TREATMENT ALTERNATIVES EVALUATION
AMERICAN CYANAMID SUPERFUND SITE
IMPOUNDMENTS NO. 1 AND 2

540534

SUBMITTED TO:

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FOCUS PROJECT NO. 081002

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ACRONYMS AND ABBREVIATIONS

ACI	American Consumer Industries
ARARs	Applicable, Relevant, and Appropriate Requirements
BTEX	benzene, toluene, ethylbenzene, and xylene
Btu	British thermal unit
$^{\circ}C$	degrees Centigrade
CA	coal aggregate
CAA	Clean Air Act
$CaCO_3$	agricultural lime
CaO	quicklime
$Ca(OH)_2$	hydrated lime
CFB	circulating fluidized bed
CFR	Code of Federal Regulations
DTA	differential thermal analysis
$^{\circ}F$	degrees Fahrenheit
FFS	focused feasibility study
Focus	Focus Environmental, Inc.
FRP	fiberglass reinforced plastic
HDPE	high density polyethylene
HWC	Hazard Waste Combustor
HC	hard-crumbly
HTSD	high temperature simulated distillation
hr	hour
H_2S	hydrogen sulfide
ID	inducted draft
lb	pound
LOS	light oil sludge

MACT	Maximum Achievable Control Technology
NESHAP	National Emission Standards for Hazardous Air Pollutants
PCB	polychlorinated biphenyl
Pfizer	Pfizer Inc.
OBG	O'Brien & Gere
QMG	Quantum Management Group
RCRA	Resource Conservation and Recovery Act
SO_2	sulfur dioxide
SVOC	semi-volatile organic compound
TCLP	toxicity characteristic leaching procedure
TGA	thermogravimetric analysis
TSDF	treatment, storage, and disposal facility
U.K.	United Kingdom
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
VR	viscous-rubbery
WC	water cap

1.0 EXECUTIVE SUMMARY

1.1 PROJECT OVERVIEW

The American Cyanamid Superfund Site in Bridgewater, NJ (the Site) is a 435 acre industrial property located within an urban area comprised of a mixture of commercial, residential, and industrial properties. The site previously contained 27 separate waste storage impoundments, most of which have been remediated. Impoundments 1 and 2 contain sludge residues from the distillation of light oil from a coking process. The sludge primarily consists of both viscous-rubbery (VR) material and hard-crumbly (HC) material. A water cap (WC) is used in both impoundments to control fugitive emissions. The impoundment materials have very challenging material handling properties, are highly odorous, produce high concentrations of fugitive volatile organic compound (VOC) emissions when disturbed, and have a low pH value (1-4) because of the presence of sulfuric acid.

1.2 PROJECT OBJECTIVES

The overall objective of this project is to perform a preliminary technical, regulatory, and cost screening of technologies which may be applicable for performing remediation services at the site. Recommendations will be made regarding additional analytical data needed to evaluate these technologies and bench-scale, pilot-scale, or full-scale testing needed to demonstrate each technology. The recommended technologies will be evaluated in detail during a subsequent Focused Feasibility Study (FFS).

The project is being conducted by a team comprised of three firms, including O'Brien & Gere (OBG), Arcadis, and Focus Environmental, Inc. (Focus). The work of the three consulting firms is being coordinated by Quantum Management Group (QMG) for Pfizer.

O'Brien & Gere is responsible for evaluating waste excavation, materials handling, in-situ treatment, and containment technologies. Arcadis is primarily responsible for evaluating fugitive air emission generation and control issues and evaluating in-situ stabilization alternatives to render the material safe for excavation. Focus is primarily responsible for evaluating waste excavation, pretreatment, and thermal treatment alternatives. Focus' specific scope of work includes:

- Review existing site investigation and treatability reports to determine what data exists that may be required to plan, design, and implement material excavation and thermal treatment remedies.
- Perform a data gap analysis to determine what additional data may need to be collected to implement material excavation and thermal treatment remedies.
- Provide recommendations for treatability tests (lab, pilot, or full-scale) that may be required to implement material excavation and thermal treatment remedies.
- Identify and evaluate materials handling technologies that may be appropriate for removing the materials from the impoundments.

- Evaluate various thermal treatment alternatives that could potentially be used to treat the excavated materials. These alternatives include:
  - Cement kiln processing of materials (offsite)
  - Circulating fluidized bed (CFB) utility boiler processing of materials (offsite)
  - Indirect thermal desorption with fuel recovery (offsite)
  - Commercial hazardous waste incineration (offsite)
  - Indirect thermal desorption with fuel recovery (onsite)
  - Mobile incineration (onsite).

1.3 CONCLUSIONS

1.3.1 Data Gap Analysis

Extensive site investigations have been conducted for Impoundment 1 and Impoundment 2 materials over a period of approximately 30 years. A comprehensive site investigation was conducted by OBG in 2010. Sufficient high quality data are available in the 2010 OBG report for most of the analytes that are typically addressed in site characterization studies. These parameters include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, aldehydes, explosives, polychlorinated biphenyls (PCBs), alcohols, and general chemistry parameters (chloride, cyanide, nitrogen (ammonia), nitrogen (nitrate), nitrogen (nitrite), pH, sulfite, sulfide, and total phenolics).

The major analytical data gaps that were identified by Focus are related to material handling properties, thermal properties, material safety properties, and corrosion and materials of construction. The parameters for which additional data are required to perform the FFS include viscosity, acidity, moisture, ultimate analysis, proximate analysis, sulfur, ash fusion temperature, melting point, flash point, calorific value, and high temperature simulated distillation. Additional data will be required for detailed design, including corrosion studies and materials of construction compatibility (non-metals).

1.3.2 Excavation, Dewatering, Neutralization and Material Handling

A number of excavation techniques were evaluated, including the use of hydraulic dredging and mechanical excavation using cranes or trackhoes with various types of buckets (clamshells, dragline, or excavator bucket). This analysis concluded that the highest ranked excavation technique was to use a trackhoe with an excavator bucket with a thumb. The thumb would be use to hydraulically extrude water from the impoundment materials, to the extent practical, in the excavator bucket. Removing water by this method may raise the pH of some categories (VR, HC, etc.) of dewatered materials sufficiently that they could be accepted at some offsite treatment facilities without further onsite neutralization or blending with dry reagent materials.

The excavation would be conducted using a structural or floating containment cell. A water cap would be maintained over the excavation area and an oil cap would be installed on top of the water cap. The water cap would be amended with a hydrated lime slurry to assist in neutralizing excavated materials. The oil cap would absorb fugitive VOCs released from the disturbed material during the excavation process.

1.3.3 Thermal Treatment Systems

Based on the analysis presented in this report, the thermal treatment options were ranked with the lowest ranking value indicating the most favored option and highest ranking value indicating the least favored option. The alternatives were ranked as follows:

1. Cement kilns
2. Thermal desorption with fuel recovery (onsite)
3. Thermal desorption with fuel recovery (offsite)
4. Hazardous waste incineration (offsite)
5. Hazardous waste incineration (onsite)
6. Utility boiler (offsite).

A discussion of the pros and cons of each technology is presented below.

Cement and Aggregate Kilns

The primary advantages of cement kilns are as follows:

- Cement kiln technology has been used for over 20 years and is well developed for recovering energy from high calorific value materials.
- Several cement companies are potentially capable of accepting Impoundment 1 and 2 impoundment materials.
- Cement kilns currently processing impoundment materials are operating under both Resource Conservation and Recovery Act (RCRA) and Clean Air Act (CAA) permits.
- Impoundment 1 & 2 materials will require blending with reagent materials to develop a friable material that can be fed with conventional hoppers, belt conveyors and screw conveyors. Cement kilns can use cement kiln dust for this purpose, which would be recycled to the cement kiln anyway. Therefore, this blending would not affect the rate at which the cement kiln could process impoundment materials.
- Blending impoundment materials with cement kiln dust will generate fugitive VOC emissions, which can be controlled by conducting this operation in an enclosed building and using the building ventilation air as combustion air in the cement kiln.
- Cement kilns operate at temperatures in the range of 2,500-2,900°F and are highly efficient at destroying all organic components of the waste.
- Ash materials in the waste is incorporated into cement products, therefore, no additional land disposal is required for residual materials.

- Sulfur dioxide (SO_2) produced by combusting impoundment materials reacts with alkali components of the cement raw materials, removing as much as 95% of the SO_2 within the combustion process.
- Cement kilns, aggregate kilns, and utility boilers will have the smallest carbon footprint of the offsite technologies evaluated. Virtually all of the carbon in the impoundment material will be combusted to CO_2, but the use of waste as a fuel offsets the use of coal as a primary fuel.
- Cement kilns have moderate waste treatment costs relative to the other thermal technologies evaluated.

The primary issues related to the use of cement kilns include:

- In some cases, permits would need to be modified to accept hazardous solid materials or materials carrying specific RCRA waste codes (D001-ignitable, D002-corrosive, D018-benzene).
- Material handling system upgrades may be required for some cement kiln systems in order to accept and process the viscous impoundment materials.
- Sulfur in impoundment materials causes cement clinker to become sticky and slag on internal equipment and increases stack SO_2 emissions. The concentration of sulfur in impoundment materials fed to most cement kilns is limited to a range of approximately 0.5-2.0%. The average sulfur content of the impoundment materials is in the range of 6-8%. Therefore, impoundment materials must be blended with large quantities of low sulfur content wastes from other sources to meet the feed material sulfur concentration limit. The requirement to blend the sulfur content of the impoundment materials down will control the annual waste acceptance rate for the impoundment materials.
- Chlorine, sodium and potassium also affect the cement chemistry. The impacts of these elements on the cement manufacturing process must be evaluated on a site-specific basis, taking into account the concentrations of each element in waste derived fuels, cement raw materials, and coal used as auxiliary fuel. Sodium and potassium can have a positive effect in cement kilns since they react with sulfur and chlorine to form salts that can be removed from the system.
- Many cement kilns are currently operating at less than full capacity due to the low demand for cement products. For example, many cement kilns may currently be operating for only one month out of every two month period. Two or more cement kilns would need to be contracted to minimize waste delivery disruptions during site remediation periods when a cement kiln is not operating or accepting waste shipments.

<u>Thermal Desorption with Fuel Recovery</u>

The primary advantages of thermal desorbers with fuel recovery are as follows:

- There are three potential thermal desorption contractors that operate treatment, storage, or disposal facilities (TSDFs) and one contractor that has a fleet of six mobile thermal desorption systems.
- Thermal desorption technology is well developed, has been used for approximately 20 years, and has been developed specifically to treat high organic content wastes, primarily from the petroleum refining industry.
- Stationary thermal desorption facilities have RCRA and CAA permits in place
- Thermal desorption system may potentially recover from 40-60% of the VR and HC materials as a saleable fuel product, partially offsetting the cost of treatment.

- Implementation of an onsite thermal desorption treatment system would eliminate the cost of transporting impoundment materials to an offsite commercial facility (located in Texas or Michigan).
- The thermal desorption system will have a moderate carbon footprint compared to the other technologies evaluated. The carbon footprint will be larger than cement kilns, aggregate kilns, and utility boilers but smaller than incinerators. Focus estimates that approximately 40-60% of the carbon in the impoundment material may be recovered as oil. This oil can be used as a fuel and offset the use of other fossil fuels. Implementing an onsite thermal desorption system would also reduce the carbon footprint by eliminating fuel used by offsite transportation of impoundment materials. However, the recovered residual materials would still be transported offsite and generate a carbon footprint.
- Thermal desorption treatment will have moderate waste treatment costs compared to the other thermal treatment technologies.

The primary issues related to the use of a thermal desorption system include:

- A significant mass of reagent material may need to be blended with the impoundment material to achieve acceptable material handling characteristics. The additional mass of reagent material added by this required blending will affect the overall waste treatment rate and annual waste treatment capacity.
- Implementation of an onsite thermal treatment system may generate significant regulatory and community relations issues.
- Use of an offsite thermal desorption system will result in large transportation costs for the impoundment materials.

Hazardous Waste Incinerators

The primary advantages of hazardous waste incinerators are as follows:

- The technology is well developed, has been used for over 20 years, and there are four firms operating six facilities which are potentially capable of treating the waste.
- Incineration destroys the organic components of the waste and converts the inorganic components to an ash which may be land disposed. Since no usable products or fuels are produced, incineration is less sensitive to the chemical characteristics of the feed material than the other thermal treatment technologies evaluated.
- Offsite hazardous waste incinerators have RCRA and CAA permits in place and are generally permitted to process a wide variety of RCRA waste codes.

Issues associated with hazardous waste incinerators are as follows:

- Most of the offsite commercial hazardous waste incinerators primarily process solids packaged in drums and have limited or no bulk solids feed capabilities.
- Because of the high calorific value of the wastes, materials may require re-packaging in small drums (20 gallons) to be fed to a commercial incinerator.
- Waste treatment costs for stationary commercial hazardous waste incinerators are very high relative to the other thermal treatment alternatives evaluated.
- Use of an offsite incineration system will result in large transportation costs for the impoundment materials.

- There are currently no operational mobile incineration systems in the U.S. or contractors offering mobile incineration services. A mobile incinerations system could be developed by modifying an existing directly heated thermal desorption system or by constructing a new system. However, the entire capital cost of the equipment would likely need to be absorbed by the project.
- Hazardous waste incinerators will have the largest carbon footprint of the offsite technologies evaluated. Virtually all of the carbon in the impoundment material will be combusted to CO_2. Auxiliary fuel will also be required in the rotary kiln to initiate combustion of the impoundment materials and in the thermal oxidizer to complete the destruction of organic compounds.
- Implementation of an onsite incineration system may generate significant regulatory and community relations issues.

Utility boilers

The primary advantages of utility boilers are as follows:

- The technology is well developed and has been used for approximately 20 years.
- The technology is well-suited to processing high sulfur content materials because limestone can be fed into the combustion chamber to react with any SO_2 that is produced.
- Cement kilns, aggregate kilns, and utility boilers will have the smallest carbon footprint of the offsite technologies evaluated. Virtually all of the carbon in the impoundment material will be combusted to CO_2, but the use of waste as a fuel offsets the use of coal as a primary fuel.
- Estimated treatment costs at the utility boiler (excluding onsite pretreatment costs) are far less than costs for any of the other technologies evaluated.

Issues associated with utility boilers are as follows:

- Only one utility boiler was identified that is currently processing impoundment materials.
- This facility does not have a RCRA permit to accept any hazardous materials.
- It is highly unlikely that the impoundment materials could be pretreated at the site using reagents to render the material non-hazardous.
- Due to new regulations (which have currently been stayed by the court), it is likely that utility boilers will not be able to accept waste derived materials after 2014 without obtaining a RCRA permit.
- The utility boiler facility does not plan to apply for a RCRA permit that would allow them to accept waste derived materials that require a RCRA permit for treatment.

1.3.4 Treatment Schedules

Treatment schedules for both onsite and offsite treatment technologies were based on processing 50,272 tons of dewatered impoundment materials. Treatment schedules for offsite cement kilns, aggregate kilns, and thermal desorption were based on each vendor's estimated annual waste acceptance capacity. Waste acceptance capacities for incinerators were based on assumed fractions of typical thermal capacities. Waste acceptance capacities are primarily based:

- Capacity to process the sulfur in the impoundment material (because of cement chemistry issues)
- Amount of liquid fuels that are available from other sources for blending with impoundment solids

- Amount of total capacity that would be allocated to impoundment materials versus amount needed to service other clients.

Treatment schedules for onsite treatment with a mobile incinerator or mobile thermal desorption systems were based on mass and energy balance calculations to calculate instantaneous throughput capacities and application of a 70% operating factor to calculate annual capacities.

Total estimated waste treatment schedules are as follows:

- Offsite aggregate kiln 12.6 years
- Offsite cement kilns 5-8.4 years
- Offsite thermal desorber 5.6 years
- Offsite hazardous waste incinerator 7.7 years
- Onsite mobile thermal desorber 5.6 years
- Onsite mobile incinerator 7.6 years.

Treatment schedules can be shortened by utilizing more than one treatment outlet or using multiple mobile systems.

1.4 RECOMMENDATIONS

1.4.1 Waste Characterization

A waste sampling and analysis program should be implemented to fill the data gaps described in Section 1.3.1.

1.4.2 Excavation Pilot Testing

A detailed discussion and analysis of alternative impoundment materials excavation methods is presented in Section 3.0. Based on this analysis, the recommended method of waste excavation is to use a long-reach trackhoe. The trackhoe would be equipped with an excavation bucket and thumb which could be used to compress the excavated materials and dewater them to the extent practical. The excavation would be conducted using either a structural or floating containment cell. The water cap would be amended with a hydrated lime ($Ca(OH)_2$) slurry to raise the pH of the water, absorb acid gases, and neutralize impoundment materials as they are raised through the water cap. A floating oil layer would be used on top of the water cap to absorb fugitive VOC emissions. It is essential that all of these excavation and emission control concepts be tested at a pilot scale to determine their effectiveness.

1.4.3 Materials Handling Bench and Pilot Testing

Materials handling pilot tests should be conducted by each potential offsite disposal facility. These tests would involve blending impoundment materials with dry reagents (cement kiln dust, cement kiln raw materials, thermal desorber solids, etc.) that are readily available at the site. Mixtures containing various ratios of impoundment materials to dry reagents should be tested using the full-scale materials handling equipment at the facility.

1.4.4 Thermal Treatability Testing

Based on the analysis of thermal treatment alternatives, one of the most viable alternatives from a technical, regulatory and cost perspective is to use impoundment materials as a fuel in a cement kiln. Waste acceptance testing should initially be conducted at two cement kilns. One of the kilns should use a "blend to liquid fuel" approach and the other kiln should use a "blend to solid fuel" approach. Waste acceptance testing requires 1-liter size samples of each material and bench-scale testing requires 5-gallon bucket quantities of materials.

If the waste acceptance tests results indicate that the facilities can receive the wastes, bench-scale tests should then be conducted. One test would include blending impoundment materials with various types of liquid fuel wastes that are available at the facility. This test would include preparing liquid waste fuel to impoundment material blends at various ratios. Typical ratios would be in the range of 2.5:1 to 5:1. For each blend, the physical and chemical properties of the mixture (viscosity, sulfur content, calorific value), and the ability to maintain the blended material in suspension would be measured or observed. The mixture with the best fuel and material handling properties would then be tested on a full-scale.

The second bench-scale test would be conducted at a facility that would blend the impoundment materials with cement kiln dust or powdered cement kiln raw materials and feed the material as a bulk solid using a conveyor system. This test would include blending various ratios of dry reagents to impoundment materials to determine the optimum blend. Criteria to be used in determining the optimum blend include the amount of reagents required, the amount of effort required to blend the materials, and the material handling properties of the mixture. The bench-scale tests would require 5-gallon bucket quantities of each material.

If bench-scale tests are successful, full-scale tests should then be conducted. These tests would include blending, handling, and processing impoundment materials using the full-scale equipment that is available at each facility. The amount of impoundment materials fed to a cement kiln would be very small relative to the total mass of raw materials (limestone) and other fuels (coal) processed. Therefore, it is unlikely that feeding impoundment materials would have any measurable effect on most cement kiln operating parameters, with the possible exception of SO_2 emissions. During tests at both facilities, data should be gathered to support engineering calculations to assess the increase in SO_2 emissions above a baseline measured when impoundment material was not being fed. These full-scale tests would require 1-2 roll-off boxes of material for each type of material to be tested (VR, HC, etc.).

1.4.5 Thermal Treatment Pilot Testing – Thermal Desorption System

Thermal desorption with fuel recovery is also a viable alternative for treating the impoundment materials from a technical, regulatory and cost perspective. For the thermal desorption system, bench-scale and full-scale tests should be conducted to evaluate material pretreatment requirements and treatment process results.

For treatment at offsite thermal desorption facilities, it is likely that impoundment materials would need to be fed using the existing materials handling equipment because the facility services a large number of clients. Bench-scale tests should first be conducted by blending the impoundment materials with a reagent material (cement kiln dust, lime kiln dust, boiler ash, sand, recycled thermal desorber solids, etc.) to determine the optimum ratio of reagents to impoundment materials to feed the material as a bulk solid. The reagent material should be chosen based on local availability, cost, and material handling property modification effectiveness.

The second phase of bench-scale treatability testing would be to use a bench-scale thermal desorber to determine the approximate distribution of products (oil, treated solids, non-condensable gases) produced by treating the impoundment material. These tests should be conducted using both raw impoundment materials (to get the best precision on analytical and mass balance results) and blends of impoundment materials with reagent materials (to check for chemical reactions between impoundment materials and reagents). These tests would be performed in a commercial laboratory that routinely conducts these types of tests.

If bench-scale testing is successful, full-scale testing would be recommended using blended feed material. The primary objectives of the test would be to determine the achievable waste feed rate, determine the required solids treatment temperature, and collect samples of each residual stream for analysis. Samples of feed material, treated solid materials, and collected oil should be collected. The treated solid materials would be analyzed to determine compliance with waste disposal requirements (RCRA land disposal restrictions). Samples of the recovered oil would be analyzed to determine the calorific value, viscosity, water content, ash content, metals content, sulfur content, and halogen content.

If a thermal desorption system were implemented onsite, a material handling system could be designed specifically for the application to eliminate the solids blending requirements. A conceptual design for such a system might include a screw feeder with some type of hydraulically actuated “pusher” to keep material from bridging in the hopper. This concept would need to be tested on a pilot scale.

2.0 HISTORICAL DATA EVALUATION

2.1 OVERVIEW

The primary objective of this section is to perform a data gap analysis regarding the analytical data and treatability test data needed to plan, design, and implement a thermal treatment remedy (including materials handling components). The analytical data gap analysis was performed by first defining the analytical data needed to implement various types of materials handling methods and either onsite or offsite thermal treatment remedies. Factors that were considered included:

- Regulatory requirements
- Material pretreatment and handling requirements
- Thermal treatability of the material
- Potential to generate stack emissions
- Potential to generate fugitive emissions and odors
- Materials of construction requirements (both metallic and non-metallic)
- Potential to generate slag or cause damage refractory in thermal treatment devices.

The analytical data gap analysis also included reviewing historical site investigation and treatability test reports and summarizing and/or cross referencing analytical data that are applicable to a thermal treatment remedy. The available analytical data were then compare with the required analytical data in order to define the analytical data gaps that should be filled during subsequent site investigation, treatability, and pilot studies.

The data gap analysis also included reviewing historical treatability test reports, evaluating the results, and comparing the results to treatability data needed to implement various types of materials handling and thermal treatment remedies. Where sufficient data exists, it will be used in evaluating remedial alternatives. Where data are insufficient or non-existent, recommendations will be made regarding treatability test programs to be conducted during future phases of work.

2.2 ANALYTICAL DATA NEEDS

Table 2-1 contains a list of analytical data parameters which are required to plan, design, and implement various types of thermal treatment alternatives. Table 2-1 also contains regulatory cross-references and comments describing why the data are required to implement a thermal remedy. Thermal treatment remedies that were considered in developing Table 2-1 include combustion of impoundment materials for energy recovery in cement kilns or utility boilers, treatment in a thermal desorption system for recovery of recyclable oil, and high temperature incineration. Not every parameter in Table 2-1 applies to every technology.

2.3 DATA RESOURCES

2.3.1 Reference List

There have been many site investigation and treatability studies conducted for the management, treatment and remediation of the Impoundment 1 and 2 materials over approximately the last 30 years. Table 2-2 lists 36 reports that were provided to Focus by QMG and/or OBG.

2.3.2 2010 OBG Report

In 2010, OBG conducted an extensive site investigation and collected a large number of composite samples. The report resulting from that work is titled "*Former American Cyanamid Site Impoundments 1 and 2 Characterization Program Summary Report, November 16, 2010.*" The OBG report is referred to in this document as the "2010 OBG Report". The sampling plan was designed to characterize each impoundment as a whole by collecting samples from a representative horizontal grid as well as from various depths within each impoundment.

OBG identified the following specific types of primary impoundment materials within both impoundments:

- Water cap (WC): a water cap is maintained on top of each impoundment to suppress fugitive emissions. The water cap in Impoundment 1 overlays a synthetic liner, whereas the water cap in Impoundment 2 overlays impoundment materials. Therefore, the chemical composition of the water caps is somewhat different between the two impoundments.
- Viscous-rubbery (VR) material: material is black and tar-like and very cohesive. The material is difficult to handle due to cohesion and tackiness. The physical properties of the material vary with temperature, becoming more fluid at increasing temperatures. This material is generally present as the upper layer of impoundment material in each impoundment.
- Hard-crumbly (HC) material: material is black and resembles broken asphalt. The material is not cohesive and can be easily broken by hand into small pieces. This material is generally present at the bottom layer in each impoundment.

Smaller quantities of other types of materials were also identified:

- Coal aggregate (CA) material: Grey fine-grained material, reported in the 2010 OBG Report to have been placed on the surface of Impoundment 1 to attempt to construct a stable surface. It has also been reported that coal "fines" were placed directly into Impoundment 1 and used to create ramps and berms during a materials handling investigation in the 1980s[20]. The coal aggregate material was found in Impoundment 1 only, and appears to have shifted deeper into the impoundment over time.
- Clay-like material: grey color similar to CA material, cohesive and fine grained. Generally located in the upper portion of Impoundment 1 only.

- Sand/silt-like material: this material is a brown, fine-grained non-cohesive material that was located in the middle to lower portion of Impoundment 1 only.
- Fine-grained white material: This material resembles spent lime and floated to the surface during sampling events. This material was encountered in Impoundment 2 only.
- Yellow oily liquid: found suspended at two intervals, from 3-4 feet below the top of the impoundment materials and again from 6-7 feet. This material was encountered in Impoundment 1 only.

Detailed analytical data were collected for each of the primary types of materials (HC, VR, WC) plus the CA. Limited analytical data were also collected for the yellow oily liquid. No data were collected for the sand/silt-like material, clay-like material, and fine-grained white material. In addition to the various types of solid/sludge and liquid matrix samples that were collected, air headspace samples were also collected for the WC, VR, HC and CA materials.

A summary of the types of chemical analyses that were conducted for each matrix is presented in Table 2-3. Detailed analytical data and statistical analyses of these data are presented in the OBG 2010 report and are not reproduced in this report.

2.3.3 Historical Documents

Historical documents include site investigation and characterization data, remedial evaluation reports, thermal treatment and materials handling treatability test reports, and reports addressing other miscellaneous topics. Many of the older reports provide useful analytical data along with the results of treatability tests for various technologies. The results from these reports may be used in scoping and planning future treatability tests. However, a number of data quality issues were identified with the historical data, some of which have been described on page 4 of the 2010 OBG Report. These issues include:

- Historical samples were generally collected from non-specific sampling locations and were biased to the more accessible areas near the impoundment berms.
- Sampling objectives were generally to support treatability testing for specific technologies or other activities and samples may have been intentionally biased to account for worst case waste characteristics.
- Many of the historical studies were based on grab samples which may not have been representative of the contents of the impoundments.
- Many of the historical samples were collected more than 20 years ago. Analytical technology has advanced, allowing for evaluation of compounds at lower detection limits. Historical data may artificially bias statistical results high because of high analytical detection limits.
- Characteristics of the impoundment materials may have changed substantially over time due to weathering (loss of volatiles, chemical reactions, etc.), removal of materials from the impoundments (light oil sludge removed from Impoundment 1 between 1965-66 and from Impoundment 2 between 1986-87), or materials added to impoundments (CA added to the Impoundment 1 in 1985).

- Various methods of collecting and handling samples were used, which resulted in a wide range of water contents of the samples “as analyzed” or “as used” in treatability studies. In many cases, the moisture basis for an analysis (“as received”, “dewatered”, or “dry”) was not reported. The failure to report the moisture content basis for some samples lends uncertainty to the interpretation of the data.
- Analytical methods were not always clearly defined and/or some analytical techniques that were used may have not been appropriate for the waste matrix. For example, moisture content was sometimes determined by drying when high concentrations of VOCs were present that would have been lost during the drying step and reported as water.

2.4 DATA COMPILATION

In order to compare data needs with available data, a waste characterization database was developed to summarize the existing data. The fields in the database include the document author, document title, document date, type of study (site characterization or treatability), waste type (VR, HC, WC, etc.), impoundment number, specific analyte or parameter type, analyte concentration or parameter value and units (for selected data), analytical method, comments, and page or table number where the data were located.

Due to the large amount of data available, the data were “filtered” before entering them into the database. In all cases, the existence of data for specific parameters, analytes, or an analyte group (i.e., target analyte list for VOCs, SVOCs, or metals) in a given report was recorded in the database. For selected analyte concentrations or other parameters, numerical values were entered into the database. For other analyte concentrations or parameters, values were incorporated by reference via footnotes.

The OBG 2010 Report analytical data are very comprehensive and were collected from a number of representative samples. All of the data from the OBG 2010 Report were incorporated by reference into the database. In addition, analytical detection concentration values for benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, regulated metals, sodium, and general chemistry parameters from the 2010 OBG report were entered into the database. These parameters have a number of critical health and safety, regulatory, and process implications. Selectively entering these data into the database allowed statistical summaries to be generated for each category of materials (VR, HC, WC, etc.) within each impoundment, whereas the OBG 2010 Report combined data from all waste categories and impoundments into a single statistical summary per analyte. The purpose of reducing the data in this manner was to determine if there were significant differences in chemical characteristics between waste categories or impoundments that may affect waste excavation, pretreatment, or treatment approaches. The conclusion from this analysis was that the chemical characteristics for each category of material (VR, HC) were very similar between the two impoundments.

The data from the OBG 2010 Report are considered to be most representative of current conditions within the impoundments and generally have a higher quality than data from previous studies. Where data for an analyte that was measured in the 2010 OBG Report was identified in other studies, the availability of the data in the other studies was recorded but the concentration values or other numerical parameters were not entered into the waste characterization database.

However, there were a number of parameters and/or analytes that had been recorded during previous studies that were not included in the OBG 2010 Report. These waste characterization parameters typically were related to the application of a specific technology, such as thermal treatment or solidification. Examples of these types of parameters included calorific value, sulfur content, moisture content, density, corrosivity, flash point, etc. In all cases, available numerical values for these types of analytes or parameters were entered into the database.

A statistical summary of what is believed to the most representative site characterization and treatability data are presented in Table 2-4. These data are segregated by impoundment and are sorted by waste stream type. Full printouts of the raw data are included in Appendix A (sorted by analyte or parameter, waste stream, impoundment number, and reference number).

2.5 ANALYTICAL DATA GAP ANALYSIS

An analytical data gap analysis was prepared by comparing the analytical data needed to implement a materials handling and thermal treatment remedy (Table 2-1) with available data resources (Table 2-4 and Appendix A). Table 2-5 lists the required data and whether the existing data are sufficient or if an analytical data gap exists. Table 2-6 recommends analytical methods to be used in the future to fill identified data gaps.

It should be noted that all offsite treatment facilities (cement kilns, utility boilers, thermal desorbers, and incinerators) will require samples of impoundment materials for waste acceptance analysis. Each facility has a suite of analyses that are performed, including in some cases analytical methods that have been developed by the facility. If impoundment materials are destined for offsite treatment, many of the data gaps may be filled by having potential disposal facilities perform waste analyses as part of their waste acceptance procedures. For evaluation on on-site treatment alternatives, data gaps should be filled by having analyses conducted by Pfizer's contractors.

In some cases, some data may be available for a parameter but insufficient information are available to determine the quality of the data. For example, some of the data in historical reports is reported on a dry basis, some is reported on a wet basis with the moisture content specified, some is reported on a wet basis without the moisture content specified, and some is reported with no indication of whether the results are reported on a wet or dry basis. Because of the large range in water content that may be present in samples of impoundment materials, all data should be interpreted within the context of what is known about the moisture content of the sample.

In general, adequate and high quality data are available in the 2010 OBG report for most of the analytes that are typically addressed in site characterization studies. These parameters include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, aldehydes, explosives, polychlorinated biphenyls (PCBs), alcohols, and general chemistry parameters (chloride, cyanide, nitrogen (ammonia), nitrogen (nitrate), nitrogen (nitrite), pH, sulfite, sulfide, and total phenolics). In addition, the OBG 2010 report includes data on the concentration of compounds in the head space for containers of various types of the impoundment materials.

In terms of evaluating materials handling and thermal treatment remedies, the major data gaps are related to material handling properties and combustion properties of the materials. A brief synopsis of the major data gaps is provided below. It should be noted that virtually all of the offsite thermal treatment contractors require samples for waste acceptance testing. They typically prefer to perform testing in their own laboratories rather than relying on data generated by third parties. Thermal treatment contractors may also use their own proprietary test methods or methods of interpreting the data that are unique to their own equipment.

The data gaps have been divided into two groups, those that need to be filled to perform a feasibility analysis of an alternative and those that are required for detailed design of an alternative. The feasibility study data gaps include:

- RCRA Toxicity Characteristic Leaching Procedure (TCLP) – offsite disposal facilities will require that the impoundment materials be analyzed for RCRA characteristics for VOCs, SVOCs, pesticides, herbicides and metals.
- Inorganic chemical analysis - sodium and potassium in the feed material to cement kilns may be beneficial in that they react with sulfur and chlorine and forms a fluxing agent that prevents slagging within process equipment. Analysis of boron is required for compliance with New Jersey air emission regulations.
- Flash point – Flash point is important because of health & safety, materials handling, offsite transportation of materials, impoundment material acceptance by offsite TSDFs, and Resource Conservation and Recovery Act (RCRA) waste characteristic classification.
- Proximate analysis – Proximate analyses (moisture, ash, volatile matter, and fixed carbon) are required to perform mass and energy balances for thermal treatment systems.
- Moisture – Moisture is a critical parameter in estimating the impoundment material throughput capacity for any type of thermal treatment device and estimating the amount of aqueous condensate that will be generated by a thermal desorption system. Moisture will be determined as part of the proximate analysis, however, it is determined by a drying method that may evaporate volatile compounds and bias the moisture results high. Therefore, moisture analyses will also be conducted using Karl Fischer titration methods (ASTM D203-08). Moisture analyses will be conducted on samples of materials that have been dewatered by various methods to test the dewatering efficiency.
- Ultimate analysis – Ultimate analyses (C, H, O, N, S, Cl, Br, F) are required to perform mass and energy balances for thermal treatment systems.
- Sulfur forms – The form (sulfate, pyritic, and organic) and concentration of sulfur in the impoundment material has several impacts on all types of thermal treatment systems. These include the amount of SO_2 generated during combustion, which (1) affects the selection of materials of construction and process operating condition to minimize corrosion, (2) affects the design of the scrubbing system to control SO_2 emissions, and (3) affects the quantity of reagents

(hydrated lime or sodium hydroxide) required to scrub SO_2 from the gas stream. Some effects of sulfur are treatment technology specific. For thermal desorption systems with fuel recovery, the distribution of sulfur in recovered oil (which will be sold) versus the solids product (which will be land disposed) affect the value of the recovered oil. Cement kilns typically have a specification on the amount of sulfur that is allowed in the blended fuel material because sulfur causes the cement clinker to become sticky and fouls process equipment. The concentration of sulfur in the impoundment material will limit the rate at which a cement kiln can accept the Impoundment 1 and 2 materials and ultimately the rate at which the site remediation can be conducted if a cement kiln is chosen as the thermal treatment technology.

- Calorific value – Calorific values are required to perform mass and energy balances for thermal treatment systems and to estimate the potential fuel value of the material. Calorific values will be reported on a dry basis so that the "as fed" calorific value can be calculated based on the results of dewatering studies.
- Melting point – The impoundment materials will be dewatered onsite and shipped offsite as a solid material. The "stickiness" characteristics of the impoundment materials as a function of temperature should be investigated to determine how the material behaves (i.e., melts or becomes sticky) as a function of temperature.
- pH – offsite disposal facilities have waste acceptance limits for the pH of materials that they may receive. The minimum pH limit is typically in the range of 2-4. Samples of dewatered materials will be tested for pH to confirm that materials can meet offsite facility waste acceptance limits.
- Ash fusion temperature – Sodium hydroxide was used as a neutralization reagent in the process that originally generated the sludge. Limited analytical data indicates that concentrations of sodium in the VR and HC materials are in the range of 5,000 mg/kg. Sodium salts can form slag that attacks refractory in hazardous waste incinerators. Ash fusion temperature data will be collected to determine the range of temperatures over which slagging problems may occur.
- High temperature simulated distillation (HTSD) - HTSD tests will be conducted to determine the fraction of the impoundment materials volatilized as a function of temperature. HTSD tests will be used to estimate the amount of recyclable oil and solid residual products that might be produced by heating the impoundment materials to alternative temperature end points. HTSD analyses will be used to set process operating conditions for evaluating both onsite or offsite thermal desorption with product recovery options.

The data gaps that should be filled to perform a detailed analysis of alternatives include:

- Corrosivity – The average pH of the VR and HC materials is in the range of 1-4. The low pH of these materials may present severe corrosion issues for some types of metal equipment. To date, very limited corrosion studies have been conducted only for impoundment materials in contact with carbon steel at ambient temperature conditions under both quiescent and mixed conditions. Corrosion studies are recommended to be conducted for other materials of construction that may be considered for process equipment. In addition, thermal equipment will operate at elevated temperatures at which corrosion rates may be significantly higher than at ambient conditions. Therefore, corrosion studies should also be conducted over a range of elevated temperatures. It should be noted that the pH of a sample depends to a large degree on the moisture content of the sample. Therefore, corrosion studies should be conducted for impoundment materials with moisture contents representative of both in-situ and dewatered conditions.
- Materials compatibility – The high concentration of solvents in the Impoundment materials will affect the selection of non-metallic components of a waste treatment system (plastics, rubber, etc. used in belts, hoses, gaskets, piping, etc.). These materials should be compatible with the types and concentrations of solvents that are present. Some of the required material compatibility data

are readily available in the literature. However, limited material compatibility testing may be required for some materials of construction.

2.6 SUMMARY OF PREVIOUS TREATABILITY TEST RESULTS

A number of bench-scale treatability tests have been conducted on the solid components of the Impoundments which are relevant to potential materials handling and thermal treatment remedies. Topics addressed in these tests include:

- Evaluation of viscosity of impoundment materials blended with fuels or solvents
- Evaluation of combustion characteristics of impoundment materials blended with fuels or solvents
- Evaluation of the material handling properties of impoundment materials blended with Portland cement, limestone aggregate, or other proprietary reagents
- Solidification treatability studies
- Solid phase biological treatment, including benzene stripping evaluations
- Indirect thermal desorption bench-scale treatability studies (studies from three vendors).

A brief synopsis of treatability studies on each of these topics is presented in Section 2.6.1 through 2.6.5. The objective of this section is to provide a general description of the scope of each test to provide a quick reference to available resources. The original study should be reviewed to for a description of detailed test conditions and results.

2.6.1 Fuel/Solvent Blending

A number of studies were conducted in the early 1980's regarding blending impoundment materials with fuels or solvents to develop a usable fuel. These studies were all directed towards developing a liquid material that was suitable for firing through a burner. The desirable characteristics of such a fuel include high calorific value, low viscosity, small particle sizes, and consistent calorific value. It should be noted that some of the cement kilns that are currently utilizing waste fuels fire them through a lance instead of a burner. Fuels fired through a lance have less stringent quality requirements than those fired through a burner.

<u>Petroleum Associates, Letter - Evaluation of Light Oil Sludge Material as Fuel, 01/21/83 (Reference 4)</u>

A test burn was conducted at Ohio State University to determine if the viscosity of the sludges could be reduced to pumpable levels by blending sludges with toluene, kerosene, No. 6 fuel oil, or hexane. They were unable to achieve a mixture that pumped, atomized and combusted properly with the equipment utilized.

OBG, Letter - Fuel Preparation Study - Impoundments 1 and 2 (Reference 9)

Materials from Impoundments 1 and 2 possess recoverable energy value, high acidity, and high sulfur concentrations. OBG conducted a study to investigate preparing a liquid fuel from the impoundment materials. Various solvents (trichloroethylene, monochlorobenzene, acetone, toluene, xylene, diesel oil, kerosene, and several solvent blends) were used to reduce the viscosity of the samples. The best solvents for most samples were the chlorinated cyclic hydrocarbons followed by cyclic compounds such as xylene and toluene. In general, diesel oil was a poorer solvent than kerosene. Alcohols did not dissolve most of the waste sludges. It was noted that grinders were required to reduce the HC material to a small particle size to prevent subsequent separation into distinct layers. Focus believes it would be impractical to blend the impoundment materials with chlorinated solvents because hydrochloric acid would be generated during the combustion of the chlorinated materials which would require additional gas scrubbing capacity.

Various compositions were produced using a Centrimil (a centrifugal impact mill consisting of a high speed rotor with impact mills around its periphery). Compositions 1-4 and 8 contained a large percentage of light oil sludge (LOS). Blends containing up to 50% HC material were found to be possible. Composition 5 (modified) contained 34.8 % VR, 43.5% HC, and 21.7% toluene, with a viscosity of 38,000 cps @ 88°F after Centrimil processing. Composition 6 contained 50% HC and 50% No. 6 fuel oil, with a viscosity after Centrimil processing of 11,400 cps @ 86°F. Composition 7 contained 60% HC and 40% No. 6 fuel oil, with a viscosity of 176,000 cps after processing at 93°F. Observation of the blended samples a month later showed an increase in viscosity.

Zorex Corporation, Memo - Test Burn at Ohio State University (March 25-26, 1983) (Reference 11)

Various No. 6 fuel oil dilutions with Composition 5 from the OBG Fuel Preparation Study were tested for combustion efficiency when incinerated. Numerous fuel delivery system modifications were made to overcome material handling and fuel incompatibility issues. Pump cavitation due to solvent boiling was noted at 60°C.

OBG, Fuel Blending Summary Report/Test Burn Report (Reference 13)

The overall objective of the fuel blending facility was to achieve a homogenous mixture of the three layers (LOS, VR, HC) of Impoundments 1 and 2 with a maximum particle size of 100 microns and a viscosity of 15,000-20,000 cps. A total of ten fuel blends were produced using monochlorobenzene and xylene as solvents. Four of these blends, selected as test burn blends, were successfully used as fuels during a pilot plant incineration test at Trane Thermal’s laboratory facility. All four of the test burn blends contained significant percentages of LOS, in addition to HC and VR material.

P.S. Brzozowski, Memo - Fuel Blending Volume Reduction (Reference 12)

A 30-50% decrease in HC material volume was witnessed during fuel blending facility operations. The material was crushed prior to blending which resulted in a smaller particle size and higher bulk density than the original material. The waste also settled to a smaller volume due to the static pressure of the materials in the drums.

OBG, Letter - Impoundment 2 LOS-VR Evaluation (Reference 17)

Bench-scale testing was performed on material from Impoundment 2 to determine the viscosity and stability of various LOS/VR blends and to estimate power requirements for a full-scale mixing system. This information is of limited use as the LOS material has since been removed from Impoundments 1 and 2.

2.6.2 Combination Material Handling and Thermal Treatment Tests

ABB, Bartlett-Snow Rotary Calciner Treatability Test Report (Reference 26)

Testing in a batch-scale calciner (indirect thermal desorber) was conducted to determine the process feasibility for the application. Two feeds from Impoundments 1 and 2 were tested. One was a mixture of tar (moisture content not specified) and the other was a mixture of tar and approximately 18% Portland cement containing 20% moisture. After several adjustments to the system temperature and screw feed system to reduce the formation of balls of material, it was determined that a product exit temperature of 300°F and retention time of 30 minutes would be capable of reducing the benzene concentration to below the TCLP limit.

OBG, Group III Impoundments CMS_FS Volume 2 (Reference 29)

Development of feed stock for thermal desorption testing was comprised of Phase I and Phase II conditioning trials.

Phase I primarily focused on material handling aspects, while the objective of Phase II was to produce a mixture consistent with thermal desorption technology requirements. Tests were conducted on mixtures containing materials from the HC, VR/HC, and VR layers of Impoundments 1 and 2. Conditioning agents used during Phase I included between Portland cement (15-30% by weight), cement kiln dust (20-25% by weight), and a powdered limestone (20-25% by weight) and hydrated lime (5% by weight) mixture. Based on comparisons of tackiness, pH, temperature, and particle size, the VR/20% Portland cement mixture was chosen for Phase II conditioning and thermal desorption testing. The Phase I tests also included measurements of fugitive VOC and acid gas emissions from each blend of material.

During Phase II conditioning, limestone aggregate was added to the Phase I sludge in amounts sufficient to reduce the calorific value to 1,000 Btu/lb and the sulfur content to 1-2%. These parameters were based on input from four thermal contractors selected for thermal desorption testing. This resulted in feed mixtures with a Phase I/limestone aggregate mixture of 22:1, 16:1, 12:1, and 10:1. Two aerobic systems, SoilTech's Low Temperature Thermal Aeration system and OBG's Low Temperature Thermal Desorption system were chosen. The two anaerobic systems selected included SoilTech's Anaerobic Thermal Processor system and Roy F. Weston's Low Temperature Thermal Treatment system. Detailed analytical results from each vendor's test are included in Reference 29.

OBG, Group III Impoundments Field Demonstration Test (Reference 30)

This report describes the results of pre-treatment and treatment activities that were conducted as part of a thermal desorption pilot study. Phase I conditioning consisted of adding Portland cement at 5% by weight increments to raw impoundment materials contained within a 30 yd^3 roll-off container. The material was mixed for 30 minutes with an excavator. For some batches, granular limestone ($CaCO_3$) was used in lieu of Portland cement as the conditioning agent. After 30 minutes of mixing, pulverized lime was added in 2.5% by weight increments to increase the heat of hydration and the volatilization of organic compounds. Mixing was continued for an additional 30-45 minutes. Phase II conditioning consisted of adding 9 yd^3 of 1-1/2 inch angular granite aggregate to each of the Phase I batches. The roll-off box was equipped with a cover and emission capture system. The ventilation gas was treated through a particulate filter and activated carbon. Extensive air sampling was conducted for the ventilation gas for VOCs, particulates, carbon monoxide, hydrogen sulfide (H_2S), and lower explosive limit (LEL). The appearance, pH, and temperature of the material during the mixing operation were also recorded.

Thermal desorption tests were conducted using a directly heated thermal desorption system. This test was generally unsuccessful in treating the materials because of condensation of water and organics in the offgas cleaning system.

2.6.3 Solidification Tests

American Cyanamid, Hazcon Solidification Technology Evaluation, 02/06/90, (Reference 19)

Three solidification formulations were tested and compared as remedial alternatives for the contaminated impoundment materials in Impoundments 2 and 6. Two were proprietary formulations owned by Hazcon (Cloronan) and Harmon (various commercial additives). A third test was conducted by American Cyanamid with organophillic clay for comparison. All three alternatives were found to reduce the leachability of the organic constituents in the impoundment materials by approximately 70%; however, the results were not within acceptable TCLP limits. Long term structural stability of the material was not determined by this effort and there was a significant increase in product volume.

2.6.4 Solid Fuel Blending Tests

Kipin, Coal Blending Tests (Reference 25)

An attempt was made to remediate the impoundments by blending waste anthracite coal with the impoundment waste. The contractor assembled and operated a facility on-site to produce the solid fuel product. Two major problems occurred, off-site odor complaints and an inability to develop a market for the product. During excavation of the material, the contractor unintentionally drained the odor suppressing water cover into the excavation hole. The loss of the water cover allowed solar radiation to heat the impoundment materials, releasing odiferous organic compounds. This project demonstrated the requirement to maintain a liquid cover over the impoundments at all times.

2.6.5 Solid Phase Biological Treatment

American Cyanamid, Solid Phase Treatment of Impoundment 1 & 2 Material, 12/01/91 (Reference 23)

Biotreatment was investigated to determine if volatiles present in the Impoundment 1 and 2 materials could be treated to TCLP standards. Pretreatment was required to neutralize, strip benzene, and bulk the material to improve material handling and air flow properties for aerobic composting. There was a significant increase in product volume following the bulking operation but the type and amount of bulking material was not described in the report. Air stripping proved to be an effective method of removing the benzene, with 84-99% of the benzene being removed within two days. However, further treatment was required to meet the benzene TCLP standards. Greater than 99% of the benzene was removed after 7 days of treatment.

2.6.6 Indirect Thermal Desorption

Three indirect thermal desorption treatment processes have previously been tested on a bench-scale basis for materials from Impoundment 1 and Impoundment 2. These studies include:

- Littleford Process Pilot Study, 11/12/91 (Reference 21)
- Remediation Technologies, Draft Report – Bench Thermal Treatability Study, 12/01/91 (Reference 22)
- SoilTech, Bench-scale Test of SoilTech Anaerobic Thermal Process for Desorption of Organic Contaminants, 12/01/91 (Reference 24).

These reports provide information on the types and quantities of residual streams produced over waste treatment temperatures ranging from 230°F (Littleford), 270-528°F (Retec) and 750-1,100°F (SoilTech). The Littleford and Retec studies had distinctly different goals than the SoilTech study. The objectives of the Littleford and Retec studies, both of which were conducted at relatively low waste treatment temperatures, were to simply remove the volatile compounds and produce residual solids that could be used as fuel in a cement kiln. The Littleford process produced a solid fuel product with a calorific value ranging from 7,200-12,900 Btu/lb. Retec added quicklime (CaO) to the feed due to the low pH and equipment pitting concerns. No pitting of the steel components of the system was observed during the testing.

The objective of the SoilTech study, which was conducted at a much higher operating temperature, was to vaporize as much as possible of the impoundment material to use it as a fuel within the SoilTech process. This approach also minimized the amount of residual solids produced which required land disposal.

2.7 MATERIAL TAKEOFF CALCULATIONS

The total in-situ wet mass of materials to be managed was estimated using material volume estimates provided by OBG. These estimates were based on waste profile data in the 2010 OBG Report, historical waste density values for VR and HC materials, and waste density values for other parameters that were derived from handbook, literature, or Focus historical data. The total in-situ mass of each category of materials was separated into water and dry mass based on an assumed in-situ moisture content value. It should be noted that the assumed in-situ moisture content of some categories of materials may be lower than values that have been reported in historical reports for Impoundments 1 and 2. This is because the sampling techniques that were used to collect samples during some historical studies included water from the water cap rather than reflecting true in-situ conditions for each layer of impoundment material.

An estimate of the dewatered mass of each category of materials was also prepared based on assumed dewatered moisture contents. The assumed dewatering technology would include a combination of gravity drainage and mechanical extrusion. The results of the material takeoff calculations for both in-situ and dewatered conditions are presented in Table 2-7.

3.0 MATERIAL EXCAVATION, PRETREATMENT, HANDLING, AND TRANSPORTATION

3.1 OVERVIEW

There are a number of process steps that may be required prior to final treatment of the impoundment materials. These steps fall into the general categories of material excavation, pretreatment, material handling, and transportation. The purpose of Section 3.0 is to:

- Define design and operating objectives for each of these areas
- Describe both conventional and innovative methods for performing each of these functions
- Rate each of the methods relative to the respective objectives
- Recommend methods that should be considered for further engineering evaluation and/or for bench, pilot, or full-scale testing.

The primary objectives of the material excavation, pretreatment, handling and transportation processes include:

- Achieve waste management rates that match the capacity of the final waste treatment process or processes. Annual waste treatment capacities for a single waste treatment process are in the range of 5,000-15,000 tons/year.
- Maintain a liquid cap over all contaminated materials in the impoundments until the materials are removed from the impoundment in order to minimize fugitive emissions of VOCs and acid gases (SO_2 and H_2S)
- Minimize the disturbance of impoundment materials as they are removed from the impoundments in order to minimize the release of fugitive emissions
- Minimize the exposed surface area of disturbed impoundment materials in the impoundment and in unenclosed material handling equipment to minimize the release of fugitive emissions
- Minimize the time duration that surfaces of impoundment materials are exposed to the ambient air
- Control the chemistry of the water cap to capture acid gases and neutralize the excavated waste to the extent practicable
- Collect and treat fugitive emissions to the extent necessary to protect site workers and the public
- To the extent practicable, dewater materials during the excavation process to meet offsite treatment facility acceptance criteria (no free liquids)
- Neutralize acid materials in-situ and/or in conjunction with the excavation process to the extent practicable
- Minimize exposure of metal parts (particularly complex mechanical assemblies and hydraulic systems) to corrosive environments
- Minimize exposure of non-metallic parts (plastics and rubber) to solvent-laden environments that may damage materials
- Minimize the amount of ancillary treatment required for managing excavated materials (water treatment, material dewatering, neutralization, reagent blending).

3.2 MATERIAL EXCAVATION

3.2.1 Excavation Issues

Site-Specific Excavation Issues

There are a number of site-specific excavation issues that will apply to any material removal method because of the design, construction methods, size, and geometry of the waste impoundments. Plan and cross-sectional views of the impoundments are presented in Figure 3-1 and Figure 3-2, respectively (figures obtained from Reference 20). Each impoundment is approximately 300 feet wide by 300 feet long and contains about an 8-10 foot depth of impoundment materials with a 1-4 foot deep water cap. Both impoundments were constructed of materials present onsite.

Lagoon 1 was designed as a 2.1-acre site with a depth of 16 feet from the top of the berm to the top of the lining soil with a working volume of 8.3 million gallons (Reference 4, page 14). The lagoon bottom was lined with a layer of approximately 12 inches of clayish-silt material (Reference 4, page 14). Lagoon 2 was designed as a 1.7-acre site with a depth of 13 feet from the top of the berm to the top of the lining soil with a working volume of 7.1 million gallons (Reference 4, page 18). The lagoon bottom was reportedly lined with a layer of approximately 12 inches of clayish-silt material (Reference 4, page 18).

Key questions regarding the logistics of excavating the impoundments include:

- Should both impoundments need to be excavated simultaneously to maintain the same hydrostatic head in both impoundments to prevent hydraulic heave (upwelling of water and/or waste) in an excavated impoundment caused by the hydrostatic head of material in the un-excavated impoundment?
- To what extent will other impoundment materials flow into the excavated area during the excavation of impoundment material?
- To what extent is the flowability of the various types of impoundment materials dependent on the ambient temperature?
- Should the impoundments be excavated in lifts (~1-2') to gradually lower the water table to prevent the water cap from running into the excavation hole and exposing the impoundment material surface?
- Should water be added to the impoundment to replace impoundment materials as they are removed?
- Should the impoundments be backfilled with soil or rock as they are excavated to maintain the water cap at a constant elevation?
- How will the "rind" of impoundment materials, remaining on the impoundment berms, be removed in order to prevent odors as the elevation in each impoundment is lowered while impoundment materials are being excavated?
- Will the impoundment berms be able to structurally support the equipment that would be used to excavate the rind?
- Once an area is excavated, can a rock road be built on top of the clay liner without the weight of the rock road and any equipment operating on the road, puncturing the clay liner?

- Should the clay layer be reinforced with load bearing plates (wooden swamp mats or equivalent) to allow rock roads to be built on the clay layer?
- What are the consequences if the clay layer is penetrated?

Equipment Specific Excavation Issues

Issues to be considered for any type of excavation equipment include:

- Ability to dig through stiff or hard materials (especially in cold weather)
- Amount of disturbance of impoundment materials in the impoundment, which may increase fugitive emissions
- Ability of the excavation equipment to reach the impoundment materials from the berm (or outside of the berm)
- Ability to contain the excavated materials and minimize exposure to the air
- Ability to dewater the excavated materials during the excavation process
- Accuracy in controlling excavation depth to avoid damaging the clay layer on the bottom of the impoundments
- Amount of mechanical and hydraulic equipment components, which may be damaged by sulfuric acids or solvents in the waste and the potential cost to periodically repair or replace these components
- Capital and operating costs of the equipment
- Capacity of the excavation equipment relative to the capacity of the ultimate waste disposal facility to process the material.

3.2.2 Alternative Excavation Methods

Several potential material excavation alternatives were evaluated:

- Hydraulic dredging
  - Hydraulic dredging with auger head
  - Hydraulic dredging with cutter head
  - Water jet and pump
  - Heat and pump

- Mechanical excavation
  - Auger
  - Clamshell bucket
  - Dragline bucket
  - Excavator bucket.

A Focus representative attended the Western Dredging Association (WEDA) national meeting in Nashville, Tennessee on June 5-8, 2011. Discussions were held with a number of firms that perform environmental dredging and excavation work, manufacture dredging equipment, and provide add-on equipment and services (GPS systems, software, etc.). The following sections present Focus' opinions based on previous experience with excavation of other impoundment materials and information gathered from environmental dredging and excavation contractors and equipment suppliers at the WEDA conference.

3.2.3 Hydraulic Dredging

Hydraulic Dredge with Auger Head or Cutter Head

Hydraulic dredges operate by suspending the material to be dredged as a slurry, pumping the slurry to a dewatering system, separating the solid materials from the water, and recycling the water back to the impoundment. The concentration of solids in the slurry is typically in the range of 15% by weight. Hydraulic dredges are most applicable for removing relatively soft sediments with small particle sizes (silts, clays, soft sludges). Hydraulic dredges may be equipped with various types of heads to fluidize the materials to be removed. There are two common types of hydraulic dredges: auger heads (Figure 3-3) and cutter heads (Figure 3-4). These hydraulic heads may be mounted to a swinging ladder, which has one end fixed, and the depth of the other end can be adjusted. The ladder can also swing from side to side, within approximately a 60° arc. These types of dredges would normally be mounted on a boat; however, because of the depth of the water cap in the impoundments, the acidity of the water in the impoundments and the difficulty of accessing the impoundments, a boat mounted dredge would not be practical for this application. However, it might be possible to custom design mechanical components of a dredge system that could be mounted on a crane and access the material from the impoundment berm or constructed civil works. The primary advantage of a hydraulic dredge is that it could potentially remove materials from below a floating water cap without breaking the water surface. However, there are a number of potential issues with hydraulic dredging:

- Cutter heads would agitate the impoundment materials, potentially resulting in high VOC emission rates through the water cap
- Loss of fugitive emissions from slurry water during subsequent solids separation and water treatment steps
- Plugging of pipes with viscous materials, especially during cold weather or unplanned shutdowns
- Mechanically-complex equipment submerged in an acid and solvent-laden environment, resulting in corrosion damage for expensive mechanical equipment or the requirement to utilize more corrosion-resistant materials of construction (stainless steels)
- Large infrastructure required for water handling, water treatment, and waste solids dewatering.

Because of the issues cited above, Focus does not believe that it is practical to use a hydraulic dredge to remove the materials from the impoundments. Focus is aware of one remediation project (Sydney Tar Ponds in Sydney, Nova Scotia), in which impoundment material was dredged and an attempt was made to pump the slurry to an on-shore treatment facility. The project failed because the sludge materials plugged the piping, particularly during cold weather, and could not be transported to the treatment system.

Hydraulic Dredging with Water Jetting and Pumping

High-pressure water systems are commonly used for tank cleaning by fluidizing the residual materials in the tank and then pumping the slurry to a container or treatment system. Conceptually, a water jet and pump system would be similar to a hydraulic dredge except that the dredge cutter head would be replaced by a water jet system. The water jet and pump system would generally have the same advantages and issues as the hydraulic dredge.

Hydraulic Dredging by Heating and Pumping

Impoundment materials could conceivably be heated in-situ to lower the viscosity of the materials and then pumping the impoundment materials to a container. Focus has not been involved in any application using this approach; however, a conceptual design of such a system might include the features described below.

A heat exchanger consisting of a series of bayonet type heat exchangers (which are typically used to heat tanks) would be mounted on a frame. The heat exchanger would be heated by circulating hot oil (Dowtherm, Therminol, or equivalent) through the equipment. The heat exchanger would be lowered into place with a crane. Flexible piping would be used to connect the heat exchanger to the hot oil heating system. Once the viscosity of the material was reduced sufficiently, it could be pumped out of the impoundment. Key issues to be considered for this approach include:

- Heating impoundment material will raise the vapor pressure of VOC compounds, increasing the fugitive VOC emission rate
- Treatability testing would be required to determine the temperature at which the viscosity of the materials would allow the material to readily flow to the suction of a pump and be pumped through a pipeline
- The high viscosity of the heated impoundment materials may make it difficult for the materials to flow to the inlet suction line of a pump
- Heating unconfined impoundment materials would result in high heat losses to the surrounding impoundment materials, the water layer, and the ambient air. The water cap and water in the impoundment materials would prevent the impoundment material from being heated to a temperature above the boiling point of water (212°F)
- Pumping the heated materials through a pipeline would be a difficult challenge because of the temperature of the materials, the need to utilize flexible piping, and the logistics of frequently moving the heat exchanger, pump, and piping to new locations

- There would be significant safety concerns with handling hot oil in equipment that would be exposed to an acid environment and would need to be moved frequently
- Heating and pumping could potentially be applicable to VR material and possibly HC material. It would not be applicable to the CA material or the clay-like or sand/silt-like materials.

3.2.4 Mechanical Excavation

Mechanical excavation can be conducted using either cranes or trackhoes to operate some type of bucket or auger. Various buckets (clamshell buckets, dragline buckets, or excavator buckets) can be used to remove the impoundment material. A brief description of the advantages and issues of each combination of equipment is presented below.

Cranes

The chief advantage of a crane is the long reach. Each impoundment is approximately 300 feet long by 300 feet wide. Cranes are available with sufficient reach to excavate materials at the center of the impoundments with the crane sitting outside of the impoundment berms. The chief disadvantage of using a crane is the high rental cost and long cycle times because of the need to transfer impoundment materials over a long distance. Rental cost for a conventional crane, with a 200 foot reach, would be approximately $14,000/month (with no attachments) plus $35,000/month in operating costs (including a two man crew, insurance, fuels, consumables; but excluding taxes). Purchase costs for environmental buckets may range from $5,000-$10,000 for carbon steel materials of construction. Operating costs for excavating impoundments would be somewhat higher than these values because of health and safety requirements.

Trackhoes

The chief advantage of a trackhoe is its mobility and moderate capital cost. The estimated cost for a Caterpillar 324 or equivalent trackhoe is $200,000 for used equipment and $300,000 for new equipment respectively. The monthly rental cost for a Caterpillar 324 (or equivalent long reach trackhoe) would be approximately $10,000/month plus $25,000/month in operating costs (including a one man crew, insurance, fuels, and consumables; but excluding taxes).

One limitation of a trackhoe is its reach, which is defined as the distance from the center of the equipment to the tip of the bucket. A super long reach backhoe (Caterpillar 324 or equivalent) has a reach of 61 feet (Caterpillar Performance Handbook, 39th Edition, page 4-143). Accessing materials at the center of an impoundment will require excavating an area of the impoundment and then backfilling the excavated area to provide a stable working surface to reach subsequent areas of the impoundment.

A second limitation of a long reach trackhoe is the maximum weight that can be lifted with the boom and stick fully extended. The maximum size of the bucket and any attachments would be limited because of this weight limitation. A trackhoe would not be able to lift heavy construction materials, such as containment structures, with the boom and stick fully extended.

Augers

An auger could potentially be mounted on a trackhoe to bore into the waste and auger it out to a second transfer conveyor. The auger could be designed to perform a waste dewatering function. The performance of the auger could be affected as the material handling properties of the impoundment materials change as a function of ambient temperature. At low ambient temperatures, the material may become stiff and not flow to the inlet end of the auger. At high ambient temperatures, the material may become more fluid and difficult to convey through the auger, especially at steeper auger slopes as the deepest impoundment material is excavated. An auger-based system would have very limited reach into the impoundments and would have to be implemented by excavating an area and then backfilling to form a stable base from which the trackhoe could operate. The auger would have a limited zone of influence at the inlet end of the auger and it would be difficult to remove materials from the bottom of the impoundment with a high degree of precision.

Clamshells

Clamshells consist of a two-sided bucket that closes around the impoundment material. Conventional clamshell buckets are designed to maximize production rates, with little emphasis on dewatering materials or controlling fugitive emissions. However, environmental clamshell buckets (Figure 3-5) are designed to both dewater materials and control fugitive emissions. These buckets typically close from both sides, press the solids to dewater them, and include flexible vents on top of the bucket through, which water is removed. The vents close once most of the water is removed from the bucket of material.

Clamshells are typically operated by a crane but can also be attached to a trackhoe. The clamshell buckets may be opened and closed either by using a series of cables and pulleys or by using hydraulic actuators attached to the clamshell or mounted on the stick of an excavator (Figure 3-5). Clamshells are equipped with cable and pulley closure mechanisms, which rely on the weight of the bucket to sink into the material to be excavated. According to one manufacturer of cable operated clam shell buckets, clamshell buckets are typically used to excavate relatively soft materials. Soft materials have a blow count of 5 or less, as defined by ASTM Method D1586 (blows per 6 inches with a 140 pound hammer falling a distance of 30 inches) (personal conversation between Angela Berlin, Focus Environmental, Inc. and Ray Bergeron, CableArm, August 22, 2011). Sampling data for the impoundment materials (presented in Reference 4) indicate that the HC materials range from 5 to 150 blow counts, with an average of 23 blow counts for Impoundments 1 and 2, collectively. Blow count data were not available for the VR materials, which were documented in Reference 4 as “pushable”. Therefore, clamshells equipped with cable and pulley closure mechanisms may be appropriate for excavating the VR material, which makes up about 20% of the total in-situ volume of the impoundment materials.

Clamshell buckets with cable and pulley closure mechanisms may not be appropriate for excavating the HC material, which makes up about 50% of the in-situ volume of impoundment materials. Excavating the HC materials with a clamshell would require using a hydraulic closure mechanism. However, the clamshell bucket could be immersed in up to 10 feet of low pH water and solvent-laden impoundment material during excavation operations. Damage to the hydraulic system in this environment is a significant concern. According to Caterpillar, the cost to disassemble and repair a hydraulic system on a Cat 324 excavator would be in the range of $60,000 (personal communication, Bill Troxler, Focus Environmental with Mike McCormick, Caterpillar, August 18, 2011). Therefore, a custom-designed trackhoe stick would be required to mount the hydraulic system far enough away from the clamshell bucket so that it would not be exposed to acid and solvent-laden impoundment materials. Sacrificial rods might be used to connect the hydraulic cylinder to the clamshell bucket.

Dragline Buckets

A dragline bucket is an open excavation bucket connected to a cable that is dragged through the impoundment material to be excavated. Draglines can be used to excavate stiff or hard materials. However, they create extensive disturbance to the material being excavated as the excavation bucket is dragged through the waste, which could lead to an increase in VOC emissions. Dragline buckets also require a larger operating area than either clamshell buckets or excavator buckets and could be difficult to operate inside of a small excavation cell.

Excavator Buckets

A typical excavator bucket may be fitted with either teeth (for ripping hard materials) or have a smooth face (for excavating softer materials). The bucket is attached to a stick on a trackhoe and operated by a hydraulic cylinder. The same issues with hydraulic systems that were discussed under the clamshell bucket above would also apply to the excavator bucket.

An excavator bucket can also be equipped with a thumb, which is typically used to grasp materials. The thumb may be rotated by a hydraulic actuator or it may be stationary. Figure 3-6 presents photographs of an excavator bucket with a standard hydraulic thumb.

For this application, the thumb would be modified to fit tightly inside of the bucket when it is full of excavated material. A curved plate with a contour similar to the back of the excavator bucket would be attached to apply force to hydraulically extrude the water from the impoundment material in the bucket. The bucket would be modified with holes or slots to drain the water from the bucket. Figure 3-7 presents a conceptual diagram of the excavator bucket and thumb. In this design, the thumb is stationary and does not require a hydraulic actuator system.

One concern with this type of system would be discharging the material from the bucket after a significant force has been applied to extrude the water from the material. Material can typically be discharge by shaking a bucket or banging the bucket on the ground. For this application, a frame with a "banging bar" might be required over the receiving container. Another alternative, which might be used to aid in releasing the material from the bucket, would be to lubricate the empty bucket with oil from a floating oil layer as described later in this section. A third alternative would be to coat the bucket with a high-density polyethylene (HDPE) coating. The coating could be applied as a spray, similar to the process used to apply pick-up truck beds liners. The durability of this type of liner would depend on the type of material being excavated and would need to be determined by pilot testing.

3.2.5 Excavation Summary

Table 3-1 summarizes the issues associated with each type of potential material excavation mechanism. Green dots denote positive attributes of the technology, yellow dots denote neutral attributes of the technology, and red dots denote significant concerns with the technology.

3.2.6 Excavation Pilot Test Recommendations

Based on the analysis presented above, Focus recommends that full-scale pilot testing should be conducted for waste excavation by using a long-reach trackhoe equipped with an excavator bucket and thumb. The objectives of the pilot testing would include:

- Determine the performance of a modified excavator bucket and thumb in dewatering impoundment materials
- Assess the performance of a chemically amended water cap in suppressing acid gas emissions
- Assess the performance of a floating oil layer in suppressing VOC emissions
- Determine the waste dewatering efficiency and fugitive emission rates over a range of waste excavation rates (yd^3/hr of excavated material)
- Determine the flow characteristics of the materials in the impoundments (i.e., do they flow to backfill the excavation hole under certain ambient temperature conditions?).

The trackhoe would be equipped with a 1 yd^3 bucket with drainage holes or slots and a modified stationary thumb to dewater materials as they are excavated. Excavations would be conducted using a structured containment cell or a floating containment cell similar to the one shown in Figure 3-5.

The first set of test conditions would be to excavate the material through the existing water cap and measure VOCs and acid gas emissions. The second set of test conditions would include dosing the water cap with a hydrated lime ($Ca(OH)_2$) slurry to raise the pH of the water, minimize corrosion of equipment, and absorb acid gases as they are released from the impoundment material. As the filled trackhoe bucket is raised through the water layer, some neutralization of the waste may also be achieved.

The second set of test conditions would also include placing a floating oil layer on top of the water layer. This oil layer would serve three functions: (1) during the descent of the backhoe bucket, it would coat and lubricate the bucket so that excavated materials could be more easily released from the bucket, (2) during the ascent of the backhoe bucket, it would coat the outside of the impoundment material and form a barrier to inhibit loss of VOCs, and (3) it would absorb VOCs emitted by disturbing the impoundment materials.

VOCs have a much higher tendency to partition into oils than into water. The octanol/water partition coefficient presents a relative measure of this partitioning behavior. The VOCs, which are present at the highest concentrations in the impoundment materials, are the BTEX compounds. The log of the octanol/water partition coefficient (K_{ow}) and solubility in water at 25°C of the BTEX compounds are as follows:

	K_{ow}	Solubility
• Benzene	2.13	1,880 mg/l
• Toluene	2.74	535 mg/l
• Ethylbenzene	3.15	161 mg/l
• o-Xylene	2.77	171 mg/l
• m-Xylene	3.20	161 mg/l
• p-Xylene	3.15	200 mg/l.

As shown above, the BTEX compounds are sparingly soluble in water. Once the impoundment materials are disturbed, it is likely that the water layer over an excavation area will become saturated with VOCs. Any subsequent VOCs entering the water column would be emitted to the atmosphere. In contrast, the BTEX compounds are much more soluble in oils (such as octanol) than in water. For example, benzene would partition by a ratio of $10^{2.13}$ parts in octanol to 1 part in water (135:1 ratio).

This remediation concept should be tested on a bench scale to determine the effectiveness of an oil cap in minimizing VOC losses. The type of oil to be used for the floating barrier would need to be determined by further literature review and/or bench-scale testing. The oil could possibly be a material that is inexpensive and readily available, such as used motor oil. Once the oil becomes saturated with BTEX compounds, it could be skimmed off and disposed of or distilled to remove the BTEX compounds and the oil reused as the liquid cap.

Table 3-2 presents a conceptual model for estimating the excavation production rate of a long-reach excavator with a modified thumb. Table 3-3 presents model inputs for each type of impoundment materials and estimated average excavation rates. This model is based on concepts presented in the Caterpillar Performance Handbook, 39th edition. However, the model has been modified to account for the saturated state of the materials as they are excavated from the impoundments, the use of the excavator thumb to dewater material, and the limited bucket fill factor due to the use of the thumb. The input values used in this model should be measured during the pilot test in order to provide a more reliable estimate of achievable excavation rates.

The analysis presented in Table 3-2 and Table 3-3 indicates that estimated excavation rates would be in the range of 20,000-45,000 tons/year for the various types of impoundment materials. The analysis presented in Section 4.0 indicates that the waste acceptance rate for most offsite treatment facilities is likely to be in the range of 5,000-15,000 tons/year. The waste acceptance rate may be increased by contracting with multiple treatment outlets. Therefore, it appears that one excavator would be sufficient for this application.

Full-scale Excavation Concept

During full-scale excavation, a series of three rock roads would be constructed across each impoundment as it is excavated. Figure 3-8 presents a conceptual diagram of the excavation plan. After the trackhoe excavates the material in front of and to the sides of each segment of road, the road would be extended by an incremental amount (~20 feet). The material of construction of the road would need to be selected to withstand the acid conditions in the lagoon and to maintain the material's structural integrity. For example, limestone would not be an appropriate material of construction since it would react with the sulfuric acid in the waste. Granite might be an appropriate material of construction since it is primarily composed of compounds that are not reactive with acids (SiO_2 ~72% and Al_2O_3 ~14%). Acceptability of granite as a construction material would need to be confirmed by compatibility testing with the impoundment material.

3.3 MATERIAL PRETREATMENT

Waste pretreatment operations that may be required to implement subsequent waste transportation or treatment processes include waste dewatering, neutralization, and liquid fuel blending. Dewatering and neutralization would be done at the site in order to meet waste acceptance criteria for offsite disposal facilities. Liquid fuel blending would be performed by a fuel blender at a cement kiln, aggregate kiln or a fuel blending facility. A brief discussion of the objectives of each of these pretreatment steps and potential approaches for conducting each of them is presented below.

3.3.1 Waste Dewatering

Waste acceptance criteria for offsite thermal treatment systems require that material contain no free liquids, as determined by the RCRA paint filter test, 40 CFR 264.313. The estimated in-situ moisture contents of the various types of impoundment materials range from 15% and 35%, as shown in Table 2-7. As these materials are excavated, there will be some mixing with the water cap and the moisture contents are expected to increase.

Waste dewatering methods that were evaluated include:

- Hydraulic extrusion
- Dewatering screw
- Gravity drainage
- Reagent addition.

Different dewatering techniques are likely to be required for the various types of impoundment materials present in the impoundments. A brief discussion of each of these techniques is presented below.

Hydraulic Extrusion

Some dewatering can be accomplished using an excavation auger or an excavator bucket with a thumb to hydraulically extrude water, as described in Section 3.4. This approach is most applicable to the VR material. This is because the viscosity differential between the VR material and water would allow water to flow at a much higher rate than the VR material when both are placed under pressure. This dewatering concept may be less effective for the HC or CA materials, which are more granular in nature and may contain water in the pore space between grains of material. This dewatering method would have limited effectiveness for the clay-like and sand/silt-like materials, which have very fine grain sizes and contain water in the pore spaces between grains of material. These materials would have a tendency to flow when placed under pressure.

Dewatering Screw

A dewatering screw is a modified screw conveyor mounted in a hopper that is set on an incline. As the screw turns, water is liberated and flows to the lowest elevation in the hopper and then to a discharge point. The dewatering screw may require a bridge breaking device to be mounted in the hopper above the screw to prevent bridging of material above the screw. The dewatering screw could be used in conjunction with a hydraulic extrusion system.

Gravity Drainage

Gravity drainage could be performed by transferring the impoundment material into a pretreatment building and either dewatering the waste in (1) a roll-off container, or (2) by dumping the waste into a drainage pit with a sloped floor.

The roll-off container would be equipped with a false floor and installed on a slope to allow the material to drain into an outlet pipe. The roll-off container could be covered to minimize fugitive emissions.

If a drainage pit were used, the water would drain by gravity to the lower sections of the pit and ultimately to a tank. Porous barriers, such as rock gabions, could be placed in the drainage pit to prevent semi-solid impoundment materials from draining to the lowest elevations of the pit and plugging the discharge piping. The pit must be constructed of acid and solvent resistant materials of construction. If the material were spread out in the pit, the waste could be amended by adding reagents to increase the pH of the impoundment material and alter the material handling properties. Fugitive emissions from the dewatering and reagent amendment operations would need to be collected and controlled. Due to the high concentrations of VOCs in the waste, this could be a considerable expense. For example, assuming an average VOC concentration of 5% in the impoundment materials, a 10% loss of VOCs results in 250 tons of VOC emissions from 50,000 tons of dewatered impoundment materials. At an activated carbon loading of 10% by weigh, 2500 tons of activated carbon would be required. Because of the potentially large mass of VOCs, other control mechanisms such as catalytic oxidation and/or thermal oxidation should also be evaluated.

Reagent Addition

Some dry chemical reagents (quicklime, cement kiln dust, lime kiln dust) contain CaO which will chemically react with water to form solid hydrated lime. This technology is commonly used for drying soil materials in construction applications. However, addition of reagents containing CaO to water will generate a large quantity of heat which can increase the volatilization rate for organic compounds. Therefore, bench-scale treatability testing of reagent addition should be done to assess these effects.

3.3.2 Neutralization

Offsite disposal facilities typically limit the range of pH values at which materials will be accepted. The low end of the range varies from 2-4 and the high end of the range varies from 9-12. The pH of the materials in the impoundments typically ranges from 1-4.

Some pH adjustment will be achieved simply by dewatering the impoundment materials. Since the sulfuric acid will primarily be in the water phase, removing as much water as practical will increase the pH of the dewatered material. A variety of reagents could also be used to raise the pH of the impoundment material, including boiler ash, cement kiln dust, lime kiln dust, agricultural lime ($CaCO_3$), quicklime (CaO), and hydrated lime ($Ca(OH)_2$. Reaction of alkali reagents with water and/or sulfuric acid will liberate large amounts of heat, resulting in increased VOC emissions. Reagent materials that are readily available in the vicinity of the site should first be identified. Bench-scale or pilot-scale treatability tests should then be conducted for 2-3 alternative reagents

- Change in pH versus amount of reagent added
- Temperature rise of waste versus amount of reagent added
- VOC emissions versus amount of reagent added
- Change in physical handling properties versus amount of reagent added.

A major challenge in performing pH adjustment will be blending the reagents with the impoundment materials, especially the VR material. Blending will require significant power input via a trackhoe bucket or trackhoe fitted with some type of tilling attachment. Reagent blending could be accomplished in the waste dewatering pit described in the preceding section.

The reagent materials will also modify the material handling properties of the waste. However, they will also add to the mass of any material that is treated offsite and increase disposal costs. Therefore, the pH should only be adjusted to the extent required to meet the waste acceptance criteria for the disposal facility.

Liquid Fuel Blending

A number of cement kilns and fuel blenders currently blend "dispersable solids" with liquid wastes to produce a pumpable liquid fuel that can be fed to the kiln through a lance. The impoundment material must be primarily organic in nature so that it can be dissolved in a liquid waste. Any solids in the impoundment material must be small enough so they can be kept in suspension in an agitated storage tank. The VR and HC materials will likely meet these criteria. However, it is unlikely that the coal aggregate, clay-like, or sand/silt-like materials can be handled by a "blend to liquid" method.

Fuel blenders typically use waste solids to waste liquid ratios ranging from 20% waste solids/80% waste liquids up to 40% waste solids/60% waste liquids. At these ratios of waste solids to waste liquids, it is impractical to perform fuel blending at the site because of the large increase in mass of materials that would subsequently need to be transported to a cement or aggregate kiln. Therefore, any pilot test evaluation of fuel blending should be conducted at the cement kiln or fuel blender, using waste liquids that are available at that facility for blending.

Dry Solids Blending

Some cement kilns have the capacity to pretreat impoundment materials and to feed them as a solid fuel. Pretreatment steps may include shredding impoundment materials and mixing them with drying agents such as cement kiln dust. The shredded materials may then be fed to the cement kiln using either belt or pneumatic conveyors. This method of material handling may be appropriate for the CA, clay-like, and sand/silt-like materials. However, the available commercial capacity for handling impoundment materials by this method is much more limited than the availability of facilities that blend dispersible solids into liquid fuels.

3.4 MATERIAL HANDLING

If a treatment technology requires the impoundment material to be transferred by a belt or screw conveyor, it is likely that the material will need to be amended by mixing it with some type of dry reagent material. The blended material must be friable enough to flow though hoppers and be readily transferred by the conveyor system. The ratio of dry blending reagent to impoundment materials should be determined by pilot testing at the treatment facility. These tests should be conducted using the blending materials that are normally used at the facility. Blending ratios may be as high as 1 part dry solids to 1 part impoundment materials. These tests would determine the amount of pretreatment required to reliably handle the materials using the specific types of conveyors at that facility.

Cement kilns typically use cement kiln dust or powdered cement kiln raw materials as a blending reagent. Since these materials would be fed to the cement kiln anyway, they will not affect the capacity of the cement kiln to treat the impoundment material. For thermal desorbers, any blending material that is mixed with the waste increases the total mass of material to be treated. This reduces the feed rate for the impoundment material.

3.5 MATERIAL TRANSPORTATION

Impoundment materials would be shipped by truck using roll-off boxes or shipped by rail using intermodal containers. Each type of container would typically hold about 15 tons of impoundment material. Each container would require a double plastic liner to contain liquid leaks and to keep the container clean when it is unloaded. Each container would need to be sealed to prevent fugitive emissions. One issue that would need to be determined by pilot testing would be the potential to accumulate flammable concentrations of vapors inside of a sealed container.

4.0 THERMAL TREATMENT ALTERNATIVES - OFFSITE

4.1 OVERVIEW

A number of commercial thermal treatment facilities were evaluated to determine their capability to process the Impoundment 1 and 2 materials from a technical, regulatory, and cost perspective. This section of the report addresses only fixed-base commercial waste thermal treatment systems. Mobile thermal equipment that could provide onsite treatment services is described in Section 5.0. Types of thermal treatment technologies that were evaluated included:

- Cement or aggregate kilns and associated fuel blenders
- Utility boilers
- Thermal desorption systems
- Hazardous waste incinerators.

A map showing the locations of these commercial treatment facilities is presented in Figure 4-1. These facilities utilize a variety of approaches for managing impoundment materials, including feeding the material directly (with or without pretreatment) as a fuel, blending the material with wastes from other generators for use as a fuel, thermally treating the material to fractionate it into an organic fuel quality liquid and/or solid material that can be land disposed, and incinerating the material.

Facilities evaluated by Focus were identified through contacts with trade associations (Cement Kiln Recycling Coalition and Coalition for Responsible Incineration), historical information from Focus files and/or meetings, telephone calls, or other contacts with vendors. Information from each of the potential treatment contractors was collected through questionnaires, teleconferences, and historical information from Focus files. The types of information that were gathered to perform the initial capabilities screening for each facility included:

- Process capabilities (technology used for materials handling, thermal treatment, and disposal of residuals).
- Annual waste processing capacity (total tons/year and tons/year that could be dedicated to the project). This includes consideration of potential downtime due to primary market conditions (i.e. for cement) and/or maintenance activities.
- Regulatory status of the facility, particularly the capability to handle materials with applicable RCRA waste codes (potential waste codes may include D001-ignitabile, D002-corrosive, and D018-benzene toxicity characteristic leaching procedure (TCLP), and whether they have a CAA and benzene National Emission Standards for Hazardous Air Pollutants (NESHAP) certification.
- Waste acceptance criteria (including both chemical and physical parameters). Key specific parameters of concern include sulfur content, calorific value, pH, water content, flash point, and metals.
- Capabilities for shipping and receiving of impoundment materials (i.e., truck, rail, types of containers, physical forms of materials).

- Other potential issues in using the facility (i.e., odor issues, worker health and safety issues, etc.).

An assessment of the potential off-site thermal treatment alternatives for each category of technology is presented below.

4.2 CEMENT KILNS, AGGREGATE KILNS, & ASSOCIATED FUEL BLENDERS

4.2.1 Identification of Facilities

Table 4-1 includes contact information regarding U.S. cement kilns, aggregate kilns, and associated fuel blenders that are currently licensed to process some types of RCRA hazardous materials. All listed cement kiln and fuel blenders are members of the Cement Kiln Recycling Coalition.

A fuel blender identifies, transports, and blends fuels to meet the specifications of a cement company or aggregate company. A fuel blender may either be a wholly owned subsidiary of a cement company and supply fuel exclusively to that cement company or they may be an independent fuel blender that supplies fuel to multiple cement or aggregate kilns. In cases where a cement company owns a captive fuel blending company, fuel blending is typically prepared at the cement kiln facility. Independent fuel blenders typically have their own blending facilities and blended fuels are shipped to multiple locations.

4.2.2 Process Description

Cement kilns are very large (150-600 feet long) rotary kilns that operate at cement production temperatures in the range of 2,500-2,900°F. At these temperatures, virtually all of the organic waste components are destroyed and the sulfur is converted to SO_2. The SO_2 subsequently reacts with and is neutralized by the alkali components of the cement. Pumpable liquid waste fuels may be fed directly to the primary kiln or pre-calciner through a liquid waste lance. Bulk solid waste fuels may be introduced through a feed chute to the pre-calciner or through a feed mechanism mounted in a mid-section of the kiln. Cement and aggregate kilns have utilized impoundment materials for many years as a fuel source.

Aggregate kilns are also large rotary kilns that are used to produce expanded light-weight aggregate. They are different from cement kilns in that they do not processing alkaline materials which can react with SO_2 inside of the kiln. Instead, aggregate kilns utilize a wet venturi scrubber to control acid gas emissions.

Since cement and aggregate kilns are using the fuel value of wastes to reduce their auxiliary fuel usage, they typically will specify a minimum calorific value for materials, which they will accept, with 5,000 British thermal units per pound (Btu/lb) as a common lower limit for waste acceptance. The dewatered VR and HC materials have calorific values far in excess of these values. However, the clay-like and sand/silt-like materials may have lower calorific values, which make them unacceptable as cement kiln or aggregate kiln fuels unless they are blended with higher calorific value materials.

4.2.3 Regulatory Issues

All of the cement kilns and aggregate kilns that are currently processing hazardous wastes have both RCRA and CAA permits. However, their RCRA permits may be for liquids only and/or they may not include permission to process some of the RCRA characteristics codes that are likely to be carried by the impoundment materials, specifically D001 (ignitable), D002 (corrosive), and D018 (benzene). In some cases, cement kilns may not currently have permit conditions that would allow them to accept the impoundment materials but are in the process of modifying their permits or have indicated a willingness to consider pursuing a permit modification.

Since the material has a high concentration of benzene, the facility must also have a CAA benzene NESHAP certification. Some facilities limit the concentration of benzene in the wastes that they accept because they do not have this certification.

4.2.4 Waste Acceptance Criteria

Cement and/or aggregate kilns may have a variety of waste characteristics acceptance criteria, including some or all of the following:

- Prohibitions on accepting waste with free liquids
- Limitations on waste pH value
- Limitations on waste benzene content
- Limitations on waste sulfur content
- Minimum calorific value requirements.

It may be possible to pretreat materials on-site to dewater impoundment materials, increase the pH value, solidify materials, and reduce benzene content. However, the waste sulfur content is likely to be the limiting factor for the rate at which a cement kiln can accept impoundment materials. Cement kilns typically limit the amount of sulfur in the impoundment materials because sulfur can affect the quality of the cement clinker product, cause operational problems because of slagging in the system, and increase stack emissions of SO_2. However, a cement kiln is a very alkaline environment and most of the SO_2 that is produced reacts with alkali materials within the kiln. Data in the literature indicates that the scrubbing efficiency of in-situ SO_2, within cement kilns, is in the range of 95%.

The allowable amount of sulfur in waste fuels depends on the chemistry of the specific cement kiln process and the amount of sulfur in other input materials (i.e., sulfur in coal or raw materials). A typical sulfur concentration limit for impoundment materials as-fed to a cement kiln is in the range of 0.5-2.0%.

The sulfur content of the impoundment 1 and 2 materials ranges from approximately 2 to 11% (wet basis) with an average of approximately 6-8% (wet basis). Therefore, Impoundment 1 and 2 materials will have to be blended with large quantities of low-sulfur content materials from other sources. This required blending will reduce the effective rate at which cement kilns can process the impoundment materials.

The aggregate kiln that was identified does not accept solid fuels. Therefore, the solids would need to be blended to a liquid by a fuel blender before the fuel is delivered to the site. The aggregate kiln has a sulfur limit in the liquid fuel of 1% as fired. Liquids with higher sulfur contents can be accepted, but there is a surcharge of $0.05 per gallon for every 1% of sulfur above 2% in the fuel as delivered. Assuming that the VR and HC solid materials contain 6-8% sulfur, they would have to be blended at about a 4:1 ratio with liquids containing no sulfur to avoid this surcharge. However, this ratio is within the normal range (2.5:1 to 5:1) for liquids to waste blending operations.

To be considered a viable fuel, the impoundment material should have a caloric value of >5,000 Btu/lb (wet basis). The calorific value of the VR and HC materials is in the range of 6,000-12,000 Btu/lb (wet basis), with an average calorific value in the range of 7,000-10,000 Btu/lb (wet basis). After the waste is dewatered, the calorific values will be somewhat higher. The calorific values of the clay-like and silt-like materials in the impoundments are unknown. However, it is likely that these materials will have very low calorific value unless they are blended with VR or HC material. Therefore, an onsite blending operation would likely be required to pretreat the clay-like and silt-like impoundment materials into an acceptable cement kiln fuel quality material. The caloric value of the CA material is also unknown but this material should have a significant calorific value, likely greater than 5,000 Btu/lb.

All of the cement or aggregate kilns would require representative samples in order to evaluate if they can accept the waste.

4.2.5 Shipping and Receiving of Impoundment materials

A cement or aggregate kiln would have to be able to receive the materials as a bulk solid to be considered as a viable outlet for the Impoundment 1 and 2 materials or the solids would have to be blended to a liquid by a fuel blender before they are delivered to the cement or aggregate kiln. Table 4-2 identifies the capability of each identified facility to receive the impoundment material as a hazardous bulk solid or bulk liquid via truck or rail.

Many of the cement kilns and the one identified aggregate kiln are capable of receiving and processing only bulk liquids. Some have liquids heating capabilities, others do not. Based on the viscosity of the impoundment materials and results from previous material handling studies, Focus does not believe Impoundment 1 and 2 materials can be handled as a pumpable liquid without extensive blending with other liquid waste-derived fuels. Typical ratios for blending liquids wastes with impoundment materials that have been quoted by various companies range from 1.5:1 up to 5:1.

4.2.6 Pretreatment Requirements

Most (but not all) of the facilities that were surveyed required that solid materials delivered to the facility contain no free liquids. Therefore, the material would likely have to be dewatered at the site. Most facilities also required the pH of the material to be above a minimum value, typically in the range of 2-4 and below a maximum value, typically 9-12.5. Therefore, onsite neutralization would also be required. Some of the facilities also had benzene concentration limits as low as 500 mg/kg. Achieving a low benzene concentration would likely require onsite thermal desorption pre-treatment, which, in Focus' opinion, is not economically practical and would eliminate these facilities from further consideration.

Some cement kilns have the capabilities to feed only liquid waste fuels whereas others have the capabilities to feed both liquid and solid waste fuels. Because of the high viscosity of the Impoundment 1 and 2 VR materials and the more solid physical characteristics of the other impoundment materials (i.e., HC, clay-like, silt-like, and CA material), Focus does not believe it is practical to handle any of these materials as a direct burn liquid. Blending VR materials with liquid waste fuels from other sources, to develop a liquid fuel blend, may be a technically feasible approach. It should be noted that cement kilns typically feed liquid waste fuels through a lance rather than a burner. The quality of material fed through a lance (i.e., viscosity, solids content, water content, etc.) is lower than the quality required to fire the fuel through a burner.

The waste solid fuel fed to a cement kiln (i.e., HC, clay-like, silt-like, and CA material) will require blending impoundment materials with cement kiln dust or other reagent material to produce a friable material that can be handled with conventional hoppers, belt conveyors, and screw augers. This blending operation will generate high concentrations of fugitive emissions which can be controlled by conducting the operation in an enclosed building and utilizing the building ventilation air as combustion air in the cement kiln.

4.2.7 Processing Capabilities

Waste volume receipt and facility total annual production limitations are indicated on Table 4-2. One factor to consider for cement kilns is that most of systems are currently operating at well below full cement production capacity because of economic conditions and the low demand for cement. For example, a cement kiln might operate for only a one out of two month period. Because of the current low operating factor, most cement kilns appear to be running at or close to their capacity to process impoundment materials, for which they are currently contracted. Cement kilns may also have an annual turn-around period where the plant is down for an extended period of time to perform major maintenance.

Since most cement and aggregate kilns have limited onsite waste storage capacity, any non-operating time would be very disruptive to a site remediation operation. Waste storage at the site would be required to accumulate excavated materials if a cement or aggregate kiln was not accepting impoundment materials at a given time. Because of the lack of guaranteed waste acceptance capacity on a consistent basis, two or more outlets should be contracted if cement/aggregate kilns are the chosen waste disposal alternative.

4.2.8 Carbon Footprint

Cement kilns, aggregate kilns, and utility boilers will have the smallest carbon footprint of the offsite technologies evaluated. Virtually all of the carbon in the impoundment material will be combusted to CO_2, but the use of waste as a fuel offsets the use of coal as a primary fuel.

4.2.9 Costs

Based on historical data, estimated unit treatment costs for cement kilns range from $350-550 per ton. This unit cost excludes onsite excavation, pretreatment, packaging, waste transportation, materials handling equipment upgrades, or permit modifications. All of the cement kilns contacted require samples of material for analysis and a materials handling evaluation before a more definitive cost estimate can be provided.

The estimated unit treatment cost in the aggregate kiln is approximately $550 per ton. This cost includes transporting the solid impoundment material to a fuel blender, blending the solid impoundment material with liquid fuels, transporting the liquid waste/solid waste blend to the aggregate kiln, and utilizing the blended material as fuel.

4.2.10 Summary

Several cement kilns and one aggregate kiln were identified which may provide a viable technical approach to processing the impoundment materials. The key issues related to treatment of the impoundment materials in cement or aggregate kilns include:

- All of the cement kilns and the one aggregate kiln that are using impoundment materials as a fuel are operating under both RCRA and CAA permits. However, many of the cement kilns and the one aggregate kiln currently have equipment and permits that allow them to process only liquid waste fuels. Some kilns have expressed an interest in modifying their equipment and permits to allow them to accept solid impoundment materials.
- None of the cement kilns surveyed currently have equipment that would allow them to feed the impoundment materials directly. All will require some type of pretreatment or blending with liquids or solids to develop waste-derived fuel materials that can be fed to the kiln.
- The amount of sulfur in the impoundment materials far exceeds the concentration that is acceptable in the feed material to cement kilns and aggregate kilns (typically 0.5-2.0%). The impoundment material will require blending with other low-sulfur content liquid fuels at liquid to solid ratios ranging from 1.5:1 to 5:1. The availability of liquid fuels and the required liquid to solid fuel ratio will be the factor controlling the processing rate for the impoundment materials at most facilities.

Based on the data in Table 4-2, two criteria were used to screen cement kilns for further consideration: (1) currently have the capability to accept waste solid materials or have a relationship with a fuel blender who could blend solid and liquid waste fuels offsite and deliver them to the facility, and (2) currently have or may be willing to consider modifying RCRA and CAA permits to be able to accept the impoundment materials. Based on these criteria, the cement plants that have the most potential for handling the Impoundment 1 and 2 materials are the Continental Cement plant in Hannibal, Missouri, the LaFarge Cement Plant in Fredonia, Kansas and the Essroc Cement plant in Logansport, Indiana. Other cement plants might be able to handle the impoundment materials but would require equipment upgrades or additions and/or permit modifications. These facilities include the Holcim plant in Holly Hill, South Carolina and the Giant Cement plant in Harleyville, SC. The Norlite aggregate kiln in Cohoes, New York might also be able to handle the impoundment material but it would need to be blended to a liquid before it is delivered to the Norlite site. This blending could potentially be performed by Norlite's fuel blender partner, Tradebe, at their facility in Bridgeport, Connecticut.

4.3 FLUIDIZED BED BOILERS

4.3.1 Identification of Facilities

Focus has identified one fluidized bed coal combustion boiler that is currently permitted to accept non-hazardous impoundment materials. The contact information for this facility is included in Table 4-1. This facility is the Piney Creek Power Plant, located in Clarion, Pennsylvania. Waste fuel is supplied to the plant by Colmac Resources, a waste fuels broker. Colmac is owned by American Consumer Industries (ACI), which also owns an interest in the Piney Creek plant. ACI also owns interests in two other similar power plants that are located in Carbon County, Utah and Colstrip, Montana.

Colmac's sole employee, Richard Turnbell, is a fuels broker. Colmac has a relationship with Lobbe, a relatively large German waste management services firm that Colmac would use to provide remediation and environmental management expertise for any acid tar remediation projects in the United States. Richard Turnbell has been a consultant to Lobbe for approximately 3-4 years.

Lobbe has performed several acid tar remediation projects in Germany. Lobbe lists five acid tar remediation projects on their web site that were all performed between 1994 and 1999. Four of the projects were relatively small (150-4,500 tons of tar) and were primarily for cleaning concrete pits or tanks. The fourth project was a relatively large (44,000 tons) open impoundment, similar in size to this project. Lobbe provides remediation services and also operates a vacuum assisted thermal desorption treatment plant and an acid tar treatment mixing plant in Rositz, Germany. According to Turnbell, Lobbe would set up a U.S. subsidiary to perform the remediation work at the site. Lobbe has not performed any full-scale work in the U.S. but has conducted one pilot test in conjunction with Colmac.

4.3.2 Process Description

The Piney Creek power plant utilizes a CFB boiler with a rating of 33 MW (112 MM Btu/hr). The power plant produces steam, which is used to generate electricity. The Piney Creek facility primarily burns coal waste refuse, which is the low-Btu value impoundment material remaining from the coal mining process, that is discarded by mining companies. Coal refuse consists primarily of mixtures of coal and rock. The Piney Creek Facility burns approximately 625 tons per day of coal waste refuse. The Piney Creek plant uses limestone injection (~150 tons/day) to the combustion bed to control SO_2 emissions. The limestone reacts with the SO_2, produced by combustion of fuel and wastes, which allows the plant to process material with high sulfur content.

4.3.3 Regulatory Issues

The Piney Creek facility is currently permitted to accept only non-hazardous alternative fuels. The plant is currently operating under a CAA Title V permit but does not have a RCRA permit. The United States Environmental Protection Agency (U.S. EPA) issued a final rule on October 30, 2008, which revised the definitions of solid waste (FR 64668-64788). The revised definitions in the Code of Federal Regulations (CFR) (including 40 CFR Parts 260, 261, and 271) exclude certain hazardous secondary materials from regulation, under Subtitle C of RCRA. The purpose of the changes was to encourage safe and environmentally sound recycling, resource conservation, and to respond to several court decisions concerning the definition of solid waste. On June 4, 2010, the U.S. EPA proposed additional rules on the identification of non-hazardous secondary materials that are solid wastes (40 CFR 241, Subpart A). The changes included the classification of non-hazardous secondary materials as solid wastes under RCRA, when burned in combustion units. These additional rules were finalized on March 21, 2011. The new rules would require facilities like Piney Creek to be subject to either the CAA Section 129 or Section 112 requirements, depending on whether or not they are considered solid wastes under RCRA. Facilities affected by these rules have a 3-year period to comply with the possibility of an additional 1-year extension. However, the March 2011 regulations have been challenged by industry and environmental groups. The regulations are currently stayed by a federal court and the disposition or final resolution of these regulations is uncertain. It highly unlikely that the Piney Creek facility would be permitted to continue to accept waste-derived materials after the compliance date if the stay is lifted and/or the rules remain relatively unchanged.

4.3.4 Waste Acceptance Criteria

The Piney Creek power plant is currently permitted to accept only materials that are not classified as RCRA hazardous materials. Therefore, the impoundment materials would have to be pre-treated at the site to remove any RCRA characteristics (primarily D001-ignitable, D002-corrosive, and D018-benzene TCLP).

Both the VR and HC material contain a relatively high concentration of sodium (approximately 5,000 mg/kg). Sodium salts can melt at relatively low temperatures and cause slagging problems in fluid bed incinerators. Preliminary indications from the Piney Creek facility is that they believe the impoundment materials could be processed because the VR and HC material will make up a small fraction of the total feed material. However, this assumption would need to be verified with additional analytical tests or pilot testing.

4.3.5 Shipping/Receiving of Impoundment materials

Impoundment materials can be shipped by dump truck from the Site to the Piney Creek Power Plant at the rate of about 500 tons/week of pretreated material. If agreements can be reached with two other larger power plants, the total waste receiving capacity of all three plants is estimated at 2,000 tons/week.

4.3.6 Pretreatment Requirements

Colmac/Lobbe would propose to first conduct bench-scale (bucket) testing with various types and amounts of dry reagents in order to determine if they could make the impoundment materials RCRA non-hazardous and secondly, to solidify the materials so they can be readily handled as a solid and have an acceptable calorific value for combustion (7,000-9,000 Btu/lb). A variety of dry reagents could be evaluated to attempt to remove benzene and declassify the material as a RCRA hazardous waste. The potential reagents include high calcium fly ash, lime kiln dust, cement kiln dust, and quicklime. The ratio of reagent to acid tar may be as much as 40 pounds of reagent per 100 pounds of acid tar. The heat of reaction between the alkali components and water will raise the temperature of the material. Based on Colmac’s previous work with acid tars, reagent/acid tar mixture temperatures in the range of 175-225°F may be generated. The end product would be tested to determine its suitability for use as an alternative fuel. Adding reagents would also de-tackify the material and produce a friable material which could be fed with conventional materials handling equipment. It should be noted that Focus does not believe that the RCRA benzene characteristic can be removed simply by the addition of dry reagents because of the viscous nature of some of the materials and the high waste moisture content which tends to suppress the temperature rise when alkali reagents are added to the waste.

4.3.7 Processing Capabilities

The Piney Creek plant is permitted to process up to 10% by weight of non-hazardous alternative fuels. Based on a coal waste refuse feed rate of 625 tons/day, this maximum feed rate of alternative waste fuels would be 62.5 tons/day. The waste, as received at the power plant, would include approximately 50,000 tons of dewatered materials from Impoundments 1 and 2, plus 20,000 tons of reagents for a total mass of 70,000 tons of material. It would take 980 operating days to process the materials if the Piney Creek facility accepts materials only from the Site. At an operating factor of 75%, this is a period of approximately 3.6 years. If agreements can be reached with the two larger power plants, the schedule could be reduced to less than one year, based solely on the projected capacity of the power plants to receive the material.

4.3.8 Carbon Footprint

Utility boilers, cement kilns, and aggregate kilns will have the smallest carbon footprint of the offsite technologies evaluated. Virtually all of the carbon in the impoundment material will be combusted to CO_2, but the use of waste as a fuel offsets the use of coal as a primary fuel.

4.3.9 Costs

The estimated unit cost for the combustion of waste-derived materials delivered to the Piney Creek plant is $40 per ton of pretreated materials. This cost excludes material excavation, pretreatment onsite, and transportation. Colmac estimates that the waste transportation cost from the site to the Piney Creek facility would be approximately $60 per ton of pretreated materials.

4.3.10 Summary

The conclusions from the evaluation of the fluidized bed coal fired boiler alternative include:

- Focus believes it is highly unlikely that Colmac/Lobbe can treat the impoundment materials and remove all of the RCRA characteristics (primarily benzene TCLP) by simply adding chemical reagents. It may be possible to remove the RCRA characteristics by using chemical reagents in combination with a low temperature thermal desorption process, possibly a vacuum-enhanced system. Lobbe has apparently operated a similar vacuum-enhanced thermal desorption system in Germany. Focus also believes that this approach is more likely to work with the HC material, which has some porosity, rather than the VR material, which behaves as a continuous phase.
- Addition of reagents onsite will increase the quantity of materials that must be transported offsite for treatment by as much as 20,000 tons (assuming 50,000 tons of dewatered impoundment materials).
- Because of its relatively low-waste processing capacity (500 tons/week), Colmac recommends that the Piney Creek power plant should be utilized as a pilot plant to demonstrate the processing of materials from the Site. Colmac has identified two larger coal fired boilers in Pennsylvania which are potentially interested in burning waste-derived fuels. However, neither of them has actually burned waste derived materials yet or is permitted to process these materials.
- There is a significant risk in pursuing waste disposal in a fluidized bed boiler as the single solution for managing materials from the Site. This is because there is a high degree of regulatory uncertainty regarding the capability of the Piney Creek facility or other power plants to accept RCRA hazardous materials after 2014. Under the current regulations (which have been stayed by the court), utility boilers will not be able to accept hazardous waste derived materials after 2014 unless they obtain the required RCRA and CAA permits. Contractual agreements to accept the materials would need to be in place and the permitting process would need to be started about 2-3 years before impoundment materials could be processed in an offsite utility boiler.

4.4 HAZARDOUS WASTE INCINERATORS

4.4.1 Identification of Facilities

Table 4-1 contains contact information regarding U.S. and Canadian hazardous waste incinerators that are potentially capable of treating all or a portion of the impoundment material from the site. These facilities were identified through their membership in the Coalition for Responsible Waste Incineration and Focus historical files.

4.4.2 Process Description

All of the commercial hazardous waste incinerators that were identified utilize rotary kiln technology with the exception of one small fluidized bed incinerator. The rotary kilns vary in size and waste treatment capabilities. Most commercial incinerators are large (8-12 foot diameter X 40-75 feet long) and have thermal capacities in the range of 100-200 MM Btu/hr. All are equipped with secondary combustion chambers. Emission control equipment varies from plant to plant, but typically includes some combination of quench chambers, wet scrubbers, and baghouses.

Feed packaging capabilities vary, with almost all commercial incinerators feeding pumpable liquid wastes, drummed solid wastes, and a few feed bulk solids wastes. All incinerators have some limit on the calorific value per container of material in order to prevent excessive instantaneous heat release. For high calorific value materials, such as the VR and HC material, this may require repackaging the impoundment materials in small packages such as 20-gallon drums.

4.4.3 Regulatory Issues

All commercial hazardous waste incinerators are currently permitted to accept a wide range of waste types bearing a range of RCRA waste codes. All hazardous waste incinerators are also currently in compliance with the CAA Hazard Waste Combustor (HWC) Maximum Achievable Control Technology (MACT) standards and have benzene NESHAP certifications. Therefore, commercial hazardous waste incineration is the offsite waste disposal technology that is the least likely to encounter permitting issues related to processing the Impoundment 1 and 2 materials.

4.4.4 Waste Acceptance Criteria

Hazardous waste incinerators are very robust devices and are capable of handling wastes with a wide variety of chemical characteristics and have fewer waste acceptance limitations that cement kilns, aggregate kilns, utility boilers, and thermal desorbers. It is likely that most of the hazardous waste incinerators could treat the impoundment materials. However, there are likely to be cost surcharges for processing wastes with certain characteristics, such as:

- High sulfur content - Sulfur combusts to form SO_2 and requires extensive acid gas scrubbing using sodium hydroxide, hydrated lime or quicklime.
- High moisture content - Moisture is a heat sink and affects waste throughput capacity.
- High calorific value - High calorific value wastes reduce the throughput capacity of the incinerator because of the amount of organic gases produced and the amount of air required to combust these materials. This lowers the effective waste throughput capacity of the system.

All of the hazardous waste incineration facilities would require representative samples in order to evaluate if they can accept the waste.

4.4.5 Shipping and Receiving of Impoundment materials

Table 4-2 identifies the types of shipping/receiving methods available at each hazardous waste incinerator. Alternatives shipping methods may include both truck and rail.

4.4.6 Waste Packaging

Table 4-2 also identifies the types of waste packaging accepted at each hazardous waste incinerator. Packaging may include bulk liquids, containerized liquids, bulk solids, and containerized solids. Several of the commercial incinerators have the capability to accept bulk solids. However, a major limitation for most hazardous waste incinerators is their solid material packaging requirements. Wastes with high calorific values must be packaged in small containers (<20 gallons) to limit the total thermal duty (Btu/container) in a batch charge to the incinerator. The size of the batch charge depends on the calorific value of the material, the waste combustion rate, and the size of the incinerator. Feeding large quantities of high calorific value materials in a batch charge would cause the system to become thermally unstable. One large hazardous waste incinerator (Waste Technologies Industries) indicated that impoundment materials would need to be packaged in containers no larger than 20 gallon drums. This waste packaging method is impracticable for processing large quantities of impoundment materials. At 200 pounds of waste per 20 gallon drum, it would take approximately 500,000 drums to package approximately 50,000 tons of dewatered impoundment materials.

4.4.7 Processing Capabilities

Most large hazardous waste incinerators have a total thermal capacity of about 200 MM Btu/hr. Approximately 100 MM Btu/hr of this capacity would be available for processing solids in the kiln and the remainder would be used in the thermal oxidizer. Since commercial hazardous waste incinerators serve a diverse client base, only a fraction of their capacity could be allocated to one client. An estimate of the waste acceptance rate for a large hazardous waste incinerator was based on the following assumptions:

- 15 MM Btu/hr thermal capacity allocated to impoundment material

- Average calorific value of dewatered impoundment material is 8,000 Btu/lb.
- 80% operating factor (7008 hours per year).

Base on these assumptions, the waste processing rate would be 0.94 tons/hr and 6,570 tons/year.

4.4.8 Carbon Footprint

Hazardous waste incinerators will have the largest carbon footprint of the offsite technologies evaluated. Virtually all of the carbon in the impoundment material will be combusted to CO_2. Auxiliary fuel will also be required in the rotary kiln to initiate combustion of the impoundment materials and in the thermal oxidizer to complete the destruction of organic compounds.

4.4.9 Costs

Based on historical data, estimated unit treatment costs for hazardous waste incineration ranges from $900-$1,500 per ton. This cost excludes onsite excavation, pretreatment, packaging, or waste transportation.

4.4.10 Summary

Conclusions from the evaluation of hazardous waste incinerators include:

- Hazardous waste incinerators are very robust in terms of their capabilities to thermally process the impoundment materials, particularly materials with high sulfur contents since most hazardous waste incinerators are equipped with wet scrubbers.
- Most hazardous waste incinerators currently have both RCRA and CAA permits that would allow them to accept the Impoundment 1 and 2 impoundment materials.
- Very few hazardous waste incinerators currently have the capability to handle bulk remediation wastes. Most hazardous waste incinerators require materials to be packaged in drums and the amount of waste per drum may be limited by the heat release rate of the impoundment material.
- Of the alternatives considered, hazardous waste incineration has the highest unit treatment cost, with cost estimates ranging from $900-$1,500 per ton (excluding waste excavation, pretreatment and transportation).

4.5 THERMAL DESORBERS

4.5.1 Identification of Facilities

Table 4-1 contains contact information for two U.S. and one Canadian commercial thermal desorption systems that are potentially capable of treating impoundment materials from the site. The three thermal desorption systems that were identified include DuraTherm (Houston, TX), EQ (Bellville, MI), and Clean Harbors (Sarnia, Ontario). The equipment at the EQ facility is owned and operated by DuraTherm under contract to EQ. These facilities were identified through Focus' historical files. On August 12, 2011, Clean Harbors acquired all of the outstanding stock of DuraTherm.

All three companies would require that the material be excavated, dewatered, and possibly neutralized at the Site before it is shipped to a fixed-base treatment, storage, and disposal facility. EQ and Clean Harbors both have remediation divisions that may be capable of performing these services while DuraTherm would rely on a third party to perform these services.

Both DuraTherm and EQ have the capability to provide mobile thermal desorption services and both recommended the use of a mobile thermal desorption system as a far more cost effective project delivery method than shipping impoundment materials to their fixed facilities. The mobile thermal desorption system could be implemented at the Site or possibly at a commercial treatment, storage, and disposal facility (TSDF) located closer to the Site. This option is described in more detail in Section 5.0.

4.5.2 Process Description

Commercial thermal desorbers are designed primarily for processing wastes from the petroleum processing industry (drilling muds, tank bottoms, impoundment sludge, spent catalysts, etc.). Indirectly heated thermal desorbers utilize a horizontal drum that rotates inside of a heated furnace. Auxiliary fuel burners generate a hot gas which circulates in annular space between the outside of the drum and the interior of the furnace. The products of combustion from the combustion of the auxiliary fuel do not come in contact with the impoundment materials. The temperature of the material inside of the drum is raised by heat transfer through the walls of the drum. The impoundment material are heated in an inert atmosphere (nitrogen or steam blanketed) in order to maintain the oxygen concentration of the process gas below the minimum oxidant concentration, at which combustion can occur. Therefore, indirectly heated thermal desorbers can treat impoundment materials with an unlimited organic content.

The organics that are vaporized in the drum are passed through an emission control system, typically consisting of some combination of scrubbers, condensers, and thermal oxidizers. Hydrocarbons that are recovered in the scrubber or condenser can be further processed and recycled as a liquid fuel. Both the DuraTherm and EQ facilities utilize a proprietary scrubber that has been designed specifically for recovering hydrocarbons from the thermal desorber offgas.

The hydrocarbon recovery efficiency is primarily a function of the solids treatment temperature and the operating conditions in the emission control system. At higher solids temperatures, a larger fraction of the high molecular weight (high boiling point) compounds are removed from the waste feed material but a larger percentage of organic compounds are also cracked into low molecular weight compounds. In order to maximize the amount of oil recovered, commercial units are capable of treating solids to temperatures in the range of 800-1,000°F. At this temperature range, the residual solids discharged from the drum are dry granular materials that can be land-disposed.

One issue that must be addressed for any thermal desorption system is the distribution of sulfur in the residual treatment products (treated solids or oil). The distribution will be dependent upon the solids treatment temperature. The concentration of sulfur in the recovered oil will affect the value of the oil.

Because of the issues described above, bench, pilot or full-scale treatability testing is required to determine the optimum treatment temperature for any specific impoundment material.

4.5.3 Regulatory Issues

Both the DuraTherm and EQ facilities have RCRA permits to handle a wide variety of hazardous wastes. Both facilities also maintain NESHAPs certifications for handling benzene containing wastes. The Clean Harbors facility in Canada operates under Canadian hazardous waste regulations but has licenses in place that allow it to import and treat impoundment materials from the U.S.

4.5.4 Waste Acceptance Criteria

The DuraTherm facility routinely processes high organic content sludges from the petroleum industry. It is possible that DuraTherm could accept dewatered impoundment materials without requiring neutralization pretreatment at the Site.

The EQ facility primarily treats soils contaminated with petroleum hydrocarbons. The EQ facility operates under a RCRA recycling exemption, which requires wastes that are thermally treated to contain at least 2% recoverable oil. The amount of recoverable oil in the VR and HC material is likely in the range of 20-50%, depending on the treatment temperature. However, clay-like material, sand/silt-like material, and CA materials may contain less than the required minimum amounts of recoverable oil.

The Clean Harbors facility has a variety of waste acceptance criteria, including debris content, particle size, material handling properties, moisture content, sulfur content, halogen content, mercury content, PCB content, metals, no free liquids, and calorific value. Wastes may be accepted with characteristics that are outside of the range of their waste acceptance criteria, however treatment surcharges may apply.

All of the thermal desorption facilities would require representative impoundment material samples in order to evaluate whether or not the waste could be accepted.

4.5.5 Shipping and Receiving of Impoundment materials

All of the commercial thermal desorber facilities that were identified have the capability of accepting bulk hazardous solids. Table 4-2 identifies the capability of each facility to receive impoundment material as a bulk hazardous solid via truck or rail. This table also describes the types of packaging required (bulk truck, roll-off box, etc.).

4.5.6 Pretreatment Requirements

The commercial thermal desorption facilities typically feed bulk, friable solids using hoppers, belt conveyors, and screw augers. The Impoundment 1 and 2 materials will require dewatering, possibly pH adjustment, and then pretreatment with some type of reagent material (i.e., hydrated lime, quick lime, cement kiln dust, lime kiln dust, recycled treated desorber solids, sand, etc.) in order to feed the material through the existing feed equipment. The preferred reagent material would be recycled treated thermal desorber solids, since these materials would be available at no cost and would not add mass to the amount of treated materials that would require land disposal.

In some cases, blend ratios could be as high as 1-2 parts of reagent material per 1 part of impoundment material. Establishing the optimum blend ratio would require bench-scale and full-scale treatability testing at each facility. Blending reagent material with impoundment materials will reduce the effective waste feed rate proportionally. Alternatively, a facility’s material handling equipment could possibly be modified to feed the Impoundment 1 and 2 materials without blending with other materials. The practicality of this would have to be evaluated on a case-by-case basis; therefore, taking into account space constraints and the need to maintain the existing waste feed equipment to service the needs of other customers.

4.5.7 Processing Capabilities

The DuraTherm facility has two thermal desorption systems installed. The EQ facility has one thermal desorption system installed, with space available for a second unit. The Clean Harbors facility has one thermal desorption system installed. Table 4-2 identifies the total annual waste processing capacity of each facility for the types of wastes that they currently process. Because of the high fraction of high boiling point material in the Impoundment 1 and 2 impoundment materials, the actual capacity to process the impoundment materials may be substantially less than the stated values, perhaps by as much as one-half. It should be noted that the capacity (as stated in Table 4-2) is for all customers, not the capacity that could be allocated to a single customer. For example, EQ stated that approximately 50% of their capacity was currently committed to other contracts. Taking into account these two factors, a facility’s actual capacity to accept materials from the Site may only be approximately 25% of the values shown in Table 4-2.

4.5.8 Carbon Footprint

The thermal desorption system will have a moderate carbon footprint compared to the other technologies evaluated. The carbon footprint will be larger than cement kilns, aggregate kilns, and utility boilers but smaller than incinerators. Focus estimates that approximately 40-60% of the carbon in the impoundment material may be recovered as oil. This oil can be used as a fuel and offset the use of other fossil fuels.

4.5.9 Costs

Estimated costs for treatment of impoundment materials in thermal desorption systems range from approximately $400-$700 per ton. This cost excludes waste excavation, pretreatment onsite, and transportation.

4.5.10 Summary

Conclusions from the evaluation of thermal desorption technologies include:

- Indirect thermal desorption is a well established technology for treating materials with high concentrations of petroleum. It appears likely that the technology can be adapted to treat the materials from Impoundments 1 and 2.
- Waste throughput rates for existing thermal desorption systems are relatively low, with typical throughput rates in the range of 1-2 tons/hour.
- The major differences between petroleum wastes and Impoundment 1 and 2 materials relate to the physical handling properties, the flash point, and the pH value of the materials. It is highly likely that impoundment materials will have to be pretreated with a dry reagent material (i.e., quick lime, hydrated lime, agricultural lime, cement kiln dust, lime kiln dust, recycled thermal desorber solids, fly-ash, sand, etc.) to improve material handling properties and raise the pH of the material.
- Indirect thermal desorption has the potential to recover a significant fraction of the impoundment material as a saleable fuel product. Based on the results of previous treatability studies (i.e., Littleford, Retec, and SoilTech), the amount of oil that can be recovered and the amount of residual solids produced that require land disposal depend primarily on the waste treatment temperature. Based on previous treatability studies, it may be possible to recover 40-50% of the VR and HC materials as a saleable oil product. The sale of this product could partially offset waste treatment costs.

4.6 OVERALL SUMMARY

Table 4-3 summarizes the process capability and regulatory status of each facility that was evaluated to potentially process the Impoundment 1 and 2 materials. The dots are color coded as follows:

- Green – acceptable
- Yellow – potentially acceptable (may require equipment upgrades or permit modifications)
- Red – unacceptable (fatal flaw that may eliminate a facility from further consideration).

5.0 THERMAL TREATMENT ALTERNATIVES – ONSITE INCINERATOR

5.1 IDENTIFICATION OF SYSTEMS

Mobile incinerators have been used extensively to treat contaminated soils and sludges. The objective of this section is to identify systems that could potentially be used to process the impoundment materials, assess the issues associated with each one, and estimate the capital and operating costs for a mobile incineration system.

Mobile hazardous waste incinerators were used extensively in the U.S. to treat materials from CERCLA sites from about 1990 until the early 2000's. However, there are currently no mobile hazardous waste incinerators operating in the U.S. Focus has identified two directly-heated thermal desorption systems that were designed to be retrofitted with refractory in the kiln so that they could function as hazardous waste incinerators. One is a used system that is owned by Astec Industries and is currently located in the United Kingdom (Astec plant). The other is a new system that is owned by EDSR (a U.K. based contractor), which is currently located in Chattanooga, TN (EDSR plant). Neither of these plants is currently owned by a U.S. based remediation contractor; therefore, a contractor would need to be identified to own or lease and operate the plant. Both plants are also currently for sale and may or may not be available at the time the remediation is conducted at the Site. However, a similar new mobile hazardous waste incineration system could be built for the application. Much of the discussion in Section 5.0 applies to either the existing systems or a new mobile incineration system.

Figure 5-1 is a process flow diagram that shows the existing unit operations for the Astec plant. The Astec plant includes a soil feed system, directly heated rotary dryer, pugmill, treated soil stacking conveyor, multiclones, thermal oxidizer, evaporative cooler, baghouse, induced draft (ID) fan, quench, packed scrubber, and stack. The EDSR plant has a similar process flow diagram, but does not include the quench and scrubber. The primary difference between the two plants is their size, with the Astec plant being larger (8 foot diameter x 40 foot long kiln) than the EDSR plant (7 foot diameter x 32 foot long kiln). Both plants would require significant refurbishing or modifications to process the impoundment materials. These changes are described below:

- Feed system - The existing feed systems were designed to handle friable soil materials. To use the existing feed systems, the impoundment materials would have to be pretreated by blending them with reagent materials to make them friable. Adding reagent material to the feed would approximately double the mass of materials that must be treated and the total operating costs. In order to avoid significantly increasing the mass of material to be treated, the existing soil feed system would need to be replaced with a specially designed feed system as described later in this section.
- Rotary kiln - The rotary kiln is designed for treating soil and has a bare metal shell equipped with soil lifters. To process high calorific value impoundment material, the soil lifters would need to be removed and replaced with a refractory lining to handle the high temperatures that would be generated by the combustion of the impoundment materials.

- Treated solids cooling system - the pugmill is designed for processing a high flow rate of treated soil at a temperature of <1,000°F. The pugmill on each plant would need to be replaced with a refractory lined wet ash drag conveyor, which could handle high temperature (1,600°F) ash material.
- Quench and scrubber - the Astec plant includes a quench and acid gas scrubber. The EDSR plant was designed to add a quench and acid gas scrubber but this equipment has not yet been purchased. The Astec plant wet scrubber was designed for a concentration of sulfur in the waste feed material of less than 1%. A detailed engineering analysis would be required to determine what process modifications would be required to handle the concentration of SO_2 that would be generated by processing the high sulfur content (6-8% before blending with reagent materials) impoundment materials. Modifications could include adding additional scrubber packing or possibly adding an additional scrubber in series with the existing scrubber. For the EDSR plant, a wet scrubbing system would need to be specifically designed to handle the projected SO_2 load.
- Baghouse - due to the high concentration of sulfur in the feed material and the conversion of the sulfur to SO_2 in the rotary kiln and thermal oxidizer, the baghouse would likely encounter severe corrosion problems. The baghouse would be replaced with a venturi scrubber which could remove particulates, HCl, and SO_2.

Because of the large number of equipment modifications that would be required and the cost to ship the Astec plant from the U.K., a detailed engineering analysis would be required to determine if it would be more cost effective to purchase and modify the existing Astec equipment or purchase new, purpose built equipment for the project. The size of the EDSR plant is too small to complete the project within a reasonable time period. Therefore, the remainder of this section (process description, cost estimate) is based on the assumption that new mobile incineration equipment would be purchased for the project.

5.2 PROCESS DESCRIPTION

Brief discussions of each of the major process areas of a new mobile incineration system are presented below.

- Feed system – A feed system would be specifically designed for handling the impoundment materials. The system would include a feed hopper mounted on load cells, a screw feeder, and a retractable hydraulic pusher mounted over the feed hopper to force impoundment material down into the screw feeder. A high reach fork lift equipped with a bucket would be used to place feed materials into the feed hopper. This system would need to be inerted to prevent fires.
- Rotary kiln incinerator – The rotary kiln is 40-foot long by 8-foot internal shell diameter. The rotary kiln is equipped with a natural gas fired burner and a combustion air blower. The rotary kiln is constructed of carbon steel shell with a refractory lining. The rotary kiln will be operated to achieve a residual material treatment temperature of 1,650^{o}F. The residence time of the material in the drum is approximately 20 minutes.
- Hot cyclone – gases from the rotary kiln pass through a hot cyclone to remove about 70% of the particulate matter.
- Thermal oxidizer – the gas exiting the rotary kiln incinerator would be directed to a thermal oxidizer operating at an exit gas temperature of 1,750^{o}F. This temperature was chosen to minimize slagging which may occur because of the high concentration of sodium in the waste (~5,000 mgkg). The thermal oxidizer is equipped with a natural gas fired burner. The thermal oxidizer has a gas residence time of 2.0 seconds.

- Quench chamber – the gas exiting the secondary combustion chamber is quenched in an alloy (Hastalloy, C-22, etc.) quench chamber. Process water is injected at the top of the quench chamber and atomized with compressed air to make small droplets. The temperature of the gas exiting the quench chamber is approximately 180^{o}F.
- Venturi scrubber – a venturi scrubber is used to capture particulates and metals. The venturi scrubber would be constructed of alloy materials of construction and would have a pressure drop of 30 inches water column.
- Scrubber – the gas exiting the ID fan is directed to a fiberglass reinforced plastic (FRP) packed scrubber. A 20% sodium hydroxide solution is injected into the scrubber to neutralize acid gases (SO_2 and HCl). The scrubber exhaust gas is directed to the ID fan. The scrubber water blowdown, which contains about 3% total dissolved solids, is discharged to a publically owned treatment works.
- ID fan – an ID fan is used as the prime mover to pull gases through the system and exhaust the gas to the stack.
- Stack – exhaust gases are discharged to the atmosphere through a 75-foot high stack.

5.3 REGULATORY ISSUES

Since the Site is a CERCLA site, a mobile incineration system would not be required to obtain any state or federal permits but it would be required to comply with Applicable, Relevant, and Appropriate Requirements (ARARs). Therefore, the technical requirements of the ARARs would have to be demonstrated (i.e., storage system designs, thermal system operating requirements, stack emission limits, etc.). The schedule to comply with ARARs could be shorter than the schedules to actually obtain RCRA and CAA permits.

5.4 COMMUNITY RELATIONS ISSUES

Implementation of an onsite incineration system would likely generate significant community relations issues. These issues can best be managed by close coordination and communication with the local stakeholders through community involvement groups and other outreach programs. However, it is difficult to predict in advance the potential for success of these programs.

5.5 WASTE CHARACTERISTICS DESIGN BASIS

The first step in assessing the capacity of the rotary kiln incineration system was to develop a waste characterization design basis for the parameters required to perform a mass and energy balance. These parameters include carbon, hydrogen, oxygen, nitrogen, sulfur, chlorine, moisture, ash and calorific value. Some waste characterization data are available in Table 2-4 (historical waste characterization data) and Table 2-7 (material takeoffs). These tables include the following data for the VR and HC materials:

- Estimated mass of dewatered waste by category (VR, HC, CA, etc.)
- Estimated moisture content for each category of dewatered impoundment material
- Proximate analysis (moisture, volatile matter, ash, fixed carbon)
- Ultimate analysis (chlorine, sulfur, nitrogen)

- Calorific value.

The ultimate analysis data do not include sufficient information on carbon, hydrogen, and oxygen content of the impoundment materials. These values were assumed for the VR and HC materials, and the assumed values were then used to calculate the calorific values of the materials. The calculated calorific values of the materials were then compared to the measured calorific values. A comparison of measured and estimated calorific values (Btu/lb), on a dry basis, is as follows:

	Measured	Calculated
• VR – Impoundment 1	13,456	13,730
• HC – Impoundment 1	13,497	13,992
• VR – Impoundment 1	14,677	14,503
• HC – Impoundment 1	13806	13,960

Calculated calorific values were in very good agreement with the measured calorific values, validating the assumed carbon, hydrogen, and oxygen content values.

There are no ultimate, proximate, or calorific value data available for the clay-like, sand/silt-like, and coal aggregate materials. For these materials, ultimate analysis and calorific values were calculated based on the following assumptions:

- Clay-like and sand/silt-like materials were assumed to consist of 10% VR, 10% HC materials, and the balance inert soil materials.
- Coal aggregate was assumed to consist of 15% VR, 15% HC materials, 50% bituminous coal, and the balance inert rock materials.

Table 5-1 presents the results of the estimated waste composition analysis. This analysis shows that the estimated weighted average calorific value of all of the dewatered materials in both impoundments is in the range of 8,023-8,652 Btu/lb on a wet (dewatered) basis and 9,948-10,741 Btu/lb on a dry basis.

5.6 PROCESSING CAPABILITIES

An estimate of the rotary kiln incinerator capacity was developed based on the thermal duty of the unit. It was assumed that the rotary kiln has a capacity of 30 MM Btu/hr (excluding the thermal oxidizer) and that 10 MM Btu/hr of this capacity would be required for auxiliary fuel to heat the impoundment material up to ignition temperature and maintain combustion. The remaining capacity of the rotary kiln would be 20 MM Btu/hr. At a calorific value of 8,000 Btu/lb, this would be result in a waste processing rate of 1.25 tons/hr.

At an operating factor of 70% (6,132 hr/yr), the annual waste processing capacity would be about 7,665 tons/year. Based on a total quantity of dewatered feed material of 50,272 tons/hr, the duration of treatment operations would be about 6.6 years.

5.7 SUMMARY

Onsite treatment of the Impoundment 1 and 2 materials with a mobile incinerator is technically feasible. Due to the potential duration of the project and the lack of other future identified projects in the U.S. that could utilize a mobile incineration system, it is likely that the entire capital expense of the equipment would need to be absorbed by the project. However, this capital cost would be partially offset by eliminating waste transportation costs that will be incurred by all of the offsite treatment options. The major impediments to the implementation of an onsite incinerator are likely to be political and community relations issues.

6.0 THERMAL TREATMENT ALTERNATIVES – ONSITE THERMAL DESORBER

6.1 IDENTIFICATION OF SYSTEMS

As described in Section 4.0, DuraTherm has a fleet of six mobile thermal desorption systems. One or more of these systems, or possibly a new purpose built system, could be deployed to the Site. While other contractors own and operate mobile indirect thermal desorption systems, their systems have been designed for treating soil with low levels of organic contamination. These systems would not be appropriate for treating the impoundment materials because of the high concentration of organic materials in the impoundment materials.

6.2 PROCESS DESCRIPTION

The DuraTherm mobile thermal desorption system process is similar, but not identical, to the stationary equipment described in Section 4.5.2. The main difference between the mobile and stationary thermal desorption systems is the configuration of the gas cleaning system downstream of the oil scrubber. In the stationary system, this stream is directed to a thermal oxidizer and the organics are destroyed. In the mobile systems, this stream is passed through a condenser and the water vapor and light hydrocarbons are condensed. In some cases, these light hydrocarbons may have a low flashpoint and require offsite disposal. The analyses presented in this section assumes a purpose-built system would be used that would have a flow sheet similar to the fixed-base system.

6.3 REGULATORY ISSUES

Since the site is a CERCLA site, a mobile thermal desorption system would not be required to actually obtain any state or federal permits but it would be required to comply with ARARs. Therefore, the technical requirements of the ARARs would have to be demonstrated (i.e., storage system designs, thermal system operating requirements, stack emission limits, etc.). However, the schedule to comply with the ARARs could be shorter than the schedules to actually obtain RCRA and CAA permits.

6.4 COMMUNITY RELATIONS ISSUES

Implementation of an onsite thermal desorption system would likely generate significant community relations issues. These issues can be managed by close coordination and communication with the local stakeholders through community involvement groups and other outreach programs. However, it is difficult to predict in advance the potential for success of these programs.

6.5 PROCESSING CAPABILITIES

The estimated waste processing rate for the DuraTherm mobile systems is in the range of 1-2 tons per hour (excluding any blended reagent materials). At an annual operating factor of 70%, this results in an annual waste processing rate of approximately 6,000-12,000 tons per year for one unit. Multiple units could possibly be used to increase the annual capacity.

6.6 SUMMARY

The process issues related to the implementation of an onsite DuraTherm system are the same as those issues identified for a stationary thermal desorption facility as described in Section 4.5.9. An onsite thermal desorption system will incur additional costs for site preparation, equipment mobilization, erection, commissioning and performance testing that are not required for an existing stationary system. However, these costs are likely to be less that the cost of transporting the impoundment materials to the DuraTherm or EQ offsite thermal desorption facilities located in Texas and Michigan, respectively.

7.0 SCHEDULE SUMMARY

7.1 TREATMENT SCHEDULES

A treatment schedule was estimated for each offsite and onsite technology based on the total quantity of dewatered impoundment materials (50,272 tons) and the estimated waste acceptance or processing rate at each facility. These schedules are shown in Table 7-1. The overall project schedule could be reduced by using more than one offsite treatment outlet or using multiple onsite units.

8.0 TREATABILITY TESTING RECOMMENDATIONS

8.1 OVERVIEW

There are a number of areas where information is unavailable or insufficient regarding the treatability of the impoundment materials by excavation, materials pretreatment, material handling, transportation and thermal treatment processes. These areas include:

- Corrosion of metallic materials of construction
- Waste compatibility with various non-metallic (plastic and rubber) materials of construction
- Waste flowability versus temperature
- Waste pH versus amount and types of reagents
- Waste moisture content achievable by alternative waste dewatering methods
- Potential to generate flammable concentrations of vapors in closed shipping containers
- Fugitive emissions produced by alternative materials excavation, handling and pretreatment methods
- Fugitive emissions suppression by water caps, hydrated lime amended water caps, and oil caps
- Fugitive emissions capture by alternative methods
- Material handling properties achieved by blending dry reagents with the impoundment materials
- Amount and types of liquid waste required for blending with impoundment materials to prepare a liquid waste-derived fuel
- Waste throughput rate and amounts and chemical characteristics of residual streams produced as a function of process conditions for full-scale thermal desorption systems.

Focus recommends that bench-scale, pilot-scale, or full-scale treatability tests should be conducted to evaluate these issues. Bench-scale treatability tests may be conducted at commercial laboratories, pilot-scale tests may be conducted at the Site, and full-scale tests may be conducted at cement kilns or commercial thermal desorption facilities. Table 8-1 summarizes the scope for each recommended treatability test. Brief descriptions of each of the recommended treatability tests are presented below.

8.2 TEST DESCRIPTIONS

8.2.1 Metal Corrosion Tests

The impoundment material is highly acidic (pH 1-4) and will attack many metallic materials of construction, particularly carbon steel. Data should be collected to assess the corrosion rate for the types of metals that the waste is likely to come into contact with. Waste samples should include both un-dewatered and dewatered materials. Test coupon samples should include carbon steel (used in shipping containers), T-1 steel (used in excavation equipment), and 316 stainless steel (used in process equipment). Tests will be conducted by partially immersing coupons of the selected samples in the impoundment material for a defined time period and at the maximum temperature to which the metal would be exposed. Corrosion rates will be measured for the submerged section, at the liquid vapor interface, and in the vapor phase. Potential waste treatment facilities may need to conduct additional corrosion tests for the specific materials of construction and at the process conditions used in their equipment.

8.2.2 Material Compatibility Tests

Tests should be conducted to assess the compatibility of various plastic and rubber materials of construction with the impoundment materials. Plastic and rubber materials that are likely to be used include: high density polyethylene (used in container or equipment liners), polyethylene (used in roll-off container liners and covers), Viton (used in hydraulic system gaskets), rubber (used in conveyor belts and hoses), and fiberglass (used in piping).

Exposure of the plastic samples to the waste will be by immersion. The samples will then placed in a sealed container and left at room temperature. After a defined period of time, the samples are removed and evaluated for the desired properties, including change in tensile strength, elongation, weight, decomposition, cracking, and swelling.

8.2.3 Waste Flowability

The flowability of the impoundment materials should be evaluated over a range of ambient temperatures. The flowability of the waste affects materials handling operations, particularly belt and screw conveyors. These tests may be conducted at offsite treatment facilities using full-scale materials handling equipment under both summer and winter conditions.

8.2.4 pH Versus Amount of Reagents

Commercial waste treatment facilities establish minimum and maximum pH values as a waste acceptance criterion, with minimum values being in the range of 2-4 and maximum values being in the range of 9-12. A number of alternative reagents could be used to adjust the pH of the impoundment materials, including boiler ash, agricultural lime, cement kiln dust, lime kiln dust, quicklime and hydrated lime. Bench-scale tests should be conducted for readily available reagents to assess the pH of the waste as a function of the amount of reagent added, the temperature rise, and the amount of VOCs generated as a result of the temperature rise from the chemical reaction. These tests should also evaluate changes in material handling properties as a function of the type and dose of chemical reagent.

8.2.5 Waste Moisture Content

Most offsite treatment facilities require that wastes delivered to them contain no free liquids. Various methods may be used to dewater the impoundment materials, including mechanical extrusion, gravity dewatering, and dewatering by chemical reagent addition. Samples dewatered by each of these methods should be analyzed by the paint filter test to determine the residual moisture content. Based on experience with similar materials, water may separate from the viscous materials over time or as the material is vibrated (as would occur during transportation). Testing should be conducted using some sort of shaking device (paint can shaker, screen sieve shaker, etc.) to see if this would occur with impoundment materials that have no free liquids as determined by an initial visual observation.

8.2.6 LEL Concentration in Shipping Containers

Based on the concentrations of VOCs in the impoundment materials, it is likely that the concentration of organics in the headspace of a sealed shipping container could exceed a safe fraction of the LEL. Samples should be taken from the headspace of sealed shipping containers over a range of ambient temperatures and storage times. These data will be used to determine if shipping containers should be vented or inerted during storage or transport.

8.2.7 Fugitive Emissions

Fugitive emissions of VOCs, acid gases, and odiferous compounds will affect personal protective equipment requirements, process equipment and building ventilation and/or inerting requirements, and the ambient concentrations at the site boundary. Fugitive emission rates and capture efficiencies should be assessed for the key steps of the remediation process, including excavation, pretreatment, materials handling, transportation and treatment. One of the concepts presented in Section 3.0 for the control of fugitive emissions was to use a floating oil cap which would absorb VOCs. This concept should be tested the laboratory to determine the effectiveness of various types of oil material caps in suppressing VOC emissions.

8.2.8 Materials Handling Properties of Waste/Dry Reagent Blends

It is likely that the impoundment materials will need to be mixed with other dry reagent materials to modify their material handling properties so that the mixture may be readily conveyed using conventional hoppers and conveyors. Potential materials that could be used for mixing include cement kiln dust, cement raw materials, boiler ash, lime kiln dust, quicklime, hydrated lime, agricultural lime, sand, or treated solids discharged from a thermal desorption system. Bench-scale and full-scale material handling tests should be conducted by each potential waste treatment facility based on the types of reagents that are readily available at the site. Different blend ratios of impoundment materials to inert dry materials should be prepared and qualitative tests should be conducted by feeding the mixtures through the full-scale process equipment. The blend ratio is extremely important for thermal desorption systems because the blended reagent materials add mass to the feed material and reduce the thermal desorption system's capacity to treat impoundment materials.

8.2.9 Fuel Properties of Waste/Liquid Fuel Blends

Many cement kilns utilize a "blend to liquids" process where solid materials are dissolved in a liquid fuel. The weight ratio of solid waste to liquid waste is an important factor in determining the annual capacity at which the facility may be able to process the solid waste because of the limited availability of liquid waste fuels. The first step in performing this test is to perform bench-scale tests in the laboratory to determine if the waste can be dissolved in the available waste liquid fuels and the optimum solid waste fuel to liquid waste fuel ratio. These bench-scale tests would then be confirmed using full-scale equipment to test the capability to convey the solids to the mixing vessel, dissolve the impoundment material in the liquid waste fuels, pump the blended materials to a storage tank, and keep the material in suspension in an agitated tank.

8.2.10 Distribution of Treatment Residual Materials

Thermal desorbers with fuel recovery produce three main products: an oil (which may be used as a fuel), treated solids, and non-condensable gases. Bench-scale tests should be conducted in an indirectly heated thermal desorber to determine the distribution of these products and to collect samples to chemically analyze each material. These tests should be conducted in a commercial laboratory.

8.2.11 Waste Blend Treatment Properties

For thermal desorbers, a full-scale test should be performed to confirm the rate at which the blended feed material can be processed by the system. This test would include processing roll-off box quantities of the mixed material and measuring the waste mixture feed rate, measuring the amount of oil recovered, measuring the amount of treated solids produced, collecting process operating data, and collecting samples of residual streams such as treated solids or recovered oil. The samples of recovered oil and treated solids should be analyzed for parameters required to determine potential disposal methods and value or cost of disposing of the oil. These parameters would include calorific value, sulfur, water, and ash.

Table 2-1. Analytical Data Needs for Thermal Treatment Alternatives

Parameter	Regulatory Citation	Regulatory	Thermal Treatability	Stack Emissions	Fugitive Emissions	Odors	Health & Safety	Materials of Constr.- Metals	Materials of Constr. - Non-metals	Refractory Damage	Slagging Potential	Material Pretreatment	Materials Handling	Number of Issues	Basis for Data Requirement
Organic Compounds - Total															
VOCs	N.J.A.C. 7:27 subchapters 8 & 17	X	X	X	X	X	X		X				X	8	Fugitive emissions & odors, personnel exposure, damage to belts and hoses, NJ air toxics regulations
Benzene	40 CFR 61.342(b)	X	X	X	X	X	X		X				X	8	Fugitive emissions, personnel exposure, CAA benzene NESHAP rule applicability, NJ air toxics regulations
SVOCs	N.J.A.C. 7:27 subchapters 8 & 17	X	X	X	X	X	X		X					7	Thermal treatability because of high boiling points, NJ air toxics regulations
PCBs - Homologues	N.J.A.C. 7:27 subchapters 8 & 17, 40 CFR 761	X	X	X			X							4	TSCA applicability, waste acceptance by offsite disposal facilities, NJ air toxics regulations
PCBs - Arochlors	N.J.A.C. 7:27 subchapters 8 & 17, 40 CFR 761	X	X	X			X							4	TSCA applicability, waste acceptance by offsite disposal facilities, NJ air toxics regulations
Aldehydes	N.J.A.C. 7:27 subchapters 8 & 17	X		X	X	X								4	Odors, personnel exposure, NJ air toxics regulations
Alcohols	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Explosives	N.J.A.C. 7:27 subchapters 8 & 17	X		X									X	4	NJ air toxics regulations
Pesticides	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations

Table 2-1. Analytical Data Needs for Thermal Treatment Alternatives

Parameter	Regulatory Citation	Regulatory	Thermal Treatability	Stack Emissions	Fugitive Emissions	Odors	Health & Safety	Materials of Constr.-Metals	Materials of Constr. - Non-metals	Refractory Damage	Slagging Potential	Material Pretreatment	Materials Handling	Number of Issues	Basis for Data Requirement
Organic Compounds - TCLP															
VOCs - TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
SVOCs-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Pesticides - TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Herbicides - TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Metals - Total															
Arsenic	40 CFR 63.1219, 40 CFR 63.1220, N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	Incinerator & Cement Kiln MACT standards, NJ air toxics regulations
Barium	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Beryllium	40 CFR 63.1219, 40 CFR 63.1220, N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	Incinerator & Cement Kiln MACT standards, NJ air toxics regulations
Boron	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Cadmium	40 CFR 63.1219, 40 CFR 63.1220, N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	Incinerator & Cement Kiln MACT standards, NJ air toxics regulations

Table 2-1. Analytical Data Needs for Thermal Treatment Alternatives

Parameter	Regulatory Citation	Regulatory	Thermal Treatability	Stack Emissions	Fugitive Emissions	Odors	Health & Safety	Materials of Constr.- Metals	Materials of Constr. - Non-metals	Refractory Damage	Slagging Potential	Material Pretreatment	Materials Handling	Number of Issues	Basis for Data Requirement
Chromium	40 CFR 63.1219, 40 CFR 63.1220, N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	Incinerator & Cement Kiln MACT standards, NJ air toxics regulations
Copper	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Lead	40 CFR 63.1219, 40 CFR 63.1220, N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	Incinerator & Cement Kiln MACT standards, NJ air toxics regulations
Manganese	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Mercury	40 CFR 63.1219, 40 CFR 63.1220, N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Nickel	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Selenium	N.J.A.C. 7:27 subchapters 8 & 17	X		X										2	NJ air toxics regulations
Sodium										X	X			2	Attacks refractory, contributes to slagging
Potassium										X	X			2	Attacks refractory, contributes to slagging
Metals - TCLP															
Arsenic-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Barium-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities

Table 2-1. Analytical Data Needs for Thermal Treatment Alternatives

Parameter	Regulatory Citation	Regulatory	Thermal Treatability	Stack Emissions	Fugitive Emissions	Odors	Health & Safety	Materials of Constr.- Metals	Materials of Constr. - Non-metals	Refractory Damage	Slagging Potential	Material Pretreatment	Materials Handling	Number of Issues	Basis for Data Requirement
Cadmium-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Chromium-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Lead-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Mercury-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Selenium-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Silver-TCLP	40 CFR 261.24	X												1	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities
Cyanide	40 CFR 261.23(5)	X					X							3	RCRA characteristic waste classification, waste acceptance by offsite disposal facilities, H&S issues
Sulfide	40 CFR 261.23(5)	X				X	X							3	RCRA characteristic waste classification, waste accpetance by offsite disposal facilities, odors
Flash Point	40 CFR 261.21	X	X				X						X	4	Material storage & handling, RCRA ignitability characteristic, waste acceptance by offsite disposal facilities

Table 2-1. Analytical Data Needs for Thermal Treatment Alternatives

Parameter	Regulatory Citation	Regulatory	Thermal Treatability	Stack Emissions	Fugitive Emissions	Odors	Health & Safety	Materials of Constr.- Metals	Materials of Constr. - Non-metals	Refractory Damage	Slagging Potential	Material Pretreatment	Materials Handling	Number of Issues	Basis for Data Requirement
Corrosivity	40 CFR 261.22	X											X	2	Materials of construction selection, RCRA corrosivity characteristic, waste acceptance by offsite disposal facilities
Proximate Analysis															
Moisture			X									X		2	Thermal treatment waste throughput capacity, fuel costs, material dewatering, residual water treatment/disposal costs
Volatile matter			X											1	Thermal treatment waste throughput capacity
Ash			X											1	Thermal treatment waste throughput capacity, disposal of treatment residuals
Fixed carbon			X											1	Thermal treatment waste throughput capacity, disposal of treatment residuals
Ultimate Analysis															
Carbon			X											1	Thermal treatment mass & energy balance calculations
Hydrogen			X											1	Thermal treatment mass & energy balance calculations
Oxygen			X											1	Thermal treatment mass & energy balance calculations
Nitrogen		X	X											2	Potential NOx formation during thermal treatment

Table 2-1. Analytical Data Needs for Thermal Treatment Alternatives

Parameter	Regulatory Citation	Regulatory	Thermal Treatability	Stack Emissions	Fugitive Emissions	Odors	Health & Safety	Materials of Constr.-Metals	Materials of Constr. - Non-metals	Refractory Damage	Slagging Potential	Material Pretreatment	Materials Handling	Number of Issues	Basis for Data Requirement
Sulfur		X	X	X				X						4	Potential SO_2 formation during thermal treatment, air emissions control, neutralization reagent quantity, sulfur concentration limit in cement products
Chloride			X					X						3	HCl and Cl_2 formation during thermal treatment, air emissions control, corrosion issues, neutralization reagent quantity
Bromine			X					X						3	HBr and Br_2 formation during thermal treatment, air emissions control, corrosion issues
Fluorine			X					X						3	HF and F_2 formation during thermal treatment, air emissions control, corrosion issues
Physical Properties															
Calorific Value		X	X											2	Thermal treatment waste throughput capacity, fuel usage, TSDF waste acceptance limits
Density (bulk)													X	1	Waste mass calculatios, material storage volume requirements
pH		X						X	X				X	5	Metal corrosion, personnel exposure
Specific Gravity													X	1	Material storage & handling
Viscosity			X										X	2	Material storage & handling
Acidity								X				X		3	Neutralization reagent selection and quantity estimates
Ash Fusion Temperature			X								X			2	Slagging potential in thermal oxidizer or fluid bed boiler
Melting Point													X	1	Material handling

Table 2-1. Analytical Data Needs for Thermal Treatment Alternatives

Parameter	Regulatory Citation	Regulatory	Thermal Treatability	Stack Emissions	Fugitive Emissions	Odors	Health & Safety	Materials of Constr.-Metals	Materials of Constr. - Non-metals	Refractory Damage	Slagging Potential	Material Pretreatment	Materials Handling	Number of Issues	Basis for Data Requirement
Thermal Properties															
High Temp. Simulated Dist.			X											1	Thermal treatment residual product distribution as a function of temperature
Geotechnical Properties (a)															
Particle size distribution			X										X	2	Material pretreatment and handling, particulate carryover in thermal treatment device
Atterberg limits			X										X	2	Material pretreatment and handling
Proctor density													X	1	Backfill compaction

(a) Applicable to sand, silt and clay-like materials, and clay liner. Remediation of underlying soils is not within the scope of this study.

Table 2-2. References

No.	Preparer	Reference	Date	Pages	Source	Type
1	American Cyanamid	Memo - Waste Disposal Investigations - Light Oil Sludge Lagoons	12/09/77	4	OBG	Remedial Evaluation
2	American Cyanamid	Process Description - Primary Sludge Disposal	03/09/81	35	OBG	Remedial Evaluation
3	Zorex Corporation	An Evaluation of The Incineration Option for the Disposal of Contents of Lagoons 1,2,3,4,5,14 and 26	06/18/82	16	OBG	Remedial Evaluation
4	O'Brien & Gere	Lagoons 1 & 2 Characterization	10/01/82	56	OBG	Characterization
5	Zorex Corporation	Physical and Chemical Properties of Sludges in Lagoons 1 & 2	10/05/82	61	OBG	Characterization
6	O'Brien & Gere	Source Assessment and Remedy Program Lagoons 1 and 2	12/01/82	25	OBG	Other
7	Petroleum Associates	Letter - Evaluation of LOS Material as Fuel	01/21/83	4	OBG	Other
8	Zorex Corporation	Memo - Test Burn at Ohio State University (Jan 30, 1983)	02/10/83	2	OBG	Remedial Evaluation
9	O'Brien & Gere	Letter - Fuel Preparation Study - Lagoons 1 and 2	02/23/83	25	OBG	Remedial Evaluation
10	O'Brien & Gere	Letter - Lagoons 1 and 2 Remedial Program	03/13/83	8	OBG	Other
11	Zorex Corporation	Memo - Test Burn at Ohio State University (March 25-26, 1983)	04/01/83	3	OBG	Remedial Evaluation
12	P.S. Brzozowski	Memo - Fuel Blending Volume Reduction	06/23/83	4	OBG	Other
13	O'Brien & Gere	Fuel Blending Summary Report/Test Burn Report	08/22/83	118	OBG	Remedial Evaluation
14	O'Brien & Gere	Letter - Lagoon 1 & 2 Closure Summary	03/06/84	10	OBG	Other
15	O'Brien & Gere	Lagoon 1 & 2 Closure Program - Wastewater Treatment	03/31/86	47	OBG	Characterization
16	Robert O. Lampi	Litigation Materials - Kipin Industries vs American Cyanamid Company	04/24/86	292	OBG	Other
17	O'Brien & Gere	Letter - Lagoon 2 LOS-VR Evaluation	06/08/87	26	OBG	Remedial Evaluation
18	O'Brien & Gere	Lagoon 1 Investigatory Program	04/18/88	17	OBG	Characterization
19	American Cyanamid	Hazcon Solidification Technology Evaluation	02/06/90	20	Pfizer	Treatability Test

Table 2-2. References

No.	Preparer	Reference	Date	Pages	Source	Type
20	Blasland, Bouck & Lee	Impoundment Characterization Program Final Report - Volume I	08/01/90	306	OBG	Characterization
21	Littleford	Littleford Process Pilot Study Report	11/12/91	188	Pfizer	Treatability Test
22	Remediation Technologies	Draft Report – Bench Thermal Treatability Study	12/01/91	21	Pfizer	Treatability Test
23	American Cyanamid	Solid Phase Treatment of Lagoon 1 & 2 Material	12/01/91	10	Pfizer	Treatability Test
24	SoilTech	Bench-Scale Test of SoilTech Anaerobic Thermal Process for Desorption of Organic Contaminants	12/01/91	85	Pfizer	Treatability Test
25	American Cyanamid	Memo - Status Report and Program Direction Impoundment Group IV Lagoons	05/29/92	14	OBG	Other
26	ABB	Bartlett-Snow Rotary Calciner Treatability Test Report	04/16/93	35	Pfizer	Treatability Test
27	Blasland, Bouck & Lee	Group II Impoundments Corrective Measures Study/Feasibility Study Report	11/01/93	522	Pfizer	Treatability Test
28	O'Brien & Gere	Work Plan Impoundments 1 and 2 Pre-design Testing, Bound Brook, New Jersey Site	10/01/95	35	Pfizer	Site Investigation
29	O'Brien & Gere	Group III Impoundments CMS_FS Volume 2	11/01/97	328	OBG	Remedial Evaluation
30	O'Brien & Gere	Group III Impoundments Field Demonstration Test	04/01/01	423	OBG	Remedial Evaluation
31	O'Brien & Gere	Impoundment Remedy Appropriateness Evaluation Report	02/01/05	176	OBG	Other
32	O'Brien & Gere	Final Scope of Work Impoundments 1 & 2 Characterization Program Sample Locations	03/10/10	16	Pfizer	Site Investigation
33	O'Brien & Gere	Figure 1, Bound Brook Impoundments 1 & 2 Characterization Program Sample Locations	06/01/10	1	Pfizer	Site Investigation
34	O'Brien & Gere*	Impoundment 1-2 Sludge Tables	07/22/10	81	Pfizer	Site Investigation
35	O'Brien & Gere*	Impoundment 1-2 Water Cap Tables	07/22/10	7	Pfizer	Site Investigation
36	O'Brien & Gere	Former American Cyanamid Site Impoundments 1 & 2 Characterization Program Summary Report*	11/16/10	193	OBG	Characterization

Table 2-3. Waste Characterization Data Reported in 2010 OBG Report

Parameter	Viscous-Rubbery Material	Hard Crumbly Material	Coal Aggregate	Clay-Like Material	Sand & Silt-Like Material	Water Cap	Oily Liquid	Air Headspace	Data (a) Compilation Notes
VOCs	X	X	X			X	X	X	(b)
SVOCs	X	X	X			X	X		(c)
Metals	X	X	X			X	X		(d)
General Chemistry									
Chloride	X	X	X				X		(e)
Cyanide	X	X	X				X		(e)
Nitrogen, ammonia	X	X	X			X	X		(e)
Nitrogen, nitrate	X	X	X				X		(e)
Nitrogen, nitrate + nitrite	X	X	X				X		(e)
pH	X	X	X			X			(e)
Sulfite	X	X	X				X		(e)
Total Phenolics	X	X	X						(e)
Sulfide	X	X	X						(e)
Biochemical Oxygen Demand, 5-day						X			(e)
Carbonaceous Biochemical Oxygen Demand, 5-day						X			(e)
Chemical Oxygen Demand						X			(e)
Oil & Grease						X			(e)
Total Dissolved Solids						X			(e)
Total Organic Carbon						X			(e)
Total Suspended Solids						X			(e)
HEM Petroleum Hydrocarbons						X			(e)
Aldehydes	X	X	X					X	(c)
Explosives	X	X	X			X			(c)
PCB Arochlors	X	X							(c)
PCB Congeners	X	X							(c)
Alcohols									(c)
Volatile Fatty Acids						X			(c)
Acid Gases								X	(c)

(a) Notes refer to the process that was used to filter data for inclusion in the database presented in Appendix A and Table 2-4.
(b) VOC TAL incorporated by reference from OBG 2010 Report, except for BTEX compound detections which are included in Appendix A and Table 2-4.
(c) Incorporated by reference from OBG 2010 Report.
(d) Data for RCRA or MACT regulated metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag) plus sodium detections entered into the database.
Remainder of metal TAL incorported by reference from OBG 2010 Report.
(e) Analytical detections from OBG 2010 Report included in database in Appendix A and Table 2-4.

Table 2-4. Historical Analytical Data Summary

Waste Stream	Analyte	Test Units	Reporting Basis	Impoundment 1 Avg (a)	Impoundment 1 Max (a)	Impoundment 1 Min (a)	Impoundment 1 # Data Points	Impoundment 2 Avg (a)	Impoundment 2 Max (a)	Impoundment 2 Min (a)	Impoundment 2 # Data Points
Hard Crumbly Material	Alcohols	ug/kg	Wet	(b) (c)				(b) (c)			
(HC)	Aldehydes and Explosives	mg/kg	Wet	(b) (c)				(b) (c)			
	Calorific Value	Btu/lb	Wet	**7,155.44**	9,745.98	5,234.00	9	**10,702.56**	12,702.01	8,500.00	9
	Calorific Value	Btu/lb	Dry	**13,497.12**	16,010.50	10,039.70	5	**13,805.97**	16,651.30	9,007.00	7
	Chloride	mg/kg		**1,123.75**	2,270.00	56.30	11	**1,507.75**	7,010.00	43.10	14
	Corrosivity, agitated conditions	in/yr		**0.08**	0.08	0.08	1	**0.08**	0.08	0.08	1
	Corrosivity, quiescent conditions	in/yr		**0.03**	0.03	0.03	1	**0.03**	0.03	0.03	1
	Cyanide	mg/kg		**10.60**	10.60	10.60	1	**0.44**	0.44	0.44	1
	Density	lb/gal	Wet	**10.09**	10.10	10.07	3	**9.61**	9.64	9.60	3
	Flash Point	°F		**68.00**	68	68	1	**68.00**	68.00	68.00	1
	Metals-TAL	mg	Wet	(d) (c)				(d) (c)			
	Metals-Arsenic	mg/kg	Wet	**8.79**	15.80	3.90	10	**3.86**	7.10	2.40	12
	Metals-Barium	mg/kg	Wet	**48.10**	48.10	48.10	1	(d) (c)			
	Metals-Beryllium	mg/kg	Wet	**0.49**	0.73	0.25	2	(d) (c)			
	Metals-Cadmium	mg/kg	Wet	(d) (c)				(d) (c)			
	Metals-Chromium	mg/kg	Wet	**10.85**	50.20	2.70	13	**5.64**	16.10	1.00	14
	Metals-Lead	mg/kg	Wet	**65.28**	126.00	8.20	13	**43.95**	84.40	9.00	14
	Metals-Mercury	mg/kg	Wet	**1.03**	1.90	0.06	13	**1.75**	20.90	0.05	14
	Metals-Selenium	mg/kg	Wet	**8.80**	13.00	3.00	12	**6.31**	10.50	2.10	14
	Metals-Silver	mg/kg	Wet	(d) (c)				(d) (c)			
	Metals-Sodium	mg/kg	Wet	**2,533.33**	3,090.00	1,860.00	6	**3,200.71**	11,400.00	1,020.00	14
	Nitrogen - ammonia	mg/kg		**68.66**	147.00	18.90	7	**17.37**	25.50	5.20	3
	PCB-Aroclors	ug/kg	Wet	(d) (c)				(d) (c)			
	PCB-Congeners	pg/g	Wet	(b) (c)				(d) (c)			
	pH	pH	Wet	**2.91**	8.96	0.56	11	**1.29**	2.33	0.30	12
	Phenolics	mg/kg		**179.12**	444.00	52.90	11	**92.77**	279.00	14.80	14
	Proximate Analysis	%									
	Ash	%	Dry	**2.10**	4.10	1.00	4	**2.98**	4.50	1.70	5
	Ash	%	Wet	**1.01**	1.56	0.56	4	**2.18**	3	1	5
	Fixed Carbon	%	Dry	**57.76**	65.20	47.70	5	**36.56**	44.90	29.90	5
	Fixed Carbon	%	Wet	**31.38**	39.17	24.78	5	**26.79**			
	Moisture	%	Wet	**44.80**	62.00	32.00	5	**26.10**	33.50	21.50	5
	Volatile Matter	%	Dry	**37.78**	50.80	24.90	5	**60.46**	68.30	51.00	5
	Volatile Matter	%	Wet	**21.23**	34.54	11.67	5	**44.92**	53.62	33.92	5
	Solids	%		(f)				**44.90**	44.90	44.90	1
	Sulfur-Inorganic	%		**7.49**	8.17	6.90	3	**2.87**	3.77	1.97	2
	Sulfur-Sulfate	mg/kg		(f)				**260,000.00**	260,000.00	260,000.00	1
	Sulfur-Sulfide	mg/kg		**47.62**	66.20	21.50	5	**144.54**	512.00	30.60	5
	Sulfur-Sulfite	mg/kg		**256.42**	755.00	76.30	5	**409.75**	1,030.00	45.40	11
	Sulfur-Total	%	Dry	**12.36**	20.60	6.10	5	**11.64**	14.90	8.80	5
	Sulfur-Total	%	Wet	**5.95**	11.22	1.85	10	**7.53**	11.00	1.97	10
	SVOC-TAL	mg/kg	Wet	(c)				(c)			
	Total Organic Carbon (TOC)	mg TOC/g						**44.00**	44.00	44.00	1
	Ultimate Analysis	%									
	Chloride	%	Wet	**0.26**	0.40	0.10	5	**0.30**	0.30	0.30	5
	Hydrogen	%	Wet	**8.54**	10.20	4.80	5	**8.48**	9.30	8.10	5
	Nitrogen	%	Wet	**0.36**	0.70	0.20	5	**0.22**	0.30	0.20	5
	VOC-TAL	mg/kg	Wet	(c)				(c)			
	BTEX-Benzene	ug/kg	Wet	**78,948,333.33**	207,000,000.00	5,680,000.00	12	**64,378,571.43**	183,000,000.00	19,000,000.00	14
	BTEX-Ethylbenzene	ug/kg	Wet	**217,662.50**	529,000.00	2,150.00	12	**200,976.92**	591,000.00	84,300.00	13
	BTEX-Toluene	ug/kg	Wet	**16,712,315.38**	40,700,000.00	70,100.00	13	**13,400,000.00**	40,200,000.00	4,870,000.00	14
	BTEX-Xylene (total)	ug/kg	Wet	**2,592,526.56**	6,910,000.00	6,083.99	16	**2,460,000.00**	6,950,000.00	1,070,000.00	13

Table 2-4. Historical Analytical Data Summary

Waste Stream	Analyte	Test Units	Reporting Basis	Impoundment 1				Impoundment 2			
				Avg (a)	Max (a)	Min (a)	# Data Points	Avg (a)	Max (a)	Min (a)	# Data Points
Viscous Rubbery Material	Alcohols	ug/kg	Wet	(b) (c)				(b) (c)			
(VR)	Aldehydes and Explosives	ug/kg	Wet	(b) (c)				(b) (c)			
	Calorific Value	Btu/lb	Dry	**13,455.58**	15,801.90	8,542.40	5	**14,676.68**	16,246.40	10,258.10	5
	Calorific Value	Btu/lb	Wet	**8,364.81**	10,604.00	5,040.02	10	**10,490.40**	12,266.03	7,950.03	10
	Chloride	mg/kg		**742.20**	1,790.00	158.00	5	**211.29**	680.00	40.90	13
	Corrosivity, agitated conditions	in/yr		**0.08**	0.08	0.08	1	**0.08**	0.08	0.08	1
	Corrosivity, quiescent conditions	in/yr		**0.03**	0.03	0.03	1	**0.03**	0.03	0.03	1
	Cyanide	mg/kg		**7.70**	7.70	7.70	1	**0.95**	1.30	0.59	2
	Density	lb/gal	Wet	**9.80**	9.80	9.80	3	**9.19**	9.20	9.18	3
	Flash Point	°F		**68.00**	68.00	68.00	1	**68.00**	68.00	68.00	1
	Metals-TAL	mg	Wet	(d) (c)				(d) (c)			
	Metals-Arsenic	mg/kg	Wet	**7.84**	13.80	2.50	5	**3.23**	5.80	1.90	13
	Metals-Barium	mg/kg	Wet	**51.25**	65.10	37.60	4	(d) (c)			
	Metals-Beryllium	mg/kg	Wet	**0.68**	0.94	0.35	4	(d) (c)			
	Metals-Cadmium	mg/kg	Wet	(d) (c)				(d) (c)			
	Metals-Chromium	mg/kg	Wet	**17.58**	56.20	2.40	8	**2.69**	7.70	1.20	13
	Metals-Lead	mg/kg	Wet	**25.45**	35.70	14.20	8	**66.35**	235.00	21.40	13
	Metals-Mercury	mg/kg	Wet	**0.63**	1.30	0.20	7	**0.27**	0.79	0.04	12
	Metals-Selenium	mg/kg	Wet	**4.18**	5.50	3.40	5	**6.38**	13.30	3.60	13
	Metals-Silver	mg/kg	Wet	(c)				(c)			
	Metals-Sodium	mg/kg	Wet	**3,115.00**	4,500.00	1,730.00	2	**2,746.15**	5,810.00	1,470.00	13
	Nitrogen - ammonia	mg/kg		**25.58**	43.80	16.50	4	**29.50**	57.60	8.70	5
	PCB-Aroclors	ug/kg	Wet	(d) (c)				(d) (c)			
	PCB-Congeners	pg/g	Wet	(b) (c)				(d) (c)			
	pH	pH	Wet	**3.74**	12.36	1.04	7	**1.64**	2.20	1.09	12
	Phenolics	mg/kg		**114.87**	319.00	8.60	6	**108.13**	275.00	21.50	13
	Proximate Analysis	%									
	Ash	%	Dry	**3.78**	9.30	1.20	5	**1.64**	2.30	1.00	5
	Ash	%	Wet	**2.17**	4.98	0.74	5	**1.22**	2	1	5
	Fixed Carbon	%	Dry	**50.86**	62.60	42.90	5	**33.60**	36.30	31.90	5
	Fixed Carbon	%	Wet	**30.31**	36.93	27.93	5	**25.10**	26.45	24.08	5
	Moisture	%	Wet	**40.10**	46.50	34.00	5	**25.20**	29.00	22.50	5
	Volatile Matter	%	Dry	**45.36**	54.70	33.20	5	**64.80**	66.70	61.50	5
	Volatile Matter	%	Wet	**26.53**	36.10	19.59	5	**40.20**	51.69	2.12	5
	Solids	%		(g)				**33.10**	33.10	33.10	1
	Sulfur-Inorganic	%		**1.53**	1.75	1.30	2	**1.54**	2.10	0.97	2
	Sulfur-Sulfate	mg/kg		(g)				**10,800.00**	10,800.00	10,800.00	1
	Sulfur-Sulfide	mg/kg		**39.42**	54.10	24.10	6	**78.85**	225.00	26.20	4
	Sulfur-Sulfite	mg/kg		**534.33**	990.00	128.00	3	**297.29**	453.00	163.00	7
	Sulfur-Total	%	Dry	**12.64**	20.30	6.50	5	**8.40**	9.20	7.60	5
	Sulfur-Total	%	Wet	**7.46**	13.40	2.41	9	**8.00**	21.00	5.40	10
	SVOC-TAL	mg/kg	Wet	(c)				(c)			
	Ultimate Analysis	%									
	Chloride	%	Wet	**0.26**	0.40	0.10	5	**0.28**	0.40	0.20	5
	Hydrogen	%	Wet	**8.64**	10.00	8.00	5	**8.54**	9.90	8.00	5
	Nitrogen	%	Wet	**0.28**	0.50	0.10	5	**0.22**	0.30	0.20	5
	VOC-TAL	mg/kg	Wet	(c)				(c)			
	BTEX-Benzene	ug/kg	Wet	**15,557,762.50**	69,800,000.00	99,100.00	8	**29,500,000.00**	70,000,000.00	6,900,000.00	13
	BTEX-Ethylbenzene	ug/kg	Wet	**76,818.75**	387,000.00	1,480.00	8	**1,049,576.47**	7,390,000.00	74,600.00	17
	BTEX-Toluene	ug/kg	Wet	**4,198,942.50**	21,000,000.00	1,440.00	8	**9,298,181.82**	19,500,000.00	3,930,000.00	11
	BTEX-Xylene (total)	ug/kg	Wet	**1,212,700.00**	6,210,000.00	4,500.00	8	**2,133,636.36**	5,130,000.00	970,000.00	11

Table 2-4. Historical Analytical Data Summary

Waste Stream	Analyte	Test Units	Reporting Basis	Impoundment 1 Avg (a)	Impoundment 1 Max (a)	Impoundment 1 Min (a)	Impoundment 1 # Data Points	Impoundment 2 Avg (a)	Impoundment 2 Max (a)	Impoundment 2 Min (a)	Impoundment 2 # Data Points
Coal Aggregate	Alcohols	ug/kg	Wet	(d) (c)				(e)			
(CA)	Aldehydes and Explosives	ug/kg	Wet	(b) (c)							
	Chloride	mg/kg		**921.33**	1,340.00	374.00	3				
	Metals-TAL	mg	Wet	(d) (c)							
	Metals-Arsenic	mg/kg	Wet	**5.28**	5.70	4.70	4				
	Metals-Barium	mg/kg	Wet	**81.50**	81.50	81.50	1				
	Metals-Beryllium	mg/kg	Wet	**0.73**	0.73	0.73	1				
	Metals-Cadmium	mg/kg	Wet	(d) (c)							
	Metals-Chromium	mg/kg	Wet	**5.45**	7.30	3.00	4				
	Metals-Lead	mg/kg	Wet	**104.58**	168.00	7.80	4				
	Metals-Mercury	mg/kg	Wet	**1.52**	2.60	0.07	4				
	Metals-Selenium	mg/kg	Wet	**8.78**	12.90	2.80	4				
	Metals-Silver	mg/kg	Wet	(d) (c)							
	Metals-Sodium	mg/kg	Wet	**3,515.00**	4,160.00	2,870.00	2				
	Nitrogen - ammonia	mg/kg		**137.40**	207.00	31.20	3				
	PCB-Aroclors	ug/kg	Wet	(d) (c)							
	PCB-Congeners	pg/g	Wet	(d) (c)							
	pH	pH	Wet	**4.70**	7.63	1.01	4				
	Phenolics	mg/kg		**393.67**	766.00	166.00	3				
	Sulfur-Sulfide	mg/kg		**78.63**	106.00	36.70	3				
	Sulfur-Sulfite	mg/kg		**84.85**	116.00	53.70	2				
	SVOC-TAL	mg/kg	Wet	(c)							
	VOC-TAL	mg/kg	Wet	(c)							
	BTEX-Benzene	ug/kg	Wet	**40,633,333.33**	53,600,000.00	18,000,000.00	3				
	BTEX-Ethylbenzene	ug/kg	Wet	**148,142.50**	249,000.00	1,570.00	4				
	BTEX-Toluene	ug/kg	Wet	**8,694,100.00**	15,800,000.00	36,400.00	4				
	BTEX-Xylene (total)	ug/kg	Wet	**2,211,125.00**	3,430,000.00	24,500.00	4				
Yellow Oily Liquid	Chloride	mg/kg	Wet	**704.50**	869.00	540.00	2	(f)			
	Nitrogen - ammonia	mg/kg	Wet	**64.30**	64.30	64.30	1				
	Sulfur-Sulfite	mg/kg	Wet	**186.00**	186.00	186.00	1				
Sludge Composite (0 - 0.5 feet)	Flash Point	°F		**67.60**	67.60	67.60	1	**55.00**	55.00	55.00	1
Sludge Composite (1 - 2 feet)	Flash Point	°F		**45.00**	45.00	45.00	1	**59.00**	59.00	59.00	1
Sludge Composite (2 - 3 feet)	Flash Point	°F		**45.00**	45.00	45.00	1	**57.00**	57.00	57.00	1
Sludge Composite	Sodium	mg/kg		(g)				**5,870.00**	5,870.00	5,870.00	1
Aqueous Phase-Water Cap	Biochemical Oxygen Demand (BOD)	mg/L	Wet	**5.60**	5.60	5.60	1	**13.10**	13.10	13.10	1
	Chemical Oxygen Demand (COD)	mg/L	Wet	**64.70**	64.70	64.70	1	**100.00**	100.00	100.00	1
	pH	pH	Wet	**8.73**	8.73	8.73	1	**2.73**	8.00	0.10	3
	Total Dissolved Solids (TDS)	mg/L	Wet	**46.00**	46.00	46.00	1	**79.00**	79.00	79.00	1
	Total Organic Carbon (TOC)	mg/L	Wet	**14.50**	14.50	14.50	1	**22.00**	22.00	22.00	1
	Total Suspended Solids	mg/L	Wet	**6.00**	6.00	6.00	1	**15.00**	15.00	15.00	1

(a) Averages, maximums, and minimums calculated only from verified analytical detections. Non-detects were not entered into database.
(b) Minimal analyte detections.
(c) Full target analyte list available in "Former American Cyanamid Site Impoundments 1 & 2 Characterization Program Summary Report", OBG, 11/16/2010.
(d) Analyte below detection limit in samples.
(e) Coal aggregate material only present in Lagoon 1.
(f) Yellow oily liquid only encountered in Lagoon 1.
(g) Material from Lagoon 1 not analyzed.

Note: If extensive analytical data were available in the 2010 OBG Report, historical data were not entered or included in this summary. In the event of a data gap in the OBG 2010 data, a compilation of valid historical data were used. See Table 2-5, which identifies data gaps that currently exist.

Table 2-5. Analytical Data Gaps

Parameter	OBG 2010 Report	Historical Reports	Data Sufficient	Data Gap
Organic Compounds - Total				
VOCs	X		Yes	
Benzene	X		Yes	
SVOCs	X		Yes	
PCBs - Homologues	X		Yes	
PCBs - Arochlors	X		Yes	
Aldehydes	X		Yes	
Alcohols	X		Yes	
Explosives	X		Yes	
Pesticides				Yes
Organic Compounds - TCLP				
VOCs - TCLP				Yes
SVOCs-TCLP				Yes
Pesticides - TCLP				Yes
Herbicides - TCLP				Yes
Metals - Total				
Arsenic	X		Yes	
Barium	X		Yes	
Beryllium	X		Yes	
Boron				Yes
Cadmium	X		Yes	
Chromium	X		Yes	
Copper	X		Yes	
Lead	X		Yes	
Manganese	X		Yes	
Mercury	X		Yes	
Nickel	X		Yes	
Selenium	X		Yes	
Sodium	X		Yes	
Potassium	X		Yes	

Table 2-5. Analytical Data Gaps

Parameter	OBG 2010 Report	Historical Reports	Data Sufficient	Data Gap
Metals - TCLP				
Arsenic-TCLP				Yes
Barium-TCLP				Yes
Cadmium-TCLP				Yes
Chromium-TCLP				Yes
Lead-TCLP				Yes
Mercury-TCLP				Yes
Selenium-TCLP				Yes
Silver-TCLP				Yes
Cyanide	X		Yes	
Sulfide	X		Yes	
Flash Point		X		Yes
Corrosivity		X		Yes
Proximate Analysis				
Moisture		X		Yes
Volatile matter		X		Yes
Ash		X		Yes
Fixed carbon		X		Yes
Ultimate Analysis				
Carbon		X		Yes
Hydrogen		X		Yes
Oxygen		X		Yes
Nitrogen		X	Yes	
Sulfur		X		Yes
Chloride	X		Yes	
Bromine				Yes
Fluorine				Yes
Physical Properties				
Calorific Value		X	Yes	
Density (bulk)		X	Yes	
pH	X		Yes	
Specific Gravity		X	Yes	
Viscosity				Yes
Acidity				Yes
Ash Fusion Temperature				Yes
Melting Point				Yes
Thermal Properties				
High Temp. Simulated				Yes

Table 2-6. Recommended Analytical Methods to Fill Data Gaps

Analysis	Analytical Method	Lab	Sample Matrix	Detection Limit	Detection Limit Units	Minimum Sample Quantity
ORGANIC CHEMICAL ANALYSES						
Pesticides	SW-846 8081B	TestAmerica	Solid		mg/l	30 g
ORGANIC TCLP ANALYSES						
VOCs - TCLP	SW-846 1311/8260B	TestAmerica	Solid		mg/l	100 g
SVOCs - TCLP	SW-846 1311/8270D	TestAmerica	Solid		mg/l	100 g
Pesticides - TCLP	SW-846 1311/8081B	TestAmerica	Solid		mg/l	100 g
Herbicides - TCLP	SW-846 1311/8151A	TestAmerica	Solid		mg/l	100 g
INORGANIC CHEMICAL ANALYSES						
Boron	SW-846 6010C	TestAmerica	Solid		mg/kg	50 g
INORGANIC TCLP ANALYSES						
Arsenic (As) - TCLP	SW-846 1311/6020A	TestAmerica	Solid		mg/l	100 g
Barium (Ba) - TCLP	SW-846 1311/6020A	TestAmerica	Solid		mg/l	100 g
Cadmium (Cd) - TCLP	SW-846 1311/6020A	TestAmerica	Solid		mg/l	100 g
Chromium (Cr) - TCLP	SW-846 1311/6020A	TestAmerica	Solid		mg/l	100 g
Lead (Pb) - TCLP	SW-846 1311/6020A	TestAmerica	Solid		mg/l	100 g
Mercury (Hg) - TCLP	SW-846 1311/7471B	TestAmerica	Solid		mg/l	100 g
Selenium (Se) - TCLP	SW-846 1311/6020A	TestAmerica	Solid		mg/l	100 g
Silver (Ag) - TCLP	SW-846 1311/6020A	TestAmerica	Solid		mg/l	100 g
RCRA CHARACTERISTICS						
Flashpoint	ASTM D93-10a	TestAmerica	Solid		°F	10 g
Corrosivity (Liquids)	SW-846 1110A	TestAmerica	Liquids		inches/year	

Table 2-6. Recommended Analytical Methods to Fill Data Gaps

Analysis	Analytical Method	Lab	Sample Matrix	Detection Limit	Detection Limit Units	Minimum Sample Quantity
PROXIMATE ANALYSIS						
Moisture	ASTM D3171-03	Hazen	Solid		%	10 g
Ash	ASTM D3174-04	Hazen	Solid		%	
Volatile Matter	ASTM D3175-07	Hazen	Solid		%	
Fixed Carbon	by difference	Hazen	Solid		%	
UTIMATE ANALYSIS						
Carbon	ASTM D5373-08	Hazen	Solid		%	10 g
Hydrogen	ASTM D5373-08	Hazen	Solid		%	
Nitrogen	ASTM D5373-08	Hazen	Solid		%	
Oxygen	By Difference	Hazen	Solid		%	
Sulfur	ASTM D4239-11	Hazen	Solid		%	
Bromine	ASTM D2710-09	TBD	Solid		mg/kg	
Fluorine	ASTM D3761-10	Hazen	Solid		mg/kg	
PHYSICAL PROPERTY ANALYSIS						
Viscosity	ASTM D7042/D445-11a	TBD	Solid		centipoise	10 g
Corrosion of Metals	ASTM G-31-72	Corrosion Testing Laboratories, Inc.	Solid		inches/year	5 gallons
Material Compatibility	ASTM D543	Intertek Plastics Technology Laboratories	Solid		NA	5 gallons
pH	SW-846 9045D	Hazen	Solid		pH units	20 g
Ash Fusion Temperature	ASTM D1857/D1857M-04(2010)	Hazen	Solid		°F	100 g
Melting Point	ASTM D87-09	TBD	Solid		°F	10 g
THERMAL PROPERTY ANALYSIS						
High Temperature Simulated Distillation (HTSD)	ASTM D2887-08	Triton Analytics	Solid			10 g

TBD = To be Determined

Table 2-7. Material Takeoffs for Impoundment Materials

	Waste Volume		Bulk Density (wet)		Wet Mass		Estimated In-Situ Conditions						Estimated Dewatered Conditions					
Material	**Imp. 1 (yd^3)**	**Imp. 2 (yd^3)**	**Imp. 1 ($tons/yd^3$)**	**Imp. 2 ($tons/yd^3$)**	**Imp. 1 (tons)**	**Imp. 2 (tons)**	**Moisture (%, wet)**	**Imp. 1 Dry Mass (tons)**	**Imp. 2 Dry Mass (tons)**	**Total Dry Mass (tons)**	**Total Water (tons)**	**Total Wet Mass (tons)**	**Moisture (%, wet)**	**Total Dry Mass (tons)**	**Total Water (tons)**	**Total Wet Mass (tons)**	**Water Removed (tons)**	**Notes**
Viscous Rubbery (VR)	900	10,900	0.99	0.93	891	10,115	18	730	8,295	9,025	1,981	11,006	16	9,025	1,719	10,744	262	(a,b
Hard Crumbly (HC)	13,700	12,900	1.01	0.97	13,834	12,505	30	9,684	8,754	18,438	7,902	26,340	22	18,438	5,200	23,638	2,701	(a,b)
Clay-Like Material	2,700		1.54	1.54	4,152	0	35	2,699	0	2,699	1,453	4,152	30	2,699	1,157	3,856	297	(c,d,e)
Sand/Silt-Like Material	1,900		1.62	1.62	3,075	0	20	2,460	0	2,460	615	3,075	14	2,460	401	2,861	215	(c,f,g)
Coal Aggregate	5,000		0.70	0.70	3,508	0	15	2,982	0	2,982	526	3,508	12	2,982	407	3,388	120	(b,h)
Other (Mix of VR & HC)		6,500	1.00	0.95	0	6,167	24	0	4,687	4,687	1,480	6,167	19	4,687	1,099	5,786	381	
Subtotal Solids	**24,200**	**30,300**			**25,460**	**28,787**		**18,555**	**21,735**	**40,290**	**13,957**	**54,247**		**40,290**	**9,982**	**50,272**	**3,975**	
Water Cap	9,317	10,204			7,847	8,594	100			0	16,440	16,440	100	0	16,440	16,440		
Grand Total (n)	**33,517**	**40,504**			**33,307**	**37,381**				**40,290**	**30,398**	**70,688**		**40,290**	**26,423**	**66,713**		

(a) Density value is average of historical data collected for Impoundment 1 and Impoundment 2.

(b) Moisture contents estimated by Bill Troxler. Moisture content reported in Reference 21 (Littleford Pilot Study) ranged from 25-40% for VR and 26-45% for HC for disturbed samples. It has been assumed that these materials would have been mixed with water from the water cap during sampling and that actual in-situ moisture contents would be lower than reported in the Littleford study.

(c) Source of density values: http://www.simetric.co.uk/si_materials.htm

(d) Clay, wet excavated	1826	kg/m^3	
(e) Clay, dry excavated	1089	kg/m^3	
(f) Sand, wet	1922	kg/m^3	
(g) Sand, dry	1602	kg/m^3	
(h) Coal, bituminous, broken	833	kg/m^3	
(i) Imp. 1 surface area	2.1	acre	Reference 29
(j) Imp. 1 water cap depth	2.75	ft	May range from 1-4 feet depending on time of year and precipitation. Water cap on top of synthetic liner.
(k) Imp. 2 surface area	2.3	acre	References 29
(l) Imp. 1 water cap depth	2.75	ft	May range from 1-4 feet depending on time of year and precipitation.

(m) No quantitative data, assume volume of material is insignificant.

(n) Material quantities do not include the lagoon clay liner or any underlying contaminated soil.

Table 3-1. Evaluation of Excavation Alternatives

Evaluation Factors	Hydraulic Excavation[a]			Mechanical Excavation			
	Hydraulic Dredge	Water Jet and Pump	Heat and Pump	Standard Trackhoe with Auger	Crane with Environmental Clamshell Bucket	Crane with Dragline Bucket	Long-reach Trackhoe with Excavator Bucket
Ability to Handle Multiple Materials (VR, HC, etc.)	Yellow	Yellow	Red	Yellow	Red	Green	Green
Reach of Crane or Trackhoe	Green	Green	Green	Red	Green	Green	Yellow
Civil Works Required for Access to Wastes	Green	Green	Green	Red	Green	Green	Yellow
Accuracy in Controlling Excavation Depth	Yellow	Red	Yellow	Yellow	Green	Yellow	Green
Ability to Excavate Flat Bottom	Yellow	Red	Red	Red	Green	Yellow	Green
Excavation Rate	Yellow	Yellow	Red	Red	Yellow	Green	Green
Ability to Remove Hard or Stiff Materials	Yellow	Yellow	Red	Yellow	Red	Green	Green
Performance Affected by Ambient Temperature	Yellow	Yellow	Red	Yellow	Red	Green	Green
Disturbance to Liquid Cap	Green	Green	Green	Green	Yellow	Yellow	Yellow
Disturbance of Waste Materials	Red	Red	Red	Green	Yellow	Red	Yellow
Dewatering Waste Materials During Excavation	Red	Red	Red	Green	Yellow	Red	Green
Exposure of Mechanical Parts to Acid Conditions	Red	Yellow	Red	Yellow	Yellow	Yellow	Yellow
Exposure of Hydraulic Systems to Acid Conditions	Green	Green	Green	Green	Green	Green	Yellow
Equipment Capital or Rental Cost	Red	Red	Red	Yellow	Red	Red	Yellow
Equipment Operating Costs	Yellow	Yellow	Red	Green	Yellow	Yellow	Green
Treatment of Slurry Water	Red	Red	Red	NA	NA	NA	NA
Control of Fugitive Emissions from Slurry Water	Red	Red	Red	NA	NA	NA	NA
Plugging of Slurry Pipelines	Red	Red	Red	NA	NA	NA	NA
Safety Issues with Hot Oil System	NA	NA	Red	NA	NA	NA	NA
Energy Usage for Heating Materials	NA	NA	Red	NA	NA	NA	NA

(a) Crane mounted

Color	Rating
Green	Good
Yellow	Fair
Red	Poor

Table 3-2. Excavator Production Calculations

Cycle Components	Swing empty bucket to excavation area	8	seconds
	+ Lower bucket and dig materials	10	seconds
	+ Raise bucket	10	seconds
	+ Sqeeze and drain materials with thumb	60	seconds
	+ Swing loaded bucket to container and raise bucket	8	seconds
	+ Drop bucket load into container	20	seconds
Cycle Time (CT)		1.93	minutes/cycle
Waste No.		1	
Waste Material		Viscous Rubbery (VR)	
Operating Time (OT)	= Operating time	50	min/hr
Cycles per Hour (CH)	= Operating Time (OT) x Cycle Time (CT)	25.86	cycles/hr
Level Bucket Capacity (LBC)	= Capacity of bucket filled to top (not heaped)	1.00	yd^3
Bucket Fill Factor (BFF)	= Fraction of bucket filled after waste compression with thumb	0.50	dimensionless
Swell Factor (SF)	= Volume swell of compressed material in bucket versus in-situ material	5.00	%
Load Factor (LF)	= 100% / (100% + SF%)	0.95	dimensionless
Estimated Load (EL)	= Level Bucket Capacity (LBC) * Bucket Fill Factor (BFF) * Load factor (LF)	0.48	bank yd^3 per bucket
Instantaneous Hourly Production (IHP)	= Estimated Load (EL) * Cycles per Hour (CH)	12.32	bank yd^3/hr
Efficiency Factor (EF)	= Operating efficiency, allowing downtime for maintenance, weather, etc.	75.0	%
Average Hourly Production (AHP)	= Instantanoues Hourly Production (IHP) x Efficiency Factor (EF)	9.24	bank yd^3/hr
Bank Density (BD)	= In-situ density of material	0.99	tons/yd^3
Average Excavation Rate (AER)	= Average Hourly Production (AHP) x Bank Density (BD)	9.14	tons/hr

Notes:
BCY = bank cubic yards, weight of one cubic yard of in-situ material
LCY = loose cubic yards, weight of one cubic yard of loose disturbed material that has swelled during excavation

Table 3-3. Material Excavation Data

Waste No.	Material	Bank Density (tons/yd³)	SF Swell Factor[a] (%)	LF Load Factor (dimensionless)	Loose Density (ton/yd³)	BFF Bucket Fill Factor[a] (dimensionless)	Average Hourly[b] Excavation Rate (tons/hr)	Annual[c] Excavation Rate (tons/hr)
1	Viscous Rubbery (VR)	0.99	5	0.95	0.94	0.50	9.14	19,011
2	Hard Crumbly (HC)	1.01	10	0.91	0.92	0.75	13.36	27,789
3	Clay-Like Material	1.54	10	0.91	1.40	0.75	20.37	42,370
4	Sand/Silt-Like Material	1.62	10	0.91	1.47	0.75	21.42	44,554
5	Coal Aggregate (CA)	0.70	10	0.91	0.64	0.75	9.26	19,261
6	Other (Mix of VR & HC)	1.00	8	0.93	0.93	0.63	11.28	23,462

(a) After material is compressed in excavator bucket using fixed thumb.
(b) Based on 75% operating factor
(c) Based on 5-day per week operating schedule, 8 hours/day.

Table 4-1. Offsite Treatment Facilities Contact Information

Company	Address	Name/Title	Phone & E-mail	Technology	Applicable
Cement and Aggregate Kilns/Fuel Blenders					
Ash Grove Cement	1801 North Santa Fe Ave Chanute, KS 66720	Randy Pryor Plant Manager	(620) 431-4500	Cement Kiln (no steam generator)	
Ash Grove Cement	4343 Highway 108 Foreman, AR 71836	Carey Austell Plant Manager	(870) 542-6217	Cement Kiln	
Ash Grove Cement	11011 Cody Street Overland Park, KS 66210	Bryan Dalby Corporate Envr. Engr	(913) 451-8900	NA	NA
Cadence Environmental Energy, Inc.	1235 North Loop West, Suite 717 Houston, TX 77008	Tom Lecky * Sales Manager	(713) 802-0250 (office) (480) 766-0642 (cell)	Fuel Blender (for Ash Grove)	NA
Buzzi Unicem	100 Brodhead Rd Bethlehem, PA 18017	Adam Swercheck* Purchasing	(610) 882-5025	Corporate	(2) RCRA permitted kilns in U.S.
Buzzi Unicem	3301 S. County Rd 150 W Greencastle, IN 46135	Bob West/Tony Bannon Env. Mgr.	(765) 653-9766	Cement Kiln	Maybe - in process of modifying RCRA permit to accept bulk solids.
Buzzi Unicem	2524 South Sprigg St Cape Girardeau, MO 63703	Paul Shell (verify spelling) Env. Mgr.	(573) 335-5591	Cement Kiln	Solids in drums only.
Sumter Transport	1880 Lynette Dr Sumter, SC 29154	Brian Wilson Field Manager	(800) 479-7496 (803) 840-1953	3rd Party Kiln/Blender	Working with Buzzi Greencastle to process bulk solids.
Continental Cement Co.	10107 Highway 79 Hannibal, MO 63401-7859	Andrea Farr	(573) 221-1740	Cement Kiln	Yes
Green America	10107 Highway 79 Hannibal, MO 63401	Howard Ray * Sales Manager	(931) 446-0757 (cell)	Fuel Blender (for Continental)	
Essroc (Secondary for Tradebe)	3084 W County Rd 225 S Logansport, IN 46947		(610) 837-6725 Corporate in Nazareth, PA	Cement Kiln	Less transportation costs to Norlite from Bridgeport, CT
Tradebe United Industrial Services Bridgeport United Recycling	50 Cross Street Bridgeport, CT 06610	Don Perrotti* Sales	(203) 238-8155 dperrotti@unitedindustrialservices.com	TSDF/Fuel Blender (for Norlite and Essroc)	
Tradebe	4343 Kennedy Ave East Chicago, IN 46312	Erika Frederick TTR Direct Manager	(800) 388-7242 Erika.Frederick@tradebe.com	TSDF/Fuel Blender	
Giant Cement Company	654 Judge Street Harleyville, SC 29448-3119	Tammy Hamilton * Customer Service Chemist	(803) 496-5033	Cement Kiln	Maybe - benzene limits, Btu/lb limits, etc.
	1530 S. State St, Suite 406 Chicago, IL 60605	Gary Martini	(312) 567-9865 gmartini@grr-giant.com		

Table 4-1. Offsite Treatment Facilities Contact Information

Company	Address	Name/Title	Phone & E-mail	Technology	Applicable
Cement and Aggregate Kilns/Fuel Blenders, cont.					
Holcim	200 Safety Street Hwy 453 Holly Hill, SC 29059	Archie Goodman Operations Manager	(803) 496-1473	Cement Kiln	
Geocycle	2175 Gardner Blvd Holly Hill, SC 29059	Keith Brown Sales Manager	(662) 549-1200 Keith.BROWN@geocycle.com	Fuel Blender (for Holcim)	
Keystone Cement	6512 Nor-Bath Blvd Bath, PA 18014	Gary Oakley Sales Manager (Located in Pittsburgh, PA)	(804) 895-0091	Cement Kiln	No - sulfur limits, handle liquids only
Lafarge North America	1400 S. Cement Road Fredonia, KS 66736		(620) 378-4458	Cement kiln	Yes
Systech Environmental Corporation	1420 S. Cement Road Fredonia, KS 66736	Joseph Durczynski	(620) 378-4451 (602) 757-7956	Fuel blender (for LaFarge)	
LaFarge North America	11435 County Road 176 Paulding, OH 45879		(248) 534-5666	Cement kiln	Pumpable liquids only No hazardous solids
Systech Environmental Corporation	11397 County Road 176 Paulding, OH 45879	Paul Wonsack*	(419) 399-4835 (248) 534-5666	Fuel blender (for LaFarge)	
Systech Environmental Corporation	3085 Woodman Dr, Suite 300 Dayton, OH 45420	Erica Hawk* Customer Service Rep.	(800) 888-8011 x 313	Fuel Blender (for LaFarge)	
Systech Environmental Corporation		Zach Unruh	(816) 260-5357 Zach.Unruh@lafarge-na.com		
Norlite Corp. (Primary for Tradebe)	628 South Saratoga St Cohoes, NY 12047	Charlie Story V.P Business Development	(800) 234-0401 (518) 857-3485	Aggregate Kiln	Operate 2 rotary kilns
Tradebe United Industrial Services Bridgeport United Recycling	50 Cross Street Bridgeport, CT 06610	Don Perrotti* Sales	(203) 238-8155 dperrotti@unitedindustrialservices.com	TSDF/Fuel Blender (for Norlite and Essroc)	
Rineco	819 Vulcan Road Benton, Arkansas 72015	Dawn Hearn	(501) 778-9089 (800) 377-4692	Fuel Blender for various kilns	May have limits on benzene and sulfur.
Fluid Bed Power Plants					
Piney Creek L. P. Power Plant	428 Power Lane Clarion, PA 16214		(814) 226-8001	Fluidized Bed Power Plant	
Colmac Resources, Inc.	8337 Ingleton Circle Easton, Maryland 21601	Richard Turnbell* Vice President	(410) 820-9836 rht@atlanticbb.net	Broker (for Piney Creek)	

Table 4-1. Offsite Treatment Facilities Contact Information

Company	Address	Name/Title	Phone & E-mail	Technology	Applicable
Commercial Indirect Thermal Desorption Facilities					
Clean Harbors	265 Front Street North Sarnia, Ontario, Canada	Jim Noles	(336) 676-1077 noles.james@cleanharbors.com	Indirect Thermal Desorber	Yes
Duratherm	2700 Avenue S San Leon, TX 77539	Paul Nowlin	(281) 339-1352	Indirect Thermal Desorber (Fixed and mobile units available) DuraTherm Unit(s)	Yes
EQ - Environmental Quality	49350 North I-94 Service Dr Belleville, MI 48174	Bob Koss	(800) 592-5489 (740) 816-2507 (cell?)	Indirect Thermal Desorber (Fixed and mobile units available)	Yes
Commercial Hazardous Waste Incinerators					
Clean Harbors	Norwell, MA	Jane McCarthy* Pfizer Natl Acct Rep	(610) 967-6895 (484) 809-2518 (cell)	(Corporate Account Manager)	NA
Clean Harbors	4090 Telfer Road, Rural Route #1 Corunna, ON NON 1 G0 CA	Jim Noles	(336) 676-1077 noles.james@cleanharbors.com	Rotary Kiln (large)	Yes
Clean Harbors	309 American Circle El Dorado, AR 71730	Dan Roblee	(870) 863-7173	Rotary Kiln (small)	No (small)
Clean Harbors	2027 Independence Parkway South La Porte, TX 77571	Jeff Culpepper	(281) 930-2300	Rotary Kiln (large)	Yes
Clean Harbors	2247 South Highway 71 Kimball, NE 69145	Paul Whiting/ Vice President	(308) 235-4012	Fluidized bed (small)	No (small)
Clean Harbors	P.O. Box 1339 Grantsville, UT 84029		(435) 884-8100	Rotary Kiln (large)	TBD (distance)
Ross Incineration Services, Inc.	36790 Giles Road Grafton, OH 44044	John Chunuk * Sales Manager	(800) 878-7677 (440) 328-6094	Rotary Kiln (large)	Yes
Veolia	Baton Rouge, LA	Jeff Reiterman* Regional Sales Manager jeff.reiterman@veoliaes.com Stacy Hagler (backup)	(724) 452-7708 (412) 352-3207 (cell) (484) 361-7834 (cell)	NA	NA
Veolia	Highway 73 Port Arthur, TX 73643	Rean Swanson Technical Manager	(409) 736-2821	Rotary Kiln (large)	Yes
Veolia	# 7 Mobile Avenue Sauget, IL 62201	Doug Harris/ Thermal Operations Mgr.	(618) 271-2804	Rotary Kiln (small)	No (small)
Waste Technologies Industries	1250 St. George Street East Liverpool, OH 43920	Fred Sigg/ Technical Manager	(330) 385-7337	Rotary Kiln (large)	Yes

* Best Corporate contact.

Table 4-2. Offsite Treatment Facilities

				Waste Transportation Options			Material Packaging Accepted			Solids Hand.	Storage Capacity		Facility Capacity					Focus Estimate
Facility	**Facility Type**	**Location**	Distance (miles)	Truck	Rail	Currently Receiving Bulk Solids by Rail	Bulk Liquids	Bulk Solids	Contain. Solids	Solids Feed System	Liquids (gallons)	Solids (roll-offs)	Total Liquids Capacity (gals/year)	Total Liquids[a] Capacity (tons/year)	Total Solids Capacity (tons/year)	Permitted Total Waste Capacity (tons/year)	Practical[b] Total Waste Capacity (tons/yr)	Bound Brook Material Acceptance (tons/yr)
Cement Kilns (Fuel Blenders)																		
Ash Grove (Cadence)	Cement Kiln	Chanute, KS	1285	Yes	No	No	Truck only	Non Haz Only	5-7 Gal Containers	Elevator Conveyor	325,000	2 - 4 Rolloffs	40,000,000	150,120	9,000	159,120	(d)	(d)
Ash Grove (Cadence)	Cement Kiln	Foreman, AR	1380	Yes	No	No	Truck only	Non Haz Only	5-7 Gal Containers	Elevator Conveyor	300,000	3 - 4 Rolloffs	40,000,000	150,120	9,000	159,120	(d)	(d)
Buzzi (Sumter Transportation)	Cement Kiln	Greencastle, IN	730	Yes	No	No	Truck only	None	No	Blend to Liquid	(d)	(d)	(d)			(d)	(d)	(d)
Buzzi (Sumter Transportation)	Cement Kiln	Cape Girardeau, MO	1005	Yes	No	No	Truck only	None	No	Blend to Liquid	(d)	(d)	(d)			(d)	(d)	(d)
Continental (Green America)	Cement Kiln	Hannibal, MO	986	Yes	Yes	Yes	Truck and rail	Roll-off, sludge/vacuum boxes, intermodal containers	Drums, supersaks	Blend to liquids, shredded solids by belt & pneumatic conveyor	575,000	66	23,100,000	87,000	20,000	107,000	87,000	5,000 - 15,000
Essroc (Tradebe)	Cement Kiln	Logansport, IN	783	Yes	Yes	Yes	Yes	Yes	No	Blend to Liquid	(d)	36	(d)	37,479	23,000	(d)	60,479	5,000-10,000
Giant (Multiple)	Cement Kiln	Harleyville, SC	692	Yes	Yes (c)	(d)	Yes (tanker heating available)	Roll-off	(d)	Direct solids belt feed conveyor	(d)	(d)	(d)			(d)	(d)	(d)
Holcim (Geocycle)	Cement Kiln	Holly Hill, SC	690	Yes	Yes	Yes	Yes (no tanker heating)	Non-hazardous only	(d)	Direct solids belt feed conveyor	500,000	(d)	(d)			(d)	104,000	4,000-8,000
Keystone (Multiple)	Cement Kiln	Bath, PA	60	Yes	Yes	(d)	Yes	(d)	(d)	(d)	(d)	(d)	(d)			(d)	(d)	(d)
Lafarge (Systech)	Cement Kiln	Paulding, OH	625	Yes	Yes	No	Yes	None	No	None	(d)	(d)	25,000,000	93,825		152,000	116,000	5,000 - 15,000
Lafarge (Systech)	Cement Kiln	Fredonia, KS	1310	Yes	Yes	No	Yes	Hazardous	Yes	Blend to liquids	(d)	(d)	22,000,000	82,566	23,034	105,600	96,000	5,000 - 15,000
Aggregate Kiln (Fuel Blender)																		
Norlite (Tradebe)	Aggregate Kiln	Cohoes, NY	243	Yes	No	No	Yes	None	None	None	(d)	None	8,000,000	30,024		40,000	(d)	3,000 - 5,000
Fluid Bed Power Plants																		
Piney Creek (Colmac)	Boiler	Clarion, PA	300	Yes	Yes	Yes	None	Non haz, dump truck, roll-off	Non haz	Feed conveyor	(d)	(d)	(d)			22,813	(d	(d)

Table 4-2. Offsite Treatment Facilities

				Waste Transportation Options			Material Packaging Accepted			Solids Hand.	Storage Capacity		Facility Capacity					Focus Estimate
Facility	**Facility Type**	**Location**	Distance (miles)	Truck	Rail	Currently Receiving Bulk Solids by Rail	Bulk Liquids	Bulk Solids	Contain. Solids	Solids Feed System	Liquids (gallons)	Solids (roll-offs)	Total Liquids Capacity (gals/year)	Total Liquids[a] Capacity (tons/year)	Total Solids Capacity (tons/year)	Permitted Total Waste Capacity (tons/year)	Practical[b] Total Waste Capacity (tons/yr)	Bound Brook Material Acceptance (tons/yr)
Thermal Desorbers																		
Clean Harbors	Indirect TD	Sarnia, Ontario	588	Yes	Possible (d)	Possible (d)	Yes	Roll-off	No	Feed conveyor	(d)	None	(d)			None	(d)	(d)
Duratherm	Indirect TD	San Leon, TX	1595	Yes	(available in Houston)	No	No	Roll-off	Supersack	Screw feeder	No	(d)	None		32000	32,000	(d)	8,000 - 10,000
EQ	Indirect TD	Belleville, MI	600	Yes	Yes	Yes	Yes	Gondolas, Intermodals	Yes	Screw feeder	No	(d)	None		16000	16,000	(d)	4,000 - 8,000
Hazardous Waste Incinerators																		
Clean Harbors	HW Incinerator (liquid injection)	Sarnia, Ontario	588	Yes	Bulk liquids	No	Tanker, rail	No	No	None	2,000,000	None		100,000		100,000	None	No solids treatment
Clean Harbors	HW Incinerator (fluidized bed)	El Dorado, AR	1301	Yes	Bulk liquids	No	Yes	Limited, via truck	Drums	Shredder/auger	1,859,444	Drum storage only	(d)			(d)	Limited	(d)
Clean Harbors	HW Incinerator	Kimball, NE	1666	Yes	Yes	Yes	Yes	Roll-off (sealed, <5% free liquid)	Yes	(d)	240,000	750 tons	(d)			(d)	(d)	(d)
Clean Harbors	HW Incinerator (rotary kiln)	Deer Park, TX	1600	Yes	Yes	Yes	Yes	Intermodals, Roll-off (sealed, <5% free liquid)	Drums	Train I (feed pit, clamshell, conveyor system) Train II (feed pit, clamshell, conveyor, bucket elevator)	830,000 (tank) 132,000 (tankers), 1,490,000 (drums)	200	(d)			Train I (180 MM BTU/hr combined), Train II (213.5 MM BTU/hr combined)	(d)	(d)
Clean Harbors	HW Incinerator (rotary kiln)	Aragonite, UT	2232	Yes	Yes	Yes	Yes	Intermodals, Roll-off (sealed, <5% free liquid)	Yes	Feed hopper and solids feed chute into kiln	480,000	1,200 tons non-flam	(d)			140 MM BTU/hr combined	(d)	(d)
Ross	HW Incinerator (rotary kiln)	Grafton, OH	472	Yes	No	No	Yes	Roll-off	Drums	(d)	(d)	(d)	(d)			(d)	(d)	(d)
WTI	HW Incinerator (rotary kiln)	East Liverpool, OH	380	Yes	Yes	Yes	Yes	Roll-off	20 gal drums (due to high calorific value)	Crane, clamshell bucket, feed chute	284,000	60 roll-offs	(d)			60,000	(d)	(d)
Veolia	HW Incinerator (rotary kiln)	Port Arthur, TX	1508	Yes	Yes	Yes	Yes	Yes	Roll-off (sealed), drums	(d)	(d)	(d)	(d)			60,000	(d)	884 - 2,652
Veolia	HW Incinerator	Sauget, IL	920	Yes	No	No	Yes	Roll-off (sealed)	Drums	(d)	(d)	(d)	(d)			30,000	(d)	(d)

(a) Assumed density of liquid wastes: 7.506 lb/gallon
(b) Practical capacity is based on actual throughput, considering plant downtime.
(c) Rail access is offsite, requires material transfer
(d) Information to be provided by vendor.
(e) Treatability and/or pilot testing required.
(f) Sample analysis required.

Table 4-2. Offsite Treatment Facilities

			Material Hazard Class Accepted				Waste Characteristics Limits									
Facility	**Facility Type**	**Location**	Liquids RCRA Haz (ton/yr)	Solids RCRA Haz D001	Solids RCRA Haz D002	NESHAPS Certified Benzene D018	Liquids pH	Solids pH	Liquids Viscosity (c.p.s.)	Solids % Moisture	Specific Gravity	Sulfur (as fed) (%)	Halogens (as fed) (%)	Minimum Cal Value (Btu/lb)	D018 Benzene in Solids (mg/kg)	**Notes**
Cement Kilns (Fuel Blenders)																
Ash Grove (Cadence)	Cement Kiln	Chanute, KS	Yes	Yes	No	Yes	2 - 12.5	2 - 12.5	(d)	<20%	(d)	Blend or space shipments	Blend or space shipments	>5,000	Blend or space shipments	As of 07/11, one year away from modifying RCRA Part B to accept and treat bulk solids to be received in rolloffs or via rail.
Ash Grove (Cadence)	Cement Kiln	Foreman, AR	Yes	Yes	No	Yes	2 - 12.5	2 - 12.5	(d)	<20%	(d)	Blend or space shipments	Blend or space shipments	>5,000	Blend or space shipments	As of 07/11, one year away from modifying RCRA Part B to accept and treat bulk solids to be received in rolloffs or via rail.
Buzzi (Sumter Transportation)	Cement Kiln	Greencastle, IN	Yes	Yes	Yes	Yes	Neutralize in transit	Neutralize in transit	(d)	Blend	(d)	Blend	(d)	(d)	No limit	Part B permit modification submitted to accept and treat bulk solids.
Buzzi (Sumter Transportation)	Cement Kiln	Cape Girardeau, MO	Yes	Yes	Yes	Yes	Neutralize in transit	Neutralize in transit	(d)	Blend	(d)	Blend	(d)	(d)	No limit	Part B permit modification submitted to accept and treat bulk solids.
Continental (Green America)	Cement Kiln	Hannibal, MO	Yes	Yes	Yes	Yes	>3	(d)	(d)	(d)	(d)	(d)	(d)	>5,000	(d)	Totally enclosed blending and processing buildings that vent organic vapors to the burning zone of the kiln.
Essroc (Tradebe)	Cement Kiln	Logansport, IN	Yes	Yes	Yes	Yes	5-9	5-9	(d)	(d)	(d)	5	(d)	(d)	No limit	Totally enclosed blending and processing building that vent organic vapors to the burning zone of the kiln. No capability to handle non-dispersable solids (rocks, PPE, etc.)
Giant (Multiple)	Cement Kiln	Harleyville, SC	Yes	(d)	Yes	Yes	4-10, no exceptions	>4	(d)	(d)	<1.2	<2	(d)	>2000 or >5000	<100	Benzene limit not attainable for Pfizer impoundment material
Holcim (Geocycle)	Cement Kiln	Holly Hill, SC	Yes	(d)	None	Yes	>2	(d)	(d)	(d)	(d)	~0.5	<1.0	(d)	(d)	Not currently approved to accept CERCLA wastes
Keystone (Multiple)	Cement Kiln	Bath, PA	Yes	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	Very stringent state permit limits
Lafarge (Systech)	Cement Kiln	Paulding, OH	Yes	(d)	None	(d)	>2, prefer 4-9	(d)	(d)	(d)	(d)	(b)	(d)	(d)	(d)	
Lafarge (Systech)	Cement Kiln	Fredonia, KS	Yes	(d)	None	(d)	>2, prefer 4-9	(d)	(d)	(d)	(d)	(b)	(d)	(d)	(d)	
Aggregate Kiln (Fuel Blender)																
Norlite (Tradebe)	Aggregate Kiln	Cohoes, NY	Yes	No	No	No	2-12.5		(d)	(d)	(d)	1.0	(d)	(d)	(d)	
Fluid Bed Power Plants																
Piney Creek (Colmac)	Boiler	Clarion, PA	No	No	No	No	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)	No	Use limestone injection to control SO_2 emissions. Plant not currently RCRA permitted. Plan is to use additives and render material non-hazardous.

Table 4-2. Offsite Treatment Facilities

			Material Hazard Class Accepted				Waste Characteristics Limits									
Facility	**Facility Type**	**Location**	Liquids RCRA Haz (ton/yr)	Solids RCRA Haz D001	Solids RCRA Haz D002	NESHAPS Certified Benzene D018	Liquids pH	Solids pH	Liquids Viscosity (c.p.s.)	Solids % Moisture	Specific Gravity	Sulfur (as fed) (%)	Halogens (as fed) (%)	Minimum Cal Value (Btu/lb)	D018 Benzene in Solids (mg/kg)	**Notes**
Thermal Desorbers																
Clean Harbors	Indirect TD	Sarnia, Ontario	Yes	No	No	No	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)	
Duratherm	Indirect TD	San Leon, TX	(d)	Yes	Yes	Yes	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)	
EQ	Indirect TD	Belleville, MI	Yes	Yes	Yes	Yes	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)	
Hazardous Waste Incinerators																
Clean Harbors	HW Incinerator (liquid injection)	Sarnia, Ontario	Yes	No	No	Yes	(f)	N/A	<1,000	N/A	(f)	(f)	<2	(f)	N/A	
Clean Harbors	HW Incinerator (fluidized bed)	El Dorado, AR	Yes	Yes	Yes	Yes	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	
Clean Harbors	HW Incinerator	Kimball, NE	Yes	Yes	Yes	Yes	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	Approved for delisting of incinerator ash.
Clean Harbors	HW Incinerator (rotary kiln)	Deer Park, TX	Yes	Yes	Yes	Yes	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	Train I (RCRA, TSCA) Train II (RCRA)
Clean Harbors	HW Incinerator (rotary kiln)	Aragonite, UT	Yes	No	Yes	Yes	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	RCRA, TSCA
Ross	HW Incinerator (rotary kiln)	Grafton, OH	Yes	Yes	Yes	Yes	On-site neutralization	On-site neutralization	(f)	(f)	(f)	(f)	(f)	(f)	(f)	
WTI	HW Incinerator (rotary kiln)	East Liverpool, OH	Yes	Yes	Yes	Yes	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	
Veolia	HW Incinerator (rotary kiln)	Port Arthur, TX	Yes	Yes	Yes	Yes	Evaluate with materials of construction	Evaluate with materials of construction	(f)	No free liquids	(f)	(f)	(f)	Blend at incinerator with low cal value material	No limit	Can feed as bulk solid. Solidify with lime prior to shipment (<1% Na or K alkali or refractory damage). Can treat low flash point waste.
Veolia	HW Incinerator	Sauget, IL	Yes	Yes	Yes	Yes	Evaluate with materials of construction	Evaluate with materials of construction	(f)	No free liquids	(f)	(f)	(f)	Blend at incinerator with low cal value material	No limit	Closed loop system for high odor solids/liquids. Specialty is reactive wastes.

(a) Assumed density of liquid wastes: 7.506
(b) Practical capacity is based on actual throughput, considering plant downt
(c) Rail access is offsite, requires material transfer
(d) Information to be provided by vendor.
(e) Treatability and/or pilot testing required.
(f) Sample analysis required.

Table 4-3. Offsite Treatment Alternatives Evaluation

Company/Location	Technology	Distance from Bound Brook (miles)	RCRA and CAA Permitted	Permitted for RCRA Haz Bulk Solids	Can Obtain or Modify Required Permit(s)	Total Facility Capacity (tons/yr)	Total Capacity Bound Brook Waste (tons/yr)	Storage Capacity	D001 (Ignitability)	D002 (Corrosivity)	pH Acceptable	D018 (Benzene)	Benzene NESHAPS Certified (D018)	Sulfur Acceptable	Calorific Value (Btu/lb) Acceptable	Shipping - Truck	Shipping - Rail	Notes
Ash Grove (Cadence) Chanute, KS	Cement Kiln	1285	Green	Red	Yellow	Red		Yellow	Green	Red	Red	Green	Green	Yellow	Green	Green	Red	At least a year away from submitting RCRA permit modification application to treat bulk solids.
Ash Grove (Cadence) Foreman, AR	Cement Kiln	1380	Green	Red	Yellow	Red		Yellow	Green	Red	Red	Green	Green	Yellow	Green	Green	Red	At least a year away from submitting RCRA permit modification application to treat bulk solids.
Buzzi Unicem (Sumter) Greencastle, IN	Cement Kiln	730	Green	Red	Yellow				Green	Green	Yellow	Green	Green	Yellow	Red	Green	Red	Maybe - in process of modifying RCRA permit Sumter has viscosity limits
Buzzi Unicem (Sumter) Cape Girardeau, MO	Cement Kiln	1005	Green	Red	Red	Red		Red	Green	Green	Red	Green	Green	Yellow	Red	Red	Red	Non haz solids in drums only. Sumter has viscosity limits
Continental (Green America) Hannibal, MO	Cement Kiln	986	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Green	Green	Yellow	Green	Green	Green	
Essroc (Tradebe) Logansport, IN	Cement Kiln	783	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Green	Green	Yellow	Green	Green	Green	
Giant Cement Company Harleyville, SC	Cement Kiln	692	Green	Green	Green	Green	Yellow		Green	Green	Yellow	Red	Red	Yellow	Green	Green	Green	Maybe - benzene limits, Btu/lb limits, etc.
Holcim (Geocycle) Holly Hill, SC	Cement Kiln	690	Green	Red	Yellow	Green	Yellow	Green	Green	Green	Yellow	Green	Green	Yellow	Green	Green	Green	

Table 4-3. Offsite Treatment Alternatives Evaluation

Company/Location	Technology	Distance from Bound Brook (miles)	RCRA and CAA Permitted	Permitted for RCRA Haz Bulk Solids	Can Obtain or Modify Required Permit(s)	Total Facility Capacity (tons/yr)	Total Capacity Bound Brook Waste (tons/yr)	Storage Capacity	D001 (Ignitability)	D002 (Corrosivity)	pH Acceptable	D018 (Benzene)	Benzene NESHAPS Certified (D018)	Sulfur Acceptable	Calorific Value (Btu/lb) Acceptable	Shipping - Truck	Shipping - Rail	Notes
Keystone Cement Bath, PA	Cement Kiln	60	🟢	🔴	🔴				🟢	🟢		🟢	🟢	🔴				Sulfur, as fed <2% Pumpable liquids only.
Lafarge (Systech) Fredonia, KS	Cement Kiln	1310	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟡	🟢	🟢	🟢	
LaFarge (Systech) Paulding, OH	Cement Kiln	625	🟢	🔴	🟡	🟢			🟢	🟢	🟡	🟢	🟢	🟡	🟢	🟢	🟢	
Norlite Corp. (Tradebe) Cohoes, NY	Aggregate Kiln (x2)	243	🟢	🟢	🟢	🟡		🟡	🟢	🟢	🟡	🟢	🟢	🟡	🟢	🟢	🟢	Operate 2 rotary kilns
Piney Creek (Colmac) Clarion, PA	Fluidized Bed Boiler	300	🔴	🔴	🔴	🟢		🟢	🔴	🔴	🔴	🔴	🔴	🟢	🟢	🟢	🟢	
Duratherm San Leon, TX	Indirect Thermal Desorber	1595	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟢	🟡	🟢	🟢	🟡	🟢	🟢	🟢	
EQ Belleville, MI	Indirect Thermal Desorber (Duratherm Unit)	600	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟢	🟡	🟢	🟢	🟢	
Clean Harbors Sarnia, Ontario Canada	Indirect Thermal Desorber	588	🟢	🟢	🟢	🟡	🟡	🟡	🟢	🟢	🟡	🟢	🟢	🟡	🟢	🟢	🟢	
Clean Harbors Sarnia, Ontario Canada	HW Incinerator Liquid Injection Incinerator	588	🟢	🟡	🟢	🟢		🟢	🟢	🟢	🟡	🟢		🟡		🟢	🟢	

Table 4-3. Offsite Treatment Alternatives Evaluation

Company/Location	Technology	Distance from Bound Brook (miles)	RCRA and CAA Permitted	Permitted for RCRA Haz Bulk Solids	Can Obtain or Modify Required Permit(s)	Total Facility Capacity (tons/yr)	Total Capacity Bound Brook Waste (tons/yr)	Storage Capacity	D001 (Ignitability)	D002 (Corrosivity)	pH Acceptable	D018 (Benzene)	Benzene NESHAPS Certified (D018)	Sulfur Acceptable	Calorific Value (Btu/lb) Acceptable	Shipping - Truck	Shipping - Rail	Notes
Clean Harbors El Dorado, AR	HW Incinerator Rotary Kiln (Small)	1301	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	
Clean Harbors Kimball, NE	HW Incinerator Fluidized Bed (Small)	1666	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	
Clean Harbors Deer Park, TX	HW Incinerator Rotary Kiln (Large)	1600	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	
Clean Harbors Aragonite, UT	HW Incinerator Rotary Kiln (Large)	2232	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	
Ross Grafton, OH	HW Incinerator Rotary Kiln (Large)	472	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	
Veolia Port Arthur, TX	HW Incinerator Rotary Kiln (Large)	1508	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	
Veolia Sauget, IL	HW Incinerator Rotary Kiln (Small)	920	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	
WTI East Liverpool, OH	HW Incinerator Rotary Kiln (Large)	380	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	

Table 4-3. Offsite Treatment Alternatives Evaluation

Company/Location	Technology	Distance from Bound Brook (miles)	RCRA and CAA Permitted	Permitted for RCRA Haz Bulk Solids	Can Obtain or Modify Required Permit(s)	Total Facility Capacity (tons/yr)	Total Capacity Bound Brook Waste (tons/yr)	Storage Capacity	D001 (Ignitability)	D002 (Corrosivity)	pH Acceptable	D018 (Benzene)	Benzene NESHAPS Certified (D018)	Sulfur Acceptable	Calorific Value (Btu/lb) Acceptable	Shipping - Truck	Shipping - Rail	Notes

Parameter Legend

RCRA and CAA Permitted	🔴	Facility is not currently permitted under RCRA or CAA.
	🟡	N/A
	🟢	Facility currently holds valid RCRA and CAA permits.
Permitted for RCRA Haz Bulk Solids	🔴	Facility is not currently permitted to receive or treat bulk solids.
	🟡	N/A
	🟢	Facility is currently permitted to receive and treat bulk solids.
Can Obtain or Modify Required Permit(s)	🔴	Faclity is unable or unwilling to obtain required permits to accept bulk solids.
	🟡	Facility has submitted or is willing to submit required permit and/or modification application(s).
	🟢	N/A
Total Facility Capacity (tons/yr)	🔴	Low capacity plant.
	🟡	N/A
	🟢	High capacity plant.
Total Capacity Bound Brook Waste (tons/yr)	🔴	<2,500 tons/yr
	🟡	2,500 - 7,500 tons/yr
	🟢	7,500 - 15,000 tons/yr
Storage Capacity	🔴	Facility does not have adequate capacity on-site to store bulk solids.
	🟡	Facility may have capacity or ability to expand bulk solids storage area if required.
	🟢	Facility currently has adequate bulk solids storage capacity.
D001 (Ignitability)	🔴	Facility is not permitted to accept or treat D001 characteristic material or .
	🟡	Facility is willing/able to submit permit modification application to obtain ability to accept D001 characteristic material.
	🟢	Facility is currently permitted to accept D001 characteristic material.

Table 4-3. Offsite Treatment Alternatives Evaluation

Company/Location	Technology	Distance from Bound Brook (miles)	RCRA and CAA Permitted	Permitted for RCRA Haz Bulk Solids	Can Obtain or Modify Required Permit(s)	Total Facility Capacity (tons/yr)	Total Capacity Bound Brook Waste (tons/yr)	Storage Capacity	D001 (Ignitability)	D002 (Corrosivity)	pH Acceptable	D018 (Benzene)	Benzene NESHAPS Certified (D018)	Sulfur Acceptable	Calorific Value (Btu/lb) Acceptable	Shipping - Truck	Shipping - Rail	Notes
	D002 (Corrosivity)		🔴															Facility is not permitted to accept or treat D002 characteristic material, or if permitted, unable or unwilling to accept the Bound Brook waste due to equipment issues or blending logistics.
			🟡															Facility is permitted to accept D002 characteristic material and may be able/willing to consider accepting the Bound Brook waste.
			🟢															Facility is permitted to accept D002 characteristic material and is willing/able to accept the Bound Brook waste at pH <2.
	pH Acceptable		🔴															Facility cannot or will not accept the Bound Brook material at pH <2.
			🟡															Facility may be able to accept the Bound Brook material with pH of 2.5 - 12.5, which may require pretreatment/neutralization onsite prior to shipment.
			🟢															Facility is willing and able to accept the Bound Brook material at pH <2.
	D018 (Benzene)		🔴															Facility is not permitted to accept D018 characteristic material.
			🟡															Facility is permitted to accept D018 characteristic material, or willing to submit application for modification of permit, but has limits on yearly amount or concentration that can be accepted.
			🟢															Facility Is willing and able to accept D018 characteristic material with no limits.
	Benzene NESHAPS Certified (D018)		🔴															Facility is not NESHAPS Certified.
			🟡															Facility is willing/able to obtain NESHAPS certification within project timeframe.
			🟢															Facility is currently NESHAPS certified.
	Sulfur Acceptable		🔴															Facility has strict sulfur limits, which are exceeded in the Bound Brook material.
			🟡															Facility may have limits on sulfur acceptance, based on emissions limits or product quality concerns. May be able/willing to accept Bound Brook waste if enough low sulfur waste available for blending.
			🟢															Facility is willing and able to accept the Bound Brook material with no sulfur limits.
	Calorific Value (Btu/lb) Acceptable		🔴															Facility is unable/unwilling to accept the Bound Brook material due to calorific value too high (some incinerators) or too low (cement kilns).
			🟡															Facility may be able to blend the Bound Brook waste to obtain acceptable calorific value.
			🟢															Calorific value of Bound Brook material acceptable.
	Shipping - Truck		🔴															Facility does not accept bulk solids shipments via truck.
			🟡															Facility may be willing/able to accept bulk solids via truck.

Table 4-3. Offsite Treatment Alternatives Evaluation

Company/Location	Technology	Distance from Bound Brook (miles)	RCRA and CAA Permitted	Permitted for RCRA Haz Bulk Solids	Can Obtain or Modify Required Permit(s)	Total Facility Capacity (tons/yr)	Total Capacity Bound Brook Waste (tons/yr)	Storage Capacity	D001 (Ignitability)	D002 (Corrosivity)	pH Acceptable	D018 (Benzene)	Benzene NESHAPS Certified (D018)	Sulfur Acceptable	Calorific Value (Btu/lb) Acceptable	Shipping - Truck	Shipping - Rail	Notes

		● (green)	Facility accepts bulk solids shipments via truck.
	Shipping - Rail	● (red)	Facility does not accept bulk solids shipments via rail.
		● (yellow)	Facility able/willing to make arrangements to accept bulk solids shipments via rail.
		● (green)	Facility currently accepts bulk solids shipments via rail.

Table 5-1. Mass & Energy Balance - Waste Composition Basis

Parameter	Units (a)	Viscous Rubbery (VR)	Hard Crumbly (HC)	Clay-Like Material	Sand/Silt-Like Material	Coal Aggregate (CA)	Other (Mix of VR & HC)	Total
Impoundment 1								
Waste Mass	tons, dry	730	9,684	2,699	2,460	2,982	0	18,555
Waste Mass	tons, wet	869	12,415	3,856	2,861	3,388	0	23,389
Calorific Value	Btu/lb, dry basis	13,456	13,497	2,695	2,695	10,422	13,476	9,948
Calorific Value	Btu/lb, wet basis	11,303	10,528	1,887	2,318	9,806	10,915	8,023
Proximate Analysis								
Volatile matter	%, dry basis	45.36	38.69	8.41	8.41	27.20	42.03	28.58
Ash	%, dry basis	3.78	2.15	80.59	80.59	27.54	2.97	28.41
Fixed Carbon	%, dry basis	50.86	59.16	11.00	11.00	45.26	55.01	43.01
Subtotal	%, dry basis	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Moisture	%, wet basis	16.00	22.00	30.00	14.00	5.91	19.00	19.79
Volatile matter	%, wet basis	38.10	30.18	6.83	6.83	13.66	34.14	21.38
Ash	%, wet basis	3.18	1.68	54.29	70.29	62.66	2.43	27.63
Fixed Carbon	%, wet basis	42.72	46.14	8.89	8.89	17.77	44.43	31.21
Subtotal	%, wet basis	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Ultimate Analysis								
Carbon	%, dry basis	78.74	80.43	15.92	15.92	59.68	79.59	58.84
Hydrogen	%, dry basis	2.36	2.41	0.48	0.48	3.11	2.39	1.96
Oxygen	%, dry basis	1.57	1.61	0.32	0.32	3.93	1.59	1.57
Nitrogen	%, dry basis	0.47	0.60	0.11	0.11	0.80	0.53	0.48
Sulfur	%, dry basis	12.64	12.36	2.50	2.50	4.97	12.50	8.47
Chlorine	%, dry basis	0.43	0.43	0.09	0.09	0.14	0.43	0.29
Ash	%, dry basis	3.78	2.15	80.59	80.59	27.37	2.97	28.39
Subtotal		100.00	100.00	100.00	100.00	100.00	100.00	100.00
Ultimate Analysis								
Carbon	%, wet basis	66.14	62.74	12.89	12.89	25.78	64.44	43.19
Hydrogen	%, wet basis	1.98	1.88	0.39	0.39	0.77	1.93	1.30
Oxygen	%, wet basis	1.32	1.25	0.26	0.26	0.52	1.29	0.86
Nitrogen	%, wet basis	0.39	0.47	0.09	0.09	0.17	0.43	0.31
Sulfur	%, wet basis	10.62	9.64	2.03	2.03	4.05	10.13	6.68
Chlorine	%, wet basis	0.36	0.34	0.07	0.07	0.14	0.35	0.23
Moisture	%, wet basis	16	22	30.00	14.00	5.91	19.00	19.79
Ash	%, wet basis	3.18	1.68	54.29	70.29	62.66	2.43	27.63
Subtotal		100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 5-1. Mass & Energy Balance - Waste Composition Basis

Parameter	Units (a)	Viscous Rubbery (VR)	Hard Crumbly (HC)	Clay-Like Material	Sand/Silt-Like Material	Coal Aggregate (CA)	Other (Mix of VR & HC)	Total
Impoundment 2								
Waste Mass	tons, dry	8,295	8,754	0	0	0	4,687	21,735
Waste Mass	tons, wet	9,874	11,223	0	0	0	5,786	26,883
Calorific Value	Btu/lb, dry basis	14,676	14,676	2,935	2,935	10,782	14,676	10,741
Calorific Value	Btu/lb, wet basis	12,328	11,447	2,055	2,524	10,145	11,888	8,652
Proximate Analysis								
Volatile matter	%, dry basis	64.80	60.46	12.53	12.53	33.38	62.63	42.93
Ash	%, dry basis	1.64	2.98	80.46	80.46	27.35	2.31	28.71
Fixed Carbon	%, dry basis	33.60	36.56	7.02	7.02	39.27	35.06	28.36
Subtotal	%, dry basis	100.04	100.00	100.00	100.00	100.00	100.00	100.00
Moisture	%, wet basis	16.00	22.00	30.00	14.00	5.91	19.00	19.79
Volatile matter	%, wet basis	54.43	47.16	10.16	10.16	18.65	50.80	32.68
Ash	%, wet basis	1.38	2.32	54.17	70.17	62.49	1.85	27.85
Fixed Carbon	%, wet basis	28.22	28.52	5.67	5.67	12.94	28.35	19.69
Subtotal	%, wet basis	100.03	100.00	100.00	100.00	100.00	100.00	100.00
Ultimate Analysis								
Carbon	%, dry basis	84.88	80.49	16.54	16.54	60.61	82.69	59.41
Hydrogen	%, dry basis	2.55	2.41	0.50	0.50	3.13	2.48	1.97
Oxygen	%, dry basis	1.70	1.61	0.33	0.33	3.95	1.65	1.58
Nitrogen	%, dry basis	0.37	0.37	0.07	0.07	0.75	0.37	0.34
Sulfur	%, dry basis	8.40	11.64	2.00	2.00	4.23	10.02	7.68
Chlorine	%, dry basis	0.47	0.50	0.10	0.10	0.15	0.48	0.33
Ash	%, dry basis	1.64	2.98	80.46	80.46	27.18	2.31	28.68
Subtotal		100.00	100.00	100.00	100.00	100.00	100.00	100.00
Ultimate Analysis								
Carbon	%, wet basis	71.30	62.78	13.41	13.41	26.56	67.04	43.67
Hydrogen	%, wet basis	2.14	1.88	0.40	0.40	0.80	2.01	1.31
Oxygen	%, wet basis	1.43	1.26	0.27	0.27	0.53	1.34	0.87
Nitrogen	%, wet basis	0.31	0.29	0.06	0.06	0.13	0.30	0.20
Sulfur	%, wet basis	7.06	9.08	1.61	1.61	3.43	8.07	6.04
Chlorine	%, wet basis	0.39	0.39	0.08	0.08	0.15	0.39	0.27
Moisture	%, wet basis	16.00	22.00	30.00	14.00	5.91	19.00	19.79
Ash	%, wet basis	1.38	2.32	54.17	70.17	62.49	1.85	27.85
Subtotal		100.00	100.00	100.00	100.00	100.00	100.00	100.00

(a) All analyses listed as "wet basis" assume material has been dewatered.

Table 7-1. Treatment Schedule Summary

Treatment Facilities	Technology	Location	Waste Acceptance Rate (tons/year)	Treatment[(a)] Schedule (years)
Offsite Facilities				
Norlite (Tradebe)	Aggregate Kiln	Cohoes, NY	4,000	12.6
Holcim (Geocycle)	Cement Kiln	Holly Hill, SC	6,000	8.4
Essroc (Tradebe)	Cement Kiln	Logansport, IN	7,500	6.7
Continental (Green America)	Cement Kiln	Hannibal, MO	10,000	5.0
LaFarge (Systech)	Cement Kiln	Fredonia, KS	10,000	5.0
Duratherm	Indirect Thermal Desorber	San Leon, TX	9,000	5.6
Veolia	Hazardous Waste Incinerator	Port Arthur, TX	6,570	7.7
Ross	Hazardous Waste Incinerator	Grafton, OH	6,570	7.7
Clean Harbors	Hazardous Waste Incinerator	Deer Park, TX	6,570	7.7
Onsite Facilities				
Mobile Incinerator	Hazardous Waste Incinerator	Bound Brook, NJ	7,665	6.6
Mobile Thermal Desorber	Indirect Thermal Desorber	Bound Brook, NJ	9,000	5.6

(a) Based on 50,272 tons of material.

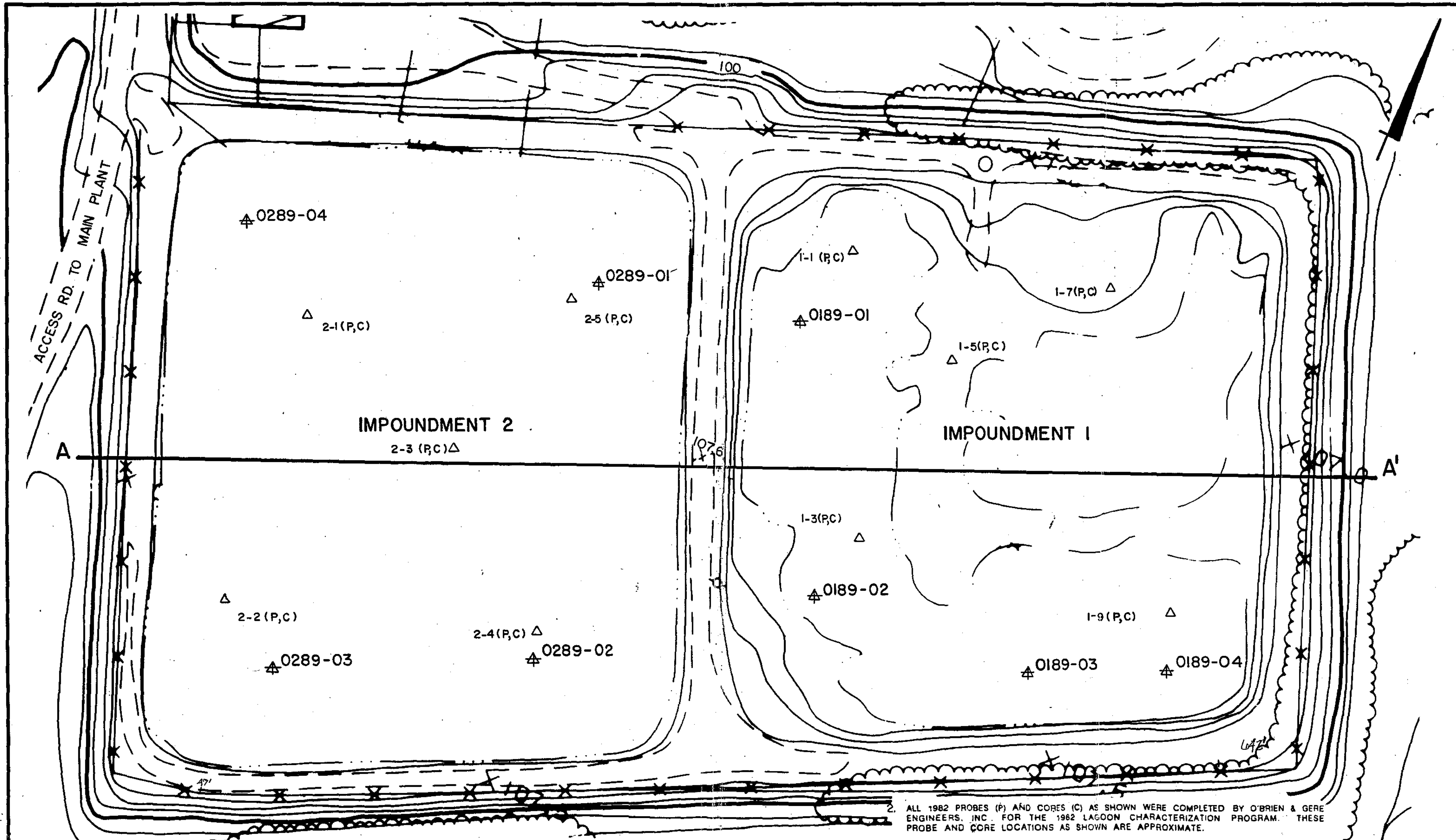
Table 8-1. Summary of Bench-Scale, Pilot-Scale, and Full-Scale Test Recommendations

Test Description	Recommended Testing Organization	Test Location	Test Scale	Test Reference Methods	Sample Matrix	Analytical Parameters	Analytical (a) Reference Methods	Quantity Required for Treatability Test
Metal Corrosion Tests	CTL	Newark, DE	Bench-scale	ASTM G-31	Metal coupon			5-gallon bucket
Material Compatibility Tests	IPTL	Pittsfield, MA	Bench-scale	ASTM D543	Plastic samples (gaskets, liners, piping)	Tensile strength, elongation, decomposition, swelling, cracking	NA	5-gallon bucket
Waste Flowability Versus Temperature	Shaw	Knoxville, TN	Bench-scale	TBD	Impoundment waste		TBD	5-gallon bucket
Waste pH Versus Amount and Type of Reagents	Shaw	Knoxville, TN	Bench-scale	TBD	Impoundment waste	pH	SW-846 1110A	5-gallon bucket
Waste Moisture Content Versus Dewatering Methods	Focus	Bound Brook, NJ	Pilot-scale	TBD	Dewatered impoundment waste	Moisture	ASTM E203-08	Roll-off container
LEL Concentrations in Shipping Containers	Focus	Bound Brook, NJ	Pilot-scale	TBD	Container headspace air	Ignitability, LEL	ASTM D93-10a, LEL Monitor	Roll-off container
Fugitive Emission Suppresion with Reagent Amended Water Cap and/or Oil Cap	Shaw	Knoxville, TN	Bench-scale	TBD	Impoundment waste	VOCs, SO_2, H_2S	EPA T-014A	5-gallon bucket
Fugitive Emissions Testing (Generation, Capture & Treatment)	Focus/Arcadis/ OBG	Bound Brook, NJ	Pilot-scale	TBD	Ambient air, ventilation air	VOCs, SO_2, H_2S	EPA T-014A	Roll-off container
Material Handling Properties of Solid Waste/Reagent Blends	Cement Kilns/Thermal Desorbers	Multiple	Full-scale	TBD	Impoundment waste/solid reagent blends	NA	NA	Roll-off container
Fuel Properties of Solid Waste/Liquid Fuel Blends	Cement Kilns	Multiple	Bench-scale and Full-scale	TBD	Impoundment waste/solid reagent/liquid fuel blends	Viscosity	ASTM D7042/D445-11a	Roll-off container
						Calorific Value	ASTM D5468	
						Compatibility	ASTM D5058	
Waste Blend (Solid or Liquid) Treatment Properties	Cement Kilns/Thermal Desorbers	Multiple	Bench-scale and Full-scale	TBD	Feed waste materials	Calorific Value	ASTM D5468	Roll-off container
						Sulfur	ASTM D4239-11	
					Treated solid waste materials	Calorific Value	ASTM D5468	1-liter
						Sulfur	ASTM D3761-10	
					Recovered oil	Calorific Value	ASTM D5468	1-liter
						Sulfur	ASTM E776	

(a) Alternative analytical methods may be acceptable and must be reviewed on a case-by-case basis.

(b) Acronyms

CTL = Corrosion Testing Laboratory
IPTL = Intertek Plastics Laboratories, Inc.
NA = not applicable
OBG = O'Brien & Gere
Shaw = Shaw Environmental & Infrastructure, Inc.
TBD = test methods to be developed in work plans.



1. PLAN PREPARED BY PHOTOGRAMMETRIC SURVEY CONDUCTED ON APRIL 4, 1989.

2. ALL 1982 PROBES (P) AND CORES (C) AS SHOWN WERE COMPLETED BY O'BRIEN & GERE ENGINEERS, INC. FOR THE 1982 LAGOON CHARACTERIZATION PROGRAM. THESE PROBE AND CORE LOCATIONS AS SHOWN ARE APPROXIMATE.

LEGEND

1989 MANUAL CORE

△ 1982 SAMPLE LOCATION (P= PROBE, C= CORE)

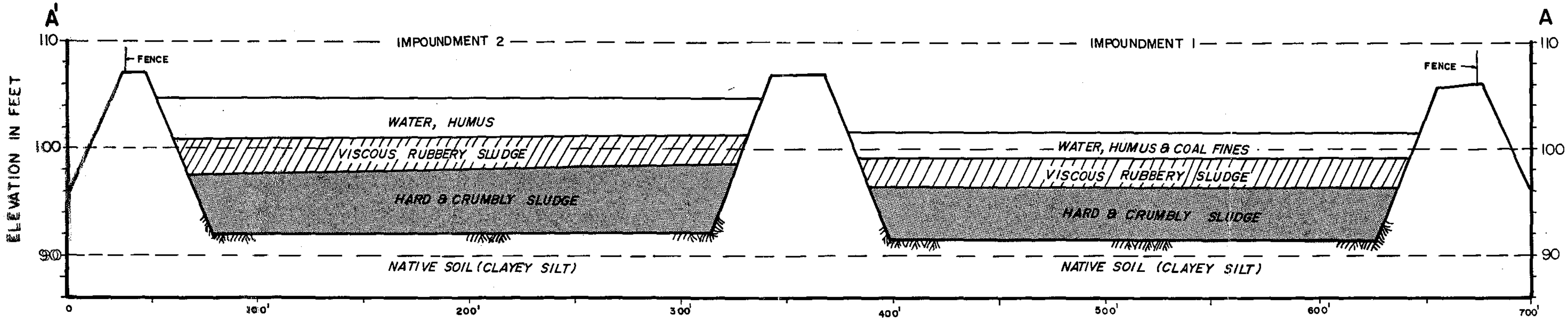
BLASLAND, BOUCK & LEE
ENGINEERS & GEOSCIENTISTS

AMERICAN CYANAMID
BOUND BROOK, NEW JERSEY

IMPOUNDMENTS 1 & 2

SCALE 0 50'

FIGURE 3-1



NOTES:
1. ELEVATIONS AS SHOWN BASED ON AMERICAN CYANAMID DATUM. SUBTRACT 69.29' FROM AMERICAN CYANAMID DATUM TO CONVERT TO U.S.G.S.
2. INTERIOR SIDE SLOPES OF BERMS AS SHOWN ARE INFERRED AND ARE DRAWN AT A 2 HORIZONTAL TO 1 VERTICAL SLOPE.
3. IMPOUNDMENTS AS SHOWN ARE DEFINED BY THE RESULTS OF O'BRIEN & GERE 1982 AND BLASLAND, BOUCK & LEE 1989 IMPOUNDMENT CHARACTERIZATION WORK EFFORTS

LEGEND

- VISCOUS RUBBERY SLUDGE
- HARD & CRUMBLY SLUDGE

BLASLAND, BOUCK & LEE
ENGINEERS & GEOSCIENTISTS

AMERICAN CYANAMID
BOUND BROOK, NEW JERSEY

IMPOUNDMENTS 1 & 2
REPRESENTATIVE CROSS SECTIONS

VERTICAL SCALE
0 10'

HORIZONTAL SCALE
0 50'

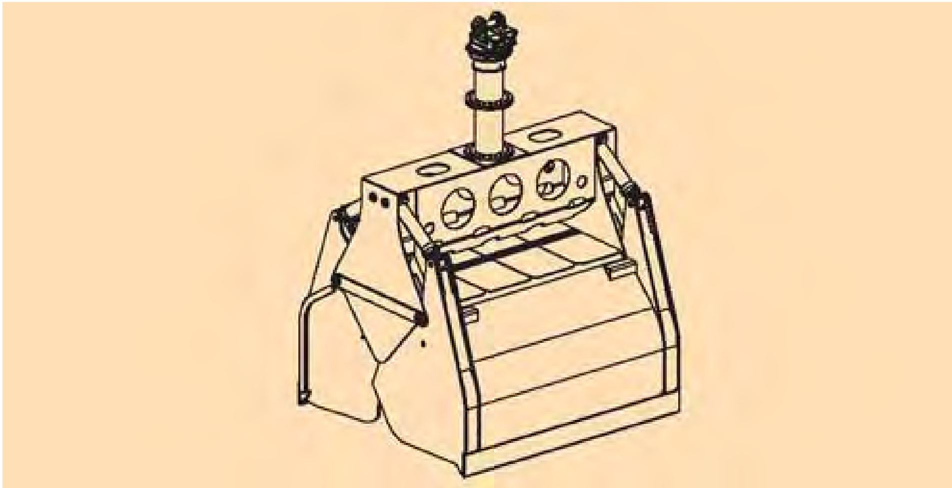
FIGURE
3-2

Courtesy of Liquid Waste Technology, LLC
(Permission Pending)

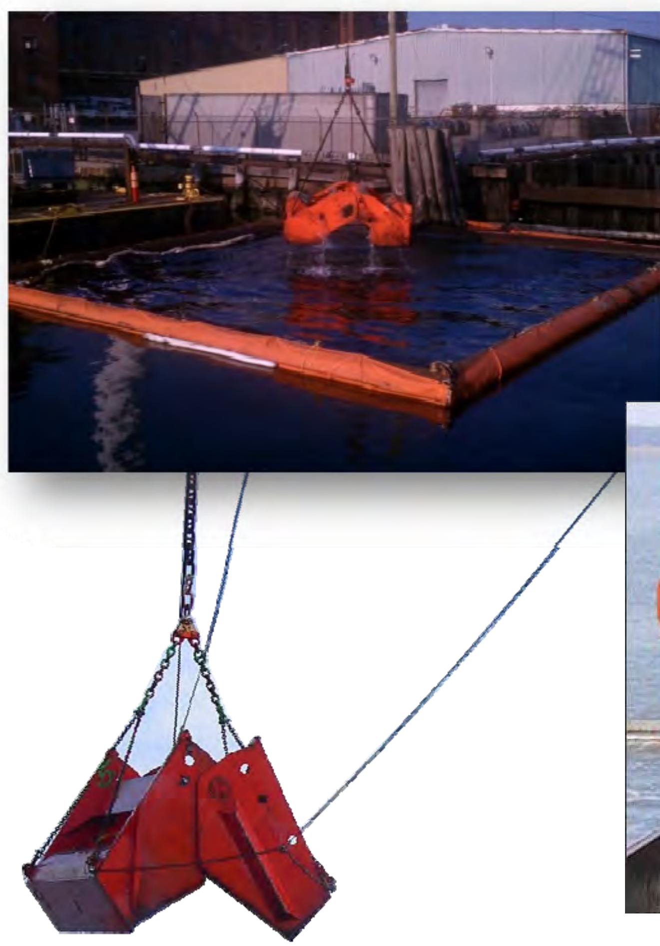
Figure 3-3. Dredge Auger Head

Courtesy of Ellicott Dredges
(Permission Pending)

Figure 3-4. Dredge Cutter Head



Hydraulic Environmental Clamshell Bucket
Courtesy of Rotobec, Inc. (Permission Pending)



Cable Operated Environmental
Clamshell Bucket and Dredge Cell
Courtesy of CableArm Environmental
Systems @ www.cablearm.com

Figure 3-5. Environmental Clamshell Buckets

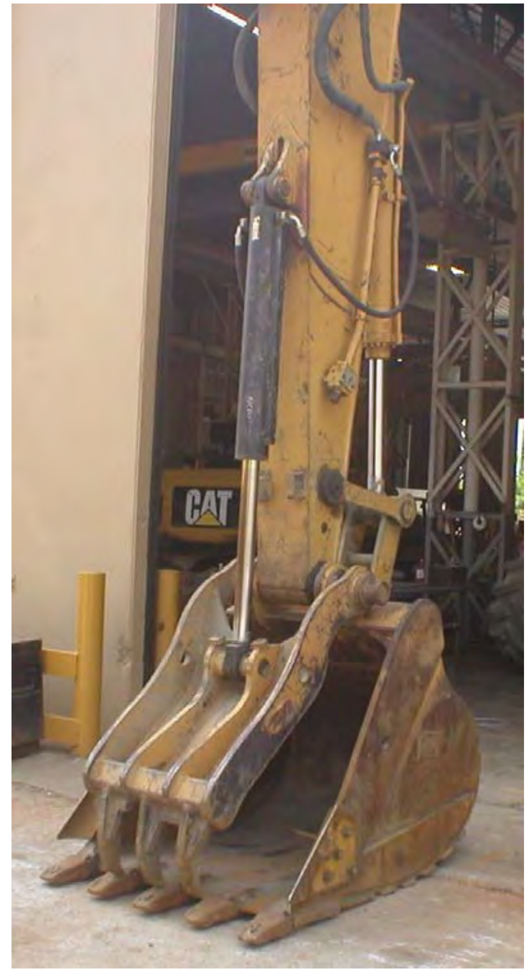


Figure 3-6. Excavator Bucket with Hydraulic Thumb

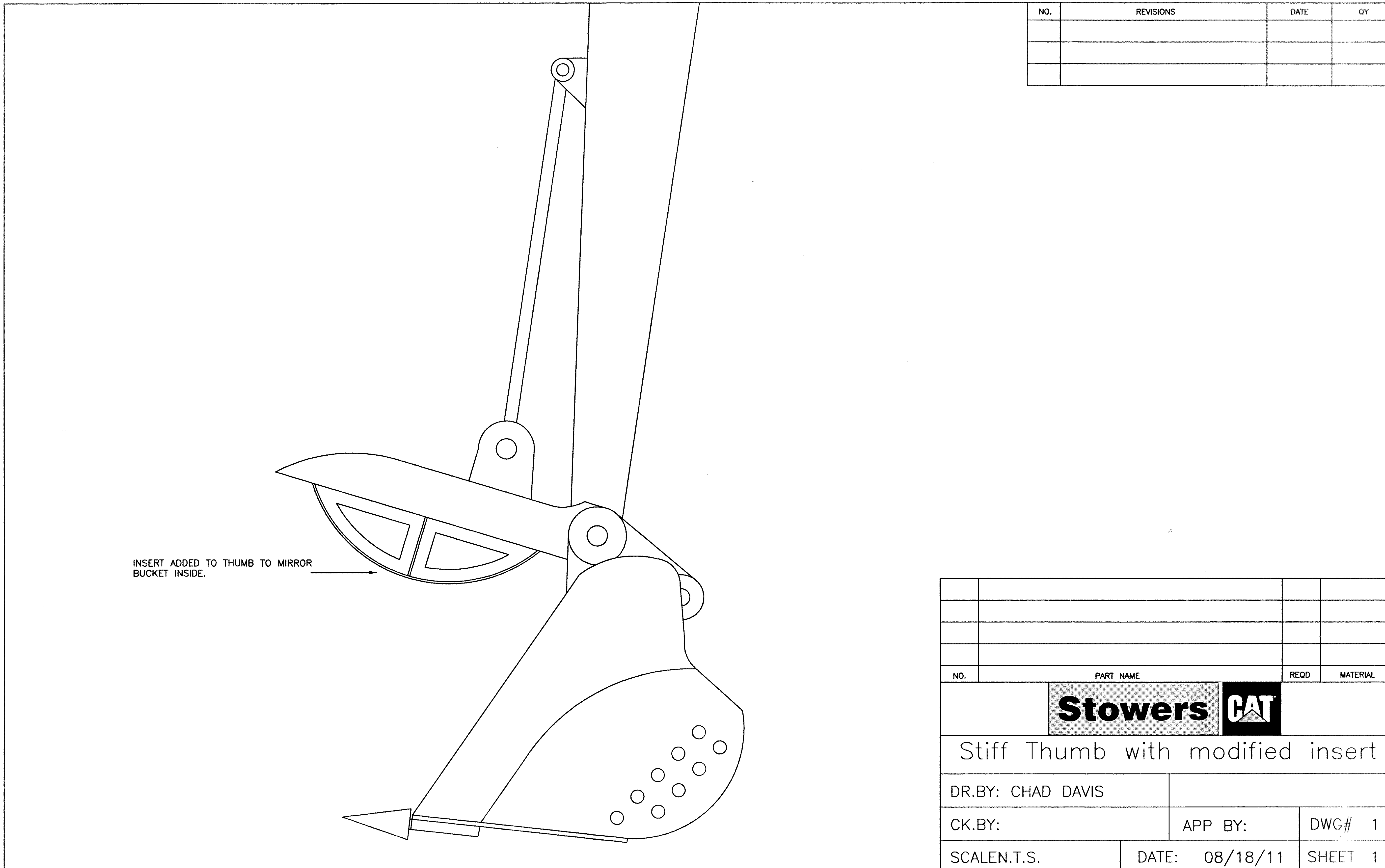


Figure 3-7. Excavator Bucket with Stiff Thumb and Modified Insert

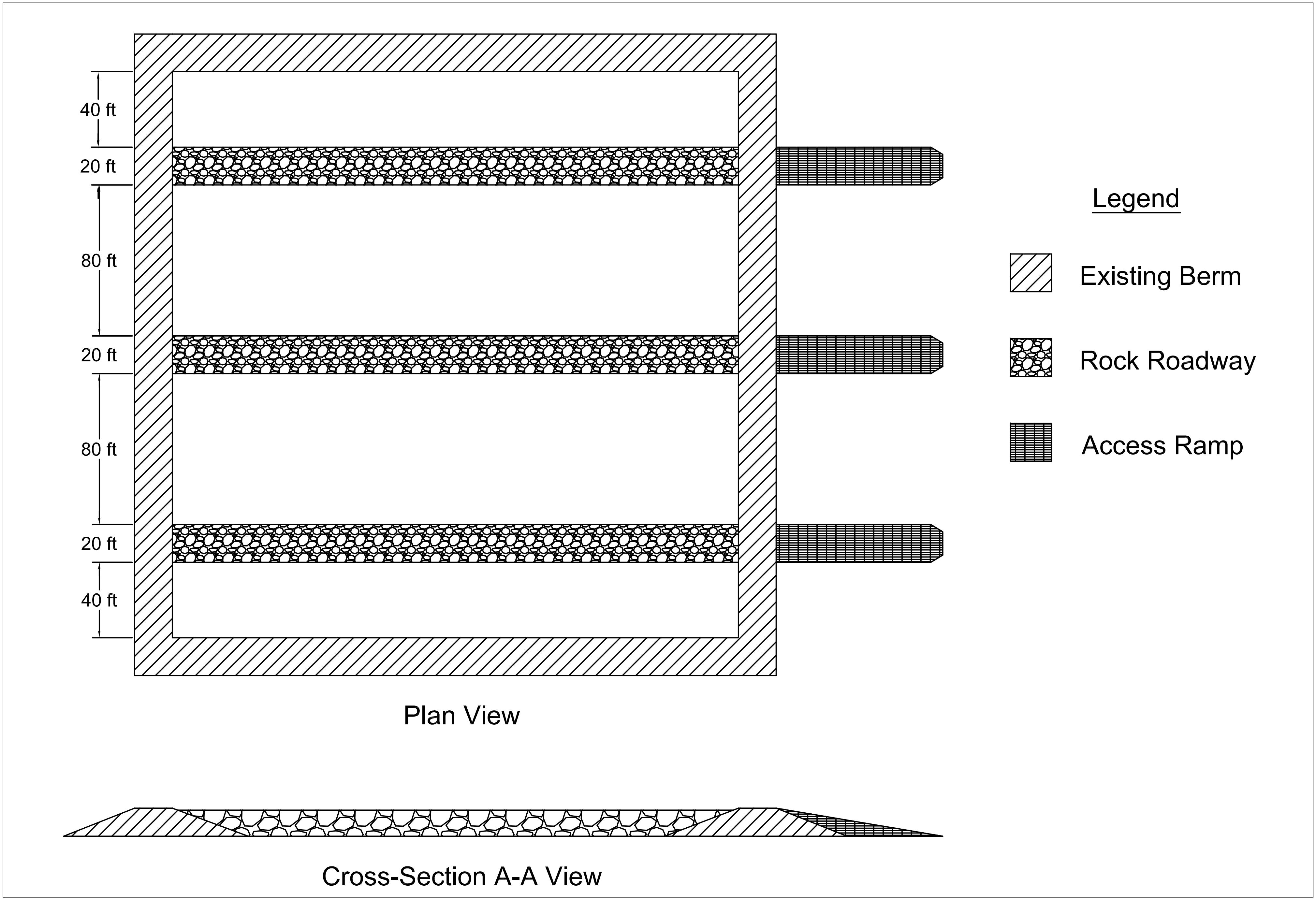
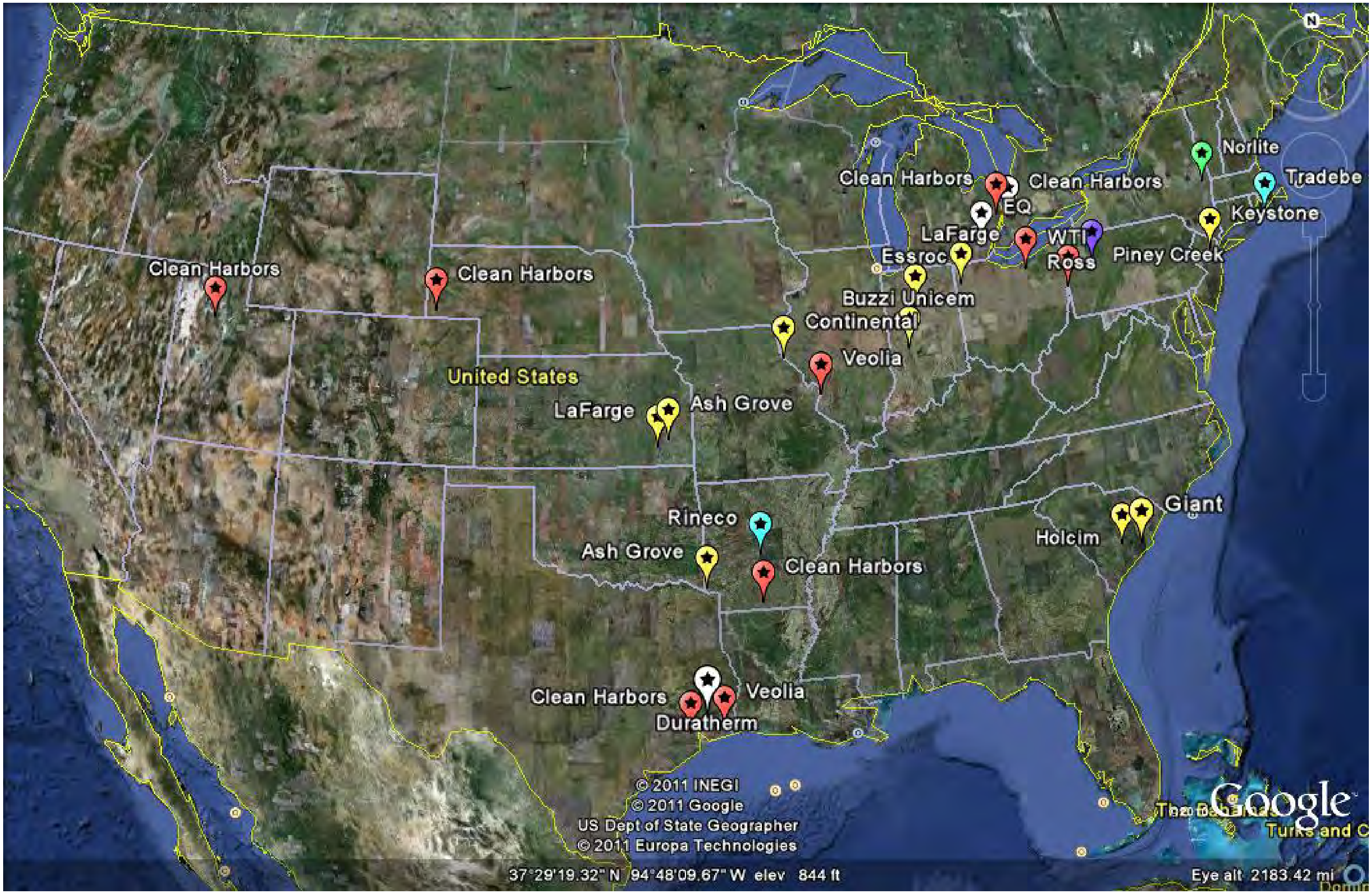


Figure 3-8. Conceptual Excavation Diagram



Cement Kilns   Fuel Blender   Aggregate Kiln   Fluid Bed Boilers   Thermal Desorbers   HW Incinerators

Figure 4-1. Offsite Thermal Treatment Facilities

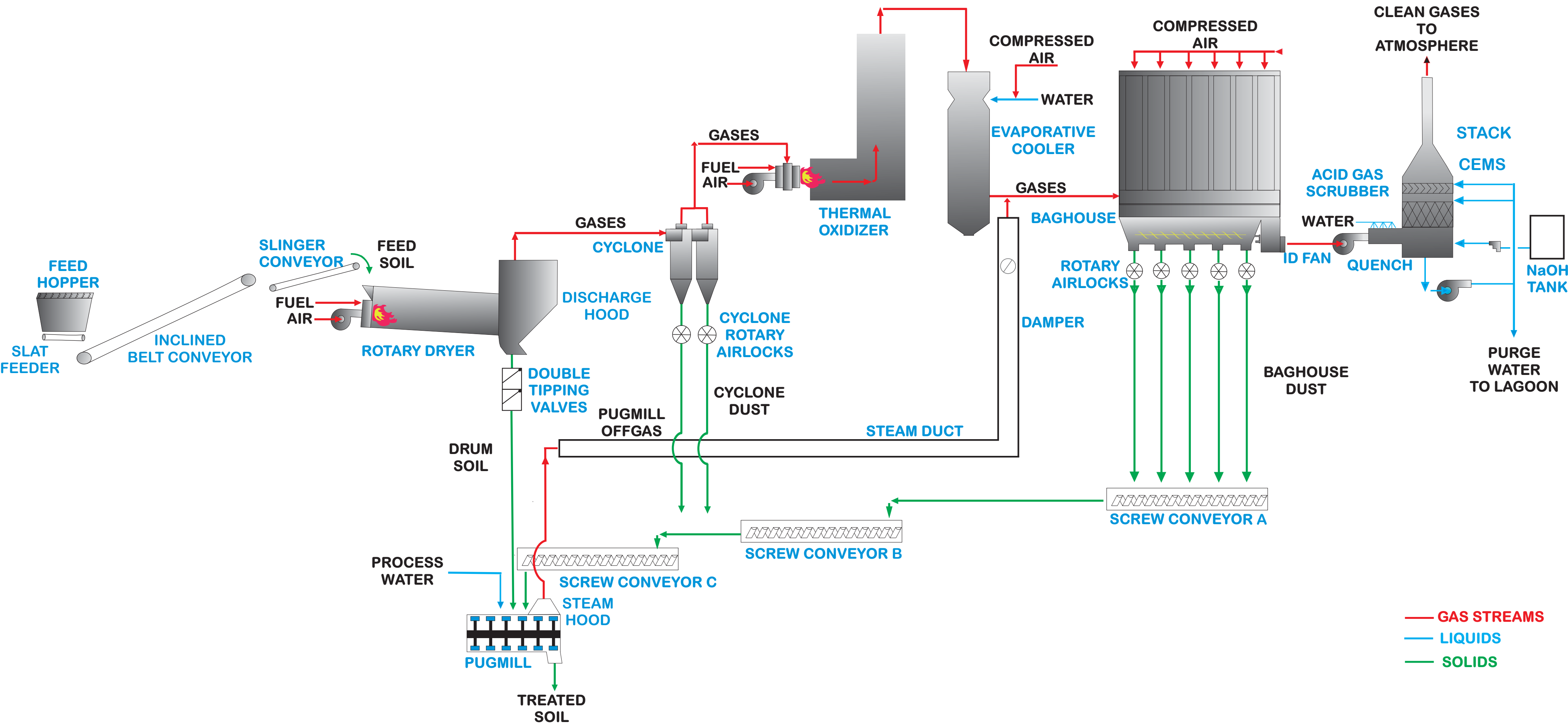


Figure 5-1. Process Flow Diagram - Astec Thermal Desorption System

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Aqueous Phase-Water Cap						Thermal treatment		30	Table 2.6
2	Aqueous Phase-Water Cap						Thermal treatment evaluation	Baseline analytical results	30	Table 2.6
1&2	Aqueous Phase-Water Cap		2.00	M gal			Water layer treatment tests	Water cover over Lagoons 1 and 2, to a depth of 1 - 2 feet.	15	2
1&2	Aqueous Phase-Water Cap						Water layer treatment	Wastewater treatment concept	15	
1&2	Baghouse dust						Thermal treatment	Baghouse residue	30	Table 2.2
1	Coal Aggregate						Material Mass Estimates	Investigation to locate areas of free LOS	18	
1	Emissions-Ambient Air						Thermal treatment		30	Table 2.2, 2.5
2	Emissions-Ambient Air						Thermal treatment		30	Table 2.2, 2.5
1	Emissions-Fugitive						Remedial alternatives	Mass balance emissions estimates based	31	2-12 thru 2-
1	Emissions-Fugitive						Remedial alternatives	Emission "drop" factor method based on	31	2-9 thru 2-11
1	Emissions-Fugitive						Waste Characterization	PID readings	36	Table 1
2	Emissions-Fugitive						Remedial alternatives	Mass balance emissions estimates based	31	2-12 thru 2-
2	Emissions-Fugitive						Remedial alternatives evaluation	Emission "drop" factor method based on historical data.	31	2-9 thru 2-11
2	Emissions-Fugitive						Waste Characterization	PID readings	36	Table 2
1	Hard Crumbly Material						Material Mass Estimates	Investigation to locate areas of free LOS still remaining in Lagoon 1. Note: Loose VR changes to LOS with heat.	18	
1&2	Hard Crumbly Material						Waste Characterization	All data included in reference 4	5	
1&2	Hard Crumbly Material						Fuel blend & sell - solid product	Kipin Industries vs American Cyanamid litigation materials. Acidic LOS still present in Lagoon 1.	16	
1&2	Sludge Blend						Dewatering Tests	Primary sludge dewatering for any and all affected lagoons from 1982, forward.	2	1-11
1&2	Sludge Blend						Fuel & solvent blending tests	Test Burn at Ohio State University.	8	7-9
1&2	Sludge Blend						Remedial alternatives evaluation	Recycle/reuse alternatives	10	1-3
1&2	Sludge Blend						Fuel & solvent blending tests	Test Burn at OSU. Pump cavitation due to solvent boiling noted at 60°C.	11	1-3
1&2	Sludge Blend						Fuel blending volume reduction		12	1-2
1&2	Sludge Blend						Fuel & solvent blending tests	All batches include blending of LOS, VR, and HC layers.	13	
1&2	Sludge Blend						Remedial alternatives evaluation	Blend and sell/solidification/on-site landfilling options	14	3
1&2	Sludge Blend						Remedial alternatives evaluation	Status Report only	25	
1&2	Sludge Blend						Thermal treatment evaluation	Post-phase II conditioning	30	Table 2.2
1&2	Sludge Blend						Thermal treatment evaluation	Post-phase I conditioning	30	Table 2.2
1	Viscous Rubbery Material						Material Mass Estimates	Investigation to locate areas of free LOS still remaining in Lagoon 1. Note: Loose VR changes to LOS with heat.	18	

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1&2	Viscous Rubbery Material						Waste Characterization	All data included in reference 4	5	
1&2	Viscous Rubbery Material						Fuel blend & sell - solid product	Kipin Industries vs American Cyanamid litigation materials. Acidic LOS still present in Lagoon 1.	16	
1&2	Water/humus						Waste Characterization	All data included in reference 4	5	
2	Emissions-Ambient Air	Acid Gases					Waste Characterization	Ambient air monitoring during excavation activities	29	2-20, Table 2-4
2	Emissions-Fugitive	Acid Gases					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement (VR, VR/HC, HC)	29	2-28 thru 2-31, Table 2-6
2	Emissions-Fugitive	Acid Gases					Waste Characterization	Direct monitoring of water layer emissions	29	2-17, 2-17, Table 2-3
2	Emissions-Fugitive	Acid Gases					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate (VR, VR/HC, HC)	29	2-35 thru 2-37, Table 2-8
1	Coal Aggregate	Alcohols					Waste Characterization		36	Table 10
2	Coal Aggregate	Alcohols					Waste Characterization		36	Table 10
1	Hard Crumbly Material	Alcohols					Waste Characterization		36	Table 10
2	Hard Crumbly Material	Alcohols					Waste Characterization		36	Table 10
1	Viscous Rubbery Material	Alcohols					Waste Characterization		36	Table 10
2	Viscous Rubbery Material	Alcohols					Waste Characterization		36	Table 10
1	Coal Aggregate	Aldehydes					Waste Characterization		36	Table 7
2	Coal Aggregate	Aldehydes					Waste Characterization		36	Table 7
1	Hard Crumbly Material	Aldehydes					Waste Characterization		36	Table 7
2	Hard Crumbly Material	Aldehydes					Waste Characterization		36	Table 7
1	Viscous Rubbery Material	Aldehydes					Waste Characterization		36	Table 7
2	Viscous Rubbery Material	Aldehydes					Waste Characterization		36	Table 7
1	Hard Crumbly Material	Ash, dry basis	4.10	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Ash, dry basis	1.00	%	1-4B		Thermal treatment evaluation	Littleford DryLittleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Ash, dry basis	13.90	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Ash, dry basis	1.80	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Ash, dry basis	1.50	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Ash, dry basis	2.70	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Ash, dry basis	4.50	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Ash, dry basis	4.10	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Ash, dry basis	1.70	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Ash, dry basis	1.90	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1&2	Sludge Blend	Ash, dry basis					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67
1	Viscous Rubbery Material	Ash, dry basis	9.30	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Ash, dry basis	4.20	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Ash, dry basis	2.40	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Ash, dry basis	1.20	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Ash, dry basis	1.80	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Ash, dry basis	1.50	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Ash, dry basis	1.80	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Ash, dry basis	2.30	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Ash, dry basis	1.00	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Ash, dry basis	1.60	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1&2	Sludge Blend	Benzene-TCLP					Biological Treatment	Residuals from air stripping and biotreatment.	23	Figures 1-2, Tables 1-2 Figures 1-2, Tables 1-2
1	Aqueous Phase-Water Cap	Biochemical Oxygen Demand (BOD)	5.60	mg/L	IM01WCAP 01_04192010		Waste Characterization		36	Table 19
2	Aqueous Phase-Water Cap	Biochemical Oxygen Demand (BOD)	13.10	mg/L	IM02WCAP 01_04192010		Waste Characterization		36	Table 19
1	Water/humus	Biochemical Oxygen Demand (BOD)		mg/L			Waste Characterization	BOD(28), range 400 to 1900, direct test	4	P. 20, Table 3
1	Water/humus	Biochemical Oxygen Demand (BOD)		mg/L			Waste Characterization	BOD(5), range 400 to 600, direct test	4	P. 20, Table 3
2	Water/humus	Biochemical Oxygen Demand (BOD)		mg/L			Waste Characterization	BOD(5), range 200 to 800, direct test	4	P. 20, Table 3
2	Water/humus	Biochemical Oxygen Demand (BOD)		mg/L			Waste Characterization	BOD(28), range 200 to 3000, direct test	4	P. 20, Table 3
1&2	Sludge Blend	BTEX					Remedial alternatives evaluation		27	p. 344

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Coal Aggregate	BTEX-Benzene	53,600,000.00	ug/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Benzene	18,000,000.00	ug/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Benzene	50,300,000.00	ug/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	68,700,000.00	ug/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	137,000,000.00	ug/kg	IM01HCOM 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	181,000,000.00	ug/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	24,900,000.00	ug/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	5,680,000.00	ug/kg	IM01HCOA 02_04302010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	12,200,000.00	ug/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	14,900,000.00	ug/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	69,600,000.00	ug/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	43,300,000.00	ug/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	54,100,000.00	ug/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	129,000,000.00	ug/kg	IM01HCOO 02_05642010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Benzene	207,000,000.00	ug/kg	IM01HCOF 02_05042010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	52,500,000.00	ug/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	59,800,000.00	ug/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	19,500,000.00	ug/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	86,700,000.00	ug/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	19,000,000.00	ug/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	183,000,000.00	ug/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	50,700,000.00	ug/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	30,400,000.00	ug/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	52,600,000.00	ug/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	100,000,000.00	ug/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	130,000,000.00	ug/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	37,700,000.00	ug/kg	IM01HCOA 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Benzene	27,000,000.00	ug/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	BTEX-Benzene	52,400,000.00	ug/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	18,000,000.00	ug/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	1,860,000.00	ug/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	269,000.00	ug/kg	IM01VROA 01_04302010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	13,500,000.00	ug/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	99,100.00	ug/kg	IM01VROM 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	69,800,000.00	ug/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	934,000.00	ug/kg	IM01VROD 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Benzene	20,000,000.00	ug/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	24,000,000.00	ug/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	16,700,000.00	ug/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	27,500,000.00	ug/kg	IM02VROK 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	23,300,000.00	ug/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	43,900,000.00	ug/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	34,200,000.00	ug/kg	IM02VRON 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	24,400,000.00	ug/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	39,500,000.00	ug/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	30,200,000.00	ug/kg	IM02VROC 01_04262010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	70,000,000.00	ug/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	6,900,000.00	ug/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	23,600,000.00	ug/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Benzene	19,300,000.00	ug/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Ethylbenzene	119,000.00	ug/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Ethylbenzene	1,570.00	ug/kg	IM01CAOR 01_05032010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Ethylbenzene	249,000.00	ug/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Ethylbenzene	223,000.00	ug/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	BTEX-Ethylbenzene	156,000.00	ug/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	117,000.00	ug/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	2,150.00	ug/kg	IM01HCOG 01_05032010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	103,000.00	ug/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	427,000.00	ug/kg	IM01HCOF 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	303,000.00	ug/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	16,800.00	ug/kg	IM01HCOA 02_04302010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	153,000.00	ug/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	267,000.00	ug/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	221,000.00	ug/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	317,000.00	ug/kg	IM01HCOM 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Ethylbenzene	529,000.00	ug/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	323,000.00	ug/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	356,000.00	ug/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	219,000.00	ug/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	116,000.00	ug/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	121,000.00	ug/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	146,000.00	ug/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	84,300.00	ug/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	171,000.00	ug/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	121,000.00	ug/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	155,000.00	ug/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	91,400.00	ug/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	591,000.00	ug/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Ethylbenzene	118,000.00	ug/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Ethylbenzene	72,900.00	ug/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Viscous Rubbery Material	BTEX-Ethylbenzene	5,490.00	ug/kg	IM01VROD 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Ethylbenzene	387,000.00	ug/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Ethylbenzene	1,580.00	ug/kg	IM01VROM 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Ethylbenzene	51,400.00	ug/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Ethylbenzene	76,700.00	ug/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Ethylbenzene	18,000.00	ug/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Ethylbenzene	1,480.00	ug/kg	IM01VROA 01_04302010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	5,530,000.00	ug/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	103,000.00	ug/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	153,000.00	ug/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	129,000.00	ug/kg	IM02VROK 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	324,000.00	ug/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	74,600.00	ug/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	118,000.00	ug/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	139,000.00	ug/kg	IM02VRON 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	418,000.00	ug/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	89,300.00	ug/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	1,280,000.00	ug/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	7,390,000.00	ug/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	1,600,000.00	ug/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	166,000.00	ug/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	81,900.00	ug/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	133,000.00	ug/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Ethylbenzene	114,000.00	ug/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Toluene	13,500,000.00	ug/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Toluene	36,400.00	ug/kg	IM01CAOR 01_05032010		Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Coal Aggregate	BTEX-Toluene	15,800,000.00	ug/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Toluene	5,440,000.00	ug/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	17,400,000.00	ug/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	33,000,000.00	ug/kg	IM01HCOO 02_05642010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	29,700,000.00	ug/kg	IM01HCOM 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	4,480,000.00	ug/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	6,280,000.00	ug/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	1,220,000.00	ug/kg	IM01HCOA 02_04302010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	40,700,000.00	ug/kg	IM01HCOF 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	6,810,000.00	ug/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	70,100.00	ug/kg	IM01HCOG 01_05032010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	14,900,000.00	ug/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	35,800,000.00	ug/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	16,700,000.00	ug/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Toluene	10,200,000.00	ug/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	17,100,000.00	ug/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	13,500,000.00	ug/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	5,000,000.00	ug/kg	IM01HCOA 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	8,940,000.00	ug/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	7,190,000.00	ug/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	9,240,000.00	ug/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	4,870,000.00	ug/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	40,200,000.00	ug/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	4,940,000.00	ug/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	11,300,000.00	ug/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	10,700,000.00	ug/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	BTEX-Toluene	22,900,000.00	ug/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	6,620,000.00	ug/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Toluene	25,100,000.00	ug/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	220,000.00	ug/kg	IM01VROD 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	670,000.00	ug/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	3,290,000.00	ug/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	40,100.00	ug/kg	IM01VROM 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	4,370,000.00	ug/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	21,000,000.00	ug/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	1,440.00	ug/kg	IM01VROA 01_04302010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Toluene	4,000,000.00	ug/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	9,140,000.00	ug/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	3,930,000.00	ug/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	10,900,000.00	ug/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	6,870,000.00	ug/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	19,500,000.00	ug/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	18,200,000.00	ug/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	5,070,000.00	ug/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	8,560,000.00	ug/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	7,110,000.00	ug/kg	IM02VRON 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	5,970,000.00	ug/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Toluene	7,030,000.00	ug/kg	IM02VROK 01_04232010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Xylene (total)	3,430,000.00	ug/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Xylene (total)	3,370,000.00	ug/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Xylene (total)	2,020,000.00	ug/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 3
1	Coal Aggregate	BTEX-Xylene (total)	24,500.00	ug/kg	IM01CAOR 01_05032010		Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	BTEX-Xylene (total)	2,270,000.00	ug/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	1,800,000.00	ug/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	1,600,000.00	ug/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	4,650,000.00	ug/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	235,000.00	ug/kg	IM01HCOA 02_04302010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	5,300,000.00	ug/kg	IM01HCOF 02_05042010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	2,000,000.00	ug/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	5,510,000.00	ug/kg	IM01HCOO 02_05642010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	6,910,000.00	ug/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	3,090,000.00	ug/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	3,830,000.00	ug/kg	IM01HCOM 02_05052010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	23,700.00	ug/kg	IM01HCOG 01_05032010		Waste Characterization		36	Table 3
1	Hard Crumbly Material	BTEX-Xylene (total)	4,240,000.00	ug/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	1,160,000.00	ug/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	3,610,000.00	ug/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	3,960,000.00	ug/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	1,600,000.00	ug/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	2,750,000.00	ug/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	1,610,000.00	ug/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	2,250,000.00	ug/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	1,450,000.00	ug/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	1,070,000.00	ug/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	1,520,000.00	ug/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	2,230,000.00	ug/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	1,820,000.00	ug/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 3
2	Hard Crumbly Material	BTEX-Xylene (total)	6,950,000.00	ug/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Viscous Rubbery Material	BTEX-Xylene (total)	6,210,000.00	ug/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Xylene (total)	18,000.00	ug/kg	IM01VROM 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Xylene (total)	737,000.00	ug/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Xylene (total)	1,250,000.00	ug/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Xylene (total)	311,000.00	ug/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Xylene (total)	4,500.00	ug/kg	IM01VROA 01_04302010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Xylene (total)	71,100.00	ug/kg	IM01VROD 01_05052010		Waste Characterization		36	Table 3
1	Viscous Rubbery Material	BTEX-Xylene (total)	1,100,000.00	ug/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	1,840,000.00	ug/kg	IM02VRON 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	3,990,000.00	ug/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	1,720,000.00	ug/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	2,230,000.00	ug/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	1,970,000.00	ug/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	970,000.00	ug/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	1,390,000.00	ug/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	1,060,000.00	ug/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	1,660,000.00	ug/kg	IM02VROK 01_04232010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	5,130,000.00	ug/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 3
2	Viscous Rubbery Material	BTEX-Xylene (total)	1,510,000.00	ug/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 3
1	Ash	Calorific Value					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	Calorific Value					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Hard Crumbly Material	Calorific Value	7,747.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization	range 5,995 to 9,499	4	p.11, 17, 21 Table 4
1	Hard Crumbly Material	Calorific Value	6,100.00	Btu/lb			Groundwater Assessment		6	Table 2

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Calorific Value	16,010.50	Btu/lb	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
1	Hard Crumbly Material	Calorific Value	15,228.10	Btu/lb	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
1	Hard Crumbly Material	Calorific Value	10,039.70	Btu/lb	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
1	Hard Crumbly Material	Calorific Value	15,739.30	Btu/lb	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
1	Hard Crumbly Material	Calorific Value	10,468.00	Btu/lb	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
1	Hard Crumbly Material	Calorific Value	6,100.00	Btu/lb			Waste Characterization	Sludge analytical	28	Table 1-1
2	Hard Crumbly Material	Calorific Value	9,678.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization	range 9,007-10,349 , 2 samples collected at layers	4	Table 7
2	Hard Crumbly Material	Calorific Value	10,000.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization		4	p.21
2	Hard Crumbly Material	Calorific Value	8,500.00	Btu/lb			Groundwater Assessment		6	Table 2
2	Hard Crumbly Material	Calorific Value	13,682.70	Btu/lb	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
2	Hard Crumbly Material	Calorific Value	15,028.00	Btu/lb	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
2	Hard Crumbly Material	Calorific Value	16,180.90	Btu/lb	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
2	Hard Crumbly Material	Calorific Value	15,742.90	Btu/lb	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
2	Hard Crumbly Material	Calorific Value	16,651.30	Btu/lb	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 5
2	Hard Crumbly Material	Calorific Value	8,500.00	Btu/lb			Waste Characterization	Sludge analytical	28	Table 1-1
2	Hard Crumbly Material	Calorific Value	3,730.00	Btu/lb		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-6
2	Hard Crumbly Material	Calorific Value	12,000.00	Btu/lb		ASTM D3286-85	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	Hard Crumbly Material	Calorific Value	708.00	Btu/lb			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
1	Sludge Blend VR/HC	Calorific Value					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	Calorific Value					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Viscous Rubbery Material	Calorific Value	8,923.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization	range 6,429-10,604	4	p.11, 16, 17, 21, Table 4
1	Viscous Rubbery Material	Calorific Value	8,300.00	Btu/lb			Groundwater Assessment		6	Table 2
1	Viscous Rubbery Material	Calorific Value	15,801.90	Btu/lb	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
1	Viscous Rubbery Material	Calorific Value	14,728.80	Btu/lb	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
1	Viscous Rubbery Material	Calorific Value	8,542.40	Btu/lb	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
1	Viscous Rubbery Material	Calorific Value	14,098.30	Btu/lb	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
1	Viscous Rubbery Material	Calorific Value	14,106.50	Btu/lb	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
1	Viscous Rubbery Material	Calorific Value	8,300.00	Btu/lb			Waste Characterization	Sludge analytical	28	Table 1-1
2	Viscous Rubbery Material	Calorific Value	9,000.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization		4	p.21
2	Viscous Rubbery Material	Calorific Value	9,000.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization	range 8,594-9,545 , 2 samples collected at layers	4	p.11, 21, Table 7
2	Viscous Rubbery Material	Calorific Value	11,500.00	Btu/lb			Groundwater Assessment		6	Table 2
2	Viscous Rubbery Material	Calorific Value	16,158.90	Btu/lb	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
2	Viscous Rubbery Material	Calorific Value	15,365.10	Btu/lb	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
2	Viscous Rubbery Material	Calorific Value	10,258.10	Btu/lb	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
2	Viscous Rubbery Material	Calorific Value	16,246.40	Btu/lb	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
2	Viscous Rubbery Material	Calorific Value	15,354.90	Btu/lb	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical, water free basis.	21	App 1, Table 4
2	Viscous Rubbery Material	Calorific Value	11,500.00	Btu/lb			Waste Characterization	Sludge analytical	28	Table 1-1
2	Viscous Rubbery Material	Calorific Value	22,000.00	Btu/lb		ASTM D3286-85	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	Viscous Rubbery Material	Calorific Value	5,460.00	Btu/lb		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-6
2	Viscous Rubbery Material	Calorific Value	1,260.00	Btu/lb			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	VR/HC Interface Layer	Calorific Value	6,980.00	Btu/lb		ASTM D3286-85	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	VR/HC Interface Layer	Calorific Value	1,190.00	Btu/lb			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	Calorific Value	16,000.00	Btu/lb		ASTM D3286-85	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	VR/HC Interface Layer	Calorific Value	7,750.00	Btu/lb		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-6
1	Water/humus	Calorific Value	8,273.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization		4	p.15, Table 7
2	Water/humus	Calorific Value	1,257.00	Btu/lb		Parr Bomb Calorimeter Test	Waste Characterization	range 547 to 1,968, 2 samples taken	4	p.15, Table 7
1&2	Sludge Blend	Carbon					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67
1&2	Viscous Rubbery Material	Carbon					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, p. 29, p.33 App I, p. 25, p. 33
1	Aqueous Phase-Water Cap	Chemical Oxygen Demand (COD)	64.70	mg/L	IM01WCAP 01_04192010		Waste Characterization		36	Table 19
2	Aqueous Phase-Water Cap	Chemical Oxygen Demand (COD)	100.00	mg/L	IM02WCAP 01_04192010		Waste Characterization		36	Table 19
2	Hard Crumbly Material	Chemical Oxygen Demand (COD)	16.00	mg COD/g		EPA Method 410.1	Waste Characterization		4	p.21
1	Leachate	Chemical Oxygen Demand (COD)		mg/L		EPA Method 410.1	Waste Characterization	Leachate from LOS layer, range 690 to 9410	4	P. 15, 20, Table 3
1	Leachate	Chemical Oxygen Demand (COD)		mg/L		EPA Method 410.1	Waste Characterization	Leachate from VR layer, range 2110 to 3140	4	P. 15, 20, Table 3
2	Leachate	Chemical Oxygen Demand (COD)		mg/L		EPA Method 410.1	Waste Characterization	Leachate from VR layer, range 930 to 3730	4	P. 15, 20, Table 3
2	Leachate	Chemical Oxygen Demand (COD)		mg/L		EPA Method 410.1	Waste Characterization	Leachate from LOS layer, range 41,400 to 77,800	4	P. 15, 20, Table 3
2	Leachate	Chemical Oxygen Demand (COD)		mg/L		EPA Method 410.1	Waste Characterization	Leachate from HC layer, range 3140 to 6960	4	P. 15, 20, Table 3
1	Water/humus	Chemical Oxygen Demand (COD)		mg/L		EPA Method 410.1	Waste Characterization	COD (Manual), Range 980 to 1860, direct test	4	P. 20, Table 3
2	Water/humus	Chemical Oxygen Demand (COD)		mg/L		EPA Method 410.1	Waste Characterization	COD (Manual), Range 1470 to 4360, direct test	4	P. 20, Table 3
1	Coal Aggregate	Chloride	1,050.00	mg/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 6
1	Coal Aggregate	Chloride	374.00	mg/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 6
1	Coal Aggregate	Chloride	1,340.00	mg/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	1,130.00	mg/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Chloride	1,740.00	mg/kg	IM01HCOF 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	996.00	mg/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	2,190.00	mg/kg	IM01HCOO 02_05062010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	894.00	mg/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	506.00	mg/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	2,270.00	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	540.00	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	869.00	mg/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	56.30	mg/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Chloride	1,170.00	mg/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	217.00	mg/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	106.00	mg/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	831.00	mg/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	2,190.00	mg/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	488.00	mg/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	507.00	mg/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	7,010.00	mg/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	253.00	mg/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	43.10	mg/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	3,460.00	mg/kg	IM02HCOA 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	220.00	mg/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	252.00	mg/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	5,460.00	mg/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Chloride	71.40	mg/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Chloride	527.00	mg/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Chloride	861.00	mg/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Chloride	375.00	mg/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Chloride	158.00	mg/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Chloride	1,790.00	mg/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	183.00	mg/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	217.00	mg/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	100.00	mg/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	Chloride	53.60	mg/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	680.00	mg/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	79.10	mg/kg	IM02VROK 01_04262010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	672.00	mg/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	76.30	mg/kg	IM02VROC 01_04262010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	268.00	mg/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	282.00	mg/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	53.90	mg/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	40.90	mg/kg	IM02VRON 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Chloride	41.00	mg/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 6
1	Yellow Oily Liquid	Chloride	540.00	mg/kg			Waste Characterization	6-7 foot depth	36	Table 25
1	Yellow Oily Liquid	Chloride	869.00	mg/kg			Waste Characterization	4-5 foot depth	36	Table 25
1	Hard Crumbly Material	Chloride, as received	0.20	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Chloride, as received	0.40	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Chloride, as received	0.30	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Chloride, as received	0.10	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Chloride, as received	0.30	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Chloride, as received	0.30	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Chloride, as received	0.30	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Chloride, as received	0.30	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Chloride, as received	0.30	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Chloride, as received	0.30	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Viscous Rubbery Material	Chloride, as received	0.30	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Chloride, as received	0.20	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Chloride, as received	0.40	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Chloride, as received	0.30	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Viscous Rubbery Material	Chloride, as received	0.10	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Chloride, as received	0.40	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Chloride, as received	0.30	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Chloride, as received	0.20	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Chloride, as received	0.20	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Chloride, as received	0.30	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Hard Crumbly Material	Corrosivity	0.03	in/yr			Waste Characterization	Quiescent conditions	4	p.11, 17, 21
1	Hard Crumbly Material	Corrosivity	0.08	in/yr			Waste Characterization	Agitated conditions	4	p.11, 17, 21
2	Hard Crumbly Material	Corrosivity	0.03	in/yr			Waste Characterization	Quiescent conditions	4	p.11, 17, 21
2	Hard Crumbly Material	Corrosivity	0.08	in/yr			Waste Characterization	Agitated conditions	4	p.11, 17, 21
1&2	Hard Crumbly Material	Corrosivity					Waste Characterization	Sludge analytical	28	Table 1-1
1	Viscous Rubbery Material	Corrosivity	0.03	in/yr			Waste Characterization	Quiescent conditions	4	p.11, 17, 21
1	Viscous Rubbery Material	Corrosivity	0.08	in/yr			Waste Characterization	Agitated conditions	4	p.11, 17, 21
2	Viscous Rubbery Material	Corrosivity	0.08	in/yr			Waste Characterization	Agitated conditions	4	p.11, 17, 21
2	Viscous Rubbery Material	Corrosivity	0.03	in/yr			Waste Characterization	Quiescent conditions	4	p.11, 17, 21
1&2	Viscous Rubbery Material	Corrosivity					Waste Characterization	Sludge analytical	28	Table 1-1
1	Hard Crumbly Material	Cyanide	10.60	mg/kg	IM01HCOG 01_05032010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Cyanide	0.44	mg/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Cyanide	7.70	mg/kg	IM01VROD 01_05052010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Cyanide	1.30	mg/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Cyanide	0.59	mg/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Density	10.07	lb/gal			Groundwater Assessment		6	Table 2
1	Hard Crumbly Material	Density	10.10	lb/gal			Waste Characterization	Sludge analytical	28	Table 1-1
1	Hard Crumbly Material	Density	10.10	lb/gal			Waste Characterization	Sludge analytical	29	1-3 Table 1-1
2	Hard Crumbly Material	Density	9.64	lb/gal			Groundwater Assessment		6	Table 2
2	Hard Crumbly Material	Density	9.60	lb/gal			Waste Characterization	Sludge analytical	28	Table 1-1

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Density	9.60	lb/gal			Waste Characterization	Sludge analytical	29	1-3 Table 1-1
1&2	Hard Crumbly Material	Density					Waste Characterization		4	Table 4, Table 7
1	Viscous Rubbery Material	Density	9.80	lb/gal			Groundwater Assessment		6	Table 2
1	Viscous Rubbery Material	Density	9.80	lb/gal			Waste Characterization	Sludge analytical	28	Table 1-1
1	Viscous Rubbery Material	Density	9.80	lb/gal			Waste Characterization	Sludge analytical	29	1-3 Table 1-1
2	Viscous Rubbery Material	Density	9.18	lb/gal			Groundwater Assessment		6	Table 2
2	Viscous Rubbery Material	Density	9.20	lb/gal			Waste Characterization	Sludge analytical	28	Table 1-1
2	Viscous Rubbery Material	Density	9.20	lb/gal			Waste Characterization	Sludge analytical	29	1-3 Table 1-1
1&2	Viscous Rubbery Material	Density					Waste Characterization		4	Table 4, Table 7
1	Aqueous Phase-Water Cap	Explosives					Waste Characterization		36	Table 20
2	Aqueous Phase-Water Cap	Explosives					Waste Characterization		36	Table 20
1	Coal Aggregate	Explosives					Waste Characterization		36	Table 7
2	Coal Aggregate	Explosives					Waste Characterization		36	Table 7
1	Hard Crumbly Material	Explosives					Waste Characterization		36	Table 7
2	Hard Crumbly Material	Explosives					Waste Characterization		36	Table 7
1	Viscous Rubbery Material	Explosives					Waste Characterization		36	Table 7
2	Viscous Rubbery Material	Explosives					Waste Characterization		36	Table 7
1	Aqueous Phase-Water Cap	Fatty Acids					Waste Characterization		36	Table 21
2	Aqueous Phase-Water Cap	Fatty Acids					Waste Characterization		36	Table 21
1	Hard Crumbly Material	Fixed Carbon, dry basis	47.70	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Fixed Carbon, dry basis	61.50	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Fixed Carbon, dry basis	53.20	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Fixed Carbon, dry basis	61.20	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Fixed Carbon, dry basis	65.20	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Fixed Carbon, dry basis	39.50	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Fixed Carbon, dry basis	34.30	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Fixed Carbon, dry basis	34.20	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Fixed Carbon, dry basis	44.90	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Fixed Carbon, dry basis	29.90	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1&2	Sludge Blend	Fixed Carbon, dry basis					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67
1	Viscous Rubbery Material	Fixed Carbon, dry basis	52.20	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Fixed Carbon, dry basis	42.90	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Fixed Carbon, dry basis	46.70	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Fixed Carbon, dry basis	62.60	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Fixed Carbon, dry basis	49.90	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Fixed Carbon, dry basis	31.90	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Fixed Carbon, dry basis	36.30	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Fixed Carbon, dry basis	32.30	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Fixed Carbon, dry basis	35.50	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Fixed Carbon, dry basis	32.00	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Hard Crumbly Material	Flash Point	68.00	°F			Waste Characterization	Less than 20°C	4	p.11, 17, 21
2	Hard Crumbly Material	Flash Point	68.00	°F			Waste Characterization	Less than 20°C	4	p.11, 17, 21
1&2	Hard Crumbly Material	Flash Point	20.00	°C			Waste Characterization	less than 20C	4	p.17, 22
1	Sludge Blend	Flash Point	45.00	°F	1-C	ASTM D3828-87	Thermal treatment evaluation	Littleford Dryer Process Pilot Study, composite of discreet field samples (2 - 3 feet).	21	App 1, Page 36
1	Sludge Blend	Flash Point	45.00	°F	1-B	ASTM D3828-87	Thermal treatment evaluation	Littleford Dryer Process Pilot Study, composite of discreet field samples (1 - 2 feet).	21	App 1, Page 36
1	Sludge Blend	Flash Point	67.60	°F	1-A	ASTM D3828-87	Thermal treatment evaluation	Littleford Dryer Process Pilot Study, composite of discreet field samples (0 - 0.5 feet).	21	App 1, Page 36
2	Sludge Blend	Flash Point	59.00	°F	2-B	ASTM D3828-87	Thermal treatment evaluation	Littleford Dryer Process Pilot Study, composite of discreet field samples (1 - 2 feet).	21	App 1, Page 36
2	Sludge Blend	Flash Point	57.00	°F	2-C	ASTM D3828-87	Thermal treatment evaluation	Littleford Dryer Process Pilot Study, composite of discreet field samples (2 - 3 feet).	21	App 1, Page 36
2	Sludge Blend	Flash Point	55.00	°F	2-A	ASTM D3828-87	Thermal treatment evaluation	Littleford Dryer Process Pilot Study, composite of discreet field samples (0 - 0.5 feet).	21	App 1, Page 36

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Viscous Rubbery Material	Flash Point	68.00	°F			Waste Characterization	Less than 20°C	4	p.11, 17, 21
2	Viscous Rubbery Material	Flash Point	68.00	°F			Waste Characterization	Less than 20°C	4	p.11, 17, 21
1&2	Viscous Rubbery Material	Flash Point	20.00	°C			Waste Characterization	less than 20C	4	P.17, 22
2	Hard Crumbly Material	Hydrocarbons-Petroleum Total	200.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Hard Crumbly Material	Hydrocarbons-Petroleum Total	4,930.00	ppm		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Viscous Rubbery Material	Hydrocarbons-Petroleum Total	32,600.00	ppm		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Viscous Rubbery Material	Hydrocarbons-Petroleum Total	1,440.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	Hydrocarbons-Petroleum Total	6,730.00	ppm		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	VR/HC Interface Layer	Hydrocarbons-Petroleum Total	1,010.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
1	Hard Crumbly Material	Hydrogen, as received basis	10.00	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Hydrogen, as received basis	9.40	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Hydrogen, as received basis	10.20	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Hydrogen, as received basis	4.80	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Hydrogen, as received basis	8.30	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Hydrogen, as received basis	9.30	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Hydrogen, as received basis	8.10	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Hydrogen, as received basis	8.50	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Hydrogen, as received basis	8.30	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Hydrogen, as received basis	8.20	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1&2	Sludge Blend	Hydrogen, as received basis					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67
1	Viscous Rubbery Material	Hydrogen, as received basis	8.00	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Viscous Rubbery Material	Hydrogen, as received basis	10.00	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Hydrogen, as received basis	8.30	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Hydrogen, as received basis	8.10	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Hydrogen, as received basis	8.80	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Hydrogen, as received basis	8.40	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Hydrogen, as received basis	9.90	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Hydrogen, as received basis	8.20	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Hydrogen, as received basis	8.20	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Hydrogen, as received basis	8.00	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Coal Aggregate	Metals-Arsenic	5.30	mg/kg	IM01CA0S 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Arsenic	5.70	mg/kg	IM01CA0R 01_05032010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Arsenic	5.40	mg/kg	IM01CA0Q 01_05042010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Arsenic	4.70	mg/kg	IM01CA0P 01_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	13.00	mg/kg	IM01HC0F 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	5.10	mg/kg	IM01HC0J 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	5.10	mg/kg	IM01HC0L 03_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	9.10	mg/kg	IM01HC0G 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	15.80	mg/kg	IM01HC0M 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	4.50	mg/kg	IM01HC0N 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	3.90	mg/kg	IM01HC0B 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	7.30	mg/kg	IM01HC0O 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	12.70	mg/kg	IM01HC0K 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Arsenic	11.40	mg/kg	IM01HC0A 02_04302010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	2.90	mg/kg	IM02HC0A 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	6.70	mg/kg	IM02HC0J 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	4.70	mg/kg	IM02HC0M 02_04292010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Metals-Arsenic	2.80	mg/kg	IM02HC0L 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	4.90	mg/kg	IM02HC0E 02_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	2.60	mg/kg	IM02HC0N 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	3.90	mg/kg	IM02HC0K 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	2.40	mg/kg	IM02HC0B 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	3.10	mg/kg	IM02HC0D 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	7.10	mg/kg	IM02HC0F 03_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	2.70	mg/kg	IM02HC0I 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Arsenic	2.50	mg/kg	IM02HC0G 02_04262010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Arsenic	3.90	mg/kg	IM01VR0K 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Arsenic	2.50	mg/kg	IM01VR0H 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Arsenic	10.30	mg/kg	IM01VR0D 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Arsenic	13.80	mg/kg	IM01VR0A 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Arsenic	8.70	mg/kg	IM01VR0M 01_05052010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	3.60	mg/kg	IM02VR0M 01_04292010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	2.60	mg/kg	IM02VR0B 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	1.90	mg/kg	IM02VR0J 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	2.70	mg/kg	IM02VR0N 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	2.70	mg/kg	IM02VR0D 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	3.10	mg/kg	IM02VR0A 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	2.40	mg/kg	IM02VR0K 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	5.80	mg/kg	IM02VR0F 01_04202010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	3.30	mg/kg	IM02VR0H 01_04272010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	4.80	mg/kg	IM02VR0E 01_04212010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	2.70	mg/kg	IM02VR0G 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Arsenic	3.70	mg/kg	IM02VR0I 01_04232010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	Metals-Arsenic	2.70	mg/kg	IM02VR0C 01_04262010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Barium	81.50	mg/kg	IM01CA0R 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Barium	48.10	mg/kg	IM01HC0G 01_05032010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Barium	42.40	mg/kg	IM01VR0A 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Barium	65.10	mg/kg	IM01VR0M 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Barium	37.60	mg/kg	IM01VR0K 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Barium	59.90	mg/kg	IM01VR0D 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Beryllium	0.73	mg/kg	IM01CA0R 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Beryllium	0.73	mg/kg	IM01HC0G 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Beryllium	0.25	mg/kg	IM01HC0A 02_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Beryllium	0.69	mg/kg	IM01VR0A 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Beryllium	0.73	mg/kg	IM01VR0D 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Beryllium	0.94	mg/kg	IM01VR0M 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Beryllium	0.35	mg/kg	IM01VR0K 01_05062010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Chromium	3.00	mg/kg	IM01CA0S 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Chromium	4.50	mg/kg	IM01CA0P 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Chromium	7.00	mg/kg	IM01CA0R 01_05032010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Chromium	7.30	mg/kg	IM01CA0Q 01_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	5.00	mg/kg	IM01HC0E 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	5.10	mg/kg	IM01HC0F 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	5.30	mg/kg	IM01HC0B 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	13.40	mg/kg	IM01HC0G 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	3.30	mg/kg	IM01HC0I 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	5.10	mg/kg	IM01HC0J 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	50.20	mg/kg	IM01HC0A 02_04302010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	9.00	mg/kg	IM01HC0M 02_05052010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Metals-Chromium	6.10	mg/kg	IM01HC0K 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	22.80	mg/kg	IM01HC0O 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	2.70	mg/kg	IM01HC0L 02_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	5.70	mg/kg	IM01HC0N 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Chromium	7.40	mg/kg	IM01HC0L 03_05072010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	16.10	mg/kg	IM02HC0E 02_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	3.10	mg/kg	IM02HC0A 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	2.60	mg/kg	IM02HC0B 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	1.10	mg/kg	IM02HC0I 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	5.20	mg/kg	IM02HC0C 02_04226010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	5.00	mg/kg	IM02HC0D 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	6.70	mg/kg	IM02HC0F 03_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	8.50	mg/kg	IM02HC0K 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	9.30	mg/kg	IM02HC0J 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	1.20	mg/kg	IM02HC0N 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	1.00	mg/kg	IM02HC0M 02_04292010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	4.20	mg/kg	IM02HC0L 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	6.80	mg/kg	IM02HC0N 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Chromium	8.10	mg/kg	IM02HC0G 02_04262010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	2.40	mg/kg	IM01VR0H 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	56.20	mg/kg	IM01VR0K 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	3.20	mg/kg	IM01VR0F 01_05042010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	10.70	mg/kg	IM01VR0M 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	16.70	mg/kg	IM01VR0D 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	4.50	mg/kg	IM01VR0O 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	37.40	mg/kg	IM01VR0A 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Chromium	3.30	mg/kg	IM01VR0C 02_04302010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	2.30	mg/kg	IM02VR0K 01_04262010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	Metals-Chromium	1.40	mg/kg	IM02VR0J 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	1.20	mg/kg	IM02VR0I 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	2.20	mg/kg	IM02VR0B 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	2.50	mg/kg	IM02VR0F 01_04202010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	1.40	mg/kg	IM02VR0C 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	2.30	mg/kg	IM02VR0H 01_04272010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	3.20	mg/kg	IM02VR0G 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	3.00	mg/kg	IM02VR0D 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	1.20	mg/kg	IM02VR0M 01_04292010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	4.80	mg/kg	IM02VR0E 01_04212010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	1.80	mg/kg	IM02VR0N 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Chromium	7.70	mg/kg	IM02VR0A 01_04222010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Lead	92.50	mg/kg	IM01CA0P 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Lead	7.80	mg/kg	IM01CA0R 01_05032010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Lead	168.00	mg/kg	IM01CA0Q 01_05042010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Lead	150.00	mg/kg	IM01CA0S 01_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	52.50	mg/kg	IM01HC0O 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	38.60	mg/kg	IM01HC0A 02_04302010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	76.80	mg/kg	IM01HC0N 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	80.20	mg/kg	IM01HC0B 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	23.60	mg/kg	IM01HC0M 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	45.30	mg/kg	IM01HC0L 03_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	84.80	mg/kg	IM01HC0E 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	121.00	mg/kg	IM01HC0J 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	118.00	mg/kg	IM01HC0F 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	65.00	mg/kg	IM01HC0L 02_05072010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Metals-Lead	21.20	mg/kg	IM01HC0G 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	126.00	mg/kg	IM01HC0I 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Lead	67.70	mg/kg	IM01HC0K 02_05062010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	29.40	mg/kg	IM02HC0L 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	32.00	mg/kg	IM02HC0F 03_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	37.50	mg/kg	IM02HC0K 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	26.30	mg/kg	IM02HC0N 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	9.00	mg/kg	IM02HC0A 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	46.70	mg/kg	IM02HC0N 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	84.40	mg/kg	IM02HC0C 02_04226010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	31.00	mg/kg	IM02HC0I 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	35.10	mg/kg	IM02HC0M 02_04292010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	71.50	mg/kg	IM02HC0D 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	9.40	mg/kg	IM02HC0J 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	29.30	mg/kg	IM02HC0J 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	67.20	mg/kg	IM02HC0B 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	42.70	mg/kg	IM02HC0E 02_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Lead	73.20	mg/kg	IM02HC0G 02_04262010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	14.20	mg/kg	IM01VR0F 01_05042010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	28.60	mg/kg	IM01VR0D 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	29.30	mg/kg	IM01VR0H 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	35.70	mg/kg	IM01VR0C 02_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	22.90	mg/kg	IM01VR0A 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	34.50	mg/kg	IM01VR0K 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	19.20	mg/kg	IM01VR0M 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Lead	91.90	mg/kg	IM01VR0O 01_05062010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	81.80	mg/kg	IM02VR0C 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	27.10	mg/kg	IM02VR0M 01_04292010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	61.10	mg/kg	IM02VR0E 01_04212010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	95.80	mg/kg	IM02VR0F 01_04202010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	30.70	mg/kg	IM02VR0K 01_04262010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	Metals-Lead	235.00	mg/kg	IM02VR0D 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	62.20	mg/kg	IM02VR0A 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	92.20	mg/kg	IM02VR0G 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	59.50	mg/kg	IM02VR0B 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	24.10	mg/kg	IM02VR0H 01_04272010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	26.60	mg/kg	IM02VR0N 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	21.40	mg/kg	IM02VR0J 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Lead	45.10	mg/kg	IM02VR0I 01_04232010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Mercury	1.40	mg/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Mercury	2.60	mg/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Mercury	0.07	mg/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Mercury	2.00	mg/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	1.90	mg/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	1.70	mg/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	0.06	mg/kg	IM01HCOA 02_04302010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	0.44	mg/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	0.67	mg/kg	IM01HCOM 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	1.30	mg/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	0.32	mg/kg	IM01HCOO 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	0.43	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	1.90	mg/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	1.80	mg/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	0.58	mg/kg	IM01HCOG 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	0.63	mg/kg	IM01HCOF 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Mercury	1.70	mg/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.05	mg/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.87	mg/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.11	mg/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.43	mg/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	20.90	mg/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.49	mg/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Metals-Mercury	0.43	mg/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.06	mg/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.08	mg/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.49	mg/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.11	mg/kg	IM02HCOA 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.26	mg/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.19	mg/kg	IM02HCOC 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Mercury	0.08	mg/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 5
1&2	Sludge Blend	Metals-Mercury					Remedial alternatives evaluation		27	p. 344
1	Viscous Rubbery Material	Metals-Mercury	0.77	mg/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Mercury	1.30	mg/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Mercury	0.20	mg/kg	IM01VROM 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Mercury	0.96	mg/kg	IM01VROD 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Mercury	0.29	mg/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Mercury	0.57	mg/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Mercury	0.32	mg/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.58	mg/kg	IM02VROG01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.21	mg/kg	IM02VROF01_04202010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.08	mg/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.79	mg/kg	IM02VROK 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.30	mg/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.08	mg/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.65	mg/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.13	mg/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.10	mg/kg	IM02VROC 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.07	mg/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	Metals-Mercury	0.04	mg/kg	IM02VRON 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Mercury	0.25	mg/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 5
1&2	Viscous Rubbery Material	Metals-Mercury					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, p. 29-32
1	Coal Aggregate	Metals-Selenium	12.90	mg/kg	IM01CA0S 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Selenium	7.40	mg/kg	IM01CA0P 01_05052010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Selenium	2.80	mg/kg	IM01CA0R 01_05032010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Selenium	12.00	mg/kg	IM01CA0Q 01_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	11.30	mg/kg	IM01HC0J 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	9.50	mg/kg	IM01HC0N 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	10.60	mg/kg	IM01HC0M 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	5.30	mg/kg	IM01HC0L 03_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	5.10	mg/kg	IM01HC0L 02_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	13.00	mg/kg	IM01HC0K 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	9.50	mg/kg	IM01HC0O 02_05062010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	3.00	mg/kg	IM01HC0G 01_05032010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	12.90	mg/kg	IM01HC0F 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	7.40	mg/kg	IM01HC0E 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	5.70	mg/kg	IM01HC0B 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Selenium	12.30	mg/kg	IM01HC0I 02_05052010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	6.00	mg/kg	IM02HC0M 02_04292010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	10.50	mg/kg	IM02HC0F 03_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	9.30	mg/kg	IM02HC0E 02_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	2.10	mg/kg	IM02HC0A 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	4.50	mg/kg	IM02HC0I 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	4.10	mg/kg	IM02HC0N 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	5.00	mg/kg	IM02HC0O 02_04272010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Metals-Selenium	6.70	mg/kg	IM02HC0L 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	7.10	mg/kg	IM02HC0K 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	4.70	mg/kg	IM02HC0C 02_04226010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	7.20	mg/kg	IM02HC0D 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	5.50	mg/kg	IM02HC0B 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Selenium	6.30	mg/kg	IM02HC0G 02_04262010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Selenium	4.20	mg/kg	IM01VR0M 01_05052010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Selenium	10.00	mg/kg	IM01VR0O 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Selenium	5.50	mg/kg	IM01VR0K 01_05062010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Selenium	3.40	mg/kg	IM01VR0H 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Selenium	3.60	mg/kg	IM01VR0C 02_04302010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	4.70	mg/kg	IM02VR0K 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	5.60	mg/kg	IM02VR0M 01_04292010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	10.40	mg/kg	IM02VR0E 01_04212010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	3.60	mg/kg	IM02VR0J 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	6.80	mg/kg	IM02VR0G 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	13.30	mg/kg	IM02VR0F 01_04202010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	5.60	mg/kg	IM02VR0D 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	4.60	mg/kg	IM02VR0N 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	4.80	mg/kg	IM02VR0H 01_04272010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	6.00	mg/kg	IM02VR0I 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	5.40	mg/kg	IM02VR0A 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	6.10	mg/kg	IM02VR0B 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Selenium	6.00	mg/kg	IM02VR0C 01_04262010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Sodium	4,160.00	mg/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 5
1	Coal Aggregate	Metals-Sodium	2,870.00	mg/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Metals-Sodium	2,160.00	mg/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Sodium	1,860.00	mg/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Sodium	3,030.00	mg/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Sodium	1,990.00	mg/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Sodium	3,090.00	mg/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-Sodium	3,070.00	mg/kg	IM01HCOO 02_05062010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	4,700.00	mg/kg	IM02HCOA 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	11,400.00	mg/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	2,170.00	mg/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	4,420.00	mg/kg	IM02HCOC 02_04222010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	1,070.00	mg/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	2,630.00	mg/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	1,740.00	mg/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	1,020.00	mg/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	3,910.00	mg/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	2,920.00	mg/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	1,770.00	mg/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	2,870.00	mg/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	1,950.00	mg/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-Sodium	2,240.00	mg/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 5
1	Leachate	Metals-Sodium	1,303.00	mg/L			Thermal treatment evaluation	Littleford Dryer Process Pilot Study. Value avg of leachate samples 1A, 1B, and 1C.	21	App 1, p. 29-32
2	Leachate	Metals-Sodium	1,990,000.00	ug/L			Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2.	19	Table 7
2	Leachate	Metals-Sodium	1,243.00	mg/L			Thermal treatment evaluation	Littleford Dryer Process Pilot Study. Value avg of sludge samples 2A, 2B, and 2C.	21	App 1, p. 29-32
1	Sludge Blend	Metals-Sodium	3,353.00	mg/kg			Thermal treatment evaluation	Littleford Dryer Process Pilot Study. Value avg of sludge samples 1A, 1B, and 1C.	21	App 1, p. 29-32

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Sludge Blend	Metals-Sodium	5,870.00	mg/kg			Thermal treatment evaluation	Littleford Dryer Process Pilot Study. Value avg of sludge samples 2A, 2B, and 2C.	21	App 1, p. 29-32
1	Viscous Rubbery Material	Metals-Sodium	1,730.00	mg/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 5
1	Viscous Rubbery Material	Metals-Sodium	4,500.00	mg/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	6,580.00	mg/kg			Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2.	19	Table 7
2	Viscous Rubbery Material	Metals-Sodium	1,470.00	mg/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	2,680.00	mg/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	3,540.00	mg/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	1,740.00	mg/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	2,720.00	mg/kg	IM02VROC 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	3,010.00	mg/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	5,810.00	mg/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	2,160.00	mg/kg	IM02VROK 01_04262010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	2,010.00	mg/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	2,400.00	mg/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	2,090.00	mg/kg	IM02VRON 01_04232010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	3,120.00	mg/kg	IM02VROF01_04202010		Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-Sodium	2,950.00	mg/kg	IM02VROG01_04262010		Waste Characterization		36	Table 5
1	Aqueous Phase-Water Cap	Metals-TAL					Waste Characterization		36	Table 18
2	Aqueous Phase-Water Cap	Metals-TAL					Waste Characterization		36	Table 18
1	Ash	Metals-TAL					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	Metals-TAL					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Coal Aggregate	Metals-TAL					Waste Characterization		36	Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Coal Aggregate	Metals-TAL					Waste Characterization		36	Table 5
1	Hard Crumbly Material	Metals-TAL					Waste Characterization		36	Table 5
2	Hard Crumbly Material	Metals-TAL					Waste Characterization		36	Table 5
2	Leachate	Metals-TAL					Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2.	19	Table 7
1	Sludge Blend	Metals-TAL					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, p. 29-32
2	Sludge Blend	Metals-TAL					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, p. 29-32
1&2	Sludge Blend	Metals-TAL					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67, 84
1&2	Sludge Blend	Metals-TAL					Remedial alternatives evaluation		27	p. 344
1	Sludge Blend VR/HC	Metals-TAL					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1	Viscous Rubbery Material	Metals-TAL					Waste Characterization		36	Table 5
2	Viscous Rubbery Material	Metals-TAL					Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2.	19	Table 7
2	Viscous Rubbery Material	Metals-TAL					Waste Characterization		36	Table 5
1	Yellow Oily Liquid	Metals-TAL					Waste Characterization		36	Table 24
1	Ash	Moisture					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	Moisture					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1&2	Hard Crumbly Material	Moisture		%			Waste Characterization	Sludge analytical	28	Table 1-1
1&2	Sludge Blend	Moisture					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67
1&2	Sludge Blend	Moisture					Thermal treatment evaluation	ABB batch scale calciner, mixture of tar from 1 & 2 (mixed with portland cement).	26	p. 3
1	Sludge Blend VR/HC	Moisture					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	Moisture					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1&2	Viscous Rubbery Material	Moisture		%			Waste Characterization	Sludge analytical	28	Table 1-1

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Moisture, as received	50.00	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Moisture, as received	32.00	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Moisture, as received	62.00	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Moisture, as received	44.00	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Moisture, as received	36.00	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Moisture, as received	23.00	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Moisture, as received	24.00	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Moisture, as received	21.50	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Moisture, as received	33.50	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Moisture, as received	28.50	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Viscous Rubbery Material	Moisture, as received	46.50	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Moisture, as received	34.00	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Moisture, as received	41.00	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Moisture, as received	38.00	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Moisture, as received	41.00	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Moisture, as received	25.50	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Moisture, as received	22.50	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Moisture, as received	29.00	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Moisture, as received	24.50	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Moisture, as received	24.50	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1&2	Sludge Blend	Naphthalene					Remedial alternatives evaluation		27	p. 344
1&2	Sludge Blend	Nitrogen					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67
1	Coal Aggregate	Nitrogen - ammonia	207.00	mg/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 6
1	Coal Aggregate	Nitrogen - ammonia	31.20	mg/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 6
1	Coal Aggregate	Nitrogen - ammonia	174.00	mg/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Nitrogen - ammonia	64.30	mg/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Nitrogen - ammonia	39.50	mg/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Nitrogen - ammonia	30.00	mg/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Nitrogen - ammonia	18.90	mg/kg	IM01HCOG 01_05032010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Nitrogen - ammonia	132.00	mg/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Nitrogen - ammonia	48.90	mg/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Nitrogen - ammonia	147.00	mg/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Nitrogen - ammonia	25.50	mg/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Nitrogen - ammonia	5.20	mg/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Nitrogen - ammonia	21.40	mg/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 6
1	Leachate	Nitrogen - ammonia		mg/L			Waste Characterization	Leachate from LOS layer, range 1.97 to 18.6	4	Table 3
1	Leachate	Nitrogen - ammonia		mg/L			Waste Characterization	Leachate from VR layer, range 7 to 14.5	4	Table 3
2	Leachate	Nitrogen - ammonia		mg/L			Waste Characterization	Leachate from LOS layer, range 97 to 253	4	Table 3
2	Leachate	Nitrogen - ammonia		mg/L			Waste Characterization	Leachate from VR layer, range 0.45 to 2.7	4	Table 3
2	Leachate	Nitrogen - ammonia		mg/L			Waste Characterization	Leachate from HC layer, range 2.93 to 5.41	4	Table 3
1	Viscous Rubbery Material	Nitrogen - ammonia	19.60	mg/kg	IM01VROA 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Nitrogen - ammonia	43.80	mg/kg	IM01VROD 01_05052010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Nitrogen - ammonia	16.50	mg/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Nitrogen - ammonia	22.40	mg/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Nitrogen - ammonia	9.50	mg/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Nitrogen - ammonia	8.70	mg/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Nitrogen - ammonia	39.80	mg/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Nitrogen - ammonia	31.90	mg/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Nitrogen - ammonia	57.60	mg/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 6
1	Yellow Oily Liquid	Nitrogen - ammonia	64.30	mg/kg			Waste Characterization	4-5 foot depth	36	Table 25
1	Hard Crumbly Material	Nitrogen, as received basis	0.20	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Nitrogen, as received basis	0.70	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Nitrogen, as received basis	0.20	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Nitrogen, as received basis	0.30	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Hard Crumbly Material	Nitrogen, as received basis	0.40	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Nitrogen, as received basis	0.20	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Nitrogen, as received basis	0.20	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Nitrogen, as received basis	0.30	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Nitrogen, as received basis	0.20	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
2	Hard Crumbly Material	Nitrogen, as received basis	0.20	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 5
1	Viscous Rubbery Material	Nitrogen, as received basis	0.30	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Nitrogen, as received basis	0.20	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Nitrogen, as received basis	0.30	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Nitrogen, as received basis	0.10	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Viscous Rubbery Material	Nitrogen, as received basis	0.50	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Nitrogen, as received basis	0.20	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Nitrogen, as received basis	0.30	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Nitrogen, as received basis	0.20	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Nitrogen, as received basis	0.20	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
2	Viscous Rubbery Material	Nitrogen, as received basis	0.20	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material analytical, as received.	21	App 1, Table 4
1	Leachate	Nitrogen, TKN		mg/L		EPA Method 351.2	Waste Characterization	Leachate from LOS layer, range 2 to 19	4	Table 3
1	Leachate	Nitrogen, TKN		mg/L		EPA Method 351.2	Waste Characterization	Leachate from VR layer, range 7 to 15	4	Table 3
2	Leachate	Nitrogen, TKN		mg/L		EPA Method 351.2	Waste Characterization	Leachate from LOS layer, range 97 to 253	4	Table 3
2	Leachate	Nitrogen, TKN		mg/L		EPA Method 351.2	Waste Characterization	Leachate from HC layer, range 3 to 5	4	Table 3
2	Leachate	Nitrogen, TKN		mg/L		EPA Method 351.2	Waste Characterization	Leachate from VR layer, range 1 to 3	4	Table 3
1&2	Leachate	Nitrogen, TKN					Waste Characterization		4	p. 10,16,20,21, Table 3
1&2	Sludge Blend	Oxygen					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1&2	Viscous Rubbery Material	Oxygen					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, p. 29, p.33
1	Hard Crumbly Material	PCBs - Arochlors					Waste Characterization		36	Table 8
2	Hard Crumbly Material	PCBs - Arochlors					Waste Characterization		36	Table 8
1&2	Sludge Blend	PCBs - Arochlors					Remedial alternatives evaluation		27	p. 344
1	Viscous Rubbery Material	PCBs - Arochlors					Waste Characterization		36	Table 8
2	Viscous Rubbery Material	PCBs - Arochlors					Waste Characterization		36	Table 8
1	Hard Crumbly Material	PCBs - Homologues					Waste Characterization		36	Table 9
2	Hard Crumbly Material	PCBs - Homologues					Waste Characterization		36	Table 9
1	Viscous Rubbery Material	PCBs - Homologues					Waste Characterization		36	Table 9
2	Viscous Rubbery Material	PCBs - Homologues					Waste Characterization		36	Table 9
1	Aqueous Phase-Water Cap	pH	8.73	pH	IM01WCAP 01_04192010		Waste Characterization		36	Table 19
2	Aqueous Phase-Water Cap	pH					Water layer treatment tests	Lagoon 2 titration data	15	Table 1
2	Aqueous Phase-Water Cap	pH	0.10	pH		EPA Method 9045	Waste Characterization		29	2-22, Table 2-5
2	Aqueous Phase-Water Cap	pH	0.10	pH		EPA Method 9045	Waste Characterization		29	2-22, Table 2-5
2	Aqueous Phase-Water Cap	pH	8.00	pH	IM02WCAP 01_04192010		Waste Characterization		36	Table 19
1	Ash	pH					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	pH					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Coal Aggregate	pH	4.68	pH	IM01CAOP 01_05052010		Waste Characterization		36	Table 6
1	Coal Aggregate	pH	5.46	pH	IM01CAOR 01_05032010		Waste Characterization		36	Table 6
1	Coal Aggregate	pH	1.01	pH	IM01CAOS 01_05052010		Waste Characterization		36	Table 6
1	Coal Aggregate	pH	7.63	pH	IM01CAOQ 01_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	1.89	pH	IM01HCOK 02_05062010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	1.64	pH	IM01HCOJ 02_05042010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	pH	5.98	pH	IM01HCOG 01_05032010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	6.51	pH	IM01HCOL 02_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	0.93	pH	IM01HCOF 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	0.71	pH	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	0.94	pH	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	8.96	pH	IM01HCOE 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	1.93	pH	IM01HCON 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	0.56	pH	IM01HCOO 02_05062010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	pH	1.93	pH	IM01HCOA 01_04302010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	11.50	pH			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Hard Crumbly Material	pH	12.40	pH			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Hard Crumbly Material	pH	2.33	pH	IM02HCON 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	1.81	mg/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	0.30	pH	IM02HCOC 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	1.10	pH	IM02HCOA 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	2.04	pH	IM02HCOB 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	1.23	mg/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	2.22	pH	IM02HCOI 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	0.52	pH	IM02HCOK 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	0.66	pH	IM02HCOF 03_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	1.45	pH	IM02HCOE 02_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	1.19	pH	IM02HCOD 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	pH	0.64	pH	IM02HCOG 02_04262010		Waste Characterization		36	Table 6
1&2	Hard Crumbly Material	pH					Waste Characterization	Sludge analytical	28	Table 1-1
1	Leachate	pH		pH		EPA Method 120.1	Waste Characterization	Leachate from VR layer, range 1.0 TO 1.1	4	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Leachate	pH		pH		EPA Method 120.1	Waste Characterization	Leachate from LOS layer, range 1.3 to 2.5	4	Table 3
2	Leachate	pH		pH		EPA Method 120.1	Waste Characterization	Leachate from VR layer, range 1.7 TO 2.1	4	Table 3
2	Leachate	pH		pH		EPA Method 120.1	Waste Characterization	Leachate from LOS layer, range 1.9 to 2.9	4	Table 3
2	Leachate	pH		pH		EPA Method 120.1	Waste Characterization	Leachate from HC layer, range 1.1 TO 1.4	4	Table 3
2	Leachate	pH	4.55	pH			Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2.	19	Table 7
1&2	Leachate	pH				EPA Method 150.1	Waste Characterization		4	P. 15, 20, Table 3
1&2	Leachate	pH					Waste Characterization		4	p. 10,16,20,21, Table 3
1&2	Sludge Blend	pH					Remedial alternatives evaluation		27	p. 106
1	Sludge Blend VR/HC	pH					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	pH					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1	Viscous Rubbery Material	pH	1.60	pH	IM01VROC 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	pH	1.22	pH	IM01VROO 01_05062010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	pH	3.45	pH	IM01VROM 01_05052010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	pH	1.04	pH	IM01VROK 01_05062010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	pH	4.82	pH	IM01VROA 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	pH	1.72	pH	IM01VROH 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	pH	12.36	pH	IM01VROF 01_05042010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.44	pH			Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2.	19	Table 7
2	Viscous Rubbery Material	pH	13.10	pH			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Viscous Rubbery Material	pH	11.80	pH			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Viscous Rubbery Material	pH	1.62	pH	IM02VROJ 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	2.03	pH	IM02VROA 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.81	pH	IM02VROM 01_04292010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.31	pH	IM02VROD 01_04222010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	pH	1.76	pH	IM02VROF 01_04202010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.54	pH	IM02VROB 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.09	pH	IM02VROE 01_04212010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.57	pH	IM02VROG 01_04262010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	2.20	pH	IM02VRON 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.36	pH	IM02VROC 01_04262010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	2.19	pH	IM02VROI 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	pH	1.25	pH	IM02VROK 01_04262010		Waste Characterization		36	Table 6
1&2	Viscous Rubbery Material	pH					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, p. 33
1&2	Viscous Rubbery Material	pH					Waste Characterization	Sludge analytical	28	Table 1-1
2	VR/HC Interface Layer	pH	12.10	pH			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	pH	13.00	pH			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
1	Coal Aggregate	Phenolics	249.00	mg/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 6
1	Coal Aggregate	Phenolics	166.00	mg/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 6
1	Coal Aggregate	Phenolics	766.00	mg/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	179.00	mg/kg	IM01HCON 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	84.20	mg/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	290.00	mg/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	328.00	mg/kg	IM01HCOL 02_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	52.90	mg/kg	IM01HCOA 01_04302010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	178.00	mg/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	62.90	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	444.00	mg/kg	IM01HCOI 02_05052010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	64.30	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Phenolics	163.00	mg/kg	IM01HCOB 02_05052010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Phenolics	124.00	mg/kg	IM01HCOO 02_05062010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	34.10	mg/kg	IM02HCOA 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	223.00	mg/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	20.40	mg/kg	IM02HCOO 02_04272010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	279.00	mg/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	182.00	mg/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	55.30	mg/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	42.40	mg/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	93.80	mg/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	26.90	mg/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	14.80	mg/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	127.00	mg/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	84.60	mg/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	55.20	mg/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Phenolics	60.30	mg/kg	IM02HCOL 02_04272010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Phenolics	8.60	mg/kg	IM01VROA 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Phenolics	84.50	mg/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Phenolics	319.00	mg/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Phenolics	32.80	mg/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Phenolics	180.00	mg/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Phenolics	64.30	mg/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	47.60	mg/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	88.10	mg/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	21.50	mg/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	107.00	mg/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	187.00	mg/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	Phenolics	90.30	mg/kg	IM02VROH 01_04272010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	275.00	mg/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	32.10	mg/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	45.20	mg/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	143.00	mg/kg	IM02VROC 01_04262010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	126.00	mg/kg	IM02VROM 01_04292010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	91.90	mg/kg	IM02VRON 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Phenolics	151.00	mg/kg	IM02VROK 01_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Solids	61.90	%			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Hard Crumbly Material	Solids	44.90	%		ASTM D-129	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	Hard Crumbly Material	Solids	95.30	%			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Viscous Rubbery Material	Solids	33.10	%		ASTM D-129	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	Viscous Rubbery Material	Solids	66.40	%			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Viscous Rubbery Material	Solids	97.90	%			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	Solids	58.30	%			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	VR/HC Interface Layer	Solids	93.20	%			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	Solids	42.20	%		ASTM D-129	Waste Characterization		29	2-14, Table 2-2
1	Leachate	Specific Conductance		mg/L		EPA Method 120.1	Waste Characterization	Leachate from LOS layer, range 936 to 25,800	4	Table 3
1	Leachate	Specific Conductance		mg/L		EPA Method 120.1	Waste Characterization	Leachate from VR layer, range 36,500 to 47,300	4	Table 3
2	Leachate	Specific Conductance		mg/L		EPA Method 120.1	Waste Characterization	Leachate from VR layer, range 4300 to 12,000	4	Table 3
2	Leachate	Specific Conductance		mg/L		EPA Method 120.1	Waste Characterization	Leachate from HC layer, range 16,800 to 45,100	4	Table 3
2	Leachate	Specific Conductance		mg/L		EPA Method 120.1	Waste Characterization	Leachate from LOS layer, range 4,476 to 4,976	4	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1&2	Leachate	Specific Conductance				EPA Method 120.1	Waste Characterization		4	P. 15, 20, Table 3
1&2	Leachate	Specific Conductance					Waste Characterization		4	p. 10,16,20,21,Table 3
1&2	Sludge Blend	Specific Gravity	1.57	Specific Gravity			Thermal treatment evaluation	mixed in with the organic matter, non-homogeneous material	3	2-2
1&2	Sludge Blend	Specific Gravity					Thermal treatment evaluation	ABB batch scale calciner, mixture of tar from 1 & 2 (mixed with portland cement).	26	p. 3, 14
1&2	Sludge Blend	Specific Gravity					Remedial alternatives evaluation		27	p. 3
2	Emissions-Fugitive	Sulfur Gases					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement (VR, VR/HC, HC)	29	2-28 thru 2-31, Table 2-6
2	Emissions-Fugitive	Sulfur Gases					Waste Characterization	Direct monitoring of water layer emissions	29	2-17, 2-17, Table 2-3
2	Emissions-Fugitive	Sulfur Gases					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate (VR, VR/HC, HC)	29	2-35 thru 2-37, Table 2-8
1	Hard Crumbly Material	Sulfur-Inorganic	8.17	%			Waste Characterization		4	p.17, Table 4
1	Hard Crumbly Material	Sulfur-Inorganic	6.90	%			Waste Characterization		4	p.17, Table 4
1	Hard Crumbly Material	Sulfur-Inorganic	7.40	%			Waste Characterization		4	p.17, Table 4
2	Hard Crumbly Material	Sulfur-Inorganic	1.97	%			Waste Characterization		4	Table 7
2	Hard Crumbly Material	Sulfur-Inorganic	3.77	%			Waste Characterization		4	Table 7
1	Viscous Rubbery Material	Sulfur-Inorganic	1.30	%			Waste Characterization		4	Table 4
1	Viscous Rubbery Material	Sulfur-Inorganic	1.75	%			Waste Characterization		4	Table 4
2	Viscous Rubbery Material	Sulfur-Inorganic	0.97	%			Waste Characterization		4	Table 7
2	Viscous Rubbery Material	Sulfur-Inorganic	2.10	%			Waste Characterization		4	Table 7
1	Water/humus	Sulfur-Inorganic	0.14	%			Waste Characterization		4	Table 4
2	Water/humus	Sulfur-Inorganic	0.10	%			Waste Characterization	.1%, 2 samples taken	4	p.15, Table 7
2	Aqueous Phase-Water Cap	Sulfur-Sulfate	900,000.00	mg/kg		EPA Method 375.4	Waste Characterization	>900,000 mg/kg	29	2-22, Table 2-5
2	Ash	Sulfur-Sulfate					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Sulfur-Sulfate	32,000.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Hard Crumbly Material	Sulfur-Sulfate	2,180.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Hard Crumbly Material	Sulfur-Sulfate	260,000.00	mg/kg		ASTM D-129	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
1	Sludge Blend VR/HC	Sulfur-Sulfate					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	Sulfur-Sulfate					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Viscous Rubbery Material	Sulfur-Sulfate	10,800.00	mg/kg		ASTM D-129	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	Viscous Rubbery Material	Sulfur-Sulfate	296.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Viscous Rubbery Material	Sulfur-Sulfate	11,600.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	VR/HC Interface Layer	Sulfur-Sulfate	147,000.00	mg/kg		ASTM D-129	Waste Characterization		29	2-14, Table 2-2
2	VR/HC Interface Layer	Sulfur-Sulfate	31,200.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	VR/HC Interface Layer	Sulfur-Sulfate	2,050.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
1	Ash	Sulfur-Sulfide					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	Sulfur-Sulfide					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Coal Aggregate	Sulfur-Sulfide	36.70	mg/kg	IM01CAOR 01_05032010		Waste Characterization		36	Table 6
1	Coal Aggregate	Sulfur-Sulfide	106.00	mg/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 6
1	Coal Aggregate	Sulfur-Sulfide	93.20	mg/kg	IM01CAOP 01_05052010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfide	21.50	mg/kg	IM01HCOA 01_04302010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfide	46.70	mg/kg	IM01HCOG 01_05032010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Sulfur-Sulfide	62.90	mg/kg	IM01HCOK 02_05062010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfide	40.80	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfide	66.20	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfide	4.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Hard Crumbly Material	Sulfur-Sulfide	4.20	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Hard Crumbly Material	Sulfur-Sulfide	95.70	mg/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfide	512.00	mg/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfide	30.60	mg/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfide	53.20	mg/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfide	31.20	mg/kg	IM02HCOA 02_04222010		Waste Characterization		36	Table 6
1	Sludge Blend VR/HC	Sulfur-Sulfide					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	Sulfur-Sulfide					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1	Viscous Rubbery Material	Sulfur-Sulfide	36.60	mg/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Sulfur-Sulfide	52.60	mg/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Sulfur-Sulfide	35.10	mg/kg	IM01VROA 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Sulfur-Sulfide	24.10	mg/kg	IM01VROH 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Sulfur-Sulfide	34.00	mg/kg	IM01VROM 01_05052010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Sulfur-Sulfide	54.10	mg/kg	IM01VROK 01_05062010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfide	4.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Viscous Rubbery Material	Sulfur-Sulfide	4.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Viscous Rubbery Material	Sulfur-Sulfide	225.00	mg/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfide	29.50	mg/kg	IM02VROA 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfide	26.20	mg/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Viscous Rubbery Material	Sulfur-Sulfide	34.70	mg/kg	IM02VROJ 01_04232010		Waste Characterization		36	Table 6
2	VR/HC Interface Layer	Sulfur-Sulfide	4.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	Sulfur-Sulfide	4.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
1	Ash	Sulfur-Sulfite					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	Sulfur-Sulfite					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Coal Aggregate	Sulfur-Sulfite	116.00	mg/kg	IM01CAOQ 01_05042010		Waste Characterization		36	Table 6
1	Coal Aggregate	Sulfur-Sulfite	53.70	mg/kg	IM01CAOS 01_05052010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfite	76.30	mg/kg	IM01HCOJ 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfite	94.80	mg/kg	IM01HCOF 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfite	186.00	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfite	170.00	mg/kg	IM01HCOE 02_05042010		Waste Characterization		36	Table 6
1	Hard Crumbly Material	Sulfur-Sulfite	755.00	mg/kg	IM01HCOL 03_05072010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	30.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Hard Crumbly Material	Sulfur-Sulfite	178.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Hard Crumbly Material	Sulfur-Sulfite	145.00	mg/kg	IM02HCOA 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	785.00	mg/kg	IM02HCOG 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	157.00	mg/kg	IM02HCOI 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	1,020.00	mg/kg	IM02HCOF 03_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	322.00	mg/kg	IM02HCOB 02_04222010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	559.00	mg/kg	IM02HCOK 02_04262010		Waste Characterization		36	Table 6

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Sulfur-Sulfite	47.40	mg/kg	IM02HCOM 02_04292010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	225.00	mg/kg	IM02HCOJ 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	1,030.00	mg/kg	IM02HCOC 02_04262010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	57.90	mg/kg	IM02HCON 02_04232010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	45.40	mg/kg	IM02HCOE 02_04212010		Waste Characterization		36	Table 6
2	Hard Crumbly Material	Sulfur-Sulfite	161.00	mg/kg	IM02HCOD 02_04222010		Waste Characterization		36	Table 6
1	Sludge Blend VR/HC	Sulfur-Sulfite					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	Sulfur-Sulfite					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1	Viscous Rubbery Material	Sulfur-Sulfite	485.00	mg/kg	IM01VROC 01_04302010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Sulfur-Sulfite	128.00	mg/kg	IM01VROO 01_05062010		Waste Characterization		36	Table 6
1	Viscous Rubbery Material	Sulfur-Sulfite	990.00	mg/kg	IM01VROF 01_05042010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfite	365.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Viscous Rubbery Material	Sulfur-Sulfite	30.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Viscous Rubbery Material	Sulfur-Sulfite	163.00	mg/kg	IM02VROI 01_04232010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfite	455.00	mg/kg	IM02VROC 01_04262010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfite	453.00	mg/kg	IM02VROE 01_04212010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfite	269.00	mg/kg	IM02VROF 01_04202010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfite	195.00	mg/kg	IM02VROD 01_04222010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfite	376.00	mg/kg	IM02VROG 01_04262010		Waste Characterization		36	Table 6
2	Viscous Rubbery Material	Sulfur-Sulfite	170.00	mg/kg	IM02VROB 01_04222010		Waste Characterization		36	Table 6
2	VR/HC Interface Layer	Sulfur-Sulfite	30.00	ppm			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	Sulfur-Sulfite	643.00	ppm			Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	VR/HC Interface Layer	Sulfur-Sulfite	296.00	mg/kg		ASTM D-129	Waste Characterization		29	2-14, Table 2-2

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Yellow Oily Liquid	Sulfur-Sulfite	186.00	mg/kg			Waste Characterization	6-7 foot depth	36	Table 25
1	Ash	Sulfur-Total					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	Sulfur-Total					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Hard Crumbly Material	Sulfur-Total	5.41	%			Waste Characterization	range 1.85 - 7.4 %	4	p.11, 17, 21, Table 4
1	Hard Crumbly Material	Sulfur-Total	4.15	%			Groundwater Assessment		6	Table 2
1	Hard Crumbly Material	Sulfur-Total	16.50	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Sulfur-Total	6.10	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Sulfur-Total	10.30	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Sulfur-Total	8.30	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Sulfur-Total	20.60	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Sulfur-Total	4.15	%			Waste Characterization	Sludge analytical	28	Table 1-1
2	Hard Crumbly Material	Sulfur-Total	2.87	%			Waste Characterization	1.97-3.77% 2 samples taken	4	Table 7
2	Hard Crumbly Material	Sulfur-Total	7.93	%			Groundwater Assessment		6	Table 2
2	Hard Crumbly Material	Sulfur-Total	8.80	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Sulfur-Total	9.60	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Sulfur-Total	13.70	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Sulfur-Total	14.90	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Sulfur-Total	11.20	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Sulfur-Total	7.93	%			Waste Characterization	Sludge analytical	28	Table 1-1
2	Hard Crumbly Material	Sulfur-Total	11.00	%		ASTM D-129	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	Hard Crumbly Material	Sulfur-Total	1.30	%			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Hard Crumbly Material	Sulfur-Total	5.60	%		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
1	Sludge Blend VR/HC	Sulfur-Total					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	Sulfur-Total					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1	Viscous Rubbery Material	Sulfur-Total	7.50	%			Waste Characterization	Range 2.41-12.58, 2 samples	4	Table 4
1	Viscous Rubbery Material	Sulfur-Total	6.88	%			Groundwater Assessment		6	Table 2
1	Viscous Rubbery Material	Sulfur-Total	15.20	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Sulfur-Total	11.70	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Sulfur-Total	6.50	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Sulfur-Total	9.50	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Sulfur-Total	20.30	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Sulfur-Total	6.88	%			Waste Characterization	Sludge analytical	28	Table 1-1
2	Viscous Rubbery Material	Sulfur-Total	7.14	%			Waste Characterization	Range 6.84-7.43%	4	Table 7
2	Viscous Rubbery Material	Sulfur-Total	6.63	%			Groundwater Assessment		6	Table 2
2	Viscous Rubbery Material	Sulfur-Total	9.20	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Sulfur-Total	9.20	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Sulfur-Total	7.80	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Sulfur-Total	8.20	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Sulfur-Total	7.60	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Sulfur-Total	6.63	%			Waste Characterization	Sludge analytical	28	Table 1-1
2	Viscous Rubbery Material	Sulfur-Total	6.10	%		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
2	Viscous Rubbery Material	Sulfur-Total	21.00	%		ASTM D-129	Waste Characterization	Sludge analytical	29	2-14, Table 2-2
2	Viscous Rubbery Material	Sulfur-Total	0.67	%			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
1	VR/HC Interface Layer	Sulfur-Total	5.40	%			Waste Characterization	Sludge analytical	29	1-3, Table 1-1
2	VR/HC Interface Layer	Sulfur-Total	17.00	%		ASTM D-129	Waste Characterization	Sludge analytical	29	2-14, Table 2-2

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	VR/HC Interface Layer	Sulfur-Total	1.10	%			Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	Sulfur-Total	4.30	%		EPA Method 418.1	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-27, Table 2-5
1	Water/humus	Sulfur-Total	3.12	%			Waste Characterization		4	Table 4
2	Water/humus	Sulfur-Total	1.80	%			Waste Characterization	range 0.4 - 3.25%, 2 samples taken	4	p.15, Table 7
1	Aqueous Phase-Water Cap	SVOCs-TAL					Waste Characterization		36	Table 17
2	Aqueous Phase-Water Cap	SVOCs-TAL				EPA Method 8240	Waste Characterization		29	2-22, Table 2-5
2	Aqueous Phase-Water Cap	SVOCs-TAL					Waste Characterization		36	Table 17
1	Ash	SVOCs-TAL					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	SVOCs-TAL					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Coal Aggregate	SVOCs-TAL					Waste Characterization		36	Table 4
2	Coal Aggregate	SVOCs-TAL					Waste Characterization		36	Table 4
1	Hard Crumbly Material	SVOCs-TAL					Waste Characterization		36	Table 4
2	Hard Crumbly Material	SVOCs-TAL					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-26, Table 2-5
2	Hard Crumbly Material	SVOCs-TAL				EPA Method 8240/8270	Waste Characterization	Sludge analytical	29	2-13, Table 2-2
2	Hard Crumbly Material	SVOCs-TAL					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Hard Crumbly Material	SVOCs-TAL					Waste Characterization		36	Table 4
1&2	Hard Crumbly Material	SVOCs-TAL					Waste Characterization	Sludge analytical	28	Table 1-1
2	Leachate	SVOCs-TAL					Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2	19	Table 6
1&2	Sludge Blend	SVOCs-TAL					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1&2	Sludge Blend	SVOCs-TAL					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 77-82
1&2	Sludge Blend	SVOCs-TAL					Thermal treatment evaluation	ABB batch scale calciner, mixture of tar from 1 & 2 (mixed with portland cement).	26	p. 22, p. 28-31
1	Sludge Blend VR/HC	SVOCs-TAL					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	SVOCs-TAL					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1&2	Thermal Treatment - Ash	SVOCs-TAL					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-3
1	Viscous Rubbery Material	SVOCs-TAL					Waste Characterization		36	Table 4
2	Viscous Rubbery Material	SVOCs-TAL					Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2	19	Table 6
2	Viscous Rubbery Material	SVOCs-TAL					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-26, Table 2-5
2	Viscous Rubbery Material	SVOCs-TAL				EPA Method 8240/8270	Waste Characterization	Sludge analytical	29	2-13, Table 2-2
2	Viscous Rubbery Material	SVOCs-TAL					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Viscous Rubbery Material	SVOCs-TAL					Waste Characterization		36	Table 4
1&2	Viscous Rubbery Material	SVOCs-TAL					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, Table 6
1&2	Viscous Rubbery Material	SVOCs-TAL					Waste Characterization	Sludge analytical	28	Table 1-1
2	VR/HC Interface Layer	SVOCs-TAL					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	SVOCs-TAL				EPA Method 8240/8270	Waste Characterization		29	2-13, Table 2-2
2	VR/HC Interface Layer	SVOCs-TAL					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-26, Table 2-5
1	Yellow Oily Liquid	SVOCs-TAL					Waste Characterization		36	Table 23
1&2	Leachate	SVOCs-TCLP					Thermal treatment evaluation	ABB batch scale calciner, mixture of tar from 1 & 2 (mixed with portland cement).	26	p. 22, 26
1&2	Sludge Blend	SVOCs-TCLP					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-4
1&2	Thermal Treatment - Ash	SVOCs-TCLP					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-4

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Aqueous Phase-Water Cap	Total Dissolved Solids (TDS)	46.00	mg/L	IM01WCAP 01_04192010		Waste Characterization		36	Table 19
2	Aqueous Phase-Water Cap	Total Dissolved Solids (TDS)	79.00	mg/L	IM02WCAP 01_04192010		Waste Characterization		36	Table 19
1	Leachate	Total Dissolved Solids (TDS)		mg/L		EPA Method 160.1	Waste Characterization	Leachate from VR layer, range 2420 to 9339	4	Table 3
1	Leachate	Total Dissolved Solids (TDS)		mg/L		EPA Method 160.1	Waste Characterization	Leachate from LOS layer, range 340 to 9460	4	Table 3
2	Leachate	Total Dissolved Solids (TDS)		mg/L		EPA Method 160.1	Waste Characterization	Leachate from VR layer, range 860 to 6070	4	Table 3
2	Leachate	Total Dissolved Solids (TDS)		mg/L		EPA Method 160.1	Waste Characterization	Leachate from HC layer, range 4100 to 14,100	4	Table 3
2	Leachate	Total Dissolved Solids (TDS)		mg/L		EPA Method 160.1	Waste Characterization	Leachate from LOS layer, range 11,900 to 14,470	4	Table 3
1&2	Leachate	Total Dissolved Solids (TDS)					Waste Characterization		4	P. 15, 20, Table 3
1&2	Leachate	Total Dissolved Solids (TDS)					Waste Characterization		4	p. 10,16
1	Water/humus	Total Dissolved Solids (TDS)		mg/L		EPA Method 415.1	Waste Characterization	Range 900 to 8480, direct test	4	P. 10,16, Table 3
2	Water/humus	Total Dissolved Solids (TDS)		mg/L		EPA Method 415.1	Waste Characterization	Range 1260 to 19,150, direct test	4	P. 10,16, Table 3
1	Aqueous Phase-Water Cap	Total Organic Carbon (TOC)	14.50	mg/L	IM01WCAP 01_04192010		Waste Characterization		36	Table 19
2	Aqueous Phase-Water Cap	Total Organic Carbon (TOC)	22.00	mg/L	IM02WCAP 01_04192010		Waste Characterization		36	Table 19
1	Ash	Total Organic Carbon (TOC)					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	Total Organic Carbon (TOC)					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Hard Crumbly Material	Total Organic Carbon (TOC)	44.00	mg TOC/g		EPA Method 415.1	Waste Characterization		4	p.21
1	Leachate	Total Organic Carbon (TOC)		mg/L		EPA Method 415.1	Waste Characterization	Leachate from VR layer, range 1050 to 1230	4	P. 15, 20, Table 3
1	Leachate	Total Organic Carbon (TOC)		mg/L		EPA Method 415.1	Waste Characterization	Leachate from LOS layer, range 530 to 3600	4	P. 15, 20, Table 3
2	Leachate	Total Organic Carbon (TOC)		mg/L		EPA Method 415.1	Waste Characterization	Leachate from VR layer, range 520 to 1230	4	P. 15, 20, Table 3
2	Leachate	Total Organic Carbon (TOC)		mg/L		EPA Method 415.1	Waste Characterization	Leachate from HC layer, range 1040 to 2700	4	P. 15, 20, Table 3
2	Leachate	Total Organic Carbon (TOC)		mg/L		EPA Method 415.1	Waste Characterization	Leachate from LOS layer, range 9700 to 12,200	4	P. 15, 20, Table 3
1&2	Leachate	Total Organic Carbon (TOC)				EPA Method 415.1	Waste Characterization	Leachate = contact of distilled water with lagoon sludge. Values ranged 3.6 mg/g - 5.3 mg/g	4	P. 15, 20, Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1&2	Leachate	Total Organic Carbon (TOC)					Waste Characterization		4	p. 10,16,20,21, Table 3
1	Sludge Blend VR/HC	Total Organic Carbon (TOC)					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	Total Organic Carbon (TOC)					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
1	Water/humus	Total Organic Carbon (TOC)		mg/L		EPA Method 415.1	Waste Characterization	Range 500 to 760, direct test	4	P. 10,16, Table 3
2	Water/humus	Total Organic Carbon (TOC)		mg/L		EPA Method 415.1	Waste Characterization	Range 580 to 1310, direct test	4	P. 10,16, Table 3
1	Aqueous Phase-Water Cap	Total Suspended Solids	6.00	mg/L	IM01WCAP 01_04192010		Waste Characterization		36	Table 19
2	Aqueous Phase-Water Cap	Total Suspended Solids	15.00	mg/L	IM02WCAP 01_04192010		Waste Characterization		36	Table 19
1&2	Hard Crumbly Material	Viscosity					Waste Characterization		4	Table 4, Table 7
1&2	Hard Crumbly Material	Viscosity	5,600.00	cps	Composition 6		Fuel & solvent blending tests	HC (50%), No. 6 oil (50%) at 82°F.	8	8
1&2	Hard Crumbly Material	Viscosity	1,200.00	cps	Composition 6		Fuel & solvent blending tests	HC (50%), No. 6 oil (50%) at 77°F.	8	8
1&2	Hard Crumbly Material	Viscosity	28,000.00	cps	Composition 7		Fuel & solvent blending tests	HC (60%), No. 6 oil (40%) at 80°F.	8	8
2	Sludge Blend	Viscosity					Material handling tests	LOS/VR proposed blending facility	17	
1&2	Sludge Blend VR/HC	Viscosity	192,000.00	cps	Composition 5		Fuel & solvent blending tests	VR (40%), HC (50%), Toluene (10%) at 80°F.	8	8
1&2	Sludge Blend VR/HC	Viscosity	55,000.00	cps	Composition 5 Mod		Fuel & solvent blending tests	VR (34.8%), HC (43.5%), Toluene (21.7%) at 81°F.	8	8
1&2	Viscous Rubbery Material	Viscosity					Waste Characterization		4	Table 4, Table 7
1	Aqueous Phase-Water Cap	VOCs-TAL					Waste Characterization		36	Table 16
2	Aqueous Phase-Water Cap	VOCs-TAL				EPA Method 8240	Waste Characterization		29	2-21, Table 2-5
2	Aqueous Phase-Water Cap	VOCs-TAL					Waste Characterization		36	Table 16
1	Ash	VOCs-TAL					Thermal treatment evaluation	Direct fired rotary kiln LTTT feed from Phase II conditioningtreatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
2	Ash	VOCs-TAL					Thermal treatment evaluation	Direct fired rotary kiln treatment (including cyclone, baghouse, thermal oxidizer) at various treatment temperatures and retention times.	30	Table 2.2
1	Coal Aggregate	VOCs-TAL					Waste Characterization		36	Table 3
2	Coal Aggregate	VOCs-TAL					Waste Characterization		36	Table 3

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
2	Emissions-Ambient Air	VOCs-TAL				EPA TO-14	Waste Characterization	Ambient air monitoring during excavation activities	29	2-19, Table 2-4
2	Emissions-Fugitive	VOCs-TAL				EPA TO-14	Waste Characterization	Direct monitoring of water layer emissions	29	2-16, 2-17, Table 2-3
2	Emissions-Fugitive	VOCs-TAL				EPA TO-14	Material handling tests	Phase I conditioning trial, mixed with 20% portland cement (VR, VR/HC, HC)	29	2-28 thru 2-31, Table 2-6
2	Emissions-Fugitive	VOCs-TAL					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate (VR, VR/HC, HC)	29	2-35 thru 2-37, Table 2-8
1	Hard Crumbly Material	VOCs-TAL					Waste Characterization		36	Table 3
2	Hard Crumbly Material	VOCs-TAL					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Hard Crumbly Material	VOCs-TAL				EPA Method 8240	Waste Characterization	Sludge analytical	29	2-13, Table 2-2
2	Hard Crumbly Material	VOCs-TAL					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-26, Table 2-5
2	Hard Crumbly Material	VOCs-TAL					Waste Characterization		36	Table 3
1&2	Hard Crumbly Material	VOCs-TAL					Waste Characterization	Sludge analytical	28	Table 1-1
1	Headspace Air	VOCs-TAL					Waste Characterization		36	Table 26 & 27
2	Headspace Air	VOCs-TAL					Thermal treatment evaluation	Mixbox	30	Table 2.2
2	Headspace Air	VOCs-TAL					Waste Characterization		36	Table 26 & 27
2	Leachate	VOCs-TAL					Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2	19	Table 5
1&2	Sludge Blend	VOCs-TAL					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-3
1&2	Sludge Blend	VOCs-TAL					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 73-76
1&2	Sludge Blend	VOCs-TAL					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 73-76
1&2	Sludge Blend	VOCs-TAL					Thermal treatment evaluation	ABB batch scale calciner, mixture of tar from 1 & 2 (mixed with portland cement).	26	p. 22, p. 27
1&2	Sludge Blend	VOCs-TAL					Remedial alternatives evaluation		27	p. 24, p. 344
1	Sludge Blend VR/HC	VOCs-TAL					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2
2	Sludge Blend VR/HC	VOCs-TAL					Thermal treatment evaluation	Baseline analytical results	30	Table 2.2

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1&2	Thermal Treatment - Ash	VOCs-TAL					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-3
1	Viscous Rubbery Material	VOCs-TAL					Waste Characterization		36	Table 3
2	Viscous Rubbery Material	VOCs-TAL					Remedial alternatives evaluation	Chloronan solidification of blend Lagoon 2 - solids	19	Table 5
2	Viscous Rubbery Material	VOCs-TAL					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-26, Table 2-5
2	Viscous Rubbery Material	VOCs-TAL					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	Viscous Rubbery Material	VOCs-TAL				EPA Method 8240	Waste Characterization	Sludge analytical	29	2-13, Table 2-2
2	Viscous Rubbery Material	VOCs-TAL					Waste Characterization		36	Table 3
1&2	Viscous Rubbery Material	VOCs-TAL					Thermal treatment evaluation	Littleford Dryer Process Pilot Study	21	App 1, Table 6
1&2	Viscous Rubbery Material	VOCs-TAL					Waste Characterization	Sludge analytical	28	Table 1-1
2	VR/HC Interface Layer	VOCs-TAL					Material handling tests	Phase I conditioning trial, mixed with 20% portland cement	29	2-23 thru 2-26, Table 2-5
2	VR/HC Interface Layer	VOCs-TAL					Material handling tests	Phase II conditioning trial - Phase I conditioning trial material (mixed with 20% portland cement) mixed with 0.75 inch limestone aggregate	29	2-31 thru 2-35, Table 2-7
2	VR/HC Interface Layer	VOCs-TAL				EPA Method 8240	Waste Characterization		29	2-13, Table 2-2
1	Yellow Oily Liquid	VOCs-TAL					Waste Characterization		36	Table 22
1	Yellow Oily Liquid	VOCs-TAL					Waste Characterization		36	Table 22
1&2	Carbon-spent	VOCs-TCLP					Thermal treatment evaluation	LTTT	30	Table 2.2
1&2	Leachate	VOCs-TCLP					Thermal treatment evaluation	ABB batch scale calciner, mixture of tar from 1 & 2 (mixed with portland cement).	26	p. 22, 26
1&2	Sludge Blend	VOCs-TCLP					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-4
1&2	Thermal Treatment - Ash	VOCs-TCLP					Thermal treatment evaluation	Indirect thermal desorption, ReTec pilot unit. (20% LOS, 40% VR, 40% HC)	22	3-4
1	Hard Crumbly Material	Volatile Matter, dry basis	45.80	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Volatile Matter, dry basis	50.80	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Volatile Matter, dry basis	36.70	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Hard Crumbly Material	Volatile Matter, dry basis	24.90	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1	Hard Crumbly Material	Volatile Matter, dry basis	30.70	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Volatile Matter, dry basis	61.20	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Volatile Matter, dry basis	51.00	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Volatile Matter, dry basis	68.30	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Volatile Matter, dry basis	57.80	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
2	Hard Crumbly Material	Volatile Matter, dry basis	64.00	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 5
1&2	Sludge Blend	Volatile Matter, dry basis					Thermal treatment evaluation	SoilTech bench-scale ATP system, sludge blend: 10% LOS, 45% VR, 45% HC.	24	p. 67
1	Viscous Rubbery Material	Volatile Matter, dry basis	54.70	%	1-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Volatile Matter, dry basis	52.10	%	1-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Volatile Matter, dry basis	38.50	%	1-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Volatile Matter, dry basis	33.20	%	1-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1	Viscous Rubbery Material	Volatile Matter, dry basis	48.30	%	1-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Volatile Matter, dry basis	66.30	%	2-5B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Volatile Matter, dry basis	66.60	%	2-4B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Volatile Matter, dry basis	61.50	%	2-3B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Volatile Matter, dry basis	66.70	%	2-2B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
2	Viscous Rubbery Material	Volatile Matter, dry basis	62.90	%	2-1B		Thermal treatment evaluation	Littleford Dryer Process Pilot Study, raw material anaytical.	21	App 1, Table 4
1&2	Viscous Rubbery Material	Waste Mass					Groundwater Assessment		6	Table 1
1	Hard Crumbly Material	Waste Volume	13,000.00	yd3			Waste Characterization	Between estimated depths of 2.8 - 7.8 feet below surface. (Coal aggregate deposited in 1980s included in volume estimate.)	29	1-2
2	Hard Crumbly Material	Waste Volume	12,000.00	yd3			Waste Characterization	Between estimated depths of 4.3 - 8.3 feet below surface.	29	1-2
1&2	Hard Crumbly Material	Waste Volume					Waste Characterization		4	Table 1, Table 7
1	Lagoon Capacity	Waste Volume	8.30	M gal			Waste Characterization		4	14-15
2	Lagoon Capacity	Waste Volume	7.10	M gal			Waste Characterization		4	14

Imp. No.	WasteStream	Analyte	Test Value	Test Units	Sample Ref	Test Method	Studies	Comments	Ref No	Location in Ref
1	Lagoon Surface Area/Dimensions	Waste Volume	2.10	acre			Waste Characterization	16' D from top of berm to top of lining soil. Lined with approx 12 inches clayish-silt material, before reaching sand/gravel.	4	14-15
1	Lagoon Surface Area/Dimensions	Waste Volume	2.10	acre			Waste Characterization		29	1-1
2	Lagoon Surface Area/Dimensions	Waste Volume	1.70	acre			Waste Characterization	13' D from top of berm to top of lining soil, working volume 7.1 M gallons. Lined with approx 12 inches clayish-silt material, before reaching native sand/gravel.	4	14
2	Lagoon Surface Area/Dimensions	Waste Volume	2.30	acre			Waste Characterization		29	1-1
1	Viscous Rubbery Material	Waste Volume	6,500.00	yd3			Waste Characterization	Between estimated depths of 0 - 2.8 feet below surface. (Coal aggregate deposited in 1980s included in volume estimate.)	29	1-2
2	Viscous Rubbery Material	Waste Volume	12,000.00	yd3			Waste Characterization	Between estimated depths of 0 - 4.3 feet below surface.	29	1-2
1&2	Viscous Rubbery Material	Waste Volume					Waste Characterization		4	Table 1, Table 4, Table 7
1&2	Viscous Rubbery Material	Waste Volume					Waste Characterization		4	Table 1, Table 7
1&2	Viscous Rubbery Material	Waste Volume					Groundwater Assessment		6	Table 1
1&2	Water/humus	Waste Volume					Waste Characterization		4	Table 1, Table 4