John Signore

From: Mazurkiewicz, Richard [richard.mazurkiewicz@aecom.com]
Sent: Thursday, November 21, 2013 9:54 AM
To: Jim Carter External
Cc: John Signore; Brehm, Kevin
Subject: Draft Remediation Report - Tulip Corp. 3125 Highland Avenue Niagara Falls, NY
Attachments: 13-11-20 DRAFT Tulip Remediation Report.pdf

Jim,

Please find the attached report for the soil remediation completed at the subject property. I will finalize this report upon your review. Please contact me with any questions or comments in the meantime.

Thanks,

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November 20, 2013

Mr. James Carter
Tulip Corporation
14955 Salt Lake Avenue
City Of Industry, California 91746

Subject: Remediation Documentation Report
Tulip Corporation
3125 Highland Avenue
Niagara Falls, New York
AECOM Project 60271770

Dear Mr. Carter,

AECOM Technical Services, Inc. (AECOM) submits this report for the lead-impacted soil remediation activities that were conducted at the subject property (Site). The purpose of the remediation was to chemically stabilize the area of lead impact at the Site as identified in AECOM's October 10, 2011, *Phase II Environmental Site Assessment* (ESA) report. The soil stabilization area is located on the north side of the building, near the location of a historical coal pile storage area.

Background

On August 15-19, 2011, at the request of Tulip Corporation (Tulip Corp.), AECOM performed Phase II ESA activities at the Site for a potential property transfer. The ESA included advancing three soil probes (P-11A, P-11B, and P-11C) near the north side of the building, in the location of a former coal pile storage area. The probe locations around the former coal pile area and Site features are illustrated on **Figure 1**.

Shallow (1 to 3 feet deep) soil samples in the former coal pile area were collected for laboratory analysis of semi-volatile organic compounds (SVOCs) and Resource Conservation and Recovery Act (RCRA) metals. Several SVOCs were detected in the soil samples with concentrations above the New York State Department of Environmental Conservation (NYSDEC) Subpart 375-6, Remedial Program Soil Cleanup Objectives (SCOs; December 14, 2006) for the groundwater pathway, the ecological resources route, and/or the industrial public health pathway (direct contact). The RCRA metals analyzed were detected in one or more of the soil samples. Lead and arsenic concentrations exceeding the SCOs for the groundwater pathway, the ecological resources route, and/or the industrial public health pathway (direct contact) were documented in soil samples collected from borings P-11B and P-11C. Lead was reported at a concentration of 90,100 milligrams per kilogram (mg/kg) in the soil sample collected from P-11B. Lead was also reported at a concentration of 13,400 mg/kg in a soil sample collected from boring P-11C. The results of investigation were documented in AECOM's October 10, 2011, *Phase II Environmental Site Assessment* report.

In November 2011, AECOM completed a supplemental assessment (SA) in the location of the former coal pile area to further characterize the nature and extent of specific impacts identified during the Phase II ESA. The SA was focused on lead, arsenic, and SVOCs at concentrations that were above the NYSDEC SCOs in soil in the former coal pile storage area.

Lead, arsenic, and SVOC concentrations exceeded the applicable SCOs in one or more samples from each of the borings sampled as part of the SA. The highest lead and arsenic impacts are located outside the north side of the building, east of the plastic bead storage silo. The highest SVOC impacts are located north and east of the former coal pile area. Exceedances are typically limited to the shallower samples collected from the fill material and from near the fill-clay interface. The results of the SA were documented in AECOM's April 4, 2012, *Supplemental Assessment* report.

On June 20, 2012, AECOM provided Tulip with a proposal for remediation services at the Site. The proposal included options to treat the lead, arsenic, and SVOC impacts in soil near the historical coal pile storage area on the north side of the building, within a defined area. On June 27, 2012 Tulip Corp. retained AECOM to implement treatment of the lead and arsenic contaminants by in situ chemical stabilization to render the soil non-hazardous by leachability characteristics and to then cover the area with an engineered cap/barrier to provide a physical barrier to mitigate the future potential for direct human contact with the impacted soil.

AECOM implemented the remedial action (in situ soil stabilization and engineered cap/barrier) at the Site in October 2012. The remainder of this report documents the implementation of the soil stabilization activities and presents the results of the post remedial soil analytical results.

Soil Treatment Overview

A phased approach was utilized to remediate the lead impacted soil at the Site. The phases were as follows:

- Bench scale testing;
- Initial soil stabilization treatment with calcium oxide and soil confirmation sampling;
- A second spot/"polishing" soil treatment with a phosphate mixture and soil confirmation sampling;
- Removal and proper disposal of excess soils and area debris resulting from the soil mixing remedial action; and
- Installation of the cap/barrier.

The soil mixing process utilized involved using a blender mounted on an excavator to distribute chemical amendments throughout the target soil area to treat contaminants of concern. The blending process loosens and reduces the bearing capacity of the soils. As such, the treatment area excluded a zone of approximately 8 feet along the storage silo or other structures/utilities to protect the structural stability of the building/structure/utilities. The estimated lateral and vertical extents of soil impacts were based on the results of AECOM's August and November 2011 ESA activities. The treatment area is illustrated on **Figure 1**. The impacted soil within the remediation area was blended to depths of 2, 5, and 8 feet below ground surface (bgs) as illustrated on **Figure 2**.

Bench Scale Testing

On July 18, 2012, AECOM collected pre-remediation samples from the target soil treatment area for bench scale testing to evaluate the efficacy of amendment chemicals and evaluate dosing to stabilize the leachable lead in the soil. The bench scale testing results indicated that the arsenic concentrations in soil in the planned remediation area are non-hazardous by leachability characteristics, thus do not have to be chemically stabilized. Note that the soil mixing remedial option chosen for the Site does not directly address the SVOC impacts in soil; however, some reduction of SVOCs will occur during the soil-mixing process through volatilization. AECOM retained Redox Tech, LLC (Redox-Tech) located in Downers Grove, Illinois to do the bench scale testing and their results concluded that a mix design of 7% calcium oxide by weight stabilized the lead in the soil in the remediation area to below the United States Environmental Protection Agency (US EPA) toxicity characteristic leaching procedure (TCLP) hazardous level of 5 milligrams per liter (mg/L). Mixing lead-affected soil with calcium oxide precipitates lead to a relatively non-leachable form of lead hydroxide. Redox-Tech's bench scale testing results showed a reduction in leachable lead from between 99.7 to 99.9% (based on the highest pre-remediation TCLP result of 930 mg/L).

Soil Mixing with Calcium Oxide

The initial soil mixing for stabilization of the lead-affected soil at the Site with calcium oxide was completed between October 8 and 23, 2012. A total of 153 tons of calcium oxide was blended into approximately 2,300 tons of lead impacted soil. The remediation area (approximately 80 feet by 80 feet) was divided into 41 cells as illustrated on **Figure 3**. AECOM collected a total of 13 post-remediation TCLP lead samples (C-10, C-11, and C-20 on October 15, 2012 and C-12, C-13, C-18, C-21, C-25, C-26, C-33, C-35, C-38, and C-41 on October 23, 2012) after the soil mixing to evaluate the effectiveness of the field scale soil stabilization. The post remediation TCLP results ranged from 22.6 to 0.01 mg/L, which is a significant reduction in leachable lead (99.4%). However, to be below the US EPA TCLP hazardous criteria of 5 mg/L, the reduction in leachable lead needed to be greater than 99.5% in aggregate (based on the highest pre-remediation TCLP result of 930 mg/L). As a result, soil samples collected from 4 of the 13 treatment cells tested (C-10, C-11, C-20, and C-35), had post remediation TCLP lead results above the US EPA hazardous TCLP level of 5 mg/L, which represents only an estimated less than 20% of the treatment area. Soil lead TCLP results are summarized on **Table 1** and the cell locations of the post-remediation TCLP samples are illustrated on **Figure 3**. The soil confirmation laboratory analytical reports are provided as **Attachment A**.

Additional Soil Mixing/Polishing with Phosphate

On November 19, 2012, AECOM collected eight additional lead TCLP samples to evaluate supplementary amendments to reach the leachable lead target concentration of less than 5 mg/L. Redox-Tech's evaluation concluded that a mixture of tricalcium phosphate, trisodium phosphate, and dicalcium phosphate could be utilized to further lower the residual leachable lead, with their results indicating that he mixed soil would be to below the 5 mg/L level. The additional mixing of lead-affected soil with the phosphate mixture precipitates lead to a relatively non-leachable form of lead phosphate.

Based on the project objective of getting leachable lead within the remediation area to below 5 mg/L, AECOM recommended remixing approximately 11,150 pounds of the phosphate mixture into nine treatment cells (C-6, C-7, and C-8 to 2 feet deep; C-9, C-34, and C-35 to 5 feet deep; and C-10, C-11, and C-20 to 8 feet deep) within the remediation area (approximately 230 to 250 cubic yards).

The remixing was completed from December 13 through 18, 2012. AECOM collected three post-polishing TCLP lead samples from cells 34, 10, and 8. AECOM selected these three cells, which had the highest post calcium oxide mixing lead TCLP concentrations, to evaluate the efficacy of the phosphate re-treatment. Post phosphate treatment lead TCLP samples were collected on December 15, 2012. The TCLP lead results from cells C-10 and C-34 were below 5.0 mg/L and the lead TCLP result from cell C-8 was above 5.0 mg/L. Redox-Tech stated that phosphate mixture may take a little longer to dissolve completely and help bind to the lead. The phosphate mixture was allowed to chemically react for an additional week and another lead TCLP sample was collected from cell C-8 on December 21, 2012. The December 21, 2012 lead TCLP result was below 5.0 mg/L.

Soil Analytical Results

Fifteen post-treatment lead TCLP laboratory results, representing cells 8, 10, 12, 13, 18, 19, 21, 24, 25, 26, 33, 34, 36, 38, and 41, document that the chemically-stabilized lead impacted soil in the remediation area is below the US EPA TCLP hazardous criteria. Soil lead TCLP results are summarized on **Table 1** and the locations of the post-remediation TCLP samples are illustrated on **Figure 3**. The soil confirmation laboratory analytical reports are provided as **Attachment A**.

In addition, two composite waste samples, WC-3 and WC-4, were collected for landfill waste characterization. On December 17, 2012, AECOM collected waste composite samples from 10 locations (each composite sample comprised of 5 samples). The composite waste sample locations were spatially located to be representative of the soils to be removed from the Site as a result of the soil blending remediation process (WC-3 representing the south half of the remediation area and WC-4 representing the north half of the remediation area). The waste composite samples document that:

- Lead TCLP analytical results were below the applicable US EPA TCLP hazardous level of 5.0 mg/L (WC-3, 3.8 mg/L and WC-4, 1.7 mg/L);
- Arsenic TCLP analytical results are below the applicable US EPA TCLP hazardous criteria of 5 mg/L (WC-3, 0.0097 mg/L and WC-4, <0.0056 mg/L); and
- VOC TCLP analytical results were below the laboratory method detection limits.

The locations of the waste composite samples are illustrated on **Figure 4** and the waste characterization laboratory analytical report is provided as **Attachment B**.

Excess Soil Removal

On June 13 and 14, 2013, Op-Tech Environmental Services Inc. (Op-Tech; Buffalo, New York) removed approximately 624 tons of chemically stabilized lead impacted soils. The soils were taken to Waste Management, Inc.'s (Waste Management) recycling and disposal facility located in Chaffee, New York. The soil for disposal was a result of the blending process, *i.e.* the addition of chemical stabilizers added to the soil which created additional soil volume. The lead-impacted soil taken off-Site was chemically stabilized with a mixture of calcium oxide and a phosphate mixture to reduce the lead concentration to below the US EPA TCLP hazardous level for lead of 5.0 mg/L.

As previously mentioned above, composite waste samples WC-3 and WC-4 were obtained from 10 locations subsequent to soil blending with calcium oxide. The composite waste sample locations were spatially located to be representative of the soils to be removed from the remediation area as a result of the soil blending remediation process (WC-3 representing the south half of the remediation area and WC-4 representing the north half of the remediation area).

The waste profile sample analytical consisted of TCLP metals, TCLP volatile organic compounds (VOCs), TCLP SVOCs, gasoline range organics, diesel range organics, polychlorinated biphenyls, pH, and flashpoint. The composite waste characterization laboratory analytical results document that the soil taken off-Site is not characteristically hazardous. The signed waste characterization profile form and landfill soil disposal inventory list is provided as **Attachment C** (the waste composite laboratory report is included in **Attachment B**).

Site Health & Safety

Plan

A Site-specific Health and Safety Plan (in accordance with the Occupational Safety and Health Administration [OSHA] 29 CFR 1910) was prepared for the soil blending remediation activities. AECOM reviewed the Site Health and Safety Plan with all field personnel prior to commencing the field activities. A qualified AECOM employee was present during all remediation fieldwork. A copy of AECOM's Site-specific Health and Safety Plan was presented to each subcontractor providing construction services prior to commencing work.

Dig Safely New York, Inc. was contacted at least three days prior to commencing field activities to locate public utilities. In addition, a private utility locator (The Underground Detective, Cincinnati, Ohio) was utilized to locate on-Site private utilities within and around the soil remediation area. Other than encountering two unknown historical sewer utilities while completing the soil blending (see Underground Utility Management below), no health and safety incidents occurred.

Community Air Monitoring

AECOM completed air dust monitoring, as required by the New York Community Air Monitoring Program (CAMP) during the soil mixing and excess soil excavation activities. Three dust monitoring stations (one, monitor #65, located at the up-wind property boundary to the northwest of the work area, nearest to Highland Avenue) and two at the down-wind property boundary (monitor #13, located along the northeast property boundary, and monitor #47, located along the southeast of the work area). The air monitoring locations are illustrated on **Figure 1**. The air monitoring was established prior to initiating soil mixing and excess soil removal activities.

AECOM utilized three tripod mounted Dusttrak II 8530 aerosol monitors to continuously monitor dust conditions during soil mixing activities. Each dust monitor was mounted on a tripod stand with the monitor situated approximately 5 feet above the ground surface. The purpose of the air monitoring is to measure construction generated dust so AECOM could implement measures, if necessary, to limit dust from leaving the Site. The air monitor readings are a time weighted 15 minute average. If particulate levels at the down-wind property boundary were more than the dust risk action level (after subtracting the up-wind/ambient levels), dust suppression measures (spraying the work area with water and/or waiting until winds reduce) were implemented.

AECOM developed a Site-specific dust risk action level that ensures adherence to both the CAMP fence line total dust level of 150 micrograms per cubic meter ($\mu g/m^3$) and the US EPA ambient air quality standard for lead (adjusted for the duration of the soil mixing work [16 days]). The calculated dust action level for lead is 233 $\mu g/m^3$. Note that the calculated lead action level is a conservative value that assumes all of the dust particles measured at the downgradient property boundary has a lead concentration with the highest measured on-Site concentration (90,100 mg/kg). AECOM measured five excursions of the CAMP air monitoring action level of 150 $\mu g/m^3$ (one each on October 15, 16 17, 21, and 22, 2012). There was only one reading (October 15, 2012, 334 $\mu g/m^3$) that exceeded the calculated lead dust action level of 233 $\mu g/m^3$. Each of the dust monitoring excursions occurred during times when initial cell blending occurred (when bags of calcium oxide were being opened and dispensed). Corrective action after each excursion of the dust action level consisted of both ceasing the physical soil blending and adding water to the mix area before continuing. The Dusttrak II monitoring data is provided as **Attachment D**.

Dust monitoring was also completed during the June 13 and 14, 2013 excess soil removal activities. AECOM utilized two tripod mounted Dusttrak II 8530 aerosol monitors to continuously monitor dust conditions during the excess soil excavation activities (one, monitor #65, located at the up-wind property boundary and the other, monitor #47, located along the southeast of the work area). Each dust monitor was mounted on a tripod stand with the monitor situated approximately 5 feet above the ground surface. AECOM completed hourly visual checks at the downgradient (#47) monitoring station. There were no excursions dust action levels. Note that the consistency of the post remediated soil was soft and wet and there were intermittent light showers during the June 13, 2013 soil removal activities.

Personal Air Monitoring

AECOM followed the OSHA lead standard for construction sites (1926.62) and was compliant with OSHA 1926.62, biological monitoring (1926.62(j)(2). AECOM field personnel wore a personal air monitoring pump with filter media that was analyzed in a laboratory to monitor potential lead exposure of which the results were compared to the applicable Permissible Exposure Limit, 8-hour average, of 50 $\mu g/m^3$ (1926.62(c)(1). AECOM also informed each subcontractor providing construction services of the OSHA lead standard for construction sites prior to commencing work.

AECOM completed personal monitoring on October 9 and 10, 2012 (during the first two days of soil mixing) in an effort to measure the risk of potential lead exposure. AECOM field personnel wore a BDX II constant flow air sampler (2 liter per minute flow rate). A new filter cassette was placed into the air sampler and the sampler pump was started at the beginning of the work day. The filter cassette with the amount of time worn recorded on the chain-of-custody form was sent to Schneider Laboratories Global (Richmond, Virginia) via overnight delivery. The personal air monitoring laboratory results were reported at below the laboratory method detection limits for both October 9 and 10, 2012. The personal air monitoring laboratory analytical reports are provided as **Attachment E**.

Underground Utility Management

On October 8, 2012, AECOM disconnected the catch basin located on the north end of the remediation area because the stormwater conveyance pipe passed through the planned remediation area. The catch basin was plugged and grouted at the catch basin end. The catch basin pipe was cut and plugged approximately 20 feet to the south, where the pipe entered the remediation area. The catch basin was re-routed around the eastern edge of the remediation area and reconnected on January 29, 2013. The sewer pipe was re-routed around the remediation area because the remediated soil was still too soft from the soil blending process.

On October 11, 2012, AECOM encountered a previously undisclosed or/and unknown stormwater sewer utility located in cell 10 (**Figure 5**). The utility consisted of a 10-inch diameter clay tile pipe (4 feet deep) running parallel to, and 8 feet out from, the building. The pipe was traced to the west within the remediation area and was found to elbow (90 degrees) towards the building, 3 feet west of the sewer manhole. The pipe was in deteriorated condition. Water appeared to be flowing out of the pipe; however, it was unclear if it was an active or abandoned utility. AECOM discussed the sewer pipe with the plant manager, Mr. John Signore. Mr. Signore was not aware of the pipe but requested that it be reconnected after the soil mixing and testing was completed. On February 4, 2013, the pipe was reconnected to the existing sewer that runs parallel to the building (5 feet out from the building).

On October 13, 2012, AECOM encountered a second 10-inch diameter clay tile pipe (running perpendicular from the building and in line with the manhole located 5 feet from the building) in the remediation area. The perpendicular pipe was traced to the north and was broken and discontinuous and appeared to be a formerly abandoned utility. Water was not observed in the pipe. Mr. Signore was notified of the perpendicular pipe. Mr. Signore was not aware of the perpendicular pipe's existence. Based on no water appearing in the pipe and its broken and discontinuous condition, Mr. Signore did not request that the pipe be reconnected. The sewer utility locations are illustrated on **Figure 5**.

Engineered Cap/Barrier Installation

The purpose of the geomembrane and pavement surfaces covering the remediated soils will serve two functions 1) as a surface barrier to mitigate direct contact with the remediated soils and 2) mitigate surface water infiltration through the remediated soils. On July 29, 2013 through August 1, 2013 AECOM provided oversight over the installation of an engineered cap/barrier (geomembrane) over the southern two-thirds of the remediation area by Op-Tech. A geomembrane was selected as a cover for the southern portion of the remediated area due to the soft consistency of the blended remediated soils. The geomembrane was constructed by laying down a geotextile fabric (Marafi 1100N) directly over the remediated soils. A geomembrane (Rufco 4000B) was placed directly over the geotextile fabric. The geomembrane was covered with a 6-inch layer of sand for protection. The final surface was covered with 4 inches of No. 2 crusher stone (gravel). The geomembrane surface was constructed so that it is slightly crowned near the center (approximately 15 inches higher than the surrounding grade).

The northern one-third portion of the remediation area was finished with a combination of asphalt (northeastern) and concrete (northwestern) pavement by Tulip Corp. to facilitate the use of the area for semi-trucks accessing the storage silo to the west of the remediation area. On July 29, 2013, AECOM provided oversight over the removal of approximately 90 tons of chemically stabilized lead impacted soils down to 2 feet bgs due to the soft consistency of the blended soils beneath the paved area. The excavated soil was taken to the Waste Management recycling and disposal facility in Chaffee, New York. A heavy geotextile fabric (Marafi 1100N) was applied over the treated soil, which was then backfilled with No. 1 crusher stone to approximately 6 inches below the surrounding grade. The backfill was statically compacted (rolling without vibration). Based on field observations of soft soil beneath the western half of the paved area, Op-Tech put down two layers of Tensar (TX 140) Geoweb material at 9 and 5 inches below the top of the No. 1 crusher stone. Tulip Corp. selected to resurface the western half of the paved area with concrete, which would be a more resilient material over the soft remediated soils in this area. Mr. John Signore notified AECOM on September 27, 2013 that the asphalt and concrete pavement work was completed.. AECOM performed the final cap/barrier review at the Site on October 8, 2013. The geomembrane cap/barrier and pavement locations are illustrated on **Figure 6**. A photographic log depicting various portions of the remediation process, including pictures of the geomembrane and pavement cap/barrier, is provided as **Attachment F**. The landfill waste disposal documentation for the removal of the soft soils under the paved area is provided as **Attachment G**.

Construction Debris Disposal

Construction debris consisting of buried railroad ties, concrete, and asphalt from the northern and western portions of the remediation area were piled and and covered with plastic sheeting while performing the soil remediation activities. On August 5, 2013, approximately 52 tons of construction debris was removed from the Site by Op-Tech. The construction debris was taken to Waste Management's landfill located in Chaffee, New York. Copies of the construction debris waste characterization profile form, waste sampling laboratory analytical report, and landfill waste disposal documentation is provided as **Attachment H**.

Conclusions

AECOM concludes the following, based on the soil remediation activities conducted at the Site from July 2012 to September 2013:

- In August 15-19, 2011, elevated concentrations of lead above the NYDEC SCO were found in shallow (1 to 3 feet bgs) soil samples collected on the north side of the Tulip Corp. building near the location of a historical coal pile storage area (east of the plastic bead storage silo).
- Bench scale testing was performed by Redox-Tech in order to find the appropriate amendment to treat the approximate 2,300 tons of lead impacted soil in the former coal pile area. The bench scale testing was performed on soil samples collected from the areas that had the highest total lead concentrations as a conservative measure to ensure that the lead-impacted soil within the treatment area would be stabilized to less than the US EPA TCLP hazardous criteria of 5 mg/L. Redox-Tech reported a TCLP result of 930 mg/L for a soil sample collected near P-11B during laboratory bench scale testing, exceeding the US EPA TCLP hazardous criteria of 5 mg/L;
- On October 8 through 23, 2012, a total of approximately 2,300 tons of lead impacted soil in the former coal pile area was chemically treated by Redox-Tech via in situ blending with 153 tons of calcium oxide;
- On December 13 through 18, 2012, 11,150 pounds of phosphate mixture was blended into approximately 390 to 425 tons of soil in nine treatment cells located near the northwest and southeast corners of the remediation area. The additional phosphate treatment was based on soil confirmation sampling results that documented post-calcium oxide treated soil lead TCLP results above 5 mg/L in these areas;
- Fifteen post-treatment lead TCLP laboratory results document that the chemically stabilized lead impacted soil in the remediation area is below the US EPA TCLP hazardous criteria. In addition, two composite waste samples, WC-3 and WC-4, were collected for landfill waste characterization. The waste composite samples document that lead and arsenic TCLP results were below the applicable US EPA TCLP hazardous criteria. The laboratory analytical results of waste composite samples also document that TCLP SVOC concentrations are below the laboratory method detection limits. Thus, the in situ soil blending at the Site have appeared to adequately stabilized the lead, arsenic, and SVOC impacts within the remediation area;
- On January 29 through February 4, 2013, the storm water catch basin (located to the north of the remediation area) and an unknown sewer (running parallel to, and 8 north of, the building) were reconnected to the existing sewer utility running parallel to the building;
- On June 13 and 14, 2013, Op-Tech removed approximately 624 tons of non-hazardous chemically stabilized lead impacted soils from the Site. The soils were taken to Waste Management's recycling and disposal facility located in Chaffee, New York. The soil for disposal was a result of the blending process, *i.e.* the addition of chemical stabilizers added to the soil and from the un-compaction (fluffing) of the blended soils;
- On July 29, 2013, AECOM provided oversight over the removal of an additional approximate 90 tons of chemically stabilized lead impacted soils beneath the paved portion of the remediation area due to the soft consistency of the blended soils;
- On July 30, 2013 through August 1, 2013, Op-Tech installed an engineered cap/barrier (geomembrane) over the southern one-third of the remediation area and in September 2013, the northern one-third portion of the remediation area was resurfaced with a combination of asphalt and concrete pavement by Tulip Corp. The purpose of the geomembrane and pavement surfaces

is to 1) provide a surface barrier to prevent direct contact with the remediated soils and 2) prevent surface water infiltration through the remediated soils;

- On August 5, 2013, approximately 52 tons of construction debris consisting of buried railroad ties, concrete, and asphalt from the northern and western portions of the remediation area was removed from the Site by Op-Tech. The construction debris was taken to Waste Management's landfill located in Chaffee, New York; and
- AECOM performed a final cap/barrier review at the Site on October 8, 2013, documenting that the direct contact pathway is incomplete and that the cap/barrier will inhibit surface water infiltration through the remediated soils.

Closing

Please contact either of the undersigned with any questions or comments.

Sincerely yours,

AECOM, Inc.

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Kevin L. Brehm
Principal/Office Manager
414.944.6145
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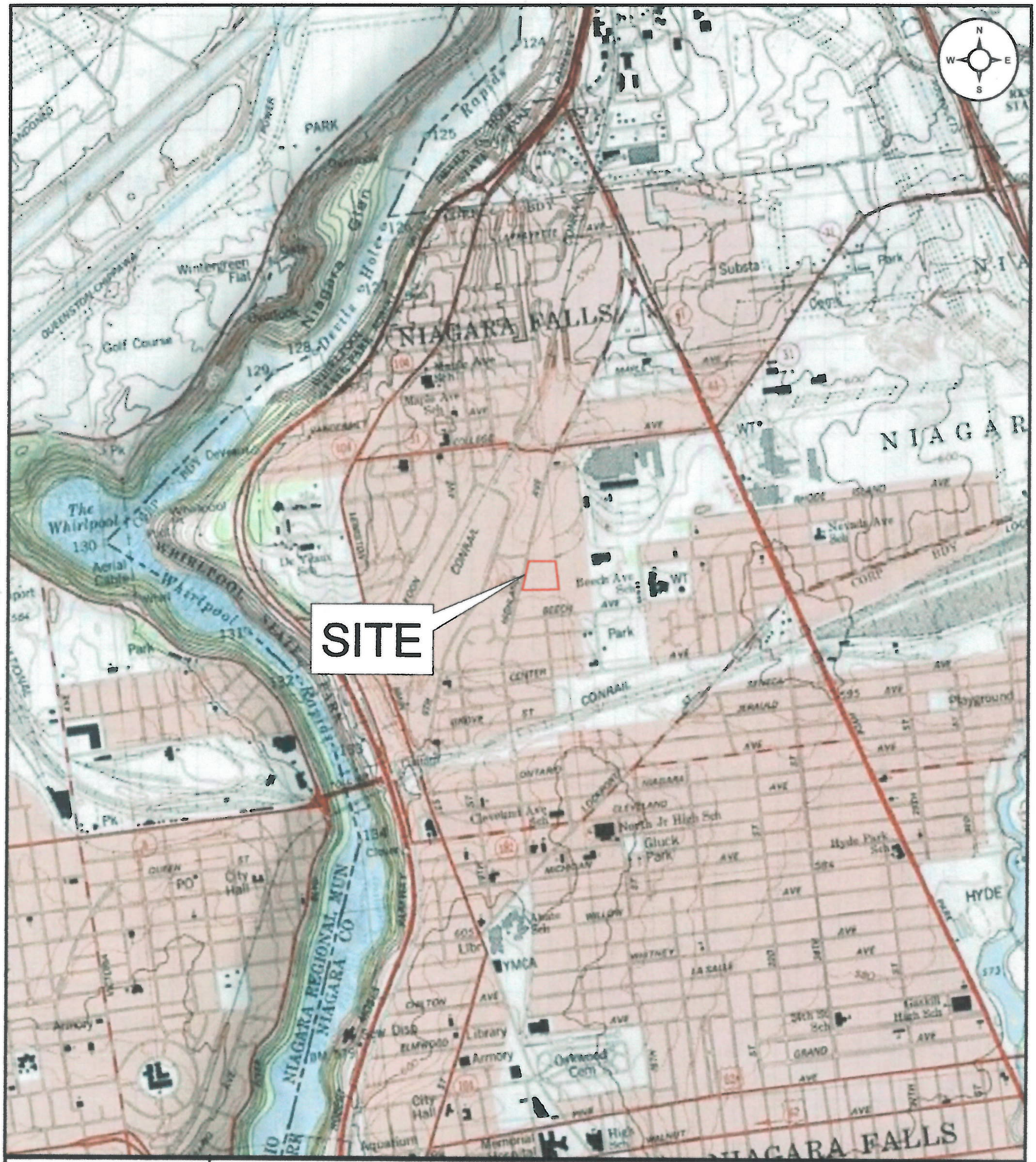
Attachments:

Table 1 – Soil Lead TCLP Results

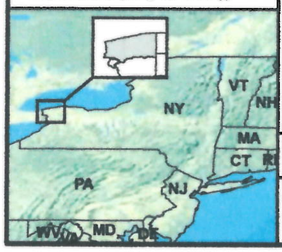
Figure 1 – Site Layout and Remediation Area
Figure 2 – Lead Remediation Area Depths
Figure 3 – Lead Remediation Area - Soil Blending Cells
Figure 4 – Waste Disposal Sample Locations
Figure 5 – Sewer Maintenance Map
Figure 6 – Cap/Barrier Location Map

Attachment A – TCLP Soil Confirmation Sampling Laboratory Analytical Reports
Attachment B – Excess Soil Waste Profile Form and Laboratory Analytical Reports
Attachment C – Landfill Soil Inventory List
Attachment D – Air Monitoring Data
Attachment E – Personal Air Monitoring Laboratory Analytical Reports
Attachment F – Photographic Log of Remediation Activities
Attachment G – Landfill Waste Disposal Documentation - Soft Soils Beneath Paved Portion of Remediation Area
Attachment H – Construction Debris Waste Profile Form, Waste Characterization Laboratory Analytical Report, and Landfill Waste Disposal

Figures



Site Location (Niagara County)



SITE LOCATION MAP
Tulip Corporation Property
3125 Highland Avenue
Niagara Falls, New York 14305

AECOM Project: 60220285.1

Date: 08/22/11

0 0.25 0.5 0.75 1 Miles

Source: NGS USA Topographic Maps
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FIGURE 1

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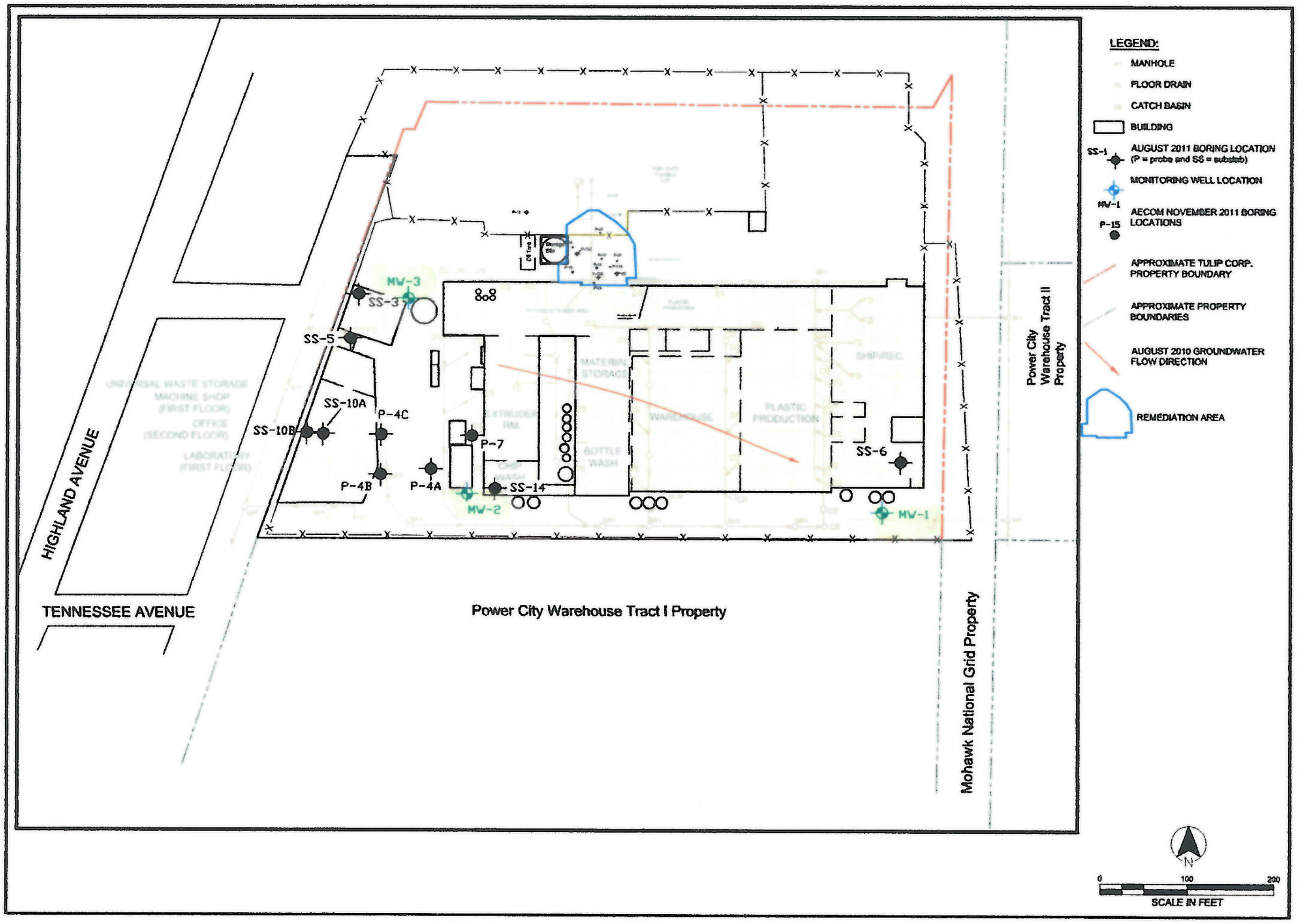

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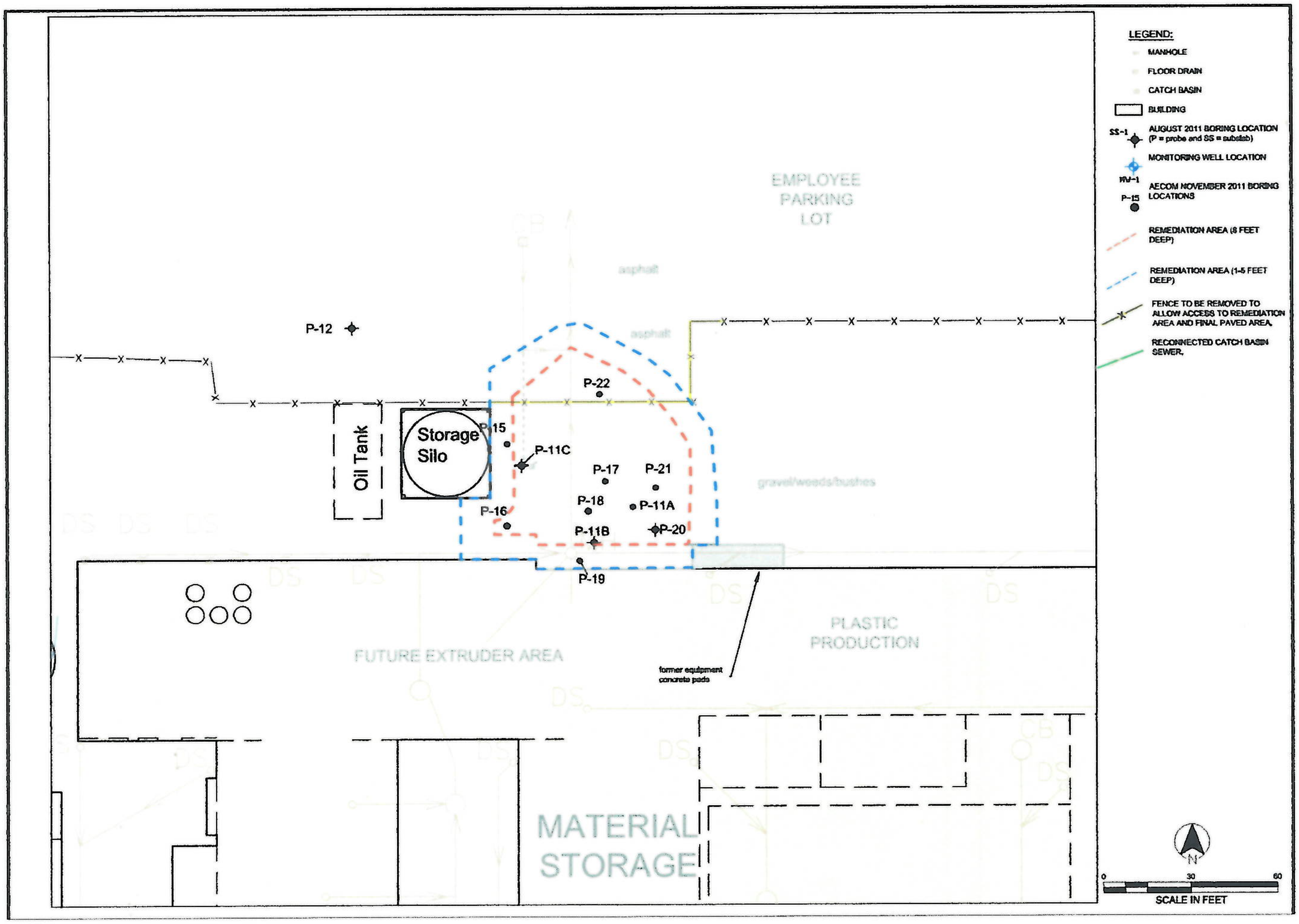
Site Layout Map
Tulip Corporation
3125 Highland Avenue
Niagara Falls, New York

SCALE:	DATE:	AECOM PROJECT:
AS NOTED	08/01/2012	60271770

Figure
2



NO.	DESCRIPTION	DATE	BY

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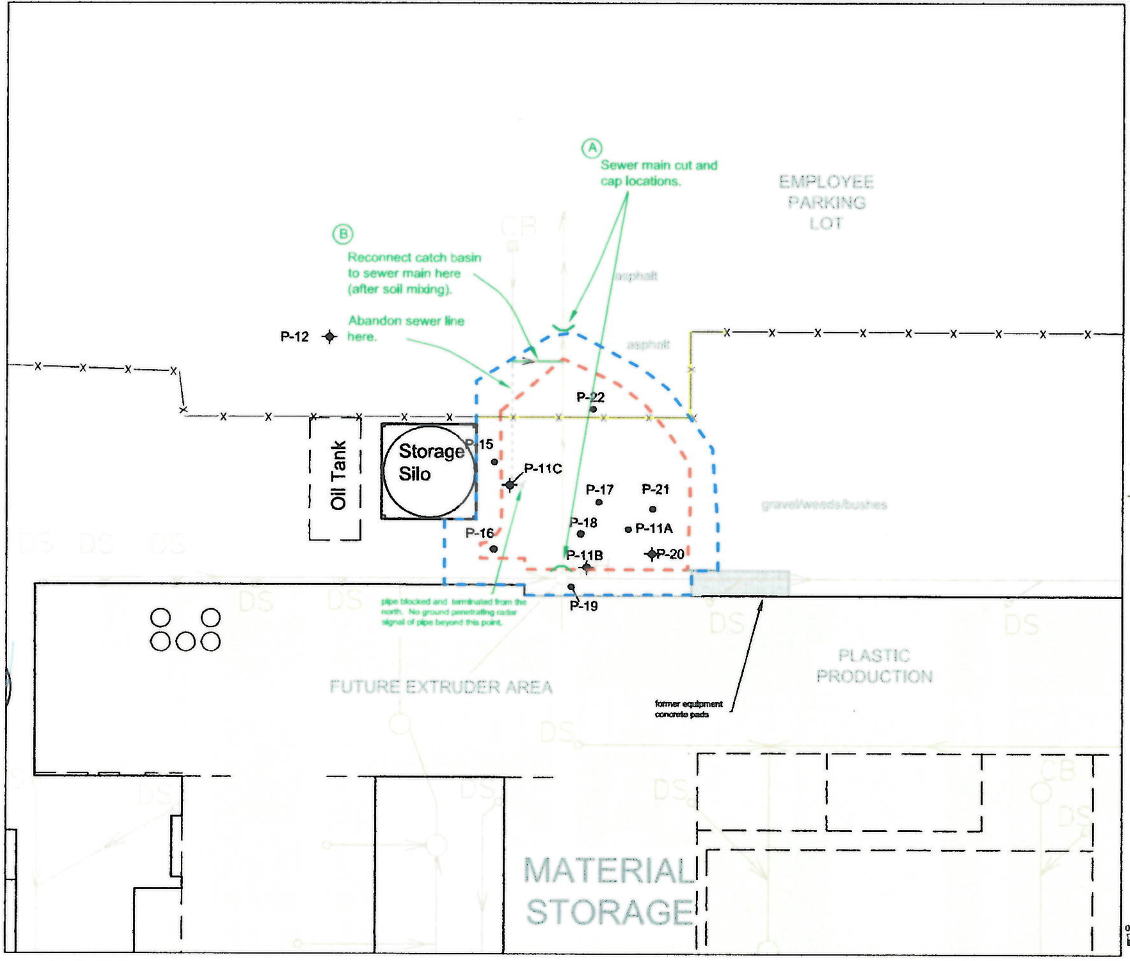
Remediation Area Map
Tulip Corporation
3125 Highland Avenue
Niagara Falls, New York

SCALE:	DATE:	AECOM PROJECT:
AS NOTED	03/01/2012	60271770

Figure
3



LEGEND:

	MANHOLE
	FLOOR DRAIN
	CATCH BASIN
☐	BUILDING
P-11C ✦	AECOM August 2011 BORING LOCATIONS
P-15 ●	AECOM NOVEMBER 2011 BORING LOCATIONS
🟥 - -	REMEDIATION AREA (8 FEET DEEP)
🟦 - -	REMEDIATION AREA (1-5 FEET DEEP)
Ⓐ	SEWER MAIN TO BE CUT AND CAPPED AT MANHOLE NEAR BUILDING AND AT APPROXIMATELY 80 FEET TO THE NORTH (NORTHERN BOUNDARY OF REMEDIATION AREA). SEWER MAIN WILL BE RECONNECTED SUBSEQUENT TO COMPLETION OF REMEDIATION ACTIVITIES.
Ⓑ	DAMAGED STORM SEWER AND CATCH BASIN TO BE RECONNECTED SUBSEQUENT TO COMPLETION OF REMEDIATION ACTIVITIES.
- - -	ABANDONED SEWER PIPE.
—x—	FENCE TO BE REMOVED TO ALLOW ACCESS TO REMEDIATION AREA AND FINAL PAVED AREA.

	NO.	DESCRIPTION	DATE	BY
DRAWN BY:				
rpr				
CHECKED BY:				
TS				
APPROVED BY:				
KB				

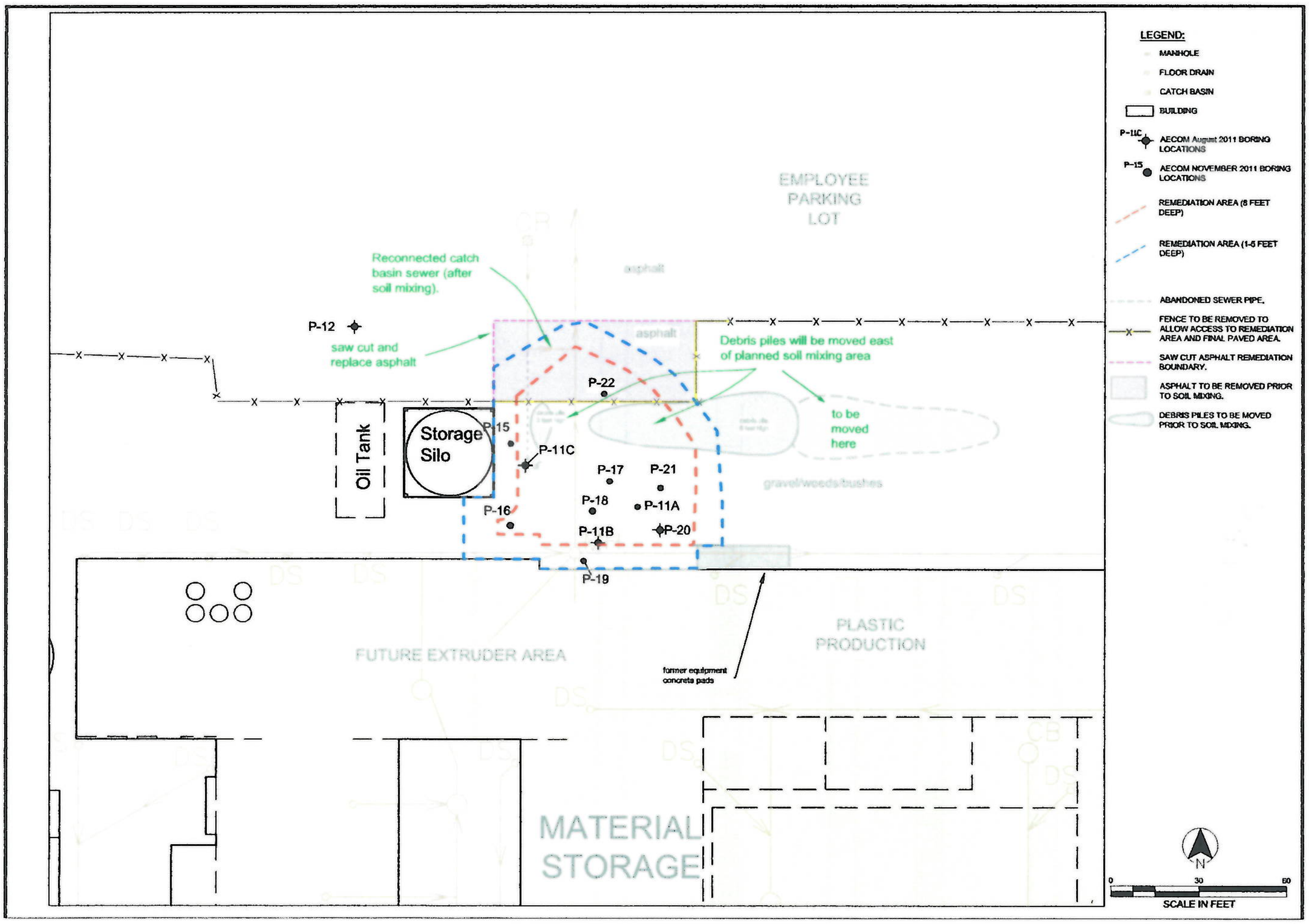
AECOM

AECOM Environment
1555 N RiverCenter Drv. Ste 214
Milwaukee, Wisconsin 53212
T 414.944.6080 F 414.944.6081
www.aecom.com

Sewer Preservation and Repair Map
Tulip Corporation
3125 Highland Avenue
Niagara Falls, New York

SCALE:	DATE:	AECOM PROJECT:
AS NOTED	08/01/2012	60271770

Figure
4



NO.	DESCRIPTION	DATE	BY

DRAWN BY: PDR
CHECKED BY: TS
APPROVED BY: KB

AECOM

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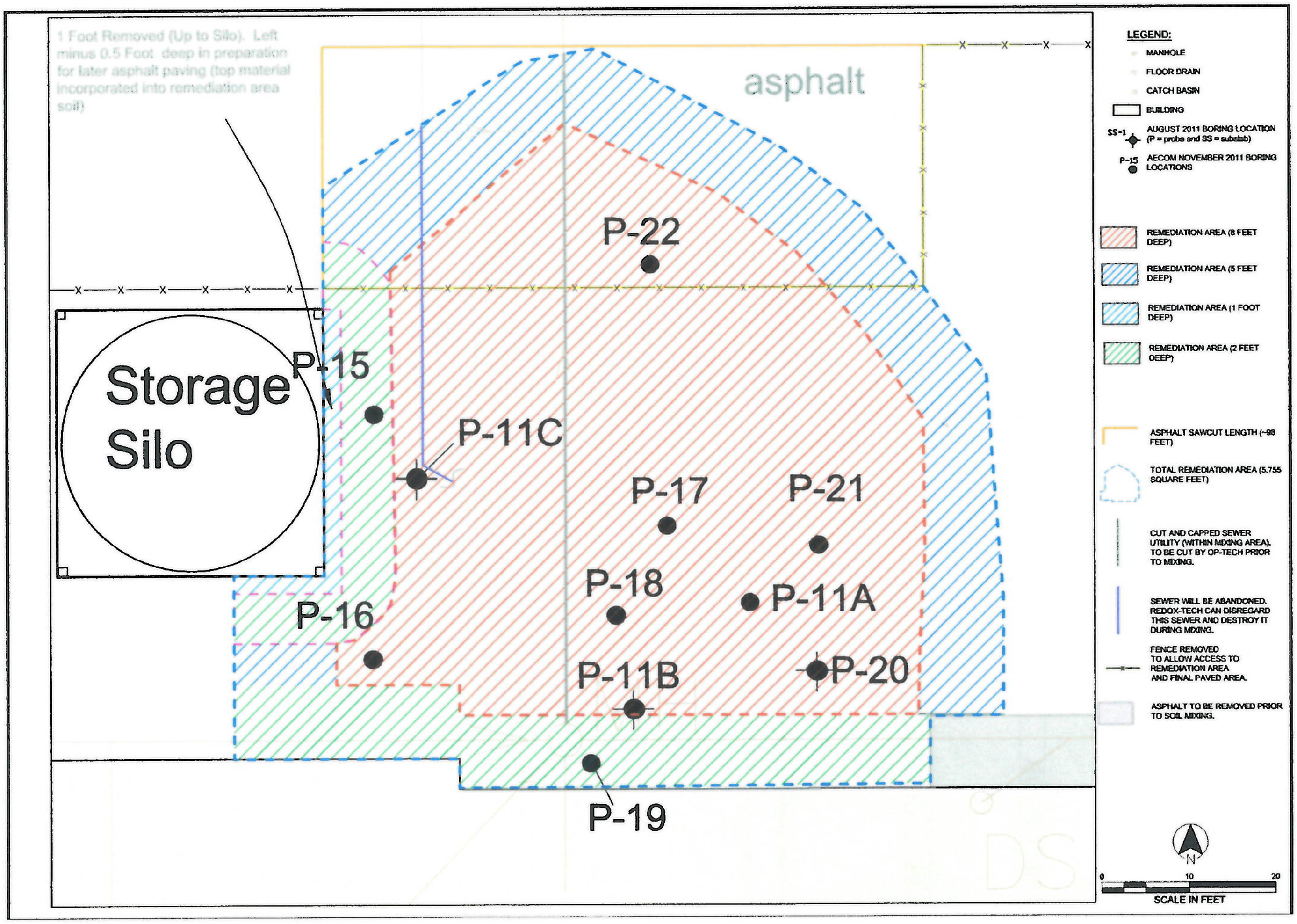
Remediation Area Preparation Map
Tulip Corporation
3125 Highland Avenue
Niagara Falls, New York

SCALE:	DATE:	AECOM PROJECT:
AS NOTED	08/01/2012	60271770

Figure
5



	NO.	DESCRIPTION	DATE:	BY:
DRAWN BY:				
rpa				
CHECKED BY:				
TS				
APPROVED BY:				
KB				

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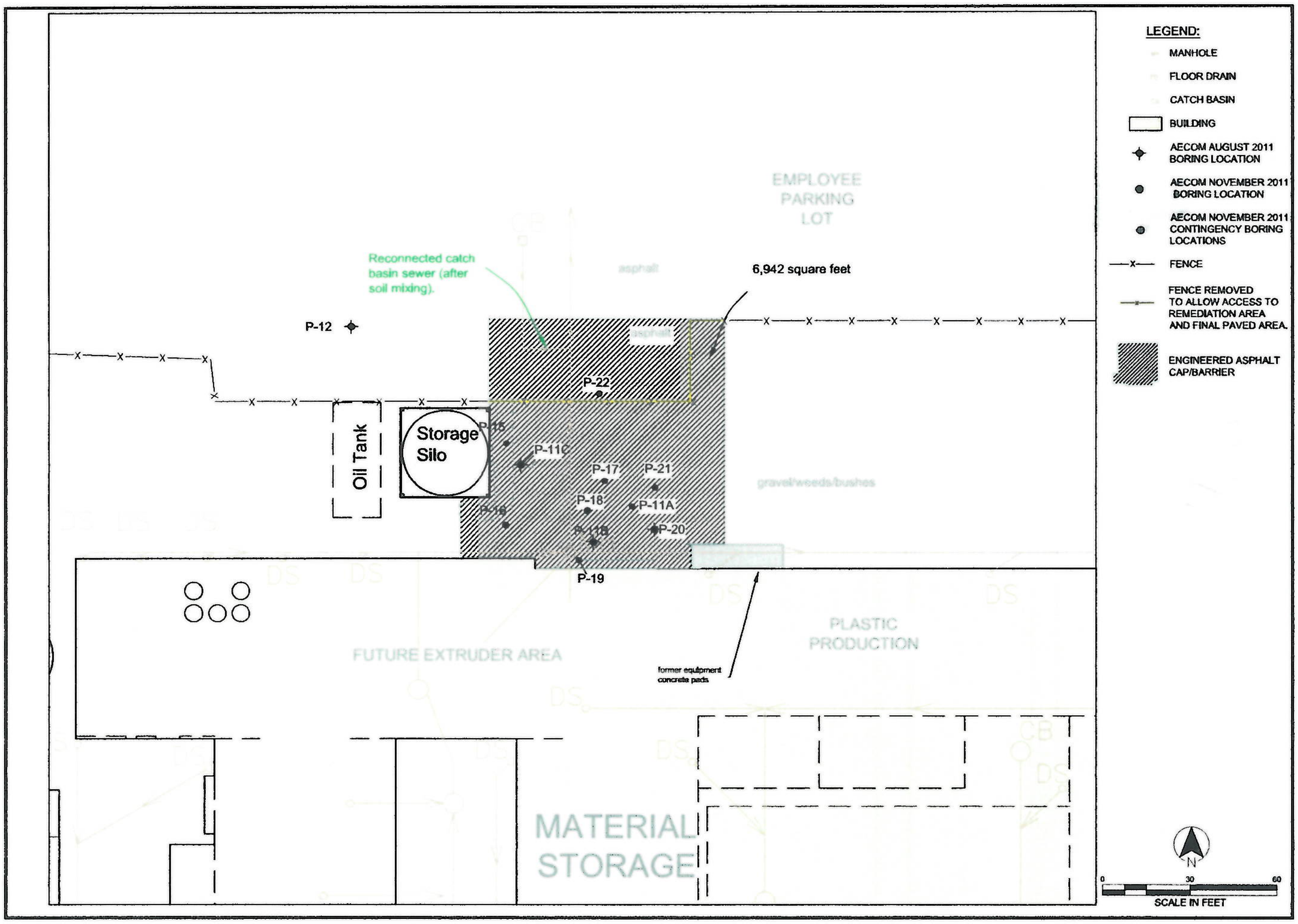
Remediation Area Soil Mixing Depth Map
Tulip Corporation
3125 Highland Avenue
Niagara Falls, New York

SCALE:	DATE:	AECOM PROJECT:
AS NOTED	08/01/2012	60271770

Figure

6



NO.	DESCRIPTION	DATE	BY

DRAWN BY: FPR
CHECKED BY: TS
APPROVED BY: KB

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Engineered Asphalt Cap/Barrier Map
Tullp Corporation
3125 Highland Avenue
Niagara Falls, New York

SCALE: AS NOTED
DATE: 08/01/2012
AECOM PROJECT: 60271770

Figure
7

CELL FIELD MAP

🟩 TCLP < 5 mg/L

🟧 TCLP > 5 mg/L

TCLP Lead Result (mg/L) in each cell where available

⑥ = Cell Number

N

Scale (Feet) 0 5 10

REMIX AREAS IN RED

AECOM

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Figure 1

Attachment A

REDOX TECH, LLC
"Providing Innovative In Situ Soil and Groundwater Treatment"

August 6, 2012

Via Email

Richard Mazurkiewicz
AECOM
11425 W. Lake Park Dr. Ste 100
Milwaukee, WI 53224
T: 414.359.3030
F: 414.359.0822
Email: Richard.mazurkiewicz.com

RE: Lead and Arsenic Treatability Study Report
Tulip Corporation Site, Niagara Falls, NY

Dear Mr. Mazurkiewicz:

Redox Tech is pleased to present the following treatability study report. This testing was conducted on site-specific soil for purposes of determining an appropriate method for stabilizing lead and arsenic.

Introduction

Redox Tech, LLC (Redox Tech) proposes to stabilize lead and arsenic in soil at the Tulip Corporation site in Niagara Falls, New York using a soil blending technique, addressing soils to a depth of up to 8 feet below ground surface. Area soil is sand and gravel. As part of the cleanup strategy, the remediation area will likely be paved after stabilization activities area completed. To avoid a dewatering step, the chemistry evaluation for this project focused on dry reagents. Current site soil is adequate for construction of the parking lot.

Soil samples indicate lead concentrations as high as 17,000 mg/kg, and arsenic concentrations as high as 30 mg/kg. The goal is to stabilize lead and arsenic to achieve a non-hazardous, TCLP goal of 5.0 mg/L for both lead and arsenic.

Sample Collection.

The following samples collected by AECOM were used in the treatability study:

☐	Sample A:	P-20 (0-1') – 071812	(ReSP Lab. No 2012 07 001)
☐	Sample B:	P-16 (0-1') – 071812	(ReSP Lab. No 2012 07 002)
☐	Sample C:	P-18 (0-1') – 071812	(ReSP Lab. No 2012 07 003)
☐	Sample D:	P-11b (0-1') – 071812	(ReSP Lab. No 2012 07 004)

Initial Sample Characterization.

Each soil sample was reduced in size to pass through a 3/8-inch sieve and homogenized. Each sample was analyzed for total and untreated TCLP arsenic and lead. A summary of the initial analyses and treatability study results is provided in **Table 1.**

Arsenic

Study samples A, B, C and D had total arsenic concentrations of 16, <15, <16, and 37 mg/kg, respectively; and TCLP arsenic concentrations of <0.030, 0.035, <0.030 and 0.045 mg/L, respectively (see Table 1). All of these TCLP values are well below the TCLP regulatory level of 5 mg/L. There appears to be no correlation between the total arsenic concentrations and the untreated arsenic TCLP concentrations.

Lead

Samples A, B, C, and D had total lead concentrations of 2200, 42,000, 19,000 and 85,000 mg/kg lead, respectively; and TCLP lead concentrations of 220, 690, 210 and 930 mg/L, respectively (see Table 1). Lead has a weak correlation between the total lead concentrations and the TCLP lead concentration with a correlation coefficient of 0.79.

Stabilization Study.

Each soil sample was subjected to a series of dosage trials (1%, 5% and 8% by weight) of three different commercial-grade basic reagents including calcium oxide (CaO), magnesium oxide (MgO) and Portland Cement. The dosed samples were subsequently leached using the TCLP screening level procedure.

Arsenic

The arsenic concentrations in the untreated TCLP leachate were well below the regulatory level of 5 mg/L (see Table 1). The leachate of the dosed samples for all three reagents was analyzed for arsenic to document any effect the stabilization chemistry used for lead had on the arsenic solubility. The TCLP arsenic remained very low (at or less than 0.21 mg/L) for all of the dosage trials. Most results (37 of the 44 dosage trials) were below the detection limit.

Lead

Calcium Oxide

All of the Samples A, B, C and D were effectively stabilized below the TCLP regulatory level of 5 mg/L for lead when dosed with 8% CaO with leachable concentrations of 1.4, 0.14, 0.10 and 0.20 mg/L, respectively. This represents lead reductions of 99.4, 99.98, 99.95 and 99.98 percent, respectively. At dosages of 1% and 5% CaO, lead remained relatively soluble in the TCLP test.

Since, 8% CaO dosage demonstrated an effective remedy for all samples, a series of dosages between 5% and 8% CaO were tested for lead on each of the samples to identify the optimal treatment dose. All of the Samples A, B, C and D were effectively stabilized below the TCLP regulatory level for lead when dosed with 7% CaO with leachable concentrations of 0.70, 0.067, 0.066 and 0.16 mg/L, respectively. This represents lead reductions of 99.7, 99.99, 99.97 and 99.99 percent, respectively. At 6% CaO dosage, lead in all four samples remained relatively soluble in the TCLP test and exceed the target concentration of 5 mg/L.

Magnesium Oxide

Samples A, B and D were effectively stabilized below the TCLP regulatory level of 5 mg/L for lead when dosed with 8% MgO with leachable concentrations of 4.8, 2.3 and 0.83 mg/L, respectively. This represents lead reductions of 98.1, 99.7 and 99.9 percent respectively. Sample C had a TCLP lead concentration of 8.8 mg/L, slightly above the regulatory limit. For dosages of 1% and 5% MgO, lead remained relatively soluble in the TCLP test.

Portland Cement

Lead remained relatively soluble in the TCLP test for each of the Portland Cement dosage trials in all four samples at cement dosages of up to 8 weight percent. The leachable lead results in these trials were all above 80 mg/L.

The TCLP extract from the 7% CaO treatment from each sample was sent to ESC Laboratory in Mt. Juliet, Tennessee for certified verification of the screening arsenic and lead analysis. The verification results are provided in Table 1. The certified lab and the screening arsenic and lead results demonstrate excellent agreement of between the analyses.

Application Parameters.

The best performing reagent for the site samples is CaO, which demonstrated the highest reduction in leachable lead at 8% dosage and performed equally well at the 7% dosage. The application and mixing of the reagent at the site has raised concerns about post-application geotechnical strength and heat generation. Three empirical bench tests on the samples were performed to help provide information in making application decisions. The three tests, performed on all four samples, included percent moisture, heat generation and strength. The results of the application parameters are provided in Table 2.

Percent moisture was tested for samples that were untreated and dosed with 7% CaO. The moisture results were between 4.5% and 6.8%. The 7% dosed samples experienced a drying effect where each sample had a decrease in moisture between 0.2% and 0.6%.

Heat generation and strength testing was performed for samples that were either untreated or dosed with 8% CaO, and then saturated with deionized water. The untreated samples experienced no temperature increase. Each of the samples dosed with CaO experienced a temperature increase between 3.1 C^O and 5.5 C^O. None of the samples had measurable geotechnical strength as measured with a hand penetrometer. However, each of the samples dosed with CaO had the ability to support the weight of the penetrometer, in that the penetrometer did not sink into the sample. None of the untreated samples could support the weight of the penetrometer.

Conclusions.

For the site samples, there appears to be a weak correlation between the total concentrations for lead and the untreated TCLP concentrations. There appears to be no correlation between the total concentrations for arsenic and the untreated TCLP arsenic concentrations.

All of the samples had untreated arsenic concentrations in the TCLP test well below the regulatory level. The arsenic concentrations remained very low in the TCLP test for all of the reagent dosage trials.

Three of the four samples were stabilized for lead using 8% MgO. All of the samples were stabilized for lead using 7% CaO.

The addition of CaO has a slight drying effect on the site samples as demonstrated by the moisture measurements.

There is a measurable increase in temperature with the addition of CaO and water to each of the samples, indicating heat generation.

There is noticeable improvement in geotechnical strength with the addition of CaO to the site samples.

The certified lab and the screening arsenic and lead results demonstrate excellent agreement between the analyses.

Thank you for the opportunity to conduct these tests for AECOM. If you have any questions or concerns, please do not hesitate to call me at (630) 705-0390.

Regards,

Steve Markesic
Redox Tech, LLC

Table 1
Treatability Study Results - AECOM, Niagara Falls, New York

Soil Sample	Formulation (wt %)			Arsenic			Lead		
	CaO	MgO	Portland Cement	Total Arsenic (mg/kg)	Leachable Arsenic (mg/L)	Reduction in Arsenic (%)	Total Lead (mg/kg)	Leachable Lead (mg/L)	Reduction in Lead (%)
Treatment Goals					5			5	
A P-20 (0'-1') 071812 2012 07 001	--	--	--	16	<0.030		2,200	220	
	1.0	--	--		<0.030	N/A		210	16
	5.0	--	--		<0.030	N/A		100	60
	6.0	--	--		<0.030	N/A		57	77
	7.0	--	--		<0.030	N/A		0.70	99.7
				lab verification	<0.020	N/A	*lab verification*	0.08	99.97
	8.0	--	--		<0.030	N/A		1.4	99.4
	--	1.0	--		<0.030	N/A		210	16
	--	5.0	--		<0.030	N/A		150	40
	--	8.0	--		<0.030	N/A		4.8	98.1
	--	--	1.0		<0.030	N/A		250	0.0
	--	--	5.0		<0.030	N/A		220	12
	--	--	8.0		<0.030	N/A		100	60
B P-16 (0'-1') 071812 2012 07 002	--	--	--	<15	0.035		42,000	690	
	1.0	--	--		<0.030	N/A		440	36
	5.0	--	--		<0.030	N/A		150	78
	6.0	--	--		<0.030	N/A		52	93
	7.0	--	--		<0.030	N/A		0.067	99.99
				lab verification	<0.020	N/A	*lab verification*	0.055	99.99
	8.0	--	--		<0.030	N/A		0.14	99.98
	--	1.0	--		<0.030	N/A		510	26
	--	5.0	--		<0.030	N/A		210	70
	--	8.0	--		<0.030	N/A		2.3	99.67
	--	--	1.0		0.049	0.0		620	10
	--	--	5.0		<0.030	N/A		470	32
	--	--	8.0		<0.030	N/A		100	86
C P-18 (0'-1') 071812 2012 07 003	--	--	--	<16	<0.030		19,000	210	
	1.0	--	--		<0.030	N/A		219	0.5
	5.0	--	--		<0.030	N/A		120	45
	6.0	--	--		<0.030	N/A		76	66
	7.0	--	--		<0.030	N/A		0.066	99.97
				lab verification	<0.020	N/A	*lab verification*	0.059	99.97
	8.0	--	--		<0.030	N/A		0.10	99.95
	--	1.0	--		<0.030	N/A		220	0.0
	--	5.0	--		<0.030	N/A		160	27
	--	8.0	--		<0.030	N/A		8.8	96
	--	--	1.0		<0.030	N/A		210	4.5
	--	--	5.0		<0.030	N/A		170	23
	--	--	8.0		<0.030	N/A		80	64

Table 1
Treatability Study Results - AECOM, Niagara Falls, New York

Soil Sample	Formulation (wt %)			Arsenic			Lead		
	CaO	MgO	Portland Cement	Total Arsenic (mg/kg)	Leachable Arsenic (mg/L)	Reduction in Arsenic (%)	Total Lead (mg/kg)	Leachable Lead (mg/L)	Reduction in Lead (%)
Treatment Goals					5			5	
D P-11b (0'-1') 071812 2012 07 004	--	--	--	37	0.045		85,000	930	
	1.0	--	--		<0.030	N/A		640	43
	5.0	--	--		0.036	83		440	61
	6.0	--	--		<0.030	N/A		170	85
	7.0	--	--		<0.030	N/A		0.16	99.99
				lab verification	<0.020	N/A	*lab verification*	0.18	99.98
	8.0	--	--		<0.030	N/A		0.20	99.98
	--	1.0	--		0.13	38		920	19
	--	5.0	--		0.031	85		440	61
	--	8.0	--		<0.030	N/A		0.83	99.9
	--	--	1.0		0.21	0.0		1110	1.8
	--	--	5.0		0.10	51		1130	0.0
	--	--	8.0		0.10	51		200	82

Notes:		
	--	No chemical added for the treatment.
	N/A	Data is not available.
	🟨	The result is at or below the treatment goal.

Table 2
Application Parameters - AECOM, Niagara Falls, New York

Sample	CaO (Quicklime) (% by weight)	Maximum Temperature[1] (C°)	Strength[2] (ton/ft^2 penetrometer)	Moisture[3] (% by weight)
P-20 (0'-1') - 071812 (ReSP Lab No. 2012 07 001)	0	24.0	<0.5	5.3
	7	N/A	N/A	5.1
	8	29.5	<0.5	N/A
P-16 (0'-1') - 071812 (ReSP Lab No. 2012 07 002)	0	24.1	<0.5	6.8
	7	N/A	N/A	6.2
	8	27.9	<0.5	N/A
P-18 (0'-1') - 071812 (ReSP Lab No. 2012 07 003)	0	23.7	<0.5	6.0
	7	N/A	N/A	5.4
	8	27.5	<0.5	N/A
P-11b (0'-1') - 071812 (ReSP Lab No. 2012 07 004)	0	23.4	<0.5	5.1
	7	N/A	N/A	4.5
	8	26.5	<0.5	N/A

Notes:

[1] Fifty grams of the untreated material was mixed with 8% by weight CaO and then mixed with 30% by weight deionized water. The temperature measured for the table above indicates the highest temperature reached within the first 30 minutes following the addition of water to the treated sample.

[2] The samples from the maximum temperature test were allowed to rest for 24 hours in sealed containers. Then each sample was measured for strength using a pocket penetrometer. None of the samples had strength above 0.5 ton/ft^2. None of the untreated samples could support the weight of the penetrometer. However, all of the samples with 8% CaO could support the weight of the penetrometer.

[3] Each of the as-received samples were mixed with 7% by weight CaO and tested for moisture content.