REPORT ON

PILOT PLANT STUDY FOR INTEGRATED SEDIMENT DECONTAMINATION SYSTEM

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EXECUTIVE SUMMARY

Sediments from the NY/NJ Harbor areas are dredged routinely to maintain navigable water depths for shipping channels and berthing areas to facilitate commerce and safe navigation. Historically, the dredged materials were disposed in the ocean at the "Mud Dump" off Sandy Hook. However, ocean disposal has been restricted due to greater regulatory restrictions on contaminant concentrations in the dredged sediments. The dredged sediments often contain elevated levels of metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), chlorinated pesticides and herbicides, dioxins (PCDDs), and furans (PCDFs).

Metcalf & Eddy has performed pilot plant tests to treat 10 cy (cubic yards) of New York/New Jersey (NY/NJ) Harbor sediments, using the Integrated Sediment Decontamination System (ISDS). The tests were conducted in Building 141, Suez Street in Port Newark, New Jersey from September to December 1996. The M&E pilot tests comprised essentially the following three steps:

- Screening of raw sediment for the removal of oversize +1/4-inch materials;
- Removal of organic contaminants from the sediments by solvent extraction; and
- Solidification and stabilization to immobilize heavy metals, and to prepare materials for reuse as an aggregate, fill material, or other useful product.

As a part of the pilot plant study, the raw sediment was screened using a double-deck screen with a 1/4-inch size opening. The (-)1/4-inch size was used in the solvent extraction (ORG-X^{SM}) process of the ISDS. The pilot plant study used 3-stage, 5-stage, 7-stage, and continuous solvent extraction operations, although only the 5-stage, 7-stage, and continuous extractions were evaluated for ORG-X^{SM} process performance. The solvent extracted sediment was thereafter mixed with 15 percent and 30 percent cement and was allowed to cure as a part of the SOLFIX^{SM} (solidification and stabilization) process to immobilize the heavy metals present in the sediment.

Based upon the solvent extraction and solidification/stabilization pilot plant treatability study with NY/NJ harbor sediment, the following conclusions can be made:

- The semivolatile organic compound and PCB removal efficiency of the ORG-X℠ solvent extraction processes was very high, ranging from low 90s to 100 percent.

- The initial concentration of dioxin and its congeners were very low in the screened sediment, which resulted in comparatively lower removal efficiency for this group.

- The furan and its congeners removal efficiency of ORG-X℠ processes ranged from the low 80s to 95 percent.

- The presence of very fine silt and clay fractions in the sediment resulted in air binding of solidified and stabilized SOLFIX℠ products and low Universal Compressing Strength (UCS). Additional binding agents would need to be added to improve physical properties of stabilized products for beneficial reuse. A SOLFIX℠ mixture with 15 percent cement and a suitable binding agent is envisioned for the full-scale operation. A detailed evaluation would be required for the type and proportion of required binding agent.

- Based upon the TCLP extract analyses of the solidified and stabilized SOLFIX℠ products, all metals were immobilized in the solidified matrix.

- The solvent mixture used in the ORG-X℠ process effectively decontaminates the sediment and is easily regenerated to almost pure form.

- The ORG-X℠ process wastewater (stripper bottom water) is almost free of contaminants and can likely be discharged to a POTW without additional treatment.

However, sediment pore water may require additional treatment before discharge to POTW, if phase separation is allowed to occur for a long time.

- Based on the results of the activated carbon analysis, the ORG-X℠ process vapor stream should not pose any environmental emission problem.

- The performance of 5-stage, 7-stage and continuous solvent extraction ORG-X℠ processes were comparable within the analytical accuracy of the laboratory data. Since all three solvent extraction processes produced comparable contaminant removal efficiencies, a full-scale ORG-X℠ process is recommended using a 5-stage continuous countercurrent extraction system as the most cost-effective treatment process.

- The concentrated organics generated from the pilot plant study were disposed at an off-site facility for incineration. For a full-scale sediment treatment system, a base catalyzed dechlorination (BCD) process may be used for organics destruction. The waste stream, produced from the BCD process, could be reused as a fuel for steam or cogeneration of power. This process needs to be optimized in detail during the preliminary engineering process.

Based upon the pilot plant study data, the planning level (±30 percent) capital costs for a 100,000 cubic yards/year and 500,000 cubic yards/year capacity ISDS facility is estimated to be $16 million and $40 million, respectively. The annual operation and maintenance (O&M) cost is estimated to be $85 per cubic yard and $56 per cubic yard of raw sediment for a 100,000 cubic yards/year and 500,000 cubic yards/year capacity ISDS system, respectively.

SECTION 1
INTRODUCTION

1.1 GENERAL PROJECT DESCRIPTION

Metcalf & Eddy (M&E) has prepared this report on the pilot plant project for sediment decontamination under Contract No. 725024 with Brookhaven National Laboratory (BNL). The work was described and performed in accordance with the Work Plan (submitted on September 16, 1996), the Health & Safety Plan (submitted on September 24, 1996), and the Quality Assurance Project Plan (submitted on October 4, 1996). Appendices A, B, and C contain the Project Work Plan, Healthy and Safety Plan, and the Quality Assurance Project Plan, respectively, for this pilot plant study. The pilot plant tests treated 10 cy (cubic yards) of New York/New Jersey (NY/NJ) Harbor sediments, using M&E's Integrated Sediment Decontamination System (ISDS) for both the M&E process as well as the U.S. Army Corps of Engineers' (USACE) direct stabilization process. The tests were conducted in Building 141, Suez Street in Port Newark, New Jersey from September to December 1996. The M&E pilot tests comprised the following three steps:

- Screening of raw sediment for the removal of oversize +1/4-inch materials;
- Removal of organic contaminants from the sediments by solvent extraction; and
- Solidification and stabilization to immobilize heavy metals, and to prepare materials for reuse as an aggregate, fill material, or other useful product.

The USACE tests evaluated the stabilization/solidification of untreated-screened-raw sediment. The chemical analysis of most samples was managed by BNL and the physical tests were completed by U.S. Army Engineer Waterways Experiment Station (WES). The analytical results were submitted to M&E in June, 1997 for evaluation and analysis. Appendix D contains the analytical data received from BNL and USACE.

1.2 BACKGROUND

Sediments from the NY/NJ Harbor areas are dredged routinely to maintain navigable water depths for shipping channels and berthing areas to facilitate commerce and safe navigation. Historically, the dredged materials were disposed in the ocean at the "Mud Dump" off the Sandy Hook. However, ocean disposal has been restricted due to greater regulatory restrictions on contaminant concentrations in the dredged sediments. The planning document titled, "Dredged Material Management Plan for the Port of New York and New Jersey," indicated that approximately one-third of the dredged material, or 1-2 million cubic yards per year, will have to be treated. The dredged sediments often contain elevated levels of metals, polynuclear aromatic hydrocarbons (PAHs), such as tars, oils, fuels, polychlorinated biphenyls (PCBs), chlorinated pesticides and herbicides, dioxins (PCDDs), and furans (PCDFs).

Section 405 of the Water Resources and Development Act of 1992 has authorized evaluation of technologies for decontaminating dredged sediments and/or potential reuse of the treated materials. Accordingly, BNL, in support of the USACE New York District (NYD), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE), and Affiliated NY/NJ Universities, contracted Metcalf & Eddy to:

1. Perform a bench-scale treatability study to determine process and technology effectiveness towards decontamination on the dredged sediments.

2. Verify bench-scale treatability test results and develop full-scale design parameters through a pilot-scale program.

M&E and USACE performed the bench-scale treatability studies independently and then combined their efforts for the pilot program at Port Newark. The work was combined into one project because the solidification/stabilization processes were similar and the work could be done using the same equipment at the same location.

1.3 SUMMARY OF BENCH-SCALE TEST RESULTS

Metcalf & Eddy completed the bench-scale treatability tests to evaluate its proprietary technologies to treat contaminated dredged sediment. The results of the bench-scale tests are presented in a separate report. The objectives of the bench-scale test were to:

- Evaluate the feasibility of decontaminating the dredged estuarine sediments from Newtown Creek, which is representative of sediment from various areas of the New York and New Jersey Harbor system;
- Evaluate the feasibility of producing useful, recyclable end-products; and
- Determine process information for the design and operation of a pilot plant and estimating the operating and capital costs of a full-scale plant.

The three sequential Integrated Sediment Decontamination System technologies are:

- HYDRO-SEP℠: A sediment screening and washing process to produce clean, larger-size fractions and reduce the quantity to be treated by downstream operations;
- ORG-X℠: a solvent extraction process to remove the organic contaminants from the sediment; and
- SOLFIX℠: A solidification/stabilization process for fixing and immobilizing the inorganic contaminants (typically metals), and for improving the physical properties (strength and erosion properties) of the end-products.

The integration of the three technologies effectively allows the treatment of sediment feedstocks with different physical and/or chemical characteristics.

The bench-scale tests conducted at the Generale de Rehabilitation des Sites (GRS) facility in Paris, France were completed in late 1995 and early 1996 for these process cases:

- ORG-X℠ process;
- SOLFIX℠ process to directly stabilize the raw sediment; and
- SOLFIX℠ process to stabilize the ORG-X℠ product.

The HYDRO-SEP℠ washing tests were not performed as the sediment contained less than 0.4 percent of material greater than 2 mm (millimeters), which was on the low side of the expected 0.1-34.4 percent range for the Newtown Creek sediment. It is generally believed that the larger particles (+1/4-inch) can be washed clean and would pass the reuse criteria.

The bench-scale treatability test results were very encouraging as the ORG-X℠ process significantly reduced the undesirable organic contaminants in the fine particle sediments and the SOLFIX℠ process stabilized and solidified the material. The bench-scale study used a three-stage solvent extraction of the sediment, and the contaminant removal range is presented below. The results below show both the M&E/GRS anaylsis done for process optimization monitoring, and the specific contaminant analyses conducted by BNL.

M&E/GRS RESULTS

Light hydrocarbons (up to C_{18})	99.9 percent
Medium-weight hydrocarbons	86 percent
Total hydrocarbons	91 percent
Heavy hydrocarbons	92 percent
Residual carbon	37 percent
Total organic carbon	30 percent

BNL RESULTS

PCBs (total)	79 - 92 percent
Pesticides	94 - 98 percent
Chlorinated herbicides	See Note A
Semi-volatile organics	47 - 91 percent
Dioxins	See Note B
Furans	See Note B

Notes:
A. Not calculable but significant amount in spent solvent.
B. Not meaningful because most figures were low and less than the Minimum Detection Limit (MDL).

Sometimes the percent removal of the individual dioxins/furans could not be calculated because the concentration was below the minimum detection limit for both the raw sediment and the product, or because the input and output materials did not balance when the concentrations and accuracy were very low. Based upon contaminant concentrations in the solvent, it was estimated that dioxins/furans removal ranged between 60-84%.

M&E did not have the benefit of the BNL analytical results during the bench-scale tests. M&E believed that the percent removal of most organic contaminants of concern could be increased with process improvements during the pilot phase. The recommended operational changes for the pilot plant tests were:

- Using more than three extraction cycles either in batch or continuous mode of operation;
- Use warm recycle solvent;
- Use a higher solvent-to-sediment ratio greater than 1; and
- Use a mixture of closely related solvents to increase the solubility of mixture in the aqueous sediment layer.

The bench-scale SOLFIX℠ process produced solid products of a desirable unconfined compressive strength (UCS) at reasonable reagent/additive costs. The solid product exhibits lower permeability and higher erosion resistance than the soil/sediment product from ORG-X℠. The mixture quantities can be varied and accelerators can be added to attain other desirable features, such as a less strong material that cures quickly at lower cost. The results are summarized below:

	UCS by M&E/GRS	UCS by BNL
Direct SOLFIX℠ product (from stabilization of raw sediment)	728 psi	102 psi
ORG-X℠ plus SOLFIX℠ product	600 psi	487 psi

The leaching properties, using the standard Toxicitity Characteristic Leaching Procedure (TCLP) method, were very low for both the raw sediment as well as the three products produced by the study. The TCLP results for PCBs were significantly less for the stabilized ORG-X℠ product than the directly stabilized raw sediment. The reduction range was 45 percent to >99 percent for the individual and group total PCBs.

Based on bench-scale test results, the operating costs were estimated for continuous production plants with different capacities. The costs are tabulated below for the three different process combinations that would be applicable depending on physical characteristics, removal of organics and/or metals, and production capacity.

PROCESS	PRODUCTION-SCALE PLANT (100,000 cy/yr)	FULL-SCALE PLANT (500,000 cy/yr)
HYDRO-SEP℠ and SOLFIX℠	$54/cy	$44/cy
HYDRO-SEP℠ and ORG-X℠	$64/cy	$45/cy
HYDRO-SEP℠, ORG-X℠ and SOLFIX℠	$80/cy	$67/cy

Notes/Basis:

1. HYDRO-SEP℠ separates and treats oversize particles estimated at 10 percent of raw sediment. The other 90 percent is treated by the subsequent process(s).
2. Organic waste oil does not contain regulated dioxin quantities. It is possible that some will cost an additional $40/cy to incinerate at $2.00/lb (pound), if regulated (when the Total Equivalent Toxicity Quotient [(TETQ} > 1 ppb).
3. The ORG-X℠ process removes 90-99 percent of the organic contaminant of concern and the SOLFIX℠ process stabilizes the heavy metals to meet the TCLP criteria for use upland.

1.4 PROJECT OBJECTIVES FOR PILOT-PLANT TEST

The objectives of the pilot-plant testing program are as follows:

- Demonstrate that the three technologies of screening, solvent extraction, and solidification/stabilization can decontaminate pilot-scale quantities (up to 10 cy) of dredged estuarine sediments from Newtown Creek. The Newtown Creek sediment is believed to be representative of sediments from various areas of the New York and New Jersey Harbor system.

- Provide additional technical process data that could be used for preliminary engineering design of a commercial facility.

- Continue to optimize the process parameters using various test runs.

- Provide data to better estimate the capital and operating costs for a possible future 100,000 cy/year production plant and 500,000 cy/year full-scale plant. However, this work scope does not require the completion of a preliminary engineering design.

1.5 DESCRIPTION OF CONTENTS IN SUBSEQUENT REPORT SECTIONS

Section 2 describes the actual experimental procedures and processing information for both the M&E and USACE pilot plant tests. It identifies the process data collection program and the sample collection program, in order to logically relate the results, the pilot plant process, and operation.

Section 3 presents the results of the screening, solvent extraction and solidification/ stabilization tests. The performance of the various unit operations is evaluated for the main variables. The chemical and physical properties of the products and some intermediates are presented.

Section 4 discusses issues related to the production and full-scale operations, including preliminary planning level capital and operating (O&M) cost estimates for the sediment decontamination.

SECTION 2

PILOT PLANT PROGRAM - EXPERIMENTAL PROCEDURES

2.1 PILOT PLANT MOBILIZATION

Figure 2-1 shows the site location at Building 141 (warehouse), Suez Street, Port Newark, New Jersey. Figures 2-2 and 2-2a show the overall plot plan and enlarged plot plan of the site with the mobilized items. M&E, with the assistance of BNL and the New Jersey Institute of Technology (NJIT), mobilized a temporary office trailer/command center including sanitary facilities, potable water, telephone, telefax, copier, electrical and water service to the physical pilot plant and support equipment. M&E delineated support zones, contamination reduction zones, and exclusion zones, as well as the "explosion-proof" zone, which was the 50-foot boundary from the solvent extraction module. M&E calibrated the air monitoring and site instrumentation. M&E also mobilized the pressure washing equipment, decon equipment, backhoe, drum mover, and other small equipment and tools for use in sediment processing.

As shown in Figure 2-2, the pilot plant equipment and the plant maintenance trailer were installed in the east side of the 200-foot by 460-foot by 20-foot high empty warehouse. The feed sediment material was stored in two 10 cy roll-off boxes inside the warehouse prior to treatment. As a part of the pilot plant testing program, M&E performed both batch and continuous solvent extractions of the contaminated sediment. In a batch extraction process, prescreened sediment was mixed with appropriate proportions of solvent mixtures in a batch reactor equipped with a variable speed motorized agitator. After mixing the sediment with the solvent for a predetermined period, the solvent-sediment mixture was allowed to settle to decant the solvent from the top. Fresh solvent was added into the batch reactor and extraction continued. As a part of the pilot test program, M&E performed 3, 5, and 7 batch extractions of the sediment, after which the settled sediment was dried in a dryer before solidification and stabilization. The decanted solvent was distilled in a distillation column to recover the solvent for recycle in the solvent extraction process. The organics extracted from the sediment, are concentrated in the reheater unit of the distillation

column. For the purpose of pilot plant study, the concentrated organics were disposed offsite. Figure 2-3 shows the skid mounted batch solvent extraction unit with associated drying, distillation and other unit process equipment used in the pilot plant study.

The continuous solvent extraction pilot plant system consisted of a 6-inch diameter glass column of approximately 40 inches in height containing 18-plates. Sediment and fresh solvent were counter-currently fed in this unit as part of the pilot plant study. The batch and continuous solvent extraction processes are discussed in detail later in this Section.

Construction of the batch pilot plant involved unloading skid-mounted, solvent-extraction processing modules, then interconnecting the electrical, piping and mechanical systems. The continuous solvent extraction system was mounted on a skid and operated adjacent to the batch plant. The continuous extraction run was completed as the last and separate test. Drums of fresh solvents were stored outside the building in a designated fenced area.

The various work areas included HDPE or PVC tarps with berms to collect any potential spills. The batch/continuous system also had a containment pan under the equipment.

Exclusion zones were set up and marked inside and outside the warehouse. An explosion-proof zone was marked on the floor with paint around the solvent extraction pilot system, within the exclusion zone.

2.2 GENERAL PROCESS SUMMARY

Figure 2-4 presents the block flow diagram of M&E's pilot test. The test program was divided into two separate pilot tests after the initial screenings of raw sediment to remove oversize materials and large debris.

Test Program I SOLFIX℠: Solidification/stabilization of prescreened sediment

Test Program II ORG-X℠ + SOLFIX℠: Removal of organic contaminants followed by solidification and stabilization of prescreened sediment.

The common initial pretreatment involved the removal of oversize material and debris using a double-deck vibrating screen and the adjustment of the water content to approximately 35 percent solids.

The (±)1/4-inch oversize/debris was placed in drums for disposal to a non-hazardous landfill, and the (-)1/4-inch material was put in 5-gallon containers for processing by either ORG-X℠ or SOLFIX℠ or both.

An additional 75 gallons of (-)1/4-inch sediment was reprocessed with a 18-mesh screen into three 55 gallon drums. These unit operations were a part of M&E's continuous solvent extraction pilot plant program.

In the Test Program I, the direct solidification/stabilization of sediment used the methodologies developed by USACE. Approximately 8 cy of prescreened sediment was mixed with Portland cement in a 9 cf (cubic feet) mortar mixer to produce three products. The three products, which were produced by crushing cured monolith blocks are:

- Construction fill/soil with 0.1 part cement to 1 part screened sediment
- Construction fill/soil with 0.2 parts cement to 1 part screened sediment
- Aggregate with 0.4 parts cement to 1 part screened sediment

In Test Program II, approximately 2 cy of prescreened sediment was first treated using the solvent extraction (ORG-X) process to remove the organic contaminants. The "organics free" sediment was then solidified and stabilized with Portland cement to produce two products. The two products, which were produced by crushing the monolith blocks are:

- Construction fill/soil with 0.15 parts cement to 1 part screened and ORG-X℠ treated sediment; and
- Aggregate with 0.3 parts cement to 1 part screened and ORG-X℠ treated sediment.

These ratios of cement (0.15 and 0.3 parts) to sediment are lower than the corresponding ratios (0.2 and 0.4 parts) used in the direct solidification/stabilization because the ORG-X℠ sediment product contains less water (45-50 percent solids) than the pretreated sediment (35 percent solids). This allows comparison of similar products for evaluation of properties and costs.

2.3 HYDRO-SEP℠ SEDIMENT SCREENING AND MOISTURE ADJUSTMENT

Figure 2-5 presents the process flow diagram of the pilot-scale test. The sediment was received in two roll-offs, each filled with 5 cy of raw sediment from the Newtown Creek area of the NY Harbor. After mixing the sediment well with the 12-inch bucket of an extended backhoe machine, samples were taken. The analysis indicated 38.3 percent solids in one roll-off and 38.5 percent solids in the other roll-off. The specific gravity was 1.45. Accordingly, sediment moisture content was adjusted to approximately 32-35 percent solids to meet ORG-X (solvent extraction) process requirements.

The sediment was screened at 1/4-inch using a 48-inch diameter standard Sweco double-deck vibratory screen. The screening rate was approximately 90-100 gallons/hour. The 1/4-inch screened undersize was collected in 5-gallon plastic containers. The 1/4-inch oversize materials and debris were collected in two 55-gallon drums. The debris consisted of stones, asphalt, sneakers, rope, metal parts, welding rods, wooden blocks, logs, rags, etc.

The screened sediment in 5-gallon containers formed three batches:

Batch 1: 37 containers (#O-1 to #O-37) which were used for the ORG-X℠ process. A representative sample was analyzed at 34.4 percent solids.

Batch 2: 145 containers (#O-38 to #O-182). Most of the initial numbers were used for the ORG-X℠ process and the rest was used for SOLFIX℠.

Batch 3: 205 containers (#O-183 to #O-200 designated and planned for the ORG-X process and #S-1 to S-177 for the SOLFIX℠ process).

An additional volume of the (-)1/4-inch sediment was rescreened with a U.S. Sieve #18-mesh screen (1 mm opening) to produce 25 gallons of (-)18 mesh sediment in each of three 55-gallon (total 75 gallons of sediment processed) HDPE drums for the pilot plant solvent extraction process using continuous Schiebel extractor. Approximately 3 gallons of +18-mesh to -1/4-inch mesh was collected as unwashed sand.

2.4 ORG-X℠ SOLVENT EXTRACTION OF SEDIMENTS

The basic ORG-X℠ solvent extraction pilot plant operation was performed in two operating modes:

- Batch solvent extraction operating mode using a batch reactor and solvent extraction
- Continuous operation mode using a Schiebel column extractor

As mentioned previously, only 75 gallons of prescreened sediment was ORG-X℠ pilot tested using the continuous extraction operating mode. The major unit operations of both the solvent extraction operating modes are discussed below.

2.4.1 Batch Solvent Extraction Operation

The batch solvent extraction process consists of the following unit operations:

- Solvent Extraction of Sediments
- Solvent Recovery and Organic Separation (Distillation)
- Sediment Drying
- Wastewater Stripping

These unit operations are shown on the Process Flow Diagram on Figure 2-5.

A. Solvent Extraction of Sediments

The basic solvent extraction was performed in a mixer-settler extractor tank. The tank was a 56-gallon capacity cylindrical tank. Within the tank there was a propeller mixer with a three-blade impeller and a two-bar bottom scraper equipped with a variable speed motor.

At the beginning of the first extraction cycle, the screened sediment was added to the batch extractor unit, which contained the recovered fresh solvent from the partial sediment drying of previous batch. The extractor was then sealed and purged with inert nitrogen gas. Following the purge, the extractor was filled with an additional extraction solvent(s) from the solvent storage/recovery tank for a 1:1 ratio of solvent:sediment on a weight basis. The sediment-solvent(s) mixture was thereafter agitated for about 15 minutes at the full speed of the agitator, and then allowed to settle for about 10 minutes. When the majority of the solids portion of the mixture settled out, the extract solution was decanted from the top of the settled solids in the solvent-laden sediment. The pilot plant skid was equipped with a centrifuge to remove any fine solids present in the decanted solvent. However, initial pilot tests showed that the decanted solvent did not contain significant sediment. Therefore, subsequent pilot plant operations did not use centrifuge in decanted

solvent. A bag filter was used to filter the minimal amount of suspended particles present in decanted solvent. The extraction process was repeated with fresh/recovered solvent several times until the organic contaminants were removed from the sediment. The pilot plant testing program varied the number of extraction stages to determine the effect of extraction cycles on sediment decontamination. At the end of extraction cycles, the settled and extracted sediment was transferred to the dryer unit. After some trial runs, the following official test runs were completed for 3, 5, and 7 extractions.

Number of Extractions	Number of Batches*	Batch Sequence
3	15	#1-15
5	5	#21-25
7	5	#16-20

* A batch charge was four 5-gallon containers with approximately 200 lbs of sediment at approximately 35 percent solids.

The solvent used for the ORG-X^{SM} batch and continuous extraction operations contains a proprietary formulation with two solvents. Most extractions were completed with warm solvent between 100-140°F to improve extraction efficiency.

B. Sediment Drying

Partial drying of the extracted sediment was done in a 34-gallon Littleford FM Series Pilot Mixer. The dryer was equipped with a steam jacket and direct steam injection ports. Direct steam was not used for the test run as jacket heatings of solvent-laden sediment was found to be effective. Steam was first supplied to the steam jacket to indirectly heat the sediment slurry to first evaporate the water and solvent azeotrope mixture. The sediment drying was continued until 45-50 percent solid concentration was attained. At this point almost all of the solvent was evaporated and sufficient water was retained for the hydration

with cement in the SOLFIX℠ process. The entire drying process was done with the extractor/dryer mixing paddles rotating. This increased heat transferred and reduced the drying time required.

The solvent/water azeotrope condensate was initially recycled to the extractor for the next batch operation. After recovery of the solvent from the extracted sediment slurry in the dryer, the overhead vapor temperature increased to about 212°F , corresponding to the boiling point of water, indicating completion of solvent recovery from the sediments. The drying was continued past this point for at least 15 minutes, when the residual solvent in the sediment dropped to less than 1 ppm (parts per million). After the drying process was complete, the solids were removed through the discharge port on the bottom of the dryer. In the pilot plant study, the heated sediment was collected in heavy-duty polyethylene bags with proper labels for identification and batch numbering.

C. Solvent Recovery and Organic Separation (Distillation)

The decanted solvent layer from the extractor was pumped to the solvent evaporator. The evaporator consisted of a 50-gallon stainless steel heating kettle with a recirculating reboiler and packed distillation column. The distillation column was 8-inch diameter and 10 feet high with 6-feet of small intalox stainless steel packing. The reflux was maintained constant at 4 gallons/hour. In the solvent evaporator, the solvent mixture with organic contaminants was heated to 172 to 185°F, the boiling point of the azeotropic solvent-water mixtures. The evaporation process was continued until most of the solvents and water were removed. The temperature of the boiling liquid rised as the high boiling point contaminants concentrate and approaches the temperature of the applied steam at 40-50 psig.

The vapor formed during evaporation was directed to the main condenser. The condensed vapor formed a heterogeneous condensate consisting of a solvent layer displaced above a

heavier aqueous layer. This mixture was directed to the solvent decanter, where the aqueous and solvent layers were separated by decanting. The solvent decanter was maintained at a temperature of 130-140°F, the desired recycled solvent temperature used for extraction.

The recovered solvents were recycled back to solvents storage tank. The recovered water drained by gravity into the water receiver where it was stored until water stripping operations were performed. The water was steam stripped to remove residual solvents.

The organic contaminants (waste oil) that concentrate in the solvent evaporator kettle had sufficient solvent to maintain fluidity and prevent fouling of the reboiler. The waste oil was further concentrated in an oil polisher for each of the various extraction test campaigns, as the waste oil contained more than 50 percent solvent near the end of the evaporation cycle. Medium pressure steam was used in the oil polisher. Polishing continued until there was little evaporation and when the temperature was 250°F and/or the steam pressure was 25 psig.

D. Wastewater Stripping

The wastewater tank received water from the dryer and from the distillation decanter. The aqueous layer from the decanter contained some solvents in the wastewater feed depending upon the solubility at the operating temperature. The condensate from the dryer also contained some solvents depending on the operating procedure. The solvents from the water were removed by steam stripping.

In the pilot unit, steam was injected at the bottom of the column to strip the light-to-moderate boiling point organics. The stripper column was 4-inch diameter and contained 8 trays. Feed water was pumped through the feed preheater to slightly above the solvent/water azeotropic boiling point. The hot feedwater then entered the top of the

column where a portion of it flashed upon entering. The non-vaporized portion of the feedwater ran down the column trays where it was stripped of residual solvents by upflowing steam. The wastewater was collected in a 300 gallon PVC tank for analysis and disposal. The solvent azeotrope vapors were condensed and recycled in the solvent storage tank.

2.4.2 Continuous Solvent Extraction Operation

The pilot program tested a continuous extraction column as an alternative to the batch extractor.

The continuous pilot solvent extraction process used a vertical Schiebel glass column to extract organics from the sediment. The solvent extraction step in the continuous process differs from the batch system while the other three operating steps remain essentially identical. Accordingly, only the extraction step of the continuous solvent extraction are discussed below.

The continuous extraction system contained a sediment feed tank, one solvent storage tank, a Schiebel glass column containing extraction plates with paddles for mixing at each plate. The column was 6-inch diameter and 40 inches tall. The (-)18-mesh screened sediment at 35 percent solids concentration was placed in a 55-gallon drum and mixed with suitable amounts of solvent mix to make it pumpable. The solvent feed tank was filled with the fresh solvents. Solvents entered the continuous extraction column at the bottom for counter-current extraction of organic contaminants from the sediment. The solvent-laden sediment (solvent-laden) left the column bottom into containers. The organic-rich solvents (solvent extract) left the column from the top and were stored in 55-gallon drums. The treated, solvent-laden sediment was thereafter transferred to the dryer of the skid-mounted pilot plant equipment for residual solvent recovery and partial sediment drying. The organic-rich solvents were fed to the distillation unit for solvent recovery, organic separation and water stripping.

The column operated well with no flooding and no entrainment of solid particles in the solvent extract when the main parameters were in this range:

Solvent feed rate: 4-8 gph (gallons per hour)

Sediment (with solvent) feed rate: 20-30 gph
(sediment [at 35 percent solids] solvent ratio 1:05)

Motor speed: 60-120 rpm (revolutions per minute)

Solvent extract rate: 4-8 gph

Sediment solvent-laden: 20-30 gph

2.5 SOLFIX℠ SOLIDIFICATION/STABILIZATION

The test procedures for the solidification/stabilization of sediment were essentially the same for the two main pilot plant cases:

I Solidification/stabilization of prescreened raw sediment (USACE Process)

II Solidification/stabilization of ORG-X℠ treated prscreened sediment (M&E Process)

Overall, approximately 8 cy of screened raw sediment was solidified/stabilized using the following three mixing ratios specified by the USACE-WES:

A. 0.1 parts Portland cement to 1 part (weight basis) screened raw sediment (after decanting seawater)

B. 0.2 parts Portland cement to 1 part (weight basis) screened raw sediment (after decanting seawater)

C. 0.4 parts Portland cement to 1 part (weight basis) screened raw sediment (after decanting seawater)

Approximately 2 cy of ORG-X℠ treated sediment was solidified/stabilized using the mixing ratios as follows:

A. 0.15 parts Portland cement to 1 part (weight basis) of screened, treated sediment.

B. 0.3 parts Portland cement to 1 part (weight basis) of screened, treated sediment.

The mixture was cured in molds resembling sidewalk slabs. During the curing, some physical properties were monitored.

Procedures Followed

The following procedures were used for the direct solidification/stabilization experiments of raw sediments:

- Decanted free seawater over top of sediments from buckets and recorded. The clear seawater layer slowly formed over the sediment and the amount stabilized after several days. All solidification/stabilization batches were done at least one week after screening and placing the material in buckets.

- Calculated the amount of Portland cement required based on the weight of sediment after decanting seawater.

- Added sediment and Portland cement into 9 cf (cubic feet) mortar mixer. The batch was mixed for 10 minutes to form a homogeneous product.
- For several batches of each test mixture the following were done:

  a. Prepared two sidewalk slabs (3.5 inches high) -- one with 12-gauge wire mesh screen and one without screen.

b. Performed cone penetrometer readings for each type of formulation during curing at these times: 4, 24, 48, 72, 96, and 120 hours from start.

c. Poured mixture in 2-inch cubes and 6-inch diameter x 12-inch high cylinder molds for each formulation for M&E and for shipment to WES/BNL for physical and leaching tests. Each mold was cured with available moisture (wet paper towel in enclosed cooler).

d. Crush the formulations into soil ≤1/4-inch for the 0.1 and 0.2 part cement formulation and ≤1-inch for the 0.4 part cement formulation. Ship samples in various 1-gallon and 5-gallon containers to WES/BNL for chemical and leaching tests.

The solidification/stabilization of the ORG-X℠ treated and screened sediment was essentially the same except for the following:

a. There was no water layer to decant from sediment, as it was 45-50 percent solids.

b. The solidification/stabilization formulation used 0.15 and 0.30 parts cement to 1 part sediment. The amount of cement was less than the corresponding samples with the higher moisture content raw sediment (0.2 part cement for soil and 0.4 part cement for aggregate). This is because there was less water to hydrate and it was also difficult to mix greater than 0.3 parts cement without adding water.

2.6 MONITORING PLAN AND DATA COLLECTION

Data sheets for recording related monitoring parameters were completed for both the

ORG-X℠ and SOLFIX℠ test runs. Appendix A, Work Plan contains the sample data sheet used to collect and record daily monitoring and pilot plant operation data.

These process data and samples were collected for both monitoring the day-to-day operations, as well as for future calculations of mass balances and performance. Often the data was taken after steady-state was attained for the semi-continuous operations. The monitoring samples were usually analyzed by the next day, whereas the performances samples were submitted to BNL and WES for analytical purposes.

2.7 SAMPLING PLAN AND ANALYSIS

The M&E Quality Assurance Project Plan (QAPP) contained in Appendix-C presents the details of samples to be taken and analytical requirements and methods for process monitoring. These samples were analyzed by Accutest. These process monitoring samples were collected for the operation and optimization of the solvent extraction pilot plant. The QAPP prepared by BNL and Associated Universities presents the details on the performance samples analyzed by BNL-contracted laboratories. Table 2-1 summarizes the sampling locations and quantities, analytical requirements and methods for the samples analyzed by M&E. The stream numbers refer to the Process Flow Diagram on Figure 2-5. In order to evaluate the performance independently, the BNL and Associated Universities Team prepared the sampling protocol presented in Table 2-2. This table lists the sample name, stream number, as referenced on Figure 2-5, the sample size and the destination. These samples were analyzed by BNL contracted laboratories and USACE-WES for physical and chemical properties.

2.8 UTILITIES AND SIDESTREAMS

2.8.1 Waste Handling Summary

All wastes generated were labeled and segregated. All wastes remained on-site indoors, arrangements were made for disposal, and analysis obtained when needed. The wastes produced were as follows:

A. Investigative derived wastes (IDW): Contaminated trash, personal protective equipment (PPE), plastic, etc., were combined and stored in roll-offs for disposal to a non-hazardous landfill.

B. Spent solvent: At the end of the pilot test, five 55-gallon, steel, closed head drums of recovered solvents were shipped to Laidlaw for fuel-blend incineration.

C. Organic waste oil: Two drums of waste oil, which contained PCBs and low levels of dioxins/furans with some residual solvents and water, were shipped to Laidlaw for incineration at the Coffeyville, KS facility.

D. Wastewater: This includes all process wastewaters and decontamination wash water. It was collected in a Frac tank on-site. The amount generated was 4,000 gal, and it contained less than 0.1 percent organic solvents. The wastewater was shipped to a POTW after analysis and acceptance.

2.8.2 Steam Condensate From Steam Traps

Condensate from steam traps is non-hazardous clean water from the pilot plant auxiliary boiler. This water was not in contact with any process waste streams, and was disposed of in the sewer.

2.8.3 Cooling Water

All condensers were supplied with circulating cooling water, except for the vent condenser, which used city water. The city water return was disposed to the sewer at a flow of less than 1/2 GPM.

2.8.4 Vent

A permit was obtained to discharge the vent from both the batch and continuous organic extraction plants. This vent gas consisted primarily of nitrogen purge gas, traces of oxygen and other atmospheric gases, and some solvents and water. The majority of the solvent was condensed by the vent condensers. However, to assure that organic vapors are removed with a high efficiency, an activated carbon scavenger was located downstream of the carbon canister or final vent outlet. The carbon canisters effectively captured organics, as the vent outlet was frequently analyzed with an on-line hand-held VOC analyzer and organics were non-detectible (< 1 ppm).

2.8.5 Leaks or Accidental Discharge of Process Streams Containing Sediment Contaminants

A secondary containment pan below the entire pilot plant was provided to contain unexpected discharges of process streams. Minor spills were washed and discharged into the Frac tank.

Tertiary containment was provided by a raised-edge membrane surface around the extraction pilot unit. Other unit operations such as screening and stabilization also had a raised-edge membrane to contain the spill. The spill areas contained a sump and an air operated diaphragm pump to collect the wash water for pumping into the Frac tank.

2.9 PILOT PLANT SITE CLOSURE

The pilot plant was internally decontaminated by emptying all solvent and circulating wash water several times. At the end of the pilot plant internal cleaning, all equipment external surfaces were cleaned with wash water/soap solution, and all other construction equipment and tools were decontaminated with wash solution. The wash water was collected in the Frac tank.

Wipe tests were conducted to confirm that PCB contamination is below 10 mg/100 cm^2 in several areas.

Most equipment and materials were removed from the site in November. In December the sidewalk chunks were crushed for the various samples shipped to BNL/WES. At the end, the warehouse floor was cleaned with a vacuum machine to remove dust.

TABLE 2-1
SAMPLING SUMMARY FOR SAMPLES ANALYZED BY M&E

PROCESS	STREAM NO.	MATRIX	TOC 9060	PERCENT SOLVENTS/ WATER (2)	PERCENT MOISTURE	UNCONFINED COMPRESSIVE STRENGTH ASTM D-2166	FULL TCLP 1311/ SW-846	DISPOSAL PARAMETERS (1)	SPECIFIC GRAVITY Field
Sediment (each roll-off)	1	Wet sediment							
Oversize Material	3	Gravel			1/batch set				
Recycled solvent	30	Solvent Mixture		1/batch set					
After 3-stage batch solvent extraction	12	Partially Dried Sediment	1/batch set	1/batch set	1/batch set				1/batch set
After 5-stage batch solvent extraction	12	Partially Dried Sediment	1/batch set	1/batch set	1/batch set				1/batch set
After 7-stage batch solvent extraction	12	Partially Dried Sediment	1/batch set	1/batch set	1/batch set				1/batch set
After continuous solvent extraction	18	Sediment & solvent	1/batch set		1/batch set				1/batch set
Stabilized & solidified sediment	6A/6B	Soil/Fill product							
Stabilized & solidified sediment after ORG-X solvent extraction	21A	Soil/Fill product				1			1
Stabilized sediment	6C	Aggregate product							
Stabilized sediment after ORG-X solvent extraction	21B	Aggregate product				1			1
Concentrated waste oil from distillation/oil polisher	13	Oil						1	
Wastewater from collection tank	14	Water	1					1	
Vent stack (3)	-	Gas		2/day					

Notes:

BEB94/BNLSAMP.XLW

(1) Other disposal parameters to be determined upon selection of TSDF.

(2) USEPA Method 8240 for solvent, direct aqueous injection for alcohol, and Carl Fischer method for % moisture.

(3) Vent is monitored with organics detection instrument twice daily for breakthrough of solvent after the first & second carbon adsorption canisters.

TABLE 2-2. SAMPLING PROTOCOL FOR METCALF & EDDY PILOT PLANT PROCESS RUN (OCTOBER/NOVEMBER 1996)

Sample/Stream Name	Sample Point	Quantity & Destination
Starting Feed Material		
1. Sediment (as dredged)	(1)	5 gal to BNL 1 gal to BNL/WES
2. Screened sediment w/o decanted water (2) (3 discrete samples)	(2)	3x3+ gal to BNL
3. Fresh solvent A	(11)	32 oz to BNL
Fresh solvent B	(11)	32 oz to BNL
4. Water-washed oversize	(3)	1 gal to BNL
5. Decanted water	(2A)	4x32 oz to BNL
Intermediates		
6. ORG-X℠ batch run products		
3 stages, 4-sample composite	(12)	1 gal to BNL
5 stages, 4-sample composite	(12)	1 gal to BNL
7 stages, 3-sample composite	(12)	1 gal to BNL
7. ORG-X℠ continuous extraction product		
4-sample composite from 2 drier outputs	(18)	1 gal to BNL
8. Concentrated organics		
3 stages, sample composite	(13)	32 oz to BNL
5 stages, sample composite	(13)	32 oz to BNL
7 stages, sample composite	(13)	32 oz to BNL
continuous, sample composite		32 oz to BNL
9. Wastewater		
3 stages, sample composite	(14)	4x32 oz to BNL
5 stages, sample composite	(14)	4x32 oz to BNL
7 stages, sample composite	(14)	4x32 oz to BNL
continuous, sample composite		4x32 oz to BNL
10. Solvent recycle	(30)	32 oz to BNL

TABLE 2-2. SAMPLING PROTOCOL FOR METCALF & EDDY PILOT PLANT PROCESS RUN (OCTOBER/NOVEMBER 1996) (continued)

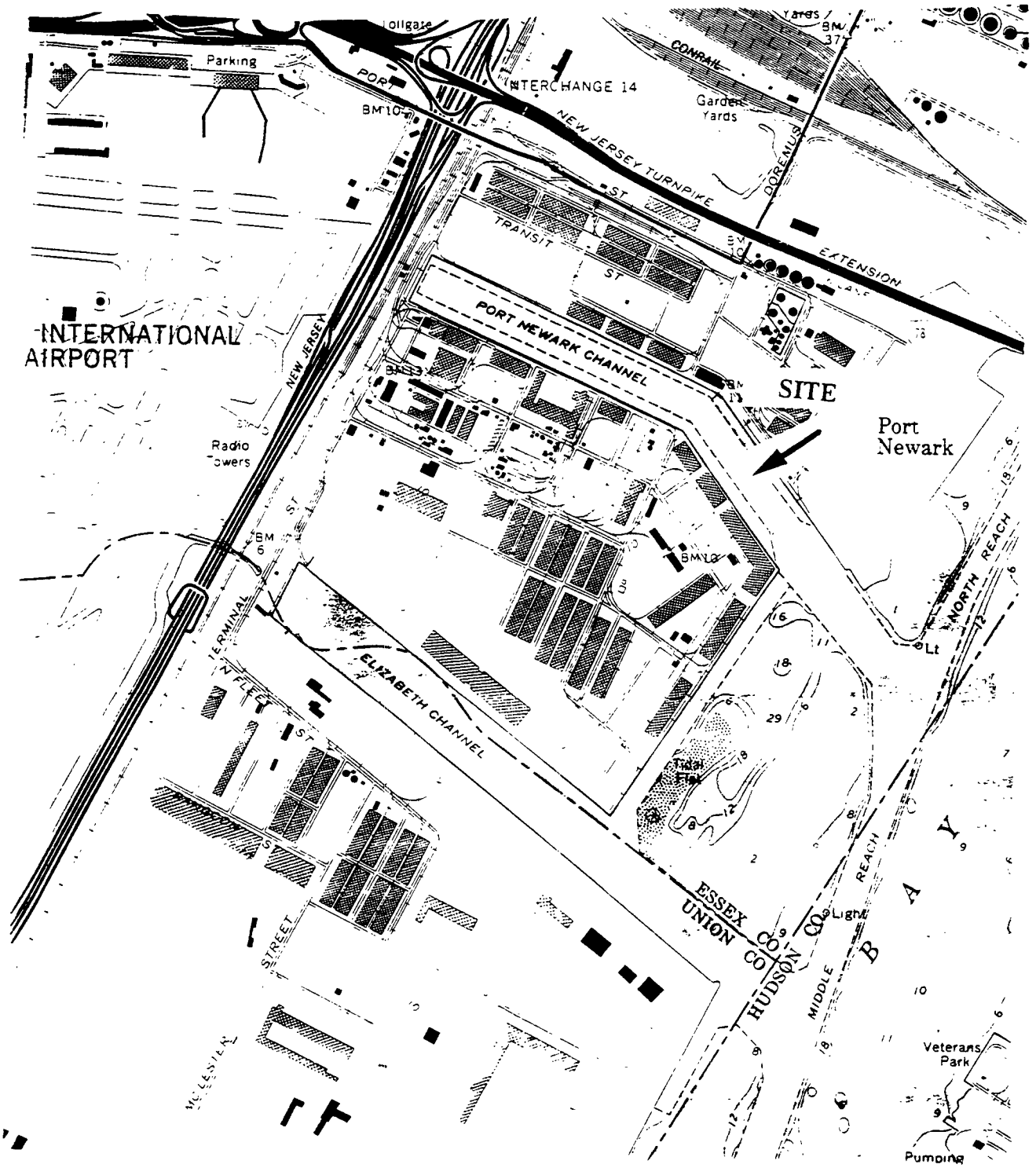
Sample/Stream Name	Sample Point	Quantity & Destination
Final Products		
11a. SOLFIX℠ products (cure for 28 days)	(6A) Crush <1 inch	2 gal to BNL
	Sidewalk chunk	1 gal to BNL/WES
	(6B) Crush <1 inch	2 gal to BNL
	Sidewalk chunk	1 gal to BNL/WES
	(6C) Crush <1 inch	2 gal to BNL
	Sidewalk chunk	1 gal to BNL/WES
11b. SOLFIX℠ products (2-inch cubes for UCS; triplicate 2 sets; cured for 28 days)	(6A,B,C)	9 to BNL 9 to WES
12a. ORG-X/SOLFIX℠ from 7-stage composite (cure for 28 days)	(21A) Crush <1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
	(21B) Crush <1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
12b. ORG-X/SOLFIX℠ from 7-extraction stages (2 inch cubes for UCS; triplicate 2 sets; cured for 28 days)	(21A,B)	6 gal to BNL 6 gal to BNL/WES
13. Activated carbon from vent canister	(V)	5 gal to BNL
Blanks		
14. Field blank		4x32 oz to BNL
15. Dilution water blank (city water)	(W)	4x32 oz to BNL
16. Portland cement (Type I) added		1 gal to BNL

TABLE 2-2. SAMPLING PROTOCOL FOR METCALF & EDDY PILOT PLANT PROCESS RUN (OCTOBER/NOVEMBER 1996) (continued)

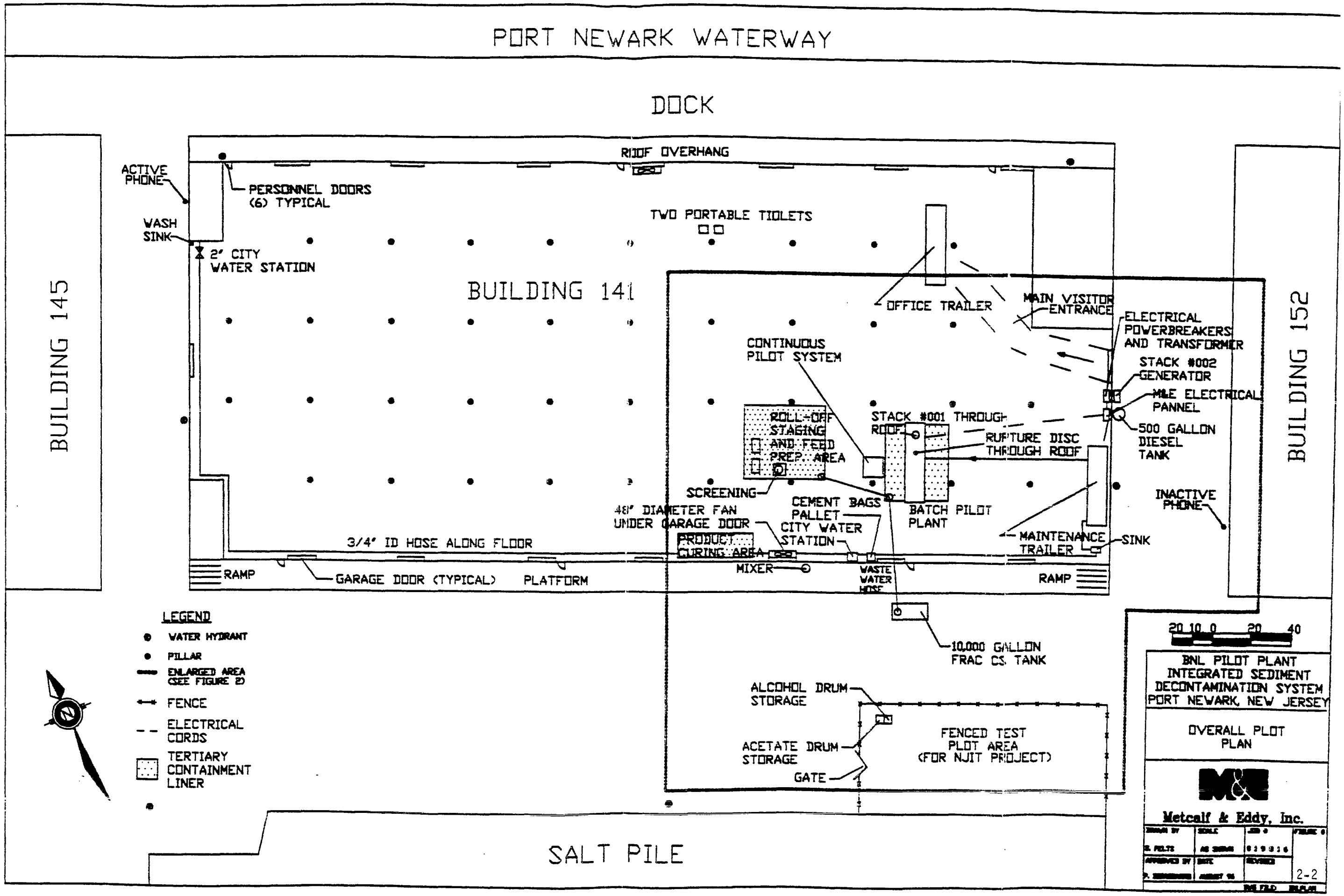
Sample/Stream Name	Sample Point	Quantity & Destination
Addendum I	Prepared three discrete sets of ORG-X/SOLFIX^{SM} products (21A and 21B) from three of the same discrete samples used to composite the 7-stage ORG-X^{SM} batch product (Item 6).	
ORG-X^{SM}/SOLFIX^{SM} (cure to 28 days)		
1. 7-stage ORG-X^{SM} Sample A to form ORG-X/SOLFIX^{SM} Sample A	(21A) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
	(21B) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
2. 7-stage ORG-X^{SM} Sample B to form ORG-X/SOLFIX^{SM} Sample B	(21A) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
	(21B) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
3. 7-stage ORG-X^{SM} Sample C to form ORG-X/SOLFIX^{SM} Sample C	(21A) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
	(21B) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
Addendum II	Prepared three discrete sets of SOLFIX^{SM} (6B and 6C) from three batch run buckets.	
SOLFIX^{SM} (cure for 28 days)		
1. Bucket A	(6B) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
	(6C) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
2. Bucket B	(6B) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
	(6C) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES

TABLE 2-2. SAMPLING PROTOCOL FOR METCALF & EDDY PILOT PLANT PROCESS RUN (OCTOBER/NOVEMBER 1996) (continued)

Sample/Stream Name	Sample Point	Quantity & Destination
3. Bucket C	(6B) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
	(6C) Crush < 1 inch	2 gal to BNL
	Monolith	1 gal to BNL/WES
Addendum IIIA	Collected cylinder (6-inch deep by 12-inch high) samples of SOLFIX℠ (cure for 28 days)	
1. Consolidation test		1 cylinder of 6C to WES
2. Permeability test		3 cylinders each of 6A, 6B, 6C to WES
Addendum IIB	Collect cylinder (6-inch deep by 12-inch high) samples of ORG-X/SOLFIX℠, N.B., cure for 28 days (7-stage ORG-X℠)	
1. Consolidation test		1 cylinder of 21A to WES
2. Permeability test		3 cylinders each of 21A and 21B to WES
Addendum IV	Manufactured Soil - Dr. Dick Lee	
1. ORG-X℠ - up to 40 gallons		Transition bags #21-25
2. ORG-X/SOLFIX℠ - up to 40 gallons		Transition bags #16-21 15 percent cement
Addendum V - Stevens University		
1. 4-5 pails (5 gal) of ORG-X℠ only		



Prepared for: Brookhaven National Laboratory Upton, N.Y.	Prepared by: Metcalf & Eddy, Inc. P.O. Box 1500 Somerville, NJ 08876
SITE LOCATION ON USGS TOPO MAP BNL Pilot Study - Newark, NJ	
August 1996	Figure 2-1


PORT NEWARK WATERWAY
DOCK
ROOF OVERHANG
ACTIVE PHONE
PERSONNEL DOORS (6) TYPICAL
WASH SINK
2" CITY WATER STATION
TWO PORTABLE TIOLETS
BUILDING 141
BUILDING 145
BUILDING 152
OFFICE TRAILER
MAIN VISITOR ENTRANCE
ELECTRICAL POWERBREAKERS AND TRANSFORMER
STACK #002 GENERATOR
M&E ELECTRICAL PANNEL
500 GALLON DIESEL TANK
CONTINUOUS PILOT SYSTEM
ROLL-OFF STAGING AND FEED PREP. AREA
STACK #001 THROUGH ROOF
RUPTURE DISC THROUGH ROOF
SCREENING
CEMENT BAGS
PALLET
CITY WATER STATION
BATCH PILOT PLANT
INACTIVE PHONE
48" DIAMETER FAN UNDER GARAGE DOOR
PRODUCT CURING AREA
MIXER
WASTE WATER HOSE
MAINTENANCE TRAILER
SINK
3/4" ID HOSE ALONG FLOOR
RAMP
GARAGE DOOR (TYPICAL)
PLATFORM
RAMP
10,000 GALLON FRAC CS TANK
LEGEND
WATER HYDRANT
PILLAR
ENLARGED AREA (SEE FIGURE 2)
FENCE
ELECTRICAL CORDS
TERTIARY CONTAINMENT LINER
ALCOHOL DRUM STORAGE
ACETATE DRUM STORAGE
GATE
FENCED TEST PLOT AREA (FOR NJIT PROJECT)
SALT PILE
20 10 0 20 40
BNL PILOT PLANT
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PORT NEWARK, NEW JERSEY
OVERALL PLOT PLAN
Metcalf & Eddy, Inc.
2-2

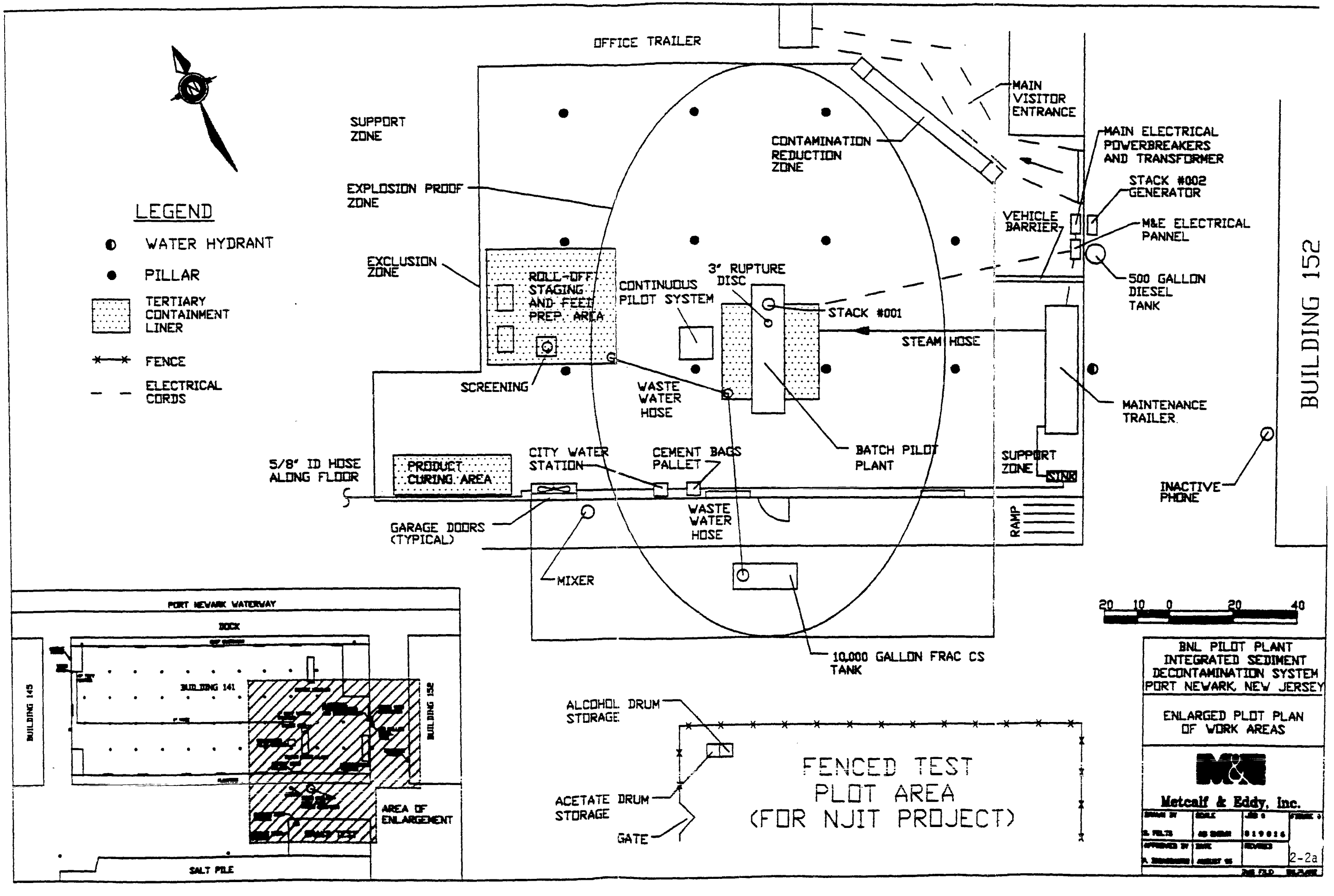
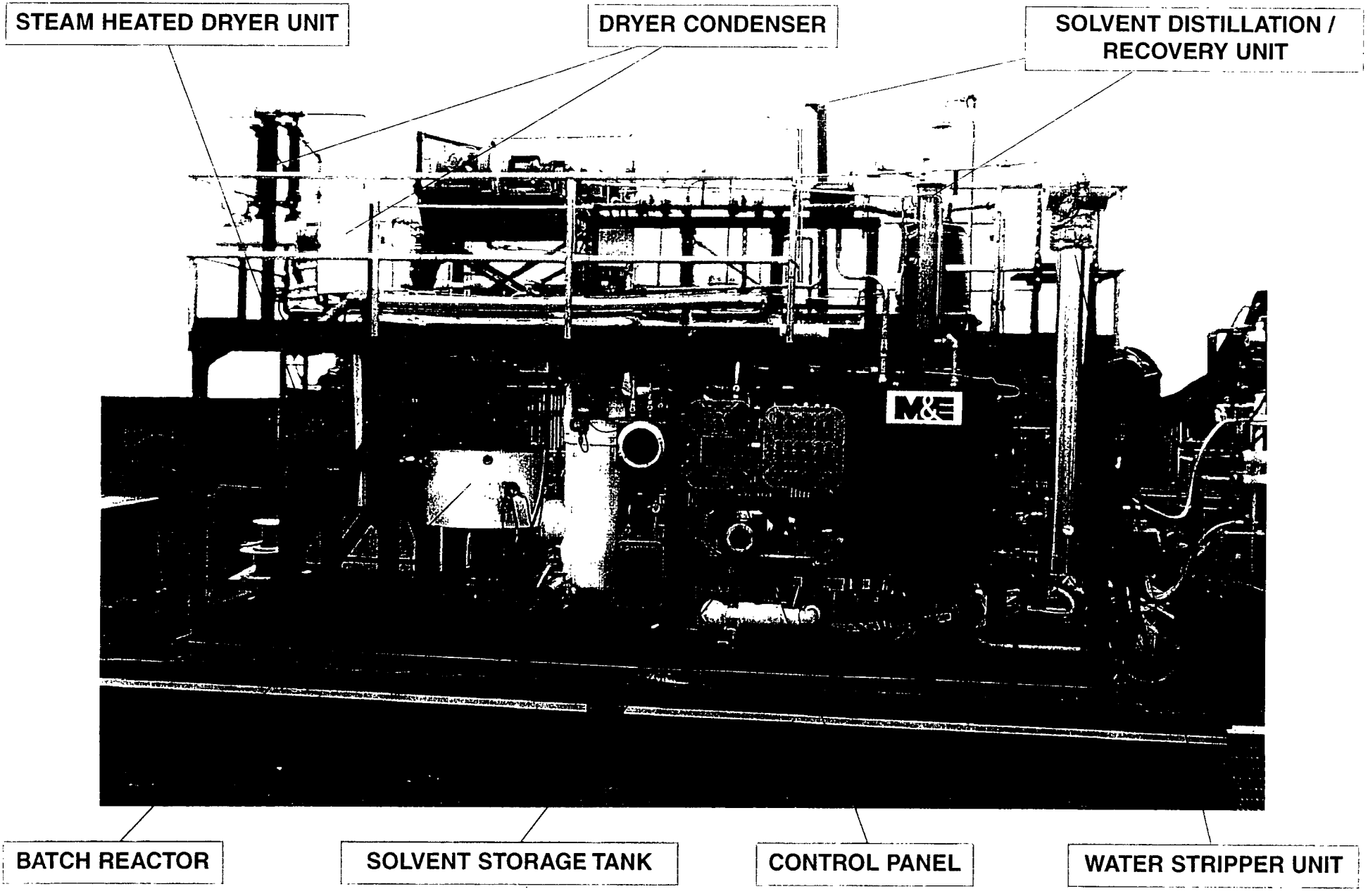

LEGEND
WATER HYDRANT
PILLAR
TERTIARY CONTAINMENT LINER
FENCE
ELECTRICAL CORDS
OFFICE TRAILER
SUPPORT ZONE
EXPLOSION PROOF ZONE
CONTAMINATION REDUCTION ZONE
EXCLUSION ZONE
ROLL-OFF STAGING AND FEED PREP. AREA
SCREENING
CONTINUOUS PILOT SYSTEM
3" RUPTURE DISC
STACK #001
STEAM HOSE
WASTE WATER HOSE
MAIN VISITOR ENTRANCE
MAIN ELECTRICAL POWERBREAKERS AND TRANSFORMER
STACK #002 GENERATOR
VEHICLE BARRIER
M&E ELECTRICAL PANNEL
500 GALLON DIESEL TANK
MAINTENANCE TRAILER
INACTIVE PHONE
BUILDING 152
5/8" ID HOSE ALONG FLOOR
PRODUCT CURING AREA
CITY WATER STATION
CEMENT BAGS PALLET
BATCH PILOT PLANT
SUPPORT ZONE
SINK
RAMP
WASTE WATER HOSE
GARAGE DOORS (TYPICAL)
MIXER
10,000 GALLON FRAC CS TANK
20 10 0 20 40
PORT NEWARK WATERWAY
DOCK
BUILDING 145
BUILDING 141
BUILDING 152
AREA OF ENLARGEMENT
SALT PILE
ALCOHOL DRUM STORAGE
ACETATE DRUM STORAGE
GATE
FENCED TEST PLOT AREA (FOR NJIT PROJECT)
BNL PILOT PLANT
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PORT NEWARK, NEW JERSEY
ENLARGED PLOT PLAN OF WORK AREAS
Metcalf & Eddy, Inc.
2-2a

Figure 2-3

BROOKHAVEN NATIONAL LABORATORY
SOLVENT EXTRACTION PILOT PLANT STUDY



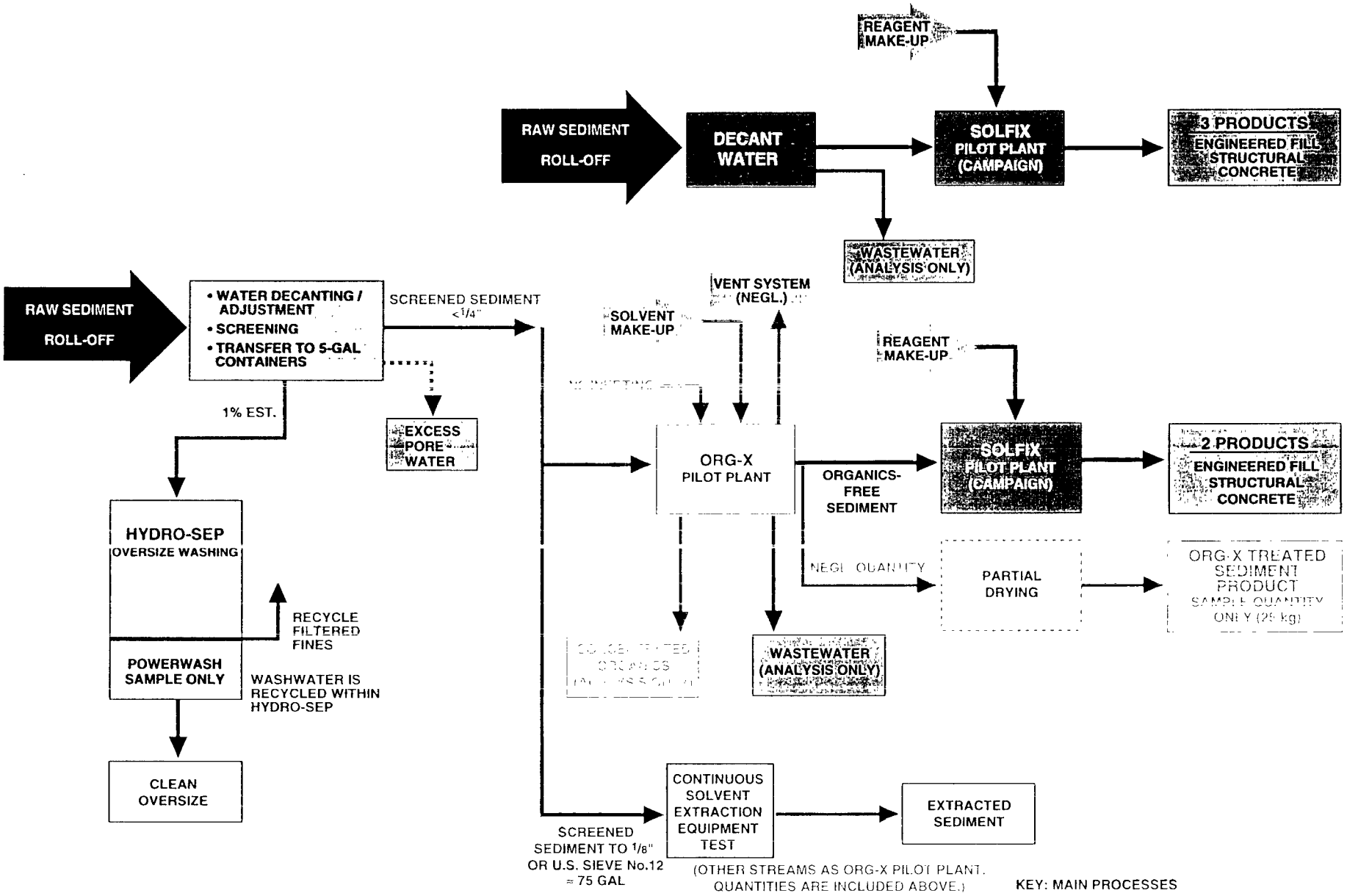


FIGURE 2-4. ISDS - PILOT PLANT BLOCK FLOW DIAGRAM

FROM MAIN
CITY WATER
W
TWO ROLL-OFFS
UNTREATED SEDIMENT
ORG-X & SOLFIX PROCESS ENVELOPE
VENT TO ATM
(V) SPENT CARBON AFTER COMPLETION OF PILOT RUNS
DISTILLATION COLUMN
CWR
CWS
DISTILLATION CONDENSER
CWR
CWS
STRIPPER CONDENSER
CWR
CWS
DRYER CONDENSER
AGITATOR
SOLVENT EVAPORATOR
BAG FILTER
SM
REBOILER
CL
EVAPORATOR PUMP
EXTRACTOR
DECANTER
WASTEWATER FEED TANK
SL
CL
WASTEWATER STRIPPER
SL
STRIPPER PUMP
14
TO WASTE WATER TANK
1
VIBRATORY SCREEN
3
SEDIMENT OVERSIZE (+)1/4-INCH
55 GAL DRUM
SCREENED SEDIMENT (-)1/4"
5 GAL PAILS
2
30
2
SL
CL
SOLVENT HEATER (SECONDARY)
SOLVENT FEED PUMP
11
SOLVENT MAKE-UP
SOLVENT STORAGE TANK
SM
CL
13
WASTE OIL
OUTSIDE DISPOSAL
SM
DRYER
CL
12&18
BAG
COLLECTION DRUM
SOLFIX PROCESS ENVELOPE
TO WASTE WATER TANK
DECANTED WASTE WATER
2A
5
CEMENT BAGS
SEDIMENT MIXER
6A 0.1 PARTS CEMENT
6B 0.2 PARTS CEMENT
6C 0.4 PARTS CEMENT
BY USACE-WES PROCESS
SOLFIX CURING MOLDS
SOLFIX UNIT
CEMENT BAGS
20
0.15 PARTS CEMENT
0.3 PARTS CEMENT
SEDIMENT MIXER
ORG-X & SOLFIX CURING MOLDS

Metcalf & Eddy, Inc.

PILOT SCALE PROCESS FLOW DIAGRAM FOR INTEGRATED SEDIMENT DECONTAMINATION SYSTEM

M&E PROJECT NO. 019816	DRW.		DATE		SCALE: NONE
	CKD.		DATE		
BNL CONTRACT NO.	APP.		DATE		FIG. 2-3

SECTION 3
RESULTS AND DISCUSSION

3.1 PILOT PLANT STUDY RESULTS

Table 3-1 presents the physical and chemical characteristics of the raw sediment before and after screening using a 1/4-inch size screen. One grab sample was taken from the raw sediment (Sample No. MEPP-1-1) and two samples were taken (Sample Nos. MEPP-2-65 and MEPP-2-108) from the (-)1/4-inch screened sediment. Table 3-1 also presents the average of the two screened sediment analytical results. The screened sediment average analytical data has been used for evaluation of the pilot plant performance.

Table 3-1 shows that the physical characteristics of the screened sediment did not changed significantly from the raw sediment. The total solids, total organic carbon (TOC), and the total sulfide concentrations in the raw and screened sediment ranged between 37 percent to 39 percent, 10.2 percent to 11.7 percent, and 6,100 mg/kg to 8,800 mg/kg, respectively. The total hydrocarbon concentration in the raw sediment was 20,000 mg/kg compared to the average 24,350 mg/kg in the screened sediment. The concentrations of some semivolatile organic compounds, namely naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, etc. are significantly higher in the screened sediment than in the raw sediment, although the polychlorinated biphenyls (PCBs) concentrations in the raw and screened sediments are more comparable. The maximum and minimum semivolatile organic compound concentrations in the screened sediment were 257,496 ug/kg (phenanthrene) and 699 ug/kg (dibenzo (a, h) anthracene), respectively. Dioxin concentrations in the raw sediment are observed to be higher than in the screened sediment. The highest dioxin concentration in the screened sediment was the OCDD compound (13,411 ng/kg) compared to 38,881 ng/kg for this same compound in the raw sediment. Furan concentrations are typically somewhat higher in the raw sediments. The 1234678-HPCDF compound had the highest concentration at 8,824 ng/kg in the screened sediment, and 14,024 ng/kg in the raw sediment. The metals concentrations in

the raw and screened sediments are comparable with somewhat higher concentrations in the raw sediments for most compounds. From the metal group, zinc had the highest concentration, at 1,505 mg/kg in the screened sediment, and 2,070 mg/kg in the raw sediment.

Table 3-2 presents the physical and chemical characteristics of the screened sediment before and after solvent extraction using the 5-stage, 7-stage and continuous ORG-X^{SM} extraction processes. As presented in Table 3-2, the particle size distribution of the ORG-X^{SM} treated sediment did not changed significantly from the untreated sediment. However, the clay fraction of the treated sediment increased to about 41.4 percent from 35.4 percent in the untreated sediment, and the silt fraction decreased from 43.9 percent in the untreated sediment to about 39 percent in the screened sediment. Based upon the analytical data, the treated sediment has 30 percent less TOC concentration than the untreated sediment. Table 3-2 shows that the individual PCB congeners removal efficiency ranged between 93 percent to 100 percent and the total PCB removal efficiency of the ORG-X^{SM} process ranged between 97 percent to 99 percent. Figure 3-1 presents the total PCB removal of the 5-stage, 7-stage and continuous extraction ORG-X^{SM} processes. Based upon the analytical data presented in Table 3-2, the dioxin removal efficiency of the ORG-X^{SM} process ranged between high sixty percentile and low eighty percentile. The initial low dioxin concentrations in the screened sediment resulted in comparatively lower removal efficiency in the ORG-X^{SM} treated sediment. Figure 3-2 presents the total dioxin removal of the 5-stage, 7-stage and continuous extraction ORG-X^{SM} processes. The furan removal efficiency of the ORG-X^{SM} process ranged between 80 percent to 95 percent. Figure 3-3 presents the total furan removal of the 5-stage, 7-stage and continuous extraction ORG-X^{SM} processes. Each of the three ORG-X^{SM} processes piloted for solvent extraction also exhibited high semivolatile organic compound removal efficiencies. The 7-stage ORG-X^{SM} process removed 99 percent of phenanthrene, which had the highest concentration of 257,496 ug/kg concentration in the untreated screened sediment. The 5-stage and the continuous extraction processes accomplished 98 percent phenanthrene removal from the untreated screened sediment. Figure 3-4 presents the selected semivolatile organics removal of the piloted ORG-X^{SM} processes. Based upon the analytical results, the performances of 5-stage,

7-stage and continuous solvent extraction processes are comparable to one another within the analytical accuracy limits of identified compounds.

Table 3-3 presents the physical properties of the solidified and stabilized sediment using the different proportions of cement mixture. By comparing the Unconfined Compressive Strength (UCS) of the untreated and ORG-X^{SM} treated sediment, the ORG-X^{SM} treated sediment containing only 15 percent cement has 217 psi UCS compared to 128 psi UCS of untreated sediment containing 20 percent cement. However, Table 3-3 shows that the UCS of the ORG-X^{SM} treated sediment has not increased significantly with higher cement content (30 percent cement compared to 15 percent cement) although the permeability has decreased by one order of magnitude in the higher cement mix. The lower dry density results of the solidified materials suggest presence of entrapped air in the matrix. The very fine silt and clay fraction of the sediment has resulted in entrapped air in the solidified material and caused comparatively lower UCS. Based upon the solidified material physical characteristics presented in Table 3-3, it is believed that additional binding agent needs to be added in the solidified mix to improve the physical properties, and may improve the UCS.

Table 3-4 presents the TCLP extract analytical results for the solidified materials. The TCLP extract results show extremely low to below detection limit concentrations of targeted compounds including PCBs, semivolatile organic compounds, dioxins, furans and metals.

Table 3-5 presents the analytical results for the extraction and recycled solvents for the targeted compounds. By comparing the concentrations of organic compounds present in the screened sediment in Table 3-2 and the extraction solvents in Table 3-5, it is evident that the ORG-X^{SM} solvent extraction processes were very effective in removing the organic compounds present in the sediment. Based upon the analytical data of the recycled solvent in Table 3-5, it can be concluded that sediment was extracted with almost pure solvent in each of extraction steps. The very low dioxin concentrations in the recycled solvent may have resulted from the matrix interferences due to the nature of the samples.

Table 3-6 shows the stripper bottom water analyses results for the 5-stage, 7-stage and continuous ORG-X℠ solvent extraction processes. Table 3-6 shows that the steam stripping operation effectively removed all contaminants and solvents from the water produced during the sediment drying operation of the ORG-X℠ process. Based upon the stripper bottom water analysis results, it can be concluded that contaminants did not escape into the environment and the treated water can either be reused in the process or discharged into a POTW without any subsequent treatment.

Table 3-7 presents the analytical results of the free water collected from the top of the screened sediment after a contact time of more than two weeks, and the activated carbon used in the vent line of ORG-X℠ process equipment. Based upon the below detection limit and/or very low contaminant concentration in the activated carbon, it can be concluded that ORG-X℠ process effectively concentrates all contaminants in the waste oil fraction, and the possibility of contaminant emission to the atmosphere is very low. Based upon the analytical results, the free or decanted sediment water may require treatment before discharging into a POTW, if phase separation (sediment and water) is allowed to occur for a long period of time.

Based upon the pilot plant study data, the total low pressure (at 50 psi) steam requirements were estimated to be 0.25 lb/lb towards sediment drying (based upon screened sediment at 35 percent solids) and solvent distillation/recovery and water stripping operation. The required cooling water flow was estimated to be 4 gallons per hour for every pound of screened sediment processing using the ORG-X℠ process. The electrical energy and inert nitrogen consumption were estimated to be 1 kwh and 0.1 cfm respectively per 100 lb of screened sediment processing. Make-up solvents requirements were estimated at 0.001 lb/lb of screened sediment.

3.2 DISCUSSION

The solvent extraction and solidification/stabilization pilot plant treatability study with the NY/NJ harbor sediment leads to the following conclusions.

- The semivolatile organic compound and PCB removal efficiency of the ORG-X℠ solvent extraction processes was very high ranging from low 90s to 100 percent.

- The initial concentration of dioxin and its congeners were very low in the screened sediment which resulted in comparatively lower removal efficiency for this group.

- The furan and its congeners removal efficiency of ORG-X℠ processes ranged from low 80s to 95 percent.

- The presence of very fine silt and clay fraction in the sediment resulted in air binding of solidified and stabilized SOLFIX℠ products and low UCS. Additional binding agents need to be added to improve physical properties of stabilized products for beneficial reuse. SOLFIX℠ mixture with 15 percent cement and a suitable binding agent is envisioned for the full-scale operation. A detailed evaluation would be required for the type and proportion of required binding agent.

- Based upon the TCLP extract analyses of the solidified and stabilized SOLFIX℠ products, all metals were fully immobilized in the solidified matrix.

- The solvent mixture used in the ORG-X℠ process effectively decontaminates the sediment and is easily regenerated to almost pure form.

- The ORG-X℠ process wastewater (stripper bottom water) is almost free of contaminants and can likely be discharged into a POTW without additional treatment. However, sediment pore water may require additional treatment before discharge to POTW, if phase separation is allowed to occur for a long time.

- Based on the results of the activated carbon analysis, the ORG-X℠ process vapor stream should not pose any environmental emission problem.

- The performance of 5-stage, 7-stage and continuous solvent extraction ORG-X℠ processes were comparable within the analytical accuracy of the laboratory data. Since all three solvent extraction processes produced comparable contaminant removal efficiencies, a full-scale ORG-X℠ process is recommended using a 5-stage continuous countercurrent extraction system as the most cost-effective treatment process.

- The concentrated organics generated from the pilot plant study were disposed at an off-site facility for incineration. For a full-scale sediment treatment system, base catalyzed dechlorination (BCD) process may be used for organics destruction. The waste stream, produced from BCD process, can be reused as a fuel for steam or cogeneration of power. This process needs to be optimized in detail during the preliminary engineering process.

TABLE 3-1. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - PHYSICAL AND CHEMICAL PROPERITIES OF RAW AND SCREENED SEDIMENTS[1,3]

		As Dredged MEPP-1-1	Screened Sediment MEPP-2-65	Screened Sediment MEPP-2-108	Screened Sediment AVERAGED[2]
Particle size in % Dry Weight (ASTM D422-modified)					
Medium gravel	> 4.75 mm	0.00	0.00	0.00	0.00
Fine gravel	2-4.75	0.55	3.06	2.03	2.55
V. coarse sand	0.85-2	1.19	1.91	1.68	1.80
Coarse sand	0.425-0.85	2.56	2.83	2.96	2.90
Medium sand	0.24-0.425	5.26	4.38	4.20	4.29
Fine sand	0.106-0.24	10.30	9.71	7.83	8.77
V. fine sand	0.075-0.106	3.56	3.23	2.88	3.06
Clay		30.20	36.40	34.30	35.35
Silt		45.30	45.80	42.00	43.90
pH (EPA 9045A)		7.88	8.07	8.12	8.10
Total Solids in % Dry Weight (EPA 160.3)		39.00	36.80	37.20	37.00
Total Sulfides in mg/Kg Dry Weight (EPA 9030M)		6,100	6,700	8,800	7,750
Total Organic carbon in % Dry Weight (ASTM D4129-82M)		10.20	11.60	11.70	11.65
Hydrocarbons in mg/Kg Dry Weight (EPA 3580/8015 Modified)		20,000	22,300	26,400	24,350
Polychlorinated Biphenyls in ug/Kg Dry Weight (EPA MM680/HRGC/MS)					
44'-Di	# 15		86.7	66.6	76.7
244'-Tri	# 28		215	356	286
22'55'-Tetra	# 52	116	261	179	220
33'44'-Tetra	# 77	21.3	19.0	12.8	15.9
2344'5-Penta	# 118	289		143	143
233'44'-Penta	# 105	112	113	62	87
33'44'5-Penta	# 126			**0.4**	**0.4**
233'44'5-Hexa	# 156	30.5	24.3	14.8	19.6
22'344'55'-Hepta	# 180	210	173	118	146
22'33'44'55'-Octa	# 194	49.2	41.0	33.1	37.1
22'33'44'55'6-Nona	# 206	30.1	45.9	43.9	44.9
Deca	# 209	25.6	55.1	61.7	58.4
PCB Totals:					
-Di			666	390	528
-Tri			1,490	933	1,212
-Tetra		1,310	1,760	1,280	1,520
-Penta		1,810	1,810	1,110	1,460
-Hexa		1,350	1,270	1,040	1,155
-Hepta		784	651	476	564
-Octa		143	223	188	206
-Nona		44	76	80	78

TABLE 3-1 (cont'd). BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - PHYSICAL AND CHEMICAL PROPERITIES OF RAW AND SCREENED SEDIMENTS[1,3]

	As Dredged MEPP-1-1	Screened Sediment MEPP-2-65	Screened Sediment MEPP-2-108	Screened Sediment AVERAGED[2]
Semivolatile Compounds in ug/Kg Dry Weight (EPA 8270A)				
Naphthalene	6,339	35,773	38,671	37,222
2-Methylnaphthalene	7,798	35,321	35,487	35,404
Acenapthylene	2,662	7,804	8,410	8,107
Acenaphthene	6,905	40,170	43,408	41,789
Dibenzofuran	4,512	28,651	31,806	30,228
Fluorene	8,403	52,818	61,596	57,207
Phenanthrene	39,801	245,157	269,835	257,496
Anthracene	10,748	55,277	70,489	62,883
Fluoranthene	26,903	134,986	87,646	111,316
Pyrene	20,385	93,711	96,297	95,004
bis-2-ethylhexylphthalate	49,258	45,583	25,713	35,648
Benzo(a)anthracene	8,970	36,873	40,107	38,490
Chrysene	9,773	33,538	33,989	33,764
Benzo(b)fluoranthene	7,700	29,754	26,078	27,916
Benzo(k)fluoranthene	2,763	11,051	10,388	10,719
Benzo(e)pyrene	3,984	12,988	12,428	12,708
Benzo(a)pyrene	5,815	20,800	20,830	20,815
Perylene	1,089	3,429	3,641	3,535
Indeno(1,2,3-cd)pyrene		1,368	1,446	1,407
Dibenz(a,h)anthracene		699		699
Benzo(g,h,i)perylene	678	1,394	1,132	1,263
Dioxins and Furans in ng/Kg Dry Weight (EPA 8290)				
2378-TCDD	81	42	28	35
12378-PeCDD	299	45	33	39
123478-HxCDD	1,764	45	35	40
123678-HxCDD	592	111	83	97
123789-HxCDD	2,106	103	66	84
1234678-HpCDD	11,377	1,744	1,380	1,562
OCDD	38,881	15,395	11,428	13,411
2378-TCDF	460	351	283	317
12378-PeCDF	612	522	427	475
23478-PeCDF	226	179	154	167
123478-HxCDF	2,874	2,157	1,916	2,037
123678-HxCDF	1,032	838	657	748
234678-HxCDF	485	305	152	228
123789-HxCDF	9	82	8	45
1234678-HpCDF	14,024	9,784	7,864	8,824
1234789-HpCDF	112	160	143	151
OCDF	1,135	7,814	7,819	7,817
Totals: Dioxins				
-TCDD	1,240	315	231	273
-PeCDD	5,570	379	210	294
-HxCDD	23,185	1,117	777	947
-HpCDD	42,265	3,532	2,414	2,973
Totals: Furans				
-TCDF	4,797	3,906	3,197	3,552
-PeCDF	7,437	5,945	4,813	5,379
-HxCDF	11,545	8,612	7,058	7,835
-HpCDF	16,327	11,737	9,695	10,716

TABLE 3-1 (cont'd). BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - PHYSICAL AND CHEMICAL PROPERITIES OF RAW AND SCREENED SEDIMENTS[1,3]

	As Dredged MEPP-1-1	Screened Sediment MEPP-2-65	Screened Sediment MEPP-2-108	Screened Sediment AVERAGED[2]
Metals in mg/kg Dry Weight (EPA 6010A and EPA 7471)				
Ag	17.2	14.4	13.6	14.0
As	42.4	63.2	72.2	67.7
Cd	47.1	31.1	25.9	28.5
Cr	432	334	304	319
Cu	1,410	1,140	1,040	1,090
Ni	440	355	339	347
Pb	631	605	658	632
Sb	4.93	4.48	4.64	4.56
Se	4.42	9.54	12.20	10.87
Zn	2,070	1,580	1,430	1,505
Hg	3.67	3.29	3.71	3.50

NOTES:

1. All contaminant concentrations are based upon Brookhaven's analytical results. Refer to Appendix D of this report for details.
2. Average values for the two screened sediment samples (MEPP-2-65 and MEPP-2-108); if one value was nondetected for one of the samples, the detected value for the other sample was reported.
3. Only analytes that were detected in at least one of the samples are reported. Only detected values are presented, nondetected values are not shown, and detected estimated values (below the instrument detection limit) are shown in **bold**.

TABLE 3-2. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - PHYSICAL AND CHEMICAL CHARACTERISTICS OF SCREENED SEDIMENT AND ORG-X TREATED SEDIMENT [1,3]

			OrgX Products					
		Screened Sediment AVERAGED [2]	5 Stage MEPP-8-1		7 Stage MEPP-9-1		Continuous MEPP-10-1	
			concentration	% removal	concentration	% removal	concentration	% removal
Particle size in % Dry Weight (ASTM D422-modified)								
Medium gravel	> 4.75 mm	0.00	0.00	--	0.00	--	0.00	--
Fine gravel	2-4.75	2.55	0.43	--	0.22	--	0.91	--
V. coarse sand	0.85-2	1.80	1.94	--	1.84	--	2.03	--
Coarse sand	0.425-0.85	2.90	2.63	--	2.69	--	2.66	--
Medium sand	0.24-0.425	4.29	4.60	--	4.07	--	3.89	--
Fine sand	0.106-0.24	8.77	7.94	--	8.54	--	7.97	--
V. fine sand	0.075-0.106	3.06	3.04	--	3.34	--	2.93	--
Clay		35.35	41.40	--	41.10	--	41.40	--
Silt		43.90	39.00	--	38.50	--	39.60	--
pH (EPA 9045A)		8.10	8.01	--	7.94	--	7.63	--
Total Solids in % Dry Weight (EPA 160.3)		37	44	--	46	--	40	--
Total Sulfides in mg/Kg Dry Weight (EPA 9030M)		7,750	10,000	--	10,000	--	9,200	--
Total Organic carbon in % Dry Weight (ASTM D4129-82M)		11.65	8.50	27%	8.20	30%	8.40	28%
Polychlorinated Biphenyls in ug/Kg Dry Weight (EPA MM680/HRGC/MS)								
2-Mono	Congener # 1		1.64	--	0.70	--	1.69	--
44'-Di	# 15	76.7	6.31	92%	5.70	93%	6.70	91%
244'-Tri	# 28	286	5.68	98%	4.77	98%	6.06	98%
22'55'-Tetra	# 52	220	1.91	99%	1.60	99%	1.60	99%
33'44'-Tetra	# 77	15.9	0.84	95%	0.98	94%	0.77	95%
2344'5-Penta	# 118	143	5.00	97%	5.72	96%	4.91	97%
233'44'-Penta	# 105	87.5	1.91	98%	2.28	97%	1.80	98%
233'44'5-Hexa	# 156	**0.4**	**0.49**	--	0.61	--	**0.55**	--
33'44'55'-Hexa	# 169	19.6		--	0.06	100%		--
22'344'55'-Hepta	# 180	146	3.03	98%	3.17	98%	3.73	97%
22'33'44'55'-Octa	# 194	37.1	0.71	98%	0.90	98%	0.87	98%
22'33'44'55'6-Nona	# 206	44.9	1.04	98%	1.11	98%	1.07	98%
Deca	# 209	58.4	2.01	97%	2.07	96%	2.27	96%
PCB Totals:								
-Mono			7.5	--	5.4	--	8.0	--
-Di		528	15.7	97%	11.5	98%	16.0	97%
-Tri		1,212	27.3	98%	23.3	98%	31.4	97%
-Tetra		1,520	22.3	99%	23.1	98%	20.7	99%
-Penta		1,460	24.8	98%	26.1	98%	26.8	98%
-Hexa		1,155	20.0	98%	24.2	98%	20.8	98%
-Hepta		564	10.7	98%	11.6	98%	13.6	98%
-Octa		206	3.0	99%	3.5	98%	3.3	98%
-Nona		78	1.6	98%	1.7	98%	1.7	98%

TABLE 3-2 (cont'd). BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - PHYSICAL AND CHEMICAL CHARACTERISTICS OF SCREENED SEDIMENT
AND ORG-X TREATED SEDIMENT [1,3]

	OrgX Products						
	Screened Sediment AVERAGED [2]	5 Stage MEPP-8-1		7 Stage MEPP-9-1		Continuous MEPP-10-1	
		concentration	removal	concentration	removal	concentration	removal
Semivolatile Compounds in ug/Kg Dry Weight (EPA 8270A)							
3/4-Methylphenol		37,761	--	15,874	--	14,259	--
Benzoic acid		401	--	479	--	198	--
Naphthalene	37,222	1,029	97%	1,017	97%	1,517	96%
2-Methylnaphthalene	35,404	640	98%	545	98%	837	98%
Acenapthylene	8,107	983	88%	738	91%	906	89%
Acenaphthene	41,789	503	99%	185	100%	589	99%
Dibenzofuran	30,228	808	97%	552	98%	904	97%
Diethylphthalate			--	32	--	41	--
Fluorene	57,207	1,062	98%	605	99%	1,226	98%
Phenanthrene	257,496	4,301	98%	2,856	99%	4,963	98%
Anthracene	62,883	1,739	97%	1,292	98%	1,933	97%
Di-n-butyl phthalate		104	--	80	--	77	--
Fluoranthene	111,316	3,041	97%	2,476	98%	3,464	97%
Pyrene	95,004	2,630	97%	2,116	98%	2,710	97%
bis-2-ethylhexylphthalate	35,648	823	98%	979	97%	877	98%
Benzo(a)anthracene	38,490	1,057	97%	894	98%	1,135	97%
Chrysene	33,764	1,181	97%	1,009	97%	1,261	96%
Benzo(b)fluoranthene	27,916	1,217	96%	1,013	96%	1,171	96%
Benzo(k)fluoranthene	10,719	360	97%	444	96%	520	95%
Benzo(e)pyrene	12,708	470	96%	405	97%	507	96%
Benzo(a)pyrene	20,815	755	96%	671	97%	815	96%
Perylene	3,535	554	84%	556	84%	545	85%
Indeno(1,2,3-cd)pyrene	1,407	198	86%	185	87%	211	85%
Dibenz(a,h)anthracene	699		100%		100%		100%
Benzo(g,h,i)perylene	1,263	188	85%		100%		100%
Dioxins and Furans in ng/Kg Dry Weight (EPA 8290)							
2378-TCDD	35	9.1	74%	10.2	71%	9.5	73%
12378-PeCDD	39	11.7	70%	12.5	68%	13.3	66%
123478-HxCDD	40	13.4	66%	13.1	67%	14.8	63%
123678-HxCDD	97	21.3	78%	22.2	77%	26.5	73%
123789-HxCDD	84	30.2	64%	28.7	66%	33.1	61%
1234678-HpCDD	1,562	317	80%	322	79%	350	78%
OCDD	13,411	3,094	77%	3,047	77%	3,191	76%
2378-TCDF	317	57.3	82%	57.5	82%	61.8	80%
12378-PeCDF	475	75.0	84%	76.3	84%	75.5	84%
23478-PeCDF	167	28.8	83%	29.9	82%	32.4	81%
123478-HxCDF	2,037	250	88%	254	88%	265	87%
123678-HxCDF	748	95.9	87%	96.5	87%	105	86%
234678-HxCDF	228	44.7	80%	43.7	81%	50	78%
123789-HxCDF	45	2.6	94%	2.1	95%	3.3	93%
1234678-HpCDF	8,824	1,147	87%	1,097	88%	976	89%
1234789-HpCDF	151	30.6	80%	28.0	82%	36.7	76%
OCDF	7,817	1,133	86%	1,011	87%	1,275	84%
Totals: Dioxins							
-TCDD	273	60	78%	59	78%	60	78%
-PeCDD	294	82	72%	80	73%	78	73%
-HxCDD	947	257	73%	255	73%	273	71%
-HpCDD	2,973	630	79%	637	79%	651	78%

TABLE 3-2 (cont'd). BROOKHAVEN NATIONAL LABORATORY INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - PHYSICAL AND CHEMICAL CHARACTERISTICS OF SCREENED SEDIMENT
AND ORG-X TREATED SEDIMENT [1,3]

		OrgX Products					
	Screened Sediment AVERAGED [2]	5 Stage MEPP-8-1		7 Stage MEPP-9-1		Continuous MEPP-10-1	
		concentration	removal	concentration	removal	concentration	removal
Totals: Furans							
-TCDF	3,552	411	88%	427	88%	432	88%
-PeCDF	5,379	642	88%	607	89%	592	89%
-HxCDF	7,835	938	88%	930	88%	941	88%
-HpCDF	10,716	1,391	87%	1,337	88%	1,234	88%
Metals in mg/kg Dry Weight (EPA 6010A and EPA 7471)							
Ag	14.0	18.0	--	16.8	--	13.4	--
As	67.7	92.1	--	84.7	--	69.2	--
Cd	28.5	33.4	--	31.9	--	24.9	--
Cr	319	399	--	373	--	297	--
Cu	1,090	1,420	--	1,310	--	1,070	--
Ni	347	424	--	400	--	318	--
Pb	632	818	--	795	--	599	--
Sb	4.56	5.5	--	5.1	--	5.7	--
Se	10.9	15.4	--	14.4	--	11.0	--
Zn	1,505	1,860	--	1,750	--	1,400	--
Hg	3.50	6.0	--	5.3	--	5.2	--

NOTES:

1. All contaminant concentrations are based upon Brookhaven's analytical results. Refer to Appendix D of this report for details.
2. The average values for the two screened sediment samples (MEPP-2-65 and MEPP-2-108) presented in Table 3-1. for one of the samples, the detected value for the other sample was reported.
3. Only analytes that were detected in at least one of the samples are reported. Only detected values are presented, nondetected values are not shown, and detected estimated values (below the instrument detection limit) are shown in **bold**. Blanks indicate nondetected values.

TABLE 3-3. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - PHYSICAL PROPERITIES OF SOLIDIFIED AND STABILIZED SEDIMENT [1]

	M&E ORG-X Treated Sediment Followed by SOLFIX		USACE-WES Screened Sediment		
	15% Cement Mix	30% Cement Mix	10% Cement Mix	20% Cement Mix	40% Cement Mix
USC in psi	217	614	29	128	492
Water Content at 60 degree C	53.0	26.9	60.7	27.7	18.1
Water Content at 100 degree C	71.6	53.7	70.3	51.4	32.1
Specific Gravity	2.70	2.69	2.53	2.61	2.63
Coefficient of Permeability in cm/sec	1.16E-06	4.15E-07	1.42E-05	5.46E-06	3.12E-07
Dry Density in lbs/cu. ft	51.6	64.1	38.1	47.5	57.5
Atterburg Limits					
Liquid	103	--	126	--	--
Plastic	59	--	67	--	--
Slope Angle Degrees		--	35.5	--	--

NOTES:
1. All analytical data are based upon the average of all sample test results provided by USACE-WES.

TABLE 3-4. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - TCLP EXTRACT ANALYTICAL RESULTS FOR SOLIDIFIED AND STABILIZED PRODUCTS [1,2]

	M&E ORG-X Treated Sediment Followed by SOLFIX		USACE-Solidified Product of Screened Sediment		
	15% Cement Mix MEPP-25-1	30% Cement Mix MEPP-26-1	10% Cement Mix MEPP-22-1	20% Cement Mix MEPP-23-1	40% Cement Mix MEPP-24-1
Polychlorinated Biphenyls in ng/L (EPA MM680/HRGC/MS) -- TCLP Extract					
2-Mono	1.40	0.52	25.80	27.20	21.90
44'-Di	0.28	0.18	1.70	1.60	2.40
244'-Tri	0.33	0.11	1.50	2.50	5.90
22'55'-Tetra	0.21	0.11	0.61	1.70	5.00
33'44'-Tetra	**0.03**	0.02		0.09	0.25
2344'5-Penta	0.42	0.09	**0.23**	0.97	3.40
233'44'-Penta	0.14			0.45	1.40
233'44'5-Hexa	**0.05**			0.13	0.37
22'344'55'-Hepta	0.26	0.21	**0.16**	1.20	3.20
22'33'44'55'-Octa	0.07	0.09		**0.31**	0.76
22'33'44'55'6-Nona					1.20
Deca					1.70
PCB Totals:					
-Mono	2.30	1.10	36.70	38.00	30.50
-Di	0.92	0.64	22.80	19.90	17.20
-Tri	1.50	1.00	10.70	16.30	32.80
-Tetra	1.30	0.44	2.80	10.30	31.00
-Penta	1.90	0.35	0.58	7.20	22.40
-Hexa	1.60	1.10	0.23	6.20	17.60
-Hepta	0.58	0.45	**0.16**	3.50	11.40
-Octa	0.14	0.09		**0.65**	2.90
-Nona					1.20
Semivolatile Compounds in ug/L (EPA 8270A) - TCLP Extract					
Phenol	1.00		4.25	3.44	1.84
3/4-Methylphenol		3.61	8.49	7.44	4.58
Benzoic acid	59.84	250.72	118.40	88.68	38.14
Naphthalene	12.76	4.69	76.40	65.59	95.02
2-Methylnaphthalene	3.55	0.93	27.61	26.76	32.22
Acenaphthene	0.92		25.65	23.38	26.86
Dibenzofuran	0.85		18.82	17.84	19.28
Fluorene	0.90		26.04	25.34	27.68
Phenanthrene	2.29		45.48	48.79	48.43
Anthracene			7.90	8.38	8.88
Di-n-butyl phthalate	3.29	0.33	2.88	2.56	3.68
Fluoranthene			6.70	6.62	7.94
Pyrene			4.04	4.48	5.17
bis-2-ethylhexylphthalate	1.22	3.49	1.01	0.66	2.10
Dioxins and Furans in pg/L (EPA 8290) - Extract					
OCDD	83.3496	31.0614	41.4371	25.8517	190.5405
2378-TCDF		4.2372		**2.4149**	6.6853
12378-PeCDF					*9.3355*
123478-HxCDF				**3.3641**	32.4991
123678-HxCDF					9.8921
234678-HxCDF			**5.1596**		9.403
1234678-HpCDF	*21.5757*	**5.6461**	14.79	9.0197	132.4047
1234789-HpCDF					7.5288
OCDF	24.4596	8.0791	10.7971		83.291
Totals: Dioxins					
-HpCDD					*40.444*
Totals: Furans					
-TCDF		4.2372		**4.183**	28.7434
-PeCDF	**4.2259**			**3.0427**	65.3487
-HxCDF	6.4883		**5.1596**	**3.3641**	102.2042
-HpCDF	**21.5757**	**5.6461**	14.79	9.0198	170.3558

TABLE 3-4(cont'd). BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - TCLP EXTRACT ANALYTICAL RESULTS FOR SOLIDIFIED AND STABILIZED PRODUCTS [1,2]

	M&E ORG-X Treated Sediment Followed by SOLFIX		USACE-Solidified Product of Screened Sediment		
	15% Cement Mix MEPP-25-1	30% Cement Mix MEPP-26-1	10% Cement Mix MEPP-22-1	20% Cement Mix MEPP-23-1	40% Cement Mix MEPP-24-1
Metals in mg/L (EPA 1131/3010/6010A) - Extract					
-Arsenic	0.018	0.029	0.034	0.018	0.016
-Barium	0.292	0.215	0.167	0.232	0.328
-Cadmium	0.035				0.162
-Chromium	0.100	0.020	0.015	0.017	0.010
-Lead	0.007				0.013
-Mercury	0.034				0.053
-Selenium	0.019	0.024	0.025	0.014	0.016
-Silver	0.192	0.001	0.007	0.001	0.193

NOTES:

1. All contaminant concentrations are based upon Brookhaven's analytical results. Refer to Appendix D of this report for details.
2. Only analytes that were detected in at least one of the samples are reported. Only detected values are presented, nondetected values are not shown, and detected estimated values (below the instrument detection limit) are shown in **bold**.

TABLE 3-5. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - ANALYTICAL RESULTS FOR EXTRACTION AND
RECYCLED SOLVENTS FOR THE ORG-X PROCESS [1,2]

	5 Stage Extraction Solvent MEPP-12-1	7 Stage Extraction Solvent MEPP-13-1	Continuous Extraction Solvent MEPP-14-1	Recycled/Distilled Solvent MEPP-18-1
pH (EPA 9045A)	6.73	6.78	6.38	8.58
Total Sulfides in mg/L (EPA 9030M)				
	12	43	2	3
Total Organic carbon in % (ASTM D4129-82M)				
	62.90	71.00	81.90	40.50
Hydrocarbons in mg/L (EPA 3580/8015 Modified)				
	530,000	533,000	594,000	13,500
Polychlorinated Biphenyls in ng/L (EPA MM680/HRGC/MS)				
2-Mono Congener # 1	1,908	1,995	2,198	
44'-Di # 15	1,467	1,713	2,023	
244'-Tri # 28	3,472	4,862	5,060	
22'55'-Tetra # 52	2,126	2,892	2,009	
33'44'-Tetra # 77	300	366	356	
2344'5-Penta # 118	130	168	177	
233'44'-Penta # 105	1,123	1,264	1,568	
233'44'5-Hexa # 156	333	411	473	
22'344'55'-Hepta # 180	2,734	2,651	3,143	
22'33'44'55'-Octa # 194	**619**	606	**694**	
22'33'44'55'6-Nona # 206	**716**	**656**	720	
Deca # 20	1,064	1,087	**1,320**	
PCB Totals:				
-Mono	3,486	3,383	4,197	
-Di	8,802	10,957	7,864	
-Tri	20,375	27,656	24,582	
-Tetra [3]	18,129	24,322	23,469	
-Penta [3]	15,473	19,713	20,832	
-Hexa	14,105	16,153	19,686	209
-Hepta	7,620	7,528	10,768	
-Octa [3]	1,458	1,764	1,232	
-Nona	448	397	1,165	
Semivolatile Compounds in ug/L (EPA 8270A)				
Naphthalene	875	988	681	
2-Methylnaphthalene	969	1,019	874	
Acenaphthene	1,259	1,202	1,254	
Dibenzofuran	932	838	972	
Fluorene	1,744	1,563	1,673	
Phenanthrene	6,733	5,932	6,970	
Anthracene	1,779	1,547	1,758	
Di-n-butyl phthalate				28
Fluoranthene	3,666	3,468	4,152	
Pyrene	2,696	2,282	2,685	
bis-2-ethylhexylphthalate	959	926	2,494	
Benzo(a)anthracene	1,111	971	1,120	
Chrysene	1,046	852	1,100	
Benzo(b)fluoranthene	634	544	671	
Benzo(k)fluoranthene	263	240	312	
Benzo(e)pyrene	365	320	375	
Benzo(a)pyrene	605	506	623	
Perylene	114	106	120	
Indeno(1,2,3-cd)pyrene	182	164	185	
Dibenz(a,h)anthracene	83	83	70	
Benzo(g,h,i)perylene	220	184	214	

TABLE 3-5. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - ANALYTICAL RESULTS FOR EXTRACTION AND
RECYCLED SOLVENTS FOR THE ORG-X PROCESS [1,2]

	5 Stage Extraction Solvent MEPP-12-1	7 Stage Extraction Solvent MEPP-13-1	Continuous Extraction Solvent MEPP-14-1	Recycled/Distilled Solvent MEPP-18-1
Dioxins and Furans in pg/L (EPA 8290)				
2378-TCDD	291	277	368	
12378-PeCDD	309	311	410	
123478-HxCDD	289	283	346	
123678-HxCDD	896	862	1,100	
123789-HxCDD	428	456	586	
1234678-HpCDD	16,280	16,090	20,310	96
OCDD	164,460	151,490	191,300	911
2378-TCDF	3,090	3,130	3,980	22
12378-PeCDF	5,100	4,780	6,220	31
23478-PeCDF	1,600	1,540	1,940	12
123478-HxCDF	21,920	21,290	27,610	127
123678-HxCDF	**8,270**	8,120	10,080	46
234678-HxCDF	**2,020**	2,040	2,110	
123789-HxCDF	62	64	83	
1234678-HpCDF	100,430	100,540	112,160	571
1234789-HpCDF	1,380	1,620	1,810	15
OCDF	128,760	133,180	247,050	1,750
Totals: Dioxins				
-TCDD	2,430	2,360	3,230	*5*
-PeCDD	2,330	2,340	3,100	*12*
-HxCDD	7,340	7,730	9,710	18
-HpCDD	28,210	29,480	34,220	114
Totals: Furans				
-TCDF	42,570	39,800	51,950	158
-PeCDF	59,420	57,590	77,610	345
-HxCDF	89,960	85,900	112,030	464
-HpCDF	116,750	118,970	132,060	676
Volatile Compounds in ug/L (EPA 8240A; rev 1)				
Methylene chloride			9,307	8,087,994
Toluene	61,046	55,622	4,379	
Metals in mg/L (EPA 1131/3010/6010A)				
As	18.90	16.10	17.10	
Cr	22.10	22.30	24.90	
Cu	1.44	1.40	1.30	
Ni	13.80	16.70	10.10	
Pb	1.21	1.58	1.06	0.54
Sb	2.14	5.82		
Se	8.85	10.00	13.50	
Zn	10.10	8.50	6.94	

NOTES:

1. All contaminant concentrations are based upon Brookhaven's analytical results. Refer to Appendix D of this report for details.
2. Only analytes that were detected in at least one of the samples are reported. Only detected values are presented, nondetected values are not shown, and detected estimated values (below the instrument detection limit) are shown in **bold**.
3. Concentrations may be underestimated

TABLE 3-6. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - ANALYTICAL RESULTS OF ORG-X STRIPPER BOTTOM WASTE WATER [1,2]

	5 Stage Wastewater MEPP-16-1	7 Stage Wastewater MEPP-17-1	Continuous Wastewater MEPP-28-1
pH (EPA 9045A)	6.53		
Total Organic carbon in % (ASTM D4129-82M)			
	24.80		
Hydrocarbons in mg/L (EPA 3580/8015 Modified)			
	5.9		
Polychlorinated Biphenyls in ng/L (EPA MM680/HRGC/MS)			
244'-Tri # 28	**0.12**	0.31	0.75
22'55'-Tetra # 52	**0.06**	0.14	0.65
2344'5-Penta # 118	0.13		1.30
233'44'-Penta # 105			**0.39**
233'44'5-Hexa # 156			0.15
22'344'55'-Hepta # 180	0.45	2.16	**1.04**
22'33'44'55'-Octa # 194		0.38	0.22
PCB Totals:			
-Mono	**0.04**		
-Di		**0.22**	
-Tri	0.36		2.59
-Tetra	0.15		4.96
-Penta	0.34		6.57
-Hexa	0.46		4.17
-Hepta	0.59		1.02
-Octa			0.35
Semivolatile Compounds in ug/L (EPA 8270A)			
Phenol			
2-Methylphenol			**0.9500**
3/4-Methylphenol	**16.8300**		55.1600
Isophorone			10
Benzoic acid	**20**		
Di-n-butyl phthalate	**2.3**	**1.9**	**1.9**
bis-2-ethylhexylphthalate	400	582	353
Dioxins and Furans in pg/L (EPA 8290)			
123678-HxCDD			3.2
123789-HxCDD			3.7
1234678-HpCDD	**12.8**	21.5	33.4
OCDD	226.0	261.8	353.4
123478-HxCDF		**3.1**	
123678-HxCDF			*5.8*
234678-HxCDF	**6.5**	**4.1**	8.5
123789-HxCDF			**1.4**
1234678-HpCDF	9.2	8.6	71.2
1234789-HpCDF			**4.8**
OCDF	25.7	14.4	80.1
Totals: Dioxins			
-HxCDD			12.6
-HpCDD	11.3	37.8	57.0
Totals: Furans			
-TCDF			9.5
-PeCDF			24.0
-HxCDF	**6.5**		53.4
-HpCDF	9.2	12.0	90.7

TABLE 3-6 (cont'd). BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - ANALYTICAL RESULTS OF ORG-X STRIPPER BOTTOM WASTE WATER [1,2]

	5 Stage Wastewater MEPP-16-1	7 Stage Wastewater MEPP-17-1	Continuous Wastewater MEPP-28-1
Volatile Compounds in ug/L (EPA 8240A; rev 1)			
Carbon disulfide			1.0
Acetone	64	273	50
Methylene chloride			0.8
Benzene	3.0	7.0	
Toluene			2.2
Metals in mg/L (EPA 6010A and 7471)			
Ag			0.00
As		0.01	0.01
Cd		0.00	0.00
Cr		0.00	0.01
Cu		2.75	5.63
Ni		0.02	0.03
Pb		0.07	0.04
Sb			0.01
Se			0.00
Zn		0.14	0.14

NOTES:

1. All contaminant concentrations are based upon Brookhaven's analytical results. Refer to Appendix D of this report for details.
2. Only analytes that were detected in at least one of the samples are reported. Only detected are presented, nondetected values are not shown, and detected estimated values (below the instrument detection limit) are shown in **bold**.

TABLE 3-7. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT PLANT STUDY - ANALYTICAL RESULTS FOR THE SCREENED SEDIMENT FREE WATER AND ORG-X ACTIVATED CARBON [1,2]

	Screened Sediment Free Water MEPP-6-1	Activated Carbon MEPP-27-1
Polychlorinated Biphenyls in ng/L (EPA MM680/HRGC/MS)		
2-Mono Congener # 1	40.96	
44'-Di # 15	27.09	
244'-Tri # 28	133.70	
22'55'-Tetra # 52	48.59	
33'44'-Tetra # 77	5.39	
2344'5-Penta # 118	3.09	
233'44'-Penta # 105	25.40	
233'44'5-Hexa # 156	7.34	
22'344'55'-Hepta # 180	62.75	**0.04**
22'33'44'55'-Octa # 194	12.85	
22'33'44'55'6-Nona # 206	14.55	
Deca # 209	19.44	
PCB Totals:		
-Mono	69.02	
-Di	182.06	
-Tri	289.86	
-Tetra	350.00	
-Penta	342.01	
-Hexa	381.42	
-Hepta	229.97	**0.04**
-Octa	68.90	
-Nona	29.35	
Semivolatile Compounds in ug/L (EPA 8270A)		
Benzoic acid	**8.4**	
Naphthalene	54	14
2-Methylnaphthalene	25	
Acenaphthene	37	
Dibenzofuran	26	
Fluorene	45	
Phenanthrene	116	
Anthracene	32	
Di-n-butyl phthalate	**2.0**	87
Fluoranthene	70	
Pyrene	53	
bis-2-ethylhexylphthalate	33	131
Benzo(a)anthracene	**20**	
Chrysene	**16**	
Benzo(b)fluoranthene	**11**	
Benzo(k)fluoranthene	**3.2**	
Benzo(e)pyrene	**5.7**	
Benzo(a)pyrene	**9.9**	
Indeno(1,2,3-cd)pyrene	**2.6**	
Benzo(g,h,i)perylene	**2.6**	

TABLE 3-7. BROOKHAVEN NATIONAL LABORATORY INTEGRATED SEDIMENT DECONTAMINATION SYSTEM PILOT PLANT STUDY - ANALYTICAL RESULTS FOR THE SCREENED SEDIMENT FREE WATER AND ORG-X ACTIVATED CARBON [1,2]

	Screened Sediment Free Water MEPP-6-1	Activated Carbon MEPP-27-1
Dioxins and Furans in pg/L (EPA 8290)		
2378-TCDD	4.4	
12378-PeCDD	5.9	
123678-HxCDD	15.1	
123789-HxCDD	13.1	
1234678-HpCDD	284.8	**4.1**
OCDD	2215.2	43.0
2378-TCDF	58.2	
12378-PeCDF	74.6	
23478-PeCDF	**25.5**	
123478-HxCDF	387.0	**2.1**
123678-HxCDF	165.7	
234678-HxCDF	42.1	
1234678-HpCDF	1588.6	
1234789-HpCDF	48.8	
OCDF	1809.1	16.9
Totals: Dioxins		
-TCDD	34.1	
-PeCDD	17.1	
-HxCDD	126.9	
-HpCDD	509.6	**4.1**
Totals: Furans		
-TCDF	580.9	
-PeCDF	827.5	
-HxCDF	1403.7	3.3
-HpCDF	1711.6	
Volatile Compounds in ug/L (EPA 8240A; rev 1)		
Methylene chloride	1.2	
Metals in mg/L (EPA 6010A and 7471)		
Ag	0.02	
As	0.14	1.55
Be		0.36
Cd	0.03	
Cr	0.36	4.45
Cu	1.38	6.08
Ni	0.36	5.85
Pb	0.72	1.26
Sb	0.01	
Se	0.02	0.61
Tl	0.01	
Zn	1.61	4.44
Hg	0.02	

NOTES:

1. All contaminant concentrations are based upon Brookhaven's analytical results. Refer to Appendix D of this report for details.
2. Only analytes that were detected in at least one of the samples are reported. Only detected are presented, nondetected values are not shown, and detected estimated values (below the instrument detection limit) are shown in **bold**.

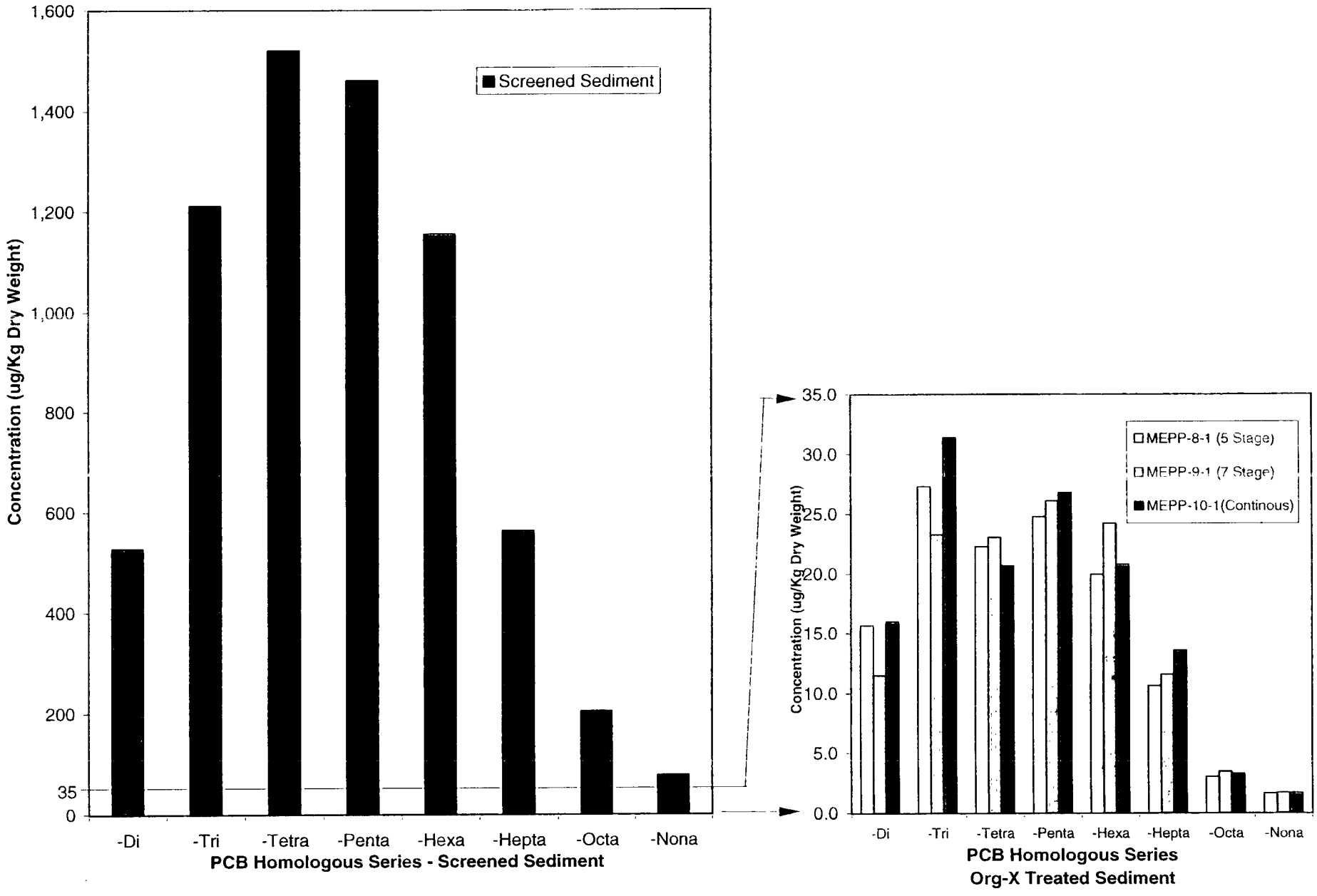


FIGURE 3-1. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT STUDY - TOTAL PCB REMOVAL BY THE ORG-X PROCESS

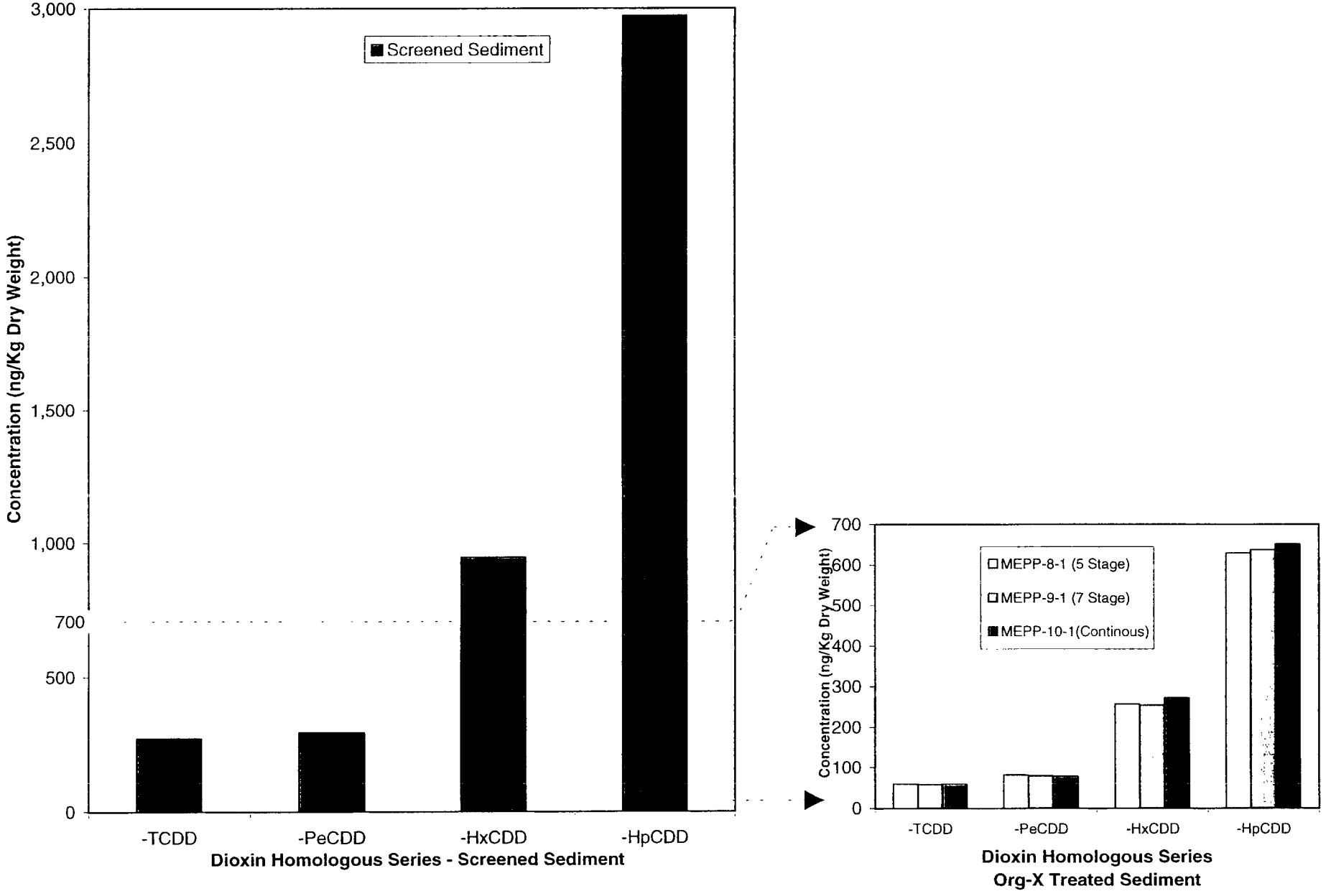


FIGURE 3-2. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT STUDY - TOTAL DIOXIN REMOVAL BY THE ORG-X PROCESS

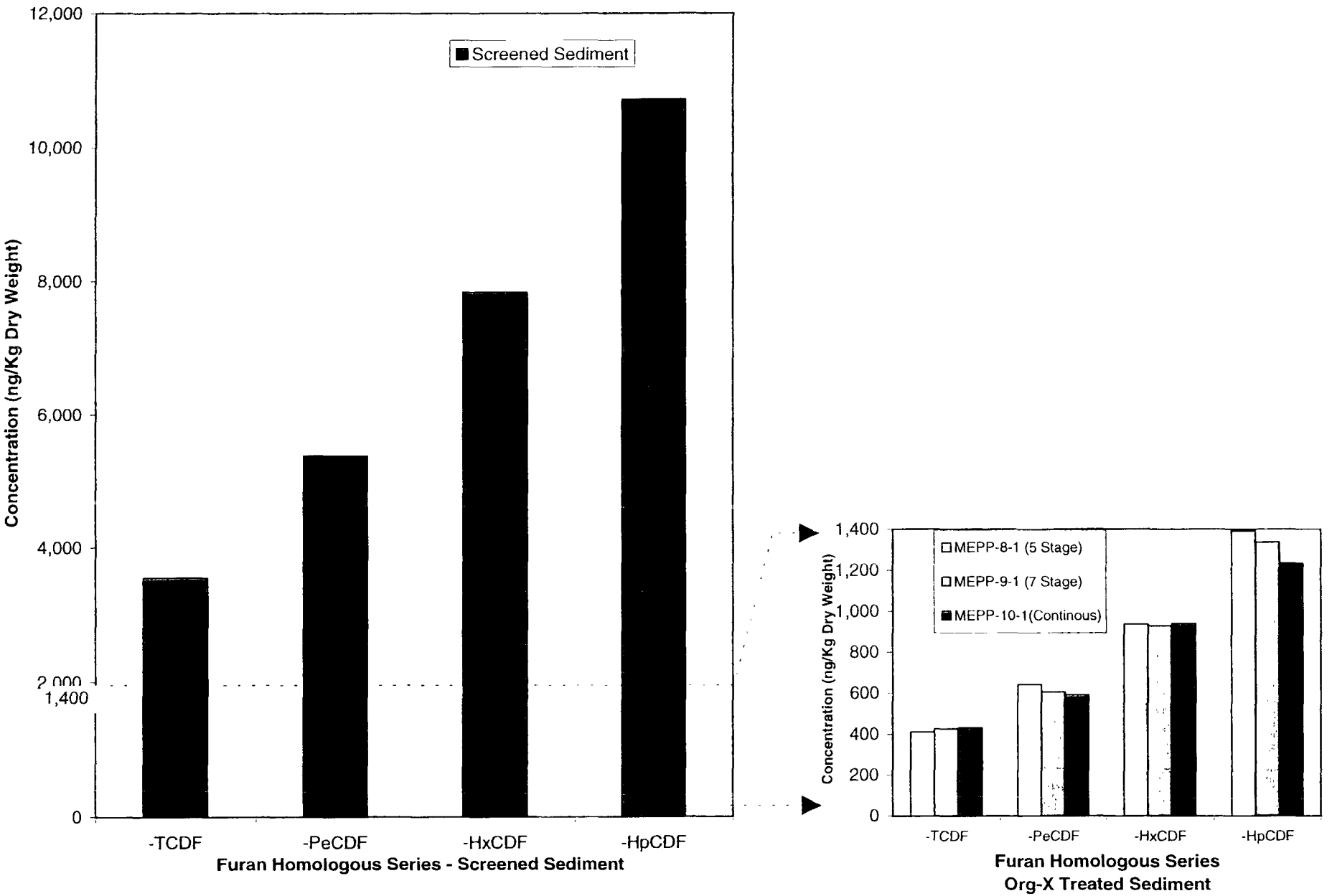


FIGURE 3-3. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT STUDY - TOTAL FURAN REMOVAL BY THE ORG-X PROCESS

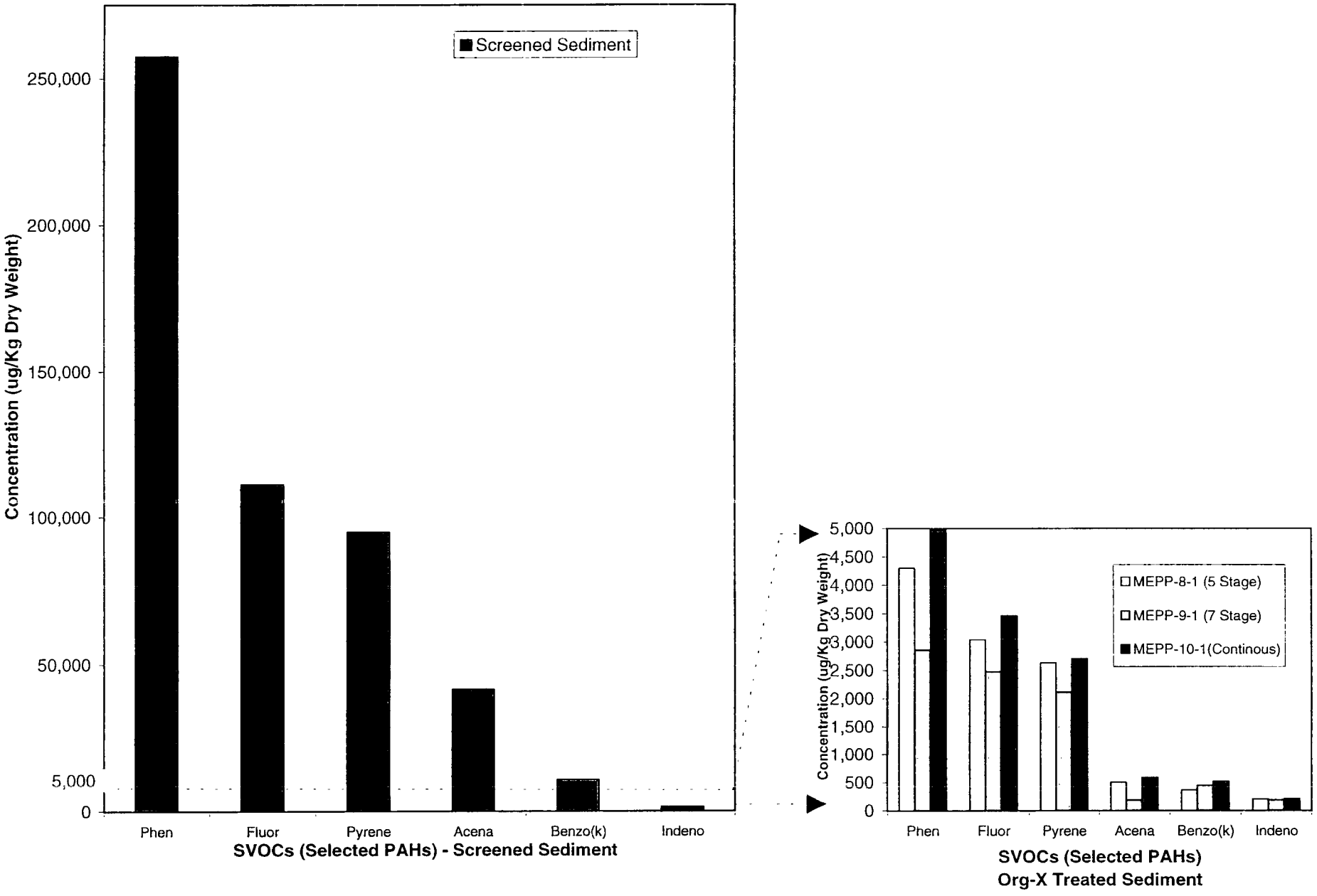


FIGURE 3-4. BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PILOT STUDY - SEMIVOLATILE COMPOUND (SELECTED PAHs) REMOVAL BY THE ORG-X PROCESS

FROM NY/NJ HARBOR

DREDGED SEDIMENT

HYDROSEP PLANT

CAPACITY: 1,667 CY/DAY WITH EXCESS WATER

OPERATION: 8 HOURS/DAY

FEATURES:

- GRIZZLY W/OVERSIZE WASHING
- 1/4 INCH SCREENING (DOUBLE DECK)

OVERSIZE SEDIMENT (1/4 INCH)- 5,000 TONS/YR (ESTIMATED)

OFF-SITE

CEMENT & BINDING AGENT

193 TONS/DAY

SOLFIX PLANT

ENGINEERED SOIL: 1470 TONS/DAY (W/7% MOISTURE LOSS)

STABILIZED SEDIMENT FOR CURING

SOLFIX WAREHOUSE

SIZE: APPROXIMATELY 200 FT x 400 FT x 30 FT HIGH (80,000 SF) WITH 20,000 SF OPERATIONS SPACE

SOLVENT #1

384 GAL/DAY

SOLVENT #2

72 GAL/DAY

ORG-X PLANT

OPERATION: 24 HOURS/DAY

CAPACITY: 1,650 TONS/DAY OF SCREENED SEDIMENT @35% SOLIDS

FEATURES:

(1) 5-STAGE COUNTERCURRENT CONTINUOUS EXTRACTION
(2) 1:1 SOLVENT TO SEDIMENT RATIO
(3) INDIRECT STEAM STRIPPING OF WASTEWATER

ORG-X TREATED SEDIMENT

1284 @45% SOLIDS TONS/DAY

CONCENTRATED ORGANICS TO BASE CATALYZED DECHLORINATION (BCD) OF CONTAMINATES

60 GPM

EXCESS SEDIMENT WATER (AFTER SEDIMENT DRYING AND WATER PURIFYING)

TO POTW

REV	DATE	DESCRIPTION	DRW	CHK	APP

METCALF & EDDY
BRANCHBURG, NEW JERSEY

BROOKHAVEN NATIONAL LABORATORY | METCALF & EDDY PROJECT NO. 3798.6

BROOKHAVEN NATIONAL LABORATORY
CONCEPTUAL BLOCK FLOW DIAGRAM FOR A FULL SCALE (500,000 CY/YR CAPACITY) INTEGRATED SEDIMENT DECONTAMINATION SYSTE

DRW	SP	DATE		SCALE:	NONE
CHK	TR	DATE	10/17/97	NO.	Figure 4-1
APP	JC	DATE			

SECTION 4
FULL-SCALE TREATMENT SYSTEM

4.1 DESIGN BASIS

M&E's pilot plant study with the Integrated Sediment Decontamination System (ISDS) showed that the ORG-X℠ process can effectively remove organics contaminants to a very low concentration. High contaminant removal efficiency (as high as 100 percent for some SVOC compounds) was accomplished for PCBs and semi-volatile organic compounds. The initial dioxin concentration in the raw/screened sediment was very low (in nanogram/kg level) and accordingly resulted in comparatively lower dioxin removal efficiency. The SOLFIX℠ process of the ISDS effectively immobilized heavy metals and the TCLP extract analysis showed very negligible leaching potential. The solidified material could be used as a general fill material, but could not be used as structural aggregate based upon the analytical results for the physical properties. The physical test results indicate that the high fine fractions (clay and silt) lead to air entrapment in solidified material and poor physical properties. It is believed that addition of a suitable binding agent would improve physical characteristics of the solidified materials. Additional studies need to be performed to optimize the binding agent requirements.

The pilot studies disposed of the concentrated organics at an off-site incineration facility because the amount of concentrated organics, produced from the pilot plant study, was very small. However, for a full-scale treatment system, it may be appropriate to incorporate an on-site base catalyzed dechlorination (BCD) facility to destroy the organics produced from the ORG-X℠ process to reduce costs and minimize long term liability. M&E's pilot plant test program did not include any BCD process. Accordingly, additional BCD optimization study would need to be performed before initiating a full-scale design. Based upon the pilot plant test results, it is believed that a sediment prescreening system comprising a grizzly and vibratory screens will be adequate. Based upon the pilot plant test results, the conceptual Block Flow Diagram and Process Flow Diagram of a full-scale ISDS is presented on Figures 4-1 and 4-2, respectively. All reagent

requirements for the ISDS process are based upon the pilot plant study results and the discussion presented in Section 3 of this report. The full-scale treatment system is expected to have only three waste streams discharged to the environment: (1) the (+)1/4-inch oversize debris; (2) the excess water from the ORG-X℠ process; and (3) the inert gas stream from the ORG-X℠ purging operation. The oversize debris will be disposed of at an off-site landfill after washing. It is assumed that a full-scale ISDS system would be installed at a well-developed location, and the excess water produced from ORG-X℠ stripper bottom operation would be discharged into a POTW facility. Therefore, the only permit that is envisioned for a full-scale ISDS system would be the air permit, although the air emission quantity is expected to be low.

Figure 4-3 shows the conceptual site layout for a full-scale ISDS. For the purpose of the conceptual layout, it was assumed that access roads all around the full-scale facility will be available for easy material movement. The conceptual site layout assumes 7 days storage for raw sediment and finished SOLFIX℠ products. It was also assumed that the site layout will permit close location of inter-dependent unit operations and unit processes to optimize material handling and processing. As shown on Figure 4-3, approximately 14 acres of land would be needed for a full-scale ISDS facility. It should be noted that the layout on Figure 4-3 includes sufficient space for the BCD unit to destroy the organics produced from sediment processing.

4.2 PROJECT AND ANNUAL O&M COST ESTIMATE

The projected full-scale ISDS facility capital and annual operation and maintenance (O&M) cost estimate was based upon the following assumptions.

- The site will be a developed parcel of land with easy access to roads/highways and utilities, such as electricity, POTW, and city water supply.

- The capital and O&M cost is based upon a pile-to-pile basis, and does not include costs for sediment dredging, transportation/unloading at the site, SOLFIX℠ solidified material loading and transportation.

- Electricity cost has been assumed to be $0.08 per kilowatt hour (kwh).

- Costs for the two solvents has been estimated at $2.50 and $2.00 per gallon.

- Cement bulk rate supply cost was estimated at $80 per ton. Cement addition rate was estimated at 15 percent of ORG-X℠ treated sediment.

- Plant maintenance cost has been assumed to be 4 percent of installed equipment cost.

- An annual interest rate of 10 percent and plant life of 10 years was considered for capital amortization.

- The project capital and the O&M cost estimate does not include costs associated with the BCD process. However, the planning level capital cost estimate considers a 30 percent contingency. The annual O&M cost provides a 15 percent contingency.

- The O&M cost estimate does not account for any financial return from the sale of finished SOLFIX℠ products.

Based upon the above assumptions, the estimated capital cost for a 500,000 cubic yards/year capacity ISDS system is estimated to be about $40 million. The treatment cost is expected to be about $56 per cubic yard of sediments processed through the ISDS process. Tables 4-1 and 4-2 present the planning level project capital and O&M cost estimates for a full-scale ISDS facility.

Based upon Tables 4-1 and 4-2, the capital and annual O&M costs for a 100,000 cubic yard per year capacity ISDS facility are estimated to be $16 million and $85 per cubic yard of sediment processing, respectively. The labor cost component for a 100,000 cubic yard plant was assumed to be the same as that of a full-scale (500,000 cubic yards/year) ISDS facility. It should be noted that BCD organic destruction process wastes could be used in the ISDS for cogeneration of power. However, optimization studies would need to be performed for the BCD process. Additionally, preliminary engineering needs to be performed to further refine the full-scale capital and O&M cost estimates.

TABLE 4-1

BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM (ISDS)
FULL-SCALE TREATMENT PLANT (500,000 cy/yr Capacity)
PLANNING LEVEL PROJECT COST ESTIMATE

1. EQUIPMENT AND ACCESSORIES			
o Sediment screening system with associated pumps and conveyors	=	$400,000	
o Org-X solvent extraction system with associated equipment	=	$14,500,000	
o Sediment solidification & stabilization system	=	$600,000	
o Warehouses and storage facilities, 120,000 sq. ft. @$40/sq. ft.	=	$4,800,000	
o Installation cost @7% of equipment cost	=	$1,085,000	
SUBTOTAL OF EQUIPMENT & ACCESSORIES		$21,385,000	= $21,385,000
2. NON-COMPONENT COST			
o Site preparation @3% of 1	=	$642,000	
o Instrumentation @3% of 1	=	$642,000	
o Electrical @5% of 1	=	$1,069,000	
o Yard and process piping @5% of 1	=	$1,069,000	
SUBTOTAL OF NON-COMPONENT COST	=	$3,422,000	= $3,422,000
3. Subtotal of items 1 and 2			= $24,807,000
4. Contractor's overhead and profit @12% of item 3			= $2,977,000
5. Subtotal of items 3 and 4			= $27,784,000
6. Contingency @30% of item 5			= $8,335,000
7. Subtotal of items 5 and 6			= $36,119,000
8. Engineering, Legal and Administrative expense @10% of item 7			= $3,611,900
9. Total Estimated Project Cost (Items 7 and 8) (Rounded to the nearest '000)			= **$39,731,000**

TABLE 4-2

BROOKHAVEN NATIONAL LABORATORY
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM (ISDS)
FULL-SCALE TREATMENT PLANT (500,000 cy/yr Capacity)
PLANNING LEVEL ANNUAL O&M COST ESTIMATE

1. LABOR AND CHEMICALS				
O 5 Operators per shift for 3 shifts/day @$50,000 per operator/yr.	=	$750,000		
O 1 plant manager and 1 plant chemist @$55,000/yr.	=	$110,000		
O Cement 57,900 tons/yr @$80 per ton	=	$4,632,000		
O Makeup Solvent #1 115,200 gallons/yr @$2.5 per gallon	=	$288,000		
O Makeup Solvent #2, 21,600 gallons/yr @$2 per gallon	=	$43,200		
SUBTOTAL		$5,823,200	=	$5,823,200
2. UTILITIES AND CONSUMABLES				
O 12000 kw per hr for 300 days @$0.08 per kwh	=	$6,912,000		
O Other consumables like nitrogen, gac, etc.	=	$500,000		
SUBTOTAL	=	$7,412,000	=	$7,412,000
3. Plant maintenance cost @4% of installed equipment cost			=	$800,000
4. Amortized capital cost @10% APR for 10 years plant life (PWF=6.145)			=	$6,470,000
5. Disposal of wastewater to POTW @$2/1000 gal for 60 gpm flow			=	$52,000
6. Disposal of oversize materials, 5,000 tons/yr @$100/ton			=	$500,000
7. Subtotal of items 1 to 6			=	$21,057,200
8. Contingency @15%			=	$3,158,600
9. Contractr's Overhead and profit @15% of 7 and 8			=	$3,632,000
10. Total Estimated Annual O&M Cost (Items 7+8+9) (Rounded to the nearest '000)			=	**$27,848,000**
11. Sediment Treatment cost per CY			=	**$55.70**

RAW SEDIMENT
SPRAY WATER
VG-100
VIBRATOR/GRIZZLY
(+1 INCH)
(+1/4 INCH)
S-100A/B
VIBRATORY OR ROTARY
WET SCREENS
OVERSIZE DEBRIS
STOCK PILE
SOLVENT MIX
FROM T-203
E-200 A-G
MIXER/SETTLER
EXTRACTOR
NOTE:
E-200 B,C,D,E,F,G
NOT SHOWN
CEMENT SUPPLY
T-251 A/B
CEMENT SILOS
CV-250 A/B
CEMENT CONVEYORS
TREATED
SEDIMENT
TO MX-250
P-210
DRYER
PUMP
DR-200 A/B
SEDIMENT
DRYER
MX-250
PUG MILL
G-250
SOIL WAREHOUSE
SOLIDIFIED SOIL
STOCKPILE
SOLIDIFIED SOIL
STOCKPILE
TRUCK
FEED CONVEYOR
TO OFFSITE
BACKHOE OR
FRONT END LOADER
VIA TRUCK
5,000 GAL
T-201
SOLVENT "A"
TANK
(5,000 GAL CS)
P-201
PUMP
RECYCLE
SOLVENT
X-203
SOLVENT
HEATER
SM
OIL
T-203
SOLVENT
MIX/RECYCLE
TANK
(20,000 GAL CS)
P-203 A/B
PUMP
VIA TRUCK
5,000 GAL
T-202
SOLVENT "B"
TANK
(5,000 GAL CS)
P-202
PUMP
X-210 A/B
DISTILLATION
CONDENSER
REFLUX
CWR
CWS
C-210
DISTILLATION
COLUMN
X-220
STRIPPER
CONDENSER
X-200
DRYER
CONDENSER
T-210
SOLVENT
EVAPORATOR
F-200 A/B
BAG
FILTER
SM
X-211
REBOILER
CL
P-210
EVAPORATOR
PUMP
RECYCLE
SOLVENT
T-220
DECANTER
WASTEWATER
T-215
WASTEWATER
FEED
TANK
X-216
WASTEWATER
HEATER
SL
C-220
WASTEWATER
STRIPPER
X-217
WASTEWATER
REBOILER
X-215
WASTEWATER
INTERCHANGER
P-215
STRIPPER
PUMP
P-217
WASTEWATER
REBOILER
PUMP
T-205A/B/C
WASTEWATER
CHECK TANKS
(5,000 GAL
EACH)
TO POTW
P-205 A/B
PUMP
T-204A/B
WASTE OIL
TANKS
(5,100 GAL
EACH)
P-204 A/B
PUMP
TO BCD PROCESS
VENT
VENT
COLLECTION
SYSTEM
G-220
CARBON ADSORPTION &
SOLVENT RECOVERY
SYSTEM
SL
X-241
OIL POLISHER
/COOLER
T-240
OIL POLISHER
EVAPORATOR
SH OR HOT OIL
X-240
WASTE
OIL
REBOILER
WASTE OIL
NITROGEN
VIA TRUCK
5000 GAL/TRUCK
T-206
NITROGEN
TANK
5,000 GAL
TO
PURGE
SYSTEM
X-206
NITROGEN
EVAPORATOR
150-300 psi SH
50-150 psi SM
0-50 psi SL
U-300 A/B
STEAM
BOILERS
NG
OFF-SITE
WATER
OFF-SITE
CONDENSATE
RETURN (CL)
CWS
CWR
U-301 A/B
COOLING
WATER
TOWERS

ORG-X PLANT
1650 TONS/DAY OF
SCREENED SEDIMENT @ 35% SOLIDS

REV	DATE	DESCRIPTION	DRW	CHK	APP

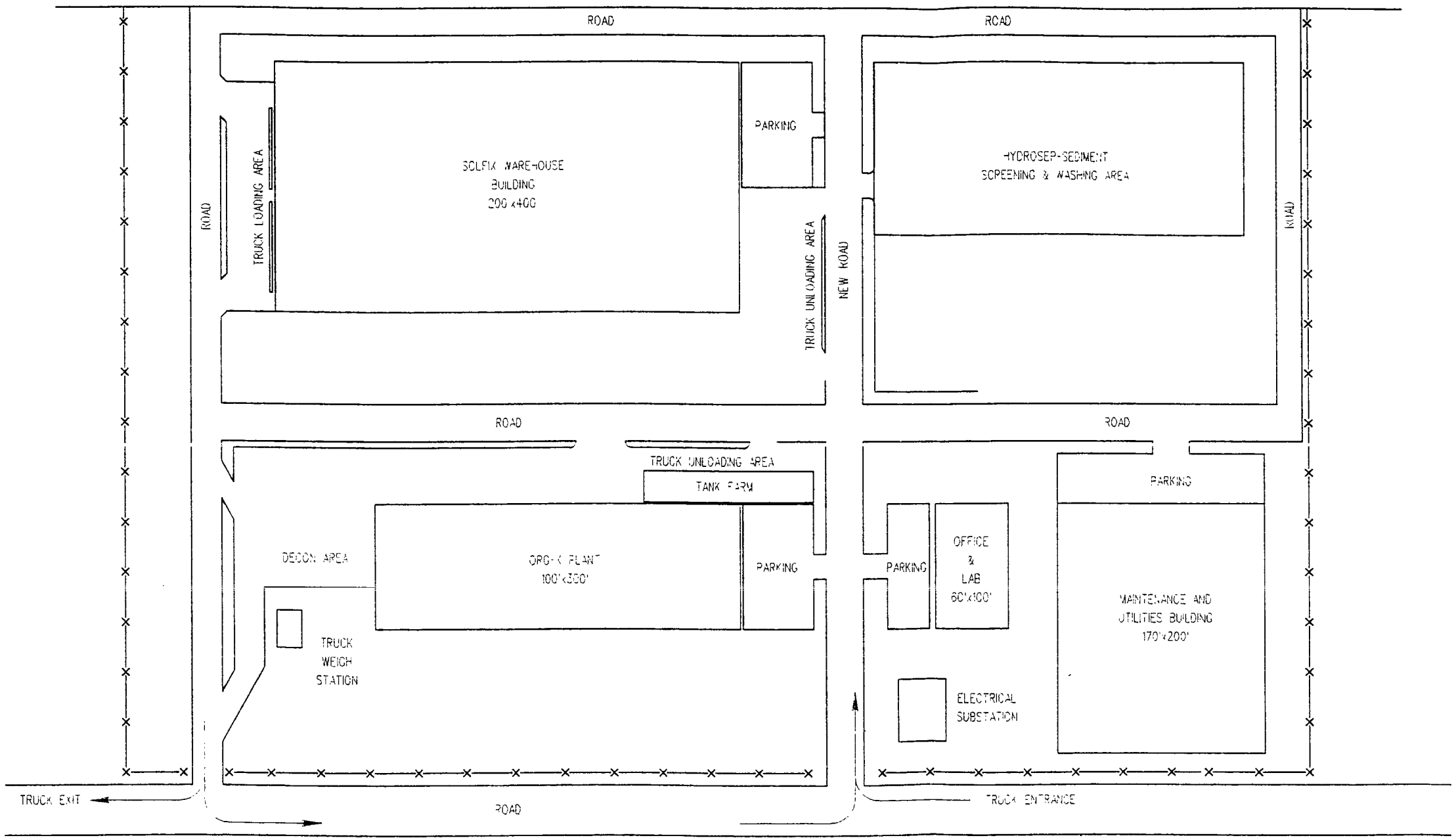
METCALF & EDDY
BRANCHBURG, NEW JERSEY

BROOKHAVEN NATIONAL LABORATORY

METCALF & EDDY
PROJECT NO. 019816

BROOKHAVEN NATIONAL LABORATORY
CONCEPTUAL PROCESS FLOW DIAGRAM FOR A
FULL SCALE (500,000 CY/YR CAPACITY)
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM

DRW	BP	DATE		SCALE: NONE
CHK	TR	DATE	10/17/97	NO. Figure 4-2
APP	JC	DATE		



SITE PLAN
SCALE: 1"=100'

NOTE
SITE AREA = APPROXIMATE 13.63 ACRES

RE.	DATE	DESCRIPTION	DRW	CHK	APP

METCALF & EDDY
BRANCHBURG, NEW JERSEY

BROOKHAVEN NATIONAL LABORATORY

METCALF & EDDY
PROJECT NO. 21[illegible]

BROOKHAVEN NATIONAL LABORATORY
CONCEPTUAL SITE LAYOUT FOR A
FULL SCALE (500,000 CY/YR CAPACITY)
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM

DRW	BP	DATE	
CHK	TR	DATE	10/17/97
APP	JC	DATE	

SCALE: AS NOTED
NO. Figure 4-3

APPENDIX A

WORK PLAN FOR METCALF & EDDY'S INTEGRATED SEDIMENT DECONTAMINATION SYSTEM

WORK PLAN
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1.0 INTRODUCTION

1.1 GENERAL

Under a contract with Brookhaven National Laboratory, Metcalf & Eddy has been contracted to plan and execute a pilot plant study to decontaminate sediments from Newtown Creek using its Integrated Sediment Decontamination System.

This introduction, Section 1, continues with a brief summary of the project background and bench-scale treatability results. Then it presents the project objectives, project schedule and project organization. Section 2 presents the general process description. Section 3 discusses the site preparation and set-up of the pilot plant. Section 4 revisits the processes and presents a more detailed description of the pilot plant. Section 5 describes the process monitoring plan and data collection using field instruments and other measuring devises. Section 6 lists the sampling plan and analysis requirements. Section 7 discusses the environmental effects and controls as well as waste management. The last section, Section 8, describes the decontamination and demobilization procedures.

1.2 BACKGROUND

Sediments from the New York/New Jersey Harbor areas are dredged routinely to maintain navigable water depths for shipping channels and berthing areas to facilitate commerce and safe navigation. Historically, the dredged materials were disposed in the ocean. However, ocean disposal has been restricted due to greater regulatory restrictions on contaminant concentrations in the dredged sediments. The dredged sediments typically contain elevated levels of metals, polynuclear aromatic hydrocarbons (PAHs) (tars, oils, fuels), polychlorinated biphenyls (PCBs), chlorinated pesticides and herbicides, dioxins (PCDDs), and furans (PCDFs).

Section 405 of the Water Resources and Development Act of 1992 has authorized evaluation of technologies for decontaminating dredged sediments and/or potential reuse of the treated materials. Accordingly, the Brookhaven National Laboratory (BNL), in support of the U.S. Army Corps of Engineers, New York District (COE-NYD), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE), contracted Metcalf & Eddy and six other contractors to perform bench-scale treatability studies to identify cost-effective remedial alternatives for decontamination of the dredged sediments.

To date, all bench-scale treatability tests have been completed and some Phase II pilot-plant tests are underway.

1.3 SUMMARY OF BENCH-SCALE TEST RESULTS

Metcalf & Eddy (M&E) completed the bench-scale treatability tests to evaluate its proprietary technologies to treat contaminated dredged sediment. The objectives of the bench-scale test were:

- to demonstrate the feasibility of decontaminating the dredged estuarine sediments from Newtown Creek, which is representative of sediment from various areas of the New York and New Jersey Harbor system;

- to produce useful, recyclable end-products; and

- to optimize and determine process information for the operation of a pilot plant and generate design information for operating and capital costs for large-scale production plants.

The three sequential Integrated Sediment Decontamination System (ISDS) technologies are:

- HYDRO-SEP℠: a soil washing process to produce clean, larger-size fractions and reduce the quantity to be treated by downstream operations;

- ORG-X℠: a solvent extraction process to remove organic contaminants; and

- SOLFIX℠: A solidification/stabilization process for reducing the leaching properties for inorganic contaminants and for improving strength and erosion properties of the end-products.

The integration of the three technologies effectively allows the treatment of sediment feedstocks with different physical and/or chemical characteristics. The harbor sediments are usually contaminated to various degrees with heavy metals, pesticides, polycyclic aromatic hydrocarbons (tar, oil, fuels), polychlorinated biphenyls, dioxins, and furans. In the past, the dredged sediment was disposed in the ocean. Presently, however, more stringent testing requirements and recent regulations have significantly reduced the amount of sediment for ocean disposal. The remainder will soon require remedial solutions on a large, industrial scale.

The bench-scale tests conducted at the GRS facility in Paris, France, were completed in late 1995 and early 1996 for:

- the ORG-X℠ process;

- the SOLFIX℠ process to directly stabilize the raw sediment; and

- the SOLFIX℠ process to stabilize the ORG-X℠ product.

The HYDRO-SEP℠ washing tests were not performed as the sediment contained less than 0.4 percent of material greater than 2mm, on the low side of the expected 0.1-34.4 percent

range for the Newtown Creek sediment.

The results are very encouraging as the ORG-X℠ process significantly reduces the undesirable organic contaminants and the SOLFIX℠ process stabilizes and solidifies the material into useful products.

ORG-X℠ Process: The ORG-X℠ process reduced the organics as follows using three countercurrent solvent extraction stages:

GRS RESULTS

Light hydrocarbons (up to C_{18})	99.9%
Medium-weight hydrocarbons	86%
Total hydrocarbons	91%
Heavy hydrocarbons	92%
Residual carbon	37%
Total organic carbon	30%

BNL RESULTS

PCBs (total)	79 - 92%
Pesticides	94 - 98%
Chlorinated herbicides	See Note a
Semi-volatile organics	47 - 91%
Dioxins	See Note b
Furans	See Note b

Notes:
a) Not calculable but significant amount in spent solvent.
b) Not meaningful because most figures were low and less than the Minimum Detection Limit (MDL).

Sometimes the percent removal could not be calculated because the concentration was below the minimum detection limit for both the new sediment and the product, or because the input

and output materials did not balance when the concentrations and accuracy were very low. For example, the spent solvent contained 61-84% of the initial total dioxin/furan groups.

M&E did not have the benefit of the BNL analytical results during the bench-scale tests. M&E strongly believes the percent removal of most contaminants can be increased with inexpensive process improvements during the pilot phase. The recommended operational changes in the draft report were:

- Use continuous countercurrent extraction with more than three stages;
- Use warm/hot recycle solvent;
- Use a higher solvent-to-sediment ratio; and
- Use a mixture of closely related solvents with the same equipment.

SOLFIX℠ Process: The SOLFIX℠ process produced solid products of a desirable unconfined compressive strength (UCS) at low reasonable reagent/additive costs. The solid product also exhibits lower permeability and higher erosion resistance than the soil/sediment product from ORG-X℠. The mixture quantities can be varied and accelerators can be added to attain other desirable features, such as a less strong material that cures quickly at minimum cost. The results are summarized below:

	UCS by GRS	UCS by BNL
Direct SOLFIX℠ product	728 psi	102 psi
ORG-X℠ plus SOLFIX℠ product	600 psi	487 psi

The leaching properties were very low for both the raw sediment as well as the three products produced by the study. The TCLP results for PCBs were significantly less for the ORG-X℠ product. The reduction range was 45% to > 99% for the individual and group totals.

Both the ORG-X℠ and SOLFIX℠ processes have been sufficiently adapted to continue with

the pilot plant program. This report contains process block diagrams, material balances, process study, and project management information.

Costs and Commercialization

The operating costs were also estimated for continuous production plants with state-of-the-art process control. The costs are tabulated below for the three different process combinations that would be applicable depending on physical characteristics, removal of organics and/or metals, and production capacity.

PROCESS	PRODUCTION-SCALE PLANT (100,000 cy/yr)	FULL-SCALE PLANT (500,000 cy/yr)
HYDRO-SEP℠ and SOLFIX℠	$54/cy	$44/cy
HYDRO-SEP℠ and ORG-X℠	$64/cy	$45/cy
HYDRO-SEP℠ and SOLFIX℠	$80/cy	$67/cy

Notes:
1. HYDRO-SEP℠ separates and treats oversize particles estimated at 10% of raw sediment. The other 90% is treated by the subsequent process(es).
2. Organic waste product does not contain regulated dioxin quantities. It is unlikely that it will cost an additional $40/cy to incinerate at $2.00/lb, if regulated (when the Total Equivalent Toxicity Factor [TETF] >1 ppm).

The ultimate development of a full-scale decontamination facility will probably require private/public partnering to provide adequate funding and a willing host community for a site. Other key factors involved in the full-scale project are:

- Provision of a reliable dredged material supply;

- Characterization of the quantity, physical and chemical characteristics of the supply to allow for a realistic estimate of the processing costs;

- Specifications and criteria for use of recycled material; and

- Incentives for creating an end-market for recycled materials.

1.4 PROJECT OBJECTIVES FOR PILOT-PLANT TEST

The objectives of the pilot-plant testing program are as follows:

- Demonstrate that the three technologies can decontaminate pilot-scale quantities (up to 10 cubic yards) of dredged estuarine sediments from Newtown Creek, which are representative of sediments from various areas of the New York and New Jersey Harbor system.

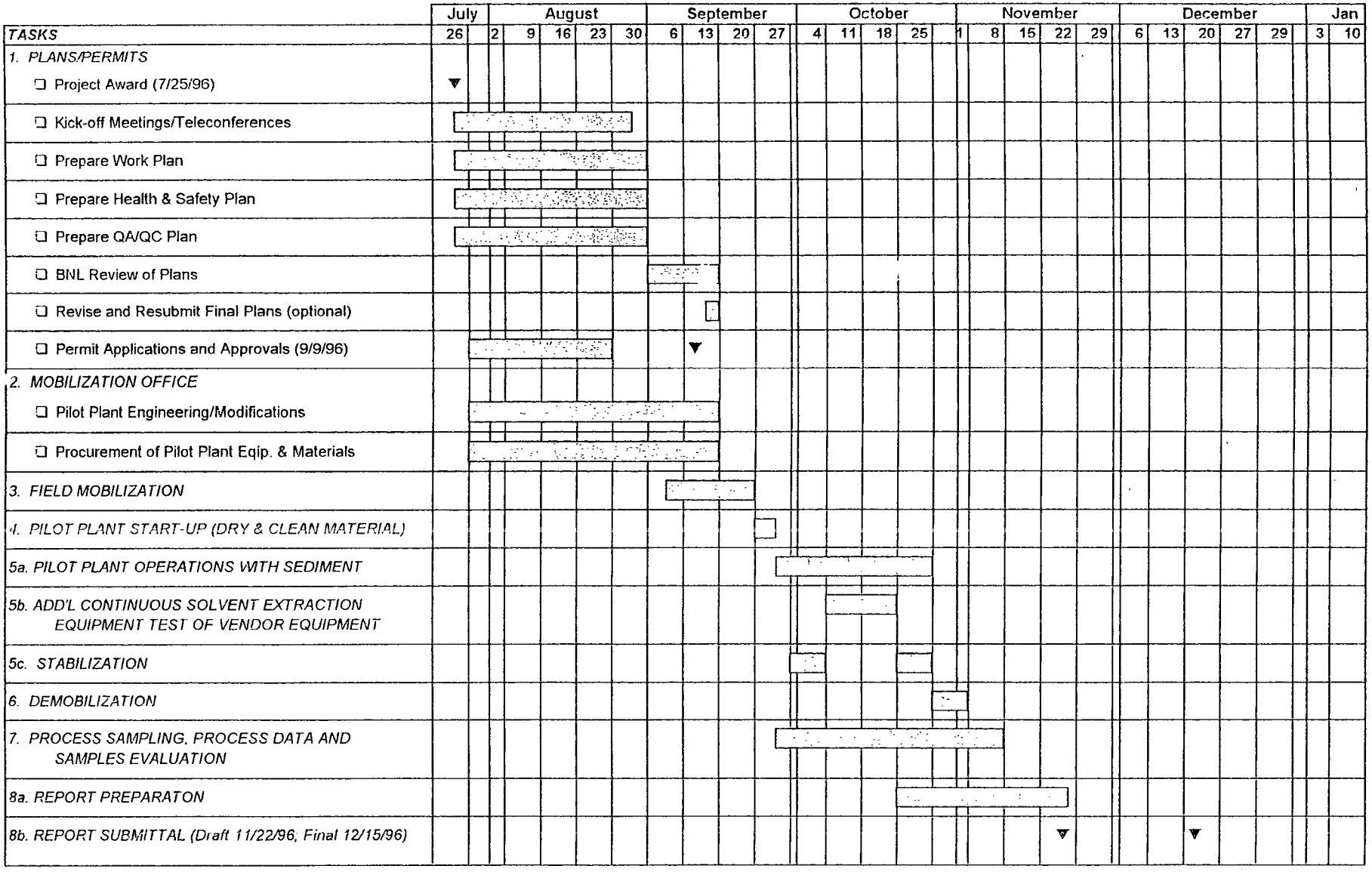
- Provide additional technical process data for a preliminary engineering design of a commercial facility.

- Continue to optimize the process parameters using various runs.

- Generate information leading to a preliminary engineering design to better estimate the capital and operating costs for the proposed 100,000 cy/yr production plant and 500,000 cy/yr full-scale plant.

1.5 SCHEDULE FOR PILOT PLANT TEST

The project was awarded on July 25, 1996. Figure 1-1 presents a schedule that shows the start and duration of these major tasks:



Metcalf & Eddy

SCHEDULE FOR PHASE II PILOT-SCALE PLANT TEST PROGRAM

M&E Integrated Sediment Decontamination System

Figure 1-1

- plans/permits
- mobilization office
- field mobilization
- pilot plant start-up
- pilot plant operations with sediment
- demobilization
- process sampling, process data and sample evaluation
- report preparation and submittal

During field mobilization, the sediment in the roll-offs will arrive on September 17, 1996. After check-out and start-up with water, the initial screening of feed sediment will begin either late the week ending September 20, 1996 or early the week ending September 27, 1996.

The processing of sediment in the ORG-X℠ and SOLFIX℠ plants will be 3-5 weeks in late September and October 1996. After evaluation of data collected, a draft report is scheduled to be issued to BNL on November 22, 1996. The final report is scheduled for completion on December 15, 1996, if all BNL comments and all BNL sample analytical work by BNL is received per this proposed schedule.

1.6 PROJECT ORGANIZATION FOR THE PILOT PLANT TEST

Metcalf & Eddy's organization for the pilot-scale test has been refined and is shown in Figure 1-2. BNL is the client with overall contractual management. The project director for BNL is **Dr. Keith W. Jones**. BNL will be assisted by New Jersey Institute of Technology (NJIT) to manage and coordinate the overall site activities. NJIT is represented by **Professor William Librizzi, Robert Emery** and **Jeff Duteau**. Also, other New York/New Jersey Universities (Rensselaer, Rutgers and Steven's Institute of Technology), the U.S. Army Corps of Engineers, New York District (COE-NYD), the U.S. Environmental Protection Agency (EPA),

and the U.S. Department of Energy (DOE) will be conducting the process evaluation.

The M&E project team will be lead by **John Henningson**, who will serve as project director and provide direct liaison with BNL. The project work will be managed from M&E's office in Branchburg, New Jersey, which is within an hour's drive of BNL, the participating universities, and the proposed pilot sites. The daily project management will be provided by **Philip DiGasbarro**, who will coordinate the preparation of plans, the field mobilization of pilot equipment, the operation of the pilot plant and the preparation of the report.

The following personnel are committed to this project. Most of the resumes were provided earlier and can be provided again upon request.

John Henningson is the director of the M&E New York office. He has extensive experience in managing and directing various wastewater treatment and hazardous waste projects. He has also directed staff to conduct engineering studies and construction of various sediment treatment projects.

Philip DiGasbarro will serve as project manager, site manager and back-up (alternate) Site Health and Safety Officer, and will interface and work closely with the BNL project team. He has managed numerous projects to design and construction, including chemical, solvent extraction, and hazardous waste incineration plants. He completed the BNL bench-scale project as well as the treatability tests on thermal desorption/BCD of soils from a former pesticide site. Last year, he was the process engineering manager for the pilot operation of M&E's HYDRO-SEP℠ soil washing remediation technology.

The members of the Technical Advisory Team, **Dr. Edward Cichon, Neville Chung, Pier Mantovani, Georges Pottecher**, and **Michael Dennis**, have extensive experience in remediation technologies and numerous other environmental fields, and can provide advice as needed. **Georges Pottecher** conducted the bench-scale tests of the Newtown Creek sediment

in France. He has also managed the development and commercialization of the ORG-X℠ solvent extraction technology.

Tushar Roy will serve as the process engineering manager and operator for the operation of the pilot-scale plant. He has related experience designing both pilot- and/or full-scale wastewater treatment and soil washing/leaching plants.

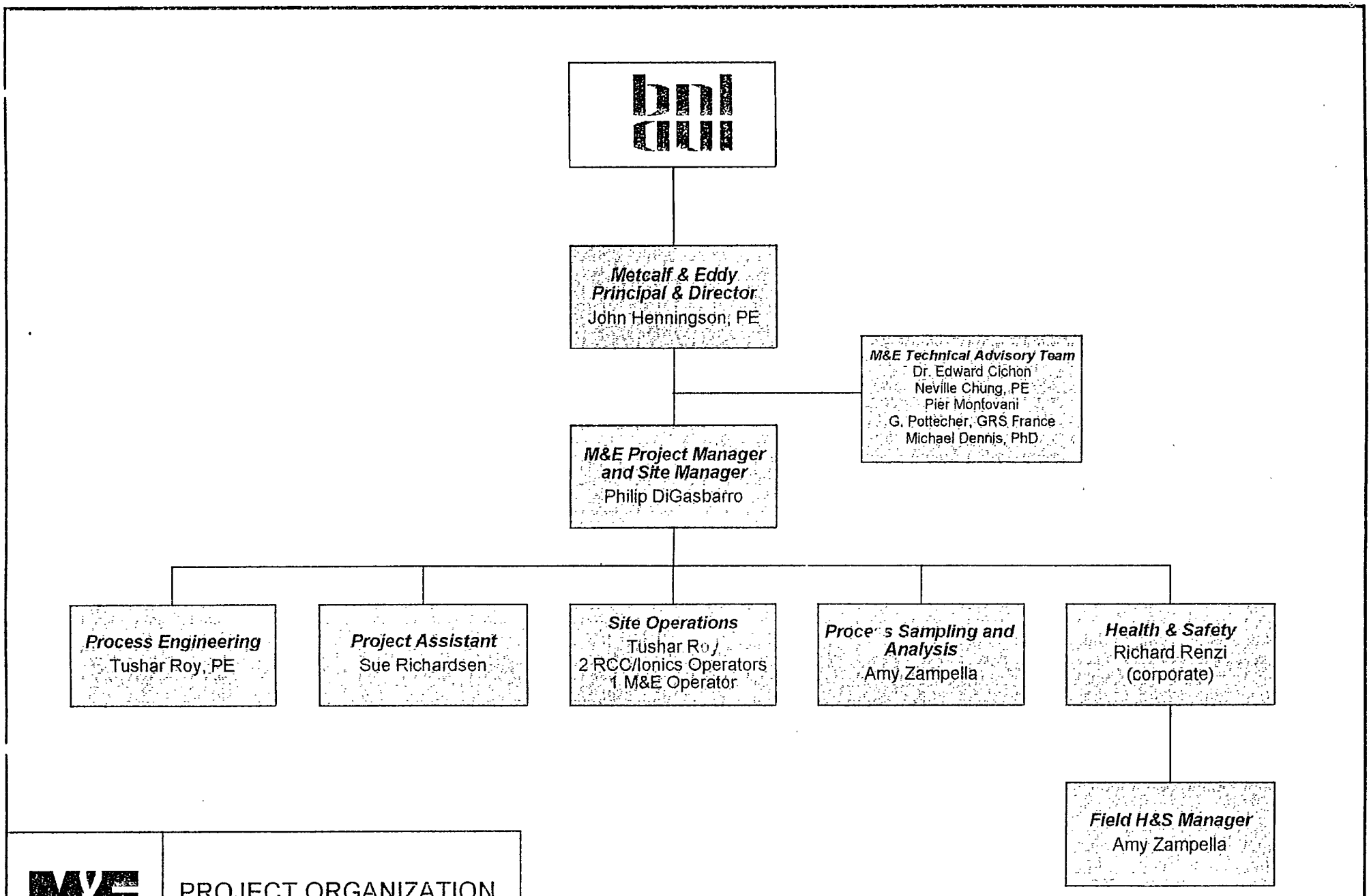
Michael Dennis is a project chemist who is available for consultation on the design of the analytical program, the QA/QC measures, and the review and validation of analytical data.

Amy Zampella will coordinate the collection, analysis and evaluation of laboratory samples. She and **Tushar Roy** will perform some of the process control laboratory tests in the field. Amy will also be the Field Health and Safety Officer.

Richard Renzi is the corporate health and safety officer who will review the Health and Safety Plan prepared by the team.

Sue Richardsen is the project office assistant who will work both in the field and at the M&E Branchburg office.

Two RCC/IONICS field employees, **Steven O'Laughlin** and **Robert Weisner,** will perform various tasks to mobilize, operate, maintain and demobilize the pilot plant systems. They report to the RCC office Project Manager, **Dale Owens.** The two RCC field employees will jointly operate the process units with the M&E employees. **John Williams** is another M&E operator, who will operate the field equipment such as the extendhoe and mortar mixer.



M&E
Metcalf & Eddy

PROJECT ORGANIZATION FOR PILOT-SCALE TEST PROGRAM

Figure 1-2

2.0 PILOT PLANT MOBILIZATION

Figure 2-1 shows the site location at Building 141 (warehouse), Suez Street, Port Newark, New Jersey 017114. Figures 2-2 and 2-2a show the overall plot plan and enlarged plot plan of the site with the mobilized items. M&E (with the assistance of BNL and the New Jersey Institute of Technology [NJIT] will mobilize a temporary office trailer/command center including sanitary facilities, potable water, telephone, fax, copier, electrical and water service to the physical plant and support equipment. M&E will delineate support zones, contamination reduction zones, and exclusion zones. M&E will also delineate the "explosion-proof" zone, which is a 50-foot boundary from the solvent extraction systems. M&E will also calibrate air monitoring and site instrumentation. M&E will mobilize pressure washing equipment, decon equipment, backhoe, drum mover, and other small equipment and tools for use in material handling.

The batch pilot plant, continuous pilot system and maintenance trailer will be installed in the east side of the 200-foot by 460-foot by 20-foot high empty warehouse. The feed sediment material will be stored in two 8' x 11' x 3' roll-off boxes inside the warehouse prior to treatment. Other raw materials to be used by M&E will be stored/staged inside the warehouse or inside the fenced area for a NJIT project.

Construction of the pilot plant by RCC/IONICS and M&E will involve unloading skid-mounted, solvent-extraction processing modules, then interconnecting the electrical, piping and mechanical systems. The continuous solvent extraction system is mounted on a skid and will be adjacent to the batch/continuous plant. Drums of solvents will be stored outside the building in a designated fenced area.

The various work areas will include HDPE or PVC tarps with berms to collect any potential spills. The batch/continuous system also has a containment pan under the equipment.

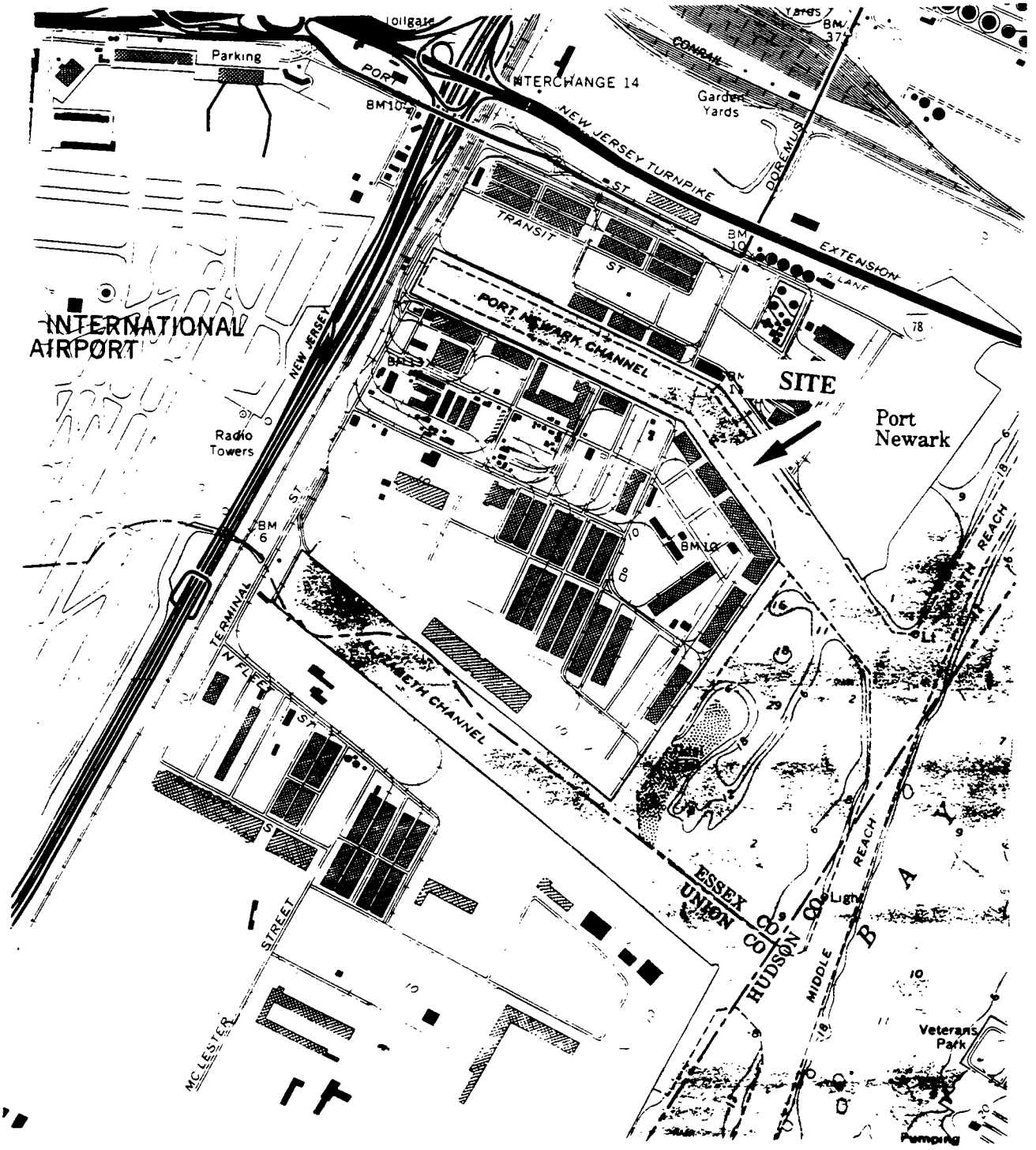
Start-up of M&E's portion of the pilot plant will involve:

- Energizing and testing the screening solvent extraction and stabilizing systems/equipment for correct function.

- Checking that all other support equipment such as conveyors, agitators, pumps, scales, etc. are functioning when energized.

- The equipment/systems will be either run dry or with air, water, or steam if used during processing.

Exclusion zones will be set up and marked inside and outside the warehouse. An explosion-proof zone will be marked on the floor with paint around the solvent extraction pilot system, within the exclusion zone.



Prepared for: Brookhaven National Laboratory Upton, N.Y.	Prepared by: Metcalf & Eddy, Inc. P.O. Box 1500 Somerville, NJ 08876
SITE LOCATION ON USGS TOPO MAP BNL Pilot Study - Newark, NJ	
August 1996	Figure 2-1

L

PORT NEWARK WATERWAY

DOCK

BUILDING 145

BUILDING 152

ROOF OVERHANG

ACTIVE PHONE

PERSONNEL DOORS (6) TYPICAL

WASH SINK

2" CITY WATER STATION

TWO PORTABLE TIOLETS

BUILDING 141

OFFICE TRAILER

MAIN VISITOR ENTRANCE

ELECTRICAL POWERBREAKERS AND TRANSFORMER

STACK #002 GENERATOR

M&E ELECTRICAL PANNEL

500 GALLON DIESEL TANK

CONTINUOUS PILOT SYSTEM

ROLL-OFF STAGING AND FEED PREP AREA

STACK #001 THROUGH ROOF

RUPTURE DISC THROUGH ROOF

INACTIVE PHONE

SCREENING

48" DIAMETER FAN UNDER GARAGE DOOR

CEMENT BAGS PALLET

CITY WATER STATION

BATCH PILOT PLANT

MAINTENANCE TRAILER

SINK

3/4" ID HOSE ALONG FLOOR

PRODUCT CURING AREA

MIXER

WASTE WATER HOSE

RAMP

GARAGE DOOR (TYPICAL)

PLATFORM

RAMP

10,000 GALLON FRAC CS TANK

ALCOHOL DRUM STORAGE

ACETATE DRUM STORAGE

GATE

FENCED TEST PLOT AREA (FOR NJIT PROJECT)

LEGEND

- WATER HYDRANT
- PILLAR
- ENLARGED AREA (SEE FIGURE 2)
- FENCE
- ELECTRICAL CORDS
- TERTIARY CONTAINMENT LINER

SALT PILE

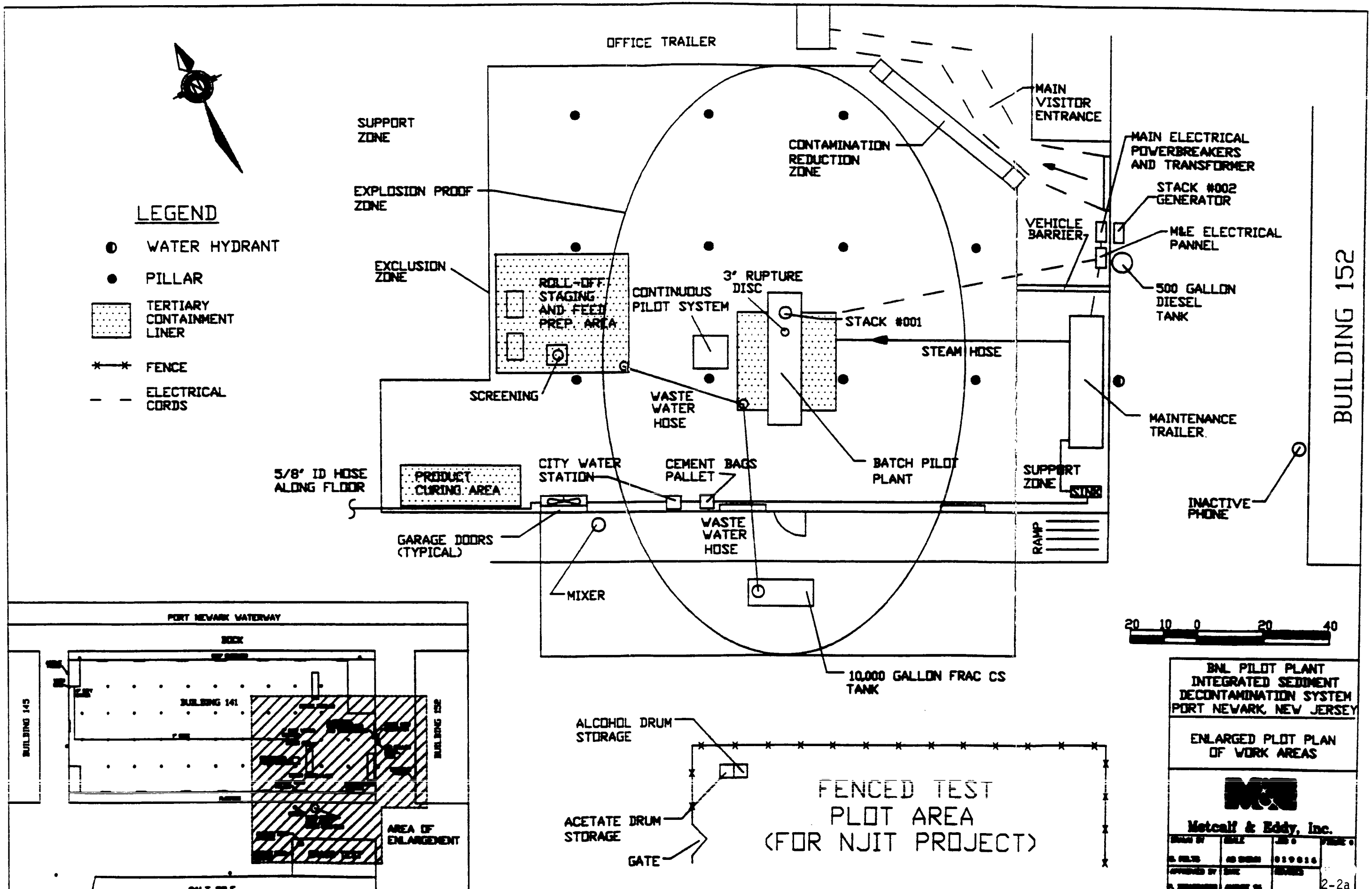
20 10 0 20 40

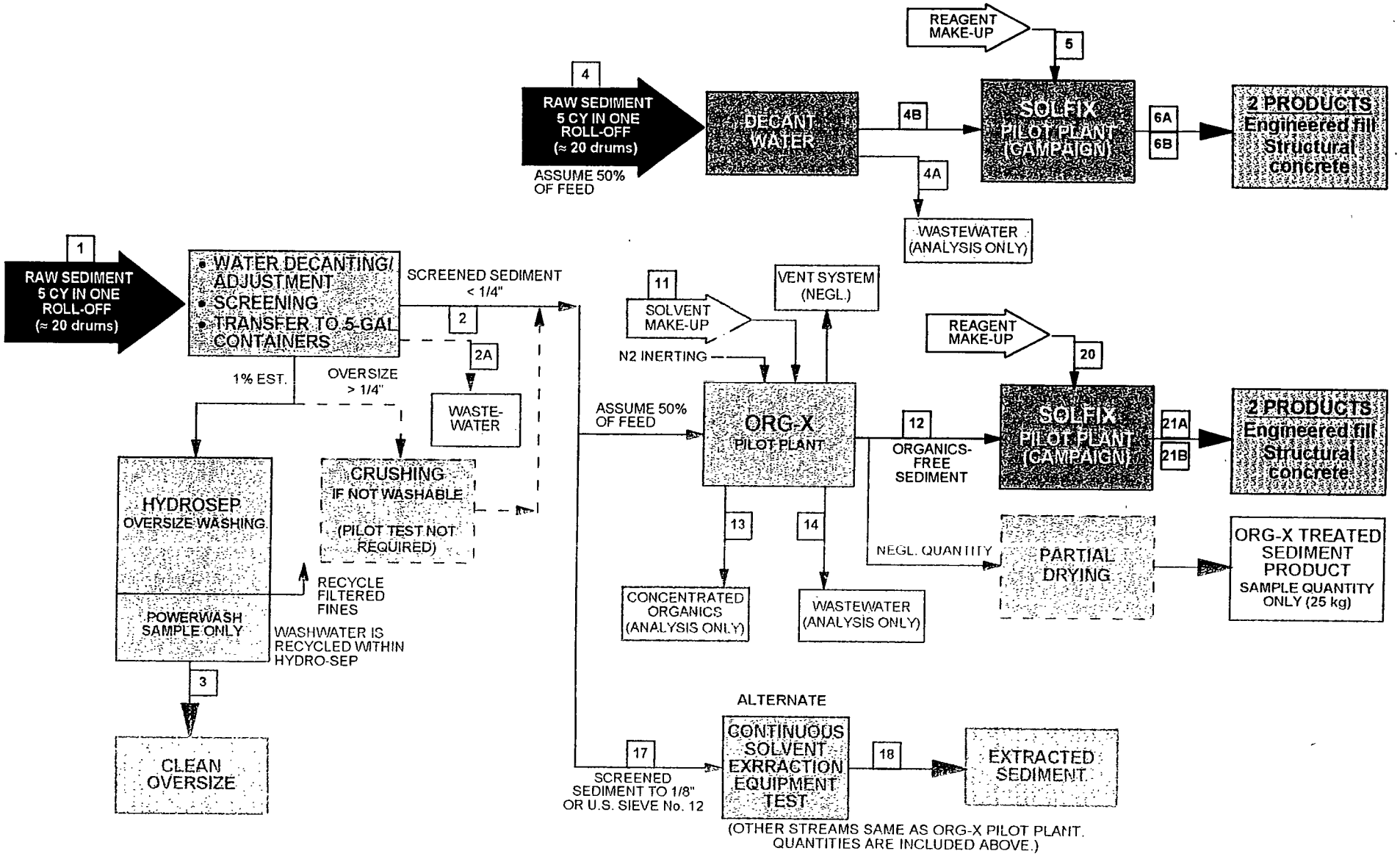
BNL PILOT PLANT
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PORT NEWARK, NEW JERSEY

OVERALL PLOT PLAN

Metcalf & Eddy, Inc.

2-2


LEGEND
WATER HYDRANT
PILLAR
TERTIARY CONTAINMENT LINER
FENCE
ELECTRICAL CORDS
OFFICE TRAILER
SUPPORT ZONE
EXPLOSION PROOF ZONE
EXCLUSION ZONE
CONTAMINATION REDUCTION ZONE
MAIN VISITOR ENTRANCE
MAIN ELECTRICAL POWERBREAKERS AND TRANSFORMER
STACK #002 GENERATOR
VEHICLE BARRIER
M&E ELECTRICAL PANNEL
500 GALLON DIESEL TANK
ROLL-OFF STAGING AND FEED PREP. AREA
CONTINUOUS PILOT SYSTEM
3" RUPTURE DISC
STACK #001
STEAM HOSE
SCREENING
WASTE WATER HOSE
MAINTENANCE TRAILER
BUILDING 152
BATCH PILOT PLANT
5/8" ID HOSE ALONG FLOOR
PRODUCT CURING AREA
CITY WATER STATION
CEMENT BAGS PALLET
SUPPORT ZONE
SINK
INACTIVE PHONE
WASTE WATER HOSE
RAMP
GARAGE DOORS (TYPICAL)
MIXER
10,000 GALLON FRAC CS TANK
20 10 0 20 40
PORT NEWARK WATERWAY
DOCK
BUILDING 145
BUILDING 141
BUILDING 152
AREA OF ENLARGEMENT
SALT PILE
ALCOHOL DRUM STORAGE
ACETATE DRUM STORAGE
GATE
FENCED TEST PLOT AREA (FOR NJIT PROJECT)
BNL PILOT PLANT
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PORT NEWARK, NEW JERSEY
ENLARGED PLOT PLAN OF WORK AREAS
Metcalf & Eddy, Inc.
2-2a



Metcalf & Eddy

PILOT-SCALE PLANT BLOCK FLOW DIAGRAM

Figure 3-1

UTILITIES:

- STEAM BOILER
- COOLING WATER TOWER
- POWER GENERATOR
- AIR COMPRESSOR
- N2 INERTING SYSTEM

KEY: MAIN PROCESSES

- PRE-TREATMENT WITH HYDRO-SEP OF CLEAN OVERSIZE
- ORG-X SOLVENT EXTRACTION OF ORGANICS FROM SEDIMENT
- SOLFIX FIXATION OF METALS/ORGANICS AND PRODUCT MANUFACTURING

containers) of sediment per batch charged to the extractor dryer. The contaminants in the sediment are extracted several times with a solvent mixture (acetate and alcohol) from the recycle storage tank. The overall batch cycle is approximately four (4) hours. Two batches are planned for the one-shift operation.

The main steps are as follows:

1. Solvent Make-up to Pilot Plant

   Initially and periodically charge solvent(s) from drums to solvent recycle tank. This will be done with an air-driven or hand pump after properly grounding both the drum(s) and pilot plant equipment.

2. Solvent Extraction of Sediment

   a. Charge sediment from 5-gallon containers to premix-tank and/or extractor. This is done by emptying contents of container into charge funnel.

   b. Charge solvent to extractor and mix for several minutes with agitator.

   c. Discharge solvent top-layer to solvent recovery section.

   d. Discharge sediment layer to dryer for evaporation/drying of solvent/water.

   e. Repeat steps a through d for each extraction stage.

3. Solvent Recovery - Distillation

   The spent solvent is distilled to recover the acetate/alcohol/water mixture for future reuse. The bottoms product will consist of the concentrated organic contaminants.

4. Sediment Drying

The extracted sediment is partially dried by steam heating the dryer jacket. The overhead vapors are condensed to collect the solvent/water mixture in a tank. The partially dried sediment is emptied into plastic bags placed in a metal container.

5. Wastewater Stripping

The aqueous layers are decanted from the dryer distillation condensate and are collected in a tank. The aqueous feed is then steam-stripped in a column to recover the solvent from the wastewater. The wastewater is cooled and discharged to a wastewater collection tank for off-site disposal.

Continuous Solvent Extraction Equipment

A continuous extraction column is utilized to replace the several batch solvent extraction steps. The solvent and pre-mixed sediment/solvent is fed to the column from drums to feed tanks with air-driven pumps. The spent solvent and wet extracted sediments are then processed in the other ORG-X℠ plant equipment.

Stabilization of Sediment (SOLFIX℠)

The raw sediment in 5-gallon containers is mixed with bags of Portlant cement (and water if required) into a mortar mixer to produce two product types:

- engineered fill soil using a low cement/sediment ratio
- structured concrete-like product using a high cement/sediment ratio

The concrete-like product is placed in small molds and the engineered fill soil is placed in a stockpile for crushing to desired size. The treated partially-dried sediment

from the ORG-X℠ pilot plant is also stabilized like the raw sediment to produce the two types of products.

Four products will be made by adding various amounts of cement and some water to sediment in a mortar mixer:

- engineered fill soil with untreated sediment (0.2 parts Portland cement and 1.0 part untreated sediment)

- concrete-like product with untreated sediment (0.4 parts Portland cement and 1.0 part untreated sediment)

- engineered fill soil with ORG-X℠ treated sediment (approximately 0.15 parts Portland cement and 1.0 part treated sediment)

- concrete-like product with ORG-X℠ treated sediment (approximately 0.3 parts Portland cement and 1.0 part treated sediment)

Product handling methods will depend on the size and weight of the container and material. The stabilized sediment will be placed into various size curing molds. Small, lightweight (<30 lbs.) molds will be moved to the finished product staging area by hand. Larger molds (>30 lbs.) will be moved with a drum lifter or front-end loader. Any dust generated will be controlled using water, which is a raw material in the products.

4.0 DESCRIPTION OF THE PILOT PLANT

4.1 GENERAL

The pilot plant testing involves demonstration of the following two technologies:

- direct solidification/stabilization of the raw sediment using the SOLFIX process;
- solidification/stabilization of the sediment using the SOLFIX process after pretreatment of sediment comprising screening for oversize particles removal (HYDRO-SEP℠ process), and solvent extraction for organic contaminant removal (ORG-X process).

The unit processes involved in the pilot plant testing are:

- sediment screening and moisture adjustment;
- solvent extraction of organic contaminants from the sediment;
- solidification/stabilization of the sediment for beneficial reuse.

The direct solidification/stabilization technology needs only coarse screening and does not need solvent extraction of the organics. However, the other technology comprises all three unit processes. The following presents the detailed operation of each of the three unit processes.

4.2 SEDIMENT SCREENING AND MOISTURE ADJUSTMENT

This pretreatment unit operation renders the sediment suitable for solvent extraction and stabilization by solidification. The two physical characteristics of the sediments which affect the solvent extraction process are:

- sediment particle size;
- sediment moisture content.

The required particle size for the batch and continuous solvent extraction process is (-)1/4-inch and (-)1/16-inch, respectively. The preferred moisture content for the site-specific solvent extraction process was determined to be 35 percent (approximately) during the benchscale testing.

The raw sediment is expected to be delivered in two 10-cubic-yard rolloff boxes, each containing 5 cy of sediment, for pilot plant testing. One rolloff box will undergo direct SOLFIX process for stabilization and solidification. The other rolloff box will be used for sediment screening, followed by solvent extraction and solidification/stabilization.

A sediment sample will be taken from the rolloff box to determine initial moisture content. Depending upon sediment initial moisture content, water will be added into the rolloff box to adjust moisture content to the desired level (≈35 percent w/w). The sediment will be thoroughly homogenized in the rolloff box using a backhoe equipped with a 12-inch size bucket with rubber blade.

Sediment will thereafter be screened in a batch operation. The screen size will be ¼-inch to prepare the feed material for batch solvent extraction process. The feed material for the continuous solvent extraction process will be prepared by screening the sediment using a

1/16-inch size sieve. The oversized screened material will be stored in 5-gallon buckets for crushing, sample analysis and disposal.

4.3 SOLVENT EXTRACTION

The following two types of solvent extraction operations will be performed during the pilot plant study:

- batch operation mode;
- continuous operation mode.

General information of the solvent extraction operations follows. The Standard Operating Procedures (SOP) of the solvent extraction system, which is confidential, contains more details and step-by-step operating procedures.

4.3.1 Batch Solvent Extraction Operation

The batch solvent extraction operation consists of the following steps:

- Extraction;
- Solvent Recovery and Organic Separation;
- Solid Drying; and
- Water Stripping.

A description of the above operational steps follows:

A. Extraction

The extraction process or organics from the sediment takes place in a premix tank. The

premix tank is a 59-gallon capacity cylindrical tank. Within the tank there is a propeller mixer and bottom scraper. Cooling/heating coils surround the tank for temperature control, if needed, for operation at various desired temperatures.

At the beginning of the first extraction cycle, the screened sediment is added to the premix tank. The tank is then sealed and purged with inert nitrogen gas. Following the purge, the tank is filled with extraction solvents from the solvent storage/recovery tank in a 1:1 weight basis. The sediment-solvents mixture is agitated for about 10 to 15 minutes, and then allowed to settle for about 2 to 5 minutes. When the majority of the solids portion of the mixture has settled, the extract solution is decanted from the top of settled solids. The extract solution can be centrifuged to remove any fine solids for recycle to extractor/drier. The extraction process is repeated with fresh/recovered solvent several times until the organic contaminants are removed from the sediment. The pilot plant testing program envisages 3, 5, and 7 extraction stages to determine the effect of extraction cycles on sediment decontamination.

At the end of extraction cycles, the sediment layer is transferred to the extractor/dryer. The mixture in the extractor/dryer can be further extracted with additional extraction cycles. The solvent layer can be centrifuged. The centrate is routed to the solvent evaporator and the centrifuged solids are collected in the solids chute and returned to the extractor/dryer. Figure 4-1 presents the process flow diagram of the solvent extraction.

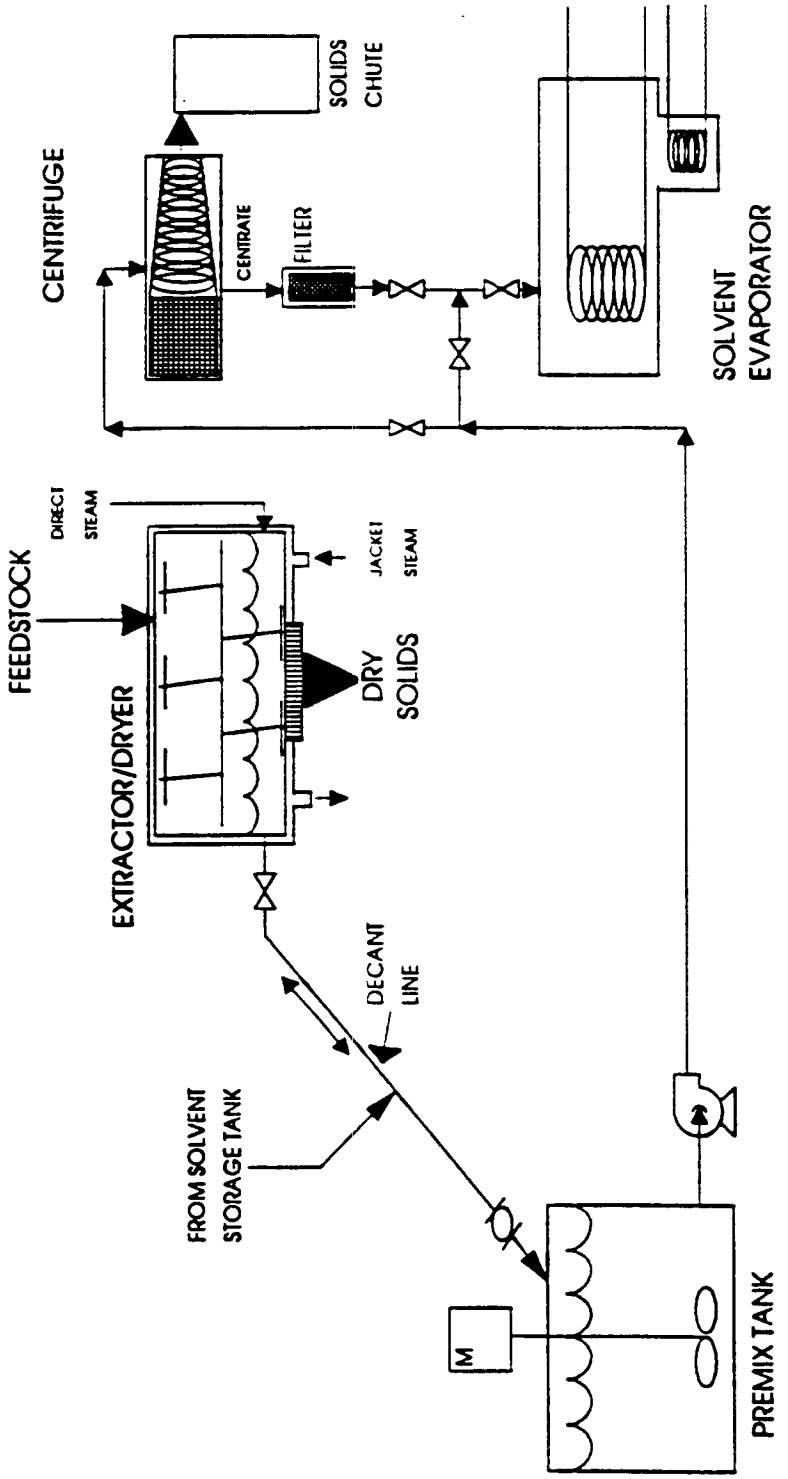
B. Solvent Recovery and Organic Separation

The solvents from the premix tank and extractor/dryer are pumped to the solvent evaporator. In the solvent evaporator, the solvents organic mixture is heated to about 78° to 85°C, the boiling point of the azeotropic mixture. Evaporation process is continued until the solvents are depleted. At that point, the temperature of the boiling liquid rises until it reaches the boiling point of pure water.

Evaporation continues at the higher temperature until most of the solvent is removed. The

FIGURE 4-1

EXTRACTION



vapor formed during evaporation is directed to the main condenser. The condensed vapor forms a heterogeneous condensate consisting of a solvent phase displaced above a heavier aqueous phase. This mixture is directed to the solvent decanter, where the aqueous and solvent phases are separated by decanting. The solvent decanter is maintained at a suitable temperature so that the aqueous and solvents are not miscible, thus, maintaining the two-phase system with reduced solvent solubility in water.

The recovered solvents are recycled back to solvent storage tank. The recovered water drains by gravity into the water receiver where it is stored until water stripping operations are performed. Ultimately, the water is steam stripped to remove residual solvents.

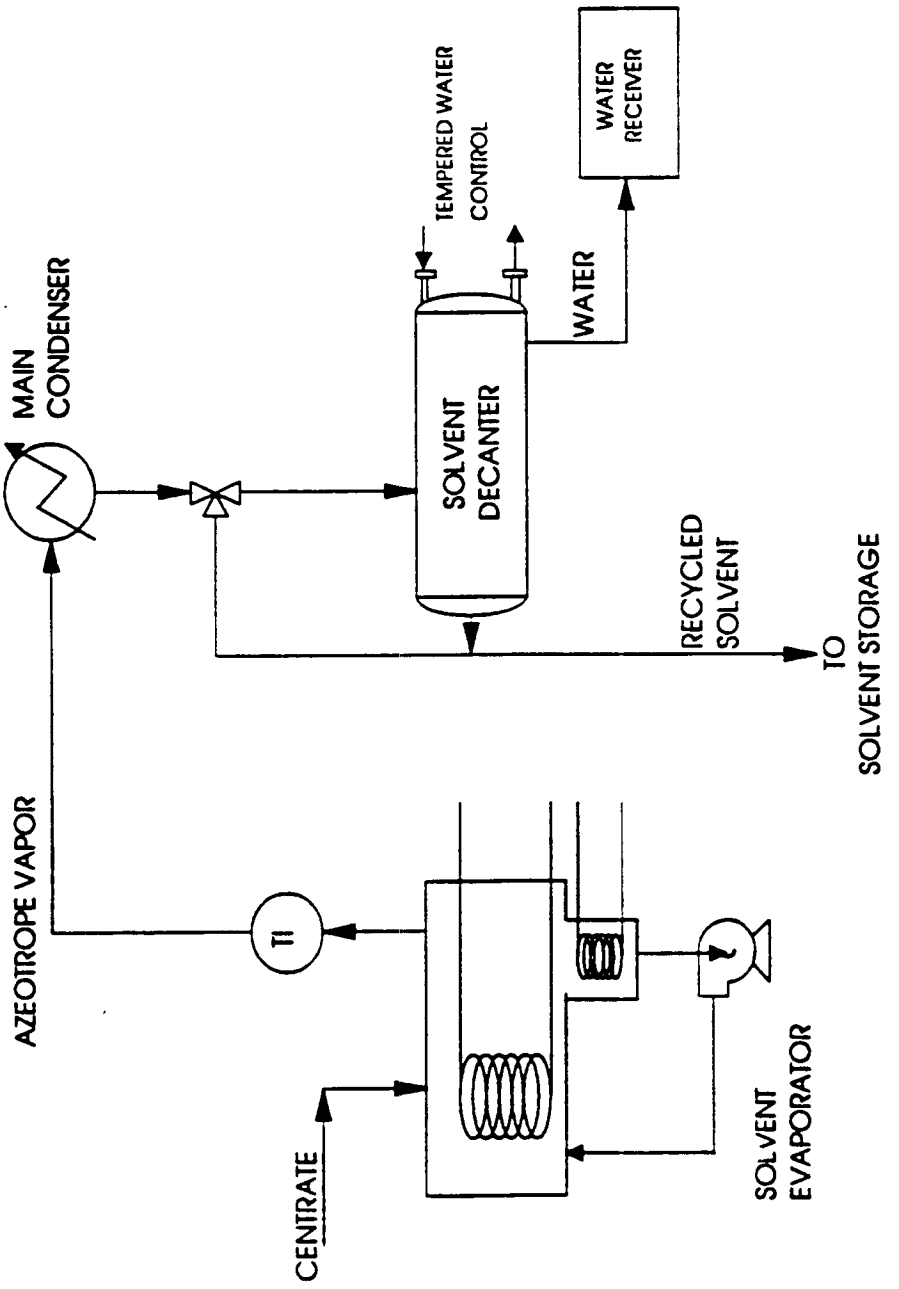
The organic contaminants (waste organics) that remain behind in the solvent evaporator will still have traces of solvents that must be removed. The polishing of waste organics to remove solvents is only accomplished if the quantity of organic contaminant present is sufficient. If the amount of waste organics is low, or the waste organics are not free-flowing at normal temperature, some solvent is left to have homogeneity and fluidity. Waste organic samples can be withdrawn from a sample valve during recirculation. The polishing cycle in the solvent evaporator involves two steps: organic rehydration and final polishing.

The waste organics are rehydrated by adding water to the system. The water solvent azeotrope will vaporize and concentrate the waste organics. Water facilitates removal of solvents due to the solvents' high affinity for water. The point of solvent depletion in the organics is determined by monitoring the overhead vapor temperature. Final polishing is then continued until the majority of the water is also removed, which has been determined to be normally assured when the bottoms temperature reaches about 220° F to 250°F. Figure 4-2 presents the flow diagram of solvent recovery operation.

C. Solids Drying

The solids in the extractor/dryer after the last extraction cycle and/or solvent decantation

FIGURE 4-2
SOLVENT RECOVERY FROM ORGANICS



operation are ready for drying. Drying of the solids is done in the same extractor/dryer vessel. The extractor/dryer is equipped with a steam jacket and direct steam injection ports. To dry the extracted solids, steam is first supplied only to the steam jacket to indirectly heat the extractor/dryer and its contents to about 78°C to 85°C. Then water and/or steam can be injected into the extractor/dryer vessel. The entire drying process is done with the extractor/dryer mixing paddles rotating. This increases the heat transfer and reduces the drying time required. Alternatively, vacuum can be applied to increase the drying rate. The solvent and steam form an azeotrope that is removed from the extractor/dryer, and is directed either to the premix tank or to the dryer condensers. After most of the solvent is removed, the temperature of the vapor rises to the boiling point of water. The drying is continued past this point for a short time to ensure that as much of the residual solvent as possible is removed. The steam condensate left in the solids from the direct injection of steam will leave the solids with about 10-30 percent water content, by weight, to minimize formation of dust. After the drying process is complete, the solids are removed through the discharge port on the bottom of the extractor/dryer. The solids are collected in high-temperature-resistant bags with proper identification.

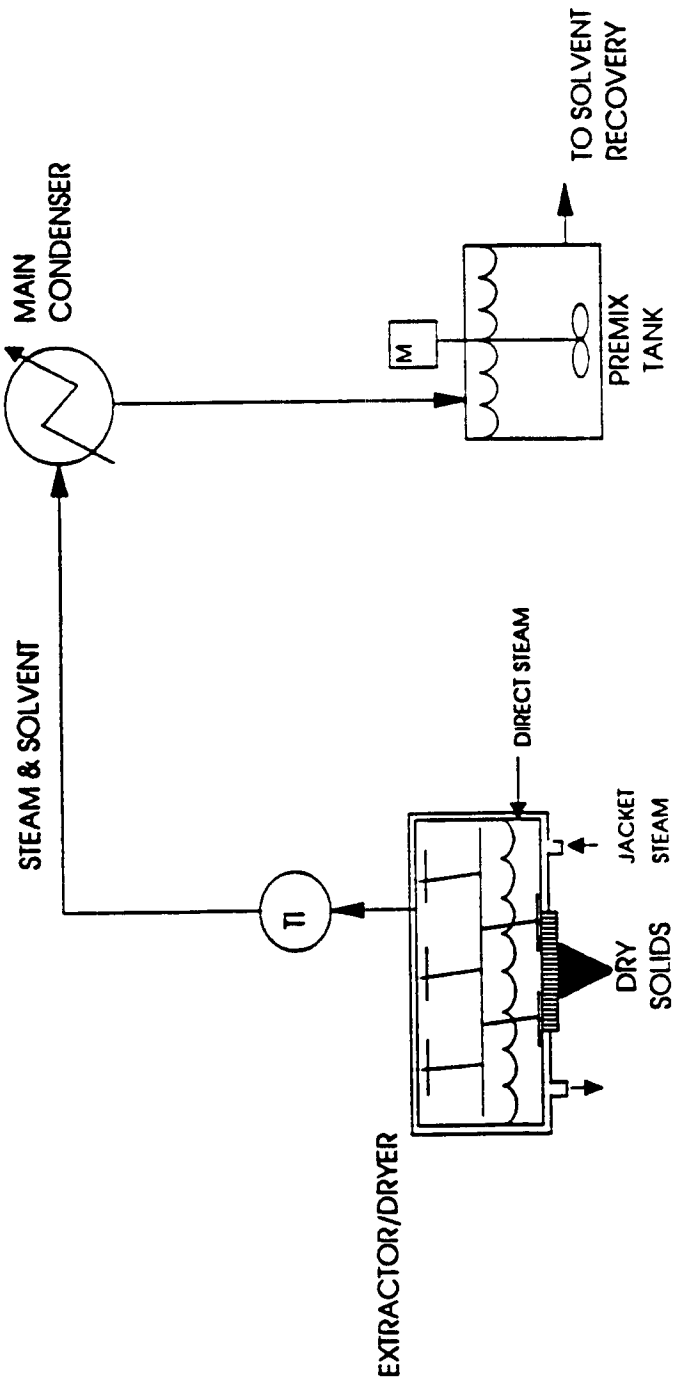
The vapor that has been directed to the dryer condenser during the drying cycle is condensed. The condensate is directed to the premix tank along with any solids that may carry-over during the drying process. The solvent is then reclaimed through the normal recovery path as described in step B above. Figure 4-3 presents the flow diagram of the solids drying operation.

D. Water Stripping

Decanted water in the water receiver tank will contain some residual solvents depending upon the solubility at the operating temperature. The residual solvents are removed from the water by steam stripping.

Steam is added to the bottom of the vertical steam stripping column to heat the column to the

FIGURE 4-3
SOLIDS DRYING



desired temperature. Feed water is then pumped through the feed preheater where it is heated to slightly above the solvents' azeotropic boiling point. The hot feedwater then enters the top of the column where a portion of it flashes upon entering. The non-vaporized portion of the feedwater runs down the column to the top tray and thence to all subsequent trays where it is stripped of residual solvents by upflowing steam. Water stripper bottoms are returned to the water receiver tank. When steady state is reached, the water stripper bottoms stream is re-routed to be discharged. This discharged, stripped water is stored for later analysis. The solvent azeotrope vapors generated are returned to the water stripper condenser and the recovered solvents are recycled. Figure 4-4 shows the flow diagram of the water stripping operation.

4.3.2 Continuous Solvent Extraction Operation

Similar to batch extraction operation, the continuous solvent extraction process consists of the following four steps:

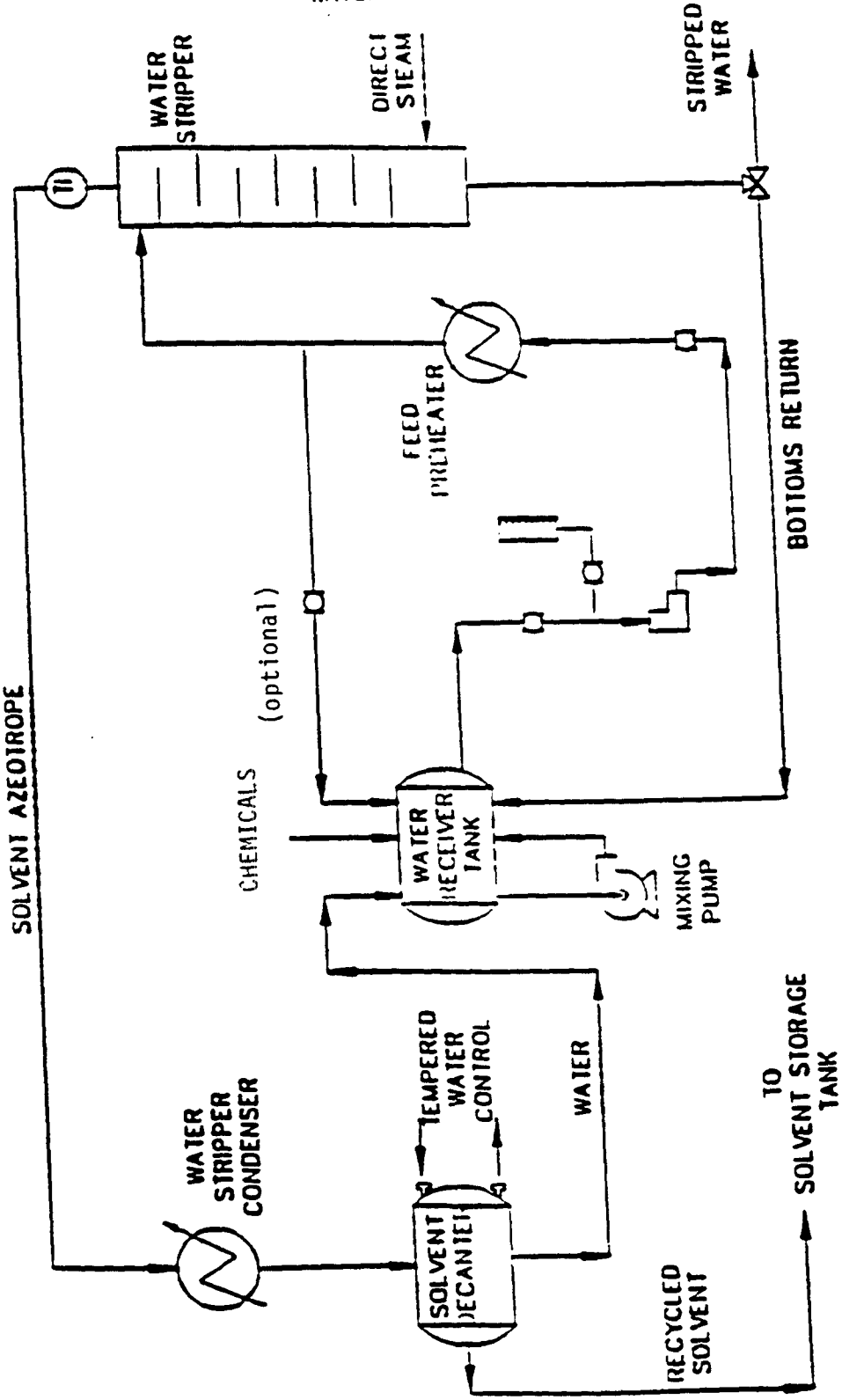
- Extraction;
- Solvent Recovery and Organics Separation;
- Solid Drying; and
- Water Stripping.

The pilot plant continuous solvent extraction process uses a vertical glass column containing 18 plates to extract organics from the sediment. The main extraction operation step in the continuous process differs from the batch solvent extraction system while the other three operating steps remain essentially identical. Accordingly, the extraction step of the continuous solvent extraction is discussed below.

The continuous extraction system contains a sediment feed tank, one solvent storage tank, a glass column containing extraction plates with paddles for mixing at each plate. The screened

FIGURE 4-4

WATER STRIPPING



sediment will first be placed in a 55-gallon drum. Depending upon the initial sediment moisture content, additional water along with solvents (less than a 1:1 ratio on weight basis) will be added into the drum and thoroughly mixed using air driven agitator. The solvent feed tank will be filled up with fresh solvent. Air pressure will be applied in the solvent storage column/tank. Solvents will enter the continuous extraction column from the bottom for counter-current extraction of organics from the sediment. The solvent-laden sediment will come out from the column bottom and will be stored in 55-gallon drums. The organic-rich solvents will come out from column top and will also be stored in 55-gallon drums. The treated, solvent-laden sediment will be transferred to the dryer unit of batch pilot plant equipment for residual solvent recovery and sediment drying. The organic-rich solvents will be fed to the distillation unit of the batch pilot plant setup for solvent recovery, organic separation and water stripping.

4.4 SOLIDIFICATION/STABILIZATION

The solidification/stabilization operation will be performed as follows:

- direct solidification/stabilization of the raw sediment after coarse screening;

- solidification/stabilization of sediment after pretreatment with screening and solvent extraction unit processes.

About 5 cubic yards of raw sediment will undergo direct solidification/stabilization process using the admixtures recommended by the Army Corps of Engineers. Required amount of sediment will first be taken in a 9 cubic foot capacity mortar mixer fitted with rubberized paddles. Reagents will be added into the mixer and be reacted with the sediment for about 10 to 15 minutes. The mixed product will then be poured into molds of suitable size and shape and be allowed to cure. The cured product physical property (unconfined compressive strength) will be monitored with a hand-held penetrometer.

About 5 cubic yards of sediment, after pretreatment with screening and solvent extraction processes, will also be solidified/stabilized using a mortar mixer. Pretreated sediment and necessary reagents will be added into the mortar mixer and will be allowed to react together for about 10 to 15 minutes. The mixed product will then be allowed to cure in suitable molds. Two types of solidified products will be produced from the pilot study:

- engineered soil with an unconfined compressive strength (UCS) <20 psi;
- concrete-like structured products (or anchor blocks) with a UCS >1,000 psi.

The strength of the cured product will be monitored routinely for each of the batches. Samples will be taken from the cured product for TCLP testing by BNL and physical testing by both M&E and US ACE/WES.

5.0 MONITORING PLAN AND DATA COLLECTION

5.1 GENERAL

The collection of data showing related monitoring parameters will be conducted during all pilot plant operations.

5.2 DATA SHEETS

Blank Pilot Test Data Sheets are attached in Appendix A. The corresponding data sheets are as follows:

- Chronology of Operation
- Feed Preparation
- Extraction
- Evaporation
- Decant Water Stripping
- Solids Drying
- Batch Summary
- Daily Monitoring Checklist
- Solidification/Stabilization

5.3 MASS BALANCE

The weight of feedstock put into the pilot plant and the weight of the solids, organic and water products, and all samples taken from the unit, will be recorded. This data will allow the development of mass balances. Records will also be kept on the amount of steam injection into the water stripper and steam injection to the extractor/dryer.

Mass balances on the solvent will also be performed by recording the inventory of solvent before and after the test run, as well as any solvent additions to the unit. (Solvent loss to the solids, organic and water products will be determined by chemical analysis.

5.4 MONITORING PLAN SUMMARY

The Quality Assurance Project Plan (QAPP) provides a summary of the key parameters monitored with regard to environmental effectiveness of the treatment process. Other parameters may be monitored for operation requirements, such as cooling water and steam flow rates, temperatures, etc.

6.0 SAMPLING PLAN AND ANALYSIS REQUIREMENTS

The Quality Assurance Project Plan (QAPP) prepared by M&E presents the details of samples to be taken and analytical requirements and methods only for the samples to be analyzed by M&E. The QAPP prepared by BNL and Associated Universities will present the details on the samples to be analyzed by others. Table 6-1 summarizes the sampling locations and quantities, analytical requirements and methods. The stream numbers refer to the block-flow diagram in Figure 3-1.

Additional stream samples will also be taken for process control and equipment performance purposes. These will be analyzed according to some methods listed in Table 6-1 for similar matrix types.

TABLE 6-1
PRELIMINARY PROPOSED SAMPLING SUMMARY
BNL SEDIMENT DECONTAMINATION PILOT STUDY
NEWARK, NEW JERSEY

BE886\BNLSAMP

				ANALYTICAL PARAMETER, FREQUENCY AND METHOD										
PROCESS	STREAM NO.	MATRIX	TOC 9060	PERCENT SOLVENTS/ WATER (2)	PERCENT MOISTURE	SVOCs 8270	PESTICIDES/ PCBs 8080	HERBICIDES 8150	DIOXINS/ FURANS 8290	METALS 6010	UNCONFINED COMPRESSIVE STRENGTH ASTM D-2166	FULL TCLP 1311/ SW-846	DISPOSAL PARAMETERS (1)	SPECIFIC GRAVITY Field
Person Responsible:			M&E	M&E	M&E	BNL	BNL	BNL	BNL	BNL	M&E & BNL	M&E & BNL	M&E	M&E
Sediment (each roll-off)	1,2	Wet sediment	4		4									2
Oversize Material	3	Gravel			BNL-1	1	1	1	1	1				
Recycled solvent		Solvent Mixture		1/day										
After 3-stage batch solvent extraction	12	Dry sediment	1/batch		1/batch	1	1	1	1	1				
After 5-stage batch solvent extraction	12	Dry sediment	1/batch		1/batch	1	1	1	1	1				
After 7-stage batch solvent extraction	12	Dry sediment	1/batch		1/batch	1	1	1	1	1				
After continuous solvent extraction	18	Sediment & solvent	1/batch	1/day	1/batch	1	1	1	1	1				
Stabilized & solidified sediment	6A	Concrete product									1	1		
Stabilized & solidified sediment after solvent extraction	21A	Concrete product									1	1		
Stabilized sediment	6B	Engineered fill product									1	1		
Stabilized sediment after solvent extraction	21B	Engineered fill product									1	1		
Concentrated organics from solvent extraction	13	Oil	1	1		1	1	1	1	1				
Wastewater from pilot study	14	Water	1	1		1	1	1	1	1				
Vent stack	–	Gas		2/day (3)										
Total Estimated Quantity			50	30	51	7	7	7	7	7	4	4		2

Notes:

(1) Other disposal parameters to be determined upon selection of TSDF.

(2) USEPA Method 8240 for acetate, direct aqueous injection for alcohol, and Carl Fischer method for % moisture.

(3) Vent is monitored with organics detection instrument twice daily for breakthrough of solvent after the first & second carbon adsorption canisters. Number is not included in total.

– Internal streams to be added later. No detail component sampling is planned.

7.0 ENVIRONMENTAL EFFECTS AND WASTE MINIMIZATION

7.1 WASTE STREAMS/WASTE MINIMIZATION

The pilot plant will produce "product" streams of solids, wastewater, and organic waste as described in previous sections. Some non-product wastes or secondary stream also exist and are described below.

M&E will store treated sediment generated from ORG-X℠ inside the exclusion zone in plastic bags placed in a container. The product from SOLFIX℠ will be stored in large molds. A suitable work zone is designated for material storage. All containers/molds will be properly labeled. The wastewater will be stored in a Frac tank. M&E will package, label and properly segregate all other pilot plant waste streams. These waste streams will include decontamination wastes, waste solvent at the end of the project, waste personal protective equipment and other trash. Manifests will be prepared for BNL if any wastes are determined to be hazardous.

7.2 STEAM CONDENSATE FROM STEAM TRAPS

Condensate from steam traps is non-hazardous clean water from the pilot plant auxiliary boiler. This water will never be in contact with any process waste streams. The total quantity of condensate which will not normally exceed 150 gallons per day will be either collected in Frac tanks or disposed of in the sewer.

7.3 BOILER BLOWDOWN

Occasional blowdown from the 9 HP boiler will be required to prevent scaling on the heating elements. This blowdown, which will not normally exceed 5 gallons per day, will be

collected in Frac tanks or sewered. All makeup water to the boiler is obtained from the potable water supply.

7.4 STORMWATER

The pilot operations will be conducted inside the warehouse or at the outside overhang. No rain water collection is anticipated.

7.5 VENT

A permit was obtained to discharge the vent from both the batch and continuous organic extraction plants. The atmospheric vent discharge is necessary to eliminate non-condensable gases from the various condenser systems in order to prevent reduction of heat transfer efficiency. Normally, this vent gas will consist primarily of nitrogen purge gas, traces of oxygen and other atmospheric gases, and some solvents and water. The majority of the solvent will normally be condensed by the vent condensers. However, to assure that organic vapors are removed with a high efficiency, an activated carbon scavenger will be located downstream of the carbon canister or final vent outlet. It must be verified prior to operation that the solvent being used is effectively captured by carbon. If not, a suitable alternative unit operation must be employed. The system is designed to capture amine solvents and, therefore, the vent system design must be carefully considered when using alternate solvents.

7.6 WASTE HANDLING SUMMARY

During the pilot test, all wastes generated will be labeled and segregated. All wastes will remain on site indoors near the pilot plant until analysis is available and arrangements are made for disposal. The wastes anticipated to be produced are as follows:

a. Investigative derived wastes (IDW): Contaminated trash, personal protective

equipment (PPE), plastic, etc., will be combined and stored in 55-gallon drums.

b. Used solvent: At the end of the test, there should be about 4-8 55-gallon, steel, closed head drums of used solvent for recycling and/or disposal to an off-site location.

c. Product solids, organic waste and excess feed: Any excess feed will be solidified with Portland cement. The engineered fill/soil and concrete-like products will be disposed of at an off-site incinerator, with a manifest, using 5-gallon containers or 55-gallon drums.

d. Aqueous wastes: This includes all the wastewater from process, decontamination water and boiler blowdown. This will be collected in a Frac tank on site. The amount generated is expected to be between 5,000 and 10,000 gallons. The decontamination waste will consist of approximately 10% solids, 5% solvent, and 85% water. The decontamination wastes may be decanted to produce an aqueous phase and a solids phase. The solids phase will be stabilized with Portland cement.

e. Carbon canisters: Carbon canisters are employed in the pilot plant vent system to remove any solvent vapors escaping the primary vent condenser. A smaller carbon canister is used to filter secondary containment pan water. It is expected that several 50-gallon, plastic carbon canisters will be expended. These will probably be sent for off-site disposal (incineration).

7.7 LEAKS OR ACCIDENTAL DISCHARGE OF PROCESS STREAMS CONTAINING SEDIMENT CONTAMINANTS

A secondary containment pan below the entire pilot plant is provided to contain unexpected

discharges of process streams. Material will be removed from the secondary containment pan and returned to the process. The volume of secondary containment available is approximately twice the volume of all material in the process unit.

Tertiary containment is provided by a raised-edge membrane surface around the extraction pilot unit. Other unit operations such as screening and stabilization will also have a raised-edge membrane to contain the spill. Any spills outside these areas will be removed with absorbent pads.

8.0 PILOT PLANT SITE CLOSURE

This procedure is from the equipment suppliers.

8.1 DECONTAMINATION

The decontamination plan for the pilot plant after exposure to various contaminants follows. This plan is also applicable for any hazardous contaminant. The steps of this plan must be performed in the order specified to prevent cross contamination. Many steps must be run concurrently to prevent overfilling of process vessels.

During the decontamination process, a sample of recycled solvent must be analyzed for contaminants of concern. This will confirm that solvent is not contaminated and can be sent to a recycling company.

Extractor/Dryer

Fill the extractor/dryer with solvent to the normal solvent fill lines. Wash the inside by turning on the paddles for five minutes. Decant the solvent to the empty premix tank. Disconnect the steam injection line from the bottom of the extractor/dryer on the decant side (disconnect downstream of the isolation valve). Drain the remaining 8 gallons of solvent into carboys. The use of carboys that have already been contaminated is desired. Return this solvent to the evaporator directly.

After purging with nitrogen, fill the extractor/dryer again and wash for five more minutes. Decant the solvent to the premix tank again. The premix tank should be full now. Drain the remaining 8 gallons of solvent into carboys. The use of carboys that have already been contaminated is desired. Return this solvent to the evaporator directly.

Fill the extractor/dryer for the third time and wash for five more minutes. When the premix tank is empty, decant the solvent to the premix tank again. Take a grab sample of the solvent for later contaminant testing to confirm that the extractor/dryer is decontaminated. Drain the remaining 8 gallons of solvent into carboys. Return the solvent to the evaporator directly. The extractor/dryer has now been rinsed three times with clean solvent.

Premix Tank and Centrifuge

Run the mixer and decant pump, then start to centrifuge the solvent. Line up the centrate return back to the premix tank for the first five minutes. Fill the premix tank with more solvent from the third rinse of the extractor/dryer as room becomes available. Continue centrifugation until the extractor/dryer and premix tank are empty. Fill the premix tank with clean solvent, by the premix tank fill line, until the high level warning light comes on (with the mixer off).

Turn on the mixer and decant pump and centrifuge the new solvent in the premix tank. Line up the centrifuge centrate return back to the premix tank for the first five minutes. Sample the solvent for later analysis to confirm that the premix tank and centrifuge are decontaminated. When the premix tank is empty, secure the mixer and decant pump. Flush the centrifuge head by opening the head flush valve for one minute. This sends clean solvent to the centrifuge plows and discharge nozzle. Secure the centrifuge.

Drain the feed pump and lines by draining the low point sample line into a carboy. Return the solvent to the evaporator. The premix tank has now been rinsed with 75 gallons of solvent from the extractor/dryer and 37 gallons of clean solvent. A normal batch of solvent processed through the premix tank is 25 gallons, so the tank is effectively being rinsed more than four times.

Centrate Tank and Pump

The centrate tank will fill during the centrifugation step, so pumping solvent to the evaporator must start before the tank overfills. Pump one gallon through the sample tap also to rinse it out. Pour the solvent removed back into the evaporator. Check the evaporator level to make sure it is not overfilled. If necessary, evaporate some of the solvent.

When all the solvent from the centrifuge has been pumped to the evaporator, secure the centrate pump. The solvent from the end of the drain sequence shall be sampled, and the sample tested for PCBs to confirm that the centrate tank has been decontaminated. Drain the solvent from the sample line on the inlet to the evaporator and return it to the evaporator.

Evaporator

All the contaminants introduced to the pilot plant will now be in the evaporator. Evaporate the solvent down to a level of about 50 liters. Drain the solvent into the contaminated solvent barrel. Add about six gallons of clean solvent to the evaporator. Run the recirculation pump for five minutes to clean out the piping. Drain the evaporator again into the contaminated solvent barrel. Add six gallons of solvent again, mix for five minutes, and drain. Add six gallons of solvent, for the third time, mix for five minutes, and drain. Sample the third rinse for analysis to confirm that the evaporator is decontaminated. The contaminant collection point has now been rinsed three times.

Solvent Removal

Remove residual solvent from the water stripper, if used, by steaming the column. When the water stripper is clean, shut the vent isolation valve to keep solvent vapor out.

Remove the inventory of solvent in the solvent storage tank by pumping it out through the fill connection into barrels. When the solvent tank empties, secure the solvent pump. Drain the

solvent cooling loop into the storage tank now by opening the sample/vent line on the auxiliary skid. Open the premix tank cooling coil line isolation valve. Shut the sample/vent on the auxiliary skid and start the pump again. When no more solvent will pump out, secure the pump and drain the solvent out of low point drains.

Fill the solvent tank with 20 gallons of water. Start the solvent pump and pump water through all the solvent systems. Make sure the refrigeration system is secured before sending water to the solvent cooling loop. Pump the water from the solvent system into the evaporator. Line up the solvent drain from the solvent decanter to a carboy instead of to the solvent storage tank. Evaporate the solvent out of the water, collecting it in a carboy, which can be returned to the clean solvent barrel. Leave the solvent lineup this way for the rest of the cleanup to collect the recovered solvent separately.

Remove all the solvent from the extractor/dryer by directly injecting steam for 10 minutes. Open the decant valves to allow steam to sweep the solvent in the lines into the mixer. Make sure the extractor/dryer condenser is isolated from the evaporator and water stripper condensers. When finished steaming the extractor/dryer, shut the vent isolation valve to keep solvent vapor out of the extractor/dryer.

Shut the decant valves from the extractor/dryer. Fill the premix tank to the top with water by hooking a hose into the low point sample tap in the feed line. Run the mixer and feed pump in recirculation for five minutes, then start to centrifuge the water. Send the centrate back to the premix tank for the first minute. Continue centrifugation until the premix tank is empty.

Check the level of the centrate tank to make sure it is not overfilled during the centrifugation of the water in the premix tank. Allow the centrate tank to fill to the top with water before starting to pump the water into the evaporator. Pump about one gallon of water through the sample line and return it to the evaporator. Continue pumping water from the centrate tank to the evaporator until the centrate tank is empty.

Apply jacket-coil and heat exchanger steam to the evaporator to remove the residual solvent in the water. Chemical addition may be necessary, depending on the solvent used, to get all the solvent out of the water. When the temperature of the liquid in the evaporator reaches 212°F, all the solvent will be gone. Drain the water to a barrel.

Drain the water/solvent legs out of the bottom of the solvent decanter and put them in the waste solvent drum. The bulk of the solvent is now removed from the pilot plant.

External Surfaces and Other Construction Equipment/Tools

Any surfaces that are contaminated with contaminants of concern will be cleaned by swabbing with solvent. Hexane/Methanol mixed in a 50/50 ratio can be utilized. This will be done at the time contamination occurs.

At the end of the final pilot plant internal cleaning, all equipment external surfaces will be cleaned with a steam cleaner. However, the wash water will be collected in a Frac tank and tested for contaminants.

All other construction equipment and tools will be decontaminated with wash solution.

8.2 EQUIPMENT REMOVAL

Dismantling of the pilot plant begins following completion of the decontamination process. All necessary components are removed, packed on the trailer, and secured for shipment. This phase is expected to take about five days. M&E and RCC/IONICS project personnel will conduct this operation and supervise outside contractors, as necessary.

8.3 REMOVAL OF PILOT PLANT FROM SERVICE

The pilot plant equipment is cleaned and decontaminated after each project. However, before

disposing components of the pilot plant at time of removal from service, wipe tests shall be conducted to confirm that PCB contamination is below 10 mg/100 cm^2 (or other predetermined levels for contaminants other than PCBs) on process equipment surfaces. Ten (10) wipe tests are required to confirm proper decontamination.

APPENDIX A

PILOT PLANT DATA SHEETS

CHRONOLOGY

Client _____ Feed _____ Date _____

Time

0500 - 0530

0530 - 0600

0600 - 0630

0630 - 0700

0700 - 0730

0730 - 0800

0800 - 0830

0830 - 0900

0900 - 0930

0930 - 1000

1000 - 1030

1030 - 1100

1100 - 1130

1130 - 1200

1200 - 1230

1230 - 1300

1300 - 1330

1330 - 1400

1400 - 1430

1430 - 1500

1500 - 1530

1530 - 1600

1600 - 1630

1630 - 1700

1700 - 1730

1730 - 1800

1800 - 1830

1830 - 1900

1900 - 1930

1930 - 2000

2000 - 2030

2030 - 2100

2100 - 2130

2130 - 2200

2200 -

FEED PREPARATION

Date _____

Feedstock _____ Initials _____

Batch # _____ Extraction # _____

Screened Feed Mass

Bucket (1)		Bucket (2)		Bucket (3)	
Gross	_____ lbs	Gross	_____ lbs	Gross	_____ lbs
Tare	_____ lbs	Tare	_____ lbs	Tare	_____ lbs
Net	_____ lbs	Net	_____ lbs	Net	_____ lbs

Bucket (4)		Bucket (5)		Bucket (6)	
Gross	_____ lbs	Gross	_____ lbs	Gross	_____ lbs
Tare	_____ lbs	Tare	_____ lbs	Tare	_____ lbs
Net	_____ lbs	Net	_____ lbs	Net	_____ lbs

Total Net Wt. _____ lbs **Approximate Volume** _____ gal.

EXTRACTION

Date _____

Feedstock _____ Initials _____

Batch # _____ Extraction # _____

Solvents Added

Fill Length _____ min. Solvent pump discharge temp (8) _____ F

Solvent tank: Before fill _____ liters Level after fill _____ liters

Nitrogen purge: Flow rate _____ Length _____ min.

Time	OVHD Temp. (4)	Ext/Dryer Temp. (10)	Remarks

EVAPORATION LOG

Date _____

Feedstock _____ Initials _____

Batch # _____ Page _____ of _____

Time									
Overhead Temp. F (4)									
Evaporator Liquid F (6)									
Solvent Decanter F (7)									
Solvent Temp. F (8)									
Cooling Water Temp. (F)									
Water Receiver Level (liters)									
Solvent Tank Level (liters)									
Evaporator Level (liters)									
Reflux Rate (GPH)									
Steam Coil Pres. (PSIG)									
Steam Coil Flow (mls/min)									
Oil Polish HTR. Pres. (PSIG)									
Oil Polish HTR. Pres. (mls/min)									
Centrifuge On/Off									
Centrate Path (evap. p/m tank, N/A)									

Comments _____

_____

_____

_____

_____

	empty	full
Sample bottle wt:		

DECANT WATER STRIPPING

Date _____ Initials _____

Feedstock _____ Batch # _____

Time									
Water Receiver Level (liters)									
Flow Rate (GPH)									
Feed Temp. (F)									
Overhead Temp. (F)									
Bottoms Temp. (F)									
Steam Flow Differential (PSIG)									
Heater Steam Pres. (PSIG)									
Heater Steam Flow (mls/min)									
Product Water pH									

Time injection steam started _____ Total prod. water received _____

Time feed introduced to column _____ Time feed to column stopped _____

Time start collecting prod. water _____ Time column steam secured _____

Comments _____

SOLIDS DRYING

Date _____

Feedstock _____ Initials _____

Batch # _____ Chemical Addition (if any) _____

Time									
Overhead Temp. F (4)									
Solids Temp. F (10)									
Dryer Power High/Low									
Injection Steam On/Off									
Injection Steam Inlet (PSIG)									
Injection Steam Outlet (PSIG)									
Jacket Steam Pres. (PSIG)									
Jacket Condensate Flow (mls/min)									

Product Solids:

Gross Weight _____ lbs

Tare _____ lbs

Net prod. solids _____ lbs

Comments _____

BATCH SUMMARY

Date Begin _____ Date Complete _____

Feedstock _____

Carbon Filter

Installation Wt. _____ lbs

Removal Wt. _____ lbs

Solvent Decanter

Preload _____ liters

Removed TEA _____ liters

Removed Water _____ liters

Centrate Filter

Installed Wt. _____ grams Size _____

Removed Wt. _____ grams # Removed _____

Solvent Use

Load _____ lbs

Unload _____ lbs

Feed Loaded _____ lbs

Chemical Load _____ mls

Treated Products Recovered:

Solids _____ lbs

Water _____ lbs

Oil _____ lbs

DAILY MONITORING CHECKLIST

TIP Calibration

Time _____ Standard Used _____ Result _____

	Ambient Air Monitoring	**Time**	**Result**
1.	Background test with TIP for Total Organic Vapors at Bldg. 141E	_____	_____
	at Bldg. 141W	_____	_____
2.	Breathing Zone with TIP for Total Organic Vapors (if > 5 ppm,	_____	_____
	collect draegers and assess PPE level)	_____	_____
3.	Breathing Zone Draeger Tubes		
	a) Alcohol	a)_____	a)_____
	b) Acetate	b)_____	b)_____
4.	Stack/carbon canister outlet, with TIP for Total Organic Vapors,	1)_____	1)_____
	twice a day, four hours apart (NTE 0.1/lbs/hr) (if > 25 ppmv,	2)_____	2)_____
	replace carbon)		
5.	In-between carbon canisters, with TIP for total organic vapors,	1)_____	1)_____
	twice a day, four hours apart (if > 180 ppmv, carbon)	2)_____	2)_____
6.	Record flow rate out of the stack by recording the inlet nitrogen	_____ _____	_____ _____
	rate at the stack once a day. Sum to obtain number.	_____ _____	_____ _____
7.	Breathing zone with aerosol meter for particulates (if > 1 mg/m^3,	_____	_____
	reassess PPE and engineering controls)	_____	_____
8.	Process area for combustible gases (if > 1.0% LEL, leave area,	_____	_____
	de-energize system except for fans)	_____	_____
9.	Check for odors outside building	_____	_____
		_____	_____

Safety Equipment Check

1.	Check pressure readings on fire extinguishers	_____	_____
2.	Check operation of safety shower and eye wash	_____	_____

Area Safety Inspection

1.	Check general order and housekeeping (clean, needs	_____	_____
	improvement)	_____	_____
2.	Check tools in use (at proper locations and clean?)	_____	_____
3.	Check Pilot Unit for proper storage and handling of combustible	_____	_____
	material	_____	_____
4.	Overall general safety (OK, or note problems)	_____	_____
		_____	_____

DAILY MONITORING CHECKLIST (continued)

Excess Water Monitoring	Time	Result
1. Amount of water inventory in sump		
2. Amount of water transferred to tanker since last check		
3. Tank number		
4. Tank level		
5. New water since last check (yes or no)		
6. Tanker water or barrel water samples sent to lab for analysis (for disposal purposes)		

Type of sample	Sample number

Site Safety Officer or Alternate

Date

SOLIDIFICATION/STABILIZATION

Date _____

Initials _____

Batch # _____

Sediment Details:

Bucket (1)		Bucket (2)		Bucket (3)	
Gross	_____ lbs	Gross	_____ lbs	Gross	_____ lbs
Tare	_____ lbs	Tare	_____ lbs	Tare	_____ lbs
Net	_____ lbs	Net	_____ lbs	Net	_____ lbs

Bucket (4)		Bucket (5)		Bucket (6)	
Gross	_____ lbs	Gross	_____ lbs	Gross	_____ lbs
Tare	_____ lbs	Tare	_____ lbs	Tare	_____ lbs
Net	_____ lbs	Net	_____ lbs	Net	_____ lbs

Total wt. of Sediment Taken (1 + 2 + 3 + 4 + 5 + 6) =

Reagents Added:

Reagent A added = _____
Reagent B added = _____
Reagent C added = _____

Penetrometer Reading:

After 24 hours = _____
After 48 hours = _____
After 72 hours = _____
After 96 hours = _____
After 120 hours = _____
After 144 hours = _____
After 7 days = _____
After 14 days = _____
After 21 days = _____

3.0 GENERAL PROCESS SUMMARY

3.1 FEED MATERIAL AND SCREENING

The sediment will arrive in two 10-cy roll-offs, each filled with 5 cy of sediment. Handling of feed material (sediment) will involve decanting water with pump and scooping the material from two roll-offs with a small front-end loader/backhoe or manually shoveling it onto the vibrating screen.

The screened undersize is transferred directly to 5-gallon buckets by screen or is scooped with another pail from the receiving tub to 5-gallon pails. The oversize is also collected in 5-gallon containers. The sample of the oversize is washed with water in a container/mixer for analysis.

3.2 MATERIAL (SEDIMENT) PROCESSING

The process block flow diagram in Figure 3-1 shows sediment processing trains and the main operations. The first train involves direct stabilization (SOLFIX℠) of 5 cy of sediment in a 10 cy roll-off container. The second train involves the solvent extraction (ORG-X℠) and stabilization (SOLFIX℠) of the solvent extracted sediment. Solvent extraction of the sediment is done both with a batch pilot plant with its associated semi-continuous unit operations and a continuous solvent extraction system. The sections below summarize the main operating steps. Section 4 describes the processing steps in more detail and the Standard Operating Procedures cover the confidential processing information.

Batch ORG-X℠ Pilot Plant

The ORG-X℠ Pilot Plant can process approximately 25 gallons (five 5-gallon containers) of sediment per batch charged to the extractor dryer. The contaminants in

APPENDIX B

HEALTH AND SAFETY PLAN FOR BNL PHASE II PILOT-SCALE TEST

METCALF & EDDY HEALTH AND SAFETY PLAN
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Appendix C	Signature Page
Appendix D	Health & Safety Plan Amendment Page
Appendix E	Material Safety Data Sheets (MSDS) or their equivalent
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Appendix G	Heat Stress
Appendix H	Cold Stress
Appendix I	PPE Inspection Procedures
Appendix J	First Report of Injury Form
Appendix K	Health & Safety Plan Approval
Appendix L	AWT Policies & Procedures - Confined Space Entry

SECTION 1
INTRODUCTION

1.1 SCOPE AND APPLICABILITY OF THE SITE HEALTH AND SAFETY PLAN

The purpose of this Health and Safety Plan (HASP) is to define the requirements and designated protocols to be followed at the work area during the Brookhaven National Laboratory (BNL) Phase II Pilot-Scale Test. Applicability extends to all Metcalf & Eddy (M&E) employees, contractors, subcontractors, and visitors.

All personnel on-site, contractors and subcontractors included, shall be informed of the site emergency response procedures and any potential fire, explosion, health, or safety hazards of the operation. This HASP summarizes those hazards and defines protective measures planned for the site.

This plan must be reviewed and an agreement to comply with the requirements must be signed by all personnel prior to entering the exclusion zone or contamination reduction zone. The signature page is included as Appendix C.

Personnel requesting access to the exclusion zone must provide OSHA certification and medical monitoring documentation. Access to equipment and material storage areas by non-M&E personnel or subcontractors requires prior M&E approval and escort by the M&E Site Manager or M&E Site Safety Officer.

During development of this plan, consideration was given to current safety standards as defined by EPA/OSHA/NIOSH, health effects and standards for known contaminants, and procedures designed to account for the potential for exposure to unknown substances. Specifically, the following reference sources have been consulted:

- OSHA 29 CFR 1910.120 and EPA 40 CFR 311
- OSHA/NIOSH/EPA/USCG Occ. Health and Safety Guidelines
- NIOSH Pocket Guide to Chemical Hazards
- (ACGIH) Threshold Limit Values

If during the site activities it becomes necessary to update or alter information contained in this HASP, an amendment should be prepared and made a permanent part of this HASP. A form for preparing an amendment to this HASP is included as Appendix D.

M&E has also consulted the Health and Safety Plan prepared by the project subcontractor, RCC/IONICS, for specific information relating to the solvent extraction system.

1.2 VISITORS

All visitors entering the site will be required to read and verify compliance with the provisions of this HASP. In addition, visitors will be expected to comply with relevant OSHA requirements such as medical monitoring (Sec. 6), training (Sec. 4), and respiratory protection (if applicable). Visitors will be required to follow the Site Coordinator's sign-in procedures detailed in Section 8.7. Visitors will also be expected to provide their own personal protective equipment.

In the event that a visitor does not adhere to the provisions of the HASP, he/she will be requested to leave the work area. If he/she fails to do so, all work shall stop and the project manager and regional safety coordinator shall be notified. All nonconformance incidents will be recorded in the site log.

1.3 GENERAL INFORMATION

PROJECT SITE NAME: BNL Phase II Pilot-Scale Test of Dredged Sediments

CLIENT: Brookhaven National Laboratory (BNL)/Associated Universities, Inc.

SITE LOCATION: Newark, New Jersey

HASP PREPARED BY: Amy Zampella/Phil DiGasbarro of M&E, Inc.

PROJECT OBJECTIVE: Decontamination Pilot Study of Dredged Contaminated Sediments

PROPOSED ON-SITE WORK DURATION: September-November, 1996

BACKGROUND REVIEW: Complete:_X__ Preliminary:____ Incomplete:____

SECTION 2
TASK/OPERATION SAFETY AND HEALTH RISK ANALYSIS

2.1 HISTORICAL OVERVIEW OF PROJECT AND BACKGROUND INFORMATION

Sediments from the New York/New Jersey Harbor areas are dredged routinely to maintain navigable water depths for shipping channels and berthing areas to facilitate commerce and safe navigation. Historically, the dredged materials were disposed in the ocean. However, ocean disposal has been restricted due to greater regulatory restrictions on contaminant concentrations in the dredged sediments. The dredged sediments typically contain elevated levels of metals, polynuclear aromatic hydrocarbons (PAHs) (tars, oils, fuels) , polychlorinated biphenyls (PCBs), chlorinated pesticides and herbicides, dioxins (PCDDs), and furans (PCDFs) as shown in Table 2-1. Appendix A lists both the raw material range previously available from the Request for Proposal and the average of six samples available to date for the treatability studies. The actual sediment used for M&E's bench-scale study was a black mayonnaise-like paste that contained a few particles (or 0.2% on dry basis) greater than 2 mm, and exhibited an oily, foul odor.

Section 405 of the Water Resources and Development Act of 1992 has authorized evaluation of technologies for decontaminating dredged sediments and/or potential reuse of the treated materials. Accordingly, the Brookhaven National Laboratory (BNL), in support of the U.S. Army Corps of Engineers, New York District (COE-NYD), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE) contracted Metcalf & Eddy and six other contractors to perform bench-scale treatability studies to identify cost-effective remedial alternatives for decontamination of the dredged sediments.

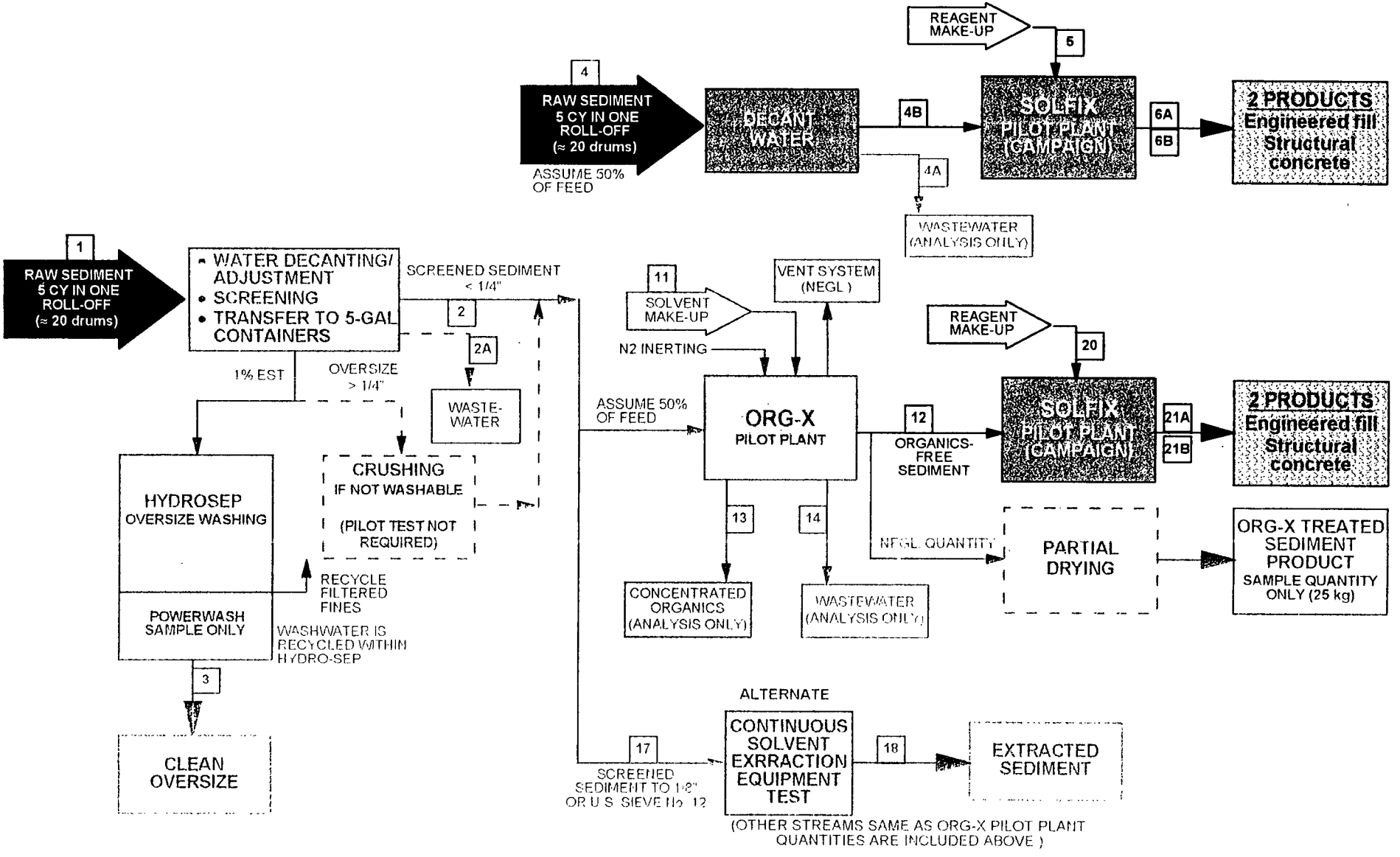
Metcalf & Eddy (M&E) performed bench-scale treatability tests using the Newtown Creek sediments to demonstrate the effectiveness of its proprietary technologies for decontaminating the dredged sediments. M&E tested its SOLFIX stabilization and solidification technology on the raw dredged sediment alone as well as in conjunction with the organics removal technology via solvent extraction (ORG-X). Appendix B presents the bench-scale data generated for the treated materials.

The pilot study will be conducted inside an empty warehouse located in Newark, New Jersey to be provided by the Port Authority of NY/NJ (Figure 2-1). M&E will conduct the pilot study using the Integrated Sediment Decontamination System (ISDS), which incorporates sediments screening, solvent extraction, and stabilization/solidification processes (Figure 2-2). M&E will design, construct and operate the soil screening and stabilization portions of the system. RCC/IONICS and M&E will construct and operate a batch and continuous solvent extraction pilot-scale system.

It should be noted that the property/building is under the jurisdiction of the Port Authority of NY/NJ, while the on-site coordinator will be New Jersey Institute of Technology (NJIT).

TABLE 2-1
CONTAMINANTS OF CONCERN IN RAW SEDIMENT
BNL SEDIMENT PILOT STUDY

Compound	Maximum Concentration Reported (ppb)
POLYCHLORINATED BIPHENYLS (PCBs):	
Total PCBs	5360
PESTICIDES:	
DDD	162
DDE	161
Dieldrin	74
SEMI-VOLATILE ORGANIC COMPOUNDS:	
Bis-2-ethylhexylphthalate	48,630
Benzo(a)anthracene	4,484
Benzo(b)fluoranthene	2,922
Benzo(k)fluoranthene	1,107
Benzo(a)pyrene	2,550
Indeno(123-cd)pyrene	1,100
POLYCHLORINATED DIBENZO-P-DIOXINS:	
2,3,7,8-TCDD	0.042
Total TCDD	0.25
Total PeCDD	0.38
Total HxCDD	1.4
Total HpCDD	4.5
OCDD	17.46
POLYCHLORINATED DIBENZO-P-FURANS:	
Total TCDF	2.4
Total PeCDF	2.8
Total HxCDF	5.2
Total HpCDF	6.0
OCDF	4.42
METALS:	
Arsenic	0.033
Cadmium	0.037
Chromium	0.377
Copper	1.2
Nickel	0.297
Lead	0.617
Zinc	1.73



Metcalf & Eddy

PILOT-SCALE PLANT BLOCK FLOW DIAGRAM

FIGURE 2-2

UTILITIES

- STEAM BOILER
- COOLING WATER TOWER
- POWER GENERATOR
- AIR COMPRESSOR
- N2 INERTING SYSTEM

KEY: MAIN PROCESSES

- PRE-TREATMENT WITH HYDRO-SEP OF CLEAN OVERSIZE
- ORG-X SOLVENT EXTRACTION OF ORGANICS FROM SEDIMENT
- SOLFIX FIXATION OF METALS/ORGANICS AND PRODUCT MANUFACTURING

2.2 SITE/HAZARD OVERVIEW

APPARENT HAZARD		TYPE OF FACILITY		STATUS OF FACILITY	
Serious		Imp.		Active	
Moderate	X	Dump		Inactive	X
Low		Landfill		Unknown	
None		Open			
Unknown		Enc.			
		Other	X	**Unused warehouse (owned by the Port Authority of NY/NJ) to be used for a sediment pilot study**	

WASTE TYPES		WASTE CHARACTERISTICS		TYPE/FORM OF HAZARD	
Gas		Toxic	X	Dust (cement and dry sediments)	X
Liquid	X	Corrosive		Liquid	X
Sludge	X	Ignitable (solvents)	X	Fumes	
Solid	X	Volatile (solvents)	X	Vapors	X
Unknown		Radioactive		Contact	X
Other		Reactive		Respiratory	X
		Unknown		Other (injection)	
		Other (raw sediment is non-hazardous)	X	IDLH (oxygen deficiency)	

2.3 TASK HAZARD DESCRIPTIONS

2.3.1 SITE PREPARATION/MOBILIZATION

Figures 2-3a and 2-3b show the overall plot plan and enlarged plot plan of the site with the mobilized items. M&E (with the assistance of BNL and the New Jersey Institute of Technology [NJIT]) will mobilize a temporary office trailer/command center including sanitary facilities, potable water, telephone, fax, copier, electrical and water service to the physical plant and support equipment. M&E will delineate support zones, contamination reduction zones, and exclusion zones. M&E will also calibrate air monitoring and site instrumentation. M&E will mobilize pressure washing equipment, decon equipment, a forklift, backhoe, drum mover, and other small equipment for use in material handling.

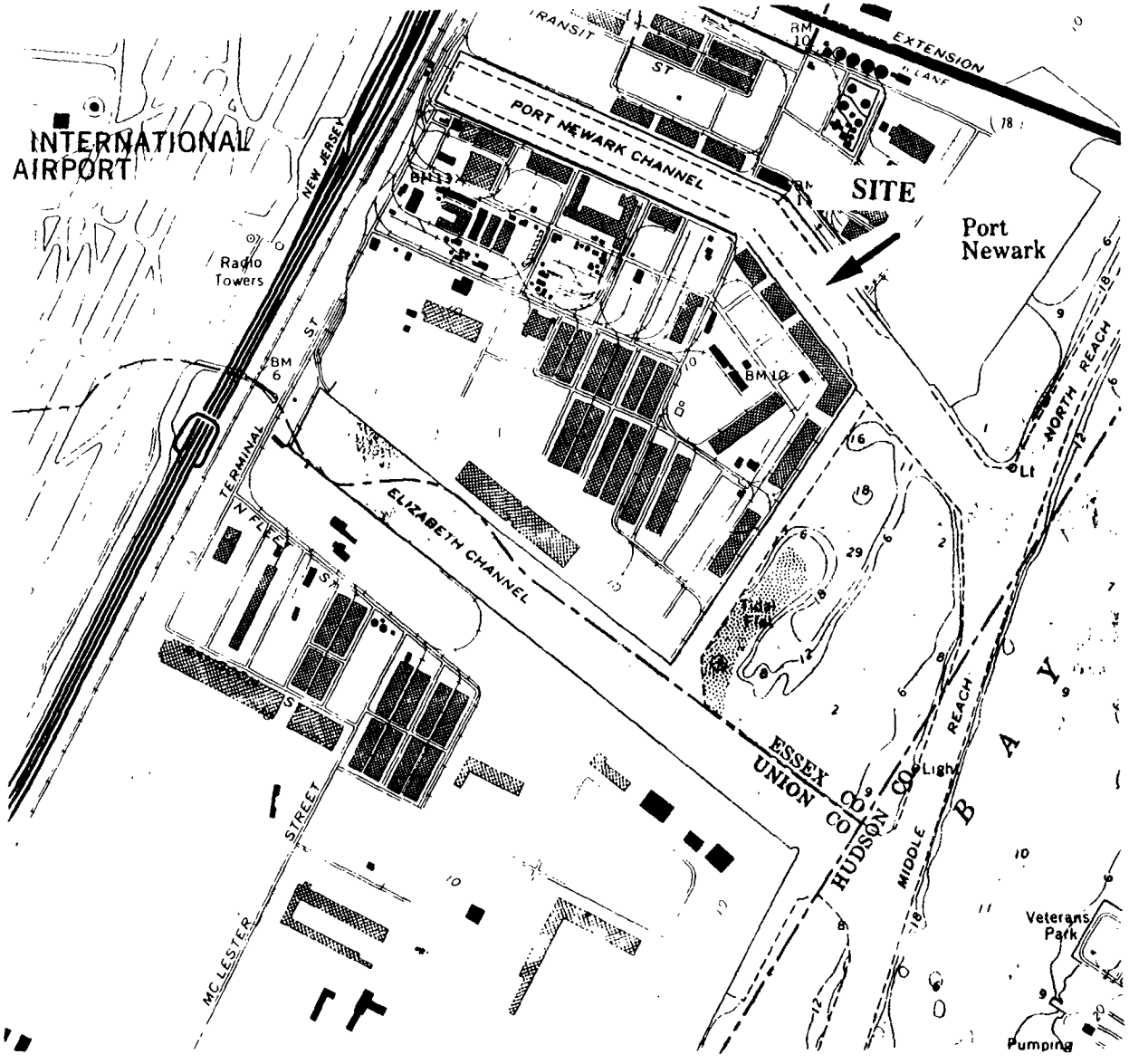
The batch pilot plant, continuous pilot system and maintenance trailer will be installed in the east side of the 200-foot by 460-foot by 20-foot high empty warehouse. The feed sediment material will be stored in 8' x 11' x 3' roll-off boxes inside the warehouse prior to treatment. Other raw materials to be used by M&E will be stored/staged inside the warehouse or inside the "grass test" fenced area.

Construction of the pilot plant by RCC/IONICS and M&E will involve unloading skid-mounted, solvent-extraction processing modules, then interconnecting the electrical, piping and mechanical systems. Drums of solvents will be stored outside the building in a designated fenced area.

Startup of M&E's portion of the pilot plant will involve:

- Energizing and testing the screening solvent extraction and stabilizing systems/equipment for correct function.
- Checking that all other support equipment such as conveyors, agitators, pumps, scales, etc. are functioning when energized.
- The equipment/systems will be either run dry or with air, water, or steam if used during processing.

Exclusion zones will be set up and marked inside and outside the warehouse. An explosion-proof zone will be marked on the floor with paint around the solvent extraction pilot/system, within the exclusion zone.



Prepared for: Brookhaven National Laboratory Upton, . Y.	Prepared by: Metcalf & Eddy, Inc. P.O. Box 1500 Somerville, NJ 08876
SITE LOCATION ON USGS TOPO MAP BNL Pilot Study - Newark, NJ	
August 1996	Figure **2-1**

PORT NEWARK WATERWAY

DOCK

BUILDING 145

BUILDING 141

BUILDING 152

ROOF OVERHANG

ACTIVE PHONE

PERSONNEL DOORS (6) TYPICAL

WASH SINK

2" CITY WATER STATION

TWO PORTABLE TIOLETS

OFFICE TRAILER

MAIN VISITOR ENTRANCE

ELECTRICAL POWERBREAKERS AND TRANSFORMER

CONTINUOUS PILOT SYSTEM

STACK #002 GENERATOR

MAE ELECTRICAL PANNEL

500 GALLON DIESEL TANK

ROLL-OFF STAGING AND FEED PREP AREA

STACK #001 THROUGH ROOF

RUPTURE DISC THROUGH ROOF

INACTIVE PHONE

SCREENING

48" DIAMETER FAN UNDER GARAGE DOOR

CEMENT BAGS PALLET

CITY WATER STATION

BATCH PILOT PLANT

MAINTENANCE TRAILER

SINK

3/4" ID HOSE ALONG FLOOR

PRODUCT CURING AREA

MIXER

WASTE WATER HOSE

RAMP

GARAGE DOOR (TYPICAL)

PLATFORM

RAMP

10,000 GALLON FRAC CS TANK

ALCOHOL DRUM STORAGE

ACETATE DRUM STORAGE

GATE

FENCED TEST PLOT AREA (FOR NJIT PROJECT)

SALT PILE

LEGEND

- WATER HYDRANT
- PILLAR
- ENLARGED AREA (SEE FIGURE 2)
- FENCE
- ELECTRICAL CORDS
- TERTIARY CONTAINMENT LINER

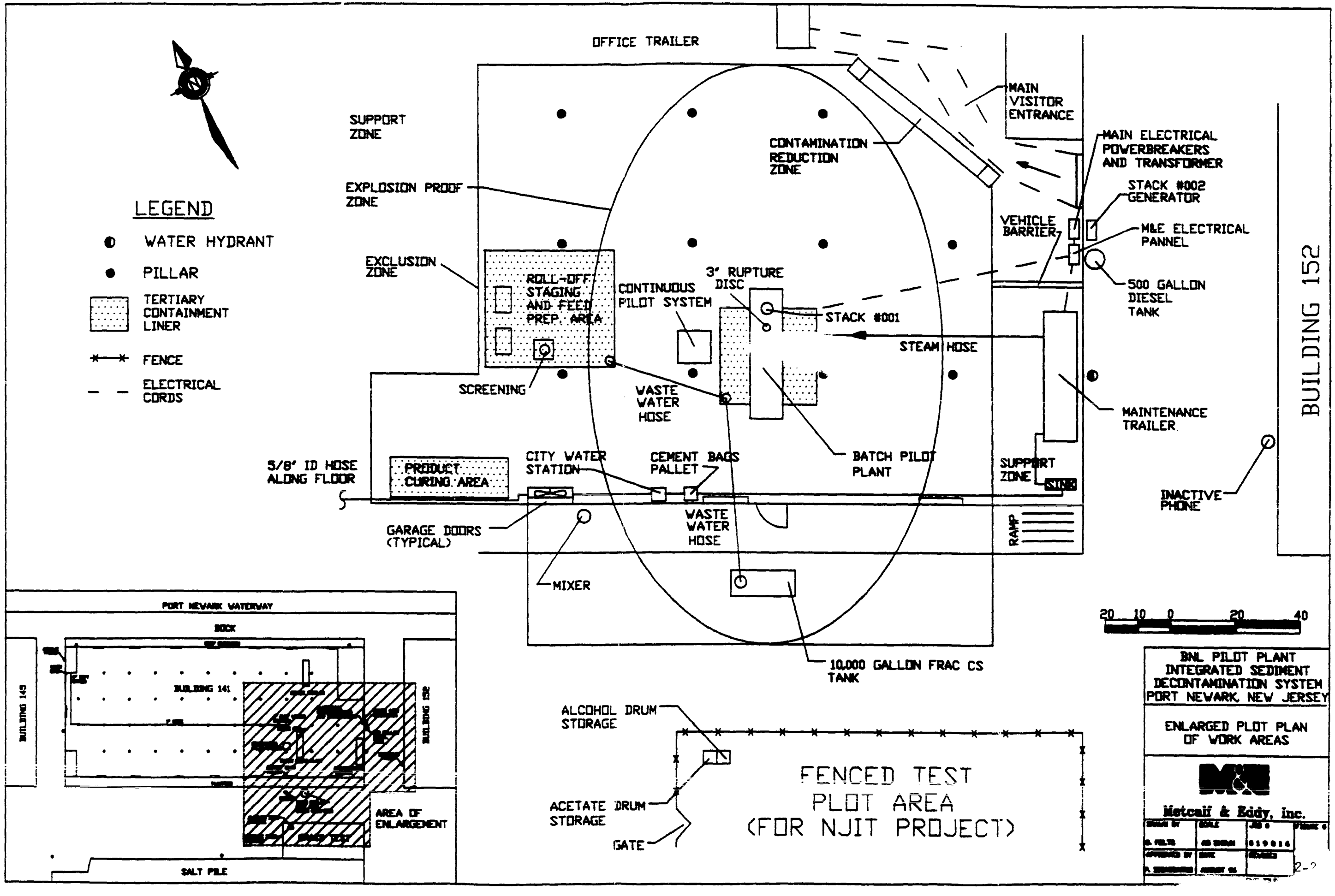
20 10 0 20 40

BNL PILOT PLANT
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PORT NEWARK, NEW JERSEY

OVERALL PLOT PLAN

Metcalf & Eddy, Inc.

2-2


LEGEND
WATER HYDRANT
PILLAR
TERTIARY CONTAINMENT LINER
FENCE
ELECTRICAL CORDS
OFFICE TRAILER
SUPPORT ZONE
EXPLOSION PROOF ZONE
EXCLUSION ZONE
CONTAMINATION REDUCTION ZONE
MAIN VISITOR ENTRANCE
MAIN ELECTRICAL POWERBREAKERS AND TRANSFORMER
STACK #002 GENERATOR
VEHICLE BARRIER
M&E ELECTRICAL PANNEL
500 GALLON DIESEL TANK
ROLL-OFF STAGING AND FEED PREP. AREA
CONTINUOUS PILOT SYSTEM
3" RUPTURE DISC
STACK #001
STEAM HOSE
SCREENING
WASTE WATER HOSE
MAINTENANCE TRAILER
BUILDING 152
5/8" ID HOSE ALONG FLOOR
PRODUCT CURING AREA
CITY WATER STATION
CEMENT BAGS PALLET
BATCH PILOT PLANT
SUPPORT ZONE
SINK
INACTIVE PHONE
GARAGE DOORS (TYPICAL)
WASTE WATER HOSE
RAMP
MIXER
10,000 GALLON FRAC CS TANK
20 10 0 20 40
PORT NEWARK WATERWAY
DOCK
BUILDING 145
BUILDING 141
BUILDING 152
AREA OF ENLARGEMENT
SALT PILE
ALCOHOL DRUM STORAGE
ACETATE DRUM STORAGE
GATE
FENCED TEST PLOT AREA (FOR NJIT PROJECT)
BNL PILOT PLANT
INTEGRATED SEDIMENT DECONTAMINATION SYSTEM
PORT NEWARK, NEW JERSEY
ENLARGED PLOT PLAN OF WORK AREAS
Metcalf & Eddy, Inc.

2.3.2 MATERIAL HANDLING

Feed Material and Screening

Handling of feed material (sediment) will involve decanting water with pump and scooping the material from two roll-offs with a small front-end loader/backhoe or manually shoveling it onto the vibrating screen.

The screened undersize is transferred directly to 5-gallon buckets by screen or is scooped with another pail from the receiving tub to 5-gallon pails. The oversize is also collected in 5-gallon containers. The sample of the oversize is washed with water in a container/mixer for analysis.

Material (sediment) Processing

Figure 2-2 shows sediment processing trains and the main operations. The first train involves direct stabilization (SOLFIX) of 5 cy of sediment in a 10 cy roll-off container. The second train involves the solvent extraction (ORG-X) and stabilization (SOLFIX) of the solvent extracted sediment. Solvent extraction of the sediment is done both with a batch pilot plant with its associated unit operations and a continuous solvent extraction system. The sections below summarize the main operating steps. The Work Plan and Standard Operating Procedures describe the systems and operations in more detail.

A process flow diagram is shown in Figure 2-2 and the main unit operations are described below.

A. Batch ORG-X Pilot Plant

The ORG-X Pilot Plant can process 25 gallons (five 5-gallon containers) of sediment per batch charged to the extractor dryer. The contaminants in the sediment are extracted several times with a solvent mixture (acetate and alcohol) from the recycle storage tank. The overall batch cycle is approximately four (4) hours. Two batches are planned for the one-shift operation.

The main steps are as follows:

1. Solvent Make-up to Pilot Plant

Initially and periodically charge solvent(s) from drums to solvent recycle tank. This will be done with an air-driven or hand pump after properly grounding both the drum(s) and pilot plant equipment.

2. Solvent Extraction of Sediment

   a. Charge sediment from 5-gallon containers to premix-tank and/or drive extractor. This is done by emptying contents of container into charge funnel.

   b. Charge solvent to extractor and mix for several minutes with agitator.

   c. Discharge solvent top-layer to solvent recovery section.

   d. Discharge sediment layer to dryer for evaporation/drying of solvent/water.

   e. Repeat steps a through d for each extraction stage.

3. Solvent Recovery - Distillation

   The spent solvent is distilled to recover the acetate/alcohol/water mixture for future reuse. The bottoms product will consist of the concentrated organic contaminants.

4. Sediment Drying

   The extracted sediment is partially dried by steam heating the dryer jacket. The overhead vapors are condensed to collect the solvent/water mixture in a tank. The partially dried sediment is emptied into plastic bags placed in a metal container.

5. Wastewater Stripping

   The aqueous layers are decanted from the dryer distillation condensate and are collected in a tank. The aqueous feed is then steam-stripped in a column to recover the solvent from the wastewater. The wastewater is cooled and discharged to a wastewater collection tank for off-site disposal.

B. Continuous Solvent Extraction Equipment

A continuous extraction column is utilized to replace the several batch solvent extraction steps. The solvent and pre-mixed sediment/solvent is fed to the column from drums to feed tanks with air-driven or hand pumps. The spent solvent and wet extracted sediments are then processed in the other ORG-X plant equipment.

C. Stabilization of Sediment (SOLFIX)

The raw sediment in 5-gallon containers is mixed with bags of Portlant cement (and water if required) into a mortar mixer to produce two product types:

- engineered fill soil using a low cement/sediment ratio
- structured concrete-like product using a high cement/sediment ratio

The concrete-like product is placed in small molds and the engineered fill soil is placed in a stockpile for crushing to desired size. The treated partially-dried sediment from the ORG-X pilot plant is also stabilized like the raw sediment to produce the two types of products.

2.3.3 PRODUCTS HANDLING

Four products will be made by adding various amounts of cement and some water to sediment in a mortar mixer:

- engineered fill soil with untreated sediment
- concrete-like product with untreated sediment
- engineered fill soil with treated sediment
- concrete-like product with treated sediment

Product handling methods will depend on the size and weight of the container and material. The stabilized sediment will be placed into various size curing molds. Small, lightweight (<30 lbs.) molds will be moved to the finished product staging area by hand. Larger molds will be moved with a drum lifter or front-end loader. Any dust generated will be controlled using water, which is part of a raw material for the products.

2.3.4 DEMOBILIZATION

Demobilization will consist of emptying the process equipment of solids and liquids and then decontaminating the equipment by power washing or steam cleaning. Liquids will be put in wastewater tanks, tested and disposed of at an off-site facility. A wipe test will be done on the extraction equipment to ensure it is decontaminated.

2.4 TASK-BY-TASK RISK ANALYSIS AND HAZARD DESCRIPTIONS

The evaluation of hazards is based upon knowledge of site conditions and anticipated risks posed by the specific operation. The following subsections describe each task/operation in terms of the specific hazards associated with it. In addition, Table 1 provides a listing of chemical hazards of concern by task and the MSDS sheets are included as Appendix C. Table 2-3 provides a Unit/Task Risk Analysis Summary. The protective measures to be implemented during completion of those operations are also identified under Section 5, Personal Protection Equipment. A copy of AWT's Health & Safety Policies and Work Practice Guidelines with the Policy & Procedures referred to herein will be available on site for review.

TABLE 2-2

CHEMICAL HAZARDS OF CONCERN BY TASK

Task	Chemical Hazards
1. Site Preparation/ Mobilization	Contaminants in sediment. Carbon monoxide in construction equipment exhaust. Alcohol, acetate, freon, and nitrogen in solvent extraction process. Portland Cement for stabilizing treated sediment.
2. Material Handling	Contaminants in sediment. Carbon monoxide in construction equipment exhaust. Alcohol, acetate, freon, and nitrogen in solvent extraction process. Portland Cement for stabilizing treated sediment.
3. Material Processing	Contaminants in sediment. Carbon monoxide in construction equipment exhaust. Alcohol, acetate, freon, and nitrogen in solvent extraction process. Portland Cement for stabilizing treated sediment.
4. Product Byproduct Handling	Contaminants in wastewater or solvent concentrates (oil/tar); vented gases in solvent extraction process.
5. Demobilization	Carbon monoxide in construction equipment exhaust. Alcohol, acetate, freon, and nitrogen. Unused bags of Portland Cement.
6. Chemicals Handling	Solvents, caustics. See MSDS, Appendix E.

TABLE 2-3
UNIT/TASK RISK ANALYSIS SUMMARY

I. SUPPORT ZONE

Process Element	Hazards	Protective Actions
General Hazards (for all support zone tasks)	Slip/falls on walk surfaces Tripping hazards	Stay alert around operating equipment Good housekeeping practices Rubber safety boots required
	Falls from heights	Fall protection > 4 ft. AWT Policy #1002 - Elevated Work
	Electrical hazards	Follow lock-out/tagout policy #903
	Heat stress	Cold vests/AWT Policy #609 - Heat Stress
	Cold/wet environment	Layered clothing/rain coat in cold weather
	Noise	Hearing protection
	Bob Cat or backhoe operations Forklift operations Scissorlift operation if used	Ensure all operators of moving equipment have appropriate license and/or training
Process Equipment Set-up	Heavy equipment on site	Stay alert around moving equipment. Ensure that load limitations of equipment do not exceed the capacity.
	Insects and snakes Poison oak	Stay alert for insects and snakes and poisonous plants
	Lifting	Use proper lifting techniques or where possible use lifting devices
	Grounding and Bonding of equipment and any container with solvents	Use AWT Grounding and Bonding Policy #902

I. SUPPORT ZONE (Continued)

Process Element	Hazards	Protective Actions
Process Equipment Start-up	Unexpected movement of equipment	Stay alert - Watch for overhead hazards and moving equipment
	Installation of climbing devices	Refer to Work from Elevation Policy #1002 Tie off with lanyards when using harnesses
	Poison oak exposure	Stay alert for poisonous plants
	Grounding and Bonding of Equipment	Use AWT Grounding and Bonding Policy #902
	Rotating equipment	Make sure machine guards are in place
Demobilization	Heavy equipment on site	Stay alert around moving equipment. Ensure that load limitations of equipment do not exceed the capacity.
	Insects and snakes Poison oak	Stay alert for insects and snakes and poisonous plants outside warehouse.
	Lifting	Use proper lifting techniques or where possible use lifting devices.
	Grounding & Bonding of equipment	Use AWT Grounding and Bonding Policy #902

TABLE 2-3 (Continued)
UNIT/TASK RISK ANALYSIS SUMMARY

II. EXCLUSION ZONE

Process Element	Hazards	Protective Action
General Hazards (for all exclusion zone tasks)	Exposure to low levels of dioxins/furans, PCBs, pesticides, organics in sediment	Personal protection equipment Modified Level D Safety glasses Safety boots - rubber/steel toed Tyvek poly-coated - taped Hard hat Follow decontamination procedures Section 9.0 of HASP Cold vests/AWT Policy #609 - Heat Stress Upgrade to Level C if indicated by exposure monitoring
Sediment Screening	Exposure to sediment contaminants. Also contaminated water.	General precautions and PPE.
	Forklift, drum lift, or backhoe	Ensure that all operators have proper license and training for machinery.
	Shoveling contaminated sediments	Use proper labor techniques. Be alert.
	Spill of sediment or contaminated water	Monitor process. Use spill control techniques/equipment.
Solvent Extraction, Solvent Distillation, Wastewater Stripping and Drying	Solvent or water contaminated with target compounds Spill of process liquids/splash	General precautions and PPE. Spill control equipment available. Monitor process. Use spill control techniques.
	Exposure to mixture of alcohol and acetate	Spill control equipment available. Carefully monitor process. Air monitoring for organic vapors.

* Maximum required; downgrade to Modified Level D base on air monitoring results.

II. EXCLUSION ZONE (Continued)

Process Element	Hazards	Protective Action
	Flammability of solvents	No smoking policy and explosion-proof zone will be instituted.
	Exposure to vented gases	Unit will have vent condenser(s), water scrubber and activated carbon canisters to control vapors and reduce any potential fire hazards. The vent and emergency relief exit outside roof (>25')
	Exposure to steam	System is enclosed and vented to outside. Check and repair leaks.
Stabilization	Forklift, drum lift, or backhoe	Ensure that all operators have proper license and training for machinery.
	Cement Spill of treated sediment or stabilizers	General precautions and PPE. Spill control equipment available. Monitor process.
	Moving cured product molds	Use proper lifting techniques, or where possible, use lifting devices.
UNIT OPERATIONS		
Compressor	Diesel exposure Spills	Spill prevention/control equipment.
	High-pressure hoses	Secure hose connections.
Baker Wastewater Tank	Spills of contaminated liquid	Spill control techniques. Spill control equipment available. Monitor process carefully.

II. EXCLUSION ZONE (Continued)

Process Element	Hazards	Protective Action
UNIT OPERATIONS (contd)		
Refueling Equipment and Avoiding spills • mortar mixer • generator • construction equipment (backhoe, forklift)	Exposure to flammable liquids	Follow AWT Policy #902 on Bonding and Grounding of equipment. No smoking. Eye goggles/faceshield. Emergency show/eyewash.
	Potential for spills	Have spill control/absorbent nearby. Work cautiously. Wipe off nozzle of hose with absorbent material.
	Noise from Generator	Hearing protection required when equipment is running.
Sample collection	Lifting samples	Proper lifting techniques.
	Working near heavy equipment (Bobcat, forklift)	Constant communication with driver. Be alert.
Sample preparation	Crusher for oversize and sediment lumps	Stay alert. Keep hands clear of moving equipment. Follow lock-out/tag-out procedures
Process equipment modifications/repairs	Slips/trips/falls due to hoses and wires Electrical/shock hazard Overhead work	Good housekeeping practices. Use established walkways. Follow lock-out/tag-out procedures Keep out from under suspended loads
Process equipment start-up	Unexpected movement of equipment	Stay alert - Watch for overhead hazards and moving equipment.
	Installation of climbing devices	Refer to Work from Elevation Policy #1002 Tie off with lanyards when using harnesses
	Poison oak exposure	Stay alert for poisonous plants outside building.
	Grounding and Bonding of Equipment	Use AWT Grounding and Bonding Policy #902
	Rotating equipment	Make sure machine guards are in place.
Equipment decontamination	High-pressure water or steaming equipment	Use splash shields. Direct away from personnel.

2.4.1 TASK 1 - SITE PREPARATION/MOBILIZATION

M&E will mobilize and set up the equipment in an empty warehouse provided by BNL.

Hazards associated with M&E's site preparation/mobilization include the following:

- Native wildlife such as rodents, ticks and snakes present the possibility of bites and associated diseases such as Lyme disease.
- Noise levels exceeding the OSHA PEL of 90 dBA are both a hazard and a hinderance to communication.
- Exhaust (carbon monoxide) from the construction equipment.
- Chemical hazards due to contact with contaminated sediment. See Table 1 and Section 5 for information on potential compounds and associated hazards.
- Chemicals such as solvents used during the pilot study.
- Fire/explosion hazards
- Moving parts on equipment may catch clothing. Free or falling parts from overhead may cause head injury.
- Moving equipment over uneven terrain may cause the vehicle to roll over or get stuck in a rut or mud. Be aware of hazards associated with moving heavy machinery and other associated injury.
- High-pressure hydraulic lines and air lines used on equipment are hazardous when they are in ill repair or incorrectly assembled.
- Heat/cold stress.
- Electric hazards from exposed circuits.

Hazard Prevention

- Avoid wildlife when possible. In case of an animal bite, perform first aid and seek medical attention. For prevention of or treatment of Lyme disease, see Appendix F.
- Review the contaminants suspected to be on site and perform air monitoring as required in Section 5 of this HASP.
- Shut down equipment and/or divert exhaust fumes.

- All non-welded connections, lines, and cables should be inspected daily for weak spots, frays, etc. Be aware of location of overhead wires and structures.

- Implement hearing conservation program.

- A face shield should be used if there is a splash danger.

- Hard hats should be worn at all times when working around construction. Secure loose clothing. Check boom prior to approaching crane.

- Review the chemicals to be used in the study; perform air monitoring as required in Section 5 of this HASP.

- Equipment must be inerted and/or grounded. The explosion-proof zone is to be maintained by not generating sparks.

- Lock tag, and try all equipment before working on them.

- Smoking on site is prohibited and will be strictly enforced.

- Take precautions against heat/cold stress, see Appendices G and H.

2.4.2 TASK 2 - MATERIAL HANDLING

Hazards associated with materials handling include the following:

- On-site chemical hazards due to contact with sediment during activities. See Table 1 for information on potential compounds and associated hazards.

- Chemical hazards associated with chemicals used during solvent extraction and stabilization.

- Noise above 90 dBA.

- Moving parts on machinery.

- Electrical hazards if machinery is not properly connected, grounded, and guards are not in place.

Hazard Prevention

- Review the contaminants suspected to be on site and perform air monitoring as required in Section 5 of this HASP.

- Wear additional PPE when in the solvent extraction area, as detailed in Section 5.2.
- Implement hearing conservation program.
- Be alert around subcontractor's equipment. Report any observation of damaged or unsafe conditions to the subcontractor's safety officer.
- Inspect all safety guards, railings, platforms, and switches daily and repair immediately when needed.
- All chains, lines, tubing, and cables should be inspected daily for weak spots, frays, leaks, etc.
- Lock-out and tag-out any circuits when working on machinery or electrical.

2.4.3 TASK 3 - MATERIAL PROCESSING

Hazards associated with material processing include the following:

- On-site chemical hazards due to contact with sediment during activities. See Table 1 for information on potential compounds and associated hazards.
- Chemical hazards when working around chemicals used during solvent extraction and stabilization.
- Inhalation of vented gases generated during solvent extraction.
- Solvent transfer operations.
- Moving parts on machinery. High-pressure hydraulic or air lines.
- Fire and explosion hazards from solvents and vented gases.
- Noise above 90 dBA.
- Electrical hazards, such as from process machinery drives.

Hazard Prevention

- Review contaminants and perform air monitoring. Wear PPE as required.
- Avoid contact with chemicals. Wear additional PPE when in the solvent extraction area. See Section 5.2 for PPE and Appendix E for MSDS.

- The solvent extraction system will have vent condensers, a water tank, and activated carbon canisters to collect vapors and reduce any potential fire hazard. The vent stream will also be monitored downstream of the carbon canisters to check for vapor releases.

- Subcontractor shall take precautions during transfer of solvents from drums to the pilot plant holding tank, and follow company SOPs. Inherently safe pump and non-sparking tools must be used. Grounding must be completed prior to operations.

- Secure loose clothing. Inspect daily and repair as necessary all safety guards, railings, switches, etc. Repair or replace leaking or worn hoses or high-pressure lines.

- Implement an explosion-proof zone within the site exclusion zone.

- Implement hearing conservation measures.

- Be alert around subcontractor's equipment. Report any observation of damaged equipment or unsafe conditions to the subcontractor's safety officer.

- Inspect and repair or replace as necessary any worn or damaged electrical cables, covers, switches, guards, etc. Test grounding protection daily and repair or replace as necessary. Follow lock-out/tag-out procedure when working on machinery or electrical.

- Review and follow all SOPs in operating and maintenance manual in the Work Plan.

2.4.4 TASK 4 - PRODUCT HANDLING/SAMPLING

Hazards associated with product handling include the following:

- On-site chemical hazards due to contact with contaminated water and solvent. See Table 1 for information on potential compounds and associated hazards.

- On-site chemical hazards from improperly treated soil.

- Moving cured product molds generated during sediment stabilization.

- Overhead hazards from falling material.

- Moving parts from machinery.

- Exhaust inhalation from loader/backhoe or forklift.

Hazard Prevention

- Perform air monitoring and wear appropriate PPE. Keep products moist with water, polymer or foam as needed.
- Wear chemical protective equipment when handling any off-specification material.
- Use proper lifting techniques or, where possible, lifting devices.
- Wear hard hat and watch for and avoid overhead hazards.
- Keep all safety guards in place. Inspect daily and repair/replace as needed.
- Avoid breathing backhoe/loader and forklift exhaust. Stand clear of machines.

2.4.5 TASK 5 - DEMOBILIZATION

Hazards associated with site demobilization include the following:

- Native wildlife such as rodents, ticks and snakes present the possibility of bites and associated diseases such as Lyme disease.
- Noise levels exceeding the OSHA PEL of 90 dBA are both a hazard and a hinderance to communication.
- Exhaust (carbon monoxide) from the construction equipment.
- On-site chemical hazards due to contact with untreated sediment during construction activities. See Table 1 for information on potential compounds and associated hazards.
- Chemicals used for solvent extraction and stabilization.
- Moving parts on equipment may catch clothing. Free or falling parts from overhead may cause head injury.
- Moving equipment over uneven terrain may cause the vehicle to roll over or get stuck in a rut or mud. Be aware of hazards associated with moving heavy machinery and other associated injury.
- High-pressure hydraulic lines and air lines used on equipment are hazardous when they are in ill repair or incorrectly assembled.
- Heat/cold stress.

- Electrical hazards.

Hazard Prevention

- Avoid wildlife when possible. In case of an animal bite, perform first aid and seek medical attention. For prevention of or treatment of Lyme disease, see Appendix F.
- Implement hearing conservation program.
- Shut down equipment and/or divert exhaust fumes.
- Review the contaminants suspected to be on site and perform air monitoring as required in Section 5 of this HASP.
- All chains, lines, and cables should be inspected daily for weak spots, frays, etc. Be aware of location of overhead wires and structures.
- Ear muffs and ear plugs effectively reduce noise levels and will be used during construction operations.
- A face shield should be used if there is a splash danger.
- Hard hats should be worn at all times when working around construction. Secure loose clothing. Check boom prior to approaching crane.
- Follow preventive measures for heat/cold stress as detailed in Appendices E and F.
- Follow lock-out/tag-out procedure when working on machinery or electric circuits.

2.5 PHYSICAL HAZARDS

See MSDS sheets included in Appendix E for information on the physical hazards of site contaminants and materials to be brought on site.

SECTION 3
KEY PERSONNEL AND RESPONSIBILITIES

3.1 PERSONNEL

Company	Title	Name/ Alternate	Responsibility
M&E	Project Manager	P. DiGasbarro	Coordinates all aspects of the project to ensure a safe and successful completion.
M&E	Construction Manager/ Project Engineer	P. DiGasbarro	Directs task-specific operations to ensure a safe and successful completion.
M&E	Project/Process Engineer	T. Roy	Perform project and process engineering tasks.
M&E and	Site Health & Safety Officer	A. Zampella P. DiGasbarro (alternate)	Acts as site safety officer and enforces compliance with health and safety plan.
M&E site	Corporate Health & Safety Officer	R. Renzi	Reviews and approves the health and safety plan for corporate and regulatory compliance if required. Responds to issues raised by Office Health and Safety officer as needed.
M&E	Field/Operators Personnel	P. DiGasbarro T. Roy	Perform job tasks as required.
RCC/IONICS	Project Manager (Bellevue, WA only)	D. Owens	Provides RCC/IONICS office support.
RCC/IONICS	Field Operators and Maintenance	S. O'Laughlin R. Weisner	Perform job tasks as required on solvent extraction system.

3.2 HEALTH AND SAFETY RESPONSIBILITIES

The Site Health and Safety Officer (SHSO) is responsible for project safety, decontamination, environmental monitoring and implementation of emergency procedures. The SHSO will assure that all on-site personnel comply with the provisions of this Health and Safety Plan (HASP). The SHSO is responsible for designating and marking work zones and for restricting access to Exclusion Zones and Decontamination Stations to properly attired personnel. At a minimum, either the SHSO or one person on-site must be trained in First Aid and CPR.

SECTION 4
PERSONNEL TRAINING REQUIREMENTS

4.1 TRAINING REQUIREMENTS AND ANNUAL REFRESHER COURSE

All personnel performing environmental investigations or who are entering the exclusion or decontamination zone shall have received training in accordance with OSHA 29 CFR 1910.120(e) (3) or have gained experience equivalent to this training and documented in company files. Specifically, the training will include 40 hours of initial course instruction plus 3 days actual field experience. The 40 hours of instruction will cover, at a minimum, the following items:

- Hazard Types
- Basic Industrial Hygiene
- Basic Toxicology
- Worker Rights and Responsibilities Under 29 CFR
- Environmental Monitoring Equipment
- Hazard Evaluation
- Safe Work Practices
- Site Safety Plans
- Personal Protective Equipment
- Decontamination
- Emergency Response
- Contingency Plans
- Engineering Controls

An eight hour refresher course is provided annually. Employees completing the required training are given a certificate of successful completion. Documentation of training requirements is available upon request from M&E.

4.2 SAFETY BRIEFING

An initial briefing will be conducted for all field personnel by the SHSO to discuss project specific health and safety information and concerns. As needed, additional briefings will be conducted to reinforce health and safety awareness and understanding and to allow the personnel opportunity for comments or questions related to site health and safety. At a minimum, health and safety briefings will be performed at the start of a new task, and when conditions other than those described or expected are encountered.

SECTION 5
PERSONAL PROTECTIVE EQUIPMENT

This section describes the general requirements of the EPA designated Levels of Protection (A-D), and the specific levels of protection required for each task at the Site.

5.1 LEVELS OF PROTECTION

The specific levels of protection and necessary components for each have been divided into four categories according to the degrees of protection afforded:

Level A: Should be worn when the highest level of respiratory, skin, and eye protection is needed.

Level B: Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection. Level B is the primary level of choice when encountering unknown environments.

Level C: Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin protection is needed.

Modified Level D: (D_1 & D_2) Should be worn in any area where respiratory or skin hazards are essentially non-existent. It provides minimal protection against chemical hazards.

Level D: Should be worn in any area where respiratory or skin hazards are essentially non-existent. It provides minimal protection against chemical hazards.

Level D Personal Protection Equipment

Level D Personal Protective Equipment will consist of the following items:

- Gloves (as necessary)
- Boots/shoes, leather with chemical-resistant shoe covers or chemical-resistant, steel toe and shank
- Safety glasses (if needed)
- Hard hat (if needed)
- Ear plugs/muffs (where required)

Modified Level D_1 Personal Protection Equipment

Modified Level D_1 Personal Protective Equipment will consist of the following items:

- Polycoated Tyvek® coveralls
- Latex or nitrile inner gloves
- Nitrile outer gloves
- Latex booties or PVC overboots
- Cotton inner or leather outer gloves (as needed)
- Steel-toed/shanked work boot or shoes
- Safety glasses with side shields
- Hard hat
- Hearing protection (as required)
- Cool vests (as needed)
- Insulated coveralls, boots, gloves and headliner (as needed)

Modified Level D_2 Personal Protection Equipment

Modified Level D_2 Personal Protection Equipment will consist of the following items:

- Chemically resistant coveralls (Kappler CPF III or Tychem 7500)
- Latex or nitrile inner gloves
- Chemically-resistant outer gloves (North Silvershield or Safety 4-4H)
- Steel-toed/shanked work boots or shoes
- Chemically-resistant overboots (Safety 4-4H)
- Hard hat
- Safety glasses with side shields
- Face shield (chemical splash-potential)
- Hearing protection (as required)
- Cool vests (as required)
- Insulated coveralls, boots, gloves and headliner (as needed)

Level C Personal Protection Equipment

Level C Personal Protective Equipment will consist of the following items:

- Full face piece respirator (NIOSH approved) with organic vapor and HEPA cartridges
- Chemically resistant coveralls (Kappler CPF III or Tychem 7500)
- Latex or nitrile inner gloves
- Chemically-resistant outer gloves (North Silvershield or Safety 4-4H)
- Steel-toed/shanked work boots or shoes
- Chemically-resistant overboots (Safety 4-4H)
- Hard hat
- Safety glasses with side shields
- Face shield (chemical splash-potential)
- Hearing protection (as required)
- Cool vests (as required)
- Insulated coveralls, boots, gloves and headliner (as needed)

Level B Personal Protection Equipment

Level B Personal Protective Equipment will consist of the following items:

- Open circuit, pressure-demand self-contained breathing apparatus (SCBA) or open air pressure demand supplied airline system
- Chemically resistant coveralls (Kappler CPF III or Tychem 7500)
- Latex or nitrile inner gloves
- Chemically-resistant outer gloves (North Silvershield or Safety 4-4H)
- Steel-toed/shanked work boots or shoes
- Chemically-resistant overboots (Safety 4-4H)
- Hard hat
- Safety glasses with side shields
- Face shield (chemical splash-potential)
- Hearing protection (as required)
- Cool vests (as required)
- Insulated coveralls, boots, gloves and headliner (as needed)
- Communications (optional)

Level A Personal Protection Equipment

Level A Personal Protective Equipment will consist of the following items:

- Open circuit, pressure-demand self-contained breathing apparatus (SCBA) or open air pressure demand supplied airline system
- Totally encapsulated, chemical resistant suit
- Latex or N-Dex inner gloves
- Boots, steel toe and shank
- Communications (optional)
- Hard hat
- Hearing protection (as required)
- Cools vests (as needed)
- Insulated cover-alls, boots, gloves and headliner (as needed)

5.2 SPECIFIC LEVELS OF PROTECTION PLANNED FOR THE SITE

The following levels of protection will be utilized during activities at the site:

Task 1 - Site Preparation - Level D for preparing area and mobilizing units.

Task 2 - Material Handling - Handling of raw sediment will be performed in Modified Level D_1.

Task 3 - Processing - Modified Level D_1 (sediment screening and stabilization) and Modified Level D_2 (solvent extraction area).

Task 4 - Product Handling/Sampling - Modified Level D_1 (sediment screening and stabilization) and Modified Level D_2 (solvent extraction area) will be used.

Task 5 - Demobilization - Modified Level D_1 until system is power-wash cleaned, then Level D.

Upgrade to Level C may be required based on site observation and air monitoring during on-site activities.

5.3 REASSESSMENT OF PROTECTION PROGRAM

The Level of Protection provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or findings of investigations. When a significant change occurs, the hazards should be reassessed. Some indicators of the need for reassessment are:

- Commencement of a new work phase, such as work that begins on a different portion of the site.
- Change in job tasks during a work phase.
- Change of season/weather.
- When temperature extremes or individual medical considerations limit the effectiveness of PPE.
- Contaminants other than those previously identified are encountered or suspected.
- Change in ambient levels of contaminants.
- Change in work scope which effects the degree of contact with contaminants.
- Results of air sampling indicate exposure to employees above PELS.

5.4 STANDARD OPERATING PROCEDURES FOR RESPIRATORY PROTECTION DEVICES AND PERSONAL PROTECTIVE CLOTHING

Standard operating procedures for air purifying respirators, self-contained breathing apparatus and personal protective clothing can be found in Appendix E of this plan, PPE Inspection Procedures.

5.5 UPGRADING OF LEVELS OF PROTECTION

Personnel will carry and be prepared to upgrade to the next level of protection in the event that any of the circumstances described below occur:

- Air monitoring indicates that an action level as provided in Section 5 is exceeded.
- Leak or breach in equipment and/or spill of material from the solvent extraction process occurs. M&E Personnel will immediately leave the area until an assessment of the situation is performed by the SHSO and Level of Protection is determined.
- An approved amendment to this HASP provides for a change in the level of protection for a specific task.

SECTION 6
MEDICAL SURVEILLANCE REQUIREMENTS

Prior to being assigned to site activities, all site personnel who are entering the exclusion or contamination reduction zone shall participate in a medical surveillance program as required by OSHA 29 CFR 1910.120(f). At a minimum, this medical monitoring shall include:

- Complete medical and occupational histories
- Physical examination
- Pulmonary function tests
- Eye examination and visual acuity
- Audiometry
- Complete blood count
- Blood PCB
- Urine screen for heavy metals
- Fasting SMA 12

The medical evaluation shall categorize employees as fit-for-duty and able to wear respiratory protection. Documentation is the responsibility of each employer.

In addition, medical monitoring shall be provided at the following times:

- When employees have been injured, receive a health impairment, or develop signs or symptoms which may have resulted from an exposure.

- As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible over exposure to hazardous substances, health hazards or exposure above an OSHA PEL.

- As soon as possible following an emergency incident where personnel may have been exposed.

- Whenever there is a time loss injury or illness.

SECTION 7
FREQUENCY AND TYPES OF AIR MONITORING

Air monitoring shall be performed to estimate airborne contaminant concentrations of lead and acetic acid content in order to verify and determine the level of worker protection needed. All monitoring equipment shall be calibrated, operated and maintained according to the manufacturer's specifications. Manufacturer's operating instructions shall be available on site.

Air monitoring techniques and instrumentation shall be used in accordance with the Regulatory Agency's Field Sampling Procedures. All monitoring equipment must be calibrated, operated and maintained according to the manufacturer's specifications.

At a minimum, equipment shall be "field calibrated" at the start and end of each work day and whenever equipment operation is questionable.

The following Table 3 summarizes the type of instrument, task, location, monitoring frequency, action level and action to be taken if the trigger/alarm level is exceeded.

TABLE 7-1
Air Monitoring, Actions Levels, and Corrective Actions

Instrument/Item	Task	Sampling Location	Monitoring Frequency	Action Level	Action
MIE Miniram Aerosol meter	Task 2, 3, 4, 5	Breathing Zone	Continuous	a) dust at 2.5 mg/m^3[1]	• Use dust suppression techniques • Curtail operations • Upgrade to Level C[2]
PID/FID for organic vapors	Task 2, 3, 4, 5	Breathing Zone	Continuous	> 125 ppm[3] > 6,250 ppm[4]	• Level C[2] • Level B or leave site[5]
Combustible Gas Meter	Task 2, 3, 4	Process Areas	Continuous	> 10% LEL	• Leave area, de-energize pilot equipment power, repair leaks[5]

(1) This value protects for the dust/particulate action level of 5 mg/m^3.

(2) Level C protection requires a full-face respirator and provides an additional protection factor of 50.

(3) This value is 50% of the TWA for alcohol. The TWA value for the other main solvent, acetate, is higher than alcohol.

(4) Based on a respirator fit factor of 50.

(5) Personnel will egress from the site and inform the Health & Safety Officer, who will evaluate the need to upgrade the level of protection.

SECTION 8
SITE CONTROL MEASURES

8.1 BUDDY SYSTEM

Personnel shall be organized in such a manner that each person of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency. At a minimum, two persons must be present at the site.

8.2 SITE COMMUNICATION PLAN

Successful communications between field teams as well as contact with personnel in the support zone is essential. The following communications systems will be available during activities at the site:

- Hand signals
- On-site telephone

Hand Signal	Definition
Hand clutching throat	Out of air/cannot breath
Hands on top of head	Need assistance
Thumbs up	OK/I'm alright/I understand
Thumbs down	No/negative
Arms waving upright	Send backup support
Grip partners wrist	Exit area immediately

Visual, voice or radio communications must be maintained at all times.

8.3 WORK ZONE DEFINITIONS

Work zones shall be delineated by the SHSO by means of flagging, marking tape and/or signs. There shall be three work zones for the purpose of site control and personal protection. These zones are described as follows and are shown on Figure 2-3b.

- Exclusion Zone - The Exclusion Zone is defined as the area that is considered to be contaminated, is potentially contaminated, or could become contaminated. This zone will be delineated by the SSO based on air-monitoring results and the need to control access in and out of the work area due to physical hazards. At this time the Exclusion Zone is defined as the material storage area, an area encompassing the slab, and process equipment. All personnel working in the Exclusion Zone will use the appropriate level of protection (see Part II Section 5.0). All areas considered to be part of the Exclusion Zone will be physically marked off by some means (e.g., caution tape). The entire Exclusion Zone will be treated as

an "explosion-proof" zone due to the use of flammable solvents during the extraction procedure. A no-smoking, no-sparks policy will be instituted in this area. Signs will be posted, caution will be taken to use non-sparking tools.

- Contamination Reduction Zone - The CRZ serves as the interface between the Exclusion Zone (contaminated) and the Support Zone (clean). This transition zone serves as a buffer to further reduce the probability of the Support Zone becoming contaminated. This zone provides additional assurance that the physical transfer of contaminated substances on people, on equipment, or in the air is limited through a combination of decontamination procedures, distances between zones, air dispersion evaluations, zone restrictions, and work functions.

  Material supplies will be staged within the CRZ for the servicing of equipment or for use by personnel within the Exclusion Zone. All vehicles, equipment, and personnel will be totally decontaminated before leaving this area. All protective clothing that is removed will be stored in the CRZ.

- Support Zone - The Support Zone is considered "clean" or uncontaminated. Support equipment such as office trailers, equipment, and supplies will be located in this zone.

8.4 NEAREST MEDICAL ASSISTANCE

Information on the nearest medical assistance can be found under Section 11; Emergency Resources. Figure 4 provides a map of the route to the nearest medical facility. The route to the hospital will be verified by the Health and Safety Officer prior to the start of activities and Figure 4 is to be prominently posted on-site.

8.5 SAFE WORK PRACTICES

The following general safety procedures shall be followed by all persons entering and/or working on the site:

- All on-site personnel and any visitors to the site during work activities described in this health and safety plan shall read and sign this safety plan prior to entering and/or working on the site. The master copy (with signature sheet) of this safety plan will be held by the designated Site Health and Safety Officer. A signature sheet is provided as Appendix A of this plan, as mentioned previously in this HASP.

- No project personnel may be allowed on-site without the prior knowledge and consent of the designated SHSO and project manager.

- There will be no activities conducted on-site without sufficient backup personnel. At a minimum, two persons must be present during on-site activities. Visual (i.e., hand signals), voice or radio communication will be maintained at all times.

- Project personnel shall bring to the attention of the designated site safety officer any unsafe condition or practice associated with on-site project-related activities.

- All heavy equipment operation, and general construction activities shall be performed while in compliance with 29 CFR 1926 and 29 CFR 1910.

- All project personnel who are required to work within the exclusion zone or are likely to be exposed to hazardous substances and/or health hazards or to wear purifying or air supplied respirators must first meet the training and medical requirements of 29 CFR 1910.120 and 29 CFR 1910.134.

- Field work will be conducted only during daylight hours unless adequate lighting is provided.

- No eating, drinking, smoking, chewing gum or tobacco, application of cosmetics, or any practice that increases the probability of hand-to-mouth transfer and ingestion of contaminated materials will be allowed in Exclusion Zones or Contaminant Reduction Zone. Smoking materials and any other ignition sources such as sparking equipment will not be allowed in Exclusion Zones and Contaminant Reduction Zone.

- Contact lenses shall not be worn in Exclusion Zones or Contaminant Reduction Zone.

- No jewelry which interferes with protective clothing fit will be worn.

- No beards, sideburns or mustaches will be allowed which interfere with respirator mask seals if respirators are used. The SHSO will determine if facial hair presents such an interference.

- Dust control measures should be instituted if visible dust is created during on-site activities by moving all personnel upwind or laterally from the dust source, and by misting the dust source with a water spray.

- Aerial obstructions such as power lines and tree branches will be verified prior to movement of large equipment. A 20 foot horizontal clearance must be maintained between aerial obstructions.

- When using portable electrical tools and appliances use three-wire grounded extension cords and ground fault interruptions (GFI) to reduce the potential for electrical shock.

- All site activities shall conform with the AWT Health and Safety Policies & Work Practice Guidelines. A copy of each manual shall be available on-site during all operations.

- Hands, face and all other potentially contaminated areas shall be thoroughly cleaned prior to eating or leaving the site.

- Inspectors must avoid unnecessary contamination (i.e., walking through known or suspected exclusion zones or contaminated puddles, kneeling or sitting on the ground, leaning against potentially contaminated barrels or equipment).

- Workers will remain clear of "the barricaded swing path" of heavy equipment, will stay in sight of the operator, and will only approach when the operator has removed hands and feet from the controls.

- All heavy equipment will be operated a safe distance (min. 20 feet) from overhead power lines.

- All workers are required to wear OSHA-approved hearing protection when noise exceeds 85 decibels.

- Maintain good housekeeping practices. Clean general area to be cleaned at end of each day.

- Ensure that the area is highly visible, delineate zones to maintain safe distances from vehicular traffic.

- Moving equipment over uneven terrain may cause the vehicle to roll over or get stuck in a rut or mud.

- Inspect all safety guards, railings, platforms, and switches daily and repair immediately when needed.

- Personnel must be cognizant of body position or body parts in relationship to moving objects.

- All workers/visitors on-site are encouraged to wear approved hearing protection.

- Take sufficient breaks to cool down. Replenish fluids periodically. A work-rest regimen will be implemented by the SSO in accordance with NIOSH and ACGIH guidelines.

- Take ample breaks to warm up and replenish fluids. Wear sufficient clothing to allow venting or retention of body heat.

8.6 SANITATION

- An adequate supply of potable water shall be available on-site. Portable containers used to dispense drinking water shall be capable of being tightly closed and equipped with a tap. Water shall not be dipped from containers.

- Any container used to distribute drinking water shall be clearly marked as to the nature of contents and not used for any other purpose.

- Refrigerators used for the storage of food items shall be labeled "Food Items Only".

- Restroom facilities shall be made available at hazardous waste site locations.

8.7 VISITOR RULES/SECURITY

- NJIT personnel will be responsible for implementing and maintaining control of the visitors' log book. Visitors should give advance notice by telephone before visiting the site.

- During the time period of site mobilization and the soil decontamination pilot study test, trespassing will not be permitted. Appropriate signs of this notice will be posted.

- Only authorized personnel and legitimate visitors will be permitted entrance to the premises. Visitors should enter the east door and proceed directly to the M&E office trailer to register in the visitors' book. Information to be recorded includes name, affilition, person being visited, and arrival and departure times.

- During working hours, all six (6) personnel doors (three each along the north and south sides of the building) must be unlocked for unrestricted exit. Several of the fourteen (14) garage doors may also be opened. Vigilance on the part of authorized personnel is necessary to control trespassers (see Figure 2-3a).

- All doors must be closed and locked at the end of the work day. All of the doors are locked from the inside except the southwest exit door, which is locked from the outside on leaving. Gates on the generator fence must be secured with a chain and lock when access to the generator is not needed and at the end of the work day.

SECTION 9
DECONTAMINATION PROCEDURES

9.1 PERSONNEL DECONTAMINATION PROCEDURES

Personnel Decontamination Stations will be set up as close to ongoing work as practicable so that personnel will pass through a Decontamination Station upon leaving an Exclusion Zone.

Personnel will become thoroughly familiar with the following decontamination procedure to be used for Modified Level D and Level C before work begins in Exclusion Zones:

1. Place equipment and/or samples in area designated.

2. Wash boots and outer gloves using soap in water solution and rinse with water.

3. Remove tape from around boots and gloves and deposit in plastic liner.

4. Remove overboots and outer gloves and place in plastic bags.

5. Remove hard hat and safety glasses. Decontaminate as necessary and wash with sanitizing solution (MSA sanitizing solution or equivalent). Rinse with potable water and allow to dry at the end of each day.

6. If respirators are used, wipe down the respirator exterior with a wet paper towel.

7. Remove disposable coveralls by rolling coverall down and away from body and place in plastic bag.

8. Remove respirator and deposit in plastic liner. Avoid touching face with fingers. Respirators shall be washed in a sanitizing solution (MSA sanitizer or equivalent), rinsed with potable water and allowed to air dry at the end of each day.

9. Remove boots and store in appropriate location.

10. Remove disposable inner gloves by pulling off inside out and place in plastic bag.

11. Wash hands, face and any other potentially contaminated areas with water and hand soap followed by a potable water rinse.

12. Shower and launder personal clothing as soon as possible upon completing daily activities.

13. All plastic bags of materials generated will remain on-site.

14. All rinse waters generated will be stored on-site. The water will be sampled and properly disposed as necessary.

Level D decontamination procedures include normal work day procedures including:

1) Brush dirt from boots.

2) Remove gloves, safety glasses, hard hat, ear plugs/muffs, as needed.

3) Wash hands and face with water and hand soap followed by a potable water rinse.

4) Shower and launder personal clothing as soon as possible upon completing daily activities.

9.2 EQUIPMENT DECONTAMINATION PROCEDURES

All equipment which comes into direct contact with potentially contaminated material, surface water or groundwater shall be decontaminated prior to leaving the contamination reduction zone. Equipment decontamination procedures will consist of the following:

1. Physically removed packed dirt and debris with a stiff bristle long handle brush and water.

2. Steam clean all potentially contaminated surface areas, if needed.

3. Scrub all potentially contaminated surface areas with a water/industrial detergent soap solution.

4. Rinse scrub solution off with steam and/or water.

5. Allow to drip and air dry on-site.

6. Scan with monitoring equipment to ensure absence of volatile vapors.

7. Repeat steps 1 through 6 if vapors are detected.

NOTE: All Electronic monitoring equipment will be wrapped in plastic to eliminate the need for extensive decontamination protocols which could harm the electronics.

9.3 DECONTAMINATION EQUIPMENT

1	Steam cleaner (if needed)
2 - 3	Long handle (2 - 3') soft bristle scrub brush
1	Boot wash basin (20-gallons)
1	Box industrial detergent
3	High pressure spray washer
1	Mild soap in dispenser (16 oz.)
2	Plastic wash bowl
1	Package plastic bag liners (20 - 55-gallon)
1	Roll of duct tape
1	Roll of 6' x 30' plastic sheeting
1	Portable field table
1	Respirator cleaning bucket, sanitizing solutions and sponge
10	Paper towels (100/roll)
--	Water supply
1	Squeeze bottle

SECTION 10
EMERGENCY RESPONSE/CONTINGENCY PLAN

This section describes contingencies and emergency planning procedures to be implemented at the Site. This plan is compatible with local, state and federal disaster and emergency management plans as appropriate.

10.1 PRE-EMERGENCY PLANNING

During the site briefings held periodically/daily, all employees will be trained in and reminded of provisions of the emergency response plan, communication systems, and evacuation routes. The plan will be reviewed and revised if necessary, on a regular basis by the SHSO. This will ensure that the plan is adequate and consistent with prevailing site conditions.

10.2 PERSONNEL ROLES AND LINES OF AUTHORITY

The SHSO has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measure to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area, and evacuation of adjacent residents. He/she is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The SHSO may be called upon to act on the behalf of the site supervisor, and will direct responses to any medical emergency. The individual contractor organizations are responsible for assisting the project manager and site health and safety officer in his/her mission within the parameters of their scope of work. The site coordinator, NJIT, and the property/building owner, Port Authority of NY/NJ, should be contacted in case of a building emergency.

10.3 EMERGENCY RECOGNITION AND PREVENTION

Section 2.6 provides a listing of physical hazards on-site. Personnel will be familiar with techniques of hazard recognition from preassignment training and site specific briefings. The SHSO is responsible for ensuring that prevention devices or equipment are available to personnel.

10.4 EVACUATION ROUTES/PROCEDURES

In the event of an emergency which necessitates an evacuation of the site, the following alarm procedures will be implemented:

1. Activate site warning alarm
2. Proceed to the closest exit with your buddy
3. Gather at the decontamination area (relocate if necessary)
4. SHSO notifies appropriate emergency response personnel

5. SHSO to perform head count to verify all personnel present
6. SHSO notifies the supervisor and project manager
7. SHSO notifies Regional Safety Coordinator.

In the event of any emergency, site security, if needed, will be arranged by the local police department.

10.5 CONTINGENCY PROCEDURES

First aid supplies and fire protection equipment will be available on-site as well as an audible evacuation alarm. Prior to on-site work, specific procedures for the transportation of injured personnel to local hospitals will be developed and arrangements will be made as needed with local police, fire companies and ambulance services for response to on-site emergencies as necessary. A working relationship with an emergency response team that is prepared to assess and cleanup large-scale spills will be consummated as needed. That team will be available for mobilization to the site if the need arises.

10.6 EMERGENCY PROCEDURES

1. Personnel on-site will use the "buddy" system (pairs). Buddies should pre-arrange hand signals or other means of emergency signals for communication in case of lack of radios or radio breakdown.

2. In emergencies, the following hand signals are suggested:

   a. Hand gripping throat: out of air, can't breath.

   b. Grip partner's wrist or place both hands around waist: leave area immediately, no debate.

   c. Hands on top of head: need assistance.

   d. Thumbs up: OK, I'm alright, I understand.

   e. Thumbs down: No, negative.

3. Site work area entrance and exit routes will be planned, and emergency escape routes delineated by the SHSO. An emergency alarm (air horn, etc.) will be sounded in a series of three short blasts to signify site evacuation.

4. Visual contact will be maintained between "pairs" on-site with the team remaining in close proximity in order to assist each other in case of emergencies.

5. Work crew members will inform each other of non-visual effects of toxic exposure: headaches, dizziness, blurred vision, cramps, irritation of eyes, skin or respiratory tract.

6. In the event that any member of the work crew experiences any adverse effects or symptoms of exposure while on-site, the entire work crew will immediately halt work and act according to the instructions provided by the Site Health and Safety Officer.

7. The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the team and a re-evacuation of the hazard and the level of protection required. This re-evacuation will be conducted by appropriate on-site safety personnel.

10.7 EMERGENCY MEDICAL TREATMENT PROCEDURES

Any person who becomes ill or injured in the exclusion and/or contamination reduction zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to the project manager and SHSO. The SHSO will prepare a First Report of Injury Form (Appendix J) as appropriate.

Any person being transported to a clinic or hospital for treatment should take with them a complete copy of the site health and safety plan.

Any vehicle used to transport contaminated personnel will be treated and cleaned as necessary.

Any person who becomes ill or injured without the concern of contamination shall also seek appropriate medical assistance.

10.8 FIRE OR EXPLOSION

In the event of a fire or explosion, follow evacuation procedures and contact the local fire department immediately. Upon their arrival, the project manager or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on-site.

10.9 SPILL OR LEAKS

In the event of a spill or a leak, site personnel will leave the area and inform the designated spill responder or alternate immediately. A spill response plan (Table 10-1) has been developed in the event of an on-site chemical spill and the details are in Table 10. The first step to any material spill will be to notify the designated spill response person or alternate, who should don any special PPE and evacuate the area of all unnecessary personnel.

10.10 EMERGENCY EQUIPMENT/FACILITIES

All emergency alerting and response equipment shall be available at the interface of the support and contamination reduction zone. At a minimum this shall include the following:

- First Aid Kit
- Fire Extinguisher (10 lb. 2A:10B:10C)
- Mobile Telephone or available site telephone
- Eye wash delivering a minimum of 0.4-gallons per minute for 15 minutes or a garden hose attached to a potable water supply (within 100 feet of travel from a hazard).

10.11 HAZARD COMMUNICATION PLAN

M&E personnel will have available on-site a copy of their hazard communication plan and site chemical inventory. MSDS shall be available for all agents listed in the chemical inventory as well as all site contaminants. MSDS sheets for site contaminants are provided in Appendix E. M&E personnel will communicate with contractor's employees to inform each other of labeling procedures and chemicals brought on-site. BNL's hazard communication information for this site will be available on site and must be reviewed in connection with this Health & Safety Plan prior to commencing site activities.

TABLE 10-1
SPILL RESPONSE PLAN

Material Spilled	Material Location	Neutralizing Agent	Ratio of Neutralizing Agent vs. Quantity Spilled	Spill Cleanup Procedures	Personal Protective Equipment	Spill Waste Disposal Procedures	Spill Responder/ Alternate
Raw Sediment	Roll-offs, Drums, or Pails	Not Applicable	Not Applicable	Eliminate the source of release; right a tipped drum, plug a hole with a sorbent pad, or overpack a ruptured drum. Contain the release with a sorbent boom. Shovel sediment back into container. Wipe with rags, mop, etc. Then wash down the area with clean water.	Modified Level D_1 as detailed in Section 5.1 of this HASP	Not applicable	All operators
Contaminated Water	Process Areas or Tanks	Not Applicable	Not Applicable	Eliminate the source of release; right a tipped drum, plug a hole with a sorbent pad, or overpack a ruptured drum. Contain the release with a sorbent boom or mop and place in drum. Direct water to sumps and pump to wastewater tank. Wash down the area with clean water.	Modified Level D_1 as detailed in Section 5.1 of this HASP	Not applicable	All operators
Solvents or Sediment with Solvent	Drums or Pilot equip-ment	None or water to dilute	Not Applicable	Eliminate the source of the release, right a tipped drum, plug a hole with a sorbent pad, or overpack a ruptured drum. Contain the release with a sorbent boom. Soak up the spilled material with absorbent material. The area may be slippery. Place cones around the spill area until it dries.	Modified Level D_2 as detailed in Section 5.1 of this HASP	Place material and absorbent material into the spill waste drum. Label the drum with the date, your name, and "Spill Waste". Notify the Project Manager of your activities.	All operators

TABLE 10-1
SPILL RESPONSE PLAN
(Continued)

Material Spilled	Material Location	Neutralizing Agent	Ratio of Neutralizing Agent vs. Quantity Spilled	Spill Cleanup Procedures	Personal Protective Equipment	Spill Waste Disposal Procedures	Spill Responder/ Alternate
Portland Cement or Sediments with Cement	Stabiliza-tion Area	None	Not Applicable	Eliminate the source of release; right a tipped drum, plug a hole with a sorbent pad, or overpack a ruptured drum. Contain the release with a sorbent boom. Shovel cement/sediment back into container. Wipe with rags, mop, etc. Then wash down the area with clean water.	Modified Level D_1 as detailed in Section 5.1 of this HASP	Not Applicable	All operators

SECTION 11
EMERGENCY RESOURCES

The following emergency information will be posted prominently on site for appropriate use of M&E personnel:

AREA RESOURCES

Ambulance:	Ambulance - 911
Hospital Emergency Room:	St. James Hospital - 201-589-1300
Poison Control Center:	1-800-962-1253
Port Authority Police Desk:	201-578-2180
Fire Department:	911 or 201-733-7400
NJDEP Hotline:	609-292-0611
Regulatory Agency:	
Cleanup Contractor:	ChemTrec - 1-800-424-9300

SITE NUMBERS

M&E BNL Pilot Study Project	201-817-8106 FAX 201-817-7438

EMERGENCY CONTACTS

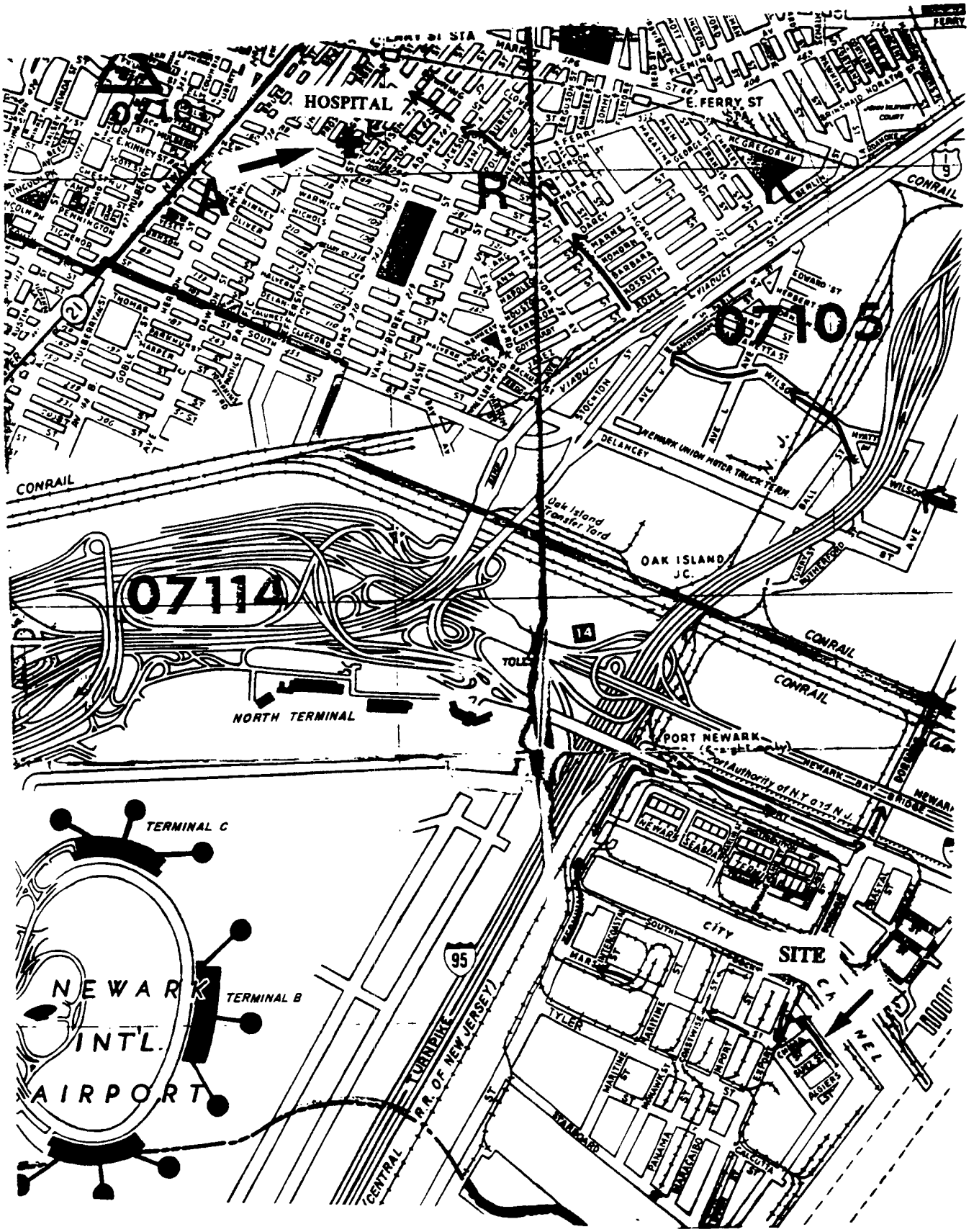
M&E Project Manager/ Engineer:	Phil DiGasbarro	(w) 908-685-6247 (pager) 908-825-0344 (h) 908-218-3724
M&E Corporate Safety Officer:	Richard Renzi	(w) 617-246-4450 (pager) 1-800-532-5870 (h) 508-475-0190
M&E Project Safety Officer:	Amy Zampella	(w) 908-685-6249 (pager) 908-825-0427 (h) 908-253-0628
M&E Project Engineer:	Tushar Roy	(w) 908-685-6255 (h) 610-865-6387

EMERGENCY CONTACTS (contd)

Hospital (name, address, phone):		St. James Hospital 155 Jefferson Street Newark, NJ 201-589-1300
Hospital Route (as indicated on Figure 11-1)		Left on Export St. to left on Marsh St. heading west. Right on Terminal St. to end. Left on Doremus St. to left on Wilson Ave. Head west until it turns into Ferry St. Take Ferry St. for seven (7) blocks. Turn left on Jefferson St. Go one block and hospital is on the right side on the corner of Jefferson and Lafayette Streets.
NJIT Site Coordinator (on site)	Mr. Robert Emery	201-596-6373 FAX 201-802-1946
	Mr. Jeff Duteau	201-642-7088
NJIT Site Director	Prof. William Librizzi	201-596-5846 FAX 201-802-1946
Port Authority Property/ Building Owner (contact in case of building emergency)	Beth Rooney	201-690-3480
BNL Project Manager	Dr. Keith W. Jones	516-344-4588 FAX 516-344-5271
RCC/IONICS Project Manager	Mr. Dale Owens	206-828-2400

Note:

The project managers will make pre-emergency arrangements with emergency response personnel and has verified their ability to respond to a site emergency.



BROOKHAVEN NATIONAL LABORATORY	
UPTON, NEW YORK	
ROUTE TO ST. JAMES HOSPITAL BNL PILOT STUDY - NEWARK, N.J.	
Prepared for: Brookhaven National Lab. Upton, New York	Prepared by: Metcalf & Eddy, Inc. P.O. Box 1500 Somerville, NJ 08876

SECTION 12

CONFINED SPACE ENTRY PROCEDURES

Although confined space activities are not anticipated for this project, M&E has included this section in the HASP as required by 1910.120. In no case shall M&E employees enter confined spaces. Other contractors shall follow their own procedures for entering confined spaces and not reference this section. The AWT Policies & Procedures "Confined Space Entry" is provided as Appendix L to this plan. This Policy & Procedure must be followed for implementing the OSHA 29 CFR 1910.146 Regulations.

APPENDIX A
RAW SEDIMENT DATA SUMMARY

TRIAD JOINT DATA

	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
1	Analytical Results for	NC960501-4,-5,-6	Date of Last Revision		18Jun96			QA: 26Jun96				
2			By		RJWilke			RJW				
3				Legend:								
4				Normal Type = Below Detection Limit								
5				**Bold Type = Valid Data**								
6				*Italics = Estimated Maximum Possible Concentration*								
7	**Gross Physico-Chemical Properties**											
8												
9												
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
11												
12	Particle size											
13	Medium gravel > 4.75 mm	ASTM D422 (Mod)	% wt (dry)	0.46	0.28	0.05						
14	Fine grave 2-4.75	ASTM D422 (Mod)	% wt (dry)	0.06	0.22	0.05						
15	V. coarse sand 0.85-2	ASTM D422 (Mod)	% wt (dry)	0.16	0.39	0.19						
16	Coarse sand 0.425-0.85	ASTM D422 (Mod)	% wt (dry)	0.53	1	0.81						
17	Medium sand 0.24-0.425	ASTM D422 (Mod)	% wt (dry)	3.43	4.22	3.75						
18	Fine sand 0.106-0.24	ASTM D422 (Mod)	% wt (dry)	10.6	8.88	8.4						
19	V. fine sand 0.075-0.106	ASTM D422 (Mod)	% wt (dry)	3.44	4.14	3.11						
20	Clay	ASTM D422 (Mod)	% wt (dry)	22.5	20.6	20.9						
21	Silt	ASTM D422 (Mod)	% wt (dry)	61.6	57.3	60.4						
22												
23												
24	pH	EPA 9045A	pH units	7.36	7.61	7.8	3	7.59	0.18	0.13		2.37
25												
26	Solids (total)	EPA 160.3	% wt (dry)	33.1	37.5	36.8	3	35.80	1.93	1.37		5.39
27												
28	Sulfides (total)	EPA 9030M	mg/kg (dry)	4300	5000	11000	3	6766.67	3007.03	2126.29		44.44
29												
30	Organic carbon (total)	ASTM D4129-82M	% wt (dry)	7.4	8.15	7.5	3	8.10	0.27	0.19		3.31
31												
32												
33												
34												
35	**Total Petroleum Hydrocarbons**											
36	Petroleum hydrocarbons	EPA 9071/418.1	mg/Kg	4000	4100	4200	3	4100.00	81.65	57.74		1.99
37												
38												
39												
40												
41												
42												
43												
44												
45												

	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
136												
137												
138												
139												
140												
141												
142												
143												
144												
145												
146												
147												
148	Semivolatile Compounds (including PAHs):											
149												
150	Phenol	EPA 8270A	ug/kg (dry)	2819.2	2370.3	1666.05	3	2285.18	474.60	335.60		20.77
151	bis(2-Chloroethyl)ether	EPA 8270A	ug/kg (dry)	3611.3	3036.28	2352.36	3	2999.98	514.60	363.88		17.15
152	2-Chlorophenol	EPA 8270A	ug/kg (dry)	2936.49	2468.91	2005	3	2470.13	380.28	268.90		15.40
153	1,3-Dichlorobenzene	EPA 8270A	ug/kg (dry)	2898.41	2436.9	1813.13	3	2382.81	444.71	314.46		18.66
154	1,4-Dichlorobenzene	EPA 8270A	ug/kg (dry)	2805.43	2358.72	1858.63	3	2340.93	386.73	273.46		16.52
155	1,2-Dichlorobenzene	EPA 8270A	ug/kg (dry)	3002.23	2524.19	2050.42	3	2525.61	388.58	274.76		15.39
156	Benzyl alcohol	EPA 8270A	ug/kg (dry)	2466.58	2073.83	1554.77	3	2031.73	373.43	264.06		18.38
157	2,2'-oxybis(1-Chloropropane)	EPA 8270A	ug/kg (dry)	5022.46	4222.74	3720.09	3	4321.76	536.28	379.21		12.41
158	2-Methylphenol	EPA 8270A	ug/kg (dry)	3460.1	2925.96	2282.07	3	2896.04	489.55	346.16		16.90
159	3/4-Methylphenol	EPA 8270A	ug/kg (dry)	3418.01	2873.76	2184.18	3	2825.32	504.87	357.00		17.87
160	N-Nitroso-di-n-propylamine	EPA 8270A	ug/kg (dry)	3254.85	2736.58	3289.5	3	3093.64	252.88	178.81		8.17
161	Hexachloroethane	EPA 8270A	ug/kg (dry)	4059.53	3413.13	3830.87	3	3767.84	267.63	189.24		7.10
162	Nitrobenzene	EPA 8270A	ug/kg (dry)	2079.87	1730.46	1831.17	3	1880.50	146.85	103.84		7.81
163	Isophorone	EPA 8270A	ug/kg (dry)	1209.04	1005.93	991.77	3	1068.91	99.25	70.18		9.29
164	2-Nitrophenol	EPA 8270A	ug/kg (dry)	5989.25	4983.08	3556.87	3	4843.07	997.94	705.65		20.61
165	2,4-Dimethylphenol	EPA 8270A	ug/kg (dry)	3043.95	2532.58	1974.89	3	2517.14	436.58	308.71		17.34
166	bis(2-Chloroethoxy)methane	EPA 8270A	ug/kg (dry)	3087.54	2568.84	1764.58	3	2473.65	544.27	384.88		22.00
167	Benzoic acid	EPA 8270A	ug/kg (dry)	7227.25	6013.1	4499.09	3	5913.15	1116.01	789.14		18.87
168	2,4-Dichlorophenol	EPA 8270A	ug/kg (dry)	4005.19	3332.34	2170.49	3	3169.34	757.83	535.87		23.91
169	1,2,4-Trichlorobenzene	EPA 8270A	ug/kg (dry)	2920.26	2429.67	2034.02	3	2461.32	362.50	256.32		14.73
170	Naphthalene	EPA 8270A	ug/kg (dry)	4825.94	5129.89	5116.97	3	5024.27	140.34	99.23		2.79
171	4-Chloroaniline	EPA 8270A	ug/kg (dry)	3094.92	2574.99	3586.22	3	3085.04	412.48	291.67		13.37
172	Hexachlorobutadiene	EPA 8270A	ug/kg (dry)	294[illegible]18	2446.24	328[illegible]5	3	2889.46	343.06	242.58		11.87
173	4-Chloro-3-methylphenol	EPA 8270A	ug/kg (dry)	319[illegible].26	2657.64	2302.92	3	2718.27	366.41	259.09		13.48
174	2-Methylnaphthalene	EPA 8270A	ug/kg (dry)	3800.25	3641.38	3445.99	3	3562.54	84.11	59.47		2.36
175	Hexachlorocyclopentadiene	EPA 8270A	ug/kg (dry)	3155.25	2845.21	4292.29	3	3430.92	622.10	439.89		18.13
176	2,4,6-Trichlorophenol	EPA 8270A	ug/kg (dry)	4054.83	3656.4	3282.56	3	3667.93	311.30	220.12		8.49
177	2,4,5-Trichlorophenol	EPA 8270A	ug/kg (dry)	4063.48	3664.2	3431.58	3	3719.75	260.95	184.52		7.02
178	2-Chloronaphthalene	EPA 8270A	ug/kg (dry)	1976.94	1782.69	1388.01	3	1715.88	245.03	173.26		14.28
179	2-Nitroaniline	EPA 8270A	ug/kg (dry)	3664.94	3304.82	4051.6	3	3673.79	304.94	215.62		8.30
180	Dimethylphthalate	EPA 8270A	ug/kg (dry)	1491.21	1344.69	1149.92	3	1328.61	139.79	98.85		10.52

A	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
181	2,6-Dinitrotoluene	EPA 8270A	ug/kg (dry)	5974.2	5387.17	5060.55	3	5473.97	378.01	267.30		6.91
182	2,4-Dinitrotoluene	EPA 8270A	ug/kg (dry)	4116.14	3711.68	3813.97	3	3880.60	171.71	121.42		4.42
183	Acenapthylene	EPA 8270A	ug/kg (dry)	1210.78	1030.69	3163.84	3	1801.84	985.88	602.98		53.61
184	3-Nitroaniline	EPA 8270A	ug/kg (dry)	6904.97	6226.48	5265.44	3	6132.30	672.64	475.63		10.97
185	Acenaphthene	EPA 8270A	ug/kg (dry)	5746.56	4500.89	4882.33	3	5043.26	521.12	368.49		10.33
186	2,4-Dinitrophenol	EPA 8270A	ug/kg (dry)	12876.83	11611.54	13137	3	12541.79	666.31	471.15		5.31
187	4-Nitrophenol	EPA 8270A	ug/kg (dry)	6310.5	5690.43	12626.82	3	8209.25	3133.93	2216.03		38.18
188	Dibenzofuran	EPA 8270A	ug/kg (dry)	3170.42	2880.48	3747.43	3	3266.10	360.35	254.80		11.03
189	Diethylphthalate	EPA 8270A	ug/kg (dry)	1096.63	988.79	1182.33	3	1089.25	79.18	55.99		7.27
190	4-Chlorophenyl-phenylether	EPA 8270A	ug/kg (dry)	2589.36	2334.93	2477.28	3	2467.18	104.11	73.62		4.22
191	Fluorene	EPA 8270A	ug/kg (dry)	6662.7	6567.36	6377.57	3	6535.88	118.52	83.80		1.81
192	4-Nitroaniline	EPA 8270A	ug/kg (dry)	7653.7	6901.64	6344.21	3	6966.52	536.56	379.41		7.70
193	4,6-Dinitro-2-methylphenol	EPA 8270A	ug/kg (dry)	7253.86	6799.53	8257.28	3	7436.90	609.03	430.65		8.19
194	N-Nitrosodiphenylamine	EPA 8270A	ug/kg (dry)	2494.42	2338.18	1851.05	3	2227.88	273.99	193.74		12.30
195	4-Bromophenyl-phenylether	EPA 8270A	ug/kg (dry)	3383.85	3171.9	4258.24	3	3604.66	470.18	332.47		13.04
196	Hexachlorobenzene	EPA 8270A	ug/kg (dry)	2949.01	2764.29	3516.99	3	3076.76	320.29	226.48		10.41
197	Pentachlorophenol	EPA 8270A	ug/kg (dry)	5711.2	5353.47	6247.28	3	5770.65	367.31	259.73		6.37
198	Phenanthrene	EPA 8270A	ug/kg (dry)	27751.03	25600.62	31640.33	3	28330.66	2499.53	1767.44		8.82
199	Anthracene	EPA 8270A	ug/kg (dry)	9793.22	9563.8	11754.9	3	10370.64	983.29	695.29		9.48
200	Di-n-butylphthalate	EPA 8270A	ug/kg (dry)	702.77	658.75	610.26	3	657.26	37.78	26.72		5.75
201	Fluoranthene	EPA 8270A	ug/kg (dry)	29118.82	26737.82	35169.16	3	30341.93	3549.07	2509.57		11.70
202	Pyrene	EPA 8270A	ug/kg (dry)	24347.42	22914.83	22296.5	3	23186.25	859.00	607.40		3.70
203	Butylbenzylphthalate	EPA 8270A	ug/kg (dry)	1788.29	1669.52	1095.6	3	1517.80	302.45	213.87		19.93
204	3,3'-Dichlorobenzidine	EPA 8270A	ug/kg (dry)	2894.54	2702.29	1126.83	3	2241.69	790.95	559.29		35.28
205	bis-2-ethylhexylphthalate	EPA 8270A	ug/kg (dry)	85302.95	80233.06	77935.71	3	81157.24	3077.84	2176.36		3.79
206	Benzo(a)anthracene	EPA 8270A	ug/kg (dry)	11760.13	10584.66	11234.31	3	11193.10	480.69	339.90		4.29
207	Chrysene	EPA 8270A	ug/kg (dry)	11752.07	10723.07	11427.23	3	11300.79	429.50	303.70		3.80
208	Di-n-octylphthalate	EPA 8270A	ug/kg (dry)	905.55	841.01	586.86	3	777.81	137.57	97.27		17.69
209	Benzo(b)fluoranthene	EPA 8270A	ug/kg (dry)	9379.22	8721.4	9692.16	3	9264.26	404.56	286.07		4.37
210	Benzo(k)fluoranthene	EPA 8270A	ug/kg (dry)	3008.23	2847.37	2509.45	3	2808.35	229.78	162.48		8.18
211	Benzo(a)pyrene	EPA 8270A	ug/kg (dry)	4880.23	5952.1	5506.63	3	5446.32	439.66	310.89		8.07
212	Indeno(123-cd)pyrene	EPA 8270A	ug/kg (dry)	8058.59	8215.7	8005.83	3	8093.37	89.14	63.03		1.10
213	Dibenz(a,h)anthracene	EPA 8270A	ug/kg (dry)	2138.89	2960.33	2632.26	3	2540.49	331.32	234.28		13.04
214	Benzo(ghi)perylene	EPA 8270A	ug/kg (dry)	2295.79	2926.14	2679.17	3	2633.70	259.34	183.38		9.85
215	Benzo(e)pyrene	EPA 8270A	ug/kg (dry)	1757.46	1632.21	1542.05	3	1643.91	88.33	62.46		5.37
216	Perylene	EPA 8270A	ug/kg (dry)	3382.54	2931.85	3445.48	3	3253.29	228.74	161.74		7.03
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	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
245	**Dioxins and Furans**											
246	2378-TCDD	EPA 8290	ppt	26.7	23.6	27.9	3	26.07	1.81	1.28		6.95
247	12378-PeCDD	EPA 8290	ppt	67.8	61.1	57.8	3	62.23	4.16	2.94		6.69
248	123478-HxCDD	EPA 8290	ppt	86.9	*90.1*	*80.9*	3	86.63	4.08	2.89		4.71
249	123678-HxCDD	EPA 8290	ppt	203	189	161	3	184.33	17.46	12.35		9.47
250	123789-HxCDD	EPA 8290	ppt	219	260	219	3	229.33	14.61	10.33		6.37
251	1234678-HpCDD	EPA 8290	ppt	2080	2110	2110	3	2400.00	410.12	290.00		17.09
252	OCDD	EPA 8290	ppt	18280	12270	10020	3	13523.33	3486.64	2465.43		25.78
253												
254	2378-TCDF	EPA 8290	ppt	260	294	269	3	274.33	14.38	10.17		5.24
255	12378-PeCDF	EPA 8290	ppt	205	238	197	3	213.33	17.75	12.55		8.32
256	23478-PeCDF	EPA 8290	ppt	117	128	116	3	120.33	5.44	3.84		4.52
257	123478-HxCDF	EPA 8290	ppt	1070	1500	957	3	1175.67	233.93	165.41		19.90
258	123678-HxCDF	EPA 8290	ppt	379	530	333	3	414.00	84.15	59.50		20.33
259	234678-HxCDF	EPA 8290	ppt	213	276	191	3	226.67	36.02	25.47		15.89
260	123789-HxCDF	EPA 8290	ppt	9.9	37.1	42.4	3	29.80	14.24	10.07		47.77
261	1234678-HpCDF	EPA 8290	ppt	3720	5240	3020	3	3993.33	926.69	655.27		23.21
262	1234789-HpCDF	EPA 8290	ppt	125	156	107	3	129.33	20.24	14.31		15.65
263	OCDF	EPA 8290	ppt	3470	4630	2180	3	3420.00	1008.99	713.47		29.50
264												
265	**Totals: Dioxins**											
266	-TCDD	EPA 8290	ppt	490	423	489	3	467.33	31.35	22.17		6.71
267	-PeCDD	EPA 8290	ppt	655	925	1040	3	873.33	161.37	114.10		18.48
268	-HxCDD	EPA 8290	ppt	2220	2250	2000	3	2156.67	111.46	78.81		5.17
269	-HpCDD	EPA 8290	ppt	6110	4380	4340	3	4943.33	825.12	583.45		16.69
270												

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	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
271	Totals: Furans											
272	-TCDF	EPA 8290	ppt	2130	2200	2260	3	2223.33	66.50	47.02		2.99
273	-PeCDF	EPA 8290	ppt	2710	3380	2510	3	2870.00	376.65	266.33		13.12
274	-HxCDF	EPA 8290	ppt	4190	5440	3760	3	4463.33	712.57	503.88		15.96
275	-HpCDF	EPA 8290	ppt	5480	6650	4020	3	5376.67	1075.31	760.36		20.00
276												
277												
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279												
280												
281												
282												
283												
284												
285												
286												
287												
288												
289												
290												
291												
292	Metals											
293	Ag	EPA 6010A	mg/kg (dry)	13.9	13.9	12.8	3	13.53	0.52	0.37		3.83
294	As	EPA 6010A	mg/kg (dry)	26.6	26.3	24.5	3	26.47	1.68	1.19		6.34
295	Be	EPA 6010A	mg/kg (dry)	0.571	0.489	0.54	3	0.53	0.03	0.02		6.34
296	Cd	EPA 6010A	mg/kg (dry)	23.8	23.7	21.9	3	23.13	0.87	0.62		3.77
297	Cr	EPA 6010A	mg/kg (dry)	269	269	251	3	263.00	8.49	6.00		3.23
298	Cu	EPA 6010A	mg/kg (dry)	834	838	757	3	809.67	37.28	26.36		4.60
299	Ni	EPA 6010A	mg/kg (dry)	171	168	156	3	165.00	6.48	4.58		3.93
300	Pb	EPA 6010A	mg/kg (dry)	499	505	437	3	480.33	30.74	21.74		6.40
301	Sb	EPA 6010A	mg/kg (dry)	6.23	3.31	2.35	3	3.96	1.65	1.17		41.63
302	Se	EPA 6010A	mg/kg (dry)	5.45	3.2	3.12	3	3.92	1.06	0.76		27.53
303	Tl	EPA 6010A	mg/kg (dry)	2.88	2.45	2.7	3	2.67	0.17	0.12		6.32
304	Zn	EPA 6010A	mg/kg (dry)	1490	1400	1230	3	1373.33	107.81	76.23		7.85
305	Hg (total)	EPA 7471	mg/kg (dry)	2.14	2.32	2.42	3	2.29	0.12	0.08		5.05
306												
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	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
46												
47												
48												
49												
50												
51												
52	Polychlorinated Biphenyls											
53												
54	PCBs:	EPA MM680/HRGC/MS	ug/kg (dry)									
55	2-Mono	Congenor #1	ug/kg (dry)				0	ERR	ERR	ERR		ERR
56	44'-Di	#15	ug/kg (dry)				0	ERR	ERR	ERR		ERR
57	244'-Tri	#28	ug/kg (dry)				0	ERR	ERR	ERR		ERR
58	22'55'-Tetra	#52	ug/kg (dry)				0	ERR	ERR	ERR		ERR
59	33'44'-Tetra	#77	ug/kg (dry)				0	ERR	ERR	ERR		ERR
60	2344'5-Penta	#118	ug/kg (dry)				0	ERR	ERR	ERR		ERR
61	233'44'-Penta	#105	ug/kg (dry)				0	ERR	ERR	ERR		ERR
62	33'44'5-Penta	#126	ug/kg (dry)				0	ERR	ERR	ERR		ERR
63	233'44'5-Hexa	#156	ug/kg (dry)				0	ERR	ERR	ERR		ERR
64	33'44'55'-Hexa	#169	ug/kg (dry)				0	ERR	ERR	ERR		ERR
65	22'344'55'-Hepta	#180	ug/kg (dry)				0	ERR	ERR	ERR		ERR
66	22'33'44'55'-Octa	#194	ug/kg (dry)				0	ERR	ERR	ERR		ERR
67	22'33'44'55'6-Nona	#206	ug/kg (dry)				0	ERR	ERR	ERR		ERR
68	Deca	#209	ug/kg (dry)				0	ERR	ERR	ERR		ERR
69												
70	PCB Totals:											
71	-Mono	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
72	-Di	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
73	-Tri	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
74	-Tetra	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
75	-Penta	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
76	-Hexa	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
77	-Hepta	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
78	-Octa	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
79	-Nona	EPA MM680/HRGC/MS	ug/kg (dry)				0	ERR	ERR	ERR		ERR
80												
81												
82												
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86												
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A	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
91												
92												
93												
94												
95												
96												
97												
98												
99												
100												
101	**Chlorinated Pesticides and Herbicides**											
102												
103												
104	**Pesticides (Cl):**											
105	a-BHC	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
106	a-Chlordane	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
107	Aldrin	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
108	beta-BHC	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
109	delta-BHC	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
110	4,4'-DDD	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
111	4,4'-DDE	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
112	4,4'-DDT	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
113	Dieldrin	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
114	Endrin	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
115	Endrin aldehyde	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
116	Endosulfan I	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
117	Endosulfan II	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
118	Endosulfan sulfate	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
119	g-BHC (Lindane)	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
120	g-Chlordane	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
121	Heptachlor	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
122	Heptachlor epoxide	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
123	Methoxychlor	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
124	Toxaphene	EPA 8080	ug/kg (dry)				0	ERR	ERR	ERR		ERR
125												
126												
127	**Chlorinated Herbicides**											
128	2,4-D	EPA 8150A (Mod)	mg/kg (dry)				0	ERR	ERR	ERR		ERR
129	2,4,5-TP (Silvex)	EPA 8150A (Mod)	mg/kg (dry)				0	ERR	ERR	ERR		ERR
130	2,4,5-T	EPA 8150A (Mod)	mg/kg (dry)				0	ERR	ERR	ERR		ERR
131												
132												
133												
134												
135												

	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
341	**Metals (TCLP)**											
342	-Arsenic	EPA 1311/3010/6010A	mg/L (extract)				0	ERR	ERR	ERR		ERR
343	-Barium	EPA 1311/3010/6010A	mg/L (extract)				0	ERR	ERR	ERR		ERR
344	-Cadmium	EPA 1311/3010/6010A	mg/L (extract)				0	ERR	ERR	ERR		ERR
345	-Chromium	EPA 1311/3010/6010A	mg/L (extract)				1	0.00	0.00	ERR		ERR
346	-Lead	EPA 1311/3010/6010A	mg/L (extract)				0	ERR	ERR	ERR		ERR
347	-Mercury	EPA 1311/7470	mg/L (extract)				0	ERR	ERR	ERR		ERR
348	-Selenium	EPA 1311/3010/6010A	mg/L (extract)				0	ERR	ERR	ERR		ERR
349	-Silver	EPA 1311/3010/6010A	mg/L (extract)				0	ERR	ERR	ERR		ERR
350												
351	**Organo-Cl Pesticides (TCLP)**											
352												
353	-Chlordane	EPA 1311/8080	mg/L (extract)				0	ERR	ERR	ERR		ERR
354	-Endrin	EPA 1311/8080	mg/L (extract)				0	ERR	ERR	ERR		ERR
355	-Heptachlor	EPA 1311/8080	mg/L (extract)				0	ERR	ERR	ERR		ERR
356	-Heptachlor epoxide	EPA 1311/8080	mg/L (extract)				0	ERR	ERR	ERR		ERR
357	-Lindane (g-BHC)	EPA 1311/8080	mg/L (extract)				0	ERR	ERR	ERR		ERR
358	-Methoxychlor	EPA 1311/8080	mg/L (extract)				0	ERR	ERR	ERR		ERR
359	-Toxaphene	EPA 1311/8080	mg/L (extract)				0	ERR	ERR	ERR		ERR
360												

A	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
361	**Cl Herbicides (TCLP)**											
362	-2,4-D	EPA 1311/8150A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
363	-2,4,5-TP (Silvex)	EPA 1311/8150A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
364												
365	**Volatile Organics (TCLP)**											
366	-Benzene	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
367	-Carbon tetrachloride	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
368	-Chlorobenzene	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
369	-Chloroform	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
370	-1,4-Dichlorobenzene	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
371	-1,2-Dichloroethane	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
372	-1,1-Dichloroethene	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
373	Methyl ethyl ketone	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
374	Tetrachloroethene	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
375	Trichloroethene	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
376	Vinyl chloride	EPA 1311/8240A	mg/L (extract)				0	ERR	ERR	ERR		ERR
377												
378	**Semi-Volatiles (TCLP)**											
379	-Hexachloroethane	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
380	-Nitrobenzene	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
381	-Hexachlorobutadiene	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
382	-2,4-Dinitrotoluene	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
383	-Hexachlorobenzene	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
384	-2,4,6-Trichlorophenol	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
385	-2,4,5-Trichlorophenol	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
386	-Pentachlorophenol	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
387	-Pyridine	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
388	-o-Cresol	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
389	-m,p-Cresols	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
390	-Total Cresols	EPA 1311/8270A	mg/L (extract)				0	ERR	ERR	ERR		ERR
391												
392	**PAHs (TCLP)**											
393	Naphthalene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
394	2-Methylnaphthalene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
395	Acenapthylene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
396	Acenaphthene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
397	Dibenzofuran	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
398	Fluorene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
399	Phenanthrene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
400	Anthracene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
401	Fluoranthene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
402	Pyrene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
403	Benzo(a)anthracene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
404	Chrysene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
405	Benzo(b)fluoranthene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR

A	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
406	Benzo(k)fluoranthene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
407	Benzo(a)pyrene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
408	Indeno(123-cd)pyrene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
409	Dibenz(a,h)anthracene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
410	Benzo(ghi)perylene	EPA 1311/8270A (Mod)	mg/L (extract)				0	ERR	ERR	ERR		ERR
411												
412	Dioxins/Furans (TCLP)											
413	2378-TCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
414	12378-PeCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
415	123478-HxCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
416	123678-HxCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
417	123789-HxCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
418	1234678-HpCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
419	OCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
420												
421	2378-TCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
422	12378-PeCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
423	23478-PeCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
424	123478-HxCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
425	123678-HxCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
426	234678-HxCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
427	123789-HxCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
428	1234678-HpCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
429	1234789-HpCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
430	OCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
431												
432	Totals: Dioxins											
433	-TCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
434	-PeCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
435	-HxCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
436	-HpCDD	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
437												
438	Totals: Furans											
439	-TCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
440	-PeCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
441	-HxCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
442	-HpCDF	EPA 8290	ng/L (extract)				0	ERR	ERR	ERR		ERR
443												
444												
445												
446												
447	PCBs (TCLP)	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
448	2-Mono	Congenor #1	ug/L (extract)				0	ERR	ERR	ERR		ERR
449	44'-Di	#15	ug/L (extract)				0	ERR	ERR	ERR		ERR
450	244'-Tri	#28	ug/L (extract)				0	ERR	ERR	ERR		ERR

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A	A	B	C	D	E	F	G	H	I	J	K	L
10	Analyte	Method	Units	-4	-5	-6	n	Mean	SD	SEMEAN		CV (%)
451	22'55'-Tetra	#52	ug/L (extract)				0	ERR	ERR	ERR		ERR
452	33'44'-Tetra	#77	ug/L (extract)				0	ERR	ERR	ERR		ERR
453	2344'5-Penta	#118	ug/L (extract)				0	ERR	ERR	ERR		ERR
454	233'44'-Penta	#105	ug/L (extract)				0	ERR	ERR	ERR		ERR
455	33'44'5-Penta	#126	ug/L (extract)				0	ERR	ERR	ERR		ERR
456	233'44'5-Hexa	#156	ug/L (extract)				0	ERR	ERR	ERR		ERR
457	33'44'55'-Hexa	#169	ug/L (extract)				0	ERR	ERR	ERR		ERR
458	22'344'55'-Hepta	#180	ug/L (extract)				0	ERR	ERR	ERR		ERR
459	22'33'44'55'-Octa	#194	ug/L (extract)				0	ERR	ERR	ERR		ERR
460	22'33'44'55'6-Nona	#206	ug/L (extract)				0	ERR	ERR	ERR		ERR
461	Deca	#209	ug/L (extract)				0	ERR	ERR	ERR		ERR
462												
463	**PCB Totals (TCLP):**											
464	-Mono	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
465	-Di	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
466	-Tri	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
467	-Tetra	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
468	-Penta	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
469	-Hexa	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
470	-Hepta	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
471	-Octa	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR
472	-Nona	EPA MM680/HRGC/MS	ug/L (extract)				0	ERR	ERR	ERR		ERR

APPENDIX B
TREATED PRODUCT DATA SUMMARY

A	B	C	D	E	F	G	H	I	J	K
					TABLE B-1					
					ORG-X PROCESS PERFORMANCE					
					Analytical Results - M&E/GRS End Product					
					(Air-dried solids after ORG-X solvent extract)					
Gross Physico-Chemical Properties					dry soil	dry soil				
		Raw Sediment Comment	Raw Sediment Mean	Comment ORG-X	ME-01	ME-02	n	Mean	Amount Change	% Change
Particle size	% wt (dry)									
Medium gravel > 4.75 mm	% wt (dry)		0.04		0.000	0.000	2	0	0.04	100.00
Fine gravel 2-4.75	% wt (dry)		0.38		0.220	1.800	2	1.01	-0.63	-165.79
V. coarse sand 0.85-2	% wt (dry)		0.83		2.070	11.800	2	6.935	-6.105	-735.84
Coarse sand 0.425-0.85	% wt (dry)		2.15		26.800	14.100	2	20.35	-18.2	-846.51
Medium sand 0.24-0.425	% wt (dry)		5.05		13.800	11.400	2	12.5	-7.45	-147.52
Fine sand 0.106-0.24	% wt (dry)		9.57		15.100	13.700	2	14.4	-4.83	-50.47
V. fine sand 0.075-0.106	% wt (dry)		2.80		4.200	4.100	2	4.15	-1.35	-48.21
Clay	% wt (dry)		35.57		10.800	16.000	2	13.4	22.17	62.33
Silt	% wt (dry)		44.95		28.500	29.200	2	27.85	17.1	38.04
pH	pH units		7.90		7.100	6.820	2	6.96	0.94	11.90
Solids (total)	% wt (dry)		33.05		97.400	97.300	2	97.35	-64.3	-194.55
Sulfides (total)	mg/kg (dry)		7833.33		140.000	120.000	2	130	7703.33	98.34
Organic carbon (total)	% wt (dry)		7.32		6.130	6.060	2	6.095	1.225	16.73
Unconf Compression Strgth	psi		NA					NA		
Bulk Density	lbs/ft3		NA					NA		
Polychlorinated Biphenyls										
PCBs:	ug/kg (dry)									
2-Mono	ug/kg (dry)		57.33		4.000	3.700	2	3.85	53.48	93.28
44'-Di	ug/kg (dry)		64.67		28.600	28.000	2	28.80	35.87	55.47
244'-Tri	ug/kg (dry)		168.17	Reject	15.500	22.900	2	19.20	148.97	NC
22'55'-Tetra	ug/kg (dry)		269.33		22.500	20.200	2	21.35	247.98	92.07
33'44'-Tetra	ug/kg (dry)		13.83		4.200	4.400	2	4.30	9.53	68.91
2344'5-Penta	ug/kg (dry)		6.00	Reject	4.700	2.300	2	3.50	2.5	NC
233'44'-Penta	ug/kg (dry)		66.67		9.000	9.300	2	9.15	57.52	86.28
33'44'5-Penta	ug/kg (dry)		0.50		0.270	0.260	2	0.27	0.235	47.00
233'44'5-Hexa	ug/kg (dry)		17.12		1.600	1.600	2	1.60	15.52	90.65
33'44'55'-Hexa	ug/kg (dry)	All <	0.00	All <	0.030	0.030	2	0.03	-0.03	NC
22'344'66'-Hepta	ug/kg (dry)		73.37		9.300	9.400	2	9.35	64.02	87.26
22'33'44'55'-Octa	ug/kg (dry)		17.10		1.900	2.000	2	1.95	15.15	88.60
22'33'44'55'6-Nona	ug/kg (dry)		11.93		1.800	1.700	2	1.85	10.28	86.17
Deca	ug/kg (dry)		7.20		1.400	1.400	2	1.40	5.8	80.56
PCB Totals:										
-Mono	ug/kg (dry)		106.82		16.800	16.400	2	16.60	92.02	84.72
-Di	ug/kg (dry)		379.33		76.200	79.100	2	77.65	301.68	79.53
-Tri	ug/kg (dry)		727.83		104.000	111.000	2	107.50	620.33	85.23
-Tetra	ug/kg (dry)		1588.33		144.000	160.000	2	152.00	1436.33	90.43
-Penta	ug/kg (dry)		1236.67		104.000	114.000	2	109.00	1127.67	91.19
-Hexa	ug/kg (dry)		808.33		60.500	64.800	2	62.65	745.68	92.25
-Hepta	ug/kg (dry)		294.50		35.500	35.300	2	35.40	259.1	87.98
-Octa	ug/kg (dry)		95.83		8.800	9.100	2	8.95	86.88	90.76
-Nona	ug/kg (dry)		20.38		2.200	2.600	2	2.40	17.98	88.22

A	A	B	C	D	E	F	G	H	I	J	K
1							TABLE B-1				
2							ORG-X PROCESS PERFORMANCE				
3											
4							Analytical Results - M&E/GRS End Product				
5							(Air-dried solids after ORG-X solvent extract)				
6											
7	Gross Physico-Chemical Properties					dry soil	dry soil				
8			Raw	Raw							
9			Sediment	Sediment	Comment					Amount	%
10	Analyte	Units	Comment	Mean	ORG-X	ME-01	ME-02	n	Mean	Change	Change
72	Chlorinated Pesticides and Herbicides										
73											
74											
75	Pesticides (Cl):										
76	a-BHC	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
77	a-Chlordane	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
78	Aldrin	ug/kg (dry)		75.02	All <	1.770	1.770	2	1.77	73.25	>97.64
79	beta-BHC	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
80	delta-BHC	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
81	4,4'-DDD	ug/kg (dry)		162.10		3.530	14.820	2	9.18	152.925	94.34
82	4,4'-DDE	ug/kg (dry)		150.57	All <	3.530	3.550	2	3.54	147.03	>97.65
83	4,4'-DDT	ug/kg (dry)	All <	28.90	All <	3.530	3.550	2	3.54	25.36	NC
84	Dieldrin	ug/kg (dry)		74.45	All <	3.530	3.550	2	3.54	70.91	>95.25
85	Endrin	ug/kg (dry)	All <	28.90	All <	3.530	3.550	2	3.54	25.36	NC
86	Endrin aldehyde	ug/kg (dry)	All <	28.90	All <	3.530	3.550	2	3.54	25.36	NC
87	Endosulfan I	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
88	Endosulfan II	ug/kg (dry)	All <	28.90	All <	3.530	3.550	2	3.54	25.36	NC
89	Endosulfan sulfate	ug/kg (dry)	All <	28.90	All <	3.530	3.550	2	3.54	25.36	NC
90	g-BHC (Lindane)	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
91	g-Chlordane	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
92	Heptachlor	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
93	Heptachlor epoxide	ug/kg (dry)	All <	14.47	All <	1.770	1.770	2	1.77	12.7	NC
94	Methoxychlor	ug/kg (dry)	All <	144.53	All <	17.660	17.740	2	17.70	126.83	NC
95	Toxaphene	ug/kg (dry)	All <	1445.15	All <	176.590	177.380	2	176.99	1268.165	NC
96											
97											
98	Chlorinated Herbicides										
99	2,4-D	mg/kg (dry)	All <	0.20	All <	0.200	0.200	2	0.20	0	0.00
100	2,4,5-TP (Silvex)	mg/kg (dry)	All <	0.05	All <	0.050	0.050	2	0.05	0	0.00
101	2,4,5-T	mg/kg (dry)	All <	0.05	All <	0.050	0.050	2	0.05	0	0.00
102											
103											
104											
105											
106											
107											
108	Semivolatile Compounds (incl										
109	Phenol	ug/kg (dry)		638.00		151.090	201.800	2	176.45	461.555	72.34
110	bis(2-Chloroethyl)ether	ug/kg (dry)	All <	754.50	All <	128.000	144.000	2	136.00	618.5	NC
111	2-Chlorophenol	ug/kg (dry)	All <	691.67	All <	138.000	155.000	2	146.50	545.17	NC
112	1,3-Dichlorobenzene	ug/kg (dry)	All <	507.33	All <	132.000	149.000	2	140.50	366.83	NC
113	1,4-Dichlorobenzene	ug/kg (dry)	All <	517.00		56.400	56.900	2	56.65	460.35	<89.04
114	1,2-Dichlorobenzene	ug/kg (dry)	All <	573.67		48.100	68.700	2	58.40	515.27	<89.82
115	Benzyl alcohol	ug/kg (dry)	All <	1378.33	All <	321.000	361.000	2	341.00	1037.33	NC
116	2,2'-oxybis(1-Chloropropane)	ug/kg (dry)	All <	864.17	All <	112.000	126.000	2	119.00	745.17	NC
117	2-Methylphenol	ug/kg (dry)	All <	875.60	All <	139.000	157.000	2	148.00	727.6	NC
118	3/4-Methylphenol	ug/kg (dry)		1389.67		245.000	262.000	2	253.50	1136.17	81.76
119	N-Nitroso-di-n-propylamine	ug/kg (dry)		1091.50	All <	189.000	212.000	2	200.50	891	>81.63
120	Hexachloroethane	ug/kg (dry)	All <	1243.83	All <	181.000	203.000	2	192.00	1051.83	NC
121	Nitrobenzene	ug/kg (dry)	All <	570.83	All <	98.000	112.000	2	105.00	465.83	NC
122	Isophorone	ug/kg (dry)	All <	334.33	All <	59.000	67.000	2	63.00	271.33	NC
123	2-Nitrophenol	ug/kg (dry)	All <	1054.67	All <	247.000	283.000	2	265.00	789.67	NC
124	2,4-Dimethylphenol	ug/kg (dry)	All <	717.17	All <	111.000	127.000	2	119.00	598.17	NC
125	bis(2-Chloroethoxy)methane	ug/kg (dry)	All <	631.83	All <	99.000	113.000	2	106.00	525.83	NC
126	Benzoic acid	ug/kg (dry)	All <	1335.17		4214.000	3417.000	2	3815.50	-2480.33	-185.77
127	2,4-Dichlorophenol	ug/kg (dry)	All <	684.33	All <	151.000	173.000	2	162.00	522.33	NC
128	1,2,4-Trichlorobenzene	ug/kg (dry)	All <	623.17		222.000	197.000	2	209.50	413.67	<86.36
129	Naphthalene	ug/kg (dry)		2726.67		756.000	753.000	2	754.50	1972.17	72.33
130	4-Chloroaniline	ug/kg (dry)		1002.83	All <	113.000	130.000	2	121.50	881.33	>87.88
131	Hexachlorobutadiene	ug/kg (dry)	All <	711.33	All <	149.000	170.000	2	159.50	551.83	NC
132	4-Chloro-3-methylphenol	ug/kg (dry)	All <	839.17	All <	120.000	138.000	2	129.00	710.17	NC
133	2-Methylnaphthalene	ug/kg (dry)		2304.00		517.000	466.000	2	491.00	1813	78.69
134	Hexachlorocyclopentadiene	ug/kg (dry)	All <	668.33	All <	183.000	208.000	2	195.50	472.83	NC
135	2,4,6-Trichlorophenol	ug/kg (dry)	All <	843.17	All <	203.000	231.000	2	217.00	626.17	NC
136	2,4,5-Trichlorophenol	ug/kg (dry)	All <	798.00	All <	188.000	214.000	2	201.00	597	NC
137	2-Chloronaphthalene	ug/kg (dry)	All <	369.67	All <	76.000	86.000	2	81.00	288.67	NC
138	2-Nitroaniline	ug/kg (dry)	All <	1092.17	All <	178.000	203.000	2	190.50	901.67	NC
139	Dimethylphthalate	ug/kg (dry)	All <	312.17	All <	62.000	71.000	2	66.50	245.67	NC
140	2,6-Dinitrotoluene	ug/kg (dry)	All <	1388.00	All <	276.000	314.000	2	295.00	1093	NC
141	2,4-Dinitrotoluene	ug/kg (dry)	All <	1011.83	All <	206.000	234.000	2	220.00	791.83	NC

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5							(Air-dried solids after ORG-X solvent extract)				
6											
7	Gross Physico-Chemical Properties					dry soil	dry soil				
8			Raw	Raw							
9			Sediment	Sediment	Comment					Amount	%
10	Analyte	Units	Comment	Mean	ORG-X	ME-01	ME-02	n	Mean	Change	Change
142	Acenaphthylene	ug/kg (dry)		1288.50		123.000	115.000	2	119.00	1169.5	90.76
143	3-Nitroaniline	ug/kg (dry)	All <	1350.53	All <	273.000	310.000	2	291.50	1059.03	NC
144	Acenaphthene	ug/kg (dry)		1042.33		134.000	77.000	2	105.50	936.83	89.88
145	2,4-Dinitrophenol	ug/kg (dry)	All <	2467.33	All <	578.000	657.000	2	617.50	1849.83	NC
146	4-Nitrophenol	ug/kg (dry)	All <	1618.17		274.000	312.000	2	293.00	1325.17	<81.89
147	Dibenzofuran	ug/kg (dry)		1172.00		400.000	376.000	2	388.00	784	NC
148	Diethylphthalate	ug/kg (dry)	All <	276.17	All <	54.000	152.000	2	103.00	173.17	NC
149	4-Chlorophenyl-phenylether	ug/kg (dry)	All <	540.33	All <	140.000	159.000	2	149.50	390.83	NC
150	Fluorene	ug/kg (dry)		1369.17		385.000	319.000	2	337.00	1032.17	75.39
151	4-Nitroaniline	ug/kg (dry)	All <	1319.00	All <	284.000	323.000	2	303.50	1015.5	NC
152	4,6-Dinitro-2-methylphenol	ug/kg (dry)	All <	1731.33	All <	396.000	534.000	2	465.00	1266.33	NC
153	N-Nitrosodiphenylamine	ug/kg (dry)	All <	586.50	All <	124.000	167.000	2	145.50	441	NC
154	4-Bromophenyl-phenylether	ug/kg (dry)	All <	1016.17	All <	271.000	365.000	2	318.00	698.17	NC
155	Hexachlorobenzene	ug/kg (dry)	All <	779.00	All <	205.000	276.000	2	240.50	538.5	NC
156	Pentachlorophenol	ug/kg (dry)	All <	1038.83	All <	298.000	402.000	2	350.00	688.83	NC
157	Phenanthrene	ug/kg (dry)		6586.00		2340.000	2358.000	2	2349.00	4237	64.33
158	Anthracene	ug/kg (dry)		3702.17		1116.000	1062.000	2	1089.00	2613.17	70.58
159	Di-n-butyl phthalate	ug/kg (dry)		1226.80		264.000	261.000	2	262.50	964.1	78.60
160	Fluoranthene	ug/kg (dry)		10323.67		2472.000	2526.000	2	2499.00	7824.67	75.79
161	Pyrene	ug/kg (dry)		7101.67		3774.000	3426.000	2	3598.50	3502.17	49.31
162	Butylbenzylphthalate	ug/kg (dry)		1473.17		174.000	122.000	2	148.00	1325.17	89.95
163	3,3'-Dichlorobenzidine	ug/kg (dry)	All <	287.67	All <	126.000	138.000	2	132.00	155.67	NC
164	bis-2-ethylhexylphthalate	ug/kg (dry)		48630.83		6722.000	6042.000	2	6382.00	42248.83	86.90
165	Benzo(a)anthracene	ug/kg (dry)		4484.17		1273.000	1360.000	2	1316.50	3167.67	70.64
166	Chrysene	ug/kg (dry)		4584.33		1972.000	1802.000	2	1887.00	2697.33	58.84
167	Di-n-octylphthalate	ug/kg (dry)	Rejected		All <	85.000	31.000	2	58.00	-58	NC
168	Benzo(b)fluoranthene	ug/kg (dry)		2922.17		1444.000	1651.000	2	1547.50	1374.67	47.04
169	Benzo(k)fluoranthene	ug/kg (dry)		1107.33		870.000	487.000	2	678.50	578.83	52.27
170	Benzo(a)pyrene	ug/kg (dry)		2550.83		897.000	876.000	2	886.50	1664.33	65.25
171	Indeno(123-cd)pyrene	ug/kg (dry)		1075.67		387.000	378.000	2	382.50	693.17	64.44
172	Dibenz(a,h)anthracene	ug/kg (dry)		397.00		189.000		1	189.00	208	52.39
173	Benzo(ghi)perylene	ug/kg (dry)		1254.33		370.000	313.000	2	341.50	912.83	72.77
174	Benzo(e)pyrene	ug/kg (dry)		2125.50		701.000	767.000	2	734.00	1391.5	65.47
175	Perylene	ug/kg (dry)		948.50		539.000	450.000	2	494.50	454	47.87
176											
177											
178											
179											
180											
181	Dioxins and Furans										
182	2378-TCDD	ng/kg (dry)		41.52		21.000	19.000	2	20.00	21.52	51.83
183	12378-PeCDD	ng/kg (dry)		60.15		46.000	34.300	2	40.15	20	33.25
184	123478-HxCDD	ng/kg (dry)		49.22		52.100	37.400	2	44.75	4.47	9.08
185	123678-HxCDD	ng/kg (dry)		141.67		79.800	62.600	2	71.10	70.57	49.81
186	123789-HxCDD	ng/kg (dry)		133.80		123.000	94.900	2	108.95	24.85	18.45
187	1234678-HpCDD	ng/kg (dry)		2091.67		789.000	693.000	2	741.00	1350.67	64.57
188	OCDD	ng/kg (dry)		17463.33		5880.000	5560.000	2	5720.00	11743.33	67.25
189											
190	2378-TCDF	ng/kg (dry)		340.00		683.000	707.000	2	795.00	-455	-133.82
191	12378-PeCDF	ng/kg (dry)		310.83		225.000	176.000	2	200.50	110.33	35.50
192	23478-PeCDF	ng/kg (dry)		146.40		363.000	297.000	2	330.00	-183.6	-125.41
193	123478-HxCDF	ng/kg (dry)		1303.33		1800.000	1510.000	2	1655.00	-351.67	-26.98
194	123678-HxCDF	ng/kg (dry)		484.00		400.000	334.000	2	367.00	97	20.91
195	234678-HxCDF	ng/kg (dry)		186.00		497.000	405.000	2	451.00	-265	-142.47
196	123789-HxCDF	ng/kg (dry)		23.23	All <	17.600	13.000	2	15.30	7.93	>34.14
197	1234678-HpCDF	ng/kg (dry)		4988.33		3080.000	2930.000	2	3005.00	1981.33	39.69
198	1234789-HpCDF	ng/kg (dry)		110.52		108.000	90.000	2	99.00	11.52	10.42
199	OCDF	ng/kg (dry)		4418.33		2010.000	2270.000	2	2140.00	2278.33	51.57
200											
201	Totals: Dioxins										
202	-TCDD	ng/kg (dry)		246.10		378.000	280.000	2	333.00	-86.9	-35.31
203	-PeCDD	ng/kg (dry)		378.17		620.000	476.000	2	548.00	-169.83	-44.91
204	-HxCDD	ng/kg (dry)		1370.00		900.000	725.000	2	812.50	557.5	40.69
205	-HpCDD	ng/kg (dry)		4450.00		1590.000	1450.000	2	1520.00	2930	65.84
206											
207	Totals: Furans										
208	-TCDF	ng/kg (dry)		2371.67		4760.000	3760.000	2	4260.00	-1908.33	-80.48
209	-PeCDF	ng/kg (dry)		2853.33		4740.000	3630.000	2	4185.00	-1331.67	-46.67
210	-HxCDF	ng/kg (dry)		5175.00		5220.000	4610.000	2	4915.00	260	5.02
211	-HpCDF	ng/kg (dry)		6068.33		3780.000	3550.000	2	3665.00	2413.33	39.77

	A	B	C	D	E	F	G	H	I	J	K
1						TABLE B-1					
2						ORG-X PROCESS PERFORMANCE					
3											
4						Analytical Results - M&E/GRS End Product					
5						(Air-dried solids after ORG-X solvent extract)					
6											
7	Gross Physico-Chemical Processes					dry soil	dry soil				
8			Raw	Raw							
9			Sediment	Sediment	Comment					Amount	%
10	Analyte	Units	Comment	Mean	ORG-X	ME-01	ME-02	n	Mean	Change	Change
212											
213											
214											
215											
216											
217	Metals										
218	Ag	mg/kg (dry)		18.42					NA	NC	NC
219	As	mg/kg (dry)		33.48					NA	NC	NC
220	Be	mg/kg (dry)	All <	0.56	All <	0.192	0.184	2	0.19	0.372	NC
221	Cd	mg/kg (dry)		37.05		36.000	36.500	2	36.25	0.8	2.16
222	Cr	mg/kg (dry)		376.67		384.000	386.000	2	385.00	-8.33	-2.21
223	Cu	mg/kg (dry)		1171.67		1160.000	1200.000	2	1180.00	-8.33	-0.71
224	Ni	mg/kg (dry)		287.17		290.000	289.000	2	289.50	7.67	2.58
225	Pb	mg/kg (dry)		617.00		624.000	632.000	2	628.00	-11	-1.78
226	Sb	mg/kg (dry)		10.29		8.410	6.960	2	7.69	2.605	25.32
227	Se	mg/kg (dry)		3.24		2.760	2.680	2	2.72	0.52	18.05
228	Tl	mg/kg (dry)	All <	2.77		1.760	1.920	2	1.85	0.92	<33.21
229	Zn	mg/kg (dry)		1725.00		1690.000	1720.000	2	1705.00	20	1.16
230	Hg (Total)	mg/kg (dry)		1.29		2.870	3.240	2	3.06	-1.765	-136.82
231											
232											
233											
234											
235											

A	A	B	C	D	E	F	G	H	I	J	K
1						TABLE B-1					
2						ORG-X PROCESS PERFORMANCE					
3											
4						Analytical Results - M&E/GRS End Product					
5						(Air-dried solids after ORG-X solvent extract)					
6											
7	Gross Physico-Chemical Properties					dry soil	dry soil				
8			Raw	Raw							
9			Sediment	Sediment	Comment					Amount	%
10	Analyte	Units	Comment	Mean	ORG-X	ME-01	ME-02	n	Mean	Change	Change
236											
237	Metals (TCLP)										
238	-Arsenic	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
239	-Barium	mg/L (extract)	All <	0.50000		0.500	0.500	2	0.50000	0	<0
240	-Cadmium	mg/L (extract)	All <	0.01000	?? - check	0.540	0.510	2	0.52500	-0.515	<-5150
241	-Chromium	mg/L (extract)		0.02833	?? - check	0.050	0.050	2	0.05000	-0.02167	-76.49
242	-Lead	mg/L (extract)	All <	0.05000		0.100	0.090	2	0.09500	-0.045	<-90
243	-Mercury	mg/L (extract)	All <	0.00100		0.001	0.001	2	0.00100	0	<0
244	-Selenium	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
245	-Silver	mg/L (extract)	All <	0.01000		0.010	0.010	2	0.01000	0	<0
246											
247	Organo-Cl Pesticides (TCLP)										
248	-Chlordane	mg/L (extract)	All <	0.00500	All <	0.005	0.005	2	0.00500	0	NC
249	-Endrin	mg/L (extract)	All <	0.00050	All <	0.001	0.001	2	0.00050	0	NC
250	-Heptachlor	mg/L (extract)	All <	0.00050	All <	0.001	0.001	2	0.00050	0	NC
251	-Heptachlor epoxide	mg/L (extract)	All <	0.00050	All <	0.001	0.001	2	0.00050	0	NC
252	-Lindane (g-BHC)	mg/L (extract)	All <	0.00050	All <	0.001	0.001	2	0.00050	0	NC
253	-Methoxychlor	mg/L (extract)	All <	0.00100	All <	0.001	0.001	2	0.00100	0	NC
254	-Toxaphene	mg/L (extract)	All <	0.01000	All <	0.010	0.010	2	0.01000	0	NC
255											
256	Cl Herbicides (TCLP)										
257	-2,4-D	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
258	-2,4,5-TP (Silvex)	mg/L (extract)	All <	0.01000	All <	0.010	0.010	2	0.01000	0	NC
259											
260	Volatile Organics (TCLP)										
261	-Benzene	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
262	-Carbon tetrachloride	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
263	-Chlorobenzene	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
264	-Chloroform	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
265	-1,4-Dichlorobenzene	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
266	-1,2-Dichloroethane	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
267	-1,1-Dichloroethene	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
268	Methyl ethyl ketone	mg/L (extract)	All <	5.00000	All <	5.000	5.000	2	5.00000	0	NC
269	Tetrachloroethene	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
270	Trichloroethene	mg/L (extract)	All <	0.20000	All <	0.200	0.200	2	0.20000	0	NC
271	Vinyl chloride	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
272											
273	Semi-Volatiles (TCLP)										
274	-Hexachloroethane	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
275	-Nitrobenzene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
276	-Hexachlorobutadiene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
277	-2,4-Dinitrotoluene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
278	-Hexachlorobenzene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
279	-2,4,6-Trichlorophenol	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
280	-2,4,5-Trichlorophenol	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
281	-Pentachlorophenol	mg/L (extract)	All <	0.25000	All <	0.250	0.250	2	0.25000	0	NC
282	-Pyridine	mg/L (extract)	All <	0.25000	All <	0.250	0.250	2	0.25000	0	NC
283	-o-Cresol	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
284	-m,p-Cresols	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
285	-Total Cresols	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC

A	B	C	D	E	F	G	H	I	J	K
					TABLE B-1					
					ORG-X PROCESS PERFORMANCE					
					Analytical Results - M&E/GRS End Product					
					(Air-dried solids after ORG-X solvent extract)					
Gross Physico-Chemical Properties					dry soil	dry soil				
		Raw	Raw							
		Sediment	Sediment	Comment					Amount	%
Analyte	Units	Comment	Mean	ORG-X	ME-01	ME-02	n	Mean	Change	Change
PAHs (TCLP)										
Naphthalene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
2-Methylnaphthalene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Acenaphthylene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Acenaphthene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Dibenzofuran	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Fluorene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Phenanthrene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Anthracene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Fluoranthene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Pyrene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Benzo(a)anthracene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Chrysene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Benzo(b)fluoranthene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Benzo(k)fluoranthene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Benzo(a)pyrene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Indeno(123-cd)pyrene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Dibenz(a,h)anthracene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Benzo(ghi)perylene	mg/L (extract)	All <	0.10000	All <	0.100	0.100	2	0.10000	0	NC
Dioxins/Furans (TCLP)										
2378-TCDD	ng/L (extract)	All <	0.00317	All <	0.003	0.001	2	0.00175	0.00142	NC
12378-PeCDD	ng/L (extract)	All <	0.00717	All <	0.008	0.001	2	0.00325	0.00392	NC
123478-HxCDD	ng/L (extract)	All <	0.00700	All <	0.005	0.001	2	0.00310	0.0039	NC
123678-HxCDD	ng/L (extract)	All <	0.00600	All <	0.004	0.000	2	0.00218	0.003825	NC
123789-HxCDD	ng/L (extract)	All <	0.00617	All <	0.005	0.001	2	0.00290	0.00327	NC
1234678-HpCDD	ng/L (extract)		0.00867	Reject	0.003	0.002	2	0.00240	0.00627	NC
OCDD	ng/L (extract)		0.03033	Reject	0.008	0.008	2	0.00795	0.02238	NC
2378-TCDF	ng/L (extract)	All <	0.00233	All <	0.004	0.000	2	0.00231	0.000025	NC
12378-PeCDF	ng/L (extract)	All <	0.00417	All <	0.006	0.001	2	0.00336	0.000818	NC
23478-PeCDF	ng/L (extract)	All <	0.00400	All <	0.006	0.001	2	0.00317	0.000838	NC
123478-HxCDF	ng/L (extract)		0.00533	Reject	0.005	0.002	2	0.00350	0.00183	NC
123678-HxCDF	ng/L (extract)	All <	0.00317	Reject	0.005	0.001	2	0.00259	0.000588	NC
234678-HxCDF	ng/L (extract)		0.00467	Reject	0.007	0.004	2	0.00535	-0.00068	NC
123789-HxCDF	ng/L (extract)	All <	0.00467	All <	0.006	0.001	2	0.00310	0.00157	NC
1234678-HpCDF	ng/L (extract)		0.00925	Reject	0.004	0.002	2	0.00325	0.006	NC
1234789-HpCDF	ng/L (extract)	All <	0.00650	All <	0.004	0.001	2	0.00240	0.0041	NC
OCDF	ng/L (extract)	All <	0.00883	Reject	0.007	0.002	2	0.00440	0.00443	NC
Totals: Dioxins										
-TCDD	ng/L (extract)	All <	0.00317	All <	0.005	0.002	2	0.00335	-0.00018	NC
-PeCDD	ng/L (extract)	All <	0.00717	All <	0.008	0.001	2	0.00325	0.00392	NC
-HxCDD	ng/L (extract)	All <	0.00617	All <	0.014	0.004	2	0.00915	-0.00298	NC
-HpCDD	ng/L (extract)		0.01167		0.003	0.002	2	0.00240	0.00927	79.43
Totals: Furans										
-TCDF	ng/L (extract)	All <	0.00233	All <	0.004	0.000	2	0.00230	0.00003	NC
-PeCDF	ng/L (extract)	All <	0.00400	?? - check	0.012	0.001	2	0.00655	-0.00255	<43.75
-HxCDF	ng/L (extract)		0.01100	?? - check	0.022	0.008	2	0.01525	-0.00425	-38.64
-HpCDF	ng/L (extract)		0.00925	All <	0.009	0.003	2	0.00560	0.00365	<39.46

A	A	B	C	D	E	F	G	H	I	J	K
1						TABLE B-1					
2						ORG-X PROCESS PERFORMANCE					
3											
4						Analytical Results - M&E/GRS End Product					
5						(Air-dried solids after ORG-X solvent extract)					
6											
7	Gross Physico-Chemical Processes					dry soil	dry soil				
8			Raw	Raw						Amount	%
9			Sediment	Sediment	Comment						
10	Analyte	Units	Comment	Mean	ORG-X	ME-01	ME-02	n	Mean	Change	Change
340	PCBs (TCLP)										
341											
342	PCBs:	ug/L (extract)		0.02603		0.002	0.002	2	0.00180	0.02423	93.08
343	2-Mono	ug/L (extract)		0.00342		0.001	0.001	2	0.00077	0.00265	77.49
344	44'-Di	ug/L (extract)		0.00583	All <	0.000	0.000	2	0.00034	0.005495	>94.25
345	244'-Tri	ug/L (extract)		0.00307	All <	0.000	0.000	2	0.00022	0.002850	>93.00
346	22'55'-Tetra	ug/L (extract)		0.00024	All <	0.000	0.000	2	0.00005	0.000190	>81.25
347	33'44'-Tetra	ug/L (extract)		0.00012	All <	0.000	0.000	2	0.00007	0.000065	>46.83
348	2344'5-Penta	ug/L (extract)		0.00106	All <	0.000	0.000	2	0.00007	0.000995	>93.87
349	233'44'-Penta	ug/L (extract)		0.00004	All <	0.000	0.000	2	0.00007	-2.5E-05	NC
350	33'44'5-Penta	ug/L (extract)	All <	0.00031	All <	0.000	0.000	2	0.00006	0.00025	>80.65
351	233'44'5-Hexa	ug/L (extract)		0.00006	All <	0.000	0.000	2	0.00007	-1.0E-05	NC
352	33'44'55'-Hexa	ug/L (extract)	All <	0.00194	All <	0.000	0.000	2	0.00009	0.001850	>95.62
353	22'344'55'-Hepta	ug/L (extract)		0.00039	All <	0.000	0.000	2	0.00015	0.00024	>61.54
354	22'33'44'55'-Octa	ug/L (extract)		0.00019	All <	0.000	0.000	2	0.00015	0.00004	NC
355	22'33'44'55'6-Nona	ug/L (extract)	All <	0.00014	All <	0.000	0.000	2	0.00009	0.00005	NC
356	Deca	ug/L (extract)	All <								
357											
358	PCB Totals:										
359	-Mono	ug/L (extract)		0.03497		0.002	0.003	2	0.00280	0.03217	91.99
360	-Di	ug/L (extract)		0.03523		0.004	0.004	2	0.00385	0.03138	89.07
361	-Tri	ug/L (extract)		0.03662		0.001	0.003	2	0.00205	0.03457	94.40
362	-Tetra	ug/L (extract)		0.02352		0.001	0.001	2	0.00078	0.022785	96.68
363	-Penta	ug/L (extract)		0.01562		0.000	0.000	2	0.00022	0.015405	98.62
364	-Hexa	ug/L (extract)		0.01230	All <	0.000	0.000	2	0.00008	0.012225	>99.39
365	-Hepta	ug/L (extract)		0.00602	All <	0.000	0.000	2	0.00007	0.00595	>98.84
366	-Octa	ug/L (extract)		0.00150	All <	0.000	0.000	2	0.00015	0.00135	>90.00
367	-Nona	ug/L (extract)	All <	0.00022	All <	0.000	0.000	2	0.00015	0.00007	NC
368											
369											
370	NA = Not Applicable or Available										
371	NC = Cannot be calculated because : 1) two values are inequalities , or 2) at least one value is rejected or not available.										

A	A	B	C	D	E
1		**TABLE B-2**			
2		**CONTAMINATED SOLVENT ANALYSES**			
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
9	Chlorinated Pesticides and Herbicides				
10					
11					
12	Pesticides (Cl):				
13	a-BHC	ug/g		<4.95	
14	a-Chlordane	ug/g		<4.95	
15	Aldrin	ug/g		<4.95	
16	beta-BHC	ug/g		<4.95	
17	delta-BHC	ug/g		<4.95	
18	4,4'-DDD	ug/g		<9.90	
19	4,4'-DDE	ug/g		<9.90	
20	4,4'-DDT	ug/g		<9.90	
21	Dieldrin	ug/g		<9.90	
22	Endrin	ug/g		<9.90	
23	Endrin aldehyde	ug/g		<9.90	
24	Endosulfan I	ug/g		<4.95	
25	Endosulfan II	ug/g		<9.90	
26	Endosulfan sulfate	ug/g		<9.90	
27	g-BHC (Lindane)	ug/g		<4.95	
28	g-Chlordane	ug/g		<4.95	
29	Heptachlor	ug/g		<4.95	
30	Heptachlor epoxide	ug/g		<4.95	
31	Methoxychlor	ug/g		<49.51	
32	Toxaphene	ug/g		<495.05	
33					
34					
35	Chlorinated Herbicides				
36	2,4-D	mg/kg (dry)		<6	
37	2,4,5-TP (Silvex)	mg/kg (dry)		<2	
38	2,4,5-T	mg/kg (dry)		<2	
39					
40					
41					
42					

A	A	B	C	D	E
1		**TABLE B-2**			
2		**CONTAMINATED SOLVENT ANALYSES**			
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
43	Semivolatile Compounds (incl				
44	Phenol	ug/g		1.11	
45	bis(2-Chloroethyl)ether	ug/g		<0.87	
46	2-Chlorophenol	ug/g		<0.72	
47	1,3-Dichlorobenzene	ug/g		<0.66	
48	1,4-Dichlorobenzene	ug/g		0.30	
49	1,2-Dichlorobenzene	ug/g		6.00	
50	Benzyl alcohol	ug/g		<2.01	
51	2,2'-oxybis(1-Chloropropane)	ug/g		<0.96	
52	2-Methylphenol	ug/g		<1.00	
53	3/4-Methylphenol	ug/g		<1.02	
54	N-Nitroso-di-n-propylamine	ug/g		<1.24	
55	Hexachloroethane	ug/g		<1.30	
56	Nitrobenzene	ug/g		<0.69	
57	Isophorone	ug/g		1.76	
58	2-Nitrophenol	ug/g		<1.28	
59	2,4-Dimethylphenol	ug/g		<0.92	
60	bis(2-Chloroethoxy)methane	ug/g		<.70	
61	Benzoic acid	ug/g		<1.60	
62	2,4-Dichlorophenol	ug/g		<1.10	
63	1,2,4-Trichlorobenzene	ug/g		<0.87	
64	Naphthalene	ug/g		3.12	
65	4-Chloroaniline	ug/g		0.68	
66	Hexachlorobutadiene	ug/g		<1.26	
67	4-Chloro-3-methylphenol	ug/g		<1.23	
68	2-Methylnaphthalene	ug/g		0.63	
69	Hexachlorocyclopentadiene	ug/g		<1.24	
70	2,4,6-Trichlorophenol	ug/g		<1.63	
71	2,4,5-Trichlorophenol	ug/g		<1.61	
72	2-Chloronaphthalene	ug/g		<0.48	
73	2-Nitroaniline	ug/g		<1.76	
74	Dimethylphthalate	ug/g		<0.49	
75	2,6-Dinitrotoluene	ug/g		<2.08	
76	2,4-Dinitrotoluene	ug/g		<1.52	
77	Acenapthylene	ug/g		0.59	
78	3-Nitroaniline	ug/g		<1.72	
79	Acenaphthene	ug/g		0.74	
80	2,4-Dinitrophenol	ug/g		<5.00	
81	4-Nitrophenol	ug/g		<2.71	
82	Dibenzofuran	ug/g		<0.32	
83	Diethylphthalate	ug/g		<0.40	

A	A	B	C	D	E
1	TABLE B-2				
2	CONTAMINATED SOLVENT ANALYSES				
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
84	4-Chlorophenyl-phenylether	ug/g		<1.05	
85	Fluorene	ug/g		0.80	
86	4-Nitroaniline	ug/g		<1.77	
87	4,6-Dinitro-2-methylphenol	ug/g		<2.76	
88	N-Nitrosodiphenylamine	ug/g		<0.75	
89	4-Bromophenyl-phenylether	ug/g		<1.60	
90	Hexachlorobenzene	ug/g		<1.35	
91	Pentachlorophenol	ug/g		<2.36	
92	Phenanthrene	ug/g		2.56	
93	Anthracene	ug/g		1.76	
94	Di-n-butyl phthalate	ug/g		0.67	
95	Fluoranthene	ug/g		5.67	
96	Pyrene	ug/g		4.38	
97	Butylbenzylphthalate	ug/g		0.66	
98	3,3'-Dichlorobenzidine	ug/g		<0.79	
99	bis-2-ethylhexylphthalate	ug/g		39.77	
100	Benzo(a)anthracene	ug/g		2.38	
101	Chrysene	ug/g		2.58	
102	Di-n-octylphthalate	ug/g		0.75	
103	Benzo(b)fluoranthene	ug/g		1.71	
104	Benzo(k)fluoranthene	ug/g		0.64	
105	Benzo(a)pyrene	ug/g		1.38	
106	Indeno(123-cd)pyrene	ug/g		0.83	
107	Dibenz(a,h)anthracene	ug/g		0.43	
108	Benzo(ghi)perylene	ug/g		1.02	
109	Benzo(e)pyrene	ug/g		1.21	
110	Perylene	ug/g		0.22	
111	Indeno(1,2,3,-cd)pyrene	ug/g		0.83	
112	Dibenz(a,h)anthracene	ug/g		0.43	
113	Benzo(g,h,i)perylene	ug/g		1.02	
114					
115					

A	A	B	C	D	E
1		**TABLE B-2**			
2		**CONTAMINATED SOLVENT ANALYSES**			
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
116	Dioxins and Furans				
117	2378-TCDD	ng/kg (dry)		8.0	
118	12378-PeCDD	ng/kg (dry)		9.8	
119	123478-HxCDD	ng/kg (dry)		10.2	
120	123678-HxCDD	ng/kg (dry)		30.1	
121	123789-HxCDD	ng/kg (dry)		<22.0	
122	1234678-HpCDD	ng/kg (dry)		499	
123	OCDD	ng/kg (dry)		3710	
124					
125	2378-TCDF	ng/kg (dry)		75.4	
126	12378-PeCDF	ng/kg (dry)		66.3	
127	23478-PeCDF	ng/kg (dry)		34	
128	123478-HxCDF	ng/kg (dry)		298	
129	123678-HxCDF	ng/kg (dry)		110	
130	234678-HxCDF	ng/kg (dry)		31.5	
131	123789-HxCDF	ng/kg (dry)		<1.20	
132	1234678-HpCDF	ng/kg (dry)		1170	
133	1234789-HpCDF	ng/kg (dry)		25.3	
134	OCDF	ng/kg (dry)		1010	
135					
136	Totals: Dioxins				
137	-TCDD	ng/kg (dry)		66.8	
138	-PeCDD	ng/kg (dry)		93.9	
139	-HxCDD	ng/kg (dry)		275	
140	-HpCDD	ng/kg (dry)		1070	
141					
142	Totals: Furans				
143	-TCDF	ng/kg (dry)		660	
144	-PeCDF	ng/kg (dry)		752	
145	-HxCDF	ng/kg (dry)		1100	
146	-HpCDF	ng/kg (dry)		1430	
147					
148					
149					
150					
151					

A	A	B	C	D	E
1		**TABLE B-2**			
2		**CONTAMINATED SOLVENT ANALYSES**			
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
152	Metals				
153	Ag	ug/L		0.91	
154	As	ug/L		32.53	
155	Be	ug/L		0.21	0.202
156	Cd	ug/L		3.36	3.078
157	Cr	ug/L		72.83	70.219
158	Cu	ug/L		78.54	74.924
159	Ni	ug/L		39.74	38.143
160	Pb	ug/L		309.36	302.204
161	Sb	ug/L		3.32	3.864
162	Se	ug/L		55.34	37.715
163	Tl	ug/L		-11.90	-4.967
164	Zn	ug/L		126.39	125.953
165	Hg (Total)	ug/L			
166					
167					
168	Metals (TCLP)				
169	-Arsenic	mg/L (extract)		NA	
170	-Barium	mg/L (extract)		NA	
171	-Cadmium	mg/L (extract)		NA	
172	-Chromium	mg/L (extract)		NA	
173	-Lead	mg/L (extract)		NA	
174	-Mercury	mg/L (extract)		NA	
175	-Selenium	mg/L (extract)		NA	
176	-Silver	mg/L (extract)		NA	
177					
178	Organo-Cl Pesticides (TCLP)				
179	-Chlordane	mg/L (extract)		NA	
180	-Endrin	mg/L (extract)		NA	
181	-Heptachlor	mg/L (extract)		NA	
182	-Heptachlor epoxide	mg/L (extract)		NA	
183	-Lindane (g-BHC)	mg/L (extract)		NA	
184	-Methoxychlor	mg/L (extract)		NA	
185	-Toxaphene	mg/L (extract)		NA	
186					
187	Cl Herbicides (TCLP)				
188	-2,4-D	mg/L (extract)		NA	
189	-2,4,5-TP (Silvex)	mg/L (extract)		NA	
190					
191	Volatilve Organics (TCLP)				
192	-Benzene	mg/L (extract)		NA	

A	A	B	C	D	E
1		**TABLE B-2**			
2		**CONTAMINATED SOLVENT ANALYSES**			
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
193	-Carbon tetrachloride	mg/L (extract)		NA	
194	-Chlorobenzene	mg/L (extract)		NA	
195	-Chloroform	mg/L (extract)		NA	
196	-1,4-Dichlorobenzene	mg/L (extract)		NA	
197	-1,2-Dichloroethane	mg/L (extract)		NA	
198	-1,1-Dichloroethene	mg/L (extract)		NA	
199	Methyl ethyl ketone	mg/L (extract)		NA	
200	Tetrachloroethene	mg/L (extract)		NA	
201	Trichloroethene	mg/L (extract)		NA	
202	Vinyl chloride	mg/L (extract)		NA	
203					
204	Semi-Volatiles (TCLP)				
205	-Hexachloroethane	mg/L (extract)		NA	
206	-Nitrobenzene	mg/L (extract)		NA	
207	-Hexachlorobutadiene	mg/L (extract)		NA	
208	-2,4-Dinitrotoluene	mg/L (extract)		NA	
209	-Hexachlorobenzene	mg/L (extract)		NA	
210	-2,4,6-Trichlorophenol	mg/L (extract)		NA	
211	-2,4,5-Trichlorophenol	mg/L (extract)		NA	
212	-Pentachlorophenol	mg/L (extract)		NA	
213	-Pyridine	mg/L (extract)		NA	
214	-o-Cresol	mg/L (extract)		NA	
215	-m,p-Cresols	mg/L (extract)		NA	
216	-Total Cresols	mg/L (extract)		NA	
217					

A	A	B	C	D	E
1		**TABLE B-2**			
2		**CONTAMINATED SOLVENT ANALYSES**			
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
218	PAHs (TCLP)				
219	Naphthalene	mg/L (extract)		NA	
220	2-Methylnaphthalene	mg/L (extract)		NA	
221	Acenapthylene	mg/L (extract)		NA	
222	Acenaphthene	mg/L (extract)		NA	
223	Dibenzofuran	mg/L (extract)		NA	
224	Fluorene	mg/L (extract)		NA	
225	Phenanthrene	mg/L (extract)		NA	
226	Anthracene	mg/L (extract)		NA	
227	Fluoranthene	mg/L (extract)		NA	
228	Pyrene	mg/L (extract)		NA	
229	Benzo(a)anthracene	mg/L (extract)		NA	
230	Chrysene	mg/L (extract)		NA	
231	Benzo(b)fluoranthene	mg/L (extract)		NA	
232	Benzo(k)fluoranthene	mg/L (extract)		NA	
233	Benzo(a)pyrene	mg/L (extract)		NA	
234	Indeno(123-cd)pyrene	mg/L (extract)		NA	
235	Dibenz(a,h)anthracene	mg/L (extract)		NA	
236	Benzo(ghi)perylene	mg/L (extract)		NA	
237					
238	Dioxins/Furans (TCLP)				
239	2378-TCDD	ng/L (extract)		8	
240	12378-PeCDD	ng/L (extract)		9.8	
241	123478-HxCDD	ng/L (extract)		10.2	
242	123678-HxCDD	ng/L (extract)		30.1	
243	123789-HxCDD	ng/L (extract)		22	
244	1234678-HpCDD	ng/L (extract)		499	
245	OCDD	ng/L (extract)		3710	
246					
247	2378-TCDF	ng/L (extract)		75.4	
248	12378-PeCDF	ng/L (extract)		66.3	
249	23478-PeCDF	ng/L (extract)		34	
250	123478-HxCDF	ng/L (extract)		298	
251	123678-HxCDF	ng/L (extract)		110	
252	234678-HxCDF	ng/L (extract)		31.5	
253	123789-HxCDF	ng/L (extract)		1.2	
254	1234678-HpCDF	ng/L (extract)		1170	
255	1234789-HpCDF	ng/L (extract)		25.3	
256	OCDF	ng/L (extract)		1010	
257					

A	A	B	C	D	E
1		**TABLE B-2**			
2		**CONTAMINATED SOLVENT ANALYSES**			
3					
4	Gross Physico-Chemical Properties		solvent	contam.	duplicate
5			comment	solvent	
6					
7	Analyte	Units		ME-24	ME-24D
258	Totals: Dioxins				
259	-TCDD	ng/L (extract)		66.8	
260	-PeCDD	ng/L (extract)		93.9	
261	-HxCDD	ng/L (extract)		275	
262	-HpCDD	ng/L (extract)		1070	
263					
264	Totals: Furans				
265	-TCDF	ng/L (extract)		660	
266	-PeCDF	ng/L (extract)		752	
267	-HxCDF	ng/L (extract)		1100	
268	-HpCDF	ng/L (extract)		1430	
269					
270					
271	PCBs (TCLP)				
272					
273	PCBs:	ug/L (extract)			
274	2-Mono	ug/L (extract)		NA	
275	44'-Di	ug/L (extract)		NA	
276	244'-Tri	ug/L (extract)		NA	
277	22'55'-Tetra	ug/L (extract)		NA	
278	33'44'-Tetra	ug/L (extract)		NA	
279	2344'5-Penta	ug/L (extract)		NA	
280	233'44'-Penta	ug/L (extract)		NA	
281	33'44'5-Penta	ug/L (extract)		NA	
282	233'44'5-Hexa	ug/L (extract)		NA	
283	33'44'55'-Hexa	ug/L (extract)		NA	
284	22'344'55'-Hepta	ug/L (extract)		NA	
285	22'33'44'55'-Octa	ug/L (extract)		NA	
286	22'33'44'55'6-Nona	ug/L (extract)		NA	
287	Deca	ug/L (extract)		NA	
288					
289	PCB Totals:				
290	-Mono	ug/L (extract)		NA	
291	-Di	ug/L (extract)		NA	
292	-Tri	ug/L (extract)		NA	
293	-Tetra	ug/L (extract)		NA	
294	-Penta	ug/L (extract)		NA	
295	-Hexa	ug/L (extract)		NA	
296	-Hepta	ug/L (extract)		NA	
297	-Octa	ug/L (extract)		NA	
298	-Nona	ug/L (extract)		NA	

A	A	B	C	D	E	F	G	H	I	J	K
1						TABLE C-1					
2						DIRECT SOLFIX PROCESS PERFORMANCE					
3											
4	Gross Physico-Chemical Properties					solid block	solid block				
5											
6			Feed	Feed	Comment					Amount	%
7	Analyte	Units	Comment	Mean	SO:LFIX	ME-21	ME-22	n	Mean	Change	Change
8											
9	Metals (TCLP)										
10	-Arsenic	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
11	-Barium	mg/L (extract)	All <	0.50000	All <	0.5000	0.5000	2	0.50000	NC	NC
12	-Cadmium	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
13	-Chromium	mg/L (extract)		0.02833	All <	0.0100	0.0100	2	0.01000	0.02	>64.70
14	-Lead	mg/L (extract)	All <	0.05000	All <	0.0500	0.0500	2	0.05000	NC	NC
15	-Mercury	mg/L (extract)	All <	0.00100	All <	0.0010	0.0010	2	0.00100	NC	NC
16	-Selenium	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
17	-Silver	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
18											
19	Organo-Cl Pesticides (TCLP)										
20	-Chlordane	mg/L (extract)	All <	0.00500	All <	0.0050	0.0050	2	0.00500	NC	NC
21	-Endrin	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
22	-Heptachlor	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
23	-Heptachlor epoxide	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
24	-Lindane (g-BHC)	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
25	-Methoxychlor	mg/L (extract)	All <	0.00100	All <	0.0010	0.0010	2	0.00100	NC	NC
26	-Toxaphene	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
27											
28	Cl Herbicides (TCLP)										
29	-2,4-D	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
30	-2,4,5-TP (Silvex)	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
31											
32	Volatile Organics (TCLP)										
33	-Benzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
34	-Carbon tetrachloride	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
35	-Chlorobenzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
36	-Chloroform	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
37	-1,4-Dichlorobenzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
38	-1,2-Dichloroethane	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
39	-1,1-Dichloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
40	Methyl ethyl ketone	mg/L (extract)	All <	5.00000	All <	5.0000	5.0000	2	5.00000	NC	NC
41	Tetrachloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
42	Trichloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
43	Vinyl chloride	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
44											
45	Semi-Volatiles (TCLP)										
46	-Hexachloroethane	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
47	-Nitrobenzene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
48	-Hexachlorobutadiene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
49	-2,4-Dinitrotoluene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
50	-Hexachlorobenzene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
51	-2,4,6-Trichlorophenol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
52	-2,4,5-Trichlorophenol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
53	-Pentachlorophenol	mg/L (extract)	All <	0.25000	All <	0.2500	0.2500	2	0.25000	NC	NC
54	-Pyridine	mg/L (extract)	All <	0.25000	All <	0.2500	0.2500	2	0.25000	NC	NC
55	-o-Cresol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
56	-m,p-Cresols	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
57	-Total Cresols	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
58											

A	A	B	C	D	E	F	G	H	I	J	K
1						TABLE C-1					
2						DIRECT SOLFIX PROCESS PERFORMANCE					
3											
4	Gross Physico-Chemical Properties					solid block	solid block				
5										Amount	%
6			Feed	Feed	Comment					Change	Change
7	Analyte	Units	Comment	Mean	SO:LFIX	ME-21	ME-22	n	Mean		
59	PAHs (TCLP)										
60	Naphthalene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
61	2-Methylnaphthalene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
62	Acenaphtylene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
63	Acenaphthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
64	Dibenzofuran	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
65	Fluorene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
66	Phenanthrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
67	Anthracene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
68	Fluoranthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
69	Pyrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
70	Benzo(a)anthracene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
71	Chrysene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
72	Benzo(b)fluoranthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
73	Benzo(k)fluoranthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
74	Benzo(a)pyrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
75	Indeno(123-cd)pyrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
76	Dibenz(a,h)anthracene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
77	Benzo(ghi)perylene	mg/L (extract)	All <	0.10000	All <						
78											
79	Dioxins/Furans (TCLP)										
80	2378-TCDD	ng/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
81	12378-PeCDD	ng/L (extract)	All <	0.00717	All <	NA	NA		NA	NC	NC
82	123478-HxCDD	ng/L (extract)	All <	0.00700	All <	NA	NA		NA	NC	NC
83	123678-HxCDD	ng/L (extract)	All <	0.00600	All <	NA	NA		NA	NC	NC
84	123789-HxCDD	ng/L (extract)	All <	0.00617	All <	NA	NA		NA	NC	NC
85	1234678-HpCDD	ng/L (extract)		0.00667	All <	NA	NA		NA	NC	NC
86	OCDD	ng/L (extract)		0.03033	All <	NA	NA		NA	NC	NC
87											
88	2378-TCDF	ng/L (extract)	All <	0.00233	All <	NA	NA		NA	NC	NC
89	12378-PeCDF	ng/L (extract)	All <	0.00417	All <	NA	NA		NA	NC	NC
90	23478-PeCDF	ng/L (extract)	All <	0.00400	All <	NA	NA		NA	NC	NC
91	123478-HxCDF	ng/L (extract)		0.00533	All <	NA	NA		NA	NC	NC
92	123678-HxCDF	ng/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
93	234678-HxCDF	ng/L (extract)		0.00467	All <	NA	NA		NA	NC	NC
94	123789-HxCDF	ng/L (extract)	All <	0.00467	All <	NA	NA		NA	NC	NC
95	1234678-HpCDF	ng/L (extract)		0.00925	All <	NA	NA		NA	NC	NC
96	1234789-HpCDF	ng/L (extract)	All <	0.00850	All <	NA	NA		NA	NC	NC
97	OCDF	ng/L (extract)	All <	0.00683	All <						
98											
99	Totals: Dioxins										
100	-TCDD	ng/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
101	-PeCDD	ng/L (extract)	All <	0.00717	All <	NA	NA		NA	NC	NC
102	-HxCDD	ng/L (extract)	All <	0.00617	All <	NA	NA		NA	NC	NC
103	-HpCDD	ng/L (extract)		0.01167	All <	NA	NA		NA	NC	NC
104											
105	Totals: Furans										
106	-TCDF	ng/L (extract)	All <	0.00233	All <	NA	NA		NA	NC	NC
107	-PeCDF	ng/L (extract)	All <	0.00400	All <	NA	NA		NA	NC	NC
108	-HxCDF	ng/L (extract)		0.01100	All <	NA	NA		NA	NC	NC
109	-HpCDF	ng/L (extract)		0.00925	All <	NA	NA		NA	NC	NC
110											
111											
112	PCBs (TCLP)										
113						NA	NA		NA		
114	PCBs:	ug/L (extract)		0.02603	All <	NA	NA		NA	NC	NC
115	2-Mono	ug/L (extract)		0.00342	All <	NA	NA		NA	NC	NC
116	44'-Di	ug/L (extract)		0.00583	All <	NA	NA		NA	NC	NC
117	244'-Tri	ug/L (extract)		0.00307	All <	NA	NA		NA	NC	NC
118	22'55'-Tetra	ug/L (extract)		0.00024	All <	NA	NA		NA	NC	NC
119	33'44'-Tetra	ug/L (extract)		0.00012	All <	NA	NA		NA	NC	NC
120	2344'5-Penta	ug/L (extract)		0.00106	All <	NA	NA		NA	NC	NC
121	233'44'-Penta	ug/L (extract)	All <	0.00004	All <	NA	NA		NA	NC	NC
122	33'44'5-Penta	ug/L (extract)		0.00031	All <	NA	NA		NA	NC	NC
123	233'44'5-Hexa	ug/L (extract)	All <	0.00006	All <	NA	NA		NA	NC	NC
124	33'44'55'-Hexa	ug/L (extract)		0.00184	All <	NA	NA		NA	NC	NC
125	22'344'55'-Hepta	ug/L (extract)		0.00039	All <	NA	NA		NA	NC	NC
126	22'33'44'55'-Octa	ug/L (extract)	All <	0.00019	All <	NA	NA		NA	NC	NC
127	22'33'44'55'6-Nona	ug/L (extract)	All <	0.00014	All <	NA	NA		NA	NC	NC
128	Deca										
129											

A	A	B	C	D	E	F	G	H	I	J	K
1						TABLE C-1					
2						DIRECT SOLFIX PROCESS PERFORMANCE					
3											
4	Gross Physico-Chemical Properties					solid block	solid block				
5											
6			Feed	Feed	Comment					Amount	%
7	Analyte	Units	Comment	Mean	SOLFIX	ME-21	ME-22	n	Mean	Change	Change
130	PCB Totals:										
131	-Mono	ug/L (extract)		0.03497	All <	NA	NA		NA	NC	NC
132	-Di	ug/L (extract)		0.03523	All <	NA	NA		NA	NC	NC
133	-Tri	ug/L (extract)		0.03682	All <	NA	NA		NA	NC	NC
134	-Tetra	ug/L (extract)		0.02352	All <	NA	NA		NA	NC	NC
135	-Penta	ug/L (extract)		0.01562	All <	NA	NA		NA	NC	NC
136	-Hexa	ug/L (extract)		0.01230	All <	NA	NA		NA	NC	NC
137	-Hepta	ug/L (extract)		0.00802	All <	NA	NA		NA	NC	NC
138	-Octa	ug/L (extract)		0.00150	All <	NA	NA		NA	NC	NC
139	-Nona	ug/L (extract)	All <	0.00022	All <	NA	NA		NA	NC	NC
140											
141	NA = Not applicable or Not Available										
142	NC = Cannot be calculated because (1) two values are inequalities, or (2) at least one value is rejected or not available.										

A	B	C	D	E	F	G	H	I	J	K
					TABLE C-1					
					DIRECT SOLFIX PROCESS PERFORMANCE					
Gross Physico-Chemical Properties					solid block	solid block				
		Raw Sediment	Raw Sediment	Comment					Amount	%
Analyte	Units	Comment	Mean	SO:LFIX	ME-21	ME-22	n	Mean	Change	Change
Metals (TCLP)										
-Arsenic	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-Barium	mg/L (extract)	All <	0.50000	All <	0.5000	0.5000	2	0.50000	NC	NC
-Cadmium	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
-Chromium	mg/L (extract)		0.02633	All <	0.0100	0.0100	2	0.01000	0.02	>84.70
-Lead	mg/L (extract)	All <	0.05000	All <	0.0500	0.0500	2	0.05000	NC	NC
-Mercury	mg/L (extract)	All <	0.00100	All <	0.0010	0.0010	2	0.00100	NC	NC
-Selenium	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-Silver	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
Organo-Cl Pesticides (TCLP)										
-Chlordane	mg/L (extract)	All <	0.00500	All <	0.0050	0.0050	2	0.00500	NC	NC
-Endrin	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
-Heptachlor	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
-Heptachlor epoxide	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
-Lindane (g-BHC)	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	0.00050	NC	NC
-Methoxychlor	mg/L (extract)	All <	0.00100	All <	0.0010	0.0010	2	0.00100	NC	NC
-Toxaphene	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
Cl Herbicides (TCLP)										
-2,4-D	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-2,4,5-TP (Silvex)	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	0.01000	NC	NC
Volatile Organics (TCLP)										
-Benzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
-Carbon tetrachloride	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
-Chlorobenzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
-Chloroform	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
-1,4-Dichlorobenzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
-1,2-Dichloroethane	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
-1,1-Dichloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
Methyl ethyl ketone	mg/L (extract)	All <	5.00000	All <	5.0000	5.0000	2	5.00000	NC	NC
Tetrachloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
Trichloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	0.20000	NC	NC
Vinyl chloride	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
Semi-Volatiles (TCLP)										
-Hexachloroethane	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-Nitrobenzene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-Hexachlorobutadiene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-2,4-Dinitrotoluene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-Hexachlorobenzene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-2,4,6-Trichlorophenol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-2,4,5-Trichlorophenol	mg/L (extract)	All <	0.25000	All <	0.2500	0.2500	2	0.25000	NC	NC
-Pentachlorophenol	mg/L (extract)	All <	0.25000	All <	0.2500	0.2500	2	0.25000	NC	NC
-Pyridine	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-o-Cresol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-m,p-Cresols	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	0.10000	NC	NC
-Total Cresols	mg/L (extract)	All <	0.10000	All <						

TABLE C-1

DIRECT SOLFIX PROCESS PERFORMANCE

Gross Physico-Chemical Properties		Raw Sediment	Raw Sediment	Comment	solid block	solid block			Amount	%
Analyte	Units	Comment	Mean	SO:LFIX	ME-21	ME-22	n	Mean	Change	Change
PAHs (TCLP)										
Naphthalene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
2-Methylnaphthalene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Acenaphthylene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Acenaphthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Dibenzofuran	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Fluorene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Phenanthrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Anthracene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Fluoranthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Pyrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Benzo(a)anthracene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Chrysene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Benzo(b)fluoranthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Benzo(k)fluoranthene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Benzo(a)pyrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Indeno(123-cd)pyrene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Dibenz(a,h)anthracene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Benzo(ghi)perylene	mg/L (extract)	All <	0.10000	All <	NA	NA		NA	NC	NC
Dioxins/Furans (TCLP)										
2378-TCDD	ng/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
12378-PeCDD	ng/L (extract)	All <	0.00717	All <	NA	NA		NA	NC	NC
123478-HxCDD	ng/L (extract)	All <	0.00700	All <	NA	NA		NA	NC	NC
123678-HxCDD	ng/L (extract)	All <	0.00800	All <	NA	NA		NA	NC	NC
123789-HxCDD	ng/L (extract)	All <	0.00617	All <	NA	NA		NA	NC	NC
1234678-HpCDD	ng/L (extract)		0.00867	All <	NA	NA		NA	NC	NC
OCDD	ng/L (extract)		0.03033	All <	NA	NA		NA	NC	NC
2378-TCDF	ng/L (extract)	All <	0.00233	All <	NA	NA		NA	NC	NC
12378-PeCDF	ng/L (extract)	All <	0.00417	All <	NA	NA		NA	NC	NC
23478-PeCDF	ng/L (extract)	All <	0.00400	All <	NA	NA		NA	NC	NC
123478-HxCDF	ng/L (extract)		0.00533	All <	NA	NA		NA	NC	NC
123678-HxCDF	ng/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
234678-HxCDF	ng/L (extract)		0.00467	All <	NA	NA		NA	NC	NC
123789-HxCDF	ng/L (extract)	All <	0.00467	All <	NA	NA		NA	NC	NC
1234678-HpCDF	ng/L (extract)		0.00925	All <	NA	NA		NA	NC	NC
1234789-HpCDF	ng/L (extract)	All <	0.00650	All <	NA	NA		NA	NC	NC
OCDF	ng/L (extract)	All <	0.00683	All <	NA	NA		NA	NC	NC
Totals: Dioxins										
-TCDD	ng/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
-PeCDD	ng/L (extract)	All <	0.00717	All <	NA	NA		NA	NC	NC
-HxCDD	ng/L (extract)	All <	0.00617	All <	NA	NA		NA	NC	NC
-HpCDD	ng/L (extract)		0.01167	All <	NA	NA		NA	NC	NC
Totals: Furans										
-TCDF	ng/L (extract)	All <	0.00233	All <	NA	NA		NA	NC	NC
-PeCDF	ng/L (extract)	All <	0.00400	All <	NA	NA		NA	NC	NC
-HxCDF	ng/L (extract)		0.01100	All <	NA	NA		NA	NC	NC
-HpCDF	ng/L (extract)		0.00925	All <	NA	NA		NA	NC	NC
PCBs (TCLP)										
PCBs:	ug/L (extract)				NA	NA		NA		
2-Mono	ug/L (extract)		0.02603	All <	NA	NA		NA	NC	NC
44'-Di	ug/L (extract)		0.00342	All <	NA	NA		NA	NC	NC
244'-Tri	ug/L (extract)		0.00583	All <	NA	NA		NA	NC	NC
22'55'-Tetra	ug/L (extract)		0.00307	All <	NA	NA		NA	NC	NC
33'44'-Tetra	ug/L (extract)		0.00024	All <	NA	NA		NA	NC	NC
2344'5-Penta	ug/L (extract)		0.00012	All <	NA	NA		NA	NC	NC
23'44'5-Penta	ug/L (extract)		0.00106	All <	NA	NA		NA	NC	NC
33'44'5-Penta	ug/L (extract)	All <	0.00004	All <	NA	NA		NA	NC	NC
233'44'5-Hexa	ug/L (extract)		0.00031	All <	NA	NA		NA	NC	NC
33'44'55'-Hexa	ug/L (extract)	All <	0.00006	All <	NA	NA		NA	NC	NC
22'344'55'-Hepta	ug/L (extract)		0.00194	All <	NA	NA		NA	NC	NC
22'33'44'55'-Octa	ug/L (extract)		0.00039	All <	NA	NA		NA	NC	NC
22'33'44'55'6-Nona	ug/L (extract)	All <	0.00019	All <	NA	NA		NA	NC	NC
Deca	ug/L (extract)	All <	0.00014	All <	NA	NA		NA	NC	NC

A	A	B	C	D	E	F	G	H	I	J	K
1						TABLE C-1					
2						DIRECT SOLFIX PROCESS PERFORMANCE					
3											
4	Gross Physico-Chemical Properties					solid block	solid block				
5			Raw	Raw							
6			Sediment	Sediment	Comment					Amount	%
7	Analyte	Units	Comment	Mean	SO:LFIX	ME-21	ME-22	n	Mean	Change	Change
130	PCB Totals:										
131	-Mono	ug/L (extract)		0.03497	All <	NA	NA		NA	NC	NC
132	-Di	ug/L (extract)		0.03523	All <	NA	NA		NA	NC	NC
133	-Tri	ug/L (extract)		0.03662	All <	NA	NA		NA	NC	NC
134	-Tetra	ug/L (extract)		0.02352	All <	NA	NA		NA	NC	NC
135	-Penta	ug/L (extract)		0.01562	All <	NA	NA		NA	NC	NC
136	-Hexa	ug/L (extract)		0.01230	All <	NA	NA		NA	NC	NC
137	-Hepta	ug/L (extract)		0.00602	All <	NA	NA		NA	NC	NC
138	-Octa	ug/L (extract)		0.00150	All <	NA	NA		NA	NC	NC
139	-Nona	ug/L (extract)	All <	0.00022	All <	NA	NA		NA	NC	NC
140											
141	NA = Not applicable or Not Available										
142	NC = Cannot be calculated because (1) two values are inequalities, or (2) at least one value is rejected or not available.										

A	B	C	D	E	F	G	H	I	J	K
					TABLE C-2					
					ORG-X AND SOLFIX PROCESS PERFORMANCE					
Gross Physico-Chemical Properties					solid block	solid block				
		Raw	Raw	ORG-X/						
		Sediment	Sediment	SOLFIX					Amount	%
Analyte	Units	Comment	Mean	Comment	ME-10	ME-11	n	Mean	Change	Change
Metals (TCLP)										
-Arsenic	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-Barium	mg/L (extract)	All <	0.50000	All <	0.5000	0.5000	2	NA	NC	NC
-Cadmium	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	NA	NC	NC
-Chromium	mg/L (extract)		0.02833	All <	0.0200	0.0100	2	0.01500	0.01	>47.05
-Lead	mg/L (extract)	All <	0.05000	All <	0.0500	0.0500	2	NA	NC	NC
-Mercury	mg/L (extract)	All <	0.00100	All <	0.0010	0.0010	2	NA	NC	NC
-Selenium	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-Silver	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	NA	NC	NC
Organo-Cl Pesticides (TCLP)										
-Chlordane	mg/L (extract)	All <	0.00500	All <	0.0050	0.0050	2	NA	NC	NC
-Endrin	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	NA	NC	NC
-Heptachlor	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	NA	NC	NC
-Heptachlor epoxide	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	NA	NC	NC
-Lindane (g-BHC)	mg/L (extract)	All <	0.00050	All <	0.0005	0.0005	2	NA	NC	NC
-Methoxychlor	mg/L (extract)	All <	0.00100	All <	0.0010	0.0010	2	NA	NC	NC
-Toxaphene	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	NA	NC	NC
Cl Herbicides (TCLP)										
-2,4-D	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-2,4,5-TP (Silvex)	mg/L (extract)	All <	0.01000	All <	0.0100	0.0100	2	NA	NC	NC
Volatile Organics (TCLP)										
-Benzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
-Carbon tetrachloride	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
-Chlorobenzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
-Chloroform	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
-1,4-Dichlorobenzene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
-1,2-Dichloroethane	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
-1,1-Dichloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
Methyl ethyl ketone	mg/L (extract)	All <	5.00000	All <	5.0000	5.0000	2	NA	NC	NC
Tetrachloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
Trichloroethene	mg/L (extract)	All <	0.20000	All <	0.2000	0.2000	2	NA	NC	NC
Vinyl chloride	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
Semi-Volatiles (TCLP)										
-Hexachloroethane	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-Nitrobenzene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-Hexachlorobutadiene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-2,4-Dinitrotoluene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-Hexachlorobenzene	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-2,4,6-Trichlorophenol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-2,4,5-Trichlorophenol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-Pentachlorophenol	mg/L (extract)	All <	0.25000	All <	0.2500	0.2500	2	NA	NC	NC
-Pyridine	mg/L (extract)	All <	0.25000	All <	0.2500	0.2500	2	NA	NC	NC
-o-Cresol	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-m,p-Cresols	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
-Total Cresols	mg/L (extract)	All <	0.10000	All <	0.1000	0.1000	2	NA	NC	NC
PAHs (TCLP)										
Naphthalene	mg/L (extract)	All <	0.10000	All <	0.0600	0.0600	2	NA	NC	NC
2-Methylnaphthalene	mg/L (extract)	All <	0.10000	All <	0.0600	0.0600	2	NA	NC	NC
Acenaphthylene	mg/L (extract)	All <	0.10000	All <	0.0300	0.0300	2	NA	NC	NC
Acenaphthene	mg/L (extract)	All <	0.10000	All <	0.0300	0.0300	2	NA	NC	NC
Dibenzofuran	mg/L (extract)	All <	0.10000	All <	0.0200	0.0200	2	NA	NC	NC
Fluorene	mg/L (extract)	All <	0.10000	All <	0.0200	0.0200	2	NA	NC	NC
Phenanthrene	mg/L (extract)	All <	0.10000	All <	0.0200	0.0200	2	NA	NC	NC
Anthracene	mg/L (extract)	All <	0.10000	All <	0.0200	0.0200	2	NA	NC	NC
Fluoranthene	mg/L (extract)	All <	0.10000	All <	0.0200	0.0200	2	NA	NC	NC
Pyrene	mg/L (extract)	All <	0.10000	All <	0.0300	0.0300	2	NA	NC	NC
Benzo(a)anthracene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Chrysene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Benzo(b)fluoranthene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Benzo(k)fluoranthene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Benzo(a)pyrene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Indeno(123-cd)pyrene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Dibenz(a,h)anthracene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Benzo(ghi)perylene	mg/L (extract)	All <	0.10000	All <	1.0000	1.0000	2	NA	NC	NC
Dioxins/Furans (TCLP)										
2378-TCDD	mg/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
12378-PeCDD	mg/L (extract)	All <	0.00717	All <	NA	NA		NA	NC	NC
123478-HxCDD	mg/L (extract)	All <	0.00700	All <	NA	NA		NA	NC	NC

A	A	B	C	D	E	F	G	H	I	J	K
1							TABLE C-2				
2							ORG-X AND SOLFIX PROCESS PERFORMANCE				
3											
4	Gross Physico-Chemical Properties					solid block	solid block				
5			Raw	Raw	ORG-X/						
6			Sediment	Sediment	SOLFIX					Amount	%
7	Analyte	Units	Comment	Mean	Comment	ME-10	ME-11	n	Mean	Change	Change
99	Totals: Dioxins										
100	-TCDD	ng/L (extract)	All <	0.00317	All <	NA	NA		NA	NC	NC
101	-PeCDD	ng/L (extract)	All <	0.00717	All <	NA	NA		NA	NC	NC
102	-HxCDD	ng/L (extract)	All <	0.00617	All <	NA	NA		NA	NC	NC
103	-HpCDD	ng/L (extract)		0.01167	All <	NA	NA		NA	NC	NC
104											
105	Totals: Furans										
106	-TCDF	ng/L (extract)	All <	0.00233	All <	NA	NA		NA	NC	NC
107	-PeCDF	ng/L (extract)	All <	0.00400	All <	NA	NA		NA	NC	NC
108	-HxCDF	ng/L (extract)		0.01100	All <	NA	NA		NA	NC	NC
109	-HpCDF	ng/L (extract)		0.00925	All <	NA	NA		NA	NC	NC
110											
111											
112	PCBs (TCLP)										
113											
114	PCBs:	ug/L (extract)									
115	2-Monoch	ug/L (extract)		0.02603	All <	NA	NA		NA	NC	NC
116	4,4'-Dichl	ug/L (extract)		0.00942	All <	NA	NA		NA	NC	NC
117	244'-Tri	ug/L (extract)		0.00583		NA	NA		NA	NC	NC
118	22'55'-Tetra	ug/L (extract)		0.00307	All <	NA	NA		NA	NC	NC
119	33'44'-Tetra	ug/L (extract)		0.00024	All <	NA	NA		NA	NC	NC
120	23445-Penta	ug/L (extract)		0.00012	All <	NA	NA		NA	NC	NC
121	233'44'-Penta	ug/L (extract)		0.00106	All <	NA	NA		NA	NC	NC
122	33'445-Penta	ug/L (extract)	All <	0.00004	All <	NA	NA		NA	NC	NC
123	233'445-Hexa	ug/L (extract)		0.00091	All <	NA	NA		NA	NC	NC
124	33'4455'-Hexa	ug/L (extract)	All <	0.00008	All <	NA	NA		NA	NC	NC
125	22'344'55'-Hepta	ug/L (extract)		0.00184	All <	NA	NA		NA	NC	NC
126	22'33'44'55'-Octa	ug/L (extract)		0.00039	All <	NA	NA		NA	NC	NC
127	22'33'44'55'6-Nona	ug/L (extract)	All <	0.00019	All <	NA	NA		NA	NC	NC
128	Deca	ug/L (extract)	All <	0.00014	All <	NA	NA		NA	NC	NC
129											
130	PCB Totals:										
131	-Mono	ug/L (extract)		0.05467	All <	NA	NA		NA	NC	NC
132	-Di	ug/L (extract)		0.03525	All <	NA	NA		NA	NC	NC
133	-Tri	ug/L (extract)		0.03662		NA	NA		NA	NC	NC
134	-Tetra	ug/L (extract)		0.02352		NA	NA		NA	NC	NC
135	-Penta	ug/L (extract)		0.01562		NA	NA		NA	NC	NC
136	-Hexa	ug/L (extract)		0.01230	All <	NA	NA		NA	NC	NC
137	-Hepta	ug/L (extract)		0.00602	All <	NA	NA		NA	NC	NC
138	-Octa	ug/L (extract)		0.00150	All <	NA	NA		NA	NC	NC
139	-Nona	ug/L (extract)	All <	0.00022	All <	NA	NA		NA	NC	NC
140											
141	NA = Not Applicable or Not Available.										
142	NC = Cannot be calculated because: (1) two values are nequsubes or (2) at least one value is rejected or not available.										

APPENDIX C
SIGNATURE PAGE

APPENDIX C
SIGNATURE PAGE

I have read and reviewed the site-specific Health and Safety Plan for the BNL Sediment Pilot Study and understand the information presented. I will comply with the provisions contained therein.

NAME	ORGANIZATION	DATE

SIGNATURE PAGE (contd)

NAME	ORGANIZATION	DATE

SIGNATURE PAGE (contd)

NAME	ORGANIZATION	DATE

APPENDIX D
HEALTH & SAFETY PLAN AMENDMENT PAGE

APPENDIX D
HEALTH & SAFETY PLAN AMENDMENT

Amendment #_____

Site Name BNL Sediment Pilot Study

Date_____

Completed By:_____

Reason for Amendment_____

_____

_____

_____

Task Activities to be Performed_____

_____

_____

_____

Level of Protection Required_____

_____

_____

_____

Describe required changes to designated work zones, if any. Attach plan if necessary._____

_____

_____

_____

_____ _____

Office Health & Safety Coordinator Date

_____ _____

Project Manager Date

APPENDIX E
MATERIAL SAFETY DATA SHEETS (MSDS)

Raw sediment contaminants:

DDD
DDE
Dieidrin
Dioxins/Furans
- 2,3,7,8-TCDD
- 1,2,3,4,7,8-HCDF
- HCDD
- OCDD

Polychlorinated Biphenyls (PCBs)
Polyaromatic Hydrocarbons (PAHs) aka Coal Tar Volatiles
Arsenic
Cadmium
Chromium
Copper
Nickel
Lead
Zinc

Materials to be brought on site:

Alcohol
Acetate
Freon 22
Nitrogen (compressed)
Methanol
Hexane
Alconox™
Powersorb
Citric Acid
Hydrochloric Acid
Type II Cement
Acetone
Nitric Acid
Gasoline
Diesel Fuel
Motor Oil
Lubricating Oil

Entry: 1

Accession Number 2245768

CAS Registry No.: 72-54-8
Material Names: DDD; TDE; 1,1-Dichloro-2,2-bis(p-chloro-phenyl) ethane; Dichlorodiphenyldichloroethane
Formula: (4-ClC6H4)2CH-CHCl2
Description: Solid () White
Sinks in water.
Label Category: None
Physical State (as shipped): Solid
Color: White
Boiling Point at 1 atm.: (decomposes)
Freezing Point: 112 (deg.C = 385 deg.K = 234 deg.F)
Storage Temperature: Ambient
Special Hazards of Combustion Products: Irritating hydrogen chloride fumes may form in fires.
Fire Extinguishing Agents: Water, foam, dry chemical, carbon dioxide
Reactivity With Water: No reaction
Actions in Case of Emergency: Stop discharge if possible. Keep people away. Avoid contact with solid and dust. Isolate and remove discharged material. Notify local health and pollution control agencies.

FIRE
Combustible.
Irritating gases may be produced when heated. Wear goggles and self-contained breathing apparatus. Extinguish with water, dry chemicals, foam, or carbon dioxide.

EXPOSURE
CALL FOR MEDICAL AID.

DUST
Irritating to eyes, nose and throat. Harmful if inhaled. If in eyes, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.

SOLID
Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.

IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

WATER POLLUTION

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

(SD) Response to Discharge: Issue warning-water contamination
Should be removed
Chemical and physical treatment

(AF) Personal Protective Equipment: Dust mask; goggles or face shield; rubber gloves

(RC) Symptoms Following Exposure: Ingestion causes vomiting and delayed symptoms similar to those caused by DDT. Contact with eyes causes irritation.

(TE) Treatment of Exposure:
INGESTION: treatment should be given by a physician and is similar to that given following ingestion of DDT.
EYES: flush with water.

(HI) Toxicity By Ingestion: Grade 2; oral LD50 = 1.2 g/kg (mouse), 3.4 g/kg (rat)

orl-rat TDLo:250 mg/kg (15-19D post):TER BNEOBV 3,26,213,75

orl-mus LD50:590 mg/kg AIPTAK 73,128,46

SAFETY PROFILE: Moderately toxic by ingestion. An experimental teratogen. Other experimental reproductive effects. Mutation data reported. When heated to decomposition it emits toxic fumes of Cl^-.

BIM000 CAS:4104-14-7 ***HR: 3***

O,O-BIS(p-CHLOROPHENYL)ACETIMIDOYL-PHOSPHORAMIDOTHIOATE

mf: $C_{14}H_{13}Cl_2N_2O_2PS$ mw: 375.22

SYNS: BAY 33819 ◇ BAYER 38819 ◇ DRC-714 ◇ GOPHACIDE ◇ PHOSAZETIM

TOXICITY DATA with REFERENCE

orl-rat LD50:3700 μg/kg FMCHA2 -,C117,83

skn-rat LD50:25 mg/kg FMCHA2 -,C117,83

ipr-rat LD50:3500 μg/kg AIPTAK 169,108,67

orl-mus LD50:12 mg/kg TXAPA9 25,42,73

ipr-mus LD50:5500 μg/kg AIPTAK 169,108,67

orl-dog LD50:23 mg/kg PCOC** -,107,66

orl-gpg LD50:20 mg/kg AIPTAK 169,108,67

ipr-gpg LD50:14 mg/kg AIPTAK 169,108,67

CONSENSUS REPORTS: EPA Extremely Hazardous Substances list.

SAFETY PROFILE: Poison by ingestion, skin contact, and intraperitoneal routes. A pesticide. When heated to decomposition it emits very toxic fumes of SO_x, PO_x, Cl^-, and NO_x. See also ESTERS.

BIM250 CAS:55-56-1 ***HR: 2***

1,6-BIS(5-(p-CHLOROPHENYL)BIGUANIDINO)HEXANE

mf: $C_{22}H_{30}Cl_2N_{10}$ mw: 505.52

SYNS: 1,6-BIS(p-CHLOROPHENYLDIGUANIDO)HEXANE ◇ CHLORHEXIDIN (CZECH) ◇ CHLORHEXIDINE ◇ 1,6-DI(4'-CHLOROPHENYLDIGUANIDO)HEXANE ◇ 1,1'-HEXAMETHYLENEBIS(5-(p-CHLOROPHENYL)BIGUANIDE ◇ HIBITANE ◇ OLVASAN ◇ ROTERSEPT ◇ STERIDO

TOXICITY DATA with REFERENCE

skn-hmn 1500 μg/3D-I MLD 85DKA8 -,127,77

mma-sat 400 nmol/L CBINA8 28,249,79

dnr-esc 7 μmol/disc CBINA8 28,249,79

orl-mus TDLo:1680 mg/kg (7D pre):REP MEXPAG 10,361,64

orl-rat LD50:9200 mg/kg YACHDS 6,2599,78

orl-mus LD50:9850 mg/kg YACHDS 6,2599,78

SAFETY PROFILE: Mildly toxic by ingestion. Experimental reproductive effects. A human skin irritant. Mutation data reported. When heated to decomposition it emits very toxic fumes of Cl^- and NO_x.

BIM500 CAS:72-54-8 ***HR: 3***

1,1-BIS(4-CHLOROPHENYL)-2,2-DICHLOROETHANE

DOT: NA 2761

mf: $C_{14}H_{10}Cl_4$ mw: 320.04

PROP: Crystalline solid. Mp: 110°, vap d: 11.

SYNS: 1,1-BIS(p-CHLOROPHENYL)-2,2-DICHLOROETHANE ◇ 2,2-BIS(p-CHLOROPHENYL)-1,1-DICHLOROETHANE ◇ 2,2-BIS(4-CHLOROPHENYL)-1,1-DICHLOROETHANE ◇ DDD ◇ p,p'-DDD ◇ 1,1-DICHLOOR-2,2-BIS(4-CHLOOR FENYL)-ETHAAN (DUTCH) ◇ 1,1-DICHLOR-2,2-BIS(4-CHLOR-PHENYL)-AETHAN (GERMAN) ◇ 1,1-DICHLORO-2,2-BIS(p-CHLOROPHENYL)ETHANE ◇ 1,1-DICHLORO-2,2-BIS(4-CHLOROPHENYL)-ETHANE (FRENCH) ◇ 1,1-DICHLORO-2,2-BIS(p-CHLOROPHENYL)ETHANE (DOT) ◇ 1,1-DICHLORO-2,2-BIS(PARACHLOROPHENYL)ETHANE (DOT) ◇ 1,1-DICHLORO-2,2-DI(4-CHLOROPHENYL)ETHANE ◇ DICHLORODIPHENYL DICHLOROETHANE ◇ p,p'-DICHLORODIPHENYL-DICHLOROETHANE ◇ 1,1-DICLORO-2,2-BIS(4-CLORO-FENIL)-ETANO (ITALIAN) ◇ DILENE ◇ ENT 4,225 ◇ ME-1700 ◇ NCI-C00475 ◇ RCRA WASTE NUMBER U060 ◇ RHOTHANE ◇ RHOTHANE D-3 ◇ ROTHANE ◇ p,p'-TDE ◇ TDE (DOT) ◇ TETRACHLORODIPHENYLETHANE

TOXICITY DATA with REFERENCE

cyt-rat:oth 10 μg/L 34LXAP -,555,76

otr-mus:emb 28400 nmol/L JNCIAM 54,981,75

orl-rat TDLo:54 g/kg/78W-C:ETA NCITR* NCI-CG-TR-131,78

orl-mus TDLo:39 g/kg/2Y-C:NEO JNCIAM 52,883,74

orl-rat LD50:113 mg/kg GUCHAZ 6,154,73

orl-mus LDLo:600 mg/kg JPETAB 88,400,46

skn-rbt LD50:1200 mg/kg AFDOAQ 16,3,52

CONSENSUS REPORTS: IARC Cancer Review: Animal Sufficient Evidence IMEMDT 5,83,74. NCI Carcinogenesis Bioassay (feed); Clear Evidence: rat NCITR* NCI-CG-TR-131,78; No Evidence: mouse NCITR* NCI-CG-TR-131,78. EPA Genetic Toxicology Program.

DOT Classification: ORM-A; Label: None.

SAFETY PROFILE: Confirmed carcinogen with experimental carcinogenic, neoplastigenic, and tumorigenic data. Poison by ingestion. Moderately toxic by skin contact. Mutation data reported. An insecticide. When heated to decomposition it emits toxic fumes of Cl^-. See also DDT.

BIM750 CAS:72-55-9 ***HR: 3***

2,2-BIS(p-CHLOROPHENYL)-1,1-DICHLOROETHYLENE

mf: $C_{14}H_8Cl_4$ mw: 318.02

SYNS: DDE ◇ p,p'-DDE ◇ DDT DEHYDROCHLORIDE ◇ 1,1-DICHLORO-2,2-BIS(p-CHLOROPHENYL)ETHYLENE ◇ p,p'-DICHLORODIPHENYLDICHLOROETHYLENE ◇ 1,1'-DICHLOROETHENYLIDENE)BIS(4-CHLOROBENZENE) ◇ NCI-C00555

TOXICITY DATA with REFERENCE
sln-dmg-orl 1 pph ENMUDM 7,325,85
msc-mus:lym 40 mg/L/4H MUREAV 59,61,79
ipr-rat TDLo:3500 μg/kg (7D pre):REP ENDOAO 91,1095,72
orl-mus TDLo:9700 mg/kg/78W-C:CAR NCITR* NCI-TR-131,78
orl-ham TDLo:36 g/kg/86W-C:NEO CNREA8 43,776,83
orl-mus TD:17 g/kg/78W-C:CAR NCITR* NCI-TR-131,78
orl-rat LD50:880 mg/kg TXAPA9 14,515,69
orl-mus LD50:700 mg/kg JPETAB 88,400,46

CONSENSUS REPORTS: IARC Cancer Review: Animal Limited Evidence IMEMDT 5,83,74. NCI Carcinogenesis Bioassay (feed); Clear Evidence: mouse NCITR* NCI-CG-TR-131,78; No Evidence: rat NCITR* NCI-CG-TR-131,78. EPA Genetic Toxicology Program.

SAFETY PROFILE: Suspected carcinogen with experimental carcinogenic and neoplastigenic data. Poison by ingestion. Experimental reproductive effects. Mutation data reported. An insecticide. When heated to decomposition it emits very toxic fumes of Cl^-. See also CHLORINATED HYDROCARBONS, ALIPHATIC.

BIN000 CAS:80-06-8 ***HR: 2***
1,1-BIS(p-CHLOROPHENYL)METHYLCARBINOL
mf: $C_{14}H_{12}Cl_2O$ mw: 267.16

SYNS: BCPE ◇ 1,1-BIS(p-CHLOROPHENYL)ETHANOL ◇ 1,1-BIS(4-CHLOROPHENYL)ETHANOL ◇ BIS(p-CHLOROPHENYL)METHYL CARBINOL ◇ 1,1-BIS(4-CHLORPHENYL)-AETHANOL (GERMAN) ◇ CHLORFENETHOL ◇ DCPC ◇ DCPE ◇ DICHLORODIPHENYLETHANOL ◇ p,p'-DICHLORODIPHENYLMETHYLCARBINOL ◇ 4,4'-DICHLORO(METHYL BENZHYDROL) ◇ 4,4'-DICHLORO-α-METHYLBENZHYDROL ◇ 4,4'-DICHLORO-α-METHYLBENZOHYDROL ◇ DI-(p-CHLOROPHENYL)ETHANOL ◇ DI(p-CHLOROPHENYL) METHYLCARBINOL ◇ DIMITE ◇ DMC ◇ ENT 9,624 ◇ QIKRON

TOXICITY DATA with REFERENCE
orl-rat LD50:500 mg/kg ARSIM* 20,8,66
ipr-rat LD50:725 mg/kg OYYAA2 2,148,68

SAFETY PROFILE: Moderately toxic by ingestion and intraperitoneal routes. A pesticide. When heated to decomposition it emits toxic fumes of Cl^-.

BIN500 CAS:117-27-1 ***HR: 2***
1,1-BIS(p-CHLOROPHENYL)-2-NITROPROPANE
mf: $C_{15}H_{13}Cl_2NO_2$ mw: 310.19

SYNS: C.I. AZOIC DIAZO COMPONENT 37 ◇ CS 645A ◇ DNP ◇ ENT 22,784 ◇ 2-NITRO-1,1-BIS(p-CHLOROPHENYL)PROPANE ◇ 1,1'-(2-NITROPORPYLIDENE)BIS(4-CHLOROBENZENE)◇ PROLAN ◇ PROLAN (CSC)

TOXICITY DATA with REFERENCE
orl-rat LD50:750 mg/kg MEIEDD 10,946,83

SAFETY PROFILE: Moderately toxic by ingestion. An insecticide. When heated to decomposition it emits very toxic fumes of Cl^- and NO_x. See also AROMATIC AMINES.

BIN750 CAS:80-07-9 ***HR: 1***
BIS(p-CHLOROPHENYL)SULFONE
mf: $C_{12}H_8Cl_2O_2S$ mw: 287.16

TOXICITY DATA with REFERENCE
orl-mus LD50:24 g/kg HCACAV 29,1317,46

CONSENSUS REPORTS: Reported in EPA TSCA Inventory.

SAFETY PROFILE: Mildly toxic by ingestion. See also SULFONATES. When heated to decomposition it emits very toxic fumes of Cl^- and SO_x.

BIO500 CAS:55216-04-1 ***HR: 3***
BIS(p-CHLOROPHENYLTHIO)DIMETHYLTIN
mf: $C_{14}H_{14}Cl_2S_2Sn$ mw: 435.99

SYN: BIS(p-CHLOROPHENYLTHIO)DIMETHYLSTANNANE

TOXICITY DATA with REFERENCE
ivn-mus LD50:56 mg/kg CSLNX* NX#01645

OSHA PEL: TWA 0.1 mg(Sn)/m^3 (skin)
ACGIH TLV: TWA 0.1 mg(Sn)/m^3 (skin) (Proposed: TWA 0.1 mg(Sn)/m^3; STEL 0.2 mg(Sn)/m^3 (skin))
NIOSH REL: (Organotin Compounds) TWA 0.1 mg(Sn)/m^3

SAFETY PROFILE: Poison by intravenous route. See also TIN COMPOUNDS. When heated to decomposition it emits very toxic fumes of Cl^- and SO_x.

BIO625 CAS:789-02-6 ***HR: 3***
2,2-BIS(o,p-CHLOROPHENYL)-1,1,1-TRICHLOROETHANE
mf: $C_{14}H_9Cl_5$ mw: 354.48

SYNS: o,p'-DDT ◇ 1,1,1-TRICHLORO-2-(o-CHLOROPHENYL)-2-(p-CHLOROPHENYL)ETHANE

TOXICITY DATA with REFERENCE
dns-rat-ipr 10 mg/kg JTEHD6 16,493,85
cyt-rat:oth 10 μg/L 34LXAP -,555,76
orl-rat TDLo:2150 mg/kg (female 1-22D post):REP BECTA6 12,373,74
orl-rat TDLo:250 mg/kg (female 15-19D post):TER BNEOBV 26,283,75
orl-mus LDLo:1000 mg/kg JPETAB 88,400,46
ipr-mus LD50:1577 mg/kg BECTA6 11,359,74

CONSENSUS REPORTS: EPA Genetic Toxicology Program.

SAFETY PROFILE: Moderately toxic by ingestion and intraperitoneal routes. An experimental teratogen. Other experimental reproductive effects. Mutation data

-mus LD50:63 mg/kg JJANAX 26,221,73
-mus LD50:396 mg/kg JJANAX 26,221,73

AFETY PROFILE: Poison by intramuscular and intra-ous routes. Moderately toxic by intraperitoneal and ubcutaneous routes. When heated to decomposition it its very toxic fumes of NO_x and SO_x.

DHA425 CAS:53866-33-4 ***HR: 2***
4-DIDEUTERIOESTRADIOL
F: $C_{18}H_{22}D_2O_2$ mw: 274.42
SYN: ESTRA-1,3,5(10)-TRIENE-2,4-D2-3,17-DIOL,(17-β)-

OXICITY DATA with REFERENCE
-ham TDLo:360 mg/kg/15W-I:CAR MOPMA3 278,83

AFETY PROFILE: Questionable carcinogen with experimental carcinogenic data. When heated to decomposition it emits acrid smoke and irritating fu es.

DHA450 CAS:14621-84-2 ***HR: 3***
DIDEUTERODIAZOMETHANE
F: CD_2N_2 mw: 44.06

AFETY PROFILE: An explosive. When heated to decomposition it emits toxic fumes of NO_x. See also DIAZOMETHANE.

DHB309 ***HR: 1***
DIEFFENBACHIA (VARIOUS SPECIES)

OP: Tall, unbranched ornamentals with long, ivory-otted leaves. They are extremely popular as indoor nts, and are grown outdoors in southern Florida and awaii.

SYNS: CAMILICHIGUI (MEXICO) ◇ CANNE-A-GRATTER (HAITI) ◇ CANNE-MADERE (HAITI) ◇ DICHA (CUBA) ◇ DIEFFENBACHIA UCUALTA ◇ DIEFFENBACHIA SEQUINE ◇ DUMBCANE ◇ DUMB PLANT ◇ MOTHER-IN-LAW'S TONGUE PLANT ◇ PELA PUERCO (DOMINICAN REPUBLIC) ◇ RABANO (PUERTO RICO) ◇ TUFT ROOT

AFETY PROFILE: The leaf contains calcium oxalate crystals and chewing them results in burning pain in the ps, mouth and throat, possibly followed by inflammaon and blistering. The cut or crushed leaves may also use contact dermatitis or conjunctivitis. Systemic effects are usually not seen because of the insolubility of alcium oxalate. See also OXALATES.

DHB400 CAS:60-57-1 ***HR: 3***
DIELDRIN
DOT: UN 2761
F: $C_{12}H_8Cl_6O$ mw: 380.90

ROP: White crystals; odorless. Mp: 150°, vap d: 13.2. ol in water; sol in common organic solvents.

SYNS: ALVIT ◇ COMPOUND 497 ◇ DIELDREX ◇ DIELDRINE (FRENCH) ◇ DIELDRITE ◇ ENT 16,225 ◇ HEOD ◇ HEXACHLORO-EPOXYOCTAHYDRO-endo,exo-DIMETHANONAPHTHALENE ◇ 3,4,5,6,9,9-HEXACHLORO-1a,2,2a,3,6,6a,7,7a-OCTAHYDRO-2,7:3,6-DIMETHANONAPHTH(2,3-b)OXIRENE ◇ ILLOXOL ◇ INSECTICIDE No. 497 ◇ NCI-C00124 ◇ OCTALOX ◇ PANORAM D-31 ◇ QUINTOX ◇ RCRA WASTE NUMBER P037

TOXICITY DATA with REFERENCE
mmo-sat 1 mg/L JOHEA8 68,184,77
mma-hmn:fbr 1 μmol/L MUREAV 42,161,77
dns-hmn:fbr 1 μmol/L MUREAV 42,161,77
dni-hmn:hla 400 μmol/L MUREAV 92,427,82
otr-rat-orl 5 mg/kg CNREA8 40,1157,80
orl-rat TDLo:14 μg/kg (multi) :REP PCBPBS 13,20,80
orl-ham TDLo:30 mg/kg (female 8D post):TER TJADAB 9,11,74
orl-rat TDLo:200 mg/kg/2Y-C:ETA FCTXAV 2,551,64
orl-mus TDLo:546 mg/kg/65W-C:CAR ARTODN Suppl.2,197,79
orl-mus TD:11 g/kg/3Y-C:NEO FCTXAV 11,415,73
orl-mus TD:714 mg/kg/85W-C:CAR LAINAW 44,392,81
orl-man LDLo:65 mg/kg 34ZIAG -,215,69
unk-hmn LDLo:28 mg/kg ATXKA8 22,115,66
orl-rat LD50:38300 μg/kg JAFCAU 3,402,55
ihl-rat LC50:13 mg/m³/4H 85GMAT -,73,82
skn-rat LD50:56 mg/kg RPZHAW 18,161,67
ipr-rat LD50:35 mg/kg CBPCBB 85,437,86
ivn-rat LD50:9 mg/kg BJIMAG 21,269,64
orl-mus LD50:38 mg/kg SPEADM 78-1,13,78
ipr-mus LDLo:26 mg/kg TXAPA9 23,288,72
ivn-mus LD50:10.5 mg/kg TXAPA9 23,408,72
orl-dog LD50:65 mg/kg GUCHAZ 6,198,73
orl-mky LD50:3 mg/kg 32ZDAL -,79,70
ihl-cat LC50:80 mg/m³/4H GTPZAB 8(4),30,64

CONSENSUS REPORTS: IARC Cancer Review: Group 3 IMEMDT 7,196,87; Human Inadequate Evidence IMEMDT 5,125,74; Animal Sufficient Evidence IMEMDT 5,125,74. NCI Carcinogenesis Bioassay (feed); Clear Evidence: mouse NCITR* NCI-CG-TR-21,78; No Evidence: rat NCITR* NCI-CG-TR-22,78; Inadequate Studies: rat NCITR* NCI-CG-TR-21,78.

OSHA PEL: TWA 0.25 mg/m³ (skin)
ACGIH TLV: TWA 0.25 mg/m³ (skin)
DFG MAK: 0.25 mg/m³
NIOSH REL: (Dieldrin) Lowest reliable detectable level.
DOT Classification: ORM-A; Label: None.

SAFETY PROFILE: A human poison by ingestion and possibly other routes. Poison experimentally by inhalation, ingestion, skin contact, intravenous, and intraperitoneal routes. Experimental teratogenic and reproductive data. Absorbed readily through the skin and by other routes. It is a central nervous system stimulant. Questionable carcinogen with experimental carcinogenic, neoplastigenic, and tumorigenic data. Human mutation data reported. An insecticide. Dieldrin is considerably

more toxic than DDT by ingestion and skin contact. Dieldrin or its derivatives may accumulate in the body from chronic low dosages. When heated to decomposition it emits toxic fumes of Cl^-. See also ALDRIN.

DHB500 CAS:84-19-5 ***HR: D***
DIENESTROL DIACETATE
mf: $C_{22}H_{22}O_4$ mw: 350.44

SYNS: DIENOESTROL DIACETATE ◇ 4,4'-(1,2-DIETHYLIDENE-1,2-ETHANEDIYL)BIS(PHENOL) DIACETATE ◇ 4,4'-(DIETHYLIDENE-ETHYLENE)DIPHENOL DIACETATE ◇ FARMACYROL ◇ LIPAMONE ◇ RETALON-ORAL

TOXICITY DATA with REFERENCE
orl-uns TDLo:663 μg/kg (female 1-53D post):REP AJVRAH 32,1599,71

SAFETY PROFILE: Experimental reproductive effects. When heated to decomposition it emits acrid smoke and fumes.

DHB550 CAS:13029-44-2 ***HR: 2***
(E,E)-DIENESTROL
mf: $C_{18}H_{18}O_2$ mw: 266.36

SYNS: α-DIENESTROLPHENOL, 4,4'-(DIETHYLIDENEETHYLENE) DI-, trans-, (E,E)- ◇ PHENOL, 4,4'-(1,2-DIETHYLIDENE-1,2-ETHANEDIYL)BIS-, (E,E)-(9CI)

TOXICITY DATA with REFERENCE
mnt-ham:emb 10 mg/L TOLED5 31(Suppl),204,86
imp-ham TDLo:640 mg/kg/38W-I:ETA CNREA8 43,5200,83

SAFETY PROFILE: Questionable carcinogen with experimental tumorigenic data. Mutation data reported. When heated to decomposition it emits acrid smoke and irritating fumes.

DHB600 CAS:298-18-0 ***HR: 3***
dl-DIEPOXYBUTANE
mf: $C_4H_6O_2$ mw: 86.10

PROP: Colorless liquid. Bp: 138°, mp: 4°, d: 1.112 @ 18°/4°.

SYNS: dl-BUTADIENE DIOXIDE ◇ 1,2:3,4-DIANHYDRO-dl-THREITOL ◇ (±)-1,2:3,4-DIEPOXYBUTANE ◇ dl-1,2:3,4-DIEPOXYBUTANE

TOXICITY DATA with REFERENCE
mmo-ssp 20 mmol/L ADWMAX -,193,62
dns-ham:lvr 1 μmol/L ENMUDM 6,1,84
scu-rat TDLo:335 mg/kg/67W-I:ETA JNCIAM 37,825,66
skn-mus TDLo:132 mg/kg/66W-I:CAR CNREA8 43,159,83
scu-mus TDLo:13200 μg/kg/68W-I:CAR CNREA8 43,159,83
scu-mus TD:260 mg/kg/65W-I:NEO JNCIAM 37,825,66
orl-rat LD50:210 mg/kg IHFCAY 6,1,67
ihl-rat LC50:56 ppm/4H IHFCAY 6,1,67
skn-mus LDLo:400 mg/kg JNCIAM 31,41,63
skn-rbt LD50:800 mg/kg IHFCAY 6,1,67

CONSENSUS REPORTS: IARC Cancer Review: Group 2B IMEMDT 7,56,87; Animal Sufficient Evidence IMEMDT 11,115,76. EPA Genetic Toxicology Program.

SAFETY PROFILE: Suspected carcinogen with experimental carcinogenic, neoplastigenic, and tumorigenic data. Poison by ingestion, inhalation, and skin contact. Mutation data reported. When heated to decomposition it emits acrid smoke and irritating fumes.

DHB800 CAS:564-00-1 ***HR: 3***
meso-1,2,3,4-DIEPOXYBUTANE
mf: $C_4H_6O_2$ mw: 86.10

SYNS: (R*,S*)-2,2'-BIOXIRANE ◇ 1,2:3,4-DIANHYDROERYTHRITOL ◇ meso-DIEPOXYBUTANE ◇ (R*,S*)-DIEPOXYBUTANE ◇ ERYTHRITOL ANHYDRIDE

TOXICITY DATA with REFERENCE
mmo-sat 100 μg/plate ENMUDM 6(Suppl 2),1,84
mmo-ssp 51 mmol/L ADWMAX -,193,62
skn-mus TDLo:26 g/kg/22W-I:NEO 14JTAF -,275,[illegible]
skn-mus TD:26 g/kg/22W-I:ETA JNCIAM 31,41,63
skn-mus LDLo:400 mg/kg JNCIAM 31,41,63

CONSENSUS REPORTS: IARC Cancer Review: Group 2B IMEMDT 7,56,87; Animal Sufficient Evidence IMEMDT 11,115,76.

SAFETY PROFILE: Suspected carcinogen with experimental carcinogenic, neoplastigenic, and tumorigenic data. Poison by skin contact. Mutation data reported. When heated to decomposition it emits acrid smoke and irritating fumes.

DHB875 ***HR: D***
trans-1,2,3,4-DIEPOXYCYCLOHEXANE
mf: $C_5H_8O_2$ mw: 100.11

SYN: (E)-3,8-DIOXATRICYCLO(5.1.0.0^{2,4})OCTANE

TOXICITY DATA with REFERENCE
mmo-smc 32 mmol/L MUREAV 117,213,83
mma-smc 8 mmol/L MUREAV 117,213,83
mrc-smc 8 mmol/L MUREAV 117,213,83

SAFETY PROFILE: Mutation data reported. When heated to decomposition it emits acrid smoke and fumes.

DHC000 CAS:24854-67-9 ***HR: 3***
1,2,9,10-DIEPOXYDECANE
mf: $C_{10}H_{18}O_2$ mw: 170.28

TOXICITY DATA with REFERENCE
unk-mus TDLo:510 mg/kg:ETA RARSAM 3,193,[illegible]

New Jersey Hazardous Substance Fact Sheet on
2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN. Chemical Abstract Services (CAS) Number 1746016.

****
* HAZARDOUS SUBSTANCE FACT SHEET
* RIGHT TO KNOW PROGRAM
* NEW JERSEY DEPARTMENT OF HEALTH
****

Common Name: 2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN
CAS Number: 1746-01-6
DOT Number: None

RTK Substance number: 1806
Date: February 1988

HAZARD SUMMARY

* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin is a CARCINOGEN--HANDLE WITH EXTREME CAUTION, and may be a TERATOGEN.
* Exposure can cause a severe acnelike skin rash to develop. This can be bad enough to be disabling and may persist for many years.
* Exposure can damage the liver.
* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin can cause nervous system damage with symptoms of weakness, pain in the legs and numbness.

IDENTIFICATION

2,3,7,8-Tetrachlorodibenzo-p-Dioxin is a colorless, needle-shaped material. It is not manufactured but occurs as an impurity in the manufacture of other chemicals, including herbicides and fungicides.

REASON FOR CITATION

* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin is on the Hazardous Substance List because it is cited by NIOSH, IARC, NTP, CAG and EPA.
* This chemical is on the Special Health Hazard Substance List because it is a CARCINOGEN and a TERATOGEN.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

* Exposure to hazardous substances should be routinely evaluated. This may include collecting personal and area air samples. You can obtain copies of sampling results from your employer. You have a legal right to this information under OSHA 1910.20.

* If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.

WORKPLACE EXPOSURE LIMITS
NIOSH: The recommended airborne exposure limit is the lowest feasible level.

It should be recognized that 2,3,7,8-Tetrachlorodibenzo-p-Dioxin can be absorbed through your skin, thereby increasing your exposure.
* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin is a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.

WAYS OF REDUCING EXPOSURE
* Where possible, enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
* A regulated, marked area should be established where 2,3,7,8-Tetrachlorodibenzo-p-Dioxin is handled, used, or stored.
* Wear protective work clothing.
* Wash thoroughly immediately after exposure to 2,3,7,8-Tetrachlorodibenzo-p-Dioxin and at the end of the workshift.
* Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to potentially exposed workers.

This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to 2,3,7,8-Tetrachlorodibenzo-p-Dioxin:

* Exposure can cause headaches, weakness and digestive disturbance. Most symptoms develop slowly, over many days.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to 2,3,7,8-Tetrachlorodibenzo-p-Dioxin and can last for months or years:

Cancer Hazard
* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin is a PROBABLE CARCINOGEN in humans. There is some evidence that it causes lymphomas cancer in humans and it has been shown to cause (liver, lung, mouth, tongue and skin cancer in animals.
* Many scientists believe there is no safe level of exposure to a carcinogen. Such substances may also have the potential for causing reproductive damage in humans.

Reproductive Hazard
* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin may be a teratogen in humans since it has been shown to be a teratogen in animals.
* There is limited evidence that 2,3,7,8-Tetrachlorodibenzo-p-Dioxin may decrease fertility in males and females.

Other Long-Term Effects
* Exposure can cause a severe acne-like skin rash (Chlora..e) to develop. This can be severe enough to be disabling and may persist for years.
* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin can damage the liver.
* Exposure can affect the nervous system. Symptoms include lack of energy, loss of sex drive, personality and mood changes, and numbness, weakness and pain in the legs.
* 2,3,7,8-Tetrachlorodibenzo-p-Dioxin can effect porphyrin metabolism and may cause a skin disease called Porphyria Cutanea Tarda.

MEDICAL

Medical Testing
If any exposure is believed to have occurred, the following are recommended:

* Liver function tests.
* Exam of the nervous system.
* Urinary Uroporphyrin excretion.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under OSHA 1910.20.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, ENGINEERING CONTROLS are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.
In evaluating the controls present in your workplace, consider: (1) how hazardous the substance is, (2) how much of the substance is released into the workplace and (3) whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.

In addition, the following controls are recommended:

* Where possible, automatically transfer 2,3,7,8-Tetrachlorodibenzo-p-Dioxin from drums or other storage containers to process containers. Further information on 2,3,7,8-Tetrachlorodibenzo-p-Dioxin can be found in the NIOSH Current Intelligence Bulletin #40, 84-104.

Good WORK PRACTICES can help to reduce hazardous exposures. The following work practices are recommended:

* Workers whose clothing has been contaminated by 2,3,7,8-Tetrachlorodibenzo-p-Dioxin should change into clean clothing promptly.
* Do not take contaminated work clothes home. Family members could be exposed.
* Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to 2,3,7,8-Tetrachlorodibenzo-p-Dioxin.
* If there is the possibility of skin exposure, emergency shower facilities should be provided.

* On skin contact with 2,3,7,8-Tetrachlorodibenzo-p-Dioxin, immediately wash or shower to remove the chemical. At the end of the workshift, wash any areas of the body that may have contacted 2,3,7,8-Tetrachlorodibenzo-p-Dioxin, whether or not known skin contact has occurred.
* Do not eat, smoke, or drink where 2,3,7,8-Tetrachlorodibenzo-p-Dioxin is handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating or smoking.
* Use a vacuum or a wet method to reduce dust during clean-up. Do not dry sweep.
* When vacuuming, a high efficiency particulate absolute (HEPA) filter should be used, not a standard shop vacuum.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT.
However, for some jobs (such as outside work, confined space entry, jobs done only once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

The following recommendations are only guidelines and may not apply to every situation.

Clothing

* Avoid skin contact with 2,3,7,8-Tetrachlorodibenzo-p-Dioxin. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
* All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

* Eye protection is included in the recommended respiratory protection.

Respiratory Protection

IMPROPER USE OF RESPIRATORS IS DANGEROUS. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing and medical exams, as described in OSHA 1910.134.

* Engineering controls must be effective to ensure that exposure to 2,3,7,8-Tetrachlorodibenzo-p-Dioxin does not occur.

* At any exposure level, use a MSHA/NIOSH approved supplied-air respirator with a full facepiece operated in the positive pressure mode or with a full facepiece, hood, or helmet in the continuous flow mode, or use a MSHA/NIOSH approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

QUESTIONS AND ANSWERS

Q: If I have acute health effects, will I later get chronic health effects?
A: Not always. Most chronic (long-term) effects result from repeated exposures to a chemical.

Q: Can I get long-term effects without ever having short-term effects?
A: Yes, because long-term effects can occur from repeated exposures to a chemical at levels not high enough to make you immediately sick.

Q: What are my chances of getting sick when I have been exposed to chemicals?
A: The likelihood of becoming sick from chemicals is increased as the amount of exposure increases. This is determined by the length of time and the amount of material to which someone is exposed.

Q: When are higher exposures more likely?
A: Conditions which increase risk of exposure include dust releasing operations (grinding, mixing, blasting, dumping, etc.), other physical and mechanical processes (heating, pouring, spraying, spills and evaporation from large surface areas such as open containers), and "confined space" exposures (working inside vats, reactors, boilers, small rooms, etc.).

Q: Is the risk of getting sick higher for workers than for community residents?
A: Yes. Exposures in the community, except possibly in cases of fires or spills, are usually much lower than those found in the workplace. However, people in the community may be exposed to contaminated water as well as to chemicals in the air over long periods. Because of this, and because of exposure of children or people who are already ill, community exposures may cause health problems.

Q: Don't all chemicals cause cancer?
A: No. Most chemicals tested by scientists are not cancer-causing.

Q: Should I be concerned if a chemical causes cancer in animals?
A: Yes. Most scientists agree that a chemical that causes cancer in animals should be treated as a suspected human carcinogen unless proven otherwise.

Q: But don't they test animals using much higher levels of a chemical than people usually are exposed to?
A: Yes. That's so effects can be seen more clearly using fewer animals. But high doses alone don't cause cancer unless it's a cancer agent. In fact, a chemical that causes cancer in animals at high doses could cause cancer in humans exposed to low doses.

Q: Can men as well as women be affected by chemicals that cause reproductive system damage?
A: Yes. Some chemicals reduce potency or fertility in both men and women. Some damage sperm and eggs, possibly leading to birth defects.

Q: Who is at the greatest risk from reproductive hazards?
A: Pregnant women are at greatest risk from chemicals that harm the developing fetus. However, chemicals may affect the ability to have children, so both men and women of childbearing age are at high risk.

Q: Should I be concerned if a chemical is a teratogen in animals?
A: Yes. Although some chemicals may affect humans differently than they affect animals, damage to animals suggests that similar damage can occur in humans.

The following information is available from:
New Jersey Department of Health
Occupational Health Service
Trenton, NJ 08625-0360
(609) 984-1863

Industrial Hygiene Information
Industrial hygienists are available to answer your questions regarding the control of chemical exposures using exhaust ventilation, special work practices, good housekeeping, good hygiene practices, and personal protective equipment including respirators. In addition, they can help to interpret the results of industrial hygiene survey data.

Medical Evaluation
If you think you are becoming sick because of exposure to chemicals at your workplace, you may call a Department of Health physician who can help you find the services you need.

Public Presentations
Presentations and educational programs on occupational health or the Right to Know Act can be organized for labor unions, trade associations and other groups.

Right to Know Information Resources
The Right to Know Infoline (609) 984-2202 can answer questions about the identity and potential health effects of chemicals, list of educational materials in occupational health, references used to prepare the Fact Sheets, preparation of the Right to Know survey, education and training programs, labeling requirements, and general information regarding the Right to Know Act. Violations of the law should be reported to (609) 984-5627.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits (called TLVs) for exposure to workplace chemicals.

CAG is the Carcinogens Assessment Group of the federal EPA.

A carcinogen is a substance that causes cancer.

The CAS number is assigned by the Chemical Abstracts Service to identify a specific chemical.

A combustible substance is a solid, liquid or gas that will burn.

A corrosive substance is a gas, liquid or solid that causes irreversible damage to human tissue or containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

A fetus is an unborn human or animal.

A flammable substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The flash point is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group that classifies chemicals according to their cancer-causing potential.

A miscible substance is a liquid or gas that will evenly dissolve in another.

mg/m3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes mutations. A mutation is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NCI is the National Cancer Institute, a federal agency that determines the cancer-causing potential of chemicals.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A reactive substance is a solid, liquid or gas that can cause an explosion under certain conditions or on contact with other specific substances.

A teratogen is a substance that causes birth defects by damaging the fetus.

TLV is the Threshold Limit Value, the workplace exposure limit recommended by ACGIH.

The vapor pressure is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

> > > > > > > > > EMERGENCY INFORMATION < < < < < < < < <
Common Name: 2,3,7,8-TETRACHLORODIBENZO-p-DIOXIN
DOT Number: None
DOT Emergency Guide code: No Citation
CAS Number: 1746-01-6

Hazard rating	NJ DOH	NFPA
FLAMMABILITY	Not Found	Not Rated
REACTIVITY	Not Found	Not Rated
CARCINOGEN		

Hazard Rating Key: 0=minimal; 1=slight;
2=moderate; 3=serious; 4=severe

FIRE HAZARDS

* Use dry chemical, CO2, water spray, or foam extinguishers.
* If employees are expected to fight fires, they must be trained and equipped as stated in OSHA 1910.156.

SPILLS AND EMERGENCIES

If 2,3,7,8-Tetrachlorodibenzo-p-Dioxin is spilled, take the following steps:

* Restrict persons not wearing protective equipment from area of spill until clean-up is complete.
* Collect powdered material in the most convenient and safe manner and deposit in sealed containers.
* It may be necessary to contain and dispose of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin as a HAZARDOUS WASTE. Contact your Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

FOR LARGE SPILLS AND FIRES immediately call your fire department. You can request emergency information from the following:

CHEMTREC: (800) 424-9300
NJDEP HOTLINE: (609) 292-7172
Other:

HANDLING AND STORAGE

* Prior to working with 2,3,7,8-Tetrachlorodibenzo-p-Dioxin you should be trained on its proper handling and storage.
* Store in tightly closed containers in a cool, well-ventilated area.

FIRST AID

In NJ, POISON INFORMATION 1-800-962-1253
Other:

Eye Contact
* Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids.

Skin Contact
* Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

OTHER COMMONLY USED NAMES

Dibenzo(b,e) 1,4-Dioxin, 2,3,7,8-Tetrachloro-

TCDBD; TCDD; Dioxin

HCG000 ***HR: 3***
1,2,3,6,7,8-HEXACHLORODIBENZODIOXIN mixed with PENTACHLORO ISOMERS and HEPTACHLORO ISOMERS 96.8% : 1.97% : 1.23%

TOXICITY DATA with REFERENCE
orl-rat LD50:750 μg/kg NCIIR* NOI-CP-12338
orl-mus LD50:500 μg/kg NCIIR* NOI-CP-12338

SAFETY PROFILE: A deadly poison by ingestion. When heated to decomposition it emits very toxic fumes of Cl^-.

HCH400 CAS:70648-26-9 ***HR: D***
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN
mf: $C_{12}H_2Cl_6O$ mw: 374.84

SYN: DIBENZOFURAN,1,2,3,4,7,8-HEXACHLORO-

TOXICITY DATA with REFERENCE
orl-mus TDLo:400 μg/kg (female 10-13D post):TER TXAPA9 90,206,87

SAFETY PROFILE: Experimental reproductive effects. When heated to decomposition it emits toxic fumes of Cl^-.

HCH500 CAS:13465-77-5 ***HR: 3***
HEXACHLORODISILANE
mf: Cl_6Si_2 mw: 268.83

SAFETY PROFILE: Potentially explosive reaction with chlorine above 300°C. Corrosive irritant to the eyes, skin and mucous membranes. When heated to decomposition or on contact with water it emits toxic fumes of HCl and Cl^-. See also CHLOROSILANES.

HCI000 CAS:67-72-1 ***HR: 3***
HEXACHLOROETHANE
DOT: NA 9037
mf: C_2Cl_6 mw: 236.72

PROP: Rhombic, triclinic, or cubic crystals, colorless, camphor-like odor. Mp: 186.6° (subl), d: 2.091, vap press: 1 mm @ 32.7°, bp: 186.8° (triple point). Sol in alc, benzene, chloroform, ether, oils; insol in water.

SYNS: AVLOTANE ◇ CARBON HEXACHLORIDE ◇ DISTOKAL ◇ DISTOPAN ◇ DISTOPIN ◇ EGITOL ◇ ETHANE HEXACHLORIDE ◇ ETHYLENE HEXACHLORIDE ◇ FALKITOL ◇ FASCIOLIN ◇ HEXACHLOR-AETHAN (GERMAN) ◇ 1,1,1,2,2,2-HEXACHLOROETHANE ◇ HEXACHLOROETHYLENE ◇ MOTTENHEXE ◇ NCI-C04604 ◇ PERCHLOROETHANE ◇ PHENOHEP ◇ RCRA WASTE NUMBER U131

TOXICITY DATA with REFERENCE
orl-rat TDLo:5500 mg/kg (6-16D preg):REP AIHAAP 40,187,79
orl-mus TDLo:230 g/kg/78W-I:CAR NCITR* NCI-CG-TR-68,78
orl-mus TD:460 g/kg/78W-I:CAR NCITR* NCI-CG-TR-68,78
orl-rat LD50:4460 mg/kg AIHAAP 40,187,79
ipr-rat LDLo:2900 mg/kg AIHAAP 40,187,79
ipr-mus LD50:4500 mg/kg ARZNAD 11,902,61
ivn-dog LDLo:325 mg/kg QJPPAL 7,205,34
skn-rbt LD50:32 g/kg AIHAAP 40,187,79
scu-rbt LDLo:4000 mg/kg QJPPAL 7,205,34
orl-gpg LD50:4970 mg/kg AIHAAP 40,187,79

CONSENSUS REPORTS: IARC Cancer Review: Group 3 IMEMDT 7,56,87; Animal Limited Evidence IMEMDT 20,467,79. NCI Carcinogenesis Bioassay (gavage); Clear Evidence: mouse NCITR* NCI-CG-TR-68,78. NCI Carcinogenesis Bioassay (gavage); No Evidence: rat NCITR* NCI-CG-TR-68,78. Community Right-To-Know List. Reported in EPA TSCA Inventory. EPA Genetic Toxicology Program.

OSHA PEL: TWA 1 ppm (skin)
ACGIH TLV: TWA 1 ppm; (Proposed: TWA 1 ppm; Suspected Human Carcinogen
DFG MAK: 1 ppm (10 mg/m^3)
NIOSH REL: (Hexachloroethane) Reduce to lowest level
DOT Classification: ORM-A; Label: None.

SAFETY PROFILE: Suspected carcinogen with experimental carcinogenic data. A poison by intravenous route. Moderately toxic by intraperitoneal route. Mildly toxic by ingestion. Experimental reproductive effects. Liver injury has resulted from exposure to this material. An insecticide. Slightly explosive by spontaneous chemical reaction. Dehalogenation of this material by reaction with alkalies, metals, etc., will produce spontaneous explosive chloroacetylenes. When heated to decomposition it emits highly toxic fumes of Cl^- and phosgene. See also CHLORINATED HYDROCARBONS, ALIPHATIC.

HCI475 CAS:14458-95-8 ***HR: 3***
5,6,7,8,9,9-HEXACHLORO-1,4,4a,5,8,8a-HEXAHYDRO-1,4:5,8-DIMETHANOPHTHALAZINE-2-OXIDE
mf: $C_{10}H_6Cl_6N_2O$ mw: 382.88

SYNS: ENT 25,582 ◇ SD 3450 ◇ SHELL SD-3450

TOXICITY DATA with REFERENCE
orl-rat LD50:2800 μg/kg TXAPA9 21,315,72
orl-mus LDLo:5500 μg/kg AECTCV 14,111,85
orl-bwd LD50:25 mg/kg TXAPA9 21,315,72

SAFETY PROFILE: Poison by ingestion. When heated to decomposition it emits toxic fumes of Cl^- and NO_x.

TOXICITY DATA with REFERENCE
orl-mus LD50:1200 mg/kg 85GDA2 2,258,80
ipr-mus LD50:8200 μg/kg AACHAX -,737,64
ivn-mus LD50:1120 μg/kg 85GDA2 2,258,80
ivn-dog LDLo:2780 μg/kg IJMRAQ 51,453,63

SAFETY PROFILE: Poison by intravenous and intraperitoneal routes. Moderately toxic by ingestion.

HAI300 CAS:6028-07-5 ***HR: 3***
HARMALOL HYDROCHLORIDE
mf: $C_{12}H_{12}N_2O \cdot ClH$ mw: 236.72

SYN: 4,9-DIHYDRO-1-METHYL-3H-PYRIDO(3,4-b)INDOL-7-OL MONOHYDROCHLORIDE

TOXICITY DATA with REFERENCE
ipr-mus LDLo:230 mg/kg QJPPAL 3,218,30
scu-mus LDLo:380 mg/kg QJPPAL 3,218,30
ivn-mus LD50:100 mg/kg CSLNX* NX#03207
scu-rbt LDLo:300 mg/kg QJPPAL 3,218,30
scu-gpg LDLo:300 mg/kg QJPPAL 3,218,30
scu-frg LDLo:250 mg/kg QJPPAL 3,218,30

SAFETY PROFILE: Poison by subcutaneous, intravenous, and intraperitoneal routes. When heated to decomposition it emits toxic fumes of NO_x and HCl.

HAI500 CAS:442-51-3 ***R: 3***
HARMINE
mf: $C_{13}H_{12}N_2O$ mw: 212.27

PROP: An alkaloid isolated from *Banisteria caapi sp.*, a South American narcotic agent (AEPPAE 129,133,28).

SYNS: BANISTERINE ◇ LEUCOHARMINE ◇ 6-METHOXYHARMAN ◇ 7-METHOXY-1-METHYL-9H-PYRIDO(3,4-b)INDOLE ◇ 1-METHYL-7-METHOXY-β-CARBOLINE ◇ TELEPATHINE ◇ YAGEINE ◇ YAJEINE

TOXICITY DATA with REFERENCE
ims-man TDLo:3 mg/kg:CNS,GIT AEPPAE 129,133,28
scu-mus LD50:243 mg/kg PCJOAU 10,1171,76
ivn-mus LDLo:50 mg/kg AEPPAE 129,133,28
ivn-rat LDLo:10 mg/kg AEPPAE 129,133,28
scu-rbt LDLo:200 mg/kg AEPPAE 129,133,28
ivn-rbt LDLo:60 mg/kg NEPHBW 10,15,71
scu-gpg LDLo:100 mg/kg AEPPAE 129,133,28
scu-frg LDLo:300 mg/kg QJPPAL 9,37,36

SAFETY PROFILE: Poison by intravenous and subcutaneous routes. Human systemic effects by intramuscular route: sleep disturbance, tremors, nausea. When heated to decomposition it emits toxic fumes of NO_x.

HAJ500 CAS:34465-46-8 ***HR: 3***
HCDD
mf: $C_{12}H_2Cl_6O_2$ mw: 390.84

PROP: Colorless solid. Mp: 239°.

SYNS: HEXACHLORODIBENZO-p-DIOXIN ◇ 1,2,3,6,7,8-HEXACHLORODIBENZO-p-DIOXIN

TOXICITY DATA with REFERENCE
eye-rbt 2 mg MOD EVHPAZ 5,87,73
orl-rat TDLo:100 μg/kg (female 6-15D post):TER ADCSAJ 120,55,73
orl-rat TDLo:100 μg/kg (female 6-15D post):REP ADCSAJ 120,55,73
orl-rat LDLo:100 mg/kg ADCSAJ 120,55,73

CONSENSUS REPORTS: IARC Cancer Review: Animal Inadequate Evidence IMEMDT 15,41,77.

SAFETY PROFILE: A deadly poison by ingestion. An experimental teratogen. An eye irritant. When heated to decomposition it emits toxic fumes of Cl^-.

HAJ700 CAS:30007-39-7 ***HR: 3***
HEAT
mf: $C_{19}H_{21}NO_2 \cdot ClH$ mw: 331.87

SYNS: 3,4-DIHYDRO-2-(((p-HYDROXYPHENETHYL)AMINO)METHYL)-1(2H)-NAPHTHALENONE HYDROCHLORIDE ◇ 3,4-DIHYDRO-2-(((2-(4-HYDROXYPHENYL)ETHYL)AMINO)METHYL)-1(2H)NAPHTHALENONE HYDROCHLORIDE ◇ 2-(β-(HYDROXYPHENYL)ETHYLAMINOMETHYL)TETRALONE HYDROCHLORIDE

TOXICITY DATA with REFERENCE
orl-rat LD50:650 mg/kg DRFUD4 7,231,82
ivn-rat LD50:22500 μg/kg DRFUD4 7,231,82
orl-mus LD50:730 mg/kg DRFUD4 7,231,82
ivn-mus LD50:33 mg/kg DRFUD4 7,231,82

SAFETY PROFILE: Poison by intravenous route. Moderately toxic by ingestion. When heated to decomposition it emits toxic fumes of NO_x and HCl.

HAJ750 ***HR: 1***
#6 HEAVY FUEL OILS

PROP: #6 Fuel oil, API gravity 5.2/1.2% S (52MLA2 1,1,83).

TOXICITY DATA with REFERENCE
skn-rbt 500 mg/24H MLD 52MLA2 1,1,83
eye-rbt 100 mg/30S MLD 52MLA2 1,1,83
orl-rat LD50:4700 mg/kg 52MLA2 1,1,83
skn-rbt LDLo:5 g/kg 52MLA2 1,1,83

SAFETY PROFILE: Mildly toxic by ingestion and skin contact. A mild eye and skin irritant. Flammable when exposed to heat or flame. When heated to decomposition it emits toxic fumes.

HAK000 CAS:7789-20-0 ***HR: D***
HEAVY WATER
mf: D_2O mw: 20.02

PROP: Mp: 3.81°, triple point temp 3.82°, bp: 101.42°.

O

D090 CAS:37203-43-3 ***HR: 3***
RATOXIN

CITY DATA with REFERENCE
TDLo:35 μg/kg (female 21-28D post):TER
33,412,77
D50:20 mg/kg 19FKA3 -,153,67

PROFILE: Poison by ingestion. An experi-
togen. When heated to decomposition it
smoke and irritating fumes.

CAS:89930-55-2 ***HR: D***
XIN A SODIUM SALT
NO_6•Na mw: 426.83

Y DATA with REFERENCE
DLo:5 mg/kg (8-9D preg):TER ARCVBP 5,167,74
TDLo:5 mg/kg (8-9D preg):REP ARCVBP 5,167,74

PROFILE: An experimental teratogen. Ex...
reproductive effects. When heated to decompo-
it emits toxic fumes of Cl^-, NO_x, and Na_2O.

HR: D
UM SANCTUM LINN., LEAF EXTRACT

ICITY DATA with REFERENCE
DLo:500 mg/kg (1-5D preg):REP IJMRAQ

PROFILE: Experimental reproductive effects.

CAS:68917-09-9 ***HR: 2***
A CYMBARUM OIL

OP: Found in the tree *Ocotea cymbarum* containing
role, 5% sesquiterpenes, 0.7% pinene, 0.6% eu-
0.2% cineol, and 0.2% fufural (FCTXAV
7,78).

OIL of SASSAFRAS BRAZILIAN

ICITY DATA with REFERENCE
-mus 100% FCTXAV 16,831,78
500 mg/24H MOD FCTXAV 16,831,78
100% FCTXAV 16,831,78
LD50:1580 mg/kg FCTXAV 16,831,78

NSENSUS REPORTS: Reported in EPA TSCA In-

PROFILE: Moderately toxic by ingestion. A skin irritant. When heated to decomposition it emits acrid smoke and irritating fumes. See also individual components.

OAH000 CAS:27858-07-7 ***HR: 2***
OCTABROMODIPHENYL
mf: $C_{12}H_2Br_8$ mw: 785.42

SYNS: BB-8 ◇ BROMKAL 80 ◇ OBB ◇ OCTABROMOBIPHENYL ◇ ar,ar,ar,ar,ar,ar',ar',ar',ar' OCTABROMO-1,1'-BIPHENYL

TOXICITY DATA with REFERENCE
orl-rat TDLo:50 mg/kg (6-15D preg):REP AIHAAP 38,307,77
orl-rat TDLo:500 mg/kg (6-15D preg):TER AIHAAP 38,307,77
orl-rat LDLo:2000 mg/kg TXAPA9 22,316,72

CONSENSUS REPORTS: Reported in EPA TSCA Inventory.

SAFETY PROFILE: Moderately toxic by ingestion. An experimental teratogen. Experimental reproductive effects. Irritating to skin, eyes, and mucous membranes. Can cause kidney and liver enlargement and thyroid hyperplasia; it is stored in fatty tissue. When heated to decomposition it emits toxic fumes of Br^-. See also POLYBROMINATED BIPHENYLS.

OAJ000 CAS:3268-87-9 ***HR: 3***
OCTACHLORODIBENZODIOXIN
mf: $C_{12}Cl_8O_2$ mw: 459.72

PROP: Colorless crystals. Mp: 239°.

SYNS: NCI-C03678 ◇ OCDD ◇ OCTACHLORODIBENZO(b,e)(1,4)DIOXIN ◇ OCTACHLORODIBENZO-p-DIOXIN ◇ 1,2,3,4,6,7,8,9-OCTACHLORODIBENZODIOXIN

TOXICITY DATA with REFERENCE
eye-rbt 2 mg MLD EVHPAZ 5,87,73
orl-rat TDLo:5 g/kg (6-15D preg):TER ADCSAJ 120,55,73
skn-mus TDLo:290 mg/kg/60W-I:ETA EVHPAZ 5,163,73
orl-rat LD50:1 mg/kg EXPEAM 38,879,82

CONSENSUS REPORTS: IARC Cancer Review: Animal Inadequate Evidence IMEMDT 15,41,77.

SAFETY PROFILE: Poison by ingestion. An experimental teratogen. An eye irritant. Questionable carcinogen with experimental tumorigenic data. When heated to decomposition it emits toxic fumes of Cl^-.

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Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

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Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] **Description:** A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA

HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m³
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m³

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m³)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift
TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m³)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m³
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m³

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m³
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m³

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19°C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10^{-6} to 10^{-3} mm at 20 °C
Molecular Weight: 188.7 to 398.5
Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 °F (141-196 °C) OC*	Autoignition Temperature: 464 °F (240 °C)	LEL: None reported	UEL: None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 °F (600-650 °C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

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Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] and NTP[169] list PCBs as an IARC probable carcinogen (overall evaluation is 2A: limited human data; sufficient ɩimal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through ıbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary*. Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

‾PA Designations
CRA Hazardous Waste (40 CFR 261.33): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Polychlorinated biphenyls
DOT Hazard Class: 9
ID No.: UN2315
ʾOT Packing Group: II
ˏOT Labe˙ CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180
Prepared by: MJ Wurth, BS; Industrial Hygiene Review: PA Roy MPH, CIH; Medical Review: AC Darlington, MD

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COAL TAR PITCH VOLATILES
CAS: 65996-93-2 **1987 TLV = 0.2 mg/m^3 as benzene-soluble fraction; recognized human carcinogen**

SYNONYMS: CTPV; particulate polycyclic organic matter (PPOM); particulate polycyclic aromatic hydrocarbons (PPAH); polynuclear aromatics (PNAs)

PHYSICAL FORM. As stated by the ACGIH,

The pitch of coal tar is the black or dark brown amorphous residue that remains after the redistillation process. The volatiles contain a large quantity of lower molecular weight polycyclic hydrocarbons. As these hydrocarbons (naphthalene, fluorene, anthracene, acridine, phenanthrene) sublime into the air, there is an increase of benzo(a)pyrene (BaP or 3,4-benzpyrene) and other higher weight polycyclic hydrocarbons in the tar and in the fumes. Polycyclic hydrocarbons, known to be carcinogenic, are of this large molecular type.

SOURCES. Emissions from coke ovens, from coking of coal tar pitch, and from Soderberg aluminum reduction electrolytic cells

USES. Base for coatings and paints; for roofing and paving; and as a binder for carbon electrodes

EXPOSURE. Inhalation

TOXICOLOGY. Epidemiologic evidence suggests that workers intimately exposed to the products of combustion or distillation of bituminous coal are at increased risk of cancer at many sites including lungs, kidney, and skin.

The chemical composition and particle size distribution of CTPV from different sources are significant variables in determining toxicity.

In a study of 22,010 US male aluminum reduction workers with over 5 years' employment in the industry, there was a slight positive association with lung cancer (SMR* = 121), which was somewhat stronger in horizontal-Soderberg workers (SMR = 162). There was a mild excess of leukemia (SMR = 170) and lymphoma (SMR = 125) in pot-room workers, but neither was statistically significant.

In a more detailed analysis of the mortality experience of this cohort up to year-end 1977, the results of other studies relative to an excess of lung cancer were not confirmed, but there were indications of a higher than expected mortality in pancreatic cancer, lymphohematopoietic cancers, genitourinary cancer

nonmalignant respiratory disease, and benign and unspecified neoplasms.

In a study in Canada of 5891 men in two aluminum reduction plants, the mortality from lung cancer was related to "tar-years" of exposure; the SMR for persons exposed for more than 21 years to the higher levels of tars was 2.3 times that of persons not exposed to tars. A follow-up study of this cohort through 1977 showed excess deaths from respiratory disease; pneumonia and bronchitis; malignant neoplasms (all sites); malignant neoplasms of the stomach and esophagus, bladder, and lung; other malignant neoplasms; Hodgkin's disease; and other hypertensive disease. Mortality from malignant neoplasms of the bladder and lung was meaningfully related to number of tar-years and of years to exposure.

Exposure to coke oven emissions is a cause of lung and kidney caner. A major study of US coke oven workers showed that mortality from lung cancer for full topside workers is 9 times the expected rate, for partial topside workers it is almost 2.5 times the expected rate, and for side oven workers, it is 1.7 times the expected rate. All these rates are based on 5 or more years of exposure in the job category. As the length of employment increases, so does the mortality experience. For example, for employees with 20 or more years of employment topside, the lung cancer rate is 20 times the expected rate.

In addition to the risk of lung cancer, the relative risk of mortality from kidney cancer for all coke oven workers is 7.5.

Certain industrial populations exposed to coal tar products have a demonstrated risk of skin cancer. Substances containing polycyclic hydrocarbons or PNAs (polynuclear aromatics), which may produce skin cancer, also produce contact dermatitis (e.g., coal tar pitch, cutting oils). Although allergic dermatitis is readily induced by PNAs in guinea pigs, it is only rarely reported in humans from occupational contact with PNAs. Incidences in humans have resulted largely from the therapeutic use of coal tar preparations. Components of pitch and coal tar produce cutaneous photosensitization; skin eruptions are usually limited to areas exposed to ultraviolet light. Most of the phototoxic agents will induce hypermelanosis of the skin; if chronic photodermatitis is severe and prolonged, leukoderma may occur. Some oils containing PNAs have been associated with changes, commonly taking the form of acne, of follicular and sebaceous glands.

[Information taken from Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H., Chemical Hazards of the Workplace, 2nd ed. (Philadelphia: J. B. Lippincott Company, 1988), 159-161.]

ARSENIC (and Compounds)
CAS: 7440-38-2
As **1987 TLV = 0.2 mg/m^3, as As; none as As_2O_3**

SYNONYMS AND COMPOUNDS: Grey arsenic; metallic arsenic; arsenic trichloride; arsenic trioxide; arsenic salts

PHYSICAL FORM. Metallic arsenic is a steel-grey, brittle metal; arsenic trichloride is an oily liquid; arsenic trioxide is a crystalline solid.

USES AND SOURCES. In metallurgy for hardening copper, lead, alloys; in pigment production; in the manufacture of certain types of glass; insecticides and fungicides, rodent poison; a by-product in the smelting of copper ores; dopant material in semiconductor manufacture

EXPOSURE. Inhalation; skin absorption; ingestion

TOXICOLOGY. Arsenic compounds are irritants of the skin, mucous membranes, and eyes; arsenical dermatoses and epidermal carcinoma are reported risks of exposure to arsenic compounds, as are other forms of cancer.

Acute arsenic poisoning is rare in the occupational setting and results primarily from ingestion of contaminated food and drink. Initial symptoms include burning lips, constriction of the throat, and dysphagia, followed by excruciating abdominal pain, severe nausea, projectile vomiting, and profuse diarrhea. Other toxic effects on the liver, blood-forming organs, central and peripheral nervous systems, and cardiovascular system may appear. Convulsions, coma, and death follow within 24 hours in severe cases. Levels of exposure associated with acute arsenic toxicity vary with the valency form of the element; trivalent arsenic compounds are the most toxic, presumably because of their avid binding to sulfhydryl groups. For arsenic trioxide, the reported estimated lethal dose ranges from 70 to 300 mg.

Acute inhalation exposures have resulted in irritation of the upper respiratory tract, even leading to nasal perforations. Occupational exposure to arsenic compounds results in hyperpigmentation of the skin and hyperkeratoses of palmar and plantar surfaces, as well as dermatitis of primary irritation type. Impairment of peripheral circulation resulting in gangrene of the fingers and toes has been reported.

Chronic arsenic intoxication by ingestion is characterized by weakness, anorexia, gastrointestinal disturbances, peripheral neuropathy, and skin disorders; with the exception of skin disorders, these signs and symptoms are not common in industrial practice. Liver damage has been observed in animals after both

ingestion and inhalation of arsenic compounds, but this has not been observed with occupational exposure.

Arsenic trichloride is a vesicant and can cause severe damage to the respiratory system upon inhalation; it is rapidly absorbed through the skin, and a fatal case following a spill on the skin has been reported. The vapor of arsenic trichloride is highly irritating to the eyes. Some organic arsenicals, such as arsanilates, have a selective effect on the optic nerve and can cause blindness.

Teratogenic effects, including exencephaly, skeletal defects, and genitourinary system defects, of arsenic compounds administered intravenously or intraperitoneally at high doses have been demonstrated in hamsters, rats, and mice. Only minimal fetal effects have been observed in studies of pregnant rats or mice exposed to lower levels by means of drinking water.

In a large number of studies, exposure to inorganic arsenic compounds in drugs, food, and water as well as in an occupational setting have been causally associated with the development of cancer, primarily of the skin and lungs. An excess mortality from respiratory cancer has been found among smelter workers and workers engaged in the production and use of arsenical pesticides. It should be noted, however, that in a number of these studies, levels of exposure are uncertain, and there is simultaneous exposure to other agents. In the most recent follow-up of 8045 smelter workers, those with the highest estimated exposure and the longest follow-up had a ninefold increase in respiratory cancer mortality.

Information on the association of arsenic with skin cancer has primarily involved nonoccupational populations exposed to contaminated drinking water. Chronic ingestion of trivalent arsenic in medicinal preparations was also associated with an increased incidence of hyperkeratosis and skin cancer.

Because there is no convincing evidence of the carcinogenicity of arsenic compounds in animals, it has been suggested that the compounds are not direct carcinogens but act in some other way. Despite the absence of suitable animal models, IARC has determined that there is sufficient evidence for carcinogenicity to humans.

DIAGNOSIS. Signs and Symptoms: Signs and symptoms include conjunctivitis and visual disturbances; ulceration and perforation of nasal septum; pharyngitis and pulmonary irritation; peripheral neuropathy; and hyperpigmentation of skin, palmar and plantar hyperkeratoses, dermatitis, and skin cancer. Arsenic may cause cancer of the lung, larynx, lymphoid system, or viscera.

Special Tests: Urinary levels of arsenic above 0.7 to 1.0 mg/liter in exposed persons may be indicative of harmful exposure, but dietary factors must be ruled out before significance is attached to any increase in the arsenic content of urine. The biological half-life of arsenic in urine in subjects with normal rena

function is 1 to 2 days. Seafood, especially shellfish, is a rich source of organic arsenic compounds, which are essentially nontoxic but affect the total urinary arsenic determination. Levels of 1.35 mg/liter or urine have occurred after a meal of lobster tails. In persons without known exposure to arsenic who have not ingested a seafood meal for 2 days before sampling, the urinary total arsenic is usually below 100 μg/g creatinine. Inorganic arsenic is excreted in the urine unchanged or as monomethylarsonic or dimethylarsonic (cacodoylic) acid; these compounds can be measured by hydride-generation atomic absorption spectrophotometry, yielding an index of exposure to inorganic arsenic. By this method, levels of urinary arsenic are generally below 20 μg/g urinary creatinine in unexposed subject. One estimate is that a time-weighted average exposure to 50 μg/m of inorganic arsenic over several days would yield an average urinary excretion of 220 μg of arsenic per gram creatinine by the latter method. A determination of arsenic in hair and nails may be useful, although its value has been questioned in industrial exposures because of the difficulty in removing all external contamination.

TREATMENT. Severe acute arsenic poisoning from occupational exposure is unlikely; if it should occur, administer BAL (dimercaprol) 10% in oil, intramuscularly (gluteal), 3 mg/kg for each injection; first and second days, one injection every 4 hours day and night; third day, one injection every 6 hours; fourth to 14th day, one injection twice a day until recovery is complete. Side effects of BAL (nausea, vomiting, pain, injection site sterile abscess formation, hypertension, tachycardia, headache, anxiety, diaphoresis, muscle cramps, seizures, coma, and urticaria) usually respond to supportive measures and decreased dosing and are typically transient. With severe acute intoxication, d-penicillamine may also be given orally in a dose of 25 mg/kg (to maximum of 500 mg) every 6 hours for the first 10 days, in addition to BAL. BAL may also be used to treat chronic arsenic intoxication.

[Information taken from Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H., Chemical Hazards of the Workplace, 2nd ed. (Philadelphia: J. B. Lippincott Company, 1988), 80-82.]

File: 30 Entry: 1

BAKER Accession Number 10307

(MID) Material Identification:

C0066 -05 CADMIUM
EFFECTIVE: 03/18/92 ISSUED: 06/30/92

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: CADMIUM
COMMON SYNONYMS: N/A
CHEMICAL FAMILY: METALS
FORMULA: CD
FORMULA WT.: 112.40
CAS NO.: 7440-43-9
NIOSH/RTECS NO.: EU9800000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 1184,1182

(PHAZ) Primary Hazards:

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	3	SEVERE (CANCER CAUSING)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	0	NONE

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

U.S. PRECAUTIONARY LABELING

POISON DANGER
MAY BE FATAL IF SWALLOWED OR INHALED. EXCEPTIONAL HEALTH HAZARD: READ MATERIAL SAFETY DATA SHEET. NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING. AVOID BREATHING DUST. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

INTERNATIONAL LABELING

HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED. POSSIBLE RISKS

OF IRREVERSIBLE EFFECTS.
DO NOT BREATHE DUST.

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

(COMP) Components:

SECTION II - COMPONENTS

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
CADMIUM	7440-43-9	99-100	.2 MG/M3	.05 MG/M3

(PHYS) Physical Properties:

SECTION III - PHYSICAL DATA

BOILING POINT: 767 C (1412 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): N/A

MELTING POINT: 321 C (609 F)
(AT 760 MM HG)

VAPOR DENSITY (AIR=1): 3.9

SPECIFIC GRAVITY: 8.64
(H2O=1)

EVAPORATION RATE: N/A

SOLUBILITY(H20): NEGLIGIBLE (<0.1%)

% VOLATILES BY VOLUME: 0
(21 C)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: SOLID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

PPEARANCE & ODOR: BLUE-WHITE SOLID. ODORLESS.

(FHAZ) Fire Hazards:

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINQUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS

CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE OR EXPLOSION.

TOXIC GASES PRODUCED

CADMIUM FUMES

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

NONE IDENTIFIED.

(HAZH) Health Hazards:

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 0.05 MG/M3

TLV IS FOR CADMIUM, DUSTS AND SALTS, AS CD.

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

'ERMISSIBLE EXPOSURE LIMIT (PEL): 0.2 MG/M3

PEL IS FOR CADMIUM DUST, AS CD.

TOXICITY OF COMPONENTS

ORAL RAT LD50 FOR CADMIUM 225 MG/KG

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: YES

CARCINOGENICITY

THIS SUBSTANCE IS LISTED AS A NTP ANTICIPATED HUMAN CARCINOGEN AND AN IARC

PROBABLE HUMAN CARCINOGEN (GROUPS 2A AND 2B).

REPRODUCTIVE EFFECTS

NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: IRRITATION OF MUCOUS MEMBRANES, DRYNESS OF MOUTH AND THROAT, HEADACHE, NAUSEA, DIZZINESS, AND MAY BE FATAL.

SKIN CONTACT: NONE IDENTIFIED

EYE CONTACT: IRRITATION

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: IS HARMFUL AND MAY BE FATAL.

CHRONIC EFFECTS: LUNG DAMAGE, KIDNEY DAMAGE

TARGET ORGANS

RESPIRATORY SYSTEM, LUNGS, KIDNEYS, BLOOD, PROSTATE

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

NONE IDENTIFIED

PRIMARY ROUTES OF ENTRY

INHALATION, INGESTION, EYE CONTACT

(AID) First Aid:

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

INHALATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

SKIN CONTACT: IN CASE OF CONTACT, FLUSH SKIN WITH WATER.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

(REGS) Regulations:

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE: NO
CERCLA HAZARDOUS SUBSTANCE: YES CONTAINS CADMIUM (RQ = 1 LB)
SARA 313 TOXIC CHEMICALS: YES CONTAINS CADMIUM
GENERIC CLASS: GENERIC CLASS REMOVED FROM CFR: 7/1/91
TSCA INVENTORY: YES
STATE LISTS: FOR PRODUCTS SOLD IN THE STATE OF CALIFORNIA, THE STATE REQUIRES

THAT WE PROVIDE TO USERS AND THEIR EMPLOYEES THE FOLLOWING MESSAGE: WARNING:

THIS PRODUCT IS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

(HAZR) Hazardous Reactions:

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG OXIDIZING AGENTS, NITRATES, NITRIC ACID

DECOMPOSITION PRODUCTS: CADMIUM FUMES

(SPIL) Spillage Disposal:

SECTION VII - SPILL & DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. WIT

CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D006 (EP TOXIC WASTE)

(EQP) Protective Equipment:

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1 PPM, A HIGH-EFFICIENCY PARTICULATE RESPIRATOR IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE RECOMMENDED.

(STOR) Storage Procedures:

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

TORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA. ISOLATE FROM INCOMPATIBLE MATERIALS.

(TRAN) Transportation Information:

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (CADMIUM)
HAZARD CLASS: 9
UN/NA: UN3077 REPORTABLE QUANTITY: 10 LBS. PACKAGING GROUP: III
LABELS: CLASS 9
REGULATORY REFERENCES: 49CFR 172.101

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)
MARINE POLLUTANTS: NO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

U.S. CUSTOMS HARMONIZATION NUMBER: 81071000003

N/A = NOT APPLICABLE OR NOT AVAILABLE
N/E = NOT ESTABLISHED

(DISC) Disclaimer:

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR

APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.
EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET.
NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

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APPROVED BY QUALITY ASSURANCE DEPARTMENT.

CADMIUM (and compounds)
CAS: 7440-43-9
Cd **1987 TLV = 0.05 mg/m^3**
CADMIUM OXIDE **--dusts, salts**
CAS: 1306-190 **= 0.005 mg/m^3**
CdO **--cadmium oxide production**
1987 Ceiling Limit = 0.05 mg/m^3
--cadmium oxide fume

SYNONYMS: None

PHYSICAL FORM. The metal is soft, ductile, silver-white electropositive; cadmium oxide may be in the form of a colorles amorphous powder or as red or brown crystals

USES. The metal is used in electroplating, solder for aluminum constituent of easily fusible alloys, deoxidizer in nickel plating process engraving, in cadmium-nickel batteries, and in reacto control rods. Cadmium compounds are used as TV phosphors; pigment in glazes and enamels; dyeing and printing; semiconductors; an rectifiers.

EXPOSURE. Inhalation

TOXICOLOGY. Cadmium oxide fume is a severe pulmonary irritant cadmium dust is also a pulmonary irritant, but it is less poten than cadmium fume because it has a larger particle size. The dust at high concentrations, could be expected to cause the sam physiologic effects as those arising from fume exposure. Severa inorganic cadmium compounds cause malignant tumors in animals.

Most acute intoxications have been caused by inhalation o cadmium oxide fume at concentrations that did not provide warnin symptoms of irritation. Concentrations of fume responsible fo fatalities have been 40 to 50 mg/m^3 for 1 hour, or 9 mg/m^3 for hours. Nonfatal pneumonitis has been reported from concentration of 0.5 to 2.5 mg/m^3, while relatively mild cases have bee attributed to even lower concentrations. Following an asymptomati latent period of 4 to 10 hours, there is characteristicall nasopharyngeal irritation followed by a feeling of ches constriction or substernal pain, with cough and dyspnea. Th patent may also experience headache, chills, muscle aches, nausea vomiting, and diarrhea. Pulmonary edema may then develop rapidly with decreased vital capacity and markedly reduced carbon monoxid diffusing capacity. In approximatly 20% of cases, dyspnea i progressive, accompanied by wheezing or hemoptysis, and may resul in death within 7 to 10 days after exposure; at autopsy, the lung ae markedly congested, and there is an intra-alveolar fibrinou exudate, as well as alveolar cell metaplasia. Among survivors, th

subsequent course is unpredictable; most cases resolve slowly, but respiratory symptoms may linger for several weeks; impairment of pulmonary function may persist for months.

In experimental animals, cadmium exposure has caused pulmonary fibrosis, but this has not been documented in humans.

Inhalation overexposure may also result in renal calculi and irreversible renal tubular injury. In one fatal human case, there was renal cortical necrosis.

Repeated exposure to lower levels of cadmium in air has resulted in chronic poisoning characterized by irreversible lung injury of emphysematous type. This is accompanied by abnormal lung function and renal tubular damage, with urinary excretion of a specific low molecular weight protein. Clinical evidence of the cumulative effects of cadmium may appear after exposure has terminated. The disease then tends to be progressive. The frequency of occurrence of proteinuria increases with length of exposure. In one study, those persons exposed to cadmium compounds for less than 2 years had no proteinuria, whereas most of those exposed for 12 years or more had proteinuria with little other evidence of renal damage. The urinary excretion of cadmium bears no known relationship to the severity or duration of exposure and is only a confirmation of absorption. Absorbed cadmium is retained to a large extent by the body, and excretion is very slow.

Other consequences of cadmium exposure are anemia, eosinophilia, yellow discoloration of the teeth, rhinitis, occasional ulceration of the nasal septum, damage to the olfactory nerve, and anosmia. The long-term ingestion of water, beans, and rice contaminated with cadmium has been proposed as the probable cause of a crippling condition ("itai-itai" or "ouch-ouch" disease) among Japanese women who have had multiple pregnancies; characteristics of the disorder include pain in the back and joints, a waddly gait, osteomalacia, bone fractures, and, occasionally, fatal renal failure.

Occupational exposure to cadmium has been implicated in a significant increase in prostate and respiratory tract cancer. IARC classified the metal as probably carcinogenic to humans, but lacking human evidence, whereas cadmium chloride is classified only as showing sufficient evidence of carcinogenicity in experimental animals. NIOSH found the evidence of cadmium's ability to cause tumors to be contradictory. However, in reconsidering this position in 1984, NIOSH cited recent epidemiologic evidence of a significant excess of respiratory cancer deaths among a cohort of cadmium production workers and concluded that cadmium and its compounds are potential carcinogens.

Rats injected subcutaneously or intramuscularly developed rhabdomyosarcomas and fibrosarcomas; with cadmium sulfate or cadmium sulfide, local sarcomas; and with cadmium chloride, local pleomorphic sarcomas and testicular interstitial cell tumors. Cadmium sulfate injected into the lingual vein of female hamsters on day 8 of pregnancy caused a high incidence of resorption and malformed offspring. Acute necrosis of rat testes follows large doses orally or parenterally, but testicular effects have not been reported thus far in humans.

[Information taken from Nick H. Proctor, Ph.D., James P. Hughes M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H., Chemical Hazards of the Workplace, 2nd ed. (Philadelphia: J. B. Lippincot Company, 1988), 111-113.]

CHROMIUM
CAS: 7440-47-3 (metal)
Cr

1987 TLV
= 0.5 mg/m^3--metal
= 0.5 mg/m^3--Cr II compounds
= 0.5 mg/m^3--Cr III compounds
= 0.05 mg/m^3--water-soluble Cr VI compounds
= 0.05 mg/m^3--certain water-insoluble Cr VI compounds (recognized human carcinogen)
= 0.05 mg/m^3--chromite ore processing (chromate), as Cr (recognized human carcinogen)

METAL AND INORGANIC COMPOUNDS, AS CR

Uses. In stainless and alloy steels, refractory products, tanning agents, pigments, electroplating, catalysts, and corrosion resistant products

Classification. Chromium can have a valence of 2, 3, or 6. Chromium compounds vary greatly in their toxic and carcinogenic effects. For this reason, the ACGIH divides chromium and its inorganic compounds into a number of groupings:

1. *Chromium metals and alloys*: Include chromium metal, stainless steels, and other chromium-containing alloys.
2. *Divalent chromium compounds* (Cr^{2+}) (chromous compounds). Include chromous chloride ($CrCl_2$) and chromous sulfate ($CrSO_4$).
3. *Trivalent chromium compounds* (Cr^{3+}) (chromic compounds). Include chromic oxide ($Cr_2[SO_4]_3$), chromic chloride ($CrCl_3$), chromic potassium sulfate ($KCr[SO_4]_2$), and chromite ore ($FeO \bullet Cr_2O_3$).
4. *Hexavalent chromium compounds* (Cr^{6+}): Include chromium trioxide (CrO_3)--the anhydride of chromic acid chromates (*e.g.*, Na_2CrO_4), dichromates (*e.g.*, $Na_2Cr_2O_7$), and polychromates.

Certain hexavalent chromium compounds have been demonstrated to be carcinogenic on the basis of epidemiologic investigations of workers and experimental studies in animals. In general, these compounds tend to be of low solubility in water and thus are subdivided into two subgroups.

a. Water-soluble hexavalent chromium compounds: Include chromic acid and its anhydride, and the monochromates and dichromates of sodium, potassium, ammonium lithium, cesium, and rubidium.
b. Water-insoluble hexavalent chromium compounds: Include zinc chromate, calcium chromate, lead chromate, barium chromate, strontium chromate, and sintered chromium trioxide.

CHROMIUM METAL AND DIVALENT AND TRIVALENT COMPOUNDS

EXPOSURE. Inhalation

TOXICOLOGY. Chromium metal is relatively nontoxic. There is little evidence for significant toxicity form chromic or chromous salts, probably because of poor penetration of skin and mucous membranes. Dermatitis from some chromic salts has been reported.

Four workers engaged in the production of ferrochrome alloys developed a nodular type of pulmonary disease with impairment of pulmonary function; air concentrations of chromium averaged 0.26 mg/m^3, although other fumes and dusts were also present. Chest roentgengrams are said to have revealed only "exaggerated pulmonic markings" in workers exposed to chromite dust. The lungs of other workers exposed to chromite dust have been shown to be the seat of pneumoconiotic changes consisting of slight thickening of interstitial tissue and interalveolar septa, with histologic fibrosis and hyalinization. A refractory plant using chromite or to make chromite brick had no excess of lung cancer deaths among its workers over a 14-year period, and it was concluded that chromite alone probably is not carcinogenic. Exposure to chromium metal does not give rise to pulmonary fibrosis.

Chromite ore roast mixed with sheep fat implanted intrapleurally in rats produced sarcomas coexisting with squamous cell carcinomas of the lungs; the same material implanted in the thigh of rats produced fibrosarcomas. However, the IARC has concluded that these studies were inadequate to fully evaluate the carcinogenicity of this compound.

Unlike nickel, chromium metal does not produce allergic contact dermatitis. Some patients exhibit positive patch tests to divalent chromium compounds, but these compounds are considerably less potent as sensitizers than hexavalent chromium compounds.

These compounds do not appear to cause other effects associated with the hexavalent chromium compounds, such as chrom ulcers, irritative dermatitis, or nasal septal perforation. A cas of chromium (chromic) sulfate-induced asthma in a plating worker confirmed by specific challenge testing and the presence of Ig antibodies, has been reported.

There is no evidence indicating carcinogenicity of trivalen chromium compounds in humans or in animals. Despite a number c animal and epidemiologic studies, the IARC has concluded that ther is inadequate data to evaluate the carcinogenicity of thes compounds.

HEXAVALENT CHROMIUM

Exposure. Inhalation

Toxicology. The water-soluble hexavalent chromium compounds such as chromic acid mist and certain chromate dusts are severe irritants of the nasopharynx, larynx, lungs, and skin. Exposure to certain hexavalent chromium compounds, mainly water-insoluble, appears to be related to increased risk of lung cancer.

Hexavalent chromium compounds have been implicated as responsible for such effects as ulcerated nasal mucosa, perforated nasal septa, rhinitis, nosebleed, perforated eardrums, pulmonary edema, asthma, kidney damage, erosion and discoloration of the teeth, primary irritant dermatitis, sensitization dermatitis, and skin ulceration.

Chromic Acid: Workers exposed to chromic acid or chromates in concentration of 0.11 to 0.15 mg/m^3 developed ulcers of the nasal septum and irritation of the conjunctiva, pharynx, and larynx, as well as asthmatic bronchitis. A worker exposed to unmeasured but massive amounts of chromic acid mist for 4 days developed severe frontal headache, wheezing, dyspnea, cough, and chest pain on inspiration; after 6 months, there was still chest pain on inspiration and cough.

In an industrial plant where the airborne chromic acid concentrations measured from 0.18 to 1.4 mg/m^3, moderate irritation of the nasal septum and turbinates was observed after 2 weeks of exposure, ulceration of the septum was present after 4 weeks, and there was perforation of the septum after 8 weeks. A worker exposed to an unmeasured concentration of chromic acid mist for 1 years developed jaundice and was found to be excreting significant amounts of chromium; liver function was mildly to moderately impaired in four other workers with high urinary chromium excretion.

Erosion and discoloration of the teeth has been attributed to chromic acid exposure. Papillomas of the oral cavity and larynx were found in 15 of 77 chrome platers exposed for an average of 6. years to chromic acid mist at air concentrations of chromium of 0. mg/m^3. There are no reports of increased lung cancer from exposure to chromic acid alone.

A concentrated solution of chromic acid in the eye cause severe corneal injury; chronic exposure to the mist cause conjunctivitis. Prolonged exposure to chromic acid mist cause dermatitis, which varies from a dry erythematous eruption to weeping eczematous condition.

Chromates: An increased incidence of bronchogenic carcinoma occur in workers exposed to certain chromate dusts. Nearly all th implications of carcinogenicity have arisen from studies of th

worker population of the chromate--bichromate industry and fro animal studies using the intermediates produced in that industry The relative risk of dying from respiratory cancer among chromat workers is more than 20 times the rate for a control population the latent period is relatively short.

Some less-soluble hexavalent chromium compounds (lead chromat and zinc chromate pigments; calcium chromate) are carcinogenic i rats, producing tumors at the sites of administration by severa routes. Lead chromate also produces renal carcinomas followin intramuscular administration in rats. As evaluated by the IARC studies of a number of other chromates, including the water-solubl chromates, were inadequate to evaluate the carcinogenicity of thes compounds, but most of the animal data suggest that the water soluble chromates are not carcinogenic.

The IARC has concluded that there is sufficient evidence o respiratory carcinogenicity in men occupationally exposed durin chromate production. There is exposure to a mixture of hexavalen chromium compounds, both soluble and insoluble, in chromat production. Data from studies of the chromate pigment industr suggest an increased risk of lung cancer, comparable to that see in chromate production. Results from studies in other occupation with chromium exposure are insufficient, according to the IARC, t establish an increased cancer risk. Exposure to soluble hexavalen chromium compounds, including chromium trioxide, in chromiu plating operations may be associated with an increased risk of lun cancer. The increased risk appears to occur in the "hard" chromiu plating operation, where the greatest exposure occurs, rather tha in the "bright" plating operations.

Chrome ulcer, a penetrating lesion of the skin, occurs chiefl on the hands and forearms where there has been a break in th epidermis and is believed to be due to a direct necrotizing effec of the chromate ion. The ulcer is relatively painless, heal slowly, and produces a characteristic depressed scar Sensitization dermatitis with varying degrees of eczema has bee reported numerous times and is the single most common manifestatic of chromium toxicity, affecting not only industrial workers bu also the general population.

[Information taken from Nick H. Proctor, Ph.D., James P. Hughes M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H., Chemica Hazards of the Workplace, 2nd ed. (Philadelphia: J. B. Lippincot Company, 1988), 155-57.]

File: 3 Entry: 1

BAKER Accession Number 10409

(MID) Material Identification:

C4305 -04 CHROMIUM
EFFECTIVE: 03/09/92 ISSUED: 06/30/92

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: CHROMIUM
COMMON SYNONYMS: N/A
CHEMICAL FAMILY: METALS
FORMULA: CR
FORMULA WT.: 52.00
CAS NO.: 7440-47-3
NIOSH/RTECS NO.: CB4200000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 4961

(PHAZ) Primary Hazards:

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	0	NONE
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	0	NONE

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT

U.S. PRECAUTIONARY LABELING

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

INTERNATIONAL LABELING

DO NOT BREATHE DUST.

SAF-T-DATA* STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

File: 31 Entry: 1

BAKER Accession Number 10442

(MID) Material Identification:

C5170 -04 COPPER
EFFECTIVE: 03/09/92 ISSUED: 06/30/9

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: COPPER
COMMON SYNONYMS: BRONZE POWDER; C.I. 77400; ARWOOD COPPER
CHEMICAL FAMILY: METALS
FORMULA: CU
FORMULA WT.: 63.55
CAS NO.: 7440-50-8
NIOSH/RTECS NO.: GL5325000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 1736,1732,1714,1720

(PHAZ) Primary Hazards:

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	0	NONE
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	1	SLIGHT

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT

U.S. PRECAUTIONARY LABELING

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

INTERNATIONAL LABELING

DO NOT BREATHE DUST.

SAF-T-DATA* STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

(COMP) Components:

SECTION II - COMPONENTS

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
COPPER	7440-50-8	90-100	1 MG/M3	1 MG/M

(PHYS) Physical Properties:

SECTION III - PHYSICAL DATA

BOILING POINT: 2595 C (4703 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): N/A

MELTING POINT: 1083 C (1981 F)
(AT 760 MM HG)

VAPOR DENSITY (AIR=1): N/A

SPECIFIC GRAVITY: 8.92
(H2O=1)

EVAPORATION RATE: N/A

SOLUBILITY(H20): NEGLIGIBLE (<0.1%)

% VOLATILES BY VOLUME: 0
(21 C)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: SOLID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: RED METAL. ODORLESS.

(FHAZ) Fire Hazards:

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINQUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE. WARNING - APPLICATION OF WATER TO HOT METAL MAY GENERATE STEAM.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS

DUST MAY FORM EXPLOSIVE MIXTURE WITH AIR.

TOXIC GASES PRODUCED

COPPER FUMES

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

NONE IDENTIFIED.

(HAZH) Health Hazards:

==========
SECTION V - HEALTH HAZARD DATA
==========

THRESHOLD LIMIT VALUE (TLV/TWA): 1.0 MG/M3

TLV IS FOR COPPER, DUSTS AND MISTS, AS CU.

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

PERMISSIBLE EXPOSURE LIMIT (PEL): 1.0 MG/M3

PEL IS FOR COPPER DUST AND MIST, AS CU.

TOXICITY OF COMPONENTS

NO INFORMATION IS AVAILABLE

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

CARCINOGENICITY

NONE IDENTIFIED.

REPRODUCTIVE EFFECTS

NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: IRRITATION OF UPPER RESPIRATORY TRACT, HEADACHE, NAUSEA, VOMITING, DIARRHEA, CHILLS, FEVER, ACHING MUSCLES

SKIN CONTACT: IRRITATION

EYE CONTACT: IRRITATION

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: NAUSEA, VOMITING, DIARRHEA

CHRONIC EFFECTS: DAMAGE TO LIVER, KIDNEYS, LUNGS

TARGET ORGANS

RESPIRATORY SYSTEM, LUNGS, SKIN, LIVER, KIDNEYS

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

WILSON'S DISEASE

PRIMARY ROUTES OF ENTRY

INHALATION, INGESTION, SKIN CONTACT, EYE CONTACT

(AID) First Aid:

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.

INHALATION: IF A PERSON BREATHES IN LARGE AMOUNTS, MOVE THE EXPOSED PERSON TO FRESH AIR.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH PLENTY OF

SOAP AND WATER FOR AT LEAST 15 MINUTES.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

(REGS) Regulations:

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE:	NO	
CERCLA HAZARDOUS SUBSTANCE:	YES	CONTAINS COPPER (RQ = 5000 LBS)
SARA 313 TOXIC CHEMICALS:	YES	CONTAINS COPPER
GENERIC CLASS:		GENERIC CLASS REMOVED FROM CFR: 7/1/91
TSCA INVENTORY:	YES	

(HAZR) Hazardous Reactions:

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, DUSTING

INCOMPATIBLES: STRONG ACIDS, STRONG OXIDIZING AGENTS, STRONG BASES, ACETYLENE, ACETALDEHYDE, MAGNESIUM

DECOMPOSITION PRODUCTS: COPPER FUMES

(SPIL) Spillage Disposal:

SECTION VII - SPILL & DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL

ENVIRONMENTAL REGULATIONS.

(EQP) Protective Equipment:

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION EXCEEDS TLV, A DUST/MIST RESPIRATOR IS RECOMMENDED. IF CONCENTRATION EXCEEDS CAPACITY OF RESPIRATOR, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, PROPER GLOVES ARE RECOMMENDED.

(STOR) Storage Procedures:

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

(TRAN) Transportation Information:

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

NTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)
MARINE POLLUTANTS: NO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

U.S. CUSTOMS HARMONIZATION NUMBER: 74101100006

N/A = NOT APPLICABLE OR NOT AVAILABLE
N/E = NOT ESTABLISHED

(DISC) Disclaimer:

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE

PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.
EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.
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THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET.
NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

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(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 723
Nickel Metal

Issued: 8/90

Section 1. Material Identification

Nickel (Ni) Description: Found in ores in combination with sulphur, oxygen, antimony, arsenic, and/or silica. The Orford (sodium sulfide and electrolysis) and the Mond (nickel carbonyl) processes are used to refine nickel. Used in electroplating, casting operations for machine parts, manufacturing acid-resisting and magnetic alloys and tapes, synthesizing acrylic esters; in surgical and dental prostheses, coinage, catalytic gastrification of coal, paint pigments, Ni-Cd batteries, ceramics and glass; and as a catalyst in hydrogenation of fats and oils.

Other Designations: CAS No. 7440-02-0, Raney alloy, Raney nickel.*

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[75] for a suppliers list.

Cautions: Nickel is an eye, skin, and respiratory tract irritant. *Chronic inhalation of nickel dust or fumes may cause cancer of the lungs and nasal passages. Nickel powder (Raney nickel) is a dangerous fire hazard.*

R	0
I	3
S	2
K	1

NFPA (catalyst): 4 / 2 / 0

Genium (metal): 1 / 2 / 0 / -

HMIS (catalyst)	
H	2
F	4
R	0
PPG†	

HMIS (metal)	
H	2
F	1
R	0
PPG†	

† Sec. 8

* Raney nickel is prepared by leaching (with 25% caustic soda solution) aluminum from an alloy of 50% aluminum and 50% nickel. It is used as a catalyst for hydrogenation. Raney nickel, a silvery gray metal powder, is a dangerous fire risk and ignites spontaneously in air (Sec. 4). Nickel catalysts cause many industrial accidents.

Section 2. Ingredients and Occupational Exposure Limits

Nickel, ca 100%

1989 OSHA PEL
8-hr TWA: 1 mg/m³

1989-90 ACGIH TLV
TLV-TWA: 1 mg/m³

1988 NIOSH REL
0.015 mg/m³

1985-86 Toxicity Data*
Dog, intravenous, LD_{Lo}: 10 mg/kg
Guinea pig, oral, LD_{Lo}: 5 mg/kg
Rat, implant, TD_{Lo}: 250 mg/kg

* See NIOSH, *RTECS* (QR5950000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 4946 °F (2730 °C)
Melting Point: 2651 °F (1455 °C)
Vapor Pressure: 1 mm at 3290 °F (1810 °C)
Atomic Weight: 58.71
Density: 8.90 at 25 °C
Water Solubility: Insoluble

Appearance and Odor: A silvery-white, hard, malleable and ductile metal.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Smother with suitable dry powder or use large amounts of water.

Unusual Fire or Explosion Hazards: Nickel is combustible as dust or powder. Raney nickel ignites spontaneously in air. Nickel carbonyl (*MSDS Collection*, No. 226), a highly toxic substance, may form under fire conditions.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since nickel dust or powder is toxic if inhaled, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Nickel is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Nickel can react violently with fluorine, ammonium nitrate, hydrogen + dioxane, performic acid, selenium, sulfur, ammonia, hydrazine, phosphorus, and titanium + potassium chlorate. Nickel is also incompatible with oxidants. Raney nickel catalysts may initiate hazardous reactions with sulfur compounds, *p*-dioxane, hydrogen, hydrogen + oxygen, ethylene + aluminum chloride, magnesium silicate, methanol, and organic solvents + heat.

Conditions to Avoid: Avoid incompatibilities.

Hazardous Products of Decomposition: Thermal oxidative decomposition of nickel can produce highly toxic nickel carbonyl.

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Section 6. Health Hazard Data

Carcinogenicity: The IARC and NTP classify nickel as, respectively, a human carcinogen (Group 1) and an anticipated human carcinogen.
Summary of Risks: Nickel dust or fume is a respiratory irritant that with chronic exposure may cause nasal or lung cancer in humans. The average latency period for the induction of these cancers appears to be about 25 yr (within a 4- to 51-yr range). Experimental studies show nickel also has neoplastigenic, tumorigenic, and teratogenic effects in laboratory animals. Hypersensitivity to nickel is common and can cause conjunctivitis, allergic contact dermatitis, and asthma. The allergic contact dermatitis ("nickel-itch," a pink papular erythema with pustulation and ulceration) usually clears within one week, but sensitization is permanent.
Medical Conditions Aggravated by Long-Term Exposure: Chronic pulmonary, upper respiratory tract, and skin disorders. Carcinoma of the paranasal sinuses, larynx, and lung may also develop.
Target Organs: Nasal cavities, lungs, skin.
Primary Entry Routes: Inhalation, dermal contact, and ingestion.
Acute Effects: Exposure to nickel fumes can cause upper respiratory tract irritation (with nonproductive cough, rapid breathing, dyspnea, chest tightness), metal fume fever (chills, fever, flu-like symptoms), asthma, inflammation of the lungs (noninfectious pneumonia), eye (conjunctiva) irritation, nausea, vomiting, and abdominal pain. Dermal contact causes "nickel itch." Ingesting large doses causes nausea, vomiting, and diarrhea.
Chronic Effects: Prolonged or repeated contact can cause nickel sensitization. Symptoms of sensitization include nickel dermatitis with eczematous skin and lichenification (hardened and leathery skin). Chronic inhalation exposure can cause chronic pulmonary irritation, chronic thickening of the mucous membranes of the nose, nasal sinusitis, anosmia (loss or impairment of the sense of smell), and perforation of the nasal septum. Chronic exposure to dust and fumes may cause carcinoma of paranasal sinuses, larynx, and lung.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Since oral toxicity for elemental nickel is low, inducing vomiting is seldom necessary. In cases of severe vomiting or diarrhea, treat for fluid replacement.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Chronic exposure to nickel dust may cause *eosinophilic pneumonitis* (Loeffler's syndrome) which responds well to systemic cortico-steroids. There are cases of host rejection of nickel-containing prostheses after development of nickel sensitivity.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personal should protect against vapor inhalation and dermal contact. Avoid dust generation. Using nonsparking tools, carefully scoop spilled material into appropriate containers for reclamation or disposal. After completing material pickup, wash spill site. Do not release to sewers or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL, ACGIH TLV, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[109]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from incompatible materials (Sec. 2). Protect against physical damage. Store Raney nickel under inert gas or water in tightly closed containers away from heat or ignition sources, acids, caustics, and oxidizing materials.
Engineering Controls: Minimize all possible exposures to potential carcinogens. Avoid vapor inhalation and dermal contact. Use only with appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.
Other Precautions: Provide preplacement and periodic medical examinations that emphasize the skin, nasal cavities, and lungs, including a 14" x 17" chest roentgenogram and urine nickel determinations.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Nickel catalyst, wetted with not less than 40% water or other suitable liquid, by weight, finely divided, activated, or spent
IMO Hazard Class: 4.2
ID No.: UN1378
IMO Label: Spontaneously combustible
IMDG Packaging Group: I

MSDS Collection **References:** 2, 3, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 140, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD; **Edited by:** JR Stuart, MS

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LEAD METAL

Material Safety Data Sheet

Effective Date: 04-06-89 Supersedes 08-08-85

PRODUCT IDENTIFICATION:

Synonyms: Granular lead, pigment metal
Formula CAS No.: 7439-92-1 Molecular Weight: 207.19
Hazardous Ingredients: Lead Chemical Formula: Pb

(PHAZ) Primary Hazards:

PRECAUTIONARY MEASURES

WARNING! MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. NEUROTOXIN. Avoid breathing dust.
Keep container closed. Wash thoroughly after handling.

(AID) First Aid:

EMERGENCY FIRST AID

In all cases call a physician immediately. If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. SEE SECTION 5.

DOT Hazard Class: Not Regulated. This substance is OSHA Regulated. See section 6.

(PHYS) Physical Properties:

Physical Data

Appearance: Small, blue-gray granules.
Odor: Odorless.
Solubility: Insoluble in water.
Boiling Point: 1740 C (3164 F) Vapor Density (Air=1):No information found.
Melting Point: 327.5 C (622 F) Vapor Pressure (mm Hg):1.77 @ 1000 C (1832 F)
Specific Gravity: 11.34 Evaporation Rate: No information found.

(FHAZ) Fire Hazards:

Fire and Explosion SECTION 2

Information

Fire: Not considered to be a fire hazard.
Explosion: Not considered to be an explosion hazard.
Fire Extinguishing Media: Use any means suitable for extinguishing surrounding fire.
Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Can produce toxic lead fumes at elevated temperatures and also react with oxidizing materials.

(HAZR) Hazardous Reactions:

Reactivity Data SECTION 3

Stability: Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products: Does not decompose but toxic lead or lead oxide fumes may form at elevated temperatures.
Hazardous Polymerization: This substance does not polymerize.
Incompatibilities: Ammonium nitrate, chlorine trifluoride, hydogen peroxide.

(SPIL) Spillage Disposal:

Leak/Spill Disposal Information SECTION 4

Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic dusts. Sweep, scoop or pick up spilled material. Vacuuming or wet sweeping may be used to avoid dust dispersal. Package for reclamation or recovery. Package unreclaimable material for disposal in a RCRA-approved waste facility.

Ensure compliance with local, state and federal regulations.

(HAZH) Health Hazards:

Health Hazard Information SECTION 5

A. Exposure/Health Effects

Inhalation: Lead can be absorbed through the respiratory system. Local irritation of bronchia and lungs can occur and, in cases of acute exposure, symptoms such as metallic taste, chest and abdominal pain, and increased lead blood levels may follow. See also Ingestion.

Ingestion: POISON! The symptoms of lead poisoning include abdominal pain and spasms, nausea, vomiting, headache. Acute poisoning can lead to muscle weakness, "lead line" on the gums, metallic taste, definite loss of appetite, insomnia, dizziness, high lead levels in blood and urine with shock, coma and death in extreme cases. Soluble lead compounds, e.g., the acetate or nitrate, are the most dangerous. The reduced solubility of the chloride or materials forming the chloride in the stomach (metal, oxides, carbonate, etc.) while still toxic, may not act as rapidly.

Skin Contact: Lead and lead compounds may be absorbed through the skin on prolonged exposure; the symptoms of lead poisoning described for ingestion exposure may occur. Contact over short periods may cause local irritation or redness.

Eye Contact: Absorption can occur through eye tissues but the more common hazards are local irritation or abrasion.

Chronic Exposure: Lead is a cumulative poison and exposure even to small amounts can raise the body's content to toxic levels. The symptoms of chronic exposure are like those of ingestion poisoning; restlessness and irritability may also be noted.

Aggravation of Pre-existing Conditions: Persons with pre-existing nerve or circulatory disorders or with skin or eye problems may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation: Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion: If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. CALL A PHYSICIAN

IMMEDIATELY. Never give anything by mouth to an unconscious person.

Skin Exposure: Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes. Call a physician.

C. TOXICITY (RTECS, 1982)

No LD50/LC50 information found relating to normal routes of occupational exposure. Mutation data cited. Reproductive effects data cited. Lead and other smelter emissions are human reproductive hazards. (Chemical Council on Enviromental Quality; Chemical Hazards to Human Reproduction, 1981)

(CTL) Control Measures:

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 0.05 mg/m3 (TWA)
-ACGIH Threshold Limit Value (TLV): 0.15 mg/m3 (TWA)

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: If the PEL is exceeded, a half-mask air-purifying (NIOSH Approved) respirator equipped with a high-efficiency filter, or any half-mask supplied air respirator may be worn up to concetrations of 50 mg per cubic meter (1000X PEL). See OSHA Standard for additional information.

Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Contact lenses should not be worn when working with this material.

(STOR) Storage Procedures:

Storage and Special Information SECTION 7

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Areas in which exposure to lead metal or lead compounds may occur should be identified by signs or appropriate means, and access to the area should be limited to authorized persons.

(DISC) Disclaimer:

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(ADD) Addendum:
Addendum to Material Safety Data Sheet

REGULATORY STATUS
This Addendum Must Not Be Detached from the MSDS Identifies SARA 313 substance(s)
Any copying or redistribution of the MSDS must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			

SARA Sec. 313

Product or Components of Product:	SARA EHS Sec. 302 RQ	TPQ	Chemicals List	CERCLA Category	Name Chemical RQ lbs	Sec.103	RCRA Sec. 261.33
LEAD METAL (7439-92-1)			No	No	Yes No 1		

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

File: 33 Entry: 1

BAKER Accession Number 10828

(MID) Material Identification:

L2347 M05 LEAD, GRANULAR OR SHOT
EFFECTIVE: 03/09/92 ISSUED: 06/30/9

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: LEAD, GRANULAR OR SHOT
COMMON SYNONYMS: C.I. 77575
CHEMICAL FAMILY: METALS
FORMULA: PB
FORMULA WT.: 207.20
CAS NO.: 7439-92-1
NIOSH/RTECS NO.: OF7525000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 2256,2266,4996

(PHAZ) Primary Hazards:

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	3	SEVERE (LIFE)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	1	SLIGHT

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

U.S. PRECAUTIONARY LABELING

POISON DANGER
HARMFUL IF INHALED. MAY CAUSE IRRITATION. MAY BE FATAL IF SWALLOWED.
EXCEPTIONAL HEALTH HAZARD: READ MATERIAL SAFETY DATA SHEET.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING. DO NOT BREATHE DUST. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

INTERNATIONAL LABELING

AVOID CONTACT WITH EYES. AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER. KEEP CONTAINER TIGHTLY CLOSED.

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

(COMP) Components:

SECTION II - COMPONENTS

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
LEAD	7439-92-1	87-99	0.05 MG/M3	0.15 MG/M
ANTIMONY	7440-36-0	0.5-5	0.5 MG/M3	0.5 MG/M
ARSENIC	7440-38-2	.01-.5	0.01 MG/M3	0.2 MG/M

(PHYS) Physical Properties:

SECTION III - PHYSICAL DATA

BOILING POINT: 1744 C (3171 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): N/A

MELTING POINT: 327 C (620 F)
(AT 760 MM HG)

VAPOR DENSITY (AIR=1): N/A

SPECIFIC GRAVITY: 11.3
(H2O=1)

EVAPORATION RATE: N/A

SOLUBILITY(H20): NEGLIGIBLE (<0.1%)

% VOLATILES BY VOLUME: 0
(21 C)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: SOLID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: WHITE TO GRAY METAL. ODORLESS.

(FHAZ) Fire Hazards:

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINQUISHING MEDIA

USE DRY CHEMICAL OR CARBON DIOXIDE. DO NOT USE WATER.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS

NONE IDENTIFIED.

TOXIC GASES PRODUCED

LEAD FUMES

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

NONE IDENTIFIED.

(HAZH) Health Hazards:

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 0.15 MG/M3

TLV IS FOR LEAD, INORGANIC DUSTS AND FUMES, AS PB.

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.05 MG/M3

PEL IS FOR LEAD, INORGANIC DUSTS AND FUMES, AS PB.

TOXICITY OF COMPONENTS

ORAL RAT LD50 FOR ARSENIC 15.1 MG/KG

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: YES OSHA REG: YES

CARCINOGENICITY

NONE IDENTIFIED.

REPRODUCTIVE EFFECTS

NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: IRRITATION OF UPPER RESPIRATORY TRACT, MAY CAUSE ANEMIA, NAUSEA, VOMITING, GASTROINTESTINAL IRRITATION, DIARRHEA, WEAKNESS, WEIGHT LOSS, CONVULSIONS

SKIN CONTACT: IRRITATION

EYE CONTACT: IRRITATION

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: ANEMIA, NAUSEA, VOMITING, GASTROINTESTINAL IRRITATION, PARALYSIS, CENTRAL NERVOUS SYSTEM DEPRESSION

CHRONIC EFFECTS: DAMAGE TO BLOOD FORMING TISSUE, ANEMIA, KIDNEY DAMAGE, BLURRED VISION, LEAD BUILD-UP IN THE CENTRAL NERVOUS SYSTEM

TARGET ORGANS

GI TRACT, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD, GINGIVAL TISSUE

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

KIDNEY DISORDERS, LIVER DISORDERS, CENTRAL NERVOUS SYSTEM DISORDERS

PRIMARY ROUTES OF ENTRY

INGESTION, INHALATION, EYE CONTACT, SKIN CONTACT

(AID) First Aid:

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.

INHALATION: IF INHALED IN LARGE AMOUNTS, MOVE EXPOSED PERSON TO FRESH AIR. GET MEDICAL ATTENTION.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH PLENTY OF SOAP AND WATER FOR AT LEAST 15 MINUTES.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION.

(REGS) Regulations:

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE: NO
CERCLA HAZARDOUS SUBSTANCE: YES CONTAINS LEAD (RQ = 1 LB) AND ANTIMONY (R
= 5000LBS) AND ARSENIC (RQ = 1 LB)
SARA 313 TOXIC CHEMICALS: YES CONTAINS ANTIMONY, ARSENIC, AND LEAD
GENERIC CLASS: GENERIC CLASS REMOVED FROM CFR: 7/1/91
TSCA INVENTORY: YES
STATE LISTS: FOR PRODUCTS SOLD IN THE STATE OF CALIFORNIA, THE STATE REQUIRES

THAT WE PROVIDE TO USERS AND THEIR EMPLOYEES THE FOLLOWING MESSAGE: WARNING:

THIS PRODUCT IS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

(HAZR) Hazardous Reactions:

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG OXIDIZING AGENTS, POTASSIUM, SODIUM, STRONG ACIDS, STRONG BASES, STRONG REDUCING AGENTS

DECOMPOSITION PRODUCTS: LEAD FUMES

(SPIL) Spillage Disposal:

SECTION VII - SPILL & DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. WITH

CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D008 (EP TOXIC WASTE)

(EQP) Protective Equipment:

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION EXCEEDS TLV, A HIGH-EFFICIENCY PARTICULATE RESPIRATOR IS RECOMMENDED

IF CONCENTRATION EXCEEDS CAPACITY OF RESPIRATOR, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, PROPER GLOVES ARE RECOMMENDED.

(STOR) Storage Procedures:

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA. ISOLATE FROM INCOMPATIBLE MATERIALS.

(TRAN) Transportation Information:

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)
MARINE POLLUTANTS: NO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: CHEMICALS, N.O.S. (NON-REGULATED)

U.S. CUSTOMS HARMONIZATION NUMBER: 78042000009

N/A = NOT APPLICABLE OR NOT AVAILABLE
N/E = NOT ESTABLISHED

(DISC) Disclaimer:

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 191C.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT

IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.
EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET.
NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

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APPROVED BY QUALITY ASSURANCE DEPARTMENT.

J. T. Baker Chemical Co.

222 Red School Lane Phillipsburg, N.J. 08865
24-Hour Emergency Telephone - (201) 859-2151
Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

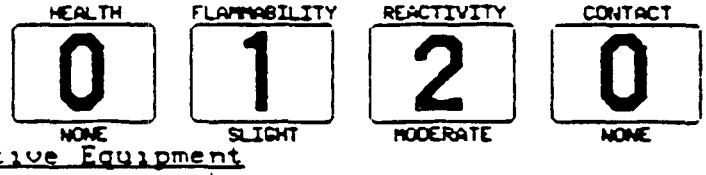
MATERIAL SAFETY DATA SHEET

SECTION I - PRODUCT IDENTIFICATION

Product Name: Zinc
Formula: Zn
Formula Wt: 65.37
CAS No.: 07440-66-6
NIOSH/RTECS No.: ZG8600000
Common Synonyms: Blue Powder
Product Codes: 4244,4290,4240,4252,4260,4248,4274,5828,4264,4270

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA™ System



Laboratory Protective Equipment

Precautionary Label Statements

STORAGE. Keep in tightly closed container.

SECTION II - HAZARDOUS COMPONENTS

Component	%	CAS No.
Zinc	90-100	7440-66-

SECTION III - PHYSICAL DATA

Boiling Point	908°C (1666°F)	Vapor Pressure(mmHg):	1
Melting Point:	420°C (788°F)	Vapor Density(air=1):	N/A
Specific Gravity: (H_2O=1)	7.14	Evaporation Rate: (Butyl Acetate=1)	N/A
Solubility(H_2O):	Negligible (less than 0.1 %)	% Volatiles by Volume:	0

Continued on Page: 2

J. T. Baker Chemical Co.
222 Red School Lane Phillipsburg, N.J 08865
24-Hour Emergency Telephone - (201) 859-2151
Chemtrec # (800) 424-9300
National Response Center # (800) 424-8802

Z0855 -01 Zinc
Effective: 09/27/85 Issued:

SECTION III - PHYSICAL DATA (Continued)

Appearance & Odor: Bluish-white odorless solid.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Fire Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Unusual Fire & Explosion Hazards
Reacts violently with water liberating and y igniting hydrogen.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure
Contact with skin or eyes may cause severe irritation or burns.
Inhalation of dust may cause irritation to upper respiratory tract.
Prolonged exposure may cause dermatitis.

SECTION VI - REACTIVITY DATA

Stability: Unstable Hazardous Polymerization: Will not occur

Conditions to Avoid: moisture

Incompatibles: strong acids, strong bases, strong oxidizing agents, alkali metals, halogenated hydrocarbons

Decomposition Products: oxides of zinc

SECTION VII - SPILL AND DISPOSAL PROCEDURES

Steps to be taken in the event of a spill or discharge
Wear suitable protective clothing. Carefully sweep up and remove.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Ventilation: Use adequate general or local exhaust ventilation to keep fume and dust levels as low as possible.

Respiratory Protection: None required where adequate ventilation conditions exist. If airborne concentration is high, use an appropriate respirator or dust mask.

Continued on Page: 3

Z0855 -01 Zinc
Effective: 09/27/85 Issue

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT (Continued)

Eye/Skin Protection: Safety glasses with sideshields, proper glove recommended.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA™ Storage Color Code: Orange

Special Precautions

Keep container tightly closed. Suitable for any general chemical area.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

Proper Shipping Name Chemicals, n.o.s.

INTERNATIONAL (I.M.O.)

Proper Shipping Name Chemicals, n.o.s.

N/A = Not Applicable or Not Available

The information published in this Material Safety Data Sheet has been com from our experience and data presented in various technical publications. the user's responsibility to determine the suitability of this information the adoption of necessary safety precautions. We reserve the right to revi Material Safety Data Sheets periodically as new information becomes availa

-- LAST PAGE --

File: 5 Entry: 2

MALLIN Accession Number 31384

(MID) Material Identification:

ZINC METAL POWDER

Material Safety Data Sheet

Effective Date: 04-06-89 Supersedes 08-09-85

PRODUCT IDENTIFICATION:

Synonyms: Powdered zinc; blue powder

Formula CAS No.: 7440-66-6 Molecular Weight: 65.37

Hazardous Ingredients: Zinc Chemical Formula: Zn

(PHAZ) Primary Hazards:

PRECAUTIONARY MEASURES

WARNING! HARMFUL IF SWALLOWED OR INHALED. COMBUSTIBLE. MAY FORM COMBUSTIBLE DUST CONCENTRATIONS IN AIR.

Avoid breathing dust.
Keep away from heat and flame.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

(AID) First Aid:

EMERGENCY FIRST AID

If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Flammable Solid

(PHYS) Physical Properties:

hysical Data

Appearance: Gray or bluish-gray powder.

Odor: Odorless.

Solubility: Insoluble in water.

Boiling Point: 907 C (1665 F)

Vapor Density (Air=1): No information found.

Melting Point: 419 C (787 F)

Vapor Pressure (mm Hg): 1 @ 487 C (909 F)

Specific Gravity: 7.14

Evaporation Rate: No information found.

NFPA Ratings: Health: 0 Flammability: 1 Reactivity: 1

(FHAZ) Fire Hazards:

Fire and Explosion

SECTION 2

nformation

Fire: Zinc powder is not pyrophoric but will burn in air at elevated temperatures. Autoignition temperatures are approximately 680 C (dust cloud) or 460 C (layer). Bulk dust in damp state may heat spontaneously and ignite on exposure to air. Releases flammable hydrogen gas upon contact with acids or alkali hydroxides.

Explosion: Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Fire Extinguishing Media: Smother with a suitable dry powder (sodium chloride, magnesium oxide).

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

(HAZR) Hazardous Reactions:

eactivity Data — SECTION 3

Stability:	Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:	Hydrogen in moist air, zinc oxide with oxygen at high temperature. Zinc metal, when melted, produces zinc vapor which oxidizes and condenses in air to form zinc fume.
Hazardous Polymerization:	This substance does not polymerize.
Incompatibilities:	Zinc powder can react violently with sulfur and halogens. Dangerous or potentially dangerous with strong oxidizing agents, lower molecular weight chlorinated hydrocarbons, strong acids and alkalies.

(SPIL) Spillage Disposal:

Leak/Spill Disposal Information — SECTION 4

Remove all sources of ignition and provide mild ventilation in area of spill. Substance may be pyrophoric and self-ignite. Clean-up personnel require protective clothing, goggles and dust/mist respirators. Sweep or vacuum up the spill in a manner that does not disperse zinc powder in the air and place the zinc in a closed container for recovery or disposal. Dispose in a RCRA approve facility.

Ensure compliance with local, state and federal regulations.

(HAZH) Health Hazards:

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation:	No adverse effects expected but dust may cause mechanical irritation. The effects may be expected to resemble those of inhaling an inert dust; possible difficulty in breathing, sneezing, coughing. When heated, the fumes are highly toxic and may cause fume fever.
Ingestion:	Extremely large oral dosages may produce gastrointestinal disturbances, due both to mechanical effects and the possibility of reaction

	with gastric juice to produce zinc chloride. Pain, stomach cramps and nausea could occur in aggravated cases.
Skin Contact:	No adverse effects expected but dust may cause mechanical irritation.
Eye Contact:	No adverse effects expected but dust may cause mechanical irritation.
Chronic Exposure:	No adverse health effects expected.
Aggravation of Pre-existing Conditions:	Persons with pre-existing skin disorders or impaired respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation:	Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:	If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person.
Skin Exposure:	Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Exposure:	Wash eyes with plenty of water for at least 15 minutes. If irritation develops, get medical attention.

C. TOXICITY (RTECS, 1982)

No LD50/LC50 information found relating to normal routes of occupational exposure.

(CTL) Control Measures:

Occupational Control Measures	SECTION 6
Airborne Exposure Limits:	-OSHA Permissible Exposure Limit (PEL): 5 mg/m3 (TWA), 10 mg/m3 (STEL) for zinc oxide fume -ACGIH Threshold Limit Value (TLV): 5 mg/m3 (TWA), 10 mg/m3 (STEL) for zinc oxide fume xide fume.
Ventilation System:	A local exhaust system which captures the contaminant at its source is recommended to prevent dispersion of the contaminant into the workroom air.

rsonal Respirators (NIOSH Approved)	For conditions of use where exposure to the dust is apparent, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.
Skin Protection:	Wear protective gloves and clean body-covering clothing.
Eye Protection:	Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

(STOR) Storage Procedures:

Storage and Special Information	SECTION 7

Keep in a tightly closed container. Protect from physical damage. Store in a cool,dry, ventilated area away from sources of heat, moisture and incompatibilities.

DISC) Disclaimer:

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****

(ADD) Addendum:

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
ust include a copy of this addendum

Hazard Categories for SARA
Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X		X		X

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.3
ZINC METAL POWDER (7440-66-6)	No	No	Yes	No	1000	No

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Enviromental Response, Compensation and Liability Act (Superfund).

Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

From Genium's MSDS Collection, to be used as a reference.

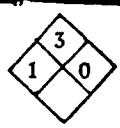
MSDS # 324
[redacted] ALCOHOL
Revision D
Issued: October 1982
Revised: September 1985

SECTION 1. MATERIAL IDENTIFICATION

18

MATERIAL NAME: [redacted] ALCOHOL
OTHER DESIGNATIONS: [redacted]

MANUFACTURER/SUPPLIER: Available from several sources, including:
Allied Corporation
PO Box 2064R
Morristown, NJ 07960 (201) 455-4400 - (800) 631-8050



SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
[redacted] ALCOHOL * Current OSHA PEL and ACGIH TLV (1985-86). The ACGIH STEL is 500 ppm, 1225 mg/m^3. NIOSH has recommended a 15-minute ceiling of 800 ppm. NOTE: NTP and IARC list CAS #0067-63-0, "[redacted] alcohol manufacture (strong acid process)" as a human carcinogen. We believe this refers to the process and not necessarily the product. Check with your suppliers.	ca 100	8-hr TWA: 400 ppm or 980 mg/m^3* Human, Eye: 20 ppm Primary irritation dose Human, Inhalation. 400 ppm: IRR Man, Oral LDLo: 8600 mg/kg Rat, Oral: 5840 mg/kg

SECTION 3. PHYSICAL DATA

Boiling point, 1 atm	180°F, (82°C)	Specific gravity (H_2O=1)	0.786
Vapor pressure @ 20°C, mmHg	33	Melting point	-127.3°F (-88.5°C)
Vapor density (Air=1)	2.07	% Volatile by volume, 20°C	ca 100
Viscosity, 20°C, cps	2.4	Evaporation rate (CCl_4=1)	2.6
Solubility in water	Completely soluble	Molecular weight	60.11

APPEARANCE & ODOR: Clear, colorless liquid with a slight non-residual alcohol type odor. Threshold odor concentration, 100% recognition by test panel, is 28.2 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
53°F (11.7°C) closed cup	750°F (399°C)	% by volume	2.0	12.0

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, alcohol foam. Use water spray to cool fire-exposed tanks containers. A fine water mist may be used to smother fire or to disperse vapors. Do not use a solid stream of water since the stream will scatter and spread the fire.

[redacted] alcohol is an OSHA Class IB flammable liquid. It is a dangerous fire hazard and a moderate explosion hazard when exposed to heat, flames or oxidizers. At 20°C, the vapor space (saturated) above [redacted] alcohol contains about 4.3 volume % of vapor. Vapors are heavier than air and may travel a considerable distance to an ignition source and flashback. Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving this material.

SECTION 5. REACTIVITY DATA

This material is stable in closed containers at room temperature under normal storage and handling conditions. It does not polymerize. [redacted] alcohol is incompatible with acetaldehyde, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide hypochlorous acid, isocyanates, nitroform, phosgene, oleum, perchloric acid, and strong oxidizing agents. Do not store [redacted] alcohol in aluminum containers.

Thermal-oxidative degradation products can include carbon monoxide.

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SECTION 6. HEALTH HAZARD INFORMATION

TLV 400 ppm (see Section 2)

At 400 ppm, vapors of [redacted] may cause mild irritation of the eyes, nose, and throat. Prolonged exposures above the TLV may cause nausea, headache, and mild narcosis. The liquid is irritating to the eyes and produces intense stinging and burning. If not promptly removed, IPA may cause eye damage. Repeated or prolonged contact with the skin may cause irritation and dermatitis. While toxic skin absorption is unlikely it should be considered in meeting the TLV. Ingestion of IPA will cause burning of the gastrointestinal tract, nausea, vomiting, bleeding, CNS depression, hemolysis, and pulmonary damage. Ingestion of as little as 10 ml may cause serious injury, while ingestion of 100 ml can be fatal. The single lethal dose for an adult is approximately 250 ml. The TLV for this material is set on the basis of eye, nose, and throat irritation. [redacted] has good warning properties.

FIRST AID: EYE CONTACT: Flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention (Inplant, community, paramedic). SKIN CONTACT: Flush exposed area with water while removing contaminated clothing. Get medical attention if irritation persists. INHALATION: Remove victim to fresh air. Restore and/or support breathing as required. Get medical help. INGESTION: Give victim milk or water. Induce vomiting by sticking finger to back of throat. Contact a physician or Poison Control Center. Never give anything by mouth to a person who is unconscious or is having convulsions.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from area, except for those involved in clean-up. Remove leaking container to safe place if feasible. Clean-up personnel need protection against liquid contact and vapor inhalation. Absorb small spills with paper towels, evaporate flammable alcohol in exhaust hood and burn dry paper. Contain large spills and collect liquid, if feasible, or absorb with vermiculite or sand. Place waste or absorbent into closed container (using non-sparking tools) for disposal. Water spray can be used to dilute and flush spill if necessary, but do not flush to water course or to sewer or enclosed area.

DISPOSAL: Burn waste liquid in an approved incinerator or dispose of via licensed waste disposal company. Absorbed liquid can be landfilled. Follow Federal, State and Local regulations.

AQUATIC TOXICITY TLm 96: 1000-100 ppm.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion proof) to meet TLV requirements. For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH approved respirator. Fume hoods should have a minimum face velocity of 100 lfm. All electrical service in use or storage areas should have an explosion-proof design. Wear impervious gloves and safety glasses to prevent contact with the skin and eyes. If repeated or prolonged contact with liquid or mist is likely, wear protective clothing including boots, apron, and face-shield or splash goggles. Remove contaminated clothing immediately and do not reuse until it has been properly laundered.

Eye wash stations and safety showers should be available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from oxidizers, heat, sparks, and open flame. Protect containers from physical damage.

Use only with adequate ventilation. Avoid inhalation of vapor and repeated or prolonged contact with the skin. Remove contaminated clothing immediately. Wash thoroughly after handling.

Ground and bond containers and equipment when transferring or pouring liquid. Use non-sparking tools.

Do not eat or smoke in areas where this material is being used or handled.

DOT CLASSIFICATION: Flammable liquid. DOT I.D. NO.: UN1219

DATA SOURCE(S) CODE (See Glossary) 1-12, 19, 20, 23, 26, 31, 34, 37, 39, 43, 47, 59, 79.R.

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APPROVALS J.O. Accorce, 11/85

INDUST. HYGIENE/SAFETY 11-85

MEDICAL REVIEW: Dec 85

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Schenectady, NY 12303-1836 USA
(518) 377-8854

Sheet No. 396
[redacted] Acetate

Issued: 10/78 Revision: A, 8/90

Section 1: Material Identification

[redacted] Acetate [redacted] Description: Prepared by treating isobutanol with acetic acid in the presence of catalysts. Used in thinners, sealants, and topcoat lacquers; as a solvent for nitrocellulose; as a flavoring agent in nonalcoholic beverages; and in perfumery.
Other Designations: CAS No. [redacted]

R 1
I 2
S 2
K 4

NFPA

HMIS
H 1
F 3
R 0
PPG*
* Sec. 8

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

Cautions: [redacted]*acetate is a very dangerous fire hazard and a moderate explosion hazard when exposed to heat, flame, or oxidizers.* It is a skin, eye, and respiratory tract irritant.

Section 2: Ingredients and Occupational Exposure Limits

[redacted] acetate, ca 100%

1989 OSHA PEL
8-hr TWA: 150 ppm, 700 mg/m³

1989-90 ACGIH
TLV-TWA: 150 ppm, 713 mg/m³

1985-86 Toxicity Data*
Rabbit, skin: 500 mg administered over 24 hr produces moderate irritation
Rat, inhalation, LC_{Lo}: 8000 ppm inhaled for 4 hr; no toxic effect noted
Rat, oral, LD_{50}: 13400 mg/kg ingested; no toxic effect noted

1987 IDLH Level
7500 ppm

1988 NIOSH REL
None established

* See NIOSH, *RTECS* (AI4025000), for additional irritative and toxicity data.

Section 3: Physical Data

Boiling Point: 243 °F (117.2 °C)
Melting Point: -145.44 °F (-98.58 °C)
Vapor Pressure: 13 torr at 20 °C
Vapor Density (Air = 1): 4
pH: Neutral
Molecular Weight: 116.16
Specific Gravity 20 °C/4 °C: 0.8712
Water Solubility: Slightly soluble (in 180 parts water)
Critical Temperature: 565 °F (296 °C)
Critical Pressure: 32 atm

Appearance and Odor: A colorless, mobile liquid with a fruity, nonresidual odor. Odor recognition threshold is 0.50 ppm for 100% of test panel.
Comment: This material can be hydrolyzed by strong aqueous acids and saponified (converted into soap) by strong bases.

Section 4: Fire and Explosion Data

Flash Point: 64 °F (17.8 °C), CC	Autoignition Temperature: 793 °F (423 °C)	LEL: 1.3% v/v	UEL: 10.5% v/v

Extinguishing Media: To fight small fires, use CO_2, or dry chemical; for large fires, use alcohol foam. A water spray can be used to cool fire-exposed containers or to reduce the burning rate of this material, but may be ineffective in putting out fire.
Unusual Fire or Explosion Hazards: [redacted]acetate, an OSHA Class IB flammable liquid, is a very dangerous fire hazard and a moderate explosion hazard when exposed to heat, flame, or oxidizers.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and fully encapsulating suit. Vapors are heavier than air and may travel to an ignition source and flash back. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5: Reactivity Data

Stability/Polymerization: [redacted]cetate is stable at room temperature in closed containers under normal storage and handling conditions. Heat contributes to instability. Hazardous polymerization cannot occur.
Chemical Incompatibilities: This material is incompatible with nitrates, strong oxidizers, strong alkalies, and strong acids. Isobutyl acetate softens and dissolves many plastics.
Conditions to Avoid: Separate this highly flammable liquid from oxidizing agents and heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of [redacted]acetate can produce toxic carbon monoxide (CO) gas.

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Section 6: Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list [redacted] acetate as a carcinogen.
Summary of Risks: Excessive inhalation is irritating to the mucous membranes and may cause dizziness, nausea, and unconsciousness. Liquid contact defats the skin and, when prolonged or repeated, can cause irritation and dermatitis. Liquid contact with the eyes is irritating. It is mildly toxic by ingestion. Isobutyl acetate hydrolyzes to acetic acid and isobutanol upon absorption into the body. Occasional complications include gastrointestinal hemorrhage, liver damage, renal damage with glycosuria (abnormal amounts of sugar in urine), cardiac failure, and pulmonary edema (fluid buildup in the lungs causing difficult breathing).
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, respiratory system.
Primary Entry Routes: Inhalation, ingestion, skin and eye contact.
Acute Effects: Vapor inhalation causes upper respiratory tract irritation, nausea, vomiting, dizziness, cough, shortness of breath, and unconsciousness. Ingestion causes gastrointestinal irritation including nausea, vomiting, and diarrhea. Symptoms of central nervous system depression include headache, muscle weakness, confusion, giddiness, and delirium.
Chronic Effects: None reported.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear. If the victim is unconscious, lay that person on left side and loosen collar and belt. Contact a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7: Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice an [redacted] acetate spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Absorb with sand or other noncombustible material. Use nonsparking tools to pick up and place absorbed material in a covered metal container for disposal. For large spills, dike far ahead for later disposal. A water stream may be used to flush this material away from sensitive areas, but do not flush this flammable material to drains or sewers. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8: Special Protection Data

Gloves: Select equipment carefully; isobutyl acetate can dissolve the plastics used in the equipment's components.
Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9: Special Precautions and Comments

Storage Requirements: Following guidelines for flammable liquids, store in closed containers in a clean, cool, well-ventilated area away from heat and ignition sources and oxidizing agents. Containers should be bonded and grounded for transfer of liquid to prevent static sparks. Use properly labeled safety cans to handle small amounts of solvent. Avoid contact with plastic materials that isobutyl can dissolve.
Engineering Controls: Do not ingest! Avoid vapor inhalation and skin and eye contact. Use only with appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.
Other Precautions: Provide a preplacement questionnaire with emphasis on detecting a history of chronic respiratory disease. Periodic examinations should consider initial effects on skin, respiratory system, and liver and kidney function.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: [redacted] acetate
DOT Hazard Class: Flammable liquid
ID No.: UN1213
DOT Label: Flammable liquid
DOT Packaging Requirements: 173.119
DOT Packaging Exceptions: 173.118

IMO Shipping Name: [redacted] acetate
IMO Hazard Class: 3.2
IMO Label: Flammable liquid
IMDG Packaging Group: II
ID No.: UN1213

MSDS Collection **References:** 38, 73, 84, 85, 88, 89, 100, 103, 109, 124, 126, 127, 132, 134, 136, 138, 140
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 309
Fluorotrichloromethane

Issued: 11/77 Revision: D, 9/92

Section 1: Material Identification

39

Fluorotrichloromethane (CCl_3F) Description: Derived from hydrogen fluoride and carbon tetrachloride in the presence of fluorinating agents such as antimony *tri-* and *penta*-fluoride. Used as a solvent, a degreasing agent, a chemical intermediate, a blowing agent; in fire extinguishers, electric insulation, and the production of polymeric resins. Formerly used in aerosol propellants (banned in the US in 1978).

Other Designations: CAS No. 75-69-4, Algofrene Type 1, Arcton 11, Electro-CF 11, Eskimon 11, FC-11, fluorocarbon No. 11, Freon 11, Freon MF, Frigen 11, Genetron 11, Halocarbon 11, Isceon 131, Isotron 11, Ledon 11, monofluorotrichloromethane, NCI-C04637, trichloromonofluoromethane, Ucon refrigerant 11.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: FC-11 may be narcotic in high concentrations. Contact with tissue may cause frostbite. *Do not* release FC-11 to the environment because FC-11 depletes the ozone.

R	1
I	1
S	2
K	0

Genium

HMIS
H 2
F 0
R 0
PPE*
* Sec. 8

Section 2: Ingredients and Occupational Exposure Limits

Fluorotrichloromethane, ca 100%

1991 OSHA PEL
Ceiling: 1000 ppm (5600 mg/m³)

1990 IDLH Level
10,000 ppm

1990 NIOSH REL
Ceiling: 1000 ppm (5600 mg/m³)

1992-93 ACGIH TLV
Ceiling: 1000 ppm (5620 mg/m³)

1990 DFG (Germany) MAK
Ceiling: 1000 ppm (5600 mg/m³)
Category IV: Substances eliciting very weak effects
Peak Exposure Limit: 2000, 60 min, momentary value (level which the concentration should never exceed), 4 peaks/shift

1985-86 Toxicity Data*
Human, inhalation, TD_{Lo}: 50000 ppm/30 min caused conjunctiva irritation, fibrosing alveolitis, and other changes of the liver.
Rat, inhalation, LC_{Lo}: 10 ppb/20 min caused general anesthesia.

* See NIOSH, *RTECS* (PB6125000), for additional toxicity data.

Section 3: Physical Data

Boiling Point: 74.7 °F (23.7 °C)
Freezing Point: -168 °F (-111 °C)
Vapor Pressure: 796 mm Hg at 77 °F (25 °C)
Vapor Density (Air = 1): 5.04 at 77 °F (25 °C)
Relative Evaporation Rate (BuAc = 1): 63
Refractive Index: 1.3865 at 18.5 °C/D
Viscosity: 0.439 cP at 70 °F (21 °C)
Octanol/Water Partition Coefficient: Log K_{ow}=2.53

Molecular Weight: 137.38
Specific Gravity: 1.494 at 63.0 °F (17.2 °C)
Water Solubility: 1 g/L at 25 °C
Other Solubilities: Alcohol, ether, and other organic solvents
Critical Temperature: 388 °F (198 °C)
Critical Pressure: 43.2 atm (635 lbs/sq in, absolute)

Appearance and Odor: Clear, colorless gas with a faint ethereal odor; liquid at temperatures below 74.7 °F (23.7 °C).

Section 4: Fire and Explosion Data

Flash Point: Nonflammable	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: For small fires, use dry chemical or carbon dioxide (CO_2). For large fires, use water spray, fog, or foam.
Unusual Fire or Explosion Hazards: Fire may produce highly toxic decomposition products (Sec. 5). Containers may explode in the heat of fire. FC-11 is 4 to 5 times heavier than air and may accumulate in low lying areas creating a potential health hazard.
Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after the fire is out. Stay away from the ends of tanks. In case of tank discoloration due to fire or rising sound from venting safety device, *withdraw immediately*. Do not release runoff from fire control methods to sewers or waterways.

Section 5: Reactivity Data

Stability/Polymerization: FC-11 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: FC-11 reacts violently with aluminum, barium, or lithium. It attacks some forms of plastic, rubber, and coatings. Other incompatibilities include sodium, potassium, calcium, zinc, and magnesium.
Conditions to Avoid: Contact with incompatibles and heat and ignition sources
Hazardous Products of Decomposition: Thermal oxidative decomposition of FC-11 can produce toxic fluoride, chloride, hydrogen chloride, hydrogen fluoride, carbonyl fluoride, phosgene, and CO_2 fumes.

Section 6: Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(165) and OSHA(166) do not list fluorotrichloromethane as a carcinogen.
Summary of Risks: At extremely high concentrations, fluorotrichloromethane causes narcosis (unconsciousness) and death from respiratory depression or cardiac sensitization. Sudden death has been reported following intentional sniffing of aerosols containing FC-11. Dizziness is an early warning that a dangerous concentration is being reached. At low concentrations, FC-11 may cause eye, nose, and throat irritation. The decomposition products (Sec. 5) of FC-11 are highly toxic. A 10 to 90% mixture of FC-11 and FC-12 caused more severe respiratory problems in humans than FC-11 or FC-12 singly. Contact with tissues may cause frostbite.
Medical Conditions Aggravated by Long-Term Exposure: Cardiovascular disease.
Target Organs: Cardiovascular, pulmonary and central nervous systems, skin.

Continue on next page

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Section 6. Health Hazard Data, *continued*

Primary Entry Routes: Inhalation.
Acute Effects: Inhalation produces dizziness, light-headedness, drowsiness, disorientation, conjunctival irritation, bronchospasm, and possible upper respiratory tract irritation, cardiac arrythmias (irregular heartbeats) and liver changes. Peripheral neuropathy has also been reported. FC-11 may cause freezing and frostbite if splashed on the skin or in the eyes. Ingestion may cause necrosis and stomach perforations.
Chronic Effects: Although there are few cases of chronic illness reported, long term exposure may damage the eyes, lungs and liver. Human exposures to 1000 ppm, 8 hr/day, 5 days/week for a total of 18 exposures produced no untoward subjective effects and there were no changes in the pulmonary function tests or electrocardiogram. Prolonged or repeated skin contact may cause defatting of the skin, dryness, redness and contact dermatitis.
FIRST AID
Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of luke-warm water for at least 15 min. If irritation or pain persist, consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of luke-warm water for at least 15 min. Place affected area in a water bath with a temperature of 104 to 108 °F (40 to 42 °C) for 20 to 30 min. Do not use dry heat. Continue rewarming until a flush returns to the affected area. For reddened or blistered skin, consult a physician.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, if large amounts are ingested, have that *conscious and alert* person drink 1 to 2 glasses of water and induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treatment is symptomatic and supportive. Keep patient calm and minimize physical exertion to avoid adrenalin surge. Monitor arterial blood gases, EKG, and vital signs. *Do not* use adrenalin because of the possibility of inducing cardiac arrythmias. Dilantin improves arrio-ventricular conduction and may be useful in the management of ventricular arrythmias.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without risk, stop flow of gas. Avoid releasing FC-11 to the environment because of its potential ozone destruction. For liquid spills, cover with absorbent and place in a container for disposal. If possible return to vendor or licensed disposal company. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: Having a half-life of 52-207 yrs, FC-11 is very stable in the troposphere. Photodissociation of FC-11 in the stratosphere produces significant amounts of chlorine atoms and leads to ozone destruction.
Environmental Transport: Bioconcentration in fish is unlikely.
Soil Absorption/Mobility: If released on soil, FC-11 evaporates into the atmosphere and passes through the soil into the groundwater where it is likely to persist for a long time.
Disposal: FC-11 is a good candidate for rotary kiln and fluidized bed incineration with an acid scrubber to remove halo acids. FC-11 may also be removed from waste water by air stripping. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U121, F002 (spent solvent, 40 CFR 261.31)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 5000 lb (2270 kg) [* per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or splash-proof chemical goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations <10,000 ppm, wear any supplied-air respirator or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polycarbonate, Viton, or polyvinyl chloride are recommended for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[309] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from heat and ignition sources and incompatibles (Sec. 5). Protect containers against physical damage.
Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Space heaters should have an independent air supply because concentrations well below the TLV level can cause damage to the heater and generate toxic gases.
Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the cardiovascular, respiratory, and central nervous systems.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Refrigerant gases, n.o.s.
DOT Hazard Class: 2.2
ID No.: UN1078
DOT Packing Group: –
DOT Label: Nonflammable Gas
Special Provisions (172.102): –

Packaging Authorizations
a) **Exceptions:** 173.306
b) **Non-bulk Packaging:** 173.304
c) **Bulk Packaging:** 173.314, 315

Quantity Limitations
a) **Passenger Aircraft or Railcar:** 75 kg
b) **Cargo Aircraft Only:** 150 kg

Vessel Stowage Requirements
a) **Vessel Stowage:** A
b) **Other:** - -

MSDS Collection References: 26, 73, 100, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 159, 163, 164, 167, 168, 176, 178, 180
Prepared by: MJ Work, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD

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NITROGEN

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NXX

Common Synonyms	Gas	Colorless	Odorless
Liquid nitrogen	Floats and boils on water.		

Avoid contact with liquid.

Fire	Not flammable.
Exposure	CALL FOR MEDICAL AID. VAPOR Not harmful. In high concentrations may cause dizziness, difficult breathing, or loss of consciousness. LIQUID Will cause frostbite. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS.
Water Pollution	Not harmful to aquatic life.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Restrict access

2. LABEL

2.1 Category: Nonflammable gas

2.2 Class: 2

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed

3.2 Formula: N_2

3.3 IMO/UN Designation: 2/1977

3.4 DOT ID No.: 1977

3.5 CAS Registry No.: 7727-37-9

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquefied gas

4.2 Color: Colorless to faint yellow

4.3 Odor: None

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Safety glasses or face shield; insulated gloves; long sleeves; trousers worn outside boots or over high-top shoes to shed spilled liquid; self-contained breathing apparatus where insufficient air is present.

5.2 Symptoms Following Exposure: Inhalation can cause asphyxiation, if atmosphere does not contain oxygen; dizziness, unconsciousness, or even death can result. Contact of liquid with skin or eyes causes frostbite burns.

5.3 Treatment of Exposure: INHALATION: remove to fresh air; apply artificial respiration if breathing has stopped; call physician. EYES: treat for frostbite burns caused by liquid. SKIN: treat for frostbite; soak in lukewarm water.

5.4 Threshold Limit Value: Non-toxic

5.5 Short Term Inhalation Limits: Not pertinent

5.6 Toxicity by Ingestion: Not pertinent

5.7 Late Toxicity: None

5.8 Vapor (Gas) Irritant Characteristics: None

5.9 Liquid or Solid Irritant Characteristics: Frostbite

5.10 Odor Threshold: Not pertinent

5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: Not pertinent (nonflammable compressed gas)

6.2 Flammable Limits in Air: Not pertinent

6.3 Fire Extinguishing Agents: Not pertinent

6.4 Fire Extinguishing Agents Not to be Used: Not pertinent

6.5 Special Hazards of Combustion Products: Not pertinent

6.6 Behavior in Fire: Containers may explode when heated.

6.7 Ignition Temperature: Not pertinent

6.8 Electrical Hazard: Not pertinent

6.9 Burning Rate: Not pertinent

6.10 Adiabatic Flame Temperature: Data not available

6.11 Stoichiometric Air to Fuel Ratio: Data not available

6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Heat of water will vigorously vaporize liquid nitrogen.

7.2 Reactivity with Common Materials: No chemical reaction. Low temperature may cause brittleness in rubber and plastics.

7.3 Stability During Transport: Stable

7.4 Neutralizing Agents for Acids and Caustics: Not pertinent

7.5 Polymerization: Not pertinent

7.6 Inhibitor of Polymerization: Not pertinent

7.7 Water Ratio (Resultant to Product): Data not available

7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: None

8.2 Waterfowl Toxicity: None

8.3 Biological Oxygen Demand (BOD): None

8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: 99.5+%

9.2 Storage Temperature: −320°F

9.3 Inert Atmosphere: No requirement

9.4 Vending: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-0-0-F-0

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Nonflammable gas

11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas

12.2 Molecular Weight: 28.0

12.3 Boiling Point at 1 atm: −320.1°F = −195.6°C = 77.6°K

12.4 Freezing Point: −354°F = −215°C = 58°K

12.5 Critical Temperature: −232.8°F = −147.9°C = 126.2°K

12.6 Critical Pressure: 490 psia = 33.5 atm = 3.40 MN/m²

12.7 Specific Gravity: 0.807 at −195.5°C (liquid)

12.8 Liquid Surface Tension: 6.3 dynes/cm = 0.063 N/m at −193°C

12.9 Liquid Water Interfacial Tension: Not pertinent

12.10 Vapor (Gas) Specific Gravity: 0.968

12.11 Ratio of Specific Heats of Vapor (Gas): 1.3982

12.12 Latent Heat of Vaporization: 85 Btu/lb = 53 cal/g = 2.2 X 10⁵ J/kg

12.13 Heat of Combustion: Not pertinent

12.14 Heat of Decomposition: Not pertinent

12.15 Heat of Solution: Not pertinent

12.16 Heat of Polymerization: Not pertinent

12.25 Heat of Fusion: 6.15 cal/g

12.26 Limiting Value: Data not available

12.27 Reid Vapor Pressure: Data not available

NOTES

NITROGEN

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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
—327	51.660	—327	.240	—328	.968	—326	.170
—326	51.540	—326	.240	—324	.958	—320	.155
—325	51.440	—325	.240	—322	.973	—316	.140
—324	51.230	—324	.240	—320	.964	—310	.132
—323	51.020	—323	.240	—318	.954	—305	.123
—322	50.810	—322	.240	—316	.944	—300	.114
—321	50.600	—321	.240	—314	.934	—295	.107
—320	50.400	—320	.240	—312	.924	—290	.101
—319	50.190	—319	.240	—310	.914	—285	.095
—318	49.980	—318	.240	—308	.904	—280	.090
—317	49.770	—317	.240	—306	.895	—275	.086
—316	49.560	—316	.240	—304	.885	—270	.082
—315	49.360	—315	.240	—302	.875	—265	.078
—314	49.150	—314	.240	—300	.865	—260	.075
—313	48.940	—313	.240	—298	.855		
—312	48.730	—312	.240	—296	.846		
—311	48.520	—311	.240	—294	.836		
—310	48.320	—310	.240	—292	.826		

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	—344	1.931	—344	.04355	0	.250
	N	—342	2.356	—342	.05223	20	.250
	S	—340	2.855	—340	.06224	40	.250
	O	—338	3.438	—338	.07372	60	.250
	L	—336	4.116	—336	.08681	80	.250
	U	—334	4.899	—334	.10170	100	.250
	B	—332	5.799	—332	.11850	120	.250
	L	—330	6.828	—330	.13740	140	.250
	E	—328	8.000	—328	.15850	160	.250
		—326	9.330	—326	.18210	180	.250
		—324	10.830	—324	.20820	200	.250
		—322	12.520	—322	.23720	220	.250
		—320	14.410	—320	.26910	240	.250
		—318	16.520	—318	.30410	260	.250
		—316	18.870	—316	.34250	280	.250
		—314	21.470	—314	.38440	300	.250
		—312	24.340	—312	.43000	320	.250
		—310	27.510	—310	.47950	340	.250
		—308	30.990	—308	.53300	360	.250
		—306	34.800	—306	.59080	380	.250
		—304	38.970	—304	.65300	400	.250
		—302	43.510	—302	.71980	420	.250
		—300	48.440	—300	.79130	440	.250
		—298	53.790	—298	.86780		
		—296	59.570	—296	.94940		
		—294	65.820	—294	1.03600		

Material Safety Data Sheet

Hoechst Celanese

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1991

METHANOL

RC3020

Issued December 31, 1988

Identification

Product name: Methanol

Chemical name: Methanol

Chemical family: Alcohol

Formula: CH_3OH

Molecular weight: 32

CAS number: 67-56-1

CAS name: Methanol

Synonyms: Methyl alcohol; carbinol; monohydroxymethane; methyl hydroxide.

Department of Transportation information
Hazard classification: Flammable Liquid
Shipping name: Methanol
United Nations number: UN1230
DOT Emergency Response Guide no.: 28

Physical data

Boiling point (760 mm Hg): 64.6°C (148°F)

Freezing point: −97.8°C (−144°F)

Specific gravity (H_2O = 1 @ 20/20°C): 0.7925

Vapor pressure (20°C): 96.0 mm Hg

Vapor density (Air = 1 @ 20°C): 1.11

Solubility in water (% by WT @ 20°C): Complete

Percent volatiles by volume: 100

Evaporation rate (BuAc = 1): 2.0

Appearance and odor: Clear, colorless, mobile liquid with mild alcohol odor.

Fire and explosion hazard data

Flammable limits in air, % by volume
Upper: 36.5
Lower: 5.5

Flash point (test method):
Tag open cup (ASTM D1310): 60°F (15°C)
Tag closed cup (ASTM D56): 54°F (12°C)

Extinguishing media:
Use CO_2 or dry chemical for small fires, alcohol-type aqueous film-forming foam or water spray for large fires. Water may be ineffective but should be used to cool fire-exposed structures and vessels

Special fire-fighting procedures:
Wear self-contained breathing apparatus (SCBA) and complete personal protective equipment when potential for exposure to vapors or products of combustion exists. Water spray can be used to reduce intensity of flames and to dilute spills to nonflammable mixture.

Unusual fire and explosion hazards:
Vapor is heavier than air and can travel considerable distance to a source of ignition and flashback. Material can burn with little or no visible flame.

Hazardous ingredients information

Component, wt. %	Exposure levels: OSHA PEL	ACGIH TLV®	IDLH(1)	SARA Sec. 313
Methanol, 99.85% CAS No. 67-56-1	200 ppm, 8-hr TWA	200 ppm(2), 8-hr TWA 250 ppm, STEL	25,000 ppm	Yes

(1) Immediately Dangerous to Life or Health
(2) potential contribution to overall exposure possible via skin absorption

Special hazard designations

	HMIS	NFPA
Health:	3	1
Flammability:	3	3
Reactivity:	0	0
Personal protective equipment:	G	—

Key: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

SARA Sec. 313 Hazard Categories

Acute health:	Yes
Chronic health:	Yes
Fire:	Yes
Sudden release of pressure:	No
Reactive:	No

Reactivity data

Stability:
Stable

Hazardous polymerization:
Will not occur.

Conditions to avoid:
Heat, sparks, flame.

Materials to avoid:
Sulfuric acid; oxidizing agents such as hydrogen peroxide, nitric acid, perchloric acid and chromium trioxide.

Hazardous combustion or decomposition products:
Carbon monoxide.

Health data

Effects of exposure/toxicity data

Acute:

Ingestion (swallowing): Poisonous if swallowed. Can affect the optic nerve resulting in blindness. Can cause mental sluggishness, nausea and vomiting leading to severe illness, possibly death (in humans). Practically non-toxic to animals (oral LD50, rats: 7.5 g/kg).

Inhalation (breathing): Extremely high levels cause stupor, headache, nausea, dizziness and unconsciousness. Practically non-toxic to animals (inhalation LC50, rats, 4 hrs: 64,000 ppm).

Skin contact: Essentially non-irritating. Repeated or prolonged contact causes drying, brittleness, cracking and irritation. Slightly toxic to animals by absorption (dermal LD50, rabbits: 20 g/kg).

Eye contact: May cause eye injury which may persist for several days. Liquid, and vapor in high concentrations, causes irritation, tearing and burning sensation.

Chronic:

Mutagenicity: *In vitro*, limited evidence of mutagenicity (mouse lymphoma forward mutation assay) *In vivo*, no information.

Carcinogenicity: No evidence of carcinogenic potential in limited animal studies in which methanol was given orally or applied to the skin.

Reproduction: Methanol – reported to cause birth defects in rats exposed to very high levels of vapors (20,000 ppm).

(continued)

mergency and first aid procedures

Ingestion (swallowing): Induce vomiting of conscious patient immediately by giving two glasses of water and pressing finger down throat. Contact a physician immediately.

Inhalation (breathing): Remove patient from contaminated area. If breathing has stopped, give artificial respiration, then oxygen if needed. Contact a physician immediately.

Skin contact: Remove contaminated clothing and wash contaminated skin with large amounts of water. If irritation persists, contact a physician.

Eye contact: Flush eyes with water for at least 15 minutes. Contact a physician immediately.

Note to physician: When plasma methanol concentrations are higher than 20 milligrams per deciliter, when ingested doses are greater than 30 milliliters, and when there is evidence of acidosis or visual abnormalities, a 10% solution of ethanol in 5% aqueous dextrose, administered intravenously, is a safe, effective antidote *(Western Journal of Medicine*, March 1985, p. 337).

Spill or leak procedures

Steps to be taken if material is released or spilled:
Eliminate ignition sources. Avoid eye or skin contact. Place leaking containers in well-ventilated area. If fire potential exists, blanket spill with foam or use water spray to disperse vapors. Contain spill to minimize contaminated area and facilitate salvage or disposal. To clean up spill, flush area sparingly with water or use an absorbent. Avoid runoff into storm sewers and ditches which lead to natural waterways. Call the National Response Center (800-424-8802) if spill is equal to or greater than reportable quantity (5000 lb/day) under "Superfund". All clean-up and disposal should be carried out in accordance with federal, state and local regulations. If required, state and local authorities should be notified.

Waste disposal method:
This product when spilled or disposed is a hazardous solid waste as defined in Resource Conservation Recovery Act regulations (40CFR261). Preferred method is incineration or biological treatment in federal/state approved facility.

Special protection information

Respiratory protection:
Use full-face NIOSH-approved self-contained breathing apparatus (SCBA) or other air-supplying full-face respirator.

Ventilation

Local exhaust: Recommended when appropriate to control employee exposure.

Mechanical (general): Not recommended as the sole means of controlling employee exposure.

Protective gloves:
Neoprene or rubber.

Eye protection:
Chemical safety goggles.

Other protective equipment:
For operations where spills or splashing can occur, use impervious body covering and boots. A safety shower and eye bath should be available.

Special precautions

Precautions to be taken in handling and storing:
Store in a cool, well-ventilated area. Do not expose to temperatures above 49°C (120°F). Keep away from heat, sparks and flame. Keep containers closed. Use only DOT-approved containers. Use spark-resistant tools. Do not load into compartments adjacent to heated cargo. When transferring follow proper grounding procedures. Use with adequate ventilation. Provide emergency exhaust. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Wash thoroughly with soap and water after handling. Wash contaminated clothing thoroughly before re-use. Discard contaminated leather clothing.

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HEXANE
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MATERIAL SAFETY DATA SHEET

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INDEX: 10890380382
CAT NO: H3034

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 110-54-3

SUBSTANCE: **HEXANE**

TRADE NAMES/SYNONYMS:
N-HEXANE; NCI-C60571; HEXYLHYDRIDE; NORMAL HEXANE; SKELLYSOLVE B; STCC 4908183; UN 1208; H-302; H-301; C6-H14; ACC10950

CHEMICAL FAMILY:
HYDROCARBON, ALIPHATIC

MOLECULAR FORMULA: C6-H14

MOLECULAR WEIGHT: 86.20

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCA E 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: HEXANE PERCENT: >99

EXPOSURE LIMITS:
HEXANE:
500 PPM (1800 MG/M3) OSHA TWA
50 PPM (180 MG/M3) ACGIH TWA
100 PPM NIOSH RECOMMENDED 10 HOUR TWA
510 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

PHYSICAL DATA

DESCRIPTION: VERY VOLATILE, COLORLESS LIQUID WITH A MILD GASOLINE-LIKE ODOR

BOILING POINT: 156 F (69 C) MELTING POINT: -139 F (-95 C)

SPECIFIC GRAVITY: 0.66 VISCOSITY: <32 SUS

VAPOR PRESSURE: 124 MMHG @ 20 C SOLUBILITY IN WATER: 0.014%

VAPOR DENSITY: 3.0

SOLVENT SOLUBILITY: ALCOHOL, CHLOROFORM, ETHER, ACETONE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

FLASH POINT: -7 F (-22 C) (CC) UPPER EXPLOSIVE LIMIT: 7.5%

LOWER EXPLOSIVE LIMIT: 1.1% AUTOIGNITION TEMP.: 437 F (223 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4,

GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS. KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION †9CFR172.101: FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS †9CFR172.101 AND 172.†02: FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: †9CFR173.119
EXCEPTIONS: †9CFR173.118

TOXICITY

HEXANE:
10 MG EYE-RABBIT MILD IRRITATION; 880 PPM EYE-HUMAN IRRITATION (38MKAJ); 190 PPM/8 WEEKS INHALATION-HUMAN TCLO; 120 GM/M3 INHALATION-MOUSE LCLO; 28,710 MG/KG ORAL-RAT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
HEXANE IS AN EYE, MUCOUS MEMBRANE AND SKIN IRRITANT. CENTRAL NERVOUS SYSTEM DEPRESSANT AND NEUROTOXIN. POISONING MAY AFFECT THE HEART. PERSONS WITH PRE-EXISTING SKIN, LIVER, KIDNEY, AND RESPIRATORY DISEASE MAY BE AT AN INCREASED RISK FROM EXPOSURE. ALCOHOL MAY ENHANCE THE TOXIC EFFECTS. A LOW ORDER OF MYOCARDIAL SENSITIZATION TO EPINEPHRINE MAY OCCUR.

EPIDEMIOLOGICAL STUDIES INVOLVING PETROLEUM REFINERY WORKERS INDICATE PERSONS WITH ROUTINE EXPOSURE TO PETROLEUM OR ONE OF ITS CONSTITUENTS MAY BE AT AN INCREASED RISK TO THE DEVELOPMENT OF BENIGN NEOPLASMS, DIGESTIVE SYSTEM CANCERS, AND SKIN CANCER, PARTICULARLY MELANOMA.

HEALTH EFFECTS AND FIRST AID

INHALATION:
HEXANE:
IRRITANT/NARCOTIC/NEUROTOXIN.
5000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- 880 PPM FOR 15 MINUTES HAS CAUSED UPPER RESPIRATORY TRACT IRRITATION. AT 1†00-1500 PPM SLIGHT NAUSEA AND HEADACHE ALSO OCCURRED. 5000 PPM FOR 10 MINUTES CAUSED MARKED VERTIGO. OTHER REPORTED SYMPTOMS ARE PERIPHERAL NEUROPATHY, GIDDINESS, INCOORDINATION, NUMBNESS OF THE LIMBS, ANOREXIA, PERSISTENT TASTE OF GASOLINE, CONFUSION, AND LOSS OF CONSCIOUSNESS IN EXTREME CASES. ANESTHESIA OF SHORT DURATION WITHOUT SEQULEA IS POSSIBLE.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE POLYNEUROPATHY WITH SYMMETRICAL SENSORY DYSFUNCTION OF THE DISTAL PORTIONS OF THE EXTREMITIES WHICH SLOWLY PROGRESSES TO MUSCLE WEAKNESS IN THE TOES AND FINGERS AND LOSS OF DEEP SENSORY REFLEXES. THE DELAY BETWEEN EXPOSURE AND PARALYSIS MAY BE DAYS TO WEEKS. THE PROGNOSIS FOR COMPLETE RECOVERY IS GOOD, ALTHOUGH THE DISORDER MAY INTENSIFY FOR MONTHS. OTHER REPORTED SYMPTOMS INCLUDE A FEELING OF DRUNKENESS, ANOREXIA, IMPOTENCE, MEMORY LOSS, FOOT DROP, BLURRED VISION, COLOR VISION ABNORMALITIES, MODERATE LOSS OF TOUCH, PIN PRICK, VIBRATION, AND THERMAL SENSATION, USUALLY ACCOMPANIED BY ANKLE JERKS, FACIAL NUMBNESS, COLD LEG SENSATIONS, AND GENERALIZED ACHING OF MUSCLES AND WEAKNESS OF BOTH LEGS. TESTING HAS SHOWN ELECTROMYOGRAPHIC ABNORMALITIES AND MOTOR NERVE CONDUCTION LOSS. AS THE NEUROPATHY BECOMES MORE SEVERE, NEUROGENIC ATROPHY OF SKELETAL MUSCLE MAY OCCUR. A LOW ORDER OF MYOCARDIAL SENSITIZATION TO EPINEPHRINE MAY OCCUR. EFFECTS ON THE NEWBORN HAVE BEEN REPORTED FROM REPEATED EXPOSURE AND EFFECTS ON THE MALE REPRODUCTIVE SYSTEM HAVE BEEN REPORTED FROM SINGLE EXPOSURE IN RATS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
HEXANE:
IRRITANT.
ACUTE EXPOSURE- VAPOR MAY CAUSE IRRITATION WITH REDNESS. 2 ML/KG/† HOURS ON RABBIT SKIN RESULTED IN ATAXIA AND RESTLESSNESS. AT 5 ML/KG/† HOURS SOME DEATHS OCCURED.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS DUE TO DEFATTING, BLISTER FORMATION, ITCHING, ERYTHEMA, PIGMENTATION AND PAIN HAVE BEEN REPORTED.

AN EPIDEMIOLOGICAL STUDY OF PETROLEUM REFINERY WORKERS HAS REPORTED ELEVATIONS IN STANDARD MORTALITY RATIOS FOR SKIN CANCER ALONG WITH A DOSE-RESPONSE RELATIONSHIP WHICH INDICATES AN ASSOCIATION BETWEEN ROUTINE WORKPLACE EXPOSURE TO PETROLEUM OR ONE OF ITS CONSTITUENTS AND SKIN CANCER, PARTICULARLY MELANOMA.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO

EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
HEXANE:
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT IN IRRITATION WITH REDNESS AND PAIN. VAPORS AT 880 PPM FOR 15 MINUTES CAUSED IRRITATION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH IRRITANTS MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
HEXANE:
NARCOTIC.
ACUTE EXPOSURE- MAY CAUSE CENTRAL NERVOUS SYSTEM EFFECTS, HEADACHE, NAUSEA, VOMITING, VERTIGO, BRONCHIAL AND GENERAL INTESTINAL IRRITATION WITH ABDOMINAL SWELLING AND PAIN. THE FATAL HUMAN DOSE MAY BE ABOUT 50 GRAMS. MAY VAPORIZE WHEN ASPIRATED INTO THE TRACHEOBRONCHIAL TREE WITH A RESULTANT RAPID DILUTION OF ALVEOLAR AIR AND MARKED FALL IN ITS OXYGEN CONTENT, WITH CONSEQUENT BRAIN DAMAGE OR CARDIAC ARREST.
CHRONIC EXPOSURE- NO HUMAN DATA AVAILABLE. EFFECTS ON THE EMBRYO HAVE BEEN REPORTED FROM REPEATED DOSES IN MICE.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
HEXANE:
DINITROGEN TETRAOXIDE: POSSIBLE EXPLOSION.
STRONG OXIDIZERS: VIGOROUS REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE TOXIC AND/OR HAZARDOUS GASES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. VAPORS MAY TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND RESTRICT ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS, OR DEPARTMENT OF LABOR. 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

HEXANE:
1000 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

2500 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN THE CONTINUOUS FLOW MODE.

5000 PPM- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS-MASK) WITH A CHIN-STYLE OR FRONT OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 01/29/85 REVISION DATE: 10/12/88

-ADDITIONAL INFORMATION-

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ALCONOX POWDER DETERGENT 14-322-4

Material Safety Data Sheet

Required under USDL Safety and Health Regulations for Shipyard Employment (29 CFR 1915)

U.S. Department of Labor
Occupational Safety and Health Administration

OMB No. 1218-00
Expiration Date 05/31/

PREPARED 1/2/85

Section I

Manufacturer's Name: ALCONOX, INC.

Emergency Telephone Number: (212) 473-1300

Address (Number, Street, City, State, and ZIP Code): 215 PARK AVENUE SOUTH
NEW YORK, N.Y. 10003

Chemical Name and Synonyms: N.A.

Trade Name and Synonyms: ALCONOX

Chemical Family: ANIONIC DETERGENT

Formula: N.A.

Section II - Hazardous Ingredients

Paints, Preservatives, and Solvents	%	TLV (Units)	Alloys and Metallic Coatings	%	TLV (Units)
Pigments: NONE			Base Metal: NONE		
Catalyst: NONE			Alloys: NONE		
Vehicle: NONE			Metallic Coatings: NONE		
Solvents: NONE			Filler Metal Plus Coating or Core Flux: NONE		
Additives: NONE			Others: NONE		
Others: NONE					

Hazardous Mixtures of Other Liquids, Solids or Gases

	%	TLV (Units)
NONE		

RECEIVED AUG 1985

Section III - Physical Data

Boiling Point (°F)	N.A.	Specific Gravity (H_2O=1)	N.A.
Vapor Pressure (mm Hg.)	N.A.	Percent Volatile by Volume (%)	N.A.
Vapor Density (AIR=1)	N.A.	Evaporation Rate (_____=1)	N.A.

Solubility in Water: APPRECIABLE

Appearance and Odor: WHITE POWDER INTERSPERSED WITH CREAM COLORED FLAKES - ODORLESS

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	Lel	Uel
NONE	N.A.	N.A.	N.A.

Extinguishing Media: WATER, CO_2, DRY CHEMICAL, FOAM, SAND/EARTH

Special Fire Fighting Procedures: FOR FIRES INVOLVING THIS MATERIAL, DO NOT ENTER WITHOUT PROTECTIVE EQUIPMENT AND SELF CONTAINED BREATHING APPARATUS

Unusual Fire and Explosion Hazards: NONE

ALCOXOX POW
04-322-4
04-322-5B,5C

Section V - Health Hazard Data

Threshold Limit Value

NO DATA AVAILABLE - TREAT AS NUISANCE DUST

Effects of Overexposure

PROLONGED EXPOSURE TO DUST MAY IRRITATE MUCOUS MEMBRANES

Emergency First Aid Procedures

EYES - FLUSH WITH PLENTY OF WATER FOR 15 MINUTES, SKIN-FLUSH WITH PLENTY OF WATER. INGESTION - DRINK LARGE QUANTITIES OF WATER TO DILUTE MATERIAL. GET MEDICAL ATTENTION FOR DISCOMFORT.

Section VI - Reactivity Data

Stability			Conditions to Avoid
	Unstable		NONE
	Stable X		

Incompatability (Materials to Avoid)

AVOID STRONG ACIDS

Hazardous Decomposition Products

MAY RELEASE CO_2 GAS ON BURNING

Hazardous Polymerization			Conditions to Avoid
	May Occur		NONE
	Will Not Occur X		

Section VII - Spill or Leak Procedures

Steps to be Taken in Case Material is Released or Spilled

MATERIAL FOAMS PROFUSELY, SHOVEL AND RECOVER AS MUCH AS POSSIBLE. RINSE REMAINDER TO SEWER. MATERIAL IS COMPLETELY BIODEGRADABLE.

Waste Disposal Method

SMALL QUANTITIES MAY BE DISPOSED OF IN SEWER. LARGE QUANTITIES SHOULD BE DISPOSED OF ACCORDING TO LOCAL REQUIREMENTS FOR NON-HAZARDOUS DETERGENT

Section VIII - Special Protection Information

Respiratory Protection Specify Type

DUST MASK

Ventilation			
	Local Exhaust NORMAL	Special N.A.	
	Mechanical (General) N.A.	Other N.A.	

Protective Gloves	Eye Protection
USEFUL - NOT REQUIRED	USEFUL - NOT REQUIRED

Other Protective Equipment

NOT REQUIRED

Section IX - Special Precautions

Precautions to be Taken in Handling and Storing

SHOULD BE STORED IN A DRY AREA TO PREVENT CAKING

Other Precautions

NO SPECIAL REQUIREMENTS OTHER THAN THE GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES EMPLOYED WITH ANY INDUSTRIAL CHEMICAL.

Form DSM Rev

MATERIAL SAFETY DATA SHEET	Ashland	ASHLAND CHEMICAL, INC. Subsidiary Of Ashland Oil Inc P.O. BOX 2219 COLUMBUS, OHIO 43216 (614) 889-3333	24-HOUR Emergency Telephone 1(800) 274-5263 or 1(800) ASHLAND

000031

CITRIC ACID ANHYD USP/FCC FN GR 50#BG

THIS MSDS COMPLIES WITH 29 CFR 1910.1200 (THE HAZARD COMMUNICATION STANDARD) RC3102

****

Product Name: CITRIC ACID ANHYD USP/FCC FN GR 50#BG
CAS NUMBER: 77-92-9

ALPHA METALS INC.
ATTN: BEVERLY SMALES
200 TECHNOLOGY DR.
ALPHARETTA, GA 30201

05 90 120 5091950-719

PRODUCT:
INVOICE: REQST
INVOICE DATE: 12/05/90
TO:

Data Sheet No: 0003677-003
Prepared: 12/12/86
Supersedes: 03/04/86

SECTION I - PRODUCT IDENTIFICATION

General or Generic ID: ORGANIC ACID

DOT Hazard Classification: NOT APPLICABLE

SECTION II - COMPONENTS

IF PRESENT, IARC, NTP AND OSHA CARCINOGENS AND CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III SECTION 313 ARE IDENTIFIED IN THIS SECTION. SEE DEFINITION PAGE FOR CLARIFICATION

INGREDIENT	% (by WT)	PEL	TLV	Note
CITRIC ACID CAS #: 77-92-9	100			(1)

Notes:

(1) PEL/TLV NOT ESTABLISHED FOR THIS MATERIAL

SECTION III - PHYSICAL DATA

Boiling Point	NOT APPLICABLE
Vapor Pressure	NOT APPLICABLE
Specific Vapor Density	NOT APPLICABLE
Specific Gravity	1.542 @ 68.00 Deg F (20.00 Deg C)
Percent Volatiles	NOT APPLICABLE
Evaporation Rate	NOT APPLICABLE

SECTION IV - FIRE AND EXPLOSION INFORMATION

FLASH POINT NOT APPLICABLE

EXPLOSIVE LIMIT NOT APPLICABLE

EXTINGUISHING MEDIA: WATER FOG OR CARBON DIOXIDE OR DRY CHEMICAL

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS:, CARBON DIOXIDE AND CARBON MONOXIDE, VARIOUS HYDROCARBONS, ETC.

FIREFIGHTING PROCEDURES: WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN THE POSITIVE PRESSURE DEMAND MODE WHEN FIGHTING FIRES.

SPECIAL FIRE & EXPLOSION HAZARDS: CAN REACT WITH CHEMICALLY REACTIVE METALS SUCH AS ALUMINUM, ZINC, MAGNESIUM, COPPER ETC. TO RELEASE HYDROGEN GAS WHICH CAN FORM EXPLOSIVE MIXTURES WITH AIR.

NFPA CODES: HEALTH- 1 FLAMMABILITY- 1 REACTIVITY- 0

SECTION V - HEALTH HAZARD DATA

PERMISSIBLE EXPOSURE LEVEL: NOT ESTABLISHED FOR PRODUCT. SEE SECTION II.

EFFECTS OF ACUTE OVEREXPOSURE:

EYES - CAN CAUSE IRRITATION.
SKIN - MAY CAUSE IRRITATION.
BREATHING - OF DUST CAN CAUSE IRRITATION OF NASAL AND RESPIRATORY PASSAGES.
IF SWALLOWED - BY NATURE OF PRODUCT PROBLEMS NOT EXPECTED, BUT INDUSTRIAL PRODUCTS ARE NEVER MEANT TO BE SWALLOWED.

FIRST AID:

IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDER CONTAMINATED CLOTHING BEFORE RE-USE.

IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.

IF SWALLOWED: IMMEDIATELY DRINK TWO GLASSES OF WATER AND INDUCE VOMITING BY EITHER GIVING IPECAC SYRUP OR BY PLACING FINGER AT BACK OF THROAT. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET MEDICAL ATTENTION IMMEDIATELY.

IF BREATHED: REMOVE INDIVIDUAL TO FRESH AIR.

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CONTINUED ON PAGE: 2

SECTION V-HEALTH HAZARD DATA (Continued)

PRIMARY ROUTE(S) OF ENTRY:

INHALATION, SKIN CONTACT

SECTION VI-REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CANNOT OCCUR

STABILITY: STABLE

INCOMPATIBILITY: AVOID CONTACT WITH:, STRONG ALKALIES., REACTIVE METALS SUCH AS ALUMINUM AND MAGNESIUM

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

SMALL SPILL: SWEEP UP MATERIAL FOR DISPOSAL OR RECOVERY.

LARGE SPILL: SHOVEL MATERIAL INTO CONTAINERS. THOROUGHLY SWEEP AREA OF SPILL TO CLEAN UP ANY RESIDUAL MATERIAL.

WASTE DISPOSAL METHOD:

SMALL SPILL: DISPOSE OF IN ACCORDANCE WITH ALL LOCAL, STATE AND FEDERAL REGULATIONS.

LARGE SPILL: DISPOSE OF IN ACCORDANCE WITH ALL LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII-PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF NEEDED USE A NIOSH/MSHA JOINTLY APPROVED DUST RESPIRATOR.(ASK YOUR SAFETY EQUIPMENT SUPPLIER)

VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW LEVEL OF OVEREXPOSURE (FROM KNOWN, SUSPECTED OR APPARENT ADVERSE EFFECTS).

PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS:, NEOPRENE, NITRILE RUBBER, POLYVINYL CHLORIDE

EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED; HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. (CONSULT YOUR SAFETY EQUIPMENT SUPPLIER)

OTHER PROTECTIVE EQUIPMENT: NORMAL WORK CLOTHING COVERING ARMS AND LEGS.

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED.SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS GIVEN IN THE DATA SHEET MUST BE OBSERVED.

THE INFORMATION ACCUMULATED HEREIN IS BELIEVED TO BE ACCURATE BUT IS NOT WARRANTED TO BE WHETHER ORIGINATING WITH THE COMPANY OR NOT. RECIPIENTS ARE ADVISED TO CONFIRM IN ADVANCE OF NEED THAT THE INFORMATION IS CURRENT, APPLICABLE, AND SUITABLE TO THEIR CIRCUMSTANCES.

HYDROCHLORIC ACID, 37%

Material Safety Data Sheet

Effective Date: 09-10-86 Supersedes 08-21-85

PRODUCT IDENTIFICATION:

Synonyms:	Muriatic acid
Formula CAS No.:	7647-01-0
Molecular Weight:	36.46 (HCl)
Hazardous Ingredients:	Hydrogen chloride
Chemical Formula:	HCl

(PHAZ) Primary Hazards:

PRECAUTIONARY MEASURES

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE. Do not get in eyes, on skin, or on clothing. Avoid breathing mist. Use only with adequate ventilation. Wash thoroughly after handling. Store in a tightly closed container. Remove and wash contaminated clothing promptly. This substance is classified as a POISON under the Federal Caustic Poison Act.

(AID) First Aid:

EMERGENCY FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

(PHYS) Physical Properties:

Physical Data

Appearance: Clear, colorless fuming liquid.

Odor: Pungent odor of hydrogen chloride.
Solubility: Infinite in water with slight evolution of heat.
Boiling Point: 53 C (127 F); Azeotrope
Vapor Density (Air=1): No information
(20.2%) boils at 109 C found. (228 F)
Melting Point: -74 C (-101 F)
Vapor Pressure (mm Hg):190 @ 25 C (77 F)
Specific Gravity: 1.18
Evaporation Rate: No information found.

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0

(FHAZ) Fire Hazards:

Fire and Explosion SECTION 2

Information

Fire: Can react with metals to release flammable hydrogen gas.
Explosion: Not considered to be an explosion hazard.
Fire Extinguishing Media: If involved in a fire, use water spray.
Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

(HAZR) Hazardous Reactions:

Reactivity Data SECTION 3

Stability: Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products: When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization: Will not occur.

Incompatibilities: A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.

(SPIL) Spillage Disposal:

Leak/Spill Disposal Information SECTION 4

Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors. Isolate or enclose the area of the leak or spill.

Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer neutralized material with excess water.

Larger spills and lot sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite). Provide forced ventilation to dissipate fumes. Dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow.

Reportable Quantity (RQ)(CWA/CERCLA): 5000 lbs.

Ensure compliance with local, state and federal regulations.

(HAZH) Health Hazards:

Health Hazard Information SECTION 5

A. Exposure/Health Effects

Inhalation: Corrosive! Inhalation of vapors can cause coughing, choking, inflamation of the nose, throat, and upper respiratory tract. Inhalation of higher concentrations may cause lung damage.

Ingestion: Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea.

Skin Contact: Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolored skin.

Eye Contact: Corrosive! Vapors are irritating and may cause damage to the eyes. Splashes may cause severe burns and permanent eye damage.

Chronic Exposure: Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

(AID) FIRST AID:

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1982)

Oral rat LD50: 900 mg/kg (Hydrochloric acid concentrated) Mutation references cited.

(CTL) Control Measures:

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 5 ppm Ceiling
-ACGIH Threshold Limit Value (TLV): 5 ppm Ceiling

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: If the TLV is exceeded a full facepiece chemical (NIOSH Approved) cartridge respirator may be worn, ingeneral, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection: Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

(STOR) Storage Procedures:

Storage and Special Information SECTION 7

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Protect from moisture.

(DISC) Disclaimer:

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********** The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, Mallinckrodt, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their independent judgment in determining its appropriateness for a particular purpose. Accordingly, Mallinckrodt, Inc. will not be responsible for damages of any kind resulting from the use of or reliance upon such information. NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS.
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(ADD) Addendum:

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS

Identifies SARA 313 substance(s).
Any copying or redistribution of the MSDS must include a copy of this addendum.

Hazard Categories for SARA

Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X	X		

SARA Sec. 313

Product or Components of Product:	SARA EHS Sec. 302 RQ	TPQ	Chemicals List	Category	CERCLA Name Chemical RQ lbs	RCRA Sec.103 261.33	Sec.
HYDROCHLORIC ACID, 37% (7647-01-0)	1	500gas	Yes	No	5000acid	No	

SARA Section 302 EHS RQ:

Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:

Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:

Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:

Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:

Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

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Material Safety Data Sheets Collection:

Sheet No. 718
Portland Cement

Issued: 8/90

Section 1 - Material Identification

Portland Cement (<1% quartz) Description: Tricalcium silicate ($3CaO \cdot SiO_2$) and dicalcium silicate ($2CaO \cdot SiO_2$) are portland cement's essential constituents, along with varying amounts of alumina, tricalcium aluminate, and iron oxide as tetracalcium aluminoferrite. Small amounts of magnesia, sodium, potassium, and sulfur are also present. Chromium may be present in the finished cement since the kiln's refractory lining and the steel balls used in the finish-milling operations are possible sources. To improve adhesion, strength, and flexibility, cement may be modified with various plastic latexes. Portland cement is used as a binding agent in concrete (a mixture of cement, gravel, and sand) and mortar. Concrete is cement diluted with 15% sand or other coarse particles, and approximately 3.75% calcium oxide.
Other Designations: CAS No. 65997-15-1, hydraulic cement, portland cement silicate.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[75] for a suppliers list.

R 0
I 2
S 3
K 0

Genium

HMIS
H 2
F 0
R 1
PPG*
* Sec. 8

Cautions: ***Portland cement's primary danger is its alkalinity.*** Calcium hydroxide, an alkaline, abrasive, and hygroscopic (moisture-absorbing) material, forms when water is added to dry cement. ***Acute contact with wet cement may cause extensive burns; chronic exposure may lead to dermatitis.*** Severe tissue damage may result if the cement hardens.

Section 2 - Ingredients and Occupational Exposure Limits

Portland cement, ca 100%
Average Composition of Portland Cement:

	%
CaO (calcium oxide)	64.0
SiO_2 (silicon dioxide)	21.0
Al_2O_3 (aluminum oxide)	5.8
Fe_2O_3 [iron (III) oxide]	2.9
MgO (magnesium oxide)	2.5
Alkali Oxides	1.4
SO_3 (sulfur trioxide)	1.7

1989 OSHA PELs	1989-90 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data*
8-hr TWA: 10 mg/m³ (total dust) 8-hr TWA: 5 mg/m³ (respirable fraction)	TLV-TWA: 10 mg/m³ nuisance dust	None established	None listed

* Monitor NIOSH, *RTECS* (VV8770000), for future data.

Section 3 - Physical Data

Vapor Pressure: Approximately 0 mm **pH:** 12 (wet cement)* **Water Solubility:** Insoluble

Appearance and Odor: Odorless, gray powder with <1% crystalline silica.

* Cement's alkalinity varies from batch to batch, depending on the excessive calcium oxides the manufacturer uses.

Section 4 - Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: This material is noncombustible. Use extinguishing media appropriate to the surrounding fire.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Calcium hydroxide forms when water is added to portland cement. Do not expose skin to wet cement. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5 - Reactivity Data

Stability/Polymerization: Portland cement is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: No hazardous incompatibilities are reported.
Hazardous Products of Decomposition: None reported.

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No. 718 Portland Cement 8/90

Section 6: Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list portland cement as a carcinogen.
Summary of Risks: Portland cement is a nuisance dust and skin, eyes, and mucous membrane irritant. Its principle health hazard—with the addition of water—occurs when it forms alkaline, abrasive, hygroscopic (moisture-absorbing) calcium hydroxide (slaked lime). Dry cement alone does not cause an alkaline burn. Some individuals appear to tolerate brief skin contact with wet cement, but others develop extensive skin burns. Repeated and prolonged skin contact can cause dermatitis including skin dryness, fissures, eczematous rashes, and dystrophy of nails. Allergic dermatitis may result from the presence of heavy metals such as chromium in the mixture. In one study, 15 of 95 cement workers reported dermatitis of the hands.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic respiratory disorders or skin diseases should minimize inhalation and skin contact.
Target Organs: Respiratory system, skin, eyes.
Primary Entry Routes: Inhalation, ingestion, skin contact.
Acute Effects: Inhalation symptoms include eye, nose, and upper respiratory tract irritation, cough, expectoration, shortness of breath, and wheezing. Eye contact (splashes) cause burning and possible corneal edema. Direct contact with wet cement may result in extensive skin burns with dermal necrosis. Within 12 to 48 hr after 1- to 6-hr exposures, first, second, and third degree burns may occur. There may be no obvious pain at the time of exposure. Ingestion of the powder or liquid form causes esophagus and stomach burns.
Chronic Effects: Chronic bronchitis and chronic dermatitis may result from chronic exposure. There are reports of x-ray changes without symptoms in cement workers exposed to portland cement. Other studies showing x-ray changes with pulmonary symptoms are noted in workers exposed primarily to the silica-containing products in portland cement. The contact dermatitis it causes may clear up only after a prolonged time after the exposures end.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Rinsing the exposed area with dextrose water may slow the hardening process. For reddened or blistered skin, consult a physician. Wash affected area with soap and water. Treat acute dermal reactions to wet cement as you would lye burns. Consult a physician immediately.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 4 to 8 oz. of milk or water. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Ingestion of large amounts of cement is unlikely. However, to prevent re-exposing the esophagus and stomach, do not induce emesis or perform gastric lavage. Immediate dilution may prevent esophageal burns. For severe esophageal burns, consider esophagoscopy within the first 24 hr. Neutralization with acidic agents is not advised because of increased risks of exothermic burns. Water-mineral oil soaks may aid in removing hardened cement from the skin. Dried on cement is extremely difficult to remove; surgical debridement and even skin grafting may be necessary. Consult an opthalmologist for ocular burns. Consider topical mydriatic-cycloplegics to guard against development of posterior synechiae and ciliary spasm.

Section 7: Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and direct contact with wet cement. Avoid creating airborne dust conditions. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Carefully scoop spilled dry material into a suitable container (with a secure lid) for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8: Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[26,73]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9: Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area. Protect containers from physical damage.
Engineering Controls: Avoid dust inhalation and direct contact with skin and eyes. Wear gloves, impervious boots, and other protective gear when pouring cement. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Differentiate between cement and concrete usage and the degree of hazard. Practice good personal hygiene and housekeeping procedures.
Other Precautions: Provide preplacement and annual physical examinations with emphasis on the respiratory tract, eyes, and skin. Avoid exposing individuals sensitive to hexachromium salts. Adding iron to cements reduces chromium levels.
Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection References: 26, 38, 73, 88, 89, 100, 101, 103, 126, 127, 132, 133, 134, 136, 138, 143
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: JR Stuart, MS

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ACETONE

Material Safety Data Sheet

Effective Date: 04-06-89 Supersedes 09-05-85

PRODUCT IDENTIFICATION:

Synonyms: Dimethylketone; 2-propanone

Formula CAS No.: 67-64-1 Molecular Weight: 58.08
Hazardous Ingredients: Acetone Chemical Formula: CH3COCH3

(PHAZ) Primary Hazards:

PRECAUTIONARY MEASURES

DANGER! EXTREMELY FLAMMABLE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION.
Keep away from heat, sparks and flame. Avoid contact with eyes, skin and clothing. Keep container closed.
Use with adequate ventilation. Avoid breathing vapor.

(AID) First Aid:

EMERGENCY FIRST AID

If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician. SEE SECTION 5.

DOT Hazard Class: Flammable Liquid

(PHYS) Physical Properties:

Physical Data

Appearance: Clear, colorless, volatile liquid.
Odor: Fragrant, mint-like
Solubility: Miscible in all proportions in water.
Boiling Point: 56.5 C (133.7 F) Vapor Density (Air=1):2.0
Melting Point: -95 C (-139 F) Vapor Pressure (mm Hg):400 @ 39.5 C (103 F)
Specific Gravity: 0.8 Evaporation Rate:(Butyl Acetate=1) ca. 7.7

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

(FHAZ) Fire Hazards:

Fire and Explosion SECTION 2

Information

Fire: Flammable liquid! Flash point:-18 C (0 F) closed cup Autoignition temperature: 465 C (869 F) Flammable limits in air, % by volume: lel: 2.6uel: 12.8

Explosion: Above flash point, vapor-air mixtures are explosive within flammable limits noted above.

Fire Extinguishing Media: Water, dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.

(HAZR) Hazardous Reactions:

Reactivity Data SECTION 3

Stability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization: Will not occur.

Incompatibilities: Oxidizing materials, chloroform, alkalies, acids, potassium t-butoxide.

(SPIL) Spillage Disposal:

Leak/Spill Disposal Information SECTION 4

Isolate or enclose the area of the leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid for reclamation when possible. Larger spills and lot sizes can be collected as hazardous waste and atomized in a suitable RCRA approved combustion chamber, or absorbed with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!

Reportable Quantity (RQ)(CWA/CERCLA) : 5000 lbs.

Ensure compliance with local, state and federal regulations.

HAZH) Health Hazards:

Health Hazard Information SECTION 5

A. Exposure/Health Effects

Inhalation: Irritating to the nose, throat, and mucous membranes. May cause dizziness, dullness, and headache. Narcotic in high concentrations.

Ingestion: May produce narcotic effects with other symptoms paralleling those from inhalation exposure.

Skin Contact: Irritating due to defatting action on skin. May cause redness, pain, drying and cracking of the skin.

Eye Contact: Vapors are irritating to the eyes. Splashes may cause severe irritation, with redness and pain.

Chronic Exposure: Prolonged or repeated skin contact may produce severe irritation or dermatitis.

Aggravation of Pre-existing Conditions: Use of alcoholic beverages enhances toxic effects.

B. FIRST AID

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.

Skin Exposure: Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1982)

Oral rat LD50: 9750 mg/kg Skin rabbit LD50: 20 gm/kg Mutation references cited. Irritation eye rabbit 3.95 mg Severe Aquatic toxicity rating: TLm96: over 1000 ppm

(CTL) Control Measures:

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 750 ppm (TWA), 1000 ppm (STEL) -ACGIH Threshold Limit Value (TLV): 750 ppm (TWA), 1000 ppm (STEL)

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: If the TLV is exceeded a full facepiece chemical (NIOSH Approved) cartridge respirator may be worn, in general, up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

(STOR) Storage Procedures:

Storage and Special Information SECTION 7

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment.

(DISC) Disclaimer:

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********** The information contained herein is provided in good faith and is believed to be correct as of the date hereof. However, Mallinckrodt, Inc. makes no representation as to the comprehensiveness or accuracy of the information. It is expected that individuals receiving the information will exercise their

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****

(ADD) Addendum:

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS.
Identifies SARA 313 substance(s).
Any copying or redistribution of the MSDS must include a copy of this addendum.

Hazard Categories for SARA

Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			

SARA Sec. 313

Product or Components of Product:	SARA EHS Sec. 302 RQ	TPQ	Chemicals List	Name Category	CERCLA Chemical RQ lbs	RCRA Sec.103	Sec. 261.33
ACETONE (67-64-1)	No	No		Yes	No 5000		U002

SARA Section 302 EHS RQ:

Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:

Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:

Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:

Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:

Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

NITRIC ACID, 70%

Material Safety Data Sheet

Effective Date: 04-06-89 Supersedes 10-21-86

PRODUCT IDENTIFICATION:

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 70%
Formula CAS No.: 7697-37-2 Molecular Weight: 63.00
Hazardous Ingredients: Nitric acid Chemical Formula: HNO3

(PHAZ) Primary Hazards:

PRECAUTIONARY MEASURES

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE. Do not get in eyes, on skin, or on clothing. Avoid breathing mist. Use only with adequate ventilation. Wash thoroughly after handling. Keep from contact with clothing and other combustible materials. Do not store near combustible materials. Store in a tightly closed container. Remove and wash contaminated clothing promptly. This substance is classified as a POISON under the Federal Caustic Poison Act.

(AID) First Aid:

EMERGENCY FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician. SEE SECTION 5.

DOT Hazard Class: Oxidizer

(PHYS) Physical Properties:

Physical Data

Appearance: Clear, colorless to slightly yellow liquid.
Odor: Suffocating acrid.
Solubility: Infinite in water.

Boiling Point: 122 C (252 F)
Melting Point: -34 C (-29 F)
Specific Gravity: 1.41
Vapor Density (Air = 1):2-3 approximately
Vapor Pressure (mm Hg):62 @ 20 C (68 F)
Evaporation Rate: No information found.
NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0 Other: Oxidize

(FHAZ) Fire Hazards:

Fire and Explosion Information

SECTION 2

Fire: Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.

Explosion: Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc.

Fire Extinguishing Media: If involved in a fire, use water spray. Special Information: Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated pressure demand or other positive pressure mode.

(HAZR) Hazardous Reactions:

Reactivity Data

SECTION 3

Stability: Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products: When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate. Will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization: Will not occur.

Incompatibilities: A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

(SPIL) Spillage Disposal:

Leak/Spill Disposal Information SECTION 4

Isolate or enclose the area of the leak or spill. Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors. Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer with excess water. Larger spills and lot sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite) and dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow. Provide forced ventilation to dissipate fumes. Reportable Quantity (RQ)(CWA/CERCLA) : 1000 lbs. Ensure compliance with local, state and federal regulations.

(HAZH) Health Hazards:

Health Hazard Information SECTION 5

A. Exposure/Health Effects

Inhalation: Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.

Ingestion: Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.

Skin Contact: Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.

Eye Contact: Corrosive! Vapors are irritating and may cause damage to the eyes. Splashes may cause severe burns and permanent eye damage.

Chronic Exposure: Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: DO NOT INDUCE VOMITING! Give large quantities of water or milk if

available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1982)

Inhalation (Rat) LC50: 244 ppm (NO2)/30M

(CTL) Control Measures:

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 2 ppm (TWA), 4 ppm (STEL) -ACGIH Threshold Limit Value (TLV): 2 ppm (TWA); 4 ppm (STEL)

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: If the TLV is exceeded, wear a supplied air, (NIOSH Approved) full-facepiece respirator, airlined hood, or self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and cannisters that contain oxidizable materials, such as activated charcoal.

Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

(STOR) Storage Procedures:

Storage and Special Information SECTION 7

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Protect from moisture.

(DISC) Disclaimer:

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(ADD) Addendum:

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS.
Identifies SARA 313 substance(s).
Any copying or redistribution of the MSDS must include a copy of this addendum.

Hazard Categories for SARA

Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X		X	

SARA Sec. 313

Product or Components of Product:	SARA EHS Sec. 302 RQ	TPQ	Chemicals List	Category	CERCLA Name Chemical RQ lbs	RCRA Sec.103	Sec. 261.33
NITRIC ACID, 70% (7697-37-2)	1000	1,000	Yes	No	1000	No	

SARA Section 302 EHS RQ:

Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:

Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:

Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:

Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:

Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR261.33

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(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 467
Automotive Gasoline, Lead-free

Issued: 10/81 Revision: A, 9/91

Section 1. Material Identification

35

Automotive Gasoline, Lead-free, Description: A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

Other Designations: CAS No. 8006-61-9, benzin, gasoline, gasolene, motor spirits, natural gasoline, petrol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*™ for a suppliers list.

R 1
I 2
S 2*
K 4
* Skin absorption

NFPA

HMIS
H 2
F 3
R 1
PPG†
† Sec. 8

Cautions: Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

1990 OSHA PELs
8-hr TWA: 300 ppm, 900 mg/m³
15-min STEL: 500 ppm, 1500 mg/m³

1990-91 ACGIH TLVs
TWA: 300 ppm, 890 mg/m³
STEL: 500 ppm, 1480 mg/m³

1990 NIOSH REL
None established

1985-86 Toxicity Data*
Man, inhalation, TC_{Lo}: 900 ppm/1 hr: toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)
Human, eye: 140 ppm/8 hr: toxic effects include mild irritation
Rat, inhalation, LC_{50}: 300 g/m³/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.
† See NIOSH, *RTECS* (LX3300000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)

Vapor Density (air = 1): 3.0 to 4.0

Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)

Water Solubility: Insoluble

Appearance and Odor: A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

Section 4. Fire and Explosion Data

Flash Point: -45 °F (-43 °C) | **Autoignition Temperature:** 536 to 853 °F (280 to 456 °C) | **LEL:** 1.3% v/v | **UEL:** 6.0% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.

Unusual Fire or Explosion Hazards: Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

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Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).
Summary of Risks: Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eye, respiratory and central nervous systems.
Primary Entry Routes: Inhalation, ingestion, skin contact.
Acute Effects: Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.
Chronic Effects: Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).
Aquatic Toxicity: Bluegill, freshwater, LC_{50}: 8 ppm/96 hr.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. Note: Resistance of specific materials can vary from product to product.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[1,69]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Gasoline (*including casing-head and natural*)
DOT Hazard Class: Flammable liquid
ID No.: UN1203
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline
IMO Hazard Class: 3.1
ID No.: UN1203
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159
Prepared by: M Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: JR Stuart, MS

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OILS, FUEL: 2

OTW

Common Synonyms	Oily liquid	Yellow-brown	Lube or fuel oil odor
Home-heating oil	Floats on water		

Stop discharge if possible
Call fire department
Avoid contact with liquid
Isolate and remove discharged material
Notify local health and pollution control agencies

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire
Cool exposed containers with water

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shorelines.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1223
3.4 DOT ID No.: 1223
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Light brown
4.3 Odor: Like kerosine; characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INHALATION causes headache and slight giddiness. INGESTION causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression.
5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting. ASPIRATION: enforce bed rest; administer oxygen; seek medical attention. EYES: wash with copious quantity of water. SKIN: remove solvent by wiping and wash with soap and water.
5.4 Threshold Limit Value: No single value applicable.
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5-15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Slight smarting of eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 136°F C.C.
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 494°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Water Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 38

8. WATER POLLUTION

8.1 Aquatic Toxicity:
20 ppm/24 hr/juvenile American shad/TL_m/fresh water
20 ppm/96 hr/rainbow trout eggs/TL_m/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 540—640°F = 282—338°C = 555—611°K
12.4 Freezing Point: —20°F = —29°C = 244°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.878 at 20°C (liquid)
12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: —19,440 Btu/lb = —10,800 cal/g = —452.17 X 10^4 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OTW	OILS, FUEL: 2

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
50	54.740
52	54.740
54	54.740
56	54.740
58	54.740
60	54.740
62	54.740
64	54.740
66	54.740
68	54.740
70	54.740
72	54.740
74	54.740
76	54.740
78	54.740
80	54.740
82	54.740
84	54.740

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
30	.429
35	.431
40	.434
45	.436
50	.439
55	.441
60	.443
65	.446
70	.448
75	.451
80	.453
85	.456
90	.458
95	.460
100	.463
105	.465
110	.468
115	.470
120	.472
125	.475
130	.477

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
30	.908
35	.908
40	.908
45	.908
50	.908
55	.908
60	.908
65	.908
70	.908
75	.908
80	.908
85	.908
90	.908
95	.908
100	.908
105	.908
110	.908
115	.908
120	.908
125	.908
130	.908

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
0	3.773
10	3.397
20	3.071
30	2.788
40	2.541
50	2.324
60	2.134
70	1.965
80	1.815
90	1.681
100	1.561
110	1.454
120	1.358
130	1.270
140	1.191
150	1.120
160	1.054
170	.995
180	.940
190	.890
200	.844
210	.802

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
55	.466
60	.474
65	.481
70	.489
75	.497
80	.505
85	.512
90	.520
95	.528
100	.535
105	.543
110	.550
115	.558
120	.565
125	.573
130	.580

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

Mobil

MOBIL OIL CORPORATION MATERIAL SAFETY DATA BULLETIN

REVISED:09/21/90

********** I. PRODUCT IDENTIFICATION **********

MOBIL SHC 630

SUPPLIER:
MOBIL OIL CORP.

CHEMICAL NAMES AND SYNONYMS:
SYN. HYDROCARBONS AND ADDITIVES

USE OR DESCRIPTION:
LUBE OIL

HEALTH EMERGENCY TELEPHONE:
(609) 737-4411

TRANSPORT EMERGENCY TELEPHONE:
(800) 424-9300 (CHEMTREC)

PRODUCT TECHNICAL INFORMATION:
(800) 662-4525

********** II. TYPICAL CHEMICAL AND PHYSICAL PROPERTIES **********

APPEARANCE: STRAW LIQUID ODOR: MILD PH: NA
VISCOSITY AT 100 F, SUS: 1125.0 AT 40 C, CS: 217.0
VISCOSITY AT 210 F, SUS: 127.0 AT 100 C, CS: 25.9
FLASH POINT F(C): 482(250) (ASTM D-92)
MELTING POINT F(C): NA POUR POINT F(C): -49(-45)
BOILING POINT F(C): > 600(316)
RELATIVE DENSITY, 15/4 C: 0.868 SOLUBILITY IN WATER: APPRECIABLE
VAPOR PRESSURE-MM HG 20C: < .1

NA=NOT APPLICABLE NE=NOT ESTABLISHED D=DECOMPOSES

FOR FURTHER INFORMATION, CONTACT YOUR LOCAL MARKETING OFFICE.

********** III. POTENTIALLY HAZARDOUS INGREDIENTS **********

NONE

SEE SECTIONS XII AND XIII FOR REGULATORY AND FURTHER COMPOSITIONAL DATA.

SOURCES: A=ACGIH-TLV, A*=SUGGESTED-TLV, M=MOBIL, O=OSHA, S=SUPPLIER
NOTE: LIMITS SHOWN FOR GUIDANCE ONLY. FOLLOW APPLICABLE REGULATIONS.

********** IV. HEALTH HAZARD DATA **********

--- INCLUDES AGGRAVATED MEDICAL CONDITIONS, IF ESTABLISHED ---

EFFECTS OF OVEREXPOSURE: SLIGHT SKIN IRRITATION.

********** V. EMERGENCY AND FIRST AID PROCEDURES **********

--- FOR PRIMARY ROUTES OF ENTRY ---

EYE CONTACT: FLUSH WITH WATER.
SKIN CONTACT: WASH CONTACT AREAS WITH SOAP AND WATER.
INHALATION: NOT EXPECTED TO BE A PROBLEM.
INGESTION: NOT EXPECTED TO BE A PROBLEM. HOWEVER, IF GREATER THAN 1/2 LITER(PINT) INGESTED, IMMEDIATELY GIVE 1 TO 2 GLASSES OF WATER AND CALL A PHYSICIAN, HOSPITAL EMERGENCY ROOM OR POISON CONTROL CENTER FOR ASSISTANCE. DO NOT INDUCE VOMITING OR GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

********** VI. FIRE AND EXPLOSION HAZARD DATA **********

FLASH POINT F(C): 482(250) (ASTM D-92)
FLAMMABLE LIMITS. LEL: .6 UEL: 7.0
EXTINGUISHING MEDIA: CARBON DIOXIDE, FOAM, DRY CHEMICAL AND WATER FOG.
SPECIAL FIRE FIGHTING PROCEDURES: WATER OR FOAM MAY CAUSE FROTHING. USE WATER TO KEEP FIRE EXPOSED CONTAINERS COOL. WATER SPRAY MAY BE USED TO FLUSH SPILLS AWAY FROM EXPOSURE. FOR FIRES IN ENCLOSED AREAS, FIREFIGHTERS MUST USE SELF-CONTAINED BREATHING APPARATUS. PREVENT RUNOFF FROM FIRE CONTROL OR DILUTION FROM ENTERING STREAMS OR DRINKING WATER SUPPLY.
UNUSUAL FIRE AND EXPLOSION HAZARDS: NONE.
NFPA HAZARD ID: HEALTH: 0, FLAMMABILITY: 1, REACTIVITY: 0

********** VII. REACTIVITY DATA **********

STABILITY (THERMAL, LIGHT, ETC.): STABLE
CONDITIONS TO AVOID: EXTREME HEAT.
INCOMPATIBILITY (MATERIALS TO AVOID): STRONG OXIDIZERS
HAZARDOUS DECOMPOSITION PRODUCTS: CARBON MONOXIDE.
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

********** VIII. SPILL OR LEAK PROCEDURE **********

ENVIRONMENTAL IMPACT: REPORT SPILLS AS REQUIRED TO APPROPRIATE AUTHORITIES. U. S. COAST GUARD REGULATIONS REQUIRE IMMEDIATE REPORTING OF SPILLS THAT COULD REACH ANY WATERWAY INCLUDING INTERMITTENT DRY CREEKS. REPORT SPILL TO COAST GUARD TOLL FREE NUMBER (800) 424-8802.
PROCEDURES IF MATERIAL IS RELEASED OR SPILLED: ADSORB ON FIRE RETARDANT TREATED SAWDUST, DIATOMACEOUS EARTH, ETC. SHOVEL UP AND DISPOSE OF AT AN APPROPRIATE WASTE DISPOSAL FACILITY IN ACCORDANCE WITH CURRENT APPLICABLE LAWS AND REGULATIONS, AND PRODUCT CHARACTERISTICS AT TIME OF DISPOSAL.
WASTE MANAGEMENT: PRODUCT IS SUITABLE FOR BURNING IN AN ENCLOSED, CONTROLLED BURNER FOR FUEL VALUE OR DISPOSAL BY SUPERVISED INCINERATION. SUCH BURNING MAY BE LIMITED PURSUANT TO THE RESOURCE CONSERVATION AND RECOVERY ACT. IN ADDITION, THE PRODUCT IS SUITABLE FOR PROCESSING BY AN APPROVED RECYCLING FACILITY OR CAN BE DISPOSED OF AT ANY GOVERNMENT APPROVED WASTE DISPOSAL FACILITY. USE OF THESE METHODS IS SUBJECT TO USER COMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS AND CONSIDERATION OF PRODUCT CHARACTERISTICS AT TIME OF DISPOSAL.

********** IX. SPECIAL PROTECTION INFORMATION **********

EYE PROTECTION: NO SPECIAL EQUIPMENT REQUIRED.
SKIN PROTECTION: NO SPECIAL EQUIPMENT REQUIRED. HOWEVER, GOOD PERSONAL HYGIENE PRACTICES SHOULD ALWAYS BE FOLLOWED.
RESPIRATORY PROTECTION: NO SPECIAL REQUIREMENTS UNDER ORDINARY CONDITIONS OF USE AND WITH ADEQUATE VENTILATION.
VENTILATION: NO SPECIAL REQUIREMENTS UNDER ORDINARY CONDITIONS OF USE AND WITH ADEQUATE VENTILATION.

********** X. SPECIAL PRECAUTIONS **********

NO SPECIAL PRECAUTIONS REQUIRED.

********** XI. TOXICOLOGICAL DATA **********

---ACUTE TOXICOLOGY---

ORAL TOXICITY (RATS): LD50: > 5 G/KG SLIGHTLY TOXIC (ESTIMATED) --- BASED ON TESTING OF SIMILAR PRODUCTS AND/OR THE COMPONENTS.

DERMAL TOXICITY (RABBITS): LD50: > 2 G/KG SLIGHTLY TOXIC (ESTIMATED) --- BASED ON TESTING OF SIMILAR PRODUCTS AND/OR THE COMPONENTS.

INHALATION TOXICITY (RATS): NOT APPLICABLE ---HARMFUL CONCENTRATIONS OF MISTS AND/OR VAPORS ARE UNLIKELY TO BE ENCOUNTERED THROUGH ANY CUSTOMARY OR REASONABLY FORESEEABLE HANDLING, USE, OR MISUSE OF THIS PRODUCT.

EYE IRRITATION (RABBITS): EXPECTED TO BE NON-IRRITATING. ---BASED ON TESTING OF SIMILAR PRODUCTS AND/OR THE COMPONENTS.

SKIN IRRITATION (RABBITS): MAY CAUSE SLIGHT IRRITATION ON PROLONGED OR REPEATED CONTACT. ---BASED ON TESTING OF SIMILAR PRODUCTS AND/OR THE COMPONENTS.

********** XII. REGULATORY INFORMATION **********

GOVERNMENTAL INVENTORY STATUS: ALL COMPONENTS REGISTERED IN ACCORDANCE WITH TSCA.

DOT:

SHIPPING NAME: NOT APPLICABLE
HAZARD CLASS: NOT APPLICABLE

US OSHA HAZARD COMMUNICATION STANDARD: PRODUCT ASSESSED IN ACCORDANCE WITH OSHA 29 CFR 1910.1200 AND DETERMINED NOT TO BE HAZARDOUS.

RCRA INFORMATION: THE UNUSED PRODUCT, IN OUR OPINION, IS NOT SPECIFICALLY LISTED BY THE EPA AS A HAZARDOUS WASTE (40 CFR, PART 261D); DOES NOT EXHIBIT THE HAZARDOUS CHARACTERISTICS OF IGNITABILITY, CORROSIVITY, OR REACTIVITY, AND IS NOT FORMULATED WITH THE CONTAMINANTS LISTED IN THE TOXICITY CHARACTERISTIC (TC) RULE AS DETERMINED BY THE TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP). HOWEVER, USED PRODUCT MAY BE REGULATED.

THIS PRODUCT HAS BEEN USDA APPROVED UNDER THE FOLLOWING CATEGORY: H2 - LUBRICANTS WITH NO FOOD CONTACT

U.S. SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) TITLE III:
THIS PRODUCT CONTAINS NO "EXTREMELY HAZARDOUS SUBSTANCES".

SARA (302) REPORTABLE HAZARD CATEGORIES: NONE

THIS PRODUCT CONTAINS NO CHEMICALS REPORTABLE UNDER SARA (313) TOXIC RELEASE PROGRAM.

THE FOLLOWING PRODUCT INGREDIENTS ARE CITED ON THE LISTS BELOW:

CHEMICAL NAME	CAS NUMBER	LIST CITATIONS
*** NO REPORTABLE INGREDIENTS ***		

--- KEY TO LIST CITATIONS ---

1 = OSHA Z, 2 = ACGIH, 3 = IARC, 4 = NTP, 5 = NCI,
6 = EPA CARC, 7 = NFPA 49, 8 = NFPA 325M, 9 = DOT HMT, 10 = CA RTK,
11 = IL RTK, 12 = MA RTK, 13 = MN RTK, 14 = NJ RTK, 15 = MI 293,
16 = FL RTK, 17 = PA RTK, 18 = CA P65.

--- NTP, IARC, AND OSHA INCLUDE CARCINOGENIC LISTINGS ---

NOTE: MOBIL PRODUCTS ARE NOT FORMULATED TO CONTAIN PCBS.

********** XIII. INGREDIENTS **********

INGREDIENT DESCRIPTION	PERCENT	CAS NUMBER
CONTAINS THE FOLLOWING BASE OILS:	> 95.00	
ALKENES, C>10 ALPHA, POLYMD.		68527-08-2
HEXANEDIOIC ACID, DITRIDECYL ESTER		16958-92-2
BENZENAMINE, N-PHENYL	0.05	122-39-4

********** APPENDIX **********

FOR MOBIL USE ONLY: (FILL NO: RL13201F) MCN: , MHC: 1* 1* NA 0* 1*, MPPEC: A, PPEC: , US85-047 APPROVE 07/26/90

****

INFORMATION GIVEN HEREIN IS OFFERED IN GOOD FAITH AS ACCURATE, BUT WITHOUT GUARANTEE. CONDITIONS OF USE AND SUITABILITY OF THE PRODUCT FOR PARTICULAR USES ARE BEYOND OUR CONTROL; ALL RISKS OF USE OF THE PRODUCT ARE THEREFORE ASSUMED BY THE USER AND WE EXPRESSLY DISCLAIM ALL WARRANTIES OF EVERY KIND AND NATURE, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE IN RESPECT TO THE USE OR SUITABILITY OF THE PRODUCT. NOTHING IS INTENDED AS A RECOMMENDATION FOR USES WHICH INFRINGE VALID PATENTS OR AS EXTENDING LICENSE UNDER VALID PATENTS. APPROPRIATE WARNINGS AND SAFE HANDLING PROCEDURES SHOULD BE PROVIDED TO HANDLERS AND USERS.

****

PREPARED BY: MOBIL OIL CORPORATION
ENVIRONMENTAL HEALTH AND SAFETY DEPARTMENT, PRINCETON, NJ
FOR FURTHER INFORMATION, CONTACT:
MOBIL OIL CORPORATION, PRODUCT FORMULATION AND QUALITY CONTROL
3225 GALLOWS ROAD, FAIRFAX, VA 22037 (800) 227-0707 X3265

APPENDIX F
LYME DISEASE

APPENDIX F
LYME DISEASE

Purpose

To prevent contact with deer ticks during field work activities, which may carry Lyme disease.

A. Site Characterization

Prior to performing a field activity in a new location, the area should be assessed for potential tick habitation. All work performed in or near wooded areas shall be assessed as "high risk" areas for tick contact.

B. Exposure Prevention

During field activities, personnel should avoid wooded and heavily vegetated areas. If this is not possible, personnel should follow the precautions set forth in Section C.

C. Personal Protective Equipment

To prevent contact with ticks which cause Lyme disease, field personnel should take the following measures:

- White colored, hooded tyveks should be worn to prevent contact and increase the sighting of ticks on the total body.
- Use duct tape at the extremities to prevent tick migration to unprotected skin.
- Spray tick repellent on tyveks prior to start of operation.
- Perform inspection of "your buddy" prior to removal of tyveks.
- Shower daily and perform personal inspection for ticks (especially in the hair and ears) and inspection for the appearance of circular rashes.

D. Exposure Recognition and Mitigation

Tick Removal

Once attached to the skin, an infected tick can take up to 24 hours to transmit the Lyme disease. Daily tick checks and prompt removal may preclude the transmission of the agent of lyme disease. Remove ticks by using tweezers to grip the tick body and firmly pull the tick straight outward. The use of alcohol, Vaseline, nail polish, or a hot match to remove the tick is discouraged and not considered effective.

Symptom Recognition

Early symptoms of Lyme disease include circular skin rashes, headache, chills, fatigue, body weakness, and fever malaise. If not treated early, Lyme disease can cause arthritis and inflammation of the heart (paracardia). Symptoms of exposure shall occur 2 to 6 weeks after contact with an infected tick. Early diagnosis and treatment with antibiotics prevent the later complications of Lyme disease. Personnel should seek medical treatment immediately if symptoms are recognized.

Exposure Mitigation

Personnel working at high risk sites and exposed to ticks will be tested for Lyme disease following completion of field activities.

APPENDIX G
HEAT STRESS

APPENDIX G
HEAT STRESS

A. Introduction

Activities in hot and humid environments can result in the exposure to the physical hazard of heat stress. The critical concern with heat stress is the effect that it can have on a worker's core body temperature. The recognition of the effects of heat stress on a body is as important as knowing the effects associated with a chemical exposure.

There are four levels of heat stress:

1. Heat Rash

Results from continuous exposure to heat and humid air. The sweat ducts become plugged and inflamed due to the swelling of the keratin layer of skin.

a. Signs - Tiny red vesicles are visible on the affected skin area.

b. Treatment - Mild drying of the skin.

2. Heat Cramps

Occurs following prolonged exposure to heat with profuse perspiration and inadequate replacement of salt. The individual satisfies their thirst by drinking water without replacing lost electrolytes. This causes a salt/water imbalance within the muscle tissue resulting in uncontrolled spasms.

a. Signs - Spasms and pains in the muscles of the abdomen and extremities.

b. Treatment - Intake of salted liquids orally or intravenously.

3. Heat Exhaustion

Occurs under sustained exertion in heat with dehydration from insufficient water and/or salt intake. The muscle, brain and skin require increased blood flow due to the heat stress condition. The cardiovascular system is insufficient to meet the needs of the body and places the patient into a mild shock.

a. Signs - Extreme weakness, fatigue, dizziness, nausea, headache, body temperature is normal or subnormal and skin is clammy, moist and pale.

b. Treatment - Immediately remove to a cooler environment, administer saline fluids and allow the person to rest in a supine position. Seek medical assistance.

4. Heat Stroke

Occurs after excessive physical exertion in heat with dehydration from insufficient water and/or salt intake. The body's regulatory process fails, resulting in a shut down of the sweating process. By eliminating one of the body's primary cooling mechanisms, the individuals core body temperature rises destroying cells, especially those of the brain controlling the central nervous system.

a. Signs - Dizziness, nausea, severe headache, collapse, delirium, hot dry skin and coma.

b. Treatment - Immediately remove to a cooler environment. Immerse in cold water or wrap in a wet sheet and vigorously fan with cool, dry air.

B. Monitoring

Permeable/Semi-Permeable/Impermeable Clothing

For operations in which individuals are wearing permeable, semi-permeable or impermeable clothing then the ACGIH TLV for heat stress should be used to control exposures. The ACGIH TLV is designed to ensure that an individual's core body temperature does not exceed 100.4 degrees F.

The TLV is based upon the measurement of environmental conditions. These conditions are expressed as a factor known as the wet bulb globe temperature index or WBGT. The WBGT can be determined using an electronic heat stress meter or through the use of a special arrangement of a three-thermometer monitoring station.

Once the index number has been determined and the type of work load has been established, a recommended work/rest regiment can be implemented to ensure a safe working condition. See table below.

PERMISSIBLE HEAT EXPOSURE

	Work Load (Values in Degrees F WBGT)		
Work-Rest Regiment	Light	Moderate	Heavy
Continuous Work	86.0	80.1	77.0
75% Work - 25% Rest/hour	87.1	82.4	78.6
50% Work - 50% Rest/hour	88.5	84.9	82.2
25% Work - 75% Rest/hour	90.0	88.0	86.0

C. Additional Health Factors

There are certain predisposing factors that can increase one's risk to heat stress. Workers not acclimated to the environment, obese individuals, those currently experiencing monitoring or diarrhea conditions, recent alcohol intake or those individuals with chronic cardiovascular disease are all at increased risk.

D. Water and Salt Intake

Workers in a hot environment can lose as much as three gallons of fluids and electrolytes in sweat, and therefore must be able to readily compensate for this loss.

Fluids should be replaced every twenty minutes and in amounts (approximately 150 ml) greater than are necessary to satisfy normal thirst (since the "thirst response" is an inadequate stimulus for fluids replacement under stressful heat conditions).

Water should be kept cool throughout the operations, a temperature of 50 - 60 degrees F. is recommended.

Salt loss can be compensated by using a 0.1% salt solution as the drinking water. Add 1 gram of NaCl to 1 liter of water or 1 level tablespoon of salt to 15 quarts of water to obtain this concentration.

E. Prevention

Certain precautions can be taken to reduce heat exposures and/or minimize their effects:

1. Schedule the more strenuous physical activities during the beginning and end of the day when external temperatures are generally cooler.

2. Do not perform any work at midday. If possible, schedule work in split shifts (such as 6:00 a.m. - 10:00 a.m. and 2:00 p.m. - 6:00 p.m.).

3. An appropriate sun screen lotion should be applied to a workers exposed skin areas.

4. Purchase ice vests to be worn by individuals in the field. These have been shown to be effective in keeping core body temperatures down in hot environments. Since the cold packs in the vest will not remain cool throughout the day, replaceable packs must also be available.

5. Potable water should be available in sprayer containers so that workers can cool down skin surfaces.

6. Provide workers with a cooled rest area. If possible, have an air conditioned van available where workers can sit during breaks and lunch. If a vehicle is not possible, then a canopy area with table and chairs should be provided.

APPENDIX H
COLD STRESS

APPENDIX H
COLD STRESS

A. Purpose

To prevent cold stress related injuries during field work operations.

B. General

- Appropriate measures shall be taken to prevent deep body core temperatures from falling below 96.8 degrees F. and to prevent cold injury to body extremities.

C. Evaluation

- Information shall be obtained either directly or indirectly as to the air temperature and wind speed at a site operations. The data shall be used to generate the equivalent chill temperature (ECT) as listed in the physical agents section of the ACGIH TLV booklet.

D. Controls

- Whenever ECTs fall below 20 degrees F., a ten minute warm-up break shall be provided after every 75 minutes of work.

- If work is performed continuously in ECTs of less than or equal to 20 degrees F., then heated warming shelters (building or vehicle) shall be made available.

- Outdoor work activities shall be terminated whenever the ECT is in the "Increasing Danger" or "Great Danger" regions (see ACGIH TLC booklet).

E. Personal Protective Equipment

- Hand Protection.

- If work is to be performed with bare hands for more than 20 minutes in an environment less than or equal to 60 degrees F., then warm air jets, radiant heaters or contact warm plates shall be made available to keep worker's hands warm.

- Gloves shall be worn when air temperatures fall below 60 degrees F. for sedentary work, 40 degrees F. for light work, and 20 degrees F. for moderate work.

- Mittens shall be worn whenever air temperatures fall below 0 degrees F.

F. Total Body

- Total body protection is required when work is to be performed in environments with temperatures less than or equal to 40 degrees F.

- This body protection shall consist of clothing for the trunk and extremities and shall include an insulated head liner, heavy socks, insulated steel-toed/steel-shank boots, insulated long underwear and insulated body coverall.

- If there is potential for clothing to become wet, then outer layer of clothing shall be water repellent.

- If body clothing is insufficient in preventing the sensation of cold or frostbite, then work activities shall be terminated until work appropriate clothing is obtained or weather conditions improve.

G. Other Considerations

- Shield the immediate work area with vehicles or tarps to reduce the cooling effects of the wind.

- Individuals suffering from diseases or who are taking medication which interferes with normal body temperature regulations shall not be allowed to work in temperatures less than or equal to 30 degrees F.

- Protective clothing that becomes wet from either contact with water or due to sweating greatly reduces insulating properties and therefore shall be immediately replaced.

APPENDIX I
PPE INSPECTION PROCEDURES

APPENDIX I
PPE INSPECTION PROCEDURES

A. Cleaning and Disinfecting Air Purifying Respirators (APR)

APRs in routine use should be cleaned and disinfected at least daily. Where respirators are used only occasionally, or when they are in storage, the cleaning interval is weekly or monthly, as appropriate.

1.0 DAILY CLEANING PROCEDURE

The steps to be followed for cleaning and disinfecting daily are as follows:

- Respirator Disassembly. Respirators are taken to a clean location where the filters, cartridges or canisters are removed, damaged to prevent accidental reuse, and discarded. For thorough cleaning, the inhalation and exhalation valves, speaking diaphragm, and any hoses are removed.

- Cleaning. In most instances, the cleaning and disinfecting solution provided by the manufacturer is used, and is dissolved in warm water in an appropriate tub. Using gloves, the respirator is placed in the tub and swirled for a few moments. A soft brush may be used to facilitate cleaning.

- Rinsing. The cleaned and disinfected respirators are rinsed thoroughly in water to remove all traces of detergent and disinfectant. This is very important for preventing dermatitis.

- Drying. The respirators may be allowed to dry in room air on a clean surface. They may also be hung upside down like drying clothes, but care must be taken not to damage or distort the facepieces.

- Reassembly and Inspection. The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. Special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

2.0 AFTER ROUTINE USE IN EXCLUSION ZONE

The steps to be followed for cleaning and disinfecting in the field are as follows:

- The mask may be washed/rinsed with soap and water.
- At a minimum, the mask should be wiped with disinfectant wipes (benzoalkaloid or alcohol), and allowed to air dry in a clean area.

B. APR INSPECTION AND CHECKOUT

1. Visually inspect the entire unit for any obvious damages, defects, or deteriorated rubber.

2. Make sure that the facepiece harness is not damaged. The serrated portion of the harness can fragment which will prevent proper face seal adjustment.

3. Inspect lens for damage and proper seal in facepiece.

4. Exhalation Valve - pull off plastic cover and check valve for debris or for tears in the neoprene valve (which could cause leakage).

5. Inhalation Valves (two) - screw off cartridges/canisters and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place.

6. Make sure a protective cover lens is attached to the lens.

7. Make sure the speaking diaphragm retainer ring is hand tight.

8. Make sure that you have the correct cartridge.

9. Don and perform negative pressure test.

C. STORAGE OF AIR PURIFYING RESPIRATORS

OSHA requires that respirators be stored to protect against:

Dust
Sunlight
Heat
Extreme Cold
Excessive moisture
Damaging chemicals
Mechanical damage

Storage of respirators should be in a clean, secure area which minimized the chance for contamination or unsanitary conditions.

D. PERSONAL PROTECTIVE CLOTHING

1. INSPECTION

Proper inspection of PPE features several sequences of inspection depending upon specific articles of PPE and it's frequency of use. The different levels of inspection are as follows:

Inspection and operational testing of equipment received from the factory or distributor.

Inspection of equipment as it is issued to workers.
Inspection after use or training and prior to maintenance.
Periodic inspection of stored equipment.
Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

The primary inspection of PPE in use for activities at the site will occur prior to immediate use and will be conducted by the user. This ensures that the specific device or article has been checked-out by the user, and that the user is familiar with its use.

TABLE 1
SAMPLE PPE INSPECTION CHECKLISTS
CLOTHING

Before use:

- Determine that the clothing material is correct for the specified task at hand.
- Visually inspect for:
  - imperfect seams
  - non-uniform coatings
  - tears
  - malfunctioning closures

- Hold up to light and check for pinholes.
- Flex product:
  - observe for cracks
  - observe for other signs of shelf deterioration
- If the product has been used previously, inspect inside and out for signs of chemical attack:
  - discoloration
  - swelling
  - stiffness

During the work task, periodically inspect for:

- Evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible effects.
- Closure failure.
- Punctures.
- Seam discontinuities.

GLOVES

Before use:

- Visually inspect for:
  - imperfect seams
  - tears, abrasions
  - non-uniform coating
  - pressurize glove with air; listen for pin-hole leaks.

APPENDIX J
FIRST REPORT OF INJURY FORM

STATE OF NEW JERSEY
EMPLOYER'S FIRST REPORT OF ACCIDENTAL INJURY OR OCCUPATIONAL ILLNESS

1. CARRIER NAME, ADDRESS	1A. POLICY NUMBER	1B. EFFECTIVE DATE	EXPIRATION DATE
CIGNA Property and Casualty Companies Workers' Compensation Center P.O. Box 171 Media, PA 19063	2. DATE OF INJURY OR ILLNESS	TIME OF DAY ☐ a.m. ☐ p.m.	SEND REPORT IMMEDIATELY AFTER INJURY DO NOT WAIT FOR DOCTOR'S REPORT
MAIL DUPLICATE (Yellow) TO	O.S.H.A. CASE NUMBER		

THIS FORM (IN QUADRUPLICATE) MUST BE COMPLETED IN THE FOLLOWING CASES ONLY:
(1) FOR EVERY ACCIDENTAL INJURY OR ILLNESS WHICH SHALL CAUSE A LOSS OF TIME FROM REGULAR DUTIES BEYOND THE WORKING DAY OR SHIFT INCLUDING SUNDAY OR ANY DAY ON WHICH EMPLOYEE WOULD USUALLY WORK, OR
(2) WHICH SHALL REQUIRE MEDICAL TREATMENT BEYOND ORDINARY FIRST AID, OR
(3) FOR THE OCCURRENCE OF AN OCCUPATIONAL ILLNESS WHETHER OR NOT TIME IS LOST.

COMPLETE THIS FORM IN ACCORDANCE WITH THE INSTRUCTIONS ON BACK OF THIS WHITE SHEET. MAIL IT PROMPTLY AS POSSIBLE. IN ALL CASES NO LATER THAN THE START OF THE SECOND (2nd) WORK DAY AFTER INJURY OCCURRED. IN CASE OF A FATAL OR SERIOUS INJURY (one that requires hospitalization) COMPLETE AND MAIL THIS IMMEDIATELY.

PLEASE PRINT OR TYPE
SEE DETAILED INSTRUCTIONS ON REVERSE SIDE (White Sheet)

EMPLOYER

3. FIRM NAME	4. EMPLOYER'S REGISTRATION NO.	5. S.I.C. NO.	6. NO. OF EMPLOYEES
	8. TELEPHONE NO. (Area Code)	9. NATURE OF BUSINESS	
7. MAILING ADDRESS (Please include City, Zip)	LOCATION, IF DIFFERENT FROM MAIL ADDRESS		

EMPLOYEE

10. NAME: LAST NAME, FIRST NAME, MIDDLE NAME	11. SOCIAL SECURITY NO.	12. Date of Birth Mo. Da. Yr.	13. AGE	14. SEX ☐ Male ☐ Female
15. HOME ADDRESS (Number and Street, City, ZIP, County)	16. OCCUPATION (Regular Job Title)	17. DEPARTMENT WHERE EMPLOYED ?		
18. TELEPHONE NO. (Area Code) / 19. WAGES Weekly $ _____ Hourly $ _____	20. NO. of HRS. (Regular work day)			

INJURY OR ILLNESS

21. WHERE DID ACCIDENT OR EXPOSURE OCCUR ? (Address, City, County)

22. WHAT WAS EMPLOYEE DOING WHEN INJURED ? (Be specific) (Please use separate sheet if necessary)

23. OBJECT OR SUBSTANCE, MACHINE OR TOOL THAT DIRECTLY INJURED EMPLOYEE

24. NATURE OF INJURY OR ILLNESS AND PART OF BODY AFFECTED (Formal Diagnosis Not Required)

25. DID EMPLOYEE DIE ?	26. WAS EMPLOYEE UNABLE TO WORK ON ANY DAY AFTER INJURY ?	27. HAS EMPLOYEE RETURNED TO WORK ?
☐ Yes, date _____ ☐ No	☐ Yes, date last worked _____ ☐ No	☐ Yes, date _____ ☐ No

28. NAME OF TREATING DOCTOR, IF ANY	29. DOCTOR'S ADDRESS: (Number and Street, City, ZIP)
30. IF HOSPITALIZED, Name of Hospital	31. ADDRESS OF HOSPITAL (Number and Street, City, ZIP)

COMPLETED BY: (Print or Type)	TITLE:
SIGNATURE:	DATE:

NEW JERSEY
DEPARTMENT OF LABOR AND INDUSTRY
DIVISION OF WORKERS' COMPENSATION
C N 381
TRENTON, NEW JERSEY 08625

MAIL ORIGINAL (White) TO

FILING OF THIS REPORT IS NOT AN ADMISSION OF LIABILITY

APPENDIX K
HEALTH & SAFETY PLAN APPROVAL

APPENDIX K
HEALTH & SAFETY PLAN APPROVAL

This site health and safety plan has been written for the exclusive use of Metcalf & Eddy, Inc. employees. M&E claims no responsibility for its use by others. The plan is written for the specified site conditions anticipated at the BNL Sediment Pilot Study project, dates and personnel, and must be amended if these conditions change.

PLAN PREPARED BY: DATE:

_____ _____

Office Safety Officer
Amy C. Zampella

REVIEWED BY: DATE:

_____ _____

Corporate Safety Officer
Richard Renzi

_____ _____

Project Manager
Phil DiGasbarro

APPENDIX L
AWT POLICIES & PROCEDURES
CONFINED SPACE ENTRY

POLICIES & PROCEDURES	SECTION A Health & Safety	NUMBER: 1001
SUBJECT: Confined Space Entry		REVISION: 0
		ISSUED: 10/93
		PAGE 1 of 13

1. Purpose

To provide for the safety of all personnel involved with confined space entries.

To implement the regulations as required by OSHA 29 CFR 1910.146 - Permit Required Confined Space.

2. Scope

This policy applies to all divisions of AWT and its subsidiary corporations.

3. Definitions

3.1 Permit Required Confined Space - An enclosed space which has the following characteristics:

- Is large enough so that an employee can enter and perform assigned work, and
- Has limited or restricted means for entry or exit, and
- Is not designed for continuous employee occupancy
- and may have one or more of the following conditions:
  - contains or potentially contains a hazardous atmosphere
  - contains a material with the potential for engulfment
  - has an internal configuration such that an entrant could be trapped or asphyxiated
  - contains any other recognized serious safety or health hazard

3.2 Confined Space Attendant (CSA) - An individual assigned to monitor activities of personnel working in a confined space. The CSA monitors and provides external assistance to those inside the confined space. The CSA can terminate any confined space entry, summon rescue personnel in the event of an emergency and assists the rescue team or perform a non-entry rescue.

3.3 Confined Space Authorized Entrant (CSAE) - An individual who is authorized by the employer to enter a permit required confined space.

3.4 Confined Space Supervisor (CSS) - An individual who is authorized by the employer to be responsible for determining if acceptable entry conditions are present at the permit space, for authorizing and canceling the entry permit and overseeing the entry operations. CSS may also serve as a CSA or CSAE if so trained in these roles and responsibilities.

APPROVED BY:

3.5 Entry - Entry into a confined space occurs as soon as any part of the entrant's body breaks the plane of an opening into the space.

3.6 Entry Permit - A printed document which defines the conditions under which a confined space may be entered, states the reason for entry, anticipated hazards, personnel involved and length of time for which the permit is valid.

3.7 Hazardous Atmosphere - An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness from one or more of the following:

- Flammable gas, vapor, or mist in excess of 10% of its Lower Flammable Limit (LFL);
- Airborn combustible dust at a concentration that meets or exceeds its LFL;
- Atmospheric oxygen concentration below 19.5% or above 23.5%;
- Atmospheric concentrations of any substance for which there is a Permissible Exposure Limit (PEL) or published dose that could result in employee exposure in excess of its PEL or dose.
- Immediately Dangerous to Life and Health (IDLH) conditions

4. Policy

4.1 Entry permits

4.1.1 An entry permit shall be completed whenever an entry into a confined space is to be performed. (Attachment 1).

4.1.2 Entry permits may be obtained by contacting the Site Safety Officer.

4.1.3 The entry permit shall be completed by the entrants prior to any entry into a permit required confined space.

4.1.4 Each completed entry permit shall be approved by the Confined Space Supervisor (CSS) prior to the start of the entry.

4.1.5 Upon completion of the operation the entry permit shall be canceled by the Confine Space Supervisor and forwarded to the Site Safety Officer for filing.

4.2 Posting/Guarding

4.2.1 A "Danger Confined Space - Entry Permit Required" sign shall be posted at the entrance to the confined space.

4.2.2 Whenever the access hole is flush with a floor or ground surface, or is in a pedestrian or vehicular passageway the area shall be roped or barricaded.

4.3 Hazard Evaluation

4.3.1 The atmosphere inside the confined space shall be remotely monitored for hazards prior to each entry and throughout the operation.

4.3.2 Direct reading instruments shall be used for oxygen concentration, combustible gases and potential toxic contaminants.

4.3.3 All monitoring equipment shall be maintained, calibrated, and operated in accordance with manufacturers specifications.

4.3.4 If any equipment malfunctions or appears to malfunction, the entry shall be terminated until the situation can be corrected.

4.4 Hazard Isolation

4.4.1 Actions to isolate confined space hazards shall be performed prior to entry. These include but are not limited to, blanking or blinding, double block and bleed or lockout and tag. See Policy #903 "Energy Control - Lockout and Tagout".

4.4.2 If the confined space is determined to contain a hazardous atmosphere then forced ventilation shall be used to reduce or eliminate the hazard.

4.4.3 If forced ventilation cannot be used or is not effective, then the Site Safety Officer shall be consulted to determine the appropriate level of personal protective equipment required to perform the task.

4.5 Communications

4.5.1 Communications between the confined space attendant (CSA) and confined space authorized entrant (CSAE) shall be continuously maintained through visual means, 2-way radio or other equivalent methods.

4.5.2 The confined space attendant (CSA) shall also have immediate availability of communication devices to contact rescue services.

4.6 Medical Requirements

4.6.1 Any member of a confined space entry team (i.e. CSS, CSAE, CSA) who will require respiratory protection to perform the entry will follow the medical requirements for 29 CFR 1910.134 Respiratory Protection and Policy #'s 606 & 607.

4.7 Training Requirements

4.7.1 All entry team members shall receive initial training in the identification of confined spaces and the requirements of this policy.

4.7.2 All confined space entry team members shall receive refresher training whenever there is a change in the confined space entry operations that present a hazard for which they have not yet been trained for, the employee's duties and or responsibilities have changed, or when evaluation of this policy identifies inadequacies in the employee's knowledge.

4.7.3 In addition, confined space attendants (CSA) shall be Red Cross certified in First Aid and Cardio-Pulmonary Resuscitation (CPR).

4.8 Rescue

4.8.1 Rescue teams trained in confined space responses must be available to assist the confined space attendant (CSA) in emergency situations.

4.8.2 Rescue teams that are a part of a fire department, Haz-Mat team or other outside agency shall be informed of the hazards associated with the confined space prior to the start of any activities.

4.9 Contractors

4.9.1 If non-Air & Water Technologies employees must also enter the confined space, then AWT shall provide them with available information on the permit space hazards and a copy of this policy.

4.9.2 Contractors shall be required to meet all applicable regulations associated with the entry and shall be responsible for providing all necessary personnel and safety equipment for the entry.

ATTACHMENT 1
AWT
CONFINED SPACE ENTRY
WORK PRACTICE GUIDELINE

A confined space provides the potential for unusually high concentrations of contaminants, explosive atmospheres, limited visibility, and restricted movement. This section will establish guidelines for safe entry into, continued work in, and safe exit from confined spaces. Additional information regarding confined space entry can be found in 29 CFR 1926.21, 29 CFR 1910.146.

Definitions

Attendant: The individual stationed outside of the permit space who monitors the authorized entrants.

Authorized entrant: An individual who enters the permit space.

Entry Supervisor: The individual responsible for determining acceptable entry conditions exist, for authorizing entry, overseeing entry operations, and for terminating entry as needed. The entry supervisor may also serve as the attendant or authorized entrant.

Confined Space: A space or work area not designed or intended for normal human occupancy; having limited means of entry and exit; and is large enough so configured that an employee can bodily enter and perform assigned work.

Entry: The action by which a person passes through an opening into a permit required confined space.

Entry permit (permit): The written or printed document that is provided by the employer to allow and control entry into a permit space. The permit shall meet the requirements of 29 CFR 1910.146(f).

Hazardous atmosphere: An atmosphere with the following conditions:

A. Greater than ten percent (>10%) of the Lower Explosive Level (LEL).

B. Airborne combustible dust greater than LEL (dust obscures vision at a distance of 5 feet or less).

C. Atmospheric oxygen concentration is less than 19.5 percent (<19.5%) or greater than 23.5 percent (>23.5%).

D. Atmospheric concentration of a substance which could result in employee exposure greater than the permissible exposure limit (>PEL) or a published exposure limit.

E. Any atmospheric condition that is immediately dangerous to life and health (IDLH).

Permit-required confined space (permit space): A confined space that has one or more of the following characteristics:

A. Contains or has the potential to contain a hazardous atmosphere.

B. Contains a material that has the potential for engulfing an entrant.

C. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross section.

D. Contains any other recognized serious safety or health hazard.

Entering a confined space requires the following to be completed:

1. **Hazard identification** - Identify and evaluate each hazard of the permit space, including determination of severity.

2. **Hazard control** - Establish and implement the means, procedures, and practices by which the permit space can be entered safely.

3. **Permit** - An entry permit will be completed before entry of a confined space.

4. **Employee information** - Signs shall be posted at permit spaces to notify employees that only authorized entrants may enter the permit spaces or that an entry permit is required.

5. **Prevention of unauthorized entry** - Prevent unauthorized employee entry through such measures as training or by posting signs and barriers, as necessary.

6. **Employee training** - Train employees, as provided by this standard, so that supervisors, attendants, authorized entrants and personnel authorizing entry can work safely in and around the permit space.

7. **Equipment** - Provide, maintain, and ensure the proper use of the equipment necessary for safe entry, including testing, monitoring, communication, and personal protective equipment.

8. **Rescue** - Ensure that the procedures and equipment necessary to rescue entrants from permit spaces are implemented and provided.

9. **Protection from external hazards** - Ensure that all pedestrian, vehicle or other barriers necessary to protect entrants from external hazards are provided.

10. Duty to other employers - Ensure that, when an employer such as a contractor plans to send employees into a permit space that is under the control of another employer (host employer), the host employer provides the contractor with all available information on permit space hazards, safety rules, and emergency procedures of which the contractor needs to be aware to comply with this standard.

In addition, the following rules must be adhered to:

1. Confined-space work shall be undertaken only under controlled traffic conditions where applicable.

2. Vehicles shall not be left running near confined space work or near air-moving equipment being used for confined space ventilation.

3. Smoking in confined spaces is prohibited.

4. Verify that any hot work (welding, burning, open flames, or spark-producing operation) that is to be performed in the confined space has been approved and that the permit is attached to the confined-space permit. The hot work authorization shall be noted prominently on either the entry or on a separate hot work permit that is attached to the confined-space permit.

Procedures

1. Implement measures necessary to prevent unauthorized entry.

2. Identify and evaluate hazards of permit spaces before employees enter the space. This will be implemented in the project pre-planning stages. The Site Safety Officer can be contacted for assistance.

3. The following should be considered before entry into a permit space. To ensure a safe entry the necessary procedures and equipment to complete the items below should be used throughout the entry.

   a. Acceptable entry condition shall be determined based on the characteristics of the space.

   b. The permit space shall be isolated and completely protected against the release of energy or material. This can be accomplished by: blanking; double block and bleed system; lockout of all energy sources; blocking or disconnecting mechanical linkages; misaligning or removing sections of lines; pipes, or ducts.

   c. Barriers should be provided to protect entrants from external hazards.

4. The following equipment should be provided for each permit space entry. The equipment shall be adequately maintained, calibrated in accordance with manufacturers specifications and employees who use the equipment shall be adequately trained.

   a. Air monitoring equipment to properly measure O_2, LEL, and toxic atmospheres.

   b. Ventilating equipment such as blowers.

   c. Communications equipment.

   d. Personal protective equipment such as head protection, eye protection, hearing protection, hand protection, foot protection, respiratory protection or full body protection.

   e. Ladders, lighting, barriers, shields.

   f. Rescue and emergency equipment unless it is provided by outside rescue services.

5. The atmosphere within the permit space shall be monitored remotely before entry into the permit space.

6. At least one attendant is in communication with the entrant through the entire entry process.

7. Employees who enter or attend the permit spaces shall be designated and meet the AWT Confined Space policy requirements.

8. Rescue and emergency services shall be determined before entry.

9. Non-entry rescue may be performed by the CSA. This consists of a tripod or other proper anchorage to which a retrieval system is secured to allow the attendant to extricate the entrant from the space in an emergency. The attendant does not enter the space to perform this type of rescue.

10. Entry permits (Attachment 1) should be prepared and used during each permit space entry. The permits should be written and kept on file for a minimum of one year.

11. Site specific procedures must be in place to conclude any entry. At a minimum this will include closing the permit space, removing equipment and cancelling the permit.

12. Procedures for each employer shall be implemented when more than one employer has employees in a permit space simultaneously.

General Provisions

- Confined spaces shall be identified with a posted sign which reads: Danger - Confined Space, Entry By Permit Only.
- Only personnel trained and knowledgeable of the requirements of these Confined Space Entry Procedures will be authorized to enter a confined space or be a confined space observer.
- An Entry Permit (EP) must be issued prior to the performance of any work within a confined space. The EP will become part of the permanent and official record of the site.
- If natural ventilation is not adequate within the confined space prior to initial entry and for the duration of the EP. Positive/forced mechanical ventilation may be required. However, care should be taken not to spread contamination.
- If flammable liquids may be contained within the confined space, explosion proof equipment shall be used. All equipment shall be grounded and bonded.
- All sources of ignition must be removed prior to entry if flammable or combustible conditions exist.
- Hand tools used in confined spaces shall be in good condition, explosion proof and spark proof, when flammable condition exist and selected according to intended use. Where possible, pneumatic power tools are to be used.
- Smoking shall be prohibited in and near all confined spaces.
- Hand-held lights and other illumination utilized in confined spaces shall be equipped with guards to prevent contact with the bulb and when flammable/combustible potential hazards exist they must be explosion proof.
- Compressed gas cylinders, except cylinders used for self-contained breathing apparatus, shall not be taken into confined spaces. Gas hoses shall be removed from the space and the supply turned off at the cylinder valve when personnel exit from the confined space.
- If a confined space requires respiratory protective equipment or where rescue may be difficult, body harnesses, and lifelines will be used. The CSA shall be provided with the same equipment as those working within the confined space.

- A ladder is required in all confined spaces deeper than the employee's shoulders. The ladder shall be secured and not removed until all employees have existed the space.

- Only NIOSH/MSHA approved self-contained breathing apparatus or airline respirators equipped with a 5-minute emergency air supply (egress bottle) shall be used in confined spaces containing hazardous atmospheres or with conditions determined to be immediately dangerous to life and health.

- Where air-moving equipment is used to provide ventilation, chemicals and motor exhausts shall not be located in the vicinity to prevent introduction of harmful or hazardous vapors into the confined space.

- Vehicles shall not be left running near confined space work or near air-moving equipment being used for confined space ventilation.

Entry Supervisor Duties

1. Know the hazards faced during entry.

2. Verifies that all air monitoring is completed and all equipment is available before entry.

3. Terminates the entry when potential hazards are identified or of the end of the entry.

4. Verifies that rescue services and a means of contacting them are available.

Authorized Entrant Duties

1. Know the hazards faced during entry (i.e. sign and symptoms of exposure, routes of entry).

2. Properly trained in use of all equipment associated with the entry.

3. Communicates with the attendant.

4. Alerts the attendant when the entrant recognizes a warning sign or symptom, dangerous situation, or prohibited condition.

5. Exits the permitted space when the attendant, or entry supervisor orders an evacuation, an evacuation alarm is sounded, or a condition in #4 above exists.

Attendant Duties

1. Know the hazards faced during entry (i.e. signs and symptoms of exposure, routes of entry).

2. Is aware of behavioral effects of hazard exposure in entrants.

3. Maintains an accurate count of authorized entrants in the permit space.

4. Remains outside the permit space during entry operations until relieved by another attendant.

5. Communicates with authorized entrants.

6. Monitors activities inside and outside of the permit space. Orders the evacuation of entrants when attendant detects a prohibited condition, behavioral effects by the entrant(s), a situation outside the space that could endanger the entrant, or the attendant cannot effectively and safely perform the duties.

7. Advise unauthorized persons to leave the area.

8. Perform non-entry rescue procedures.

9. Summon rescue and emergency services when assistance is needed to exit the space.

10. Performs no duties that may interfere with these duties.

ATTACHMENT #1

CONFINED SPACE ENTRY PERMIT

AIR & WATER TECHNOLOGIES & COMPANIES

I. General Information

Operating Group: _____

Date/Time Issued: _____

Duration of Permit: _____

Date/Time Cancelled: _____

Location and Description: _____

Purpose of Entry: _____

Supervisor: _____

II. Confined Space Entrant(s)/Attendants/Helper

Entrant(s) 1. _____

2. _____

3. _____

Attendant(s) 1. _____

2. _____

3. _____

III. Communication Procedures

To be used by attendants and entrants:

_____

IV. Permit-Space Hazards (Check all that apply)

- ❑ Atmospheric hazards
  - ❑ Oxygen deficiency (<19.5%)
  - ❑ Oxgen enrichment (>23.5%)
  - ❑ Flammable gases or vapors (>10% of LFL)
  - ❑ Airborne combustible dust (< or = LFL)
  - ❑ Toxic gases or vapors (>PEL)
- ❑ Engulfment
- ❑ Mechanical hazards
- ❑ Other
  - ❑ Electric shock
  - ❑ Materials harmful to skin
  - ❑ Specify _____

V. Emergency Service

Name of Service _____

Phone Number _____

Method of Contact _____

_____

VI. Required Personal Protective Equipment

	N/A	Yes	No		N/A	Yes	No
Direct Reading Atmospheric Monitor(s)	( )	( )	( )	Hard Hat	( )	( )	( )
Safety Harnesses and Lifeline for Entrant and Attendant	( )	( )	( )	Steel-Toe Shoes/Boots	( )	( )	( )
Escape Retrieval Equipment	( )	( )	( )	Hearing Protection	( )	( )	( )
Two-Way Radios	( )	( )	( )	Safety Glasses	( )	( )	( )
SCBA/SAR for Entrant and Attendant	( )	( )	( )	Gloves	( )	( )	( )
All Electric Equipment and Illumination Devices Listed Class I, Division I, Group A,B,C & D and Nonsparking Tools	( )	( )	( )	Protective Clothing	( )	( )	( )

VII. Site Control and Monitoring

A. Pre-Entry

1. Atmospheric Checks:
   Time _____ Explosive _____ % LFL
   Oxygen _____ % Toxic _____ ppm

2. Source Isolation (No Entry):

	N/A	Yes	No
Pumps or Lines Blinded	( )	( )	( )
Disconnected or Blocked	( )	( )	( )
Electrical Lock/Tag	( )	( )	( )

3. Ventilation Modification:

	N/A	Yes	No
Mechanical	( )	( )	( )
Natural Ventilation Only	( )	( )	( )

4. Atmospheric Check After Isolation and Ventilation:
   Time _____ Explosive _____ % LFL
   Oxygen _____ % Toxic _____ ppm

5. Sampling Equipment

Equipment		
Calibration Date		
Model &/or Type		
Serial &/or Unit #		

B. Requirements Completed Prior to Entry

	N/A	Date	Time
Lockout/De-Energize/Tagout	( )	____	____
Line(s) Broken-Capped-Blanked	( )	____	____
Purge-Flush and Vent	( )	____	____
Mechanical Ventilation	( )	____	____
Secure Area (Post and Mark)	( )	____	____
Pedestrian & Vehicle Guards/Barriers	( )	____	____

	N/A	Date	Time
Lighting (Explosive Proof)	( )	____	____
Fire Extinguisher (Type)	( )	____	____

C. Atmospheric Monitoring Record

	Hazards							
			Toxics					
	Oxygen	LEL						
Time	Operating Limits							
Hr:min	19.5% to 23.5%	<10%	ppm	ppm	ppm	ppm		
PEL or Dose								
Action Level								

V. Confined Space Attendant

Confined Space Attendant is Required for All Confined space Work
Name of Attendant(s):

_____ _____

_____ _____

VI Supervisor Authorizing Entry

All Above Conditions Satisfied Yes ( ) No ( )

Department _____ Phone _____

Printed Name _____ Signature _____

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
SEDIMENT DECONTAMINATION PILOT STUDY
BROOKHAVEN NATIONAL LABORATORY
NEWARK, NEW JERSEY

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) will be implemented as part of the project work plan for the sediment decontamination pilot study being performed for Brookhaven National Laboratory (BNL) on New York/New Jersey harbor sediments. The pilot study will take place in an empty warehouse in Newark, New Jersey. Figure 2-1 of the Work Plan provides a location map of the pilot study site. The objectives of this QAPP are to:

- Provide consistent, reliable sampling protocols
- Provide for consistent, accurate analytical results
- Provide overall quality assurance measures for the process

The rationale for the QAPP is to produce data which is integral to the remedial design technology and further defines system performance and design parameters. This scope of the QAPP includes:

- data quality objectives;
- sampling procedures;
- record keeping protocols;
- equipment calibration procedures;
- data reduction, review, and reporting;
- internal quality control checks;
- corrective action procedures;
- and quality assurance review.

This plan also presents the site-specific laboratory protocols to be followed to ensure quality and integrity of data collection, accuracy, and precision of the analyses, representativeness of results, and completeness of information. The project team and functional responsibilities

are detailed in Section 1.6 of the Project Work Plan. The methodology to achieve these objectives is discussed in subsequent sections.

M&E will conduct sampling activities during the pilot test to gather system performance (process control) data. Sediment process samples will be collected mainly for outside laboratory analysis and field screening. M&E will collect samples from the feed sediment, some internal process streams, and the products to monitor the performance of the decontamination system process. Samples collected from the oversize gravel fraction will be crushed to 1/4-inch size prior to analysis. One process control sediment sample for each batch will be submitted to an off-site laboratory for total organic carbon (TOC) and percent moisture analysis on an expedited (24-hour) turnaround time. Some process control sediment samples will be analyzed for specific gravity, unconfined compressive strength, and disposal parameters. Several process control water samples will also be collected for analysis for percent solvents/percent water. M&E's proposed sampling summary is detailed in Table 1-1.

M&E will also collect performance goal samples on behalf of BNL for analysis by their own laboratory. BNL has prepared a separate QAPP for this sampling and analysis.

TABLE 1-1
PRELIMINARY PROPOSED SAMPLING SUMMARY
BNL SEDIMENT DECONTAMINATION PILOT STUDY
NEWARK, NEW JERSEY

BE898 BNLSAMP

				ANALYTICAL PARAMETER, FREQUENCY AND METHOD											
PROCESS	STREAM NO.	MATRIX	TOC 9060	PERCENT SOLVENTS/ WATER (2)	PERCENT MOISTURE	SVOCs 8270	PESTICIDES/ PCBs 8080	HERBICIDES 8150	DIOXINS/ FURANS 8290	METALS 10	UNCONFINED COMPRESSIVE STRENGTH ASTM D-2166	FULL TCLP 1311/ SW-846	DISPOSAL PARAMETERS (1)	SPECIFIC GRAVITY Field	PENETRO-METER FIELD Test
Person Responsible:			M&E	M&E	M&E	BNL	BNL	BNL	BNL	BNL	M&E & BNL	M&E & BNL	M&E	M&E	M&E
Sediment (each roll-off)	1,2	Wet sediment	4		4									2	
Oversize Material	3	Gravel			BNL-1	1	1	1	1	1					
Recycled solvent		Solvent Mixture		1/day											
After 3-stage batch solvent extraction	12	Dry sediment	1/batch		1/batch	1	1	1	1	1					
After 5-stage batch solvent extraction	12	Dry sediment	1/batch		1/batch	1	1	1	1	1					
After 7-stage batch solvent extraction	12	Dry sediment	1/batch		1/batch	1	1	1	1	1					
After continuous solvent extraction	18	Sediment & solvent	1/batch	1/day	1/batch	1	1	1	1	1					
Stabilized & solidified sediment	6A	Concrete product									1	1			1/batch
Stabilized & solidified sediment after solvent extraction	21A	Concrete product									1	1			1/batch
Stabilized sediment	6B	Engineered fill product									1	1			1/batch
Stabilized sediment after solvent extraction	21B	Engineered fill product									1	1			1/batch
Concentrated organics from solvent extraction	13	Oil	1	1		1	1	1	1	1					
Wastewater from pilot study	14	Water	1	1		1	1	1	1	1					
Vent stack	–	Gas		2/day (3)											
Total Estimated Quantity			50	30	51	7	7	7	7	7	4	4		2	50

Notes:

(1) Other disposal parameters to be determined upon selection of TSDF.

(2) USEPA Method 8240 for acetate, direct aqueous injection for alcohol, and Carl Fischer method for % moisture.

(3) Vent is monitored with organics detection instrument twice daily for breakthrough of solvent after the first & second carbon adsorption canisters. Number is not included in total.

– Internal streams to be added later. No detail component sampling is planned.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The roles of each of the M&E team members is provided in Section 1-6 and Figure 1-2 of the Project Work Plan. The field sampling supervisor, Amy C. Zampella will be responsible for project adherence to the QAPP during field and laboratory analysis. She will be the direct contact with the fixed analytical laboratory and oversee the field analyses. The Project Quality Assurance (QA) Manager, Dr. Michael Dennis, will be responsible for assistance on technical aspects of the BNL QA/QC program, which includes: laboratory QA/QC auditing (if necessary), oversight of QA/QC during field activities (as issues arise), and resolution of QA concerns.

Accutest of Dayton, New Jersey will be responsible for analysis of the majority of the project samples. The geotechnical parameter (unconfined compressive strength) will be subcontracted to Golder Associates of Mt. Laurel, NJ.

3.0 OBJECTIVES FOR MEASUREMENT OF DATA

Quality assurance is defined for this remediation process as the ability to confirm that the activities are performed correctly and that the collected data can be confidently relied upon to make remediation decisions. In order to achieve the analytical data requirements that are consistent with the objectives of each task, there will be an assessment of the performance of five data quality parameters. These data quality parameters are precision, accuracy, completeness, representativeness, and comparability. The use of accepted, published sampling and analysis methods, as well as the use of standardized units, shall aid in ensuring useability of the data.

3.1 Analytical Data Levels

To achieve the data quality criteria appropriate for this sediment decontamination pilot study, a combination of laboratory services and field screening techniques will be used. The appropriate analytical levels are distinguished based on the level of data quality and documentation to be used for this project and are discussed below. The analytical levels are based on EPA criteria for screening data and definitive data (Data Quality Objectives Process for Superfund, Interim Final Guidance, EPA 540/R/93/071, September 1993).

3.1.1 Field Screening Data

Field screening provides the lowest data quality, but yields the most rapid results. It will be used for health and safety monitoring to determine the potential human exposure to organic compounds and particulates during site operations. The following air-monitoring equipment will be used for health and safety purposes:

- Photo-ionization detector (PID), Photovac Micro TIP or equivalent
- Aerosol monitor - MIE PDM-3 Miniram
- Gas detector tubes.

A PID will be used for periodic real-time air monitoring for total volatile organic vapors present in the raw sediment and emanating from the process solvents. An MIE PDM-3 Miniram aerosol monitor will be utilized to determine the concentration of airborne particulates from inorganic and semi-volatile organic compounds present in the raw sediment. Gas detector tubes will be used to identify airborne process solvents. The project Health and Safety Plan (September 1996) details the action levels for the project.

The PID will also be used to perform stack air monitoring for measuring compliance with the project air permit. Total organic vapor readings will be measured at the stack outlet and compared to the project stack emission limit of 0.1 lbs./hour. Total organic vapors will also be measured between the carbon canisters and at the stack outlet to determine whether the carbon needs replacement.

Field screening will also be used to determine the specific gravity of the feed material and the strength of the concrete products. Data will be qualitative only. Process control samples (see Section Four) will be analyzed by the field instruments and will be consistent with screening data quality. These field analyses will be confirmed at a rate of approximately 10 percent by quantitative/definitive data analyses.

The following field equipment will be utilized for analysis of process control samples:

- Laboratory glassware and balance for specific gravity
- Field penetrometer for concrete product strength

Results of the field analyses will assist the field team in the evaluation of the efficiency of the pilot system and potential applications for full-scale operation.

3.1.2 Definitive Data (Laboratory Analysis)

Laboratory analyses are designed to provide identification of compounds and corresponding quantification in samples of various matrices. This level of analysis typically provides data to support site characterizations, environmental monitoring, confirmation of field data, engineering studies, and in specific cases, risk assessments. For this project, definitive data will be used to help assess the mass balance/performance goal analysis and process control (see Section 4.0).

Process control samples will be submitted to the laboratory for analysis by the following methods:

Total Organic Carbon (TOC)	USEPA Method 9060
Percent Solvents/Water	
- Isopropyl Alcohol	Direct Aqueous Injection
- Isopropyl Acetate	USEPA Method 8240
- Water	Carl Fischer
Percent Solids/Moisture	USEPA Method 160.3 Modified
Unconfined Compressive Strength (UCS)	ASTM Method D-2166
Toxicity Characteristic Leaching Procedure (TCLP)	
- TCLP Volatile Organics	USEPA Methods 1311/8240
- TCLP Semi-Volatile Organics	USEPA Methods 1311/8270
- TCLP Pesticides	USEPA Methods 1311/8080
- TCLP Herbicides	USEPA Methods 1311/8150
- TCLP Metals	USEPA Methods 1311/6010

The analyses for total organic carbon (TOC), percent solvents/water, and percent solids/moisture will be performed on a 24-hour turnaround.

Results of the laboratory analysis of process control samples will be used to evaluate the pilot system's ability to meet soil performance/cleanup goals.

Results of the TCLP analyses will be used to characterize the treated sediment products as non-hazardous or hazardous materials after processing. The types and frequency of definitive analyses are presented in Table 1-1.

3.2 Data Quality Criteria

Five characteristics of data quality will be considered in assessing the data produced during the sampling and analytical activities. These five characteristics (precision, accuracy, completeness, representativeness, and comparability) are defined and discussed in this section.

All analytical data will be evaluated for precision, accuracy, and completeness. The laboratory will compare precision and accuracy results to method prescribed limits.

3.2.1 Precision

Precision is a measure of agreement among individual measurements of the same property under similar conditions. Precision is expressed in terms of relative percent difference (RPD) between duplicates or in terms of the standard deviation when three or more replicate analyses are performed.

Laboratory precision will be determined through the use of a matrix spike/matrix spike duplicate (MS/MSD) for organic analysis and an MS and laboratory duplicate for inorganic analysis. The RPD between the two results will be calculated as a measure of analytical precision. Field duplicates, collected at a frequency of 5 percent will also be used to measure precision. Field duplicate analysis also provides an estimate of the sample media's actual homogeneity.

The precision is defined as the RPD of the two replicate determinations of the same matrix spike or field duplicate samples:

$$RPD = [(|D_1-D_2|)/(D_1 + D_2) \div 2] \times 100$$

where:

D_1 = first determination
D_2 = second determination

The project objective for the RPD between field duplicates is 50 percent for soil samples and 30 percent for aqueous samples.

3.2.2 Accuracy

Accuracy is defined as the degree of agreement of a measurement (or measurement average) with an accepted reference or true value. It is a measure of system bias and is usually expressed as a percentage of the true value. Accuracy will be determined in the laboratory through the use of MS/MSD, surrogates, laboratory method blanks, and laboratory control samples (LCS). Field blanks will also be analyzed to ensure that the cross-contamination of samples in the field has occurred and that concentrations measured at the laboratory represent the concentrations inherent in the field samples.

MS/MSD samples will be run for organics, while only MS samples will be run for inorganics. The percent recovery of the spiked analyte(s) will give information on the accuracy of the analytical method and procedures in that particular sample matrix. The laboratory will select samples to be analyzed for accuracy for each matrix being submitted, as required by the method.

Information on overall method performance and non-matrix effects will be obtained by calculating spike recoveries for LSC analyses for inorganic parameters. The LCS is comprised of analyte-free water or soil spike with the method analytes of concern.

Laboratory accuracy will also be evaluated by the analysis of method blanks. These blanks will be prepared in the laboratory in a similar fashion as the associated samples of a particular matrix (i.e., soil, water, etc.) and analyzed along with these samples. The results of the analysis of the blanks are a measure of the preparation accuracy and serve as a check on any sample contamination which may be encountered during sample preparation.

The %R for matrix spiked samples is defined as 100 times the observed (measured) concentration, minus the measured sample concentration, divided by the true concentration of the spike.

$$\%R = [(A-B)/T] \times 100$$

where

%R = Percent recovery
A = Measured concentration of the spiked sample
B = Measured sample concentration before the spike
T = True concentration of the spike

The %R for LCS is:

$$\%R = \frac{\text{Actual concentration}}{\text{Theoretical concentration}} \times 100$$

Laboratories shall follow method requirements with regard to spiking compounds and concentrations.

Accuracy criteria are presented in Appendix A.

3.2.3 Completeness

Completeness is a measure of the amount of "valid" data obtained compared to the amount expected to be collected under normal correct conditions. It is usually expressed as a percentage.

Completeness is calculated as the percentage of valid data points obtained compared to the quantities of valid data that were to be collected to achieve particular project requirements. Although formal data validation is not proposed for this project, completeness can be measured by other factors. Data points may not be valid if samples analyzed exceeded holding times and reanalysis of samples was not possible within the holding time, or if sample containers were broken or otherwise destroyed. A completeness criterion of 80 percent is anticipated for laboratory measurements and 70 percent for field screening measurements.

3.2.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a data population, process condition, sampling point, or an environment. Representativeness is a qualitative parameter of the sampling program. Sample collection procedures are described in Section Four. Representativeness is highly dependent on proper sample collection techniques that can be evaluated through the analysis of field duplicate samples and comparison with previous data sets.

3.2.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. To achieve comparability in this project, the data generated from aqueous matrices shall be reported using units of mass to volume, such as μg/L or mg/L and data for solid matrices will be reported in mass-to-mass units such as μg/kg or

mg/kg based on a dry weight. All sampling and analysis procedures used shall be consistent with pre-established procedures for USEPA protocols. For consistency, M&E will utilize the same analytical laboratory for the entire pilot study project.

Control limits for definitive (laboratory) data quality control are given in Appendix A. Control limits for field screening data are provided in Table 3-1. When values are outside these limits, then the cause of the exceedances will be determined and corrective action will be taken.

Table 3-1 QA Objectives for Field Screening Measurements

Parameter	Analytical Method	Precision[1]	Accuracy[2]	Completeness
Specific Gravity	Field Screening	50%	NA	70%
Concrete Strength	Field Penetrometer	50%	NA	70%

NOTES:

1. Precision - Relative percent difference (RPD) between duplicate field analyses for sample analyses; acceptable deviation from the scale for all other analyses.

2. Accuracy - Based on equipment manufacturer's specifications.

NA - Not available

4.0 SAMPLING PROCEDURES

4.1 Sampling Objectives, Locations, and Frequency

The objective of M&E's analytical program is to obtain quality data for successful operation of the sediment decontamination system. M&E will also collect samples for BNL's analysis for other target parameters, as discussed in the BNL QAPP.

The following presents the objectives and approach for each type of sample, proposed sampling locations, and estimated frequency of sample collection. The sampling locations are referenced as stream numbers in Figure 3-1, Block Flow Diagram for Sediment Decontamination part of the Project Work Plan.

4.1.1 Process Control Samples

The objective of process control sample analysis is to provide, to the extent practicable, real-time information as to the effectiveness of the sediment decontamination system in treating New York Harbor sediments. Process control samples will be collected from the feed sediment and throughout the soil washing pilot study. Samples will be collected from matrices to be generated during processing (Table 1-1). The sampling frequency is estimated as one set of process matrices per day. The sampling frequency may increase/decrease based on process conditions and the number of actual equipment settings.

4.1.2 QA/QC Samples

QA/QC samples will be collected as a check on field sampling activities, as detailed in Section 9.0 of this QAPP. Field blanks will be collected and analyzed for organic analyses of aqueous matrices only. Field blanks will not be necessary for the analytical parameters

of concern. Trip blanks will not be necessary for this project since volatile organic compounds will not be analyzed by M&E. Field duplicate samples will be collected at a frequency of 5% for all samples collected at the site.

4.2 Sample Collection

Process control samples will consist of composite samples collected at regular intervals. If necessary, the oversized material (> 1-inch) will be crushed to 1/4-inch material. Sediment samples will be collected using decontaminated stainless steel trowels and placed in laboratory prepared glass containers for off-site analysis. Sediment samples for field analysis will be placed in clean glass or plastic (high-density polyurethene) containers and analyzed for specific gravity analysis. Field penetrometer readings will be collected directly in the concrete product molds. The Appendices detail the procedures for analysis of some of these field parameters.

Field duplicate samples will be collected at a frequency of 5 percent of the number of process control samples collected for that analysis (Table 4-9).

At the time of sample collection, all samples will be labeled with the following, in accordance with accepted sample identification protocol:

- Sample identification number;
- Date and time of sample collection;
- Initials of the sample collector.

TABLE 4-9
FREQUENCY AND TYPES OF FIELD QA/QC SAMPLES

	Total Organic Carbon	Percent Moisture	Percent Solvents/ Water	Unconfined Compressive Strength	Full TLCP	Specific Gravity (field analysis)	Concrete Strength (field analysis)
Duplicates							
Sediment	5%	5%	5%	5%	0	5%	5%
Wastewater	5%	NA	5%	NA	NA	NA	NA

NA = Not applicable to the matrix.

4.3 Equipment Decontamination

All reused sampling equipment will be decontaminated prior to use in accordance with the following procedures:

- Wash and scrub with non-phosphate detergent;
- Tap water rinse;
- Rinse with 10 percent nitric acid (if analyzing for inorganics);
- Tap water rinse to remove residual nitric acid;
- Acetone solvent rinse (if analyzing for organics);
- Analyte free (deionized and distilled) water rinse;
- Air dry; and,
- Wrap in aluminum foil, shiny side out, until use.

The solvents and analyte-free (deionized and distilled) water will be obtained from an environmental supply company.

4.4 Sample Packaging, Storage, and Shipping

4.4.1 Process Control Samples

Process control sediment samples for feed will be collected, and in most cases, analyzed immediately. If the sample will not be analyzed immediately, it will be refrigerated or placed on ice to maintain a temperature of 4°C (Table 7-2). These samples will be stored in the field trailer during analysis. Soil samples for off-site analysis will be packaged, stored, and shipped as detailed in Section 4.4.2.

4.5 Sample Custody

Custody of samples must be maintained and documented from the time of sample collection to completion of analysis. A sample is considered to be under a person's custody if:

- The sample is in the person's physical possession
- The sample is in view of the person after that person has taken possession
- The sample is secured by that person so that no one can tamper with the sample
- The sample is secured by that person in an area which is restricted to authorized personnel

Process control field samples will be in the custody of the field sampling team.

All samples will be accompanied to the laboratory by a chain-of-custody form. The chain-of-custody from contains the following information:

- Project name
- Sample ID numbers
- Sampling date
- Time of collection of samples
- Name of personnel collecting the samples
- Name of personnel having custody of samples
- Times personnel have custody of samples
- Analyses requested
- Preservatives used

When the samples are transferred from one party to another (e.g. Field Sampling Engineer to courier or carrier), the individuals will sign, date, and note the time on the form. A separate chain-of-custody form will accompany each sample delivery to the laboratory. The sampling personnel will retain a copy of the form.

4.5.1 Laboratory Operations

To enable the laboratory to track the shipment of samples, the field sampling supervisor or team member will telephone the laboratory's sample receiving Manager following shipment and provide the following information:

- Exact number and type of samples collected and the sample identification numbers;
- Carrier and bill of lading number(s);
- Estimated date and time of arrival at the laboratory; and,
- Other pertinent information including special handling instructions and changes in scheduled sampling or analysis activities.

Receipt of samples at laboratories is controlled by their QA/QC procedures.

4.5.2 Laboratory Sample Custody Procedures

Once samples are received at the laboratory, laboratory custody procedures will apply. It is the laboratory's responsibility to maintain custody records throughout sample preparation and analysis. Upon receipt, all incoming samples are inspected for overall conditions and compared against the list on the chain-of-custody form. The following information is contained on the chain-of-custody form:

- Client name, address, and contact person
- Sample ID
- Date and time sampled
- Analysis methods requested
- Name of person having custody of the samples
- Preservatives used
- Number and type of container

Upon sample receipt a laboratory representative shall:

- Examine all samples and determine if proper temperature has been maintained during shipment. Samples broken or damaged during transport will be noted on the chain-of-custody form and removed from the sampling program. Field personnel will be notified as soon as possible that samples were damaged, and that they must be re-sampled, or the sampling and analysis program changed.
- Compare samples received against those listed on the chain-of-custody.
- Verify that sample holding times have not been exceeded.
- Sign and date the chain-of-custody form and attach the bill of lading to the chain-of-custody forms.
- Establish or continue chain-of-custody by listing the samples in the laboratory master sample log which contains the following information:
    - Project identification number
    - Sample numbers, both field and unique laboratory control
    - Type of samples
    - Date received in laboratory
    - Preservation
- Place samples in appropriate storage areas and notify laboratory operations manager of sample arrival.
- Initiate a laboratory chain-of-custody record for each sample to ensure that each handling of the sample is properly documented.
- Place the completed chain-of-custody records in the project file.

4.5.3 Laboratory Storage of Samples

Samples shall be maintained in cool/cold storage within a secured area prior to sample preparation and analysis. Storage refrigerators are maintained at 4°C; and the temperature is monitored and recorded daily in a bound logbook.

Refrigerator storage is designed to segregate samples to prevent cross-contamination and sample mix-up. Analysts request samples for analysis from the sample custodian, and both sign the chain-of-custody acknowledging transfer of custody to the analyst.

5.0 RECORDKEEPING

Information generated through site activities and field sampling efforts will be recorded in both field logbooks and field data sheets.

5.1 Field Logbooks

The Field Operations Site Manager will maintain a general logbook to document Site activities. Information contained in the general logbook will include:

- Daily start and completion dates and time;
- General description of days' activities;
- Summary of discussion with Project Manager, BNL, and the laboratory;
- Times of site meetings;
- Date, time, and purpose of site visitors; and,
- Other issues as warranted.

The field sampling team will also keep a sampling record logbook to document sampling procedures. This logbook will include the items detailed above, as well as any sampling issues. All logbook entries will be recorded in black or blue ink. Corrections made to any entry will be performed by drawing a single line through the incorrect information and inserting the new information at the same location.

5.2 Field Data Sheets

The field data sheets will be used to document sample collection and other pilot study data. For sample collection the type of information anticipated to be contained on the field data sheets includes:

- Sample number date and time of collection;

- Name of sample collector;
- Location of sample;
- Results of field meter readings;
- Identification of samples comprising the composite sample, where appropriate;
- Unique sample number designated for split or duplicate samples; and,
- Identification of the laboratory analyzing the samples.

Field data sheets will also be used to document system measurements of feed material and materials generated by the sediment decontamination unit. In addition, a daily site progress form may also be used in the field to document field activities.

6.0 EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCIES

All field equipment and instruments used to perform various measurements during the course of the sampling effort will be maintained, calibrated, and operated according to the manufacturer's guidelines and recommendations. Proper maintenance, calibration, and operation of each instrument will be the responsibility of the Sampling Supervisor. Procedures for calibration of the Photovac MicroTip and the aerosol meter are detailed in Appendix B.

Calibration of laboratory equipment is discussed within Section 7.0.

7.0 ANALYTICAL PROCEDURES

7.1 Analytical Methods

The analytical methods to be used for off-site laboratory analysis and on-site field analysis of samples collected at the Site are listed in Tables 7-1 and 7-2, respectively. The purpose of the analytical program is to establish whether the specified system performance goals (see Section One) have been met and to provide process control data for the sediment decontamination process.

7.2 Project-Specific Detection Limits

7.2.1 Process Control Samples

The method detection limits (MDLs) for analyses are detailed in the method listed in Table 7-1.

7.3 Practical Quantitation Limits

The practical quantitation limits for each method will be noted in the laboratory analysis.

7.4 Method Calibration

This section discusses calibration policies pertinent to the laboratory sample analysis. Calibration is a method of verifying that equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and equipment that measure a quantity, or whose performance is expected to be at a stated level, are subject to calibration. All laboratory calibration will be performed in accordance with EPA SW846.

Table 7-1

Analytical Methods, Preservatives, and Holding Times - Mass Balance/Performance Goal Samples

Parameter	Matrix	Method No.[1]	Holding Time[2,3]	Container[4]	Preservative
Total Organic Carbon	Soil	9060	28 Days	Glass	Cool 4°C
Percent Solvents/Water: Isopropyl Alcohol	Solvent Mixture	8015 (Direct Aqueous Injection)	14	Glass	Cool 4°C
Isopropyl Acetate	Solvent Mixture	8240	14	Glass	HCL < pH 2, Cool 4°C
Water	Solvent Mixture	Carl Fischer	NA	Glass	Cool 4°C
Percent Solids/Moisture	Sediment	160.3 modified	NA	Glass	Cool 4°C
Unconfined Compressive Strength	Stabilized Sediment	ASTM D2166	NA	Glass	NA
TCLP Volatile Organics	Soil	1311/8240	14/14	Glass	Cool 4°C
TCLP Semi-Volatile Organics	Soil	1311/8270	14/7/40	Glass	Cool 4°C
TCLP Pesticides	Stabilized Sediment	1311/8080	14/7/40	Glass	Cool 4°C
TCLP Metals	Stabilized Sediment	1311/6010	180	Glass	Cool 4°C
TCLP Herbicides	Stabilized Sediment	1311/8150	14/40	Glass	Cool 4°C

(1) Methods from SW846-"Test Methods for Evaluation Solid Waste, Physical/Chemical Methods", USEPA SW-846, 3rd Edition, September 1986, and from 100-200 Methods - "Method for Chemical Analysis of Water and Wastes", USEPA 600/4-79-020, March, 1983.

(2) Holding time is from the date of sampling to analysis. If two numbers are present, holding time is to extraction (first number) and then analysis (second number).

(3) TCLP holding times are: from field collection to TCLP extraction/TCLP extraction to preparative extraction/preparative extraction to analysis.

(4) Laboratory prepared and supplied with preservative.

Table 7-2

Analytical Methods, Preservatives and Holding Times
Process Control Samples

Parameter	Matrix	Method No.	Holding Time	Container	Preservation
Specific Gravity	Sediment	Field Screening	Analyze immediately	Glass beaker	NA
Concrete Strength	Concrete Products	Field Penetrometer	Analyze immediately	Concrete mold	NA

Instrument calibration typically consists of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. All sample measurements are made within the calibrated range of the instrument. Only standards traceable to National Institute of Standards and Technology (NIST) or EPA approved standards are used for calibration. The instrument response, (absorbance, peak height, etc.), over the range generally can be expressed as a linear model with a correlation coefficient, as a response factor, or mass versus response plot.

Continuing calibration usually includes measurement of the instrument response to fewer calibration standards than the five used in the initial calibration. It also requires instrument response to be compared to the initial instrument calibration response. Continuing calibration checks will be used within an analytical sequence to verify stable response throughout the sequence, and/or to demonstrate that instrument response did not drift during a period of instrument non-use. Check standards are analyzed every ten samples and at the end of each run to ensure that the instrument calibration is correct.

7.5 Standards and Reagents

7.5.1 Field

Records will be kept of the source of field decontamination solvents and deionized water used for field analysis.

7.5.2 Laboratory

All standards and laboratory reagents are dated upon receipt. The preparation and use of all standards are recorded in bond laboratory notebooks that document standard traceability to EPA or NIST standards. Additional information recorded typically includes the date of preparation, concentration of the prepared standard, and the name of the preparer.

8.0 DATA MANAGEMENT

This section describes the data reduction, review, and reporting procedures that will be used by the laboratory. Primary responsibility for implementation of these procedures within the laboratory resides with the Field Sampling Supervisor. The Field Sampling Supervisor approves all data reports before transferring the information to M&E. M&E then ensures that laboratory data are in compliance with QAPP specifications. Final responsibility for review, approval, and reporting of data resides with the M&E Project Manager.

Data processing begins with the collection of data and continues through the reduction and review processes to the final data reporting procedure. This process is outlined in the following sections.

8.1 Data Collection

8.1.1 Field

The field data generated during analysis of the process control samples will be recorded on project data sheets. The samples will be identified with the following: unique sample number, analytical parameter, time and date, analyst, instrument settings, results, and any comments on descriptions pertaining to the analysis. The field sampling supervisor will oversee all field sampling results.

8.1.2 Laboratory

The laboratory analytical data are usually recorded in the laboratory's computer system (i.e., Laboratory Information Management System (LIMS)) Data recorded include: a unique sample identification number, a project sample identification number, the analytical method used, the analyst's signature and date of analysis, reagent concentrations, instrument settings (where applicable), raw data, and any comments or descriptions pertinent to the analysis.

The laboratory analysts must sign and date all notebook entries daily. The notebooks shall be available for periodic review by the appropriate laboratory section manager or during an audit of the laboratory section, M&E, or their designated representatives.

8.2 Data Reduction

8.2.1 Field

The field data will be reduced into tables from the handwritten data sheets using Lotus 1-2-3 (Version 2.2, 2.4 or 3.1) by M&E personnel after it has been confirmed by the sampling team.

8.2.2 Laboratory

Data reduction is performed by experienced chemists and consists of automatic calculation of concentrations of analytes in samples from the raw data generated within the analytical instruments. The complexity of the data reduction depends on the specific analytical method and the number of discrete operations (extractions, digestions, dilutions, concentrations) involved in obtaining an aliquot that can be analyzed.

8.3 Data Review

8.3.1 Field

The Lotus summary tables will be checked against the field data sheets by the sampling supervisor or team member. A third party will check the tables to the data packages at a rate of 10 percent of the samples. Formal validation is not required for this project.

8.3.2 Laboratory

System reviews are performed at all levels. The individual analyst constantly reviews the quality of data through calibration checks, quality control sample results, and performance evaluation samples. These reviews are further verified by a laboratory supervisor prior to data submission. The final routine review and approval is performed by the Field Sampling Supervisor prior to reporting the results to the client. The Field Sampling Supervisor checks information and completeness of the documentation. The Field Sampling Supervisor will check all data against the QC requirements of the client. Formal data validation is not required for this project.

8.4 Evaluation of Laboratory Data

The laboratory shall apply precision and accuracy acceptance criteria to each parameter that is analyzed. When analysis of a sample set is completed, the quality control data will be reviewed and evaluated to the control limits detailed in this QAPP.

A minimum of ten measurements of precision and accuracy are required before control limits can be established. Once established, control limits are updated on a periodic basis and as additional precision and accuracy data become available.

8.5 Data Reporting

8.5.1 Field

The final field data will be incorporated into the draft project report as Lotus tables, project data sheets, and a data assessment. Concentrations and significant figures will be reported as discussed in Section 8.5.2.

8.5.2 Laboratory

The final laboratory data report will be checked and approved by the QA/QC Officer. Data will be presented in a tabular format whenever possible and will be in the "New Jersey Reduced Deliverables" laboratory report format required by Level III quality control. Reports shall contain final results uncorrected for blank contamination or spike recoveries. The number of significant figures reported must be consistent with the limits of uncertainty inherent in the analytical method; most analytical results are reported to no more than two significant figures. Data are normally reported in units commonly used for the analyses performed. For this project, concentrations in liquids are expressed in terms of weight per unit volume (e.g., μ_b/L). Concentrations in solid or semi-solid matrices are expressed in terms of weight per unit weight of sample (e.g., mg/kg) based on a dry weight.

In order to assure compliance with the specifications of this QAPP and in order to assure information is available within project files, the laboratory data package will consist of the following minimum information:

- Client's name and project name/identification;
- Summary report of laboratory QA/QC review;
- Sample identification number;
- Contractor laboratory report identification;
- Date sample was taken;
- Date sample received;
- Date sample extracted;
- Date sample analyzed;
- Methods or procedure used for analysis;
- Sample results and results of associated quality control sample analysis;
- Percent moisture, for soil samples only; and,
- Copy of the chain of custody form.

Analytical results including all raw data and bench sheets, all associated instrument calibration records and laboratory quality control analyses and records will be maintained by the laboratory for at least five years.

9.0 INTERNAL QUALITY CONTROL CHECKS

QC samples in both the laboratory and the field are used internally to ensure the quality of all sample analyses. Lab analyses performed in support of this investigation shall use standardized laboratory procedures. The QC program uses both known and unknown (or "blind") QC samples. Laboratory QC samples include continuing calibration, verification, method/reagent blanks, matrix spike/matrix spike duplicates, and surrogate spikes. Field QC samples include: trip blanks, equipment blanks, and field duplicates. Process control sample QC include reference standards, method blanks, and field duplicates. Tables 9-1 and 9-2 summarize the laboratory QC sample types and frequencies.

Table 9-1 QC SAMPLE TYPES AND FREQUENCY

Laboratory Analysis - ACCUTEST

Type	Purpose	Frequency
Method blank	Verifies clean reagents, instrument systems, and lab environment	1 per 12-hour analysis day per batch (volatiles only) 1 per batch of 20 samples (other parameters)
Laboratory replicates (including matrix spike duplicates)	Precision check on analytical method	At least one per batch of 20 samples as supplied from the field
Initial calibration verification	Verifies calibration curve	1 per batch of samples in an analytical sequence
Continuing calibration verification	Verifies calibration curve	1 for every 10 samples analyzed sequentially
Internal standard for organics only	Check on instrument stability; identifies specific matrix effects	All samples and standards

Table 9-1 QC SAMPLE TYPES AND FREQUENCY Laboratory Analysis - ACCUTEST		
Type	Purpose	Frequency
Surrogate spike for organics only	Verify accuracy of analytical data. Identify matrix effects	All samples and standards
Matrix spike/matrix spike duplicate for organics	Identify sample specific matrix effects	At least one per 20 field samples and one per matrix
Matrix spike for inorganics	Identify sample specific matrix effects	At least one per 20 field samples and one per matrix
Laboratory control sample for inorganics	Checks method performance	At least one sample per batch of 20 samples as supplied from the field

Table 9-2 QC SAMPLE TYPES AND FREQUENCY Field Analysis		
Type	Purpose	Frequency
Field duplicate	Check on the positive or negative measurements and variability in sample matrix	One sample per batch of 20 samples as supplied from the field
Field replicate	Check on analytical screening method	One sample per batch of 20 samples analyzed

9.1 Field QC

9.1.1 Field Duplicates

Field duplicates are prepared in the field in order to assess that the samples collected are representative of the pilot study conditions. Duplicates are prepared by homogenizing, or

mixing a large portion of a sample and placing equal amounts of a sample into two sets of containers. Duplicates will be collected at a frequency of one per 20 samples and will be submitted "blind" to the field lab or stationary lab. The true identity will be documented in field logbooks.

9.1.2 Field Replicates

Field replicates are prepared by taking equal aliquots of a collected sample for analysis. The field sampling technician will take aliquots of a sample and conduct analysis for specific gravity or the field penetrometer using the same procedure on each sample. Replicates are a check on the field screening technique.

9.2 Laboratory Analysis Generated QC Samples

The laboratory shall comply with the QC sample requirements for each analytical method specified. The QC sample types required for lab and field parameters are described below.

9.2.1 Initial Calibration Verification

Initial Calibration Verification (ICV) will be performed for inorganics matrices to verify the accuracy of initial calibration. The ICV standard will be analyzed immediately following the initial method calibration as the first sample in the analytical run to confirm the validity of the calibration curve.

9.2.2 Continuing Calibration Verification

Continuing calibration verification (CCV) shall be performed in accordance with EPA SW846. A CCV is chosen as one of the mid-range working calibration standards that is reanalyzed periodically throughout the sample analysis to verify that the original calibration is still valid.

9.2.3 Method/Reagent Blank

At least one method/reagent blank shall be analyzed with each sample batch tested at the laboratory, and each day of field analysis activities. A method blank is comprised of laboratory-pure, analyte-free water carried through the entire sample preparation and analysis procedure. Analysis of the method blank provides a check of the background contamination due to sample preparation procedures.

9.2.4 Matrix Spike/Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) (organics), and matrix spike (inorganics) shall be performed every 20 samples, or once for every group of less than 20 samples. Matrix spikes and matrix spike duplicates shall be performed for each group of samples submitted to the laboratory by M&E having a similar concentration range and matrix composition. MS/MSDs will not be collected in the field, but designated by the laboratory. The analyte spike shall be added prior to extraction/digestion/distillation of the sample. If the spike recovery is not within the acceptance criteria limits specific to this project, the data of those samples associated with that spiked sample must be evaluated appropriately.

9.2.5 Internal Standards

All collected samples requiring organic analysis by gas chromatography/mass spectometry shall be spiked with internal standards prior to analysis. The internal standards utilized will be as specified in the organic methods. Analysis for the internal standards provides a check on instrument stability. A drop or increase of internal standard area counts reflects a change in instrument sensitivity. This sensitivity can be caused by a matrix effect.

9.2.6 Surrogate Spikes

All collected samples requiring organic analysis by gas chromatography/mass spectrometry (including GC/MS) shall be spiked with surrogate standards prior to sample preparation. The surrogate standards encompass the range of organics types to be analyzed in the sample, and shall also serve as checks on any matrix interference exhibited by the samples. If the percent recoveries of the surrogates are outside acceptable limits, the associated samples will be reanalyzed.

9.2.7 Laboratory Control Sample

At least one Laboratory Control Sample (LCS) shall be analyzed with each inorganic sample batch. A LCS is comprised of analyte free water or soil spiked with the method analytes of concern. Analysis of the LCS provides a check on the method performance and non-matrix effect.

10.0 CORRECTIVE ACTION PROCEDURE

10.1 Field Corrective Action Procedures

The following table describes the corrective actions that will be taken to remedy out of control conditions, should they occur.

Table 10-1 TYPICAL CONDITIONS AND CORRECTIVE ACTIONS FOR FIELD PARAMETERS

Parameter	Condition	Corrective action(s)
Field instruments	Out of calibration or not calibrating	· Clean probes and recalibrate. · Obtain fresh calibration standard solutions. · Perform maintenance check on instrument. · Obtain new instrument
	Questionable Readings	· Check calibration and reanalyze

Should an out of control condition be identified, the Project Manager will be notified to verify the corrective actions that should be taken. The Project Manager will prepare a letter report summarizing the out of control condition, corrective actions taken, and data affected by the out of control condition.

10.2 Laboratory Activities

Corrective action procedures in the laboratory are often initiated by the analysts directly involved with the analysis of the samples. The laboratory analyst shall verify that all quality

control procedures are followed and that the results of the analysis of quality control samples are within the acceptance criteria. This requires that the analyst assess the correctness of all of the following items as appropriate:

- Sample preparation procedure;
- Initial calibration;
- Calibration verification;
- Method blank result; and,
- Spiked sample result.

If the assessment reveals that any of the QC acceptance criteria have not been met, the analyst must immediately assess the analytical system to locate and correct the problem. The analyst notifies the appropriate supervisor and QA/QC director of the problem and, if possible, identifies potential causes and corrective action. In turn, the QA/QC director shall notify M&E if the quality of data deliverables has been compromised or if the laboratory has determined that the problem is field related. All out of control issues and resolutions are documented by the laboratory and submitted to M&E as part of the data package deliverable.

The nature of the corrective action depends on the nature of the problem. For example, if a continuing calibration verification is determined to be out of control, the corrective action will require recalibration of the analytical system and reanalysis of all the samples analyzed since the last acceptable continuing calibration standard was run.

When the appropriate corrective action measures have been defined and the analytical system is determined to be "in control", the analyst documents the problem and the corrective action. Table 10-2 presents a summary of typical corrective actions used in the laboratory.

Data generated with an out-of-control system shall be evaluated for usefulness in light of the nature of the deficiency. If the deficiency does not impair the usefulness of the results, data are reported and the deficiency is noted. Where the usefulness of the sample results are impaired, the laboratory project manager is notified and appropriate corrective action (e.g., reanalysis) is taken.

Routine corrective action shall take place as necessary and does not require the approval of the M&E QA/QC manager. However, should significant events occur such as sample breakage or loss, exceeding sample holding times, extensive instrumentation downtime, or changes and additions to sample clean-up for removal of interferences, the laboratory shall report these events to M&E immediately.

Corrective actions are also initiated as a result of other project QA activities including performance audits, systems audits, and laboratory comparison studies.

Table 10-2. TYPICAL CORRECTIVE ACTIONS				
Corrective action level	Condition	Personnel Involved	Probable Cause	Resolution
Primary	Daily calibration is out	Bench Chemist	Instrument calibration	Recalibrate and proceed
	Retention time shift		Leak, improper temperature, etc.	Fix and proceed
	Other instrument malfunction		Change in sensitivity (defective lamp or detector)	Fix and proceed
Secondary	QC samples out of control	Bench Chemist	Preparation procedure	Reextract or redigest all affected samples and proceed.
		Supervisor and/or Manager	Standards mix	Prepare new standards and proceed.
		QA Officer	Spike mix	Prepare new spike mix; reextract or redigest all affected samples and proceed.
			Reagents	Change reagents; reextract or redigest all affected samples and proceed.

Table 10-2. TYPICAL CORRECTIVE ACTIONS

Corrective action level	Condition	Personnel Involved	Probable Cause	Resolution
Tertiary	Methods not followed Holding times not met QC spike frequency too low	Bench Chemist Supervisor Manager QA Officer Lab President (if needed) Corporate Vice President of QA (if needed)	Persistent problem or unidentifiable cause	Retrain chemist. Reorganization of a specific area (i.e., GC Laboratory, etc).

Definitions:

Corrective Action Level - Level is determined by the severity of the problem and the level of staff required in the corrective action process.
Condition - The observation that led to the discovery of the problem.
Personnel Involved - Represents the level of staff involvement that may be necessary in the corrective action process.
Probable Cause - Area of investigation to correct the condition observed.
Resolution - Procedure taken to correct the problem and restore proper functioning of the analytical system.

ATTACHMENT A TO QAPP

PROCEDURES FOR MEASURING PERCENT SOLIDS

PROCEDURE FOR MEASURING PERCENT SOLIDS

Percent solids content of some liquid samples will be determined through weight measurement of dried residue consistent with standard methods for solids analysis. Field sampling technicians will utilize paper filters and a vacuum pump for the percent solids determination. The following procedures will be employed:

1. Weigh the filter paper on a balance.

2. Pipette approximately 5 to 10 ml of the liquid sample into the vacuum filter fitted with the filter paper.

3. Separate the water from the solids with the vacuum pump.

4. Air dry the residue remaining on the filter paper.

5. Weigh the filter paper containing the dried residue.

6. Record all measurements in the field notes.

APPENDIX A

ACCUTEST'S PRECISION & ACCURACY DATA
(Available at M&E Field Trailer)

APPENDIX B

FIELD INSTRUMENT CALIBRATION PROCEDURES

Aerosol Meter Calibration

16.3 Z-Bag™ Calibrator

The Z-Bag™ is a convenient kit for zeroing the MINIRAM in the field. It provides a clean-air environment inside a plastic bag into which the MINIRAM is placed for zeroing. The Z-Bag kit consists of a one-way flow rubber bulb for manual air pumping, a filter cartridge, a zippered plastic container, and connecting hardware.

To use Z-Bag for zeroing MINIRAM proceed as follows:

1. Remove rubber bulb filter assembly from Z-Bag. Place Z-Bag on flat surface with red flow fitting facing up. Flatten bag. Remove small plastic cap from flow fitting on bag.
2. Insert ribbed elbow connector (attached to filter cartridge) into red flow fitting of plastic bag, until connector is flush with bottom of red flow fitting.
3. MINIRAM should be in its OFF condition (observe display). If display is blanked, or if MINIRAM is in the MEAS mode, key OFF.
4. Open Z-Bag and place MINIRAM inside, approximately at its center.
5. Key ZERO through the open end of the Z-Bag. Immediately zip closed the Z-Bag and begin to pump hand bulb.
6. Z-Bag should inflate as hand pumping continues, up to a height of about five inches (12 cm). Continue pumping gently to maintain bag interior pressure, until the MINIRAM displays OFF again.
7. Unzip Z-Bag and remove MINIRAM. MINIRAM is now ready for monitoring.
8. Place rubber bulb/filter assembly inside Z-Bag, and plug small plastic cap into flow fitting to close it. Zip close while flattening Z-Bag to store it to ensure cleanliness of the bag interior.

CAUTION: Do not expose Z-Bag to sub-zero freezing temperatures as the plastic zippered bag may crack.

16.4 Carrying Case (MIE model PDM-HC)

The PDM-HC is a convenient and compact hard shell carrying case designed to house a MINIRAM and a battery charger. The inside is foam padded for full protection. The outside dimensions of the PDM-HC-1 are: length - 9 1/2 inches, depth - 7 inches, and height - 3 1/2 inches.

16.5 Other Standard Accessories

Other accessories supplied with the MINIRAM are:

- Output connectors (can be used for the analog, and/or the digital output jacks)
- Hexagonal wrenches for flow accessories
- Instruction Manual

OVM/DATALOGGER

MODEL 580B

Thermo Environmental Instruments Inc.

4.4 580B CALIBRATION

The following procedure is applicable for both Cylinder and Bag Standards. The sequence requires both Zero gas and Span gas to be used. Span gas can be either contained as a cylinder or bag, in either case the exact concentration used must be known. This concentration will be entered to the 580 when the program provides its entry. With respect to Zero gas, there are several choices. Obviously a certified zero air standard in a cylinder presents no problem. Another choice would be to build a zero air standard in a bag. This can be simply accomplished with the set-up in Figures 4.1 and 4.2 using a charcoal scrubber to remove all the hydrocarbons present in the air. Charcoal does not absorb Methane; this does not cause a problem because the PID does not respond to it. Another approach which could be used in an emergency is to use room air unscrubbed.

This is acceptable if you know that there are no hydrocarbons present or they are exceptionally low in concentration. However, it is not recommended as a standard practice. The physical set up for cylinder calibration is illustrated in Figure 4.1; bag calibration in Figure 4.2.

4.4.1 CALIBRATION ROUTINE

(A) Set-up calibration assembly with zero air cylinder or bag as described in Figures 4.1 and 4.2.
(B) Model 580B set-up and zero calibration.

1. Power-up instrument using power plug.
2. Depress ON/OFF Key to ignite lamp and initiate sample pump.
3. Depress MODE/STORE Key.
4. Depress-/CRSR Key in response to LOG THIS VALUE? Prompt.
5. Depress-/CRSR Key to select Parameters Mode from the Main Menu.
6. Depress +/INC Key to advance thru the Run Mode selection parameter prompt.
7. Depress +/INC Key to advance thru the Auto Logging Mode selection parameter prompt.
8. Depress +/INC Key to advance thru the Average Time selection parameter prompt.
9. Depress +/INC Key to advance thru the Alarm Setting parameter prompt.
10. Depress +/INC Key to advance thru Lamp Selection parameter prompt.
11. Depress +/INC Key to advance thru Response Factor Setting parameter prompt.
12. Depress RESET Key to initiate calibration sequence.
13. Depress-/CRSR Key to decline restoration of the backup calibration.
14. Connect outlet of calibration tubing assembly to the Model 580B Detector Inlet as illustrated in Figure 4.2.
15. Introduce Zero Air to Model 580B by opening flow regulator.

16. Depress RESET Key to "Zero" Model 580B.
17. Close Flow Regulator.

(C) Span Calibration - assuming that the Span gas has a concentration of 250 ppm isobutylene the following procedure is followed:

18. Simultaneously Depress RESET and -/CRSR Keys to activate the movable cursor.
19. Repeat Step 18 until the cursor is at the ones place.
20. Simultaneously Depress RESET and +/INC Keys to increment the ones place value.
21. Repeat Step 20 until the ones place value reads 0.
22. Repeat Step 18 to move cursor to the tens place.
23. Repeat Step 20 until the tens place value reads 5.
24. Repeat Step 18 to move the cursor to the hundreds place
25. Repeat Step 20 until the hundreds place value reads 2.
26. Repeat Step 18 to move the cursor to the thousands place.
27. Repeat Step 20 until the thousands place value reads 0.
28. The LCD should now read:

SPAN PPM = 0250
"+" TO CONTINUE

29. Depress +/INC to accept the span conc. value.
30. Connect isobutylene cylinder (250 ppm) to calibration tubing assembly.
31. Connect outlet of calibration tubing assembly to the Model 580B Detector Inlet.
32. Introduce isobutylene standard to Model 580B by opening flow regulator.
33. Reset key to "CALIBRATE" Model 580B.
34. Close Flow Regulator.
35. Depress +/INC. Key in response to "RESET" TO CALIBRATE message.
36. Depress MODE/STORE to return to the Run Mode.

The instrument has been calibrated and is ready to make measurements.

4.5 DETERMINATION OF RESPONSE FACTORS

As mentioned above, the Model 580 can be calibrated with isobutylene but be set to read correctly, the concentration of another substance. This is done by using the Response Factor that is set in the parameter routine. The default for the response factor is 1.0. The Response Factor is the number that is multiplied by the measured concentration to obtain the correct concentration of the measured component. If the chemical to be measured is less sensitive on a PID than the standard, (usually isobutylene) then the Response Factor is greater than 1.0. If it is more sensitive than the standard then the Response Factor is less than 1.0.

The reason for a Response Factor is practicality. If it is

APPENDIX C

FIELD SCREENING PROCEDURES FOR SPECIFIC GRAVITY

Field Screening Procedures for Specific Gravity

The specific gravity will be determined using a graduated cylinder and a scale. Approximately 100 ml of sediment will be weighed to calculate the density and specific gravity. At times the related % moisture will be analyzed by the laboratory of a sample from the same lot.

APPENDIX D

FIELD PENETROMETER OPERATIONS

Model CL-700A
POCKET PENETROMETER

TECHNICAL DATA

ELE International

ELE International Inc.
P.O. Box 6004, 95 Aberdeen Drive
Lake Bluff, Illinois, USA 60044-6004

SOILTEST Products Division

CL-700A POCKET PENETROMETER

The Pocket Penetrometer was developed by Soiltest, Inc. for use by field engineers to check the visual classification of soils. The readings of the Penetrometer were compiled from several thousand unconfined compression tests of silty and clay-like soils.

OPERATION

* The red ring on the barrel of the Penetrometer holds the maximum reading of the scale for easy reading.
* Slide the ring down against the instrument handle.
* Grip the knurled portion of the handle and push the tip of the Penetrometer into the soil to the groove located 1/4" from the tip.
* Read the unconfined compression strength directly in tons per square foot (TSF) or kilograms per square centimeter (kg/cm2) from the scale. The reading is located on the lower side of the red ring.

SPECIAL NOTES

* Select test spots with a smooth surface.
* Hold the Pocket Penetrometer at right angles to the surface being tested.
* To minimize errors, take several readings near each other, discard those readings which may vary significantly from the majority and average the readings.
* When the CL-701 Adapter Foot is used for very soft soils, divide the reading by 16 to obtain the correct compression strength of the soil. Push the foot into the soil the total thickness of the Adapter Foot.

APPENDIX D

ANALYTICAL RESULTS

PURPOSES OF PHYSICAL TESTS PERFORMED ON S/S MATERIAL

Specific Gravity

Specific gravity of a solid substance is the ratio of its weight to the weight of an equal volume of water. In dealing with soils, the specific gravity is necessary for certain soil tests, such as the wet mechanical analysis. It is also necessary for computations involving volume or weight relationships, such as computing the void ratio, percent saturation, and similar values.

Permeability

The perameability of a soil is the measurement of the flow of water through the soil. For solidified samples this is the speed at which water flows through the solidified substance. The permeability is measured in centimeters per second. One objective of solidification is to decrease the amount of water that can come into contact with the solidified material. Since solidification usually produces a monolithic sample, the permeability is mesured as the speed at which water flows through the sample. Most soils that contain high percentages of sand have a permeability of aroun 10^{-3} cm/sec. A clay soil usually has a permeability of around 10^{-6} cm/sec. A low permeability is desired for the solidification of a soil that contains contaminants. The low permeability of solidified samples prevents water from contacting the contaminants and reduces the possibility of the contaminants from leaching into the groundwater.

Liquid and Plastic Limits

Clays and some other finc-grained soils exhibit the physical property of plasticity if the proper amount of water is present in the soil. A plastic soil is one that can be deformed beyond the point of recovery without cracking or change in volume. Such soil can be remolded. The liquid limit (LL) is the greatest water content which the matrial may contain and still remain plastic; more water causes it to become a thick liquid. The plastic limit (PL) is the lowest water content which the material may contain for plastic behavior;with less water the soil is semisolid and breaks into fragments if remolding is attempted. The plasticity index (PI) is the numerical difference between the liquid and plastic limits: (PI) = (LL) - (PL). A large PI inidcates a very plastic clay, a small one denotes a clay having little plasticity. As water content decreases below the plastic limit, the semisolid clay mass shrinks and bexomes stiffer. The shrinkage limit is the water content where further drying shrinkage ceases and below this water content the soil behaves as a solid

From: Daniel E Averett
To: NAN.PO1(E3PLEKRD)
Date: 1/10/97 12:40am
Subject: ASTM Methods for Soils Engineering Tests

Kerwin,

Information on methods for the subject test are provided below:

	EM*	ASTM**
Specific Gravity	APP. IV	D 854-92
Particle Size Distribution	APP. V	D 422-63
Atterburg limits	APP. III	D 4318-95
Proctor Density	APP. VI	D 698-91 ; D 1557-91
Internal Friction Angle	APP. X	D 2850-95
Permeability	APP. VII	D 5084-90
Consolidation	APP. VIII	D 2435-90

* EM 1110-2-1906 ENG & DESIGN LABORATORY SOILS TESTING

** ASTM SECTION 4 CONSTRUCTION, VOLUME 04.08 SOIL & ROCK

Danny Averett

The following tests could not be performed on the solidified/stabilized dredged material:

Compaction
Internal Friction Angle for the 0.15 M&E material
Sieve analysis
hydrometer

Reasons for not performing the above mentioned tests are:

Compaction - samples were received in a state which were solidified; normally the samples used for compaction are soil-like in nature and are air dried. The solidified material would have had to be crushed and this would have defeated the purpose of the S/S of the dredged material.

Internal Friction Angle - The 0.15 cement sample was in a state such that it could not be trimmed to a 1.4' diameter by 3.0' high specimen. The pieces were too small to trim to this size.

Sieve Analysis - there was no sand or gravel in the samples; all of the material kept breaking down so that all passed the number 200 sieve.

Hydrometer - All samples flocculated even before the first reading could be taken; the maximum amount of dispersing agent was added to no avail.

DRAFT PHYSICAL CHARACTERIZATION DATA FOR SOLIDIFIED/STABILIZED DREDGED MATERIAL

Sample	UCS, psi	Water Content 60°C	Water Content 100°C	Specific Gravity	Coef. Of Perm. cm/sec	Dry Density lbs/cu.ft	Atterburg Limits Liquid	Atterburg Limits Plastic	Slope Angle Degrees
0.1 Cement	31	61.4	71.1				126	67	35.5
	26	60.1	69.8	2.54	8.05E-06	37.7			
	30	60.5	70.0	2.51	2.04E-05	38.4			
0.2 Cement	142	24.7	51.8						
	123	27.9	51.2	2.61	7.05E-06	48.9			
	120	30.6	51.3	2.60	3.87E-06	46.0			
0.4 Cement	488	17.0	32.0						
	501	18.1	31.0	2.63	2.81E-07	58.8			
	486	19.1	33.2	2.62	3.43E-07	56.1			
0.15 M&E	234	50.3	71.1	2.70	1.61E-06	51.4	103	59	
	247	58.4	71.8						
	169	50.4	71.9	2.69	7.09E-07	51.7			
0.3 M&E	658	23.4	53.7	2.69	5.62E-07	64.7			
	627	27.3	54.4						
	556	29.9	53.0	2.69	2.68E-07	63.4			

DRAFT PHYSICAL CHARACTERIZATION DATA FOR SOLIDIFIED/STABILIZED DREDGED MATERIAL

Sample	UCS, psi	Water Content 60°C	Water Content 100°C	Specific Gravity	Coef. Of Perm. cm/sec	Dry Density lbs/cu.ft	Atterburg Limits Liquid	Atterburg Limits Plastic	Slope Angle Degrees
0.1 Cement	31	61.4	71.1				126	67	35.5
	26	60.1	69.8	2.54	8.05E-06	37.7			
	30	60.5	70.0	2.51	2.04E-05	38.4			
0.2 Cement	142	24.7	51.8						
	123	27.9	51.2	2.61	7.05E-06	48.9			
	120	30.6	51.3	2.60	3.87E-06	46.0			
0.4 Cement	488	17.0	32.0						
	501	18.1	31.0	2.63	2.81E-07	58.8			
	486	19.1	33.2	2.62	3.43E-07	56.1			
0.15 M&E	234	50.3	71.1	2.70	1.61E-06	51.4	103	59	
	247	58.4	71.8						
	169	50.4	71.9	2.69	7.09E-07	51.7			
0.3 M&E	658	23.4	53.7	2.69	5.62E-07	64.7			
	627	27.3	54.4						
	556	29.9	53.0	2.69	2.68E-07	63.4			

5/30/97

NY/NJ Harbor Sediment Decontamination Technologies Demonstration Project
Draft Summary of WES Physical Tests on Selected Treated Sediment

The table summarizes preliminary results of selected physical tests conducted by USACE Waterways Experiment Station. Raw sediment samples came from Newtown Creek in Brooklyn, which is considered to have some of the most contaminated sediment in the entire NY/NJ Harbor. Treated sediment came from pilot testing conducted by Metcalf & Eddy at Port Newark during November 1996

The first column shows treated sediment samples that underwent testing. The first three samples are products from stand-alone solidification/stabilization (S/S) using portland cement at three different proportions: 0.1 part cement; 0.2 part cement; and 0.4 part cement. The last two sediment samples are products of a two-step process - solvent-extraction (to remove organics) followed by S/S using portland cement at two different proportions: 0.15 part cement and 0.3 part cement.

The 0.1 part cement product was a monolithic concrete block instead of the granular soil-like material that we were seeking. This means that we'll have to go down to only ~~0.4-0.7~~ 0.04-0.07 part cement to make the desired soil-like material.

If you have any questions, please call me at (212) 264-2230.

Kerwin Donato
Environmental Engineer
USACE-New York District

212 264 6494 1997-08-21 14:48 #867 P.02/07

			Solfix Products		
	MEPP-22-1	**MEPP-23-1**	**MEPP-24-1**	**MEPP-25-1**	**MEPP-26-1**
	Solfix 6A	Solfix 6B	Solfix 6C	OrgX/Solfix 21A	OrgX/Solfix 21B
Report 40398E and 40398J					
Metals (TCLP)					
(mg/L (extract))					
EPA 1311/3010/6010A					
-Arsenic	**0.034**	**0.018**	**0.016**	**0.018**	**0.029**
-Barium	**0.167**	**0.232**	**0.328**	**0.292**	**0.215**
-Cadmium	< 0.001	< 0.001	**0.162**	**0.035**	< 0.001
-Chromium	**0.015**	**0.017**	**0.010**	**0.100**	**0.020**
-Lead	< 0.002	< 0.002	**0.013**	**0.007**	< 0.002
-Mercury	< 0.0004	< 0.0004	**0.053**	**0.034**	< 0.0004
-Selenium	**0.025**	**0.014**	**0.016**	**0.019**	**0.024**
-Silver	**0.007**	**0.001**	**0.193**	**0.192**	**0.001**
-Copper	**2.23**	**1.38**	**2.63**	**3.41**	**2.27**
-Iron	0.040	0.040	0.040	0.040	0.040
-Nickel	**0.395**	**0.327**	**1.560**	**0.600**	**0.557**
-Zinc	0.012	0.012	4.500	0.222	0.012

			Solfix Products		
	MEPP-22-1	**MEPP-23-1**	**MEPP-24-1**	**MEPP-25-1**	**MEPP-26-1**
	Solfix 6A	Solfix 6B	Solfix 6C	OrgX/Solfix 21A	OrgX/Solfix 21B
Report 40398G					
Dioxins/Furans (TCLP)					
(pg/L (extract))					
EPA 8290					
2378-TCDD	3.39	2.19	3.31	3.98	2.72
12378-PeCDD	5.03	3.2	4.85	5.57	3.79
123478-HxCDD	6.99	8.95	6.75	7.59	6.46
123678-HxCDD	5.22	6.71	5.04	5.67	4.82
123789-HxCDD	5.97	7.68	5.76	6.49	5.52
1234678-HpCDD	5.69	4.09	*21.03*	6.50	4.80
OCDD	**41.44**	**25.85**	**190.54**	**83.35**	**31.06**
2378-TCDF	2.86	*2.41*	**6.69**	3.21	**4.24**
12378-PeCDF	3.84	2.57	*9.34*	4.13	2.86
23478-PeCDF	3.83	2.56	3.66	4.13	2.85
123478-HxCDF	5.39	*3.36*	**32.50**	5.50	3.97
123678-HxCDF	3.93	2.53	**9.89**	4.00	2.89
234678-HxCDF	*5.16*	3.51	**9.40**	5.56	4.02
123789-HxCDF	6.25	4.02	5.96	6.37	*4.60*
1234678-HpCDF	**14.79**	**9.02**	**132.40**	*21.58*	*5.65*
1234789-HpCDF	6.06	4.27	**7.53**	6.62	4.97
OCDF	**10.80**	*7.73*	**83.29**	**24.46**	**8.08**
Totals: Dioxins					
-TCDD	3.39	2.19	3.31	3.98	2.72
-PeCDD	5.03	3.26	4.85	5.57	3.79
-HxCDD	5.97	7.68	5.76	6.49	5.52
-HpCDD	5.69	4.09	*40.44*	6.50	4.80
Totals: Furans					
-TCDF	2.86	*4.18*	**28.74**	3.21	**4.24**
-PeCDF	3.83	*3.04*	**65.35**	*4.23*	2.85
-HxCDF	*5.16*	3.36	**102.20**	**6.49**	3.76
-HpCDF	**14.79**	**9.02**	**170.36**	*21.58*	*5.65*

			Solfix Products		
	MEPP-22-1	MEPP-23-1	MEPP-24-1	MEPP-25-1	MEPP-26-1
	Solfix 6A	Solfix 6B	Solfix 6C	OrgX/Solfix 21A	OrgX/Solfix 21B
Report 40398F					
SVOC'S - Page 2 0f 2					
EPA 8270A (ug/kg dry weight)					
Acenaphthene	**25.65**	**23.38**	**26.86**	**0.92**	1.54
2,4-Dinitrophenol	8.22	7.78	7.86	7.54	17.18
4-Nitrophenol	5.23	4.94	5	4.79	7.41
Dibenzofuran	**18.82**	**17.84**	**19.28**	**0.85**	
Diethylphthalate	0.82	0.78	0.78	0.75	1.07
4-Chlorophenyl-phenylether	2.01	1.9	1.92	1.84	2.72
Fluorene	**26.04**	**25.34**	**27.68**	**0.9**	1.31
4-Nitroaniline	3.26	3.09	3.12	2.99	4.21
4,6-Dinitro-2-methylphenol	4.51	4.57	4.72	4.66	8.54
N-Nitrosodiphenylamine	1.57	1.59	1.65	1.63	2.06
4-Bromophenyl-phenylether	3.22	3.26	3.37	3.33	4.56
Hexachlorobenzene	2.34	2.38	2.46	2.43	3.63
Pentachlorophenol	3.23	3.28	3.39	3.35	10.75
Phenanthrene	**45.48**	**48.79**	**48.43**	**2.29**	0.91
Anthracene	**7.9**	**8.38**	**8.88**	0.69	0.93
Di-n-butyl phthalate	**2.88**	**2.56**	**3.68**	**3.29**	**0.33**
Fluoranthene	**6.7**	**6.62**	**7.94**	0.55	0.7
Pyrene	**4.04**	**4.48**	**5.17**	0.44	0.86
Butylbenzylphthalate	0.71	0.71	0.69	0.67	1.23
3,3'-Dichlorobenzidine	1.52	1.52	1.48	1.42	2.31
bis-2-ethylhexylphthalate	**1.01**	**0.66**	**2.1**	**1.22**	**3.49**
Benzo(a)anthracene	0.55	0.55	0.53	0.51	0.74
Chrysene	0.53	0.53	0.51	0.49	0.82
Di-n-octylphthalate	0.31	0.29	0.31	0.29	0.45
Benzo(b)fluoranthene	0.49	0.46	0.48	0.45	0.64
Benzo(k)fluoranthene	0.48	0.44	0.47	0.44	0.69
Benzo(e)pyrene	0.5	0.46	0.49	0.46	0.72
Benzo(a)pyrene	0.51	0.48	0.5	0.47	0.76
Perylene	0.58	0.54	0.57	0.53	0.79
Indeno(1,2,3-cd)pyrene	0.47	0.44	0.46	0.43	0.62
Dibenz(a,h)anthracene	0.65	0.61	0.64	0.6	0.82
Benzo(g,h,i)perylene	0.5	0.47	0.49	0.46	0.71

			Solfix Products		
	MEPP-22-1	MEPP-23-1	MEPP-24-1	MEPP-25-1	MEPP-26-1
	Solfix 6A	Solfix 6B	Solfix 6C	OrgX/Solfix 21A	OrgX/Solfix 21B
Report 40398F					
SVOC'S - Page 1 0f 2	**These data are taken from TCLP Extracts**				
EPA 8270A (ug/kg dry weight)					
Phenol	**4.25**	**3.44**	**1.84**	**1**	1.99
bis(2-Chloroethyl)ether	2.35	2.25	2.25	2.2	2.84
2-Chlorophenol	1.74	1.66	1.66	1.62	2.17
1,3-Dichlorobenzene	1.58	1.51	1.51	1.47	2.05
1,4-Dichlorobenzene	1.52	1.45	1.45	1.42	1.97
1,2-Dichlorobenzene	1.65	1.58	1.58	1.54	2.05
Benzyl alcohol	2.16	2.07	2.06	2.02	2.32
2,2'-oxybis(1-Chloropropane)	2.97	2.83	2.83	2.77	3.6
2-Methylphenol	2.21	2.11	2.11	2.07	2.67
3/4-Methylphenol	**8.49**	**7.44**	**4.58**	1.92	**3.61**
N-Nitroso-di-n-propylamine	3.29	3.14	3.14	3.07	3.76
Hexachloroethane	2.93	2.8	2.8	2.74	4.17
Nitrobenzene	2.18	2.05	2.23	2.02	2.26
Isophorone	1.22	1.14	1.25	1.13	1.38
2-Nitrophenol	3.48	3.27	3.57	3.24	3.92
2,4-Dimethylphenol	2.47	2.32	2.53	2.3	2.65
bis(2-Chloroethoxy)methane	2.07	1.95	2.13	1.93	2.38
Benzoic acid	**118.4**	**88.68**	**38.14**	**59.84**	**250.72**
2,4-Dichlorophenol	2.41	2.27	2.47	2.24	3.03
1,2,4-Trichlorobenzene	1.92	1.81	1.97	1.79	2.59
Naphthalene	**76.4**	**65.59**	**95.02**	**12.76**	**4.69**
4-Chloroaniline	1.65	1.55	1.69	1.53	2.03
Hexachlorobutadiene	3.32	3.12	3.4	3.08	4.44
4-Chloro-3-methylphenol	2.83	2.66	2.91	2.63	3.1
2-Methylnaphthalene	**27.61**	**26.76**	**32.22**	**3.55**	**0.93**
Hexachlorocyclopentadiene	2.74	2.59	2.62	2.51	4.62
2,4,6-Trichlorophenol	2.9	2.74	2.77	2.66	4.69
2,4,5-Trichlorophenol	2.97	2.81	2.84	2.72	4.61
2-Chloronaphthalene	1.01	0.95	0.96	0.92	1.42
2-Nitroaniline	4.46	4.22	4.26	4.09	4.74
Dimethylphthalate	0.96	0.91	0.92	0.88	1.24
2,6-Dinitrotoluene	4.21	3.98	4.03	3.86	5.4
2,4-Dinitrotoluene	3.38	3.2	3.23	3.1	4.15
Acenapthylene	0.63	0.6	0.61	0.58	0.85
3-Nitroaniline	3.82	3.61	3.65	3.5	5.14

		Data Legend:			
		Normal Type = Below Detection Limit			
		Bold Type = Valid Data			
		Italics = Estimated Maximum Possible Concentration			
			Solfix Products		
	MEPP-22-1	**MEPP-23-1**	**MEPP-24-1**	**MEPP-25-1**	**MEPP-26-1**
	Solfix 6A	Solfix 6B	Solfix 6C	OrgX/Solfix 21A	OrgX/Solfix 21B
Report 40473H	Some problems with PCB's in lab blank - details given in Data Review section of Case Narrative				
PCBs (TCLP)					
(ng/L (extract))					
EPA MM680/HRGC/MS					
2-Mono Congener # 1	**25.80**	**27.20**	**21.90**	**1.40**	**0.52**
44'-Di # 15	**1.70**	**1.60**	**2.40**	**0.28**	**0.18**
244'-Tri # 28	**1.50**	**2.50**	**5.90**	**0.33**	**0.11**
22'55'-Tetra # 52	**0.61**	**1.70**	**5.00**	**0.21**	**0.11**
33'44'-Tetra # 77	0.06	**0.09**	**0.25**	*0.03*	**0.02**
2344'5-Penta # 118	*0.23*	**0.97**	**3.40**	**0.42**	**0.09**
233'44'-Penta # 105	0.07	**0.45**	**1.40**	**0.14**	0.05
33'44'5-Penta # 126	0.08	0.20	0.20	0.04	0.06
233'44'5-Hexa # 156	0.09	**0.13**	**0.37**	*0.05*	0.06
33'44'55'-Hexa # 169	0.10	0.20	0.20	0.04	0.08
22'344'55'-Hepta # 180	*0.16*	**1.20**	**3.20**	**0.26**	**0.21**
22'33'44'55'-Octa # 194	0.20	*0.31*	**0.76**	**0.07**	**0.09**
22'33'44'55'6-Nona # 206	0.20	0.30	**1.20**	0.08	0.10
Deca # 20	0.30	0.20	**1.70**	0.06	0.10
PCB Totals (TCLP):					
-Mono	**36.70**	**38.00**	**30.50**	**2.30**	**1.10**
-Di	**22.80**	**19.90**	**17.20**	**0.92**	**0.64**
-Tri	**10.70**	**16.30**	**32.80**	**1.50**	**1.00**
-Tetra	**2.80**	**10.30**	**31.00**	**1.30**	**0.44**
-Penta	**0.58**	**7.20**	**22.40**	**1.90**	**0.35**
-Hexa	**0.23**	**6.20**	**17.60**	**1.60**	**1.10**
-Hepta	*0.16*	**3.50**	**11.40**	**0.58**	**0.45**
-Octa	0.20	*0.65*	**2.90**	**0.14**	**0.09**
-Nona	0.20	0.30	**1.20**	0.08	0.10

	MEPP-6-1	MEPP-15-1	MEPP-17-1	MEPP-28-1	MEPP-16-1	MEPP-27-1
	Decanted Seawater	3 Stage Extraction	7 Stage Extraction	Continuous Extraction	5Stage Extraction	Activated carbon
		Wastewater	Wastewater	Wastewater	Wastewater	
Report 40262E						
VOC'S						
ug/L						
Chloromethane	0.2	0.98	0.96	0.2	0.18	
Vinyl Chloride	0.2	0.97	0.94	0.19	0.18	
Bromomethane	0.32	1.58	1.54	0.32	0.29	
Chloroethane	0.36	1.74	1.7	0.35	0.32	
Trichlorofluoromethane	0.17	0.83	0.81	0.17	0.15	
1,1-Dichloroethene	0.3	1.49	1.45	0.3	0.27	
Carbon disulfide	0.09	0.42	0.41	**1.01**	0.08	
Acetone	1.28	**271.77**	**273.45**	**49.7**	**63.55**	
Methylene chloride	**1.19**	1.36	1.32	**0.81**	0.25	
trans-1,2-Dichloroethene	0.25	1.23	1.2	0.25	0.22	
1,1-Dichloroethane	0.11	0.55	0.53	0.11	0.1	
cis-1,2-Dichloroethene	0.21	1.05	1.02	0.21	0.19	
Chloroform	0.11	0.53	0.52	0.11	0.1	
1,2-Dichloroethane	0.18	0.87	0.85	0.17	0.16	
Vinyl acetate	0.12	0.6	0.59	0.12	0.11	
2-Butanone	3.53	17.05	17	3.39	3.19	
1,1,1-Trichloroethane	0.13	0.63	0.63	0.13	0.12	
Carbon tetrachloride	0.15	0.71	0.71	0.14	0.13	
Benzene	0.07	0.33	**7**	0.07	**2.96**	
Trichloroethene	0.19	0.9	0.89	0.18	0.17	
1,2-Dichloropropane	0.16	0.77	0.77	0.15	0.14	
Bromodichloromethane	0.12	0.58	0.57	0.11	0.11	
cis-1,3-Dichloropropene	0.11	0.55	0.55	0.11	0.1	
trans-1,3-Dichloropropene	0.15	0.73	0.73	0.14	0.14	
1,1,2-Trichloroethane	0.27	1.3	1.29	0.26	0.24	
D[illegible]nochloromethane	0.19	0.91	0.91	0.18	0.17	
[illegible]form	0.33	1.59	1.58	0.32	0.3	
4-Methyl-2-pentanone	0.26	1.25	1.25	0.25	0.24	
Toluene	0.1	**2.91**	0.47	**2.21**	0.09	
Tetrachloroethene	0.19	0.94	0.94	0.19	0.18	
2-Hexanone	0.34	1.66	1.66	0.33	0.32	
Chlorobenzene	0.08	0.39	0.39	0.08	0.08	
Ethylbenzene	0.15	0.75	0.75	0.15	0.15	
m-/p-Xylene	0.13	0.62	0.62	0.13	0.12	
o-Xylene	0.14	0.69	0.69	0.14	0.13	
Styrene	0.08	0.4	0.4	0.08	0.08	
1,1,2,2-Tetrachloroethane	0.21	1.02	1.02	0.2	0.2	

	MEPP-6-1	MEPP-15-1	MEPP-17-1	MEPP-28-1	MEPP-16-1	MEPP-27-1
	Decanted Seawater	3 Stage Extraction	7 Stage Extraction	Continuous Extraction	5Stage Extraction	Activated carbon
		Wastewater	Wastewater	Wastewater	Wastewater	
Report 40262A						
Metals						
mg/L						
EPA 6010A & EPA 7471					MEPP-6-1Dup	
Ag	**0.019**	<0.001	<0.001	**0.001**	**0.019**	< 0.19
As	**0.135**	**0.006**	**0.010**	**0.008**	**0.133**	**1.55**
Be	<0.001	<0.001	<0.001	<0.001	<0.001	**0.36**
Cd	**0.033**	**0.008**	**0.001**	**0.002**	**0.033**	< 0.19
Cr	**0.360**	**0.004**	**0.003**	**0.006**	**0.364**	**4.45**
Cu	**1.38**	**3.03**	**2.75**	**5.63**	**1.40**	**6.08**
Ni	**0.364**	**0.055**	**0.020**	**0.026**	**0.366**	**5.85**
Pb	**0.715**	**0.116**	**0.065**	**0.039**	**0.720**	**1.26**
Sb	**0.013**	< 0.004	<0.004	**0.005**	**0.011**	< 0.761
Se	**0.021**	**0.003**	<0.003	**0.003**	**0.021**	**0.61**
Tl	**0.007**	< 0.005	<0.005	<0.005	**0.006**	< 0.951
Zn	**1.61**	**0.356**	**0.136**	**0.138**	**1.62**	**4.44**
Hg (total)	**0.025**	**0.001**	< 0.0004	< 0.0004		< 0.088

	MEPP-6-1	MEPP-15-1	MEPP-17-1	MEPP-28-1	MEPP-16-1	MEPP-27-1
	Decanted Seawater	3 Stage Extraction	7 Stage Extraction	Continuous Extraction	5Stage Extraction	Activated carbon
		Wastewater	Wastewater	Wastewater	Wastewater	
Report 40262C and 40398Cr1						
Dioxins and Furans						
(pg/L)						
EPA 8290						
2378-TCDD	**4.4**	2.7	2.6	3.1	7.2	0.6
12378-PeCDD	**5.9**	3.1	3.1	2.9	9.1	2.20
123478-HxCDD	2.9	3.7	3.4	*2.2*	9.1	2.30
123678-HxCDD	**15.1**	*3.5*	3.1	**3.2**	8.3	2.10
123789-HxCDD	**13.1**	**4.0**	3.0	**3.7**	8.0	2.10
1234678-HpCDD	**284.8**	**66.0**	**21.5**	**33.4**	*12.8*	*4.10*
OCDD	**2215.2**	**1169.1**	**261.8**	**353.4**	**226.0**	**43.00**
2378-TCDF	**58.2**	2.3	2.2	4.7	6.3	
12378-PeCDF	**74.6**	2.2	2.1	3.1	6.2	1.50
23478-PeCDF	*25.5*	2.1	2.0	3.3	6.0	1.50
123478-HxCDF	**387.0**	2.6	*3.1*	18.7	6.2	*2.10*
123678-HxCDF	**165.7**	2.1	1.8	*5.8*	5.0	1.30
234678-HxCDF	**42.1**	**4.7**	*4.1*	**8.5**	*6.5*	1.60
123789-HxCDF	2.3	2.8	2.5	*1.4*	6.9	1.80
1234678-HpCDF	**1588.6**	**12.3**	**8.6**	**71.2**	**9.2**	9.40
1234789-HpCDF	**48.8**	3.7	3.2	*4.8*	9.2	3.10
OCDF	**1809.1**	**34.8**	**14.4**	**80.1**	**25.7**	**16.90**
Totals: Dioxins						
-TCDD	**34.1**	2.7	2.6	3.1	7.2	0.60
-PeCDD	**17.1**	3.1	3.1	2.9	9.1	2.20
-HxCDD	**126.9**	**18.4**	3.1	**12.6**	8.5	2.20
-HpCDD	**509.6**	**66.0**	**37.8**	**57.0**	**11.3**	*4.10*
Totals: Furans						
-TCDF	**580.9**	2.3	2.2	**9.5**	6.3	0.50
-PeCDF	**827.5**	2.1	2.1	**24.0**	6.1	1.50
-HxCDF	**1403.7**	**4.7**	*7.3*	**53.4**	*6.5*	**3.30**
-HpCDF	**1711.6**	**12.3**	**12.0**	**90.7**	**9.2**	9.40

	MEPP-6-1	MEPP-15-1	MEPP-17-1	MEPP-28-1	MEPP-16-1	MEPP-27-1
	Decanted Seawater	3 Stage Extraction	7 Stage Extraction	Continuous Extraction	5Stage Extraction	Activated carbon
		Wastewater	Wastewater	Wastewater	Wastewater	
Report 40262B and 40398A						
SVOC'S - Page 2 0f 2						
EPA 8270A (ug/L)						
Acenapthylene	0.34	0.30	0.32	0.33	0.32	16.89
3-Nitroaniline	1.65	1.48	1.54	1.61	1.56	92.29
Acenaphthene	**37.34**	0.54	0.56	0.59	0.57	29.67
2,4-Dinitrophenol	3.85	3.46	3.61	3.77	3.65	227.74
4-Nitrophenol	2.92	2.63	2.74	2.86	2.77	135.28
Dibenzofuran	**25.56**	0.35	0.36	0.38	0.37	21.37
Diethylphthalate	0.46	0.42	0.44	0.45	0.44	20.37
4-Chlorophenyl-phenylether	1.14	1.03	1.07	1.12	1.08	54.21
Fluorene	**44.55**	0.45	0.47	0.49	0.48	29.31
4-Nitroaniline	1.81	1.63	1.69	1.77	1.71	99.86
4,6-Dinitro-2-methylphenol	2.41	2.13	2.40	2.69	2.50	150.03
N-Nitrosodiphenylamine	0.67	0.60	0.67	0.75	0.70	41.35
4-Bromophenyl-phenylether	1.47	1.30	1.46	1.64	1.53	71.15
Hexachlorobenzene	1.21	1.07	1.20	1.35	1.26	62.23
Pentachlorophenol	1.40	1.24	1.40	1.57	1.46	90.02
Phenanthrene	**115.96**	0.28	0.32	0.35	0.33	21.04
Anthracene	**32.22**	0.29	0.33	0.36	0.34	22.48
Di-n-butyl phthalate	*2.02*	*2.04*	*1.87*	*1.88*	*2.31*	**86.90**
Fluoranthene	**70.03**	0.22	0.24	0.27	0.25	16.63
Pyrene	**53.25**	0.24	0.26	0.27	0.27	10.95
Butylbenzylphthalate	0.36	0.36	0.39	0.41	0.41	14.52
3,3'-Dichlorobenzidine	0.59	0.60	0.64	0.68	0.68	28.31
bis-2-ethylhexylphthalate	**33.22**	**3749.34**	**581.54**	**352.64**	**399.71**	**131.26**
Benzo(a)anthracene	*19.68*	0.24	0.26	0.28	0.28	10.14
Chrysene	*16.30*	0.24	0.26	0.28	0.28	10.89
Di-n-octylphthalate	0.16	0.16	0.17	0.19	0.19	7.29
Benzo(b)fluoranthene	*10.98*	0.21	0.23	0.25	0.25	11.03
Benzo(k)fluoranthene	*3.24*	0.23	0.25	0.27	0.27	11.86
Benzo(e)pyrene	*5.69*	0.24	0.26	0.28	0.28	12.35
Benzo(a)pyrene	*9.93*	0.25	0.27	0.30	0.29	12.82
Perylene	0.26	0.27	0.29	0.32	0.31	13.31
Indeno(1,2,3-cd)pyrene	*2.60*	0.26	0.28	0.31	0.30	10.65
Dibenz(a,h)anthracene	0.32	0.33	0.36	0.39	0.39	14.29
Benzo(g,h,i)perylene	*2.63*	0.33	0.35	0.39	0.38	11.69

	MEPP-6-1	MEPP-15-1	MEPP-17-1	MEPP-28-1	MEPP-16-1	MEPP-27-1
	Decanted Seawater	3 Stage Extraction	7 Stage Extraction	Continuous Extraction	5Stage Extraction	Activated carbon
		Wastewater	Wastewater	Wastewater	Wastewater	
Report 40262B and 40398A						
SVOC'S - Page 1 0f 2						
EPA 8270A (ug/L)						
Phenol						
bis(2-Chloroethyl)ether	1.10	1.02	1.02	0.97	1.07	57.11
2-Chlorophenol	0.97	0.91	0.90	0.86	0.95	50.31
1,3-Dichlorobenzene	0.83	0.77	0.77	0.73	0.81	42.73
1,4-Dichlorobenzene	0.87	0.81	0.80	0.77	0.84	43.81
1,2-Dichlorobenzene	0.92	0.86	0.86	0.82	0.90	46.39
Benzyl alcohol	0.85	0.79	0.79	0.75	0.83	65.24
2,2'-oxybis(1-Chloropropane)	1.58	1.47	1.46	1.39	1.53	81.75
2-Methylphenol	1.12	1.04	1.03	*0.95*	1.09	62.65
3/4-Methylphenol	1.10	*2.95*	1.02	**55.16**	*16.83*	58.93
N-Nitroso-di-n-propylamine	1.52	1.42	1.41	1.34	1.48	73.16
Hexachloroethane	1.73	1.62	1.61	1.53	1.69	83.92
Nitrobenzene	0.97	0.90	0.87	0.87	0.93	46.28
Isophorone	0.53	0.50	0.48	**10.28**	0.51	23.91
2-Nitrophenol	1.74	1.61	1.57	1.56	1.67	77.58
2,4-Dimethylphenol	1.14	1.06	1.03	1.02	1.09	51.65
bis(2-Chloroethoxy)methane	0.95	0.88	0.86	0.85	0.91	45.38
Benzoic acid	*8.37*	**244.40**	1.35	1.34	*19.94*	90.76
2,4-Dichlorophenol	1.14	1.06	1.03	1.02	1.09	59.35
1,2,4-Trichlorobenzene	1.00	0.93	0.91	0.90	0.96	54.04
Naphthalene	**54.31**	0.35	0.34	0.34	0.36	**13.60**
4-Chloroaniline	0.84	0.77	0.76	0.75	0.80	45.05
Hexachlorobutadiene	1.67	1.55	1.51	1.50	1.60	75.39
4-Chloro-3-methylphenol	1.23	1.14	1.11	1.10	1.18	55.48
2-Methylnaphthalene	**24.73**	0.51	0.50	0.49	0.53	26.41
Hexachlorocyclopentadiene	2.07	1.86	1.94	2.02	1.96	73.28
2,4,6-Trichlorophenol	1.47	1.33	1.38	1.44	1.40	83.52
2,4,5-Trichlorophenol	1.43	1.29	1.34	1.40	1.36	83.52
2-Chloronaphthalene	0.55	0.49	0.51	0.53	0.52	30.29
2-Nitroaniline	1.82	1.64	1.70	1.78	1.72	90.45
Dimethylphthalate	0.47	0.42	0.44	0.46	0.45	23.41
2,6-Dinitrotoluene	2.02	1.81	1.89	1.97	1.91	106.59
2,4-Dinitrotoluene	1.63	1.46	1.53	1.59	1.54	85.79

	MEPP-6-1	MEPP-15-1	MEPP-17-1	MEPP-28-1	MEPP-16-1	MEPP-27-1
	Decanted Seawater	3 Stage Extraction	7 Stage Extraction	Continuous Extraction	5Stage Extraction	Activated carbon
		Wastewater	Wastewater	Wastewater	Wastewater	
Report 40262D and 40389B						
Polychlorinated Biphenyls						
(ng/L)						
EPA MM680/HRGC/MS						
PCBs:						
2-Mono Congener # 1	**40.96**	**0.04**	0.09	0.12	0.08	
44'-Di # 15	**27.09**	**0.19**	0.07	0.10	0.07	
244'-Tri # 28	**133.70**	**1.25**	**0.31**	**0.75**	*0.12*	
22'55'-Tetra # 52	**48.59**	**0.33**	**0.14**	**0.65**	*0.06*	
33'44'-Tetra # 77	**5.39**	0.11	0.09	0.12	0.09	
2344'5-Penta # 118	**3.09**	*2.65*	0.09	**1.30**	**0.13**	
233'44'-Penta # 105	**25.40**	0.60	0.10	*0.39*	0.11	
33'44'5-Penta # 126	0.49	0.70	0.12	0.17	0.12	
233'44'5-Hexa # 156	**7.34**	1.33	0.08	**0.15**	0.09	
33'44'55'-Hexa # 169	0.67	1.60	0.09	0.13	0.11	
22'344'55'-Hepta # 180	**62.75**	2.14	**2.16**	*1.04*	**0.45**	*0.0400*
22'33'44'55'-Octa # 194	**12.85**	2.14	**0.38**	**0.22**	0.17	0.0700
22'33'44'55'6-Nona # 206	**14.55**	2.66	0.17	0.23	0.21	0.0900
Deca # 209	**19.44**	2.04	0.28	0.35	0.24	0.0300
PCB Totals:						
-Mono	**69.02**	**0.04**	0.09	0.12	*0.04*	
-Di	**182.06**	**1.55**	*0.22*	0.10	0.07	
-Tri	**289.86**	**5.52**	0.95	**2.59**	**0.36**	
-Tetra	**350.00**	**2.22**	0.65	**4.96**	**0.15**	
-Penta	**342.01**	**9.72**	2.18	**6.57**	**0.34**	
-Hexa	**381.42**	**6.75**	5.60	**4.17**	**0.46**	
-Hepta	**229.97**	2.14	4.01	**1.02**	**0.59**	*0.0400*
-Octa	**68.90**	2.14	1.40	**0.35**	0.17	0.0700
-Nona	**29.35**	2.66	0.17	0.23	0.21	0.0900

Data Legend:
Normal Type = Below Detection Limit
Bold Type = Valid Data
Italics = Estimated Maximum Possible Concentration

Gross Physico-Chemical Properties	MEPP-6-1 Decanted Seawater	MEPP-15-1 3 Stage Extraction Wastewater	MEPP-17-1 7 Stage Extraction Wastewater	MEPP-28-1 Continuous Extraction Wastewater	MEPP-16-1 5Stage Extraction Wastewater	MEPP-27-1 Activated carbon
Particle size						
(% Dry Weight)						
ASTM D422 (Mod)						
Medium gravel > 4.75 mm						
Fine gravel 2-4.75						
V. coarse sand 0.85-2						
Coarse sand 0.425-0.85						
Medium sand 0.24-0.425						
Fine sand 0.106-0.24						
V. fine sand 0.075-0.106						
Clay						
Silt						
pH						
EPA 150.1 pH Units					**6.53**	
Solids (total)						
EPA 160.3 % Dry Wt.						
Sulfides (total)						
EPA 9030M mg/L					0.05	
Organic carbon (total)						
ASTM D4129-82M mg/L					**24.8**	
Conductivity						
EPA 120.1 umhos/cm						
Hydrocarbons						
EPA 3580/8015 Modified ppb µg/L					**5919**	

Report 40398D	MEPP-21-1
Metals	Portland Cement
mg/kg (dry)	
EPA 6010A & EPA 7471	
Ag	< 0.178
As	**7.19**
Be	< 0.178
Cd	**0.31**
Cr	**104**
Cu	**29.0**
Ni	**45.6**
Pb	< 0.355
Sb	< 0.71
Se	< 0.533
Tl	< 0.888
Zn	**27.8**
Hg (total)	< 0.083

		OrgX Products		
	MEPP-8-1	MEPP-9-1	MEPP-10-1	
	5 Stage	7 Stage	Continuous	
Report 40398D				
Metals				
mg/kg (dry)				
EPA 6010A & EPA 7471				
Ag	**18.0**	**16.8**	**13.4**	
As	**92.1**	**84.7**	**69.2**	
Be	< 0.443	< 0.436	< 0.513	
Cd	**33.4**	**31.9**	**24.9**	
Cr	**399**	**373**	**297**	
Cu	**1420**	**1310**	**1070**	
Ni	**424**	**400**	**318**	
Pb	**818**	**795**	**599**	
Sb	**5.53**	**5.05**	**5.73**	
Se	**15.4**	**14.4**	**11.0**	
Tl	< 2.22	< 2.18	< 2.56	
Zn	**1860**	**1750**	**1400**	
Hg (total)	**5.96**	**5.31**	**5.16**	

		OrgX Products		
	MEPP-8-1	MEPP-9-1	MEPP-10-1	
	5 Stage	7 Stage	Continuous	
Report 40398C				
Dioxins and Furans				
EPA 8290 (ng/kg dry weight)				
2378-TCDD	9.09	10.23	9.48	
12378-PeCDD	11.71	12.45	13.33	
123478-HxCDD	13.44	13.11	14.80	
123678-HxCDD	21.32	22.19	26.53	
123789-HxCDD	30.20	28.66	33.13	
1234678-HpCDD	317.04	322.08	349.65	
OCDD	3093.95	3046.62	3191.00	
2378-TCDF	57.33	57.49	61.83	
12378-PeCDF	75.00	76.31	75.46	
23478-PeCDF	28.80	29.89	32.39	
123478-HxCDF	249.93	254.11	264.53	
123678-HxCDF	95.95	96.46	104.99	
234678-HxCDF	44.70	43.67	50.30	
123789-HxCDF	2.65	2.06	3.26	
1234678-HpCDF	1146.81	1096.74	975.60	
1234789-HpCDF	30.60	27.98	36.71	
OCDF	1133.33	1010.58	1275.03	
Totals: Dioxins				
-TCDD	59.98	58.71	59.57	
-PeCDD	82.18	79.54	78.43	
-HxCDD	257.32	254.80	272.66	
-HpCDD	629.56	637.40	651.50	
Totals: Furans				
-TCDF	411.20	426.64	431.68	
-PeCDF	641.72	606.95	591.92	
-HxCDF	937.72	930.15	940.92	
-HpCDF	1391.26	1336.57	1233.69	

		OrgX Products		
	MEPP-8-1	MEPP-9-1	MEPP-10-1	
	5 Stage	7 Stage	Continuous	
SVOC'S - Page 2 0f 2				
EPA 8270A (ug/kg dry weight)				
Acenaphthene	**502.54**	**185.18**	**588.79**	
2,4-Dinitrophenol	410.08	386.52	392.56	
4-Nitrophenol	256.92	242.16	245.94	
Dibenzofuran	**808.17**	**552.18**	**903.65**	
Diethylphthalate	40.93	**32.12**	**40.57**	
4-Chlorophenyl-phenylether	113.22	106.72	108.39	
Fluorene	**1062.26**	**605.07**	**1226.13**	
4-Nitroaniline	167.03	157.44	159.89	
4,6-Dinitro-2-methylphenol	226.61	207.38	222.70	
N-Nitrosodiphenylamine	74.65	68.31	73.36	
4-Bromophenyl-phenylether	134.43	123.02	132.11	
Hexachlorobenzene	105.05	96.14	103.24	
Pentachlorophenol	148.95	136.31	146.37	
Phenanthrene	**4301.13**	**2856.46**	**4962.91**	
Anthracene	**1739.36**	**1291.77**	**1932.79**	
Di-n-butyl phthalate	**103.75**	**79.75**	**76.87**	
Fluoranthene	**3041.43**	**2475.83**	**3463.69**	
Pyrene	**2629.83**	**2116.33**	**2710.40**	
Butylbenzylphthalate	27.68	24.12	25.70	
3,3'-Dichlorobenzidine	56.51	49.24	52.46	
bis-2-ethylhexylphthalate	**822.83**	**979.11**	**876.82**	
Benzo(a)anthracene	**1057.46**	**893.96**	**1134.97**	
Chrysene	**1180.56**	**1008.90**	**1261.04**	
Di-n-octylphthalate	16.98	14.85	14.63	
Benzo(b)fluoranthene	**1216.93**	**1012.54**	**1170.62**	
Benzo(k)fluoranthene	**360.17**	**444.22**	**519.90**	
Benzo(e)pyrene	**470.22**	**404.78**	**507.07**	
Benzo(a)pyrene	**755.37**	**671.47**	**814.61**	
Perylene	**553.92**	**555.63**	**544.57**	
Indeno(1,2,3-cd)pyrene	**197.73**	**185.28**	**210.64**	
Dibenz(a,h)anthracene	40.71	35.61	35.08	
Benzo(g,h,i)perylene	**188.43**	31.46	31.00	

		OrgX Products		
	MEPP-8-1	MEPP-9-1	MEPP-10-1	
	5 Stage	7 Stage	Continuous	
Report 40398A				
SVOC'S - Page 1 0f 2				
EPA 8270A (ug/kg dry weight)				
Phenol	100.22	94.22	93 22	
bis(2-Chloroethyl)ether	124.30	116.85	115 61	
2-Chlorophenol	108.82	102.30	101.21	
1,3-Dichlorobenzene	88.92	83.59	82.70	
1,4-Dichlorobenzene	90.93	85.48	84.57	
1,2-Dichlorobenzene	102.26	96.14	95.12	
Benzyl alcohol	136.86	128.66	127.29	
2,2'-oxybis(1-Chloropropane)	222.45	209.13	206.91	
2-Methylphenol	132.93	124.97	123.65	
3/4-Methylphenol	**37761.45**	**15874.20**	**14258.91**	
N-Nitroso-di-n-propylamine	158.02	148.56	146.98	
Hexachloroethane	175.25	164.75	163.00	
Nitrobenzene	95.08	91.75	90.04	
Isophorone	52.18	50.35	49.41	
2-Nitrophenol	173.69	167.60	164.49	
2,4-Dimethylphenol	109.93	106.07	104.10	
bis(2-Chloroethoxy)methane	98.58	95.13	93.36	
Benzoic acid	**400.73**	**479.32**	**198.45**	
2,4-Dichlorophenol	129.43	124.89	122.57	
1,2,4-Trichlorobenzene	113.99	109.99	107.95	
Naphthalene	**1028.56**	**1016.98**	**1517.00**	
4-Chloroaniline	100.31	96.79	94.99	
Hexachlorobutadiene	153.73	148.34	145.59	
4-Chloro-3-methylphenol	116.64	112.55	110.46	
2-Methylnaphthalene	**640.20**	**544.74**	**836.70**	
Hexachlorocyclopentadiene	170.59	160.79	163.30	
2,4,6-Trichlorophenol	175.27	165.20	167.78	
2,4,5-Trichlorophenol	166.59	157.03	159.48	
2-Chloronaphthalene	58.96	55.57	56.44	
2-Nitroaniline	183.83	173.27	175.98	
Dimethylphthalate	48.06	45.30	46.01	
2,6-Dinitrotoluene	214.67	202.34	205.50	
2,4-Dinitrotoluene	152.68	143.91	146.16	
Acenapthylene	**983.33**	**738.12**	**905.71**	
3-Nitroaniline	191.53	180.53	183.35	

		OrgX Products		
	MEPP-8-1	MEPP-9-1	MEPP-10-1	
	5 Stage	7 Stage	Continuous	
Polychlorinated Biphenyls	Report 40389B			
(ug/Kg dry weight)				
EPA MM680/HRGC/MS				
PCBs:				
2-Mono Congener # 1	**1.6**	**0.7**	**1.7**	
44'-Di # 15	**6.3**	**5.7**	**6.7**	
244'-Tri # 28	**5.7**	**4.8**	**6.1**	
22'55'-Tetra # 52	**1.9**	**1.6**	**1.6**	
33'44'-Tetra # 77	**0.8**	**1.0**	**0.8**	
2344'5-Penta # 118	**5.0**	**5.7**	**4.9**	
233'44'-Penta # 105	**1.9**	**2.3**	**1.8**	
33'44'5-Penta # 126	*0.0*	0.0	0.1	
233'44'5-Hexa # 156	**0.5**	**0.6**	*0.6*	
33'44'55'-Hexa # 169	0.0	**0.1**	0.1	
22'344'55'-Hepta # 180	**3.0**	**3.2**	**3.7**	
22'33'44'55'-Octa # 194	**0.7**	**0.9**	**0.9**	
22'33'44'55'6-Nona # 206	**1.0**	**1.1**	**1.1**	
Deca # 20	**2.0**	**2.1**	**2.3**	
PCB Totals:				
-Mono	**7.5**	**5.4**	**8.0**	
-Di	**15.7**	**11.5**	**16.0**	
-Tri	**27.3**	**23.3**	**31.4**	
-Tetra	**22.3**	**23.1**	**20.7**	
-Penta	**24.8**	**26.1**	**26.8**	
-Hexa	**20.0**	**24.2**	**20.8**	
-Hepta	**10.7**	**11.6**	**13.6**	
-Octa	**3.0**	**3.5**	**3.3**	
-Nona	**1.6**	**1.7**	**1.7**	

			Data Legend:		
			Normal Type = Below Detection Limit		
			Bold Type = Valid Data		
Gross Physico-Chemical Properties			*Italics = Estimated Maximum Possible Concentration*		
			OrgX Products		
		MEPP-8-1	**MEPP-9-1**	**MEPP-10-1**	
		5 Stage	7 Stage	Continuous	
Particle size					
(% Dry Weight)					
ASTM D422 (Mod)					
Medium gravel	> 4.75 mm	**0.00**	**0.00**	**0.00**	
Fine gravel	2-4.75	**0.43**	**0.22**	**0.91**	
V. coarse sand	0.85-2	**1.94**	**1.84**	**2.03**	
Coarse sand	0.425-0.85	**2.63**	**2.69**	**2.66**	
Medium sand	0.24-0.425	**4.60**	**4.07**	**3.89**	
Fine sand	0.106-0.24	**7.94**	**8.54**	**7.97**	
V. fine sand	0.075-0.106	**3.04**	**3.34**	**2.93**	
Clay		**41.40**	**41.10**	**41.40**	
Silt		**39.00**	**38.50**	**39.60**	
pH					
EPA 9045A	pH Units	**8.01**	**7.94**	**7.63**	
Solids (total)					
EPA 160.3	% Dry Wt.	**44.1**	**46.0**	**40.2**	
Sulfides (total)					
EPA 9030M	mg/Kg dry wt.	**10000**	**10000**	**9200**	
Organic carbon (total)					
ASTM D4129-82M	% Dry Wt.	**8.50**	**8.20**	**8.40**	
Conductivity					
EPA 120.1	umhos/cm				

	MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
	3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
Report 40262J	These presence of Methylene Choride and Tolulene may be due to contamination of the samples at Triangle Laboratory, Inc.					
VOC'S	Detection Limits are high due to the sizable dilution that had to be used with these concentrated samples					
ug/L						
8240A Rev.1						
Trichloroethene	11247	11343	10228	936	18604	9443
1,2-Dichloropropane	14809	14935	13467	1233	24496	12434
Bromodichloromethane	8088	8157	7355	673	13379	6791
cis-1,3-Dichloropropene	9703	9786	8824	808	16050	8147
trans-1,3-Dichloropropene	13977	14096	12711	1163	23120	11735
1,1,2-Trichloroethane	15948	16084	14503	1328	26380	13390
Dibromochloromethane	10418	10507	9475	867	17233	8747
Bromoform	19256	19420	17512	1603	31852	16168
4-Methyl-2-pentanone	25976	26121	23871	2237	44026	22234
Toluene	**54480**	**61046**	**55622**	**4379**	10907	**56236**
Tetrachloroethene	13744	13820	12630	1184	23294	11763
2-Hexanone	45518	45771	41829	3920	77146	38960
Chlorobenzene	4942	4969	4541	426	8375	4230
Ethylbenzene	9560	9613	8785	823	16202	8182
m-/p-Xylene	7517	7559	6908	647	12741	6434
o-Xylene	8134	8179	7474	700	13785	6962
Styrene	5042	5070	4633	434	8546	4316
1,1,2,2-Tetrachloroethane	11276	11339	10362	971	19111	9651

	MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
	3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
Report 40262J	These presence of Methylene Choride and Tolulene may be due to contamination of the samples at Triangle Laboratory, Inc.					
VOC'S	Detection Limits are high due to the sizable dilution that had to be used with these concentrated samples					
ug/L						
8240A Rev.1						
Chloromethane	29572	28749	26063	2365	47667	24003
Vinyl Chloride	23945	23278	21103	1915	38596	19436
Bromomethane	31019	30155	27337	2481	49998	25177
Chloroethane	33029	32110	29109	2642	53239	26809
Trichlorofluoromethane	8177	7949	7206	654	13180	6637
1,1-Dichloroethene	21584	20983	19022	1726	34790	17519
Carbon disulfide	5921	5756	5218	474	9544	4806
Acetone	70001	68052	61693	5599	112834	56819
Methylene chloride	19634	19087	17304	**9307**	**8087994**	15937
trans-1,2-Dichloroethene	18757	18235	16531	1500	30234	15225
1,1-Dichloroethane	10127	9845	8925	810	16324	8220
cis-1,2-Dichloroethene	17471	16984	15397	1397	28161	14181
Chloroform	8586	8347	7567	687	13839	6969
1,2-Dichloroethane	11261	10948	9925	901	18152	9140
Vinyl acetate	25387	25603	23087	2113	41993	21315
2-Butanone	259160	261361	235681	21573	428678	217591
1,1,1-Trichloroethane	9424	9504	8570	784	15588	7912
Carbon tetrachloride	9283	9362	8442	773	15356	7794
Benzene	4368	4405	3972	364	7225	3667

	MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
	3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
Report 40262F						
Metals						
mg/L						
EPA 6010A & EPA 7471						
Ag	< 0.198	< 0.198	< 0.196	< 0.195	< 0.179	
As	**13.90**	**18.90**	**16.10**	**17.10**	< 0.894	
Be	< 0.198	< 0.198	< 0.196	< 0.195	< 0.179	
Cd	< 0.198	< 0.198	< 0.196	< 0.195	< 0.179	
Cr	**18.90**	**22.10**	**22.30**	**24.90**	< 0.358	
Cu	**1.46**	**1.44**	**1.40**	**1.30**	< 0.358	
Ni	**12.10**	**13.80**	**16.70**	**10.10**	< 0.537	
Pb	**1.04**	**1.21**	**1.58**	**1.06**	**0.54**	
Sb	**1.79**	**2.14**	**5.82**	1.57	< 0.716	
Se	**8.25**	**8.85**	**10.00**	**13.50**	< 0.537	
Tl	< 0.988	< 0.99	< 0.982	< 0.975	< 0.894	
Zn	**24.80**	**10.10**	**8.50**	**6.94**	< 2.15	
Hg (total)	< 0.091	< 0.092	< 0.095	< 0.090	< 0.092	

	MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
	3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
Report 40262H						
Dioxins and Furans						
(ng/L)		Note : The units for these samples are higher than usual for liquids due to the nature of the samples				
EPA 8290						
2378-TCDD	**326**	**291**	**277**	**368**	5	**295**
12378-PeCDD	**346**	**309**	**311**	**410**	10	**311**
123478-HxCDD	**337**	**289**	**283**	**346**	10	**281**
123678-HxCDD	**1030**	**896**	**862**	**1100**	8	**874**
123789-HxCDD	**507**	**428**	**456**	**586**	9	**317**
1234678-HpCDD	**18890**	**16280**	**16090**	**20310**	**96**	**15350**
OCDD	**179220**	**164460**	**151490**	**191300**	**911**	**134050**
2378-TCDF	**3780**	**3090**	**3130**	**3980**	**22**	**2870**
12378-PeCDF	**5720**	**5100**	**4780**	**6220**	**31**	**4820**
23478-PeCDF	**1680**	**1600**	**1540**	**1940**	**12**	**1490**
123478-HxCDF	**26630**	**21920**	**21290**	**27610**	**127**	**20300**
123678-HxCDF	**9290**	**8270**	**8120**	**10080**	**46**	**7930**
234678-HxCDF	**2760**	*2020*	**2040**	**2110**	*7*	*1200*
123789-HxCDF	**64.9**	**61.8**	**64.2**	**82.9**	*7.4*	**54.1**
1234678-HpCDF	**109860**	**100430**	**100540**	**112160**	**571**	**93190**
1234789-HpCDF	**1470**	**1380**	**1620**	**1810**	**15**	**1400**
OCDF	**109910**	**128760**	**133180**	**247050**	**1750**	**661650**
Totals: Dioxins						
-TCDD	**2380**	**2430**	**2360**	**3230**	*5*	**2380**
-PeCDD	**2680**	**2330**	**2340**	**3100**	*12*	**2140**
-HxCDD	**9560**	**7340**	**7730**	**9710**	**18**	**5300**
-HpCDD	**36360**	**28210**	**29480**	**34220**	**114**	**17140**
Totals: Furans						
-TCDF	**49270**	**42570**	**39800**	**51950**	**158**	**38690**
-PeCDF	**69510**	**59420**	**57590**	**77610**	**345**	**59250**
-HxCDF	**107570**	**89960**	**85900**	**112030**	**464**	**81360**
-HpCDF	**127930**	**116750**	**118970**	**132060**	**676**	**109490**

	MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
	3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
SVOC'S - Page 2 0f 2						
EPA 8270A (ug/L)						
Acenapthylene	15.24	16.35	16.02	15.71	15.53	15.76
3-Nitroaniline	69.47	74.52	73.03	71.58	70.77	71.81
Acenaphthene	**1000.87**	**1259.22**	**1201.79**	**1254.34**	27.29	**1199.27**
2,4-Dinitrophenol	139.32	149.45	146.46	143.57	141.93	144.02
4-Nitrophenol	135.54	145.39	142.48	139.67	138.07	140.11
Dibenzofuran	**740.89**	**932.21**	**837.71**	**971.73**	17.1	**933.8**
Diethylphthalate	18.72	20.08	19.68	19.29	19.07	19.35
4-Chlorophenyl-phenylether	49.98	53.61	52.54	51.5	50.91	51.66
Fluorene	**1420.64**	**1744.34**	**1562.62**	**1673.09**	23.18	**1725.03**
4-Nitroaniline	75.8	81.31	79.68	78.11	77.22	78.36
4,6-Dinitro-2-methylphenol	107.73	115.07	114.53	111.18	132.66	111.14
N-Nitrosodiphenylamine	34.58	36.94	36.77	35.69	42.59	35.68
4-Bromophenyl-phenylether	77.99	83.31	82.92	80.49	96.04	80.46
Hexachlorobenzene	62.39	66.65	66.33	64.39	76.83	64.37
Pentachlorophenol	83.65	89.36	88.94	86.34	103.02	86.3
Phenanthrene	**5405.61**	**6732.88**	**5931.91**	**6970.06**	19.55	**6136.84**
Anthracene	**1416.48**	**1779.06**	**1546.64**	**1758.3**	20.67	**1665.33**
Di-n-butyl phthalate	9.49	10.14	10.09	9.79	**27.62**	9.79
Fluoranthene	**2814.73**	**3666.43**	**3467.56**	**4151.55**	16.26	**3370.69**
Pyrene	**2133.8**	**2696.28**	**2281.84**	**2685.49**	15.5	**2268.82**
Butylbenzylphthalate	18.15	19.2	16.89	16.38	23.12	16.38
3,3'-Dichlorobenzidine	38.5	40.72	35.81	34.74	49.04	34.74
bis-2-ethylhexylphthalate	**990.52**	**959.03**	**925.87**	**2494.3**	17.57	**929.35**
Benzo(a)anthracene	**885.32**	**1111.39**	**971.07**	**1120.06**	16.4	**940.97**
Chrysene	**816.71**	**1046**	**852.17**	**1099.52**	17.29	**930.2**
Di-n-octylphthalate	6.43	6.38	6.02	5.8	9.91	5.86
Benzo(b)fluoranthene	**512.16**	**633.56**	**544.08**	**671.01**	14.95	**595.45**
Benzo(k)fluoranthene	**228.1**	**263.23**	**240.11**	**312.22**	16.13	**217.87**
Benzo(e)pyrene	**310.51**	**365.31**	**319.83**	**374.53**	16	**340.04**
Benzo(a)pyrene	**475.99**	**604.66**	**505.91**	**623.32**	16.59	**543.16**
Perylene	**84.1**	**114.16**	**106.33**	**120.09**	17.79	**92.82**
Indeno(1,2,3-cd)pyrene	**160.09**	**182.34**	**164.25**	**185.22**	12.04	**162.9**
Dibenz(a,h)anthracene	**30.72**	**82.62**	**82.67**	**70.48**	16.12	**75.89**
Benzo(g,h,i)perylene	**188.08**	**220.37**	**184.26**	**213.98**	13.03	**185.46**

	MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
	3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
Report 40262Gr1						
SVOC'S - Page 1 0f 2						
EPA 8270A (ug/L)						
Phenol	37.84	41.61	39.07	37.87	40.67	37.61
bis(2-Chloroethyl)ether	50.08	55.07	51.71	50.12	53.83	49.78
2-Chlorophenol	43.78	48.14	45.2	43.82	47.06	43.52
1,3-Dichlorobenzene	38.65	42.51	39.91	38.69	41.55	38.42
1,4-Dichlorobenzene	40.11	44.11	41.41	40.14	43.11	39.87
1,2-Dichlorobenzene	42.77	47.04	44.16	42.81	45.98	42.52
Benzyl alcohol	44.07	48.47	45.5	44.11	47.37	43.81
2,2'-oxybis(1-Chloropropane)	73.6	80.94	75.99	73.66	79.11	73.16
2-Methylphenol	52.13	57.33	53.82	52.18	56.03	51.82
3/4-Methylphenol	51.66	56.82	53.34	51.71	55.54	51.36
N-Nitroso-di-n-propylamine	72.27	79.48	74.62	72.34	77.69	71.84
Hexachloroethane	74.33	81.74	76.75	74.4	79.9	73.89
Nitrobenzene	45.4	50.3	47.99	46.37	49.08	46.23
Isophorone	24.95	27.64	26.37	25.48	26.97	25.4
2-Nitrophenol	77.12	85.44	81.51	78.75	83.36	78.52
2,4-Dimethylphenol	54.64	60.53	57.75	55.8	59.06	55.63
bis(2-Chloroethoxy)methane	43.68	48.39	46.17	44.61	47.22	44.47
Benzoic acid	76.39	84.63	80.74	78.01	82.57	77.78
2,4-Dichlorophenol	51.01	56.51	53.91	52.09	55.14	51.93
1,2,4-Trichlorobenzene	43.44	48.13	45.92	44.37	46.96	44.24
Naphthalene	**719.31**	**875.32**	**987.78**	**680.56**	17.81	**1004.99**
4-Chloroaniline	38.19	42.32	40.37	39	41.29	38.89
Hexachlorobutadiene	76.03	84.23	80.36	77.64	82.18	77.41
4-Chloro-3-methylphenol	56.75	62.88	59.99	57.96	61.35	57.79
2-Methylnaphthalene	**783.5**	**968.62**	**1019**	**874.32**	28.01	**1014.5**
Hexachlorocyclopentadiene	72.08	77.32	75.77	74.27	73.42	74.51
2,4,6-Trichlorophenol	65.98	70.77	69.36	67.99	67.21	68.2
2,4,5-Trichlorophenol	62.98	67.56	66.2	64.9	64.15	65.1
2-Chloronaphthalene	24.52	26.3	25.78	25.27	24.98	25.35
2-Nitroaniline	78.42	84.13	82.44	80.81	79.89	81.07
Dimethylphthalate	20.23	21.7	21.26	20.84	20.6	20.91
2,6-Dinitrotoluene	80.19	86.02	84.3	82.63	81.69	82.9
2,4-Dinitrotoluene	64.44	69.13	67.74	66.41	65.65	66.62

	MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
	3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
Report 40262I	Tetra- , Penta-, Octa-, and Deca- PCB's may be underestimated due to out of QC recoveries of internal standards					
Polychlorinated Biphenyls						
(ug/L)		Note : The units for these samples are higher than usual for liquids due to the nature of the samples				
EPA MM680/HRGC/MS						
2-Mono Congener # 1	**2729**	**1908**	**1995**	**2198**	51	**2100**
44'-Di # 15	**5623**	**1467**	**1713**	**2023**	49	**1813**
244'-Tri # 28	**19078**	**3472**	**4862**	**5060**	94	**4136**
22'55'-Tetra # 52	**12816**	**2126**	**2892**	**2009**	96	**2946**
33'44'-Tetra # 77	**1176**	**300**	**366**	**356**	99	**426**
2344'5-Penta # 118	*759*	**130**	**168**	**177**	95	**316**
233'44'-Penta # 105	**3389**	**1123**	**1264**	**1568**	107	**1303**
33'44'5-Penta # 126	304	193	211	103	125	229
233'44'5-Hexa # 156	**1256**	**333**	**411**	**473**	156	**427**
33'44'55'-Hexa # 169	376	238	257	154	188	277
22'344'55'-Hepta # 180	**4348**	**2734**	**2651**	**3143**	240	**2592**
22'33'44'55'-Octa # 194	**781**	*619*	**606**	*694*	189	*615*
22'33'44'55'6-Nona # 206	*805*	*716*	*656*	**720**	235	**662**
Deca # 20	**1115**	**1064**	**1087**	*1320*	308	**1011**
PCB Totals:						
-Mono	**4820**	**3486**	**3383**	**4197**	51	**3779**
-Di	**47526**	**8802**	**10957**	**7864**	49	**11714**
-Tri	**130540**	**20375**	**27656**	**24582**	94	**24949**
-Tetra	**94849**	**18129**	**24322**	**23469**	98	**23981**
-Penta	**83965**	**15473**	**19713**	**20832**	108	**19907**
-Hexa	**50809**	**14105**	**16153**	**19686**	**209**	**15681**
-Hepta	**14325**	**7620**	**7528**	**10768**	240	**8431**
-Octa	**1942**	**1458**	**1764**	**1232**	189	**1348**
-Nona	**472**	**448**	**397**	**1165**	235	**1017**

Data Legend:
Normal Type = Below Detection Limit
Bold Type = Valid Data
Italics = Estimated Maximum Possible Concentration

Gross Physico-Chemical Properties

Extraction Solvents/Oils

		MEPP-11-1	MEPP-12-1	MEPP-13-1	MEPP-14-1	MEPP-18-1	MEPP-13-1Dup
		3 Stage	5 Stage	7 Stage	Continuous	Recycled Solvent	
Particle size							
(% Dry Weight)							
ASTM D422 (Mod)							
Medium gravel	> 4.75 mm						
Fine gravel	2-4.75						
V. coarse sand	0.85-2						
Coarse sand	0.425-0.85						
Medium sand	0.24-0.425						
Fine sand	0.106-0.24						
V. fine sand	0.075-0.106						
Clay							
Silt							
pH							
EPA 9045A	pH Units	**7.21**	**6.73**	**6.78**	**6.38**	**8.58**	**6.84**
Solids (total)							
EPA 160.3	% Dry Wt.						
Sulfides (total)							
EPA 9030M	mg/L	**20**	**12**	**43**	**1.6**	**3.0**	**59**
Organic carbon (total)							
ASTM D4129-82M	%	**80.2**	**62.9**	**71.0**	**81.9**	**40.5**	
TRPH							
EPA 3580/8015 Modified	mg/L	**548000**	**530000**	**533000**	**594000**	**13500 ppb** Bottom Layer	**499000**

	MEPP-1-1	MEPP-2-65	MEPP-2-108		
	As Dredged	Screened Sediment	Screened Sediment		
Report 40398D					
Metals					
mg/kg (dry)					
EPA 6010A & EPA 7471				MEPP 1-1 Dup	
Ag	17.2	14.4	13.6	18.9	
As	42.4	63.2	72.2	46.1	
Be	< 0.5	< 0.557	< 0.515	< 0.489	
Cd	47.1	34.1	25.3	51.5	
Cr	432	334	304	476	
Cu	1410	1140	1040	1550	
Ni	440	355	339	480	
Pb	631	605	658	697	
Sb	4.93	4.48	4.64	4.41	
Se	4.42	9.54	12.20	5.56	
Tl	< 2.5	< 2.78	< 2.57	< 2.44	
Zn	2070	1580	1430	2240	
Hg (total)	3.67	3.29	3.71		

	MEPP-1-1	MEPP-2-65	MEPP-2-108		
	As Dredged	Screened Sediment	Screened Sediment		
Report 40398C					
Dioxins and Furans					
(ng/kg dry weight)					
EPA 8290					
2378-TCDD	80.56	42.13	27.71		
12378-PeCDD	298.79	45.33	32.88		
123478-HxCDD	1763.65	44.94	34.50		
123678-HxCDD	592.11	110.60	83.06		
123789-HxCDD	2106.31	102.62	66.38		
1234678-HpCDD	11376.54	1743.81	1380.42		
OCDD	38881.24	15394.50	11427.65		
2378-TCDF	459.86	351.17	282.85		
12378-PeCDF	611.87	521.83	427.22		
23478-PeCDF	226.37	179.28	154.16		
123478-HxCDF	2873.74	2157.08	1916.00		
123678-HxCDF	1032.34	838.27	657.22		
234678-HxCDF	485.23	304.74	151.67		
123789-HxCDF	8.53	82.07	8.09		
1234678-HpCDF	14023.78	9784.04	7864.47		
1234789-HpCDF	111.69	160.06	142.70		
OCDF	1135.36	7814.21	7819.28		
Totals: Dioxins					
-TCDD	1239.90	314.63	231.23		
-PeCDD	5570.11	378.51	210.39		
-HxCDD	23185.38	1117.46	777.12		
-HpCDD	42265.03	3531.82	2414.13		
Totals: Furans					
-TCDF	4796.85	3905.69	3197.36		
-PeCDF	7437.26	5944.56	4812.60		
-HxCDF	11544.70	8612.00	7057.90		
-HpCDF	16326.98	11737.50	9694.59		

	MEPP-1-1	MEPP-2-65	MEPP-2-108		
	As Dredged	Screened Sediment	Screened Sediment		
Report 40398A					
SVOC's - Page 2 of 2					
EPA 8270A (ug/kg dry weight)					
Acenapthylene	**2661.50**	**7803.70**	**8410.05**		
3-Nitroaniline	993.52	1014.23	997.56		
Acenaphthene	**6904.96**	**40170.13**	**43408.10**		
2,4-Dinitrophenol	2127.16	2171.49	2135.79		
4-Nitrophenol	1332.68	1360.45	1338.09		
Dibenzofuran	**4512.06**	**28650.64**	**31806.30**		
Diethylphthalate	212.31	216.73	213.17		
4-Chlorophenyl-phenylether	587.32	599.56	590.71		
Fluorene	**8403.31**	**52617.69**	**61596.00**		
4-Nitroaniline	866.41	884.47	869.93		
4,6-Dinitro-2-methylphenol	1142.07	1128.60	690.46		
N-Nitrosodiphenylamine	376.21	371.77	227.44		
4-Bromophenyl-phenylether	677.50	669.51	409.59		
Hexachlorobenzene	529.44	523.19	320.08		
Pentachlorophenol	750.66	741.80	453.82		
Phenanthrene	**39801.18**	**245157.25**	**269835.04**		
Anthracene	**10748.30**	**55277.11**	**70489.39**		
Di-n-butyl phthalate	85.59	84.58	51.75		
Fluoranthene	**26902.94**	**134986.45**	**87646.09**		
Pyrene	**20385.13**	**93710.93**	**96296.76**		
Butylbenzylphthalate	125.05	127.40	123.57		
3,3'-Dichlorobenzidine	255.26	260.06	252.25		
bis-2-ethylhexylphthalate	**49257.62**	**45583.06**	**25713.29**		
Benzo(a)anthracene	**8970.37**	**36872.84**	**40106.85**		
Chrysene	**9773.10**	**33538.04**	**33989.01**		
Di-n-octylphthalate	71.13	88.19	68.34		
Benzo(b)fluoranthene	**7699.97**	**29753.66**	**26077.98**		
Benzo(k)fluoranthene	**2763.27**	**11051.38**	**10387.53**		
Benzo(e)pyrene	**3984.01**	**12987.57**	**12428.12**		
Benzo(a)pyrene	**5815.34**	**20799.85**	**20830.30**		
Perylene	**1089.02**	**3429.24**	**3640.86**		
Indeno(1,2,3-cd)pyrene	**130.93**	**1368.09**	**1445.73**		
Dibenz(a,h)anthracene	170.59	**698.70**	163.89		
Benzo(g,h,i)perylene	**678.46**	**1393.63**	**1131.78**		

	MEPP-1-1	MEPP-2-65	MEPP-2-108		
	As Dredged	Screened Sediment	Screened Sediment		
Report 40398A					
SVOC's - Page 1 of 2					
EPA 8270A (ug/kg dry weight)					
Phenol	489.49	527.74	491.47		
bis(2-Chloroethyl)ether	607.07	654.51	609.52		
2-Chlorophenol	531.46	572.99	533.61		
1,3-Dichlorobenzene	434.26	468.19	436.01		
1,4-Dichlorobenzene	444.09	478.79	445.88		
1,2-Dichlorobenzene	499.46	538.48	501.47		
Benzyl alcohol	668.40	720.62	671.10		
2,2'-oxybis(1-Chloropropane)	1086.46	1171.35	1090.84		
2-Methylphenol	649.24	699.97	651.86		
3/4-Methylphenol	633.86	683.39	636.42		
N-Nitroso-di-n-propylamine	771.77	832.07	774.88		
Hexachloroethane	855.90	922.78	859.35		
Nitrobenzene	490.62	553.26	502.32		
Isophorone	269.23	303.61	275.66		
2-Nitrophenol	896.28	1010.71	917.66		
2,4-Dimethylphenol	567.24	639.65	580.77		
bis(2-Chloroethoxy)methane	508.70	573.65	520.84		
Benzoic acid	1176.37	1326.56	1204.43		
2,4-Dichlorophenol	667.87	753.14	683.81		
1,2,4-Trichlorobenzene	588.18	663.28	602.22		
Naphthalene	**6338.74**	**35772.79**	**38671.31**		
4-Chloroaniline	517.60	583.69	529.95		
Hexachlorobutadiene	793.26	894.54	812.18		
4-Chloro-3-methylphenol	601.86	678.70	616.22		
2-Methylnaphthalene	**7797.50**	**35320.71**	**35486.60**		
Hexachlorocyclopentadiene	884.90	903.34	888.49		
2,4,6-Trichlorophenol	909.14	928.09	912.83		
2,4,5-Trichlorophenol	864.16	882.17	867.67		
2-Chloronaphthalene	305.84	312.21	307.08		
2-Nitroaniline	953.55	973.43	957.42		
Dimethylphthalate	249.31	254.51	250.33		
2,6-Dinitrotoluene	1113.55	1136.75	1118.07		
2,4-Dinitrotoluene	791.97	808.48	795.19		

	MEPP-1-1	MEPP-2-65	MEPP-2-108		
	As Dredged	Screened Sediment	Screened Sediment		
Report 40398B					
Polychlorinated Biphenyls					
(ug/Kg dry weight)					
EPA MM680/HRGC/MS					
PCBs:					
2-Mono Congener # 1	*	*	*		
44'-Di # 15	*	86.7	66.6		
244'-Tri # 28	*	215.0	356.0		
22'55'-Tetra # 52	116.0	261.0	179.0		
33'44'-Tetra # 77	21.3	19.0	12.8		
2344'5-Penta # 118	289.0	1.0	143.0		
233'44'-Penta # 105	112.0	113.0	61.9		
33'44'5-Penta # 126	2.6	1.0	*0.4*		
233'44'5-Hexa # 156	30.5	24.3	14.8		
33'44'55'-Hexa # 169	3.1	1.2	0.6		
22'344'55'-Hepta # 180	210.0	173.0	118.0		
22'33'44'55'-Octa # 194	49.2	41.0	33.1		
22'33'44'55'6-Nona # 206	30.1	45.9	43.9		
Deca # 20	25.6	55.1	61.7		
PCB Totals:					
-Mono	*	*	*		
-Di	*	666.0	390.0		
-Tri	*	1490.0	933.0		
-Tetra	1310.0	1760.0	1280.0		
-Penta	1810.0	1810.0	1110.0		
-Hexa	1350.0	1270.0	1040.0		
-Hepta	784.0	651.0	476.0		
-Octa	143.0	223.0	188.0		
-Nona	44.1	75.5	80.4		
*** Serious Interference and analytical problems for these congeners**					

Data Legend:
Normal Type = Below Detection Limit
Bold Type = Valid Data
Italics = Estimated Maximum Possible Concentration

Gross Physico-Chemical Properties

		MEPP-1-1 As Dredged	MEPP-2-65 Screened Sediment	MEPP-2-108 Screened Sediment
Particle size				
(% Dry Weight)				
ASTM D422 (Mod)				
Medium gravel	> 4.75 mm	**0.00**	**0.00**	**0.00**
Fine gravel	2-4.75	**0.55**	**3.06**	**2.03**
V. coarse sand	0.85-2	**1.19**	**1.91**	**1.68**
Coarse sand	0.425-0.85	**2.56**	**2.83**	**2.96**
Medium sand	0.24-0.425	**5.26**	**4.38**	**4.20**
Fine sand	0.106-0.24	**10.30**	**9.71**	**7.83**
V. fine sand	0.075-0.106	**3.56**	**3.23**	**2.88**
Clay		**30.20**	**36.40**	**34.30**
Silt		**45.30**	**45.80**	**42.00**
pH				
EPA 9045A	pH Units	**7.88**	**8.07**	**8.12**
Solids (total)				
EPA 160.3	% Dry Wt.	**39.0**	**36.8**	**37.2**
Sulfides (total)				
EPA 9030M	mg/Kg dry wt.	**6100**	**6700**	**8800**
Organic carbon (total)				
ASTM D4129-82M	% Dry Wt.	**10.2**	**11.6**	**11.7**
TRPH		**20000**	**22300**	**26400**
EPA 3580/8015 Mod	(mg/Kg Dry Weight)			

As of May 30, 1997														
Metcalf and Eddy														
Report#	**Entered?**	**Analysis**		**Samples**										
40262A	Y	Metals		MEPP-6	-15	-16	-17	-28		Seawater	Wastewaters			
40262B	Y	SVOC's		MEPP-6	-15	-16	-17	-28		Seawater	Wastewaters			
40262C	Y	Dioxin's and Furans		MEPP-6	-15	-16	-17	-28		Seawater	Wastewaters			
40262D	Y	PCB's		MEPP-6	-15	-16	-17	-28		Seawater	Wastewaters			
40262E	Y	VOC's		MEPP-6	-15	-16	-17	-28		Seawater	Wastewaters			
40262F	Y	Metals		MEPP-11	-12	-13	-14	-18		Extraction Solvents				
40262Gr1	Y	SVOC's		MEPP-11	-12	-13	-14	-18		Extraction Solvents				
40262H	Y	Dioxin's and Furans		MEPP-11	-12	-13	-14	-18		Extraction Solvents				
40262I	Y	PCB's		MEPP-11	-12	-13	-14	-18		Extraction Solvents				
40262J	Y	VOC's		MEPP-11	-12	-13	-14	-18		Extraction Solvents				
40262K	Y	SubContract Data		MEPP-11	-12	-13	-14	-18		Extraction Solvents				
40398A	Y	SVOC's		MEPP-1	2-65	2-108	-8	-9	-10 -27	As dredged	Screened	OrgX		
40398B	Y	PCB's		MEPP-1	2-65	2-108	-8	-9	-10 -27	As dredged	Screened	OrgX		
40398C	Y	Dioxin's and Furans		MEPP-1	2-65	2-108	-8	-9	-10	As dredged	Screened	OrgX		
40398Cr1	Y	Dioxin's and Furans		MEPP-27-1						Activated Carbon				
40398D	Y	Metals		MEPP-1	2-65	2-108	-8	-9	-10 -21 -27	As dredged	Screened	OrgX	Portland	Activated Carbon
40398E	Y	Metals(TCLP)		MEPP-22 thru MEPP-26						Solfix products and OrgX/Solfix Products				
40398F	Y	SVOC's (TCLP)		MEPP-22 thru MEPP-26						Solfix products and OrgX/Solfix Products				
40398G	Y	Dioxin's and Furans(T		MEPP-22 thru MEPP-26						Solfix products and OrgX/Solfix Products				
40398H	Y	PCB's (TCLP)		MEPP-22 thru MEPP-26						Solfix products and OrgX/Solfix Products				
40398I	Y	SubContract Data		MEPP-1	2-65	2-108	-8	-9	-10 -27	As dredged	Screened	OrgX		
40398J	Y	Extra TCLP Metals		MEPP-22 thru MEPP-26						Solfix products and OrgX/Solfix Products				