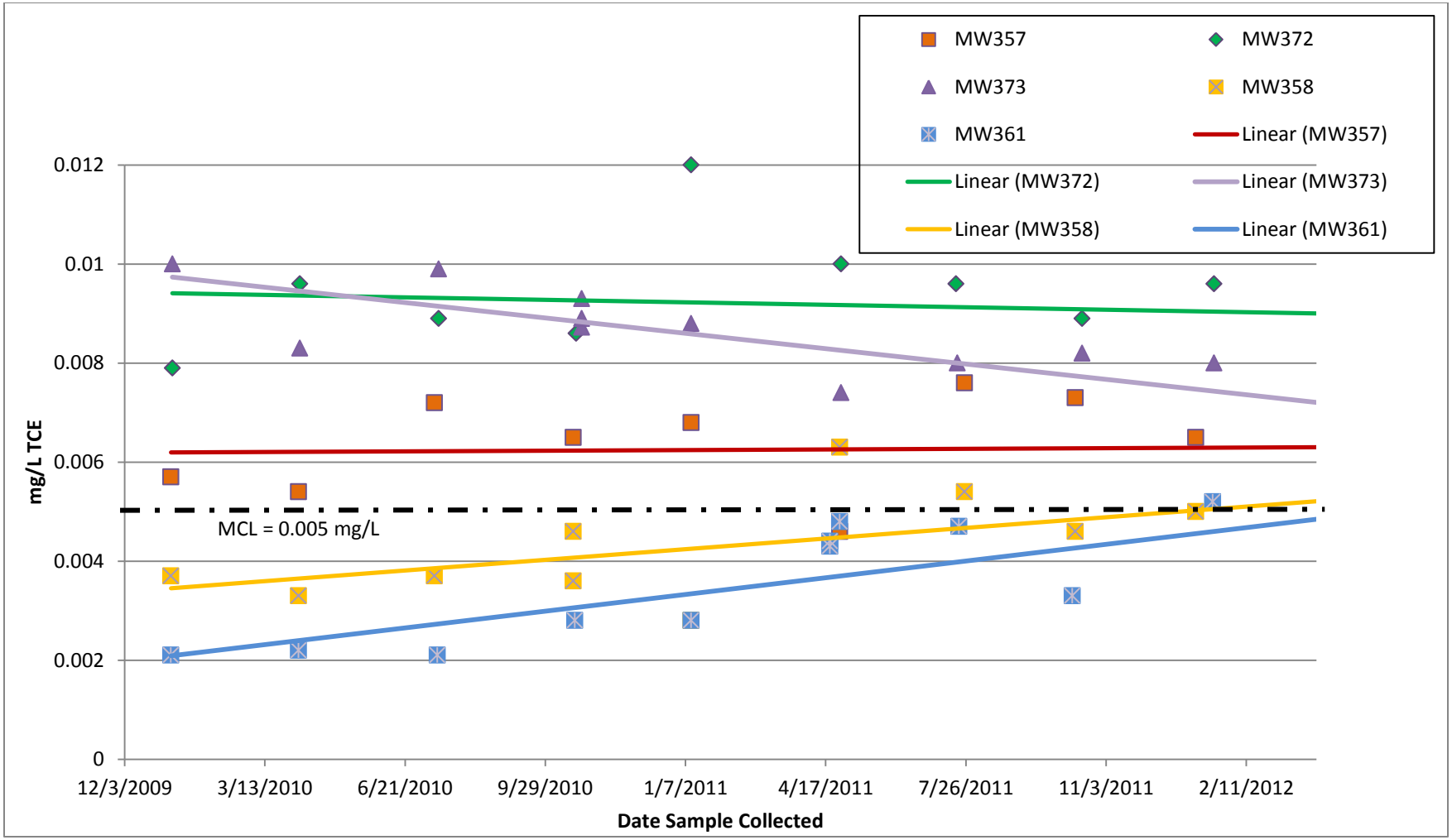

Figure B.9. TCE Concentration, All Wells w/TCE > 0.005

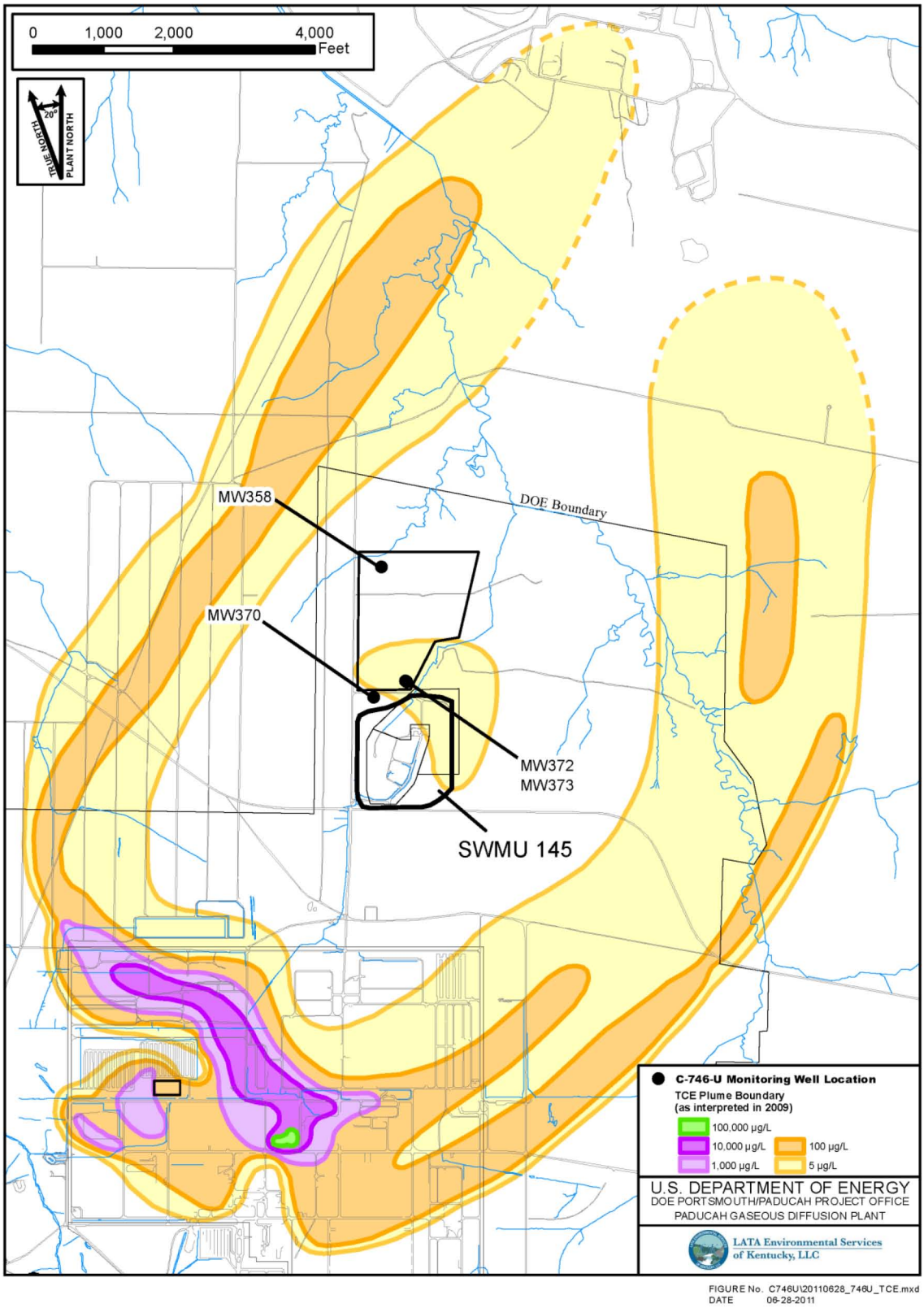

Figure B.10. Composite Trichloroethene Contours for the RGA for Calendar Year 2009

C-746-U Second Quarter 2012 Statistical Analysis URGA
Sulfate UNITS: mg/L

The CV is calculated to determine if background data are normally distributed. If so, the current test well results are compared to the TL. If not, a transformation is performed on the background and test well results, then each transformed test well result is compared to the transformed TL. If the test well result exceeds the TL, that is statistically significant evidence of elevated concentration in that well.

Background Data from Upgradient Wells

Well Number:	MW369
Date Collected	Result
3/18/2002	15.500
4/22/2002	15.800
7/15/2002	13.800
10/8/2002	6.900
1/8/2003	10.500
4/3/2003	10.500
7/8/2003	10.900
10/6/2003	16.300

Well Number:	MW372
Date Collected	Result
3/19/2002	71.700
4/23/2002	74.700
7/16/2002	74.100
10/8/2002	70.500
1/7/2003	75.800
4/2/2003	81.800
7/9/2003	83.600
10/7/2003	88.100

Statistics on Background Data

X= 45.031
S= 33.919
CV= 0.753
K factor = 2.523**
TL= 130.609

Because CV is less than or equal to 1, assume normal distribution and continue with statistical anaylsis.

Second Quarter 2012 Data Collected in April 2012

Well No.	Result	Gradient	Result >TL?
MW357	66.000	Downgradient	NO
MW360	11.000	Downgradient	NO
MW363	35.000	Downgradient	NO
MW366	43.000	Sidegradient	NO
MW369	7.600	Upgradient	NO
MW372	160.00	Upgradient	**YES**

Conclusion of Statistical Analysis on Data

The following test well(s) exceeded the Upper Tolerance Limit, which is statistically significant evidence of elevated concentration with respect to background data.

MW372

CV Coefficient-of-Variation, CV = S/X If CV is less than or equal to 1 assume normal distribution.
S Standard Deviation, S = [Sum ([(background result-X)^2]/[count of background results -1])]^0.5
TL Upper Tolerance Limit, TL = X + (K * S)
X Mean, X = (sum of background results)/(count of background results)
** Read from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities,* Interim Guidance, EPA, 1989, based on total number of background results

Figure B.11. C-746-U Second Quarter 2012 Statistical Analysis--Sulfate--URGA

C-746-U Second Quarter 2012 Statistical Analysis — LRGA
Sulfate — UNITS: mg/L

The CV is calculated to determine if background data are normally distributed. If so, the current test well results are compared to the TL. If not, a transformation is performed on the background and test well results, then each transformed test well result is compared to the transformed TL. If the test well result exceeds the TL, that is statistically significant evidence of elevated concentration in that well.

Background Data from Upgradient Wells

Well Number:	MW370
Date Collected	Result
3/17/2002	17.400
4/23/2002	37.900
7/15/2002	15.700
10/8/2002	13.400
1/8/2003	14.400
4/3/2003	18.100
7/9/2003	9.600
10/6/2003	16.500
Well Number:	MW373
Date Collected	Result
3/18/2002	163.300
4/23/2002	809.600
7/16/2002	109.400
10/8/2002	110.600
1/7/2003	113.700
4/2/2003	133.000
7/9/2003	182.100
10/7/2003	193.400

Statistics on Background Data

X= 122.381
S= 195.095
CV= 1.594
K factor = 2.523**
TL= 614.606

Because CV is greater than 1, the natural logarithm of background and test well results were calculated.

Statistics on Transformed Background Data

X= 3.985
S= 1.323
CV= 0.332
K factor = 2.523**
TL= 7.322

Transformed Background Data from Upgradient Wells

Well Number:	MW370
Date Collected	LN(Result)
3/17/2002	2.856
4/23/2002	3.635
7/15/2002	2.754
10/8/2002	2.595
1/8/2003	2.667
4/3/2003	2.896
7/9/2003	2.262
10/6/2003	2.803
Well Number:	MW373
Date Collected	LN(Result)
3/18/2002	5.096
4/23/2002	6.697
7/16/2002	4.695
10/8/2002	4.706
1/7/2003	4.734
4/2/2003	4.890
7/9/2003	5.205
10/7/2003	5.265

Second Quarter 2012 Data Collected in April 2012

Well No.	Result	Gradient	Result >TL?
MW358	92.000	Downgradient	N/A
MW361	80.000	Downgradient	N/A
MW364	62.000	Downgradient	N/A
MW367	31.000	Sidegradient	N/A
MW370	18.000	Upgradient	N/A
MW373	240.000	Upgradient	N/A

Transformed Second Quarter 2012 Data Collected in April 2012

Well Number	LN(Result)	Result >TL?
MW358	4.522	NO
MW361	4.382	NO
MW364	4.127	NO
MW367	3.434	NO
MW370	2.890	NO
MW373	5.481	NO

Conclusion of Statistical Analysis on Transformed Data

None of the test wells exceeded the Upper Tolerance Limit, which is statistically significant evidence that these wells have no elevated concentrations with respect to background data.

CV Coefficient-of-Variation, CV = S/X If CV is less than or equal to 1 assume normal distribution.
S Standard Deviation, S = [Sum ([(background result-X)^2]/[count of background results -1])]^0.5
TL Upper Tolerance Limit, TL = X + (K * S)
X Mean, X = (sum of background results)/(count of background results)
** Read from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities,* Interim Guidance, EPA, 1989, based on total number of background results

Figure B.12. C-746-U Second Quarter 2012 Statiscal Analysis--Sulfate--LRGA

C-746-S and C-746-T Third Quarter 2012 Statistical Analysis LRGA
Sulfate UNITS: mg/L

The CV is calculated to determine if background data are normally distributed. If so, the current test well results are compared to the TL. If not, a transformation is performed on the background and test well results, then each transformed test well result is compared to the transformed TL. If the test well result exceeds the TL, that is statistically significant evidence of elevated concentration in that well.

Background Data from Upgradient Wells

Well Number:	MW395
Date Collected	Result
8/13/2002	10.300
9/16/2002	9.100
10/16/2002	8.800
1/13/2003	9.000
4/10/2003	8.300
7/16/2003	8.200
10/14/2003	8.300
1/13/2004	8.200
Well Number:	MW397
Date Collected	Result
8/13/2002	14.000
9/16/2002	12.800
10/17/2002	12.300
1/13/2003	12.700
4/8/2003	12.800
7/16/2003	13.100
10/14/2003	12.100
1/13/2004	12.100

Statistics on Background Data

X= 10.756
S= 2.147
CV= 0.200
K factor = 2.523**
TL= 16.173

Because CV is less than or equal to 1, assume normal distribution and continue with statistical anaylsis.

Third Quarter 2012 Data Collected in July 2012

Well No.	Result	Gradient	Result > TL?
MW370	18.000	Downgradient	**YES**
MW373	230.00	Downgradient	**YES**
MW385	18.000	Sidegradient	**YES**
MW388	20.000	Downgradient	**YES**
MW392	6.200	Downgradient	NO

Conclusion of Statistical Analysis on Data

The following test well(s) exceeded the Upper Tolerance Limit, which is statistically significant evidence of elevated concentration with respect to background data.

MW370

MW373

MW385

MW388

CV Coefficient of Variation, CV = S/X If CV is less than or equal to 1 assume normal distribution.
S Standard Deviation, S = [Sum ([(background result-X)^2]/[count of background results -1])]^0.5
TL Upper Tolerance Limit, TL = X + (K * S)
X Mean, X = (sum of background results)/(count of background results)
** Read from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities,* Interim Guidance, EPA, 1989, based on total number of background results

Figure B.13. C-746-S&T Third Quarter 2012 Statistical Analysis--Sulfate--LRGA

C-746-S and C-746-T Third Quarter 2012 Statistical Analysis URGA
Sulfate UNITS: mg/L

The CV is calculated to determine if background data are normally distributed. If so, the current test well results are compared to the TL. If not, a transformation is performed on the background and test well results, then each transformed test well result is compared to the transformed TL. If the test well result exceeds the TL, that is statistically significant evidence of elevated concentration in that well.

Background Data from Upgradient Wells

Well Number:	MW220
Date Collected	Result
10/14/2002	10.400
1/15/2003	9.800
4/10/2003	15.400
7/14/2003	14.900
10/13/2003	13.500
1/13/2004	10.300
4/13/2004	14.300
7/21/2004	10.500
Well Number:	MW394
Date Collected	Result
8/13/2002	11.200
9/16/2002	8.300
10/16/2002	8.000
1/13/2003	8.500
4/10/2003	7.900
7/16/2003	8.400
10/14/2003	8.200
1/13/2004	8.100

Statistics on Background Data

X= 10.481
S= 2.648
CV= 0.253
K factor = 2.523**
TL= 17.161

Because CV is less than or equal to 1, assume normal distribution and continue with statistical anaylsis.

Third Quarter 2012 Data Collected in July 2012

Well No.	Result	Gradient	Result > TL?
MW221	13.000	Sidegradient	NO
MW222	11.000	Sidegradient	NO
MW223	12.000	Sidegradient	NO
MW224	15.000	Sidegradient	NO
MW369	9.400	Downgradient	NO
MW372	160.00	Downgradient	**YES**
MW384	21.000	Sidegradient	**YES**
MW387	37.000	Downgradient	**YES**
MW391	12.000	Downgradient	NO

Conclusion of Statistical Analysis on Data

The following test well(s) exceeded the Upper Tolerance Limit, which is statistically significant evidence of elevated concentration with respect to background data.

MW372

MW384

MW387

CV Coefficient of Variation, CV = S/X If CV is less than or equal to 1 assume normal distribution.
S Standard Deviation, S = [Sum ([(background result-X)^2]/[count of background results -1])]^0.5
TL Upper Tolerance Limit, TL = X + (K * S)
X Mean, X = (sum of background results)/(count of background results)
** Read from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities,* Interim Guidance, EPA, 1989, based on total number of background results

Figure B.14. C-746S&T Third Quarter 2012 Statistical Analysis--Sulfate--URGA

B.5. OTHER CONSTITUENTS

Other constituents present in upgradient wells MW372 and MW373 that do not have an identified upgradient source that accounts for these concentrations include boron, calcium, conductivity, dissolved solids, magnesium, manganese, potassium, sodium, and sulfate. Table B.1 compares mean concentrations of constituents present in RGA wells at Paducah Gaseous Diffusion Plant (PGDP) with the following:

- The mean concentrations for those same constituents in RGA wells identified as upgradient to the C-746-S&T Landfills (per the permit-required statistical evaluation for the C-746-S&T Landfill). These locations are further upgradient of the C-746-U Landfill.

- The mean background concentrations for RGA wells located upgradient of the C-746-U Landfill (from 2002-2003), without including the contribution of upgradient wells MW372 or MW373.

- The mean background concentrations for RGA wells located upgradient of the C-746 Landfill (from 2002-2003), including MW372 and MW373 [i.e., as reported in the 3rd C-746-U Landfill report, *C-746-U Contained Landfill Third Quarter Calendar Year 2012 (July–September) Compliance Monitoring Report Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PAD-ENM-0067/V3].

- The mean 3rd Quarter 2012 concentrations for all RGA wells in the vicinity of the C-746-U Landfill, except MW372 and MW373.

- The mean 3rd Quarter 2012 concentrations for MW372 and MW373.

The comparisons provided in this table demonstrate that concentrations of these constituents are similar for all of these groups, except the concentrations of boron, calcium, conductivity, dissolved solids, magnesium, potassium, sodium, and sulfate in MW372 and MW373 are above levels seen in other locations in the vicinity of the C-746-U and C-746 S&T Landfills. Some conditions local to MW372 and MW373 may be the source(s) of these constituents.

The mean concentrations of these constituents are within the range of concentrations found at RGA wells in the vicinity of PGDP. The number of samples and number of nondetects also are presented to demonstrate that most of these constituents are routinely detected in RGA groundwater at PGDP and the range of concentrations found at PGDP is sufficient to explain most of the variability without any C-746-U Landfill source.

Observations that highlight these trends include the following.

- Most constituents are frequently detected in the vast majority of RGA samples at PGDP, indicating their typical presence in native waters.

- Calcium concentrations average 28 mg/L at PGDP. Concentrations in C-746-S&T upgradient wells and concentrations in C-746-U upgradient wells (without MW372 and MW373) average 25 mg/L. The third quarter concentrations for MW372/MW373 average 73 mg/L; thus, concentrations in MW372/MW373 are above what might be considered typical for PGDP RGA groundwater. There is no indication of a measurable source of calcium from the C-746-U Landfill.

- Chloride concentrations average 46 mg/L for all PGDP RGA well samples, but also average 50 mg/L in the C-746-S&T Landfill upgradient RGA wells—wells located upgradient of the C-746-S&T

Table B.1. Summary of Concentrations in RGA PGDP Wells

Constituent (units)	Number of Nondetects	Number of Samples	Mean Conc. Detect[a]	Mean Conc. S&T Upgradient[b]	Mean Conc. Upgradient[c] w/o MW372/373	Mean Conc. U (as reported) Upgradient[d]	Mean 3rd Qtr. Conc. U w/o 372/373[e]	3rd Qtr. Mean Conc. of MW372 and MW373[f]	Comments
Boron[g] (mg/L)	1050	1211	0.69	0.54	0.88	1.1	0.23	1.6	Concentrations below RSL. Elevated concentrations in MW372/MW373 not above background. Detection limit has impact on statistics. Detection limit decreased by order of magnitude since 2003.
Calcium (mg/L)	1	1929	28	25	28	38	25	73	No RSL. Concentration similar for all PGDP groups without 372/373; above background in 372/373. C-746-U Landfill not the source. Upgradient concentrations of S&T not elevated.
Chloride (mg/L)	3	1957	46	50	50	45	29	46	Concentrations below SMCL. Concentration similar for all wells at PGDP. No C-746-U-Landfill impact.
Cobalt (mg/L)	1030	1719	0.019	0.016	0.032	0.026	0.0041	0.0010	Some concentrations above low RSL. Not above background; concentrations consistent with PGDP-wide variation; historical concentrations higher. No apparent C-746-U source.
Dissolved Solids (mg/L)	173	1583	262	226	255	321	253	590	SMCL of 500 mg/L exceeded only in MW373 since 2010. Above background in MW372/MW373. No apparent C-746-U impact.
Iron (mg/L)	599	2038	3.7	0.65	9.3	8.3	1.7	0.3	Mean Concentration less than RSL. Concentration lower in MW372/373. Concentrations within range at PGDP. No apparent C-746-U impact.
Magnesium (mg/L)	1	1929	11	9.9	11	15	10	29	No RSL. Above background in MW372 only. Markedly higher concentration in MW372/MW373, but not in S&T upgradient wells.
Manganese (mg/L)	428	1952	0.85	0.21	0.82	0.75	0.27	0.035	Above RSL of 0.32 mg/L. Historical issue at MW372/MW373 has subsided. Concentrations within range typical of PGDP. No apparent C-746-U source.
Sodium (mg/L)	2	1880	41	33	47	48	40	65	No RSL. Not above background. Somewhat higher concentration in MW372/MW373. No apparent C-746-U source.
Sulfate (mg/L)	50	1684	33	11	15	84	43	195	SMCL of 250 mg/L last exceeded in 2005. Above background in MW372. Markedly higher concentration in MW372/MW373.
Conductivity: field parameter (µmho/cm)		N/A	N/A	380	455	546	427	903	Above background in MW372. Markedly higher values in MW372/MW373.

[a] Mean concentration of parameter from database for RGA wells; detected quantities only.
[b] Mean concentration of parameter for upgradient (background) C-746-S&T Landfills wells (includes nondetect values).
[c] Mean concentration of parameter for upgradient C-746-U Landfill wells without MW372 or MW373 concentrations included in mean calculation.
[d] Mean concentration of parameter for upgradient C-746-U Landfill wells including MW372 and MW373 concentrations.
[e] Mean concentration of parameter in third quarter 2012 in C-746-U Landfill well except for MW372 and MW373.
[f] Mean concentration of parameter in third quarter 2012 in MW372 and MW373.
[g] Third quarter boron results include results only from LRGA wells MW358, MW361, MW364, MW367, MW370, and MW373.

- Landfills and further upgradient of the C-746-U Landfill. Concentrations upgradient of the C-746-U Landfill (whether they include MW372/MW373) also average 46 mg/L. Thus, it appears that chloride in the vicinity of the C-746-U Landfill has a similar concentration profile to chloride found elsewhere in the RGA at PGDP, including concentrations of chloride located further upgradient of the C-746-U Landfill and MW372 and MW373.

- Dissolved solids concentrations average 262 mg/L at PGDP. Concentrations in C-746-S&T upgradient wells and concentrations in C-746-U upgradient wells (without MW372 and MW373) average 226-255 mg/L. The third quarter concentrations for MW372/MW373 average 590 mg/L. Table B.1 compares mean concentrations of constituents present in RGA wells at PGDP with the following: thus, concentrations in MW372/MW373 are above what might be considered typical for PGDP RGA groundwater. These elevated concentrations are not the result of contributions from the C-746-U Landfill because MW372 and MW373 are located upgradient of the landfill.

- Conductivity in the upgradient C-746-S&T Landfill and C-746-U Landfill samples (not including MW372/MW373) average 380–455 µmhos/cm; but, conductivity in MW372/MW373 averages 893 µmhos/cm for the 3rd Quarter 2012. The third quarter concentrations for MW372/MW373 are above what might be considered typical for PGDP RGA groundwater. These elevated concentrations are not the result of contributions from the C-746-U Landfill because MW372 and MW373 are located upgradient of the landfill.

- Magnesium concentrations average 11 mg/L at PGDP. Concentrations in C-746-S&T upgradient wells and concentrations in C-746-U upgradient wells (without MW372 and MW373) average 9.9-11 mg/L. The third quarter concentrations for MW372/MW373 average 29 mg/L; thus, concentrations in MW372/MW373 are above what might be considered typical for PGDP RGA groundwater. These elevated concentrations are not the result of contributions from the C-746-U Landfill because MW372 and MW373 are located upgradient of the landfill.

- Sulfate concentrations average 33 mg/L in the RGA at PGDP. Concentrations upgradient to the C-746-S&T and C-746-U Landfills (not including MW372/MW373) average somewhat lower than that (12 mg/L); however, concentrations in MW372 and MW373 average 195 mg/L. This average is well above the slight concentration variations noted in other C-746-U Landfill wells that appear to be within the range of PGDP background. These elevated concentrations are not the result of contributions from the C-746-U Landfill because MW372 and MW373 are located upgradient of the landfill.

The source(s) of the elevated levels of calcium, conductivity, dissolved solids, magnesium, and sulfate in MW372 and MW373 are uncertain; however, due to the location of these wells upgradient of the C-746-U Landfill, the C-746-U Landfill is not the source. Additional evaluation of these two wells may identify the sources of these constituents.

B.6. COMPARISON TO CONSTITUENTS PRESENT IN LEACHATE

Table B.2 provides a review of the concentrations of constituents that have been evaluated in connection with the C-746-U Landfill, compared to concentrations of constituents found in the C-746-U Landfill leachate. If the C-746-U Landfill had impacts on the RGA groundwater, one principal mechanism would be via migration of the landfill leachate through the liner and through the underlying UCRS.

Table B.2. Comparison of Leachate Concentrations to RGA Groundwater Concentrations

Constituent (units)	Mean Conc. C-746-U Landfill Leachate (mg/L)[a]	Mean Conc. RGA Wells at PGDP (mg/L)[a]	3rd Quarter 2012 Mean Conc. of MW372 and MW373 (mg/L)[a]	Comments
Beta activity (pCi/L)	79	291	43	Kentucky MCL of 50 pCi/L. Although landfill leachate could be a source of some beta activity, it cannot fully account for an exceedance of the Kentucky MCL in RGA groundwater. The DAF estimated for the PGDP UCRS is approximately 58 (and would be orders of magnitude higher for migration through the landfill liner). Thus, beta activity would have to be orders of magnitude higher than it is to account for the RGA concentrations The wells with the beta activity exceedance (MW372 and MW373) are upgradient-to-the-C-746-U Landfill wells. Based on the DAF and leachate concentrations, there is no measurable C-746-U Landfill source of beta activity.
Beta activity (since January 2010) (pCi/L)	38	562	43	Kentucky MCL of 50 pCi/L. Beta activity not elevated above the MCL in leachate over last 2+ years. As above, there is a DAF of 58+; thus, no measurable C-746-U source.
Boron	0.43	0.69	1.6	Concentrations below RSL in RGA wells. Boron concentrations are lower in leachate than in RGA wells; however, concentrations are higher in upgradient wells MW372/MW373. Thus, no apparent C-746-U source, but some indication of higher concentrations in upgradient wells from other sources.
Calcium	107	28	73	No RSL. Although calcium is elevated in leachate, the leachate concentrations would have to be orders of magnitude higher to account for the RGA concentrations given the DAF of 58+. There are non-C-746-U Landfill leachate sources contributing to upgradient MW372 and MW373 concentrations. Note: the leachate sample may have suspended calcium (whole leachate sample). No apparent C-746-U source.
Chloride	39	46	46	Concentrations below SMCL of 250 mg/L. Chloride concentrations lower in in leachate than in RGA wells. Thus, the leachate is not the source of the RGA groundwater chloride concentrations. No apparent C-746-U source.
Cobalt	0.015	0.019	0.0010	Although cobalt concentrations exceed RSL, cobalt concentrations in leachate not elevated above concentrations typical of PGDP RGA groundwater. No apparent C-746-U source.
Dissolved solids	622	262	590	Dissolved solids concentrations above SMCL in leachate but at levels that are comparable to concentrations in upgradient wells MW372 and MW373. The DAF estimated for PGDP is 58+; thus, the dissolved solids concentrations in leachate would have to be orders of magnitude higher than observed to account for the RGA concentrations found in downgradient wells. No apparent C-746-U source.
Iron	2.8	0.65	0.3	Iron concentration mean below RSL in leachate. The DAF estimated for PGDP is 58+; thus, the dissolved solids concentrations in leachate would have to be orders of magnitude higher than observed to account for the RGA concentrations found in downgradient wells. Concentrations in C-746-U Landfill wells within range typical of PGDP. No apparent C-746-U source.

Table B.2. Comparison of Leachate Concentrations to RGA Groundwater Concentrations (Continued)

Constituent (units)	Mean Conc. C-746-U Landfill Leachate (mg/L)[a]	Mean Conc. RGA Wells at PGDP (mg/L)[a]	3rd Quarter 2012 Mean Conc. of MW372 and MW373 (mg/L)[a]	Comments
Magnesium	28	11	29	No RSL. Magnesium concentrations in leachate comparable to levels in upgradient wells MW372/MW373. The DAF for native materials is approximately 58. No apparent C-746-U source.
Manganese	1.2	0.85	0.035	
Sodium	63	41	65	No RSL. Sodium concentrations in leachate comparable to concentrations found in upgradient wells MW372/MW373. DAF for native materials of 58. No apparent C-746-U source.
Sulfate	198	33	195	Mean concentrations below SMCL. Sulfate concentrations in leachate comparable to concentrations found in upgradient wells MW372/MW373. No apparent C-746-U source.
Trichloroethene	Nondetect	N/A	0.0054	MCL of 0.005 mg/L. No detectable TCE in leachate. Upgradient MW372/MW373 average just above MCL of 0.005 mg/L. C-746-U is not a source of TCE to the RGA.

[a] Except for beta activity

As shown in Table B.2, there is no "fingerprint" that can be associated with the C-746-U Landfill leachate. Leachate concentrations of many constituents typically are the same order of magnitude as the mean concentrations found in RGA wells in the vicinity of PGDP [as identified in the Groundwater Operable Unit Feasibility Study (2001) and updated in the Soils Operable Unit Remedial Investigation (2013)].

Mean calcium and sulfate concentrations in leachate are higher than the other constituents, but the concentrations in leachate may have contributions from suspended solids (because leachate samples are not collected using low-flow-equivalent techniques). Overall, none of the constituents present in leachate is found at a concentration that accounts for more than a fraction of the concentration of the RGA constituents because the dilution attenuation factor (DAF) estimated for native UCRS materials at PGDP is 58, and the DAF for a lined landfill (like the C-746-U Landfill) is expected to be orders of magnitude higher.

Constituents present in the UCRS have the potential to migrate to the RGA. This migration will be attenuated based upon the nature of the materials through which the migration is occurring. For example, migration through a clay matrix will be slower than through a sandy matrix. Modeling performed at PGDP has estimated the UCRS attenuation factor at 58 (UCRS concentrations are attenuated by a factor of 58 as the constituent migrates to the RGA). A landfill liner would attenuate the leachate better than the native clay, silt, and sand materials present in the UCRS. Thus, for the constituents present in C-746-U Landfill leachate to account for the concentrations found in the RGA in the vicinity of the C-746-U Landfill, the leachate concentrations would have to be orders of magnitude higher than they are to migrate through both the landfill liner and UCRS. Thus, the C-746-U Landfill is not the source of the RGA groundwater constituents found in wells in the vicinity of the C-746-U Landfill.

B.7 COMPARISON TO CONSTITUENTS IN C-746-S LEACHATE

Table B.3 provides a review of the concentrations of constituents that have been evaluated in association with the C-746-U Landfill Groundwater Assessment and compares them to concentrations found in the S-Landfill leachate. As shown in that table, there is no "fingerprint" that can be associated with the S-Landfill leachate. The table compares S-Landfill leachate concentrations to U-Landfill leachate concentrations, mean concentrations of constituents in PGDP wells, and the mean concentrations in MW372/MW373 (wells located upgradient of the U-Landfill but downgradient of the S-Landfill) for the 3rd Quarter 2012. With the exception of manganese, concentrations of constituents are typically within an order of magnitude as the mean concentrations found in the U-Landfill leachate and do not indicate a source to RGA wells at the C-746-U Landfill.

As in the discussion for the C-746-U-Landfill presented above, constituent concentrations may be more elevated in leachate because the concentrations in leachate may have contributions from suspended solids (as leachate samples are not collected using low-flow-equivalent techniques). Overall, none of the constituents present in leachate is found at a concentration that accounts for more than a fraction of the concentration of the RGA constituents in that the DAF estimated for native materials underlying the S-Landfill is 58.

Table B.3 Comparison of S-Landfill Leachate Concentrations to RGA Groundwater Concentrations

Constituent (units)	Mean Conc. S-Landfill Leachate (mg/L)[1]	Mean Conc. U-Landfill Leachate(mg/L)[1]	Mean Conc. RGA Wells at PGDP (mg/L)[1]	Mean Conc. of MW372 and MW373(mg/L)[1]	Comments
Beta Activity (pCi/L)	24	79	29	43	S-Landfill leachate has beta activity at levels similar to RGA well activity. S-Landfill beta activity has not exceeded the MCL since 2005. The S Landfill is not a source of gross beta to RGA groundwater at measurable levels.
Boron[5]	Nondetect at 0.2-2.0	0.43	0.75	1.6	No detectable boron in S-Landfill leachate. The S Landfill is not a source of boron to the RGA, including MW372 or MW373.
Calcium	167	98	28	73	Although calcium is elevated in leachate, there are nonleachate sources contributing to MW372 and MW373 concentrations because the DAF is 58, minimum. Leachate sample may have suspended calcium (whole leachate sample).
Chloride	22	39	46	46	Chloride concentration not elevated in leachate. Chloride concentrations lower in S-Landfill leachate than typical RGA well concentrations.
Cobalt	0.0082	0.015	0.019	0.0010	Cobalt concentration not elevated in leachate. Cobalt concentrations less in S-Landfill and below typical RGA groundwater levels.
Dissolved Solids	683	622	262	585	Dissolved solids concentrations only slightly elevated in leachate. The DAF estimated for PGDP is approximately 58. Little evidence that S-Landfill is source of significant dissolved solids.
Iron	8.3	2.8	28	0.3	Iron concentration not elevated in leachate.
Magnesium	23	28	11	28	Magnesium concentration slightly elevated in leachate, but not at levels that contribute to RGA concentrations as DAF for native materials, is approximately 58.
Manganese	1.1	1.2	0.091	0.035	
Sodium	27	63	41	65	S-Landfill leachate sodium concentrations below background levels in RGA wells.
Sulfate	181	198	33	195	Sulfate concentrations lower in S-Landfill; sulfate slightly elevated in leachate, but not at levels that contribute significantly to RGA concentrations.
Trichloroethene	Nondetect	Nondetect	N/A	0.0054	No detectable TCE in leachate. The S-Landfill is not a source of TCE to the RGA in the vicinity of the U-Landfill.

[1] Except for beta activity, however, additional discussion is provided because levels are approaching the SMCL.

Although concentrations of manganese are much higher in the S-Landfill leachate, the concentrations of manganese are not elevated in wells, like MW372 and MW373, that are located downgradient of the S-Landfill. Thus, there is no indication that manganese (or any other S-Landfill leachate constituent) is migrating from the S-Landfill at concentrations that cause a measurable impact on the RGA groundwater in the vicinity of the C-746-U Landfill.

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APPENDIX C

HOME SITE WELL WATER SAMPLE ANALYTICAL RESULTS

Paducah OREIS Report for EMSPGW09-01

ABW2W12-08 from: ABW2 on 1/23/2009 Media: WG SmpMethod: GR

Comments:

Analysis	Results	Counting Error	Units	Result Qual	Foot Note	Reporting Limit	TPU	Method	V/V/A*
ANION									
Bromide	2		mg/L	U		2		SW846-9056	/ X /
Chloride	14		mg/L			2		SW846-9056	/ X /
Fluoride	0.16		mg/L			0.1		9214	/ X /
Nitrate as Nitrogen	1		mg/L	*U		1		SW846-9056	/ X / R-T
Sulfate	2		mg/L	U		2		SW846-9056	/ X /
METAL									
Aluminum	3.76		mg/L			0.2		SW846-6010B	I / X /
Antimony	0.005		mg/L	UB		0.005		SW846-6020	/ X /
Arsenic	0.0691		mg/L			0.01		SW846-6020	I / X /
Barium	0.25		mg/L			0.005		SW846-6020	/ X /
Beryllium	0.001		mg/L	U		0.001		SW846-6020	/ X /
Boron	0.2		mg/L	U		0.2		SW846-6010B	/ X /
Cadmium	0.001		mg/L	U		0.001		SW846-6020	/ X /
Calcium	36.4		mg/L			1		SW846-6010B	/ X /
Chromium	0.1		mg/L	UN		0.1		SW846-6020	/ X /
Cobalt	0.0129		mg/L			0.01		SW846-6020	/ X /
Copper	0.2		mg/L	U		0.2		SW846-6020	/ X /
Iron	14.3		mg/L			0.1		SW846-6010B	I / X /
Lead	0.0147		mg/L			0.0013		SW846-6020	/ X /
Magnesium	7.77		mg/L			0.025		SW846-6010B	/ X /
Manganese	2.28		mg/L			0.05		SW846-6020	I / X /
Mercury	0.0002		mg/L	U		0.0002		SW846-7470A	/ X /
Molybdenum	0.00115		mg/L			0.001		SW846-6020	/ X /
Nickel	0.05		mg/L	U		0.05		SW846-6020	/ X /
Potassium	19.4		mg/L			0.2		SW846-6010B	/ X /
Rhodium	0.005		mg/L	UB		0.005		SW846-6020	/ X /
Selenium	0.005		mg/L	UBX		0.005		SW846-6020	/ X /
Silver	0.001		mg/L	UB		0.001		SW846-6020	/ X /
Sodium	14.2		mg/L			1		SW846-6010B	/ X /
Tantalum	0.005		mg/L	U		0.005		SW846-6020	/ X /
Thallium	0.002		mg/L	UX		0.002		SW846-6020	/ X /
Uranium	0.00608		mg/L			0.001		SW846-6020	/ X /
Vanadium	0.2		mg/L	U		0.2		SW846-6020	/ X /
Zinc	0.2		mg/L	U		0.2		SW846-6020	/ X /
METAL-D									
Barium, Dissolved	0.0637		mg/L			0.005		SW846-6020	/ X /
Chromium, Dissolved	0.01		mg/L	U		0.01		SW846-6020	/ X /
Uranium, Dissolved	0.001		mg/L	U		0.001		SW846-6020	/ X /
PHYSC									
Dissolved Solids	238		mg/L			45		EPA-160.1	/ X /
PPCB									
PCB-1016	0.17		ug/L	U		0.17		SW846-8082	/ X /
PCB-1221	0.18		ug/L	U		0.18		SW846-8082	/ X /
PCB-1232	0.14		ug/L	U		0.14		SW846-8082	/ X /
PCB-1242	0.1		ug/L	U		0.1		SW846-8082	/ X /
PCB-1248	0.12		ug/L	U		0.12		SW846-8082	/ X /
PCB-1254	0.07		ug/L	U		0.07		SW846-8082	/ X /
PCB-1260	0.05		ug/L	U		0.05		SW846-8082	/ X /
PCB-1268	0.09		ug/L	U		0.09		SW846-8082	/ X /

*Verification/Validation/Assessment

Polychlorinated biphenyl	0.18		ug/L	UX	0.18		SW846-8082	/ X /
RADS								
Alpha activity	-5.83	3.89	pCi/L	U	33.3	4.05	SW846-9310	/ X /
Beta activity	51.8	7.79	pCi/L	U	63	9.88	SW846-9310	/ X /
Iodine-131	-2.93	5.85	pCi/L	U	6.43	5.85	RL-7124	/ X /
Radium-226	0.325	0.404	pCi/L	U	0.68	0.449	RL-7129	/ X /
Strontium-90	1.13	0.154	pCi/L	U	1.27	0.191	RL-7140	/ X /
Technetium-99	1.83	10.1	pCi/L	U	15.2	10.1	RL-7100	/ X /
Thorium-230	0.0906	0.154	pCi/L	U	1.81	0.766	RL-7128	/ X /
Tritium	220	736	pCi/L	UB	264	736	RL-7155	/ X /
SVOA								
1,2-Dichlorobenzene	5		ug/L	U	5		SW846-8260B	/ X /
1,4-Dichlorobenzene	5		ug/L	U	5		SW846-8260B	/ X /
VOA								
1,1,1,2-Tetrachloroethane	5		ug/L	U	5		SW846-8260B	/ X /
1,1,1-Trichloroethane	1		ug/L	U	1		SW846-8260B	/ X /
1,1,2,2-Tetrachloroethane	5		ug/L	U	5		SW846-8260B	/ X /
1,1,2-Trichloroethane	1		ug/L	U	1		SW846-8260B	/ X /
1,1-Dichloroethane	1		ug/L	U	1		SW846-8260B	/ X /
1,1-Dichloroethene	1		ug/L	U	1		SW846-8260B	/ X /
1,2,3-Trichloropropane	5		ug/L	U	5		SW846-8260B	/ X /
1,2-Dibromoethane	5		ug/L	U	5		SW846-8260B	/ X /
1,2-Dichloroethane	1		ug/L	U	1		SW846-8260B	/ X /
1,2-Dichloropropane	5		ug/L	U	5		SW846-8260B	/ X /
2-Butanone	10		ug/L	U	10		SW846-8260B	/ X /
2-Hexanone	10		ug/L	U	10		SW846-8260B	/ X /
4-Methyl-2-pentanone	10		ug/L	U	10		SW846-8260B	/ X /
Acetone	10		ug/L	U	10		SW846-8260B	/ X /
Acrolein	25		ug/L	UJ	25		SW846-8260B	/ X /
Acrylonitrile	10		ug/L	U	10		SW846-8260B	/ X /
Benzene	5		ug/L	U	5		SW846-8260B	/ X /
Bromochloromethane	5		ug/L	U	5		SW846-8260B	/ X /
Bromodichloromethane	5		ug/L	U	5		SW846-8260B	/ X /
Bromoform	5		ug/L	U	5		SW846-8260B	/ X /
Bromomethane	5		ug/L	U	5		SW846-8260B	/ X /
Carbon disulfide	5		ug/L	U	5		SW846-8260B	/ X /
Carbon tetrachloride	1		ug/L	U	1		SW846-8260B	/ X /
Chlorobenzene	5		ug/L	U	5		SW846-8260B	/ X /
Chloroethane	5		ug/L	U	5		SW846-8260B	/ X /
Chloroform	5		ug/L	U	5		SW846-8260B	/ X /
Chloromethane	5		ug/L	U	5		SW846-8260B	/ X /
cis-1,2-Dichloroethene	1		ug/L	U	1		SW846-8260B	/ X /
cis-1,3-Dichloropropene	5		ug/L	U	5		SW846-8260B	/ X /
Dibromochloromethane	5		ug/L	U	5		SW846-8260B	/ X /
Dibromomethane	5		ug/L	U	5		SW846-8260B	/ X /
Ethylbenzene	5		ug/L	U	5		SW846-8260B	/ X /
Iodomethane	5		ug/L	UJ	5		SW846-8260B	/ X /
Methylene chloride	5		ug/L	U	5		SW846-8260B	/ X /
Styrene	5		ug/L	U	5		SW846-8260B	/ X /
Tetrachloroethene	1		ug/L	U	1		SW846-8260B	/ X /
Toluene	9.6		ug/L		5		SW846-8260B	/ X /
Total Xylene	15		ug/L	U	15		SW846-8260B	/ X /
trans-1,2-Dichloroethene	1		ug/L	U	1		SW846-8260B	/ X /
trans-1,3-Dichloropropene	5		ug/L	U	5		SW846-8260B	/ X /
Trans-1,4-Dichloro-2-butene	5		ug/L	U	5		SW846-8260B	/ X /
Trichloroethene	1		ug/L	U	1		SW846-8260B	/ X /

Trichlorofluoromethane	5	ug/L	U	5	SW846-8260B	/ X /
Vinyl acetate	10	ug/L	U	10	SW846-8260B	/ X /
Vinyl chloride	2	ug/L	U	2	SW846-8260B	/ X /
WETCHEM						
Chemical Oxygen Demand (COD)	73	mg/L		25	EPA-410.4	/ X /
Cyanide	0.05	mg/L	JU	0.05	SW846-9010C	/ X /
Suspended Solids	77	mg/L		20	EPA-160.2	/ X /
Total Organic Carbon (TOC)	24.7	mg/L	D	1	SW846-9060	/ X /
Total Organic Halides (TOX)	21.3	ug/L		10	SW846-9020B	/ X /

ABW2W12-08R from: ABW2 on 2/12/2009 Media: WG SmpMethod: GR

Comments:

Analysis	Results	Counting Error	Units	Result Qual	Foot Note	Reporting Limit	TPU	Method	V/V/A*
ANION									
Nitrate as Nitrogen	5.6		mg/L			1		SW846-9056	/ X /

*Verification/Validation/Assessment

Paducah OREIS Report for EMSPGW09-01

TBABW212-08 from: QC on 1/23/2009 Media: WQ SmpMethod:

Comments:

Analysis	Results	Counting Error	Units	Result Qual	Foot Note	Reporting Limit	TPU	Method	V/V/A*
SVOA									
1,2-Dichlorobenzene	5		ug/L	U		5		SW846-8260B	/ X /
1,4-Dichlorobenzene	5		ug/L	U		5		SW846-8260B	/ X /
VOA									
1,1,1,2-Tetrachloroethane	5		ug/L	U		5		SW846-8260B	/ X /
1,1,1-Trichloroethane	1		ug/L	U		1		SW846-8260B	/ X /
1,1,2,2-Tetrachloroethane	5		ug/L	U		5		SW846-8260B	/ X /
1,1,2-Trichloroethane	1		ug/L	U		1		SW846-8260B	/ X /
1,1-Dichloroethane	1		ug/L	U		1		SW846-8260B	/ X /
1,1-Dichloroethene	1		ug/L	U		1		SW846-8260B	/ X /
1,2,3-Trichloropropane	5		ug/L	U		5		SW846-8260B	/ X /
1,2-Dibromoethane	5		ug/L	U		5		SW846-8260B	/ X /
1,2-Dichloroethane	1		ug/L	U		1		SW846-8260B	/ X /
1,2-Dichloropropane	5		ug/L	U		5		SW846-8260B	/ X /
2-Butanone	10		ug/L	U		10		SW846-8260B	/ X /
2-Hexanone	10		ug/L	U		10		SW846-8260B	/ X /
4-Methyl-2-pentanone	10		ug/L	U		10		SW846-8260B	/ X /
Acetone	10		ug/L	U		10		SW846-8260B	/ X /
Acrolein	25		ug/L	UJ		25		SW846-8260B	/ X /
Acrylonitrile	10		ug/L	U		10		SW846-8260B	/ X /
Benzene	5		ug/L	U		5		SW846-8260B	/ X /
Bromochloromethane	5		ug/L	U		5		SW846-8260B	/ X /
Bromodichloromethane	5		ug/L	U		5		SW846-8260B	/ X /
Bromoform	5		ug/L	U		5		SW846-8260B	/ X /
Bromomethane	5		ug/L	U		5		SW846-8260B	/ X /
Carbon disulfide	5		ug/L	U		5		SW846-8260B	/ X /
Carbon tetrachloride	1		ug/L	U		1		SW846-8260B	/ X /
Chlorobenzene	5		ug/L	U		5		SW846-8260B	/ X /
Chloroethane	5		ug/L	U		5		SW846-8260B	/ X /
Chloroform	5		ug/L	U		5		SW846-8260B	/ X /
Chloromethane	5		ug/L	U		5		SW846-8260B	/ X /
cis-1,2-Dichloroethene	1		ug/L	U		1		SW846-8260B	/ X /
cis-1,3-Dichloropropene	5		ug/L	U		5		SW846-8260B	/ X /
Dibromochloromethane	5		ug/L	U		5		SW846-8260B	/ X /
Dibromomethane	5		ug/L	U		5		SW846-8260B	/ X /
Ethylbenzene	5		ug/L	U		5		SW846-8260B	/ X /
Iodomethane	5		ug/L	UJ		5		SW846-8260B	/ X /
Methylene chloride	5		ug/L	U		5		SW846-8260B	/ X /
Styrene	5		ug/L	U		5		SW846-8260B	/ X /
Tetrachloroethene	1		ug/L	U		1		SW846-8260B	/ X /
Toluene	5		ug/L	U		5		SW846-8260B	/ X /
Total Xylene	15		ug/L	U		15		SW846-8260B	/ X /
trans-1,2-Dichloroethene	1		ug/L	U		1		SW846-8260B	/ X /
trans-1,3-Dichloropropene	5		ug/L	U		5		SW846-8260B	/ X /
Trans-1,4-Dichloro-2-butene	5		ug/L	U		5		SW846-8260B	/ X /
Trichloroethene	1		ug/L	U		1		SW846-8260B	/ X /
Trichlorofluoromethane	5		ug/L	U		5		SW846-8260B	/ X /
Vinyl acetate	10		ug/L	U		10		SW846-8260B	/ X /
Vinyl chloride	2		ug/L	U		2		SW846-8260B	/ X /

*Verification/Validation/Assessment

Laboratory Footnotes and Qualifiers

Footnote

A. Insufficient uranium present in the sample to determine an assay.
B. Maximum assay was used to calculate the MDA for total uranium activities.
C. Normal assay was used to calculate the MDA for total uranium activities.
D. The relative bias for the LCS is greater than 25%.
E. Gross activities are a calculated value. Gamma activity is converted to the corresponding gross alpha/beta measurement.
F. Insufficient sample available/provided for gross beta analysis.
G. TIMS assay used to calculate total uranium activity.
H. No nuclide meet criteria for gross gamma.
I. The MDA of all principle nuclide not identified and nuclide identified were summed to provide max, reportable activity
J. No analysis result available. Sample signal too weak.
K. No analysis result available. Total U below reporting limit.
L. No minor isotope determination available. Signal strength insufficient.
M. Result is biased high and MDA is biased low due to interfering lines and/or increases in BKG due to sample activity.
N. Measured U-235 act/mass was below MDA therefore all other cal. U isotopes & U-total will be rpt as below their resp. MDAs.
O. Gross Gamma has no output error.
P. The max plant assay was assumed since the calculated assay was not within the range of the plant cascade assays.
Q. Mass of U-235 is < or = MDM, thus mass of total U/U isotopes won't be reported. Total U/U isotopes will be < their MDAs
Asbestos – Not Detected
R. Cs-134 activity will be understated due to the short half-life and will exclude any previous site induced Cs-134.
S. Gross gamma is a Cs-137 equivalence. Activity assumes branch yield and det eff of Cs-137 for all line in spectrum.
T. Analyte is a common volatile laboratory contaminant
T1. Sample analysis is below LCR for concent.,however above report. limit for assay.
T1Z1. Samp analysis below LCR concent,above report.limit assay/.05wt% = or >2 sigma?
V. Method 5030A (Purge & Trap)
W. Analyte is present at the LCR.
X. See comments for explanation
Y. U/U-234 act are estimated. Assay used was determined by gamma. U/U-234 results can't be used for any NCS/NMC&A purposes. - Uranium
Z. Std Dev is calculated based on controls (SRM) prepared and analyzed with each sample batch. SRM is ~0.711 wt% U-235.
Z1. This 0.05 wt% value equal to or > 2 sigma for controls associated w/data.

Inorganic Qualifiers

* Duplicate analysis not within control limits.
\+ Method of standard additions (MSA) correlation coefficient less than 0.995.
A Indicates that a TIC is suspected aldol-condensation product.
B Applies when the analyte is found in the associated blank
D All compounds identified in the analysis at the secondary dilution factor.
E Result estimated due to interferences.
J Indicates an estimated value
M Duplicate injection precision not met.
N Sample spike recovery not within control limits.
Q No analytical result available or not required because total analyses< PQL.
R QC indicates that data are not usable. Resampling and re-analysis are necessary for verification.
S Result determined by method of standard additions (MSA).
U Analyte analyzed for but not detected at or below the lowest concentration reported.
W Post-digestion spike recovery out of control limits.
X Other specific flags and footnotes may be required to properly define the results.

Organic Qualifiers

A Tentatively identified compound (TIC) is suspected aldol-condensation product.
B Compound found in blank as well as sample.
C Compound presence confirmed by GC/MS (GC/MS flag).
D Compounds identified in an analysis at a secondary dilution filter.
E Result exceeds calibration range (GC/MS flag).
J Indicates an estimated value.
N Presumption evidence of a compound GC/MS flag).
P Difference between results from two GC columns unacceptable.
U Compound analyzed for but not detected at or below the lowest concentration reported.
X Other specific flags and footnotes may be required to properly define the results.
Y MS, MSD recovery and/or RPD failed acceptance criteria.
Z (Reserved by CLP for a laboratory-defined organic date qualifier.)

Rad Qualifiers

A Analyzed but not detected at the analyte quantitation limit.
B Method blank not statistically different from sample at 95% level of confidence.
D Sample is statistically different from duplicate at 95% level of confidence.

J Indicates an estimated value.
L Expected and measured value for LCS is statistically different at 95% level of confidence.
M Expected and measured value for MS is statistically different at 95% level of confidence.
R QC indicates that data are not usable. Resampling and reanalysis are necessary for verification.
T Tracer recovery is < or equal to 30% or > or equal to 105%.
U Value reported is < the MDA and/or < 2 sigma TPE.
X Other specific flags and footnotes may be required to properly define the results.

PEMS/OREIS CODES

Media Codes

AG	Soil Gas
AQ	Air Quality Control Matrix
DC	Drill Cuttings
FR	Filter Residue
FT	Filter
GR	Grout
LD	Drilling Fluid
LF	Floating/Free Product on Groundwater Table
LO	Oil, All Types (Transformer, Waste, Motor, Mineral)
LT	Liquid from tank
MD	Meteorological
MS	Metal Shavings
NA	Not Available
NW	Non-Water Liquid
QA	Aquatic Animal
QB	Aquatic Bird
QC	Aquatic (Some combination of at least 2) of bird, plant, animal; Excludes benthic organism
QN	Benthic Organism
QP	Aquatic Plant
SC	Cement
DIL	Laboratory dilution
SE	Sediment (associated with surface water)
SF	Filter Sandpack
SL	Sludge
SO	Soil
SP	Floor Sweepings
SQ	Soil/Solid Quality Control Matrix
SS	Scrapings
SW	Swab or Wipe
SZ	Solid Waste
TB	Terrestrial Bird
TC	Terrestrial (Some combination at least 2) of bird, plant, or animal.
TW	Treated Water
WC	Wall corings
WG	Groundwater
WL	Water that has leached through waste
WQ	Water Quality Control Matrix
WS	Surface Water
WW	Waste Water
WZ	Special Water Control Matrix

Smp Method Codes

?	Other, defined in COMMENTS column
CSF	Continuous Sample Flow
ES	Estimate
FPC	Flow Proportional Composite
GR	Grab
NA	Not Applicable
SC	Spatial Composite
SPLT	Split
TC	Temporal Composite

Sample Type Codes

?	Other, defined in COMMENTS column
DI	Deionized Water used for preparing blanks, etc.
FB	Field Blank
FR	Field Replicate (Code used for Field Duplicate)
FTB	Filter Blank
PRBL	Preservative blank
RB	Refrigerator blank
REG	Regular
REG2	Regular sample, secondary analysis
REP	Replicate
REP1	Replicate 1
RI	QC Equipment Rinsate/Decon
TB	Trip Blank
TLC	Toxicity Laboratory Control Sample

Verification Codes

?	Other, defined in COMMENTS column
B	Result exceeds background criteria
I	Result exceeds established criteria
S	Result exceeds statistical controls based on historical data
T	Holding time exceeded for this analysis
X	Result exceeds permit limits

Validation Codes

=	Validated result, which is detected and unqualified
?	Other, defined in COMMENTS column
D	Analyte, compound or nuclide detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
R	Result rejected by validator.
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
X	Not validated; Refer to the RSLTQUAL field for more information

Assessment Codes

BH-ER	Result may be biased high; chemical detected in associated equipment rinseate
BH-CONT	Result may be biased high due to contamination of the sample from the field or laboratory
BH-FB	Result may be biased high; chemical detected in associated field blank
BH-FB BH-RI	Result may be biased high; chemical detected in associated field blank and Result may be biased high, chemical detected in associated equipment rinsate.
BH-FB BH-TB	Result may be biased high; chemical detected in associated field blank and result may be biased high; chemical detected in associated trip blank.
BH-FB,&	Result may be biased high; chemical detected in associate field blank. See comments for additional assessment qualifiers
BH-LAB	Result may be biased high; compound is a known or probable lab contaminant.
BH-LABPR	Result biased high due to laboratory process
BH-PURGE	Result may be biased high; sample may be diluted with drilling fluid due to insufficient purging prior to sampling
BH-QC	Result may be biased high based upon lab QC (i.e. surrogate, MS/MSD, etc.)
BH-RB	Result may be biased high; chemical detected in associated refrigerator blank
BH-RI	Result may be biased high, chemical detected in associated equipment rinsate.
BH-SOLID	Result biased high due to sampling containing a large amount of solids
BH-SS	Results may be biased high; sample may contain particles of the acetate sampling sleeve

PEMS/OREIS CODES

Assessment Codes (cont.)

BH-TB	Result may be biased high, chemical detected in associated trip blank
BH-TEMP	Result biased high due to a temperature exceedance.
BL-AIR	Biased low due to air rotary drilling method.
BL-AIR,&	Biased low due to air rotary drilling method. See comments for additional assessment qualifiers.
BL-HS	Biased low due to headspace in sample container
BL-HS, BL-TEMP	Biased low due to headspace in sample container & result biased low due to a temperature exceedance.
BL-LAB	Result may be biased low; compound is a known or probable lab contaminant
BL-LABPR	Result may be biased low due to laboratory process
BL-PRES	Result may be biased low due to improper preservative added.
BL-PURGE	Result may be biased low; sample may be diluted with drilling fluid due to the insufficient purging prior to sampling
BL-PURGE,&	Result may be biased low; sample may be diluted with drilling fluid due to insufficient purging prior to sampling. See comments for additional assessment qualifiers
BL-QC	Result may be biased low based upon lab QC (i.e. surrogate, MS/MSD, etc.)
BL-T	Result may be biased low; sample holding time exceeded
BL-T,J	Result may be biased low; sample holding time exceeded, estimated
BL-TEMP	Result may be biased low due to temperature exceedance.
BL-TEMP, J	Result biased low due to a temperature exceedance, estimated.
BL-TEMP, U	Result biased low due to a temperature exceedance, not detected.
CCCSEXP	Continuous Calibration Check Standard Expired
DIL	Result is obtained from dilution
DIS-EDDF1	Discrepancies between the EDD and the Form 1. Form 1s are generated by instrument software that automatically reports all detected compounds. It is the lab's policy to not report quantities below LCRs within their EDD format. Both sets of data are correct. However, the EDD format data, which feeds OREIS, will be used for reporting.
DR	Discrepancy between summary data report and raw data.
FDUP-OUT	Field duplicate exceeds the RPD criterion
ICSEXP	Initial Calibration Standard Expired
IN-LAB	Result should be considered information only. Compound is a known or probable lab contaminant.
IN-LAB,&	Result should be considered information only. Compound is a known or probable lab contaminant. See comments for additional assessment qualifiers
IN-LABQC	Result should be considered information only. Quality control requirements of the laboratory method were not met.
IN-METH	Result should be considered information only. Lab utilized a modified method.
J	Result estimated
KYRHTAB-50	Kentucky Radiation Health and Toxic Agents Branch (KYRHTAB) has performed an independent data evaluation (not to be confused with data verification and validation) and the rad error accounts for greater than 50% of the results.
KYRHTAB-ER	Kentucky Radiation Health and Toxic Agents Branch (KYRHTAB) has performed an independent data evaluation (not to be confused with data verification and validation) and the data presents error problems (ie., no counting uncertainty or zero counting uncertainty).
KYRHTAB-LT	Kentucky Radiation Health and Toxic Agents Branch (KYRHTAB) has performed an independent data evaluation (not to be confused with data verification and validation) and the results are less than (LT) the maximum detectable activity (MDA) or detection limit and should not be plotted.
KYRHTAB-NE	Kentucky Radiation Health and Toxic Agents Branch (KYRHTAB) has performed an independent data evaluation (not to be confused with data verification and validation) and the ad error exhibits a negative value, which is a statistical outlier.
KYRHTAB-OK	Kentucky Radiation Health and Toxic Agents Branch (KYRHTAB) has performed an independent data evaluation (not to be confused with data verification and validation) and the data is acceptable for use.
LAB-PREP	Prep method used by the lab valid but not proceduralized.
LCSEXP	LCS Expired
LCSNA	Laboratory control sample not analyzed.
LCSNI	LCS Not Independent
MDA-METHOD	The recalculated MDA is considered a method-wide MDA. Batch specific MDAs were not calculated.
MDA-RECALC	The original MDA of 21.4 pCi/L was calculated incorrectly and was recalculated during the Field Laboratory evaluation.The recalculated MDA is 24.7 pCi/L.
MSMSDEXP	Matrix Spike/Matrix Spike Duplicate Standard Expired
N/A	Not Applicable
NOVAL	Validation requested but qualifier not provided due to missing Form I
NOVAL-FLAB	Validation targeted for this project but not required for field laboratory data.
NR	Assessment question not resolved.
PENP	PE Sample Not Performed
QUAL	This data should be considered qualitative due to the sampling process, the variability in the medium sampled or issues with the analytical process.
R	Result unusable
R-C	Result questionable, credibility at issue.
R-C, ?	Result questionable, credibility at issue, other defined in COMMENTS column
R-C, &	Result questionable, credibility at issue. See comments for additional assessment qualifiers

PEMS/OREIS CODES

Assessment Codes (cont.)

R-DUPVAR	Result questionable, measured variability of the field duplicate is outside PARCC parameter expectations, therefore population estimates of variability may be off by several orders of magnitude.
R-H	Result unusable due to historical trending (i.e., other)
R-HSS	Rejected due to high suspended solids content.
R-MTRX	Result rejected due to matrix interference.
R-NORAD	Result unusable; Uranium-235 portion of calculation is below reliable detection limits.
R-NORAD,&	Result unusable; Uranium-235 portion of calculation is below reliable detection limits. See comments for additional assessment qualifiers
R-NTRS	Result rejected; not a true representative sample
R-NTRSFW	Result rejected; not a true representative sample of formation water.
R-PRES	Result rejected due to improper preservative added.
R-RERUN	Result unusable; results for re-analysis should be used
R-T	Result rejected due to missing holding time
U	Not detected
U,J	Not detected and result estimated
U-RAD	Result considered a non-detect; instrument measurement error is equal to or greater than the reported result
U-RAD,&	Result considered a non-detect; instrument measurement error is equal to or greater than the reported result, see comments for additional assessment qualifiers
?	Other, defined in COMMENTS column

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APPENDIX D

PCB IN SOILS FIELD INVESTIGATION SUMMARY

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PCB IN SOILS FIELD INVESTIGATION

INTRODUCTION

The *Groundwater Assessment Plan for the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (PRS/PROJ/006/R2) identified polychlorinated biphenyls (PCBs) as a potential contaminant related to the C-746-U Landfill. Planned assessment actions related to the PCBs included a field investigation to sample and analyze shallow soils for PCB contamination to evaluate if PCB soil contamination areas exist at the northern portion of the landfill permit area. This field investigation focused on the vicinity of monitoring well cluster MW363, MW364, and MW365. PCBs historically have been detected in water samples from Upper Continental Recharge System (UCRS) well MW365, screened over the depth interval 32–42 ft below ground surface (bgs), and in the Regional Gravel Aquifer (RGA) wells, MW363, screened over the depth interval 55–65 ft bgs, and MW364, screened over the depth interval 73–83 ft bgs.

SAMPLING AND ANALYSIS PLAN SUMMARY

Data quality objectives (DQOs) for the PCB field investigation, incorporated as Appendix C of the Groundwater Assessment Plan, were used to develop the sampling and analysis approach. The intent of the investigation was to collect a limited number of soil samples in the vicinity of well MW365 and, if PCB contamination of soils was present, to "step out" within the investigation area until "clean" [less than 1 part per million (ppm) PCBs] soils were encountered. Per the DQOs, sampling was to begin on north-south and east-west axes passing through MW365. The initial sample borings were to be located 30 ft from MW365, with samples collected from the depth intervals 2–4 ft, 4–6 ft, 6–8 ft,10–12 ft, 14–16 ft, and 18–20 ft. Samples were to be analyzed using the Hach PCB in Soil Pocket Colorimeter II Test Kit, using a 5 ppm detection limit. Follow-on confirmatory sampling, to be initiated once the area of PCBs greater than (or equal to) 5 ppm was established, would identify the PCB congeners present in the source zone and refine the defined extent of PCB contamination, to a level of 1 ppm or less, using fixed-base laboratory analysis.

FIELD INVESTIGATION

Following a Paducah Remediation Services, LLC, quality assessment briefing on July 24, 2008, the field collection of samples occurred from July 30–August 5, 2008. (Table D.1 summarizes key dates of the field investigation.) Samplers used a van-mounted Model 5400 Geoprobe, with a dual-tube sampling system, to collect soil samples from the six specified depth intervals (2–4 ft, 4–6 ft, 6–8 ft, 10–12 ft, 14–16 ft, and 18–20 ft) in the first four locations (30 ft from MW365 in north, south, east, and west directions), in accordance with procedures *Direct Push Technology Sampling* (PRS-ENR-0020) (currently PAD-ENR-0020)*; Collection of Soil Samples* (PRS-ENM-2300) (currently PAD-ENM-2300); and *Decontamination of Sampling Equipment and Devices* (PRS-ENM-2702) (currently PAD-ENM-2702).

The dual tube sampling system recovered the cores from each sampling interval in 1.125-inch diameter plastic liners. In the field, the samplers trimmed the 4-ft long liners to the length of the recovered core (frequently greater than each 2-ft sample interval) and capped each end with plastic caps prior to field preservation with ice. Procedure PRS-ENM-2708 (currently PAD-ENM-2708), *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals,* governed the documentation of sample custody. The samples were placed in a secured refrigerator at the end of each day until the sample liners could be

Table D.1. Summary of Dates of Field Investigation and Sample Analyses

BORING	SAMPLE INTERVAL (ft bgs)	SAMPLE ID NUMBER	DATE SAMPLED	DATE CORE DESCRIBED AND SAMPLE PREPARED	DATE OF FIELD TEST KIT ANALYSIS	DATE OF SAMPLE SUBMITTAL TO PGDP LABORATORY
W-30	2-4	UGAPCB08-01	07/30/08	07/31/08	07/31/08	07/31/08
	4-6	UGAPCB08-02	07/30/08	07/31/08	07/31/08	07/31/08
	6-8	UGAPCB08-03	07/30/08	07/31/08	07/31/08	07/31/08
	10-12	UGAPCB08-04	07/30/08	07/31/08	07/31/08	07/31/08
	14-16	UGAPCB08-05	07/30/08	07/31/08	07/31/08	07/31/08
	18-20	UGAPCB08-06	07/30/08	07/31/08	07/31/08	07/31/08
N-30	2-4	UGAPCB08-07	08/04/08	08/05/08	08/06/08	08/06/08
	4-6	UGAPCB08-08	08/04/08	08/05/08	08/06/08	08/06/08
	4-6	DUGAPCB08-01	08/04/08	08/05/08	NA*	08/06/08
	6-8	UGAPCB08-09	08/04/08	08/05/08	08/06/08	08/06/08
	10-12	UGAPCB08-10	08/04/08	08/05/08	08/06/08	08/06/08
	14-16	UGAPCB08-11	08/04/08	08/05/08	08/06/08	08/06/08
	18-20	UGAPCB08-12	08/04/08	08/05/08	08/06/08	08/06/08
S-30	2-4	UGAPCB08-13	08/04/08	08/05/08	08/06/08	08/06/08
	4-6	UGAPCB08-14	08/04/08	08/05/08	08/06/08	08/06/08
	6-8	UGAPCB08-15	08/04/08	08/05/08	08/06/08	08/06/08
	10-12	UGAPCB08-16	08/04/08	08/05/08	08/06/08	08/06/08
	14-16	UGAPCB08-17	08/04/08	08/05/08	08/06/08	08/06/08
	18-20	UGAPCB08-18	08/04/08	08/05/08	08/06/08	08/06/08
E-30	2-4	UGAPCB08-19	08/05/08	08/05/08	08/06/08	08/06/08
	2-4	DUGAPCB08-02	08/05/08	08/05/08	NA	08/06/08
	4-6	UGAPCB08-20	08/05/08	08/05/08	08/06/08	08/06/08
	6-8	UGAPCB08-21	08/05/08	08/05/08	08/06/08	08/06/08
	10-12	UGAPCB08-22	08/05/08	08/05/08	08/06/08	08/06/08
	14-16	UGAPCB08-23	08/05/08	08/05/08	08/06/08	08/06/08
	18-20	UGAPCB08-24	08/05/08	08/05/08	08/06/08	08/06/08

*NA = not analyzed, duplicate for fixed-base lab analysis only

opened, the sample cores described (see Tables D.2 through D.5), and samples prepared for analysis at an on-site sample preparation facility.

The investigation used a field laboratory trailer located at the C-755 sample preparation facility to perform the test kit analyses. Table D.6 documents the test kit analyses. For each soil sample of the initial four soil borings, a sample also was collected for analysis by the PGDP Analytical Services using Method 8082. Table D.7 summarizes the fixed-base laboratory analyses. Both field analysis and fixed-base laboratory analysis document that PCBs are not present in the soil samples at detectable levels.

Table D.2. Sample Lithologic Descriptions for West Boring

BORING	SAMPLE INTERVAL (ft bgs)	DATE SAMPLED	LITHOLOGIC DESCRIPTION
W-30	2-4	07/30/08	SILT, 10YR4/6 (dark yellowish brown), soft, plastic, and moist, grading downward to CLAY, 10YR6/6 (brownish yellow), soft, plastic, and moist
	4-6	07/30/08	SILT, 10YR6/6 (brownish yellow), soft, plastic, and moist
	6-8	07/30/08	SILT as above
	10-12	07/30/08	SILT, 7.5YR6/6 (reddish yellow), moderately soft, low plasticity, and moist
	14-16	07/30/08	SILT, 10YR7/1 (light gray) mottled with 10YR7/6 (yellow), moderately soft, low plasticity, and moist
	18-20	07/30/08	SILT as above but with lesser mottling

Table D.3. Sample Lithologic Descriptions for North Boring

BORING	SAMPLE INTERVAL (ft bgs)	DATE SAMPLED	LITHOLOGIC DESCRIPTION
N-30	2-4	08/04/08	SILT, 10YR7/1 (light gray) mottled with 10YR7/6 (yellow), soft, plastic, and wet
	4-6	08/04/08	SILT, 10YR7/1 (light gray) mottled with 10YR6/6 (brownish yellow), moderately soft, medium plasticity, and moist. Trace 10YR2/1 (black) flecks (manganese?)
	6-8	08/04/08	SILT, 10YR5/6 (yellowish brown) with little mottling by 10YR7/1 (light gray), moderately soft, low to medium plasticity, and moist
	10-12	08/04/08	SILT, 10YR5/6 (yellowish brown), moderately soft, low to medium plasticity, and moist
	14-16	08/04/08	SILT, 10YR7/1 (light gray) with some 10YR6/8 (brownish yellow) mottling, moderately soft, medium plasticity, and moist
	18-20	08/04/08	SILT as above

Table D.4. Sample Lithologic Descriptions for South Boring

BORING	SAMPLE INTERVAL (ft bgs)	DATE SAMPLED	LITHOLOGIC DESCRIPTION
S-30	2-4	08/04/08	SILT, 10YR6/3 (pale brown), soft, medium plasticity, and moist, grading downward to SILT, 10YR6/6 (brownish yellow) mottled with 10YR7/1 (light gray), moderately soft, medium plasticity, and moist
	4-6	08/04/08	SILT, 10YR6/6 (brownish yellow), moderately soft, low plasticity, and slightly moist (grading downward to moist)
	6-8	08/04/08	SILT, 10YR6/6 (brownish yellow), moderately soft, low plasticity, and moist
	10-12	08/04/08	SILT, 7.5YR5/6 (strong brown), moderately soft, low plasticity, and moist
	14-16	08/04/08	SILT, 10YR7/1 (light gray) mottled with 10YR6/6 (brownish yellow), moderately soft to hard, low plasticity, and moist
	18-20	08/04/08	18.0-19.6': SILT as above. 19.6-19.9': SILT with some sand, 7.5YR5/6 (strong brown), hard, low plasticity, and moist. Trace pebbles. 19.9-20.0': SILT, 10YR7/1 (light gray), soft, medium plasticity, and moist

Table D.5. Sample Lithologic Descriptions for East Boring

BORING	SAMPLE INTERVAL (ft bgs)	DATE SAMPLED	LITHOLOGIC DESCRIPTION
E-30	2-4	08/05/08	SILT, 10YR7/1 (light gray) mottled with 10YR6/6 (brownish yellow), moderately soft to hard, low plasticity, and moist
	4-6	08/05/08	SILT as above but moderately soft
	6-8	08/05/08	SILT, 10YR6/6 (brownish yellow) with some mottling by 10YR7/1 (light gray), moderately hard, low plasticity, and moist. Trace pebble, rounded 10YR2/1 (black), approximately 4 mm diameter
	10-12	08/05/08	SILT, 10YR7/1 (light gray) mottled with 10YR6/6 (brownish yellow), moderately soft, low plasticity, and moist
	14-16	08/05/08	SILT as above
	18-20	08/05/08	SILT as above

Table D.6. Results of the PCB Test Kit Analyses

DATE	BORING/ CALIBRATOR	SAMPLE INTERVAL (ft bgs)	RESULTS (ABSORBANCE)				PCBs (ppm) (as PCB-1248)		
			1st READING	2nd READING	3rd READING	4th READING	1st READING	2nd READING	3rd READING
7/31/2008	DI Water*	--	0.000	0.008	0.009	--	NA	NA	NA
7/31/2008	1 ppm PCBs*	--	1.773	2.018	1.946	--	1.0	1.0	1.0
7/31/2008	5 ppm PCBs*	--	1.395	1.370	1.371	--	5.0	5.0	5.0
7/31/2008	W-30	2-4 ft	1.772	1.670	1.643	--	1.0	3.1	3.1
7/31/2008	W-30	4-6 ft	1.220	2.753	2.474	--	6.9	<1	<1
7/31/2008	W-30	6-8 ft	0.954	2.145	2.152	--	9.7	<1	<1
7/31/2008	W-30	10-12 ft	Cuvette broken–could not complete analysis						
7/31/2008	W-30	14-16 ft	4.717	4.717	4.717	--	<1	<1	<1
7/31/2008	W-30	18-20 ft	1.736	1.714	1.718	--	1.4	2.9	2.6
8/6/2008	DI Water*	--	0.000	0.001	0.002	0.004	NA	NA	NA
8/6/2008	1 ppm PCBs*	--	1.571	1.536	1.502	--	1.0	1.0	1.0
8/6/2008	5 ppm PCBs*	--	0.989	0.962	0.944	--	5.0	5.0	5.0
8/6/2008	N-30	2-4 ft	2.563	2.533	2.479	--	<1	<1	<1
8/6/2008	N-30	4-6 ft	2.019	1.981	1.941	--	<1	<1	<1
8/6/2008	N-30	6-8 ft	3.931	3.864	3.864	--	<1	<1	<1
8/6/2008	N-30	10-12 ft	1.964	1.914	1.879	--	<1	<1	<1
8/6/2008	N-30	14-16 ft	2.435	2.381	2.326	--	<1	<1	<1
8/6/2008	N-30	18-20 ft	2.877	2.812	2.751	--	<1	<1	<1
8/6/2008	S-30	2-4 ft	2.143	2.126	2.085	--	<1	<1	<1
8/6/2008	S-30	4-6 ft	2.489	2.457	2.413	--	<1	<1	<1
8/6/2008	S-30	6-8 ft	2.514	2.464	2.415	--	<1	<1	<1
8/6/2008	S-30	10-12 ft	1.695	1.655	1.618	--	<1	<1	<1
8/6/2008	S-30	14-16 ft	2.582	2.522	2.489	--	<1	<1	<1
8/6/2008	S-30	18-20 ft	1.778	1.749	1.706	--	<1	<1	<1
8/6/2008	E-30	2-4 ft	2.653	2.586	2.528	--	<1	<1	<1
8/6/2008	E-30	4-6 ft	2.306	2.246	2.192	--	<1	<1	<1
8/6/2008	E-30	6-8 ft	2.474	2.411	2.357	--	<1	<1	<1
8/6/2008	E-30	10-12 ft	2.371	2.315	2.266	--	<1	<1	<1
8/6/2008	E-30	14-16 ft	2.442	2.391	2.348	--	<1	<1	<1
8/6/2008	E-30	18-20 ft	1.698	1.660	1.627	--	<1	<1	<1

7/31/08 1st Readings were affected by improper orientation of the cuvette within the colorimeter. These data are invalid.

* = calibration standards

NA = not analyzed

Table D.7. Fixed-base Laboratory (PGDP Analytical Services) Analyses

BORING	SAMPLE INTERVAL (ft bgs)	SAMPLE ID NUMBER	RESULTS (µg/kg)								
			Aroclor-1268	PCB, Total	PCB-1016	PCB-1221	PCB-1232	PCB-1242	PCB-1248	PCB-1254	PCB-1260
W-30	2-4	UGAPCB08-01	<80	<120	<90	<120	<90	<60	<90	<80	<90
	4-6	UGAPCB08-02	<80	<120	<90	<120	<90	<60	<90	<90	<90
	6-8	UGAPCB08-03	<80	<130	<100	<130	<100	<60	<100	<90	<100
	10-12	UGAPCB08-04	<80	<130	<100	<130	<100	<60	<100	<90	<100
	14-16	UGAPCB08-05	<70	<120	<90	<120	<90	<60	<90	<80	<90
	18-20	UGAPCB08-06	<70	<120	<90	<120	<90	<60	<90	<80	<90
N-30	2-4	UGAPCB08-07	<80	<120	<100	<120	<100	<60	<100	<90	<100
	4-6	UGAPCB08-08	<80	<130	<100	<130	<100	<60	<100	<90	<100
	4-6	DUGAPCB08-01	<80	<120	<90	<120	<90	<60	<90	<80	<90
	6-8	UGAPCB08-09	<80	<120	<90	<120	<90	<60	<90	<80	<90
	10-12	UGAPCB08-10	<80	<120	<90	<120	<90	<60	<90	<90	<90
	14-16	UGAPCB08-11	<80	<120	<90	<120	<90	<60	<90	<80	<90
	18-20	UGAPCB08-12	<80	<120	<90	<120	<90	<60	<90	<80	<90
S-30	2-4	UGAPCB08-13	<80	<130	<100	<130	<100	<60	<100	<90	<100
	4-6	UGAPCB08-14	<80	<130	<100	<130	<100	<60	<100	<90	<100
	6-8	UGAPCB08-15	<80	<130	<100	<130	<100	<60	<100	<90	<100
	10-12	UGAPCB08-16	<80	<120	<90	<120	<90	<60	<90	<90	<90
	14-16	UGAPCB08-17	<80	<120	<100	<120	<100	<60	<100	<90	<100
	18-20	UGAPCB08-18	<80	<130	<100	<130	<100	<60	<100	<90	<100
E-30	2-4	UGAPCB08-19	<80	<130	<100	<130	<100	<60	<100	<90	<100
	2-4	DUGAPCB08-02	<80	<120	<90	<120	<90	<60	<90	<80	<90
	4-6	UGAPCB08-20	<80	<130	<100	<130	<100	<60	<100	<90	<100
	6-8	UGAPCB08-21	<70	<120	<90	<120	<90	<60	<90	<80	<90
	10-12	UGAPCB08-22	<80	<120	<100	<120	<100	<60	<100	<90	<100
	14-16	UGAPCB08-23	<80	<130	<100	<130	<100	<60	<100	<90	<100
	18-20	UGAPCB08-24	<80	<130	<100	<130	<100	<60	<100	<90	<100

CONCLUSIONS

None of the soil samples collected from the vicinity of the well cluster containing MW363, MW364, and MW365 contained detectable levels of PCBs. Although the field test kits identified two soil samples from boring W-30 with PCBs below the 5 ppm level of detection (from 2 to 4 ft and 18 to 20 ft), fixed-base laboratory analyses of these same samples reported no detectable level of PCBs (with detection limits of approximately 0.1 ppm). All fixed-base laboratory analyses had reporting limits less than 1 ppm PCBs. The investigation had achieved its data quality objective.

A subsequent assessment of historical monitoring well maintenance activities identified that PCBs were introduced into C-746-U Landfill wells as a result of cross-contamination from an off-site facility (associated with previous well rehabilitation activities). This cross-contamination is sufficient to explain all the PCBs found in C-746-U Landfill well monitoring well groundwater samples. No further investigation of the shallow soils was required.

APPENDIX E

ASSESSMENT OF WELL REHABILITATION SOURCE OF PCB CONTAMINATION IN C-746-U LANDFILL WELLS

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ASSESSMENT OF WELL REHABILITATION SOURCE OF PCB CONTAMINATION IN C-746-U LANDFILL WELLS

The occurrence of polychlorinated biphenyls (PCBs) in monitoring wells at the C-746-S&T and C-746-U Landfills has been noted. As described in Appendix D, no PCB source associated with soils has been found. A soil source would be unlikely to be the source of groundwater contamination because PCBs have low solubility in water and high soil organic carbon partition coefficients (K_{oc}); thus, PCBs have a tendency for adsorption of soil and organic matter and would be unlikely to migrate at detectable levels to RGA groundwater units. PCBs are not mobile in soil and are rarely observed migrating in groundwater. When PCBs do migrate in groundwater, it's usually as colloids or attached to suspended particles. Therefore, they are not readily mobile for transport through the Upper Continental Recharge System (UCRS) and Regional Gravel Aquifer (RGA) as a dissolved phase.

The nature of PCBs and the empirical association of the timing of detections of PCBs with previous well rehabilitation events suggest that the source of PCBs is cross-contamination of the wells from materials used in well rehabilitation.

Five monitoring wells of the C-746-S&T and C-746-U Landfills—MW360, MW363, MW365, MW369, and MW372—produced water with detectable PCB levels in 2008.[1] Table E.1 summarizes the PCB detections in the landfill monitoring wells.

Table E.1. Monitoring Wells with PCB Detections (January 2000 to June 2008)

Well ID	# Samples	# Detects	Min (µg/L)	Max (µg/L)	Unit
MW220	10	1	0.78	0.78	URGA
MW221	10	1	7.87	7.87	URGA
MW222	12	5	0.19	3.1	URGA
MW223	12	3	0.25	1.61	URGA
MW224	10	2	0.24	0.359	URGA
MW263	2	1	0.092	0.092	RGA
MW357	15	1	0.43	0.43	URGA
MW360	15	4	0.18	0.23	URGA
MW361	15	2	0.3	0.443	LRGA
MW363	16	11	0.48	2.84	URGA
MW364	16	2	0.3	0.35	LRGA
MW365	14	8	1.17	3.69	UCRS
MW366	15	3	0.2	0.79	URGA
MW367	15	1	0.17	0.17	LRGA
MW368	2	1	1.47	1.47	UCRS
MW369	16	12	0.2	1.15	URGA
MW370	15	1	0.188	0.188	LRGA
MW372	15	3	0.2	0.38	URGA
MW373	15	1	0.19	0.19	LRGA

Note: Bold indicates monitoring wells that produced water with detectable PCB levels in 2008.

None of the wells in the current monitoring network, however, yielded water with detectable levels of PCBs in 2002. Then in July and October of 2003, 13 wells had samples with detections of PCBs. The

[1] PCBs continue to be detected in samples from MW363, MW365, and MW369.

PCB-contaminated wells monitor the UCRS, upper RGA (URGA), and lower RGA (LRGA). The maximum PCB detection was 7.87 µg/L (in MW221). The nearly simultaneous identification of PCBs in all three landfills and in monitoring wells that monitor multiple hydrogeologic units (UCRS, URGA, and LRGA) describes a broad occurrence that suggests a pathway other than migration via a groundwater plume. Table E.2 illustrates the PCB detections over time.

Table E.2. Current Landfill Monitoring Wells with PCB Detections (by Calendar Year)

Well ID	CY 2002	CY 2003	CY 2004	CY 2005	CY 2006	CY 2007	CY 2008	Unit
MW220								URGA
MW221								URGA
MW222								URGA
MW223								URGA
MW224								URGA
MW357								URGA
MW360								URGA
MW361								LRGA
MW363								URGA
MW364								LRGA
MW365								UCRS
MW366								URGA
MW367								LRGA
MW368								UCRS
MW369								URGA
MW370								LRGA
MW372								URGA
MW373								LRGA

Shading signifies a PCB detection.

In April and May of 2003, PGDP rehabilitated 19 monitoring wells prior to the July 2003 sampling event (see Table E.3).

Table E.3. Monitoring Well Rehabilitation, April and May 2003

Well ID	Rehab Completed	Unit	PCB Detected?
MW365	4/17/2003	UCRS	Yes
MW363	4/22/2003	RGA	Yes
MW368	4/25/2003	UCRS	Yes
MW367	4/28/2003	RGA	Yes
MW364	4/29/2003	RGA	Yes
MW366	4/29/2003	RGA	Yes
MW357	5/1/2003	RGA	Yes
MW358	5/1/2003	RGA	Yes
MW360	5/2/2003	RGA	Yes
MW361	5/2/2003	RGA	Yes
MW369	5/7/2003	RGA	Yes
MW370	5/7/2003	RGA	Yes

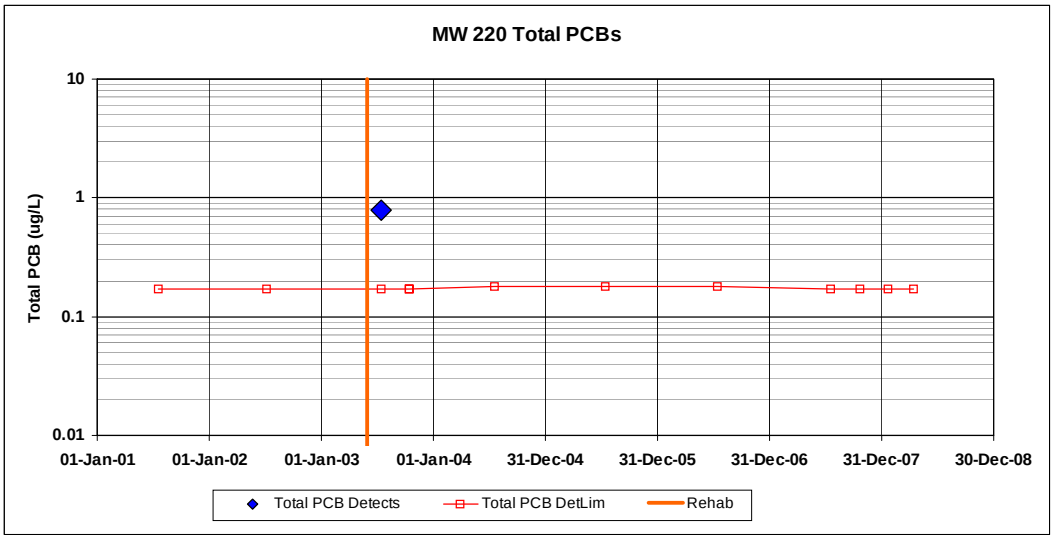
Table E.3. Monitoring Well Rehabilitation, April and May 2003 (Continued)

Well ID	Rehab Completed	Unit	PCB Detected?
MW372	5/15/2003	RGA	Yes
MW373	5/15/2003	RGA	Yes
MW221	5/19/2003	RGA	Yes
MW222	5/22/2003	RGA	Yes
MW224	5/22/2003	RGA	Yes
MW223	5/23/2003	RGA	Yes
MW220	5/30/2003	RGA	Yes
MW242	5/30/2003	RGA	No

The potential for soils to the source of the occurrence of PCBs was that PCBs in soil around the landfills (and in the sediments of the former North-South Diversion Ditch) had been dragged down the borehole during well installation and then the rehabilitation process (heat and chemical treatment) mobilized the PCBs, allowing them to move into the monitoring wells. This explanation, however, does not account for PCBs found in the C-746-U Landfill monitoring wells. A similar explanation that would account for PCB detections in RGA wells would be if PCB-contaminated isolation casing was used in the construction of the wells, resulting in contamination of the well materials during construction. (Some of the isolation casing arrived with an oily coating and paint and had to be decontaminated.) This explanation, however, does not account for PCBs found in UCRS wells.

The explanation that best addresses all information is that PCBs had been introduced inadvertently into the landfill monitoring wells during rehabilitation. The well rehabilitation equipment had been used at previous sites and had not been decontaminated thoroughly. The PGDP wells became cross-contaminated. PCBs introduced by the rehabilitation became attached to sediment or colloid particles in the PGDP monitoring wells which then were captured during sampling events.

Figures E.1 through E.18 illustrate the relationship of the PCB occurrences to well rehabilitation events for the 18 wells with PCB detections. Where the first detection of PCBs is delayed after well rehabilitation, plots of turbidity support the association of PCBs with suspended solids in the wells.



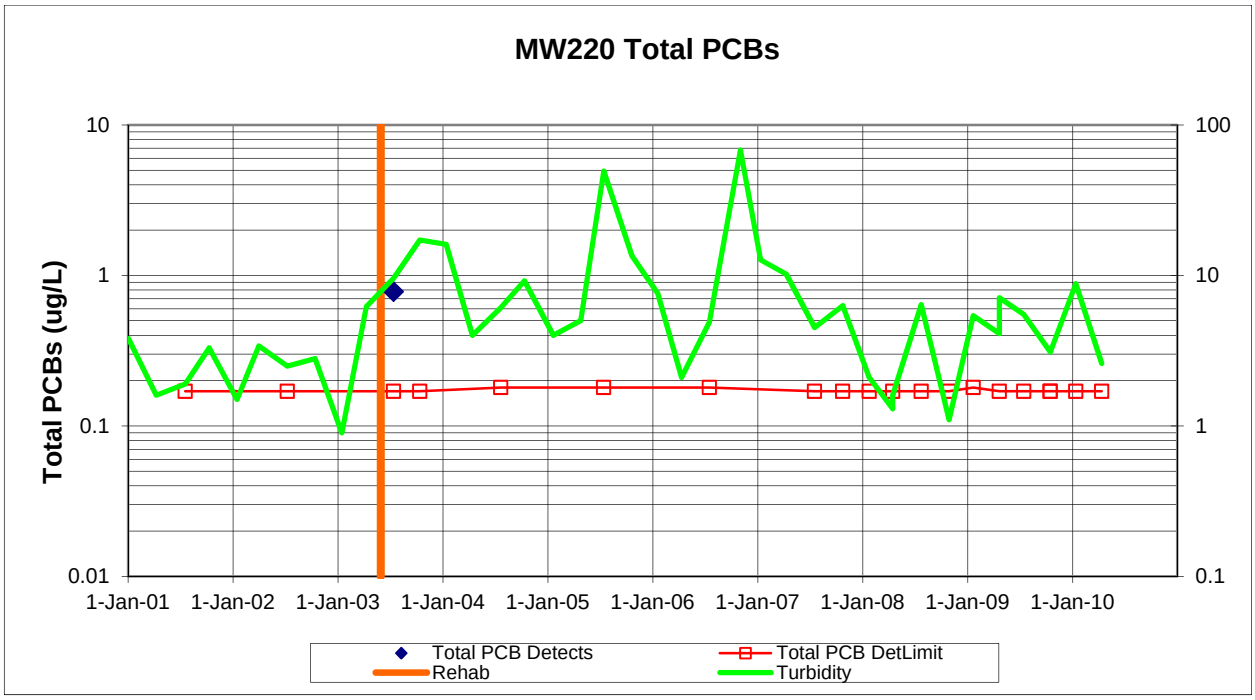


Figure E.1. PCB Analyses and Well Rehabilitation in MW220

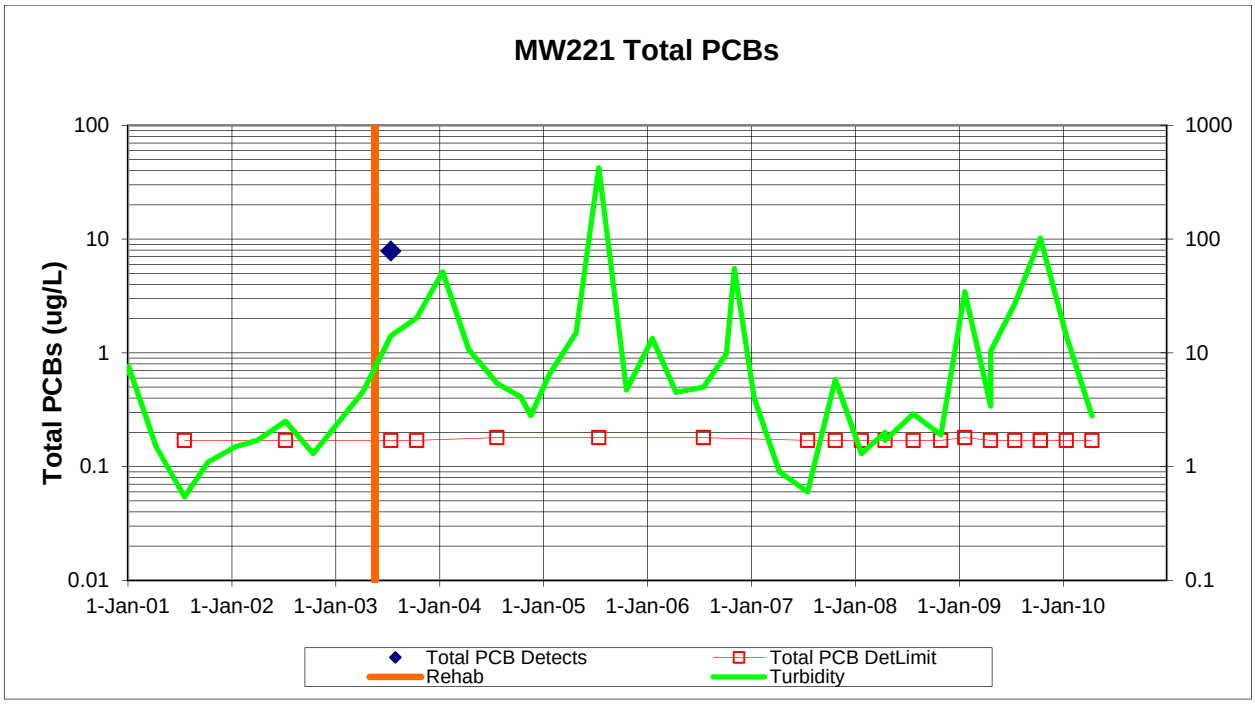


Figure E.2. PCB Analyses and Well Rehabilitation in MW221

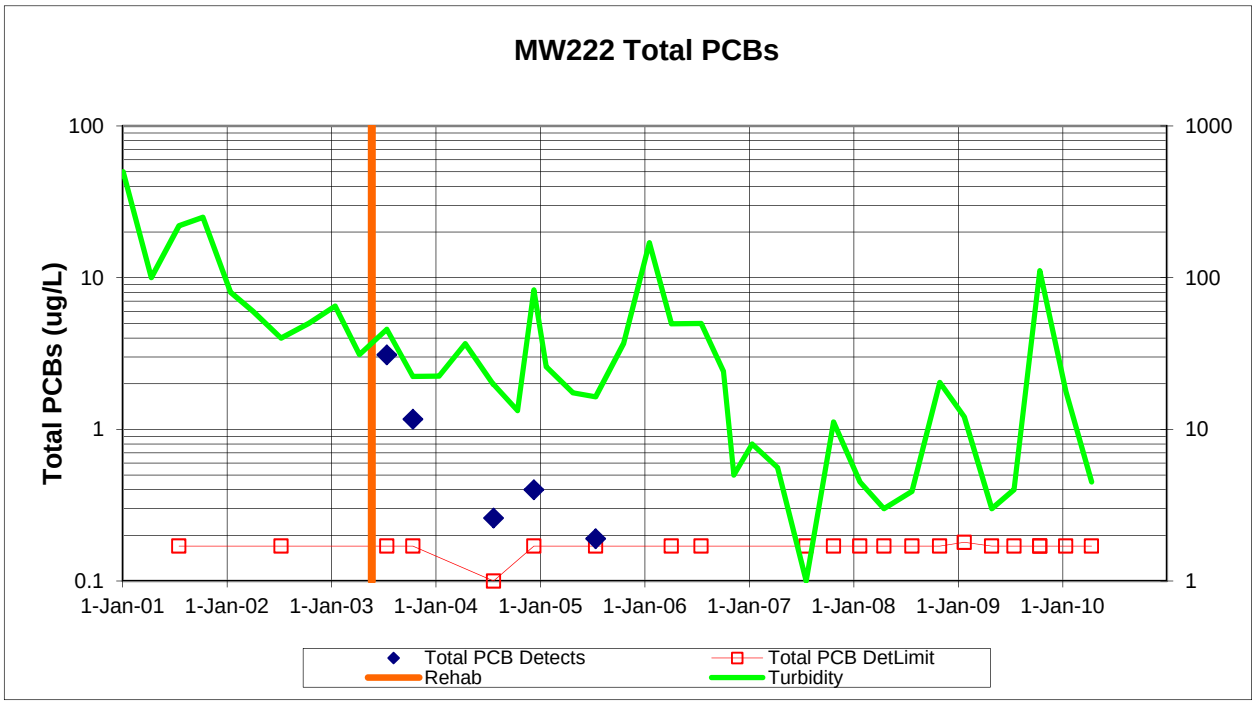


Figure E.3. PCB Analyses and Well Rehabilitation in MW222

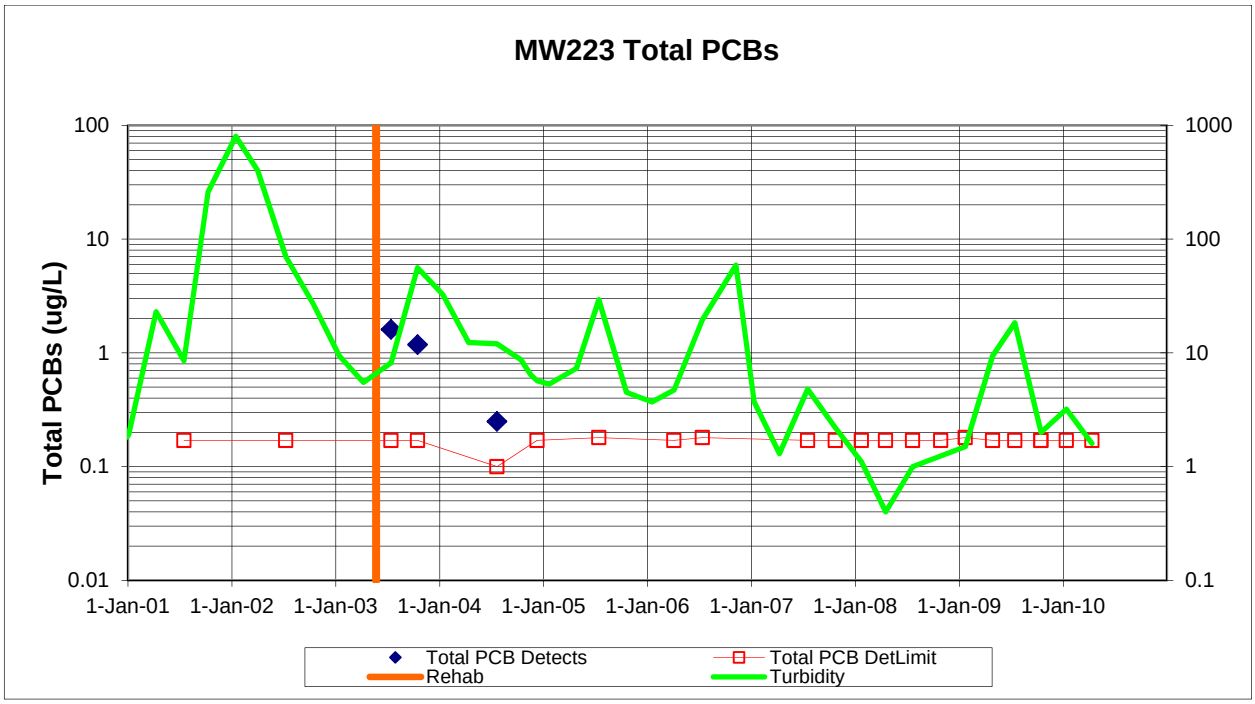


Figure E.4. PCB Analyses and Well Rehabilitation in MW223

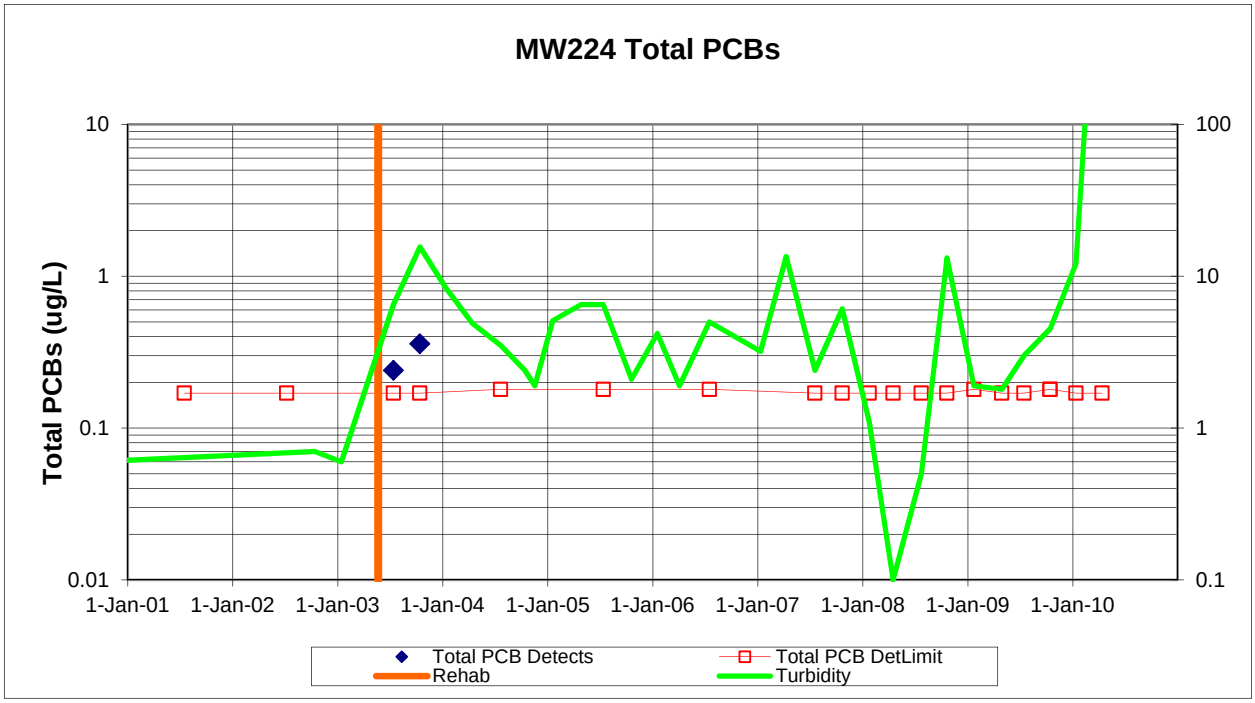


Figure E.5. PCB Analyses and Well Rehabilitation in MW224

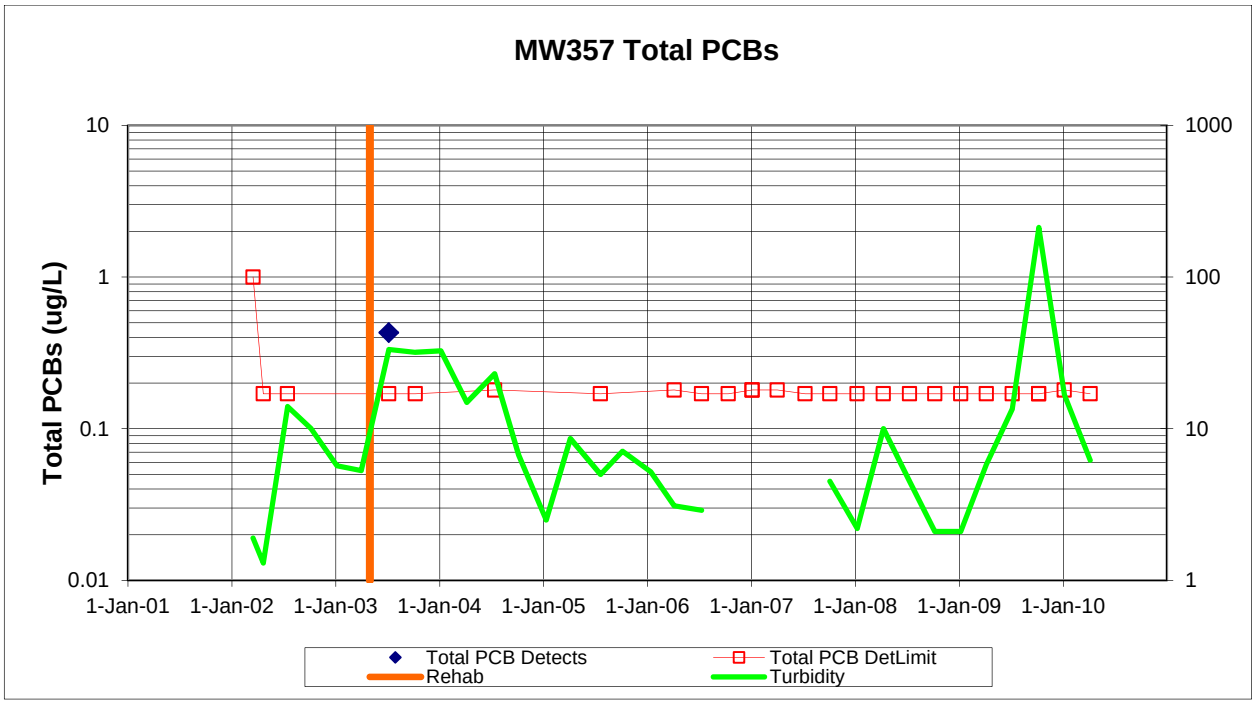


Figure E.6. PCB Analyses and Well Rehabilitation in MW357

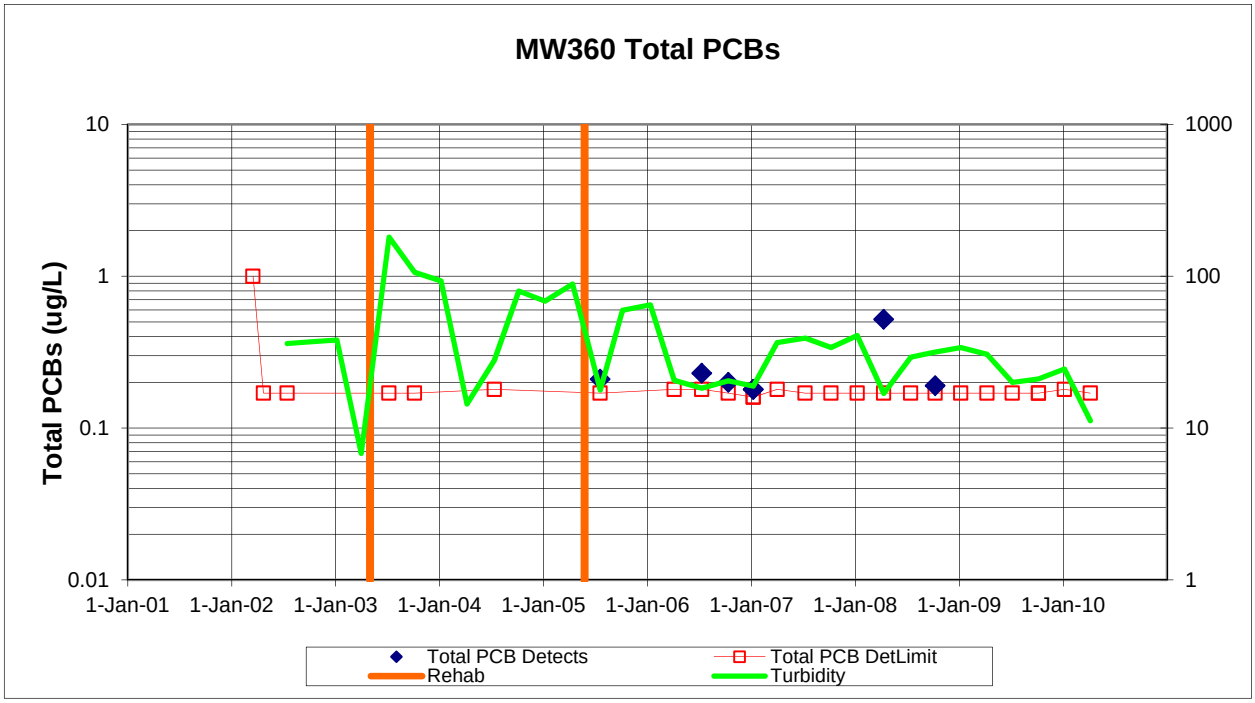


Figure E.7. PCB Analyses and Well Rehabilitation in MW360

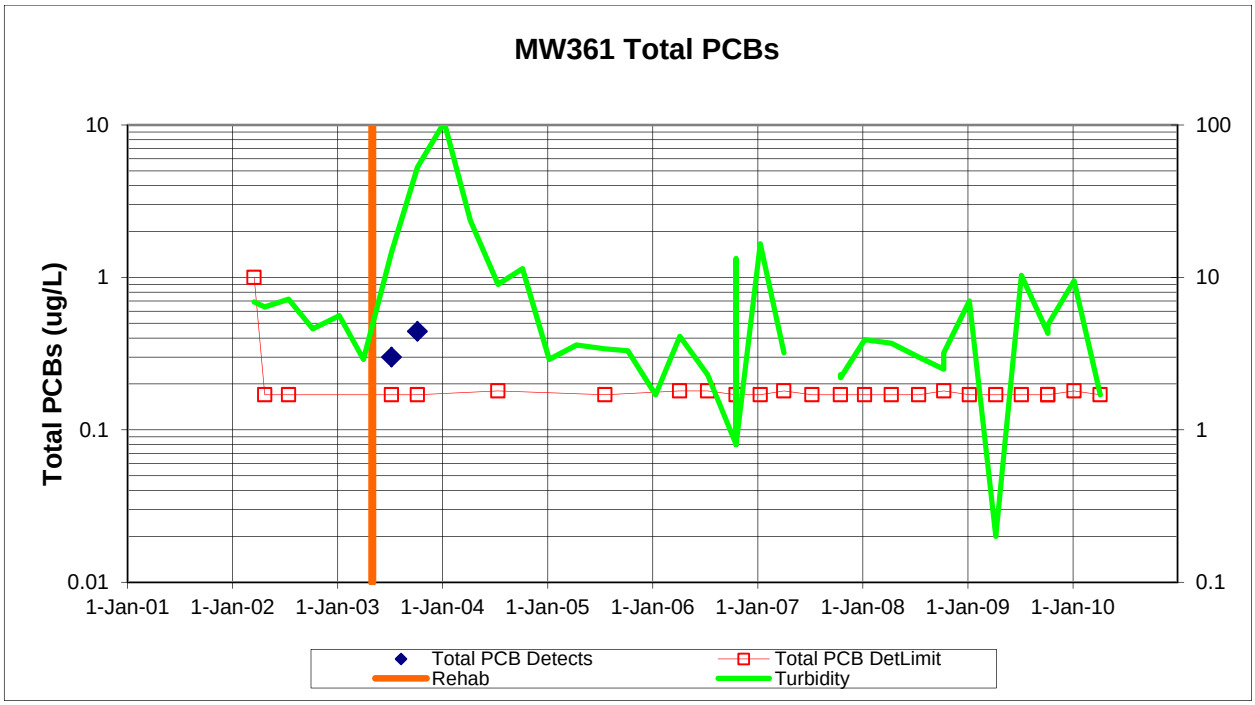


Figure E.8. PCB Analyses and Well Rehabilitation in MW361

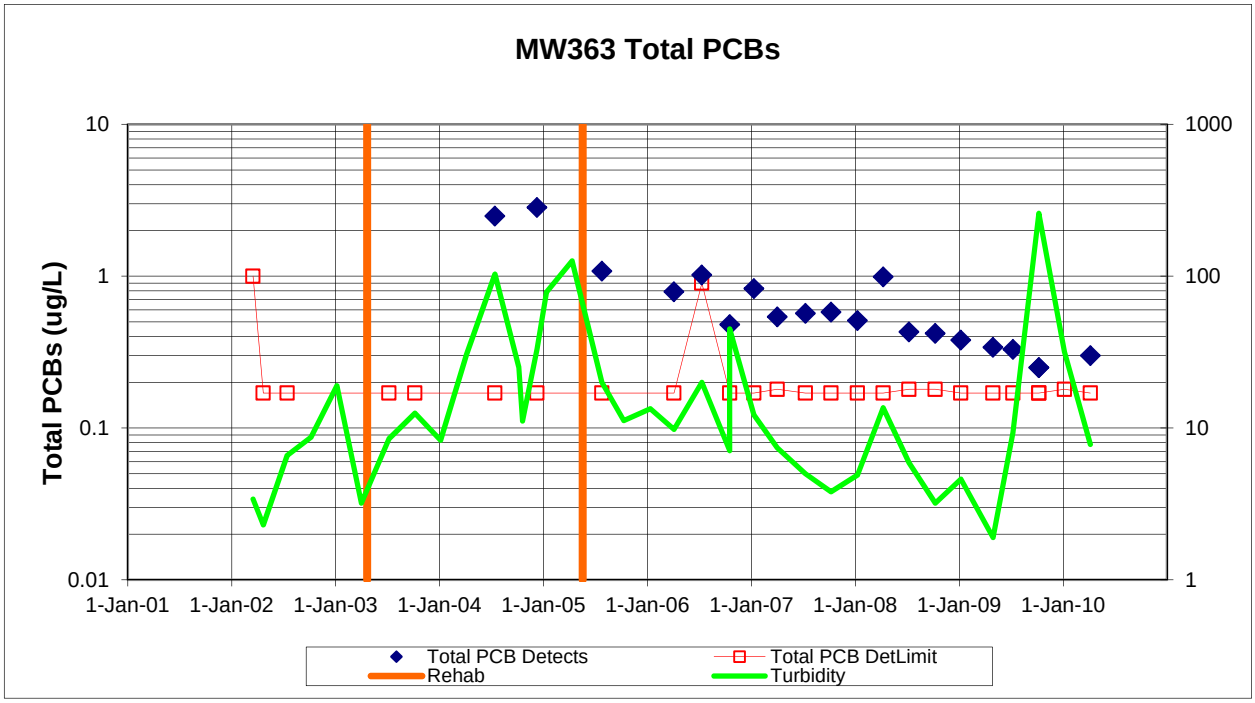


Figure E.9. PCB Analyses and Well Rehabilitation in MW363

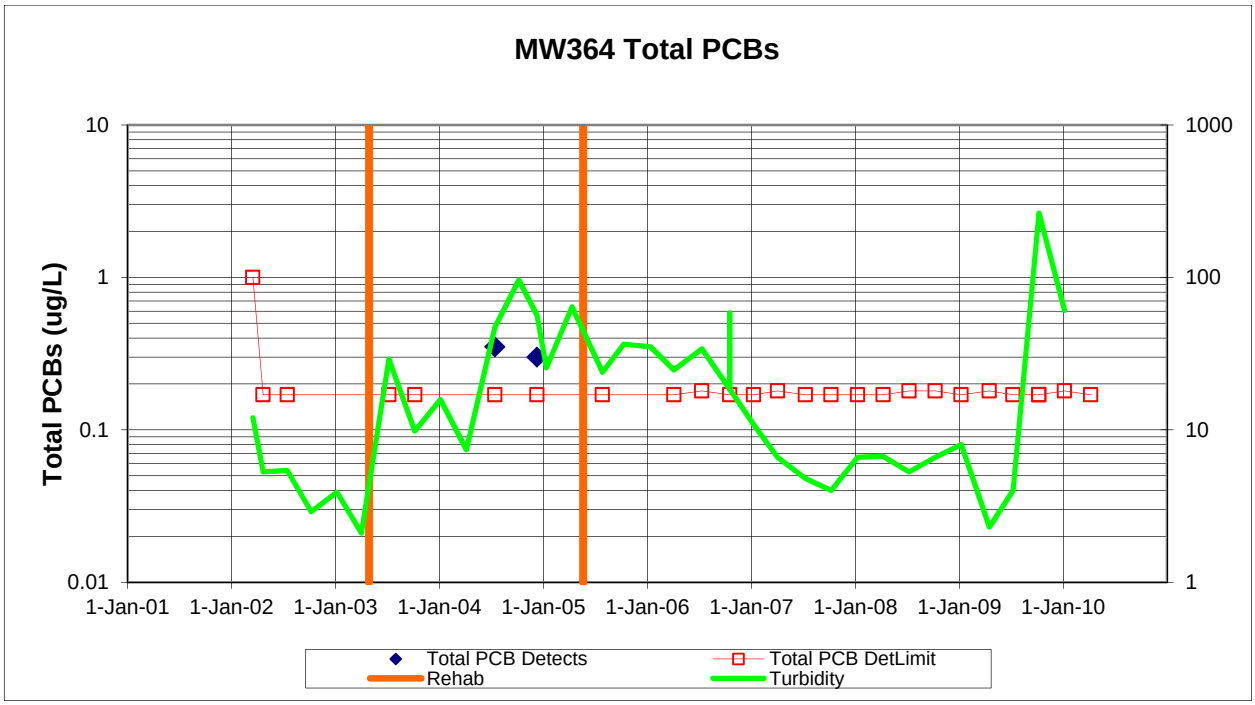


Figure E.10. PCB Analyses and Well Rehabilitation in MW364

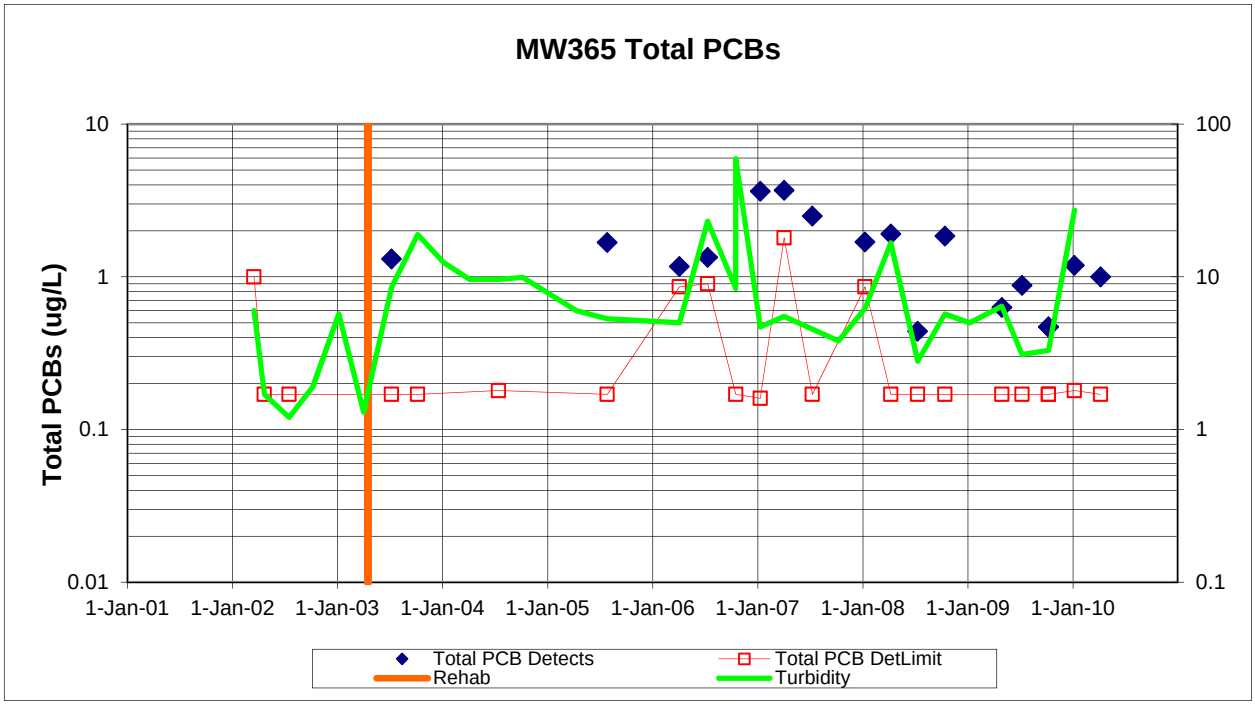


Figure E.11. PCB Analyses and Well Rehabilitation in MW365

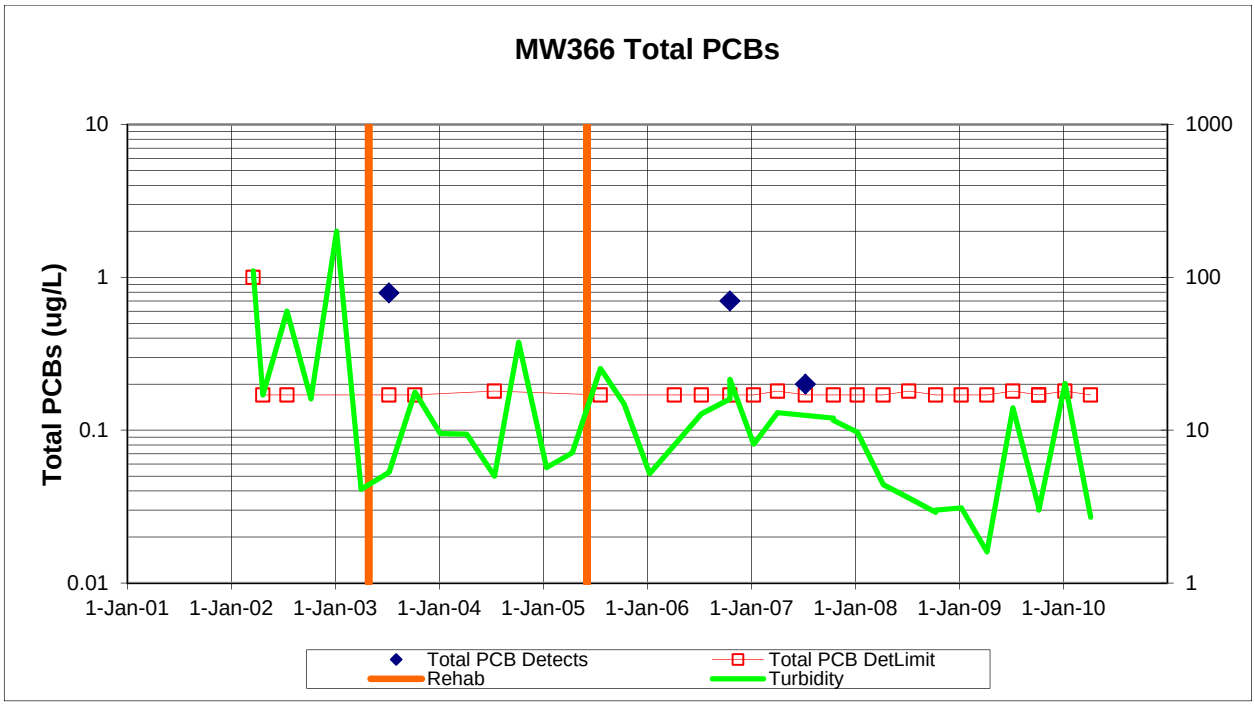


Figure E.12. PCB Analyses and Well Rehabilitation in MW366

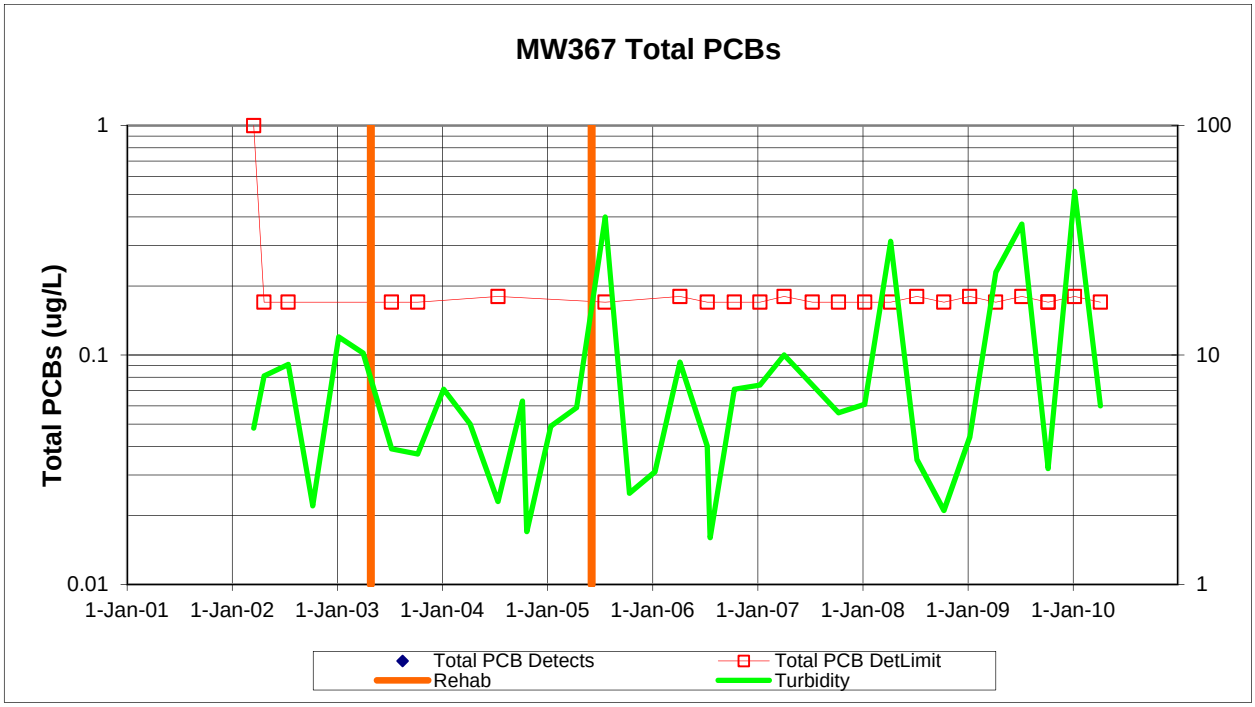


Figure E.13. PCB Analyses and Well Rehabilitation in MW367

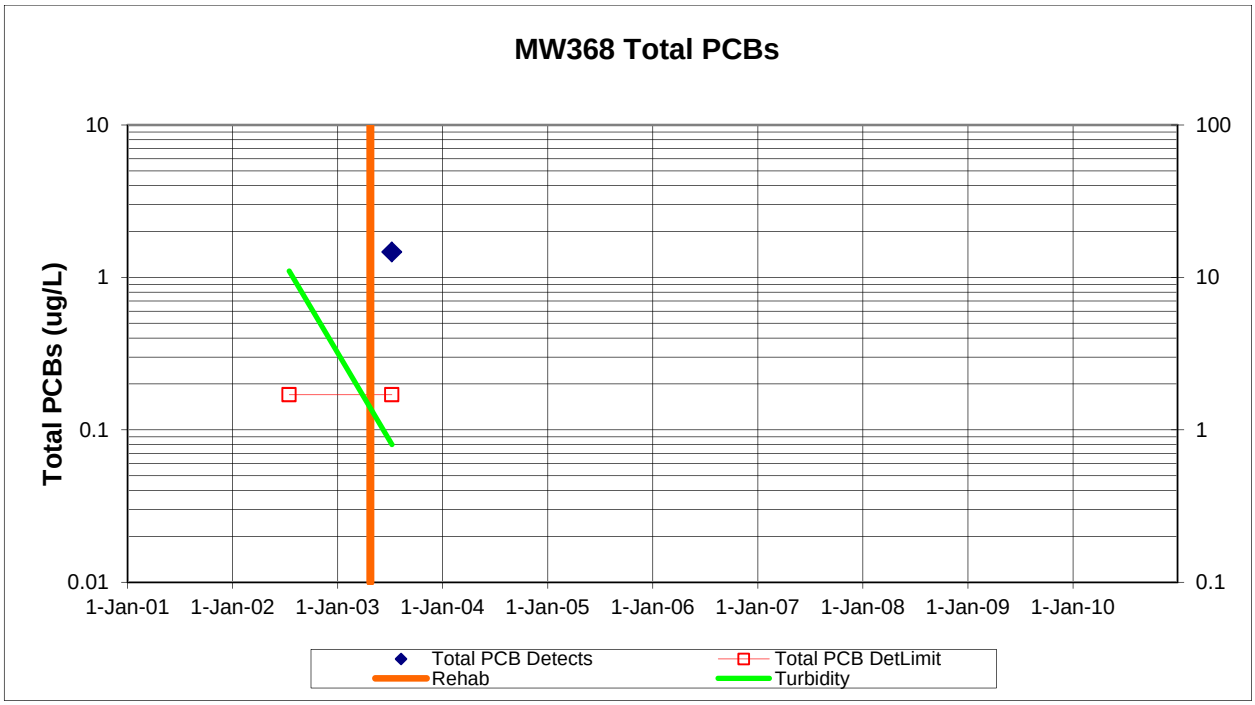


Figure E.14. PCB Analyses and Well Rehabilitation in MW368

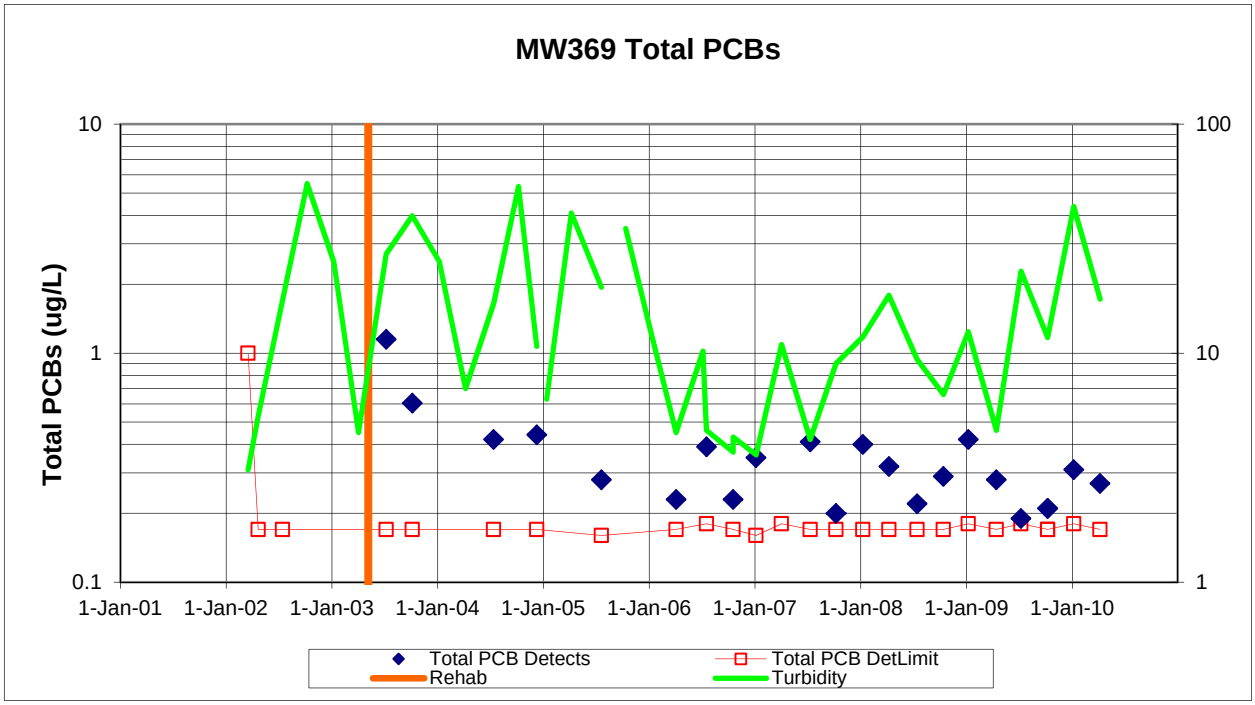


Figure E.15. PCB Analyses and Well Rehabilitation in MW369

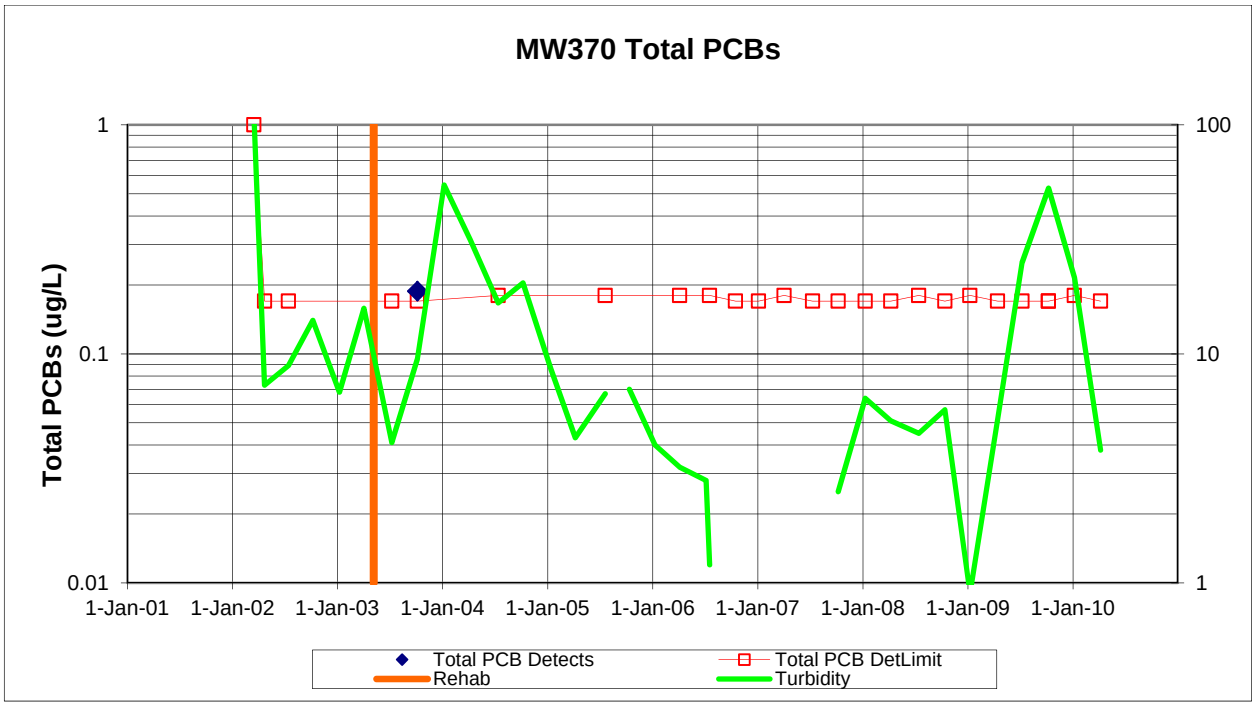


Figure E.16. PCB Analyses and Well Rehabilitation in MW370

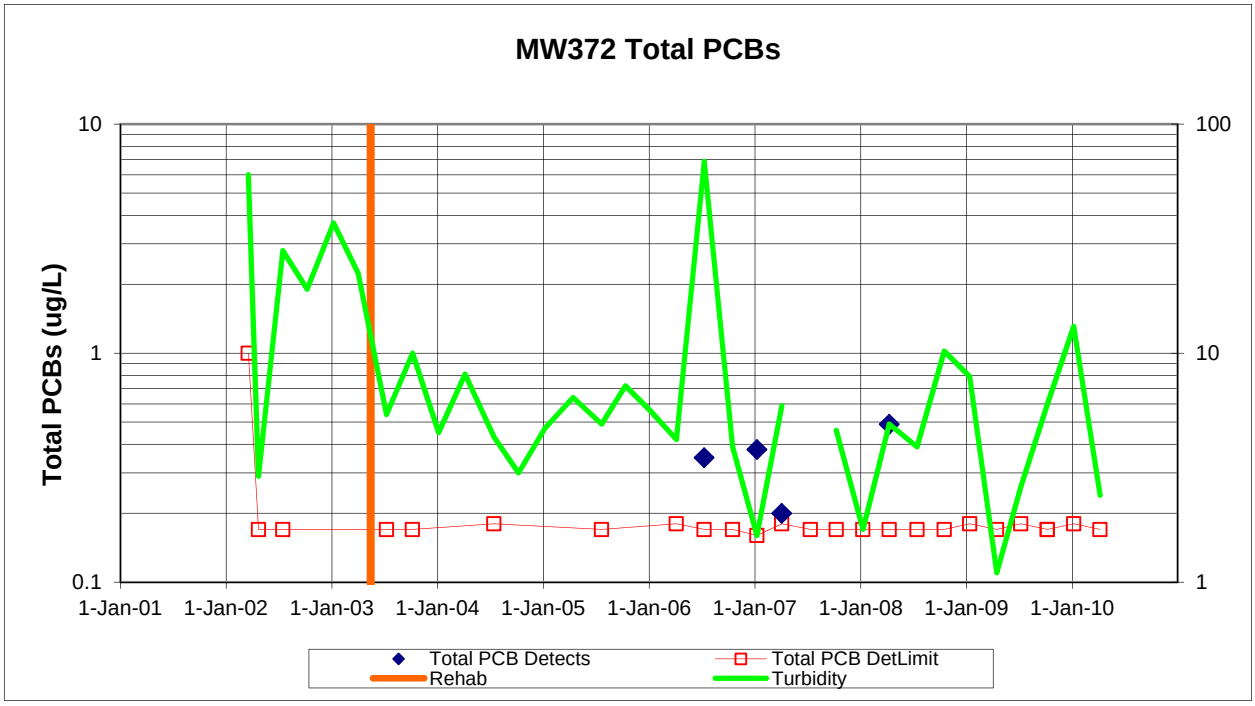


Figure E.17. PCB Analyses and Well Rehabilitation in MW372

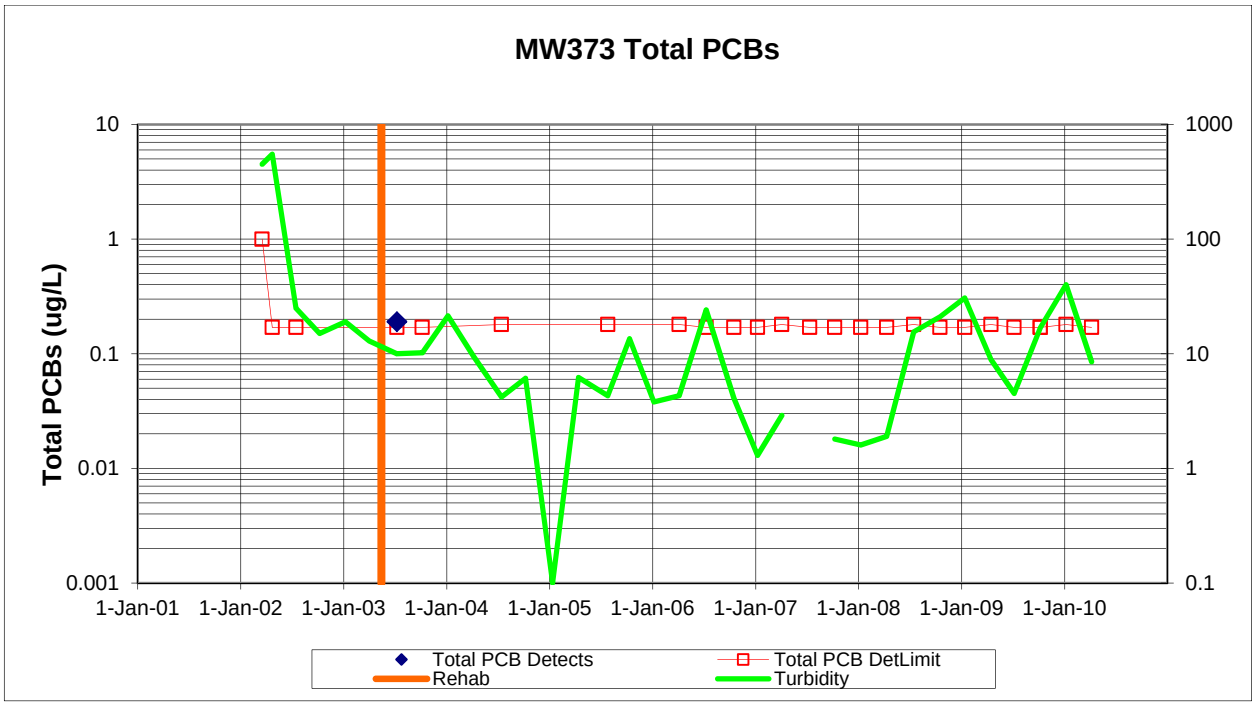


Figure E.18. PCB Analyses and Well Rehabilitation in MW373

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APPENDIX F

ASSESSMENT OF IMPACTS OF OVERPUMPING MONITORING WELLS IN THE VICINITY OF THE C-746-U LANDFILL ON POLYCHLORINATED BIPHENYLS CONCENTRATIONS

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INTRODUCTION

With the approval of the Kentucky Division of Waste Management, LATA Environmental Services of Kentucky, LLC, (LATA Kentucky) performed overpumping tests of four C-746-U monitoring wells (MW360, MW363, MW365, and MW369), beginning in March 2011, to assess impacts to the concentration of polychlorinated biphenyl (PCB)-contamination in the wells (see Appendix E for additional discussion of the suspected PCB source). MW360, MW363, and MW369 are upper Regional Gravel Aquifer (RGA) wells. MW365 is an Upper Continental Recharge System (UCRS) well. Each of these wells produced water with detectable PCB concentrations in 2008; thus, these wells were subjected to the overpumping test. NOTE: PCB levels in MW360 declined to below the laboratory detection limits beginning in 2009; however, this well still was subjected to overpumping.

The field effort for the overpumping assessment consisted of the following steps:

1. Collecting an initial groundwater sample for PCB analysis from each of the four wells by the low-flow sampling method, using the existing dedicated pumps (bladder pumps);

2. Removing the dedicated bladder pumps from the four wells followed by sustained pumping in the wells (at a rate of 1 to 2 gpm) using an inertial pump with a one-way foot valve; this pumping was accomplished using a reciprocal pumping action to more-aggressively agitate the well water;

3. Collecting groundwater samples for PCB analysis using the inertial pump one hour after sustained pumping began and again at the completion of overpumping (when monitoring of extracted water indicated turbidity had significantly declined);

4. Installing a new dedicated bladder pump (with new pump tubing) in each of the four wells; and

5. Collecting seven groundwater samples for PCB analysis from each of the four wells using the low flow method (and the new pumps), with a period of at least one day between the collection of samples in each well.

As discussed below, a review of the PCB analyses of samples collected from this effort in conjunction with the field monitoring parameters documents that PCB concentration levels are directly correlated to the turbidity of the groundwater samples. The implication of this relationship is that the PCB contamination is affixed to suspended solids within the well and well sand pack and not representative of the monitored groundwater unit.

QUALITY CONTROL

The field effort used personnel from LATA Kentucky's environmental sampling group, LATA Kentucky sampling and sample management procedures, and LATA Kentucky work control. The laboratory that performed the PCB analyses was certified by the U.S. Department of Energy Consolidated Audit Program to ensure the quality of the chemical analyses. LATA Kentucky performed data review and assessment of the completed analyses to further ensure quality control.

The groundwater analyses used a standard four-week laboratory analysis and reporting period except for the samples collected at the conclusion of overpumping (the last samples to be collected). LATA

Kentucky required a two-week analysis and reporting period for these samples to provide for timely assessment of the effectiveness of early and final stages of the overpumping test.

The laboratory analysis reported the following PCB Aroclors (each with a lower reporting limit of 0.4 µg/L):

- PCB-1016
- PCB-1221
- PCB-1232
- PCB-1242
- PCB-1248
- PCB-1254
- PCB-1254
- PCB-1260
- PCB-1268

PCB-1016 and PCB-1242 are the only Aroclors that commonly have been reported in analyses of groundwater samples from these wells.

In the overpumping test, only PCB-1242 was detected in samples from any of the wells. A discussion of the results of the individual well overpumping tests is presented below.

MW360 (UPPER RGA)

Samplers overpumped MW360 on March 7 and March 8, 2011, extracting approximately 1,175 gal of water (all wastewater generated by the overpumping test was treated for PCBs before final disposition). The overpumping continued until the water turbidity was reduced to 4.1 nephelometric turbidity units (NTUs). Post-overpumping sampling occurred April 5 through April 27, 2011.

A total of 20 previous analyses of groundwater samples from MW360 have been conducted. These include five analyses with detections of PCBs (0.18–0.52 µg/L) (samples collected during the 2006–2008 period). None of the eight analyses of 2009 and 2010 groundwater samples from MW360 reported detectable levels of PCBs.

Of the 10 samples (plus 2 duplicate samples) collected during the overpumping test, only 1 analysis (sample of April 11, 2011) reported a PCB detection, estimated at 0.272 µg/L for PCB-1242. This concentration is below the U.S. Environmental Protection Agency's (EPA's) Drinking Water Standard maximum contaminant level (MCL) of 0.0005 mg/L and subsequent sampling (after April 11, 2011) did not detect PCBs. The finding that there are no longer detections of PCBs in groundwater at MW360 is consistent with the established PCBs trend, indicating that PCBs are no longer a problem in MW360. This finding indicates that there is no continuing source of PCBs to the water in this well.

MW363 (UPPER RGA)

Overpumping of MW363 occurred on March 9 and March 10, 2011, producing 1,600 gal of water with a final turbidity of 1.8 NTUs. Post-overpumping sampling was performed over the period April 6 through April 27, 2011.

The previous analyses of groundwater samples from MW363 (total of 24) reported 19 detections of PCBs (maximum of 2.84 µg/L in 2004, declining to 0.25–0.3 µg/L in 2009 and 2010). Three analyses of samples collected in 2010 did not detect PCBs (with detection limits of 0.17–0.18 µg/L).

Analyses of the overpumping test documents the presence of PCB-1242 in 9 of 10 samples (and in the 2 duplicate samples), at estimated levels of 0.257–0.592 µg/L. With the exception of 1 outlier, the PCB-1242 levels closely relate to turbidity of the samples (Figure F.1).

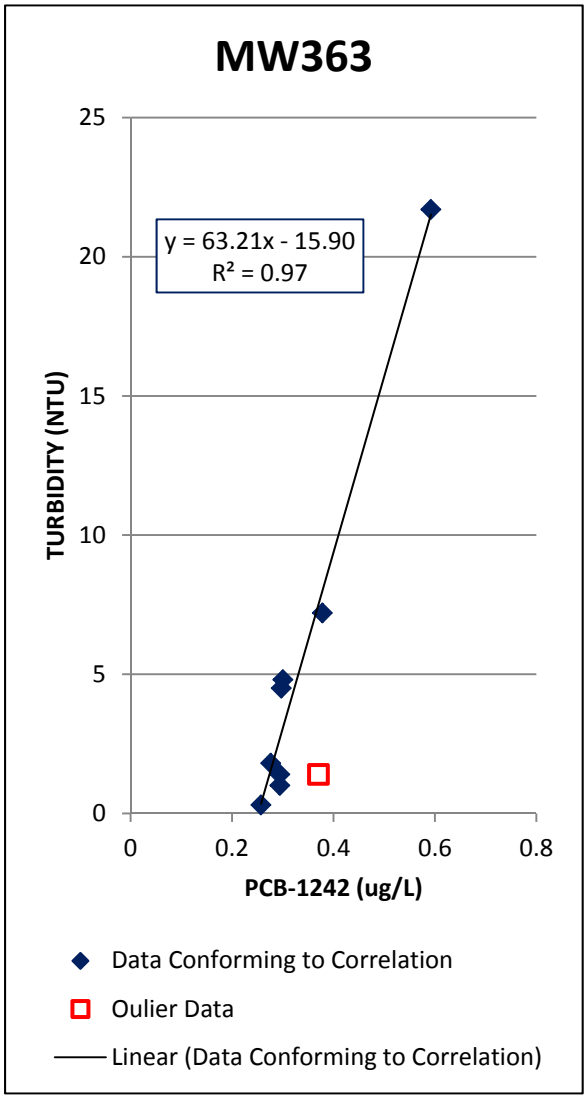

Figure F.1. PCB-1242 versus Turbidity in MW363

Except for the one sample with a concentration of 0.592 µg/L (collected in early April 2011), none of the other samples had concentrations that exceed the EPA MCL of 0.5 µg/L. Thus, the overpumping reduced concentrations of PCBs to less than the EPA MCL where they have remained since. The finding that there no longer are concentrations of PCBs in groundwater at MW363 that exceed the EPA MCL is consistent with the established PCBs trend, indicating that PCBs no longer are a problem in MW363. This finding indicates that there is no continuing source of PCBs to the water in this well.

MW365 (UCRS)

As is common with UCRS wells, MW365 was unable to sustain continued pumping. The samplers pumped the well five times (it was dry on a sixth attempt) during the period March 14 through April 7, 2011, producing a total of approximately 33 gal. Post-overpumping sampling occurred April 7 through May 3, 2011. Turbidity levels remained high in spite of development efforts under this task and were above 10 NTUs in three of the seven follow-on samples.

The 24 previous analyses of MW365 groundwater samples include 18 detections of PCBs (3.63–-0.44 µg/L). PCB-1242 was detected in all 10 of the overpumping test samples and in the two duplicate samples (ranging from 0.50–21.2 µg/L). As in MW363, PCB-1242 levels closely relate to the turbidity of the groundwater in all but one sample (Figure F.2).

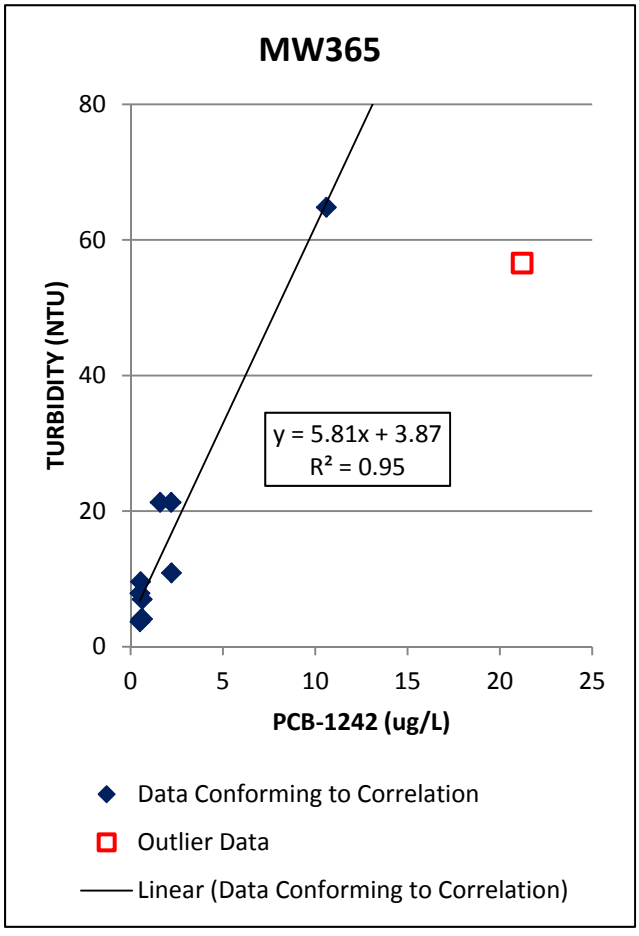

Figure F.2. PCB-1242 versus Turbidity in MW365

Sample concentrations continue to exceed the EPA MCL of 0.5 µg/L in this UCRS well. Except as noted above, none of the RGA wells has PCB concentrations that exceed the EPA MCL. Concentrations of PCBs in MW365 have decreased in response to the overpumping but remain above the EPA MCL. MW365 is located approximately 1,000 ft north of the C-746-U Landfill. This area was subjected to the soils investigation summarized in Appendix D.

The body of investigation on the PCB issue is consistent with the inadvertent introduction of PCBS into this well by cross-contamination during well rehabilitation. Unfortunately, the well overpumping did not produce enough water to remove PCBs from this well to below EPA MCLs.

MW369 (UPPER RGA)

The samplers overpumped MW369 on March 2 and March 3, 2011, with follow-on sampling from April 6 through May 3, 2011. Overpumping produced a total of 950 gal of wastewater, reducing the turbidity of the water to 0.8 NTUs.

There are 27 analyses of MW369 groundwater for PCBs, prior to the overpumping test, with 22 detections of PCBs (0.19–1.15 µg/L). Of the 10 groundwater samples and 2 duplicate samples collected for the overpumping test, PCBs were detected only 2 times at an estimated level of 0.112 µg/L for PCB-1242 (the March 3 sample at the end of overpumping and the April 11 sample). The April 11 estimated PCB-1242 occurrence was in the groundwater sample with highest turbidity.

The post-overpumping results are below the EPA MCL of 0.5 µg/L and subsequent sampling (after April 11, 2011) did not detect PCBs. The finding that there are no longer detections of PCBs in groundwater at MW369 is consistent with the established PCBs trend, indicating that PCBs are no longer a problem in MW369. This finding indicates that there is no continuing source of PCBs to the water in this well.

ANALYSIS

Table F.1 summarizes the results of the overpumping test by comparing PCB analytical results with turbidity measurements. Tables F.2 through F.5 document the field measurements of groundwater at the time of sample collection. The field measurements include the following:

- Depth-to-water (from the top of well casing),
- pH,
- Temperature,
- Conductivity,
- Turbidity,
- Dissolved oxygen, and
- Oxidation/reduction potential.

With the exception of depth-to-water, the field parameters were measured in a flow-through cell to minimize the impact of atmospheric conditions on the sample quality.

Table F.1. PCB-1242 Analyses Results and Turbidity for Overpumping Test

Sample Date	MW360				MW363			
	PCB-1242 (µg/L)		Turbidity (NTU)	Sample ID	PCB-1242 (µg/L)		Turbidity (NTU)	Sample ID
	Results[a]	Data Qualifier			Results[a]	Data Qualifier		
3/2/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/3/2011	--	--	--	--	--	--	--	--
3/7/2011	0.4	ND	11	MW360E1UG2-11	--	--	--	--
	0.4	ND	4.1	MW360E2UG2-11	--	--	--	--
	0.4	ND	--	MW360DE2UG2-11	--	--	--	--
	0.4	ND	--	MW360E3UG2-11	--	--	--	--
3/9/2011	--	--	--	--	0.378	J	7.2	MW363E1UG2-11
	--	--	--	--	0.291	J	--	MW363E2UG2-11
3/10/2011	--	--	--	--	0.291	J	--	MW363E3UG2-11
	--	--	--	--	0.276	J	1.8	MW363DE3UG2-11
3/14/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/5/2011	0.4	ND	58.9	MW360E4UG2-11	--	--	--	--
	0.4	ND	58.9	MW360DE4UG2-11	--	--	--	--
4/6/2011	--	--	--	--	0.592	J	21.7	MW363E4UG2-11
4/7/2011	--	--	--	--	--	--	--	--
4/11/2011	0.272	J	3.8	MW360E5UG2-11	0.294	J	1.4	MW363E5UG2-11
	--	--	--	--	0.37	J	1.4	MW363DE5UG2-11
4/12/2011	--	--	--	--	--	--	--	--
4/14/2011	0.4	ND	3.5	MW360E6UG2-11	0.4	ND	1	MW363E6UG2-11
4/18/2011	0.4	ND	2.6	MW360E7UG2-11	0.257	J	0.3	MW363E7UG2-11
	--	--	--	--	--	--	--	--
4/21/2011	0.4	ND	2.2	MW360E8UG2-11	0.294	J	1	MW363E8UG2-11
4/25/2011	0.4	ND	7.5	MW360E9UG2-11	0.297	J	4.5	MW363E9UG2-11
4/27/2011	0.4	ND	8.5	MW360E10UG2-11	0.3	J	4.8	MW363E10UG2-11
5/3/2011	--	--	--	--	--	--	--	--

[a] lower detection limit or estimated quantity except when highlighted

ND = not detected

J = estimated

Table F.1. PCB-1242 Analyses Results and Turbidity for Overpumping Test (Continued)

Sample Date	MW365				MW369			
	PCB-1242 (µg/L)		Turbidity (NTU)	Sample ID	PCB-1242 (µg/L)		Turbidity (NTU)	Sample ID
	Results[a]	Data Qualifier			Results[a]	Data Qualifier		
3/2/2011	--	--	--	--	0.4	ND	7.8	MW369E1UG2-11
	--	--	--	--	0.4	ND	--	MW369E2UG2-11
	--	--	--	--	0.4	ND	--	MW369DE2UG2-11
3/3/2011	--	--	--	--	0.112	J	0.8	MW369E3UG2-11
3/7/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/9/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/10/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/14/2011	2.19	--	21.3	MW365E1UG2-11	--	--	--	--
	1.6	--	21.3	MW365DE1UG2-11	--	--	--	--
	4.39	--	--	--	--	--	--	--
4/5/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/6/2011	--	--	--	--	0.4	ND	14.5	MW369E4UG2-11
4/7/2011	10.6		64.8	MW365E3UG2-11	--	--	--	--
4/11/2011	--	--	--	--	0.112	J	14.8	MW369E5UG2-11
	--	--	--	--	--	--	--	--
4/12/2011	21.2	--	56.6	MW365E4UG2-11	--	--	--	--
4/14/2011	2.21	--	10.9	MW365E5UG2-11	0.4	ND	5.8	MW369E6UG2-11
4/18/2011	0.64	--	4.1	MW365E6UG2-11	0.4	ND	9.2	MW369E7UG2-11
	0.562	--	4.1	MW365DE6UG2-11	0.4	ND	9.2	MW369DE7UG2-11
4/21/2011	0.506	--	3.7	MW365E7UG2-11	--	--	--	--
4/25/2011	0.626	--	7	MW365E8UG2-11	0.4	ND	9	MW369E8UG2-11
4/27/2011	0.535	--	9.6	MW365E9UG2-11	0.4	ND	10.3	MW369E9UG2-11
5/3/2011	0.502	--	7.9	MW365E10UG2-11	0.4	ND	7.5	MW369E10UG2-11

[a] lower detection limit or estimated quantity except when highlighted

ND = not detected

J = estimated

Table F.2. Field Measurements in the MW360 Overpumping Test

Sample Date	MW360							
	Sample ID	Conductivity	Depth	Dissolved Oxygen	Oxidation/ Reduction Potential	pH	Temperature	Turbidity
		(umho/cm)	(ft)	(mg/L)	(mV)	(SU)	(ºF)	(NTU)
3/2/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/3/2011	--	--	--	--	--	--	--	--
3/7/2011	MW360E1UG2-11	395	41.55	4.44	501	6.83	56.5	11
	MW360E2UG2-11	--	41.35	--	--	--	--	4.1
	MW360DE2UG2-11	--	--	--	--	--	--	--
	MW360E3UG2-11	--	--	--	--	--	--	--
3/9/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/10/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/14/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/5/2011	MW360E4UG2-11	445	38.1	2.11	493	6.23	55.1	58.9
	MW360DE4UG2-11	445	38.1	2.11	493	6.23	55.1	58.9
4/6/2011	--	--	--	--	--	--	--	--
4/7/2011	--	--	--	--	--	--	--	--
4/11/2011	MW360E5UG2-11	452	37.79	0.86	476	6.19	59.7	3.8
	--	--	--	--	--	--	--	--
4/12/2011	--	--	--	--	--	--	--	--
4/14/2011	MW360E6UG2-11	450	37.95	1.11	648	6.15	58.8	3.5
4/18/2011	MW360E7UG2-11	458	37.41	1.26	291	6.1	61.3	2.6
	--	--	--	--	--	--	--	--
4/21/2011	MW360E8UG2-11	448	37.53	1.56	482	6.1	59	2.2
4/25/2011	MW360E9UG2-11	459	36.21	1.55	399	6.18	61.2	7.5
4/27/2011	MW360E10UG2-11	463	35.48	1.14	262	6.18	60.6	8.5
5/3/2011	--	--	--	--	--	--	--	--

Table F.3. Field Measurements in the MW363 Overpumping Test

Sample Date	MW363							
	Sample ID	Conductivity	Depth	Dissolved Oxygen	Oxidation/ Reduction Potential	pH	Temperature	Turbidity
		(umho/cm)	(ft)	(mg/L)	(mV)	(SU)	(ºF)	(NTU)
3/2/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/3/2011	--	--	--	--	--	--	--	--
3/7/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/9/2011	MW363E1UG2-11	357	47.48	3.74	748	6.75	57	7.2
	MW363E2UG2-11	--	--	--	--	--	--	--
3/10/2011	MW363E3UG2-11	--	--	--	--	--	--	--
	MW363DE3UG2-11	--	--	--	--	--	--	1.8
3/14/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/5/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/6/2011	MW363E4UG2-11	411	44.53	2.43	116	6.31	60.8	21.7
4/7/2011	--	--	--	--	--	--	--	--
4/11/2011	MW363E5UG2-11	397	44.38	1	449	6.22	60.1	1.4
	MW363DE5UG2-11	397	44.38	1	449	6.22	60.1	1.4
4/12/2011	--	--	--	--	--	--	--	--
4/14/2011	MW363E6UG2-11	392	44.6	0.86	544	6.2	60	1
4/18/2011	MW363E7UG2-11	403	43.97	1.18	326	6.49	60.4	0.3
	--	--	--	--	--	--	--	--
4/21/2011	MW363E8UG2-11	396	44.13	1.19	521	6.15	58	1
4/25/2011	MW363E9UG2-11	397	42.8	1.32	347	6.26	60.9	4.5
4/27/2011	MW363E10UG2-11	394	42	1.03	154	6.25	59.2	4.8
5/3/2011	--	--	--	--	--	--	--	--

Table F.4. Field Measurements in the MW365 Overpumping Test

Sample Date	MW365							
	Sample ID	Conductivity	Depth	Dissolved Oxygen	Oxidation/ Reduction Potential	pH	Temperature	Turbidity
		(umho/cm)	(ft)	(mg/L)	(mV)	(SU)	(ºF)	(NTU)
3/2/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/3/2011	--	--	--	--	--	--	--	--
3/7/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/9/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/10/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/14/2011	MW365E1UG2-11	397	38.45	6.7	790	6.52	55.1	21.3
	MW365DE1UG2-11	397	38.45	6.7	790	6.52	55.1	21.3
	MW365E2UG2-11	--	--	--	--	--	--	--
4/5/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/6/2011	--	--	--	--	--	--	--	--
4/7/2011	MW365E3UG2-11	398	43.74	7.36	293	6.37	68.6	64.8
4/11/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/12/2011	MW365E4UG2-11	414	42.58	9.73	583	6.84	58.2	56.6
4/14/2011	MW365E5UG2-11	418	42.08	7.6	582	6.22	60.4	10.9
4/18/2011	MW365E6UG2-11	438	38.98	11.37	295	6.5	61.5	4.1
	MW365DE6UG2-11	438	38.98	11.37	295	6.5	61.5	4.1
4/21/2011	MW365E7UG2-11	423	39.36	7.92	525	6.1	59.8	3.7
4/25/2011	MW365E8UG2-11	424	35.7	6.96	547	6.17	62	7
4/27/2011	MW365E9UG2-11	422	33.48	5.83	366	6.17	60.6	9.6
5/3/2011	MW365E10UG2-11	428	30.22	4.98	460	6.15	59	7.9

Table F.5. Field Measurements in the MW369 Overpumping Test

Sample Date	MW369							
	Sample ID	Conductivity	Depth	Dissolved Oxygen	Oxidation/ Reduction Potential	pH	Temperature	Turbidity
		(umho/cm)	(ft)	(mg/L)	(mV)	(SU)	(ºF)	(NTU)
3/2/2011	MW369E1UG2-11	359	43.2	1.9	673	6.35	59	7.8
	MW369E2UG2-11	--	--	--	--	--	--	--
	MW369DE2UG2-11	--	--	--	--	--	--	--
3/3/2011	MW369E3UG2-11	--	43	--	--	--	--	0.8
3/7/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/9/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/10/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
3/14/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/5/2011	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
4/6/2011	MW369E4UG2-11	238	40.35	2.89	199	6.76	62.4	14.5
4/7/2011	--	--	--	--	--	--	--	--
4/11/2011	MW369E5UG2-11	214	39.89	8.09	531	7.52	61.3	14.8
	--	--	--	--	--	--	--	--
4/12/2011	--	--	--	--	--	--	--	--
4/14/2011	MW369E6UG2-11	254	40.13	8.18	533	7.32	62.8	5.8
4/18/2011	MW369E7UG2-11	244	39.72	5.16	250	6.96	62.1	9.2
	MW369DE7UG2-11	244	39.72	5.16	250	6.96	62.1	9.2
4/21/2011	--	--	--	--	--	--	--	--
4/25/2011	MW369E8UG2-11	335	38.94	9.11	519	7.38	62.4	9
4/27/2011	MW369E9UG2-11	347	38.34	8.24	310	7.37	61.4	10.3
5/3/2011	MW369E10UG2-11	348	37.97	8.7	402	7.48	60.5	7.5

Figures F.1 and F.2 illustrate the relationship between PCB-1242 levels and turbidity. Because turbidity is a measure of suspended solids, PCB concentrations could be reduced further by surging and aggressive overpumping. However, PCB concentrations in RGA wells are below the EPA MCL, such that additional well development efforts are not needed to confirm that there is no above-MCL PCB contamination present in these wells and thus no C-746-U Landfill source of above-MCL contamination.

The lone UCRS well (MW365) is not purged effectively. Even with additional purging of this well, concentrations may remain above the EPA MCL. given its location, approximately 1,000 ft north of the C-746-U Landfill, and with a negative finding of soil contamination in the vicinity (see Appendix D), no additional steps are needed to confirm that the C-746-U Landfill is not a source of this PCB contamination.

APPENDIX G

LITHOLOGIC LOGS/WELL LOGS

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The logs of Appendix G document the lateral continuity of the primary hydrogeologic units beneath the C-746-U Landfill. The map showing well locations is from *C-746-U Solid Waste Landfill Groundwater Monitoring Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-205/R1, December 2001. The lateral continuity of tops of the individual well clusters is summarized in Table G.1.

Table G.1. Table of Averaged Stratigraphic Tops (Elevations) and Thicknesses for the C-746-U Landfill Well Clusters

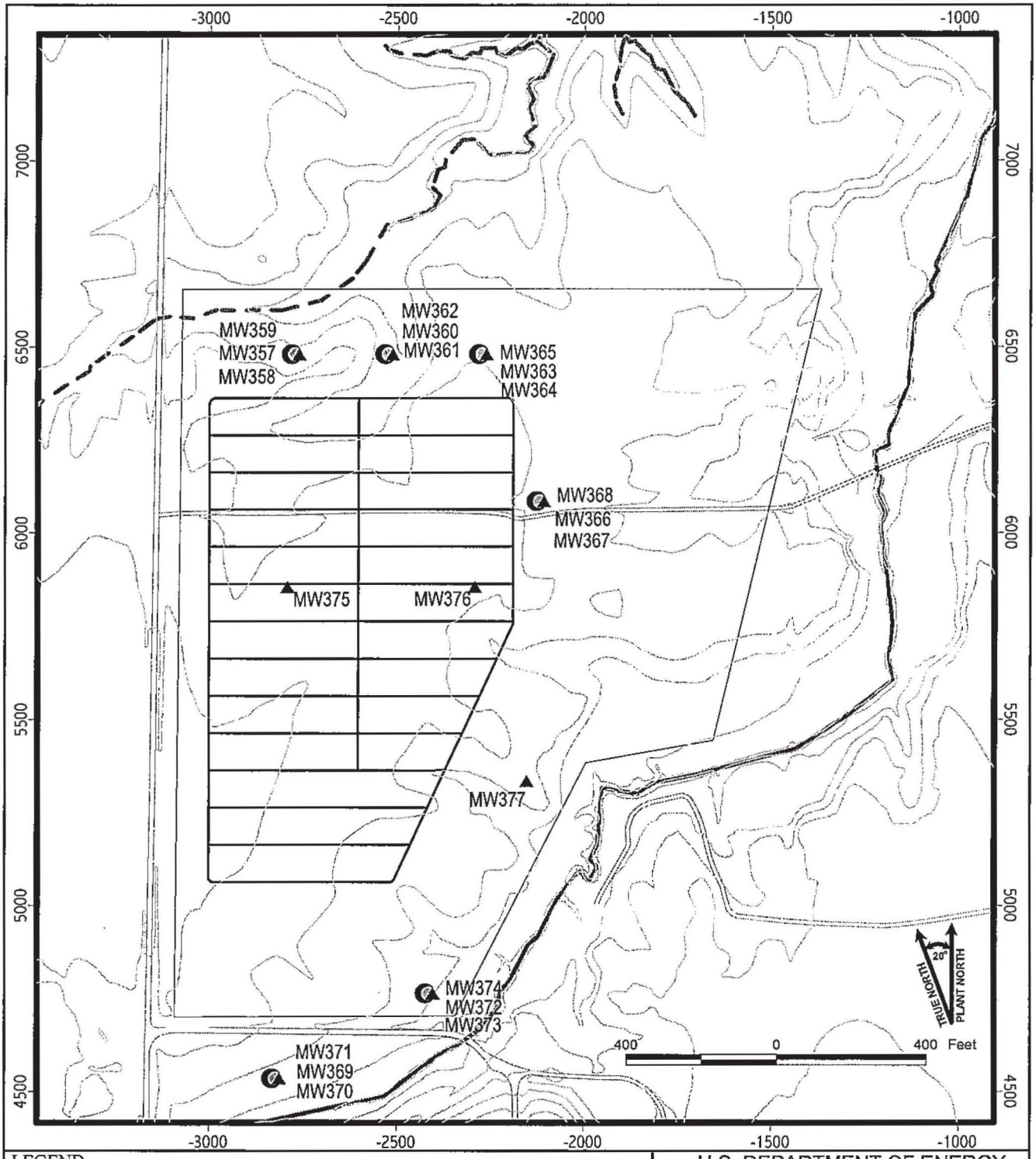
Monitoring Well Cluster	Average Surface Elevation (ft amsl)	UCD/UCRS (Hydrogeologic Units 1–3)	LCD/RGA (Hydrogeologic Units 4–5)	McNairy (Hydrogeologic Unit 6)	Dominant Lithology	Approximate Depth (ft below grade)	Thickness	Approximate Elevation of Top of Unit
	367	HU1			CL	0-28	28 ft	367
357		HU2			CL, Sdy CL	28-30	12 ft	339
358		HU3			Sd, Sdy CL	30-45	15 ft	337
359			HU4		Sd	45-55	10 ft	322
			HU5		GR, Sdy GR	55-84	29 ft	312
				HU6	CL	84		283
	359	HU1			SiCl, CL	0-19	19 ft	359
360		HU2			Sdy CL, SiCl, ClSi	19-37	18 ft	340
361		HU3			Sd, SiSd	37-45	8 ft	322
362			HU4		Sdy GR, Sd	45-60	15 ft	314
			HU5		GR	60-70	10 ft	299
				HU6	CL, ClSi	70 ft		289
	366	HU1			Silt, SiCl, ClSi	0-19	19 ft	366
363		HU2			Cl, SiCl	19-No Sample	?	347
364		HU3			SiCl	No Sample	?	?
365			HU4		Sd	52-56.5	4.5 ft	314
			HU5		Sdy GR	56.5-86	29.5 ft	309.5
				HU6	CL	86		280

Table G.1. Table of Averaged Stratigraphic Tops (Elevations) and Thicknesses for the C-746-U Landfill Well Clusters (Continued)

Monitoring Well Cluster	Average Surface Elevation (ft amsl)	UCD/UCRS (Hydrogeologic Units 1–3)	LCD/RGA (Hydrogeologic Units 4–5)	McNairy (Hydrogeologic Unit 6)	Dominant Lithology	Approximate Depth (ft below grade)	Thickness	Approximate Elevation of Top of Unit
	367	HU1			SiCl, ClSi	0-20	20 ft	367
366		HU2			ClSi	20-35	15 ft	347
367		HU3			SiCl, Sdy CL	35-50	15 ft	332
368			HU4		Sd	50-55	5 ft	317
			HU5		GR, Sdy GR	55-80	25 ft	312
				HU6	CL	80		287
	362	HU1			ClSi, Silt	0-19 ft	19 ft	362
369		HU2			Silty Sd	19-34 ft	15 ft	343
370		HU3			Sdy Silt	34-43	9 ft	328
371			HU4		Sd	43-54 ft	11 ft	319
			HU5		GR & Sd	54-76	22 ft	308
				HU6	CL	76 ft		286
	358	HU1			CL, SiCl	0-14 ft	14 ft	358
372		HU2			Silt	?	?	?
373		HU3			SiCl	?	?	?
374			HU4		Sd, Sd & GR	42-50	8 ft	316
			HU5		GR	50-71	21 ft	308
				HU6	CL	71		287

Key:
Cl = clay
ClSi = clayey silt
GR = gravel
SD = sand
Sdy = sandy
SiCl = silty clay
SiSd = silty sand
? = no or poor sample

HU = hydrogeologic unit
LCD = Lower Continental Deposits
RGA = Regional Gravel Aquifer
UCD = Upper Continental Deposits
UCRS = Upper Continental Recharge System



LEGEND:

- STREAM
- INTERMITTENT STREAM
- GROUND ELEVATION CONTOUR
- PHASED IMPLEMENTATION OF C-746-U
- ▲ UCRS WELL TO BE INSTALLED
- ◎ UPPER RGA WELL TO BE INSTALLED
- ● LOWER RGA WELL TO BE INSTALLED

NOTE: WELL NAMES ARE SHOWN IN ORDER, FROM TOP TO BOTTOM: UCRS, UPPER RGA, AND LOWER RGA.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 1. C-746-U Landfill monitoring wells to be installed.

FIGURE No. c5ac90001sk191R1apr
DATE 12-04-01

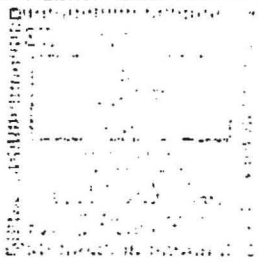
C-746 S,T, AND U LANDFILL Monitoring Wells						
Mon.Well	Plant Coord.'s @ Casing	Plant Coord.'s @ Brass Cap	KY. State Plane Coord.'s @ Casing	KY. State Plane Coord.'s @ Brass Cap	Elevation @ Top of Outer Casing	Elevation @ Brass Cap
357	N. 6451.80 W. 2829.58	N. 6450.32 W. 2829.36	N. 1946219.62 E. 752317.96	N. 1946218.17 E. 752317.61	368.98	366.86
358	N. 6444.38 W. 2851.93	N. 6442.95 W. 2851.77	N. 1946221.07 E. 752294.45	N. 1946219.69 E. 752294.07	369.13	366.62
359	N. 6448.02 W. 2840.71	N. 6446.67 W. 2840.63	N. 1946220.27 E. 752306.22	N. 1946218.99 E. 752305.79	369.21	366.65
360	N. 6467.64 W. 2627.14	N. 6466.58 W. 2626.04	N. 1946158.88 E. 752511.71	N. 1946157.49 E. 752512.34	362.27	360.03
361	N. 6487.36 W. 2617.48	N. 6486.83 W. 2616.48	N. 1946173.57 E. 752528.03	N. 1946172.71 E. 752528.76	361.55	359.46
362	N. 6477.31 W. 2621.41	N. 6476.47 W. 2620.31	N. 1946165.71 E. 752520.64	N. 1946164.52 E. 752521.35	362.11	359.63
363	N. 6521.42 W. 2392.05	N. 6522.63 W. 2392.78	N. 1946121.16 E. 752749.91	N. 1946122.56 E. 752749.69	368.78	366.25
364	N. 6535.89 W. 2373.54	N. 6536.81 W. 2374.75	N. 1946127.69 E. 752772.48	N. 1946128.99 E. 752771.70	368.39	365.95
365	N. 6528.32 W. 2383.31	N. 6529.57 W. 2384.10	N. 1946124.31 E. 752760.60	N. 1946125.76 E. 752760.33	368.23	366.00
366	N. 6121.18 W. 2246.10	N. 6121.53 W. 2244.89	N. 1945695.37 E. 752736.17	N. 1945695.23 E. 752737.42	369.16	366.87
367	N. 6145.28 W. 2247.09	N. 6145.57 W. 2245.97	N. 1945718.09 E. 752744.24	N. 1945717.94 E. 752745.38	369.48	367.37
368	N. 6134.00 W. 2247.27	N. 6134.21 W. 2246.03	N. 1945707.70 E. 752739.86	N. 1945707.43 E. 752741.09	369.23	367.07
369	N. 4564.73 W. 2957.51	N. 4564.54 W. 2958.42	N. 1944516.22 E. 751495.91	N. 1944516.37 E. 751495.00	364.32	362.02
370	N. 4589.20 W. 2957.40	N. 4589.01 W. 2958.26	N. 1944538.88 E. 751505.13	N. 1944539.08 E. 751504.28	365.20	362.95
371	N. 4576.61 W. 2957.43	N. 4576.41 W. 2958.30	N. 1944527.20 E. 751500.41	N. 1944527.35 E. 751499.53	364.75	362.56
372	N. 4817.24 W. 2486.89	N. 4816.20 W. 2487.00	N. 1944575.12 E. 752026.73	N. 1944574.19 E. 752026.25	359.60	357.33
373	N. 4823.14 W. 2509.92	N. 4822.16 W. 2509.96	N. 1944589.18 E. 752007.56	N. 1944588.28 E. 752007.16	359.88	357.72

Mon.Well	Plant Coord.'s @ Casing	Plant Coord.'s @ Brass Cap	KY. State Plane Coord.'s @ Casing	KY. State Plane Coord.'s @ Brass Cap	Elevation @ Top of Outer Casing	Elevation @ Brass Cap
374	N. 4819.04 W. 2497.62	N. 4818.02 W. 2497.78	N. 1944580.80 E. 752017.44	N. 1944579.90 E. 752016.92	359.58	357.53
375	N. 5886.80 W. 2907.85	N. 5887.13 W. 2906.55	N. 1945724.51 E. 752034.75	N. 1945724.33 E. 752036.08	370.47	368.73
376	N. 5816.34 W. 2403.20	N. 5815.10 W. 2402.97	N. 1945471.04 E. 752476.77	N. 1945469.80 E. 752476.53	370.55	368.22
377	N. 5318.27 W. 2280.94	N. 5319.38 W. 2280.09	N. 1944963.29 E. 752404.58	N. 1944964.00 E. 752405.78	365.81	363.58
384	N. 3828.36 W. 3121.20	N. 3828.26 W. 3119.62	N. 1943893.91 E. 751069.56	N. 1943893.23 E. 751070.98	365.36	363.07
385	N. 3804.81 W. 3119.46	N. 3804.72 W. 3117.96	N. 1943871.41 E. 751062.40	N. 1943870.77 E. 751063.76	365.77	363.18
386	N. 3816.45 W. 3120.54	N. 3816.28 W. 3119.05	N. 1943882.61 E. 751065.73	N. 1943881.90 E. 751067.05	365.46	363.11
387	N. 4188.73 W. 3073.18	N. 4187.91 W. 3074.44	N. 1944210.41 E. 751248.43	N. 1944210.12 E. 751246.95	363.60	361.46
388	N. 4197.35 W. 3080.77	N. 4196.58 W. 3082.14	N. 1944221.24 E. 751244.60	N. 1944221.04 E. 751243.04	363.57	360.98
389	N. 4258.20 W. 2913.08	N. 4256.78 W. 2912.00	N. 1944215.21 E. 751422.89	N. 1944213.48 E. 751423.36	364.26	361.92
390	N. 4394.91 W. 2713.38	N. 4396.00 W. 2712.24	N. 1944267.64 E. 751659.15	N. 1944268.22 E. 751660.62	360.57	358.23
391	N. 4557.92 W. 1993.30	N. 4558.12 W. 1994.68	N. 1944150.52 E. 752388.11	N. 1944151.21 E. 752386.90	366.80	364.39
392	N. 4582.37 W. 1994.30	N. 4582.74 W. 1995.72	N. 1944173.58 E. 752396.29	N. 1944174.45 E. 752395.11	366.00	363.73
393	N. 4571.03 W. 1993.08	N. 4571.17 W. 1994.65	N. 1944162.60 E. 752393.20	N. 1944163.31 E. 752391.79	366.94	364.25
394	N. 3460.44 W. 1895.64	N. 3460.79 W. 1896.92	N. 1943095.72 E. 752069.68	N. 1943096.52 E. 752068.63	378.55	376.57
395	N. 3484.23 W. 1894.71	N. 3484.66 W. 1895.93	N. 1943117.44 E. 752079.41	N. 1943118.30 E. 752078.44	379.22	377.50
396	N. 3471.98 W. 1894.83	N. 3472.47 W. 1896.14	N. 1943106.13 E. 752074.74	N. 1943107.06 E. 752073.70	378.93	376.77
397	N. 3138.13 W. 2509.29	N. 3136.78 W. 2508.90	N. 1943025.35 E. 751380.12	N. 1943023.94 E. 751379.98	387.17	385.00

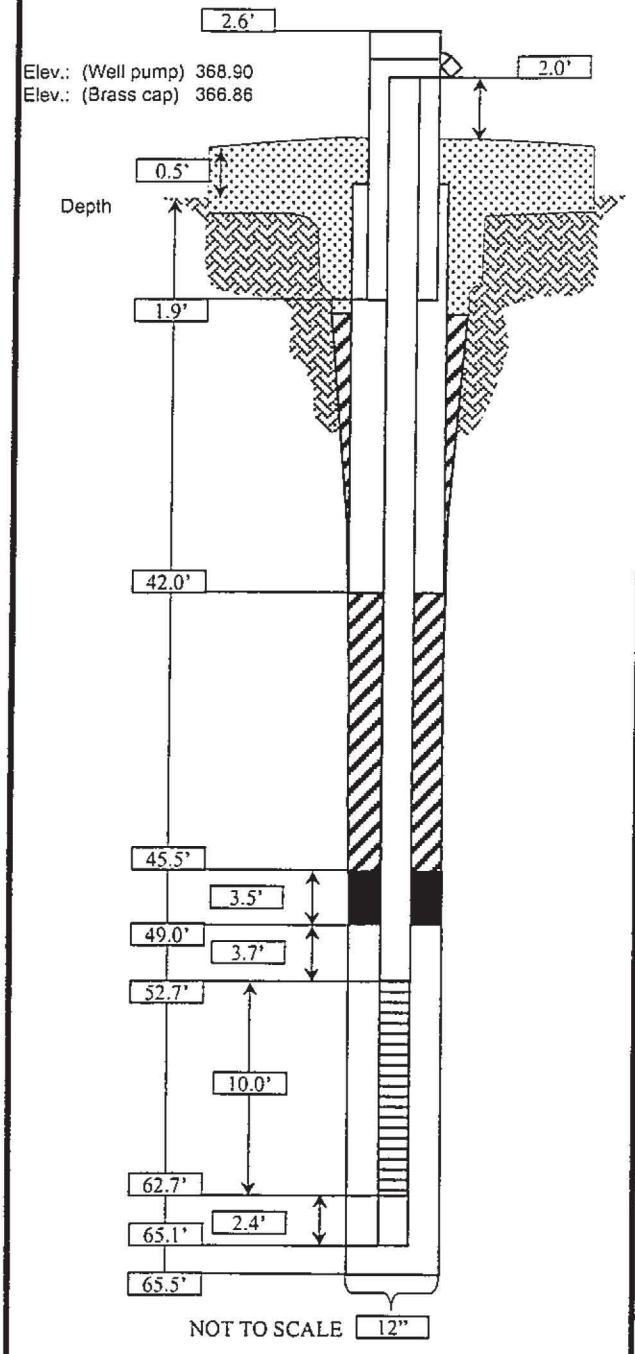
Mon.Well	Plant Coord.'s @ Casing		KY. State Plane Coord.'s @ Casing		Elevation @ Top of Inner Casing	
380	N. 7205.26 W. 5190.31		N. 1947798.67 E. 750408.15		368.64	
381	N. 7745.84 W. 4892.90		N. 1948189.46 E. 750885.61		369.30	

This is to certify to Science Applications International Corporation, that the information shown hereon was obtained under my personal supervision. The coordinates shown were calculated from a primary traverse using Accu-Air monuments A-2 and A-20 as the reference baseline. The mathematical error of closure obtained was calculated to be greater than 1: 97,989. Elevations for monitoring wells were calculated using the method of differential leveling and based upon an elevation at Accu-Air monument A-20 of 373.60 feet above Mean Sea Level. Kentucky State Plane Coordinates were calculated from data received from Bechtel Jacobs Inc. for monument locations. This information meets or exceeds the minimum standards of practice for land surveying in Kentucky.

Joel T. Prine , PLS No. 3367 — June 20, 2002



Well No. MW 357	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC		Drill Contractor: Miller Government Services
Start Date: 2/25/2002 (1515 M)		End Date: 3/10/2002 (1018 M)



Well Coord: N 6451.80
W 2829.58

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.9'
Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4
Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 55.2'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite - 925 lb.
Grout Type: Pure Gold
Weight (lbs/gal.): 9.9 - 10.2
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' - 45.5'

Centralizers (Y / N): Yes
Depth(s): 63.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 16.5 hr
Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 700 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 52.7' - 62.7'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in.
Total Length: 42.0'

Sump (Y / N): Yes
Interval BGS: 62.7' - 64.7'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
Registered Professional Geologist
Kentucky Board of Registration for Professional Geologists
PG 2290

KY 2290
8/21/02

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
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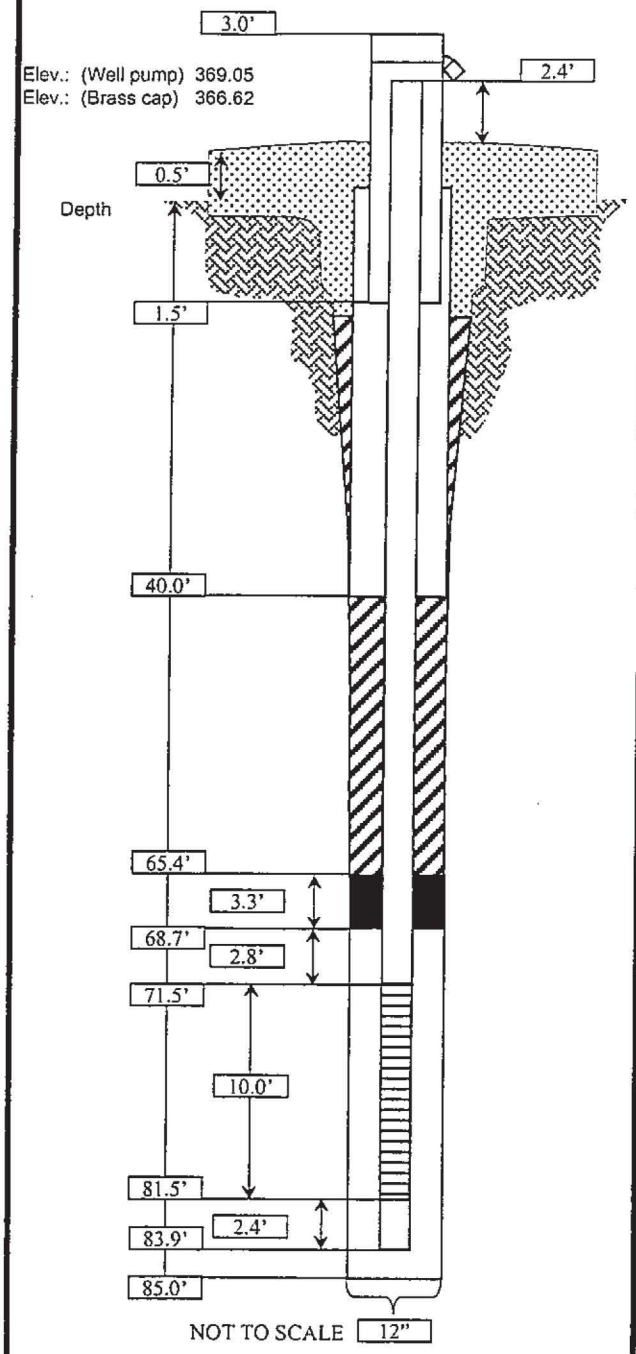
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 357 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

Well No. MW 358	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/24/2002 (1210 M)	End Date: 3/8/2002 (1545 M)	



Well Coord: N 6444.38
W 2851.93

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.5' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 74.4'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite - 1250 lb.
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0 - 10.2
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 65.4'

Centralizers (Y / N): Yes
Depth(s): 83.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 16 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 1100 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 71.5' – 81.5'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in.
Total Length: 40.0'

Sump (Y / N): Yes
Interval BGS: 81.5' – 83.5'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
Board of Registration for Professional Geologists
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James T. Calhoun KY2290
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Monitoring Well 358 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

LITHOLOGIC LOG	BORING/WELL NO.: MW358	
Facility: PGDP		Site: C-746 U
Client: Environmental Restoration Division BJC)		
Contractor: (SAIC	Drill Contractor: MGS	Driller: S. Gautney
Start Time: 1439 2/8/02	End Time: 1715 2/8/02	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow stem Augers, CME 5' Spoon CME 75		Total Depth: 39
Logged By: Wayne H. Rau		Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
1		Run #1	3.6/4.0				CLAY Trace sand dark yellowish orange 10YR 6/6 mt moderate yellowish brown 10YR 5/4 Subangular, moist firm		
2									
3									
4									
5		Run #2	4.5/5.0				CLAY, trace to little sand very Pale Orange 10YR 8/2 mt dark yellowish orange 10YR 6/6 small zones of organics, subangular moist firm		
6									
7									
8									
9									
10		Run #3	4.9/5.0				CLAY trace sand very pale orange 10YR 8/2, mt dark yellowish orange 10YR 6/6 Subangular, firm moist		
11									
12									
13									

A11824/26JUN97

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW 358	
Facility: PGDP		Site:
Client: Environmental Restoration Division BOC)		
Contractor: (SAIC	Drill Contractor:	Driller: S. Gautney
Start Time:	End Time:	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow Stem Augers, CME 5' Spoon, CME 75 >		Total Depth: 39
Logged By: Wayne Ray		Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
14							CLAY, little silt trace sand, very pale orange 10YR 8/2 mt dark yellowish orange 10YR 6/6 subangular, firm, moist. Less clay at bottom of spoon		
15		Run # 4	5.0 / 5.0						
16									
17									
18									
19									
20							CLAY, some silt trace sand, dark yellowish orange 10YR 6/6 mt Light gray N7, subangular firm, moist		
21		Run # 5	5.0 / 5.0						
22									
23									
24									
25		Run # 6					24.0 - 27.8 same as above 27.8 - 28.0 SAND, little clay dark yellowish orange 10YR 6/6 medium grained subangular to subrounded moist		
26									
27									

A1182A/26JUL97

DATA RECORDED BY:	DATE:	DATA CHECKED & REVIEWED BY:	DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW 358

Facility: PGDP

Site:

Client: Environmental Restoration Division BJC)

Contractor: (SAIC

Drill Contractor: MGS

Driller: S. Gautney

Start Time:

End Time:

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow stem Augers, CME5' spoon, CME75 >

Total Depth: 39

Logged By: Wayne Hall

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
28		Run # 6 cont.							
29							29.0 - 29.8 SAND, little gravel trace clay dark yellowish orange 10YR 6/6, coarse subangular, saturated Poorly sorted		
30									
31		Run # 7	5.0/5.0						
32							29.8 - 34.0 CLAY little silt trace sand dark yellowish orange 10YR 6/6 Mt Light Gray N7 subangular stiff moist		
33									
34							34.0 - 36.0 Same as above		
35		Run # 8	5.0/5.0				36.0 - 36.2 CLAY some silt trace sand moderate reddish brown 10R 4/6, subangular firm moist		Abundant MNO stains
36							36.2 - 39.0 SILTY CLAY trace sand, moderate yellowish brown 10YR 5/4, firm moist		
37									
38									Trace MNO stains
39									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW358

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division

Contractor: SAIC

Drill Contractor: MGS

Driller: H. DPCHADRCH

Start Time: 1337 3/5/02

End Time: 0950 3/6/02

Borehole Dia(s): 8 1/4

Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85

Total Depth: 85

Logged By: V. MULLINS

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
40							CLAY, SANDY (40%) SUBANGULAR TO SUBROUNDED, STIFF MOIST, FINE SAND, TRACE MICA, YELLOWISH RED (5YR 4/6).		
41			2.5/5.0						
42	40'/45'								
43									
44									
45									
46			32"/5.0'				SAND FINE TO MEDIUM GRAINED, MODERATELY SORTED, MOIST TO WET, TRACE SILT, TRACE MICA, YELLOWISH RED (5YR 5/8)		
47	45'/50								
48									
49									
50									
51	50'/55		1.0/5.0				SAND FINE GRAINED, WELL SORTED, SUBROUNDED, STRONG BROWN (7.5 YR 5/8) LOWER 4" SAND MEDIUM GRAINED, SUBROUNDED, TRACE COARSE PEBBLE GRAVEL (ROUNDED), DARK BROWN (7.5YR 3/4)		
52									
53									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW358	
Facility: PGDP		Site: C-746 U LANDFILL
Client: Environmental Restoration Division		
Contractor: SAIC	Drill Contractor: MGS	Driller: H. UPCHURCH
Start Time: 1337 3/5/02	End Time: 0950 3/6/02	Borehole Dia(s): 8 1/4
Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85		Total Depth: 85
Logged By: V. MULLINS		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
54									
55									
56	55' 60		3.5/5.0				GRAVEL, VERY POORLY SORTED, CHERT, VERY COARSE SAND TO VERY COARSE PEBBLE GRAVEL, TRACE COBBLE GRAVEL, STRONG BROWN (7.5 YR 4/6) LOWER 10" SAND FINE TO MEDIUM GRAINED SUBROUNDED, WELL SORTED, REDDISH BROWN (7.5 YR 6/3)		
57									
58									
59									
60									
61	60 65		20/5.0				~~SAND AS ABOVE~~ GRAVELLY (40%) ~~FINE PEBBLE TO VERY COARSE~~ SAND MEDIUM TO VERY COARSE SAND, SUBROUNDED, VERY POORLY SORTED, SOME GRAVEL (35%), FINE PEBBLE TO VERY COARSE PEBBLE GRAVEL, WET, STRONG BROWN (7.5 YR 5/6) CHERT, QUARTZ TRACE MICA		
62									
63									
64									
65									
66	65 70		22"/5.0				SAND AS ABOVE GRAVELLY (40%), FINE PEBBLE TO VERY COARSE PEBBLE GRAVEL, TRACE COBBLE GRAVEL, SUBANGULAR TO SUBROUNDED, STRONG BROWN 7.5YR 5/6, CLEAR QUARTZ, WET		
67									

DATA RECORDED BY: V. MULLINS DATE: DATA CHECKED & REVIEWED BY: DATE:

A1102A/2501

LITHOLOGIC LOG	BORING/WELL NO.: MW358	
Facility: PGDP		Site: C-746 U LANDFILL
Client: Environmental Restoration Division		
Contractor: SAIC	Drill Contractor: MGS	Driller: H. UPCHURCH
Start Time: 1337 3/5/02	End Time: 0950 3/6/02	Borehole Dia(s): 8 1/4
Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85		Total Depth: 85
Logged By: V. MULLINS		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
68									
69									
70									
71			32" / 5.0				GRAVEL SANDY (40%) MEDIUM TO VERY COARSE SAND, GRAVEL TO VERY COARSE PEBBLE GRAVEL, TRACE COBBLE GRAVEL, SUBANGULAR TO SUBROUNDED, VERY POORLY SORTED, WET, STRONG BROWN (7.5YR 5/6)		
72	70								
73	75								
74									
75									
76									
77	75						NO RECOVERY		
78	80								
79									
80									
81	80		15 / 5.0				SAND; MEDIUM TO COARSE, SUBROUNDED, WELL SORTED, CHERT, QUARTZ; WET; TRACE		
	85								

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW358

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division

Contractor: SAIC

Drill Contractor: MGS

Driller: H. DPCHDRCH

Start Time: 1337 3/5/02

End Time: 0950 3/6/02

Borehole Dia(s): 8 1/4

Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85

Total Depth: 85

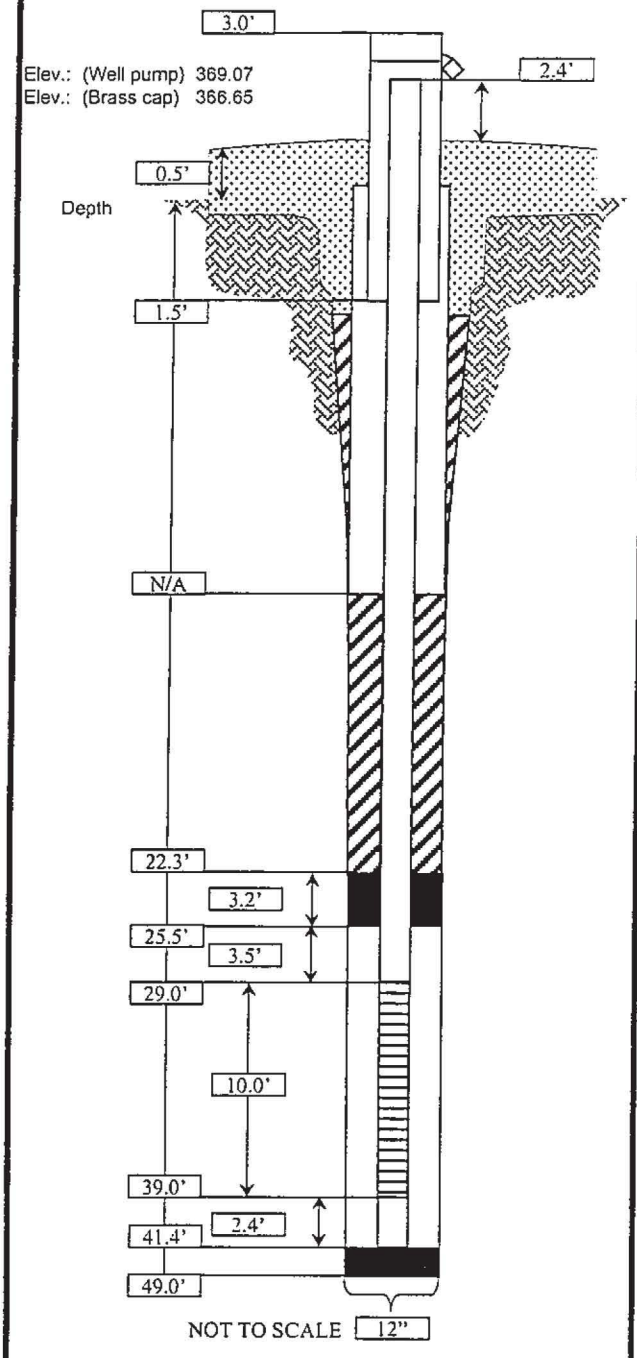
Logged By: V. MULLINS

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
82							COBBLE GRAVEL (2 EACH GREATER THAN 3") STRONG BROWN 7.5YR 5/8 IN END CAP		
83							CLAY, LIGHT BROWNISH GRAY (10YR6/2) MOTTLED WITH YELLOWISH BROWN (10YR5/6) MEDIUM STIFF TRACE FINE SAND, TRACE MICA		
84									
85							TD = 85.0 FT BGS		

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

Well No. MW 359	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/21/2002 (1510 M)	End Date: 2/23/2002 (1010 M)	



Well Coord: N 6448.02
W 2840.71

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.5' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 31.9'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 22.3'

Centralizers (Y / N): Yes
Depth(s): 40.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 20 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 900 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 29.0' – 39.0'

Isolation Casing (Y / N): No
Type: N/A
Diameter: N/A
Total Length: N/A

Sump (Y / N): Yes
Interval BGS: 39.0' – 41.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: Pel-Plug 3/8-inch TR30 Bentonite Pellets
Setup/Hydration Time: N/A
Tremied (Y / N): No

James T. Calhoun
Kentucky Board of Registration for Professional Geologists
PG 2290
Registered Professional Geologist

Jas T. Calhoun PG2290
8/21/02

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Monitoring Well 359 Construction Log

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. C90001cask300.ppt
DATE 10-29-01

LITHOLOGIC LOG	BORING/WELL NO.: MW359	
Facility: PGDP		Site: Q-746 U
Client: Environmental Restoration Division BJC		
Contractor: SAIC	Drill Contractor: MGS	Driller: S. Gentry
Start Time: 1510 2/21/02	End Time: 1008 2/22/02	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow Stem Augers, CME 5' spoon, CME 75		Total Depth: 48
Logged By: W. Cahill		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38							Drill out to 39.0		
39							39.0 - 42.0 SANDY SILT little clay, chunk yellowish brown 10YR 6/6 medium to fine grained sand moist firm	MW0	
40		Run # 1		3.0 / 5.0					
41									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

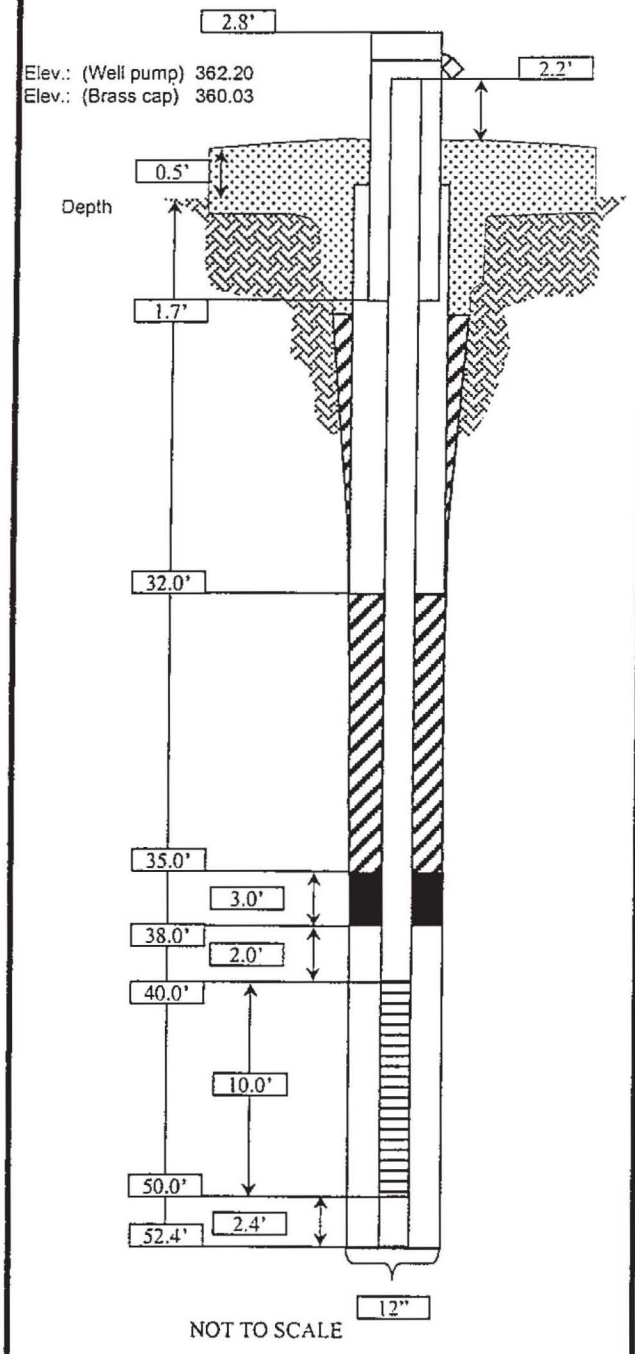
LITHOLOGIC LOG	BORING/WELL NO.: MW359	
Facility: PGDP		Site:
Client: Environmental Restoration Division BTC 1)		
Contractor: (SAIC	Drill Contractor: MGS	Driller: S. Gautney
Start Time:	End Time:	Borehole Dia(s): 8.5
Drill Method/Rig Type: Hollow Stem		Total Depth: 48
Logged By: 8¼ Hollow Stem Augers, CME 5' Spoon, CME 75		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
42		Run # 1 cont.							
43									
44									
45		Run # 2	3.5 / 5.0				44.0 - 47.5 SAND ~~little~~ with some silt, trace gravel moderate yellowish brown 10YR 5/4 banded black w/ rounded pebbles	MW0	
46									
47									Top RGA ± 48 BLS
48									
49									

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

A1102A/26JUL07

Well No. MW 360	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC		Drill Contractor: Miller Government Services
Start Date: 2/24/2002 (1500 M)		End Date: 3/7/2002 (0945 M)



Well Coord: N 6467.64
W 2627.14

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.7' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 42.7'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: 200 lb Bentonite Grout/70 gal water
Grout Type: Pure Gold
Weight (lbs/gal.): Scale Unavailable
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 35.0'

Centralizers (Y / N): Yes
Depth(s): 50.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 15 hr Vol. Fluid Added: 15 gal
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 850 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 40.0' – 50.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 32.0'

Sump (Y / N): Yes
Interval BGS: 50.0' – 52.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
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James T. Calhoun 42290
8/21/02

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

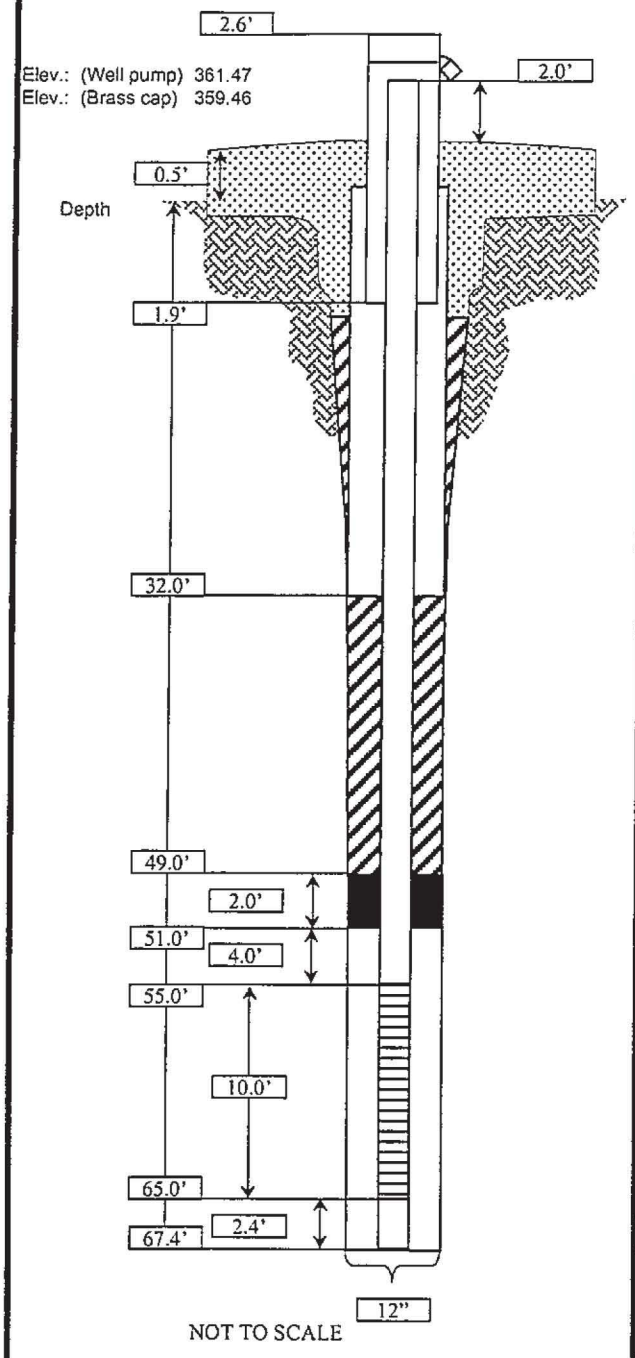
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 360 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

Well No. MW 361	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/23/2002 (1340 M)	End Date: 3/6/2002 (1015 M)	



Well Coord: N 6487.36
W 2617.48

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.9' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 57.5'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: 200 lb Bentonite Grout/70 gal water
Grout Type: Pure Gold
Weight (lbs/gal.): Scale Unavailable
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 49.0'

Centralizers (Y / N): Yes
Depth(s): 65.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 21 hr Vol. Fluid Added: 15 gal
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 550 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 55.0' – 65.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 32.0'

Sump (Y / N): Yes
Interval BGS: 65.0' – 67.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
Board of Registration for Professional Engineers
PG 2290
Registered Professional Geologist
KY

James T. Calhoun KY 2290
8/21/02

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
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Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 361 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

LITHOLOGIC LOG

BORING/WELL NO.: MW361

Facility: PGDP

Site: C-746-C LANDFILL

Client: Environmental Restoration Division BJC

Contractor: SAIC

Drill Contractor: MGS

Driller: S. GAUTNEY ~~MILLER GOV. SERVICES~~

Start Time: 1405 2/9/02

End Time: 1605 2/9/02

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow stem Augers, CME 5' spoon, CME 75 7

Total Depth: 33

Logged By: [illegible]

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
1		Run # 1	3.5/4.0				0.0 - 0.1 Grass Roots soil 0.1 - 3.5 SILTY CLAY Trace sand Dark yellowish brown 10YR 4/2 to grayish orange 10Y 7/4, firm, subangular moist,		
2									
3									
4									
5		Run # 2	3.7/5.0				CLAY, some silt trace sand, very pale orange 10YR 8/2, mt moderate yellowish brown 10YR 5/4 firm, moist subangular		Poor recovery because of binge in spoon
6									
7									
8									
9									
10		Run # 3	5.0/5.0				CLAY some silt, Trace sand light bluish grey 5B 7/1 to yellowish grey 5Y 8/1, mt moderate brown 5YR 4/4, firm subangular, moist		
11									
12									
13									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

A118284/26JUL

LITHOLOGIC LOG

BORING/WELL NO.: MW361

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division BJC)

Contractor: (SAIC

Drill Contractor: MGS

Driller: S. Gaultney

Start Time:

End Time:

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Augers, CME 5 spoon, CME 75 >

Total Depth: 33

Logged By: W. Pettit

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
14							CLAY, some silt trace sand light greenish gray 5Y 8/1, Mt moderate yellowish brown 10YR 5/4, subangular moist firm		
15		Run # 4	4.2/5.0						
16									
17									
18									
19							19.0 - 20.3 SANDY CLAY, trace gravel, moderate yellowish brown 10YR 5/4 Mt grayish yellow 10YR 7/4 subangular, firm moist		
20		Run # 5	4.5/5.0						
21									
22							20.3 - 23.5 SILTY CLAY, trace sand, moderate yellowish Brown 10YR 5/4, subangular moist firm		
23									
24							24.0 - 27.5 CLAYEY SILT, trace sand, very pale orange 10YR 8/2, Mt dark yellowish orange 10YR 6/6, firm moist subangular		
25		Run # 6	5.0/5.0						
26									
27									

A1182A/36.01

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW 361

Facility: PGDP

Site:

Client: Environmental Restoration Division BJC ,)

Contractor: (SAIC

Drill Contractor: MGS

Driller: S. Gautney

Start Time:

End Time:

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow stem Augers, CME 5' spoon, CME 75

Total Depth: 33

Logged By: W. Hall-Pa

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
28		Run # 6 cont.					27.5 - 27.7 SAND some silt, trace clay yellowish gray 5Y 8/1, Poorly sorted subangular firm, moist		
29							CLAY 27.7 - 24.0 some silt, trace sand, yellowish gray 5Y 8/1, MT moderate yellowish brown 10YR 5/4 firm moist		
30		Run # 7	4.2/4.0						
31							SILTY CLAY, trace sand, very pale orange 10YR 8/2 MT moderate yellowish brown 10YR 5/4 firm moist subangular		MNO stains
32									
33									

DATA RECORDED BY:

DATE:

DATA CHECKED & REVIEWED BY:

DATE:

A11824/25JUL97

LITHOLOGIC LOG

BORING/WELL NO.: MW361

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division

Contractor: SAIC

Drill Contractor: MAS

Driller: D. BISHOP

Start Time: 1255 2/26/02

End Time: ~~1520 2/26/02~~ 1130 2/28/02

Borehole Dia(s): 8¼

Drill Method/Rig Type: 8¼ HSA, CME 5'S.200N, CME 75

Total Depth: 75

Logged By: BRAD BAKER / KEN DAVIS

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
35							SILTY CLAY w/LITTLE GRAVEL, SILT 40%, CLAY 45%, GRAVEL 15%, REDDISH YELLOW 7.5YR 7/8, SUBROUNDED, V. POORLY SORTED, MED., MOIST		
36									
37	35-40		5.0/5.0						
38							SAND w/SOME SILT, SAND; SAND 70%, SILT 30%, STRONG BROWN 7.5YR 5/8, VARIGATED REDDISH YELLOW 7.5YR 5/6, SUBROUNDED, POORLY SORTED, MEDIUM, MOIST		
39									
40									
41							SAND SOME SILT, SAND MEDIUM 70%, SILT 30% w/TRACE OF MUSCOVITE AND MnO_2, REDDISH-YELLOW 7.5YR 5/6; SUBROUNDED; POORLY SORTED; MEDIUM, MOIST		
42	40-45		4.0/5.0						
43									
44									
45									
46							SANDY GRAVEL SAND; COARSE 40% GRAVEL 60%, REDDISH YELLOW 7.5YR 7/8, SAND, SUBROUNDED, GRAVEL-ANGULAR, POORLY SORTED, LOOSE, WET		
47	45-50		2.5/5.0						
48									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW361

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division

Contractor: SAIC

Drill Contractor: MCS

Driller: D. BISHOP

Start Time: 1255 2/26/02

End Time:

Borehole Dia(s): 8 1/4

Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOOL, CME 75

Total Depth: 75

Logged By: BRAD BAKER / KEN DAVIS

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
49									
50									
51	50-55		5/6.0				SAND W/ LITTLE SILT, COARSE 85%, SILT 15%, REDDISH YELLOW 7.5YR 7/8, SUBROUNDED, MOD. SORTED, LOOSE, WET		
52									
53									
54									
55									
56	55-60		3.0/5.0				SAND W/ SOME GRAVEL, SAND MED-COARSE 60%, GRAVEL 25%, SILT 15%, REDDISH YELLOW 7.5YR 7/8, SUB-ROUNDED, GRAVEL SUBANGULAR, POORLY SORTED, LOOSE, WET		
57									
58									
59									
60									
61	60-65		2.0/5.0				GRAVEL (50%) POORLY SORTED (UP TO 3"), SUBROUNDED TO SUB-ANGULAR, SAND (35%) MEDIUM TO COARSE, SUBROUNDED; SILT (15%); YELLOW 10YR 7/6 WET LOOSE		
62									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

A112826/25JUN

LITHOLOGIC LOG

BORING/WELL NO.: MW361

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division

Contractor: SAIC

Drill Contractor: MKS

Driller: D. BISHOP

Start Time: 1255 2/26/02

End Time:

Borehole Dia(s): 8 1/4

Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON; CME 75

Total Depth: 75

Logged By: BRAD BAKER / KEN DAVIS

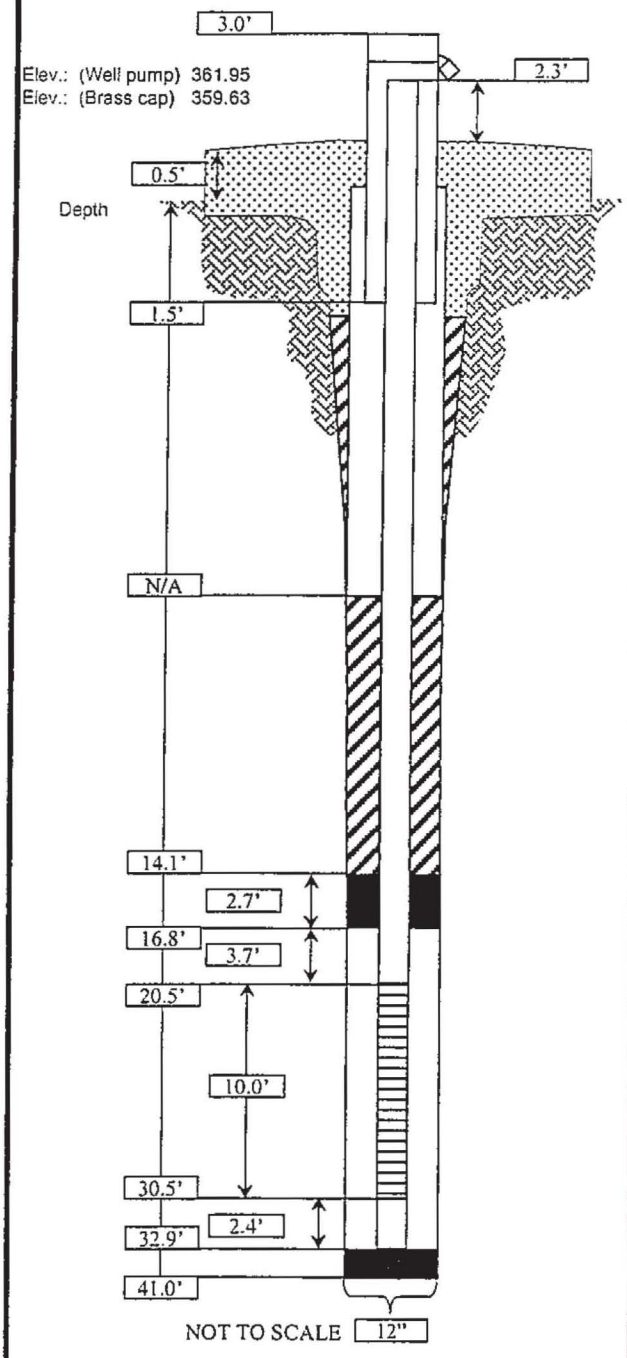
Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
63	60-65								
64									
65									
66			3.2/5.0				65-66.6 GRAVELLY SAND SAND (55%) MEDIUM ROUNDED, MODERATELY WELL SORTED, GRAVEL (30%), COARSE (UP TO 2") ROUNDED TO SUB-ANGULAR, SILT (15%) LOOSE, WET		
67	66-70								
68							66.6-68.2 FINE SAND WELL SORTED, ROUNDED, FIRM, WET W/CLAY LAMINATIONS (20%) LAMINATED V. PALE BROWN (10YR 7/4) AND LIGHT GRAY (10YR 7/1) MEDIUM PLASTICITY, MOIST		NOTE: SAND IS QUARTZ WITH 2% MICA (MUSCOVITE?) AND 1-2% OPAQUE MINERALS
69									
70							70-70.2 SAND AS ABOVE 70.2-74.9 CLAYEY SILT 50% SILT, V. PALE BROWN (10YR 7/4) AT TOP 1 FT GRADING TO MASSIVE LIGHT GRAY (10YR 7/1) INTERVAL OVER BOTTOM 3 FT, MEDIUM PLASTICITY, FIRM, MOIST		
71									
72	70-75		4.9/5.0						
73									
74									
75							TD = 75.0 FT BGS		

A11824/2/JUL/1

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

Well No. MW 362	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/19/2002 (1510 M)	End Date: 2/21/2002 (0903 M)	



Well Coord: N 6477.31
W 2621.41

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.5' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 23.3'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 9.8
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 14.1'

Centralizers (Y / N): Yes
Depth(s): 31.5'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 21.5 hr Vol. Fluid Added: 6 gal
Tremied (Y / N): No

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 1000 lb
Tremied (Y / N): No
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 20.5' – 30.5'

Isolation Casing (Y / N): No
Type: N/A
Diameter: N/A
Total Length: N/A

Sump (Y / N): Yes
Interval BGS: 30.5' – 32.5'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: Pel-Plug 3/8-inch TR30 Bentonite Pellets
Setup/Hydration Time: N/A
Tremied (Y / N): No

James T. Calhoun
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PG 2290
Registered Professional Geologist

James T. Calhoun PG 2290
8/21/02

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 362 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

LITHOLOGIC LOG

BORING/WELL NO.: MW362

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division BJC

Contractor: SAIC

Drill Contractor: MGS

Driller: S. Gootman

Start Time: 1100 2/19/02

End Time: 1410 2/19/02

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow Stem Augers, CME 5' Spoon CME 75

Total Depth: 41

Logged By: H. Fu

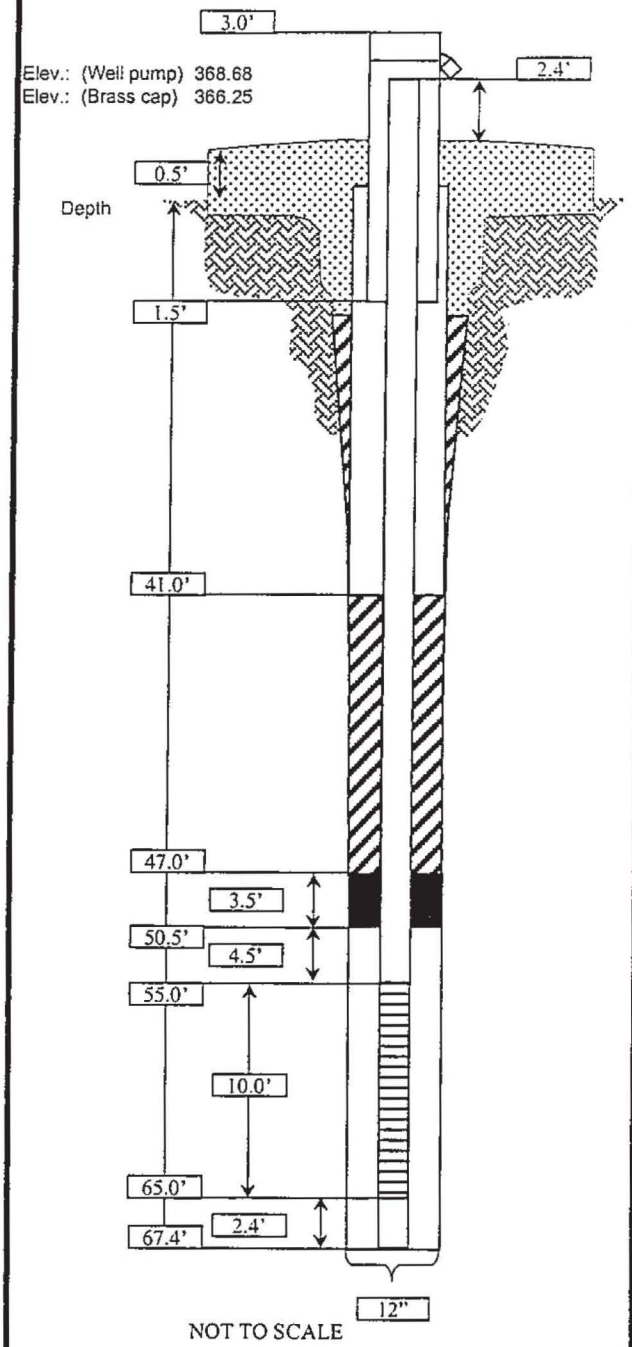
Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
28									
29									
30									
31									
32							Drill out to 33.0		
33							33.0-35.9 SAND, little clay trace silt, dark yellow ish orange 10YR 6/6 banded black N1 fine grained, soft to firm subangular moist		
34			3.3/5.0						
35		Run # 1							
36							35.9-36.3 SAND, little gravel little pebbles, dark yellowish orange 10YR 6/6 subangular moist firm, medium grained		
37									
38							38.0-41.0 SAND little clay dark yellowish orange 10YR 6/6, mn black N1 medium grained moderately sorted subangular saturated		
39		Run # 2	3.5/3.0						
40									
41									

A1182A/26JUL02

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

Well No. MW 363	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/19/2002 (1000 M)	End Date: 3/7/2002 (1115 M)	



Well Coord: N 6521.42
W 2392.05

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.5' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 57.9'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 9.8 – 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 47.0'

Centralizers (Y / N): Yes
Depth(s): 66.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 20.5 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 750 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 55.0' – 65.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 41.0'

Sump (Y / N): Yes
Interval BGS: 65.0' – 67.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
KY Board of Registration for Professional Geologists
PG 2290
Registered Professional Geologist

James T. Calhoun PG2290
8/21/02

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

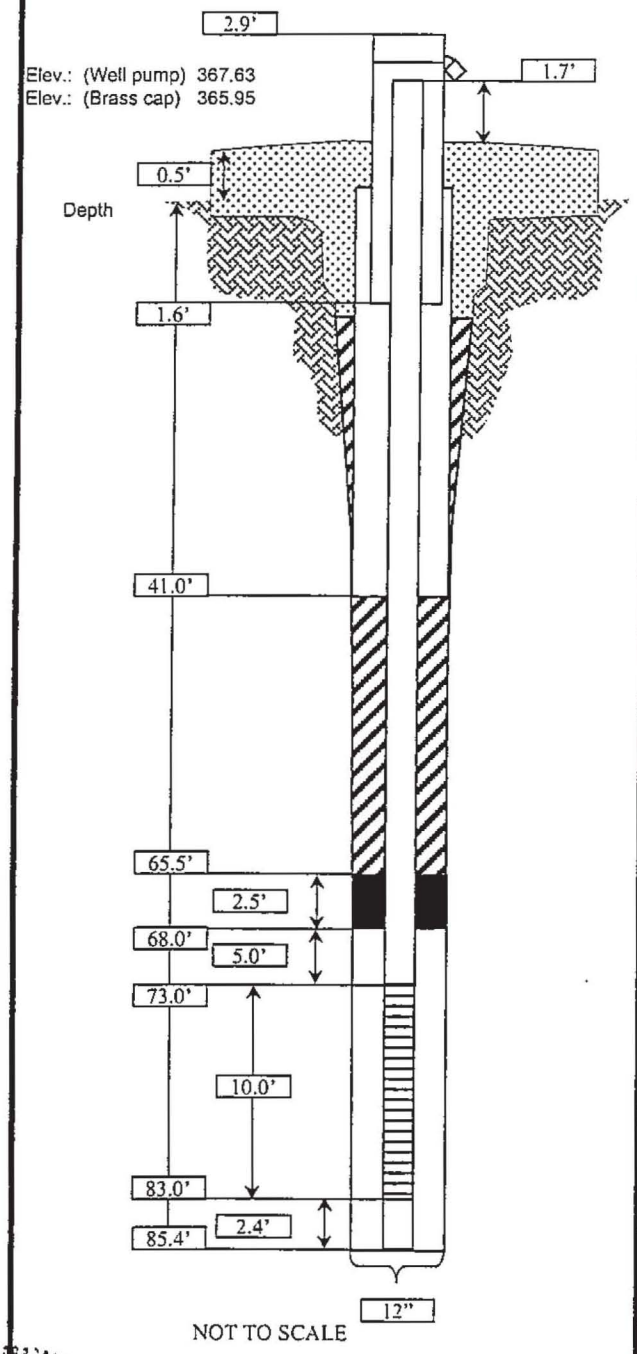
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 363 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

Well No. MW 364	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/21/2002 (1025 M)	End Date: 3/5/2002 (1035 M)	



Well Coord: N 6535.89
W 2373.54

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.6' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 75.2'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 65.5'

Centralizers (Y / N): Yes
Depth(s): 84.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 17 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 750 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 73.0' – 83.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 41.0'

Sump (Y / N): Yes
Interval BGS: 83.0' – 85.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
Kentucky Board of Registration for Professional Engineers & Land Surveyors
PG 2290
Registered Professional Geologist

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
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Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 364 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Calhoun PG2290
8/21/02

LITHOLOGIC LOG

BORING/WELL NO.: MW 364

Facility: PGDP

Site: C-746-U LANDFILL

Client: Environmental Restoration Division BJC 1)

Contractor: (SAIC

Drill Contractor: MGS

Driller: S. Gautney

Start Time: 1210 2/11/02

End Time: 1350 2/11/02

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow stem Augers CME 5' Spoon, CME 75

Total Depth: 36

Logged By: Wayne W. Pierce

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
1		Run # 1	3.5/4.0				0.0 - 0.8 SILT some clay, trace sand, dark yellowish brown 10YR 4/2 subangular, moist firm		
2							0.8 - 3.5 SILTY CLAY, trace sand very pale orange 10YR 8/2 MT dark yellowish orange 10YR 6/6, subangular firm to stiff, moist		
3									
4							4.0 - 8.2 CLAYEY SILT dark yellowish orange 10YR 6/6, MT very pale orange 10YR 8/2 subangular, moist, stiff		
5									
6		Run # 2	4.2/5.0						
7							7.5 - 8.0 Trace MNO		
8									
9									
10							9.0 - 12.2 SILT some clay, trace sand, moderate brown 10YR 5/4 MT very pale orange 10YR 8/2, subangular moist		
11		Run # 3	4.5/5.0						
12							12.2 - 12.5 Same as above except strong MNO stains		MNO
13									12.5 - 13.5 SILT some clay Trace sand moderate yellowish brown 10YR 5/4, MT very pale orange 10YR 8/2 moist stiff to firm

A1182A/26JUL02

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW364

Facility: PGDP | Site:

Client: Environmental Restoration Division BJC

Contractor: SAIC | Drill Contractor: MGS | Driller: S. Gautney

Start Time: | End Time: | Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow Stem Augers, CME 5' Spoon CME 75 | Total Depth: 36

Logged By: Wayne Kuhn | Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
14									
15		Run # 4	5.0 / 5.0				14.0-19.0 CLAYEY SILT very pale orange 10YR 8/2 mt moderate yellowish brown, moist firm to stiff		
16									
17									
18									
19									
20		Run # 5	3.5 / 5.0				19.0-22.5 CLAY, some silt, Trace sand, light brownish gray 5YR 6/2, mt moderate yellowish brown 10YR 5/4 subangular, stiff moist		
21									
22									Possible 1.5 ft material pushed down hole
23									
24									
25		Run # 6	5.0 / 5.0				24.0-29.0 SILTY CLAY dark yellowish orange 10YR 6/6, mt very pale orange 10YR 8/2 moist stiff		
26									
27									

A1182A/26JUL07

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW 364

Facility: PGDP | Site:

Client: Environmental Restoration Division BJC)

Contractor: (SAIC | Drill Contractor: | Driller: S. Gaither

Start Time: | End Time: | Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow Stem Augers CME 55 | Total Depth: 36

Logged By: [illegible] | Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
28		Run #6 cont.							
29							29.0 - 33.0 CLAY some silt dark yellowish 10YR 4/6 orange, mt moderate yellowish brown 10YR 5/4, mt pale brown 10YR 6/2 moist stiff		
30		Run #7	4.0 / 5.0						
31									
32									
33									
34									
35		Run #8	2.4 / 2.4				34.0 - 36.0 same as above except MNO staining @ 35.5 - 36.0	MNO	
36									

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

A11824/26JUL97

LITHOLOGIC LOG

BORING/WELL NO.: MW364

Facility: PGDP

Site: C-746-U LANDFILL

Client: Environmental Restoration Division (BJC)

Contractor: SAIC

Drill Contractor: MGS

Driller: S. Gautney

Start Time: 1520 2/25/02

End Time: 1250 2/28/02

Borehole Dia(s): 6.5

Drill Method/Rig Type: 8¼ Hollow stem Augers, CME 5' spoon, CME 75?

Total Depth: 88

Logged By: W.M. K. Ru

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
42									
43							Drill out to 44.0 BLS		
44							44.0 - 49.0 SILTY CLAY light greenish gray 5G 8/1 mt moderate yellowish brown 10YR 5/4 firm to stiff	MW0	
45		Run # 1	5.0 / 5.0						
46									
47									
48								MW0	
49							49.0 - 52.0 SAND same as above		
50		Run # 2	4.0 / 5.0				52.0 - 53.0 SAND, little clay trace gravel, dark yellowish orange 10YR 6/6 medium to coarse grained, poorly sorted, soft, saturated Pebbles to 1"	MW0	TOP RGA @ 52 BLS
51									
52									
53									
54							54.0 - 55.0 Sand, some gravel, trace clay, moderate yellowish brown 10YR 5/4, medium grained saturated, soft pebbles to 1" diameter		
55		Run # 3	2.5 / 4.0						

DATA RECORDED BY: [illegible] DATE: DATA CHECKED & REVIEWED BY: DATE:

A1182A/36JUN

LITHOLOGIC LOG

BORING/WELL NO.: MW364

Facility: PGDP | Site:

Client: Environmental Restoration Division

Contractor: SAIC | Drill Contractor: MGS | Driller: S. Gautney

Start Time: | End Time: | Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow stem Augers, CME 5' spoon CME 75 | Total Depth: 88

Logged By: W. H. Ku | Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
56		Run #3 cont.	2.5/1.0				55.0-56.5 SAND, little clay dark yellowish orange 10YR 6/6, medium grained moderately sorted, subangular saturated		
57									
58							58.0-60.5 GRAVELY SAND trace clay, dark yellowish orange 10YR6/6 rounded, soft to firm, saturated		
59		Run # 4							
60			2.5/5.0						H.S. Auger Refusal @ 60' BLS ~~Adjust~~ 03/22/02 Adjust spoon length
61									
62									
63									
64		Run # 5	0.0/5.0				NO Recovery		
65									
66									
67									
68									
69		Run # 6	0.3/5.0				SAND 68.0-68.3 Trace gravel Trace clay, moderate yellowish brown 10YR5/4 medium grained, poorly to very poorly sorted SOIL saturated		

A1182A/26JUL02

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW364	
Facility: PGDP		Site:
Client: Environmental Restoration Division (BJC)		
Contractor: SAIC	Drill Contractor: MGS	Driller: S. Gaufney
Start Time:	End Time:	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow Stem Augers CME 5' spoon CME 75		Total Depth: 88
Logged By: Ward H. R.		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
70–73		Run # 6 cont					No Recovery		
73–78		Run # 7	0.0/5.0				No Recovery		
78–83		Run # 8	0.0/5.0				No Recovery		
83		Run # 9							

A1182A/26JUL

DATA RECORDED BY:	DATE:	DATA CHECKED & REVIEWED BY:	DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW364

Facility: PGDP | Site:

Client: Environmental Restoration Division (BJC)

Contractor: (SAIC | Drill Contractor: MGS | Driller: S. Gautney

Start Time: | End Time: | Borehole Dia(s): 8.5

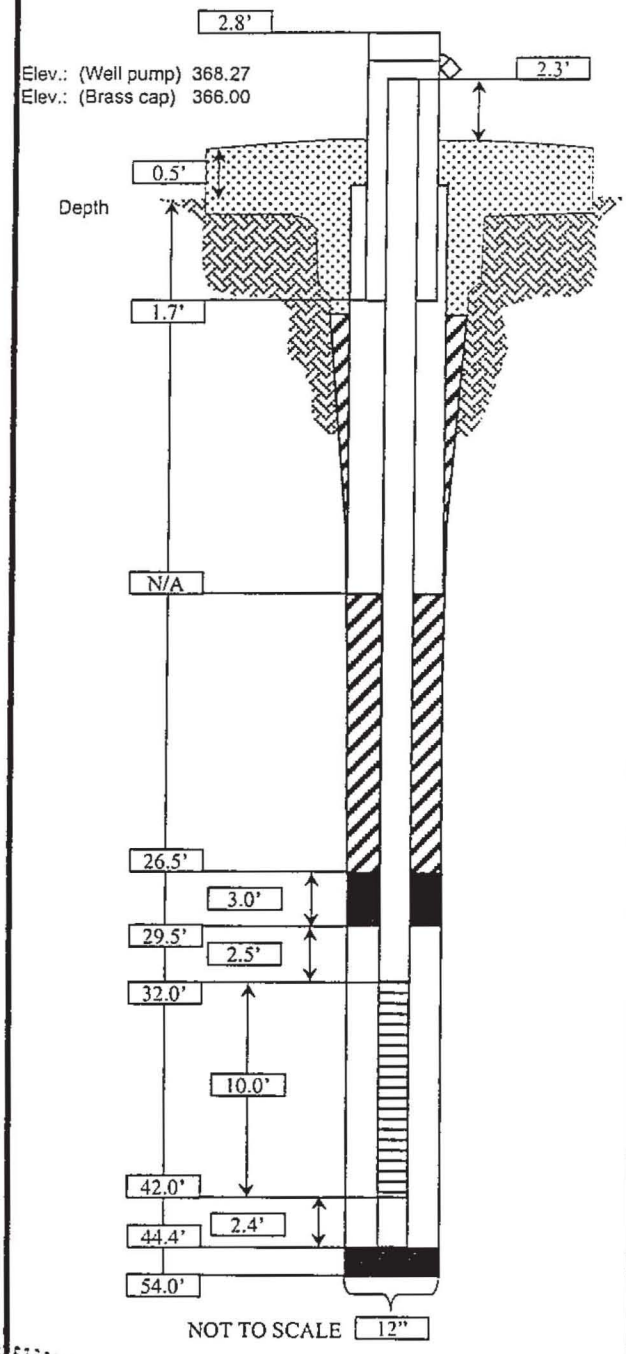
Drill Method/Rig Type: 8¼ Hollow stem Augers, CME 5' spoon, CME 75 | Total Depth: 88

Logged By: WAP/H.D. | Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
84									
85		Run 4 9 cont.	1.8/5.0						
86							CLAY trace silt light gray N7 moist, firm, sticky, Iron cemented Bands		Top McNairy @ 86.2
87									
88									

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

Well No. MW 365	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/12/2002 (1435 M)	End Date: 2/14/2002 (1115 M)	



Well Coord: N 6528.32
W 2383.31

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.7' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 34.8'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 9.8 – 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 26.5'

Centralizers (Y / N): Yes
Depth(s): 43.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 18.5 hr Vol. Fluid Added: 6 gal
Tremied (Y / N): No

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 1000 lb
Tremied (Y / N): No
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 32.0' – 42.0'

Isolation Casing (Y / N): No
Type: N/A
Diameter: N/A
Total Length: N/A

Sump (Y / N): Yes
Interval BGS: 42.0' – 44.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: Pel-Plug 3/8-inch TR30 Bentonite Pellets
Setup/Hydration Time: 17.5 hr
Tremied (Y / N): No

James T. Calhoun
Kentucky Board of Registration for Professional Geologists
PG 2290
Professional Geologist

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Monitoring Well 365 Construction Log

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Calhoun PG 2290
8/21/02

LITHOLOGIC LOG

BORING/WELL NO.: MW365

Facility: PGDP

Site: C-746-U LANDFILL

Client: Environmental Restoration Division (BJC)

Contractor: SAIC

Drill Contractor: MGS

Driller: S. Gaffney

Start Time: 1530 2/12/02

End Time: 1655 2/12/02

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow Stem Augers, 5' CME Spoon, CME75

Total Depth: 54

Logged By: Virgil L. Ferrell

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
28									
29									
30									
31									
32									
33									
34							Drill out to 34.0		
35		Run # 1	4.2/5.0				34.0 - 38.2 SILT little clay little sand pale yellowish brown 10YR 6/2, mt moderate yellowish brown 10YR 5/4 subangular, firm moist		
36									
37									
38									
39							38.0 - 40.5 same as above		
40		Run # 2	4.5/5.0						
41									

A1182A/36/01

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW 365

Facility: PGDP | Site:

Client: Environmental Restoration Division BJC

Contractor: SAIC | Drill Contractor: | Driller: Geoprobe

Start Time: | End Time: | Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow stem Auger, 5' CME Spoon, CME 75 | Total Depth: 54

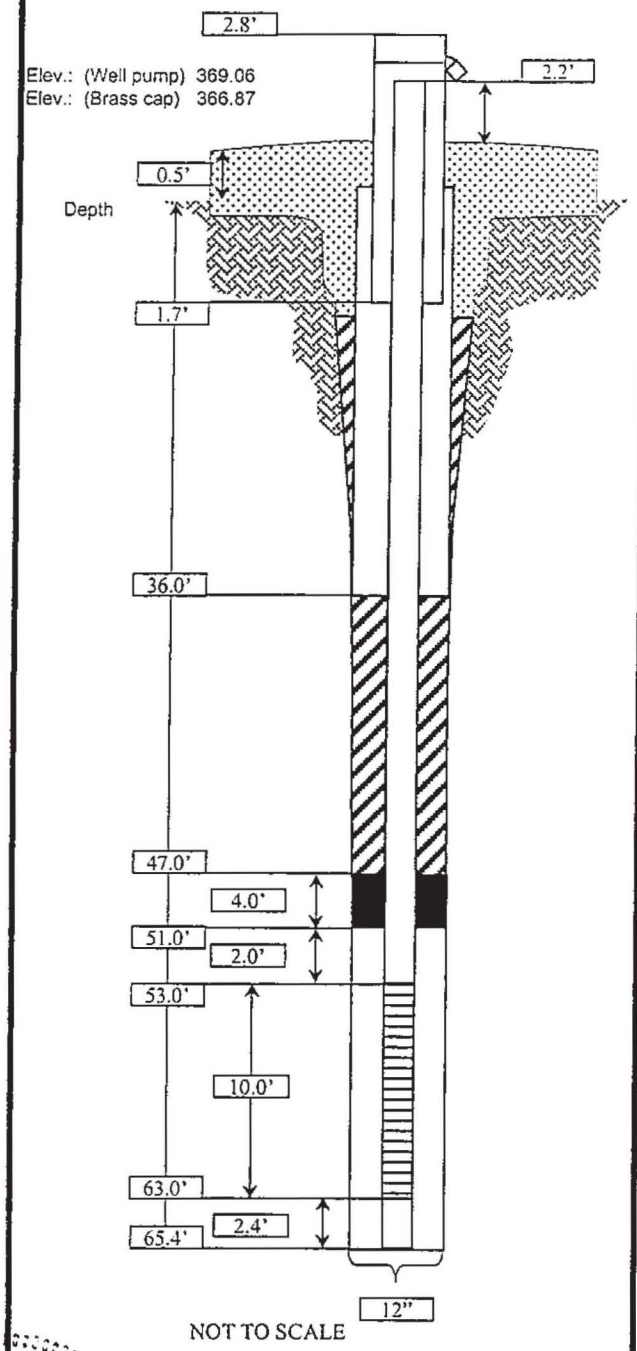
Logged By: Nicholl | Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
42		Run # 2 cont.					40.5-43.5 CLAY some silt, very pale orange 10YR 8/2 mt dark yellowish orange 10YR 6/6 firm moist		
43									
44							SILTY CLAY 44.0-49.0 light greenish gray 5G 8/1, mt moderate yellowish brown 10YR 5/4 firm to stiff		
45		Run # 3 VOA	5.0/5.0					MNO	
46									
47								MNO	
48									
49							49.0-52.0 same as above		
50		Run # 4	2.5/5.0					MNO	
51							52.0-53.5 SAND, little pebbles trace clay dark yellowish orange 10YR 6/6, medium grained, subangular poorly sorted to very poorly sorted	MNO	TOP RGA @ 52.0 BLS
52									
53									
54									
55		Run # 5 VOA	03/27/02						

A1182A/26JUL02

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

Well No. MW 366	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC		Drill Contractor: Miller Government Services
Start Date: 2/14/2002 (1020 M)		End Date: 3/11/2002 (1340 M)



Well Coord: N 6121.18
W 2246.10

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.7' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 55.7'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: 200 lbs Bentonite Grout/70 gal water
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 47.0'

Centralizers (Y / N): Yes
Depth(s): 63.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 20.5 hr Vol. Fluid Added: 15 gal
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 600 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 53.0' – 63.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 36.0'

Sump (Y / N): Yes
Interval BGS: 63.0' – 65.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Cullinoun
Kentucky Board of Registration for Professional Geologists
PG 2290
Registered Professional Geologist

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

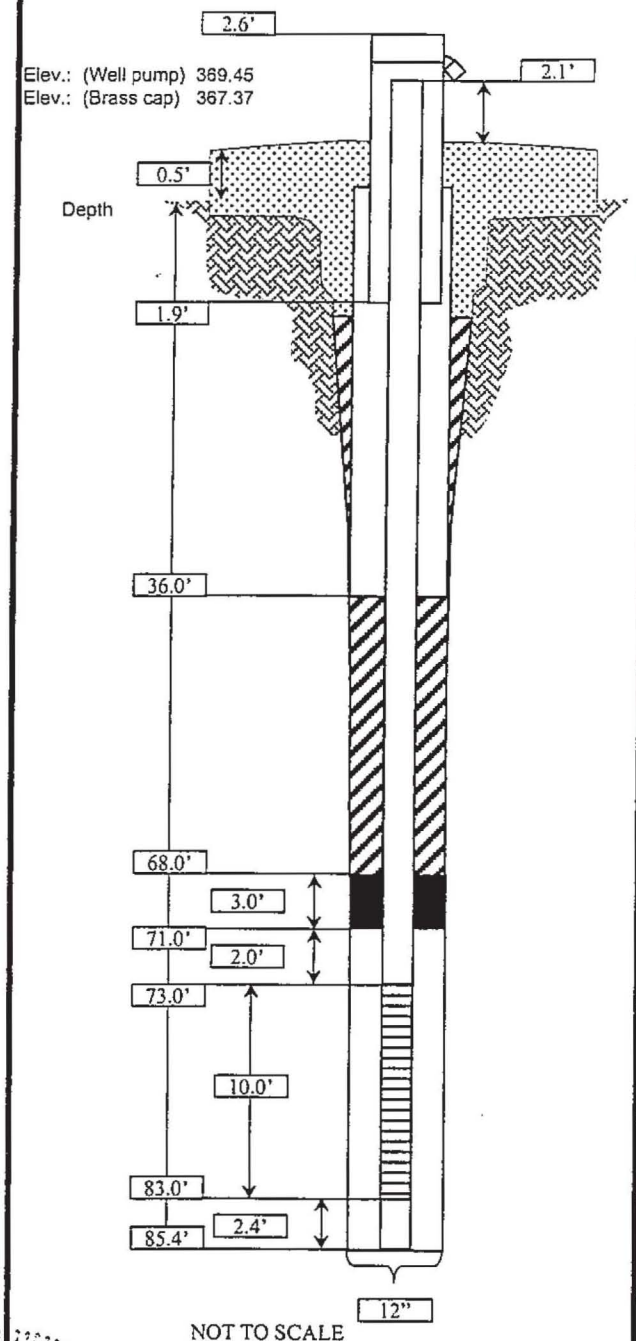
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 366 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Cullinoun KY 2290
8/21/02

Well No. MW 367	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/9/2002 (1005 M)	End Date: 3/9/2002 (1530 M)	



Well Coord: N 6145.28
W 2247.09

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.9' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 75.6'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: 200 lbs Bentonite Grout/70 gal water
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 68.0'

Centralizers (Y / N): Yes
Depth(s): 83.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 19 hr Vol. Fluid Added: 25 gal
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 950 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 73.0' – 83.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 36.0'

Sump (Y / N): Yes
Interval BGS: 83.0' – 85.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

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Monitoring Well 367 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Calhoun KY 2290
8/21/02

LITHOLOGIC LOG	BORING/WELL NO.: MW-367	
Facility:		Site:
Client:	Environmental Restoration Division	
Contractor: (	Drill Contractor: Miller	Driller: Harley Upchurch
Start Time: 1330/2/5/02	End Time: 2/8/02 1600	Borehole Dia(s): 8 1/4
Drill Method/Rig Type: HSA / CME-85		Total Depth:
Logged By: Brad Baker		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0			4.5'/5.0' 90%				Silty CLAY (CL), silt ~40%, clay ~60%; trace v. fine sand; Brown 7.5YR 4/2; leafy organics present; subrounded; v. poorly sorted; soft; moist		4 1/4" ID HSA w/ CME 5 ft sampler
1									
2							Silty CLAY (CL); silt ~40%, clay ~60%; trace v. fine sand; Pale Brown 10YR 6/3; variegated yellowish brown and lt gray; subrounded; v. poorly sorted; soft; moist		
3									
4									
5									
6			3'/5' 60%				SILT w/ some clay (MH) silt ~70%, clay ~30%; trace v. fine sand; Pale Brown 10YR 6/3 variegated yellowish brown and lt gray; subrounded; v. poorly sorted; soft; moist		
7									
8									
9									
10									
11			4'/5' 80%				SILT w/ some clay (MH) silt ~75%, clay ~25%; trace v. fine sand; Pale Brown 10YR 6/3 variegated yellowish brown and lt gray; subrounded; v. poorly sorted; stiff; moist		10.0-15.0 ft run lith description 10-14.0 ft.
12									
13									

A118/A/2/30/02

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW-367

Facility:

Site:

Client: Environmental Restoration Division

Contractor: (

Drill Contractor: Miller

Driller: Harley Upchurch

Start Time: 1330/18Feb02

End Time:

Borehole Dia(s):

Drill Method/Rig Type: HSA / CME-85

Total Depth:

Logged By: Brad Baker

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
14								X	See previous pg for 10.0 - 14.0 ft lithology
15			5'/5'				SILT w/ some clay (MH); silt ~75%, clay ~25%, trace v. fine sand; Pale Brown 10YR 6/3 variegated yellowish brown and lt. gray; subrounded, v. poorly sorted; stiff; moist		
16			100%						
17									
18									
19									
20									
21			5'/5'				Clayey SILT (ML); clay ~40%, silt ~60%, Lt Gray 10YR 7/1 variegated yellow; subrounded; v. poorly sorted; stiff; moist		
22			100%						
23									
24									
25									
26			4.6'/5.0				SILT w/ some clay (ML); silt ~75%, clay ~25%, Yellow 10YR 8/6 variegated lt. gray; subrounded; v. poorly sorted; stiff; moist		
27			92%						

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

A1182A/26JUL02

LITHOLOGIC LOG	BORING/WELL NO.: MW-367	
Facility:		Site:
Client:	Environmental Restoration Division	
Contractor: (	Drill Contractor: Miller	Driller: Harley Upchurch
Start Time: 1330/18 Feb 02	End Time:	Borehole Dia(s):
Drill Method/Rig Type: HSA/CME-85		Total Depth:
Logged By: Brad Baker		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
29			4.6'/5.0' 92%				SILT w/ some clay (ML) silt ~75%, clay ~25%; Yellow 10YR 5/6 varigated lt. gray; saturated; v. poorly sorted; stiff; moist	X	25.0-30.0 ft run 25.0-29.6 ft recovered
30									
31			4.5'/5.0' 90%				SILT w/ some clay (ML) silt ~75%, clay ~25%; Yellow 10YR 5/6 varigated lt. gray; saturated; v. poorly sorted; stiff; moist		
32									
33									
34								X	
35									

A1182A/26JUL02

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW367	
Facility: PADP		Site: C-746-U LANDFILL
Client: Environmental Restoration Division		
Contractor: SAIC	Drill Contractor: MAS	Driller: D. BISHOP
Start Time: 1432 3/7/02	End Time: 1710 3/7/02	Borehole Dia(s): 8¼
Drill Method/Rig Type: 8¼ HSA, CME 5' SPOONS, CME-75		Total Depth: 85
Logged By: V. MULLINS		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
35	35'-40'		5.0/5.0				CLAY, SILTY (40%), TRACE FINE SAND, V FILM STIFF, MOTTLED BROWNISH YELLOW (10YR 6/6) AND LIGHT BROWNISH GRAY (10YR 6/2), MOIST, LESS SILT UPPER 2 FT		
40	40'-45'		5.0/5.0				CLAY, SAND (20%) WELL SORTED, SUB-ROUNDED, FINE GRAINED, MOIST, VERY STIFF, MOTTLED LIGHT YELLOWISH BROWN (10YR 6/4) AND YELLOWISH BROWN (10YR 5/6), TRACE MICA		
45	45'-50'		5.0/5.0				45-49.5 CLAY, SANDY (40%), FINE GRAINED, WELL SORTED, SUB-ROUNDED, VERY STIFF, MOIST, MOTTLED STRONG BROWN (7.5YR 5/8) AND GRAY (7.5YR 6/1) TRACE BLACK, TRACE MICA		
48									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW 367	
Facility: PGDP		Site: C-746 U LANDFILL
Client: Environmental Restoration Division		
Contractor: SAIC	Drill Contractor: MGS	Driller: D. BISHOP
Start Time: 1432 3/7/02	End Time: 1710 3/7/02	Borehole Dia(s): 8 1/4
Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOONS, CME-75		Total Depth: 85
Logged By: V. MULLINS		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
49							49.5-50.0 CLAY SANDY (45%) FINE, WELL SORTED, SUBROUNDED, STRONG BROWN (7.5YR 5/8) ~~AND~~ LITTLE LIGHT		BROWNISH GRAY (10 YR 6/2), MOIST
50–55	50'-55		2.0/5.0				SAND FINE TO MEDIUM GRAINED, WELL SORTED, SUBROUNDED, TRACE MICA, MOIST; LIGHT YELLOWISH BROWN (10YR 6/4) IN END CAP GRAVEL, COARSE SAND TO MEDIUM PEBBLE GRAVEL, WET, LIGHT YELLOWISH BROWN (10YR 6/4)		
55–60	55'-60		28"/5.0'				GRAVEL, FINE SAND TO VERY COARSE PEBBLE GRAVEL, VERY POORLY SORTED, SUBANGULAR TO SUBROUNDED, TRACE ROUNDED, CHERT, QUARTZ, TRACE MICA, SATURATED, STRONG BROWN (7.5YR 5/6)		
60–62	60'-65		15/5.0				SAME AS ABOVE		

A11824/2830197

DATA RECORDED BY:	DATE:	DATA CHECKED & REVIEWED BY:	DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW367	
Facility: PGDP		Site: C-746-D LANDFILL
Client: Environmental Restoration Division		
Contractor: SAIC	Drill Contractor: MAS	Driller: D. BISHOP
Start Time: 1432 3/7/02	End Time: 1710 3/7/02	Borehole Dia(s): 8¼
Drill Method/Rig Type: 8¼ HSA, CME 5'SPOONS, CME-75		Total Depth: 85
Logged By: V. MULLINS		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
63									
64									
65									
66	65'-70'		22"/5.0'				SAND COARSE (60%) GRAVEL (40%), GRAVEL TO VERY COARSE PEBBLE GRAVEL, VERY POORLY SORTED, SUBANGULAR TO SUBROUNDED, SATURATED, STRONG BROWN (7.5YR 5/8), TRACE ROUNDED, CHERT, QUARTZ		
67									
68									
69									
70									
71	70'-75'		28"/5.0				SAME AS PREVIOUS SAMPLE		
72									
73									
74									
75									
74	75'-80'						NO RECOVERY		

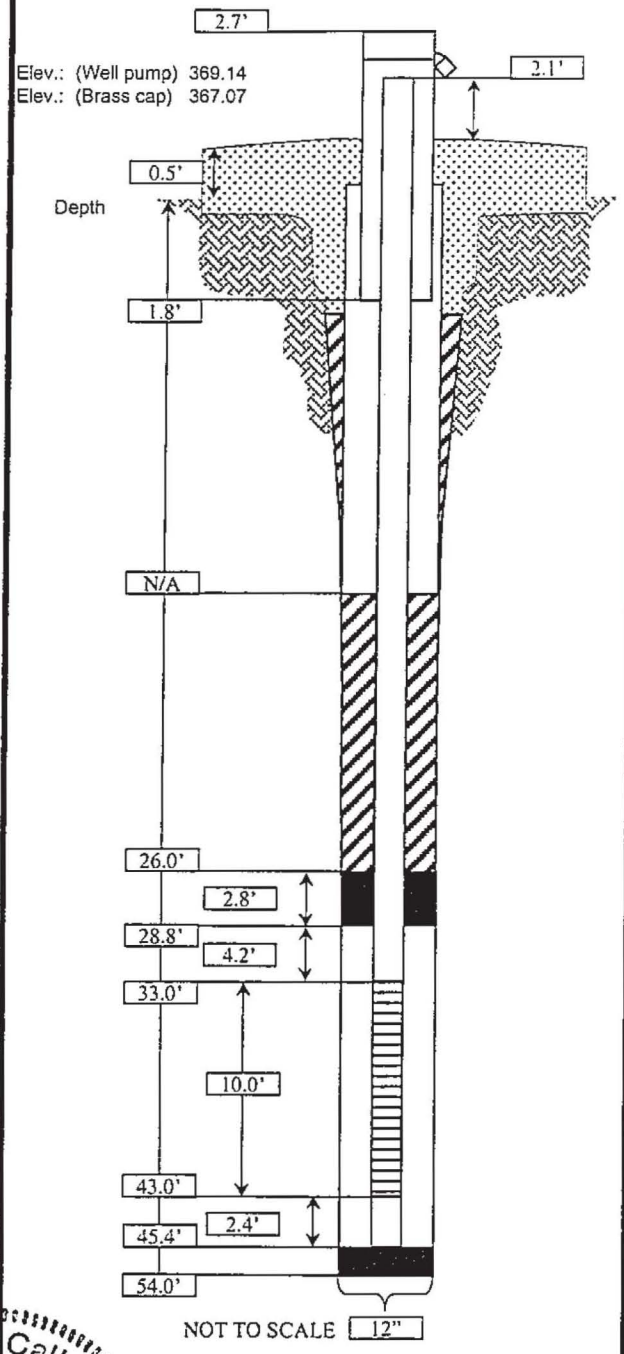
DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW367	
Facility: PGDP		Site: C-746-U LANDFILL
Client: Environmental Restoration Division		
Contractor: SAIC	Drill Contractor: MES	Driller: D. BISHOP
Start Time: 1432 3/7/02	End Time: 1710 3/7/02	Borehole Dia(s): 8¼
Drill Method/Rig Type: 8¼ HSA, CME 5' SPOONS, CME-75		Total Depth: 85
Logged By: V. MULLINS		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
77							NO RECOVERY		
78									
79									
80									
81			.5/5.0				IN END CAP CLAY SANDY (30%) FINE TO MEDIUM GRAINED; SUBANGULAR, STIFF, MOTTLED BRONISH YELLOW (10YR6/8) AND LIGHT GRAY (10YR7/1)		
82									
83									
84									
85							TD 85.0 FT BGS		

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

Well No. MW 368	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC		Drill Contractor: Miller Government Services
Start Date: 2/23/2002 (1355 M)		End Date: 2/25/2002 (1020 M)



Well Coord: N 6134.00
W 2247.27

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.8' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 35.6'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 26.0'

Centralizers (Y / N): Yes
Depth(s): 44.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 23 hr Vol. Fluid Added: 6 gal
Tremied (Y / N): No

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 1050 lb
Tremied (Y / N): No
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 33.0' – 43.0'

Isolation Casing (Y / N): No
Type: N/A
Diameter: N/A
Total Length: N/A

Sump (Y / N): Yes
Interval BGS: 43.0' – 45.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: Pel-Plug 3/8-inch TR30 Bentonite Pellets
Setup/Hydration Time: N/A
Tremied (Y / N): No

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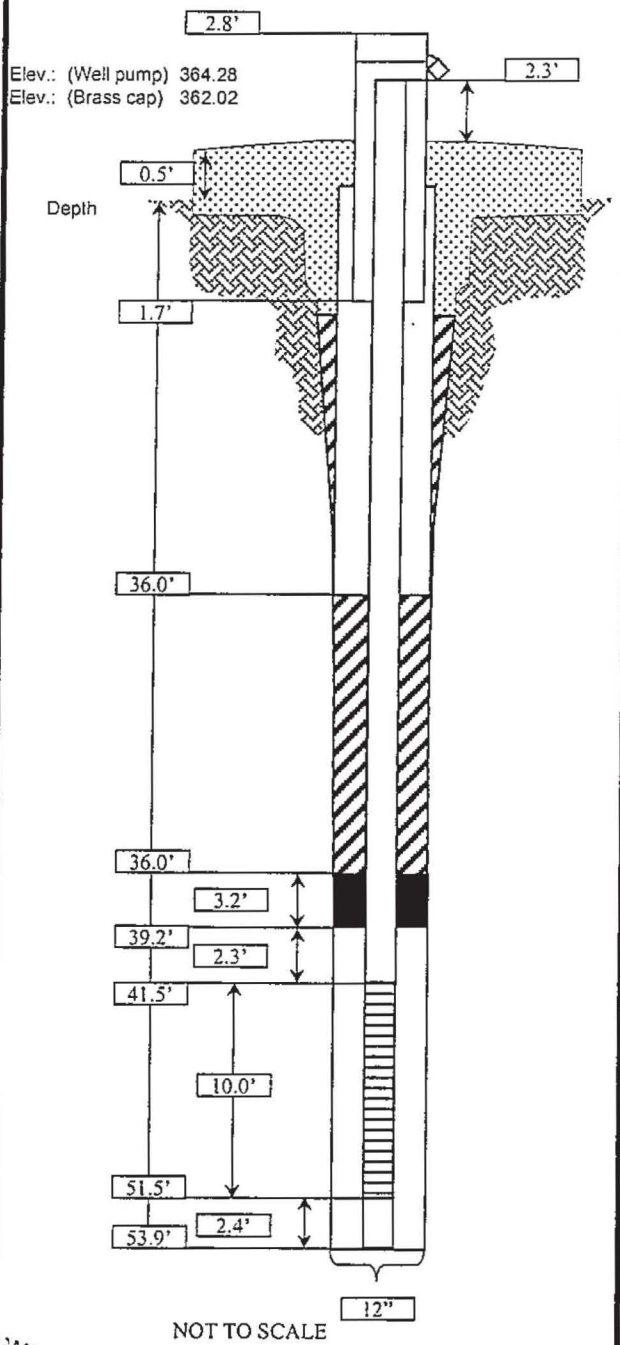
Monitoring Well 368 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Calhoun KY 2290
8/21/02

Well No. MW 369	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 2/23/2002 (1106 M)	End Date: 3/11/2002 (0953 M)	



Well Coord: N 4564.73
W 2957.51

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.7' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 44.3'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 9.8 – 9.9
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 36.0'

Centralizers (Y / N): Yes
Depth(s): 52.5'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 17 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 950 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 41.5' – 51.5'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 36.0'

Sump (Y / N): Yes
Interval BGS: 51.5' – 53.5'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

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Monitoring Well 369 Construction Log

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P.O. Box 2502
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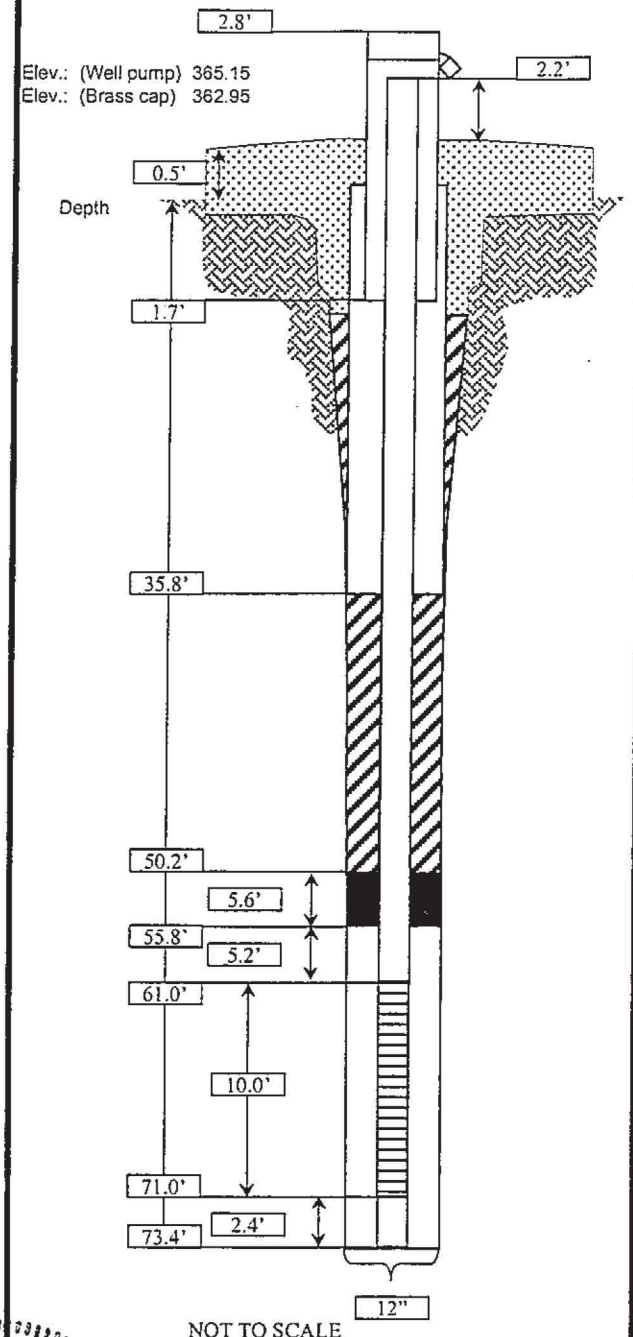
FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Calhoun KY 2290
3/21/02

Well No. MW 370	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC		Drill Contractor: Miller Government Services
Start Date: 2/8/2002 (1614 M)		End Date: 3/9/2002 (1320 M)



Well Coord: N 4589.20
W 2957.40

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.7' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 63.7'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 9.8 – 9.9
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 50.2'

Centralizers (Y / N): Yes
Depth(s): 72.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 19.5 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 750 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 61.0' – 71.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 35.8'

Sump (Y / N): Yes
Interval BGS: 71.0' – 73.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

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Monitoring Well 370 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Calhoun KY 2290
8/21/02

LITHOLOGIC LOG

BORING/WELL NO.: MW370

Facility: Paducah Gaseous Diffusion Plant

Client: Bechtel Jacobs Company

Contractor: SAIC | Drill Contractor: Miller Government Services | Driller: W. Doug Bishop

Start Time: 13:41 on 02-08-02 | End Time: 15:10 on 02-08-02 | Borehole Dia(s): 8.5 inches

Drill Method/Rig Type: Hollow Stem Augers with CME 75 | Total Depth: 35 feet

Logged By: Kenneth R. Davis of SAIC | Protection Level: D w/Nitrile/latex gloves

DEPTH (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS Alpha (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOCs (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0			3.2				Silt, clayey, brown (7.5 YR5/2) grading downward to yellow (10YR7/6), moist		Soil horizon
5			2.4				Silt, clayey, light gray (10YR7/1)mottled with yellow (10YR7/6), moist		
10			3.0				Silt, clayey, with trace sand, fine, light gray (10YR7/1) mottled with yellow (10YR7/6) grading downward to light gray (10YR7/1), moist		
15			4.3						
20			1.2				Sand (50%), fine, well sorted, silty, clayey, yellow (10YR7/6) grading downward to medium sand, well sorted, very pale brown (10YR8/2) with little yellow (10YR8/6) mottling, moist		Mottling may mark bedding planes.
25			3.5				Sand, fine, silty, light gray (10YR7/1), moist Sand, medium, well sorted, subrounded to subangular, quartz with trace opaque minerals, brownish yellow (10YR6/8), wet		Water from over-reamed hole at 30 feet
30			2.5				Sand, fine, well sorted, subrounded to subangular, quartz with trace opaque minerals, very silty grading downward to silty, yellow-(10YR7/6)-mottled-with-light-gray-(10YR7/1) to brownish yellow (10YR6/6), trace gravel at 32.2 ft and 33.6 ft, moist		
35			2.5						

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW370

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division (BJC)

Contractor: (SAIC

Drill Contractor: MGS

Driller: S. Gautney

Start Time: 1635 3/7/02

End Time: 0920 3/8/02

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow Stem Auger SCME 5' spoon CME75

Total Depth: 78'

Logged By: Wayne H. Pierce

Protection Level: ZAP 1 D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
34		Run #1	4.5/5.0				34.0 - 38.5 SILT some Clay, trace sand moderate yellowish brown 10YR 5/4 mt very pale orange 10YR 8/2, subangular moist, stiff		
35									
36									
37									
38									
39		Run #2	4.0/4.0				39.0 - 42.0 SANDY SILT trace Clay, pale reddish Brown 10R 5/4 mt grayish orange		Adjust rig height
40									
41									

DATA RECORDED BY: WAYNE PIERCE DATE:

DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW 370

Facility: PGDP	Site:
Client: Environmental Restoration Division (BJC)	
Contractor: (SAIC	Drill Contractor: MGS	Driller: S. Gaufney
Start Time:	End Time:	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow stem Augers CME 5' spoon, CME75	Total Depth: 78
Logged By: [signature]	Protection Level: D

Depth (ft)	Sample Interval	Sample Number	Recovery (ft)	ALPHA (cpm)	Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
42–43		Run # 2 cont.					42.0 - 42.0 SILTY SAND moderate yellowish brown 10YR 5/4, subangular, moist firm to stiff		Zones of Iron Cement
43–48		Run # 3	1.0 / 5.0				43.0 - 44.0 SAND, trace clay dark yellowish orange 10YR 6/6, medium to coarse grained moderately sorted, subangular, soft saturated		
48–54		Run # 4	1.0 / 6.0				SAND, 48.0 - 49.0 some gravel some clay Pale reddish brown 10R 5/4, very poorly sorted Rounded pebbles to 1"		over drill to pack sample for recovery
54–55		Run # 5	.1 / 5.0				GRAVEL 54.0 - 54.1 some sand Trace clay, Pale reddish brown 10R 5/4 very poorly sorted saturated to moist		

A18ZA/26JUL

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW 376	
Facility: PGDP		Site:
Client: Environmental Restoration Division (BJC)		
Contractor: (SAIC	Drill Contractor: MGS	Driller: S. Gaetano
Start Time:	End Time:	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow stem Auger CME 5' sfoon, CME75		Total Depth: 78
Logged By: Wayne H. Farmer		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
56		Run # 5 cont.							
57									
58									
59									
60		Run # 6	.3/5.0				59.0 - 59.3 SANDY GRAVEL trace clay dark yellowish orange 10YR 6/6 gravel rounded to subrounded sand subrounded saturated firm		
61									
62									
63									
64									
65		Run # 7	.8/5.0				64.0-64.8 SANDY GRAVEL dark yellowish orange 10YR 6/6 rounded to subrounded firm to soft saturated		
66									
67									
68									
69		Run # 8							

A1182A/3E/01/07

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW376

Facility: PGDP

Site:

Client: Environmental Restoration Division BJC)

Contractor: (SAIC

Drill Contractor: MGS

Driller: S. Gautney

Start Time:

End Time:

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow Stem Auger CME 5' Spoon, CME 75

Total Depth: 78

Logged By: Wm H. Ramey

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
70		Run # 8 cont	1.0/5.0				GRAVEL some sand, Trace Clay dk yellowish orange 10YR 6/6 saturated soft 69-70		
71									
72									
73									
74									
75		Run # 9	3.0/4.0				75.0 - 76.0 Gravel some sand Trace clay dk. yellowish orange 10YR 6/6 saturated soft		
76							76.0 - 76.2 Iron cemented sand		
77							76.2 - 77.0 CLAY some silt trace sand light grey N7 moist stiff sticky		
78									

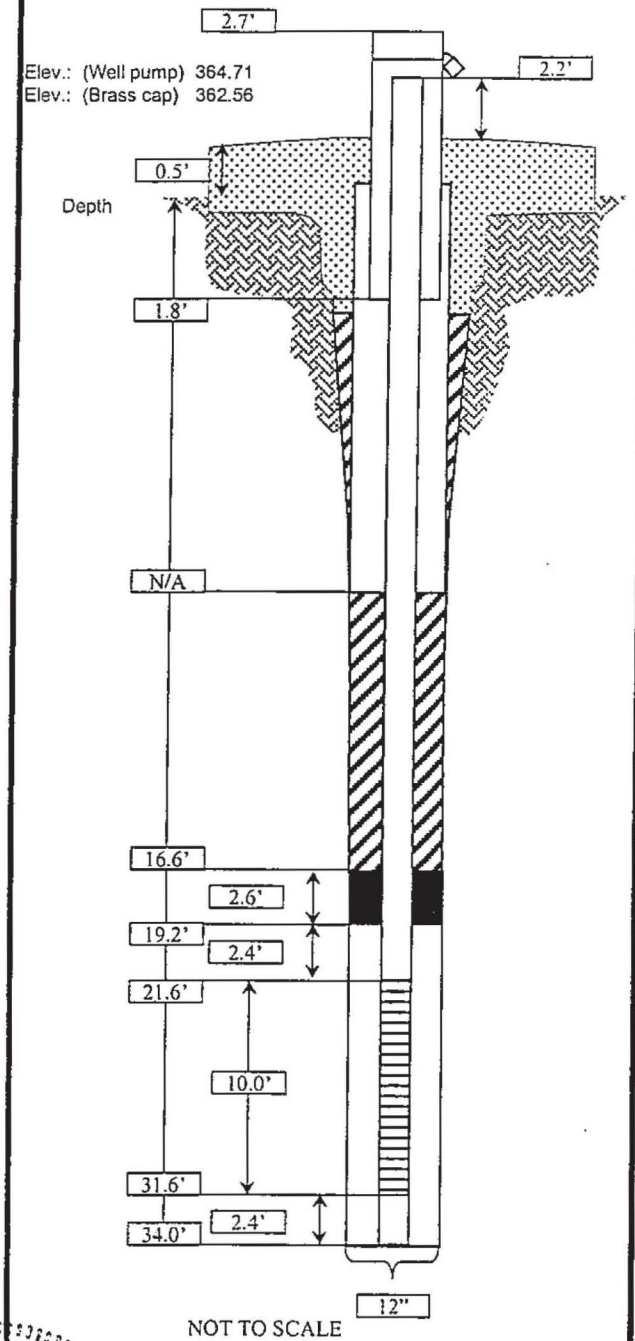
DATA RECORDED BY: VOLABLES

DATE:

DATA CHECKED & REVIEWED BY:

DATE:

Well No. MW 371	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 3/9/2002 (1620 M)	End Date: 3/10/2002 (0840 M)	



NOT TO SCALE

Well Coord: N 4576.61
W 2957.43

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.8' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 24.3'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 9.8
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 16.6'

Centralizers (Y / N): Yes
Depth(s): 32.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 14 hr Vol. Fluid Added: 8 gal
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 1050 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 21.6' – 31.6'

Isolation Casing (Y / N): No
Type: N/A
Diameter: N/A
Total Length: N/A

Sump (Y / N): Yes
Interval BGS: 31.6' – 33.6'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
Kentucky Board of Registration for Professional Geologists
PG 2290
Registered Professional Geologist

James T. Calhoun KY 2290
8/21/02

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

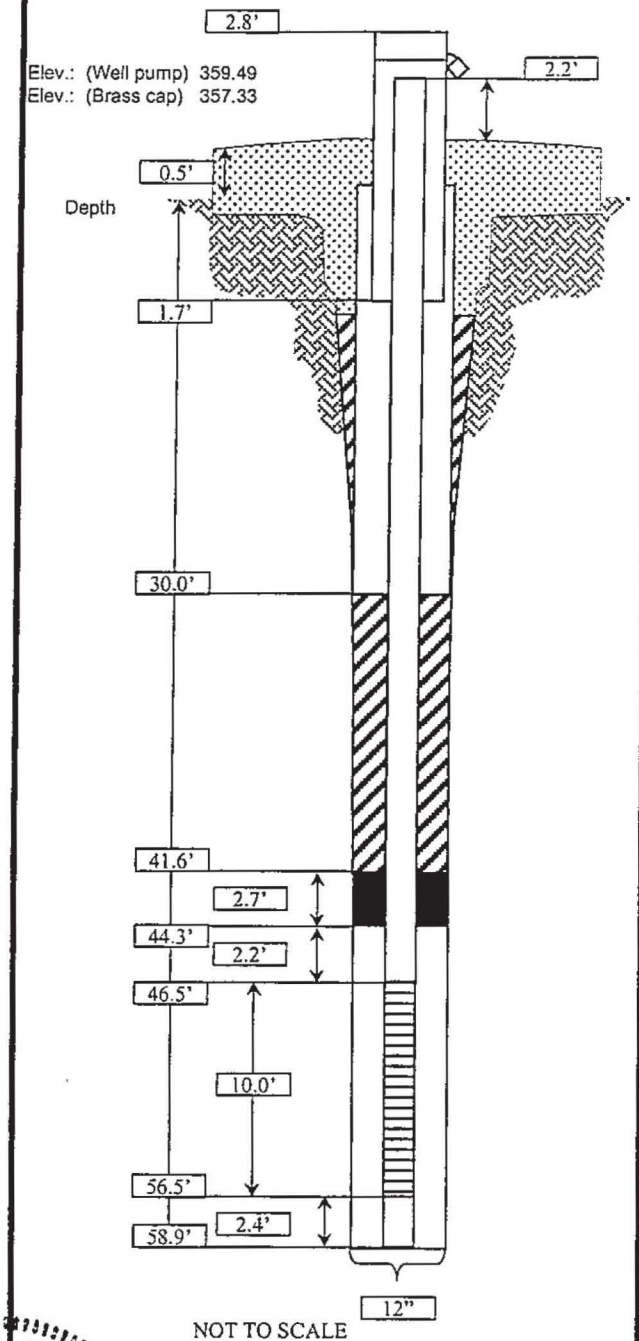
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 371 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

Well No. MW 372	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC		Drill Contractor: Miller Government Services
Start Date: 2/21/2002 (1415 M)		End Date: 3/14/2002 (0935 M)



Well Coord: N 4817.24
W 2486.89

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.7' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 49.2'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 41.6'

Centralizers (Y / N): Yes
Depth(s): 57.5'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 8 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 800 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 46.5' – 56.5'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 30.0'

Sump (Y / N): Yes
Interval BGS: 56.5' – 58.5'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
Kentucky Board of Registration for Professional Geologists
PG 2290
Registered Professional Geologist

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

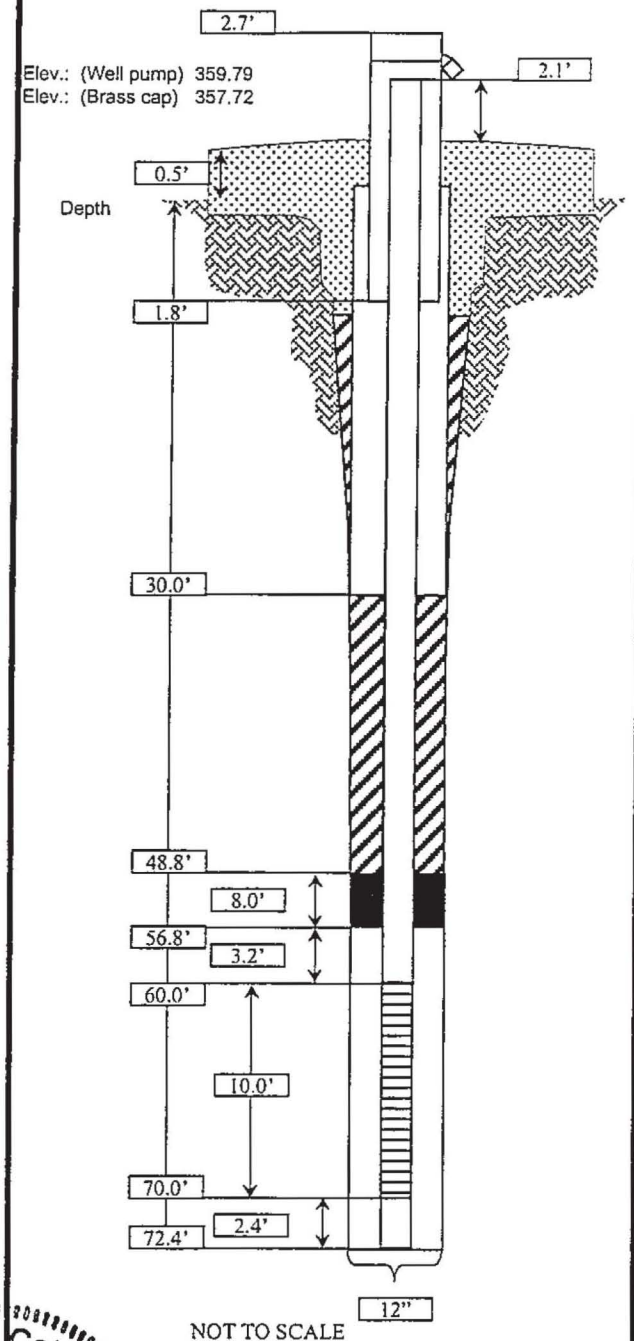
Monitoring Well 372 Construction Log

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

James T. Calhoun KY 2290
8/21/02

FIGURE No. C90001cask300.ppt
DATE 10-29-01

Well No. MW 373	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC		Drill Contractor: Miller Government Services
Start Date: 2/20/2002 (1153 M)		End Date: 3/13/2002 (1030 M)



Well Coord: N 4823.14
W 2509.92

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.8' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 62.6'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0 – 10.2
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 48.8'

Centralizers (Y / N): Yes
Depth(s): 71.0'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 22.5 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 900 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 60.0' – 70.0'

Isolation Casing (Y / N): Yes
Type: Steel
Diameter: 14-in
Total Length: 30.0'

Sump (Y / N): Yes
Interval BGS: 70.0' – 72.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun Registered Professional Geologist Kentucky Board of Registration PG 2290

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

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Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 373 Construction Log

FIGURE No. C90001cask300.ppt
DATE 10-29-01

James T. Calhoun KY 2290
8/21/02

LITHOLOGIC LOG

BORING/WELL NO.: MW373

Facility: PGDP

Site: C-746-U LANDFILL

Client: Environmental Restoration Division BJC

Contractor: SAIC

Drill Contractor: MGS

Driller: S. Gaetney

Start Time: 1158 2/10/02

End Time: 1305 2/10/02

Borehole Dia(s): 8.5

Drill Method/Rig Type: 8¼ Hollow Stem Augers, CME 5' Spoon, CME 75

Total Depth: 30

Logged By: Wayne Kerr

Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
1		Run # 1	3.5 / 4.0				0.0-1.2 CLAY, some silt, Trace sand, dark yellowish brown 10YR 4/2, subangular, moist, firm		
2							1.2-3.5 SILTY CLAY Trace sand very pale orange 10YR 8/2, mt dark yellowish ~~brown~~ orange with orange 10YR 6/6 subangular, moist firm		
3									
4							4.0-6.0 SILT some clay, Trace sand, moderate yellowish brown 10YR 5/4 subangular, moist firm to stiff		
5		Run # 2	5.0 / 5.0						
6							6.0-9.0 SILTY CLAY, Trace sand Pale brown 10YR 6/2 mt moderate brown 10YR 5/4, subangular moist, firm		
7									
8									
9							9.0-12.3 SILT, some clay, Trace sand light brownish gray 5YR 6/1, mt moderate yellowish brown 10YR 5/4, subangular moist firm to stiff		
10		Run # 3	4.2 / 5.0						
11									Trace mn stains @ 13.1
12							12.3-13.2 CLAY, some silt Trace sand, light gray NT, mt dark yellowish orange 10YR 6/6 subangular, moist stiff		
13									

A11824/26JUL02

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW373	
Facility: PGDP		Site:
Client: Environmental Restoration Division BJC)		
Contractor: (SAIC	Drill Contractor: MGS	Driller:
Start Time:	End Time:	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow Stem Augers, CME 5' spoon, CME 75		Total Depth: 30
Logged By: [illegible]		Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
14							14.0 – 15.2 SAND, some clay, little gravel, moderate brown 10YR 4/3 Rounded, moist, firm Gravel to ¼"		
15		Run #4	5.0/5.0						
16							15.2 – 19.0 SILT some clay, Trace sand, light brownish gray 5YR 6/1, mt light brown 5YR 5/6, subangular moist firm to stiff		Sharp contact @ 15.2
17									
18									
19							19.0 – 21.5 Sandy SILT, Trace clay, dark yellowish orange 10YR 6/6 subangular, moist firm		
20		Run #5	5.0/5.0						
21							21.5 – 24.0 SILT, some clay, Trace sand, dark yellowish orange 10YR 6/6, mt light Gray (N7), subangular moist, firm		
22									
23									
24							24.0 – 27.5 SILT some clay, trace sand subangular, moist firm		
25		Run #6	4.0/5.0						
26							27.5 – 28.0 SILT, little clay, Trace sand, Trace Gravel, Rounded moist, firm to stiff		
27									

A11824/26JUL97

DATA RECORDED BY:	DATE:	DATA CHECKED & REVIEWED BY:	DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW373	
Facility: PGDP		Site:
Client: Environmental Restoration Division BTC)		
Contractor: (SAIC	Drill Contractor: MGS	Driller: S. Gaetano
Start Time:	End Time:	Borehole Dia(s): 8.5
Drill Method/Rig Type: 8¼ Hollow stem Augers, 5' CME sleeve, CME 75		Total Depth: 30
Logged By: Wayne Rue		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
28		Run # 6 cont.							
29		Run # 7	1.0/1.0				SILTY CLAY, trace sand.		
30							moderate yellowish brown 10YR 5/4 moist, stiff		

A11824/26JUL97

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

LITHOLOGIC LOG

BORING/WELL NO.: MW 373

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division

Contractor: BAIC

Drill Contractor: HGS

Driller: H. UPCHURCH

Start Time: 0840 3/11/02

End Time: 1040 3/11/02

Borehole Dia(s): 8 1/4

Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85

Total Depth: 75

Logged By: WAYNE PARKER

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
30							SILT (60%), SAND (10%), CLAY (30%), MODERATE YELLOWISH BROWN (10YR 5/4) MT LIGHT GRAY (N7), MOIST, SUBANGULAR, FIRM		
31			2.0/5.0						
32		RUN #1	2.0/5.0						
33									
34									
35							35.0 - 37.0 SILT (50%) CLAY (30%), SAND (20%), MODERATE YELLOWISH BROWN (10YR 5/4) MT LIGHT GRAY (N7), MOIST, SUBANGULAR, FIRM TO STIFF		35-40 CONTINUED MOIST, SUBANGULAR FIRM TO STIFF
36									
37		RUN #2	5.0/5.0						
38							37.0 - 38.0 CLAY (55%) SILT (40%), SAND (5%), PALE YELLOWISH BROWN (10YR 8/2) MT. LIGHT BROWN (5YR 5/6) MOIST SUBANGULAR, FIRM		
39							38.0 - 40.0 SILT (100%) CLAY (20%), SAND (20%), MODERATE BROWN (10YR 5/4)		
40									
41		RUN #3	3.0/5.0				40.0 - 42.0 SAME AS ABOVE		
42							42.0 - 43.0 GRAVEL (50%) SAND (40%), CLAY (10%) DARK YELLOWISH ORANGE (10YR 6/6), SATURATED, ROUNDED TO SUB-ROUNDED PEBBLES TO 1/2", SOFT TO FIRM		
43									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

A1182A/26JUL02

LITHOLOGIC LOG

BORING/WELL NO.: MW 373

Facility: PGDP

Site: C-746 U LANDFILL

Client: Environmental Restoration Division

Contractor: BAIC

Drill Contractor: HGS

Driller: H. UPCHURCH

Start Time: 0840 3/11/02

End Time: 1040 3/11/02

Borehole Dia(s): 8 1/4

Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85

Total Depth: 75

Logged By: WAYNE PARKER

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
44									
45			2.0/5.0				45.0-46.0 GRAVEL (50%), SAND (40%), CLAY (10%), DARK YELLOWISH ORANGE (10YR 6/6), SATURATED, PEBBLES TO 3" U, POORLY SORTED, SOFT		
46		RUN #4							
47							46.0-47.0 SAND (90%), CLAY (10%) VERY PALE ORANGE (10YR 8/2), SUBANGULAR, WELL SORTED, SATURATED, SOFT		
48									
49									
50			0.3/5.0				GRAVEL (70%), SAND (25%), CLAY (5%), DARK YELLOWISH ORANGE 10YR6/6, SATURATED, ROUNDED PEBBLES, SOFT		
51									
52		RUN #5							
53									
54									
55			0.5/5.0				SAND (60%), PEBBLES (30%), CLAY (10%), DARK YELLOWISH BROWN (10YR 4/2), PEBBLES TO 1/2" ROUNDED, SATURATED, SOFT, SUBANGULAR TO SUBROUNDED SAND		
56									
57		RUN #6							

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

LITHOLOGIC LOG	BORING/WELL NO.: MW 373	
Facility: PGDP		Site: C-746 U LANDFILL
Client: Environmental Restoration Division		
Contractor: BAIC	Drill Contractor: HAS	Driller: H. UPCHURCH
Start Time: 0840 3/11/02	End Time: 1040 3/11/02	Borehole Dia(s): 8 1/4
Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85		Total Depth: 75
Logged By: WAYNE PARKER		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
58									
59									
60									
61		RUN #7					NO RECOVERY		
62									
63									
64									
65									
66		RUN #8	5.0/5.0				SAND (55%), PEBBLES (40%), CLAY (5%), DARK YELLOWISH BROWN (10YR 4/2), PEBBLES TO 3/4" ROUNDED, SOFT, SATURATED		
67									
68									
69									
70									
71		RUN #9	5.0/5.0				70.0-70.8 GRAVEL (65%), SAND (30%), CLAY (5%), DARK YELLOWISH ORANGE (10YR 6/6) V. POORLY SORTED, SATURATED, SOFT		70.8-70.9 IRON CEMENTED FINE TO MEDIUM SAND

DATA RECORDED BY: | DATE: | DATA CHECKED & REVIEWED BY: | DATE:

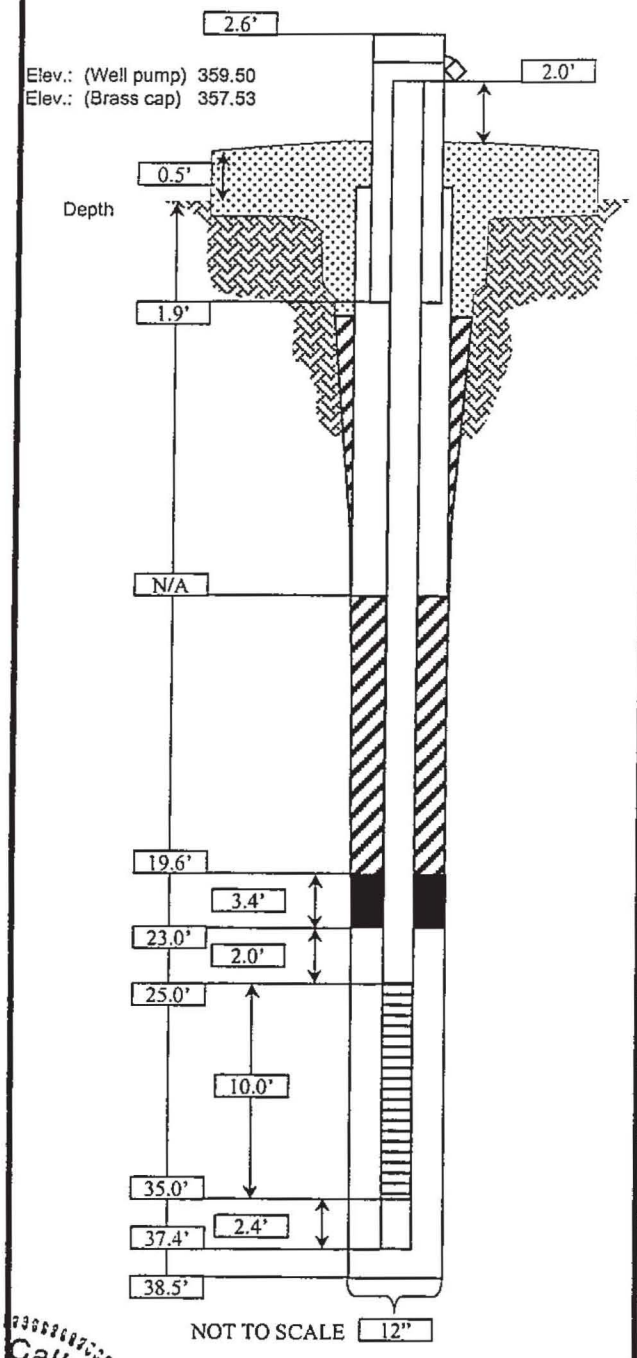
A1182A/2001

LITHOLOGIC LOG	BORING/WELL NO.: MW373	
Facility: PGDP		Site: C-746 U LANDFILL
Client: Environmental Restoration Division		
Contractor: SAIC	Drill Contractor: HHS	Driller: H. UPCHURCH
Start Time: 0840 3/11/02	End Time: 1040 3/11/02	Borehole Dia(s): 8 1/4
Drill Method/Rig Type: 8 1/4 HSA, CME 5' SPOON, CME 85		Total Depth: 75
Logged By: WAYNE PARKER		Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
72		RUN #9 CONT.					70.9-75.0 CLAY (80%), SILT (15%), SAND (5%), LIGHT BROWNISH GRAY (5YR6/1), STIFF, MOIST, SLIGHT BIOTROWS 1/4" SAND FILLED BANDED, DARK YELLOWISH ORANGE		
73									
74									
75							TD 75.0 FTBGS		

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

Well No. MW 374	Installation: N/A	
Project No.	Client/Project: BJC/C-746-U Well Abandonment/Replacement	Site: PGDP/C-746-U Landfill
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 3/9/2002 (1545 M)	End Date: 3/14/2002 (1745 M)	



Well Coord: N 4819.04
W 2497.62

Protective Casing
Material Type: Steel
Diameter: 10-in.
Depth BGS: 1.9' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: 4-ft x 4-ft Concrete Pad

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (TOR to TOS): 27.5'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: High Solids Bentonite
Grout Type: Pure Gold
Weight (lbs/gal.): 10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 0.0' – 19.6'

Centralizers (Y / N): Yes
Depth(s): 35.5'

Seal
Type: 3/8-inch TR 30 Bentonite Pellets
Source: Pel-Plug
Setup/Hydration Time: 8+ hr Vol. Fluid Added: 10 gal
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: DSI #1 Filter Sand
Amt. Used: 1050 lb
Tremied (Y / N): Yes
Source: Project File
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 25.0' – 35.0'

Isolation Casing (Y / N): No
Type: N/A
Diameter: N/A
Total Length: N/A

Sump (Y / N): Yes
Interval BGS: 35.0' – 37.0'
Bottom Cap (Y / N): Yes - 0.4-ft

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

James T. Calhoun
Kentucky Board of Registration for Professional Geologists
PG 2290
Registered Professional Geologist

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Monitoring Well 374 Construction Log

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

James T. Calhoun KY 2290
8/21/02

FIGURE No. C90001cask300.ppt
DATE 10-29-01

LITHOLOGIC LOG

BORING/WELL NO.: MW-374

Facility:

Site:

Client: Environmental Restoration Division

Contractor: SAIC

Drill Contractor: Miller

Driller: Paul Gibson

Start Time: 1545 9 Mar 02

End Time: 0900 10 Mar 02

Borehole Dia(s): 8"

Drill Method/Rig Type: 4¼" HSA / w/ 5-foot continuous split spoon

Total Depth: 43.0 ft

Logged By: Brad Baker

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0							0-28 ft drilled out - previously logged		
28	28-33'		4'/5' 80%				28.0-32.0 ft Clayey SILT, clay ~40%, silt ~60%, Brownish Yellow 10YR6/6 variegated lt gray; saturated; v. poorly sorted; med. plasticity; (ML) medium; v. moist		- Saturated soils on outside of spoon
32									
33	33-38'		5'/5' 100%				clayey SILT; clay ~40%, silt ~60%; Brownish Yellow 10YR6/6 variegated lt. gray; saturated; v. poorly sorted; med plasticity; med. density; v. moist (ML)		- Saturated soils on outside of spoon; - Angular stringer @ 35 ft - Saturated soils present at surface
38									
38	38-43'		3.5'/5' 70%				38.0-41.0 ft Silt w/some clay, silt ~70%, clay 30%; Brownish Yellow 10YR6/6 w/stringers of lt. grey clay and banded med red; saturated; v. poorly sorted; med plasticity; medium; v. moist		
41									

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

A1102A/26JUL02

LITHOLOGIC LOG

BORING/WELL NO.: MW-374

Facility:

Site:

Client: Environmental Restoration Division

Contractor: SAIC

Drill Contractor: Mills

Driller: Paul Gibson

Start Time: 1545 9 Mar 02

End Time: 0900 10 Mar 02

Borehole Dia(s): 8"

Drill Method/Rig Type: 4¼" HSA/w 5-ft split spoon

Total Depth: 43.0

Logged By: Brad Baker

Protection Level: D

Depth (ft)	SAMPLE Interval	SAMPLE Number	SAMPLE Recovery (ft)	FIELD MEASUREMENTS ALPHA (cpm)	FIELD MEASUREMENTS Beta/Gamma (cpm)	FIELD MEASUREMENTS VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
41							(41.0 - 41.5 ft) Gravel w/ some sand and little silt; gravels 55%; sand: coarse 30% silt - 15%; Brownish Yellow 10YR6/6; subangular; v. poorly sorted; loose; wet		
43							TD = 43.0 ft		

DATA RECORDED BY: DATE: DATA CHECKED & REVIEWED BY: DATE:

A1182A/26JUL02