July 19, 2010

FOCUSED FEASIBILITY STUDY
LAGOON AREA GROUNDWATER

BASF Corporation Rensselaer Facility
Rensselaer, New York

Prepared for

BASF CORPORATION
100 Campus Drive
Florham Park, New Jersey

ROUX ASSOCIATES, INC.

Environmental Consulting & Management

209 Shafter Street, Islandia, New York 11749 ♦ 631-232-2600

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1.0 INTRODUCTION

This Focused Feasibility Study (FFS) has been prepared to identify, evaluate, and select a remedial action alternative to address residual concentrations of dissolved arsenic in groundwater beneath the former Lagoon Area at the BASF Corporation (BASF) facility located in Rensselaer, New York (Figure 1). This FFS was prepared in accordance with New York State Department of Environmental Conservation (NYSDEC) Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002).

This FFS has been prepared within the context of the physical setting of the lagoon area and the remedial actions previously conducted by BASF in the former lagoon area. These remedial actions were:

- All liquids and residual wastes were removed from the lagoons and transported off-site for disposal, and the integrity of the clay liner was confirmed.
- Approximately 5,000 cubic yards of soil containing the highest concentrations of arsenic were removed from the lagoon area and transported off-site for disposal.
- The lagoons have been filled and graded, and an interim cap designed to minimize storm water infiltration to groundwater has been installed.
- A groundwater extraction system has been installed immediately to the east of the lagoon area, essentially preventing groundwater transport into the lagoon area.
- Three phases of *in-situ* treatment of residual dissolved arsenic in groundwater have been completed using metals remediation compound (MRC™).

Additionally, as per the direction of the NYSDEC, BASF conducted a limited investigation in the northern portion of the lagoon area to assess soil conditions in a location where elevated concentrations of arsenic had previously been found in groundwater. As discussed in greater depth in Section 2.5 of this document, this investigation determined that: a) little groundwater is present beneath the lagoon area; and b) the highest concentrations of arsenic in soil are at depths of approximately 14 – 16 feet below ground surface.

Previous groundwater investigations have concluded that there is little hydraulic connection between groundwater in the lagoon area and the adjacent Hudson River. Concurrent measurements of groundwater elevations and water levels in the river documented that while the river elevation would change as much as four feet in a twelve-hour time period, groundwater levels would change approximately one-tenth of a foot.

Additionally, surface water sampling conducted by AECOM as part of the ongoing sediment investigation found no arsenic above background levels in samples collected immediately adjacent to the site.

The combination of the physical setting of the lagoon area and the remedial actions previously conducted by BASF have created the following site conditions:

- There is no potential for direct contact exposure to arsenic in soil or groundwater:
  - The lagoons have been cleaned and backfilled with clean fill.
  - The entire lagoon area has been capped.
  - The little groundwater that is present beneath the lagoon is not, and will not be, used for any purpose.
- There is no impact to the adjacent Hudson River:
  - Surface water sampling conducted adjacent to the site found no elevated concentrations of arsenic.
  - The potential for surface water to transport arsenic-containing soil to the river has been eliminated by the cap.
  - The potential for groundwater to transport dissolved-phase arsenic to the river has been reduced to the extent possible by:
    - The cap minimizes infiltration into the lagoon area.
    - The combination of the sheet pile bulkhead and natural conditions has resulted in minimal hydraulic connection between the river and groundwater beneath the lagoon area.
    - The groundwater containment system (GCS) installed on the eastern side of Riverside Avenue further minimizes the volume of groundwater that may be transported into the lagoon area.
- Soil with concentrations of arsenic that failed the toxicity characteristic leaching procedure (TCLP) has been removed, reducing the potential for dissolution to groundwater.
- The dissolved-phase concentrations of arsenic in groundwater beneath the lagoon area have been substantially reduced from pre-treatment levels.

These remedial actions are further summarized in Section 2.3.

1.1 Objective and Organization of the Focused Feasibility Study

As has been previously presented to the NYSDEC, arsenic remains at concentrations greater than the Class GA groundwater standard for arsenic of 25 µg/L in groundwater in the lagoon area. The objective of this FFS is to evaluate potential remedial alternatives that may be used to address remaining arsenic in Lagoon Area groundwater and, based on the evaluation criteria specified in NYSDEC guidance documents, select the most appropriate alternative.

The identification and analysis of remedial alternatives in the FFS will be performed in accordance with the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4030, "Selection of Remedial Actions at Inactive Hazardous Waste Sites, September 13, 1989 (revised May 15, 1990)" (NYSDEC, 1990), the NYSDEC Division of Environmental Remediation (DER) guidance document titled, "Draft DER-10, Technical Guidance for Site Investigation and Remediation" (NYSDEC, 2002), and the Inactive Hazardous Waste Disposal Site Program regulation (6 NYCRR Section 375-1.10).

The remainder of this FFS is organized in the following manner:

<u>Section 2</u> – "Site Background and History," provides a summary of the physical setting of the site, including site geology and hydrogeology, and provides additional detail on the remedial actions that have previously been conducted in the lagoon area.

<u>Section 3</u> – "Remedial Action Objectives," identifies the regulatory criteria and remedial action objectives applicable to the dissolved-phase arsenic in lagoon area groundwater.

<u>Section 4</u> – "Identification and Screening of Technologies," discusses the technologies that may, either alone or in combination with other technologies, be used to address the dissolved-phase arsenic.

<u>Section 5</u> – "Description and Evaluation of Remedial Alternatives," provides a detailed evaluation of seven selected remedial alternatives using the nine NYSDEC evaluation criteria.

Section 6 – “Selection and Description of Recommended Remedial Alternative,” identifies the selected alternative and describes how it will be implemented.

2.0 SITE BACKGROUND AND HISTORY

The 80-acre BASF Rensselaer facility is comprised of three parcels that are listed separately in the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites:

- The Manufacturing Plant parcel, including the North and South Lagoons (the former "lagoon area"), is listed as NYSDEC Site No. 4-42-027;
- The BASF Closed Landfill parcel is listed as NYSDEC Site No. 4-42-004; and
- The South 40 Parcel is listed as NYSDEC Site NO. 4-42-022.

The former lagoon area (Figure 2) is located along the western side of the Manufacturing Plant area, adjacent to the Hudson River and encompasses approximately 200,000 ft^2, or slightly more less than 5 acres. The former lagoon area is separated from the rest of the plant area by Riverside Avenue, which is located immediately to the east, but is considered part of the Main Plant parcel. Together, the Main Plant and Lagoon Area constitute Operable Unit 1 (OU-1) in the Record of Decision (ROD) prepared by the NYSDEC for the Site in September 2003. The OU-1 ROD specifies that a low-permeability cap is to be installed over the lagoon area and groundwater monitoring is to be continued.

The majority of the former lagoon area is separated from the Hudson River by a sheet pile bulkhead (Figure 2). Historic construction documents show that the bulkhead was installed in three phases:

1. The first section was installed in 1936. This section began at approximately the location of the northwest corner of the north lagoon (not yet constructed when the bulkhead was installed) and extended approximately 250' to the north. The construction documents state that the sheet pile was installed to a depth of 29 feet below mean sea level (msl), or approximately 25 feet into the underlying clay.

2. The second section was installed in 1974, presumably during construction of the north and south lagoons (see below). This section was installed from approximately the mid-point of the north lagoon to a location approximately 75 feet south of the northern berm of the south lagoon. The construction documents show that the sheet piles were also installed to a depth of -29 feet msl.

3. The final section, connecting the first two, was installed in 1981. The construction documents show that this section was installed to a depth of 18 feet below the river bottom. Bathymetric surveys conducted adjacent to the site show that river is approximately 20 feet deep in this area, and clay is encountered at a depth approximately five feet below the elevation of the river bottom. Therefore, the sheet piles were installed approximately 13 feet into the clay.

Each former lagoon is approximately 400 feet long and 180 feet wide. The tops of the lagoon berms are at an elevation of approximately 19 feet above mean seal level (msl). The lagoons are approximately 12 feet deep in their centers. From approximately 9 feet above msl to the bottom at approximately 4 feet above msl, the sidewalls are lined with clay, as are the bottoms of the lagoons. The clay lining is approximately two feet thick and is reported to possess a permeability of approximately 10^{-7} centimeters per second (cm/s).

The lagoons were constructed by the former plant owner, the GAF Corporation (GAF), in 1974 - 1975. Based on information gathered during the Remedial Investigation, it has been concluded that the fill material used in the area where the lagoons were constructed contained arsenic at concentrations greater than NYSDEC Recommended Site Cleanup Objectives (RSCOs). The arsenic-containing soil was found to extend to the east beneath Riverside Avenue, supporting a conclusion that the fill material pre-dated the lagoon construction in 1974. As presented in Plate 1, arsenic was found throughout the entire soil profile that was sampled (i.e., at depths up to 14 feet below land surface [ft bls]) at concentrations as high as 79,400 mg/kg, or approximately 8 percent by weight. There is no documentation regarding the source of the fill material, but it is reasonable to conclude that the fill contained arsenic when placed on the site.

The lagoons initially received wastewater treatment plant effluent from GAF and the adjacent Sterling Chemical site (currently Albany Molecular). Following the acquisition of the property by BASF in 1978, the lagoons received wastewater treatment plant effluent from BASF and Sterling. The wastewater plant effluent was aerated for color and odor control, and the pH was adjusted prior to discharge to the Rensselaer County sanitary sewer system. Following the plant closure in 2000, the lagoons were used to manage the facility storm water.

The Lagoon Remediation Program (see Section 2.3.1) was performed between October 2003 and June 2005. All waste material was removed and transported off-site for disposal, and the lagoon rip-rap was treated to remove residuals and placed back in the bottoms of the lagoons. An interim cap has been installed over the former lagoon area. The cap has been designed to provide an equivalent degree of infiltration control as the impermeable cap specified in the ROD (refer to Section 2.5), and protects against direct contact to the underlying soil.

Soil sampling conducted in the former lagoon area during the RI found arsenic at concentrations greater than the NYSDEC Recommended Site Cleanup Objectives (RSCOs) (Roux Associates, 2001). More recent sampling in the PZ-10 area (see Section 2.4) also found arsenic in soil at levels greater than the NYSDEC RSCOs. Similar to the data obtained during the RI, the highest arsenic concentrations found in the PZ-10 area were at depths greater than 10 feet below ground surface.

The arsenic in the fill material results in the presence of dissolved arsenic in groundwater beneath the former lagoon area at levels greater than the NYSDEC Ambient Water Quality Standards and Guidance Values (AWQSGVs) and Groundwater Effluent Limitations (Technical and Operation Guidance Series [TOGS], 1.1.1 June 1998 edition), Class GA groundwater standard for arsenic of 25 micrograms per liter (µg/L).

2.1 Geology

Site geology was discussed in detail in the Remedial Investigation and Supplemental Remedial Investigation Report (Roux Associates, 2000) and Additional Remedial Investigation Activities Report (Roux Associates, 2001). Therefore, only a summary of the hydrogeology relevant to groundwater flow, fate, and transport in the vicinity of the lagoon area is presented in this section.

The Site is predominately underlain by fill, consisting of sand with silt and clay. The fill is approximately 5 to 10 feet thick beneath the BASF main plant and becomes slightly thicker beneath the lagoon area immediately adjacent to the Hudson River. Beneath the lagoon area, the fill is underlain by alluvial deposits consisting of sand with gravel and some silt and clay. These alluvial deposits are approximately 18-feet thick adjacent to the Hudson River and pinch out along the eastern edge of the wastewater lagoons. Underlying the alluvial deposits in the lagoon area and the fill beneath the Main Plant are glacial lacustrine deposits consisting of silty clay ranging from approximately 40-feet thick beneath the lagoon area and the western portion of the main plant to less than 10-feet thick beneath the eastern portion of the Main Plant. The glacial lacustrine deposits are underlain by a thin sand unit approximately 10-feet thick, which rests on glacial till. Shale bedrock is below the glacial till (Malcolm Pirnie, 1994).

Generalized Cross Sections A-A' and B-B' were prepared to present the geologic information developed during the Remedial Investigation (RI) (Roux Associates, 2000), and are provided in Plate 2.

2.2 Hydrogeology

The Site is located in the lower Hudson sub-basin of the Hudson River basin (Phillips, 1996). Regional groundwater flow is to the west and discharges into the Hudson River that borders the Site.

Site groundwater is found in the fill deposits beneath the Main Plant area, and in the alluvial deposits beneath the former lagoon area. Depth to groundwater ranges from less than one foot on the eastern portion of the property, to 12 to 15 feet on the eastern side of the former lagoon area.

Numerous groundwater elevation measurements have been taken at the Site and all have provided comparable results. Groundwater flow contours developed from the November 9, 2004 round of groundwater elevation measurements are shown on Plate 3. An average hydraulic gradient across the Site of approximately 0.007 ft/ft was estimated from measured water levels.

Hydraulic conditions in the lagoon area, however, differ from those across the remainder of the site. First, as shown on Plate 3, groundwater elevations within the lagoon area are consistently much lower than those in the Main Plant Area, a result of the influence of the subsurface utility bedding and groundwater extraction system to the east, which captures groundwater that would otherwise flow to the lagoon area. Further, because of the performance of the extraction system and the presence of the bulkhead to the west, a stagnation zone (i.e., zone of negligible groundwater flow and relatively flat hydraulic gradient) is present in the area ranging from north of the northern lagoon to approximately the mid-point of the southern lagoon.

Studies conducted in April and May 2001 as part of the Additional RI Activities (Roux Associates, 2001) documented the absence of any significant hydraulic connection between the groundwater behind the bulkhead and the Hudson River. As shown on Figure 3, despite tidal fluctuations in the river of more than five feet, only one to two inches of fluctuation were noted in LG-MW-6, located on the western side of the former lagoon area, approximately 28 feet from the river. No measurable fluctuations were seen in LG-MW-2, located on the eastern side of the former lagoon area, approximately 265 feet from the river. Based on the fact that the bulkhead is tied into the underlying clay, and the absence of any significant tidal influence on monitoring wells in the former lagoon area, it can be concluded that there is no groundwater flow through, or beneath, the bulkhead.

As shown on Plate 3, there is a steep hydraulic gradient at Riverside Avenue on the eastern side of the former lagoon area, signifying the hydraulic influence of subsurface utility bedding along Riverside Avenue groundwater at impeding westward flow of groundwater. This feature was taken advantage of by construction of the GCS trenches immediately east and parallel to Riverside Avenue to collect groundwater flow from the Main Plant. Currently, groundwater from the eastern portion of the Site is captured on the eastern side of the former lagoon area. Therefore, the majority of the current water budget input into the lagoon area is a small volume of recharge occurring from precipitation. This small volume of water input into the lagoon area is illustrated by the results of the PZ-10 area investigation in which no apparent groundwater was encountered; only moist soil was observed in some borings at a depth of approximately 12 feet.

The potential recharge is being addressed by the grading and capping that have been implemented across the lagoon area. As presented in the “Remedial Action Work Plan for Remedial Activities for Lagoon Area (Roux Associates. June 12, 2008”, it is predicted that, after maturation of the vegetated cap, the combination of evapotranspiration and soil moisture storage will prevent any significant recharge to groundwater beneath the lagoon area.

Finally, the minimal recharge into, and therefore discharge of groundwater from the lagoon area is supported by the surface water sampling conducted as part of the Hudson River sediment investigation. As previously reported to the NYSDC, surface water samples collected immediately adjacent to the site contained no elevated levels of arsenic.

2.3 Previous Remedial Actions

Several remedial actions have been performed in the former lagoon area. These include removal of the water and sediment from within the lagoons, treatment of the rip-rap lining the lagoon sidewalls, removal of approximately 5,000 cubic yards, or over 7,000 tons, of arsenic-containing soil from the lagoon berm area, installation of an extraction trench (GCS Area 2) in the northeastern portion of the former lagoon area, conducting *in situ* treatment of the dissolved arsenic, and installing an interim cap over the entire lagoon area. With the exception of the lagoon area cap, which was completed in 2010, these remedial activities were previously documented in reports to the NYSDEC.

Additionally, the investigation of the PZ-10 area was conducted in December 2009 and the results of the investigation are presented in this report as they have been incorporated into the alternatives analysis.

2.3.1 Lagoons

The Lagoon Remediation Program was conducted from October 2003 to June 2005. The remediation of the lagoons consisted of:

- Draining standing water from the north and south lagoons;
- Removal and processing of accumulated sludge from each lagoon;
- Off-site disposal of approximately 14,000 tons of lagoon sludge;
- Removal and disposal of approximately 900 feet of lagoon process piping;
- Sampling and discharge of approximately 6.3 million gallons of construction wastewater; and
- Processing of lagoon rip-rap and reuse of the rip-rap as lagoon fill material.

Post-remediation sampling in the two lagoons for VOCs, SVOCs and metals confirmed the completeness and effectiveness of the Lagoon Remediation Program. No evidence of a discharge from the lagoons themselves has been found in groundwater.

2.3.2 Soil

Soil sampling conducted during the Remedial Investigation found arsenic in lagoon soil at concentrations greater than the NYSDEC RSCOs (Plate 1). Arsenic was found above RSCOs in the majority of soil samples, and throughout the vertical profile sampled (up to 14 ft bls). Concentrations ranged from slightly over the RSCO to 79,000 mg/kg. The highest concentrations were found adjacent to the northeast corner of the north lagoon.

Soil from the area containing the highest concentrations of arsenic was removed in two phases. The first phase, conducted in November 2002, consisted of the removal of approximately 3,800 cubic yards (5,500 tons) of soil. The removal extended from Riverside Avenue on the east to the berm of the North Lagoon on the west, and included all soil to one foot below the water table. Figures 4 and 5, reproduced from the December 2005 Interim Remedial Measure Remedial Action Completion Report shows the final extent of the removal. Post-excavation sampling found arsenic at concentrations greater than the approved cleanup criterion along the excavation sidewall below Riverside Avenue, and beneath the North Lagoon berm.

Based on the presence of arsenic at levels above the approved cleanup criterion, an additional removal action was performed in April and May 2005 as part of the North Lagoon Remediation Program. An additional 1,600 tons of soil were removed from beneath the north lagoon berm during this action. Soil beneath Riverside Avenue was not accessible without destroying the road, and was not removed. Figure 5, reproduced from the December 2005 Interim Remedial Measure Remedial Action Completion Report shows the final extent of the removal.

In total, more than 7,000 tons of soil containing the highest concentrations of arsenic were removed and disposed of.

2.3.3 *In Situ* Treatment of Dissolved-Phase Arsenic

Groundwater sampling during and subsequent to the Remedial Investigation found elevated concentrations of dissolved-phase arsenic in monitoring wells installed in the perimeter of the former lagoon area. Concentrations ranged from a few hundred micrograms per liter to several thousand micrograms per liter.

To address the issue of elevated arsenic in groundwater, the arsenic-containing groundwater was initially extracted and conveyed to the groundwater treatment plant where it was treated with a combination of oxidation/precipitation and an adsorptive media. However, as discussed in a March 22, 2006 letter to the NYSDEC, after several months of operational difficulties related to achieving the discharge criterion for arsenic and managing the solids created by the treatment process, it was determined that an alternative approach of treating the arsenic *in situ* offered the potential for reducing arsenic concentration in groundwater beneath the former lagoon area, and eliminated the operational issues with the groundwater treatment system.

BASF contracted with EnviroAssociates International, Inc. (EAI) to treat the dissolved-phase arsenic *in situ*. EAI chose the Regenesis Corporations' Metals Remediation Compound (MRC™) for the treatment process. As per EAI's June 2004 "RD/RA Work Plan for *In-Situ* Treatment of Arsenic in the Lagoon Area Groundwater," MRC™ is a non-toxic organo-sulfur and polycysteinate-polylactate polymer. Based on review of the literature and knowledge of arsenic behavior in aquifers, the MRC™ works by creating reducing conditions and supplying a source of sulfur, thereby stimulating biotic and abiotic formation of insoluble arseno-sulfide precipitates. As the arseno-sulfides are formed, the dissolved-phase concentrations of arsenic decline.

2.3.3.1 Treatment Methodology

Three rounds of *in situ* treatment were performed. The first occurred in May 2005, and the second was performed in August 2006. Following a meeting with the NYSDEC on March 14, 2008, in which the results of the two initial rounds were discussed, it was concluded that a third focused treatment would be conducted to assess whether additional treatment actions could reduce arsenic levels to the Class GA standard. The third treatment was performed in June 2008. As discussed in Section 2.3.3.2 below, pre- and post-treatment groundwater monitoring was conducted to assess the effectiveness of the treatment.

In the first treatment round, MRC™ was injected into the groundwater at approximately 150 points along the berms of the two lagoons (see Figure 6A) using a direct push drilling rig, special injection rods and high pressure pumps. Depth of injection into groundwater was approximately 20 ft bls. Dosage of the MRC™ was calculated by EAI based on average concentration of the arsenic in the groundwater, area of arsenic present in groundwater, depth of the soil column contaminated with arsenic, and other hydrogeologic parameters. In the second and third treatment rounds, a similar injection methodology was used except that particular attention was focused on the areas near the wells MW-5, MW-6, PZ-6 and PZ-10, in which the highest concentrations or arsenic were observed. The dosage of MRC™ was increased and the spacing of injection points was reduced in these areas (see Figure 6B).

2.3.3.2 Results

Monitoring was conducted in seven wells and piezometers to evaluate the effectiveness of the *in situ* treatment: MW-2, MW-4, MW-5, MW-6, PZ-6, PZ-10, and PZ-14. This monitoring array allowed evaluation to the east (MW-2, PZ-14), the west (MW-5, PZ-6, MW-6), the north (PZ-10) and south (MW-4).

A total of 14 sampling events--one pre-treatment baseline event and 13 post-treatment sampling events--have been conducted. During all sampling events, both total and dissolved (as determined with the use of a 0.45 micron filter) arsenic, pH and ORP measurements were collected. During selected monitoring periods, other parameters, such as dissolved iron, manganese, sulfate and some organic acids were also determined through analysis. The results are summarized in Table 1. The trend in dissolved arsenic concentrations in each location is presented as Figure 7.

As summarized in Table 1 and shown on Figure 7, the treatment resulted in arsenic concentration reductions of up to 91 percent in five of the seven wells as measured from April 2005 (immediately before first treatment) to August 2008 (two months after third treatment). Despite the reductions in arsenic concentrations, the Class GA groundwater standard was not achieved even following multiple injections. The arsenic concentration in a sixth well, MW-2, increased from 65 to 100 µg/L, although concentrations during interim sampling events ranged from just slightly more than the Class GA groundwater standard of 25 µg/L to 185 µg/L. Arsenic in well PZ-10 did not decrease since the beginning of the treatment.

Substantial decreases were observed in MW-6 and PZ-6, the two locations containing the highest pre-treatment dissolved-phase arsenic at concentrations aside from PZ-10 (12,000 µg/L and 14,900 µg/L, respectively). As shown on Table 1 and Figure 7, arsenic concentrations had declined to 2,000 µg/L and 640 µg/L in MW-6 and PZ-6, respectively, after the 2008 treatment. This represents an 84 to 91 percent reduction in dissolved arsenic concentrations.

Relatively high reduction percentages were also observed in MW-5. Prior to treatment, MW-5 contained 920 µg/L of arsenic, while following treatment, concentrations had declined to 190 µg/L, a 90 percent reduction.

The data collected during the course of the 13 sampling events provides a basis to predict future trends in groundwater quality if the injections are terminated and if additional injections are conducted.

As shown in Table 1 and Figure 7, arsenic concentrations in all monitoring locations (except PZ-10) fluctuated based on the time from the treatment injection. Shortly following the treatment, arsenic concentrations declined and, for a period of time, remained relatively stable at the lower concentration. However, with a longer period of time from the injection, gradual rebound was observed, particularly in the wells in which initial arsenic levels were relatively low. However, with only one exception, MW-2, all arsenic levels remained below initial concentrations, with the most significant long-term reductions observed where the highest concentrations were observed.

Based on these results, it can be predicted that:

- Long-term average concentrations of arsenic in groundwater, without additional treatment, will remain at levels lower than those observed prior to treatment, but some additional rebound may occur; and
- Further treatment using MRCTM will not achieve the Class GA groundwater standard, and, following further treatment, the same gradual rebound that has previously been observed is likely.

2.4 Capping of the Former Lagoon Area

Capping of the former Lagoon Area was performed during 2009 and 2010. The capping design for the former lagoon area consists of multiple fill layers vegetated with indigenous plant species such that the combination of grading, soil moisture storage, and evapotranspiration provides an equivalent degree of prevention of recharge as the low permeable cap specified in the OU-1 ROD. The Lagoon Area capping design was accepted by the NYSDEC in a July 8, 2008 letter to BASF.

The clean fill component of the cap for the former lagoon area consists of three layers and a minimum 30-inch total thickness:

- 6-inch biota barrier;
- 18-inch common fill layer; and
- 6-inch topsoil layer.

Additional clean fill was used to bring the lagoons to grade prior to installing the biota barrier. The cap was graded to promote runoff and minimize infiltration. A detention pond was installed on the southern portion of the cap area to collect storm water.

Following placement of the fill layers, the capped area was seeded to stabilize it. Additionally, the perimeter was vegetated with a diversity of native species that will serve to extract water from the soil and prevent recharge. The cap will meet the substantive requirements for an impermeable cap as specified in the OU-1 ROD through the combination of the multiple fill layers, positive grading, vegetated cover, and integrated detention basin. The cap design is provided in more detail in the Remedial Action Work Plan for Remedial Activities for Lagoon Area (Roux Associates. June 12, 2008).

The alternative cover meets all of the substantive requirements (equivalent protection of human health and environment) for the lagoon cap as specified in the September 2003 ROD. The cover also conforms with the ROD implemented institutional controls (groundwater use restriction and restricted future use). The advantages over the conventional cap (utilizing asphalt and existing concrete) with an alternative cover (consisting of multiple fill layers vegetated with native plant species) are several. The alternative cover expands the use of green space, reduces stormwater volume through soil retention, will improve stormwater quality through filtration, and will provide green buffer zones around the property (including use as walkway along the River). The new cover is consistent with NYSDEC-approved Landfill capping remedies used for closure at the BASF Corporation Closed Landfill, Volunteer Site No.V00521.[1]

2.5 Investigation of PZ-10 Area

As per the scope of work presented in the Work Plan for a Limited Soil Investigation in the Area of PZ-10, Lagoon Area (Roux Associates. August 12, 2008)[2], soil sampling was conducted in the vicinity of monitoring well LG-PZ-10 and former monitoring well LG-MW-1 located in the lagoon area. The investigation was conducted from December 14 to December 15, 2009 to assess arsenic levels in soil and evaluate the localized hydrogeology with the objective of determining why elevated arsenic levels had previously been found in PZ-10 and the reason that the *in situ*

[1] Explanation of Significant Differences, NYSDEC, February 2010.
[2] As modified in accordance with comments received from the NYSDEC in a September 2, 2008 letter.

treatment had no effect on the arsenic levels. The report summarizing the sampling results is provided in Appendix A.

Methods

Ten soil borings (LG-SB-250 to LG-SB-259) were advanced in the vicinity of LG-PZ-10 and LG-MW-1 (Appendix A, Figure 1) using a Geoprobe® direct push sampler and a four-foot long sampling tube. Soil was collected and characterized according to the Unified Soils Classification System continuously from ground surface to approximately 16 feet below ground surface. The entire soil column was divided into two-foot long intervals (e.g., 0-2, 2-4, 4-6) and soil from each interval was homogenized and collected for laboratory analysis of arsenic using USEPA Method 6010B. Soil borings were backfilled with remaining soil cuttings and clean sand, and then finished at the surface with an asphalt patch.

Results

Soil collected during the limited investigation generally consisted of grey to brown sand and silt with minor amounts of fine gravel and clay. Wet soils were encountered at depths ranging from approximately 12.5 to 14 feet below land surface in seven of the ten soil borings (see Appendix A, Attachment 1 for boring logs). Wet soils were not, however, found at three locations (LG-SB-253, LG-SB-255, and LG-SB-257), which confirms the conceptual understanding that operation of the GCS limits the volume of groundwater in the lagoon area in general and the location of PZ-10 specifically.

Concentrations of arsenic in soil ranged from 4.1 milligrams per kilogram (“mg/kg”) in LG-SB-257 (6 to 8 foot interval) to 9,100 mg/kg in LG-SB-251 (14 to 16 foot interval). The highest concentrations of arsenic in 9 of the 10 soil borings was at the 14 to 16 foot interval, the deepest interval collected, which is also assumed to be below the water table. In the tenth boring, LG-SB-250, the highest concentration of arsenic was observed in the 10 to 12 foot interval.

Discussion

The soil sampling conducted in the PZ-10 area support several conclusions:

- The highest concentrations of arsenic are found at depths greater than 10 feet below ground surface. Within the upper two to four feet, arsenic concentrations were generally low to moderate, ranging from approximately 8 mg/Kg to 380 mg/Kg, with approximately half of the results less than 20 mg/Kg.

- There is limited groundwater in the lagoon area. Moist soil was observed in some soil borings at a depth of 12.5 to 14 feet below ground surface, but no moisture was seen in other borings. These data support a conclusion that there may be a maximum of approximately 1.5 feet of saturated thickness in the lagoon area.

- There is limited, if any, arsenic transport from the PZ-10 to other locations within the lagoon area. Since there is limited groundwater in the lagoon area, there is no mechanism by which the arsenic observed in the PZ-10 area can be transported to other locations.

3.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

This section presents the remedial goals, standards, criteria, and guidance (SCGs), and remedial action objectives (RAOs) that apply to the arsenic in the former lagoon area groundwater. The identification of the remedial goals, SCGs, and RAOs for the former lagoon area was performed in accordance with 40 CFR 300 - National Contingency Plan (NCP) (USEPA, 1994), 6 NYCRR Part 375 – Environmental Remediation Programs (NYSDEC, 2006), and NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) #4030 – Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC, 1990).

The remedial goals, which are common for all registered inactive hazardous waste sites, as provided in 6 NYCRR Part 375 and the NYSDEC Draft DER-10 guidance document (NYSDEC, 2002), are:

- Restoration to pre-disposal/pre-release conditions, to the extent feasible and authorized by law; and
- Elimination or mitigation of all significant threats to public health and the environment presented by the contaminants caused by site-related activities through the proper application of scientific and engineering principles.

The remedial goals serve to establish the foundation for developing RAOs specific to arsenic in groundwater. RAOs are operable unit-specific objectives for the protection of public health and the environment and are expressed with regard to the concentration of chemicals of concern (COCs) and comparison to chemical specific SCGs.

3.1 Identification of SCGs

Standards, Criteria and Guidance (SCGs) are promulgated requirements and non-promulgated guidance that govern activities that may affect the environment. Specifically, the standards and criteria are cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations that are generally applicable, consistently applied, and officially promulgated under federal or state law. Guidance includes non-promulgated criteria that are not legal requirements, but should be considered based on professional judgment when applicable (NYSDEC, 2002).

The three general SCG categories specified in TAGM #4030 and United States Environmental Protection Agency (USEPA) guidance documents are: location-specific SCGs; action-specific SCGs; and chemical-specific SCGs. Location-specific SCGs are restrictions placed on the concentration of COCs or performance of remedial activities solely because they are in specific locations such as floodplains, wetlands, historic places, or sensitive ecosystems. The groundwater beneath the Lagoon Area is not located in the aforementioned locations. Therefore, no applicable location-specific SCGs were identified.

Table 2 presents a comprehensive listing of potential action and chemical specific SCGs that may govern remedial actions for groundwater in the Lagoon Area.

3.1.1 Chemical Specific SCGs

The current applicable chemical specific SCG isthe NYSDEC AWQSGV and Groundwater Effluent Limitations TOGS (1.1.1 June 1998 edition) Class GA groundwater standard for arsenic of 25 µg/L.

3.2 Remedial Action Objectives

The RAOs were developed based on the chemical specific SCG discussed above. The RAOs are:

1. to prevent the migration of arsenic in groundwater from the former lagoon area; and
2. eliminate risk to human health and the environment from exposure to arsenic in groundwater.

3.3 General Response Actions

General response actions (GRAs) are specific measures that can be performed to achieve the RAOs. GRAs include treatment, containment, extraction, and institutional controls or a combination of these actions. As stated in Section 2.3, BASF has completed a number of remedial actions in the former lagoon area targeting both soil and groundwater, including removal of a significant mass of source material via excavation and three rounds of *in situ* treatment using MRC™ conducted over the period from 2005 through 2008. The objectives of all of the remedial actions have been to: 1) eliminate unacceptable risk to human health and the environment; 2) create conditions such that continuous improvement will occur; and 3) return the area under remediation to active use. The remedial actions addressed the lagoon wastewater and sludge, removed the soil containing the highest concentrations of arsenic, reduced the dissolved-phase concentrations of arsenic, and reduced the volume of groundwater potentially flowing through the former lagoon area and into the Hudson River.

Based on the experience with the previous remedial actions, the applicable GRAs for the groundwater in former lagoon area are:

- *In situ* treatment of dissolved-phase arsenic and/or the soil representing the source of the arsenic in groundwater;
- Collection and treatment of arsenic-containing groundwater;
- Containment of arsenic-containing groundwater; and
- Excavation of soil representing the source of the arsenic in groundwater.

In the following section, these GRAs are further evaluated with respect to their effectiveness and implementability.

4.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section develops the GRAs discussed in the previous section into potential remedial technologies by identifying, evaluating, and screening applicable remedial technologies that may be employed in the former lagoon area to achieve the RAO. As was discussed in Section 2.3, the remedial actions for the former lagoon area have consisted of source removal, hydraulic containment and the *in situ* treatment of the dissolved arsenic using MRC™.

The technology screening process will consider whether technologies and process options can, by themselves or in combination, meet the RAOs for arsenic in groundwater. During the screening of the technologies, the demonstrated ability of the technology to prevent potential impacts to human health and the environment and proven reliability of the technology under similar site conditions is evaluated.

The technology types and associated process options in this section have been identified based on the previous remedial actions conducted in the former lagoon area, experience with similar types of environmental conditions, and engineering judgment. The selected remedial technologies will be evaluated on the basis of:

- *Effectiveness* – The effectiveness criterion evaluates the extent to which the technology meets the established RAO and considers the short-term effectiveness, long-term effectiveness, and potential impacts to human health and the environment. Short-term effectiveness refers to the effects during construction and/or implementation of the technology. Long-term effectiveness refers to the period after the remedial action is in place.
- *Implementability* – The implementability criterion focuses on both technical and administrative feasibility of constructing and operating a remedial action. Institutional aspects of the remedial technologies with factors such as institutional constraints, time schedules, and the availability of services, equipment, and trained personnel, compliance with applicable rules and regulations being considered as part of the evaluation.

The evaluation of technology effectiveness and implementability for technology screening purposes incorporates elements from TAGM 4030 (NYSDEC, 1990), the draft DER-10 (NYSDEC, 2002), and the USEPA document, "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988b).

After screening, the remaining technologies will be evaluated as remedial alternatives to ultimately develop a recommended remedial alternative for the former lagoon area groundwater.

4.1 Technology Screening

Based on the previous remedial actions and the proposed capping of the former lagoon area, technologies that may be appropriate were selected for screening, including:

In Situ Treatment

- Bioremediation using MRC™ Injections
- Solidification

Containment

- Reactive barriers
- Capping/surface covers

Collection

- Hydraulic Containment

Removal

- Excavation and offsite disposal

The following sections provide a brief description of the above technologies and present an evaluation of the effectiveness and implementability of the technologies.

4.1.1 *In Situ* Treatment

In situ treatment systems degrade, remove, or detoxify hazardous components in place. *In situ* treatment occurs primarily within the subsurface soil, thus from other on-site treatment technologies that are primarily aboveground processes. Two *in situ* technologies, bioremediation using MRC™ and solidification are considered for the former lagoon area.

4.1.1.1 Bioremediation

In situ bioremediation is a technology in which contaminants are treated using microorganisms to consume contaminants as a primary food source, secondarily degrade contaminants by inducing a change in geochemical conditions (co-metabolism), or immobilizing contaminants by inducing geochemical changes (e.g., oxidation or reduction). Under this technology, the injection of an appropriate substrate (e.g., an electron donor) is used to create the geochemical environment necessary for degradation to occur. For *in situ* metal reduction (e.g., MRC), a sulfur-based compound is injected to create extremely reducing conditions (anaerobic) and provide sulfur to the subsurface to cause sulfate reduction to occur. Precipitation of insoluble and thermodynamically stable sulfides is considered the dominant mechanism to remove dissolved heavy metals, such as arsenic, from the groundwater. This technology requires a source of carbon to create anaerobic conditions (e.g., molasses), a source of sulfate, and a population of sulfate reducing bacteria. Sulfate reducing bacteria are normally present under natural conditions; however, in some stressed environments, the sulfate reducing bacteria may not be present, or may be present in insufficient quantities for sulfate reduction to occur.

The previous experience with use of MRC™ has documented that it is implementable, and that it is effective in reducing dissolved-phase arsenic concentrations. It will be retained for further evaluation.

4.1.1.2 Physical/Chemical Treatment

Physical treatment processes are used either to separate contaminants from soil by physical means or to immobilize them within the soil matrix. Chemical treatment processes alter the chemical structure of the contaminants to produce a less hazardous residue than the original waste. In practice, physical and chemical treatment processes often overlap, and therefore are considered together.

The physical/chemical technology considered for the former lagoon area is *in situ* solidification. Although treatability studies would need to be performed to assess the effectiveness of the technology, it can be predicted that if the arsenic in soil is solidified such that the arsenic is not able to be dissolved in groundwater, that it would be effective in reducing arsenic levels in groundwater. It is an implementable technology and will be retained.

4.1.2 Containment

Containment is a response category in which physical barriers are used to prevent infiltration of stormwater and precipitation into the subsurface soils and/or prevent or divert the horizontal flow of groundwater into or from the contaminated area. As a result, the potential for leaching from soil and the hydraulic gradient driving force for contaminant migration is significantly reduced.

Horizontal barriers (e.g., slurry walls) prevent or mitigate contaminated groundwater flow. Vertical barriers prevent further infiltration of precipitation and leaching of contaminants, which in turn cause migration of contaminated groundwater.

A cap has already been installed across the lagoon area, providing physical containment for purposes of preventing direct contact exposure with soil and groundwater, and minimizing the volume of recharge to the lagoon area. Additionally, the existing bulkhead provides containment to the west for the majority of the lagoon area. For this evaluation, a horizontal subsurface barrier could be installed at the northern and southern ends of the lagoons to contain and/or treat any groundwater that may flow in those directions.

The effectiveness of additional horizontal containment will be limited to containing the small volume of recharge that may pass through the lagoon cap. It is, however, implementable, and will be retained for further evaluation.

4.1.3 Collection

Collection is a response category in which hydraulic containment is used to prevent the migration of contaminated groundwater. Groundwater collection has already been utilized for the extraction and treatment of arsenic-containing groundwater from the lagoon area, prior to use of the MRC™ and completion of the cap. The arsenic treatment technology previously used included a combination of oxidation/precipitation and an adsorptive media.

Given the previous use of this technology, it is implementable. It will be retained for further evaluation.

4.1.4 Removal

This technology consists of the excavation of arsenic-impacted soil using readily available mechanical excavation equipment to eliminate the source of the dissolved-phase arsenic. The soil would be transported to an offsite disposal facility.

Soil removal is implementable, and can be effective in reducing dissolved-phase concentrations of constituents if an adequate mass of source material can be removed. Therefore, it will be retained for further evaluation.

5.0 DESCRIPTION AND EVALUATION OF REMEDIAL ALTERNATIVES

Based on a screening of applicable technologies, the following remedial action alternatives for the former lagoon area groundwater will be evaluated:

Remedial Alternative 1:	No Further Action
Remedial Alternative 2:	Groundwater Monitoring and Inspection of Containment Systems
Remedial Alternative 3:	Continuation of MRC™ Injections
Remedial Alternative 4:	*In Situ* Solidification
Remedial Alternative 5:	Installation of a Subsurface Barrier with Gradient Control
Remedial Alternative 6:	Hydraulic Containment
Remedial Alternative 7:	Additional Hot Spot Removal and Offsite Disposal
Remedial Alternative 8:	Complete Excavation and Offsite Disposal

Each of the above alternatives will be evaluated based on seven criteria. The results of this evaluation will be used to compare the alternatives to determine which is most appropriate for implementation. The eight criteria are provided in NYSDEC TAGM 4030 (NYSDEC, 1990), the NCP (40 CFR Part 300.430), Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, 1988b), and Draft DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002):

1. Overall protection of public health and the environment
2. Compliance with SCGs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility or volume
5. Short-term effectiveness
6. Implementability
7. Cost

Because of the remedial actions conducted previously at the site, the "Overall Protection of Public Health and the Environment," is currently achieved. Under current conditions, there is no potential for direct contact exposure to the arsenic in groundwater or transport of arsenic to the adjacent Hudson River. As a result, all alternatives are generally equally protective and the alternative selection is based on other criteria, such as whether SCGs can be achieved, short-term risks to the public health and environment, and cost.

The following sections provide a description of the remedial alternatives that were developed to address the arsenic in the former lagoon area groundwater and evaluate the alternatives based on the above seven evaluation criteria.

5.1 Remedial Alternative 1: No Further Action

In accordance with the National Contingency Plan (NCP) and the draft DER-10, a no action alternative is evaluated to provide a baseline for comparison with other alternatives. However, as was discussed above, the following remedial actions pertaining to groundwater were already performed in the Lagoon Area:

1. Excavation of soil containing high concentrations of arsenic that was serving as source areas to groundwater[3];
2. Three rounds of MRC™ injection; and
3. Installation of a vegetative cap.

Therefore, Remedial Alternative 1 is considered a No Further Action alternative for purposes of this FFS.

For this remedial alternative, all soil and groundwater with concentrations of COCs above the cleanup levels located within the former lagoon area would remain in place, and no action would be taken to further remediate or monitor arsenic in Lagoon Area groundwater.

5.1.1 Overall Protection of Human Health and the Environment

The goal of mitigating significant threats to the public health and environment is already achieved since the remedial actions and site wide controls prevent direct contact with the arsenic in groundwater, and the data that were previously collected documented no surface water impacts to the Hudson River. The addition of the cap will further reduce any possibility of arsenic impact to

[3] Interim Remedial Measure (IRM) Remedial Action Completion Report, Roux Associates, December 16, 2005.

the river. The presence of groundwater exceeding the SCGs would remain and monitoring of groundwater for dissolved arsenic would not be performed.

5.1.2 Compliance with SCGs

This alternative would not comply with the applicable chemical-specific SCGs for arsenic in groundwater.

5.1.3 Long-Term Effectiveness and Permanence

This evaluation criterion is based on the amount of residual risk of contamination that remains after the remedial action alternative is implemented and the ability of the remedy to adequately manage the residual risk, based on:

- Will there be any significant threats, exposure pathways, or risks to the community and environment?
- Will the engineering and institutional controls be adequate to limit the risk?
- Are the engineering and institutional controls reliable?
- Will the remedy continue to meet RAOs in the future?

Alternative 1 can be predicted to provide long-term effectiveness and continue to achieve the RAOs as long as the engineering controls (cap, bulkhead, and groundwater containment system) remain functional. However, under the No Action alternative, there would be no ongoing monitoring of conditions to confirm the effectiveness of these controls. Therefore, Alternative 1 scores lower than other alternatives for the permanence criterion.

5.1.4 Reduction of Toxicity, Mobility, or Volume

Previously-conducted actions have reduced the volume of contaminated groundwater beneath the lagoon area by preventing groundwater migration from the east and minimizing the volume of recharge to the lagoon area. As a result of the reduction in volume, the mobility of the arsenic has also been reduced. This alternative would not provide any additional benefit in reducing the mobility or volume of impacted groundwater, and would provide no benefit with regard to reducing the toxicity of the arsenic in groundwater.

5.1.5 Short-Term Effectiveness

Since there are no remedial actions proposed for this alternative, there is no associated construction and implementation period, and therefore no associated short-term impacts to human health and the environment.

5.1.6 Implementability

This alternative would be readily implementable.

5.1.7 Cost

Since there are no remedial actions for this alternative, there are no capital or operation costs associated with Remedial Alternative 1.

5.2 Alternative 2: Groundwater Monitoring and Inspection of Engineering Controls

For Remedial Alternative 2, groundwater monitoring will be performed to evaluate whether there are changes in groundwater levels and/or chemistry that would support a conclusion that current containment measures and engineering controls (the GCS, cap, and bulkhead) were no longer functioning as designed. Additionally, regular inspections and maintenance of the cap and observable portions of the bulkhead would be conducted to confirm that they are still providing containment.

The alternative would consist of semiannual groundwater monitoring and biennial inspections of the cap and visible portions of the bulkhead. One groundwater event would include the collection of water level information to confirm that no significant volume of groundwater is present beneath the lagoon area and the collection of groundwater samples for analysis for arsenic. The other event would consist of collecting water level information only.

5.2.1 Overall Protection of Human Health and the Environment

This alternative would provide an equivalent degree of protection of human health and the environment as all other alternatives since, under current conditions, this objective is achieved.

5.2.2 Compliance with SCGs

This remedial action alternative would not comply with the chemical specific SCG for arsenic in groundwater.

5.2.3 Long Term Effectiveness and Permanence

This alternative will provide a basis to evaluate the long-term effectiveness and reliability of the containment system and engineering controls that have been previously installed to manage the residual arsenic in groundwater. Unlike Alternative 1, in which the current containment systems and engineering controls would not be evaluated, Alternative 2 will provide groundwater chemistry, water level, and flow information so that the continued effectiveness of the systems can be determined and response actions taken if one of the systems fails.

5.2.4 Reduction of Toxicity, Mobility, or Volume

Monitoring would not further reduce the overall mobility, toxicity, or volume of contaminated media.

5.2.5 Short-Term Effectiveness

This alternative poses moderate short-term effects for remedial workers and the adjacent community. Remedial workers will be in direct contact with soil during well installation activities. Some soil and waste will be generated that will require offsite disposal at a landfill. Engineering controls including proper PPE requirements can reduce the short-term effects to workers while conducting this work.

5.2.6 Implementability

Monitoring is readily-implementable.

5.2.7 Cost

Semi-annual groundwater monitoring and biennial inspection of the cap and bulkhead are estimated to cost approximately $50,000 per year. Over a 30-year planning period, this would be approximately $1.5 million.

5.3 Alternative 3: Continuation of MRC™ Injections

Remedial Alternative 3 consists of the continuation of the MRC™ injections. The MRC™ injections have been successful in reducing arsenic concentrations in five of seven monitoring wells in the former lagoon area.

5.3.1 Overall Protection of Human Health and the Environment

Continued injection of MRCTM would provide no additional benefit with regard to protection of human health and the environment. Under current conditions, the criterion is already achieved since previously-conducted remedial actions prevent direct contact exposure to the arsenic in groundwater and groundwater transport to the Hudson River.

5.3.2 Compliance with SCGs

Based on experience gained during three previous rounds of MRC™ injection, this remedial action alternative is not predicted to provide compliance with the chemical-specific SCG of 25 µg/L for arsenic in groundwater. After three rounds of injection, dissolved arsenic in all lagoon area wells remained above NYSDEC AWQSGVs, although significant decreases in concentration were observed some locations.

5.3.3 Long Term Effectiveness and Permanence

Remedial Alternative 3 would provide a similar degree of long-term effectiveness and permanence as Alternative 2. As discussed in Section 2.3.3, although the MRC™ did reduce arsenic levels in groundwater, the SCG was not achieved, and it can be predicted that, with further injections, residual levels of arsenic above the SCG would remain in groundwater. However, the previously-implemented measures that prevent direct contact exposure and transport of contaminated groundwater would be present, and monitoring would continue to be conducted.

5.3.4 Reduction of Toxicity, Mobility, or Volume

This alternative would to some degree reduce the toxicity of the groundwater by reducing the arsenic concentrations. It would not further reduce the volume of arsenic-containing groundwater or the mobility of the arsenic-containing groundwater from current conditions. The decrease in toxicity is only a relative result, however, as the SCG is not predicted to be achieved.

5.3.5 Short-Term Effectiveness

This alternative involves standard mixing and pumping equipment and would not cause any significant impacts to the community during implementation. There would be a moderate level of risk of injury to drillers and other workers during well installation and MRC™ injection.

5.3.6 Implementability

Three rounds of MRC™ injections have been implemented in the former lagoon area. Therefore, the technology is well understood and implementation is readily performed.

5.3.7 Cost

To achieve arsenic reductions throughout the lagoon area, injection programs similar to that performed during the first phase of treatment would be necessary. The costs for that program were approximately $400,000. Assuming that additional injections would be conducted every 18 months (the approximate frequency of the previously-conducted injection program), the annual cost would be approximately $270,000. Over a 30-year planning period, the cost to implement the injection program would be approximately $8.1 million.

Monitoring and reporting costs would be similar to those estimated for Alternative 2, approximately $50,000 per year or $1.5 million over 30 years.

5.4 Alternative 4: *In Situ* Solidification

In Situ solidification involves the direct injection of reagents and additives into the subsurface soil using specialized machinery with injection augers and rotary-type mixers for blending. This process would reduce the mobility and solubility of the arsenic by reducing or eliminating the permeability of the unsaturated and saturated zone.

5.4.1 Overall Protection of Human Health and the Environment

The extent to which conducting solidification on soil in the lagoon area will provide further protection of the public health and environment is unknown. There is no current or foreseeable risk of direct contact exposure to the arsenic in groundwater, and the existing containment system and engineering controls protect against transport of arsenic-containing groundwater to the adjacent Hudson River. Even if the *in situ* solidification is able to further reduce arsenic concentrations in groundwater, only an incremental degree of protection could be obtained. Alternative 4 would include groundwater monitoring for a specified period to evaluate the effectiveness of the program.

5.4.2 Compliance with SCGs

Pilot studies would be needed to determine if the chemical specific SCG for arsenic in groundwater would be met with this technology. If it is found in pilot studies that solidification can reduce the solubility of arsenic to a level such that the SCG is achieved, the stabilization program would need to encompass the saturated thickness across the entire lagoon area and the portion of Riverside Avenue.

5.4.3 Long Term Effectiveness and Permanence

Pilot studies will need to be conducted to assess the extent to which Remedial Alternative 4 can provide additional long-term effectiveness through the immobilization of the arsenic. The uniform application and thorough mixing of the binders will be necessary to ensure effectiveness and permanence of the *in situ* solidification. The valence state, pH, and ORP of the subsurface may limit the effectiveness of the solidification as these factors could affect the long-term stability of the solidification matrix and the solubility of arsenic.

5.4.4 Reduction of Toxicity, Mobility, or Volume

This alternative would further reduce the volume of contaminated groundwater by eliminating groundwater contact with arsenic-containing soil at the base of the lagoon area. By reducing the volume of groundwater, it would also reduce the mobility of the arsenic. The reduction in volume and mobility would be relatively minor since there is little groundwater in the lagoon area under current conditions.

5.4.5 Short-Term Effectiveness

This alternative poses moderate to high short-term risks for remedial workers and the adjacent community. Remedial workers would be in direct contact with soil during solidification activities, and there would be the potential for injuries associated with the operation of heavy duty construction equipment. Dusts would be generated with the potential for off-site transport. Engineering controls including proper personal protective equipment (PPE) requirements can reduce the short-term impacts to workers while conducting this work. Dust control and air monitoring would mitigate the short–term impacts to the community.

5.4.6 Implementability

Although the solidification technology that could be used for this remedial alternative is available, there are a number of difficulties regarding the ability to implement it under the conditions at the Rensselaer site. The injection and mixing would need to be performed at depths of up to 16 feet below ground surface across the entire lagoon area. It will also need to be performed beneath Riverside Avenue, which will necessitate closure and reconstruction of the road. There is a potential for damage to the existing bulkhead during injection and mixing along the western side of the lagoon area.

5.4.7 Cost

Costs for *in situ* stabilization are quoted in a range of approximately $100 per cubic yard to more than $400 per cubic yard, depending upon site-specific factors. Given the implementation difficulties at this site discussed previously, it is reasonable to predict that the implementation costs would be at the upper portion of this cost range. Therefore, for estimation purposes, a unit cost of $300/cubic yard has been used. Assuming that the bottom four feet of soil would need to be stabilized across the entire lagoon area, a volume of approximately 30,000 cubic yards would require treatment, for a cost of $9 million. It is estimated that reconstruction of Riverside Avenue would cost $250,000, and that approximately $250,000 would be needed to protect the bulkhead during mixing. Finally, it is estimated that pilot testing of the technology to assess stabilizing agents, dosage and application techniques would cost approximately $400,000. Based on the above, the capital cost for *in situ* stabilization would be approximately $9.9 million. Monitoring would continue to be required to confirm that the stabilization remained effective. As with the other remedial alternatives that include monitoring, the costs are estimated at $50,000 per year and $1.5 million over a 30 year period.

5.5. Alternative 5: Installation of Subsurface Permeable Reactor Barriers

Remedial Alternative 5 consists of installing two subsurface permeable reactor barriers (PRBs), one along the northern end of the lagoon area, and one along the southern end of the lagoon area, to treat the arsenic in groundwater prior to the groundwater discharging to the Hudson River. Current research has shown that iron reactor walls can remove arsenic from groundwater by several mechanisms, including sorption onto iron oxides, coprecipitation with iron and formation of sulfides.

As discussed in Section 2, as a result of the containment systems and engineering controls that have previously been installed at the site, groundwater migration into, and therefore transport out of, the lagoon area is minimized. However, any groundwater that does migrate from the lagoon area would flow to either the north or the south of the bulkhead and into the river.

The two PRBs would be placed perpendicular to the bulkhead and would be designed to treat any arsenic-containing groundwater that may flow through it.

5.5.1 Overall Protection of Human Health and the Environment

This alternative could provide some additional protection of public health and the environment by treating the small volume of arsenic-containing groundwater that may be flowing from the lagoon area to the Hudson River. However, the net benefit would be small, as there is little groundwater transport into and out of the lagoon area, as illustrated by the recent results in the PZ-10 area, and there is no known impact to the river under current conditions, as documented in previous reports regarding surface water quality in the river.

5.5.2 Compliance with SCGs

This remedial action alternative would not result in compliance with the chemical specific SCG for arsenic in groundwater as arsenic levels in groundwater across the entire lagoon area would not be reduced.

5.5.3 Long Term Effectiveness and Permanence

Remedial Alternative 5 provides a small degree of additional long-term effectiveness and permanence over current conditions by providing an additional degree of management of the residual levels of arsenic in groundwater. However, monitoring will need to be conducted over time, and the PRBs will likely need to be replaced when the ability of the iron to remove the arsenic is depleted.

5.5.4 Reduction of Toxicity, Mobility, or Volume

This alternative would reduce the mobility of contaminated media by removing the arsenic from the treated groundwater. This reduction in mobility will be small in comparison to current conditions since there is little, if any, arsenic transport at this time.

5.5.5 Short-Term Effectiveness

This alternative poses moderate short-term risks for remedial workers. Remedial workers would be in direct contact with soil during installation of the PRBs, and would face risk of injury associated with heavy duty construction equipment. Soil and hazardous waste removed during excavation for the slurry wall would have to be managed and disposed of offsite at a landfill, which increases risks associated with the transport and disposal of wastes. Engineering controls including proper PPE requirements can reduce the short-term effects to workers while conducting this work. Community air monitoring would be required during excavation for the PRB and soil and waste management.

5.5.6 Implementability

The PRB technology to be used for this remedial alternative is readily available. Experienced remedial contractors are available to implement the remedial activities associated with this alternative. Mechanical equipment and contractors are available.

5.5.7 Cost

Based on previous experience in installing PRBs, an approximate cost for a 3-foot wide trench, backfilled with a mixture of iron and sand is approximately $1,500 per linear foot. It is envisioned that the northern PRB would extend from the bulkhead to Riverside Avenue, a distance of approximately 225 feet, and the southern PRB would tie into the southern end of the bulkhead, run to the southern property boundary, and be terminated at Riverside Avenue, a distance of approximately 500 feet. Based on the unit cost of $1,500 per foot and a distance of 725 feet, capital costs are estimated to be approximately $1.2 million. It is estimated that it will require approximately $250,000 to conduct bench and pilot scale tests and design the wall. Additionally, the zero valent iron technology is patented and the patent holder will require a fee of approximately 10% of the capital cost to provide a license. Therefore, total capital costs are estimated at approximately $1.5 million.

As stated previously, it is predicted that the PRBs will need to be replaced when the ability of the iron to remove the arsenic is depleted. It is estimated that replacement may be required once every ten years, resulting in and operation and maintenance cost of approximately $150,000 per year. Monitoring would be required to confirm the effectiveness of the system, with costs comparable to those estimated previously. Assuming $150,000 per year for O&M and $50,000 per year for monitoring, total O&M costs over a 30 year period would be $6.0 million.

5.6 Alternative 6: Hydraulic Containment

For Alternative 6, hydraulic containment would be used to control the transport of arsenic-containing groundwater from the former lagoon area to the adjacent Hudson River. The groundwater would be extracted and conveyed to the existing groundwater treatment system where it will be treated with a combination of oxidation/precipitation and an adsorptive media. An existing extraction trench is located in the northeastern portion of the former lagoon area. Due to limited saturated thickness (less than 2 feet in areas along the eastern side of the Lagoon Area), it is predicted that additional extraction trenches would be installed along the western side of the Lagoon Area along the Hudson River.

5.6.1 Overall Protection of Human Health and the Environment

Similar to the PRBs discussed in Alternative 5, groundwater extraction and treatment could provide a small degree of additional protection to public health and the environment by preventing discharge of arsenic-containing groundwater to the adjacent Hudson River. The incremental amount of additional protection would be limited, since there is little groundwater flow into and out of the lagoon area, and there is no evidence of any impact to the Hudson River under current conditions. Continued monitoring of groundwater to ensure migration is not occurring would be necessary.

5.6.2 Compliance with SCGs

This remedial action alternative would not result in compliance with the chemical specific SCG for arsenic in groundwater. Although arsenic-containing groundwater will be extracted, any future recharge or infiltration to groundwater within the lagoon area will contact the arsenic-containing fill material.

5.6.3 Long Term Effectiveness and Permanence

Remedial Alternative 6 may provide a small degree of additional long-term effectiveness and permanence by preventing the migration of impacted groundwater from the former lagoon area. However, as discussed for the PRBs, the additional effectiveness will be limited because under current conditions there is little, if any, arsenic transport from the lagoon area to the Hudson River.

5.6.4 Reduction of Toxicity, Mobility, or Volume

Hydraulic containment would not reduce in the toxicity mobility of the arsenic-containing groundwater. It would provide some reduction in the volume of groundwater in the lagoon area and, by doing so, would reduce the mobility of the arsenic. The incremental improvement would be low, however, as there is little groundwater in the lagoon area under current conditions.

5.6.5 Short-Term Effectiveness

This alternative poses moderate short-term effects for remedial workers. Remedial workers would be in direct contact with soil during installation of the extraction trench or multiple pumping wells. Management of the arsenic solids produced by the groundwater treatment system will result in risks to personnel involved in operating the system. Soil and hazardous waste removed during excavation for the trench would have to be managed and disposed of offsite at a landfill. Using correct personal protective equipment during these activities can reduce the short-term effects to workers.

5.6.6 Implementability

Hydraulic containment is implementable, but there are significant implementation difficulties associated with installation of an expanded extraction system, treatment of the arsenic in the groundwater to meet discharge criteria, and management of the solids created by the treatment system.

An existing extraction trench is located in the northeastern portion of the former lagoon area, but to ensure that all arsenic-containing groundwater in the lagoon area is captured, additional trenches will need to be installed along the western perimeter of the lagoon area, near the bulkhead. These will need to be tied into the existing groundwater treatment system, which will require crossing Riverside Avenue.

Previous experience with attempting to treat the arsenic-containing groundwater was only marginally successful in meeting the arsenic discharge criterion. Due to fouling and other issues, inclusion of the arsenic-containing groundwater stream reduced the up time for the system as a whole, and created operational problems for the portions of the system unrelated to arsenic treatment. As a result, it is likely that the arsenic treatment will need to be designed as a standalone system, which will remove the arsenic prior to mixing with the groundwater from the other portions of the site.

The previous attempt to extract and treat arsenic-containing groundwater used an adsorptive medium to remove the arsenic. It was found that this medium was subject to solidification as a result of the hardness in the water and, therefore, this technology cannot be used. The inability to use an adsorptive medium significantly complicates the ability to treat the arsenic to meet discharge criteria. Treatability studies will be needed to determine if a technology such as chemical precipitation can meet the discharge criteria.

If the discharge criteria can be met, the treatment process for the arsenic will generate an arsenic-containing sludge that will need to be managed. The sludge will require drying, storage, and off-site disposal. It is possible, since the sludge will concentrate the arsenic from the groundwater, that a hazardous waste could be generated.

5.6.7 Cost

Capital costs for the system are estimated at approximately $500,000, which includes $100,000 in pilot studies and design activities, $150,000 for the expanded extraction and collection system, and $250,000 for the arsenic treatment/sludge management system.

Operation and maintenance costs with the addition of the arsenic treatment component are predicted to increase substantially from the current level of operating costs. Specifically:

- A full-time operator will be needed for the system, increasing labor costs by approximately $75,000 per year;
- Use of treatment chemicals, system components and electricity will increase by approximately $5,000 per month, with the majority being for solids management;
- Waste disposal costs will be incurred. The exact costs are unknown, but are estimated at $25,000 per year; and
- Monitoring costs will increase in order to confirm that the arsenic treatment component of the treatment system continues to operate as designed, adding approximately $1,500 per month.

Based on the above estimate of $178,000 per year, the cost of the hydraulic containment system over a 30 year operating period is approximately $5.3 million, with an additional $1.5 million for groundwater monitoring.

5.7 Alternative 7: PZ-10 Soil Excavation and Offsite Disposal

Remedial Alternative 7 consists of removing soil from the PZ-10 area to remove the source of the elevated arsenic found in groundwater in this location and disposing of the soil off-site. Under this alternative, the soil in the PZ-10 area would be removed to a depth of approximately 10 feet and stockpiled. The soil from 10 to 16 feet, where the highest concentrations of arsenic were found, would be removed and disposed of off-site. Continued groundwater monitoring in the lagoon area would be conducted.

5.7.1 Overall Protection of Human Health and the Environment

Removing the soil from the PZ-10 area will provide no additional protection of human health or the environment beyond current conditions. Although it is possible that the removal would result in localized reductions in the concentrations of arsenic in groundwater, the removal would have no effect on either direct contact exposure to groundwater or the transport of arsenic to the adjacent Hudson River.

5.7.2 Compliance with SCGs

This alternative would not result in compliance with the SCG for arsenic in groundwater. Although the removal would reduce the localized concentrations of arsenic in groundwater, arsenic concentrations greater than the SCG would remain in other locations of the lagoon area.

5.7.3 Long Term Effectiveness and Permanence

Removal of the soil from the PZ-10 area would not provide greater long-term effectiveness or permanence than current conditions. Although the removal would reduce the localized groundwater concentrations, there will still be a need to manage the remaining residual levels of arsenic throughout the lagoon area.

5.7.4 Reduction of Toxicity, Mobility, or Volume

The removal would provide a reduction in the volume of arsenic in the lagoon area.

5.7.5 Short-Term Effectiveness

This alternative would result in moderate risks to site workers and the community as a result of exposure to the soil during removal and through risks associated with heavy duty construction equipment and truck transportation. This risk can be mitigated through proper planning, appropriate use of personal protective equipment while conducting the removal, and implementation of a community air monitoring program during the removal.

5.7.6 Implementability

The removal action in the PZ-10 area is implementable, but has some difficulties:

- Sheeting and shoring will need to be installed to protect the building located adjacent to PZ-10;
- Overexcavation on a grade and/or sheeting/shoring will be needed in order to excavate the soil to a depth of 16 feet without significant sidewall slumping; and
- It is unclear that the overlying soil, even with only moderate levels of arsenic, will be able to be reused. Previous attempts to reuse soil from the South 40 parcel of the site, where arsenic was present at generally comparable levels to those found in the surface soil in the PZ-10 area, were unsuccessful, and the soil was required to be disposed of off-site for disposal.

5.7.7 Cost

The area of investigation for the PZ-10 area was approximately 30' x 30'. It is noted that elevated levels of arsenic were found at depth in the majority of the borings, supporting a conclusion that the excavation area footprint would likely be expanded to a 40' x 40' area to ensure removal of the highest concentrations of arsenic. The depth of the excavation would be 16 feet.

Assuming that sheeting and shoring are used to protect the building and retain the excavation sidewalls, the following costs for excavation, disposal and restoration would be incurred:

- Sheeting and shoring: 160 linear feet to 30 feet deep @ $30/ft^2 = $144,000
- Excavation: 1,600 ft^2 x 16 ft deep @ $12/cubic yard = $11,500
- Disposal: 1,600 ft^2 x 4 ft deep x 1.4 tons/yard @ $100/ton = $33,000
- Restoration: 1,600 ft^2 x 12 ft deep x $6/yard for placement and compaction = $5,000

  1,600 ft^2 x 4 ft deep x $20/yard for clean fill = $5,000
- Engineering and oversight: (20%) = $40,000

Total capital costs: $238, 500

Groundwater monitoring would still be required at $50,000 per year, or $1.5 million over 30 years.

5.8 Alternative 8: Complete Soil Excavation and Offsite Disposal

Remedial Alternative 8 consists of the excavation of soil impacted with arsenic at concentrations above the RSCOs. Development of this alternative satisfies the goal of remediation to pre-existing conditions.

The approximate areal extent of the Lagoon Area is 200,000 ft^2, or slightly less than 5 acres. The extent of arsenic impacted soil is typically limited to 20 ft bls. Based on these assumptions, this alternative would result in the removal of approximately 150,000 cubic yards of soil.

5.8.1 Overall Protection of Human Health and the Environment

This alternative would meet each of the RAOs for providing protection to human health and the environment and prevent migration of contaminants to groundwater. Protection is afforded by removing all soil with arsenic concentrations exceeding the RSCOs. Site restoration would be accomplished using backfill from approved offsite sources. Institutional controls would not be required to provide future protection to humans and the environment.

Protection of the environment is provided through removal of arsenic impacted soil that could potentially impact groundwater.

5.8.2 Compliance with SCGs

This remedial action alternative would comply with the applicable chemical-specific SCGs for the media of concern.

5.8.3 Long Term Effectiveness and Permanence

Remedial Alternative 8 provides long-term effectiveness through the permanent removal of arsenic impacted soil from the former lagoon area. All excavated soil would be transferred to an offsite disposal facility equipped to properly manage this material.

5.8.4 Reduction of Toxicity, Mobility, or Volume

Soil excavation would effectively reduce the toxicity, mobility, and volume of soil with concentrations exceeding the RSCOs thereby reducing mobility, toxicity, and volume of contamination.

5.8.5 Short-Term Effectiveness

This alternative poses the greatest short-term impacts for remedial workers and the community. Remedial workers would be in direct contact with soil during excavation activities. Exposure would be reduced through the use of mechanical equipment for soil excavation and site preparation, to the extent practicable. Engineering controls including proper PPE requirements can reduce the short-term impacts to workers while conducting this work.

The community would be exposed to a greater risk for dust generation during excavation. Additional potential short-term risks to the community would be posed from transportation of approximately 7,500 truckloads of soil to offsite disposal facilities and bringing another 7,500 truckloads of clean soil to the site. Potential exposure would result from releases from haul vehicles along the transportation route and associated transportation-related risks. Haul vehicles would need to be secured prior to exiting the Site to prevent release of waste.

The excavation also creates a significant environmental and safety risk associated with flooding and discharge of arsenic-containing soil to the Hudson River. The excavation will need to extend to approximately 20 feet below ground surface, which is approximately 10 to 15 feet lower than the adjacent Hudson River, depending upon the river stage. Although provisions such as additional sheeting and shoring, and management of the excavation process, would be implemented to minimize the potential for the river to flow into the excavation, it will be difficult to accomplish this goal. As a result, there is the potential for flooding and erosion of contaminated soil during the excavation process.

5.8.6 Implementability

Although soil excavation is readily available and can be implemented, the excavation of the magnitude required for the entire lagoon area and the specific difficulties that will be encountered creates substantial implementability problems for this alternative. These problems include, among others:

- The design and construction of a containment system that will ensure that the excavation is not affected by the Hudson River, despite an excavation that extends ten to fifteen feet below the surface of the river;
- Stabilization of approximately 1,100 feet of Riverside Avenue when the excavation will extend more than 20 feet below the roadway surface;
- Installation of a containment structure along approximately 250 feet of the southern shore of the Hudson River to protect the newly-installed clean fill;
- Acquisition of permits to allow removal of approximately 1,100 feet of Hudson River shore line;
- Coordination of 15,000 trucks into the site, removing contaminated soil and bringing in clean fill;
- Disposal of over 200,000 tons of soil at one or more off-site disposal facilities; and
- Management of several million gallons of contaminated water, which would be generated by precipitation and infiltration from the river during the excavation activities.

5.8.7 Cost

The estimated capital cost to implement Remedial Alternative 8 is estimated to exceed $50,000,000, if it can be performed. This capital cost consists of soil excavation, disposal, and replacement of 150,000 cubic yards of soil, installation of approximately 2,300 linear feet of sheeting and shoring, management of approximately 2.5 million gallons of contaminated water, and engineering, permitting and oversight.

5.9 Comparison of Remedial Alternatives

The NCP and the NYSDEC regulation and guidance on the selection of remedial alternatives for inactive hazardous waste disposal sites require that the seven evaluation criteria be used to individually evaluate the remedial action alternatives and also evaluate comparatively to identify advantages and disadvantages of each alternative relative one another (NYSDEC, 1990 and NYSDEC, 2002).

The NCP and the NYSDEC guidance also require that alternatives be evaluated based on community acceptance. In accordance with NYSDEC guidance, alternatives are evaluated for community acceptance after the public comment period.

5.9.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is a threshold criterion that must be achieved for any alternative be considered for selection as the recommended alternative. The protection of human health and the environment can be measured by the alternative's ability to satisfy the RAO.

The containment systems and engineering controls that are currently installed in the lagoon area as part of the remedy for OU-1 under the ROD have essentially eliminated risk to human health and the environment from arsenic-impacted groundwater beneath the lagoon area by protecting against direct contact exposure and preventing transport of groundwater to the Hudson River. Any further remedial actions must not result in an increased short-term or long-term risk to be considered for selection as a recommended alternative.

Remedial Alternative 1 – No Further Action currently provides an equivalent degree of protection of human health and the environment as the other alternatives, and does not result in any additional short- or long-term risk. Like all other alternatives except Alternative 8, the SCG for arsenic in groundwater would not be achieved, but this alternative has the lowest cost. This alternative scores very low, however, with regard to long-term protection and permanence because no mechanism is established to monitor the ongoing performance of the containment systems and engineering controls that are being used to manage the residual arsenic in groundwater.

Remedial Alternative 2 provides the same degree of protection of public health and the environment as does Alternative 1, but also scores higher with regard to long-term effectiveness and permanence than does Alternative 1 because it does include monitoring of the containment and engineering control systems.

Remedial Alternatives 3 through 8 will not a substantially increase in the level of protection of human health and the environment that will already be achieved with the cap that will be in place. All of these remedial alternatives will result in a net increase in risk to onsite workers and the surrounding community during their implementation.

5.9.2 Compliance with SCGs

Compliance with SCGs, also a threshold criterion, determines whether an alternative satisfies regulatory requirements. Only Remedial Alternative 8 (complete excavation) would result in compliance with the chemical-specific SCG for arsenic in groundwater.

5.9.3 Long-Term Effectiveness and Permanence

Long-term effectiveness examines the effectiveness of the alternative to provide protection to human health and the environment and is measured by the magnitude of residual risk remaining after the remedial action and by the adequacy and reliability of controls.

Remedial Alternative 1 (No Further Action) scores low with regard to long-term effectiveness and permanence because there is no mechanism to measure the effectiveness of the containment systems and engineering controls that are currently being used to manage the residual risk. With no ongoing monitoring to identify if/when a system fails to perform as designed, there is no ability to repair the system.

Remedial Alternative 8 (Complete Excavation) provides the highest level of long term effectiveness and permanence because all of the arsenic in soil would be removed via excavation and offsite disposal. In this event, there would be no need to manage any residual risk.

Remedial Alternative 2 through 7 would provide fairly equal levels of long term effectiveness and permanence. Under current conditions, the residual arsenic in groundwater is managed such that risks to human health and the environment are reduced to negligible levels. None of Alternatives 2 through 7 appreciably adds to the permanence of the remedy, as residual arsenic will remain in soil and would need to be monitored and managed in the long term. However, all of the alternatives include a monitoring component that will allow identification of when a system is no longer providing the necessary level of containment and allowing the system to be repaired.

5.9.4 Reduction of Toxicity, Mobility, or Volume

This criterion evaluates the anticipated performance of the remedial action alternative in terms of the treatment used to reduce the toxicity, mobility, or volume, the type and quantity of residuals remaining after treatment, and the degree to which the treatment is irreversible. Specifically, this criterion evaluates the remedial alternative's ability to reduce the toxicity, mobility, or volume of the arsenic in the groundwater in the former lagoon area.

Remedial Alternative 1 and Remedial Alternative 2 would not further reduce the toxicity, mobility, or volume of arsenic-containing groundwater. However, as stated above, the volume and mobility of arsenic in groundwater beneath the Lagoon Area are currently low as a result of the containment systems and engineering controls that have already been installed.

The volume and mobility of the arsenic in groundwater will be slightly reduced by Remedial Alternatives 3 through 7, either through reducing the volume of water, such as would be the case with Alternative 6 (hydraulic control), or the concentration of the arsenic (Alternatives 3, 4, 5, and 7). In each of these alternatives, however, the additional reduction in volume and mobility will be small, since there is currently little volume or mobility of the arsenic.

Remedial Alternative 7 provides the greatest level of reduction of toxicity, mobility, and volume from the former lagoon area by complete removal of all arsenic-containing soil, which would then eliminate the potential for arsenic in groundwater.

5.9.5 Short-Term Effectiveness

Short-term effectiveness refers to the potential effects and related risks associated with the implementation of the remedial action alternative. Potential short-term effects would occur during construction and operation of the remedy.

There are no short-term risks associated with either Alternative 1 or Alternative 2.

Remedial Alternatives 3 through 7 each pose low to moderate short-term risks to workers or the public by:

- Direct contact with arsenic-containing soil and/or groundwater by on-site workers;
- Heavy duty construction equipment risks to remedial contractors and onsite workers;
- Community exposure to dust during construction activities; and
- Community safety risks during offsite transportation impacted soil and waste, and on-site delivery of clean fill.

None of these risks are, however, considered significant and all can be mitigated to a large extent by proper planning, implementation of health and safety procedures and coordination with local officials.

Alternative 8, however, poses significant short-term risks to on-site workers and transportation operators, the community, and the adjacent Hudson River. The alternative involves the excavation of approximately 150,000 cubic yards of material to a depth of sixteen feet below ground surface. Risks include:

- A construction project of this magnitude will require at least a year to complete, and during this period, workers will be exposed to contaminated soil and water, and will be in constant contact with heavy duty construction equipment and large trucks.
- Workers will be subject to severe temperatures, further endangering them.

- The depth of the excavation poses unique risks associated with cave-ins.
- The excavation will be completed at a depth below the surface of the river, creating the potential for a dam or dike failure to result in the river flooding the excavation and, when the water recedes, transporting a significant volume of arsenic-containing soil into the river.

5.9.6 Implementability

The implementability criterion evaluates the feasibility of an alternative based on the ability to construct and operate the technology, reliability of the technology, ease of undertaking additional remedial actions if necessary, ability to monitor effectiveness, the administrative feasibility, and the availability of services and materials.

Remedial Alternatives 1 (No Further Action) and 2 (Monitoring) can be readily implemented.

Remedial Alternative 3 (Continued MRC Injections) is readily implementable using existing technologies, and has been performed on three separate occasions onsite.

Pilot studies will be needed to determine how Remedial Alternative 4, *In situ* Solidification, would be implemented at the site. The solidification would be conducted at depths of 10 to 16 feet below ground surface, and would need to encompass portions of the lagoon area near the river and near Riverside Avenue.

Remedial Alternatives 5, Installation of a Subsurface Barrier, and 6, Hydraulic Containment, are implementable, but have varying degrees of difficulty. The subsurface barriers can be installed, but will require trenching of approximately 725 feet to a depth of approximately 16 to 20 feet, disposal of trenching waste, and filling the trenches with a mix of iron and sand. Previous experience with operation of a system to treat the arsenic in groundwater supports a conclusion that implementation will be difficult. It is unknown whether a treatment system can meet the discharge criterion for arsenic, but it is known that inclusion of the arsenic in the groundwater treatment system created significant operational problems, including fouling and sludge management.

Remedial Alternative 7, Additional Hot Spot Removal and Offsite Disposal, is implementable with only one significant issue: protection of the building adjacent to the PZ-10 area, where the excavation would be conducted. The former wastewater treatment building, and current office of the site supervisor, would need to be protected with sheeting and shoring during any excavation in this area.

Remedial Alternative 8, Complete Excavation and Offsite Disposal, has significant implementability issues, including:

- The design and construction of a containment system that will ensure that the excavation is not affected by the Hudson River, despite an excavation that extends ten to fifteen feet below the surface of the river;
- Stabilization of approximately 1,100 feet of Riverside Avenue when the excavation will extend more than 20 feet below the roadway surface;
- Installation of a containment structure along approximately 250 feet of the southern shore of the Hudson River to protect the newly-installed clean fill;
- Acquisition of permits to allow removal of approximately 1,100 feet of Hudson River shore line;
- Coordination of 15,000 trucks into the site, removing contaminated soil and bringing in clean fill;
- Disposal of over 200,000 tons of soil at one or more off-site disposal facilities; and
- Management of several million gallons of contaminated water, which would be generated by precipitation and infiltration from the river during the excavation activities.

5.9.7 Cost

Costs for the remedial alternatives range from $0 (Alternative 1, No Action) to more than $50 million (Alternative 8, Complete Removal), as summarized below:

- Alternative 1, No Further Action: $0.
- Alternative 2, Monitoring and Inspections: $1.5 million over a 30-year monitoring period.
- Alternative 3, Continued MRC™ Injections: $4.7 million in capital, and $1.5 million for monitoring over 30 years.
- Alternative 4, *In Situ* Solidification: $9.9 million in capital and $1.5 million for monitoring.

- Alternative 5, Permeable Reactor Barriers: $1.5 million in capital, $1.5 million for monitoring, and $4.5 million for barrier maintenance over a 30-year period.

- Alternative 6, Hydraulic Containment: $5.3 million NPV for system operation and maintenance and $1.5 million for monitoring over a 30 year period.

- Alternative 7, Partial Excavation: $250,000 in capital, and $1.5 million for monitoring over a 30 year period.

- Alternative 8, Complete Removal: Greater than $50 million.

6.0 RECOMMENDED REMEDIAL ACTION ALTERNATIVE

Presented in Table 3 is the scoring of remedial alternatives. As shown, the alternative that scores the highest is Remedial Alternative 2, Groundwater Monitoring, and Inspection of Engineering Controls. This alternative received high scores for all evaluation criteria, except Achieves SCGs. In particular, it scored well on including Long-Term Protection of Public Health and the Environment, Short-Term Effectiveness, Implementability and Cost. The scoring reflects the fact that the remedial actions conducted to date by BASF have eliminated the direct contact exposure pathway and minimized groundwater a recharge into the lagoon area, thereby minimizing transport of groundwater into the adjacent river from the lagoon area. By providing monitoring, the long-term effectiveness of the current containment systems and engineering controls can be ensured.

No other remedial alternative scored appreciably greater on any evaluation criterion, except for Remedial Alternative 8, which would achieve the SCGs. No other alternative significantly improved the Long Term Protection of Public Health and the Environment, scored higher in Short-Term Effectiveness or Implementability, or, again except for Remedial Alternative 8, Achieved SGCs. However, Remedial Alternative 8 scored very low with regard to Short-Term Effectiveness, Implementability and Cost, and was one of the lowest scoring remedial alternatives.

Based on the scoring, Remedial Alternative 2, Groundwater Monitoring and Inspection of Engineering Controls has been selected to address the dissolved-phase arsenic in the lagoon area. This alternative will consist of:

- Semi-annual monitoring of the monitoring wells in the lagoon area, with one monitoring event designed to collect both water levels and groundwater samples, and the other to collect water levels only; and

- Biennial inspections of the cap and visible portion of the bulkhead.

The results of the monitoring and inspections, and any recommendations based on the results, would be provided to the NYSDEC in an inspection report.

7.0 REFERENCES

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Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: April 2005

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.4	125	92	65	903	36.4	1.14	122	2.85	N.D.	N.D.	N.D.	N.D.	N.D.
MW 4	7.1	115	260	229	7550	276	N.D.	N.D.	7.63	N.D.	N.D.	N.D.	N.D.	N.D.
MW 5	7.3	80	4900	920	4880	619	N.D.	71.8	9.82	N.D.	N.D.	N.D.	N.D.	N.D.
MW 6	7.1	85	18000	12000	8600	515	N.D.	83.1	4.7	N.D.	N.D.	N.D.	N.D.	N.D.
PZ 6	7.1	100	21400	14900	17900	836	N.D.	90.0	7.13	N.D.	N.D.	N.D.	N.D.	N.D.
PZ 10	8.0	145	28800	21000	8820	2400	2.09	231	3.26	N.D.	N.D.	N.D.	N.D.	N.D.
PZ 14	7.6	90	662	155	20800	2390	N.D.	36.9	4.16	N.D.	N.D.	N.D.	N.D.	N.D.

DATE OF SAMPLING: June 2005

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.5	118	75.1	30	N.A.	N.A	N.A.	N.A.	2.35	N.D.	N.D	N.D	N.D	3.4
MW 4	7.1	111	110	61	N.A.	N.A	N.A.	N.A.	7.49	N.D	N.D	N.D	N.D	1.7
MW 5	7.6	82	1850	700	N.A.	N.A	N.A.	N.A.	23.1	10.6	N.D	N.D	12.5	2.1
MW 6	7.5	84	12600	8400	N.A.	N.A	N.A.	N.A.	7.66	N.D	N.D	N.D	1.0	1.0
PZ 6	7.3	115	9140	6600	N.A.	N.A	N.A.	N.A.	206	122	N.D	N.D	179	2.0
PZ 10	8.3	157	27600	19200	N.A.	N.A	N.A.	N.A.	46.2	3.7	N.D	N.D	10.7	1.8
PZ 14	7.7	80	228	57	N.A.	N.A	N.A.	N.A.	6.75	N.D	N.D	N.D	1.1	2.0

Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: July 2005

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.4	85	89	50.4	923	447	N.D.	97	N.D.	N.D.	N.D.	N.D.	N.D.	3.4
MW 4	7.3	129	120	86	8380	864	N.D.	26.4	5.1	N.D.	N.D.	N.D.	N.D.	1.7
MW 5	7.2	66	834	544	6190	1180	N.D.	4.4	13	10.6	N.D.	N.D.	12.5	2.1
MW 6	7.4	91	11800	7900	7260	4710	N.D.	21.6	5.4	N.D.	N.D.	N.D.	N.D.	1.0
PZ 6	7.0	74	6960	2900	15600	4420	N.D.	0.451	370	122	N.D.	N.D.	179	2.0
PZ 10	7.6	93	26900	21300	6280	5860	N.D.	170	150	3.7	N.D.	N.D.	10.7	1.8
PZ 14	7.1	65	170	27	19600	5660	N.D.	75.3	5.4	N.D.	N.D.	N.D.	1.1	2.0

DATE OF SAMPLING: September 2005

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.5	139	53	27	N.A.	N.A.	N.A.	N.A.	N.D.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	7.5	76	85	30	N.A.	N.A.	N.A.	N.A.	7.4	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	7.4	126	347	124	N.A.	N.A.	N.A.	N.A.	11	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	7.9	90	5400	2030	N.A.	N.A.	N.A.	N.A.	3	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	7.3	128	2410	880	N.A.	N.A.	N.A.	N.A.	70	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	7.6	96	25200	18900	N.A.	N.A.	N.A.	N.A.	N.D.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	8.2	118	120	25	N.A.	N.A.	N.A.	N.A.	N.D.	N.A.	N.A.	N.A.	N.A.	N.A.

Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: November 2005

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	8.2	37	46	32	1040	520	N.A.	N.A.	N.A.	N.D.	N.D.	N.D.	N.D.	N.D.
MW 4	6.9	36	90 (110)	30 (25)	8600 (9000)	835 (810)	N.A.	N.A.	N.A.	N.D.	N.D.	N.D.	N.D.	N.D.
MW 5	7.1	-86	324	220	5680	1260	N.A.	N.A.	N.A.	40	N.D.	N.D.	N.D.	N.D.
MW 6	6.8	-85	2800 (3010)	1940 (2100)	7700 (7950)	4200 (3960)	N.A.	N.A.	N.A.	71.7	5	N.D.	15	N.D.
PZ 6	6.6	-70	1645	420	14200	5100	N.A.	N.A.	N.A.	144	N.D.	N.D.	33.4	N.D.
PZ 10	6.7	-113	26800	20600	6900	6350	N.A.	N.A.	N.A.	51.8	3.9	10	76.2	N.D.
PZ 14	7.3	-70	67	25	18900	5250	N.A.	N.A.	N.A.	11	N.D.	N.D.	1.2	N.D.

DATE OF SAMPLING: December 2005

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.5	-44	50	30	940	485	0.753	118	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	7.1	-71	100	30	8400	920	0.362	30.3	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	6.8	-86	310	240	6100	1180	N.D.	62.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	7.0	-52	2960	1880	7100	3950	N.D.	107	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.7	-75	1710 (1790)	380 (420)	13900 (14100)	6000 (5850)	N.D.	N.D.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	6.8	-62	27200	19400	7200	6250	N.D.	79.4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	6.1	-79	85	25	19600	5800	N.D.	42.6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: January 2006

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.1	28	60	40	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	7.0	-50	110	45	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	7.0	-58	350	250	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	7.1	-91	3,100	1,900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	7.0	-85	1740	420	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	7.1	-85	28,300	21,200	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	6.9	-75	95	30	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

DATE OF SAMPLING: March 2006

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	6.8	173	170	100	11,700	752	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	6.7	-79	260	110	30,600	2,840	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	6.7	-49	600	450	15,000	2,360	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	6.6	-23	4,300	32,00	24,800	6,520	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.4	6	2,160	680	45,300	4,410	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	6.9	-72	32,400	27,100	16,700	5,520	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	6.9	-37	140	100	45,900	6,930	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater
BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: July 2006

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.0	125	300	185	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	6.9	-49	410	140	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	7.1	-71	650	480	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	7.0	-72	4,900	4,200	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.9	-69	2,900	840	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	7.5	-28	33,800	29,200	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	7.1	-13	150	120	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

DATE OF SAMPLING: October 2006

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.9	-18	210	140	9,540	2,920	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	6.7	-69	290	100	75,100	3,770	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	6.4	-72	500	360	48,600	3,660	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	6.7	-79	4,100	3,800	67,600	5,580	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.6	-58	2,200	680	44,800	8,720	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	6.9	-120	33,100	28,700	24,700	25,000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	7.9	-17	100	90	11,300	4,080	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: November 2006

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.6	104	160	125	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	7.1	-7	140	80	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	6.6	-23	420	260	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	6.7	-73	2,600	1,450	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.9	-73	2,100	620	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	6.9	-97	32,900	30,100	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	7.2	62	80	60	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

DATE OF SAMPLING: January 2007

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.8	173	50	30	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	7.5	75	60	35	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	7.2	-106	210	160	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	7.2	-31	1,800	1,100	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.8	-75	1,260	230	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	7.2	-55	31,400	26,700	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	7.6	119	70	35	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: March 2007

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.9	248	30	30	1000	40	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	7.6	209	40	30	1100	830	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	7.2	-111	180	120	56,000	4,500	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	7.2	-124	1600	960	123,000	10,700	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.7	-83	1180	190	56,700	3,700	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	7.1	-63	31,200	28,500	93,800	19,500	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	7.6	148	30	30	39,200	6,000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

DATE OF SAMPLING: May 2007

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.4	108	40	30	100	50	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	6.0	31	50	50	10,700	1100	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	7.0	-79	140	100	51,200	5000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	6.5	-81	1100	680	73,500	6,500	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.9	-79	1060	140	45,000	3000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	6.8	-75	30,600	29,200	127,000	26,500	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	7.2	-65	30	30	38,800	5,900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Table 1. Summary of Groundwater Monitoring Results In Lagoon Area, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

DATE OF SAMPLING: July 2007

Sample Location	pH	ORP	Arsenic Total µg/L	Arsenic Dissolved µg/L	Iron µg/L	Manganese µg/L	Nitrate mg/L	Sulfate mg/L	TOC mg/L	Acetic Acid mg/L	Butyric Acid mg/L	Lactic Acid mg/L	Propionic Acid mg/L	Pyruvic Acid mg/L
MW 2	7.2	100	30	30	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 4	6.0	29	40	30	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 5	7.0	-74	210	160	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
MW 6	6.4	-77	1200	800	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 6	6.3	-75	1100	240	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 10	6.6	-83	32,400	29,800	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PZ 14	7.1	-58	30	30	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

NOTES:

1. ORP – Oxidation-reduction potential.
2. TOC – Total organic carbon.
3. µg/L – micrograms per liter.
4. mg/L – milligrams per liter.
5. MW indicates a monitoring well. PZ indicates a piezometer.
6. All concentration units are as indicated. Concentrations in parenthesis indicate duplicate sample results.
7. N.D. indicates not detected.
8. N.A. indicates samples were not analyzed
9. Dissolved indicates samples were filtered with 0.45 micron filter
10. Chemical injection was conducted in May 2005, followed by reinjection in August 2006.

**Table 2. Standards, Criteria and Guidance, Focused Feasibility Study, Lagoon Area Groundwater
BASF Corporation, Rensselaer, New York**

Division of Environmental Remediation SCGs

SCG Document	Description
6 NYCRR Part 375 - Environmental Remediation Programs	Requirements regarding remedial programs, private party programs, state funded programs, state assistance to municipalities
Remedial Guidance and Policy Documents	includes a listing of DER guidance including proposed DER-10 - Technical Guidance for Site Investigation and Remediation and proposed DER-23 - Citizen Participation Handbook for Remedial Programs

Division of Solid and Hazardous Materials SCGs

SCG Document	Description
6 NYCRR Part 360 - Solid Waste Management Facilities	Solid waste management facility requirements landfill closures; C&D landfill requirements; used oil; medical waste; etc.
6 NYCRR Part 364 - Waste Transporters	Waste transporter permit requirements
6 NYCRR Part 370 - Hazardous Waste Management System: General	Definitions of terms and general standards applicable to Parts 370-374 & 376
6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes	Hazardous waste determinations
6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities	Manifest system and record keeping, certain management standards
6 NYCRR Subpart 374-1 - Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	Requirements for recyclable materials, hazardous waste burned for energy recovery, used oil burned for energy recovery, precious metal recovery, spent lead acid battery reclamation
6 NYCRR Subpart 373-2 - Final Status Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities	Hazardous waste management standards (e.g., contingency plan; releases from SWMUs; closure/post-closure; container/management; tank management; surface impoundments; waste piles; landfills; incinerators; etc.)
6 NYCRR Subpart 373-3 - Interim Status Standards for Owners and Operators of	Similar to 373-2

Table 2. Standards, Criteria and Guidance, Focused Feasibility Study, Lagoon Area Groundwater
BASF Corporation, Rensselaer, New York

SCG Document	Description
Hazardous Waste Facilities	
6 NYCRR Part 376 - Land Disposal Restrictions	Identifies hazardous waste restricted from land disposal defines land disposal

Division of Water SCGs

SCG Document	Description
Analytical Services Protocols	Analytical procedures
Technical and Operational Guidance Series (TOGS)	Includes a listing of DOW guidance including TOGS 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.
6 NYCRR Part 702.15(a), (b), (c), (d), (e) & (f)	Empowers NYSDEC to apply and enforce guidance where there is no promulgated standard
6 NYCRR Part 700-706 - NYSDEC Water Quality Regulations for Surface Waters and Groundwater	700 - Definitions, Samples and Tests; 701 - Classifications Surface Waters and Groundwaters; 702 - Derivation and Use of Standards and Guidance Values; 703 - Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards
6 NYCRR Part 750-757 - Implementation of NPDES Program in NYS	Regulations regarding the SPDES program

Division of Fish and Wildlife and Marine Resources SCGs

SCG Document	Description
Fish, Wildlife and Marine Resource Guide	Presents hazardous material guidance including Fish and Wildlife impact Analysis and the Technical Screening of Contaminated Sediments
6 NYCRR Part 182 - Endangered & Threatened Species of Fish & Wildlife	Lists endangered, threatened species and species of special concern and prohibits taking except under permit
6 NYCRR Part 608 - Use and Protection of Waters	Protect certain classified streams permits for impoundments, structures, dredge, and fill
6 NYCRR Part 666 - Administration and Management of the Wild, Scenic and Recreational	Procedural requirements for administration and management of the wild, scenic and

SCG Document	Description
Rivers System in New York State Excepting the Adirondack Park	recreational rivers

Division of Environmental Permits SCGs

SCG Document	Description
DEC Permits Guidance	Listing of guidance for permits
6 NYCRR Part 621 - Uniform Procedures	Permit processing requirements

NYS Department of State SCGs

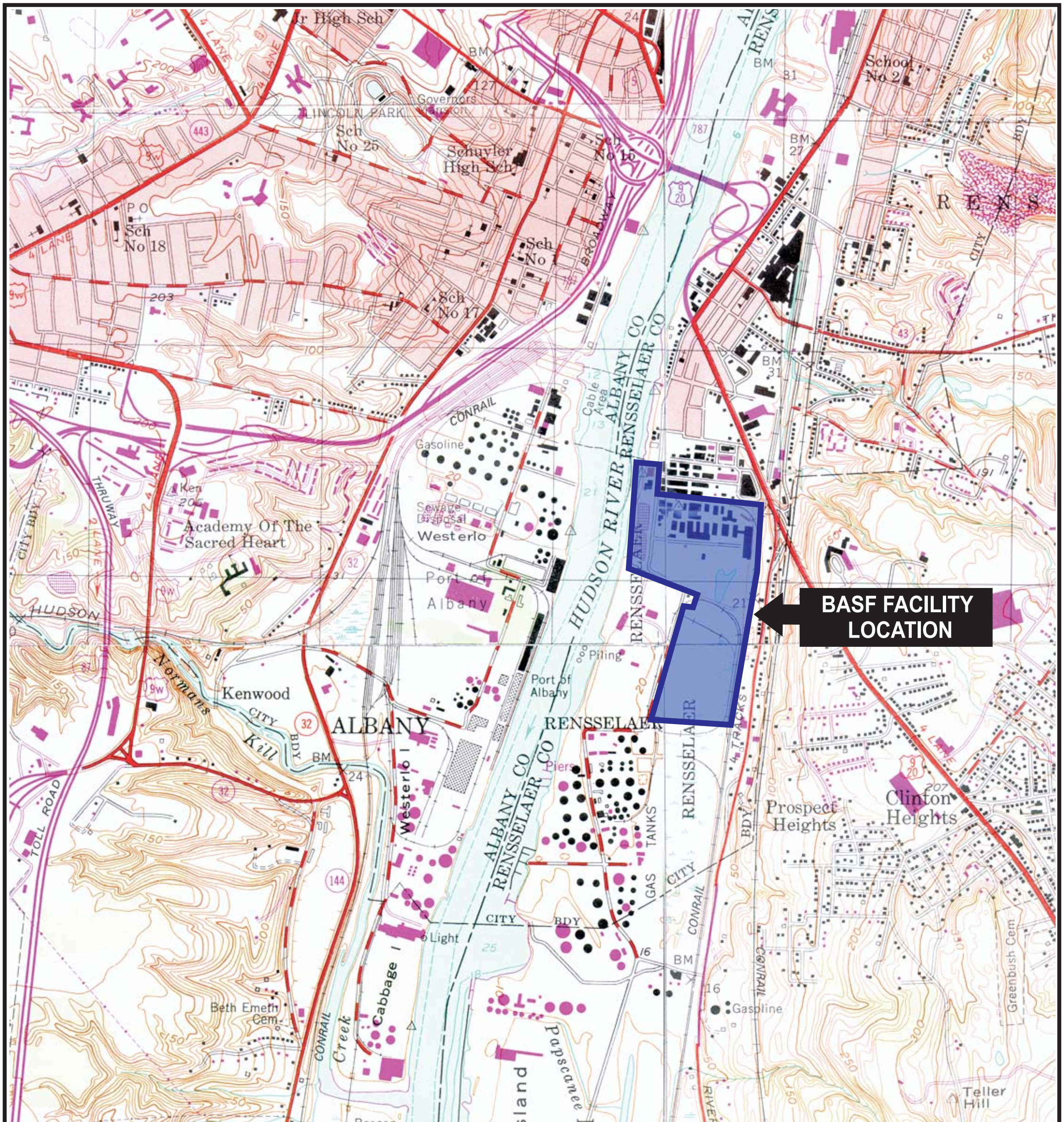
SCG Document	Description
Consistency Reviews	Guidance to insure federal and state "actions" in coastal areas are consistent with Coastal Management Program
State Coastal Policies	Policies regarding development in coastal areas
Part 600 - Department of State, Waterfront Revitalization and Coastal Resources Act	"Coastal Area" includes Lakes Erie and Ontario, the St. Lawrence and Niagara rivers, the Hudson river south of the federal dam at Troy, the East river, the Harlem river, the Kill van Kull and Arthur Kill, Long Island sound, and the Atlantic Ocean, etc.

OSHA SCGs (see "Offsite Links" above right)

SCG Document	Description
29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response	Health and Safety

Table 3. Scoring of Remedial Alternatives, Focused Feasibility Study, Lagoon Area Groundwater BASF Corporation, Rensselaer, New York

Evaluation Criteria	1 No Action	2 Ground Water Monitoring and Containment System Inspections	3 Continued MRC™ Injections	4 In-Situ Solidification	5 Permeable Reactor Barriers	6 Hydraulic Containment	7 Removal in PZ-10 Area and Continued Monitoring	8 Complete Removal
Overall Protection of Human Health and the Environment	8	8	8	8	8	8	8	10
Compliance with SCGs	2	2	2	2	2	2	2	10
Long-Term Effectiveness	2	8	8	8	8	8	8	10
Reduction of Toxicity, Mobility or Volume	0	0	2	4	4	3	4	8
Short-Term Effectiveness	10	10	8	5	6	6	6	0
Implementability	10	10	7	4	6	6	5	1
Cost	10	9	5	2	4	4	8	0
TOTAL	42	47	40	33	38	37	41	39



QUADRANGLE LOCATION

N

SOURCE:
USGS; 1980. Albany, New York;
USGS; 1980. Troy South, New York
USGS; 1980. Delmar, New York
USGS; 1980. East Greenbush, New York
7.5 Minute Topographic Quadrangles

0 2000'

Title:

SITE LOCATION MAP

Prepared for:

BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: O.R.	Date: 20AUG07	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	
Project Mgr.: O.R.	Office: NY	1
File No.: BF1149203.CDR	Project No.: 25111Y31	

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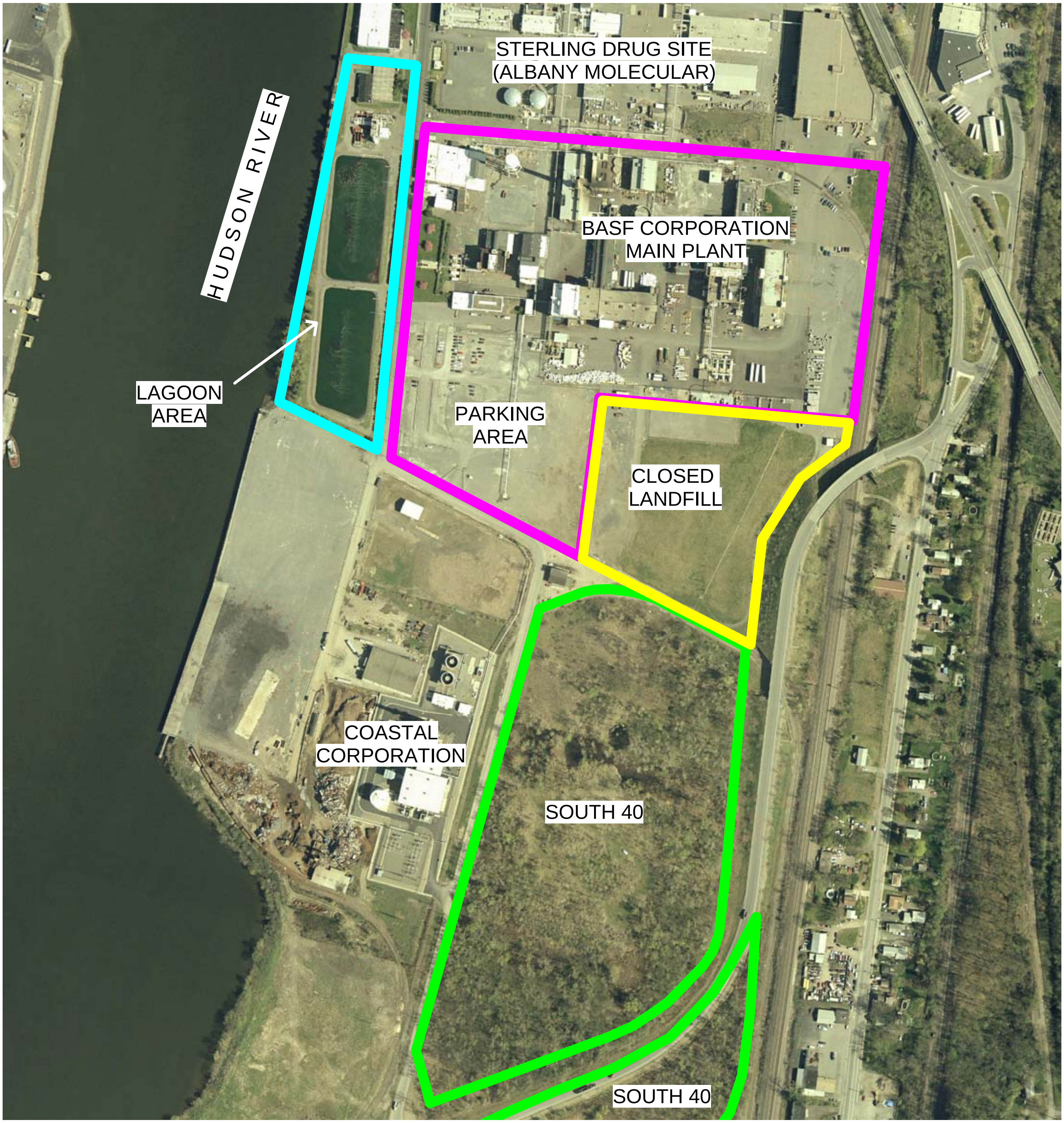


AERIAL PHOTOGRAPH DATE : SPRING 2001

Title:

SITE AREAS

RENSSELAER, NEW YORK FACILITY

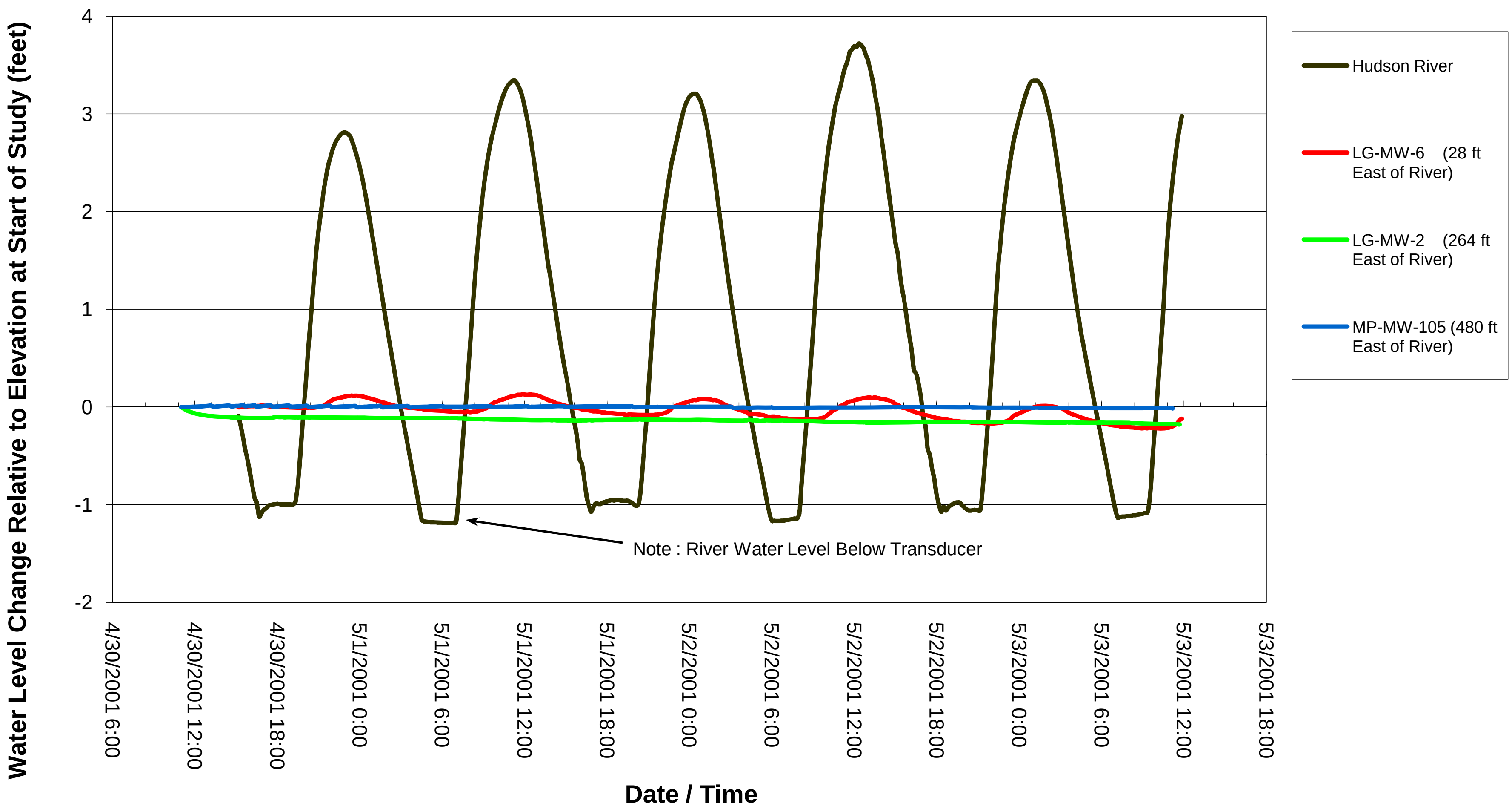
Prepared For:

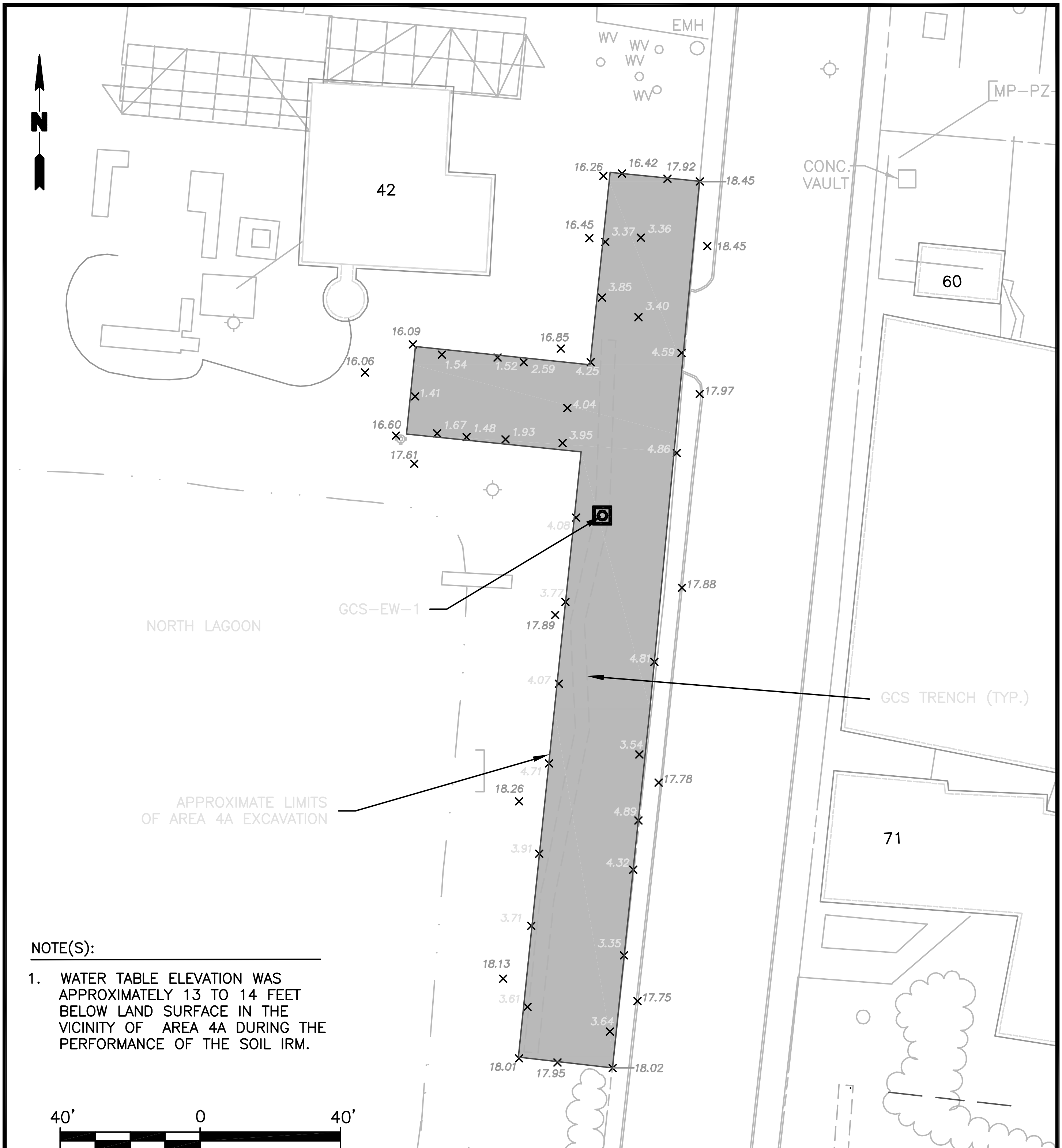
BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: N.E.	Date: 8/17/07	FIGURE
Prepared by: NE	Scale: 1" = 450'	2
Project Mgr: N.E.	Office: NY	
File No: BF1155501.WOR	Project: 25111Y31	

Figure 3.
Hydrograph of Tidal Study
BASF Rensselaer, NY





NOTE(S):

1. WATER TABLE ELEVATION WAS APPROXIMATELY 13 TO 14 FEET BELOW LAND SURFACE IN THE VICINITY OF AREA 4A DURING THE PERFORMANCE OF THE SOIL IRM.

LEGEND

EXCAVATION TO APPROXIMATELY 1' BELOW THE WATER TABLE (SEE NOTE 1)

3.61 × LOCATION OF SURVEY CONTROL POINT AND ELEVATION OF EXCAVATION BOTTOM IN FEET RELATIVE TO MEAN SEA LEVEL

18.01 × LOCATION OF SURVEY CONTROL POINT AND ELEVATION OF SURROUNDING GRADE IN FEET RELATIVE TO MEAN SEA LEVEL

Title:

AS-BUILT OF AREA 4A EXCAVATION

RENSSELAER, NEW YORK FACILITY

Prepared For:

BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES, INC. *Environmental Consulting & Management*	Compiled by: O.R.	Date: 20AUG07	FIGURE
	Prepared by: B.H.C.	Scale: AS SHOWN	4
	Project Mgr: O.R.	Office: NY	
	File No: BF1155504	Project: 25111Y31	

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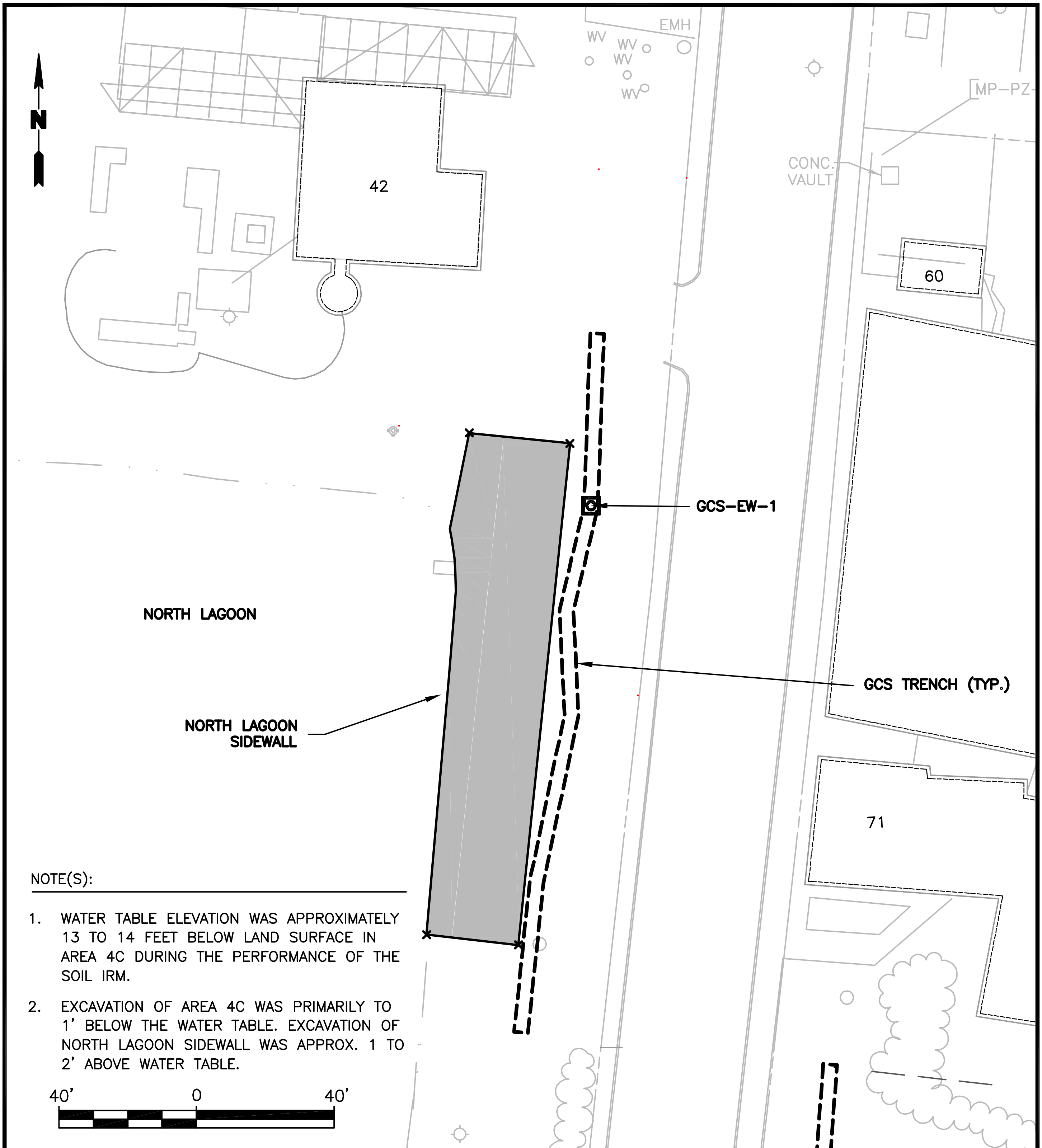

NOTE(S):

1. WATER TABLE ELEVATION WAS APPROXIMATELY 13 TO 14 FEET BELOW LAND SURFACE IN AREA 4C DURING THE PERFORMANCE OF THE SOIL IRM.
2. EXCAVATION OF AREA 4C WAS PRIMARILY TO 1' BELOW THE WATER TABLE. EXCAVATION OF NORTH LAGOON SIDEWALL WAS APPROX. 1 TO 2' ABOVE WATER TABLE.

LEGEND

(gray box)	EXCAVATION LIMITS (SEE NOTES 1 AND 2)
×	LOCATION OF SURVEY CONTROL POINT FOR LIMITS OF AREA 4C.

Title:

AS-BUILT OF AREA 4C EXCAVATION

RENSSELAER, NEW YORK FACILITY

Prepared For:

BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: W.K.	Date: 20AUG07	FIGURE
	Prepared by: B.H.C.	Scale: AS SHOWN	5
	Project Mgr: O.R.	Office: NY	
	File No: BF1149205	Project: 25111Y31	

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APPROXIMATE LOCATION OF METALS REMEDIATION COMPOUND (MRC) INJECTION POINTS

LG-MW-5 LOCATION AND DESIGNATION OF MONITORING WELL

AERIAL PHOTOGRAPH DATE : SPRING 2001

Title:

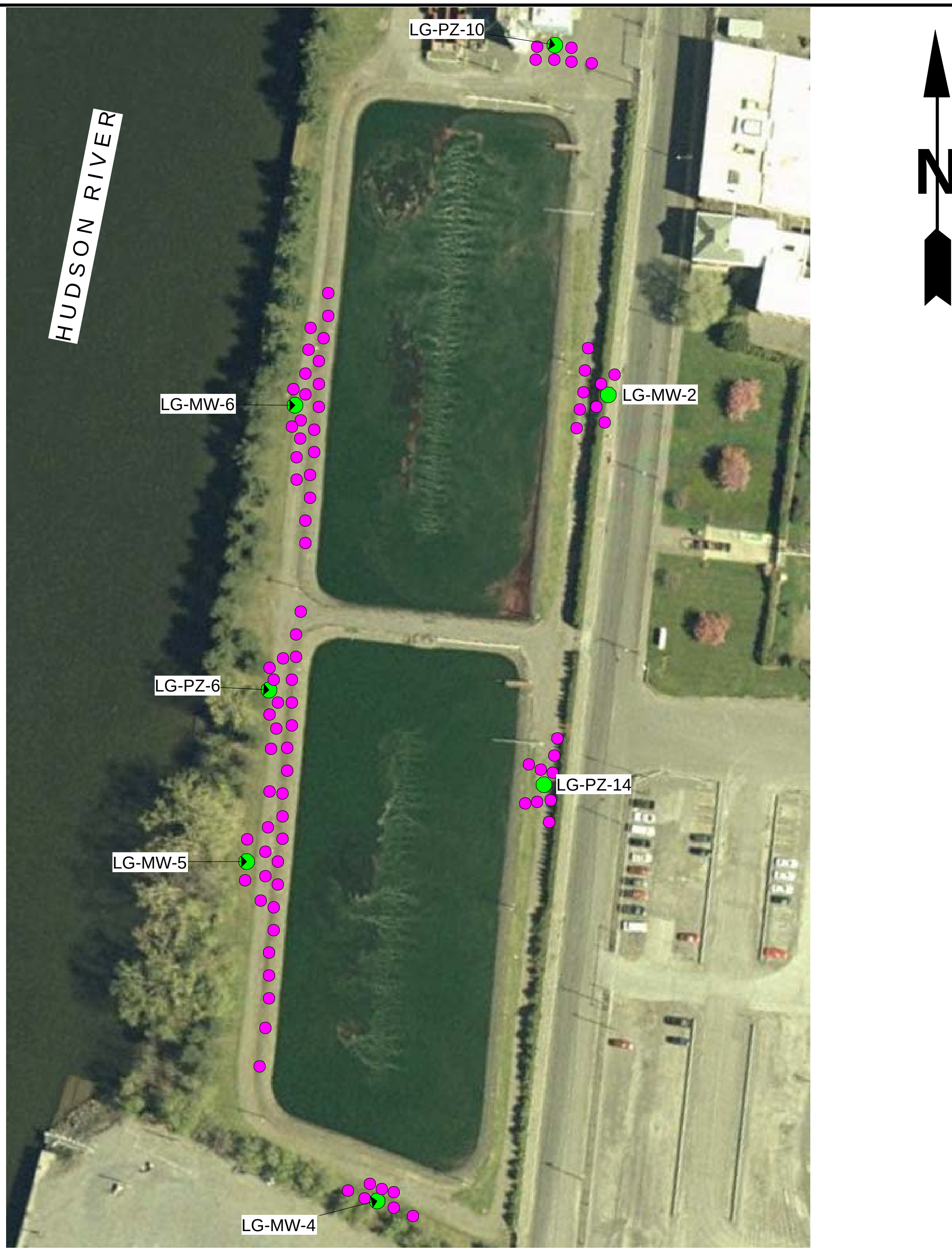
MRC INJECTION POINTS ROUND 1 (MAY 2005)

RENSSELAER, NEW YORK FACILITY

Prepared For: BASF CORPORATION FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: N.E.	Date: 8/20/07	FIGURE 6A
Prepared by: NE	Scale: 1" = 450'	
Project Mgr: N.E.	Office: NY	
File No: BF1155509.WOR	Project: 25111Y31	



APPROXIMATE LOCATION OF METALS REMEDIATION COMPOUND (MRC) INJECTION POINTS

LG-MW-5 LOCATION AND DESIGNATION OF MONITORING WELL

AERIAL PHOTOGRAPH DATE : SPRING 2001

Title:

MRC INJECTION POINTS ROUND 2 (AUGUST 2006)

RENSSELAER, NEW YORK FACILITY

Prepared For: BASF CORPORATION FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES INC *Environmental Consulting & Management*	Compiled by: N.E.	Date: 8/20/07	FIGURE 6B
	Prepared by: NE	Scale: 1" = 120'	
	Project Mgr: N.E.	Office: NY	
	File No: BF1155510.WOR	Project: 25111Y31	

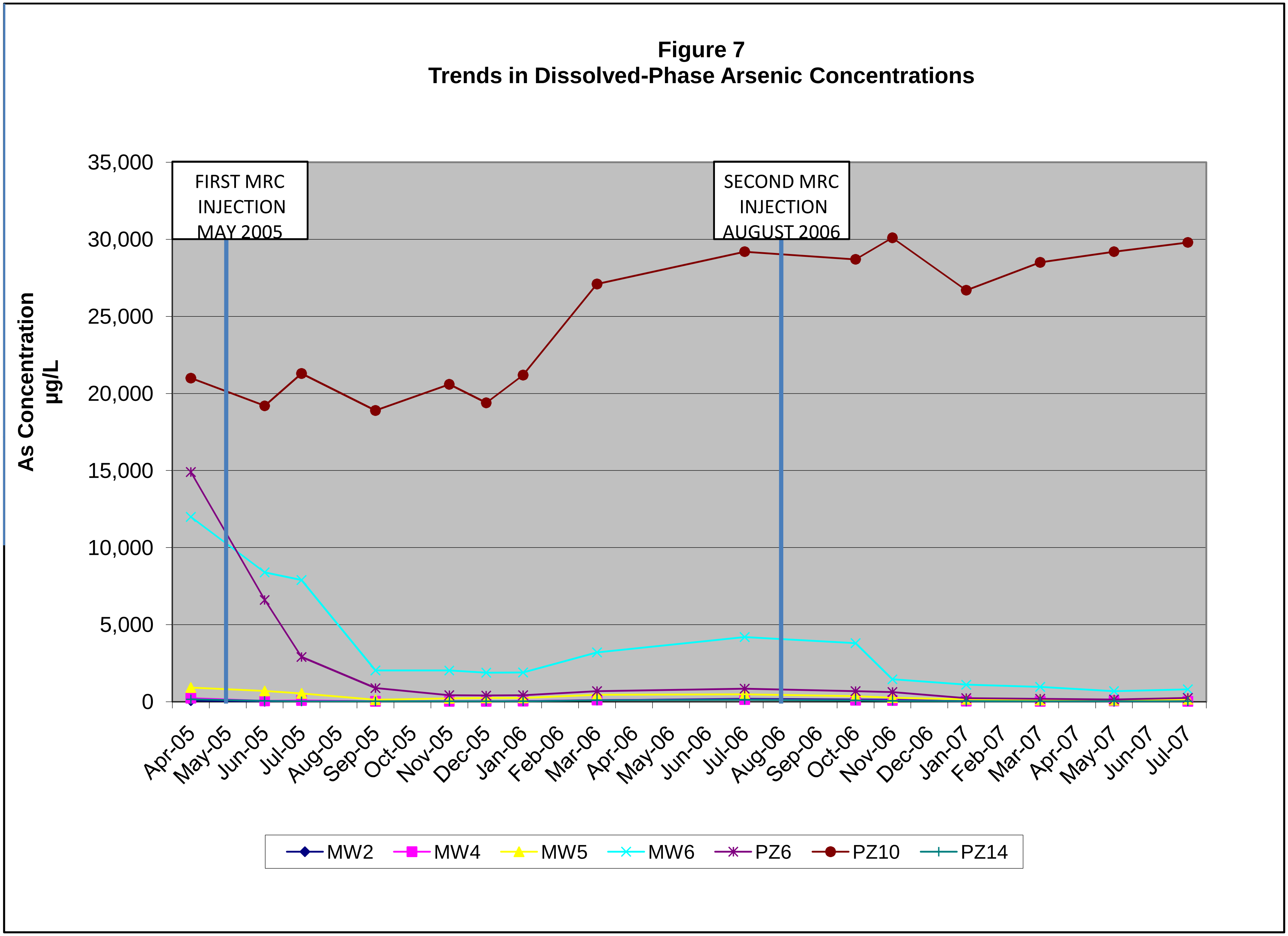


Figure 7
Trends in Dissolved-Phase Arsenic Concentrations
As Concentration µg/L
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
FIRST MRC INJECTION MAY 2005
SECOND MRC INJECTION AUGUST 2006
Apr-05 May-05 Jun-05 Jul-05 Aug-05 Sep-05 Oct-05 Nov-05 Dec-05 Jan-06 Feb-06 Mar-06 Apr-06 May-06 Jun-06 Jul-06 Aug-06 Sep-06 Oct-06 Nov-06 Dec-06 Jan-07 Feb-07 Mar-07 Apr-07 May-07 Jun-07 Jul-07
MW2
MW4
MW5
MW6
PZ6
PZ10
PZ14

LG-SB-133	
0 – 2	177
2 – 4	49.3
4 – 6	181
6 – 8	88.7
8 – 10	98.4
10 – 12	53.0

LG-SB-101	
0 – 2	43
2 – 4	29.4
4 – 6	--
6 – 8	--
8 – 10	--
10 – 12	--

LG-SB-100	
0 – 2	10.7
2 – 4	14.8
4 – 6	21.4
6 – 8	22
8 – 10	18.2
10 – 12	12.1

LG-SB-134	
0 – 2	267
2 – 4	71.7
4 – 6	118
6 – 8	45
8 – 10	146
10 – 12	404

LG-SB-129	
0 – 2	16.6
2 – 4	--
4 – 6	--
6 – 8	--
8 – 10	--
10 – 12	--
12 – 14	--

LG-SB-135	
0 – 2	160
2 – 4	159
4 – 6	58.6
6 – 8	10.1
8 – 10	9.1
10 – 12	209
12 – 14	290

LG-SB-128	
0 – 2	112
2 – 4	--
4 – 6	9.5
6 – 8	30.1
8 – 10	15.3
10 – 12	--

LG-SB-102	
0 – 2	29.6
2 – 4	138
4 – 6	236
6 – 8	154
8 – 10	80.1
10 – 12	44

LG-SB-131	
0 – 2	44.4
2 – 4	45.8
4 – 6	77.4
6 – 8	294
8 – 10	25.3
10 – 12	10.1

LG-SB-103	
0 – 2	91.8
2 – 4	45.2
4 – 6	79.2
6 – 8	--
8 – 10	--
10 – 12	97.9

LG-SB-132	
0 – 2	177
2 – 4	42.9
4 – 6	8.9
6 – 8	--
8 – 10	13.8
10 – 12	90.0

LG-SB-104	
0 – 2	14.6
2 – 4	21.3
4 – 6	165
6 – 8	47.8
8 – 10	21.6
10 – 12	79.2

LG-SB-105	
0 – 2	35.1
2 – 4	33.8
4 – 6	32.7
6 – 8	37.2

LG-SB-106	
0 – 2	9.3
2 – 4	--
4 – 6	97.4
6 – 8	79.7
8 – 10	28
10 – 12	53.3

LG-SB-107	
0 – 2	57.7
2 – 4	55.2
4 – 6	168
6 – 8	25.1
8 – 10	42.7
10 – 12	17.5

LG-SB-108	
0 – 2	15.7
2 – 4	576
4 – 6	524
6 – 8	45.0
8 – 10	143
10 – 12	31.1

LG-SB-109	
0 – 2	150
2 – 4	482
4 – 6	18.4
6 – 8	2.1
8 – 10	--
10 – 12	--
12 – 14	--

LG-SB-110	
0 – 2	22.4
2 – 4	34.6
4 – 6	--
6 – 8	--
8 – 10	--
10 – 12	--
12 – 14	--

LG-SB-111	
0 – 2	26.5
2 – 4	42.5
4 – 6	48.4
6 – 8	--
8 – 10	9.2
10 – 12	12.9

LG-SB-112	
0 – 2	15.3
2 – 4	48.7
4 – 6	60.6
6 – 8	246
8 – 10	26.4
10 – 12	--

LG-SB-113	
0 – 2	827
2 – 4	59.8
4 – 6	11.0
6 – 8	--
8 – 10	8.0
10 – 12	--

LG-SB-114	
0 – 2	11.0
2 – 4	9.4
4 – 6	--
6 – 8	9.1
8 – 10	8.0

LG-SB-115	
0 – 2	19.5
2 – 4	9.4
4 – 6	--
6 – 8	10.0
8 – 10	46.9

LG-SB-116	
0 – 2	--
2 – 4	12.3
4 – 6	16.8
6 – 8	46.0
8 – 10	37.6

LG-SB-127	
0 – 2	170
2 – 4	18.7
4 – 6	--
6 – 8	449
8 – 10	1,760
10 – 12	344
12 – 14	15.8

LG-SB-130	
0 – 2	74.9
2 – 4	641
4 – 6	319
6 – 8	602
8 – 10	171
10 – 12	58.2

LG-SB-126	
0 – 2	73.2
2 – 4	690
4 – 6	1,780
6 – 8	1,820
8 – 10	1,880
10 – 12	1,150

LG-SB-125	
0 – 2	1,070
2 – 4	2,290
4 – 6	167
6 – 8	13,700
12 – 14	2,300

LG-SB-124	
0 – 2	4,160
2 – 4	14,400
4 – 6	9,520
6 – 8	29,200
8 – 10	51,900
10 – 12	32,500

LG-SB-123	
0 – 2	230
2 – 4	17.7
4 – 6	3,050
6 – 8	52,600
8 – 10	79,400
10 – 12	16,000

LG-SB-122	
0 – 2	146
2 – 4	85.6
4 – 6	79.4
6 – 8	90.9
8 – 10	70.7
10 – 12	20.0

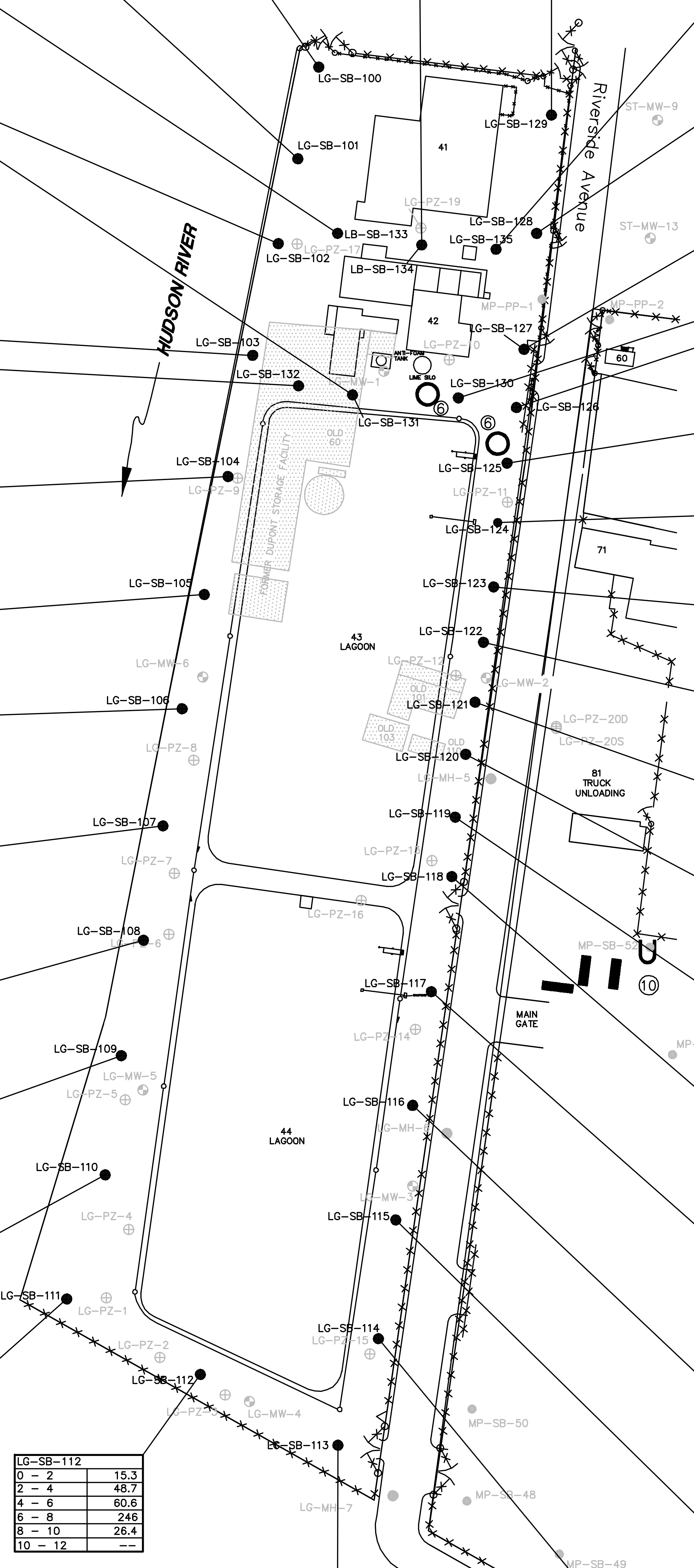
LG-SB-121	
0 – 2	44.0
2 – 4	205
4 – 6	147
6 – 8	86.1
8 – 10	39.1
10 – 12	43.8

LG-SB-120	
0 – 2	16.4
2 – 4	119
4 – 6	--
6 – 8	12.6
8 – 10	527
10 – 12	80.6
12 – 14	773

LG-SB-119	
0 – 2	17.2
2 – 4	--
4 – 6	7.7
6 – 8	--
8 – 10	23.2
10 – 12	328
12 – 14	611

LG-SB-118	
0 – 2	24.8
2 – 4	13.3
4 – 6	12.6
6 – 8	14.9
8 – 10	--
10 – 12	--

LG-SB-117	
0 – 2	50.4
2 – 4	10.2
4 – 6	--
6 – 8	--
8 – 10	--
10 – 12	20.8
12 – 14	59.7



LEGEND

LOCATION PREFIXES
- LG – LAGOON
- MP – MAIN PLANT
- LF – LANDFILL
- ST – ORGANICHEM PROPERTY (FORMERLY STERLING ORGANICS)

EXISTING BUILDING

FORMER BUILDING

FORMER OR EXISTING ALLEGED UNDERGROUND TANK OR PIT

C E O U D — DESIGNATES POTENTIAL AREA OF INTEREST, TABLE 3-1 "REMEDIAL INVESTIGATION WORKPLAN" MALCOM PIRNIE, INC., 1998

CHAINLINK FENCE

PRE-DESIGN INVESTIGATION AND OTHER HISTORIC SAMPLING LOCATIONS

- MP-SB-61 — LOCATION AND DESIGNATION OF SOIL BORING
- LG-MH-7 — LOCATION AND DESIGNATION OF SEWER BEDDING GROUNDWATER SAMPLING POINT
- MP-SB-114 — LOCATION AND DESIGNATION OF SOIL BORING SAMPLED DURING RI AND SUPPLEMENTAL RI
- MP-PP-5 — LOCATION AND DESIGNATION OF PERFORATED PIPE SAMPLING POINT
- LG-PZ-5 — LOCATION AND DESIGNATION OF PIEZOMETER
- LG-MW-4 — LOCATION AND DESIGNATION OF MONITORING WELL

DESIGNATION OF SOIL BORING

CONCENTRATION OF ARSENIC IN MILLIGRAMS PER KILOGRAM (mg/kg)

LG-SB-106	
0 – 2	9.3
2 – 4	--
4 – 6	97.4
6 – 8	79.7
8 – 10	28
10 – 12	53.3

DETECTED BELOW NYSDEC RSCOs

SAMPLE DEPTH INTERVAL IN FEET BELOW LAND SURFACE

RSCO – RECOMMENDED SOIL CLEANUP OBJECTIVES

NOTE:

1. NYSDEC RSCO FOR ARSENIC = 7.5 mg/kg

100' 0 100'

Title:

SUMMARY OF ARSENIC DETECTED ABOVE NYSDEC RSCOs IN LAGOON AREA SOILS

RENSSELAER, NEW YORK FACILITY

Prepared For:

BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES, INC. *Environmental Consulting & Management*

Compiled by: M.R.	Date: 30AUG07	PLATE
Prepared by: B.H.C.	Scale: AS SHOWN	1
Project Mgr: N.E.	Office: NY	
File No: BF1149206	Project: 25111Y31	

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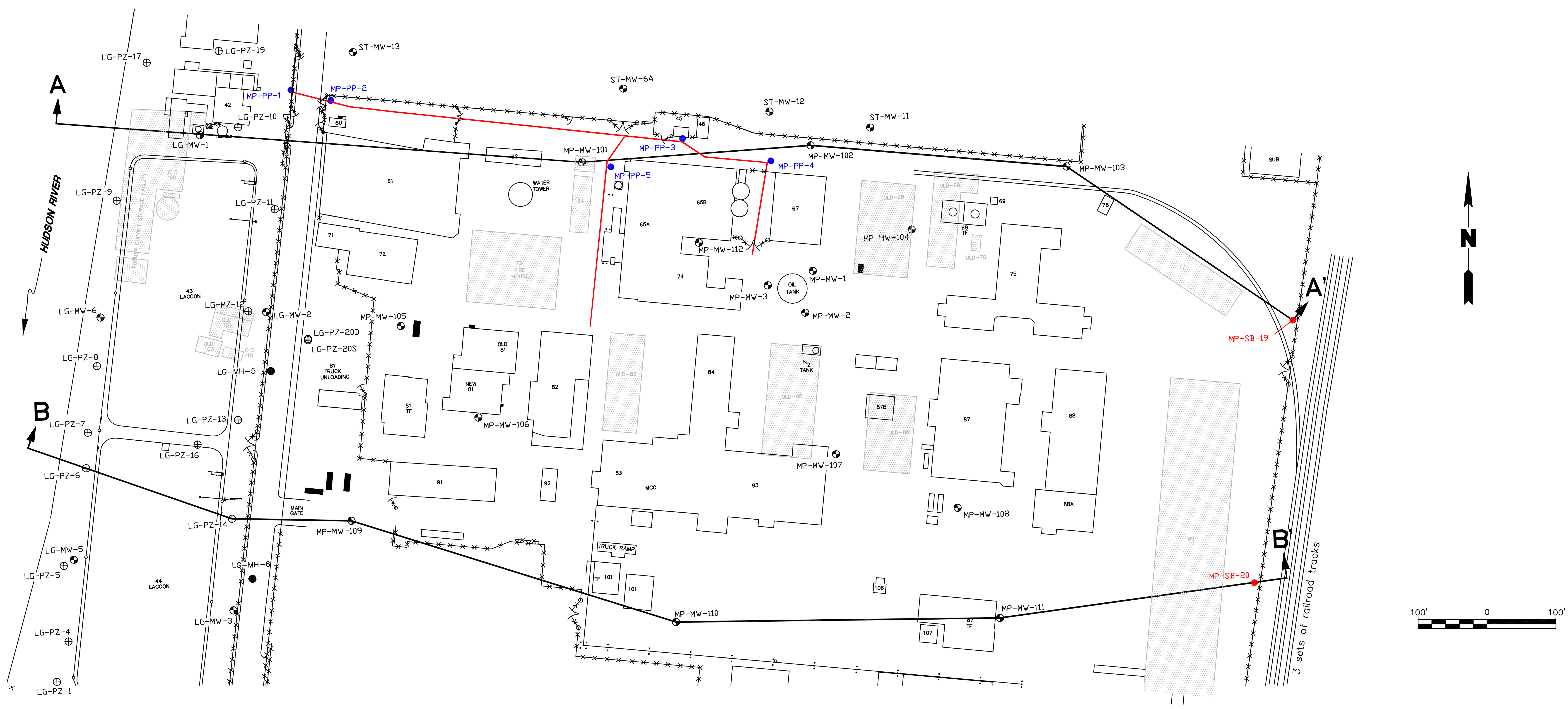
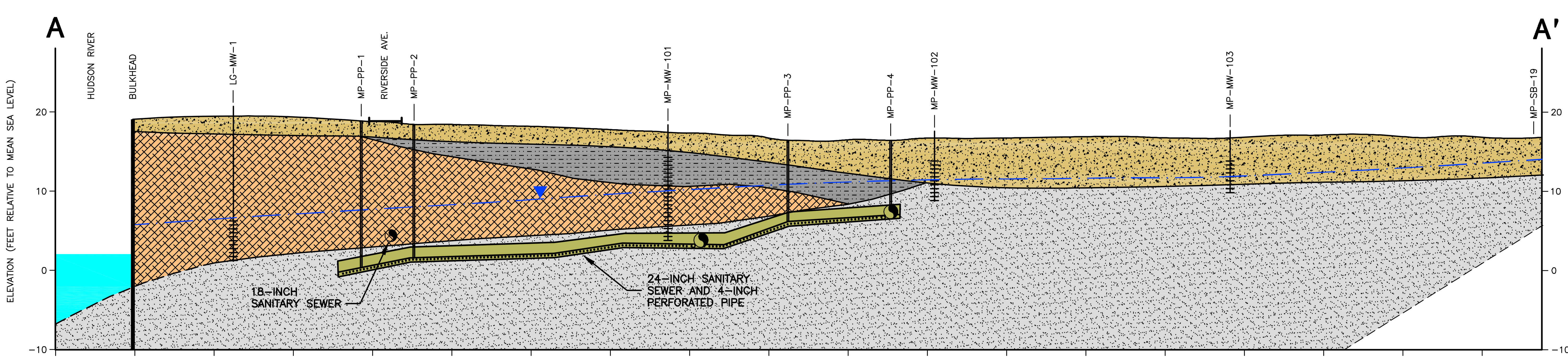
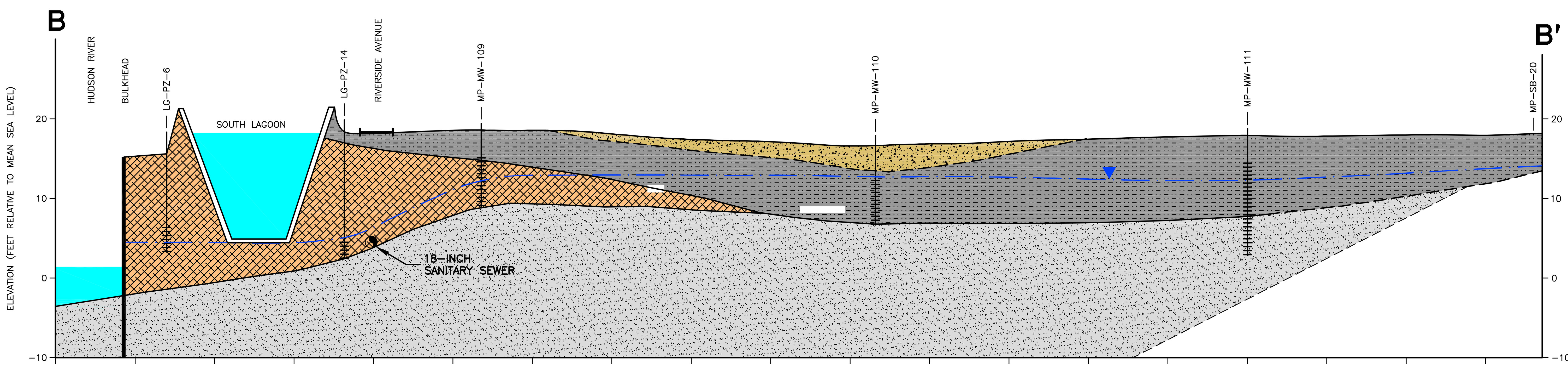


LEGEND

LOCATION PREFIXES
- LG – LAGOON
- MP – MAIN PLANT
- ST – ORGANICHEM PROPERTY (FORMERLY STERLING ORGANICS)

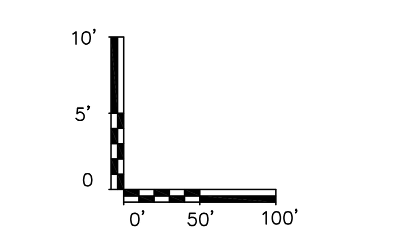
	EXISTING BUILDING
	FORMER BUILDING
	FORMER OR EXISTING ALLEGED UNDERGROUND TANK OR PIT
	OVERHEAD UTILITY SUPPORTS
	CHAINLINK FENCE
	APPROXIMATE LOCATION OF 24-INCH SANITARY SEWER AND PERFORATED PIPE
MP-SB-19	LOCATION AND DESIGNATION OF SOIL BORING
MP-PP-5	LOCATION AND DESIGNATION OF PERFORATED PIPE SAMPLING POINT
MP-MW-101	LOCATION AND DESIGNATION OF MONITORING WELL
LF-PZ-5	LOCATION AND DESIGNATION OF PIEZOMETER
LG-MH-7	LOCATION AND DESIGNATION OF SEWER BEDDING SAMPLING POINT





LEGEND

B B'	LINE OF CROSS SECTION
	WATER TABLE
	INDICATES SCREENED INTERVAL
	BROWN SAND, GRAVEL, SILT, BRICK, CRUSHED STONE, AND WOOD (FILL)
	BROWN SILT WITH SOME TO TRACE SAND AND GRAVEL (FILL)
	FINE TO COARSE SAND WITH LITTLE GRAVEL (ALLUVIUM)
	GRAY/BROWN CLAY WITH TRACE SILT (LACUSTRINE)
	CONCEPTUAL PROJECTION OF APPROXIMATE ELEVATION OF 24-INCH SANITARY SEWER AND PERFORATED PIPE REPLACED BY BASF IN 1995



VERTICAL EXAGGERATION = 10 X

NOTES:

INVERTS FOR SANITARY SEWER OBTAINED FROM SANITARY SEWER RECORD PLAN RE-1255-D SHEET 220, C.T. MALE ASOCIATES, P.C.

LAGOON CROSS SECTION IS CONCEPTUAL BASED UPON INFORMATION PROVIDED IN THE REPORT "BASF WASTEWATER EQUALIZATION LAGOON RECONSTRUCTION STUDY AND PRELIMINARY DESIGN," CLOUGH, HARBOR & ASSOCIATES 1993.

CONSTRUCTION DETAILS AND STRATIGRAPHY FOR LG-MW-1, LG-PZ-6, AND LG-PZ-14 WERE OBTAINED FROM "BASF/STERLING ORGANICS WASTE WATER LAGOONS BASELINE ASSESSMENT," MALCOLM PIRNIE, INC. 1994.

INFORMATION ON LOWER BOUNDARY OF LACUSTRINE CLAY OBTAINED FROM THE FOLLOWING REPORTS:

1. "HYDROGEOLOGICAL INVESTIGATION OF INDUSTRIAL WASTE DISPOSAL AREA" BASF WYANDOTTE CORP., RENSSELAER, N.Y. DAMES & MOORE 1979
2. "GROUND WATER CONTAINMENT AND COLLECTION SYSTEM DESIGN, STERLING DRUG INC. RENSSELAER, NY." DAMES & MOORE 1984.

Title:

GENERALIZED HYDROGEOLOGIC CROSS SECTIONS

RENSSELAER, NEW YORK FACILITY

Prepared For:

BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: S.S	Date: 20AUG07	PLATE
	Prepared by: B.H.C.	Scale: AS SHOWN	2
	Project Mgr: N.E.	Office: NY	
	File No: BF1149207	Project: BF25111Y31	

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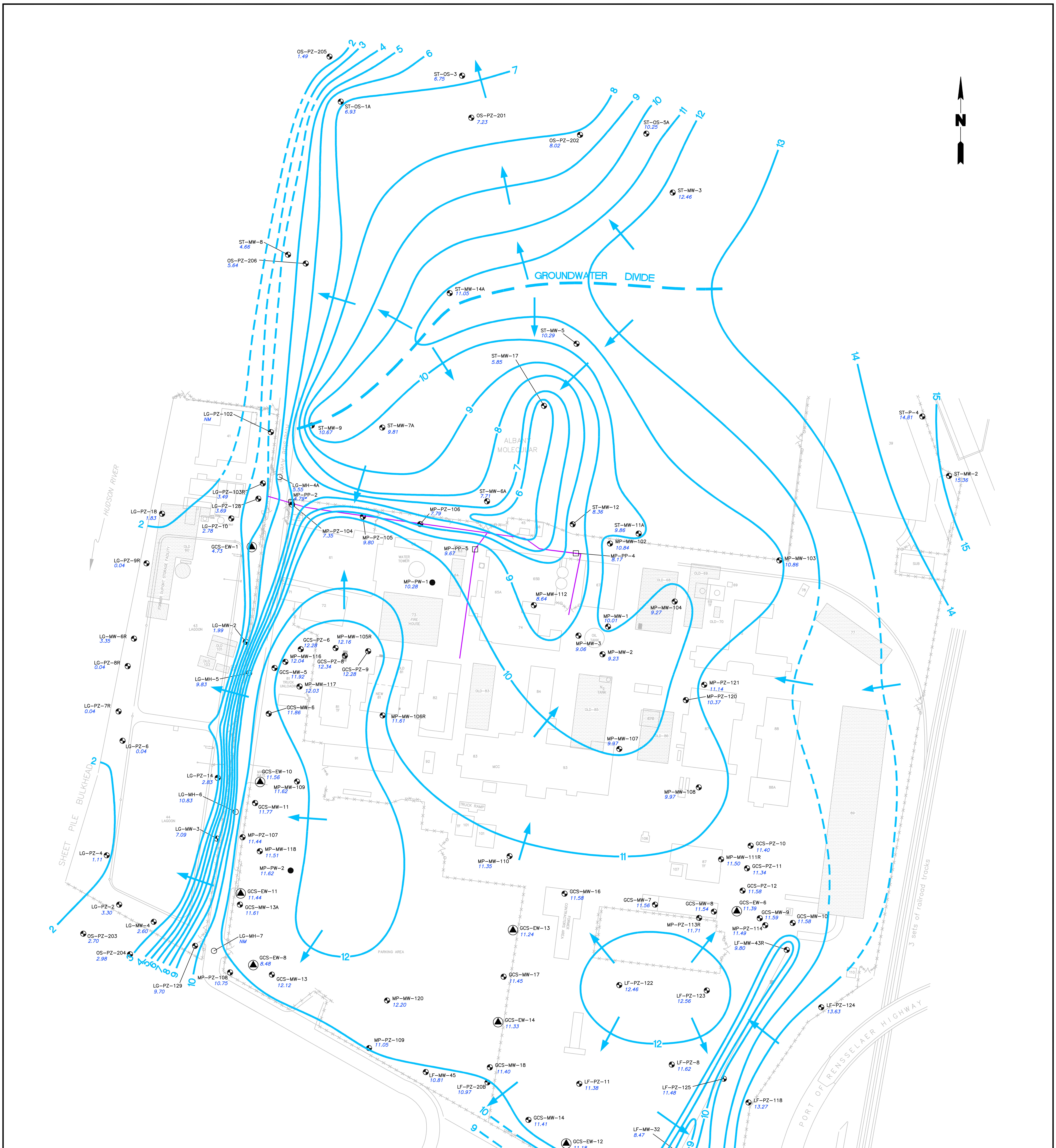


LEGEND

LOCATION PREFIXES
LG – LAGOON
MP – MAIN PLANT
LF – LANDFILL
ST – ALBANY MOLECULAR PROPERTY (FORMERLY ORGANICHEM)
OS – OFFSITE

EXISTING BUILDING

FORMER BUILDING

STORM SEWER GRATE

MP-MW-15 MONITORING WELL LOCATION AND DESIGNATION

MP-PZ-107 PIEZOMETER LOCATION AND DESIGNATION

GCS-EW-14 GCS EXTRACTION WELL SUMP LOCATION AND DESIGNATION

MP-PW-1 PUMPING WELL LOCATION AND DESIGNATION

MP-PP-4 PERFORATED PIPE RISER LOCATION AND DESIGNATION

LG-MH-6 MANHOLE LOCATION AND DESIGNATION

11.39 WATER-LEVEL ELEVATION IN FEET RELATIVE TO MEAN SEA LEVEL

NM WATER-LEVEL NOT MEASURED

* WATER LEVEL NOT USED IN MAP CONSTRUCTION

14 CONTOUR OF EQUAL WATER LEVEL ELEVATION IN FEET RELATIVE TO MEAN SEA LEVEL (DASHED WHERE INFERRED)

INFERRED DIRECTION OF FLOW

INFERRED LOCATION OF GROUNDWATER DIVIDE

APPROXIMATE LOCATION OF PERFORATED PIPE

BARBED WIRE FENCE

CHAINLINK FENCE

NOTES:

(1) BASE MAP ADAPTED FROM PLATE 1, "REMEDIAL INVESTIGATION WORKPLAN" (MALCOLM PIRNIE, INC., 1998)

(2) WATER LEVELS MEASURED ON NOVEMBER 9, 2004.

(3) WATER LEVELS FOR LOCATIONS ON ALBANY MOLECULAR PROPERTY WERE MEASURED BY SCIENCE APPLICATIONS CORPORATION ON NOVEMBER 9, 2004.

100' 0 100'

Title:

GROUNDWATER ELEVATIONS
NOVEMBER 9, 2004

RENSSELAER, NEW YORK FACILITY

Prepared For:

BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX ASSOCIATES, INC. Environmental Consulting & Management

Compiled by: N.E.	Date: 21AUG07	PLATE
Prepared by: G.M.	Scale: AS SHOWN	3
Project Mgr: N.E.	Office: NY	
File No: BF1149211	Project: 25111Y31	

APPENDIX A

PZ-10 Limited Soil Investigation Summary Report

ENVIRONMENTAL CONSULTING & MANAGEMENT
ROUX ASSOCIATES INC

ROUX

209 Shafter Street
Islandia, New York 11749 TEL 631-232-2600 FAX 631-232-9898

June 29, 2010

John R. Strang, P.E.
New York State Department of Environmental Conservation
1130 North Westcott Road
Schenectady, New York 12306-2014

Re: Limited Soil Investigation in the Vicinity of LG-PZ-10
BASF Rensselaer Facility, Rensselaer, New York
NYSDEC Site No. C442035

Dear Mr. Strang:

On behalf of BASF Corporation ("BASF"), Roux Associates, Inc. ("Roux Associates") presents this summary of soil sampling conducted in the vicinity of monitoring well LG-PZ-10 and former monitoring well LG-MW-1 located in the Lagoon Area of the BASF Rensselaer facility in Rensselaer, New York (the "Site"). The limited soil investigation was conducted from December 14 to December 15, 2009 to determine whether a source of arsenic exists in the soil surrounding these wells that can explain the high concentrations of arsenic detected in groundwater in the vicinity.

Methods

Ten soil borings (LG-SB-250 to LG-SB-259) were advanced in the vicinity of LG-PZ-10 and LG-MW-1 (Figure 1) using a Geoprobe® direct push sampler and a four-foot long sampling tube. Soil was collected and characterized according to the Unified Soils Classification System continuously from ground surface to approximately 16 feet below ground surface. The entire soil column was divided into two-foot long intervals (e.g., 0-2, 2-4, 4-6) and soil from each interval was homogenized and collected for laboratory analysis of arsenic using USEPA Method 6010B. Soil borings were backfilled with remaining soil cuttings and clean sand, and then finished at the surface with an asphalt patch.

Results

Soil collected during the limited investigation generally consisted of grey to brown sand and silt with minor amounts of fine gravel and clay. Wet soils were encountered at depths ranging from approximately 12.5 to 14 feet below land surface in most locations. Wet soils were not specifically identified at three locations (LG-SB-253, LG-SB-255, and LG-SB-257), however due to the close proximity of all soil borings, it has been assumed that groundwater is present across the study area at the approximate depth of 12.5 to 14 feet and the presence of water in these three locations was simply masked by the lithology. Soil boring logs are included as Attachment 1.

Analytical results from the limited soil investigation are presented in Attachment 2 and summarized below and in Table 1. Concentrations of arsenic in soil ranged from 4.1 milligrams per kilogram (mg/kg) in LG-SB-257 (6 to 8 foot interval) to 9,100 mg/kg in LG-SB-251 (14 to 16 foot interval). The greatest concentrations of arsenic in 9 of the 10 soil borings was at the 14 to 16 foot interval, the deepest interval collected, which is also assumed to be at or below the water table. The single exception was observed in LG-SB-250 where the highest concentration of arsenic was observed from just above the water table (10 to 12 foot interval).

Discussion

The highest concentration of arsenic detected above the water table was 380 mg/kg from the 2 to 4 foot interval in LG-SB-250. This concentration and the other soil analytical results collected from above the fringe do not suggest any potential source areas to groundwater in the vadose zone.

If you have any questions or require additional information, please do not hesitate to contact me at 631-232-2600.

Sincerely,

ROUX ASSOCIATES, INC.

Nathan Epler

Nathan Epler, Ph.D.
Principal Hydrogeologist

Attachments

cc: Maureen Schuck, New York State Department of Health
Bruce Donovan, New York State Department of Health
Keith Goertz, New York State Department of Environmental Conservation
Chris O'Neill, New York State Department of Environmental Conservation
Doug Reid-Green, BASF Corporation
Wayne St. Claire, BASF Corporation
Hank Martin, Environmental Liability Management
Michael Roux, Roux Associates, Inc.

Table 1. Summary of Arsenic Detected in Soil, BASF Rensselaer, Rensselaer, New York

Sample Location:	LG-SB-250	LG-SB-251	LG-SB-252	LG-SB-253	LG-SB-254	LG-SB-255	LG-SB-256	LG-SB-257	LG-SB-258	LG-SB-259
Sample Date:	12/14/2009	12/14/2009	12/14/2009	12/14/2009	12/14/2009	12/14/2009	12/15/2009	12/15/2009	12/15/2009	12/15/2009
Sample Depth (ft bls)										
0-2	12	10	7.4	19	22	46	13	96	9	8.7
2-4	380	79	39	160	51	120	11	32	140	13
4-6	310	110	31	270	140	110	4.9	69	150	120
6-8	5.6	NC	14	44	13	64	4.7	4.1	35	250
8-10	150	110	9.7	110	18	24	7.2	11	27	79
10-12	5,500	420	1,400	310	890	290	510	170	150	160
12-14	3,700	180	550	200	83	67	860	860	970	28
14-16	1,200	9,100	8,900	580	4,600	1,200	2,100	3,800	2,700	440

Notes:

Arsenic concentrations are presented in milligrams per kilogram (mg/kg)

ft bls - feet below land surface

NC - No sample collected

LG-SB-255	
DEPTH	As (mg/kg)
0-2	46
2-4	120
4-6	110
6-8	64
8-10	24
10-12	290
12-14	67
14-16	1,200

LG-SB-253	
DEPTH	As (mg/kg)
0-2	19
2-4	160
4-6	270
6-8	44
8-10	110
10-12	310
12-14	200
14-16	580

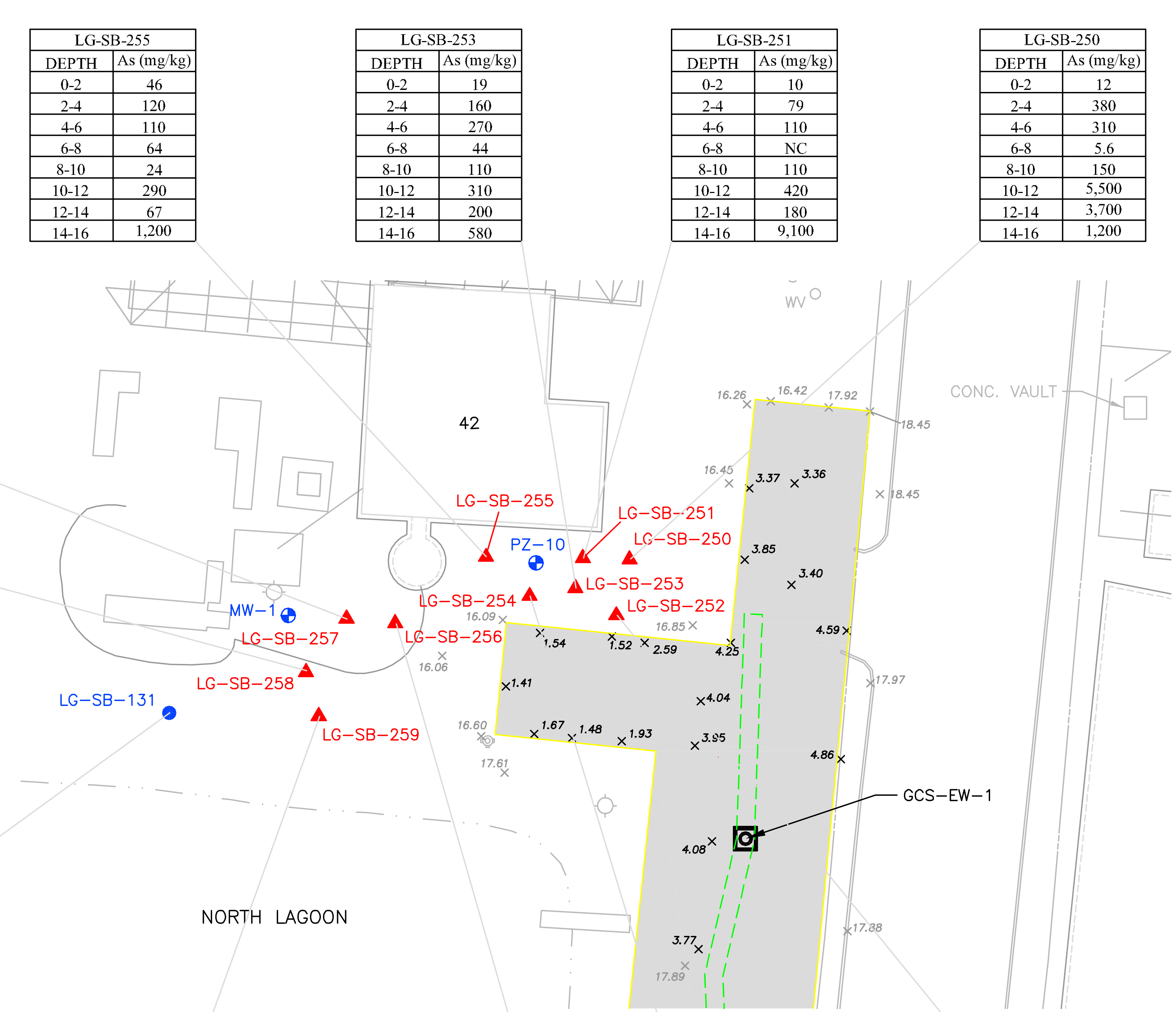
LG-SB-251	
DEPTH	As (mg/kg)
0-2	10
2-4	79
4-6	110
6-8	NC
8-10	110
10-12	420
12-14	180
14-16	9,100

LG-SB-250	
DEPTH	As (mg/kg)
0-2	12
2-4	380
4-6	310
6-8	5.6
8-10	150
10-12	5,500
12-14	3,700
14-16	1,200

LG-SB-257	
DEPTH	As (mg/kg)
0-2	96
2-4	32
4-6	69
6-8	4.1
8-10	11
10-12	170
12-14	860
14-16	3,800

LG-SB-258	
DEPTH	As (mg/kg)
0-2	9
2-4	140
4-6	150
6-8	35
8-10	27
10-12	150
12-14	970
14-16	2,700

LG-SB-131	
DEPTH	As (mg/kg)
0-2	44.4
2-4	45.8
4-6	77.4
6-8	294
8-10	25.3
10-12	10.1



LG-SB-259	
DEPTH	As (mg/kg)
0-2	8.7
2-4	13
4-6	120
6-8	250
8-10	79
10-12	160
12-14	28
14-16	440

LG-SB-256	
DEPTH	As (mg/kg)
0-2	13
2-4	11
4-6	4.9
6-8	4.7
8-10	7.2
10-12	510
12-14	860
14-16	2,100

LG-SB-254	
DEPTH	As (mg/kg)
0-2	22
2-4	51
4-6	140
6-8	13
8-10	18
10-12	890
12-14	83
14-16	4,600

LG-SB-252	
DEPTH	As (mg/kg)
0-2	7.4
2-4	39
4-6	31
6-8	14
8-10	9.7
10-12	1,400
12-14	550
14-16	8,900

LEGEND

- EXCAVATION TO APPROXIMATELY 1' BELOW THE WATER TABLE (SEE NOTE 1)
- 3.61 × LOCATION OF SURVEY CONTROL POINT AND ELEVATION OF EXCAVATION BOTTOM IN FEET RELATIVE TO MEAN SEA LEVEL
- 18.01 × LOCATION OF SURVEY CONTROL POINT AND ELEVATION OF SURROUNDING GRADE IN FEET RELATIVE TO MEAN SEA LEVEL
- ▲ GEOPROBE SAMPLING LOCATION (12/09)
- ● SOIL BORING COMPLETED DURING ADDITIONAL REMEDIAL INVESTIGATION ACTIVITIES (2/01)

NOTE

WATER TABLE ELEVATION WAS APPROXIMATELY 13 TO 14 FEET BELOW LAND SURFACE IN THE VICINITY OF AREA 4A DURING THE PERFORMANCE OF THE SOIL IRM.

30' 0 30'

Title:

GEOPROBE SAMPLING LOCATIONS

LAGOON AREA
RENSSELAER, NEW YORK FACILITY

Prepared For:

BASF CORPORATION
FLORHAM PARK, NEW JERSEY

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: N.E.	Date: 19MAR10	FIGURE
Prepared by: J.A.D.	Scale: AS SHOWN	1
Project Mgr: N.E.	Project: 25111Y36	
File: BF1154501		

N:\PROJECTS\BF251Y\BF11Y\545\BF1154501.DWG

Soil Boring Logs

ROUX
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Environmental Consulting & Management

209 Shafter Street
Islandia, New York 11749
Telephone: (631) 232-2600
Fax: (631) 232-9898

SOIL BORING LOG

WELL NO.	NORTHING	EASTING		
LG-SB-250	**Not Measured**	**Not Measured**		
PROJECT NO./NAME: **0251.0011Y035 / Lagoon Area**		LOCATION: **BASF Corporation, Rensselaer, New York**		
APPROVED BY: **M. Roux**	LOGGED BY: **J. Bundens**			
DRILLING CONTRACTOR/DRILLER: **ADT / Marty**		GEOGRAPHIC AREA: **East of closed landfill area**		
DRILL BIT DIAMETER/TYPE: **2-in. / Drive Sampler**	BOREHOLE DIAMETER: **2-inches**	DRILLING EQUIPMENT/METHOD: **5400 / Geoprobe**	SAMPLING METHOD: **2" Macro-Core**	START-FINISH DATE: **12/14/09-12/14/09**
LAND SURFACE ELEVATION: **Not Measured**	DEPTH TO WATER: **Not Measured**	BACKFILL: **Sand**		

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
		Asphalt			
		Grey, SILT, some fine Gravel, dry.			
		Grey to brown, SILT, some fine Gravel, moist.			
		Brown, SILT, some Clay, little fine gravel, moist.			
5		Brown, SILT and fine SAND, little fine gravel, moist.			
		Brown, fine SAND, little fine Gravel, moist.			
10		Light brown, SAND, some Silt, moist.			
		Dark grey to black, SILT, moist.			
		Brown to grey, SILT, some fine Sand, little fine gravel, moist.			
		Grey, SILT, some fine Sand, little fine gravel, wet.			
15		Light grey, SILT, some fine Sand, little fine gravel, moist.			
		Light grey, CLAY, moist.			Bottom of boring at 16' bls.

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Fax: (631) 232-9898

SOIL BORING LOG

WELL NO. **LG-SB-251**	NORTHING **Not Measured**	EASTING **Not Measured**
PROJECT NO./NAME **0251.0011Y035 / Lagoon Area**		LOCATION **BASF Corporation** **Rensselaer, New York**
APPROVED BY **M. Roux**	LOGGED BY **J. Bundens**	
DRILLING CONTRACTOR/DRILLER **ADT / Marty**		GEOGRAPHIC AREA **East of closed landfill area**

DRILL BIT DIAMETER/TYPE	BOREHOLE DIAMETER	DRILLING EQUIPMENT/METHOD	SAMPLING METHOD	START-FINISH DATE
2-in. / Drive Sampler	**2-inches**	**5400 / Geoprobe**	**2" Macro-Core**	**12/14/09-12/14/09**

LAND SURFACE ELEVATION	DEPTH TO WATER	BACKFILL
Not Measured	**Not Measured**	**Sand**

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
0		Grey, SILT, some fine Gravel, moist.			
		Brown, SILT, some fine Sand, little fine gravel, moist.			
		Grey, SILT, some fine Sand, little fine gravel, moist.			
5					
		Brown, SILT, some Clay, moist.			
		Brown, SILT, some fine Sand, little fine gravel, moist.			
10		Light brown, fine SAND, some Silt, little gravel, moist.			
		Brown, SILT, some fine Sand, little gravel, moist.			
		Dark grey to black, SILT, some coarse Sand, little fine gravel, wet.			
15		Light grey, SILT, some coarse Sand, little fine gravel, wet.			Bottom of boring at 16' bls.

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SOIL BORING LOG

WELL NO. **LG-SB-252**	NORTHING **Not Measured**	EASTING **Not Measured**
PROJECT NO./NAME **0251.0011Y035 / Lagoon Area**		LOCATION **BASF Corporation Rensselaer, New York**
APPROVED BY **M. Roux**	LOGGED BY **J. Bundens**	
DRILLING CONTRACTOR/DRILLER **ADT / Marty**		GEOGRAPHIC AREA **East of closed landfill area**

DRILL BIT DIAMETER/TYPE **2-in. / Drive Sampler**	BOREHOLE DIAMETER **2-inches**	DRILLING EQUIPMENT/METHOD **5400 / Geoprobe**	SAMPLING METHOD **2" Macro-Core**	START-FINISH DATE **12/14/09-12/14/09**
LAND SURFACE ELEVATION **Not Measured**	DEPTH TO WATER **Not Measured**	BACKFILL **Sand**		

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
		Grey, SILT, some fine Gravel, dry.			
		Brown, SILT, some fine Sand, moist.			
		Brown, SILT, little fine gravel, moist.			
5		Light brown, SILT, some fine Sand, trace clay, moist.			
		Brown, SILT, some fine Sand, moist.			
		Brown, SILT, some fine Gravel, moist.			
		Brown to orange, medium to coarse SAND, some fine Sand, little gravel, moist.			
10					
		Brown, SILT, some fine Sand, moist.			
		Dark Grey to black, SILT, some fine Gravel, wet.			
15		Light grey, SILT, some fine Sand, little fine gravel, moist/wet.			Bottom of boring at 16' bls.

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SOIL BORING LOG

WELL NO.	NORTHING	EASTING
LG-SB-253	**Not Measured**	**Not Measured**

PROJECT NO./NAME		LOCATION
0251.0011Y035 / Lagoon Area		**BASF Corporation**
APPROVED BY: **M. Roux**	LOGGED BY: **J. Bundens**	**Rensselaer, New York**
DRILLING CONTRACTOR/DRILLER: **ADT / Marty**		GEOGRAPHIC AREA: **East of closed landfill area**

DRILL BIT DIAMETER/TYPE	BOREHOLE DIAMETER	DRILLING EQUIPMENT/METHOD	SAMPLING METHOD	START-FINISH DATE
2-in. / Drive Sampler	**2-inches**	**5400 / Geoprobe**	**2" Macro-Core**	**12/14/09-12/14/09**

LAND SURFACE ELEVATION	DEPTH TO WATER	BACKFILL
Not Measured	**Not Measured**	**Sand**

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
0–4		Grey to brown, SILT, some fine Gravel, moist.			
4–8		Brown, SILT, some fine Sand, little fine gravel, moist.			
8–9.5		Brown, SILT, some fine Sand, moist.			
9.5–12		Brown to orange, medium to fine SAND, some Silt, little fine gravel, moist.			
12–13		Brown to orange, medium to fine SAND, some Silt, moist.			
13–14		Brown, SILT, some fine Sand, moist.			
14–16		Dark brown, SILT, some coarse Sand, moist.			Bottom of boring at 16' bls.

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SOIL BORING LOG

WELL NO. **LG-SB-254**	NORTHING **Not Measured**	EASTING **Not Measured**
PROJECT NO./NAME **0251.0011Y035 / Lagoon Area**		LOCATION **BASF Corporation Rensselaer, New York**
APPROVED BY **M. Roux**	LOGGED BY **J. Bundens**	
DRILLING CONTRACTOR/DRILLER **ADT / Marty**		GEOGRAPHIC AREA **East of closed landfill area**
DRILL BIT DIAMETER/TYPE **2-in. / Drive Sampler**	BOREHOLE DIAMETER **2-inches**	DRILLING EQUIPMENT/METHOD **5400 / Geoprobe**
SAMPLING METHOD **2" Macro-Core**	START-FINISH DATE **12/14/09-12/14/09**	
LAND SURFACE ELEVATION **Not Measured**	DEPTH TO WATER **Not Measured**	BACKFILL **Sand**

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
		Grey, SILT, some fine Gravel, dry.			
5		Brown, SILT, some fine Sand, little fine gravel, moist.			
		Brown to grey, SILT, some fine Gravel, moist.			
10		Brown to orange, medium to fine SAND, some Silt, little fine gravel, moist.			
		Brown to orange, medium to fine SAND, some Silt, little fine gravel, moist.			
		Grey, medium to coarse SAND, some Silt, little fine gravel, wet.			
15		Grey, SILT, some Sand, moist/wet.			Bottom of boring at 16' bls.

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SOIL BORING LOG

WELL NO. LG-SB-255	NORTHING Not Measured	EASTING Not Measured		
PROJECT NO./NAME 0251.0011Y035 / Lagoon Area		LOCATION BASF Corporation Rensselaer, New York		
APPROVED BY M. Roux	LOGGED BY J. Bundens			
DRILLING CONTRACTOR/DRILLER ADT / Marty		GEOGRAPHIC AREA East of closed landfill area		
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler	BOREHOLE DIAMETER 2-inches	DRILLING EQUIPMENT/METHOD 5400 / Geoprobe	SAMPLING METHOD 2" Macro-Core	START-FINISH DATE 12/14/09-12/14/09
LAND SURFACE ELEVATION Not Measured	DEPTH TO WATER Not Measured	BACKFILL Sand		

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
0		Grey, SILT, some fine Gravel, moist.			
4		Brown, SILT, some fine Sand, little fine gravel, moist.			
5					
6		Brown, fine SAND, moist.			
8		Brown, SILT, some fine Gravel, moist.			
9.5		Brown to orange, coarse to medium SAND, moist			
10					
12		Brown to grey, SILT, trace gravel, moist.			
15		Dark brown, fine SAND, some fine Gravel, moist.			Staining and odors evident.
16					Bottom of boring at 16' bls.

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SOIL BORING LOG

WELL NO. LG-SB-256	NORTHING Not Measured	EASTING Not Measured
PROJECT NO./NAME 0251.0011Y035 / Lagoon Area		LOCATION BASF Corporation, Rensselaer, New York
APPROVED BY M. Roux	LOGGED BY J. Bundens	
DRILLING CONTRACTOR/DRILLER ADT / Marty		GEOGRAPHIC AREA East of closed landfill area
DRILL BIT DIAMETER/TYPE 2-in. / Drive Sampler	BOREHOLE DIAMETER 2-inches	DRILLING EQUIPMENT/METHOD 5400 / Geoprobe
SAMPLING METHOD 2" Macro-Core	START-FINISH DATE 12/15/09-12/15/09	
LAND SURFACE ELEVATION Not Measured	DEPTH TO WATER Not Measured	BACKFILL Sand

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
		Grey, SILT, some fine Sand, little fine gravel, moist.			
		Dark grey, SILT, little fine gravel, moist.			
		Brown, fine SAND, some Silt, trace fine gravel, moist.			
5					
		Light grey, CLAY, some fine Sand, trace fine gravel, moist.			
		Grey, SILT, some Clay, moist			
		Brown, SILT, some fine Sand, trace clay, moist.			
10		Brown to orange, medium to coarse SAND, some Silt, moist			
		Brown, SILT, some fine Sand, moist.			
		Dark brown, SILT, little fine sand, moist.			
		Grey, SILT, some fine Sand, little clay, wet.			
15					Staining and odors evident.
		Dark grey to black, SILT, some Clay, moist/wet.			Bottom of boring at 16' bls.

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Islandia, New York 11749
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SOIL BORING LOG

WELL NO. **LG-SB-257**	NORTHING **Not Measured**	EASTING **Not Measured**		
PROJECT NO./NAME **0251.0011Y035 / Lagoon Area**		LOCATION **BASF Corporation Rensselaer, New York**		
APPROVED BY **M. Roux**	LOGGED BY **J. Bundens**			
DRILLING CONTRACTOR/DRILLER **ADT / Marty**		GEOGRAPHIC AREA **East of closed landfill area**		
DRILL BIT DIAMETER/TYPE **2-in. / Drive Sampler**	BOREHOLE DIAMETER **2-inches**	DRILLING EQUIPMENT/METHOD **5400 / Geoprobe**	SAMPLING METHOD **2" Macro-Core**	START-FINISH DATE **12/15/09-12/15/09**
LAND SURFACE ELEVATION **Not Measured**	DEPTH TO WATER **Not Measured**	BACKFILL **Sand**		

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
		Brown, SILT, some fine Gravel, dry.			
		Brown, SILT, moist.			
		Brown to orange, fine to medium SAND, trace clay, moist.			
		Dark grey, SILT, some Clay, moist.			
5		Brown to orange, fine to medium SAND, trace fine gravel, moist.			
		Grey, CLAY, some Silt, moist.			
		Brown, fine to medium SAND and SILT, moist.			
		Brown, SILT, some Clay, moist.			
10		Brown to orange, fine to medium SAND, little fine gravel, moist.			
		Brown, SILT, some Clay, moist.			
		Brown, coarse to medium SAND, little fine gravel, moist.			
		Brown to grey, CLAY, moist.			
15		Dark brown, fine SAND, trace silt, moist.			Bottom of boring at 16' bls.

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Islandia, New York 11749
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Fax: (631) 232-9898

SOIL BORING LOG

WELL NO. **LG-SB-258**	NORTHING **Not Measured**	EASTING **Not Measured**
PROJECT NO./NAME **0251.0011Y035 / Lagoon Area**		LOCATION **BASF Corporation Rensselaer, New York**
APPROVED BY **M. Roux**	LOGGED BY **J. Bundens**	
DRILLING CONTRACTOR/DRILLER **ADT / Marty**		GEOGRAPHIC AREA **East of closed landfill area**

DRILL BIT DIAMETER/TYPE	BOREHOLE DIAMETER	DRILLING EQUIPMENT/METHOD	SAMPLING METHOD	START-FINISH DATE
2-in. / Drive Sampler	**2-inches**	**5400 / Geoprobe**	**2" Macro-Core**	**12/15/09-12/15/09**

LAND SURFACE ELEVATION	DEPTH TO WATER	BACKFILL
Not Measured	**Not Measured**	**Sand**

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
		Brown, SILT, some fine Gravel, dry.			
		Brown, SILT, some fine Sand, moist.			
5		Brown, SILT, some fine Sand, moist.			
		Brown to orange, fine to medium SAND, trace silt, moist.			
		Brown, SILT, some fine Sand, trace clay, moist.			
10		Brown to orange, fine to medium SAND, moist.			
		Brown, SILT, some fine Sand, moist.			
		Dark brown, coarse to medium SAND, some fine Gravel, wet.			
15		Grey, CLAY, moist.			
		Dark brown, fine to medium SAND, trace silt, moist.			Bottom of boring at 16' bls.

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SOIL BORING LOG

WELL NO.	NORTHING	EASTING
LG-SB-259	**Not Measured**	**Not Measured**

PROJECT NO./NAME		LOCATION
0251.0011Y035 / Lagoon Area		**BASF Corporation**
APPROVED BY: **M. Roux**	LOGGED BY: **J. Bundens**	**Rensselaer, New York**
DRILLING CONTRACTOR/DRILLER: **ADT / Marty**		GEOGRAPHIC AREA: **East of closed landfill area**

DRILL BIT DIAMETER/TYPE	BOREHOLE DIAMETER	DRILLING EQUIPMENT/METHOD	SAMPLING METHOD	START-FINISH DATE
2-in. / Drive Sampler	**2-inches**	**5400 / Geoprobe**	**2" Macro-Core**	**12/15/09-12/15/09**

LAND SURFACE ELEVATION	DEPTH TO WATER	BACKFILL
Not Measured	**Not Measured**	**Sand**

Depth, feet	Graphic Log	Visual Description	Blow Counts per 6"	PID Values (ppm)	REMARKS
		Brown, SILT, some fine Gravel, dry.			
		Brown, SILT, some fine Sand, moist.			
		Brown, SILT, trace fine gravel, moist.			
5					5
		White, coarse GRAVEL, moist.			
		Brown, fine to medium SAND, little silt, moist.			
10					10
		Brown, fine SAND, some Silt, moist.			
		Light brown, medium to coarse SAND, some fine Gravel, wet.			
15					15
					Bottom of boring at 16' bls.

Analytical Data

175 ROUTE 46 WEST, UNIT D · FAIRFIELD, NJ 07004
198 ROUTE 46 EAST, FAIRFIELD, NJ 07004
800-426-9992 · 973-244-9770
FAX: 973-244-9787

WWW.HCVLAB.COM

Project: BASF Rennsselear NY

Client PO: Not Available

Report To: Roux Associates
209 Shafter Street
Islandia, NY 11749-5074

Attn: Mike Roux

Received Date: 12/15/2009

Report Date: 1/7/2010

Deliverables: NYDOH-CatB

Lab ID: AC48913

Lab Project No: 9121519

Jeri Rossi

Jeri Rossi - Quality Assurance Director OR Stanley Gilewicz - Laboratory Director

NJ	(07071 and 07069)	NY	(ELAP11408 and 11939)	CT	(PH-0671)	USACE
PA	(68-00463 and 68-04409)	KY	(90124)	WV	(353)	

NELAP ACCREDITED LABORATORY

HC·V
HAMPTONCLARKE·VERITECH

TABLE OF CONTENTS

SDG Narrative

HAMPTONCLARKE·VERITECH

SDG Narrative

Client: Roux Associates
Project: BASF Rennsselear NY

Hampton-Clarke/Veritech (HC·V) received the following samples on December 15, 2009:

Client ID	HCV Sample ID	Matrix	Analysis
LG-SB-250 0'-2'	AC48913-001	Soil	Arsenic (6010B)
LG-SB-250 2'-4'	AC48913-002	Soil	Arsenic (6010B)
LG-SB-250 4'-6'	AC48913-003	Soil	Arsenic (6010B)
LG-SB-250 6'-8'	AC48913-004	Soil	Arsenic (6010B)
LG-SB-250 8'-10'	AC48913-005	Soil	Arsenic (6010B)
LG-SB-250 10'-12'	AC48913-006	Soil	Arsenic (6010B)
LG-SB-250 12'-14'	AC48913-007	Soil	Arsenic (6010B)
LG-SB-250 14'-16'	AC48913-008	Soil	Arsenic (6010B)
LG-SB-251 0'-2'	AC48913-009	Soil	Arsenic (6010B)
LG-SB-251 2'-4'	AC48913-010	Soil	Arsenic (6010B)
LG-SB-251 4'-6'	AC48913-011	Soil	Arsenic (6010B)
LG-SB-251 8'-10'	AC48913-012	Soil	Arsenic (6010B)
LG-SB-251 10'-12'	AC48913-013	Soil	Arsenic (6010B)
LG-SB-251 12'-14'	AC48913-014	Soil	Arsenic (6010B)
LG-SB-251 14'-16'	AC48913-015	Soil	Arsenic (6010B)
LG-SB-252 0'-2'	AC48913-016	Soil	Arsenic (6010B)
LG-SB-252 2'-4'	AC48913-017	Soil	Arsenic (6010B)
LG-SB-252 4'-6'	AC48913-018	Soil	Arsenic (6010B)
LG-SB-252 6'-8'	AC48913-019	Soil	Arsenic (6010B)
LG-SB-252 8'-10'	AC48913-020	Soil	Arsenic (6010B)
LG-SB-252 10'-12'	AC48913-021	Soil	Arsenic (6010B)
LG-SB-252 12'14'	AC48913-022	Soil	Arsenic (6010B)
LG-SB-252 14'-16'	AC48913-023	Soil	Arsenic (6010B)
LG-SB-253 0'-2'	AC48913-024	Soil	Arsenic (6010B)
LG-SB-253 2'-4'	AC48913-025	Soil	Arsenic (6010B)
LG-SB-253 4'-6'	AC48913-026	Soil	Arsenic (6010B)
LG-SB-253 6'-8'	AC48913-027	Soil	Arsenic (6010B)
LG-SB-253 8'-10'	AC48913-028	Soil	Arsenic (6010B)
LG-SB-253 10'-12'	AC48913-029	Soil	Arsenic (6010B)
LG-SB-253 12'-14'	AC48913-030	Soil	Arsenic (6010B)
LG-SB-253 14'-16'	AC48913-031	Soil	Arsenic (6010B)
LG-SB-254 0'-2'	AC48913-032	Soil	Arsenic (6010B)
LG-SB-254 2'-4'	AC48913-033	Soil	Arsenic (6010B)
LG-SB-254 4'-6'	AC48913-034	Soil	Arsenic (6010B)
LG-SB-254 6'-8'	AC48913-035	Soil	Arsenic (6010B)
LG-SB-254 8'-10'	AC48913-036	Soil	Arsenic (6010B)
LG-SB-254 10'-12'	AC48913-037	Soil	Arsenic (6010B)
LG-SB-254 12'-14'	AC48913-038	Soil	Arsenic (6010B)
LG-SB-254 14'-16'	AC48913-039	Soil	Arsenic (6010B)
LG-SB-255 0'-2'	AC48913-040	Soil	Arsenic (6010B)
LG-SB-255 2'-4'	AC48913-041	Soil	Arsenic (6010B)
LG-SB-255 4'-6'	AC48913-042	Soil	Arsenic (6010B)
LG-SB-255 6'-8'	AC48913-043	Soil	Arsenic (6010B)

LG-SB-255 8'-10'	AC48913-044	Soil	Arsenic (6010B)
LG-SB-255 10'-12'	AC48913-045	Soil	Arsenic (6010B)
LG-SB-255 12'-14'	AC48913-046	Soil	Arsenic (6010B)
LG-SB-255 14'-16'	AC48913-047	Soil	Arsenic (6010B)
LG-SB-256 0'-2'	AC48913-048	Soil	Arsenic (6010B)
LG-SB-256 2'-4'	AC48913-049	Soil	Arsenic (6010B)
LG-SB-256 4'-6'	AC48913-050	Soil	Arsenic (6010B)
LG-SB-256 6'-8'	AC48913-051	Soil	Arsenic (6010B)
LG-SB-256 8'-10'	AC48913-052	Soil	Arsenic (6010B)
LG-SB-256 10'-12'	AC48913-053	Soil	Arsenic (6010B)
LG-SB-256 12'-14'	AC48913-054	Soil	Arsenic (6010B)
LG-SB-256 14'-16'	AC48913-055	Soil	Arsenic (6010B)
LG-SB-257 0'-2'	AC48913-056	Soil	Arsenic (6010B)
LG-SB-257 2'-4'	AC48913-057	Soil	Arsenic (6010B)
LG-SB-257 4'-6'	AC48913-058	Soil	Arsenic (6010B)
LG-SB-257 6'-8'	AC48913-059	Soil	Arsenic (6010B)
LG-SB-257 8'-10'	AC48913-060	Soil	Arsenic (6010B)
LG-SB-257 10'-12'	AC48913-061	Soil	Arsenic (6010B)
LG-SB-257 12'-14'	AC48913-062	Soil	Arsenic (6010B)
LG-SB-257 14'-16'	AC48913-063	Soil	Arsenic (6010B)
LG-SB-258 0'-2'	AC48913-064	Soil	Arsenic (6010B)
LG-SB-258 2'-4'	AC48913-065	Soil	Arsenic (6010B)
LG-SB-258 4'-6'	AC48913-066	Soil	Arsenic (6010B)
LG-SB-258 6'-8'	AC48913-067	Soil	Arsenic (6010B)
LG-SB-258 8'-10'	AC48913-068	Soil	Arsenic (6010B)
LG-SB-258 10'-12'	AC48913-069	Soil	Arsenic (6010B)
LG-SB-258 12'-14'	AC48913-070	Soil	Arsenic (6010B)
LG-SB-258 14'-16'	AC48913-071	Soil	Arsenic (6010B)
LG-SB-259 0'-2'	AC48913-072	Soil	Arsenic (6010B)
LG-SB-259 2'-4'	AC48913-073	Soil	Arsenic (6010B)
LG-SB-259 4'-6'	AC48913-074	Soil	Arsenic (6010B)
LG-SB-259 6'-8'	AC48913-075	Soil	Arsenic (6010B)
LG-SB-259 8'-10'	AC48913-076	Soil	Arsenic (6010B)
LG-SB-259 10'-12'	AC48913-077	Soil	Arsenic (6010B)
LG-SB-259 12'-14'	AC48913-078	Soil	Arsenic (6010B)
LG-SB-259 14'-16'	AC48913-079	Soil	Arsenic (6010B)

Metals Analysis:

The RPD between the QC sample and the Method Replicate for Arsenic is outside QC limits in batches 10861 and 10863. The RPD criteria were met between the LCS/LCS Method Replicate.

The recovery of Arsenic is biased high, outside QC limits in the Matrix Spike Duplicate in batch 10863. All QC criteria were met in the LCS and LCS MR.

The recovery of Arsenic is biased high, outside QC limits in the Matrix Spike in batch 10864. All QC criteria were met in the LCS and LCS MR.

The recovery of Arsenic is outside QC limits in the Matrix Spike in batch 10862. All QC criteria were met in the LCS and LCS MR.

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Jeri Rossi	Or		1/8/10
Jeri Rossi Quality Assurance Director		Stanley Gilewicz Laboratory Director	Date

Reporting Limit Definitions

HAMPTONCLARKE·VERITECH

REPORTING LIMIT DEFINITIONS

RL = Reporting Limit

MDL = Method Detection Limit

For Clean Water Act and SW846 Organic methods, the Reporting Limit is determined by the concentration of the lowest standard in the calibration curve.

For Clean Water Act Metals method, the Reporting Limit is determined by the concentration of the lowest standard in the calibration curve.

For Clean Water Act and SW846 Wet Chemistry methods, the Reporting Limit is determined by the concentration of the lowest standard in the calibration curve. For most gravimetric methods the Reporting Limit is defined as a value 3 to 5 times the MDL.

Data Package Summary Forms

Veritech Report Of Analysis

Lab#: AC48913-001 Collection Date: 12/14/2009
Sample ID: LG-SB-250 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		96
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	12

Lab#: AC48913-002 Collection Date: 12/14/2009
Sample ID: LG-SB-250 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	380

Lab#: AC48913-003 Collection Date: 12/14/2009
Sample ID: LG-SB-250 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		91
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	310

Lab#: AC48913-004 Collection Date: 12/14/2009
Sample ID: LG-SB-250 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	5.6

Lab#: AC48913-005 Collection Date: 12/14/2009
Sample ID: LG-SB-250 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		95
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	150

Lab#: AC48913-006 Collection Date: 12/14/2009
Sample ID: LG-SB-250 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	400	mg/kg	8.9	5500

Lab#: AC48913-007 Collection Date: 12/14/2009
Sample ID: LG-SB-250 12'-14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		88
Metals (single) 6010				
Arsenic	100	mg/kg	2.3	3700

Lab#: AC48913-008 Collection Date: 12/14/2009
Sample ID: LG-SB-250 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		87
Metals (single) 6010				
Arsenic	100	mg/kg	2.3	1200

Lab#: AC48913-009 Collection Date: 12/14/2009
Sample ID: LG-SB-251 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		96
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	10

Lab#: AC48913-010 Collection Date: 12/14/2009
Sample ID: LG-SB-251 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		89
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	79

Lab#: AC48913-011 Collection Date: 12/14/2009
Sample ID: LG-SB-251 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	110

Lab#: AC48913-012 Collection Date: 12/14/2009
Sample ID: LG-SB-251 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	110

Lab#: AC48913-013 Collection Date: 12/14/2009
Sample ID: LG-SB-251 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	420

Lab#: AC48913-014 Collection Date: 12/14/2009
Sample ID: LG-SB-251 12'-14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	180

Lab#: AC48913-015 Collection Date: 12/14/2009
Sample ID: LG-SB-251 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		88
Metals (single) 6010				
Arsenic	400	mg/kg	9.1	9100

Lab#: AC48913-016 Collection Date: 12/14/2009
Sample ID: LG-SB-252 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		97
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	7.4

Lab#: AC48913-017 Collection Date: 12/14/2009
Sample ID: LG-SB-252 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	39

Lab#: AC48913-018 Collection Date: 12/14/2009
Sample ID: LG-SB-252 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	31

Lab#: AC48913-019 Collection Date: 12/14/2009
Sample ID: LG-SB-252 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	14

Lab#: AC48913-020 Collection Date: 12/14/2009
Sample ID: LG-SB-252 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		95
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	9.7

Lab#: AC48913-021 Collection Date: 12/14/2009
Sample ID: LG-SB-252 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	1400

Lab#: AC48913-022 Collection Date: 12/14/2009
Sample ID: LG-SB-252 12'14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	550

Lab#: AC48913-023 Collection Date: 12/14/2009
Sample ID: LG-SB-252 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		84
Metals (single) 6010				
Arsenic	400	mg/kg	9.5	8900

Lab#: AC48913-024 Collection Date: 12/14/2009
Sample ID: LG-SB-253 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	19

Lab#: AC48913-025 Collection Date: 12/14/2009
Sample ID: LG-SB-253 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	160

Lab#: AC48913-026 Collection Date: 12/14/2009
Sample ID: LG-SB-253 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	270

Lab#: AC48913-027 Collection Date: 12/14/2009
Sample ID: LG-SB-253 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	44

Lab#: AC48913-028 Collection Date: 12/14/2009
Sample ID: LG-SB-253 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	110

Lab#: AC48913-029	Collection Date: 12/14/2009			
Sample ID: LG-SB-253 10'-12'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		95
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	310

Lab#: AC48913-030	Collection Date: 12/14/2009			
Sample ID: LG-SB-253 12'-14'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	200

Lab#: AC48913-031	Collection Date: 12/14/2009			
Sample ID: LG-SB-253 14'-16'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		88
Metals (single) 6010				
Arsenic	100	mg/kg	2.3	580

Lab#: AC48913-032	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 0'-2'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		97
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	22

Lab#: AC48913-033	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 2'-4'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		96
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	51

Lab#: AC48913-034	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 4'-6'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	140

Lab#: AC48913-035	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 6'-8'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		87
Metals (single) 6010				
Arsenic	100	mg/kg	2.3	13

Lab#: AC48913-036	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 8'-10'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	18

Lab#: AC48913-037	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 10'-12'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	890

Lab#: AC48913-038	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 12'-14'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	83

Lab#: AC48913-039	Collection Date: 12/14/2009			
Sample ID: LG-SB-254 14'-16'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		82
Metals (single) 6010				
Arsenic	100	mg/kg	2.4	4600

Lab#: AC48913-040	Collection Date: 12/14/2009			
Sample ID: LG-SB-255 0'-2'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		96
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	46

Lab#: AC48913-041	Collection Date: 12/14/2009			
Sample ID: LG-SB-255 2'-4'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	120

Lab#: AC48913-042	Collection Date: 12/14/2009			
Sample ID: LG-SB-255 4'-6'				
TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	110

Lab#: AC48913-043 Collection Date: 12/14/2009
Sample ID: LG-SB-255 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		91
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	64

Lab#: AC48913-044 Collection Date: 12/14/2009
Sample ID: LG-SB-255 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	24

Lab#: AC48913-045 Collection Date: 12/14/2009
Sample ID: LG-SB-255 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		91
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	290

Lab#: AC48913-046 Collection Date: 12/14/2009
Sample ID: LG-SB-255 12'-14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		91
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	67

Lab#: AC48913-047 Collection Date: 12/14/2009
Sample ID: LG-SB-255 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		84
Metals (single) 6010				
Arsenic	100	mg/kg	2.4	1200

Lab#: AC48913-048 Collection Date: 12/15/2009
Sample ID: LG-SB-256 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	13

Lab#: AC48913-049 Collection Date: 12/15/2009
Sample ID: LG-SB-256 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	11

Lab#: AC48913-050 Collection Date: 12/15/2009
Sample ID: LG-SB-256 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	4.9

Lab#: AC48913-051 Collection Date: 12/15/2009
Sample ID: LG-SB-256 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		84
Metals (single) 6010				
Arsenic	100	mg/kg	2.4	4.7

Lab#: AC48913-052 Collection Date: 12/15/2009
Sample ID: LG-SB-256 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		86
Metals (single) 6010				
Arsenic	100	mg/kg	2.3	7.2

Lab#: AC48913-053 Collection Date: 12/15/2009
Sample ID: LG-SB-256 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		95
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	510

Lab#: AC48913-054 Collection Date: 12/15/2009
Sample ID: LG-SB-256 12'-14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		87
Metals (single) 6010				
Arsenic	100	mg/kg	2.3	860

Lab#: AC48913-055 Collection Date: 12/15/2009
Sample ID: LG-SB-256 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		78
Metals (single) 6010				
Arsenic	100	mg/kg	2.6	2100

Lab#: AC48913-056 Collection Date: 12/15/2009
Sample ID: LG-SB-257 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	96

Lab#: AC48913-057 Collection Date: 12/15/2009
Sample ID: LG-SB-257 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	32

Lab#: AC48913-058 Collection Date: 12/15/2009
Sample ID: LG-SB-257 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		91
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	69

Lab#: AC48913-059 Collection Date: 12/15/2009
Sample ID: LG-SB-257 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	4.1

Lab#: AC48913-060 Collection Date: 12/15/2009
Sample ID: LG-SB-257 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		86
Metals (single) 6010				
Arsenic	100	mg/kg	2.3	11

Lab#: AC48913-061 Collection Date: 12/15/2009
Sample ID: LG-SB-257 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		95
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	170

Lab#: AC48913-062 Collection Date: 12/15/2009
Sample ID: LG-SB-257 12'-14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		91
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	860

Lab#: AC48913-063 Collection Date: 12/15/2009
Sample ID: LG-SB-257 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		83
Metals (single) 6010				
Arsenic	100	mg/kg	2.4	3800

Lab#: AC48913-064 Collection Date: 12/15/2009
Sample ID: LG-SB-258 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	9.0

Lab#: AC48913-065 Collection Date: 12/15/2009
Sample ID: LG-SB-258 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	140

Lab#: AC48913-066 Collection Date: 12/15/2009
Sample ID: LG-SB-258 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	150

Lab#: AC48913-067 Collection Date: 12/15/2009
Sample ID: LG-SB-258 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	35

Lab#: AC48913-068 Collection Date: 12/15/2009
Sample ID: LG-SB-258 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		92
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	27

Lab#: AC48913-069 Collection Date: 12/15/2009
Sample ID: LG-SB-258 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	150

Lab#: AC48913-070 Collection Date: 12/15/2009
Sample ID: LG-SB-258 12'-14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	970

Lab#: AC48913-071 Collection Date: 12/15/2009
Sample ID: LG-SB-258 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		73
Metals (single) 6010				
Arsenic	100	mg/kg	2.7	2700

Lab#: AC48913-072 Collection Date: 12/15/2009
Sample ID: LG-SB-259 0'-2'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		95
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	8.7

Lab#: AC48913-073 Collection Date: 12/15/2009
Sample ID: LG-SB-259 2'-4'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		91
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	13

Lab#: AC48913-074 Collection Date: 12/15/2009
Sample ID: LG-SB-259 4'-6'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		90
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	120

Lab#: AC48913-075 Collection Date: 12/15/2009
Sample ID: LG-SB-259 6'-8'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		93
Metals (single) 6010				
Arsenic	100	mg/kg	2.2	250

Lab#: AC48913-076 Collection Date: 12/15/2009
Sample ID: LG-SB-259 8'-10'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		94
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	79

Lab#: AC48913-077 Collection Date: 12/15/2009
Sample ID: LG-SB-259 10'-12'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		95
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	160

Lab#: AC48913-078 Collection Date: 12/15/2009
Sample ID: LG-SB-259 12'-14'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		96
Metals (single) 6010				
Arsenic	100	mg/kg	2.1	28

Lab#: AC48913-079 Collection Date: 12/15/2009
Sample ID: LG-SB-259 14'-16'

TestGroup/Analyte	DF	Units	RL	Result
% Solids SM2540G				
% Solids	1	percent		85
Metals (single) 6010				
Arsenic	100	mg/kg	2.4	440